UPDATED May 12, 2017

West Coast Groundfish Trawl Catch Share Program Five-year Review – Draft

June 2017

Draft—Do Not Cite

For further information contact the following:

Jim Seger, Council Staff

Abigail Harley, National Marine Fisheries Service West Coast Region

Lisa Pfeiffer, National Marine Fisheries Service Northwest Fisheries Science Center

ACKNOWLEDGEMENTS

Authors

Melissa Errend (NOAA Fisheries Northwest Fisheries Science Center)

Jennifer Gilden (Pacific Fisheries Management Council)

Abigail Harley (NOAA Fisheries West Coast Regional Office)

Wendy Morrison (NOAA Fisheries Headquarters Sustainable Fisheries Division)

Lisa Pfeiffer (NOAA Fisheries Northwest Fisheries Science Center)

Jim Seger (Pacific Fisheries Management Council)

Contributing authors

Marie Guldin, Dan Holland, Jerry Leonard, Karma Norman, Max Van Oostenburg, Suzanne Russell, Kayleigh Somers, Erin Steiner, Ashley Vizek, Amanda Warlick, (NOAA Fisheries Northwest Fisheries Science Center)

Kit Dahl (Pacific Fisheries Management Council)

Gregg Casad (U.S. Coast Guard)

Thank you for contributions, review, and insightful comments:

Kathryn Blair	Kevin Ford	Patrick Mirick
Christopher Biegel	Melissa Hooper	Stephanie Oakes
Brian Corrigan	Melanie Harsch	Josh Nowlis
Ryan Couch	Jim Hastie	Maggie Smith
John DeVore	Dayna Matthews	Chuck Tracy
Jessi Doerpinghaus	Mariam McCall	Ed Waters
Dan Erickson	Michelle McClure	
Karen Greene	Jon McVeigh	

Executive Summary

INTRODUCTION

More than 100 species are monitored or actively managed under the Pacific Coast Groundfish Fishery Management Plan (FMP) and harvested in commercial, recreational, and tribal fisheries off the coasts of Washington, Oregon, and California. The commercial fishery described below does not include tribal activities.

In 1994, the Pacific Fisheries Management Council (Council) amended the FMP to cap the number of groundfish permits with limited entry endorsements for trawl, pots, and longlines. The fishery still includes an open access component for pots, longlines and other non-trawl gears. From 1999 to 2002, nine stocks were declared overfished (Pacific ocean perch [POP], bocaccio, lingcod, canary rockfish, cowcod, darkblotched rockfish, widow rockfish, yelloweye rockfish, and Pacific whiting), and the groundfish fishery was declared a disaster; in 2003, Congress financed a $46-million, capacity-reducing, buyback loan for permanent removal of 91 vessels (35 percent of permits) from trawl and associated fisheries. A tenth stock, Petrale sole was declared overfished in 2010.

In 2011, under Amendment 20 to the groundfish FMP, the limited entry trawl sector of the commercial fishery transitioned to catch shares management, a type of limited access privilege program under the Magnuson-Stevens Fishery Conservation and Management Act. The catch share program consists of cooperatives for the at-sea mothership and catcher-processor fleets that target and process Pacific whiting at sea, and an individual fishing quota (IFQ) program for the shorebased trawl fleet that targets both Pacific whiting and a wide range of other groundfish species. By law, this type of program must be reviewed five years after implementation. This review will provide managers with information to determine if the program goals are being met.

This executive summary addresses four main topics to assess the effectiveness of the program:

1. Changes in the net benefits to the nation
2. Financial outcomes for fishery participants
3. Distribution of cost, revenues, effort, and net benefits among fishery participants
4. Changes in utilization rates of available fish species under the catch share program

BASELINE AND CATCH SHARE IMPLEMENTATION PERIOD CONTEXT

Ideally, this review would compare outcomes of the program to how the fishery would look without it. However, numerous factors influence the fishery and its value, including geopolitics, changes in world markets, substitute seafood products, production inputs, environmental conditions, changes in stock status and catch limits for target and coincidentally caught species, and incentives created by management of other fisheries. It is difficult to distinguish the direct effects of the catch share program from the many ways in which the trawl fishery has changed over the last five years.

One major factor affecting the baseline period and the period of the catch share program is the high natural variability in Pacific whiting biomass and its corresponding total allowable catch (TAC). During the Economic Data Collection (EDC) baseline period (2009-2010) and the Pacific Coast Groundfish Social Survey (PCGFSS) baseline (2010), the average TAC for whiting was about 70 percent of a 1995 to 2015 average. In contrast, average TAC since implementation (2011 to 2015) was about 120 percent of the 1995 to 2015 average, about a two-thirds increase from the baseline. This increase, coupled with the importance of whiting to the overall fishery (on average, 50 percent of all ex-vessel revenue) has a major effect on nearly all analyses. Longer time series of other datasets, such as state fish tickets, are used where possible to construct baseline periods for comparison.

RESULTS

1. HOW DID NET BENEFITS TO THE NATION DERIVED FROM THIS FISHERY CHANGE AFTER IMPLEMENTATION OF THE CATCH SHARE PROGRAM?

The Council anticipated net economic gains from the implementation of Amendment 20, primarily through increases in productivity and efficiency resulting from consolidation and increased flexibility, as well as through higher product volume and prices (3.1.1).

NET BENEFITS

Between 2011 and 2015, annual net benefits to the nation (measured by annual net revenue or revenue minus costs for all sectors of the fishery) was $54 million, more than double the 2009-2010 baseline average of $25 million. Total net benefits across all sectors were highest in 2014, at over $77 million, and lowest in 2015 at $26 million. The largest growth in net benefits came from the catcher vessel sector, and the largest contributor to net benefits was the catcher-processor sector (3.1.1(a)).

CONSOLIDATION

The Council expected that consolidation would be a major driver of increases in net benefits.

The number of catcher vessels active in the fishery has decreased from the baseline to the present, ranging from 134 vessels in 2009 down to 97 in 2015. The shoreside Pacific whiting fleet has consolidated slightly more (29 percent) than the non-whiting catcher vessel fleet (24 percent) The number of at-sea catcher vessels fishing for Pacific whiting has remained relatively constant, as has the number of motherships, which is capped by the number of mothership limited entry permits(3.1.1(b)(1)).

In the catch share program, a first receiver site license is required to receive shoreside catch share deliveries. The number of shorebased processing companies purchasing Pacific whiting and non-whiting species decreased from an average of 12 in 2009-2010 to an average of 8 from 2011 to 2015. The number of shorebased processing companies purchasing non-whiting species exclusively remained relatively constant (3.1.1(b)(1)). However, the number of buyers has decreased since the 1990s. Public comment and social surveys indicate that this level participation reflects an increased rate of consolidation in ownership and concentration of control of quota share, fishing businesses, processing capacity, and support infrastructure (3.2.2(g)(4)(c)).

To restrict consolidation in the shoreside catch share program and mothership co-ops, the Council put limits on the percentage of quota share (the long-term harvest privilege) that entities in those sectors may control. Additionally, limits were put on the amount of annually issued quota pounds that a shoreside vessel may use and hold, the annual amounts that a mothership catcher vessel may deliver, and the annual amounts that a mothership may process. Most vessel account and quota/catch history share owners do not currently appear constrained by these limits (3.1.1(b)(1)(A)). A moratorium on transfers of quota shares during the first three years of the program may have delayed some anticipated consolidation of ownership. No limits were placed on catcher-processor consolidation as long as the co-op remains in place.

FLEXIBILITY

The Council expected that the catch share program would increase participants' flexibility in many aspects of the fishery. There is substantial evidence that participants are taking advantage of increases in flexibility. Harvesters and processors have adjusted to the catch share program by altering their participation in non-catch share fisheries (3.1.2(d)(1), (3.2.2(g)(5)), days at sea (3.1.2(d)(1)), the timing of landings (3.1.2(d)(2)), the number and size of fishing trips (3.1.2(d)(2)), the location of landings (3.2.2(b)), participation in cooperatives and risk pools (3.2.2(g)(2)), diversification (3.1.2(d)(5), gear switching (3.1.2(d)(6), 3.2.2(g)(4)(a)), carryover of quota (3.1.2(d)(7)), and exiting the fishery (3.2.3(d)).

PRODUCTIVITY AND EFFICIENCY

WHITING

Efficiency (calculated as net revenue as a percentage of total revenue) among shoreside and at-sea whiting catcher vessels increased from the baseline period until 2015. However, in the shoreside whiting fishery, productivity (measure of output per unit of input calculated as an index that accounts for growth in biomass) declined 29 percent in the same period. For whiting processors, efficiency (net revenue as a percentage of total revenue; it cannot be biomass-adjusted) has increased substantially since the beginning of the catch share program, with the exception of 2015. Efficiency for all whiting sectors decreased in 2015 due to low attainment (utilization of allocation) of whiting and difficult fishing conditions (3.1.1(b)(2)). Catcher-processors are more efficient than other sectors; this has not changed since the catch share program began. There is no clear trend in efficiency for motherships.

NON-WHITING

Non-whiting vessels experienced a substantial increase in efficiency from the baseline period (8 percent) to the catch shares period (averaging 18 percent, with a high of 23 percent in 2015). The productivity index for the non-whiting groundfish trawl sector increased by 35 percent over the same period (3.1.1(b)(2)). For non-whiting processors, there has been a downward trend in processing efficiency because of increasing labor expenses as well as other costs.

PRODUCT VALUE

The Amendment 20 Environmental Impact Statement (EIS) predicted that elements of the catch share program might contribute to improvements in product quality and prices. The average value of at-sea whiting production per metric ton (mt) declined from the 2009-2010 period to the 2011 to 2015 period by about 15 percent in the mothership sector and 8 percent in the catcher-processor sector. Production value per pound in the Pacific whiting shoreside sector echoes this trend. However, most other species experienced slight to moderate increases in average production value per pound in the shoreside sector, including in the economically significant frozen sablefish (particularly with high prices in 2011) and fresh Dover sole product categories (3.1.1(b)(3)).

Seafood certification and labeling programs help inform consumers. The West Coast groundfish limited entry trawl fishery was certified as a sustainable fishery by the Marine Stewardship Council in 2014 (the Pacific whiting fishery was certified in 2010). The Monterey Bay Aquarium's Seafood Watch Program promoted several major species from “avoid” to either “best choices” or “good alternatives.” Both designating entities indicated that their findings had been based on management changes in the groundfish fisheries, including the catch share program and its stringent monitoring requirements. These designations may lead to increased consumer awareness and preference for West Coast groundfish in the future (3.1.1(b)(3)).

CONSERVATION BENEFITS

One of the primary intentions of Amendment 20 was to reduce bycatch and discard mortality for all species (3.3.2). The vessel-level accountability provided by catch shares has resulted in significant reductions in the catch of overfished species and the amount of bycatch discarded, exceeding Council rebuilding goals for overfished species (3.3.2(a)). When Amendment 20 was implemented, of the ten previously mentioned overfished species only lingcod and Pacific whiting had been rebuilt. With the implementation of the catch share program, total fishing mortality decreased for darkblotched rockfish, POP, and cowcod rockfish, largely due to the drastic decline in discards (e.g., from more than 200 mt to less than 5 mt for darkblotched).

Discards of six of the seven overfished rockfish species dropped at least 90 percent after implementation of Amendment 20 (3.3.2(a), Appendix A). For all six of these, bottom trawl gear accounted for 90 percent or more of the discards prior to 2011. The exception, widow rockfish, is more pelagic than the other overfished rockfish species and, thus, can be commonly caught (and even targeted) in midwater trawl gear, especially in the whiting directed fishery. Widow rockfish was declared rebuilt in 2012, with the Council electing to continue precautionary low harvest levels through 2016. Pacific halibut may not be retained by most West Coast groundfish trawl vessels (shoreside whiting vessels may surrender it at the dock), and each fisherman is provided a limited amount of halibut individual bycatch quota (IBQ) to account for discard mortality. After implementation of the catch share program, the amount of halibut discarded decreased significantly from an annual mean of 319 mt before the program (2002 to 2010) to 76 mt after the program (2011 to 2015) (3.3.2(a)). These changes suggest that fishermen have either adjusted fishing methods to decrease catches of these species, or decreased effort using gears that catch these species. Possible explanations include changes in location, timing, gears, excluder devices, or move-on rules (requirements to change fishing location). While halibut bycatch has declined, allocations of some overfished species have substantially increased with rebuilding, and vessels have increasingly elected to target these species within the limits of the rebuilding plan (3.3.2(a)).

There can be a tradeoff between bycatch of constraining rockfish species and bycatch of Chinook salmon, the highest bycatch salmonid in West Coast groundfish fisheries. Most Chinook bycatch is from midwater trawls in the whiting sectors. The whiting fishery risks closure if overfished rockfish limits are exceeded, whereas approaching chinook thresholds restricts only fishing shallower than 100 fathoms (triggered in 2014). Some participants have reported prioritizing rockfish avoidance over salmon. Catch within whiting sectors has increased, from an average of 5,727 Chinook (2002 to 2010) to 6,958 (2011 to 2016) after implementation of the catch share program. Increases reflect both increased whiting TAC and the post catch share shift of shoreside and mothership sector effort towards the fall, with Chinook bycatch rates highest from September through December.

Observed interactions with marine mammals and seabirds have increased on par with the increase in observer coverage. Increased effort with fixed gear in the program may lead to increased impacts on humpback whales, western gulls, and black-footed albatross populations.

2. HOW DID FINANCIAL OUTCOMES FOR PARTICIPANTS IN THE FISHERY CHANGE FOLLOWING CATCH SHARE PROGRAM IMPLEMENTATION?

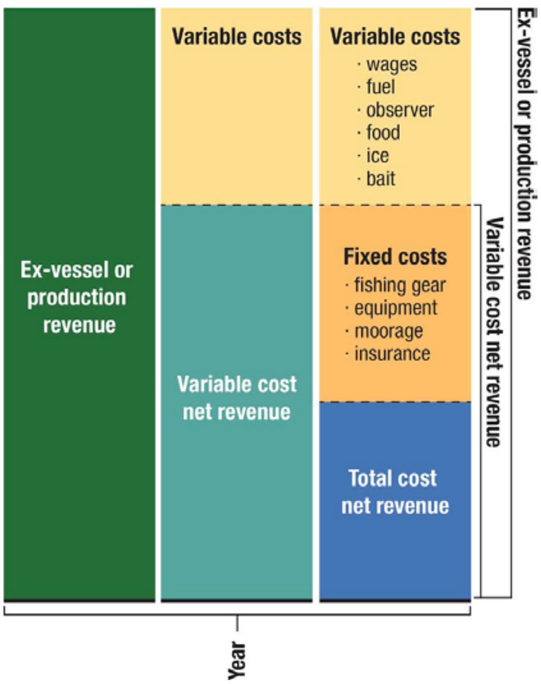


Figure ES-1. Ex-vessel or production revenue

Financial outcomes for participating vessels and processors are measured using variable cost net revenue, a representation of operating profits that accounts for the unfixed costs (fuel, crew, ice) of production only, and total cost net revenue, a representation of cash-flow profitability that considers fixed costs (e.g., purchase of a new engine or processing machinery) and variable costs (3.1.2(a)(1)) (Figure ES-1). Summary statistics describing profitability such as means, standard deviations, and medians are used to represent the performance of vessels or processors.

CATCHER VESSELS

Mean total cost net revenue and variable cost net revenue increased on average for shoreside whiting and at-sea whiting activities, as did total cost net revenue and variable cost net revenue per ton, except for 2015. Difficult fishing conditions and low attainment for whiting in 2015 affected the profitability of all whiting sectors. Mean total cost net revenue and variable cost net revenue have also increased for non-whiting trawl activities. For non-whiting trawl gear operations, mean and median total cost net revenue, as well as mean and median total cost net revenue per day, have more than doubled (on average) since 2009 and 2010 (Table ES-1). The percentage of catcher vessels with negative total cost net revenue has decreased from an average of 35 percent prior to the catch share program to 27 percent (for non-whiting catcher vessels) and 24 percent (for whiting catcher vessels) after.

Costs per fishing day have increased on average. Wages and fuel make up 75 percent of variable costs, and average costs on crew and captains’ wages per fishing day have increased in most ports. Fuel costs per day have increased as well, although they have risen most dramatically in ports with a high proportion of whiting vessels due to higher catch limits and higher fuel prices in 2011-2012.

Observer costs were not paid by the fleet prior to the catch share program. As part of the program implementation, observer coverage was increased to 100 percent, and the costs related to putting observers on the vessel were charged to the industry. To ease the transition to 100 percent coverage, a federal subsidy was implemented in 2011 ($328 per day), which decreased each subsequent year (ending at $108 per day in 2015). Starting in 2016, vessel operators began paying the full cost for their monitoring. The average monitoring cost (observer costs and electronic monitoring) was $402 per day in 2015, which was about 4 percent of the revenue in 2015.

The shoreside whiting fishery began using electronic monitoring of incidental catch as part of an exempted fishing permit beginning in 2004; this permit ended with the implementation of the catch share program. On-the-water electronic monitoring was subsequently reintroduced as an alternative to observer coverage for catch shares. Thirty-four percent of vessels started using electronic monitoring under an exempted fishing permit in 2015, this number increased to 42 percent in 2016 (3.1.2(a)(1)).

Net revenue with quota costs included is analyzed as a “lower bound” of net revenue. For non-whiting catcher vessels, the percent difference between variable cost net revenue with and without quota costs included varied by year, from a low in 2012 (mean variable cost net revenue was 0.5 percent lower with quota costs included) to a high in 2015 (mean variable cost net revenue was 25 percent lower with quota costs included In 2015, the median non-whiting vessel spent 7 percent of its revenue on quota. For whiting catcher vessels, the percent difference between variable cost net revenue with and without quota included ranged from 4 percent in 2012 to 10 percent in 2015. In 2015, the median whiting vessel spent 3.2 percent of its revenue on quota (3.1.2(a)(2)).

MOTHERSHIPS

Total cost net revenue and total cost net revenue per ton have decreased on average in the catch share period compared to the baseline. Average total cost net revenue per mt was negative in 2012 and 2015 for motherships. Average total costs may be strongly influenced by heavy investments made in a year (particularly when there are only a few vessels). Average variable cost net revenue per metric ton was positive for each year, but lower than the pre-catch share period (3.1.2(a)(1)). Some mothership vessels and catcher vessels that deliver to motherships have common ownership. This means that the earnings from the catcher vessels may be shared by motherships; therefore, in some cases, net revenue for motherships alone may not be the most accurate representation of profitability.

CATCHER-PROCESSORS

Profitability of individual catcher-processors has fluctuated across years, with little change in the overall average, comparing 2009-2010 to the catch share period (2011 to 2015). Mean variable cost net revenue and total cost net revenue per vessel were highest in 2010 and 2014.

SHORESIDE PROCESSORS (WHITING AND NON-WHITING)

For the processing sector, financial outcomes differed dramatically depending on whether the company purchased and processed Pacific whiting in addition to non-whiting groundfish species. For whiting processors, average total cost net revenue and average variable cost net revenue increased dramatically beginning in 2011, with the exception of 2015. While annual catch limits, thus volume, of Pacific whiting were higher compared to 2009 and 2010, total cost net revenue per ton of Pacific whiting was still higher in the catch share period, although this was partially due to high fixed cost expenditures (e.g., equipment) in the pre-catch share period. Variable cost net revenue per mt of production has decreased for whiting processors.

For processors that do not handle Pacific whiting, average total cost net revenue and average variable cost net revenue has decreased steadily since 2012, with lows in 2014 (3.1.2(a)(1)). The average total revenue and the variable cost net revenue earned per non-whiting processor have decreased (50 percent and 34 percent, respectively) since catch share implementation, despite potential increased harvest possible due to rebuilding stocks, moderate increases in average product prices for most species, and enhanced public perception of the fishery. Processors report that their profits have been affected by difficulties keeping workers steadily employed due to the instability of groundfish landings, which makes it more difficult for the processors to provide a steady supply of groundfish to retailers (3.2.2(g)).

While there is little evidence that the coastwide timing of landings has changed, the total number of trips and how many days an individual processor receives deliveries have generally decreased, and the average delivery size has increased (3.1.2(d)(2)). There had been an expectation that catch shares would give processors an opportunity to work with harvesters to respond to economic factors, taking into account needs for stability and reliability of product flow. However, some PCGFSS respondents view the catch share program as having exacerbated problems related to stability and reliability, particularly in communities that have experienced a decline in landings (3.2.2(g)).

CREW AND PRODUCTION WORKERS

Since implementation of catch shares, full-time employment in the groundfish fishery has decreased, part-time employment in the groundfish fishery has slightly increased, and full-time employment in other (non-groundfish) fisheries has increased among crew participating in the catch share program (3.2.2(f)). In general, participants perceived a tight link between the catch share program and changes in the availability, stability, and compensation of jobs in the groundfish trawl fishery. While there was general agreement that the number of employment opportunities tied to the groundfish trawl fishery have decreased, there were varied perspectives on impacts to job stability and compensation (3.2.2(f)).

Compensation for individual crewmembers on whiting vessels increased dramatically (while fishing in the catch share fishery) relative to 2009-2010, with the exception of 2015. Average daily wages have increased 83 percent, and average annual wages have increased 118 percent since 2011. Average daily and annual compensation for individual crewmembers on non-whiting vessels has increased modestly (63 percent and 24 percent, respectively). Since 2010, fewer crewmembers rated compensation amount as “poor” and more rated it as “excellent” in the PCGFSS, although the perspective of crew who have been displaced from the fishery is likely underrepresented in the social survey and not represented by EDC data.

Annual wages paid to processing and non-processing crew on motherships were higher in all catch share years compared to 2009 and 2010. Increases in annual wages reflected the increase in catch limits and days at sea, while daily wages paid to mothership crewmembers have, for the most part, decreased slightly. Average and daily wages for processing crew on catcher-processors have decreased by 23 percent and 20 percent, respectively, since the implementation of catch shares, but average annual and daily wages for non-processing crew have increased considerably.

For shorebased processors, employment has become more evenly distributed throughout the year, with fewer employees during former peak months, and more during the rest of the year. Average hourly compensation of non-production employees and production workers, including non-groundfish, has increased on average (3.1.2(a)(3)).

3. DID THE DISTRIBUTION OF COST, REVENUES, EFFORT, AND NET BENEFITS AMONG FISHERY PARTICIPANTS (INCLUDING COMMUNITIES AND USER GROUPS) CHANGE?

Several outcomes of the catch share program have been consistent with expectations. These outcomes include increased net benefits, consolidation, and efficiency, as illustrated by average outcomes for both individuals and for sectors. However, tradeoffs exist between maximizing economic benefits and avoiding negative consequences, such as excessive consolidation. Such consequences can be seen through changes in the distribution of costs, revenues, effort, and net benefits across fishery participants.

BY USER GROUP

CATCHER VESSELS

Individual economic performance varies widely among participants. Of the catcher vessels that participated in the limited entry trawl groundfish fishery in 2009 and 2010 and continued to participate in the IFQ program, 53 percent experienced an increase in mean annual variable cost net revenue. The average vessel experienced a 60 percent increase in variable cost net revenue.

The concentration of harvesting-related revenue in the non-whiting sector increased during the 2011 to 2015 period. This indicates a smaller number of vessels account for an increasing share of fleet revenue. Among all whiting catcher (shoreside and mothership) vessels, revenue concentration has roughly stayed the same level and is less than among non-whiting catcher vessels (3.1.1(b)(1)).

GEAR SWITCHING AND SABLEFISH

When the Council implemented the shorebased IFQ program, it included a provision allowing participants with a trawl endorsed limited entry permit to fish their quota pounds with either trawl or any other legal groundfish gear, referred to as "gear switching." In practice, most vessels that have taken advantage of this provision are those that employed fixed gear (pots and longlines) prior to 2011 and that typically have targeted sablefish. Sablefish generally has a higher ex-vessel price when caught with fixed gear. The gear-switching provision was intended to allow more flexibility for each vessel to choose its most profitable fishing strategy. The provision was also provided for environmental reasons, as fixed gear was thought to have fewer habitat impacts and minimal bycatch.

Sablefish, although a single coastwide stock, is managed with separate annual catch limits north and south of 36° N. latitude. Quota shares were allocated separately for northern and southern sablefish. The total quota issued each year, participation, and quota pound utilization in the northern sablefish fishery are higher than in the southern fishery. From 2011 to 2014, the average utilization for northern sablefish was 93 percent, but for the southern quota, it was only 43 percent.

In the years since implementation, an average of 16 vessels has taken advantage of the gear-switching provision each year. An average of six vessels switched from using trawl to using fixed gear at least part of the year. The number of gear switchers has decreased since 2011 from eight (2012) to five (2013 to 2015). An additional ten vessels, on average, that had not previously fished in the limited entry trawl fishery, called "enterers," purchased or leased trawl permits and quota to fish with fixed gear in the IFQ program from 2011 to 2015. Gear switchers accounted for an average of 7 percent of northern sablefish quota, and enterers represented 21 percent, with trawl gear using an average 64 percent of quota (3.1.2(d)(6).

In the southern sablefish fishery, participants in the IFQ pot and non-IFQ hook-and-line fisheries have reported new conflicts in southern California. Non-IFQ fishermen have reported increased pressure in their local fishing grounds from vessels that have not traditionally fished south of 36° (3.2.2(g)(5)). There is evidence to support this for the area between Point Lopez and Point Conception, where spatial analysis indicates IFQ pot locations covered 65 percent of the partially observed non-IFQ hook-and-line locations. In comparison, south of Point Conception (34°27' N. latitude), less than 1 percent of observed non-IFQ hauls directly overlapped with the location of IFQ hauls over the same periods (3.3.4(b)).

SHOREBASED PROCESSORS

WHITING

On average, revenues are shared more equally among remaining whiting processors compared to before the catch share program. This is caused by both the non-participation of smaller processors and a redistribution of revenues among remaining processors. Per mt, average variable costs declined likely due to high processing volumes following increased whiting TAC.

NON-WHITING

On average, the concentration of net revenue among non-whiting processors has not changed catch share since implementation. Median net revenue is much lower than the mean, indicating that few non-whiting processors have net revenue much higher than the mean, but most have net revenue lower than the mean.

QUOTA SHARE LESSEES AND OWNERS

The catch share program created a new type of fishery participant: a quota share owner. Quota share owners have the option to lease their annual quota pound allocations to other participants (3.1.2(d)(3)). This type of fishery participant earns income from the fishery, while avoiding some of the risks and costs of direct participation. While some benefit from this new arrangement, other vessel operators dependent on acquiring quota pound through annual leases have reported that this indirect participation as destabilizing (3.1.2(d)(3), 3.2.2(f)).

In an IFQ program, as consolidation increases, the vessels that remain in the fishery will likely spend a larger portion of their revenue on quota share purchases and/or leases of quota pounds from quota share owners who have exited or who fish less in the catch share program. The data suggest that this is occurring for both whiting and non-whiting vessels, but for non-whiting vessels to a greater extent (3.1.2(a)(2)), coinciding with general increases in revenue.

As part of the catch share program, 20 percent of the initial shoreside Pacific whiting quota allocation was given to eligible shorebased processors. Some companies also received share allocations for other species through affiliated ownership of trawl permits. In 2014, NMFS lifted the moratorium on quota share ownership transfers and required divestiture of shares in excess of caps toward the end of 2015. Since quota share trading started, whiting quota share ownership by processors has increased from 20 percent to 23 percent in 2016. These processors (originally allocated whiting quota) currently own quota shares for many non-whiting species. There is evidence that shorebased processors use their quota to support bargaining relationships with vessels to secure deliveries (3.1.2(a)(2)). For the catcher-processor and mothership sectors, trading and leasing of harvest rights occur through private formal or informal contractual lease arrangements, are not disclosed to NMFS, and are, therefore, not analyzed in this report.

BY COMMUNITY

The Council expected disparate employment and participation impacts along the coast following implementation of Amendment 20 (3.1.1). Port areas with more vessels making trawl landings (including shorebased whiting) after 2010 include south and central Washington Coast ports (aggregated to preserve confidentiality), Astoria/Tillamook, Newport, Coos Bay, Brookings, Fort Bragg, San Francisco, Monterey, Morro Bay, and Santa Barbara (3.2.3(d)(3)). Participants felt that ports in Oregon had adapted most successfully to the catch share program compared to those in other states. Newport, Oregon, appears to be adapting well to the catch share program, in part because the diversity of its fisheries and its robust infrastructure supporting adaptability to a range of management or environmental changes (3.2.2(g)(1)(b)).

DISTRIBUTION OF REVENUE AND BUYERS AMONG PORTS

Since the 1990s, the number of groundfish (whiting and non-whiting) buyers has declined across all ports. Overall, the greatest decline in the number of buyers occurred in California ports.

Two additional indicators of changes across ports since catch share implementation are distribution of volume and the ex-vessel revenue of groundfish landed. Trawl ex-vessel revenue varies, with no clear trend over time. In general, for non-whiting landings, each port area’s share of the coastwide total ex-vessel volume and corresponding revenue did not vary. With the increases in whiting total allowable catch since catch shares were implemented, ports in the south and central Washington coastal areas (Ilwaco and Westport), Astoria, and Newport show higher volumes of landings, driving corresponding higher ex-vessel revenue. Historically lower-volume port areas continued to experience declines, and four low-volume port areas (Bodega

Bay, north Washington Coast, other Washington ports, and Tillamook) that had historically purchased limited entry trawl groundfish no longer did so in the catch share period.

ENGAGEMENT

Engagement is a measure of the level of fishery participation (commercial fish landings, permit holdings, and vessel ownership) in a community, relative to the coastwide participation in that fishery. From a baseline three years prior to implementation, to the first three years of the program, engagement levels stayed constant in most communities. Exceptions were Crescent City and Coos Bay, which had the largest percentage decrease in groundfish engagement relative to other ports, and Ilwaco, which increased by a larger percentage than other communities. (3.2.2(e)).

INFRASTRUCTURE

A functioning fishing industry requires adequate infrastructure, including harbor facilities, routine dredging, providers of fishing gear and vessel maintenance, access to ice and bait, buyers and processors, and the providers and services required by buyers and processors. To the extent that anticipated participation consolidates around fewer centers of activity, shorebased resources may concentrate in fewer locations. In many ports, infrastructure loss began with overfished species declarations and subsequent buyback (see Introduction). Washington respondents reported few infrastructure losses in the catch share period, but they identified a reduction in the number of processors. Oregon respondents identified losses that occurred after implementation, with consolidation and centralization of fish activity in Newport and Astoria. Participants noted that California's trawl infrastructure appears to be shrinking, with significant losses along the southern and central coast of California (3.2.2(c)).

PUBLIC CONCERNS ABOUT THE DISTRIBUTIONAL IMPACTS OF PROGRAM COSTS

Participants in the groundfish trawl catch share fishery believe that the cost recovery fee and the costs of 100 percent on-the-water and offload monitoring can reduce profitability, and they may even discourage investments in capital repair or improvement. Cost recovery fees amounted to 3 percent of revenue in 2014-2015 for shoreside catcher vessels (3.1.2(a)(1)). Some fishermen reported that the monitoring requirement and associated costs disadvantage smaller vessels, which pay monitoring costs disproportionate to their revenue (3.2.2(g)(5)). The cost of observers was seen by many fixed-gear and small-vessel fishermen as a significant barrier to profitable participation in the groundfish trawl fishery. With the sunset of government reimbursements, the cost of observer coverage has increased from 1 percent of revenue (in 2011) to 4 percent of revenue (in 2015) for non-whiting operations, and from less than 1 percent of revenue (in 2011) to 2 percent of revenue (in 2015) for whiting operations (3.1.2(a)(1)).

Participants in California and southern Oregon have indicated that, with the decrease in vessels fishing, expenses (including travel reimbursements) for monitoring have increased. Observer companies cannot profitably maintain enough observers in each port to accommodate multiple trawl vessels that may want to fish a few days a month during good weather windows. Both vessels and processors in these areas have noted that electronic monitoring exacerbates both costs and scarcity. As vessels switch to (currently subsidized) electronic monitoring, the number of observer days that remaining vessels require decreases, which results in higher prices for those vessels and lower observer availability. All IFQ shoreside offloading activities must have catch monitors, and the observer on a trip often serves as the catch monitor for the offload. Since the vessel's observer is no longer available to act as a shoreside catch monitor for trips monitored with electronic monitoring, processors in lower volume ports pay more for catch monitors.

4. DID UTILIZATION RATES FOR SPECIFIC SPECIES CHANGE FOLLOWING CATCH SHARE PROGRAM IMPLEMENTATION?

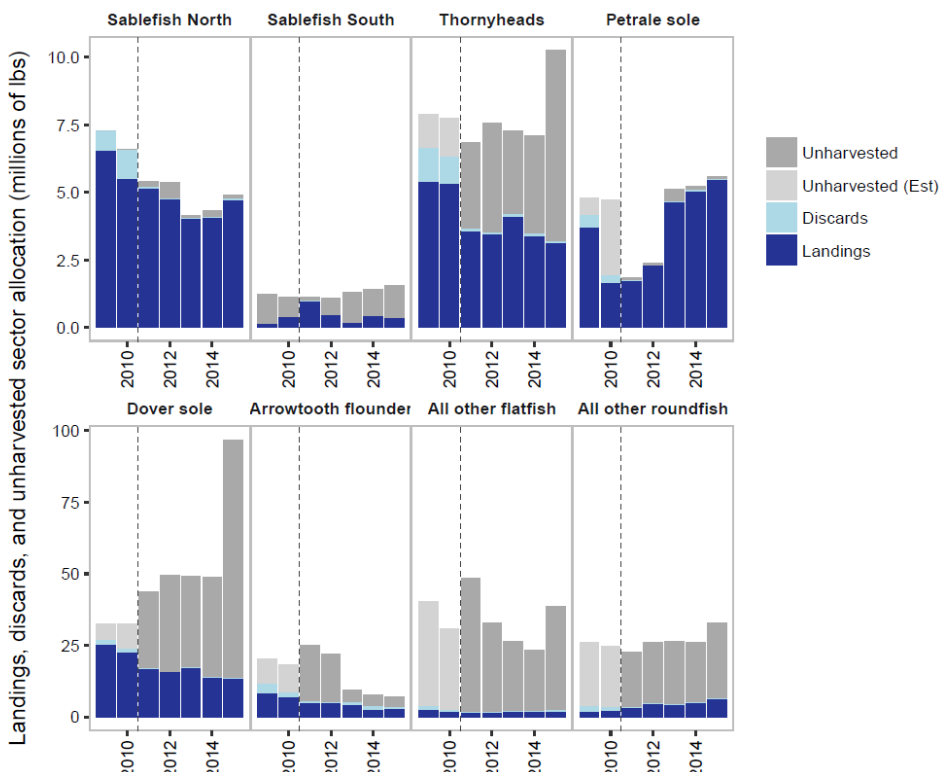


Figure ES-2. Landings (dark blue), discards (light blue), and unharvested (grey) trawl sector allocation of non-whiting groundfish species (millions of lbs). If carryover was made available for a specific quota category, the total weight was deducted from the original year and added to the following year. Except for sablefish, there was no trawl-specific quota in 2009 and 2010; for context, Unharvested (Est) (light grey) was calculated for 2009 and 2010 as the annual OY * (2011 Trawl Sector Allocation)/(2011 ACL) by stock or complex. Source: Somers et al. 2016, IFQ Program Database.

One of the goals of Amendment 20 is to “provide for full utilization of the trawl sector allocation.” For many species in the program, this goal is far from being met (3.1.3(a)(1), Appendix A).

NON-WHITING TARGET SPECIES

The non-whiting trawl fleet has used less than 50 percent of its Dover sole allocation since the implementation of catch shares, and this decreased to only 13.5 percent in 2015 with the doubling of the Dover sole annual catch limit. Utilization of allocations for many species of rockfish, roundfish, and flatfish is also far less than 50 percent. Petrale sole and northern sablefish are nearly fully utilized, while the southern allocation of sablefish is not (Figure ES-2). It is difficult to evaluate changes in utilization rates strictly, as there were no formal, species-level, non-whiting allocations to the trawl sector with the exception of sablefish north of 36°N. latitude prior to the catch share program.

Numerous economic and social factors contribute to the current and ongoing underutilization of trawl allocation for many species included in the non-whiting sector of the trawl fishery. Figure ES-3 illustrates how processors, catcher vessels, and markets are connected in a cycle that includes low utilization of groundfish stocks. Low utilization contributes to a smaller and/or inconsistent supply to processors. Without a predictable supply, processors have a difficult time securing premium markets (fresh, for example) and, instead, may have to rely on less discriminating protein markets that offer lower prices. Increased flexibility for vessels and limited communication between vessels and processors about production plans can contribute to inconsistent supply to processors, making it difficult to employ a labor force ready to process groundfish year-round. Some processors have imposed trip limits on vessels that deliver to them to limit deliveries of species for which they lack processing or marketing capacity. Low demand and corresponding lower prices from processors, in turn, make fishing less profitable and result in fewer trips, lower landings, and ultimately, low utilization. It is difficult to quantify the effect of individual factors on utilization, as they are all related in an endogenous (cyclical) way (Figure ES-3) and are influenced by external factors as well (3.1.3(a)).

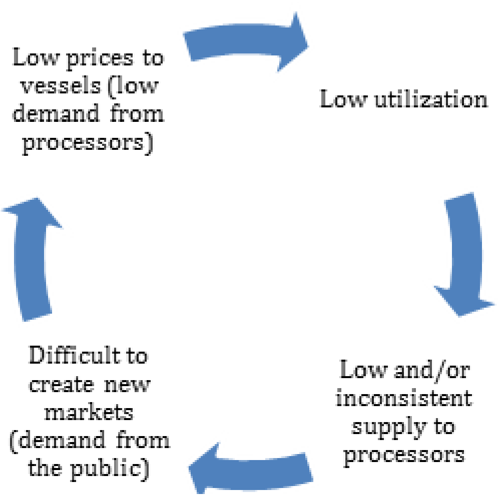


Figure ES-3. Illustration of cycle of low demand and low utilization.

One aspect of the multispecies IFQ market that may affect utilization is the challenge of predicting how much of a particular species' quota pounds a vessel will need throughout the year. Vessel operators can likely predict how much target species quota they will require throughout the year, but they may not feel confident in their ability to predict take of bycatch and constraining species. Vessels planning to fish at the end of a year often retain quota in case they need it, rather than risking being able to acquire it should the need arise. The uncertainty of being able to attain quota of overfished species, coupled with the cost of a high-bycatch event for one of these species, makes vessels risk-averse (3.3.3(c-d)). Fishing to avoid constraining species is likely to decrease the attainment of target species. Various quota risk pools were formed between groups of fishermen to reduce the risk that any individual would be shut down due to an unexpected catch event (see 3.2.2(g)(2)).

Despite concerns that the gear-switching provision prevents full utilization of species in the Dover sole, thornyhead, and sablefish (DTS) target fishery, the elimination of the gear-switching provision would not result in full attainment of Dover sole or thornyheads. Northern sablefish quota is the principal constraint on DTS trawl fishing because it is the only target stock in that fishery that approaches full utilization. Using an estimation method involving catch ratios of sablefish with Dover sole and thornyheads, catching all the sablefish allocated to the trawl sector with trawl gear (i.e., the gear-switching provision were completely eliminated) could result in an increase in Dover sole utilization from 13 percent utilized (which was the figure in 2015) to 16 percent. This would be an increase in longspine thornyhead utilization from 23 percent to 32 percent and an increase in shortspine thornyhead utilization from 42 percent to 49 percent (using 2015 quotas). These estimates are lower bounds as they take into account the changes in fishing practices that have occurred due to the scarcity of sablefish quota, which includes implementing practices that increase the amount of other species caught per pound of sablefish. Thus, while utilization of sablefish by the fixed gear fishery has contributed to the decrease in attainment of Dover sole and thornyheads by vessels fishing with trawl gear, the analysis in this review shows that, even without any participation by fixed gear vessels in the trawl sector, utilization rates for these species are not likely to be close to full attainment, especially when the higher quotas starting in 2015 for Dover sole and thornyheads are considered (3.1.3(a)).

Analyses suggest that annual vessel-use quota pound limits do not significantly and directly contribute to low attainment. However, these analyses do not assess whether vessel limits lead to conservative fishing practices to avoid constraining species that result in decreased attainment or prevent the development of boutique target fisheries. Fear of an unanticipated high bycatch event, or "lightning strike," may change behavior and decrease attainment rates because the consequences are so high. For example, if a lightning strike were to occur, vessel limits may force that vessel out of the groundfish fishery for many years.

WHITING

Attainment of Pacific whiting was somewhat below the 2014 TAC, and it was far below the 2015 TAC. Many contributing factors are not directly attributable to implementation of catch shares. For example, limited availability of overfished species allocations, combined with increased encounters with rebuilding populations, may have made overfished species increasingly constraining. In addition, low catch per unit effort for whiting was due to anomalous oceanographic conditions (the “warm blob”), and geopolitics have influenced uncertainty in the whiting export market. The flexibility that the catch share program provides allows vessels to apportion their effort strategically between West Coast Pacific whiting and Alaska pollock fisheries to maximize returns. This flexibility can benefit vessels by allowing them to minimize effort in a location experiencing unfavorable conditions, such as the high bycatch or low catch per unit of effort (CPUE) conditions of 2014 and 2015. However, the at-sea catcher vessels depend on motherships that purchase and process their catch at-sea, and the decision for fewer motherships to return to the West Coast late in 2015 may have been detrimental to the utilization of Pacific whiting allocation. Negative impacts on the catcher vessels may have been mitigated by diversification into rebuilt fisheries, because the number of endorsed mother ship/catcher vessels targeting non-whiting stocks with mid-water trawl gear from October to November increased from 2014 to 2015 (3.1.3(b)).

PROGRAM MANAGEMENT AND UTILIZATION

Stakeholders expressed concerns about the lag between the Council’s final action on modifications to the catch share program and subsequent implementation into regulations. New, non-routine rules for the groundfish trawl program have taken, on average, slightly more than two years from final Council action to implementation, for ten non-routine program rules from 2011 to 2017 (3.3.3(a)). Public comment references anticipation of increased flexibility in gear use and configuration (on which the Council took final action in March 2016) and increased access to fishing grounds through changes in spatial management such as the rockfish conservation area closures (scheduled for final Council action in September 2017) as regulatory changes that would provide an avenue to increased utilization.

OTHER CONSIDERATIONS

SAFETY

The non-whiting portion of the shoreside fishery was previously managed with a variety of landing limits that did not incentivize fishing in dangerous conditions. In the shoreside and at-sea whiting fisheries (with the exception of the catcher-processor sector, which was already operating as a cooperative), safety improvements related to easing the race for fish (for whiting) were expected with implementation of catch shares. For whiting, effort in both the at-sea and shoreside fisheries has shifted to later in the year. A similar trend was observed for catcher-processors when it moved to cooperative management in 1997. Approximately 52 percent of whiting fishermen and 41.2 percent of non-whiting fishermen report that safety has improved because of the catch share program. Interview data suggest that this can be attributed to eliminating the race for fish and pre-trip safety checks by observers.

Observer providers charge in 24-hour blocks starting at midnight. As the proportion of the observer costs borne by the vessel has increased, with a decrease in the government's observer reimbursement, the percentage of trips starting directly after midnight has increased to nearly 25 percent as vessels seek to minimize observer costs. Participants have expressed concerns that this may affect fishing safety. However, no change in incidents or accidents reported to the United States Coast Guard has been observed so far.

NEW ENTRANTS AND GENERATIONAL TIES

Some participants perceive a lack of new entrants and young people in the groundfish fishery, and they lament the increased difficulty of progressing from the back deck to owning and running an independent fishing operation, as well as concern over a loss of knowledge in the trawl fishery as the average vessel operator ages out of the fishing workforce (3.2.3(b)). Successful new entrants often have family ties to the fishing industry, as quota, vessels, knowledge, or other resources often remain in the family (3.2.3(c)). Some aging quota share owners intend to keep their permits and lease out quota pounds as a way to secure a retirement income, as opposed to selling their quota shares. When they do sell shares, transactions usually involve large increments of quota and multiple species as an individual sells an entire portfolio, with most transactions involving amounts equivalent to more than 10,000 quota pounds. There appears to be little opportunity in the market for small quota acquisitions (3.2.3(b)). Difficulty in obtaining a loan was also among the factors participants believed contributed to the lack of new entrants.

Table ES-1. Goals, objectives, and policies addressed in Five-year Review.

Goal/Objective/Standard/Key Design Component	**Primarily in Chapter(s)**			
	Econ. Perf.	**Comm. Perf.**	**Envl. Perf.**	**Prog. Mgmt.**
	(3.1)	**(3.2)**	**(3.3)**	**(3.4)**
Amendment 20 Goal: Create and implement a capacity reduction program that achieves the following:				
Increases net economic benefits.	x			
Creates individual economic stability.	x			
Provides for full utilization of the trawl sector allocation.	x			
Considers environmental impacts.			x	
Achieves individual accountability of catch and bycatch.				x
Amendment 20 Objectives:				
1. Provide a mechanism for total catch accounting.				x
2. Provide for a viable, profitable, and efficient groundfish fishery.	x			
3. Promote practices that reduce bycatch and discard mortality and minimize ecological impacts.			x	
4. Increase operational flexibility.	p			p
5. Minimize adverse effects from an individual fishing quota (IFQ) program on fishing communities and other fisheries to the extent practical.	p	p		
6. Promote measurable economic and employment benefits through the seafood catching, processing, distribution elements, and support sectors of the industry.	p	p		
7. Provide quality product for the consumer.	x			
8. Increase safety in the fishery.	p	p		
Amendment 20 Constraints and Guiding Principles				
1. Take into account the biological structure of the stocks including, but not limited to, populations and genetics.				x
2. Take into account the need to ensure that the total optimum yields (OYs) and allowable biological catch (ABC) are not exceeded.			x	
3. Minimize negative impacts resulting from localized concentrations of fishing effort.	p	p	p	
4. Account for total groundfish mortality.			x	
5. Avoid provisions where the primary intent is a change in marketing power balance between harvesting and processing sectors.				p
6. Avoid excessive quota concentration.	p	p		
7. Provide efficient and effective monitoring and enforcement.				x

Goal/Objective/Standard/Key Design Component	Primarily in Chapter(s)			
	Econ. Perf.	**Comm. Perf.**	**Envl. Perf.**	**Program Mgmt.**
	(3.1)	**(3.2)**	**(3.3)**	**(3.4)**
Amendment 20 Constraints and Guiding Principles (cont.)				
8. Design a responsive mechanism for program review, evaluation, and modification.				x
9. Take into account the management and administrative costs of implementing and overseeing the IFQ or co-op program and complementary catch monitoring programs, as well as the limited state and Federal resources available.				x
Magnuson-Stevens Act (MSA): National Standards				
1. Achieve OY and prevent overfishing.			x	
2. Use best available scientific information.				x
3. Manage stocks as a unit.				x
4. Ensure that allocations are fair and equitable, promote conservation, and prevent excessive shares.	x			
5. Consider efficiency in utilization; do not have economic allocation as sole purpose.	p			
6. Allow for variations and contingencies.				x
7. Minimize costs; avoid duplication.				x
8. Consider fishing communities to provide for their sustained participation and to minimize adverse economic impacts.		x		
9. Minimize bycatch, and bycatch mortality.			x	
10. Promote safety of human life at-sea.	x			
Catch Share Review Policy: Key design components included in MSA 303A				
Allocations				x
Eligibility		p		p
Transferability		p		p
Annual catch limits (ACLs) and accountability measures			x	
Accumulation limits/caps	x			
Cost recovery				x
Data collection/reporting, monitoring, and enforcement	p			x
Duration				x
New entrants		x		
Auctions and royalties				x

Table of Contents

ACRONYMS AND ABBREVIATIONS

ABC	Acceptable biological catch
ACL	Annual catch limit
Acts	The Coast Guard Authorization Act of 2010 and the Coast Guard and Maritime Transportation Act of 2012
AFA	American Fisheries Act
AMP	Adaptive Management Program
B_{msy}	Maximum sustained yield biomass
CAB	Community Advisory Board
CDC	Center for Disease Control
Council	Pacific Fishery Management Council
CFA	Community fishing association
CGC	California Groundfish Collective
CHA	Catch history assignment
COD	Certificate of Documentation
CPUE	Catch per unit of effort
CQF	Community quota fund
CRC	Cost Recovery Committee
CSVI	Community Social Vulnerability Indicator
CV	Coefficient of variation
DAS	Days at sea
DPC	Direct program costs
DTL	Daily trip limit
DTS	Dover sole, thornyhead, and sablefish
EA	Environmental assessment
EDC	Economic Data Collection Program
EFH	Essential fish habitat
EFP	Exempted fishing permit
EIS	Environmental impact statement
EM	Electronic monitoring
EPIRBs	Emergency Position Indicating Radio Beacons
ESA	Endangered Species Act
FEIS	Final EIS
FISHEye	The Fisheries Economic Explorer
FLSF	Fisheries Leadership and Sustainability Forum
FMP	Fishery management plan
FR	First receiver
GMT	Groundfish Management Team
HG	Headed and gutted
HHI	Herfindahl-Hirschman Index
IBQ	Individual bycatch quota
IFQ	Individual fishing quota
IFMC	Ilwaco Fishermen’s Marketing Cooperative
I/O	Input/Output Model
IO-PAC	Input-output model for Pacific Coast Fisheries
LAPP	Limited access privilege program
lb	Pound
Lowe Index	Lowe Multifactor Productivity Index
MFP	Multi-factor productivity
mt	Metric tons

MSA	Magnuson-Stevens Act
MSC	Marine Stewardship Council
MSY	Maximum Sustained Yield
NEPA	National Environmental Policy Act
NGO	Non-governmental organization
NIOSH	National Institute of Occupational Health and Safety
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOAA GC	NOAA General Counsel
NPFMC	North Pacific Fishery Management Council
NRPM	Notice of Proposed Rulemaking
NWFSC	Northwest Fisheries Science Center
OA	Open access
ODFW	Oregon Department of Fish and Wildlife
OLE	Office of Law Enforcement
OMB	Office of Management and Budget
OY	Optimum yield
PCGFSS	Pacific Coast Groundfish Social Survey
PFD	Personal flotation device
POP	Pacific Ocean perch
PWCC	Pacific Whiting Conservation Cooperative
QP	Quota pound
QPVL	Quota Pound Vessel Limit
QS	Quota share
RCA	Rockfish Conservation Area
Review Guidance	Draft Guidance for Conducting Reviews of Catch Share Programs (NMFS)
SS	Shoreside
SSC	Scientific and Statistical Committee
STD	Standard deviation
SWC	Shorebased Whiting Cooperative
TAC	Total allowable catch
TCE	Tail conditional expectation
TNC	The Nature Conservancy
USC	United States Code
USCG	United States Coast Guard
VCNR	Variable cost net revenue
VMS	Vessel monitoring system
USFWS	United States Fish and Wildlife Service
WCGOP	West Coast Groundfish Observer Program
WCR	West Coast Region
WCRO	West Coast Regional Office
WDFG	Washington Department of Fish & Wildlife

1.0 INTRODUCTION

This document is a report on the first five years of the West Coast Groundfish Trawl Catch Share Program, developed with guidance from the Pacific Fishery Management Council (Council).

The document is organized as follows:

- Chapter 1—This chapter provides an introduction, addresses the mandate for review, and discusses guiding requirements of the Magnuson-Stevens Act (MSA) and the groundfish fishery management plan (FMP).
- Chapter 2—This chapter discusses the history of the trawl rationalization program.
- Chapter 3—This chapter evaluates the trawl rationalization program's performance.
- Chapter 4—Placeholder for description of research and data needs identified by Council and advisory bodies during review, included in the final version of the report.
- Chapter 5— Placeholder for a summary of Council recommendations for program modifications, included in the final version of the report.
- Chapter 6— Placeholder for summary of next steps for NOAA Fisheries and the Council to make take to implement any desired or needed changes to the program, included in the final version of the report.
- Chapter 7— This chapter lists references cited in the document.

The introduction describes objectives of the review, beginning with the mandate for program review and the National Oceanic and Atmospheric Administration (NOAA) Headquarters' guidance for conducting reviews. The following introductory section provides goals and objectives for the program, as laid out in Amendment 20 to the groundfish fishery management plan (FMP), as well as those in the Magnuson-Stevens Fishery Conservation and Management Act (MSA) National Standards and its specific limited access privilege program (LAPP) requirements.

Mandate for Review

The Council is required by law to review the catch shares program. The MSA mandates that all LAPPs "include provisions for the regular monitoring and review by the Council and the Secretary," specifying a requirement for "a formal and detailed review 5 years after the implementation of the program" (further detail proved in Section 1.1.1). It is also required as part of Amendment 20 of the Groundfish FMP (see Section 1.1.2), as well as through a NOAA Headquarters draft guidance document (Section 1.1.3).

If the Council recommends future actions to revise the trawl rationalization program, this review may be used as background information for the Council's deliberations. However, this review is intentionally retrospective, and it is not designed to meet the requirements of the National Environmental Policy Act (NEPA) or other applicable laws for analyses of the potential effects of future action alternatives.

MSA

The purpose of this review is to meet the MSA requirement at §303A(c)(G) that LAPPs be reviewed by the applicable Fishery Management Council five years after initial program implementation. The groundfish trawl rationalization program, implemented in January 2011, meets the MSA definition of a limited access privilege program at §3(26). Therefore, the Council and the National Marine Fisheries Service (NMFS) are now under statutory obligation to begin this program review, which requires an assessment of how well the trawl rationalization program's implementation has met the original goals and objectives of Amendment 20 to the FMP. The MSA does not specify what information should be included in the review, except, at minimum, the following: a summary of progress made toward meeting the program's goals and those set out under the MSA, in addition to any suggested modifications to the program to better meet the intended goals.

Amendment 20

Appendix E.2.1.6 of Amendment 20 provides for a formal program review, as well as guidance for potential outcomes. The requirement is stated as follows:

> *The Council will conduct a formal review of program performance no later than five years after implementation and every four years thereafter. The result of the evaluation could include dissolution of the program, revocation of all or part of quota shares, or other fundamental changes to the program. At the time of its first review, the Council will consider also the use of an auction or other nonhistory based method when distributing quota share that may become available after the initial allocation.*

NOAA Headquarters Guidance

In the Council's June 2016 briefing book, Report 8, Agenda Item G.5.b, NMFS provided its *Draft Guidance for Conducting Reviews of Catch Share Programs* (Review Guidance, NMFS 2017). The Review Guidance is intended to help structure catch share program reviews so that reviews are transparent, efficient, and effective, as well as meeting MSA requirements. The process includes a diverse review team responsible for conducting analyses of effects that have taken place since the baseline period, as well as establishing a mechanism for public input. This review should determine if the program is meeting its goals and objectives, described below.

Management Goals and Objectives

This program review assesses the program performance with respect to the objectives listed below:

- The success of the trawl rationalization program in meeting the initial goals and objectives of the program, as identified in Amendment 20 to the FMP
- Meeting the goals and objectives of the FMP
- Meeting MSA National Standards at §301(a)
- Meeting LAPP requirements in MSA at Section §303A

Amendment 20 Goals and Objectives

Amendment 20 described the trawl rationalization program's goal, objectives, and constraints and guiding principles as the following:

Goal

Create and implement a capacity rationalization plan that increases net economic benefits, creates individual economic stability, provides for full utilization of the trawl sector allocation, considers environmental impacts, and achieves individual accountability of catch and bycatch.

Objectives: The above goal is supported by the following objectives:

- Provide a mechanism for total catch accounting.
- Provide for a viable, profitable, and efficient groundfish fishery.
- Promote practices that reduce bycatch and discard mortality and minimize ecological impacts.
- Increase operational flexibility.
- Minimize adverse effects from an individual fishing quota (IFQ) program on fishing communities and other fisheries to the extent practical.
- Promote measurable economic and employment benefits through the seafood catching, processing, distribution elements, and support sectors of the industry.
- Provide quality product for the consumer.
- Increase safety in the fishery.

Constraints and Guiding Principles: The above goal and objectives should be achieved while the following measures occur:

- Take into account the biological structure of the stocks including, but not limited to, populations and genetics.
- Take into account the need to ensure that the total optimum yield (OY) and allowable biological catch (ABC) are not exceeded.
- Minimize negative impacts resulting from localized concentrations of fishing effort.
- Account for total groundfish mortality.
- Avoid provisions where the primary intent is a change in the marketing power balance between the harvesting and processing sectors.
- Avoid excessive quota concentration.
- Provide efficient and effective monitoring and enforcement.
- Design a responsive mechanism for program review, evaluation, and modification.
- Take into account the management and administrative costs of implementing and overseeing the IFQ or co-op program and complementary catch monitoring programs, as well as the limited state and Federal resources available.

West Coast Groundfish FMP Goals

The FMP objective's subject areas—Conservation, Conservation, Economics, Utilization, Social Factors—are well matched to the goals of Amendment 20, as well as to FMP and MSA goals. The FMP has three management goals, which are described below:

1. Conservation—Prevent overfishing and rebuild overfished stocks by managing for appropriate harvest levels and prevent, to the extent practicable, any net loss of the habitat of living marine resources.
2. Economics—Maximize the value of the groundfish resource as a whole.
3. Utilization—Within the constraints of overfished species rebuilding requirements, achieve the maximum biological yield of the overall groundfish fishery, promote year-round availability of quality seafood to the consumer, and promote recreational fishing opportunities.

The FMP also has 17 objectives that provide more details for meeting the FMP's three management goals (Chapter 2, FMP[1]). This review will not address each of these goals or objectives individually; instead, it will use the Amendment 20 objectives to refine and inform the review of how well the trawl rationalization program meets the FMP's management goals.

[1] http://www.pcouncil.org/wp-content/uploads/2016/03/GF_FMP_FINAL_Mar2016_Mar282016.pdf

MSA National Standards

The MSA National Standards are presented below.

1. **Optimum Yield:** Conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery for the United States fishing industry.
2. **Scientific Information:** Conservation and management measures shall be based upon the best scientific information available.
3. **Management Units:** To the extent practicable, an individual stock of fish shall be managed as a unit throughout its range, and interrelated stocks of fish shall be managed as a unit or in close coordination.
4. **Allocations:** Conservation and management measures shall not discriminate between residents of different states. If it becomes necessary to allocate or assign fishing privileges among various United States fishermen, such allocation shall be (a) fair and equitable to all such fishermen; (b) reasonably calculated to promote conservation; and (c) carried out in such manner that no particular individual, corporation, or other entity acquires an excessive share of such privilege.
5. **Efficiency:** Conservation and management measures shall, where practicable, consider efficiency in the utilization of fishery resources; except that no such measure shall have economic allocation as its sole purpose.
6. **Variations and Contingencies:** Conservation and management measures shall take into account and allow for variations among, and contingencies in, fisheries, fishery resources, and catches.
7. **Costs and Benefits:** Conservation and management measures shall, where practicable, minimize costs and avoid unnecessary duplication.
8. **Communities:** Conservation and management measures shall, consistent with the conservation requirements of this Act (including the prevention of overfishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities by utilizing economic and social data that meet the requirement of paragraph (2) [i.e., National Standard 2], in order to (a) provide for the sustained participation of such communities, and (b) to the extent practicable, minimize adverse economic impacts on such communities.
9. **Bycatch:** Conservation and management measures shall, to the extent practicable, (a) minimize bycatch and (b) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch.
10. **Safety of Life at Sea:** Conservation and management measures shall, to the extent practicable, promote the safety of human life at sea.

As mandated by the MSA, NMFS has developed guidelines for each National Standard. When reviewing FMPs, FMP amendments, and regulations, the Secretary of Commerce must ensure that they are consistent with the National Standard guidelines. The final rule for revising the guidelines for National Standards 1, 3, and 7 published on October 18, 2016; however, the updated guidance does not establish requirements to revise existing management plans. The revisions improve and streamline the National Standard guidelines to enhance their utility for managers.

MSA LAPP Requirements

MSA specifies requirements for LAPPs submitted by a Fishery Management Council relevant for analysis in the Five-year Review. Section 303A(c) requires LAPPs to achieve the following:

- Assist in rebuilding a stock if it is overfished.
- Contribute to reducing over capacity if the fishery is over-capitalized.
- Promote safety, fishery conservation, management, and social and economic benefits.
- Include an effective system for enforcement, monitoring, and management.

2.0 HISTORY OF THE WEST COAST GROUNDFISH TRAWL FISHERY

The Pacific groundfish FMP was first approved in 1982, establishing management measures for over 90 species caught off the United States (U.S.)West Coast from California to Washington. Since its inception in 1982, the FMP has been amended 33 times, moving from a fishery characterized by high discards and expanding catches and capacity through various initiatives aimed at reducing fishing capacity, and, finally, through the transition to catch shares. This section reviews the historical management changes that have coincided with rebuilding stocks, bycatch reduction, and increasing net economic benefits to fishermen and fishing communities in a fishery that was declared an economic disaster less than two decades ago.

Expanding Industry Capacity and Scientific Understanding

Groundfish landings increased rapidly throughout the 1970s due to growing market demand, improved whiting processing technologies, and policies designed to encourage expansion of domestic fisheries (e.g., vessel construction funds). Large-scale harvesting and at-sea processing of Pacific whiting by foreign vessels became federally managed after the signing of the Fishery Conservation and Management Act in 1976. However, foreign fishing was supplanted by joint-venture agreements by 1989, which was further and wholly replaced by domestic processing by 1991, with the first shorebased whiting processing plant opening in 1992 (Larkins and Vacura 2012; PFMC 2016a). When the FMP was established, the fishery was facing declining biomass estimates and catches because stocks were being fished down to what were believed to be maximum sustained yield biomass levels (B_{msy}). The management philosophy of fishing a stock to B_{msy}, combined with overestimation of stock productivity, led to what are retrospectively recognized as unsustainable harvest levels. As a result, several non-whiting groundfish species were declared overfished starting in 1999. Over the same period, relative spawning biomass of Pacific whiting dropped from 96 percent to 29 percent of unfished biomass from 1983 to 2000 largely due to low stock recruitment (Berger et al. 2017). Non-whiting groundfish landings reached a peak of approximately 250 million pounds in 1982, amounting to more than $50 million in ex-vessel revenue (PFMC and NMFS 2010b). By 2000, landings had decreased by two-thirds, and revenue had decreased by half (PFMC 1999). The fleet was overcapitalized, with two to three times the number of vessels that would be needed to fully harvest landings limits for the trawl sector (Hastie 2001).

At the inception of the FMP, the trawl fishery was managed by trip limits primarily for sablefish and widow rockfish and continued evolving into a complex system with limits varying depending on species, species complex, and gear type. In 1985, trip limits shifted to biweekly landings limits, and then again to monthly limits in 1994, and bimonthly limits for most species in 1996. The lengthening of the cumulative limit periods was intended to reduce discarding. This complex set of regulations was critical to preventing short derby seasons for most species, but was laborious for managers and participants to track. It may not have reduced bycatch because landings were limited per vessel, but there was no limit on total fleetwide catch. The result was an incentive to discard lower value fish or constraining species until the trip limits of all species were reached (Gillis, Peterman and Pikitch 1995; Pikitch, Erickson, and Wallace 1988).

Limited Entry Program

To address overcapacity, improve efficiency, and meet other economic and biological goals of the FMP, the Council approved a license limitation plan through FMP Amendment 6 in 1994. Under the limited entry program, the vast majority of the fish was allocated to the limited entry sector for vessels that qualified for groundfish trawl, longline, or pot gear permits. The remainder of the fish was allocated to an "open access" component for vessels without permits using any gear except groundfish trawl. Vessels qualified for a limited entry permit if they made a specific number of landings of at least a certain weight, depending on gear type, from 1984 to 1988. Based on these requirements, 629 permits were initially issued (384 endorsed for trawl gear and 245 for fixed gear) (PFMC 2000a).

Catcher-processors had primarily been targeting Alaska pollock during the qualifying window, and they were, therefore, only able to enter the fishery by purchasing and combining enough permits appropriate for the length of their vessel based on a system of capacity rating points. This process largely accounted for the notable decline in the number of trawl-endorsed permits from 384 to 289 in 1994 (PFMC 2000a). Motherships could participate in the fishery without a limited entry permit because the program was designed specifically to license harvesting, not processing.

Persistent Overcapitalization and Economic Failure

The Amendment 6 license limitation measure was implemented with the understanding that it was a stopgap measure and that additional action would be required to reduce capacity. In the late 1990s, the fleet remained overcapitalized and fish stocks continued to decline, with non-whiting landings falling by 65 percent and revenues by 54 percent from 1983 to 1999 (PFMC 2000a). Despite an increase in the volume of whiting landings in this same period, overall revenues declined by almost 50 percent due to the lower landings of more valuable non-whiting species (PFMC 2000a). It was estimated that capital utilization rates in 1999 ranged from 27 percent to 41 percent for shoreside trawl vessels (PFMC 2000a).

In 1997, the Council adopted management measures for the Pacific whiting fishery, including sector-specific quota allocations (42 percent to the shorebased sector, 24 percent to motherships, and 34 percent to catcher-processors), effectively eliminating competition between the sectors, but the race to fish within sectors remained. One exception to this, however, was the formation of a voluntary harvesting cooperative among catcher-processors in 1997, known as the Pacific Whiting Conservation Cooperative. This agreement allowed vessel operators to divide the sector allocation amongst themselves, thereby removing the race-to-fish incentive and benefiting from improved economic efficiency, higher product recovery rates, and operational flexibility (Sylvia et al. 2008). However, there were no sector-specific allocations for bycatch species, resulting in a race to bycatch.

In 2000, the Secretary of Commerce declared the West Coast groundfish fishery a failure under section 312(a) of the MSA. The conditions in the fishery were estimated to have cost fishermen $11 million in lost revenue (NOAA 2000). This official disaster determination enabled the appropriation of $5 million in disaster relief funds to assess the economic and social effects of the commercial fishery failure and to conduct activities to restore the fishery. These funds were apportioned to the states proportional to the impacts of the disaster and were to be used to create relief programs, including access to social services, payment to impacted individuals, and cooperative fisheries research (Shaw and Conway 2007).

In the meantime, the Council and the NMFS continued to implement measures designed to help rebuild overfished stocks and improve the overall outlook for the fishery. Trip limits were further reduced to comply with rebuilding plans and certain coastal areas were closed to trawling. In 2002, the Council and NMFS established what are known as "Rockfish Conservation Areas," designed to minimize the catch of overfished rockfish by closing specific areas and depths where those species are known to co-occur with other target species. These measures were further developed and finalized in 2006 when the Council established essential fish habitat for Pacific groundfish through FMP Amendment 19 (PFMC 2016a).

Buyback Program

Discussions about the implementation of an IFQ program dated back to the 1980s, but it was not adopted at the time Amendment 6 was considered primarily due to the inability (at the time) to track landings and quota trading in a coastwide multispecies fishery prosecuted using diverse fishing strategies. In the early 2000s, renewed discussions about the possibility of an IFQ program for the trawl fishery were forestalled by the nationwide moratorium on new IFQ programs from 1996 to 2002. However, the need to reduce capacity and fishing effort in the interim remained for both whiting and non-whiting sectors. Overall, this was a period of considerable insecurity within the fishery, with shrinking catch limits contributing to continued uncertainty about the degree to which the fleet should consolidate to maximize efficiency and capital utilization rates.

To reduce capacity in the limited entry trawl fishery, a buyback program was implemented in 2003 (NMFS 2003), resulting in the permanent removal of 91 vessels and associated permits (in addition to

121 state permits for crab and shrimp associated with those vessels). It was funded through a $10 million appropriation and a $36 million loan to be repaid over 30 years with a 5 percent landings fee on trawl-caught groundfish. Estimates based on 2002 data projected that revenue per permit for both whiting and non-whiting groundfish would increase by more than 50 percent after the buyback (NMFS 2004). However, the anticipated benefits of the buyback may have been diluted by the fact that many permits that were latent at the time of the buyback were later purchased and used to fish in the groundfish fishery.

Rationalization through the Catch Share Program

After years of discussion and development, rationalization for the Pacific groundfish trawl fishery was implemented in 2011 through a catch share program established by FMP Amendments 20 and 21. For the shoreside sector, the program includes individual fishing quota allocations for 30 species and other provisions including the requirement for 100 percent observer coverage, allowance for gear-switching, and an adaptive management program to set aside quota in support of activities such as cooperative research. In addition to these changes, some management measures remained in place, such as trip limits for non-IFQ species, size limits, and area restrictions.

During the development of the program, the Council considered 26 program elements and four primary alternatives for implementing IFQs or cooperatives based on target species operation (whiting versus non-whiting) or based on shoreside versus at-sea operations. The need for greater flexibility for various fishing strategies to target the heterogeneity of quota species and minimize bycatch influenced the decision to ultimately implement IFQs (as opposed to co-ops) for the shorebased non-whiting fishery. For the shorebased whiting fishery, anticipated complexities in designing effective linkages between vessels and processors that would be necessary for the co-op option influenced the decision to implement IFQs (PFMC and NMFS 2010). Separation of the at-sea and shoreside programs was intended to avoid the elimination of one sector by another, which might result from market imbalances (PFMC and NMFS 2010).

Shorebased sector

The IFQ program represented a significant shift for the shoreside sector, establishing target and bycatch species quota allocations for participants based on historical participation. The program allocated 90 percent of the non-whiting quota shares (QS) to limited entry permit holders based on permit history and equal allocation[2] and 10 percent to the Adaptive Management Program (AMP). For whiting,

[2] The allocation formula for overfished species was indirectly influenced by these factors, but it directly considered likely bycatch needs based on permit fishing locations.

80 percent of QS was allocated to limited entry permit holders and 20 percent to qualified processors. The allocation to processors was an effort to maintain existing bargaining arrangements and to compensate for potential “stranded” capital and consolidation or redistribution of fishing effort and deliveries (PFMC and NMFS 2010).

The program also established QS control limits (restricting the amount of QS an entity can own) and QP limits (restricting the amount of quota a vessel can use). At the start of the program, some entities received amounts exceeding the QS control limits. Once QS trading started in 2014, they were required to divest down to the QS control limits by November 30, 2015.[3] Quota allocations must be moved from a participant’s quota share account into quota pounds, where they can be used, traded, sold, or leased to match and count against what participants actually catch throughout the season. A vessel must cover all its catch of IFQ species with QP and must stop participating in the fishery until any deficit is resolved. At the end of each year, QP deficits and surpluses of up to 10 percent may be rolled over to the following year (subject to annual determinations). The new observer and catch monitoring requirements created the incentive to fish selectively and co-operate to avoid exceeding individual catch limits. The capacity reduction measures beginning with the license limitation program in the mid-1990s through the implementation of the catch share program are evident in the number of vessels participating in the catch share program: declining from approximately 200 to less than 140 after the buyback program, to around 100 since 2011 (Steiner et al. 2016a).

At-Sea sectors

The mothership sector was rationalized through a limited entry system and catcher vessel co-op program, where whiting catch history assignments (quota or catch history assignment [CHA]) were made to qualified catcher vessel permits. These CHAs can be transferred in non-divisible blocks separate from the limited entry permit for which they were issued. Each year, harvester co-ops are allocated whiting and bycatch species in proportion to the CHAs of the limited entry permits that join the co-op. Catcher vessels with limited entry permits for the mothership sector are not required to join co-ops but, thus far, all have chosen to do so, and they have organized themselves into a single co-op, where permit owners joining a co-op must commit their CHA allocations for the year to a particular mothership. Similar to the IFQ allocations, there are limits on the amounts of allocation a single entity can control, harvest, or process.

[3] This deadline applied to all species except widow rockfish, which continues to be under a QS trading moratorium while it is undergoing reallocation.

The at-sea catcher-processor co-op was issued a Federal permit, and the limitation was continued on new entrants previously implemented as a stopgap measure in 2009 (Amendment 15). Essentially, provisions for catcher-processors allowed the existing co-op to continue operating, and the sector was, therefore, expected to experience fewer operational changes compared to the others. One of the most significant changes for the at-sea sectors occurred in 2009 with the Council-recommended implementation of sector-specific bycatch quota allocations for overfished species through the biennial specifications process, effectively eliminating the race-to-bycatch incentive between the two sectors. Each year, four bycatch species (canary rockfish, darkblotched rockfish, Pacific Ocean perch [POP], widow rockfish) are allocated between the at-sea sectors and among the mothership catcher vessel permits, in proportion to whiting allocations.

Mothership processor participation in the whiting fishery largely depends on market demand, ex-vessel prices, and the annual total allowable catch (TAC). From 1995 to 2008, nine vessels participated in at least one year, though only six participated consistently (PFMC and NMFS 2010). Since the implementation of catch shares, five motherships participated from 2011 to 2014, and three in 2015 when catch attainment was low (Steiner et al. 2016b). At most, nine catcher-processor vessels actively fished in the fishery throughout the early 2000s, which dropped to six vessels in 2009 and 2010, corresponding with low TAC, and then again rose to nine vessels in 2011 (PFMC and NMFS 2010; Warlick et al. 2016). An alternative way of gauging participation in the catch share program for these sectors is their days at sea, which peaked in 2013 for motherships, and increased steadily from 2009 to 2015 (with the exception of 2012) for catcher-processors.

As can be expected with this significant transition to catch shares, there were numerous further “trailing actions,” including implementing the collection of cost recovery fees, implementing certification requirements for West Coast observer providers, and providing quota share control limit flexibility for lenders. To date, many have been completed, while a few remain under consideration, highlighting the continually evolving and complex nature of the fishery. Management measures have continued to respond to rebuilding successes, such as widow rockfish, petrale sole, and canary rockfish being declared rebuilt and, therefore, allowing future increased fishing opportunities.

3.0 PROGRAM PERFORMANCE

This chapter will assess progress towards goals and objectives for the catch share program. Goals and objectives are grouped into four general subject themes: economic performance, community performance, environmental performance, and program management performance.

3.1 Economic Performance

Many of the Council's goals and objectives for the West Coast Groundfish Trawl Catch Share Program were economic in nature. The economic benefits of the fishery and the distribution of these benefits are expected to change given evolving incentives and constraints arising from the shift to catch shares management. This section examines progress toward the goals and objectives of the program related to economic performance.

The economics section of this review intends to provide a rich set of data and analysis derived from information collected through the Economic Data Collection (EDC) Program. Tables and figures provide annual data from 2009 to 2015, occasionally supplemented with additional years where data are available. Where the pre-catch share period is compared to the catch shares period, values generally refer to the pre-catch share average (2009 to 2010) and the catch share average (2011 to 2015), unless another metric is more appropriate to describe the specific statistic. Any observed changes cannot be statistically identified as being caused by the catch share program; rather, they are included to facilitate the discussion of trends and changes. The fishery is diverse; therefore, the averages reported are not necessarily representative of the full population. This is one of the reasons the Northwest Fisheries Science Center (NWFSC) has developed The Fisheries Economic Explorer (FISHEye).[4] FISHEyE is a web application that displays data summarized along several variables: target fishery, vessel size, homeport, and state. For data collected through the EDC Program, these summaries are available at the FISHEyE website and the EDC reports.[5] All dollar values are adjusted for inflation (2015 $), unless otherwise noted. Finally, data confidentiality rules restrict the display of data if there are fewer than three entities, or if a single entity's response comprises more than 90 percent of all relevant responses (see Steiner et al. 2016(a) for more information).

The EDC was designed to track the net economic benefits generated by the catch share fishery. Net benefits are calculated by subtracting monetary costs from gross revenue for fishing activities, summed over participants in each sector. These results will be presented in Section 3.1.1(a). The EDC also allows

[4] https://dataexplorer.northwestscience.fisheries.noaa.gov/fisheye/

[5] https://www.nwfsc.noaa.gov/research/divisions/fram/economic/economic_data_reports.cfm

evaluation of financial outcomes of individual entities, groups of entities, and specific fishing activities. Financial outcomes for participating vessels and processors are measured using *variable cost net revenue*, a representation of operating profits that accounts for only variable costs of production, and *total cost net revenue*, a representation of cash-flow profitability that subtracts both variable costs and fixed costs (e.g., purchase of a new engine or processing machine) from gross revenue. Measures of average profitability such as means, standard deviations, and medians are used to represent the performance of a typical vessel or fishing activity. These results will be presented in Section 3.1.2(a)(1).

Data are provided by sector for those entities that participate in the catch share program. For catcher vessels and shorebased processors, where possible, summary statistics are provided separately for entities that catch or buy Pacific whiting, and for those that do not. The classifications are explained below.

Catcher Vessels: Catcher vessels in the catch share program generally participate in a variety of activities in a single year and their choices of which fisheries to participate in vary from year to year. Thus, they are difficult to categorize. The biggest distinction, however, is whether a catcher vessel fishes for Pacific whiting. Pacific whiting is caught at much larger volumes, the vessels that target it are generally larger, and annual catch limits for Pacific whiting can vary substantially from year to year, all of which affect vessels' economic performance. For the economic performance section of this review, where possible, catcher vessels will be divided into two mutually exclusive categories, illustrated in Figure 3-1. If the vessel targeted Pacific whiting (defined as taking at least one trip in a year in which 50 percent or more of its total revenue is composed of Pacific whiting), it is categorized as a "whiting vessel." If it did not, it is categorized as a "non-whiting vessel." The categorization of a vessel may change from year to year. Where relevant, this report may also further break down the activities in which these two categories of vessels participate (Figure 3-1).

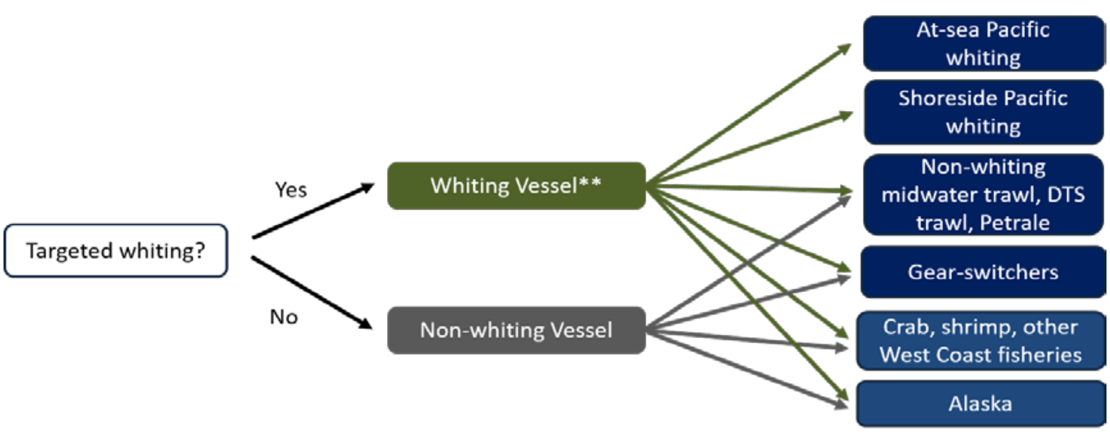


Figure 3-1. Economic performance section classification of catch share catcher vessels. **Does not include vessels that only caught whiting as bycatch.

Catcher-Processors: Vessels that catch and process Pacific whiting at sea. These vessels also participate in Alaska fisheries (primarily Alaska pollock).

Motherships: Vessels that receive and process Pacific whiting at sea. These vessels also participate in Alaska fisheries (primarily Alaska pollock). The catcher vessels that deliver to motherships are included in the catcher vessel classification.

First Receivers and Shorebased Processors: First receivers and shorebased processors are analyzed at the company level, determined by the first receiver site license owner. Companies that purchase and/or process catch share program fish are divided into three categories: whiting processors (that may also process non-whiting species), non-whiting processors, and non-processors (Figure 3-2).[6] Processors are characterized as "whiting processors" if they receive and process at least one delivery of Pacific whiting from a vessel targeting Pacific whiting in the catch share fishery.[7] Processors that receive catch share groundfish species, but not Pacific whiting, are characterized as "non-whiting processors." Some companies have first receiver site licenses but do not process any fish; they are categorized as "non-processors."

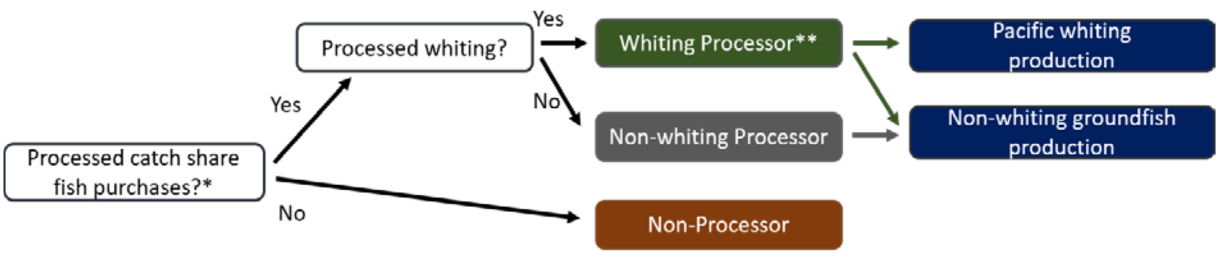


Figure 3-2. Economic performance section classification of catch share first receivers and shorebased processors. **Does not include processors that only receive whiting as bycatch.

[6] According to regulations, owners of multiple first receiver sites must acquire a license for each site (facility). To maintain analytical consistency, reduce the reporting burden for participants, and protect confidential information, data are aggregated to the company level for businesses that own multiple facilities with first receiver site licenses.

[7] First receivers may also purchase non-catch share groundfish from other groundfish sectors (i.e., the Open Access or the Limited Entry Fixed Gear Sectors) and non-vessel sources. Therefore, it is difficult to discern the proportion of groundfish purchases from non-vessel sources and groundfish production that comes from catch share-groundfish. However, the average volume of non-catch share groundfish purchases is small relative to catch share purchases (7 percent of purchase volumes on average from 2009 to 2014). The EDC Program acknowledges that, while it would be ideal to isolate costs associated with the production of exclusively catch share groundfish, the data and statistics collected for all groundfish processing activities are largely representative of groundfish production associated with the catch share program (Guldin et al. 2016).

3.1.1 Changes in Net Economic Benefits

In the transition to catch share management, changing regulations and incentives were expected to result in changes in net economic benefits from the fishery. Increases in net economic benefits were expected to result following a management shift from one primarily employing input controls (time, area, and gear restrictions) to a market-based approach constraining catch at the individual level. Expected consequences of this shift included individual accountability, increased flexibility in the time and location of fishing activities leading to more efficient use of resources, consolidation, and increases in product value (PFMC and NMFS 2010). Consolidation, in turn, affects net benefits through potential increases in productivity and proficiency from the movement of quota through a market to vessels that are more efficient.

However, consolidation was also anticipated to result in reduced employment and potentially disparate effects along the coast. To help disperse fishery benefits, the Council ultimately selected provisions that would limit economic efficiency, such as accumulation limits (PFMC and NMFS 2010). This section provides estimates of annual net economic benefits, and it analyzes the major factors affecting changes in net economic benefits: consolidation, efficiency and productivity, product value, and performance of the quota market. It also analyzes the effect of actions meant to limit consolidation. Furthermore, while this section examines total net benefits, Section 3.1.2 examines individual vessel and processor performance and profitability.

3.1.1(a) Net Economic Benefits (amend 20/MSA LAPP, FMP goals)

Increase net economic benefits (Amendment 20 Goal); Promote social and economic benefits (MSA LAPP requirement); Contribute to reducing capacity (if overcapitalized) (MSA LAPP requirement); Maximize the value of the groundfish resource as a whole (FMP Goal).

Highlights:

- Net benefits increased from $25.1 million (average 2009-2010) to nearly $54 million (average 2011 to 2015).
- Net benefits from the shoreside catcher vessel sector nearly tripled.
- The catcher-processor sector contributed the most to net benefits.
- Net benefits from the at-sea sector (catcher vessels and motherships) declined slightly.
- Net benefits from the shorebased processing sector were negative in the pre-catch share period, and they increased substantially in 2011 to 2014.
- Net benefits from all whiting sectors have varied with annual catch limits for whiting and ocean conditions.
- Non-processors contributed an average of $79 thousand per year to net benefits after catch shares implementation (no data was collected pre-catch shares).

Net economic benefits measure the size of the net benefit created by the fishery from society's perspective, defined as the net value generated by the fishery. Increasing net economic benefits was a key goal of Amendment 20, and the EDC Program is designed to enable its calculation.[8]

Net benefits are calculated by subtracting costs incurred from fishing and processing in the West Coast groundfish catch share program from gross revenue, where gross revenue includes all revenue generated from shoreside landings and at-sea deliveries of groundfish species in the catch share program (Guldin et al. 2016; Steiner et al. 2016a 2016b; Warlick et al. 2016). Costs include variable costs such as crew wages, production worker wages, captain compensation, fuel, cost recovery fees, fishing gear, packing materials, and observers[9] as well as fixed costs such as capitalized expenditures and expenses on vessel equipment, processing equipment, maintenance, and repair (Guldin et al. 2016; Steiner et al. 2016b).[10]

The Amendment 20 Final Environmental Impact Statement (FEIS) explored the potential impacts of several alternative provisions for the catch share program, including expected changes to net benefits across affected sectors. Changes to net benefits under catch share management were somewhat uncertain due to the complexity of the groundfish trawl fishery (PFMC and NMFS 2010). The FEIS emphasized that the long-term impacts were even more uncertain than the short-term effects due to changes in the biological status of stocks, allowable catches (OY/annual catch limit [ACL]),[11] and monetary costs. The only costs that are accounted for are those that are actually paid or associated with a financial transaction (Steiner et al. 2016a). In this report, this measure is called *net revenue*. A second measure is called *economic profit*. This measure includes all costs, regardless whether there is a cash or financial transaction, and it values costs at their true resource costs (including opportunity costs). An example of the difference is presented in Steiner et al. (2016a). The EDC survey forms were developed to allow calculation of net revenue as a financial measure. Under catch shares, an elimination of the profit-dissipating derby fishery in the Pacific whiting fishery (excluding the catcher-processor sector, which has been managed as a cooperative since 1997) was expected, as harvesters would no longer race for target species or bycatch (PFMC and NMFS 2010). In addition, the catch share program was expected to reduce

[8] FISHEyE refers to this as 'Total Cost Net Revenue'; therefore, figures generated from FISHEyE will show 'Total Cost Net Revenue' instead of 'Net Revenue,' but readers should interpret these as equivalent in this document.

[9] Buyback fees are included as variable costs in Section 3.1.2(a)(1), which measures the financial performance of individual entities. Buyback fees are not included as costs in the calculation of net economic benefits because they are transfers to taxpayers and, thus, part of the net benefits to the nation that the fishery produces.

[10] Costs may be considered an underestimate because the EDC forms only capture costs that are directly related to vessel fishing operations, and they do not include other expenses such as vehicles or office costs that may be related to the fishing business.

[11] Pacific whiting is managed with a total ACL under the terms of the Pacific Whiting Treaty between the United States and Canada.

the number of vessels. Prior to rationalization, the trawl fishery was viewed as economically unsustainable due to excess capacity; therefore, reducing the number of vessels would increase net benefits and economic efficiency. Net benefits for non-whiting catcher vessels were expected to rise, primarily because of increased harvests and fleet consolidation (PFMC and NMFS 2010). In particular, bycatch modeling indicated that several million dollars in additional ex-vessel revenue might be generated by the non-whiting fleet under the catch share program (PFMC and NMFS 2010).

The Council selected provisions to help disperse fishery benefits across individuals and communities, such as implementing accumulation limits and adaptive management measures, although these would prevent reaching the full potential of economic efficiency (PFMC and NMFS 2010) (Section 3.1.1(b)(1)(A)). The Council debated whether the economic benefits expected from increased harvest and efficiency would be sufficient and would occur early enough in the program to help participants cover any increased costs of the program (PFMC and NMFS 2010).

The Council and NMFS anticipated that rationalization would make it easier for harvesters in the Pacific whiting fishery to form bargaining groups to negotiate ex-vessel prices with processors (PFMC and NMFS 2010). The effects of rationalization on ex-vessel price negotiations in the shoreside whiting sector were expected to be larger than in the non-whiting target fishery due to differences in preexisting industry characteristics and regulations, including less vertical integration (entities that own both processors and harvesters) and two-month catch limits in the shoreside non-whiting fishery (PFMC and NMFS 2010).

To identify economic changes after implementation of the catch share program, the Council directed the EDC Program to collect two years of baseline data for the years 2009 and 2010. Any observed changes relative to the baseline years should be interpreted with the contextual knowledge that those years marked low TAC for Pacific whiting. For a nearly fully utilized species like Pacific whiting, changes in economic outcomes were expected to vary in proportion to ACLs, among other factors.

Table 3-1 shows industrywide net benefits across all sectors of the limited entry/catch shares groundfish trawl fishery from 2009 to 2015. On average, between 2009 to 2010 and 2011 to 2015, shorebased processors saw the greatest increase in net benefits between the pre-catch share and catch share periods (over $13 million). Net benefits nearly tripled in the shoreside catcher vessel sector and increased by a lesser percentage for the catcher-processor sector, which was managed as a cooperative before catch share program implementation. However, the at-sea mothership sector, on average, saw a slight decrease in net benefits, after fluctuating between years with positive and negative net benefits. Overall, between 2011 and 2015, annual average net revenue for all sectors of the fishery was $54 million, over twice the 2009-2010 average of $25 million. Net benefits across all sectors were highest in 2014, at over $77 million.

Table 3-1. Annual net benefits of the catch share fishery by sector (thousands of 2015 $). Mean values are provided for the pre-catch share (2009 to 2010) and catch share period (2011 to 2015). Source: EDC data. Data for non-processors are not included because data were not required from these entities until 2011.

	2009	**2010**	**Pre-catch shares avg.**	**2011**	**2012**	**2013**	**2014**	**2015**	**Catch shares avg.**
Shoreside catcher vessels	3,487	3,259	3,373	13,669	6,117	15,477	12,044	6,852	10,832
Shorebased Processors*	471	-4,064	-1,797	17,767	17,815	16,255	9,977	-832	12,197
Catcher-Processors	10,057	30,176	20,117	21,117	16,784	29,430	49,120	22,517	27,794
At-sea catcher vessels	407	2,952	1,680	3,061	296	3,020	2,362	234	1,794
Motherships	341	3,124	1,732	5,084	-1,191	1,621	3,610	-2,410	1,343
Total (all sectors)	**14,763**	**35,447**	**25,105**	**60,698**	**39,821**	**65,803**	**77,113**	**26,361**	**53,960**

Non-Processors

Relatively few non-processing companies participate in the catch share program (maximum of seven in 2011). Non-processors had to fill out the entire EDC survey form starting in 2011, so net benefits can be calculated only for 2011 to 2015. To facilitate discussion of the changes in total net benefits, net benefits generated by non-processors are not added to the totals in Table 3-2. However, they should be included in discussions of the total net benefits to the nation of the fishery in the catch share period. Including non-processors, net benefits in the catch share period were lowest in 2015, at $26.5 million, and were highest in 2014 at $77.3 million.

Table 3-2. Annual net benefits of the non-processing first receiver sector (thousands of 2015$). Source: EDC data. Data prior to 2011 are not available since these companies were not required to report such information before this year.

	2011	**2012**	**2013**	**2014**	**2015**	**Catch shares avg.**
Non-processors	105	-187	134	219	122	79
Total net benefits (Table 3-1 plus Table 3-2)	**60,803**	**39,634**	**65,937**	**77,332**	**26,483**	**54,039**

3.1.1(b) Factors Affecting Net Economic Benefits

3.1.1(b)(1) Consolidation

Highlights:

- From 2009 to 2015, the number of catcher vessels decreased by 32 percent, primarily a result of vessels exiting the shoreside fisheries. The number of at-sea whiting participants is relatively constant. The number of fixed gear vessels was highest in the first two years of the catch share program; it has since decreased.
- The number of motherships has varied between five and six between 2005 and 2014. Three motherships participated in 2015.
- The number of catcher-processors ranged between six and nine vessels from 2005 to 2015.

The number of shorebased processing companies ranged from 16 to 21 between 2009 and 2015. In this period, if processors were split between whiting and non-whiting processors, the number of whiting processors trended downward, and the number of non-whiting processors showed no trend.

The FEIS used a fleet consolidation model to explore effects of fleet consolidation on changes in vessel profits and efficiency (Lian et al. 2009; PFMC and NMFS 2010). Consolidation due to rationalization was expected to occur because of incentives to reduce costs and raise average catch per vessel, increasing efficiency and profits (PFMC and NMFS 2010).[12] However, the Council implemented accumulation limits to restrict the degree of consolidation (Section 3.1.1(b)(1)(A)). Additionally, it was proposed that quota withheld for adaptive management could be used to provide incentives for conservation or compensate for negative consequences of the program. In practice, adaptive management quota has been allocated to the fleet in the same proportions as the rest of the quota; however, other options have been proposed (Towne 2015).

Catcher vessels

The number of catcher vessels (shorebased and at-sea) participating in the fishery has decreased over time. In 2003, there was an industry-funded buyback program designed to decrease overcapacity in the

[12] Council and NMFS staff expected consolidation to result in a loss of capital asset value; they anticipated that participants who left the fishery would see decreases in the value of equipment and vessels since equipment would be viewed as surplus (PFMC and NMFS 2010). Participants' losses might be offset by the value of their QS if they were initial QS recipients.

fishery, after capacity was initially capped in 1993 through the license limitation program (Section 2.0). The buyback program resulted in a decrease in the number of active catcher vessels from 213 in 2003 to 134 in 2004 (not shown). Vessels participating in the limited entry trawl fishery decreased from 143 to 129 between 2004 (post-buyback program) and 2010 (pre-catch share program). In 2011, the first year of the catch share program, the number decreased to 112, with the lowest number of vessels to date in 2015 (97 vessels) (Figure 3-3). Thus, from 2009 to 2015, the number of catcher vessels decreased by 27 percent. However, the number of vessels participating remains greater than what was predicted in the FEIS analysis, which estimated that the number of non-whiting catcher vessels could be reduced by 50 percent to 66 percent, and whiting catcher vessels would consolidate to a lesser extent, around 30 percent to 37 percent (PFMC and NMFS 2010). [13]

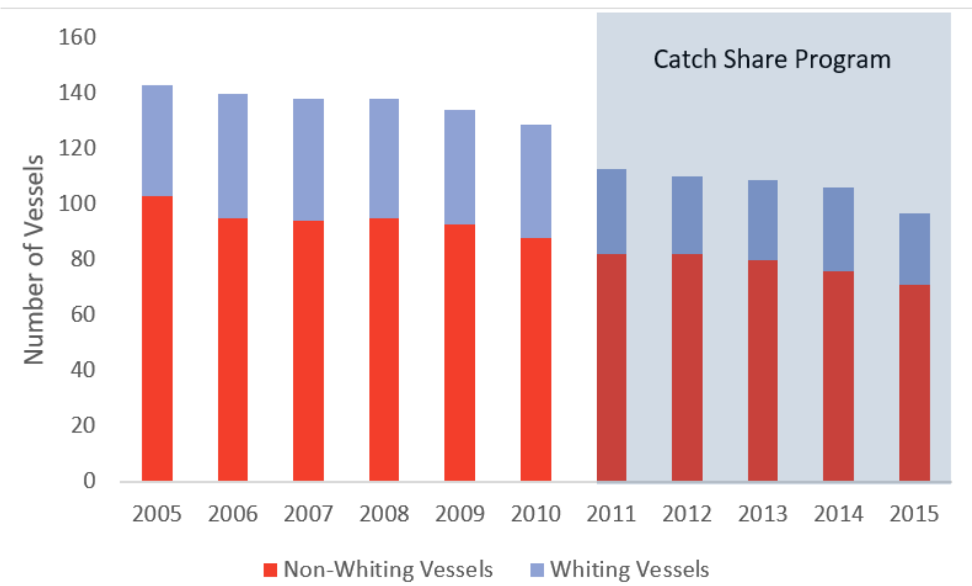


Figure 3-3. Number of catcher vessels participating in the at-sea and shorebased limited entry trawl groundfish fisheries (2005 to 2010) and the number of vessels participating in the West Coast Groundfish Trawl Catch Share Program (2011 to 2015).

Table 3-3 provides more details about the catch share activities of whiting and non-whiting vessels. Few vessels participate in the at-sea or shoreside whiting fishery only. About one-third of vessels do both, and many, especially in the pre-catch share period, participated in both non-whiting trawl activities and whiting. For non-whiting vessels, there has been an increase in the number of vessels fishing with fixed

[13] The rationalization process may still be ongoing; QS could not be permanently sold until 2014 and a number of pre-catch share regulations that constrain consolidation and efficiency remain in place.

gear (beginning in 2011 with the gear-switching provision of the catch share program), and a small number of vessels fish with both fixed and trawl gear.

Whiting vessels

Changes in the number of catcher vessels are analyzed starting in 2005, one year after implementing the buyback program. The number of whiting catcher vessels (both at-sea and shorebased) has varied over time, but it has generally decreased annually, most notably in 2011 after the start of the catch share program. In 2009 to 2010, an average of 41 vessels participated, decreasing to an average of 29 vessels from 2011 to 2015. The lowest number participated in 2015 (26) (Figure 3-3).

Table 3-3. Number of catcher vessels and their activities in the catch share program. Source: EDC data and FISHEyE.

Group	Activity	2009	2010	2011	2012	2013	2014	2015
Whiting vessels	At-sea whiting only	6	6	5	4	5	5	4
	Shoreside whiting only	1	2	3	6	5	4	6
	At-sea whiting and shoreside whiting	6	9	10	11	11	13	8
	At-sea and/or shoreside whiting and non-whiting trawl	28	24	12	6	8	8	8
	At-sea whiting, shoreside whiting and fixed gear	0	0	0	1	0	0	0
	At-sea whiting, shoreside whiting, non-whiting trawl, and Fixed gear	0	0	1	0	0	0	0
	Total Whiting vessels	***41***	***41***	***30***	***28***	***29***	***30***	***26***
Non-whiting vessels	Non-whiting trawl only	90	82	57	57	61	54	53
	Fixed gear only	3	6	22	21	18	19	17
	Non-whiting trawl and fixed gear	0	0	3	4	1	2	1
	Total Non-whiting vessels	***93***	***88***	***82***	***82***	***80***	***75***	***71***

The FEIS predicted that the at-sea portion of the fleet would decline from 20 to approximately 12 to 14 vessels (PFMC and NMFS 2010)[14], although Table 3-3 shows that identification of an "at-sea fleet" is not straightforward, as many vessels participate in multiple activities. The number of vessels participating in at-sea whiting activities has remained relatively stable, varying from 16 to 21 vessels from 2005 to 2014, although only 14 actively participated in 2015 (data available on FISHEyE). There are currently 34 mothership/catcher-vessel endorsed permits.[15] For the shorebased fleet, it was expected that the number

[14] The FEIS estimate assumed status quo season lengths, whiting OYs equivalent to 2007, and production potential of vessels based on historical data (FEIS 297).

[15] Data from NOAA Fisheries Public Permits Database: https://www.webapps.nwfsc.noaa.gov/apex_ifq/f?p=112:23.

of vessels might decline to approximately 20 to 23 vessels (PFMC and NMFS 2010). The number of vessels participating in the shorebased whiting fishery declined from an average of 35 vessels between 2005 and 2009 to 25 between 2011 and 2015 (data available on FISHEyE).

For whiting catcher vessels, revenue inequality, as measured by the Gini coefficient, has remained relatively unchanged throughout the catch share period, although it increased in 2015, indicating that revenue for whiting catcher vessels in 2015 was more concentrated among fewer vessels than it had been in the past (Table 3-4).

Non-whiting vessels

The number of catcher vessels that do not target whiting has also been decreasing steadily since 2005 (Figure 3-3). The smallest number of participating vessels occurred in 2015, at 71 vessels (24 percent decline since 2009). An average of 78 non-whiting vessels participated from 2011 to 2015.

Although trip limits precluded derby-style fishing in the non-whiting groundfish sector (PFMC and NMFS 2010), Lian et al. (2009) found that the non-whiting fleet might have been overcapitalized by more than 50 percent. The non-whiting fleet has thus far decreased in size by 24 percent from 2009 to 2015.

The Gini coefficient of catch share revenue was higher for non-whiting catcher vessels than it was for whiting catcher vessels in all years (2009 to 2015). This indicates that there is more concentration of revenue among non-whiting vessels, and it has increased over time.

Table 3-4. Gini coefficients[1] of catch share revenue inequality by sector and by species. Source: Fish ticket data via FISHEyE.

	2009	2010	Pre-catch shares avg.	2011	2012	2013	2014	2015	Catch Shares avg.
Catcher Vessels	0.32	0.42	0.37	0.46	0.49	0.54	0.52	0.45	0.49
Non-whiting	0.34	0.39	0.36	0.38	0.43	0.49	0.49	0.46	0.45
Whiting	0.21	0.33	0.27	0.28	0.25	0.26	0.27	0.36	0.28
Motherships	0.24	0.16	0.20	0.41	0.36	0.30	0.22	0.10	0.28
Catcher-Processors	0.43	0.32	0.37	0.19	0.28	0.24	0.13	0.17	0.20
Shorebased Processors	0.58	0.59	0.58	0.48	0.54	0.58	0.48	0.51	0.52
Non-whiting	0.44	0.54	0.49	0.49	0.55	0.56	0.38	0.48	0.49
Whiting	0.56	0.53	0.55	0.36	0.35	0.38	0.38	0.40	0.37

1 The Gini coefficient is a measure of income inequality where a value of 0.0 represents perfect equality. When applied to catch share revenue, it is an indicator of revenue concentration across active participants in the catch share fishery each year. A value of 0.0 would indicate that all participants' revenues were the same in a given year; a value near 1.0 would indicate that revenue is highly concentrated in a single or among a few vessels (Brinson and Thunberg 2016).

Motherships

The number of mothership vessels participating in the West Coast Pacific whiting fishery varied between five and six from 2005 to 2014 (Table 3-5). In 2015, only three motherships participated. There are currently six mothership limited entry permits. Motherships generally participate in both Alaska pollock and West Coast whiting, and decisions about when to participate on the West Coast are influenced by opportunities in Alaska, expected profits on the West Coast, and whether the mothership has to be on the West Coast for maintenance. Low participation in 2015 likely was influenced by unfavorable fishing conditions and the late decision to reallocate bycatch species. These factors led more motherships to stay in Alaska or not fish on the West Coast. Such variability could be interpreted as evidence in support of the expectation that motherships would "become more adaptable to changing conditions" (PFMC and NMFS 2010) under cooperative management. The Gini coefficient (measure of revenue inequality) has decreased from 2011 to 2015 (Table 3-4), indicative of a more equal distribution of revenue among active motherships.

Table 3-5. Number of motherships and catcher-processors participating in the West Coast Pacific whiting fishery, 2005 to 2015. Source: FISHEyE.

	Number of motherships	**Number of catcher-processors**
2005	5	6
2006	6	9
2007	6	9
2008	5	8
2009	6	5
2010	6	6
2011	5	9
2012	5	9
2013	5	9
2014	5	9
2015	3	9

Catcher-processors

The number of participating catcher-processors has ranged from six to nine vessels over the past 11 years, generally corresponding to annual catch limits for Pacific whiting (Table 3-5). Entry into or exit from the fishery was not necessarily anticipated, since rationalization was expected to have minimal impacts on the existing co-op (PFMC and NMFS 2010). The Gini coefficient has decreased relative to the increase in the number of vessels since 2009, indicative of less concentration of revenue from participation on the West Coast among participating catcher-processors (Table 3-4). Because the structure of the cooperative may allow for sharing of profits among all members, the distribution of harvest revenue may not reflect the distribution of benefits among members of the catcher-processor cooperative.

First Receivers and Shorebased Processors

The number of processors (at the company level) receiving catch share groundfish varied from 16 to 21 between 2009 and 2015, although there is no clear trend. The number of non-processors (companies that receive but do not process catch share fish) decreased from seven to three from 2011 to 2015 (Table 3-6; note that pre-catch share data are not available for non-processors). The number of whiting processors has declined from 12 in 2009 to 8 in 2015 (Table 3-6). Of the companies in the whiting processor group, about half process exclusively whiting as part of the catch share program. Consolidation patterns are less clear for non-whiting processors, which have fluctuated in number between seven and ten since 2009 (Table 3-6). Since the implementation of the catch share program, two acquisitions have either taken place or may take place.[16]

Table 3-6. Number of processors and first receivers and their activities in the catch share program. Source: EDC data and FISHEyE.

		2009	2010	2011	2012	2013	2014	2015
Whiting processors	Whiting-only*	6	6	5	5	5	5	5
	Whiting and non-whiting	6	6	4	3	3	3	3
	Total whiting processors	***12***	***12***	***9***	***8***	***8***	***8***	***8***
Non-whiting processors	Non-whiting only	7	9	8	10	10	8	10
Non-processors	Non-processors**			7	5	4	5	3

*Whiting-only means that a processing company derived less than 5 percent of its production revenue from non-whiting groundfish production.

** Data prior to 2011 are not available, since these companies were not required to provide data before this year.

However, considerable consolidation was ongoing in the processing sector in the years leading up to the catch share program. The EDC data collection provides information to allow company-level counts of first receivers beginning in 2009. Alternately, PacFIN fish ticket data provide site-level information about processing and non-processing activities along the coast, collectively referred to as ‘buyers,’ dating back to 1994. This buyer data allows a finer-scale look at how purchasing activities have changed along the West Coast since 1994. This information is presented in detail in Section 3.2, which discusses various impacts of the catch share program on communities.

[16] https://www.undercurrentnews.com/2014/01/22/californian-firm-acquires-largest-buyer-of-us-albacore/; http://www.seafoodnews.com/Story/1057559/Trident-to-Sell-Newport-Surimi-Plant-to-Pacific-Seafoods-If-Pacific-Gains-Community-Support

The Gini coefficient for whiting processors has decreased substantially, meaning that revenue is more equally distributed among the processors that remain active. The Gini coefficient has been more variable for non-whiting processors, with the decrease in 2014 corresponding to fewer processors actively buying catch share groundfish that year. Such decreases in the Gini coefficient could result if the processors that did not participate in 2014 were relatively small. Their non-participation (and, thus, exclusion from the calculation) would result in a more equal distribution of revenue among the remaining, larger processors (Table 3-4).

3.1.1(b)(1)(A) Limiting Consolidation

Avoid excessive quota concentration (Amendment 20 Objective).

Highlights:

- The Council implemented limits to restrict consolidation of QS control and QP use under the catch share program.
- Currently, few entities are close to the QS control limits on individual species.
- A small percentage of vessel accounts have reached annual QP use limits since the implementation of catch shares.
- The aggregate non-whiting quota share control limit is more binding than the sum of the individual limits, but only three entities are within 90 percent of the aggregate control limit.

The mothership sector limits are not close to binding.

The design of the catch share program included limits on quota pounds (QP) and QS to prevent excessive quota concentration (2010), an objective of Amendment 20. These limits vary by species, and they are presented in Table E-2 of the FMP, Appendix E (2010).

QP limits include the following:

- Vessel use limits (“annual QP limits”): a limit on the total QP that may be registered for a single vessel during the year (Table 3-7)
- Vessel unused QP limits (“daily QP limits”): a limit on the amount of unused QP that may be registered to a vessel at any time; applies only to overfished species and Pacific halibut (Table 3-8)

QS limits include the following:

- QS control limit: a limit on the QS that a person, individually or collectively, may control, including QS registered to that person, plus those controlled by other entities in which the person has a direct or indirect ownership interest, as well as shares that the person controls through other means (Table 3-9). These include the following:

  - Control limits for IFQ species and Pacific halibut individual bycatch quota
  - Control limit for aggregate non-whiting QS[17]

Mothership sector limits include the following:

- A limit on accumulation of mothership sector CHAs that reduces the proportion of whiting an individual or entity can accumulate via ownership of whiting CHAs
- A limit on the proportion of whiting that an individual or entity can process
- A limit on the proportion of whiting that can be delivered by any catcher vessel (50 CFR 660.111)

QP limits

Table 3-7 shows the number of vessel accounts that were at 90 percent or greater for their annual vessel use limit for each species in each year. This measures the number of vessels whose operations may have been limited by individual use limits. There were 113 occurrences from 2011 to 2015, with the most for petrale sole (17), shortspine thornyheads south of 34°27' N. latitude (17), and sablefish north of 36° N. latitude (13). The highest number of occurrences of vessel accounts operating at 90 percent or greater of their annual vessel use limit occurred in 2015 (27). These 113 occurrences accrued to 36 distinct vessel accounts.

Table 3-8 shows the number of vessel accounts at 90 percent or greater of their vessel unused QP limit for each overfished species at the end of each year. The limit applies continuously throughout the year, so the end-of-year measure is just a snapshot; it is not a relevant measure of the constraint that the limit puts on vessels throughout the year. Each time a transfer is requested, the proposed amount is checked against the vessel account’s current balance and the control limit. The transfer is rejected if it would put the vessel account over the limit. There is currently no way to calculate how constraining the limit is throughout the year with available data.

[17] Information on the calculation of the control limit for aggregate non-whiting QS is available at the West Coast Region Quota Share and Permits page: http://www.westcoast.fisheries.noaa.gov/publications/fishery_management/groundfish/catch_shares/aggregateqs-explanation.pdf.

Table 3-7. Number of vessel accounts at 90 percent or greater of their annual vessel use limit for each species in each year. Source: Final balances of the Pacific Coast Groundfish IFQ Database (https://www.webapps.nwfsc.noaa.gov/ifq/)

IFQ Species Category	2011	2012	2013	2014	2015	Total
Bocaccio rockfish south of 40°10' N. latitude	0	0	0	0	2	2
Canary rockfish	0	0	0	0	1	1
Chilipepper rockfish south of 40°10' N. latitude	0	0	1	1	0	2
Cowcod south of 40°10' N. latitude	1	2	0	1	2	6
Darkblotched rockfish	0	0	0	1	0	1
Dover sole	1	1	1	1	0	4
English sole	0	0	1	0	0	1
Lingcod	1	4	0	0	0	5
Lingcod north of 40°10' N. latitude	0	0	0	0	1	1
Minor shelf rockfish south of 40°10' N. latitude	0	0	1	0	0	1
Minor slope rockfish north of 40°10' N. latitude	0	0	0	0	1	1
Minor slope rockfish south of 40°10' N. latitude	1	2	2	2	1	8
Pacific cod	0	1	0	0	0	1
Pacific ocean perch north of 40°10' N. latitude	1	2	0	1	1	5
Petrale sole	3	4	3	2	5	17
Sablefish north of 36° N. latitude	1	1	4	4	3	13
Sablefish south of 36° N. latitude	2	1	0	3	3	9
Shortspine thornyheads south of 34°27' N. latitude	2	4	4	5	2	17
Starry flounder	1	1	1	1	1	5
Widow rockfish	1	0	0	1	3	5
Yellowtail rockfish north of 40°10' N. latitude	0	2	3	2	1	8
Total	**15**	**25**	**21**	**25**	**27**	**113**

Table 3-8. Number of vessel accounts at 90 percent or greater of their vessel unused QP limit for each overfished species and Pacific halibut at the end of each year.

IFQ Species Category	2011	2012	2013	2014	2015	Total
Bocaccio rockfish south of 40°10' N. latitude	2	3	3	2	0	10
Canary rockfish	1	1	0	0	1	3
Cowcod south of 40°10' N. latitude	1	2	0	1	1	5
Darkblotched rockfish	0	1	1	0	1	3
Pacific halibut (IBQ) north of 40°10' N. latitude	0	1	1	1	3	6
Pacific ocean perch north of 40°10' N. latitude	0	1	1	2	3	7
Widow rockfish	1	1	1	0	0	3
Yelloweye rockfish	3	3	1	1	5	13
Total	**8**	**13**	**8**	**7**	**14**	**50**

QS limits

Amendment 20 provided for revocation of QS and halibut individual bycatch quota (IBQ) that exceeded accumulation limits, and divestiture was required by November 30, 2015, to avoid revocation. An analysis provided for the rule describing the divestiture process noted that nine entities held quota in excess of the control limits for one or more individual species, and "three or less entities affected by the aggregate species limit" (80 FR 69138). Following this initial divestiture, QS limits cannot be readily evaluated historically with the publicly available database, which contains only current QS ownership information (The Pacific Coast Fisheries Permit System). Thus, for the following analysis, a data query run on December 13, 2016, was used.[18]

The QS control limits apply to QS holders, among others, who may or may not be directly involved with the fishing operation. Currently there is limited information with which to determine the link between QS holders, vessel accounts, and vessel operations. Therefore, the following analysis presents information on how frequently the QS limits are close to binding for individuals and businesses as listed on QS accounts (including companies, corporations, estates, partnerships, incorporated, limited liability, not for profit, and trusts), and it makes no attempt to consider effects on vessel operations. Table 3-9 shows the number and percentage of the two types of entities holding QS of each species that were greater than 90 percent of, and thus close to and possibly restricted by, the QS control limit on December 13, 2016.

Table 3-9 shows that relatively few entities are close to the QS control limits on individual species. Four individuals are within 90 percent of the limit for POP north of 40°10' N. latitude and yelloweye rockfish, but represent only 1.83 percent and 1.88 percent of the total individuals holding QS of each species, respectively. Ten distinct individuals are within 90 percent of the limit for at least one species (out of 247 distinct person QS owners/ total). Seven business entities are within 90 percent of the limit for shortspine thornyheads south of 34°27' N. latitude. Four businesses are within 90 percent of the limit for sablefish south of 36° N. latitude, and four businesses are within 90 percent of the limit for yelloweye rockfish. Again, the percentages of QS holders classified as businesses that these represent are small (3.83 percent, 2.21 percent, and 2.26 percent, respectively). Fourteen distinct businesses are within 90 percent of the limit for at least one species (out of 210 distinct business QS owners' total).

The control limit for aggregate non-whiting QS is more binding than the sum of the individual limits. Any time a QS transfer is requested, the amount is checked against the amount of currently held QS, both individually and collectively, as well as the aggregate limit. If the transfer would put the shareholder over the limit for any species or over the aggregate limit, the transfer would be rejected. The aggregate non-whiting QS control limit is within 90 percent of binding for only three individuals (0.64 percent of 247

[18] It is not obvious that any date of data query would be more or less relevant than any other, as QS sales can happen at any time. Thus, December 13, 2016, is used because it is the date of this analysis.

individuals who own QS) (Source: Pacific Coast Fisheries Permit System, which was queried on December 13, 2016).

Table 3-9. Number and percentage of individuals and businesses holding QS of each species that held greater than 90 percent of the QS control limit on December 13, 2016. Source: Pacific Coast Fisheries Permit System public database.

IFQ Species Category	Number of individuals with greater than 90% of control limit	Percentage of individuals with greater than 90% of control limit	Number of businesses with greater than 90% of control limit	Percentage of businesses with greater than 90% of control limit
Bocaccio rockfish south of 40°10' N. latitude	0	0.00	2	1.96
Canary rockfish	1	0.46	0	0.00
Chilipepper rockfish south of 40°10' N. latitude	1	0.46	0	0.00
Cowcod south of 40°10' N. latitude	0	0.00	2	1.96
Darkblotched rockfish	1	0.46	0	0.00
Dover sole	2	0.91	3	1.64
Lingcod north of 40°10' N. latitude	2	0.92	1	0.55
Lingcod south of 40°10' N. latitude	2	0.92	1	0.55
Minor shelf rockfish north of 40°10' N. latitude	1	0.46	0	0.00
Minor shelf rockfish south of 40°10' N. latitude	0	0.00	1	0.56
Minor slope rockfish north of 40°10' N. latitude	1	0.46	0	0.00
Minor slope rockfish south of 40°10' N. latitude	3	1.36	1	0.54
Pacific cod	1	0.46	0	0.00
Pacific halibut (IBQ) north of 40°10' N. latitude	2	0.90	2	1.12
POP north of 40°10' N. latitude	4	1.83	0	0.00
Pacific whiting	1	0.45	1	0.51
Petrale sole	1	0.46	0	0.00
Sablefish north of 36° N. latitude	1	0.46	0	0.00
Sablefish south of 36° N. latitude	0	0.00	4	2.21
Shortspine thornyheads south of 34°27' N. latitude	1	0.45	7	3.83
Starry flounder	1	0.46	1	0.56
Widow rockfish	0	0.00	1	0.68
Yelloweye rockfish	4	1.88	4	2.26

Note: "Individuals" refers to the individual limit, and "business" refers to the collective limit.

Mothership sector limits

Permits with a qualifying history were designated as catcher vessel/mothership permits through addition of a catcher vessel/mothership whiting endorsement to their limited entry groundfish permit. At the time of endorsement qualification, each permit was also allocated a CHA that would determine the share of the mothership whiting allocation associated with the whiting endorsement for that permit (PFMC 2010a).

After initial issuance, the CHAs together with the associated catcher vessel/mothership whiting endorsement became separable from the catcher vessel/mothership permit, and single permits were allowed to stack multiple CHAs. No individual or entity may own catcher vessel/mothership permits for which the CHAs represent more than 20 percent of the sector allocation. In addition, no vessel may catch more than 30 percent of the mothership sector's allocation. Finally, no individual or entity who owns a mothership permit can process more than 45 percent of the annual mothership sector allocation.

No entities currently own 90 percent or more of their limit of CHA (Pacific Coast Fisheries Permit System Database at https://www.webapps.nwfsc.noaa.gov/apex_ifq/f?p=112:23, which was queried on December 13, 2016). There have been three cases of catcher vessel/mothership permits acquiring additional CHAs through transfers, but the ownership limit is still not close to binding. No catcher vessel/mothership permit or vessels caught more than 90 percent of the 30 percent limit of the mothership sector allocation in the first five years of the program. Finally, the data to calculate the ownership accumulation limits for the mothership permits are not currently available to researchers.[19]

3.1.1(b)(2) Efficiency and Productivity

> Conservation and management measures shall, where practicable, consider efficiency in the utilization of fishery resources, except that no such measure shall have economic allocation as its sole purpose (MSA National Standard 5).

Highlights:

- Two methods are used: a productivity index, which can account for changes in biomass, and efficiency, measured as net revenue as a percentage of revenue.
- Efficiency in the whiting catcher vessel sector has increased. However, the productivity index suggests that the growth in biomass outpaced the growth in economic productivity for the shoreside sector; the at-sea sector cannot be analyzed using this method.
- The non-whiting catcher vessel sector has experienced substantial increases in efficiency and productivity.
- Catcher-processors are more efficient than other sectors, but efficiency in this sector has not changed substantially from 2009 to 2015.
- There is no clear trend in efficiency for motherships.
- Whiting processors have substantially increased in efficiency, with the exception of 2015.
- There is a downward trend in efficiency for non-whiting processors.

[19] West Coast Region, pers. comm, December 16, 2016.

The Amendment 20 FEIS is imprecise in its definition of "efficiency," and it uses the term in several ways. At one point, efficiency is defined as when "outputs are maximized for a given level of inputs, and production is at its lowest cost" (PFMC and NMFS 2010, iii). At the fleet level, however, this concept is most appropriately measured as productivity.[20] Productivity, or the relationship between the quantity of fish produced and the amount of inputs used to harvest fish, is an important metric for evaluating the performance of commercial fishing fleets, and it can be used to understand the drivers of changing profitability. Catch share programs are theorized to improve productivity as redundant capital is retired, fishing firms can better plan harvesting activities leading to more efficient composition of inputs and outputs, and/or quota is transferred from less to more efficient vessels (Thunberg et al. 2015). Increases in productivity mean that more can be produced with a given level of inputs.

Changes in productivity can be estimated in a number of ways. First, the Lowe Multifactor Productivity Index (Lowe Index) is calculated. The Lowe Index is used to estimate changes in harvesting productivity over time relative to a baseline reference period, referred to as the "multi-factor productivity" (MFP) index. The Lowe Index is used as it can be applied in a consistent manner to all catch share programs in the United States, including those with multiple outputs (species) and, thus, was identified as a metric for the evaluation of catch share programs by NMFS (Thunberg et al. 2015; Walden et al. 2014).

The Lowe Index is theoretically robust and straightforward to construct (O'Donnell 2012). It was applied to 20 fleets that had undergone transitions to catch share management in Walden et al. (2014) and Thunberg et al. (2015), including the West Coast shoreside whiting fleet and the West Coast non-whiting groundfish trawl fleet. This analysis updates that study with data collected through 2015, as well as updated biomass measures for the species targeted. The at-sea sectors are excluded because the methods are not appropriate for the processing components of these fleets (Walden et al. 2014).

The MFP index consists of multiple inputs (labor, energy, and capital) and an output variable (the value of fish production; see Walden et al. 2014 for full background and index construct). Inputs and outputs are valued by using prices for inputs and outputs that are constant over time and allow the summation of multiple species into one output vector [Here, average ex-vessel prices by species and input prices from 2009 to 2015 are used.] In simplest terms, an MFP index greater than 1.0 suggests an increase in productivity over time (through increases in the ratio of outputs to inputs). Input and output values presented in this analysis are not intended to assess net returns or profitability, as the output and input indices are constructed using fixed inflation-adjusted prices (for fish production, labor price, and fuel) and

[20] Analysis of vessel-level efficiency, or the distance any vessel is from the production frontier is beyond the scope of the current analysis

they do not include all costs incurred by vessels. Inputs include the value of vessels, capital investments, and labor and fuel expenses.

Thunberg et al. (2015) point out the following:

> A complicating factor in constructing indices for fishing fleets compared to traditional land-based industries is that MFP can be affected by changes in target species biomass. Biomass is an important input for the fishery production process as it can affect the catchability of fish, but its level and change between time periods is beyond the control of individual vessels in the fishery. Because biomass change may influence both outputs produced and the use of inputs by fishing vessels, failure to separate biomass from the remainder of the index makes it difficult to disentangle change in output and input use from biomass change.

While accounting for biomass helps contextualize the MFP index, it assumes that biomass directly correlates to the catchability of the fish, which may not always be the case. Both biomass-adjusted and biomass-unadjusted measures are provided here.

Biomass estimates are available for species that comprise 98 percent of landing weight and 98 percent of revenue. However, one caveat is that Dover sole and sablefish comprise a significant proportion of landing weight and revenue, and updated stock assessments for these two species are not yet available, necessitating the inclusion of projected rather than estimated biomass. Projected biomass estimates in stock assessment reports are, by nature, decreasing, meaning that total non-whiting biomass is underestimated in years for which projections are used. The overall productivity change could be inflated if the biomass is lower than assumed.

Non-whiting catcher vessels productivity estimate

Table 3-10 shows the output and input quantities that are used to calculate the input and output MFP indices shown in Table 3-11 for the non-whiting groundfish fleet. Annual output (valued at reference period prices) has decreased, and total inputs have decreased as well (Table 3-10), leading to the decreases in the output and input indices in Table 3-11. The Biomass Unadjusted MFP is the ratio of the output and input indices.

Table 3-11 shows that MFP has increased over the period, indicating the input index decreased more relative to the output index. For the non-whiting groundfish fishery, the average index value greater than 1.0 in catch share years (1.31) signifies a growth in productivity from the baseline period.

The biomass index for non-whiting groundfish is greater than 1.0 in post-catch share years, reflecting a slight decrease in estimated biomass[21] likely due to using projected estimates for Dover sole and sablefish, as noted above. The declining biomass index leads to a higher biomass-adjusted MFP of 1.36 in the catch share period, and still indicates a steady, large increase in productivity from the baseline period. Mamula and Collier (2015) estimate MFP for a longer historical period, and they find similar results for the catch share period. They also found a large increase in productivity for vessels that remained in the fishery following the buyback in 2003.

Table 3-10. Output and inputs in the West Coast non-whiting groundfish trawl fishery ($) (valued using inflation-adjusted average prices from 2009 to 2015). Source: EDC data.

Year	Output	Capital	Labor	Energy	Total Inputs
2009	40,654,383	6,156,503	19,866,679	8,093,421	34,116,603
2010	35,592,662	4,607,486	16,346,432	6,448,770	27,402,688
2011	32,934,458	3,837,784	13,156,704	4,368,362	21,362,850
2012	33,480,313	4,106,043	13,283,545	4,208,559	21,598,147
2013	36,472,191	4,478,455	13,125,356	5,293,080	22,896,891
2014	33,973,162	4,445,151	12,077,767	4,113,626	20,636,544
2015	33,069,335	4,479,413	10,509,680	3,681,925	18,671,018
Pre-catch shares avg.	**38,123,522**	**5,381,994**	**18,106,555**	**7,271,096**	**30,759,646**
Catch shares avg.	**33,985,892**	**4,269,369**	**12,430,610**	**4,333,110**	**21,033,090**

Table 3-11. Lowe output, input, and multi-factor productivity (MFP) indices in the West Coast non-whiting groundfish trawl fishery.

Year	Output Index	Input Index	Biomass Unadjusted MFP	Biomass Index	Biomass Adjusted MFP
2009	1.07	1.11	0.96	0.99	0.95
2010	0.93	0.89	1.05	1.01	1.06
2011	0.86	0.69	1.24	1.03	1.28
2012	0.88	0.70	1.25	1.04	1.30
2013	0.96	0.74	1.29	1.05	1.35
2014	0.89	0.67	1.33	1.05	1.39
2015	0.87	0.61	1.43	1.05	1.49
Baseline avg.	**1.00**	**1.00**	**1.00**	**1.00**	**1.01**
Catch shares avg.	**0.89**	**0.68**	**1.31**	**1.04**	**1.36**

[21] The biomass index is the inverse, so in increase in the index implies a decrease in total biomass.

Shoreside whiting catcher vessel productivity estimate

For the shoreside Pacific whiting fleet, annual average output after the implementation of catch shares was $25.7 million—almost double the baseline period (Table 3-12). This increase was largely due to increases in TAC, and would be even higher, were it not for low quota attainment in 2015. Total inputs also increased since the baseline period, though by a lesser degree, and they were driven by increases in labor inputs (Table 3-12). These patterns are summarized by the index values in Table 3-13; the output index increased from 1.0 to 1.48 and the input index varied substantially over time, but remained unchanged on average from the reference period. The ratio of theses indices gives the biomass-unadjusted MFP, which increased substantially after catch shares period but especially in 2011.
However, when the MFP is adjusted for biomass, which increased from the pre-catch shares baseline period, the biomass-adjusted MFP decreased over time. This should not be interpreted to mean that productivity itself has decreased (while output and inputs have both decreased, relatively more output is being produced with the lower amount of inputs), but rather that the biomass increase (from unusually low levels in 2009-2010) outpaced the growth in MFP.

Table 3-12. Output and inputs in the West Coast shoreside Pacific whiting fishery ($) (valued using inflation-adjusted average prices over 2009-2015). Source: EDC data

Year	Output	Capital	Labor	Energy	Total Inputs
2009	12,657,195	4,729,467	5,774,206	3,232,191	13,735,864
2010	22,095,191	5,417,162	10,905,404	7,521,351	23,843,917
2011	26,809,618	4,221,170	7,345,670	4,156,702	15,723,541
2012	22,450,534	5,025,147	8,909,252	5,001,283	18,935,681
2013	35,784,894	5,600,425	11,610,940	7,539,758	24,751,123
2014	29,429,644	5,483,046	10,328,206	5,532,713	21,343,965
2015	13,879,412	4,664,693	6,047,304	2,761,703	13,473,701
Baseline	**17,376,193**	**5,073,315**	**8,339,805**	**5,376,771**	**18,789,890**
Catch share	**25,670,820**	**4,998,896**	**8,848,275**	**4,998,432**	**18,845,602**

Table 3-13. Lowe output, input, and multi-factor productivity (MFP) indices in the West Coast shoreside Pacific whiting fishery.

Year	Output Index	Input Index	Biomass Unadjusted MFP	Biomass Index	Biomass Adjusted MFP
2009	0.73	0.73	1.00	1.09	1.09
2010	1.27	1.27	1.00	0.92	0.93
2011	1.54	0.84	1.84	0.81	1.50
2012	1.29	1.01	1.28	0.50	0.64
2013	2.06	1.32	1.56	0.36	0.57
2014	1.69	1.14	1.49	0.33	0.50
2015	0.80	0.72	1.11	0.34	0.38
Baseline avg.	**1.00**	**1.00**	**1.00**	**1.01**	**1.01**
Catch shares avg.	**1.48**	**1.00**	**1.46**	**0.47**	**0.72**

Efficiency

To estimate efficiency for the remainder of the fishery for which the Lowe Index is not appropriate, an alternative method is used. Efficiency can be calculated as net revenue (revenue minus the costs of fishing and/or production) as a percentage of revenue. This measure describes the percentage of revenue left over after all costs are paid. This measure is calculated for each sector and for whiting and non-whiting vessels and processors (Table 3-14). It can also be calculated for fishing activities (i.e., shoreside whiting, at-sea whiting, trawl, and fixed gear activities) as (1 minus the total expenses as a percentage of revenue), which are provided in section 3.1.2(a)(1).

Table 3-14. Efficiency, calculated as net revenue as a percentage of revenue, by sector and by target fishery (revenue and cost data for each sector is provided in Section 3.1.2). Source: EDC data.

	2009	**2010**	**Pre-Catch Shares avg.**	**2011**	**2012**	**2013**	**2014**	**2015**	**Catch Shares avg.**
Catcher vessels	9%	12%	10%	24%	11%	27%	22%	15%	20%
Whiting	1%	6%	4%	19%	2%	23%	13%	-9%	12%
Non-whiting	6%	9%	8%	17%	10%	20%	22%	23%	18%
Catcher-Processors	28%	51%	42%	33%	32%	44%	49%	35%	40%
Motherships	2%	10%	7%	12%	-4%	4%	8%	-12%	4%
Shorebased processors	0%	-4%	-1%	12%	13%	11%	7%	-1%	9%
Whiting	-3%	-9%	-5%	12%	15%	13%	9%	-2%	10%
Non-whiting	13%	15%	14%	12%	10%	3%	1%	2%	6%

Efficiency calculated as net revenue as a percentage of revenue corroborates the Lowe Index results for whiting and non-whiting catcher vessels (Table 3-14). Both fleets show a substantial increase in efficiency from the baseline period to the catch share period, although negative efficiency for whiting catcher vessels in 2015 reduced the average.

Catcher-processors have the highest rate of efficiency compared to other sectors, and this has not changed over the catch share period. There is no clear trend for motherships. Their efficiency is the lowest of the sectors in the fishery, although it may be affected by internal decisions about the distribution of costs and revenues within motherships and at-sea catcher vessels with common ownership.

For shorebased whiting processors, efficiency has increased substantially since the beginning of the catch share program, with the exception of 2015. However, for non-whiting processors, there has been a downward trend in processing efficiency, from an average of 14 percent before catch shares to an average of 6 percent in the catch share period. The lowest levels efficiency occurred in 2014 for non-whiting processors.

3.1.1(b)(3) Product Value

Highlights:

- Two methods are used: a productivity index, which can account for changes in biomass, and efficiency, measured as net revenue as a percentage of revenue.
- Efficiency in the whiting catcher vessel sector has increased. However, the productivity index suggests that the growth in biomass outpaced the growth in economic productivity for the shoreside sector; the at-sea sector cannot be analyzed using this method.
- The non-whiting catcher vessel sector has experienced substantial increases in efficiency and productivity.
- Catcher-processors are more efficient than other sectors, but efficiency in this sector has not changed substantially from 2009 to 2015.
- There is no clear trend in efficiency for motherships.
- Whiting processors have substantially increased in efficiency, with the exception of 2015.
- There is a downward trend in efficiency for non-whiting processors.

Another potential avenue for increases in net benefits is product value. In this section, several drivers of product value are analyzed. Some can be analyzed quantitatively with available data and others only qualitatively. Increases in product value can be driven by changes in harvesting and processing decisions, as well as by higher consumer demand. The catch share program induced changes in harvesting decisions, some of which were expected to influence the quality of raw fish inputs to processors. A few qualitative factors resulting from the catch share program that may shift consumer demand are discussed below.

100 Percent Catch Accounting

The catch share program mandated 100 percent catch accounting, meaning that all fish caught (retained or discarded) count against quota. This is monitored by 100 percent observer and catch monitor coverage. This policy was expected to influence harvesting decisions in ways that might impact product quality (PFMC and NMFS 2010). On one hand, 100 percent catch accounting might have led to lower quality landings as it discouraged high-grading (discarding lower quality fish to catch more valuable fish). On the other hand, this policy was expected to encourage more selective fishing, leading to higher quality fish being landed. There are numerous ways vessels can fish more selectively, including altering the timing (of day and of season) and location of fishing to avoid bycatch and other undesirable fish, or using excluder devices. The catch share program also allows vessels to use fixed gear (longline or pots) to catch some or all of their IFQ allocations (primarily used for sablefish). Fixed gear is more selective at targeting larger sablefish that command a higher ex-vessel price (Table 3-66 in Section 3.1.2(d)(6)).

Product Uses

Pacific whiting seasons in the shoreside and mothership sectors decompressed under catch shares (Section 3.1.2(d)(2)) as cooperative harvest privileges in the mothership sector and IFQs in the shoreside sector lessened the motivation to race for fish. This was expected to allow harvesters to time fishing operations to optimize profits, which could result in higher quality landings (PFMC and NMFS 2010). To evaluate this outcome, the percentage of total landed weight of Pacific whiting used for human food production is calculated over time (Table 3-15). PacFIN fish ticket data label shoreside Pacific whiting landings as human food, animal food, bait, or discards. This is used as a proxy for fish quality, as higher quality landings produce human food, while poorer quality landings are discarded, used for bait, or used for animal food. Table 3-15 shows that the percentage of non-whiting groundfish landings used for human consumption has decreased slightly over time, while it has increased for Pacific whiting in the catch share years, but similar to 2005. These data are not available for the at-sea sector for comparison.

Table 3-15. Percent of total landed weight from shoreside Pacific whiting fishery and trawl non-whiting groundfish fishery used for human food production (includes non-whiting groundfish caught with fixed gear using a trawl endorsement) Source: Fish ticket data.

Year	Groundfish	Whiting
2005	97.51	94.00
2006	97.41	90.53
2007	97.23	88.34
2008	97.24	86.84
2009	97.41	86.54
2010	97.50	83.83
2011	97.31	94.20
2012	97.48	94.74
2013	96.88	94.64
2014	96.19	95.25
2015	95.77	92.36
2016	96.17	92.22

Product Recovery

Given that the shoreside and mothership sectors of the Pacific whiting fishery operated as derby fisheries prior to implementation of the catch share program, it was expected that product recovery would increase due to slower paced harvesting and processing. The FEIS states that changes in the Pacific whiting fishery might not be as dramatic as those seen in the Alaska pollock fishery, because many motherships and catcher vessels that target Pacific whiting also participate in the Alaska pollock fishery, which was rationalized under the American Fisheries Act (AFA, PFMC and NMFS 2010). After implementation of the AFA, many vessels modified processing capital, improving efficiency; therefore, similar changes that might have occurred after 2011 had likely already happened for many vessels.

The product recovery rate (total product weight divided by total weight of inputs) for each sector varies from year to year for a variety of reasons, including product form changes. As expected, variation in the catcher-processor sector is smaller than variation in the mothership and shoreside whiting sectors. The recovery rate in the shoreside sector is higher than the at-sea sectors as headed-and-gutted products recover more fish than surimi and filleted whiting. Overall, the product recovery rate increased under catch shares in the mothership and shoreside sectors (Table 3-16).

Calculating product recovery rates for non-whiting groundfish by using EDC data is challenging. If groundfish is purchased by an EDC processor and then sold unprocessed to another processor, this fish could show up twice on the EDC forms, distorting product recovery rates. This is particularly relevant for shoreside processors. While EDC staff adjusts for this issue whenever feasible, unprocessed groundfish is more prevalent in the data than unprocessed Pacific whiting.

Table 3-16. Sector-wide average Pacific whiting product recovery rates.[22] Source: EDC data

Sector	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Catcher-processor	0.38	0.37	0.34	0.34	0.35	0.38	0.36
Mothership	0.39	0.27	0.34	0.50	0.50	0.33	0.31
Shoreside	0.61	0.39	0.58	0.53	0.62	0.60	0.65

Production Value

Changes in production value per pound of fish product (total value divided by total weight by product) can also indicate changes in product quality, with higher-quality products selling for higher prices, although numerous other factors could influence production value. These include, but are not limited to, changes in world markets, availability of substitutes, and composition of inputs to production.

The main products produced by the mothership sector are surimi and fishmeal, while catcher-processors mainly produced fillets and surimi, with fillet being the higher-valued product. Production value per metric ton (mt) of these product types has varied from year to year, but generally decreased from 2011 to 2013. Production value then increased in 2014 and 2015 (Table 3-17 and Table 3-18).

[22] A caveat in calculating product recovery rates is that the EDC forms include a write-in "other" product category for whiting, which could lead to inconsistencies across years and processors.

Table 3-17. Mothership sector-wide production value per mt of processed Pacific whiting by product form (2015 $). Source: EDC data.

Product form	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Total value	1,809	2,340	1,734	1,214	1,082	2,343	2,411
Fillets	2915	***	***	***	***	***	***
Fish oil	0	0	***	***	***	***	***
Fishmeal	1,381	1,796	1,276	1,543	1,631	2,593	2,001
Headed and gutted	***	***	1,910	***	1,465	***	***
Minced	1,445	***	***	***	***	***	***
Other	***	0	0	0	0	0	0
Roe	0	0	0	0	***	0	0
Surimi	2,322	2,823	2,261	2,314	1,832	2,581	2,627

Note: *** indicates that data were suppressed to protect confidential data.

Table 3-18. Catcher-processor sector-wide production value per mt of processed Pacific whiting by product form (2015 $). Source: EDC data.

Product form	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Total value	2,701	2,975	2,582	2,837	2,463	2,584	2,565
Fillets	3,469	3,304	2,960	3,444	3,252	3,051	3,074
Fish oil	***	***	***	1540	***	1355	***
Fishmeal	1,621	***	1,846	2,161	2,127	2,131	2,043
Headed and gutted	0	***	***	***	***	***	0
Minced	2,075	2,250	1,859	***	***	***	***
Roe	0	***	0	0	0	0	0
Surimi	2,291	3,192	2,639	2,738	1,882	2,447	2,435

Note: *** indicates that data were suppressed to protect confidential data.

In the shoreside sector, most species and product form combinations experienced an increase in industrywide average production value per pound (Table 3-19). The most notable exception is the decrease in production value per pound for many of the Pacific whiting product types. The most important products in terms of industrywide production value are headed-and-gutted Pacific whiting (which experienced a decrease in production value per pound under catch shares), frozen sablefish (which experienced a slight increase in production value per pound under catch shares mainly due to large price increases in 2011), and processed fresh Dover sole (which experienced an increase in production value per pound under catch shares).

Table 3-19. Shoreside sector average production value per pound (2015 $) by species and product form. Source: EDC data

Species and product form	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Arrowtooth flounder: Fresh	---	---	1.19	1.1	1.22	1.2	1.2
Arrowtooth flounder: Frozen	---	---	***	0.9	0.73	1.12	1.13
Dover sole: Fresh	2.47	2.7	3.55	3.65	3.64	3.65	3.48
Dover sole: Frozen	2.36	1.71	2.83	2.62	2.07	3.56	2.73
Dover sole: Unprocessed	0.58	1.14	0.79	0.44	0.8	0.79	0.56
English sole: Fresh	2.34	2.43	3.4	3.54	3.3	3.34	3.09
English sole: Frozen	1.33	1.18	2.6	1.15	1.57	1.41	0.94
English sole: Unprocessed	0.73	0.8	0.99	0.91	***	0.64	0.63
Lingcod: Fresh	4.13	4.56	4.25	4.08	4.29	4.76	4.68
Lingcod: Frozen	6.54	2.21	3.66	3.67	2.9	2.21	2.29
Lingcod: Unprocessed	1.37	1.82	2.77	2.53	2.17	3.21	2.5
Pacific whiting: Fillet	1.2	1.28	0.69	1.04	***	***	***
Pacific whiting: Frozen	***	0.36	0.31	0.55	0.26	0.3	0.29
Pacific whiting: Headed-and-gutted	0.61	0.61	0.6	0.68	0.51	0.51	0.37
Pacific whiting: Surimi	***	***	***	***	***	***	***
Pacific whiting: Unprocessed	***	0.11	***	***	***	***	***
Petrale sole: Fresh	3.8	4.32	5.83	5.44	5.41	5	4.87
Petrale sole: Frozen	3.37	3.26	4.46	4.34	3.73	3.63	3.34
Petrale sole: Unprocessed	1.68	2.04	2.65	2.87	2.18	2.05	1.97
Rex sole: Fresh	1.79	2.17	2.29	2.6	2.03	2.05	1.95
Rex sole: Frozen	1.65	1.38	1.73	1.99	1.77	1.48	0.98
Rex sole: Unprocessed	0.79	0.65	0.86	1.51	0.73	0.84	0.79
Rockfish: Fresh	2.97	2.9	3.01	3.28	3.29	2.95	2.92
Rockfish: Frozen	2.18	2.03	1.95	2.04	1.48	1.14	1.39
Rockfish: Unprocessed	1.34	1.16	1.55	1.21	1.81	1.54	1.5
Sablefish: Fresh	4.48	5.64	3.15	5.23	3.9	6.49	6.92
Sablefish: Frozen	5.4	5.85	7.63	5.81	4.97	5.61	5.83
Sablefish: Unprocessed	3.09	3.17	4.07	2.96	3.14	2.96	3.54
Sanddab: Fresh	---	---	***	5.39	5.31	4.1	3.83
Sanddab: Frozen	---	---	3.39	4.86	4.78	4.4	4.62
Sanddab: Unprocessed	---	---	1.33	1.39	1.38	1.37	1.18
Sharks, skates and rays: Fresh	1.3	1.8	2.97	***	1.92	1.84	2.51
Sharks, skates and rays: Frozen	1.48	2.02	2.21	2.77	2.18	2.49	2.91
Sharks, skates and rays: Unprocessed	***	0.65	0.92	0.92	0.51	0.21	0.31
Thornyheads: Fresh	1.32	1.26	***	***	***	2.99	2.2
Thornyheads: Frozen	2.58	2.41	3.64	3.81	3.11	3.17	3.11
Thornyheads: Unprocessed	1.35	1.06	1.6	2.23	1.98	2.11	2.78

Note: *** indicates that data were suppressed to protect confidential data

Markup

The industrywide average markup (output value divided by input cost) for most groundfish species is higher on average under catch shares, excluding Pacific whiting. The markups for sablefish and petrale sole have increased and decreased, respectively, under catch shares but the magnitude of the change is small compared to other species (Table 3-20).

Table 3-20. Industrywide average markup by species and sector. Source: EDC data

Species	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Arrowtooth flounder	---	---	3.46	2.67	2.82	3.47	3.88
Dover sole	1.99	2.25	2.04	2.25	1.92	1.99	1.96
English sole	2.12	1.87	2.29	2.52	2.29	1.75	2.14
Lingcod	2.02	2.20	2.25	2.30	2.12	2.14	1.78
Pacific whiting - mothership sector	4.57	3.83	3.36	3.28	3.15	3.51	3.86
Pacific whiting - shoreside sector	3.66	3.65	2.93	2.77	2.56	2.76	3.42
Petrale sole	1.95	1.40	1.46	1.46	1.46	1.64	1.51
Rex sole	2.41	2.31	2.27	2.24	2.37	2.41	2.67
Rockfish	1.54	1.46	1.59	1.52	1.61	1.59	1.75
Sablefish	1.34	1.55	1.31	1.34	1.39	1.30	1.39
Sanddab	---	---	2.41	2.88	2.54	2.25	2.34
Sharks, skates, and rays	2.74	2.35	3.05	2.38	1.93	1.75	2.33
Thornyheads	1.76	2.04	2.51	2.66	2.16	2.20	2.16

Note: --- indicates that data were not collected for that species in that year.

Product Forms

The FEIS states that “product recovery and quality may improve along with the opportunity to develop new products and markets” in the Pacific whiting fishery under the catch share program (PFMC and NMFS 2010). In the shoreside Pacific whiting fishery, the highest volume product was headed-and-gutted whiting (Figure 3-4). There was as increase in frozen whole whiting from 2009 to 2015 due to access to a new market in Africa. In the mothership sector, there was a move towards producing products other than surimi from 2011 to 2013; however, surimi was the predominant product in 2014 and 2015 (Figure 3-5). There were no major observed changes in product types in the catcher-processor sector over this period (Figure 3-6).

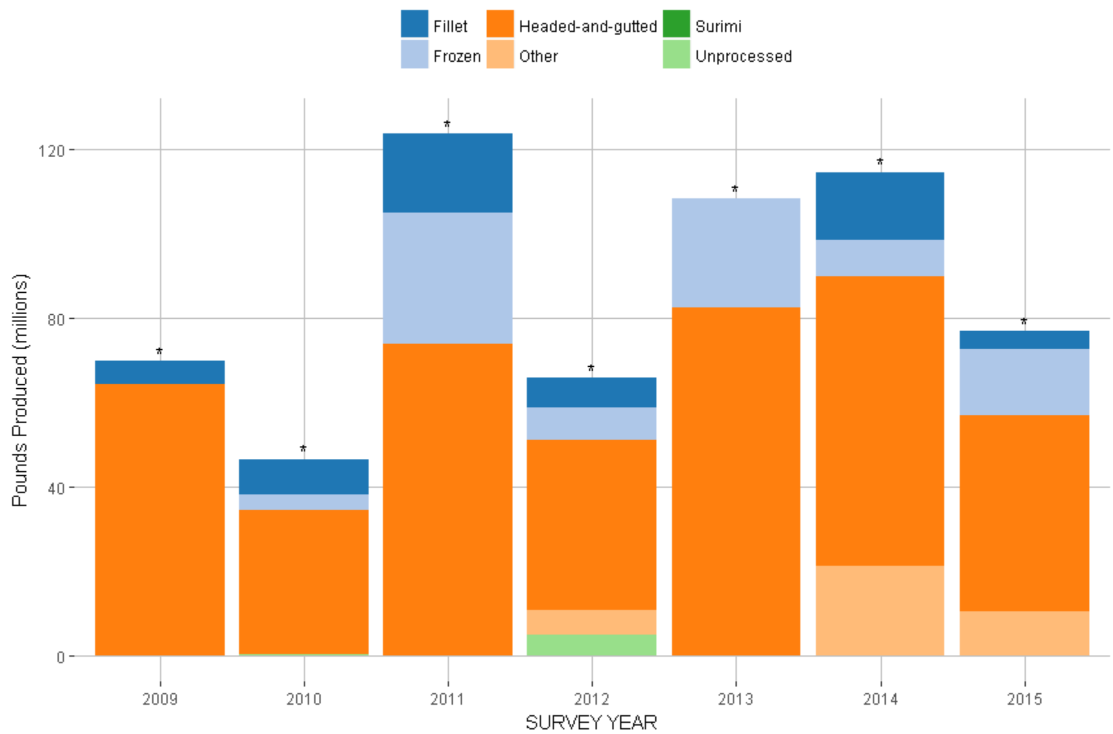


Figure 3-4. Shoreside Pacific whiting production by product form. *Some values are suppressed to protect confidential data. Source: EDC data.

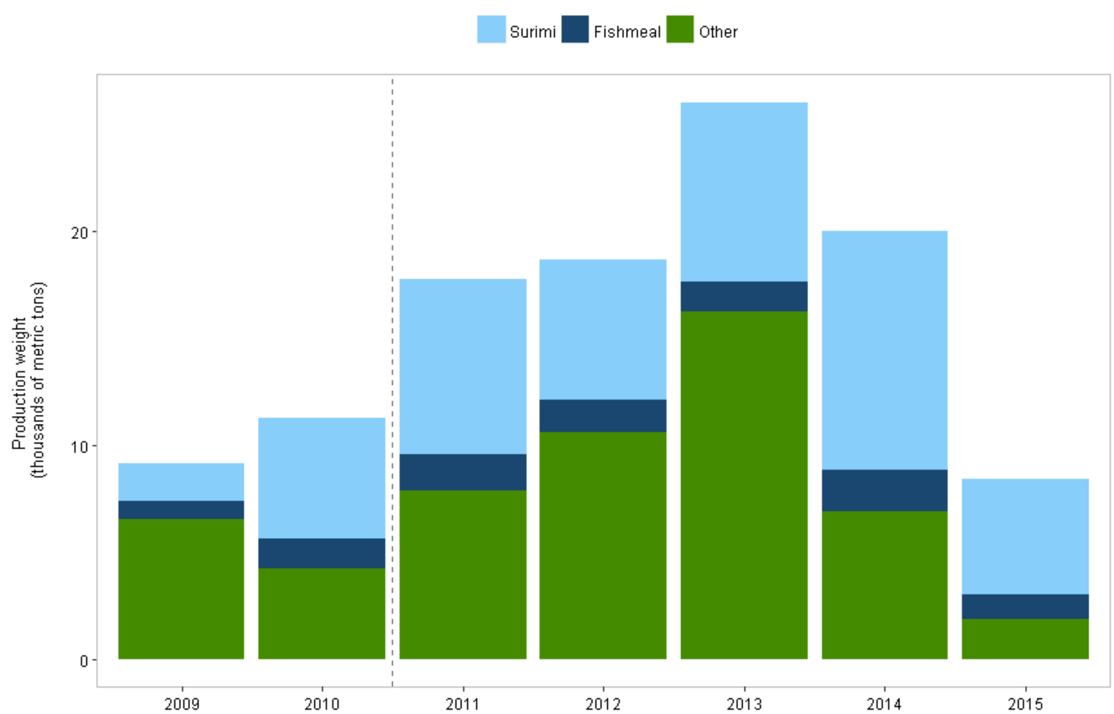


Figure 3-5. Mothership Pacific whiting production by product form. Source: EDC data.

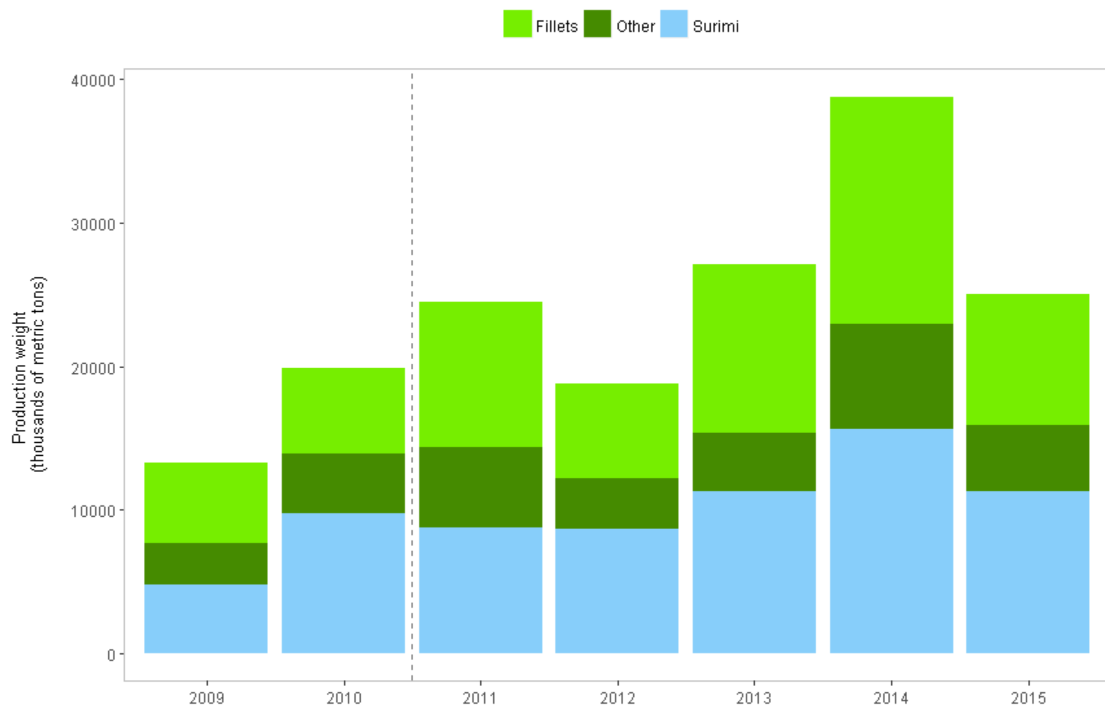


Figure 3-6. Catcher-processor Pacific whiting production by product form. Source: EDC data.

Non-whiting groundfish is mainly sold fresh or unprocessed; the major exception is sablefish, which is primarily exported as frozen. There have not been substantial shifts in product choices during this period; however, there have been some notable changes. As production of Dover sole has decreased, the proportion all processed fresh has also decreased. The proportion of rockfish processed fresh has also decreased from pre-catch share levels. There also appears to be a slight increase in unprocessed products since the baseline years of 2009 and 2010, which are generally lower value than their fresh and frozen counterparts (Figure 3-7 and Figure 3-8).

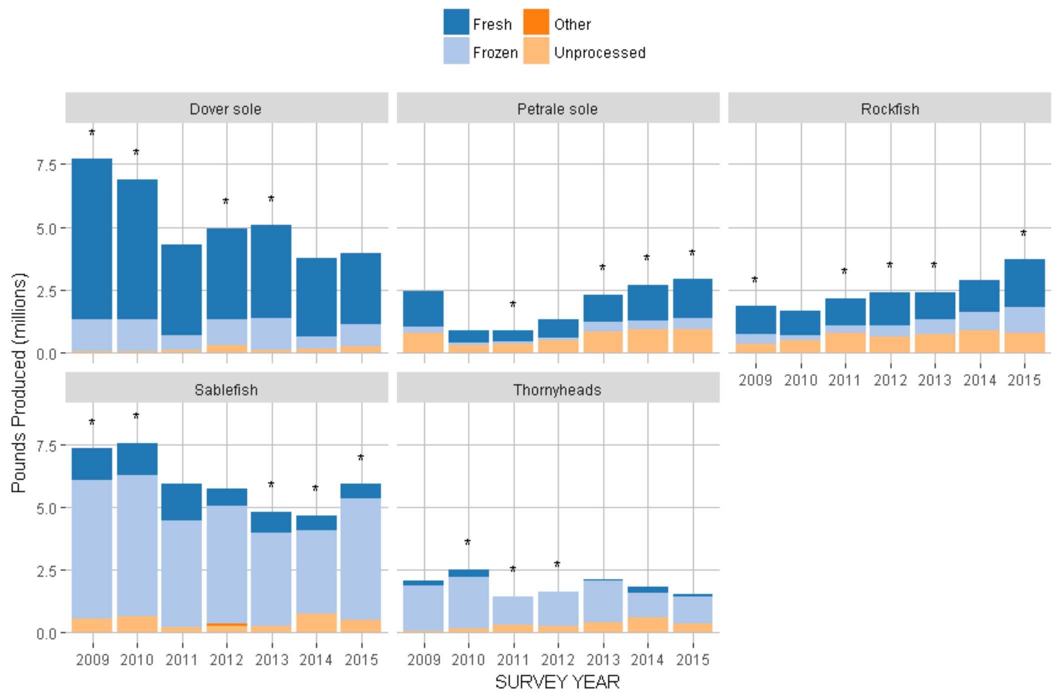


Figure 3-7. Industry-wide non-whiting groundfish production by product form and species. *Some values are suppressed to protect confidential data. Source: EDC data.

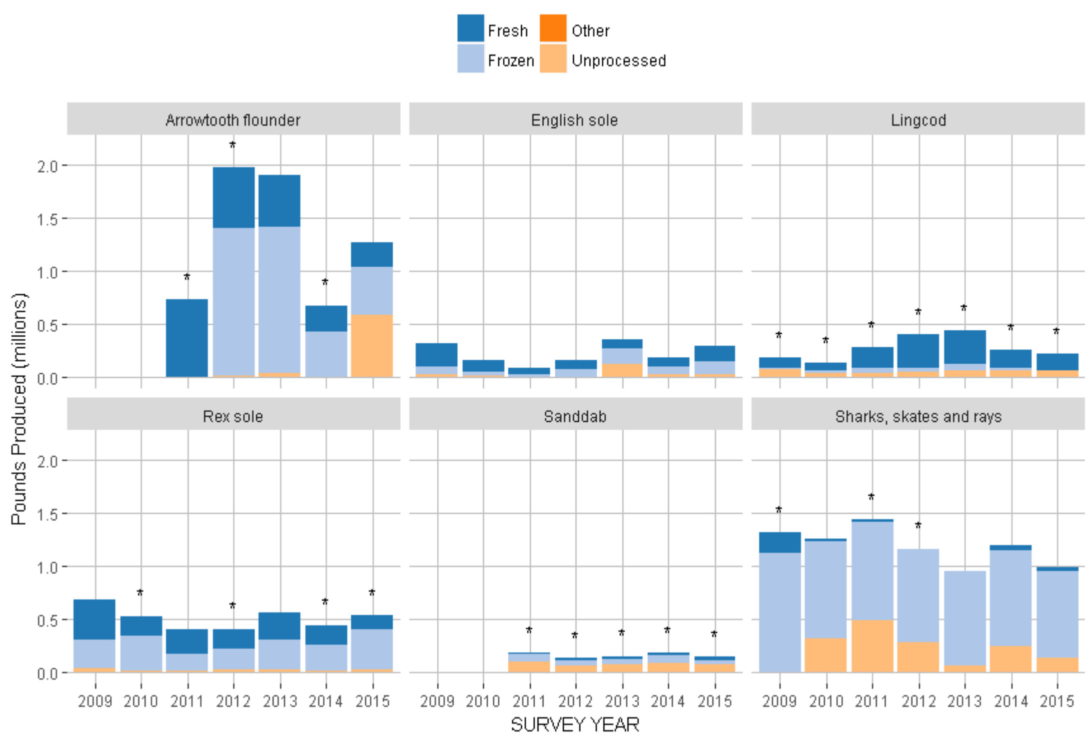


Figure 3-8. Industry-wide other non-whiting groundfish production by product form and species. *Some values are suppressed to protect confidential data. Source: EDC data.

Consumer Accessibility to West Coast Seafood

West Coast groundfish products supply both global and domestic frozen and fresh markets. Pacific whiting and sablefish are the two main species that are exported. Pacific whiting reaches markets in Europe, as well as Asia and the Middle East (Figure 3-9). Exports to Russia and the Ukraine have decreased in recent years as Russia implemented trade sanctions against Europe and the United States in 2014. Africa opened up as a new market in the last decade with an increase in exports since 2010. Most sablefish exports go to Japan, as well as to other Asian and Middle Eastern markets. A small, but rising, portion of the exports has gone to Europe and other markets in the last decade.

Shorebased processors in the non-whiting groundfish fishery have said that the catch share program has affected their ability consistently to supply groundfish markets (Figure 3-10). With the move from two-month cumulative trip limits to individual fishing quotas, vessels have more flexibility in timing participation in the groundfish fishery and the harvester/processors coordination required to maintain a consistent supply has not occurred (Section 3.1.2(d)). Processors have noted a loss in skilled labor (groundfish filleters) and a loss in certain consumer markets due to inconsistent fish supply (2016).

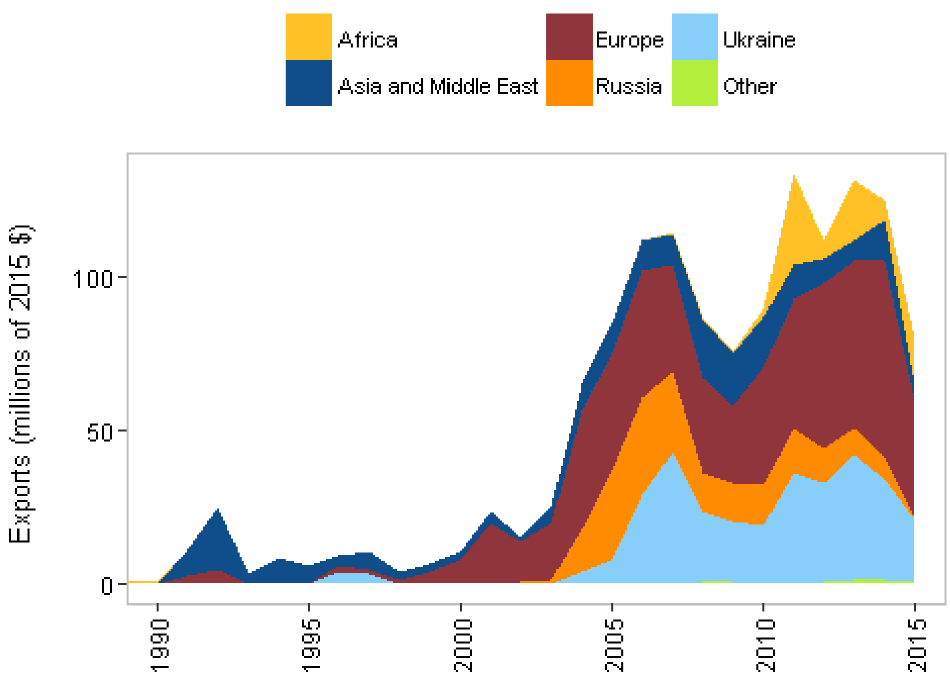


Figure 3-9. Total exports of fresh and frozen Pacific whiting (including mothership, catcher-processor, and shoreside production) from the U.S. by recipient region. Source: Guldin et al. 2016.

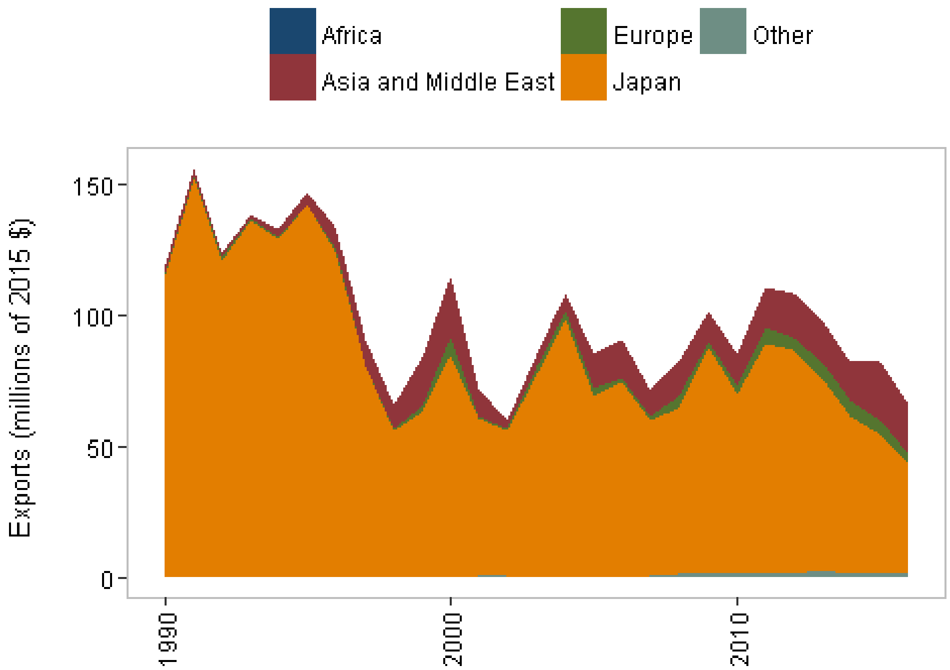


Figure 3-10. Total exports of sablefish from the West Coast by recipient region. Source: Guldin et al. 2016.

Certification Programs

At the Pacific Groundfish Quota Program Workshop in 2016, industry members and retailers discussed the lack of consumer knowledge about and familiarity with groundfish seafood products compared to other species like salmon or tilapia. Seafood certification and labeling programs are one way to provide consumers with more information about their seafood purchases. These programs are potentially important as consumers are becoming increasingly interested in the origins of their food, including seafood. They raise public awareness regarding fishing practices, increasing consumer demand for seafood from sustainable fisheries. Early evidence shows that the market effects of these programs are positive, and these effects are projected to grow as more and more seafood products are certified and labeled (Roheim 2003).

One such program was started by the Marine Stewardship Council (MSC).[23] The MSC is an international non-profit organization that designed a fisheries certification and seafood-labeling program to promote sustainable fishing. The MSC certified the Pacific whiting fishery, which uses midwater trawl gear, as

[23] https://www.msc.org/

sustainable in 2009 and recertified it in 2014. The West Coast groundfish limited entry trawl fishery became MSC-certified in 2014.

The Monterey Bay Aquarium created consumer guides, including paper wallet cards and a smartphone app, called Seafood Watch. Seafood Watch classifies seafood choices into three categories: best choices, good alternatives, and to be avoided. The following species in the West Coast Groundfish Trawl Catch Share Program were listed as best choices in 2014: Pacific whiting, sablefish, lingcod, Pacific sanddab, Dover sole, English sole, rex sole, thornyheads, and some species of rockfish (aurora, splitnose, and widow). Petrale sole and other rockfish species (blackgill, bocaccio, chilipepper, darkblotched, Pacific ocean perch, rougheye, vermillion) are listed as good alternatives. Many of these species had previously been listed as species to avoid. The change occurred because of management improvements implemented following a federal disaster declaration for the fishery in 2000 and reauthorization of MSA in 2006, including continuing recovery of overfished species, quotas that more accurately account for uncertainty, closures to protect vulnerable habitat, and excellent monitoring and control of catch.[24]

3.1.1(b)(4) Quota Market Performance

Highlights:

- Most QP transfers made are identified as self-trades.
- Cash sales make up 24 percent to 36 percent of transfers not identified as self-trades.
- The number of quota stocks with at least 10 priced single-species cash transfers increased from 5 in 2011 to 11 in 2016.
- The most traded species (in single-species trades) in 2016 were sablefish north of 36°, petrale sole, Pacific halibut IBQ, and widow rockfish.

The performance of the quota market affects the overall performance of the fishery. An efficient quota market serves to allocate QP to its highest value use. It also influences behavior, e.g., incentivizing individuals to avoid constraining species. And third, the QP market provides information to fishing businesses, fishery managers, and other stakeholder to support business planning and policy decisions (Holland 2016). Holland (2017) updates the information published in Holland (2016) to include 2016 data, and provides additional analysis to support this review. The tables and discussion in this section are from Holland (2017).

[24] https://newsroom.montereybayaquarium.org/press/huge-improvement-in-seafood-watch-rankings-for-key-west-coast-fisheries

Characteristics of QP Transfers

Because all QP transfers must be done through an online system operated by NMFS, the full population of QP transfers is analysed here. When making QP transfers through this system, the account holder making the transfer must indicate, along with the quantities of QP to be transferred, whether the transfer is a “self-trade” (meant to indicate a transfer within a company), “cash sale,” “barter,” “cash and barter,”, or “other.”

The great majority of QP transfers made are identified as self-trades [Table 3-21]. At the beginning of the year, individual QS account holders are allocated QP and must transfer this into vessel accounts for it to be used to balance catch; therefore, many of these self-trade transfers are QS permit owners transferring QP to their own vessel account, while others are between vessel accounts owned by the same company. Depending on the year, 33-40% of annual transfers are self-trades.

For the transfers that are not self-trades, a variety of trading mechanisms are used. The most frequent transfer type other than self-trade is “other.” Although transferors are asked to describe any non-monetary compensation for transfers designated as “other”, this is not required and the field is mostly left blank. Descriptions that are provided suggest that “other” includes transfers made to and from risk pools and cooperatives, contractual arrangements where payment is a share of revenue when fish is landed, and various miscellaneous reasons (e.g., gifts, corrections to prior transfers). Depending on the year, trades designated as “other” make up 45% to 57% of all transfers that are not designated as self-trades [Table 3-21].

A substantial number of transfers are described as barter. This category was meant to designate swaps of QP, though it may in fact include some transfers where another form of in-kind compensation was used. In 2013 the transfer website clarified that barter was meant to refer to QP or QS swaps, but it is not possible to verify that this is always the case, and attempts to systematically match up both sides of barter trades have not been successful. Barter transfers accounted for 13% to 22% of annual transfers other than self-trades. Another 2-4% of transfers each year that are not designated as self-trades are classified as cash-and-barter.

Transfers classified as cash sales have made up 24% to 36% of the transfers not designated as self-trades. The overall value of the sale must be indicated (though a value of zero can be entered), and this provides a way to calculate price per pound for single-species transfers. Although the transferor is asked to provide a price per pound for each individual species in the multispecies trade, this is not required and rarely filled out, and it has not been possible to use values for these multispecies cash sales to determine prices at the species level. The number of single-species cash sales increased each year during the first 5 years of the program, from 281 in 2011, to 473 in 2015 but dropped to 435 in 2016 [Table 3-21].

Table 3-21. Count of transfers by type, year, and single vs. multiple species transferred (with multispecies transfer counted as one transfer) [Source: Table 2 of Holland 2017]

Transfer	Type	Cash Sale	Barter	Cash and Barter	Other	Self-Trade	Total
2011	Single	281	221	22	395	410	
	Multi	96	64	11	196	394	2090
2012	Single	340	275	37	606	512	
	Multi	67	48	11	260	308	2464
2013	Single	384	262	48	663	641	
	Multi	63	35	12	400	327	2835
2014	Single	411	191	31	596	528	
	Multi	62	37	9	360	326	2551
2015	Single	473	206	39	419	599	
	Multi	87	53	11	341	467	2695
2016	Single	435	188	19	398	513	
	Multi	82	76	2	253	351	2317

There is a substantial amount of transfer activity for most quota species, but the level and types of transfer activity differ substantially for different species [Table 3-22]. In most cases the total number of pounds transferred is well above the total QP allocation for the species since QP are often transferred first from a QS account into a QP account owned by the same firm and then may be transferred again between vessel accounts. Even excluding transfers that are designated as self-transfers, the total QP pounds transferred during the year amount to a large fraction of the total QP allocation and for some species (e.g., canary rockfish and POP) well above 100%. In the case of canary rockfish and POP, a large fraction of the transfers are designated as "other" and many of these appear to be transfers related to risk pools, though there is no specific designation for risk pool related transfers. For Canary rockfish, the sum of transferred QP not designated as self-trades has exceeded 400% of the total QP allocation in some years, and there appears to be a very active cash market.

Table 3-22. Percentage of total sector QP transferred by transfer type for selected species [Source: Table 4 of Holland 2017]

Year	Barter	Cash and Barter	Cash Sale	Other	Total Not Self-Trade	Self-Trade	Total All Trades
	Sablefish North of 36 N. latitude						
2011	12%	4%	28%	35%	79%	85%	164%
2012	11%	1%	26%	35%	74%	91%	165%
2013	16%	4%	27%	33%	80%	94%	174%
2014	15%	3%	27%	41%	87%	83%	169%
2015	10%	6%	29%	31%	77%	101%	178%
2016	23%	1%	43%	31%	99%	86%	185%
	Petrale Sole						
2011	19%	2%	30%	40%	91%	82%	172%
2012	22%	2%	27%	30%	81%	78%	159%
2013	19%	2%	26%	33%	80%	82%	161%
2014	18%	1%	29%	46%	94%	78%	172%
2015	19%	2%	39%	28%	87%	92%	179%
2016	18%	2%	47%	27%	94%	79%	173%
	Pacific Whiting						
2011	23%	1%	5%	41%	70%	72%	142%
2012	16%	3%	11%	47%	76%	70%	147%
2013	6%	1%	5%	50%	63%	73%	135%
2014	4%	1%	5%	44%	55%	72%	127%
2015	3%	0%	3%	38%	45%	65%	110%
2016	7%	0%	8%	44%	58%	68%	126%
	Canary Rockfish						
2011	47%	4%	95%	274%	420%	593%	1013%
2012	38%	2%	80%	203%	322%	310%	633%
2013	34%	5%	76%	221%	335%	285%	620%
2014	20%	6%	83%	295%	404%	267%	671%
2015	7%	7%	30%	60%	104%	77%	181%
2016	29%	10%	72%	137%	248%	155%	403%
	Pacific Ocean Perch						
2011	12%	2%	27%	116%	157%	249%	406%
2012	17%	0%	30%	118%	166%	210%	376%
2013	18%	1%	43%	104%	166%	180%	346%
2014	18%	1%	56%	133%	208%	206%	415%
2015	12%	1%	62%	107%	183%	185%	368%
2016	18%	1%	50%	120%	189%	176%	365%

The choice between barter and cash sales appears to be somewhat dependent on whether the parties have pre-existing relationships. If we consider only “market” transfers (those identified as either barter, cash, or cash and barter), there is a clear preference for using barter over cash sales as the mechanism of trade when both parties own vessels that land fish to the same processor [Figure 3-11]. In contrast, cash sales are preferred for parties that do not share a processor [Figure 3-11]. It is not clear why this is the case, but it may be that processors tend to broker barter trades between vessels that land fish to them, and they may favor barter arrangements over cash when they themselves make transfers to vessels that fish to them. There had been a fairly steady decrease in the ratio of barter to cash sales for both groups until the share of barter jumped up in 2016 for transfers between parties that landed fish to the same processor. Barter may have some advantages over cash sales (e.g. not requiring cash up front), but cash sales may have lower transactions costs than barter when parties don’t know each other. Barter may also be a means of creating an informal risk pool where fishers help others with needed QP for unexpected catch in expectation of reciprocal help should they have an unexpected catch to balance. Holland (2013) found evidence of this behavior in the British Columbia groundfish IFQ.

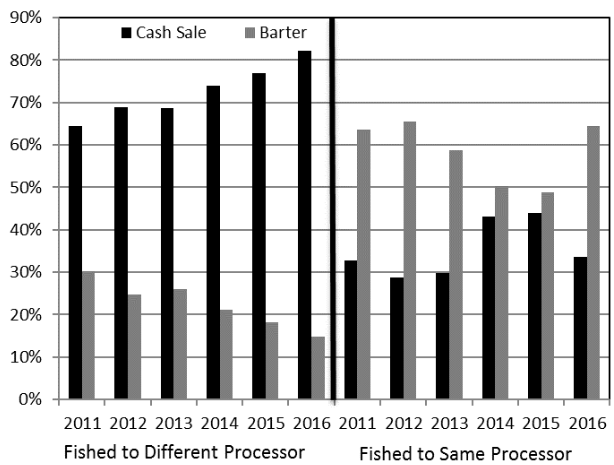


Figure 3-11. Percent of Annual Cash and/or Barter Transfers that were Cash Sales vs. Barter Depending on Whether the Parties Involved Landed Fish to the Same Processor. [Source: Holland 2017]

QP Prices

Although cash sales that include only a single species make up only a fraction of QP transfers, they are the only means by which QP prices can be estimated given the amount of market activity to date.[25] For cash sales that only included a single species, we calculate annual weighted average prices [Table 3-23].[26] There are signs that the activity in the cash market for QP, and the availability and reliability of price information, is increasing. However, the market is still quite thin for most species. About two-thirds of quota stocks have had enough single species cash sales to report prices in any given year. The number with at least 10 priced cash transfers increased from just five stocks in 2011 to 11 in 2016, but single species cash sales remain rare for most species.

One thing that is seemingly in conflict with efficient market pricing is that QP prices are a significant fraction of ex-vessel price for some species for which there is substantial unused QP available [Table 3-24]. In fact, for some species like canary and yelloweye rockfish, QP prices have been well above ex-vessel price even though only a small fraction of total QP was used in any year. If there is substantial excess supply of QP, we might expect these prices to fall, particularly after surpluses persist for a few years. In the case of yelloweye rockfish, the high prices may really reflect transactions costs. Individual transfers are very small and total transfer values are not large, and the high cost per pound may reflect distribution of the transactions costs over a small number of pounds (averaging only 8 pounds). This explanation is somewhat less likely for canary, for which transfers averaged more than 245 pounds per transfer. For Pacific halibut, which has a zero ex-vessel value (since it cannot be retained), average QP prices ranging from $1.42 to $1.73 over the 2011–2013 period are quite surprising given that utilization of QP in aggregate has not exceeded 43%. Average QP trades of Pacific halibut are more than 1,000 pounds, decreasing the likelihood that prices can be ascribed primarily to transactions costs. Regardless of whether these high prices can be ascribed to transactions costs, they suggest inefficiency in the QP market because some individuals are paying substantial amounts for QP while others are simply leaving QP unused (Holland 2017).

[25] In principle, species-specific implicit QP prices might be estimated from multispecies QP cash sales using a hedonic framework (Holland 2013). However, there do not appear to be enough multispecies cash sales or enough variation in their make-up to estimate a hedonic model with reliable prices. Hedonic models estimated with combined single-species and multispecies cash sale data yield prices nearly identical to the averages from single-species trades when the appropriate weighted least squares estimation model is used, and price estimates are not statistically significant (and many appear unrealistic) for species that did not have single-species cash sales.

[26] These prices are also reported on the IFQ website (https://www.webapps.nwfsc.noaa.gov/ifq/. To maintain confidentiality, prices are shown only when they represent transfers from at least two unique buyer-seller combinations. Thus, for some of the more rarely traded species, it is not possible to present prices. Prices less than half or more than twice maximum and minimum prices observed in prior years are also dropped when calculating averages to eliminated transfers where value information appears to have been entered in error.

Table 3-23. Average annual prices and count of single-species QP cash sales reported to NMFS with prices. [Source: Table 4 of Holland 2017]

	2011		2012		2013		2014		2015		2016	
IFQ Species	Price/lb	Sales	Price/lb	Sales	Price/lb	Sales	Price/lb	Sales	Price/lb	Sales	Price/lb	Sales
Arrowtooth flounder	--	--	$0.02	2	$0.01	5	--	7	$0.01	19	$0.01	12
Bocaccio rockfish South of 40°10' N.	$0.50	3	--	--	$0.20	4	$0.30	7	$0.27	10	$0.29	8
Canary rockfish	$1.21	4	$1.49	15	$3.09	12	$2.12	17	$1.14	29	$1.35	17
Chilipepper rockfish South of 40°10' N.	$0.05	3	$0.03	6	$0.02	5	$0.03	12	$0.02	4	--	--
Cowcod South of 40°10' N.	--	--	--	--	--	--	--	--	--	--	$2.06	6
Darkblotched rockfish	$0.40	4	$0.22	6	$0.53	10	$1.08	10	$0.52	22	$0.55	19
Dover sole	$0.06	4	--	--	--	2	--	--	--	--	--	--
English sole	--	--	--	--	--	--	--	--	--	--	--	--
Lingcod	$0.07	2	$0.05	4								
Lingcod North of 40°10' N.					--	--	--	--	--	--	$0.01	4
Lingcod South of 40°10' N.					--	--	--	--	$0.01	3	--	--
Longspine thornyheads North of 34°27' N.	$0.04	5	$0.05	12	$0.05	14	$0.06	18	$0.03	7	$0.03	2
Minor shelf rockfish North of 40°10' N.	--	--	--	--	--	--	--	--	--	--	--	--
Minor shelf rockfish South of 40°10' N.	--	--	--	--	$0.04	5	$0.03	2	--	--	--	--
Minor slope rockfish North of 40°10' N.	--	--	$0.04	4	$0.03	3	$0.03	2	$0.02	4	$0.01	7
Minor slope rockfish South of 40°10' N.	$0.05	6	$0.03	7	$0.05	7	--	--	$0.02	7	--	--
Other flatfish	--	--	--	--	--	--	--	--	--	--	--	--
Pacific cod	$0.05	11	$0.02	9	--	--	$0.02	3	$0.01	5	--	13
Pacific halibut (IBQ) North of 40°10' N.	$1.31	5	$1.19	10	$1.76	21	$0.58	15	$0.58	13	$0.72	28
Pacific ocean perch North of 40°10' N.	$0.14	3	--	--	$0.75	14	$0.99	14	$0.56	24	$0.51	15
Pacific whiting	$0.02	26	$0.04	64	$0.04	53	$0.03	26	--	--	$0.01	16
Petrale sole	$0.35	36	$0.40	20	$0.25	50	$0.28	58	$0.35	65	$0.33	62
Sablefish North of 36° N.	$1.07	54	$1.04	47	$0.88	66	$1.00	62	$1.11	57	$1.10	83
Sablefish South of 36° N.	$0.75	58	$1.05	31	$0.26	8	$0.16	22	$0.18	51	$0.17	3
Shortspine thornyheads North of 34°27' N.	$0.07	2	$0.05	9	$0.05	10	$0.06	9	$0.04	7	$0.03	17
Shortspine thornyheads South of 34°27' N.	$0.17	3	--	--	--	--	--	--	--	--	--	--
Splitnose rockfish South of 40°10' N.	--	--	--	--	--	--	--	--	--	--	--	--
Starry flounder	--	--	--	--	--	--	--	--	--	--	--	--
Widow rockfish	$0.44	6	$0.34	9	$0.53	10	$0.23	34	$0.15	52	$0.15	26
Yelloweye rockfish	$32.28	4	$21.76	9	$29.58	11	$27.07	12	$19.86	4	--	--
Yellowtail rockfish North of 40°10' N.	--	--	$0.01	8	$0.03	6	$0.02	21	$0.01	16	$0.01	9

Table 3-24. Ratio of QP prices to ex-vessel prices. [Source: Table 5 of Holland 2017] (note: for Pacific Halibut the average QP price is divide by one since the ex-vessel price is zero)

IFQ Species	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Arrowtooth flounder	--	0.16	0.09	--	0.10	0.10
Bocaccio rockfish South of 40°10' N.	0.75	--	0.25	0.40	0.37	0.36
Canary rockfish	2.24	2.91	6.18	3.88	2.05	2.75
Chilipepper rockfish South of 40°10' N.	0.08	0.04	0.03	0.04	0.03	--
Cowcod South of 40°10' N.	--	--	--	--	--	2.20
Darkblotched rockfish	0.84	0.45	1.11	2.43	1.15	1.21
Dover sole	0.15	--	--	--	--	--
English sole	--	--	--	--	--	--
Lingcod	0.09	0.07	--	--	--	--
Lingcod North of 40°10' N.	--	--	--	--	--	0.01
Lingcod South of 40°10' N.	--	--	--	--	0.01	--
Longspine thornyheads North of 34°27' N.	0.09	0.11	0.11	0.14	0.07	0.07
Minor shelf rockfish North of 40°10' N.	--	--	--	--	--	--
Minor shelf rockfish South of 40°10' N.	--	--	0.02	0.02	--	--
Minor slope rockfish North of 40°10' N.	--	--	0.07	0.08	0.06	0.03
Minor slope rockfish South of 40°10' N.	0.05	0.03	0.06	--	0.03	--
Other flatfish	--	--	--	--	--	--
Pacific cod	0.09	0.03	--	0.04	0.02	--
Pacific halibut (IBQ) North of 40°10' N.	1.31	1.19	1.76	0.58	0.58	0.72
Pacific ocean perch North of 40°10' N.	0.28	--	1.58	2.30	1.14	1.17
Pacific whiting	0.18	0.28	0.33	0.27	--	0.14
Petrale sole	0.24	0.27	0.20	0.25	0.29	0.28
Sablefish North of 36° N.	0.38	0.52	0.50	0.46	0.49	0.45
Sablefish South of 36° N.	0.33	0.51	--	--	--	--
Shortspine thornyheads North of 34°27' N.	0.10	0.06	0.06	0.07	0.05	0.04
Shortspine thornyheads South of 34°27' N.	0.04	--	--	--	--	--
Splitnose rockfish South of 40°10' N.	--	--	--	--	--	--
Starry flounder	--	--	--	--	--	--
Widow rockfish	1.01	0.81	1.18	0.53	0.37	0.36
Yelloweye rockfish	60.43	41.24	52.32	43.15	35.11	--
Yellowtail rockfish North of 40°10' N.	--	0.02	0.06	0.04	0.02	0.02

3.1.2 Individual Economic Outcomes

Provide for a viable, profitable, and efficient groundfish fishery (Amendment 20 Goal). Create individual economic stability (Amendment 20 Objective). Increase operational flexibility (Amendment 20 Objective).

In addition to affecting net economic benefits, the catch share program was expected to alter the distribution of those benefits, i.e., individual (vessel, processor, quota owner, crewmember, etc.) economic outcomes, including profitability, stability, and operational flexibility. This section includes an analysis of various measures of profitability for groups of vessels and processors. It provides information to help determine the drivers of differences in profitability between groups of vessels or processors and fishing activities. In addition, indicators that provide information about the many ways in which the catch share program affected the operational flexibility of vessels and processors are presented.

3.1.2(a) Individual Viability and Profitability

3.1.2(a)(1) Distribution of Net Revenue

Highlights:

- Average profitability generally increased for shoreside whiting and at-sea whiting activities, although difficult fishing conditions and low attainment for whiting in 2015 affected the profitability of all whiting sectors.
- For non-whiting trawl gear operations, mean and median total cost net revenue, and mean and median total cost net revenue per day have more than doubled (on average) since 2009 and 2010.
- The percentage of catcher vessels with negative total cost net revenue has decreased from an average of 35 percent prior to the catch share program to 27 percent (for non-whiting catcher vessels) and 24 percent (for whiting catcher vessels) after program implementation.
- Average expenses per fishing day on crew and captains wages have increased in most ports.
- The subsidies that were designed to decrease the cost burden of observer costs in the transition to the catch share program are decreasing over time, leading to increases in average expenses on monitoring. In 2015, the average expense on observers was $402 per day for catcher vessels.
- For the shorebased processing sector, financial outcomes differed dramatically depending on whether the company purchased and processed Pacific whiting in addition to non-whiting species.
- Whiting processors saw dramatic increases in average total cost net revenue and average variable cost net revenue increased dramatically beginning in 2011, with the exception of 2015.
- Non-whiting processors experienced steady declines in average total cost net revenue and average variable cost net revenue since the beginning of the catch share program.

Individual-level measures of net revenue were developed as indicators of individual viability and profitability with data collected by the EDC Program. Total cost net revenue ("net revenue") is calculated as total revenue minus variable and fixed costs. Net revenue is calculated at the individual vessel (or processor) level, and summary statistics (e.g., means, standard deviations, or medians) are calculated to describe the "average" vessel (or processor). Total cost net revenue is the most appropriate representation of accounting (cash flow) profitability that can be calculated using the available data. However, total cost net revenue is affected by large, fixed-cost expenditures, such as a new engine, that are incurred infrequently. Thus, total cost net revenue averaged over entities is best interpreted over a multiyear period due to this high variability across individual years. In this section, total cost net revenue is used as an indicator of accounting profitability, and variable cost net revenue (total revenue minus variable costs) is provided as an indicator of annual operating profits. All the values presented in the section are from participation in the catch share program only, although they may participate in other fisheries. Means are unweighted.

As recommended by the Scientific and Statistical Committee (SSC) (Agenda Item F.6.c Supplemental SSC Report, November 2016), these net revenue measures should be interpreted as an upper bound of the true individual values for catcher vessels, given the complexities of collecting information on quota costs and revenues. Lower bound measures will be provided in Section 3.1.2(a)(2).

The vessels and processors that participate in the catch share program are diverse, and the diversity occurs along many dimensions, including size, target species, geographic location, and corporate structure. This report primarily summarizes information by sector and for whiting and non-whiting groundfish entities. The distribution of average net revenue can easily be analyzed for each sector by state, homeport, target fishery, and vessel size class using FISHEyE from the NWFSC.[27] Using this tool, figures and tables equivalent to many of those presented below can be generated for different subsets.[28]

Catcher vessels

The FEIS predicted that rationalization would double average gross revenues for whiting vessels, from $400,000 to $800,000, due to anticipated consolidation (PFMC and NMFS 2010). No data were available to make specific predictions about profitability, but profitability was expected to increase because of fleet consolidation, improvements in harvest timing flexibility, and elimination of the race for fish (PFMC and

[27] https://dataexplorer.northwestscience.fisheries.noaa.gov/fisheye/PerformanceMetrics/

[28] In particular, average and median net revenue by homeport was proposed for presentation in this section. Due to the amount of space it would take and its ready availability on FISHEyE, interested users are directed to the web application for measures of net revenue by homeport.

NMFS 2010). For non-whiting vessels, vessel profits were expected to improve for a variety of reasons, including consolidation of 50 percent to 66 percent, decreasing the cost of harvesting non-whiting groundfish by as much as 60 percent (Lian et al. 2009) and "a reduction in encounters with overfished and constraining species and resultantly increased catch of target species in the non-whiting fishery" (PFMC and NMFS 2010). It was expected that costs associated with 100 percent observer coverage would increase consolidation and decrease profits (Lian et al. 2009).

Figure 3-12 summarizes the trends in mean variable cost net revenue and total cost net revenue for whiting vessels (including shoreside and at-sea, in blue) and non-whiting vessels (including trawl and fixed gear, in red). For non-whiting vessels, there has been an overall increase in both mean variable and mean total cost net revenue, but also an increase in the variation of variable cost net revenue among vessels. It is likely that this increase in net revenue is a result of the consolidation that has taken place, rather than increased catches. Catches in the non-whiting fishery have not increased overall, and this topic is explored more extensively in Section 3.1.3(a)(1). For whiting vessels, there has been a large increase in variable cost net revenue (and to a lesser extent, total cost net revenue), with the exception of 2015. The mean total cost net revenue (blue line) for whiting vessels was negative in 2015.

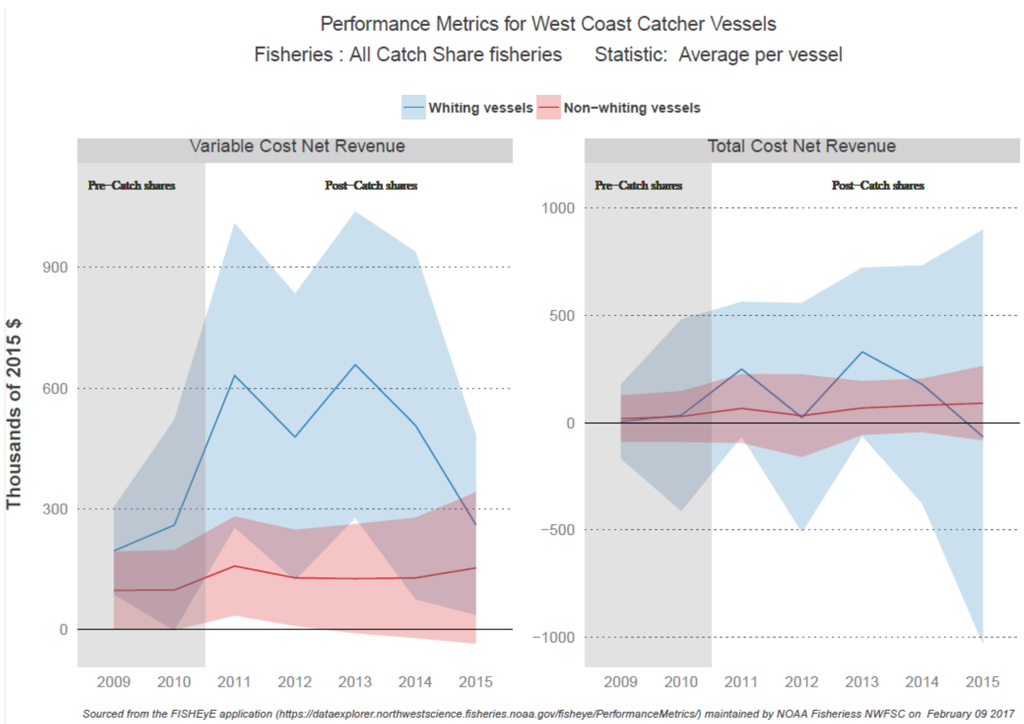


Figure 3-12. Mean variable cost net revenue and mean total cost net revenue of whiting (blue) and non-whiting (red) catch share participants, by year. Shaded areas represent the standard deviations of the means.

The standard deviations shown in Figure 3-12 indicate that the distribution of net revenue is large. The percentage of active vessels with negative net revenue is shown in Figure 3-13.[29] The percentage of non-whiting vessels with negative total cost net revenue has decreased from an average of 35 percent prior to the catch program to an average of 27 percent since 2011. The percentage of whiting vessels with negative total cost net revenue has decreased from an average of 35 percent prior to the catch share program to an average of 24 percent after, but is quite variable and was over 30 percent in 2012 and 2014. The variation could be due, at least in part, to a portion of vessels that report large fixed costs in some years. The percentage of vessels with negative variable cost net revenue (operating profits) has increased from an average of 7 percent to 11 percent for non-whiting vessels, and from 2 percent to 5 percent for whiting vessels since the catch share program began.3-50

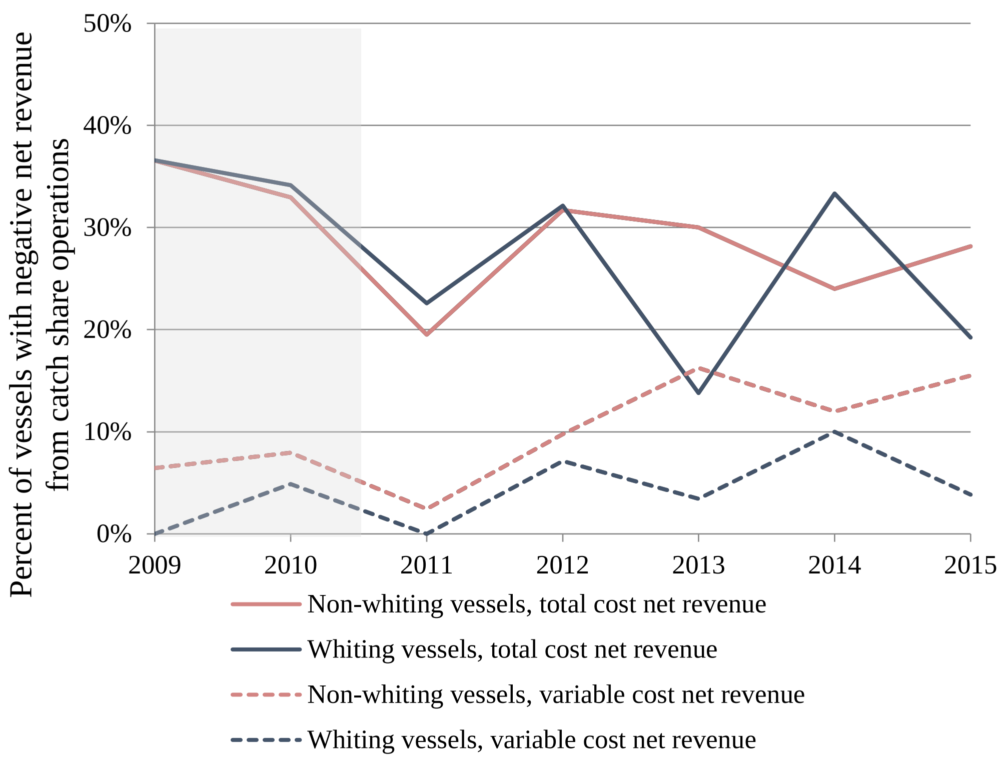


Figure 3-13. The percentage of catcher vessels with negative total cost net revenue and variable cost net revenue from catch share operations, 2009 to 2015. Source: EDC data.

[29] The designation of net revenue less than zero is somewhat arbitrary, as EDC data is not meant to replicate a vessel's exact profitability from a tax or business perspective. However, it is an indicator of the general percentage of vessels not likely to operate profitably.

The summary information in Figure 3-12 can be further broken down by fishing activity. Table 3-25, Table 3-26, Table 3-27, Table 3-28, Table 3-29, Table 3-30, Table 3-31, and Table 3-32 provide catcher vessel revenue, average revenue, expenses as a percentage of revenue, variable cost net revenue, and total cost net revenue by activity: shoreside whiting, at-sea whiting, non-whiting trawl, and non-whiting fixed gear (with a trawl permit). Averages, standard deviations (a measure of variation among vessels), medians, average and median per mt (for whiting), and average and median per day (for whiting and non-whiting) are included for each measure of net revenue. The number of vessels for each activity will not match the number of vessels in Section 3.1.1(b)(1) [Consolidation]. This is because the information in Table 3-25 through Table 3-32 is provided by fishing activity. For example, if a vessel participated in both the shoreside whiting and the non-whiting trawl fisheries, it would be represented in both tables.

Revenue from shoreside whiting operations increased substantially, likely a result of increases in whiting annual catch limits from the pre-catch share to the catch share periods (Table 3-25). Expenses as a percentage of revenue have decreased, with the exception of 2015. The sources of the decrease were declines in expenses for equipment and fishing gear, as well as fuel and lubrication as a percentage of revenue. However, 2015 was more similar to the pre-catch share years when TAC was relatively low.

For shoreside whiting operations, mean net revenue, net revenue per ton, and net revenue per day have all increased substantially between the pre-catch share and catch share periods (Table 3-26). This was driven by very large increases in net revenue from the baseline for 2012 to 2014, concurrent with the increase in annual whiting catch limits. Median total cost net revenue per ton increased from -$16 per mt on average (2009 and 2010) to $50 per mt, on average (2011 to 2015), although it fell substantially in 2015. Median total cost net revenue per mt peaked at $88 in 2013. Measures of variable cost net revenue (operating profits) show similar patterns: a peak in 2013 falling to a post-catch share implementation low in 2015 to at or near pre-catch share levels, coinciding with comparable catch levels. Variable cost net revenue per mt shows similar trends.

Similarly, revenue and average revenue increased for at-sea whiting operations, corresponding to the increases in whiting catch limits (Table 3-27). However, expenses as a percentage of revenue did not decrease as much as for shoreside whiting operations. This resulted in a slight increase in expenses as a percentage of revenue from the pre-catch share period, although overall, costs as a percentage of revenue were lower for at-sea whiting operations than shoreside whiting operations.

Mean total cost net revenue per vessel was nearly unchanged from the pre-catch share to the catch share period, although median total cost net revenue increased, and there was high variation across years (Table 3-28). Median total cost net revenue per mt increased somewhat, while mean total cost net revenue per ton decreased, driven by a large negative value in 2015. Both were at their highest levels in 2010-

2011. Measures of variable cost net revenue generally increased from the pre-catch share to the catch share periods, although the measures of variable cost net revenue decreased slightly. Ex-vessel whiting prices decreased in 2015 (Appendix A, Ex-vessel Prices, Annual Average by Species).

For non-whiting trawl operations, fleetwide fishing revenue decreased. Because of the decrease in the number of vessels, however, average fishing revenue increased by over $100,000 from the pre-catch share to the catch share period (Table 3-29). Average fishing revenue was highest in 2015. Expenses for equipment and fishing gear, as well as fuel and lubrication as a percentage of revenue, have decreased substantially. Expenses on observers have increased to 4 percent of revenue in 2015. Total expenses as a percentage of revenue decreased from an average of 92 percent in 2009-2010 to 81 percent from 2011 to 2015, and they were lowest in 2015 at 76 percent.

For non-whiting trawl operations, mean and median total cost net revenue, and mean and median total cost net revenue per day have more than doubled (on average) since 2009 and 2010 (Table 3-30). This was driven, at least in part, by the substantial consolidation that occurred. An average of 110 vessels operated non-whiting trawl gear in 2009 and 2010, decreasing to an average of 67 from 2011 to 2015. Measures of variable cost net revenue increased on average as well, although not to as great an extent. Mean variable cost net revenue increased, but the median value increased only slightly (and was highest in 2011). This difference indicates that a few vessels have substantially higher variable cost net revenue, but most have not experienced dramatic changes. Per fishing day, however, mean variable cost net revenue increased substantially throughout the entire catch shares period, and was highest in 2015 at about $3,400 per day. This was driven, in part, by a decrease in the number of vessels fishing and in total days fished.

For non-whiting fixed gear operations, pre-catch shares and catch shares data are not appropriate to compare because there were few vessels fishing with fixed gear prior to the gear-switching provision implemented with the catch share program. The only vessels fishing fixed gear in the pre-catch share period were doing so under an Exempted Fishing Permit sponsored by The Nature Conservancy.[30]

In the catch share period, fleetwide and average revenue from fixed gear operations was highest in 2011 (Table 3-31). Expenses for equipment and fishing gear as a percentage of revenue decreased throughout the catch share period, while expenses for observers and cost recovery fees increased (to a maximum of 7 percent of revenue in 2014). Total expenses as a percentage of revenue were higher for non-whiting fixed

[30] For more information, see: www.opc.ca.gov/2010/05/central-coast-groundfish-project/.

gear operations (86 percent on average from 2011 to 2015) than for non-whiting trawl gear operations (81 percent from 2011 to 2015).

Variable cost net revenue was highest for non-whiting fixed gear operations in 2011 (Table 3-32), both per vessel and per day, due in part to high sablefish prices in 2011 (Table 3-66 in Section 3.1.2(d)(6)). Variable cost net revenue for fixed gear vessels fell from 2012 to 2014, but increased again in 2015, to about $2,500/day on average. Variable cost net revenue per day of fixed gear operations is roughly comparable to non-whiting trawl gear operations, on average in the catch share period.

Table 3-25. Fleet-wide revenue, average revenue, and expenses as a percentage of revenue (2015 $) for **shoreside whiting operations** of catcher vessels, 2009 to 2015. Source: EDC data.

Shoreside whiting	2009	2010	Pre-catch shares avg.	2011	2012	2013	2014	2015	Catch shares avg.
Fleet-wide Fishing Revenue	5,969,108	10,884,420	8,426,764	24,291,580	21,918,060	27,610,230	24,575,220	9,983,392	21,675,696
Average revenue	**175,562**	**310,983**	**243,273**	**934,292**	**913,253**	**1,150,426**	**983,009**	**453,791**	**886,954**
Expenses (% of revenue)									
Crew and captain	32%	31%	31%	31%	35%	34%	36%	34%	34%
Equipment and fishing gear	52%	47%	49%	28%	36%	22%	21%	51%	32%
Fuel and lubrication	18%	21%	20%	11%	15%	10%	13%	18%	14%
Buyback fees	5%	5%	5%	5%	5%	5%	5%	5%	5%
Observers	0%	1%	1%	0%	1%	1%	1%	2%	1%
Cost recovery fees				0%	0%	0%	3%	3%	1%
Ice, food, bait, supplies	4%	3%	3%	1%	1%	1%	1%	2%	1%
Other	10%	8%	9%	4%	5%	5%	6%	11%	6%
Total Expenses	**121%**	**115%**	**118%**	**81%**	**96%**	**77%**	**86%**	**127%**	**93%**
Number of vessels	34	35		26	24	24	25	22	

Table 3-26. Total cost net revenue and variable cost net revenue (2015 $) by year and averaged by pre-catch share and catch share periods for **shoreside whiting operations** of catcher vessels. Source: EDC data.

Shoreside whiting	**2009**	**2010**	**Pre-catch shares avg.**	**2011**	**2012**	**2013**	**2014**	**2015**	**Catch shares avg.**
Total cost net revenue									
Mean per vessel	-40,156	-52,325	-46,240	186,927	34,504	272,134	137,769	-120,332	102,200
Standard deviation	101,174	422,331		258,258	531,030	303,041	382,557	838,676	
Median per vessel	-14,102	-10,869	-12,486	176,183	105,012	306,369	153,356	36,981	155,580
Mean per day	-1,435	101	-667	3,247	-1,910	5,587	1,776	-5,326	675
Median per day	-365	-656	-511	3,381	2,041	5,218	3,086	603	2,866
Mean per mt	-57	-110	-83	37	-219	71	8	-76	-36
Median per mt	-15	-18	-16	53	35	88	55	19	50
Variable cost net revenue									
Mean per vessel	74,304	128,966	101,635	500,951	406,718	569,033	381,743	146,305	400,950
Standard deviation	59,102	173,499		283,655	290,251	277,001	326,349	105,606	
Median per vessel	63,378	95,564	79,471	455,392	408,822	515,171	326,333	130,013	367,146
Mean per day	3,309	3,602	3,456	9,645	8,670	10,517	6,932	2,897	7,732
Median per day	2,286	2,807	2,546	8,077	7,346	9,833	6,363	2,372	6,798
Mean per mt	55	10	33	127	128	137	83	54	106
Median per mt	51	50	51	136	141	145	99	50	114

Table 3-27. Fleetwide revenue, average revenue, and expenses as a percentage of revenue (2015 $) for **at-sea whiting operations** of catcher vessels, 2009 to 2015. Source: EDC data.

At-sea whiting	**2009**	**2010**	**Pre-catch shares avg.**	**2011**	**2012**	**2013**	**2014**	**2015**	**Catch shares avg.**
Fleetwide Fishing Revenue	4,603,677	9,163,218	6,883,448	11,860,520	9,370,997	10,761,380	12,542,490	5,364,348	9,979,947
Average revenue	**242,299**	**436,344**	**339,321**	**658,918**	**585,687**	**597,854**	**660,131**	**383,168**	**577,152**
Expenses (% of revenue)									
Crew and captain	30%	27%	28%	27%	34%	32%	34%	31%	32%
Equipment and fishing gear	35%	17%	26%	27%	32%	16%	18%	29%	24%
Fuel and lubrication	17%	17%	17%	15%	23%	16%	17%	19%	18%
Buyback fees	5%	5%	5%	5%	5%	5%	5%	5%	5%
Observers	0%	0%	0%	0%	1%	1%	2%	2%	1%
Cost recovery fees				0%	0%	0%	3%	1%	1%
Ice, food, bait, supplies	2%	1%	1%	1%	1%	1%	1%	1%	1%
Other	8%	5%	7%	5%	7%	6%	7%	12%	7%
Total Expenses	**96%**	**73%**	**84%**	**79%**	**102%**	**77%**	**86%**	**101%**	**89%**
Number of vessels	19	21		18	16	18	19	14	

Table 3-28. Total cost net revenue and variable cost net revenue (2015 $) by year and averaged by pre-catch share and catch share periods for **at-sea whiting operations** of catcher vessels. Source: EDC data.

At-sea whiting	**2009**	**2010**	**Pre-catch shares avg.**	**2011**	**2012**	**2013**	**2014**	**2015**	**Catch shares avg.**
Total cost net revenue									
Mean per vessel	15,004	133,986	74,495	139,530	-19,578	129,238	84,796	1,084	67,014
Standard deviation	113,127	221,280	167,203	203,620	212,681	232,403	350,026	290,447	257,835
Median per vessel	5,110	81,730	43,420	136,664	56,134	70,528	80,190	14,391	71,581
Mean per day	795	4,452	2,624	3,393	-438	3,208	2,059	-1,794	1,286
Median per day	248	2,841	1,544	3,979	1,379	1,709	2,111	577	1,951
Mean per mt	3	58	31	41	-6	24	-12	-128	-16
Median per mt	3	49	26	57	29	26	33	10	31
Variable cost net revenue									
Mean per vessel	126,781	237,932	182,356	354,490	205,721	253,452	241,231	146,827	240,344
Standard deviation	112,217	215,119	163,668	231,746	220,682	247,754	328,369	190,932	243,897
Median per vessel	108,691	168,356	138,523	366,230	221,037	177,230	181,791	57,732	200,804
Mean per day	5,529	7,648	6,588	8,474	5,467	6,742	5,811	2,633	5,825
Median per day	3,274	5,264	4,269	7,496	5,391	5,820	3,935	2,005	4,929
Mean per mt	81	118	99	113	78	74	49	53	73
Median per mt	72	97	85	119	96	75	65	59	83

Table 3-29. Fleet-wide revenue, average revenue, and expenses as a percentage of revenue (2015 $) for **non-whiting trawl gear operations**, 2009-2015. Source: EDC data.

Non-whiting trawl	**2009**	**2010**	**Pre-catch shares avg.**	**2011**	**2012**	**2013**	**2014**	**2015**	**Catch shares avg.**
Fleetwide Fishing Revenue	33,407,200	27,184,720	30,295,960	26,328,490	24,368,490	26,660,120	25,046,130	26,589,690	25,798,584
Average revenue	**283,112**	**256,460**	**269,786**	**360,664**	**363,709**	**380,859**	**391,346**	**428,866**	**385,089**
Expenses (% of revenue)									
Crew and captain	38%	37%	37%	37%	37%	36%	37%	37%	37%
Equipment and fishing gear	22%	20%	21%	13%	23%	12%	11%	9%	14%
Fuel and lubrication	13%	16%	14%	13%	14%	14%	11%	7%	12%
Buyback fees	5%	5%	5%	5%	5%	5%	5%	5%	5%
Observers	0%	0%	0%	1%	1%	3%	3%	4%	3%
Cost recovery fees				0%	0%	0%	3%	3%	1%
Ice, food, bait, supplies	5%	5%	5%	3%	3%	3%	3%	2%	3%
Other	9%	9%	9%	8%	8%	7%	7%	7%	7%
Total Expenses	**92%**	**92%**	**92%**	**79%**	**91%**	**78%**	**80%**	**76%**	**81%**
Number of vessels	118	106		73	67	70	64	62	

Table 3-30. Total cost net revenue and variable cost net revenue (2015 $) by year and averaged by pre-catch share and catch share periods for **non-whiting trawl gear** operations of catcher vessels. Source: EDC data.

Non-whiting trawl	2009	2010	Pre-catch shares avg.	2011	2012	2013	2014	2015	Catch shares avg.
Total cost net revenue									
Mean per vessel	25,359	22,227	23,793	80,291	35,522	84,469	80,995	105,007	77,257
Standard deviation	116,588	110,449		108,540	217,660	132,215	123,746	170,170	
Median per vessel	32,691	21,155	26,923	52,012	39,149	63,278	46,339	68,326	53,821
Mean per day	474	264	369	1,225	-339	1,113	1,078	1,835	982
Median per day	414	496	455	1,221	865	1,378	1,690	1,954	1,422
Variable cost net revenue									
Mean per vessel	116,176	98,900	107,538	150,567	143,180	149,467	141,183	165,639	150,007
Standard deviation	103,238	96,962		126,953	123,215	142,791	139,009	187,599	
Median per vessel	116,558	88,109	102,334	132,514	110,419	108,660	83,491	109,513	108,919
Mean per day	1,974	1,727	1,851	2,716	2,661	2,430	2,782	3,409	2,800
Median per day	1,510	1,381	1,446	2,790	2,516	2,581	2,729	3,443	2,812

Table 3-31. Fleet-wide revenue, average revenue, and expenses as a percentage of revenue (2015 $) for **non-whiting fixed gear operations**, 2009 to 2015. Source: EDC data.

Non-whiting fixed gear	**2009**	**2010**	**Pre-catch shares avg.**	**2011**	**2012**	**2013**	**2014**	**2015**	**Catch shares avg.**
Fleetwide Fishing Revenue	221,051	972,030	596,540	8,133,766	5,293,378	2,829,308	4,548,830	5,194,319	5,199,920
Average revenue	**73,684**	**162,005**	**117,844**	**312,837**	**203,591**	**148,911**	**216,611**	**288,573**	**234,105**
Expenses (% of revenue)									
Crew and captain	24%	20%	22%	31%	32%	31%	30%	34%	32%
Equipment and fishing gear	32%	11%	22%	37%	28%	18%	16%	15%	23%
Fuel and lubrication	7%	5%	6%	5%	10%	8%	8%	5%	7%
Buyback fees	5%	5%	5%	5%	5%	5%	5%	5%	5%
Observers				1%	2%	3%	4%	3%	2%
Cost recovery fees				0%	0%	0%	3%	3%	1%
Ice, food, bait, supplies	12%	14%	13%	7%	8%	9%	9%	8%	8%
Other	5%	5%	5%	6%	7%	6%	8%	10%	7%
Total Expenses	**84%**	**61%**	**72%**	**92%**	**91%**	**80%**	**82%**	**84%**	**86%**
Number of vessels	3	6		26	26	19	21	18	

Table 3-32. Total cost net revenue and variable cost net revenue (2015 $) by year and averaged by pre-catch share and catch share periods for **non-whiting fixed gear operations** of catcher vessels. Source: EDC data

Non-whiting fixed gear	**2009**	**2010**	**Pre-catch shares avg.**	**2011**	**2012**	**2013**	**2014**	**2015**	**Catch shares avg.**
Total cost net revenue									
Mean per vessel	12,971	69,020	40,995	28,062	20,108	30,398	40,309	47,915	33,358
Standard deviation	34,603	63,735	49,169	253,060	91,849	81,534	157,002	145,754	145,840
Median per vessel	236	64,326	32,281	54,057	818	13,841	17,256	8,281	18,851
Mean per day	169	1,376	773	-22,558	342	1,932	-1,386	778	-4,178
Median per day	11	1,000	506	1,970	452	468	632	241	753
Variable cost net revenue									
Mean per vessel	41,392	93,606	67,499	161,620	90,171	64,384	87,745	111,833	103,150
Standard deviation	25,399	57,724	41,561	146,905	111,994	95,136	166,793	164,006	136,967
Median per vessel	43,774	93,519	68,646	136,147	65,103	26,022	35,061	89,772	70,421
Mean per day	1,185	1,963	1,574	4,161	2,447	3,802	1,520	2,458	2,877
Median per day	1,238	1,644	1,441	3,898	2,003	1,033	1,219	2,969	2,225

The standard deviations shown in Figure 3-12 indicate that there is high variability in economic performance among vessels. To display that variability while protecting confidential information, variable cost net revenue is calculated and displayed by groups of three vessels (Figure 3-19 and Figure 3-20).[31] To calculate the three-vessel averages, the vessels were ranked from lowest to highest by ex-vessel revenue in each year and aggregated into groups of three; then average costs and net revenues were calculated for these aggregations of vessels. Because these are aggregations of vessels, it can be done only for vessel groups (whiting vessels and non-whiting vessels, not for vessel operations).

For non-whiting groundfish vessels, Figure 3-14 shows consolidation (indicated by the decrease in the number of bars representing number of vessel groups) and increases in ex-vessel revenue (height of the points) and variable cost net revenue (height of the bars) per group of three vessels that occurred over time. For whiting vessels, Figure 3-15 shows a similar pattern of consolidation and increased variable cost net revenue, although the growth in revenues happened sooner. The decreased revenues in 2015 are also apparent.

[31] Total cost net revenue is not shown because the fixed costs for one vessel in a group of three are often greater than 90 percent of the total fixed costs for all three vessels, breaking the EDC Program "90-10 rule" for confidentiality (Steiner et al. 2016).

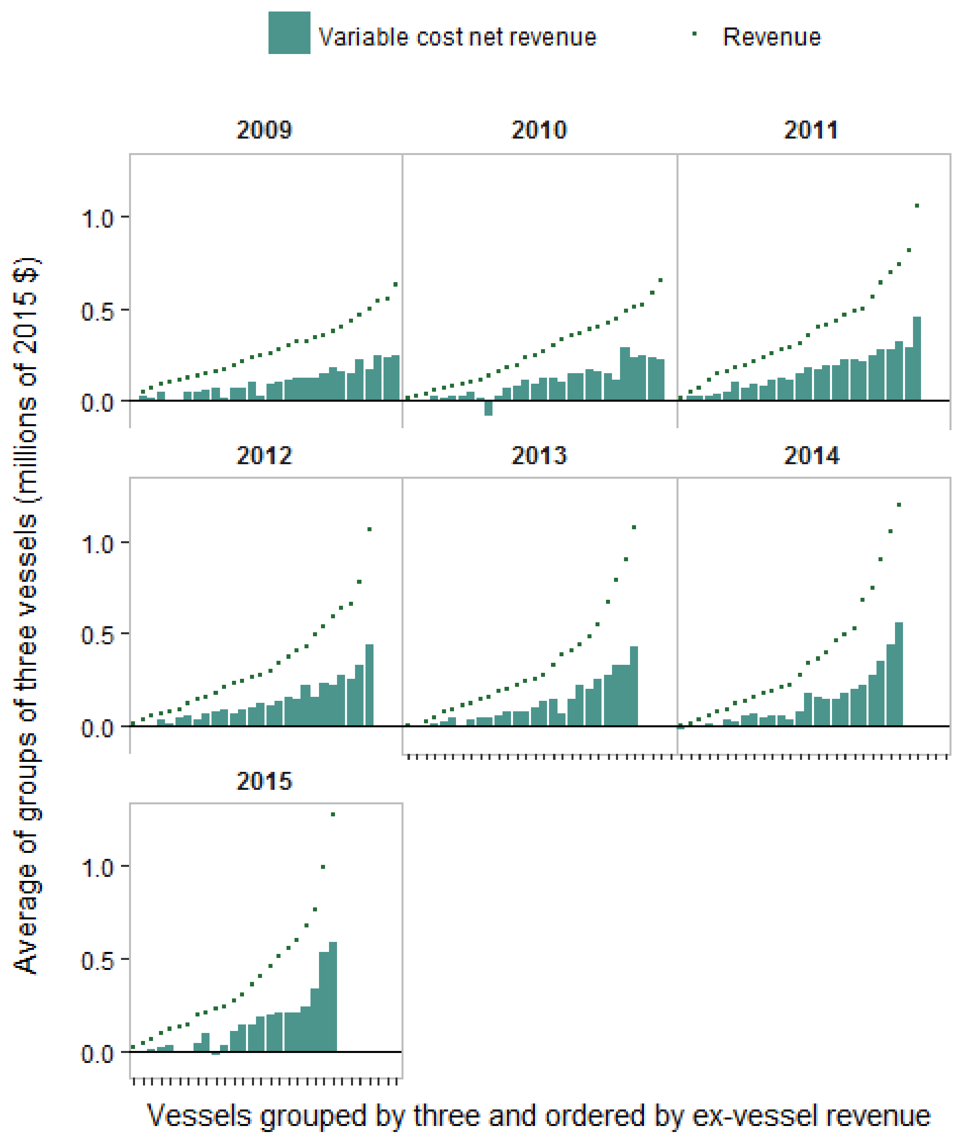


Figure 3-14. Revenue (green dots) and variable cost net revenue (green bars) in all catch share fisheries for non-whiting groundfish vessels. To protect confidentiality, vessels were sorted by revenue and put into groups of three vessels; then means were calculated for the vessel groups. Source: EDC data (updated from Steiner et al. 2016a).

Figure 3-15. Revenue (green dots) and variable cost net revenue (green bars) in all catch share fisheries for whiting vessels. To protect confidentiality, vessels were sorted by revenue and put into groups of three vessels; then means were calculated for the vessel groups. Source: EDC data (updated from Steiner et al. 2016a).

Ninety-five vessels fished before the catch share program was implemented (2009 and/or 2010) in the limited entry trawl fishery and in the catch share program, once it was implemented (2011 to 2015). Of the 95 vessels that participated in the limited entry trawl groundfish fishery in 2009 and 2010 and continued to participate in the catch share program, 74 percent experienced an increase in variable cost net revenue per day. The average vessel experienced a 74 percent increase, a result of 11 vessels experiencing a twofold increase in variable cost net revenue per day. The median percent change was a

39 percent increase. Fifty-three percent of vessels experienced an increase in annual variable cost net revenue. The average vessel experienced a 60 percent increase. The median percent change was a 10 percent increase. Examining these changes with respect to changes in days at sea can provide additional context. Even though days at sea decreased for many vessels (45 percent of vessels fished fewer days in the pre-catch share period, and the median vessel experienced a 23 percent decrease), variable cost net revenue per year and per day at sea increased for most vessels (Table 3-33-).

Table 3-33. Percentage change from the pre-catch shares average in variable cost net revenue per day (VCNR/day), annual variable cost net revenue (VCNR), and days at sea for vessels that participated both before and after catch shares implementation. Also shown are the percentage of vessels experiencing increases in each metric and the number of vessels that participated in both periods. Source: EDC data.

	Percentage change from pre-catch shares				**% of vessels experiencing increases**	**Number of vessels in both time periods**
	25th percentile	**median**	**mean**	**75th percentile**		
All catch shares						95
VCNR/day	0	39	74	109	74%	
Annual VCNR	-28	10	60	82	53%	
Days at sea	-48	-23	-9	12	45%	
At-sea whiting						21
VCNR/day	-58	7	73	61	50%	
Annual VCNR	-23	50	104	76	56%	
Days at sea	8	33	39	68	88%	
Shoreside whiting						34
VCNR/day	44	119	258	356	88%	
Annual VCNR	134	294	441	501	88%	
Days at sea	13	85	83	107	80%	
Non-whiting trawl						85
VCNR/day	-9	30	62	83	70%	
Annual VCNR	-37	-6	26	56	44%	
Days at sea	-52	-32	-24	-10	18%	

Fishery level comparisons of profitability at the vessel level can only be conducted for vessels that fished during both periods. Twenty-one vessels fished in the at-sea whiting fishery in both periods. Fifty percent of the vessels experienced an increase in variable cost net revenue per day. The mean increase was 73 percent, while the median increase was 7 percent. Fifty-six percent of at-sea whiting vessels experienced increases in annual variable cost net revenue, and the mean increase was 104 percent. The median increase was 50 percent, meaning that a small number of vessels experienced very large increases in annual variable cost net revenue and drove up the mean increase. Most vessels (88 percent) increased their days at sea.

Similarly, 88 percent of shoreside whiting vessels experienced increases in variable cost net revenue per day and per year. The percentage increases were very large, even for the lowest quartile of vessels, and days at sea increased for most vessels as well. These increases in days at sea in the whiting fisheries are associated with increases in TAC compared to the pre-catch share period.

Eighty-five non-whiting trawl vessels participated in both the pre-catch shares and catch shares periods. Seventy percent experienced increases in variable cost net revenue per day. The mean increase was 62 percent, and the median increase was 30 percent. This was driven by a general decrease in days at sea, however, as only 18 percent of vessels increased days at sea. The mean decrease in days at sea was 24 percent. Annual variable cost net revenue increased for only 44 percent of vessels. The mean increase was 26 percent, while for the median vessel, annual variable cost net revenue decreased by 6 percent. This analysis excludes the vessels that fished with fixed gear on vessels with limited entry trawl endorsements because no pre/post comparison can be made (Table 3-33).

Costs are an important driver of consolidation; economic theory suggests that less efficient vessels (i.e., those with higher relative costs) are more likely to cease participation after an IFQ program goes into effect. Table 3-34 shows average cost per day of fishing in the catch share fishery by homeport for five cost categories: captain wages, crew wages, fuel and lubrication, observers, and buyback fees.[32] Wages and fuel make up about 75 percent of variable costs, and observer and buyback fees were included due to public interest. Differences in average costs across ports may be driven by the proportion of vessels in that port that fish primarily for whiting, or the proportion primarily fishing with fixed gear, as the cost structure of those vessels can differ significantly from those targeting non-whiting species with trawl gear. Ports with a high proportion of vessels targeting whiting include Puget Sound (average of 71 percent of vessels 2009 to 2015), south and central Washington Coast (43 percent), and Newport (69 percent). Ports with a high proportion of fixed gear vessels include Morro Bay (average of 24 percent of vessels from 2011 to 2015), Washington coast (11 percent), Newport (11 percent), and Astoria (12 percent). The cost of observers for vessels has increased over time, as a federal subsidy (designed to ease the transition

[32] Costs are reported at an annual level, meaning that if there are distinct costs by port, but a vessel fishes in multiple ports, those differences cannot be detected. Observer costs are shown as ‘not applicable’ (NA) for Morro Bay/Monterey in 2015, because of 100 percent participation in and reimbursement for electronic monitoring costs; therefore, there were no monitoring costs.

to 100 percent observer coverage) has decreased each year, from $328 per day in the first years of the catch share program to $108 per day in 2015, and zero in 2016.[33] In response to the costs incurred by industry for observer coverage, some vessels participated in trial programs and fished under Exempted Fishing Permits for electronic monitoring (EM) starting in 2012. Equipment, infrastructure, maintenance, and administrative costs associated with EM were funded by a federal grant awarded to Pacific States through 2014. In more recent years, vessels have independently obtained grants from various sources to fund a portion of EM costs. NMFS does not collect detailed information about the unreimbursed costs borne by industry. The EDC Program collects the costs paid by vessels for observers and electronic monitoring as one category; thus, it is not possible to separate costs for the two.

Table 3-34. Average costs per day (2015 $) fishing in the catch share fishery, by vessels' homeport, for five cost categories. Some data are suppressed to maintain confidentiality (shown as '***'). Source: EDC data.

	Homeport	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Captain	Puget Sound	629	859	1,295	1,451	1,833	1,400	779
	South and central WA Coast	434	524	878	1,331	1,259	1,283	1,080
	Astoria	681	773	1,231	1,127	1,128	1,117	1,214
	Tillamook	456	465	***	***	***	***	***
	Newport	752	854	1,861	1,922	2,623	2,428	1,365
	Coos Bay	663	679	1,115	795	722	1,127	1,223
	Brookings	951	1,099	2,097	1,693	1,589	2,119	2,030
	Crescent City	691	651	1,058	1,121	936	1,057	***
	Eureka	797	866	1,211	1,267	1,058	1,266	1,625
	Fort Bragg	1,056	1,108	1,556	1,645	1,354	1,372	1,955
	San Francisco	397	435	776	863	910	794	***
	Morro Bay-Monterey	455	382	709	729	624	815	789
Crew	Puget Sound	882	1,396	2,359	2,376	3,336	2,665	1,352
	South and central WA Coast	661	705	1,687	2,029	2,133	2,421	1,373
	Astoria	757	793	1,456	1,421	1,363	1,351	1,562
	Tillamook	441	461	***	***	***	***	***
	Newport	1,153	1,416	2,734	2,916	3,186	3,161	1,990
	Coos Bay	766	853	1,463	1,116	876	1,256	1,544
	Brookings	1,345	1,472	2,578	2,610	2,009	2,677	2,442

[33] Dave Colpo, Pacific States Marine Fisheries Commission, pers. comm.

Table 3-34. Average costs per day (2015 $) fishing in the catch share fishery, by vessels' homeport, for five cost categories. Some data are suppressed to maintain confidentiality (shown as '***'). Source: EDC data (continued)

	Homeport	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
	Crescent City	1,277	1,007	1,687	1,358	963	1,448	***
	Eureka	783	1,014	1,498	1,453	1,280	1,466	1,924
	Fort Bragg	1,330	1,285	2,738	2,516	2,167	2,233	2,773
	San Francisco	574	743	964	1,117	911	1,565	***
	Morro Bay-Monterey	567	350	1,042	809	706	1,171	1,286
Fuel and lubrication	Puget Sound	919	1,527	1,672	1,944	2,224	1,923	1,231
	South and central WA Coast	392	565	957	1,266	1,254	1,300	1,169
	Astoria	483	690	964	1,055	910	811	528
	Tillamook	485	667	***	***	***	***	***
	Newport	824	1,432	1,673	2,108	1,849	1,956	1,336
	Coos Bay	537	626	980	720	903	764	502
	Brookings	701	740	1,167	1,356	1,145	1,574	865
	Crescent City	565	586	531	1,072	870	820	***
	Eureka	334	478	781	818	793	705	650
	Fort Bragg	510	689	898	1,018	905	811	591
	San Francisco	416	991	1,536	1,419	739	978	***
	Morro Bay-Monterey	858	376	375	471	683	676	686
Observers and Electronic Monitoring	Puget Sound	0	0	49	96	150	206	278
	South and central WA Coast	0	0	***	91	143	211	152
	Astoria	0	0	48	99	193	249	393
	Tillamook	0	0	***	***	***	***	***
	Newport	0	0	54	99	174	243	209
	Coos Bay	0	0	62	72	160	313	390
	Brookings	0	0	41	84	164	250	431
	Crescent City	0	0	57	98	155	202	***
	Eureka	0	0	41	89	187	234	412
	Fort Bragg	0	0	46	113	224	264	389
	San Francisco	0	0	65	94	155	357	***
	Morro Bay-Monterey	0	0	40	103	186	351	***
Buyback fees	Puget Sound	219	380	729	731	1,004	861	381
	South and central WA Coast	149	156	361	474	508	538	491
	Astoria	185	203	385	337	370	367	424

Table 3-34. Average costs per day (2015 $) fishing in the catch share fishery, by vessels' homeport, for five cost categories. Some data are suppressed to maintain confidentiality (shown as '***'). Source: EDC data (continued)

	Homeport	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
	Tillamook	143	128	***	***	***	***	***
	Newport	265	331	754	693	885	702	439
	Coos Bay	193	218	363	307	230	312	349
	Brookings	308	354	584	550	537	600	597
	Crescent City	235	191	349	332	253	301	***
	Eureka	182	224	338	321	291	320	469
	Fort Bragg	284	283	452	430	378	404	533
	San Francisco	92	200	364	***	***	198	***
	Morro Bay-Monterey	99	133	279	152	216	308	212

Motherships

The FEIS did not provide detailed predictions about the anticipated change in profitability of motherships beyond anticipated improvements in efficiency that might result from an elongation of the fishing season and consolidation (PFMC and NMFS 2010). Table 3-35 shows fleetwide mothership revenue, average revenue, and expenses as a percentage of revenue for motherships. Fuel costs were a larger percentage of revenue in the catch shares period, but especially in 2011-2012 when fuel prices were high. Fish purchases were also a higher percentage of revenue in the catch share period; this was expected because catch limits were higher compared to 2009-2010.

Table 3-34. Average costs per day (2015 $) fishing in the catch share fishery, by vessels' homeport, for five cost categories. Some data are suppressed to maintain confidentiality (shown as '***'). Source: EDC data (continued)

Table 3-36 shows comparable summary statistics to those provided for catcher vessels, and Figure 3-16 illustrates average variable cost net revenue and average total cost net revenue for motherships. Both net revenue measures were highest in 2011 and 2014, and they decreased substantially in 2015 relative to 2014 levels. Only three motherships participated in the West Coast Pacific whiting fishery in 2015, compared to six in 2009 and 2010 and five from 2011 to 2014.

Because of the limited number of motherships operating in each year, confidentiality rules preclude the display of net revenue distribution figures (Figure 3-14 and Figure 3-15 for catcher vessels) and costs by port (Table 3-34 for catcher vessels).

Table 3-35. Fleetwide mothership revenue, average revenue, and expenses as a percentage of revenue (thousands of 2015 $). Source: EDC data.

	2009	2010	Pre-catch shares avg.	2011	2012	2013	2014	2015	Catch shares avg.
Fleetwide Fishing revenue (thousands $)	19,855	30,892	25,373	41,132	31,646	36,606	46,884	20,268	35,307
Average fishing revenue per vessel (thousands $)	**3,309**	**5,149**	**4,229**	**8,226**	**6,329**	**7,321**	**9,377**	**6,756**	**7,602**
Expenses (% of revenue)									
Crew Wages	23.3%	20.0%	21.3%	19.3%	20.1%	19.6%	19.0%	24.5%	20.0%
Equipment and fishing gear	26.7%	21.2%	23.3%	9.3%	24.2%	18.1%	18.3%	30.3%	18.6%
Fish purchases	21.9%	26.1%	24.5%	29.7%	30.5%	31.7%	28.5%	25.9%	29.5%
Food, additives, packaging, supplies	5.4%	6.8%	6.2%	9.0%	8.4%	8.7%	8.5%	10.2%	8.8%
Fuel and Lubrication	8.7%	8.2%	8.4%	13.6%	12.4%	11.1%	11.0%	9.8%	11.7%
Observers	0.5%	0.4%	0.4%	0.5%	0.5%	0.4%	0.4%	0.5%	0.5%
Other	11.7%	7.3%	9.0%	6.1%	7.6%	5.9%	6.6%	10.7%	7.0%
Total Expenses	**98.3%**	**89.9%**	**93.2%**	**87.6%**	**103.8%**	**95.6%**	**92.3%**	**111.9%**	**96.2%**
Number of motherships	6	6		5	5	5	5	3	

Table 3-36. Total cost net revenue and variable cost net revenue (2015 $) by year for mothership vessels participating in the West Coast Catch Share Program. Source: EDC data.

Total cost net revenue	**2009**	**2010**	**Pre-catch shares avg.**	**2011**	**2012**	**2013**	**2014**	**2015**	**Catch shares avg.**
Mean per vessel	56,775	520,724	288,750	1,016,835	-238,268	324,236	722,084	-803,349	204,308
Standard deviation	743,537	711,466		1,958,726	1,514,209	910,166	2,916,656	2,412,646	
Median per vessel	-90,028	577,886	243,929	92,222	-815,719	531,841	219,197	-1,215,705	-237,633
Mean per mt	-29	257	114	127	-778	23	135	-258	-150
Median per mt	-27	276	125	24	-280	46	67	-597	-148
Variable cost net revenue									
Mean per vessel	1,257,937	1,917,827	1,587,882	2,038,367	1,538,578	1,842,755	2,724,359	1,643,578	1,957,527
Standard deviation	429,054	758,589	758,589	2,491,433	1,807,750	1,520,073	2,010,477	673,635	1,745,824
Median per vessel	1,381,623	1,967,008	1,674,316	863,114	2,578,251	2,300,296	2,975,372	1,351,082	2,013,623
Mean per mt	931	1,036	984	416	79	401	606	620	424
Median per mt	823	1,132	978	469	283	230	616	664	452

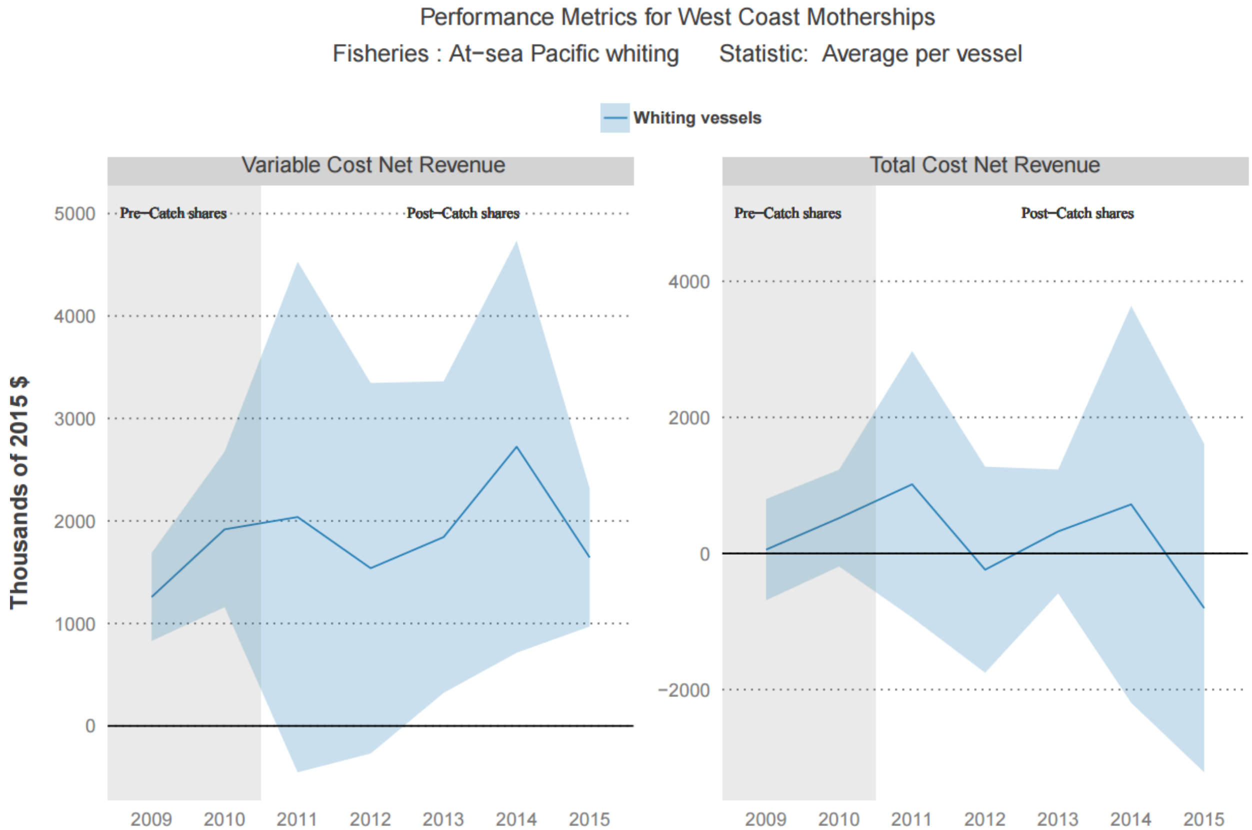


Figure 3-16. Average annual variable cost net revenue and average annual total cost net revenue of mothership catch share participants. Source: FISHEyE using EDC data.

Catcher-processors

The catcher-processors participating in the Pacific whiting fishery on the West Coast have been operating as a cooperative since 1997, so few effects of the catch share program on catcher-processor profitability were expected (PFMC and NMFS 2010).

Total expenses have been a relatively constant proportion of revenue in this sector, although fleetwide revenue increased with the increases in catch limits (Table 3-37). Mean variable cost net revenue and total cost net revenue were highest in 2010 and 2014. The means were relatively lower from 2011 to 2015 due to higher participation (nine vessels from 2011 to 2015, compared to five and six vessels in 2009 and 2010, respectively) (Table 3-38; Figure 3-17). Higher participation was driven by the higher annual catch limits for whiting from 2011 to 2015. Average and median net revenues per mt were highest in 2010, likely due, in part, to relatively higher price for surimi.

Because of the limited number of catcher-processors operating in each year, confidentiality rules preclude the display of net revenue distribution figures (Figure 3-14 and Figure 3-15 for catcher vessels) and costs by port (Table 3-34 for catcher vessels). Cost data by cost category are available on FISHEyE.

Table 3-37. Fleet-wide catcher-processor revenue, average revenue, and expenses as a percentage of revenue (thousands of 2015 $). Source: EDC data.

	2009	**2010**	**Pre-Catch Shares avg.**	**2011**	**2012**	**2013**	**2014**	**2015**	**Catch Shares avg.**
Fishing revenue (thousands $)	35,762	59,070	47,416	63,263	53,224	66,764	100,250	64,085	69,517
Average fishing revenue per vessel (thousands $)	**7,152**	**9,845**	**8,499**	**7,029**	**5,914**	**7,418**	**11,139**	**7,121**	**7,724**
Expenses (% of revenue)									
Crew wages	22.4%	19.9%	21.1%	20.2%	22.5%	20.5%	20.2%	21.6%	21.0%
Dues and memberships	0.4%	0.4%	0.4%	0.3%	0.7%	0.3%	0.4%	0.6%	0.5%
Equipment and fishing gear	24.4%	8.2%	16.3%	15.3%	18.0%	14.5%	8.4%	16.2%	14.5%
Food, additives, packaging, supplies	8.1%	7.3%	7.7%	7.6%	7.6%	5.3%	7.2%	7.1%	7.0%
Fuel and lubrication	11.7%	9.5%	10.6%	18.6%	14.3%	11.1%	10.9%	11.5%	13.3%
Observers	0.5%	0.4%	0.4%	0.5%	0.4%	0.3%	0.3%	0.5%	0.4%
Cost recovery				0.0%	0.0%	0.0%	0.3%	0.0%	0.0%
Other	4.4%	3.2%	3.8%	4.1%	4.9%	4.0%	3.3%	7.3%	4.7%
Total Expenses	**71.9%**	**48.9%**	**60.4%**	**66.6%**	**68.5%**	**55.9%**	**51.0%**	**64.9%**	**61.4%**
Number of catcher-processors	5	6		9	9	9	9	9	

Table 3-38. Total cost net revenue and variable cost net revenue (2015 $) by year for catcher-processor vessels participating in the West Coast Catch Share Program. Source: EDC data.

Total cost net revenue	**2009**	**2010**	**Pre-catch shares avg.**	**2011**	**2012**	**2013**	**2014**	**2015**	**Catch shares avg.**
Mean per vessel	2,011,459	5,029,326	3,520,392	2,346,321	1,864,918	3,270,039	5,457,731	2,501,884	3,088,179
Standard deviation	4,961,152	3,966,937		1,839,969	2,364,991	3,760,291	2,159,088	2,210,858	
Median per vessel	1,928,439	4,238,683	3,083,561	2,857,091	1,058,225	2,386,151	5,569,645	1,406,922	2,655,607
Mean per mt	-639	1,423	392	711	671	934	1,239	807	872
Median per mt	994	1,555	1,275	883	614	1,143	1,302	673	923
Variable cost net revenue									
Mean per vessel	4,006,896	6,059,606	5,033,251	3,638,759	3,120,194	4,513,902	6,557,935	3,870,423	4,340,242
Standard deviation	3,946,637	4,557,537		1,566,479	2,149,077	3,561,754	1,983,381	1,953,814	
Median per vessel	3,282,371	4,841,709	4,062,040	4,280,861	2,653,737	3,184,105	6,525,988	3,460,114	4,020,961
Mean per mt	1,472	1,799	1,636	1,308	1,459	1,374	1,514	1,347	1,400
Median per mt	1,452	1,756	1,604	1,252	1,483	1,481	1,552	1,267	1,407

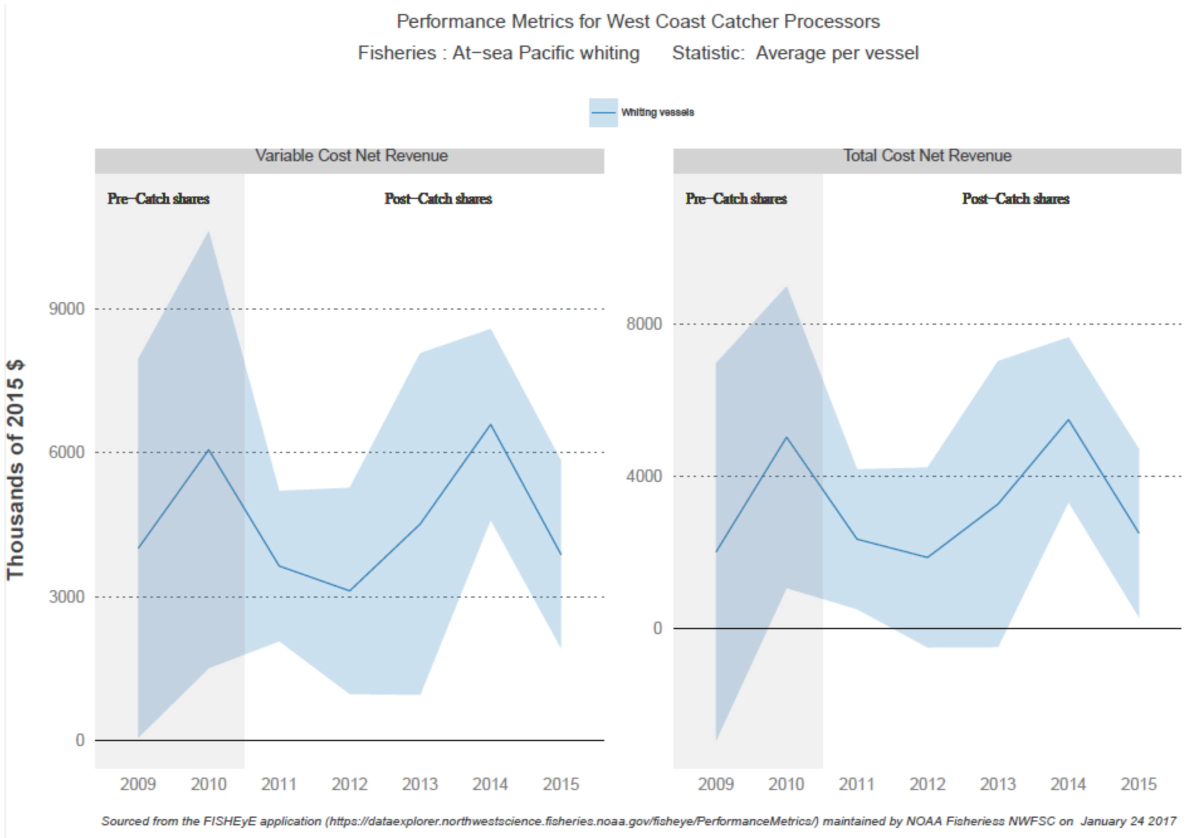


Figure 3-17. Average annual variable cost net revenue and average annual total cost net revenue of catcher-processor catch share participants. Source: FISHEyE using EDC data.

First receivers and shorebased processors

Effects of the catch share program were anticipated to vary across processors and depend on the operational characteristics and primary species purchased at a given facility (PFMC and NMFS 2010). The Amendment 20 FEIS anticipated that the catch share program would impact whiting processors by reducing peak volumes, smoothing landings throughout the year, and shifting landings spatially. One potential consequence included a reduction in the amount of processing capital necessary (creating "stranded capital"). Harvesters were expected to obtain higher prices because of the incentive to provide higher quality fish, but processor benefits were expected to be limited by their ability to influence wholesale or retail prices (PFMC and NMFS 2010). As a result, 20 percent of shorebased Pacific whiting quota shares were allocated to eligible shorebased processors to offset potential declines in capital value or the degree of consolidation. Outcomes for non-whiting processors were more uncertain. The Amendment 20 FEIS used limited information from 1997 to 2000 to predict that harvest volumes of non-whiting species would increase with rationalization, leading to positive impacts for processors if higher production volumes reduced production costs (PFMC and NMFS 2010). However, the FEIS noted that excess capacity existed in the shorebased processing industry (PFMC and NMFS 2010). It was anticipated that rationalization would help build processing volumes back up to 1990s levels, before the downturn of the non-whiting trawl fishery (Section 2.0). Increased processing volumes, bolstered by increases in processing of under-harvested species, were expected to decrease average costs relative to revenue, provide opportunities for generating higher gross revenues, and lower production costs (PFMC and NMFS 2010). No initial quota share allocation was given to processors for non-whiting groundfish.

As in the previous sections, processors are divided into two groups: those that purchase and process Pacific whiting and those that do not. Revenue and costs include only those incurred in the production of groundfish products. Net revenue measures that include the production of non-groundfish (i.e., not managed under the catch share program) species are not shown here but can be derived using FISHEyE.

For whiting processors, industrywide production revenue increased slightly from the pre-catch share period, but average revenue increased substantially due to the decrease in the number of whiting processors. Prior to the catch share program, expenses had been greater than revenue, primarily due to very large expenses on capitalized expenditures as a percentage of revenue. All other expense categories remained a relatively constant percentage of revenue, with some increases in labor expenses and expenses on off-site freezing and storage (Table 3-39).

For the whiting processors, both the mean and the median total cost net revenue have increased substantially between the pre-catch shares and catch shares periods, although the mean total cost net revenue was negative in 2015 (Table 3-40). Both the mean and median total cost net revenues per mt have increased substantially as well. Net revenue per mt was lowest in 2010. Mean variable cost net revenue increased by more than 40 percent, and the median variable cost net revenue more than tripled. Per mt, however, average variable cost net revenue declined. The difference in the per-processor and the per-mt measures is likely driven by the increased processing volume corresponding with higher Pacific whiting annual catch limits (i.e., each processor was processing a higher overall volume, even if net revenue per mt declined).

For non-whiting processors, total production revenue increased from the pre-catch share period. However, expenses have increased by a greater proportion (Table 3-41). Total expenses as a percentage of revenue averaged 86 percent in 2009-2010, and increased to 94 percent from 2011 to 2015. Increases occurred in most cost categories, including labor, storage, utilities, and other expenses. This had a large impact on net revenue.

For non-whiting processors, average total cost net revenue declined steadily from the pre-catch share period (Table 3-42). Average total cost net revenue from 2011 to 2015 was only half that of 2009 to 2010. The median total cost net revenue was much lower than the mean through the entire period, indicating that the distribution is positively skewed with some non-whiting processors with high total cost net revenue driving up the mean.

For non-whiting processors, average variable cost net revenue declined from the pre-catch share to the catch share periods, as did average variable cost net revenue per mt. These decreases were driven by negative operating profits (variable cost net revenue) per mt in 2013 and 2014. The median processor, however, experienced increased variable cost net revenue since the implementation of catch shares, driven by high median variable cost net revenue in 2011 and 2015. The distribution of variable cost net revenue is also likely positively skewed, with some non-whiting processors with relatively high variable cost net revenue driving up the mean. Figure 3-18 summarizes average variable cost net revenue, total cost net revenue, and their standard deviations, for the two groups of processors.

Table 3-39. Industrywide production revenue, average revenue, and expenses as a percentage of revenue for **whiting processors** (thousands of 2015 $), 2009 to 2015. Source: EDC data.

	2009	**2010**	**Pre-catch share avg.**	**2011**	**2012**	**2013**	**2014**	**2015**	**Post-catch share avg.**
Industrywide production revenue (thousands)	103,972	87,549	95,761	114,177	98,847	121,540	106,517	79,549	104,126
Average revenue per processor (thousands)	**8,664**	**7,296**	**7,980**	**12,686**	**12,356**	**15,192**	**13,315**	**9,944**	**12,699**
Expenses (% of revenue)									
Fish purchases	44.6%	45.2%	44.9%	43.0%	46.0%	43.4%	42.6%	45.1%	43.9%
Capitalized expenditures	21.4%	22.5%	21.9%	5.7%	2.7%	2.5%	4.8%	7.8%	4.5%
Freight	0.4%	0.7%	0.5%	0.7%	0.7%	1.0%	1.3%	2.0%	1.1%
Labor	15.0%	16.9%	15.8%	17.3%	17.4%	17.5%	18.5%	21.9%	18.3%
Monitoring	0.2%	0.5%	0.4%	0.1%	0.1%	0.2%	0.2%	0.6%	0.2%
Offsite-freezing & storage	1.3%	1.8%	1.6%	2.5%	2.7%	3.8%	3.3%	3.0%	3.1%
Packing materials	7.4%	6.7%	7.1%	5.3%	4.2%	3.9%	4.2%	4.3%	4.4%
Utilities	3.6%	3.9%	3.8%	3.9%	3.4%	3.9%	4.3%	5.3%	4.1%
Other	8.6%	10.7%	9.5%	9.7%	8.0%	11.2%	11.7%	11.8%	10.5%
Total expenses	**102.6%**	**108.9%**	**105.5%**	**88.2%**	**85.3%**	**87.3%**	**90.8%**	**102.0%**	**90.1%**
Number of whiting processors	12	12		9	8	8	8	8	

Table 3-40. Total cost net revenue and variable cost net revenue (2015 $) by year and averaged by pre- and post-catch share periods for **whiting processors** participating in the West Coast Catch Share Program. Source: EDC data.

Whiting processors									
Total cost net revenue	**2009**	**2010**	**Pre-catch share avg.**	**2011**	**2012**	**2013**	**2014**	**2015**	**Post-catch share avg.**
Mean per processor	-227,793	-647,266	-437,529	1,496,105	1,816,333	1,923,375	1,220,803	-198,475	1,251,628
Standard deviation	3,259,605	3,353,661		3,000,657	1,381,596	2,857,628	2,971,813	3,141,300	
Median per processor	29,593	-27,279	1,157	2,613,430	2,053,832	1,111,173	513,124	18,943	1,262,101
Mean per mt	97	-178	-40	161	311	165	152	-22	154
Median per mt	53	-107	-27	263	323	141	172	23	184
Variable cost net revenue									
Mean per processor	2,038,183	1,429,821	1,734,002	2,749,808	2,617,029	2,892,711	2,470,981	1,171,084	2,380,323
Standard deviation	4,685,313	2,572,186		2,490,448	1,879,550	2,957,947	3,138,086	2,781,301	
Median per processor	645,269	552,576	598,923	2,944,655	3,128,892	2,173,519	1,915,223	354,902	2,103,438
Mean per mt	527	355	441	380	470	279	336	270	347
Median per mt	530	374	452	296	424	241	335	193	298

Table 3-41. Industrywide production revenue, average revenue, and expenses as a percentage of revenue for **non-whiting processors** (thousands of 2015 $), 2009 to 2015. Source: EDC data.

Non-whiting processors	2009	2010	Pre-catch share avg.	2011	2012	2013	2014	2015	Post-catch share avg.
Industry-wide production revenue (thousands)	24,977	23,957	24,467	35,861	34,112	28,853	32,392	34,736	33,191
Average revenue per processor (thousands)	**3,122**	**2,662**	**2,892**	**4,483**	**3,411**	**2,885**	**4,049**	**3,474**	**3,660**
Expenses (% of revenue)									
Fish purchases	65.7%	59.4%	62.6%	63.8%	57.8%	61.6%	67.2%	66.5%	63.4%
Capitalized expenditures	1.9%	1.0%	1.5%	1.2%	1.4%	1.6%	0.6%	0.9%	1.1%
Labor	11.5%	15.8%	13.6%	14.4%	18.1%	19.4%	17.4%	16.3%	17.0%
Offsite-freezing and storage	0.6%	0.8%	0.7%	0.8%	2.0%	2.0%	1.5%	1.4%	1.5%
Packing materials	1.2%	1.7%	1.4%	1.8%	1.7%	1.6%	2.3%	2.0%	1.9%
Utilities	2.3%	1.8%	2.1%	2.1%	2.5%	3.2%	2.9%	3.1%	2.7%
Other	3.9%	4.0%	3.9%	4.0%	7.0%	7.6%	7.4%	7.7%	6.7%
Total expenses	87.2%	84.5%	85.9%	88.0%	90.4%	97.0%	99.3%	97.8%	94.3%
Number of non-whiting processors	7	9		8	10	10	8	10	

Table 3-42. Measures of net revenue (2015 $) by year and averaged by pre- and catch share periods for **non-whiting processors** participating in the West Coast Catch Share Program. Source: EDC data.

Non-whiting processors									
Total cost net revenue	**2009**	**2010**	**Pre-catch share avg.**	**2011**	**2012**	**2013**	**2014**	**2015**	**Post-catch share avg.**
Mean per processor	457,824	411,414	434,619	537,778	328,448	86,845	26,361	75,562	210,999
Standard deviation	1,043,332	931,306		847,189	947,877	922,833	1,142,794	370,241	
Median per processor	-17,442	4,652	-6,395	126,768	39,990	1,881	-24,902	32,768	35,301
Mean per mt	-148	605	229	660	177	-520	-725	-78	-97
Median per mt	-38	129	45	827	651	52	-22	45	311
Variable cost net revenue									
Mean per processor	632,127	519,880	576,004	708,595	467,244	256,753	216,309	220,670	373,914
Standard deviation	1,055,516	968,507		970,369	1,015,375	1,070,436	1,183,961	432,934	
Median per processor	90,376	38,408	64,392	158,960	49,719	20,465	71,392	186,254	97,358
Mean per mt	588	963	775	1,040	513	-179	-277	312	282
Median per mt	491	334	413	995	877	157	157	449	527

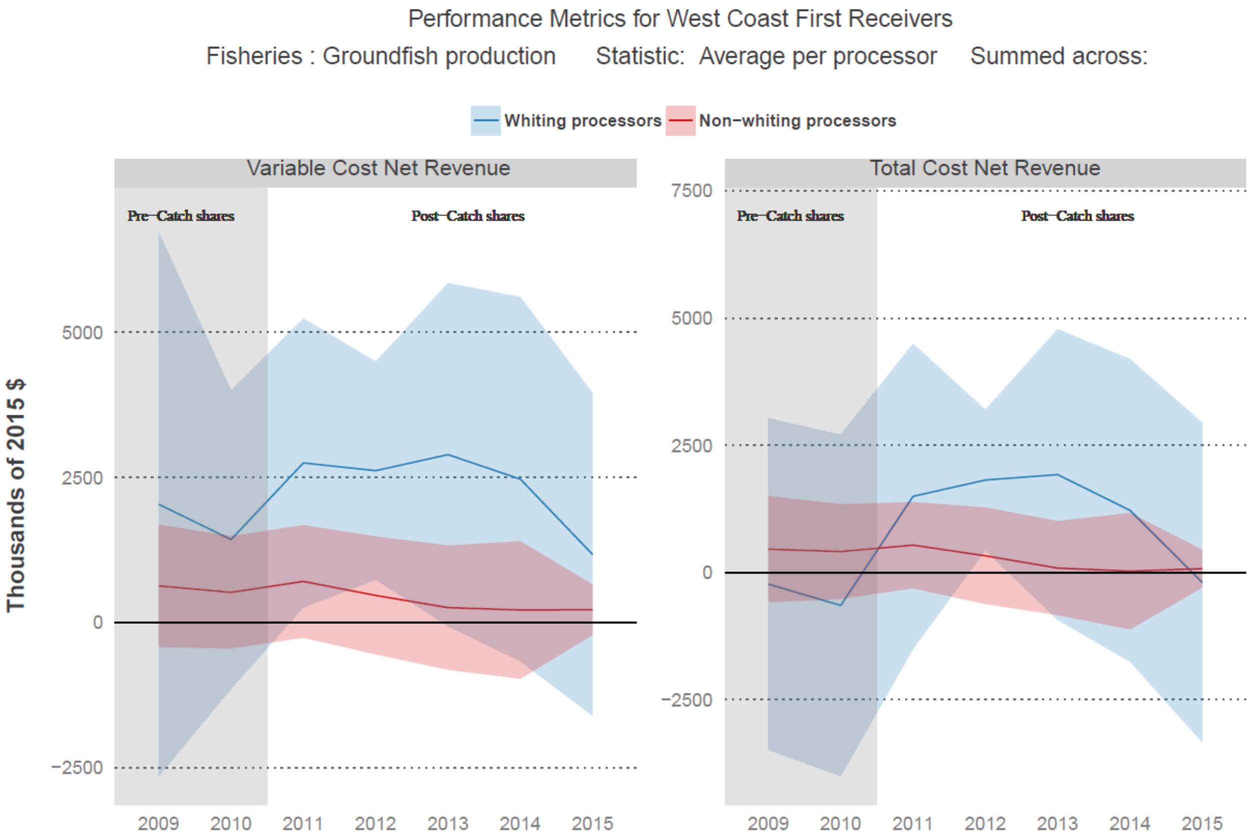


Figure 3-18. Mean annual variable cost net revenue and average total cost net revenue of whiting (blue) and non-whiting (red) catch share processors. Source: EDC data via FISHEyE.

Variable cost data by production activity for first receivers provide more context for changes in net revenue. Table 3-43 shows average cost per mt of production of whiting and non-whiting groundfish for four variable cost categories: labor, packing materials, utilities, and monitoring. Fish purchases are the largest expense category (about 70 percent of total variable costs), and labor, packing materials, and utilities are the next largest categories at 17 percent, 3 percent, and 3 percent, respectively (Guldin et al. 2016). Monitoring expenses are included for public interest. Table 3-43 cannot be disaggregated by location (like Table 3-34 for catcher vessels) to maintain confidentiality.

Labor costs per mt of non-whiting production are nearly twice that of whiting, and increased by about 20 percent from 2014 to 2015, although they had decreased in 2013 and 2014 from previous years. Expenses on utilities and packing materials per mt of non-whiting production have been relatively constant. Expenses on labor, utilities, and packing materials per mt of Pacific whiting appear to track whiting production inversely, and they were lower when annual catch limits and landings were high from 2011 to 2014. Monitoring expenses represent a much lower proportion of variable costs. For whiting production, they have decreased from pre-catch share years. For non-whiting production, monitoring costs were low ($2 per mt) in 2011, and they have increased since then to $24 per mt in 2015.[34]

Table 3-43. Average variable cost per mt (2015 $) of non-whiting groundfish production and Pacific whiting production, for four cost categories. Source: EDC data.

Cost/mt of production	2009	2010	2011	2012	2013	2014	2015
Labor							
Non-whiting groundfish production	799	1,010	1,010	1,031	849	999	1,197
Pacific whiting production	433	409	334	360	275	258	351
Monitoring							
Non-whiting groundfish production	---	---	2	10	17	16	24
Pacific whiting production	5	15	2	2	3	4	9
Packing materials							
Non-whiting groundfish production	170	188	131	122	123	159	130
Pacific whiting production	134	94	70	77	55	59	70
Utilities							
Non-whiting groundfish production	144	131	140	161	146	160	186
Pacific whiting production	106	151	96	77	68	71	101

3.1.2(a)(2) Quota Leasing Activity and Distribution of Net Revenue

Highlights:

- As consolidation increases, more quota is available from vessels that have exited the fishery, so vessels that remain are more likely to spend a larger portion of their revenue on quota.
- For non-whiting catcher vessels, the percent difference between variable cost net revenue with and without quota included varies by year, from a low in 2012 (mean variable cost net revenue was 0.5 percent lower with quota included) to a high in 2015 (mean variable cost net revenue was 25 percent lower with quota included).
- For whiting catcher vessels, mean variable cost net revenue was between 4 and 10 percent lower when quota is included (2012 to 2015).
- There is evidence that shorebased processors use their quota to support bargaining relationships with vessels to secure deliveries.

[34] There were no catch monitors for non-whiting trawl groundfish deliveries prior to 2011.

Catcher vessels

Section 3.1.1(b)(4) provides an in-depth discussion of how quota is transferred, quota prices and pounds transferred by species and by state, and development of the quota market over time. The section will explore how quota leasing activity affects vessels' net revenue to the extent supported by the available data. The costs and earnings from quota (also called "lease royalties") are important components of the economic health of the companies that fish in the catch share program. Very few existing catch share program reviews have had data to include analysis of quota leasing activities. One exception is the Ten-Year Program Review for the Crab Rationalization Management Program in the Bering Sea/Aleutian Islands (North Pacific Fishery Management Council [NPFMC] 2016). Quota costs and earnings were included in the analysis of profitability, noting the following:

> Lease royalty costs are included in the analysis in order to represent the diversion of surplus generated by vessel landings from a vessel owner's balance sheet, but in the context of gauging the benefits generated by the fishery, it should be understood that lease royalties do not represent costs in an economic sense (NPFMC 2016).

As recommended by the SSC (Agenda Item F.6.c Supplemental SSC Report, Nov 2016), the measures presented in this section should be interpreted as a lower bound of the true individual net revenue values, given the complexities of collecting information on quota costs and revenues.[35] Upper bound measures were provided in Section 3.1.2(a)(1). Note that revenue, variable cost net revenue, and total cost net revenue presented in Section 3.1.2(a)(1) and in this section are not directly comparable, and the values will not match. Steiner et al. (2016a) explain the following:

> [In Section 3.1.2(a)(1), we presented] net revenue by fishery and calendar year. This was accomplished by using cost disaggregation to allocate variable and fixed costs to each delivery. Unlike the other costs, there is no method for allocating the financial cost of quota to individual deliveries because the source of quota used to cover an individual delivery is not known. Therefore, this section is presented by survey year (fiscal year)

[35] Evidence that quota-leasing revenues are under-reported was presented to the Council Advisory Board on November 2, 2016, and to the SSC's Economic and Groundfish subcommittees on November 13, 2016. Using all data sources available, EDC scientists estimate that quota revenues may be under-reported by as much as 77 percent because the EDC survey is not designed to represent quota share owners who are not directly involved with an actively participating vessel (meaning they consider themselves the same business). Both bodies recommended that, if a more accurate measure of accounting profits and/or leakage to non-participating quota share owners is desired, a data collection survey of all quota share owners (rather than only participating fishing vessels, which are currently surveyed by the EDC) would have to be administered.

> [which is determined by the vessel or company and thus varies across entities] … rather than by calendar year.

For the catcher-processor sector, trading and leasing of harvest rights occur through private formal or informal contractual lease arrangements (Fraser 2011; Pacific Whiting Conservation Cooperative 2015), and they are, therefore, not collected by the EDC. Thus, this section focuses on catcher vessels. A discussion of the evidence of how processors are using shoreside whiting quota allocated to processors is also included.

Table 3-44 shows mean revenue, mean variable cost net revenue, and mean total cost net revenue for non-whiting catcher vessels by fiscal year, with and without quota revenue and quota costs. Examining the differences between these two measures can reveal the relative impact that quota costs and quota revenues have on vessels’ cash flows. The percent difference between variable cost net revenue with and without quota included varies by year, from a low in 2012 (mean variable cost net revenue was 0.5 percent lower with quota included) to a high in 2015 (mean variable cost net revenue was 34 percent lower with quota included).

Table 3-45 shows the same set of information for whiting catcher vessels. In general, the percentage difference between variable cost net revenue with and without quota included is smaller for whiting vessels than for the non-whiting vessels. It ranged from 4 percent in 2012 to 11 percent in 2015; i.e., mean variable cost net revenue was 11 percent lower with quota included in 2015.

Quota revenues are likely underreported. Many QS owners consider themselves separate from the business operations of a vessel or processor. Thus, quota expenses would be reported in the EDC as a vessel business expense, but the revenue from quota leasing or sales would not. This underreporting increases the calculated difference between net revenue with and without quota. Thus, the measures in this section should be thought of as a lower bound of net revenue. As consolidation increases, the vessels that remain in the fishery are more likely to lease quota from quota shareholders who have exited or who fish less in the catch share program, and they spend a larger portion of their revenue on quota. The data suggest that this is occurring for both whiting and non-whiting vessels, but to a greater extent for non-whiting vessels.

Table 3-44. Average revenue, variable cost net revenue, and total cost net revenue (thousands of 2015 $) by survey (fiscal) year with and without quota revenue and quota costs **for non-whiting groundfish vessels**. Source: Steiner et al. 2016a.

	2009	**2010**	**2011**		**2012**		**2013**		**2014**		**2015**	
	Without	Without	With	Without	With	Without	With	Without	With	Without	With	Without
Revenue	275.7	264.7	415.3	375.9	368.6	332.3	360.2	340.6	369.5	356.6	413.8	403.0
Variable cost net revenue	98.8	97.9	144.6	156.3	127.9	128.6	116.4	128.2	102.8	129.4	115.3	154.2
Total cost net revenue	19.3	28.3	53.1	64.8	31.6	32.3	57.1	69.2	54.7	81.4	53.2	92.1

Table 3-45. Average revenue, variable cost net revenue, and total cost net revenue (millions of 2015 $) by survey (fiscal) year with and without quota revenue and quota costs for **whiting vessels**. Source: Steiner et al. 2016a.

	2009	**2010**	**2011**		**2012**		**2013**		**2014**		**2015**	
	Without	Without	With	Without	With	Without	With	Without	With	Without	With	Without
Revenue	473	610	1,292	1,292	1,263	1,169	1,461	1,446	1,386	1,366	795	773
Variable cost net revenue	204	256	585	624	439	455	615	678	477	517	248	276
Total cost net revenue	-4	70	209	247	-25	-9	297	360	136	176	-97	-70

To provide more information about the distribution of net quota spending among vessels, net spending on quota as a percent of revenue for revenue quartiles is calculated (Figure 3-19). Revenue quartiles are calculated for each year; e.g., the lowest 25 percent of revenue earners in each year are in quartile "1," and the top 24 percent of revenue earners are in quartile "4." Figure 3-19 shows the distribution of quota costs as a proportion of revenue for each revenue quartile. For example, for non-whiting vessels in 2011, the median vessel in the bottom revenue quartile of vessels spent 1 percent of its revenue on quota (reported quota revenue net of quota costs). In 2015, the median vessel in the top revenue quartile of vessels spent 10 percent of its revenue on quota (net). The black bars through the points show the 25th and 75th percentiles within the quartile. Figure 3-19 shows that, in general, vessels with more revenue spend a higher percentage of their revenue on quota. The pattern is less consistent across years for whiting vessels; the top 25 percent of revenue earners spent close to 10 percent of their revenue on quota in 2013 and 2015, but much less so in the other years.

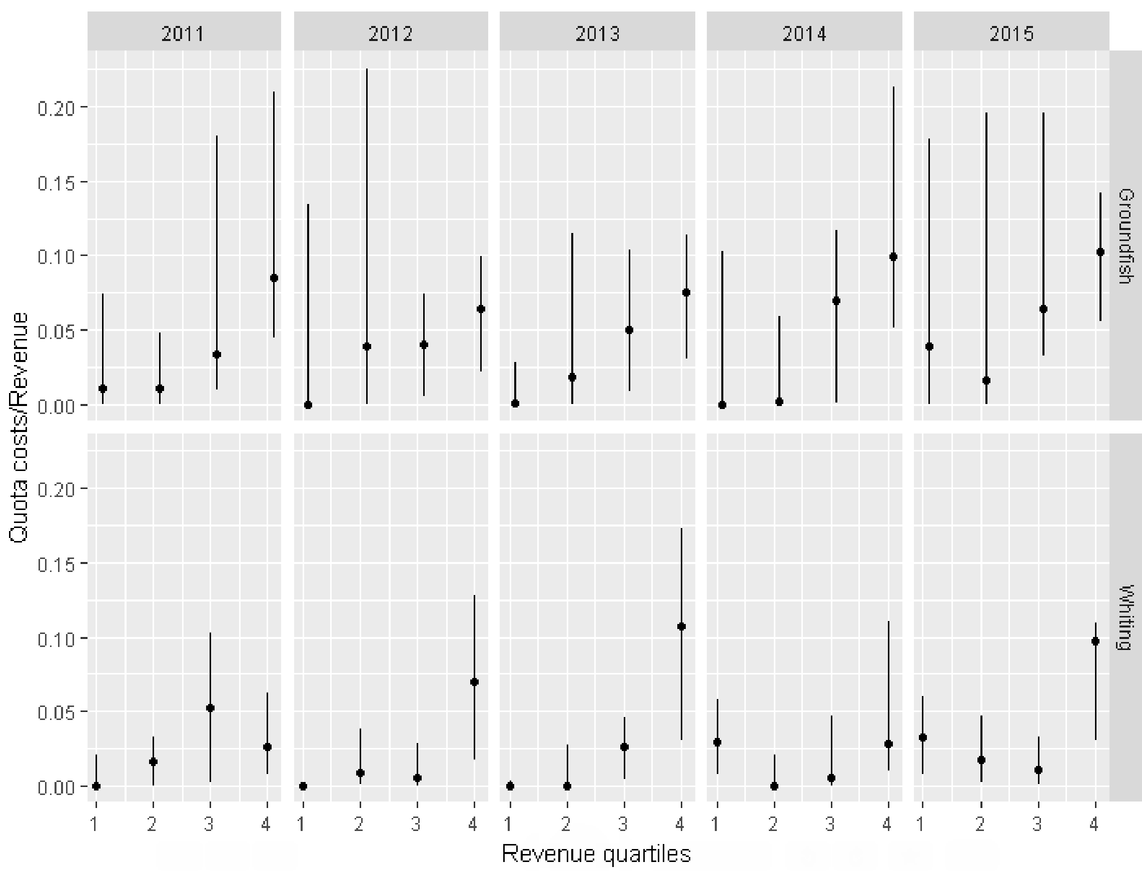


Figure 3-19. Net quota spending as a proportion of revenue, by revenue quartiles for non-whiting (groundfish) vessels and for whiting vessels. Point is the median value per quartile, and lines end at the 25th and 75th percentiles. Source: EDC and fish ticket data.

In Table 3-46, the 25th percentile, median, and 75th percentile of net spending on quota as a percent of revenue are presented. That is, the median non-whiting vessel, in terms of the proportion of revenue it spends on quota, spent 3.6 percent of revenue on quota. This increased to 7.0 percent in 2015. The 75th percentile non-whiting vessel spent 17.4 percent of their revenue on quota in 2015. For whiting vessels, the proportion is lower. The median whiting vessel spent 1.1 percent of its revenue on quota in 2011, increasing to 3.2 percent in 2015. The 75th percentile whiting vessel spent 9.7 percent of its revenue on quota in 2015. According to the quota transactions database, there were fewer than three cash transactions for whiting quota in 2015, indicating that the costs shown here are for non-whiting species.

Table 3-46. Vessels' net spending on quota as a percentage of revenue. Source: EDC and fish ticket data.

	2011	**2012**	**2013**	**2014**	**2015**
Non-whiting vessels					
25th percentile	0.0%	0.0%	0.000	0.0%	0.1%
Median	3.6%	4.6%	3.1%	4.2%	7.0%
75th percentile	19.9%	14.0%	10.9%	10.9%	17.4%
Whiting vessels					
25th percentile	0.0%	0.0%	0.0%	0.0%	0.0%
Median	1.1%	0.4%	1.0%	1.7%	3.2%
75th percentile	7.4%	3.9%	4.9%	6.2%	9.7%

Shorebased processors

As part of the West Coast Groundfish Trawl Catch Share Program, 20 percent of the shoreside Pacific whiting quota allocation was given to eligible shorebased processors. Eligibility and initial allocation percentage were determined by historical deliveries to shorebased processors. Calculation of whiting QS was based on the relative history of the eligible shoreside processor's receipts for whiting from whiting trips. NMFS calculated whiting QS based on the processor's relative history from 1998 to 2004, dropping the two years with the lowest relative history.[36] No quota allocation was given to processors for non-whiting catch share groundfish. Table 3-47 provides the initial allocation of QSs to shorebased processors.

[36] Source: Compliance guide at the following website address: http://www.westcoast.fisheries.noaa.gov/publications/fishery_management/trawl_program/catch shares-guide-appl.pdf

Table 3-47. Processor Pacific whiting QS allocation (percent). Source: NMFS IFQ Quota Share Account Balances.

Processing Company	**Initial Quota Allocation (%)**	**2012**	**2013**	**2014**	**2015**	**2016**
Trident Seafoods Corporation	4.680	4.666	4.666	4.666	10.000	10.000
Ocean Gold Seafoods Inc.	3.878	3.865	3.865	3.865	3.865	3.865
Pacific Coast Seafoods Company	3.805	3.793	3.793	3.793	3.793	2.727
Pacific Shrimp Company	2.862	2.853	2.853	2.853	2.853	2.051
Point Adams Packing Company	2.000	1.993	1.993	1.993	1.993	1.993
Ocean Beauty Seafoods LLC	0.876	0.873	0.873	0.873	0.873	0.873
Bandon Pacific Inc.	0.741	0.738	0.738	0.738	0.738	0.530
Jessies Ilwaco Fish Company	0.588	0.651	0.651	0.651	0.651	0.651
Pacific Choice Seafoods	0.560	0.558	0.558	0.558	0.558	0.402
Hallmark Fisheries	0.010	0.010	0.010	0.010	0.010	0.010
Total	20.000	20.000	20.000	20.000	25.334	23.102

While transfers of QP (transferring use of that quota pound for that year) began in 2011, there was a moratorium on transfers of quota-share percentages (permanently transferring a percent of allocation) until January 1, 2014. Due to purchases of Pacific whiting QS after the moratorium, these processors increased QS holdings (by purchasing QS from non-processors) to greater than 20 percent. After 2014, whiting processors were also permitted to purchase non-whiting groundfish QS (Table 3-48). Aside from Pacific whiting quota, the processing sector owns no more than 2.114 percent of any one quota species. Other processors or accounts linked to processors may have also acquired whiting and non-whiting QS, but are not shown in Table 3-47 and Table 3-48.

Table 3-48. Current (2015) non-whiting groundfish quota share holdings by shorebased whiting processors (only includes those processors listed in Table 3-47. Source: NMFS IFQ Quota Share Account Balances.

IFQ Species	**Quota Share (%)**
Arrowtooth flounder	0.284
Bocaccio rockfish south of 40°10' N. latitude	0.000
Canary rockfish	2.114
Chilipepper rockfish south of 40°10' N. latitude	0.108
Cowcod south of 40°10' N. latitude	0.000
Darkblotched rockfish	1.070
Dover sole	0.249
English sole	0.216
Lingcod north of 40°10' N. latitude	0.249
Lingcod south of 40°10' N. latitude	0.249
Longspine thornyheads north of 34°27' N. latitude	0.250
Minor shelf rockfish north of 40°10' N. latitude	0.810
Minor shelf rockfish south of 40°10' N. latitude	0.138
Minor slope rockfish north of 40°10' N latitude.	0.288
Minor slope rockfish south of 40°10' N. latitude	0.181
Other flatfish	0.185
Pacific cod	0.280
Pacific halibut (IBQ) north of 40°10' N. latitude	0.115
POP north of 40°10' N. latitude	1.789
Petrale sole	0.259
Sablefish north of 36° N. latitude	0.309
Sablefish south of 36° N. latitude	0.194
Shortspine thornyheads north of 34°27' N. latitude	0.247
Shortspine thornyheads south of 34°27' N. latitude	1.021
Splitnose rockfish south of 40°10' N. latitude	0.133
Starry flounder	0.116
Widow rockfish	0.000
Yelloweye rockfish	0.309
Yellowtail rockfish north of 40°10' N. latitude	1.257

There is evidence that shorebased processors are not simply selling their quota to vessels, but are using it in strategic ways to encourage vessels to deliver to them. This was not unexpected; the FEIS stated the following: "an initial allocation of whiting QS to processors functions as a means of guaranteeing supply for processors, granting processors some leverage in bargaining power as they can hold out against harvesters, and providing an incentive to make necessary capital investments to increase product recovery yield" (PFMC and NMFS 2010).

The following are quotations from the Pacific Coast Groundfish Fishery Social Survey[37] from processors describing how they are utilizing the processor quota allocation within the catch share program:

> "[Rationalization] hurt my relationship with boat owners and captains, because before, it was Olympic fishery everybody had their markets. I had 5 boats dedicated to me. Now, I still have 5 boats, but those people make their choice of where they are going to sell their fish … they do not have to bring their fish back here. They can take it to the highest bidder. And plants that do not have their own quota shares have to entice boats to come in with money. I entice boats to come in with fish, not money. Fish equals money, right? … I tell them you bring your fish to me and I will match your deliveries by 20%...I am paying you to catch my fish" —Oregon Processor

> "I got the quota… and now I use it to spread amongst the boats I have as a carrot. To make me the mark of choice" —Washington Processor

> "We have to lease quota, and basically give it to the boats to go catch it. And work out some sort of arrangement by which they'll deliver their fish to us, we give them so much additional quota …you need to become more vertically integrated in a rationalized fishery. You can't just own a plant." —Washington Processor

> "We're not leasing it out, we have to give it to them… You can't even charge a lease fee for it. If we want their 5 million pounds of whiting, we have to give them 1.5 million of our own" —Washington Processor

There is also evidence that processors barter to purchase quota (trading units of other quota species). Processors as well as processor-owned vessels trade quota with independent vessels. Between 2011 and 2015, there are 422 recorded transfers of processor-affiliated quota to independent vessels, 13 percent recorded as barter, 6 percent listed as either cash sale or cash and barter, and 81 percent listed as "other" (Source: NMFS quota transactions data). While 6 percent were associated with cash, only about 3 percent had an explicit cash value associated with them. This provides evidence that processors did not sell processor-affiliated quota to vessels in the quota market, although it could also be because the price was not known at the time of data entry or the price was not recorded. Because of these complex and non-cash arrangements, it is difficult to assess how quota trading is affecting the profitability of shorebased

[37] More information is available at the following website; https://www.nwfsc.noaa.gov/research/divisions/cb/ecosystem/humandim/groundfish-study.cfm

processors. These complications also make it difficult to assess the effect of the 20 percent whiting allocation on the profitability of the shorebased processors receiving the allocation.

3.1.2(a)(3) Crew and Production Worker Outcomes

Highlights:

- Average daily and annual compensation (while fishing in the catch share fishery) for individual crew members on whiting vessels increased dramatically relative to 2009-2010, with the exception of 2015 (daily wages increased 83 percent and annual wages increased 118 percent from the pre-catch share period).
- Average daily and annual compensation for individual crew members on non-whiting vessels has increased modestly (63 percent and 24 percent, respectively).
- For processors, employment has become more evenly distributed throughout the year, with fewer employees during former peak months, and more during the rest of the year.
- Average hourly compensation of non-production employees and production workers in processing facilities has increased on average.

Crew and production workers are an integral part of the West Coast Groundfish fishery. Data collected by the EDC Program enable analysis of changes in annual compensation, daily compensation, and worker productivity that have occurred in the fishery since the beginning of the catch share program. The data for crew presented in this section represent wages earned only while fishing in the catch share program and not while fishing, for example, for Dungeness crab, or in Alaska on the same or another vessel. Information on compensation while participating in other fisheries on catch share vessels is available in the EDC reports (Steiner et al. 2016c, 2016b; Warlick et al. 2016) and on FISHEyE. Information on average days at sea (in the West Coast groundfish catch share program only) and the average number of crew per vessel is provided for context and to measure changing effort levels. Crew outcomes are measured by annual compensation in the catch share program, daily compensation in the catch share program, and wages per ex-vessel dollar (which represents the effective crew share, ignoring changes in types and magnitude of costs deducted from ex-vessel revenue before calculating crew share).

Catcher Vessel Crew

Most crew on catcher vessels are paid a “crew share,” or a percentage of the total revenue earned by the vessel after certain expenses are deducted (Steiner et al. 2016c). The crewmembers in the groundfish fishery have been in the fishery for an average of 20 years, and they earn an average of 98 percent of their annual income from fishing (in all fisheries, not just the groundfish trawl fishery) (Russell et al. 2014).

Data for crew on catcher vessels that target whiting (Table 3-49) are provided separately from data for crew on non-whiting groundfish catcher vessels (Table 3-50). Annual crew compensation on whiting vessels (while fishing in the whiting and non-whiting catch share fisheries) increased by 117 percent, and daily compensation increased by almost 60 percent from baseline pre-catch share years to the catch share period, despite a decrease in 2015 (Figure 3-20). Compensation per $1,000 of revenue ranged from $67 (2015) to $85 (2014). The whiting TAC increased on average from the baseline period, but in 2012, annual and daily compensation was nearly twice that of 2010, a year in which TAC was comparable. Although compensation for whiting vessel crew has increased for all measures compared to the pre-catch share period, the number of crewmembers decreased 25 percent between the pre-catch share period and 2015.

Table 3-49. Whiting vessel crew (whiting and non-whiting catch share participation): average days fished per vessel, average number of crew positions per vessel, total crew positions on vessels in the catch share fishery, average compensation per year per position, average compensation per day per position, and average compensation per revenue $ per position (2015 $). Source: EDC data.

	Average days in catch share fishery	**Average crew per vessel**	**Total crew**	**Compensation per year**	**Compensation per day**	**Compensation per 1000 $ revenue**
2009	66	2.6	105	37,375	701	81
2010	75	2.7	110	45,941	712	80
2011	81	2.7	84	92,190	1,209	74
2012	81	2.9	81	97,228	1,319	83
2013	82	3.0	86	103,074	1,228	69
2014	89	2.8	85	107,900	1,258	85
2015	80	3.0	77	54,310	598	67
Pre-catch share mean	71	2.7	107.5	41,658	707	81
catch share mean	83	2.9	82.6	90,940	1,122	76

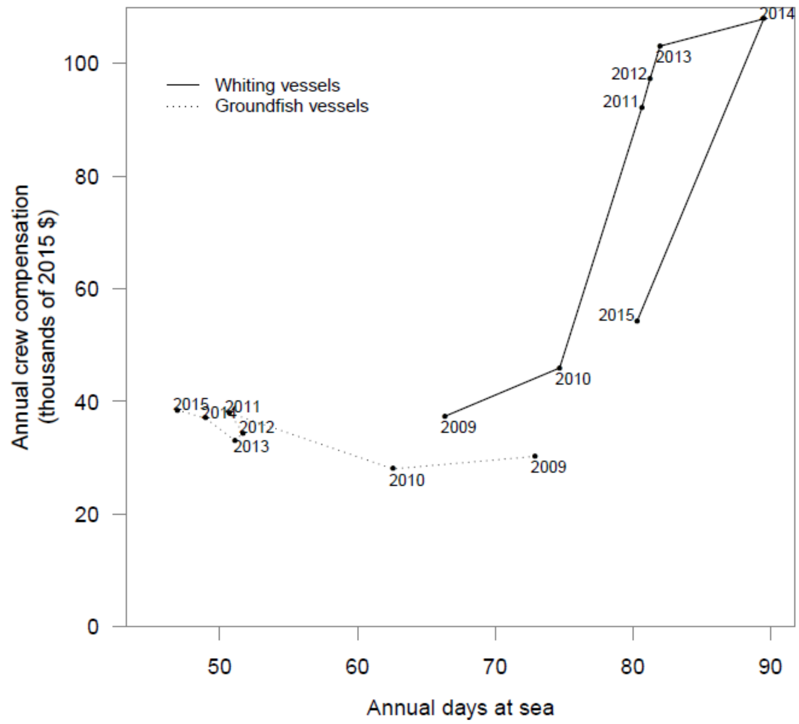


Figure 3-20. Average annual crew compensation (2015 $) versus average days at sea for vessels fishing in catch share fisheries. Crew on whiting vessels are represented by the solid line, and crew on non-whiting groundfish vessels are represented by the dotted line. Source: EDC data and (Steiner and Russell working paper).

For non-whiting vessels, crew compensation per day increased by about 70 percent from the pre-catch share to the catch share period. Average days at sea in the catch share fishery fell by 27 percent; however, the increase in daily compensation made up for the loss of days, as compensation per year increased by 24 percent from the pre-catch share to the catch share period (Table 3-50). There was much less variation from year to year in compensation compared to vessels in the whiting fishery (Figure 3-20). Compensation per 1,000 dollars of revenue increased by about 13 percent for crew on non-whiting vessels (Table 3-50).

Table 3-50. Non-whiting groundfish vessel crew (catch shares only): Average days fished per vessel, average number of crew positions per vessel, total crew positions on vessels in the catch share fishery, average compensation per year per position, average compensation per day per position, and average compensation per revenue $ per position. Source: EDC data.

	Average days in catch share fishery	**Average crew per vessel**	**Total crew**	**Compensation per year**	**Compensation per day**	**Compensation per 1000 $ revenue**
2009	73	1.9	176	30,250	476	121
2010	62	1.9	164	28,023	481	111
2011	50	2.2	181	37,993	830	112
2012	51	2.2	184	34,428	791	116
2013	50	2.2	175	33,078	649	143
2014	48	2.3	168	37,015	786	154
2015	48	2.4	173	38,393	855	911
Pre-catch share mean	67.5	1.9	170	29,137	479	116
catch share mean	49.4	2.26	176.2	36,181	782	131

Data from the Pacific Coast Groundfish Fishery Social Survey (PCGFSS) on compensation corroborates these results. Since 2010, fewer crewmembers rated compensation amount as "poor" and more rated it as "excellent" (Table 3-51). This suggests an improvement in the amount of compensation. Since 2010, the percentage of crewmembers that rated method of pay as "poor" has also declined, and those rating method of pay as "excellent" increased in 2015-2016, although the perspective of crew who have been displaced from the fishery is likely underrepresented in the PCGFSS survey. For more information about the employment from the PCGFSS, see Section 3.2.(b).

Table 3-51. Crewmembers' reported compensation amount and method of pay (percentages selecting each choice). Source: Pacific Coast Groundfish Fishery Social Survey (PCGFSS 2017).

		2010	2012	2015/2016
Compensation	Poor	16.0	10.6	8.4
	Fair	23.4	22.3	15.8
	Good	43.6	35.1	50.5
	Excellent	17.0	28.7	25.3
	Not answered	0	3.2	0
	Response Rate	98	100	96.9
Method of pay	Poor	7.6	2.2	4.3
	Fair	15.2	18.3	12.0
	Good	47.8	49.5	47.8
	Excellent	28.3	25.8	35.9
	Not answered	1.1	4.3	0
	Response Rate	95.8	98.9	94.8

Mothership Crew

There are two groups of employees on mothership vessels: processing crew (including line workers, fishmeal crew, quality control workers, technicians, cleanup workers, factory managers, combis, and mechanics who work on processing equipment) and non-processing crew (including captains, deckhands, wheelhouse workers, galley workers, and engineers).

The average number of processing crewmembers on mothership vessels has varied over time, ranging from 90 in 2009 to 66 in 2011. The average number of non-processing crewmembers has not varied substantially over time, but reached a peak of 45 in 2014 when whiting TAC was highest.

Annual wages for processing and non-processing crew were higher in all post-catch share years compared to 2009 and 2010. Annual wages were highest in 2011 for processing crew and in 2015 for non-processing crew. Average annual wages from 2011 to 2015 have increased by 70 percent for non-processing crew and by two-fold for processing crew since 2009 and 2010. This was driven by increases in the number of days participating in the catch share program. Daily wages have decreased for both crew categories. Compensation for both processor and non-processor crew wages per production dollar have remained relatively constant (Table 3-52). Thus, by most measures, compensation for crew on motherships has improved since the baseline period, but the effect of catch shares cannot be independently identified from the increase in catch limits for whiting. However, average annual and daily wages increased much more for crew on motherships than for crew on catcher-processors (below), suggesting that the catch share program has had at least some impact on the increased compensation.

Catcher-Processor Crew

Similarly, catcher-processors have both processing and non-processing crew. The average number of processing crew on catcher-processor vessels has also varied over time, ranging from 83 in 2011 to 99 in 2015. Average annual wages for processing crew were highest in 2010 and 2014 (approximately $16,000) and lowest in 2012 (approximately $9,700). Average and daily wages for processing crew have decreased by 23 percent and 20 percent, respectively, since the implementation of catch shares. Processing crew wages per production value dollar have decreased slightly over the period (Table 3-53).

The average number of non-processing crew has remained relatively constant over time, but it reached a peak of 32 in 2011. Average annual and daily wages for non-processing crew have increased considerably. Non-processor crew wages per dollar (production value) have increased.

Table 3-52. Average number of processing and non-processing crew on mothership vessels, and average annual wage per position, per day, and per production value. Source: EDC data.

Year	Days at sea		Non-processing crew				Processing crew			
	West Coast	Total days	Number	Annual wage	Daily wage	Wage per production $	Number	Annual wage	Daily wage	Wage per production $
2009	20	146	35	9,867	493	0.0030	90	4,602	230	0.0014
2010	28	119	33	13,315	476	0.0025	85	7,207	257	0.0014
2011	58	178	34	18,900	326	0.0025	66	14,448	249	0.0019
2012	46	159	32	14,067	306	0.0025	72	10,547	229	0.0019
2013	68	159	31	18,021	265	0.0026	69	12,125	178	0.0017
2014	59	174	45	20,003	339	0.0021	83	11,793	200	0.0013
2015	55	152	28	27,650	503	0.0041	80	11,390	207	0.0017
Pre-catch share avg.	24	132	34	11,591	483	0.0027	88	5,905	246	0.0014
Post-catch share avg.	57	165	34	19,728	346	0.0027	74	12,061	212	0.0016

Table 3-53. Average number of processing and non-processing crew on catcher-processor vessels, and average annual wage per position, per day, and per production value. Source: EDC Data.

Year	Days at sea		Non-processing crew				Processing crew			
	West Coast	Total days	Number	Annual wage	Daily wage	Wage per production $	Number	Annual wage	Daily wage	Wage per production $
2009	42	103	24	14,059	335	0.0020	88	13,882	331	0.0019
2010	63	137	21	19,429	308	0.0020	91	16,599	263	0.0017
2011	46	213	32	18,661	406	0.0027	83	11,517	250	0.0016
2012	33	171	23	18,622	564	0.0031	97	9,793	297	0.0017
2013	47	189	25	20,445	435	0.0028	97	10,599	226	0.0014
2014	59	171	24	28,365	481	0.0025	98	16,164	274	0.0015
2015	65	175	22	31,573	486	0.0044	99	10,251	158	0.0014
Pre-catch share avg.	52	121	22	16,744	322	0.0020	90	15,240	293	0.0018
Post-catch share avg.	50	184	25	23,533	471	0.0030	95	11,665	233	0.0015

Shorebased processors

Shorebased processors employ both production workers and non-production employees. The EDC Program collects data on the labor force of processors and includes full-time, part-time, and temporary workers.[38] In contrast to the previous sections, the employment statistics in this section include all operations (rather than groundfish-only) at shorebased processors; the design of the data collection precludes separation.[39]

Production workers include on-site workers up through the line-supervisor level who are engaged in processing, assembling, inspecting, packaging, maintenance, and similar activities (Guldin et al. 2016). Figure 3-21 illustrates the total industrywide number of production workers employed (thousands) (top) and the total industrywide pounds purchased by catch share processors in each month by species group (millions of lbs) (bottom).

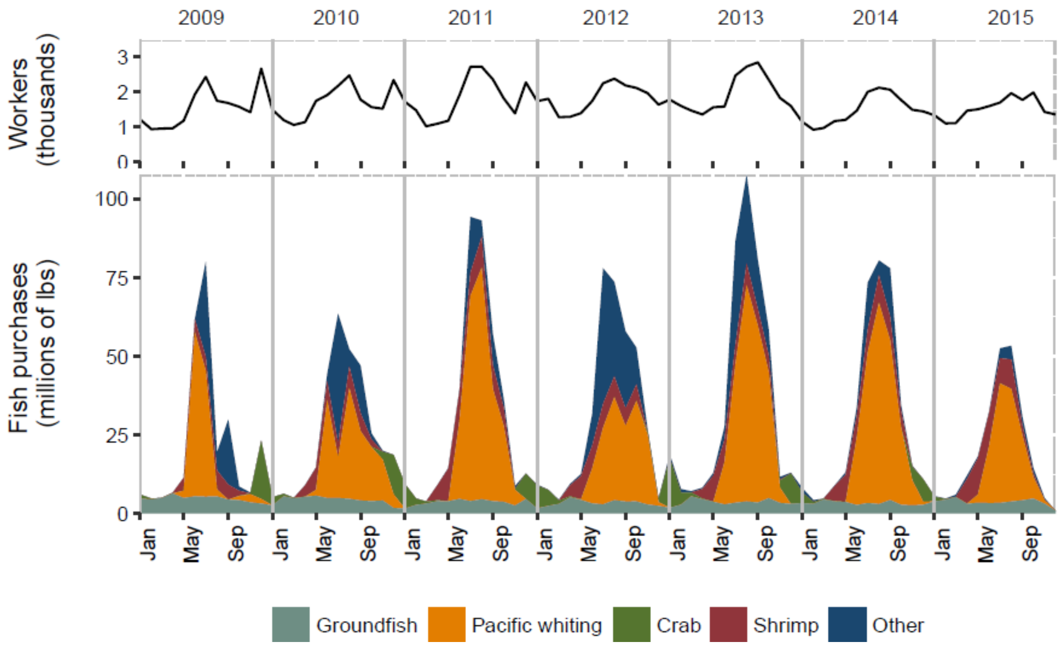


Figure 3-21. Industrywide number of production workers employed (thousands) (top) and total pounds purchased by catch share processors in each month by species group (millions of lbs) (bottom). Source: Guldin et al. 2016.

[38] The EDC follows the Census Bureau's Annual Survey of Manufacturers by collecting labor information for the week that includes the 12th of the month (Guldin et al. 2016).

[39] To reduce the burden of the survey, the employment information is not collected by species. In pre-testing, most processors were unable to provide disaggregated information. Methods to use landings data to disaggregate the labor statistics are under development.

The labor force of production workers fluctuates throughout the year due to fishing seasons and the portfolio of species being processed. Facilities employ more workers in months when purchase and production volumes are highest, which coincides with the high-volume Pacific whiting season (Table 3-54). Employment also increases in the winter months during crab season in some years. Data suggest that the months of heaviest operations may be shifting to later in the calendar year, from June and July in 2009 to August and September under catch shares (Table 3-55). Employment is somewhat more evenly distributed throughout the year under catch shares for the industry as a whole. The average number of production workers per processor (Table 3-54) and the number of hours worked (Table 3-55) increased for most months from the pre-catch share period.

Table 3-54. Mean number of production workers per processor for the week that includes the 12th of the month. Source: EDC data.

	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**Pre-catch share avg.**	**Catch share avg.**
January	63.5	70.6	107.3	108.2	104.3	81.6	82.9	67.1	96.9
February	48.8	56.5	91.9	112.4	93.7	65.3	68.4	52.7	86.3
March	49.8	50.0	63.2	79.6	86.0	68.7	64.9	49.9	72.5
April	53.1	56.6	67.8	80.1	79.4	82.9	85.7	54.9	79.2
May	65.1	86.9	68.8	86.8	91.5	79.7	88.1	76.0	83.0
June	106.9	90.7	112.1	108.5	92.6	97.3	93.4	98.8	100.8
July	127.7	103.3	159.5	131.9	144.9	133.1	99.4	115.5	133.8
August	91.6	117.5	159.8	139.6	160.0	141.1	115.2	104.6	143.1
September	93.1	88.7	138.4	128.2	167.1	137.2	103.9	90.9	135.0
October	82.6	78.0	106.4	124.1	137.9	117.7	116.4	80.3	120.5
November	78.6	75.7	81.2	115.2	107.2	99.0	83.6	77.2	97.2
December	140.1	111.1	141.7	96.0	93.7	102.6	79.5	125.6	102.7

Table 3-55. Mean hours worked by production workers per processor for the week that includes the 12th of the month. Source: EDC data.

	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**Pre-catch share avg.**	**Catch share avg.**
January	1,913	1,583	3,065	3,090	3,389	2,117	2,396	1,748	2,811
February	991	1,512	2,500	2,887	3,031	1,752	1,859	1,252	2,406
March	1,322	1,337	1,831	1,993	2,661	2,008	2,031	1,330	2,105
April	1,479	1,817	2,310	2,452	2,057	2,816	2,797	1,648	2,486
May	2,482	3,164	2,879	2,695	3,322	3,136	3,264	2,823	3,059
June	3,603	3,100	4,976	2,798	3,020	3,320	3,352	3,352	3,493
July	6,385	4,096	8,273	5,448	6,004	5,339	4,025	5,241	5,818
August	3,398	4,453	8,936	5,878	9,787	6,534	5,242	3,926	7,275
September	2,859	3,119	6,658	5,303	7,844	6,439	3,895	2,989	6,028
October	4,156	2,350	4,179	5,294	5,836	4,610	3,219	3,253	4,628
November	2,706	2,196	2,759	4,386	3,829	2,754	2,718	2,451	3,289
December	5,307	5,688	6,206	3,679	2,739	3,334	2,552	5,498	3,702

Catch share processors produce seafood products in facilities all along the West Coast, and the production and number of production workers varies by state (Figure 3-22). Catch share processors have seven processing facilities in California, nine in Oregon, and four in Washington. Processors in California have fewer workers than the rest of the West Coast, even though the number of facilities is comparable to Oregon and greater than Washington, as California processors generally have smaller operations. Spikes in production workers during winter months indicate employment during crab season. Processors in Oregon and Washington produce higher volume species like Pacific whiting and coastal pelagics, as well as crab, which is indicated in the seasonal fluctuations in their supply of production workers (more workers in the summer and fall during Pacific whiting season).

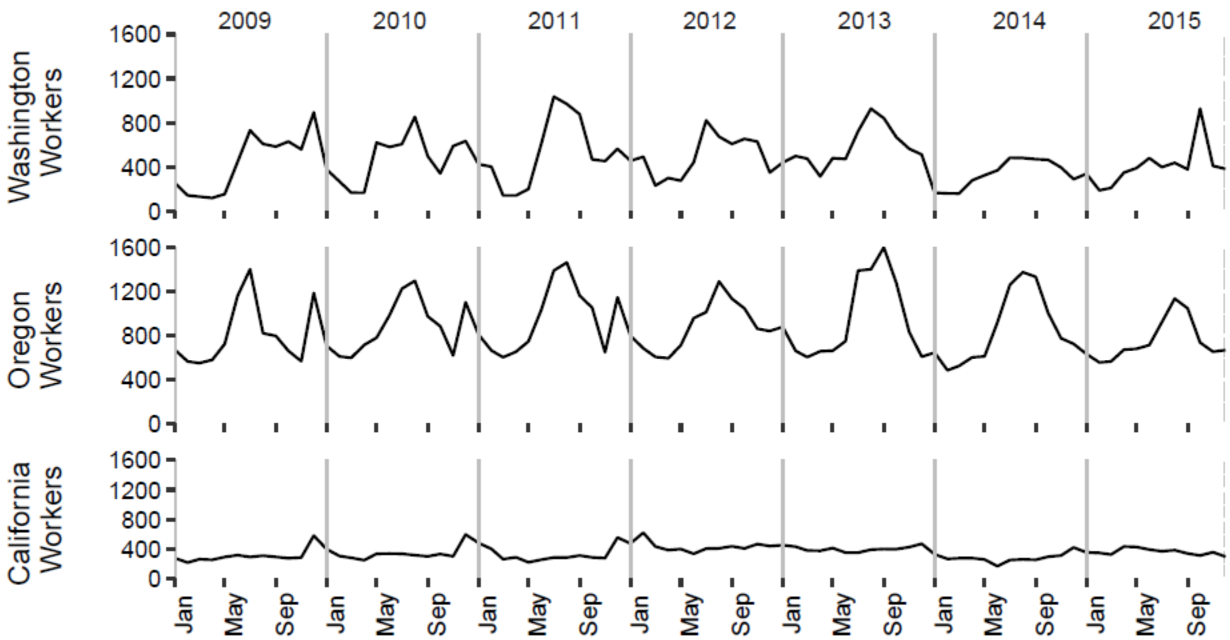


Figure 3-22. Industry-wide number of production workers employed by catch share processors by state. Source: EDC data.

In addition to production workers, catch share processors have non-production employees that include on-site supervisors and individuals responsible for sales, advertising, credit, collection, recordkeeping, and similar activities. Generally, non-production employees are employed for the entire calendar year, while many production workers are employed seasonally.

The total number of non-production employees and the hours worked have decreased under catch shares industrywide, in part due to a decrease in the number of processors over this period (Table 3-56). For the average catch share processor, hours worked for non-production employees have decreased under catch shares compared to 2009 and 2010 totals (Table 3-57). The number of non-production employees has fluctuated by one to two employees from 2009 to 2015.

Table 3-56. Industrywide total number of non-production employees and hours worked for the week that includes March 12. Source: EDC data.

	2009	2010	2011	2012	2013	2014	2015	2009-2010 avg.	2011-2015 avg.
Hours worked	12,043	17,012	9,357	7,119	9,699	7,193	7,040	14,528	8,082
Number of employees	193	262	190	171	182	176	181	228	180

Table 3-57. Mean number of non-production employees and hours worked for the week that includes March 12. Source: EDC data.

	2009	2010	2011	2012	2013	2014	2015	2009-2010 avg.	2011-2015 avg.
Hours worked	633.8	810.1	550.4	418.8	538.8	449.6	391.1	722	470
Number of employees	10.2	12.5	11.2	10.1	10.1	11.0	10.1	11	11

Average hourly compensation for production and non-production workers within each facility is calculated by dividing annual labor expenses by an estimate of total annual hours worked. Hourly compensation for non-production employees at the average catch share processor is consistently higher under catch shares compared to 2009 and 2010. Average hourly compensation for production workers decreased in 2011 and 2012, but then increased from 2013 to 2015 to levels higher than before the catch share program (Table 3-58).

Table 3-58. Average hourly compensation (2015 $). Source: EDC data.

	2009	2010	2011	2012	2013	2014	2015	2009-2010 avg.	2011-2015 avg.
Non-production employees	34.56	33.38	37.31	41.39	41.86	44.33	41.76	34	41
Production workers	15.56	14.89	13.31	14.07	14.76	17.07	18.28	15	15

3.1.2(b) Efficiency

Refer to Section 3.1.1(b)(2). The information on efficiency is addressed in that section.

3.1.2(c) Stability

Information for this section is covered in other sections. The coefficient of variation of vessels' revenues, a measure of income stability, is included in Section 3.1.2(d)(5), and a discussion of the timing and consistency of groundfish landings and potential impacts for shorebased processors is included in Section 3.1.2(d)(2).

3.1.2(d) Flexibility

Catch share programs increase flexibility in many aspects of the fishing process (Reimer et al. 2014). Vessels can fish according to what is individually optimal, and processors can offer incentives for vessels to fish according to what is optimal for them. As a result, effort, fishing, and landings patterns may shift. In addition to the information presented here, Section 3.2.2 contains qualitative information about how participants have responded to the flexibility provided by the program.

3.1.2(d)(1) Participation

Highlights:

- Vessels participate in multiple fisheries to increase income, decrease income variability, and maintain steady employment throughout the year.
- For whiting catcher vessels, average days at sea in the catch share fishery increased by about 17 percent, due, in part to higher TAC and fewer vessels fishing.
- For non-whiting groundfish vessels, the average number of days at sea in the catch share fishery decreased by 27 percent from 2009 to 2015.
- Participation, days at sea, and percent of revenue from shrimp by catch share vessels have been higher since catch-share implementation.

One of the key characteristics of this fishery is the number of distinct fishing activities that vessels participate in throughout the year (Steiner et al. 2016a). Vessels maintain diverse portfolios to increase income, decrease the variability of income, and maintain steady employment throughout the year. Vessels choose whether to participate in these activities based on their vessel characteristics, expected profits in each fishery, and other opportunities they would forego. Participants can also decide to lease their quota and not fish, for example if their vessel needs repairs, or the captain is having health problems. Of course, quota can also be leased or sold if participants decide it would be more profitable to lease their quota than to fish it themselves, decide to retire, want to invest in other non-IFQ fisheries, or leave the fishery for any other reason.

Prior to the catch share program, the non-whiting trip-limit management system spread harvest effort across the year to ensure a steady flow of groundfish to processors. In some months, the opportunity cost of groundfish participation may have been high, such as at the opening of the crab season. If vessels were to participate in the groundfish fishery in the month that the crab season opened, they would be foregoing crab fishing when the catchability of crab would be highest. Vessels that wanted to travel to Alaska may have given up non-whiting groundfish participation for a time in order to do so. Under the catch share management system, vessels can fish their allocation of groundfish at any time during the calendar year. This allows them to manage their portfolio of fishing activities effectively to maximize expected profit and to minimize the opportunity cost of participating in other fisheries. This section explores how participation decisions, including days at sea and revenue earnings over the season, have changed after the implementation of catch shares. The next section explores changes in the timing of participation.

Table 3-59, Table 3-60, Table 3-61, and Table 3-62 compare total effort in the catch share fishery to total effort in all fisheries. Table 3-59 and Table 3-60 are for whiting and non-whiting catcher vessels, respectively. The number of whiting vessels has decreased, driven partially by increased specialization (fewer whiting vessels also fishing for non-whiting). For whiting vessels, average days at sea in the catch share fishery increased by about 17 percent (due at least in part to fewer vessels fishing), and average days at sea in non-catch share fisheries (most commonly crab, shrimp, and Alaska fisheries) increased by about 12 percent. Total days at sea decreased for both categories, however, driven by the decrease in the number of vessels, which may have been furthermore influenced by the number of vessels switching to fixed gear (Table 3-59). Overall, this indicates an increase in vessel efficiency in terms of catch per day. Slightly more annual effort is being used by fewer vessels to attain the catch limits.

For non-whiting groundfish vessels, the average and total number of days at sea in the catch share fishery decreased by 27 percent and 36 percent, respectively, from 2009 to 2015. Average and total days at sea in other non-catch share fisheries both increased.

Table 3-59. Whiting vessel average and total days fishing in catch share and non-catch share fisheries. Source: EDC data.

Year	Number of vessels	Average days in catch share fishery	Total days in catch share fishery	Average days in non-catch share fisheries on catch share vessels	Total days in non-catch share fisheries on catch share vessels
2009	41	66	2,719	83	2,974
2010	41	75	3,058	91	3,376
2011	31	81	2,491	103	2,885
2012	28	81	2,275	87	2,081
2013	29	82	2,377	101	2,519
2014	30	89	2,685	94	2,452
2015	26	80	2,088	104	2,081

Table 3-60. Non-whiting groundfish vessel average and total days fishing in catch share and non-catch share fisheries. Note: Vessel counts are those vessels with complete days at sea data. Source: EDC Program.

Year	Number of vessels	Average days in catch share fishery	Total days in catch share fishery	Average days in non-catch share fisheries on catch share vessels	Total days in non-catch share fisheries on catch share vessels
2009	93	73	6,645	55	3,609
2010	88	62	5,406	55	3,651
2011	82	50	4,136	61	3,825
2012	82	51	4,187	67	4,170
2013	80	50	3,956	61	3,863
2014	75	48	3,589	75	4,361
2015	71	47	3,331	68	3,997

For mothership and catcher-processor vessels, participation and days at sea in the catch share fishery have generally tracked annual catch limits for Pacific whiting, with the exception of the number of motherships participating in 2015. Additional analysis is presented in Section 3.1.3(a)(2).

Table 3-61. Mothership vessel average and total days fishing and processing in catch share and non-catch share fisheries. Source: EDC data.

Year	Number of vessels	Average days in catch share fishery	Average days in Alaska	Total days in catch share Fishery	Total days in Alaska
2009	6	20	119	117	715
2010	6	28	117	171	584
2011	5	58	153	289	767
2012	5	46	134	230	670
2013	5	68	130	341	650
2014	5	59	145	297	723
2015	3	55	120	166	361

Table 3-62. Catcher-processor vessel average and total days fishing and processing in catch share and non-catch share fisheries. ** Some data are suppressed for confidentiality. Source: EDC data.

Year	Number of vessels	Average days in catch share fishery	Average days in Alaska	Total days in catch share Fishery	Total days in Alaska
2009	5	42	**	210	**
2010	6	63	111	377	666
2011	9	46	190	416	1709
2012	9	33	150	294	1351
2013	9	47	164	419	1480
2014	9	59	145	532	1301
2015	9	65	145	581	1306

The EDC reports contain more information about the catch and revenue composition of the average vessel that participates in each target fishery within the catch share program (at-sea Pacific whiting, shoreside whiting, non-whiting midwater trawl, DTS trawl, non-whiting non-DTS trawl, and fixed gear with a trawl endorsement ("Fishery Summaries" section of Overview, Steiner et al. 2016a).

Figure 3-23 provides more details about the participation decisions of non-whiting catcher vessels. The bottom chart shows the percent of vessels participating in each fishing activity in each year. The middle chart shows the distribution of days at sea in each activity for those vessels that participated. The top chart shows the range of percentage of revenue earned from each activity for those vessels that participated. Very few (1 percent to 7 percent) non-whiting catcher vessels fish in Alaska (green bars). Those that do, however, spend many days and earn a large percentage of revenue from Alaska fisheries (median of about 70 percent in the post-catch share implementation years). The percentage participating in crab was the highest in 2013 (58 percent), and it was close to 50 percent for the rest of the years (orange bars). Those vessels spend about 30 days (median) fishing in the crab fishery, and they earn around 40 percent of their revenue from crab. The exception is 2015, when the crab season did not open in most areas in the winter of 2015 through the spring of 2016 due to consumer safety concerns resulting from domoic acid.[40] Days at sea and revenue from crab decreased dramatically in 2015. However, the percent of vessels participating, number of days at sea, and percent of revenue from shrimp (light blue bars) were higher in 2015.

Overall, participation, days, and percent of revenue from shrimp are higher in the post-catch share years. There are several possible explanations for this, and they are not mutually exclusive. First, vessels may have shifted into the shrimp fishery when opportunities in the crab fishery were poor, although data from 2016 (when available) may provide a more complete picture of the ability of vessels to substitute into other fisheries. Second, vessels may have had to give up shrimp participation for groundfish in the trip limit system. The shrimp fishery is open for most of the year (April 1 to October 31). The increased flexibility resulting from the catch share program may have allowed more participation in shrimp. Finally, 2011 to 2015 had large shrimp populations, good fishing opportunities, and relatively high prices. Vessels may have increased participation and effort in the shrimp fishery to take advantage of these conditions. About 25 percent of vessels participate in "other" fisheries, including fixed gear sablefish outside the trawl IFQ program, tuna, salmon, and other fisheries. Days at sea and percent of revenue from these other

[40]Domoic acid is produced by algae, and it accumulates in shellfish, sardines, and anchovies. Poisoning may result from consumption of contaminated animals. Exposure to the biotoxin affects the brain, causing seizures, and possibly death.

fisheries has remained relatively stable, although it was lowest in 2011, the first year of the catch share program.

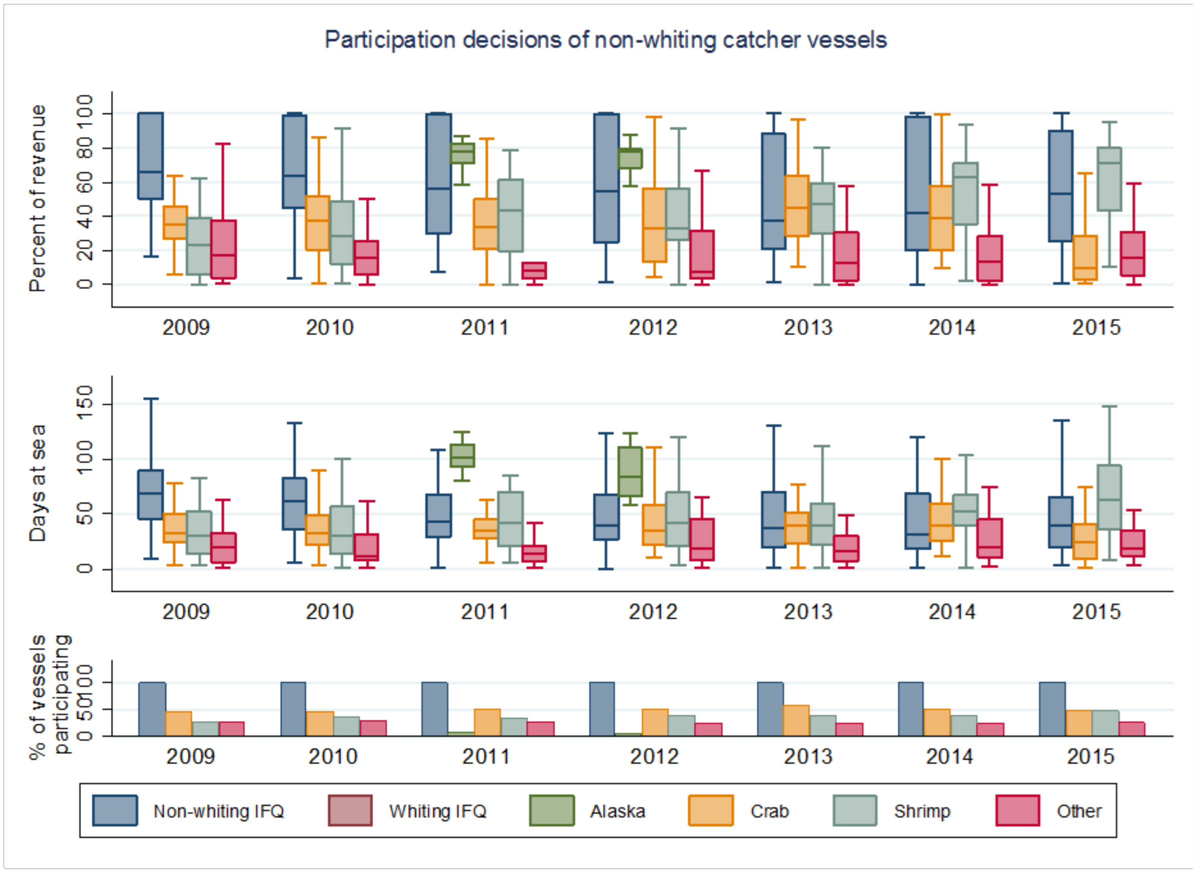


Figure 3-23. For non-whiting catcher vessels, the percent of active vessels participating in each fishing activity, the distribution of days at sea in each activity, and the distribution of the percent of revenue earned from each activity. Note¨ Shaded boxes on box plots represent the 25th and 75th percentile, the line in the middle of the box represents the median, and the whiskers represent the lower and upper adjacent values. Data are suppressed if fewer than three vessels participated in any year. Source: EDC and fish ticket data.

Figure 3-24 shows an identical set of data for whiting catcher vessels. One notable difference is that fewer whiting vessels over time are also participating in non-whiting groundfish (dark blue bars). About 65 percent of whiting vessels also fished for non-whiting groundfish in 2009 and 2010, while an average of 31 percent did so from 2011 to 2015. However, median days at sea and percentage of revenue remained relatively stable for all activities. For whiting vessels, the largest number of days and percentages of revenue were earned from fishing in Alaska (green bars). The median whiting vessel spent about 100 days and earned about 60 percent of its revenue from Alaska activities. Participation in crab by whiting vessels was lower than by non-whiting vessels, and it made up a much smaller proportion of total revenue. Less than three whiting vessels participated in crab in 2015, so their data are suppressed. Almost no whiting vessels participate in the shrimp fishery or other fisheries.

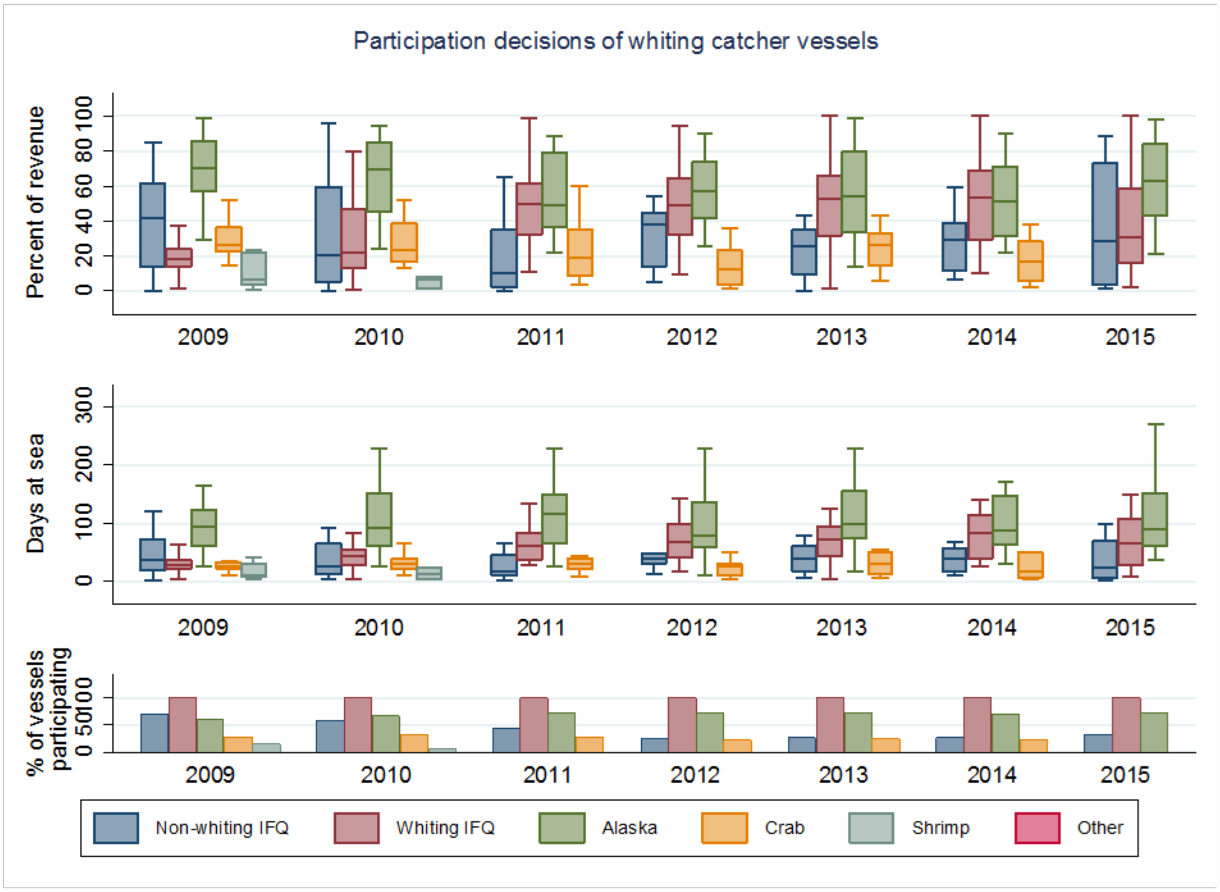


Figure 3-24. For whiting catcher vessels, the percent of active vessels participating in each fishing activity, the distribution of days at sea in each activity, and the distribution of the percent of revenue earned from each activity. Note: Shaded boxes on box plots represent the 25th and 75th percentile, the line in the middle of the box represents the median, and the whiskers represent the lower and upper adjacent values. Data are suppressed if fewer than three vessels participated in any year. Source: EDC and fish ticket data.

3.1.2(d)(2) Timing of Landings

Highlights:

- The removal of bimonthly trip limits allows vessels more flexibility in choosing when and how much to fish. This has resulted in more participation in non-catch share fisheries.
- The total number of trips has decreased, the average delivery size has increased, and the number of days an individual processor received deliveries has decreased since the implementation of catch shares.
- Coastwide, there is little evidence timing of landings has changed.
- Effort in the shoreside and at-sea whiting fisheries has shifted to later in the year.

Flexibility provided by catch shares allows vessels to fish more efficiently by changing effort timing and landings; i.e., taking fewer, larger trips in a more condensed or efficient timeframe. This flexibility also allows vessels to take advantage of opportunities in other fisheries, as discussed above.

Figure 3-25 explores changes in effort timing by non-whiting catcher vessels in different fishing activities. This figure highlights the change from the trip-limit management system, where vessels had to fish in each bimonthly period to maximize groundfish catches. Thus, between 50 and 85 vessels participated in non-whiting groundfish in each month prior to 2011. After catch shares, vessels can compress effort in the groundfish fishery and participate in fewer months, freeing up longer stretches of time to participate in other fisheries. In particular, more vessels participate in the shrimp fishery more consistently from April through October than participated prior to the catch share program, although this could also be driven by good fishing condition for shrimp in those years. Figure 3-25 also shows the lack of participation in crab in the winter of 2015/2016. It does not appear that vessels increased participation in other opportunities to make up for the lack of a crab season, although they may have fished in the spring of 2016, prior to the delayed opening of the crab fishery.

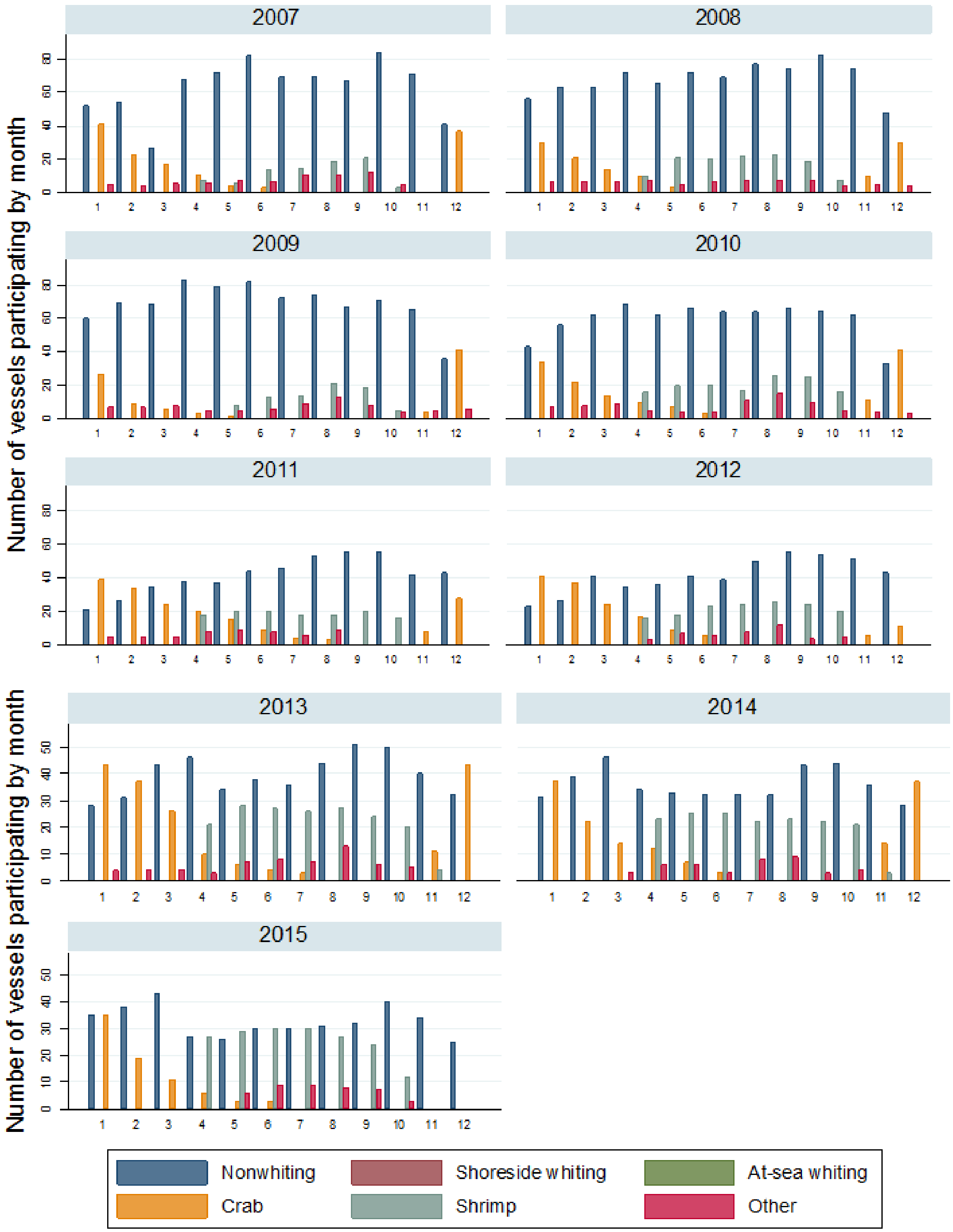


Figure 3-25. For non-whiting catcher vessels, the number of vessels active in each activity in each month, from 2007 to 2015. Note: Alaska activity is not included. Source: Fish tickets.

While the number of vessels fishing for non-whiting groundfish during any one month has decreased, Figure 3-26 shows there has not been a systematic shift in the timing of aggregate groundfish landings after the catch share program. The cumulative distribution of the percentage of non-whiting groundfish landings has not varied greatly from year to year since 2005. Because the number of vessels has decreased overall, this indicates that average delivery has increased in size.

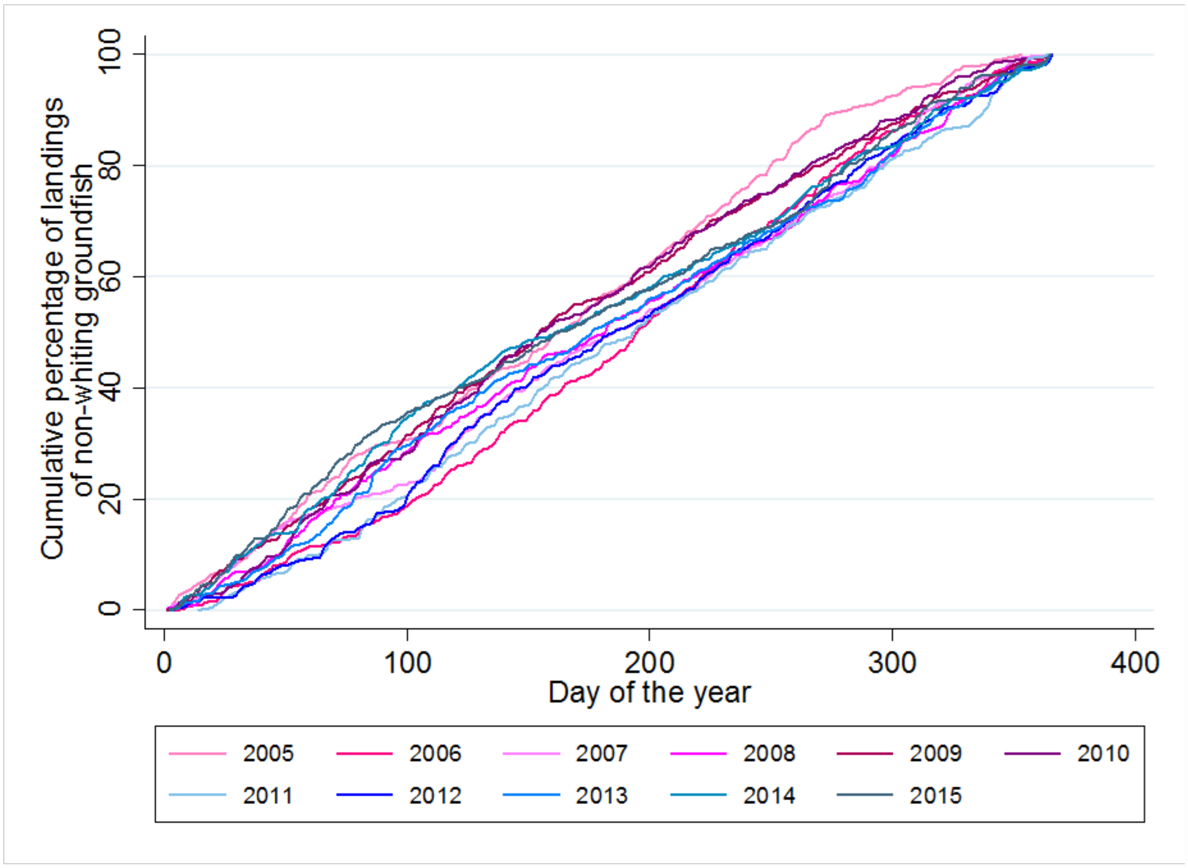


Figure 3-26. Cumulative distribution of the percentage of non-whiting groundfish landings over a year. Pre-catch share years (2005 to 2010) are colored in pinks, and catch share years (2011 to 2015) in blues. Landings by day are combined if fewer than three vessels were fishing to maintain confidentiality. Source: Fish tickets.

Figure 3-27 shows the number of whiting catcher vessels participating in each fishing activity in each month from 2007 to 2015. Alaska activity is not included in this figure and likely accounts for much of the low West Coast fishing activity early in each year. [41]

[41] Scientists at NWFSC do not have access to Alaska fish tickets.

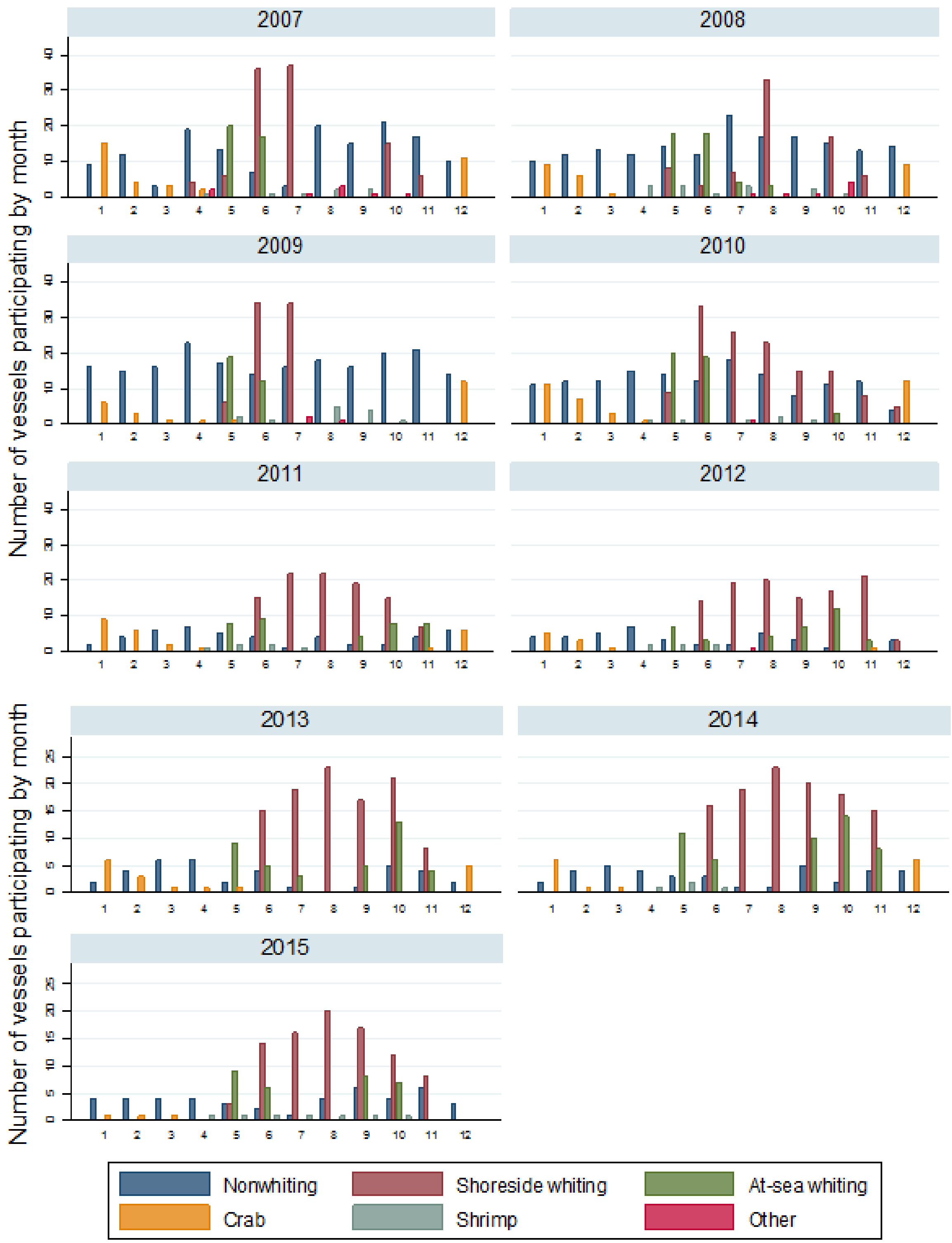


Figure 3-27. For whiting catcher vessels, the number of vessels active in each activity in each month from 2007 to 2015. Note: Alaska activity is not included. Source: Fish tickets.

As discussed above, and evident by the decrease in the size of the dark blue bars in Figure 3-27, fewer whiting vessels also participate in non-whiting activities after catch shares were put in place. Effort in the at-sea whiting fishery has shifted to later in the year (Figure 3-28). This is likely because vessels have more flexibility to finish their Alaska activities in the spring and summer before traveling to the West Coast to fish for whiting. Effort in the shoreside whiting fishery has shifted to later in the year, as indicated in Figure 3-29, which shows the cumulative distribution of landings of Pacific whiting in the shoreside sector. A similar figure cannot be produced for the at-sea whiting fishery due to requirements to maintain confidentiality.

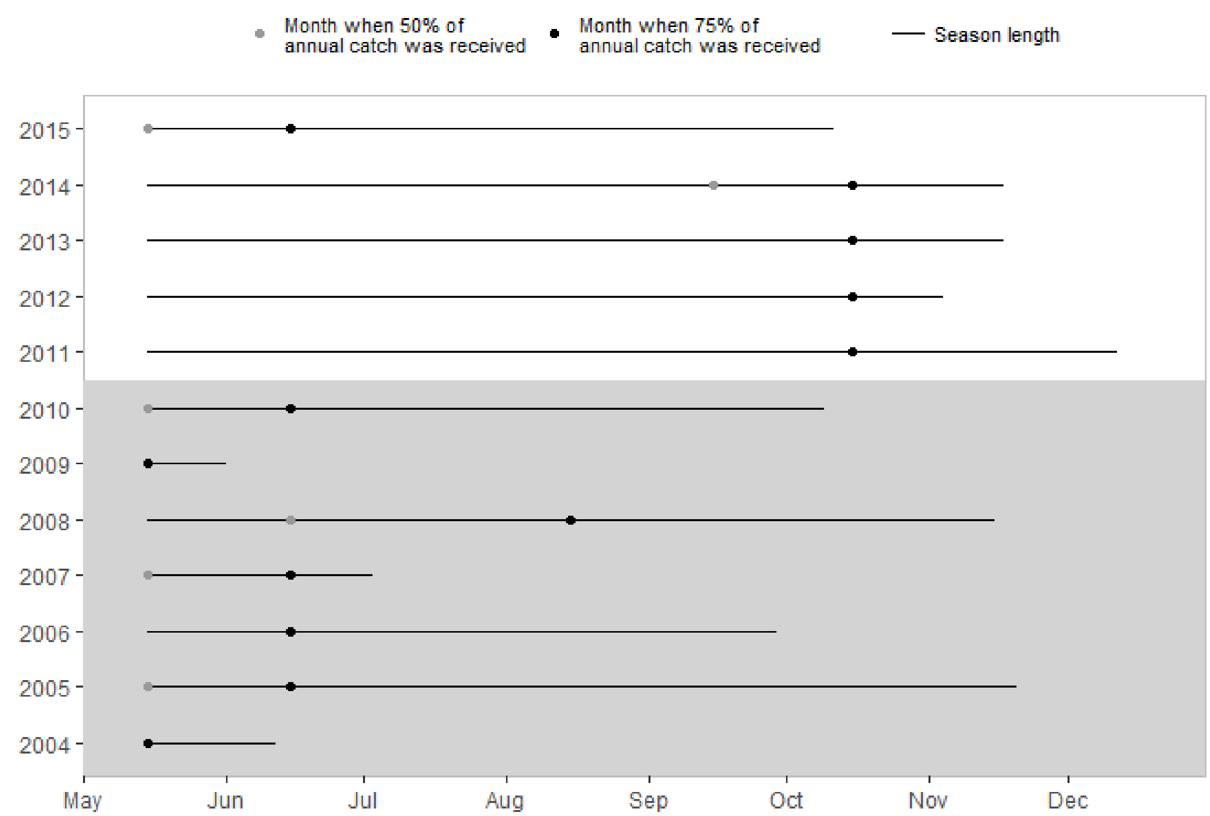


Figure 3-28. Season length for the mothership whiting fishery from 2004 through 2015, with horizontal lines representing the first and last whiting catches in each year. The shaded region represents the seven years prior to the implementation of the catch share program. If the 50 percent indicator does not show, it is because 50 percent and 75 percent of annual catch was received in the same month. Source: Steiner et al. 2016b.

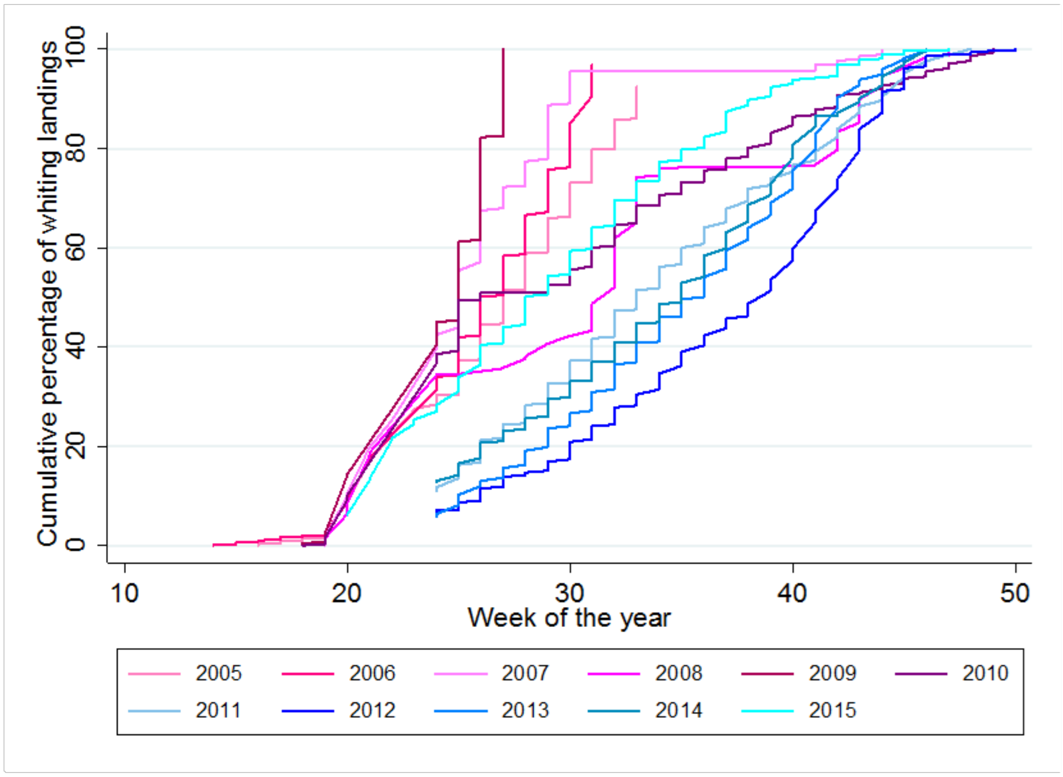


Figure 3-29. Cumulative distribution of the percentage of whiting groundfish landings in the shoreside whiting fishery. Pre-catch share years (2005 to 2010) are colored in pinks, and catch share years (2011 to 2015) in blues. Landings by week are combined if fewer than three vessels were fishing to maintain confidentiality. Source: Fish tickets.

Figure 3-29, from Steiner et al. (2016b), shows additional evidence for the decrease in the race for fish in the mothership sector. Steiner et al. (2016b) note that the following:

> The catch share program provides increased operational flexibility to both motherships and catcher vessels, demonstrated through changes in season length. The length of the season (the number of days from the first to the last haul) fluctuated during the years before catch shares, often relative to changes in the [annual] catch limit. Under current regulations, motherships can begin processing at sea on May 15. The mothership fleet had processed at least half of their annual quota by the end of May for five out of the seven years leading up to the implementation of catch shares. By comparison, processing continued into October in years after the implementation of catch shares, again indicating that the cooperative framework may give trawl vessels and motherships more operational flexibility.

The year 2015, however, is the exception. Section 3.1.3(a)(2) describes the anomalous environmental conditions that likely contributed to the low attainment of whiting in 2015.

Figure 3-30 shows an analogous figure for the catcher-processor sector, from Warlick et al. (2016). The catcher-processor sector has been operating as a cooperative since 1997, so any changes in the timing of the season were expected to be small compared to other sectors.

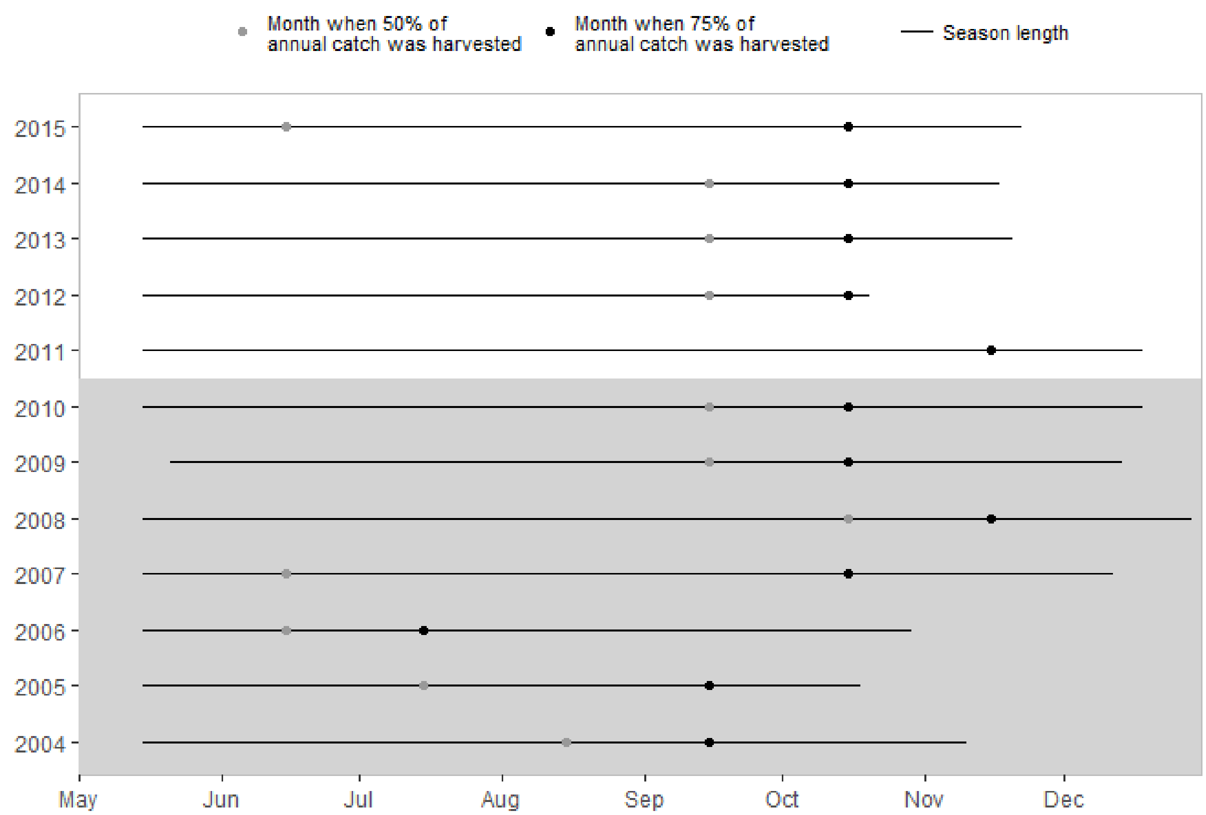


Figure 3-30. Season length for the catcher-processor whiting fishery from 2004 through 2015, with horizontal lines representing the first and last whiting catches in each year. The shaded region represents the seven years prior to the implementation of the catch shares program. Source: Warlick et al. 2016.

In addition to the timing of landings, the frequency of landings may have changed. The frequency of landings has been a particular concern for shorebased processors (2016). Fewer, larger, and longer trips may be more efficient for vessels because they minimize transit time, but they are not necessarily most efficient for processors who must employ a work force to process fish as it comes in. Figure 3-21 in Section 3.1.2(a)(3) (Crew and Production Worker Outcomes) shows the total number of production workers employed and the total purchases of each major species by catch share processors from 2009 to 2015. Guldin et al. (2016) note the following:

> The labor force of production workers at these companies fluctuates throughout the year due to fishing seasons and the portfolio of species being processed. Facilities employ more workers in months when purchase and production volumes are highest. Employment also increases during the winter months during crab season in some years… In 2014, catch share processors employed the greatest number of production workers in the month of August, with 2,117 total workers across the sector and an average of 132 per company. The fewest production workers were employed in February, with 914 total workers across the sector and an average of 57 per company. Data suggest that the months of heaviest operations may be shifting to later in the calendar year, from June and July in 2009 to August and September in 2014 and 2015.

Because there was not 100 percent observer coverage in the shoreside sector prior to implementation of the catch share program, NMFS did not compute exact measures of the total number of trips for 2005 to 2010. However, it the number of trips can be approximated using fish ticket data. The number of trips (measured precisely using observer data and approximately using fish ticket data), average delivery size (pounds of IFQ groundfish), and trip length (hours) for non-whiting trips are shown in Table 3-63. Delivery size has increased by approximately 10,000 lbs on average since the pre-catch shares period (p value of t-test<0.0000), and has an increasing trend. Trip length has increased by about five hours on average since the pre-catch shares period (p value of t-test<0.0000). The total number of non-whiting trips shows a decreasing trend even in the catch share period only. Using the approximation of the number of trips from fish ticket data, the total number of non-whiting trips has decreased by approximately 1,000 trips per year (average of pre- to average of post-catch share period).

Table 3-63. Total trips, average delivery size, and average trip length of non-whiting trips in the limited entry groundfish trawl fishery (2005 to 2010) and groundfish trawl catch share program (2011 to 2015).[42] Source: Observer and fish ticket data.

	Total trips (observer data)	Approximation of total trips (fish ticket data)	Average delivery size (lbs of IFQ groundfish)	Standard deviation of delivery size	Average trip length (hours)	Standard deviation of trip length
2005		2,496	17,713	14,586	54	34
2006		2,352	16,137	13,460	52	34
2007		2,316	20,626	14,493	61	31
2008		2,393	22,072	17,007	61	34
2009		2,735	20,491	16,757	61	32
2010		2,105	19,160	18,913	58	33
2011	1,483	1,495	25,931	22,329	62	34
2012	1,401	1,455	27,496	23,000	63	34
2013	1,349	1,376	30,835	23,081	64	32
2014	1,185	1,206	30,760	22,238	63	30
2015	1,114	1,127	35,448	24,327	63	33

For non-whiting groundfish, there seems to be little evidence that the coastwide timing of landings has changed (Figure 3-26). Although the total annual volume has decreased, both Figure 3-25 and Figure 3-26 show relatively consistent landings over the entire year. However, Figure 3-31 and Figure 3-32 shows that the total number of trips has decreased, and the average delivery size has increased since the implementation of catch shares.

This could have negative implications for individual processors better equipped to purchase smaller, more frequent deliveries of groundfish. Figure 3-31 provides a measure of the frequency of landings from the processor perspective. The figure shows the distribution of the differences in the number of days that an individual processor received deliveries compared to the average of the baseline years (2005 to 2010). This was calculated by taking the average number of delivery days per processor from 2005 to 2010, in order to calculate the average per processor, and then subtracting it from the annual values for 2011 to 2015. A difference less than zero indicates that the processor took deliveries on fewer days in that year, compared to the baseline. The annual differences are mostly negative for each of the four species considered, but are largest for Dover sole. The median change in the number of Dover sole delivery days per processor was -24 days (2011 to 2015 compared to the baseline of 2005 to 2010). The median change

[42] Total trips are not shown for 2005 to 2010 because not all trips were observed, and delivery size and trip length are summary statistics from observer data. The calculation of total trips from fish tickets is an overestimate because vessels occasionally fill out multiple fish tickets for the fish caught on a single trip, but data are included here for comparison.

in the number of petrale sole delivery days per processor was -10 days. The median change in the number of rockfish delivery days per processor was -3 days, and it was -14 days for sablefish.

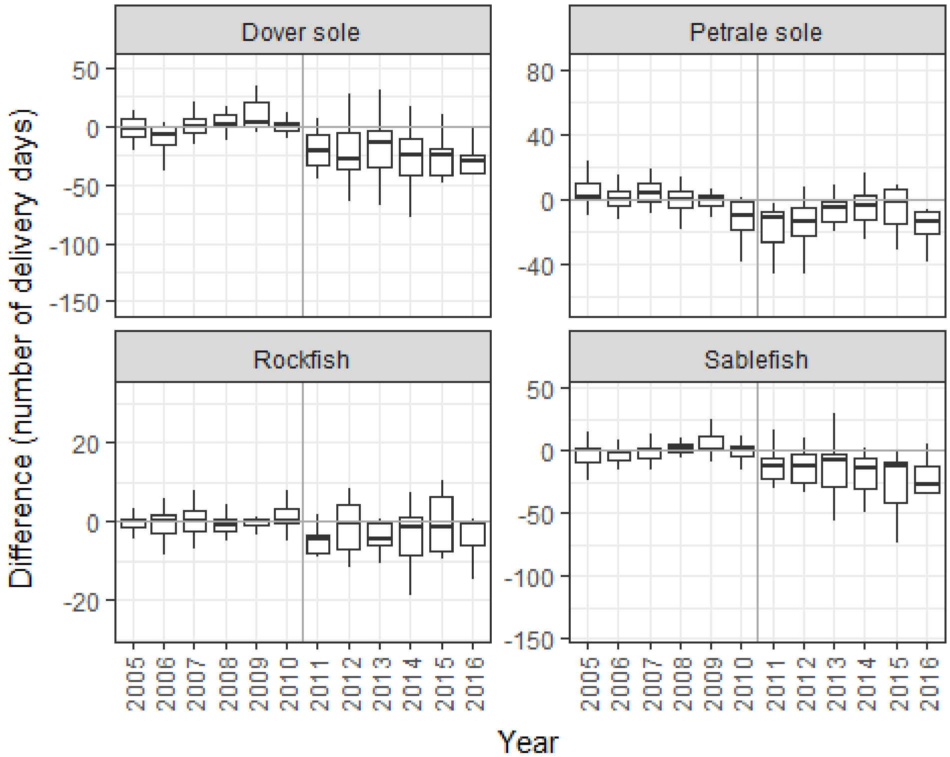


Figure 3-31. Differences in number of delivery days per processor compared to baseline (2005 to 2010). Source: Fish ticket data.

The size of deliveries to processors has increased on average, corroborating the increase in delivery size from the perspective of vessels. It is also evidence of consolidation of fishing to fewer, more efficient vessels that can make larger deliveries. By species, the median change in purchase weight (lbs) per processor (2011 to 2015) compared to the baseline (2005 to 2010) was 3,716,000 lbs for Dover sole, 1,099,000 lbs for petrale sole, 578,000 lbs for rockfish, and -269,000 lbs for sablefish (Figure 3-32).

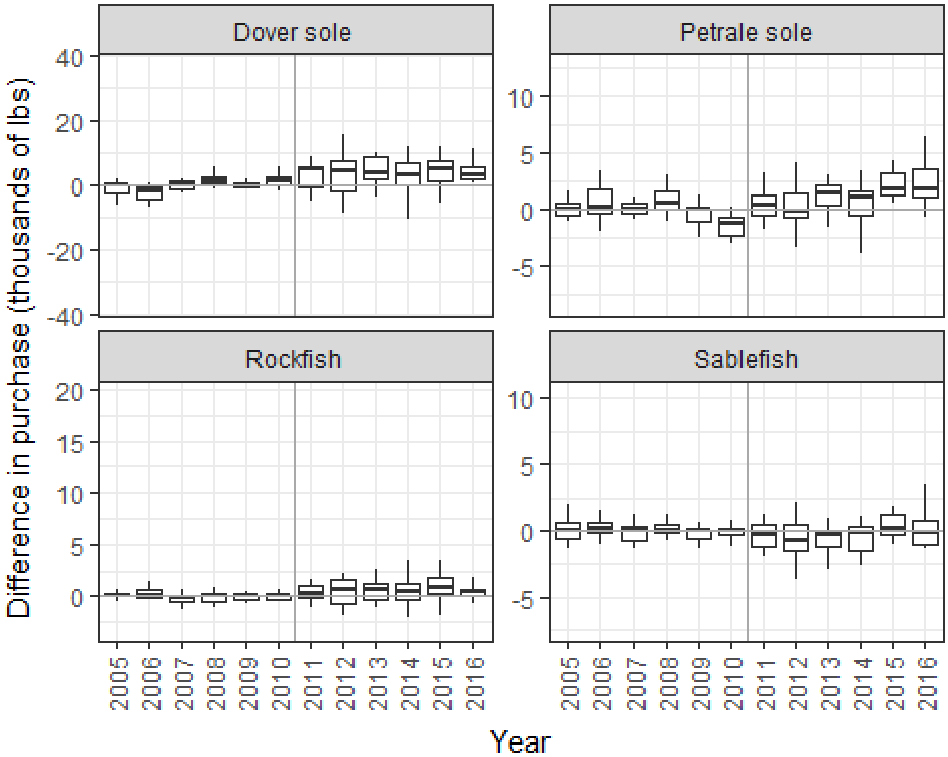


Figure 3-32. Differences in average purchase weight per day (thousands of lbs) per processor compared to the baseline (2005 to 2010), calculated by taking the average purchase weight per day per processor from 2005 to 2010, calculating the average per processor, and then subtracting it from the annual value. A difference greater than zero indicates that the average delivery size per processor was larger in that year than the baseline. Source: Fish ticket data.

3.1.2(d)(3) Location of Landings

Highlights:

- A greater percentage of buyers have exited from California than Washington or Oregon since catch share implementation, but steady decreases across all states have been observed since the 1990s.
- Astoria, Newport, and south/central Washington port areas purchased the majority of groundfish both before and after the implementation of catch shares.
- Net transfers of QP show that quota is moving into Oregon and out of Washington and California.

The location of landings may be affected by the catch share program through a variety of mechanisms. This section contains an examination of changes in the distribution of landings and an exploration of several potential drivers of these changes. These include changes in the distribution of quota through leasing and sales and changes in the way that vessels decide where to deliver their catch. The FEIS discussed shifts in fishing activity and, therefore, the location of landings that might change under rationalization (PFMC and NMFS 2010). In the FEIS, an analysis of comparative advantage was used to determine which West Coast ports might fare better or worse. The FEIS noted that ports are likely affected by several factors, including access to fishing grounds, port infrastructure (industry agglomeration), cost efficiency of harvesters, and initial allocation of quota shares. For the non-whiting groundfish fishery, changes were expected to be driven by bycatch avoidance for constraining species. For the whiting fishery, a northward shift was expected due to a lengthening of the fishing season (following the seasonal migration of the species). The analysis showed that Astoria was expected to have the greatest comparative advantage, while Neah Bay and central California ports were more disadvantaged (PFMC 2010b).

Location of landings

The number of buyers of groundfish catch has decreased over time over the entire coast. The rate of decrease in recent years has been greatest in California (Section 3.1.1(b)(1), with details in Section 3.2.2(b)). Section 3.2, Community Performance, provides detailed information about changes in the number of buyers, volume, and value of fish landings over time and over the West Coast. Total purchase volumes of catch share fish increased for some ports after catch shares implementation (Astoria and south and central Washington), although increases in the TAC of Pacific whiting since the several years prior to catch shares likely influence this trend. Total purchase volume for most other ports decreased. Three ports historically have purchased more groundfish than other ports (Astoria, Newport, and south and central Washington), and this continued to be true after the implementation of catch shares. By state, California has experienced near-uniform declines in the volume of fish purchases (landings), while other states have experienced more variable landings (Figure 3-33). See Section 3.2.2(b), Geographic Trends in Landings and Participation, for more details.

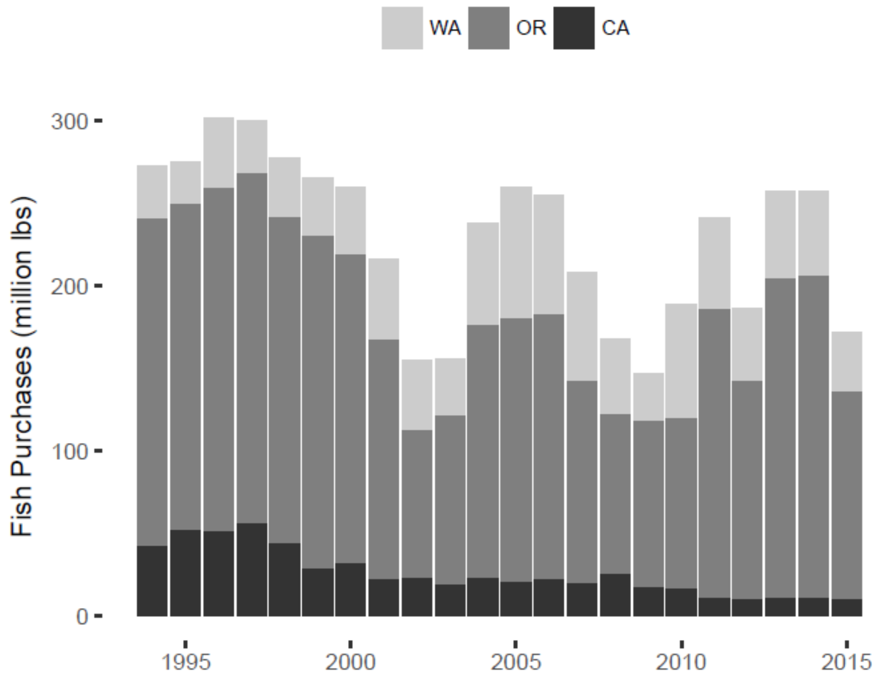


Figure 3-33. Total volume of catch share (whiting and non-whiting groundfish) purchases (millions of lbs) in each state by year. Source: Fish tickets.

Quota leasing

Quota leasing can change the distribution of landings through changes in the vessels that catch and land the fish. If a Washington-based vessel leases quota from a California-based vessel, the catch is more likely to be landed in Washington. Holland (2017) discusses the changes in the distribution of quota through leasing:

> The movement of QP between states may be of some interest to stakeholders and managers to assess some of the distributional implications of the IFQ system. Geographical shifts in QP may also help differentiate whether spatial shifts in fishing activity are the result of vessels moving or of QP moving to vessels. This information can also reveal how the market is organized and the extent to which proximity (e.g., being from the same state) makes trading relationships more likely. Of the transfers not designated as self-trades, 59 percent to 66 percent are between account owners with addresses in the same state. The ratio of trades to and from different states differs substantially. The ratio of transfers to California from other states relative to transfers from California to other states has ranged between 0.36 and 0.55 indicating a much higher likelihood of transfers moving QP out of California than into it [Figure 3-34]. The opposite is true for Oregon and Washington; Oregon has a substantially higher ratio of

incoming transfers to outgoing than either California or Washington when considering all transfers that are not self-trades and particularly when considering the ratio of incoming to outgoing cash sales. Washington had fairly even ratio of incoming and outgoing transfers and more incoming cash sales then outgoing for the first few years of the IFQ, but since 2014, the ratio of incoming to outgoing transfers has declined, particularly for cash sales.

If we consider two of the key target species in the bottom trawl fishery, sablefish and petrale sole, we see similar patterns in terms of the net total QP transferred between states (Figure 3-35). Oregon has been a net recipient of QP pounds in all years of the IFQ program and the total net incoming QP has risen substantially over time, reaching nearly 1.3 million pounds of petrale sole (22 percent of the total QP) and nearly 0.9 million pounds of sablefish (17 percent of total QP) in 2016. Net transfers of sablefish QP into Washington were positive in the first two years of the IFQ program but has decreased in recent years. Net transfers of petrale sole have been negative in all years of the IFQ program but the quantity of net transfers out of state has increased over time. California has had negative net transfers of both Petrale sole and sablefish QP in all years since the implementation of catch shares. Quantities have varied over time, but net transfers out of California were the highest in 2016 (Holland 2017).

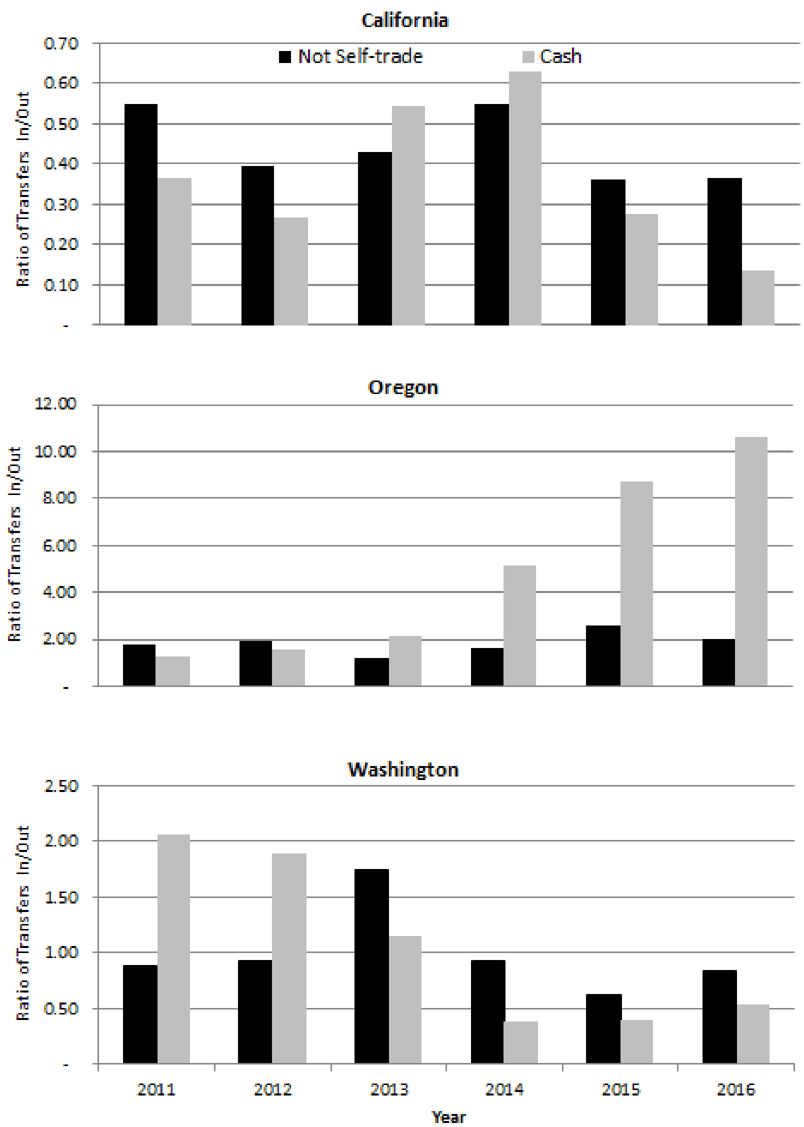


Figure 3-34. Ratio of transfers in and out of a state for cash sales and for all transfers that were not self-trades, 2011 to 2016. Source: Holland 2017.

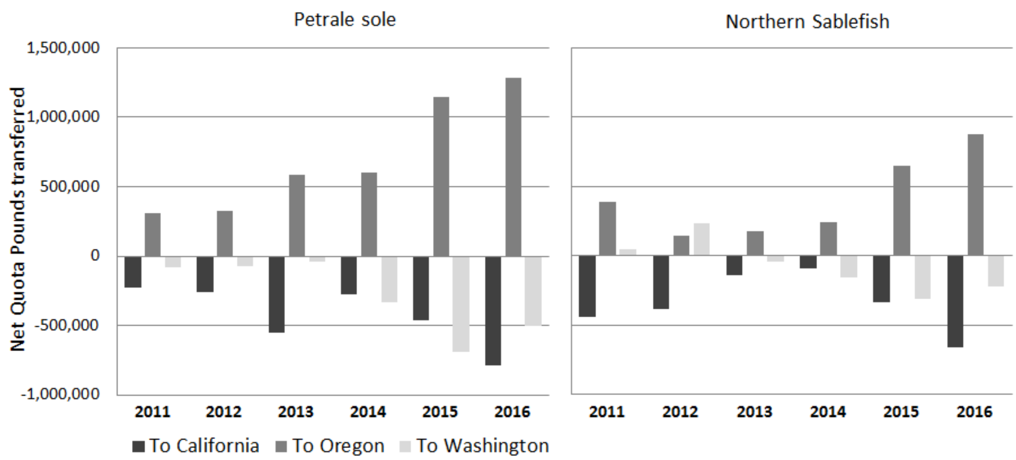


Figure 3-35. Net quota pounds of petrale sole and sablefish north of 36° N. latitude, transferred in and out of each state 2011 to 2016 (excludes self-trades). Source: Holland (2017).

Quota leases, quota sales, and distribution of active vessels along the coast are interrelated. If a California vessel sells or leases its entire quota allocation to a Washington vessel so that the California vessel is no longer active in the catch share fishery, the proportion of vessels home ported in Washington would increase. Table 3-64 shows the number of catcher vessels active in the catch share fishery by homeport each year. While the absolute number of vessels per port has decreased for all ports, the proportion of the total has increased for many ports including Astoria (17 percent increase), Morro Bay-Monterey (16 percent), Fort Bragg (14 percent), and Puget Sound ports (11 percent). The proportion of the total active vessels has decreased the most in Tillamook (no catch share vessels in 2015), Crescent City (67 percent decrease), and San Francisco (21 percent decrease).

Table 3-64. Number of catcher vessels active in the catch share fishery by homeport. Source: FISHEyE.

	2009	2010	2011	2012	2013	2014	2015
Puget Sound	14	15	15	12	12	14	13
South and central Washington Coast	5	3	3	4	4	4	3
Astoria	21	20	22	22	19	18	20
Tillamook	5	5	1	2	1	0	0
Newport	25	24	20	19	21	21	23
Coos Bay	18	18	15	14	14	13	12
Brookings	8	8	7	7	5	7	7
Crescent City	7	6	3	4	4	3	2
Eureka	10	9	7	7	7	8	6
Fort Bragg	7	7	7	6	7	7	6
San Francisco	6	8	6	6	6	4	2
Morro Bay-Monterey	7	6	7	7	9	6	3

Vessel-processor relationships

Relationships between vessels and processors can influence where catch is landed. The PCGFSS included questions about how fishermen decide where to sell catch and how processors decide from whom to buy fish. In all three study years of the PCGFSS, fishermen answered a multiple-response survey question regarding what items they considered when deciding where to sell catch. Notably, a "longstanding relationship" was the most frequently selected item (2012, 47.4 percent; 2015-2016, 52.9 percent).[43] In contrast, few fishermen considered formal relationships such as a "contract with buyer" (2010, 9.2 percent; 2012, 2.6 percent; 2015-2016, 3.4 percent) or "contract with processor" (2010, 3.8 percent; 2012, 4.4 percent; 2015-2016, 4.2 percent).

Processors were surveyed regarding what items they considered when deciding where to purchase trawl-caught groundfish. Similarly, more processors considered relationships than contracts. In 2012 and 2015-2016, 60 percent and 80 percent of processors, respectively, reported "relationship with fisherman" to be a consideration when deciding where to purchase groundfish. Fewer processors considered a "contract with fisherman/boat" (2010, 2.7 percent; 2012, 7.5 percent; 2015-2016, 10 percent). PCGFSS interview data further support the importance of relationships:

> "…it stems from a longstanding relationship. It's convenient to work for the same company all the time …we get certain benefits for working for 'em….we're not playing the market as much as other people would be. You know ups and downs. Most of the time it's a steadier supply … some sense of security there…" —QS Permit Owner, Newport, 2015-2016

> "Longstanding relationship…I've fished with them [Oregon Processor] for 15 years now." —Fisherman, Brookings Area, 2015-2016

It is also interesting to note that in comparison to contracts, more fishermen considered "best price/market" (2010, 18.5 percent; 2012, 25.4 percent; 2015-2016, 25.2 percent) when deciding where to sell catch. One participant explains as follows:

> "But if we went up there and delivered we can catch a little bit more, we can go over a little bit more in what the trip limits are as far as they're concerned… I mean we could deliver petrale here for $0.85, maybe anything under 8,000. But maybe we could deliver

[43] Note: The category of longstanding relationships was not present in the 2010 survey and was added to subsequent surveys. Results from the 2010 data collection effort reflected those who answered the 'other' option to this question and explained/described why they selected the 'other' category, 41 percent of participants indicated a longstanding relationship as a response. As a result, this descriptor was added to the subsequent survey tools.

> 15,000 up there for the whole dollar and a quarter. So it was kind of a little financial thing." —QS Owner, Astoria, 2015-2016

Furthermore, some discussed specific financial components such as the cost of travel:

> I sat that captain down, and he said, [Name omitted] you don't even need your calculator, it's simple. My boat carries 30,000 dollars' worth of fish, if I come here it's going to take 2 days to do that. If I'm fishing in Westport, I deliver it every day. I get 30,000 dollars every day. Here I get 30,000 every two days and I burn 3 times as much fuel. —Processor, Oregon, 2015-2016

To explore possible constraints on the decision-making process, fishermen were also asked what limited their choice of where to sell catch. The top two limitations have not changed over time and included "the market" (2010, 26.6 percent; 2012, 28.8 percent; 2015-2016, 31.6 percent) and "number of processors" (2010, 41.4 percent; 2012, 36.9 percent; 2015-2016, 41.9 percent). Interview data provide insight into the impact of these limitations. For instance, some participants discussed how the delivery schedules set by processors impacted the location to which they delivered catch:

> "Well Westport, we went there because the market…it was much more access to delivery schedule. I mean the market was much bigger. If we stayed in Newport, the processing capabilities of our plant, with the number of boats that they had, would dictate that you only get to deliver about once every 8 or 9 days. In Westport we could deliver every 3 days. I mean it was just as fast as you could put it on the dock. It was pretty much unbelievable." —Fisherman, Newport, 2015-2016

> "Everybody wants to go out and fish right but they can't 'cause they, there's only 4 offloads left in the week. So all the boats can't go out there and fish because –Yes and no, because [Vessel-1] goes in and offloads in Crescent City all the time. [Vessel-2] does [Processor] in Brookings. A lot of the boats have dual agreements in Oregon and California. So if they can't offload it in a California plant, they'll go use their Oregon license or they can go to the PacChoice in Crescent City." —Industry Participant, Eureka Area, 2015-2016

A loss of infrastructure in certain areas was discussed as a reason for why some sought to deliver to Newport (Section 3.2.2 (c)):

> "…so they just love coming to Newport, the fishermen, they'll deliver here if they can. So then they come and see us or it's an opportunity to drop a net off. So the fleet is moving around more. They move around to different ports more, especially the guys that

> have lost their infrastructure. They find a way to come here to deliver. So I've seen that and that helps us a lot. " —Industry Participant, Newport, 2015-2016

This Morro Bay buyer discussed observations of reduced landings by local fishermen and the presence of Oregon-based black cod vessels:

> "With the dearth of landings in Morro Bay, I'm rekindling relationships with Oregon suppliers to get groundfish. It's sad to see that less local product goes to the local consumer. There are some big boats from Oregon that are coming down here and catching lots of black cod, but of course the revenue all goes back to Oregon – it's not helping the economy in Morro Bay at all." —Processor, California, 2015-2016

Proximity to where the fish was caught was important for quick turnaround:

> "We've delivered into Astoria…Crescent City, Charleston, Coos Bay, Newport, Garibaldi, Astoria, Westport, Neah Bay…I mean, a whole bunch of them…. That was closest port to where the fish are caught, a quicker turnaround time generally, and the people we fish for had delivering stations up and down the Coast." —QS Owner, Newport, 2015-2016

While a variety of factors affect where fish are landed and processed, the PCGFSS results do not indicate that the factors have changed substantially over time.

3.1.2(d)(4) Cooperatives and Risk Pools

The catch share program has provided direct and indirect incentives and opportunities for fishermen to work together and with their communities to more optimally organize harvesting activities. These groups and organizing activities are summarized in Section 3.2.2(g)(2).

3.1.2(d)(5) Diversification

Highlights:

- Diversification has decreased after catch share program implementation for vessels remaining in the non-whiting trawl, at-sea whiting, and shoreside whiting fisheries.
- Revenue became less variable for vessels remaining in the at-sea whiting and shoreside whiting catch share fisheries.

Diversification of fishing revenue sources is a key feature of the catch share program. Not only are multiple species and species groups targeted using different fishing behavior (location, depth, gear, etc.), but most vessels also participate in a variety of fishing activities outside the catch share program. In fact, on average, only 50 percent of a vessel's annual revenue comes from the catch share fishery (data available on FISHEyE). Diversification can decrease volatility in income. Such volatility is common in fisheries, because harvesters rely on uncertain and annually, inter-annually, and spatially varying fish stocks, among many other factors. One concern about the widespread implementation of catch share programs is that they provide individuals, cooperatives, or other entities with exclusive harvest privileges for a fishery, which could decrease the ability of non-quota owning harvesters to diversify into IFQ fisheries opportunistically over the long term. However, they also (often) allow new vessels to enter through leasing and purchasing of quota, meaning that the net effect of catch shares on diversification is uncertain (Holland et al. working paper). In addition, Holland et al. (working paper) point out that "for fishers who remain in the catch share fishery, secure access to a share of the TAC may help reduce variation in annual catch, thereby offsetting increased financial risk associated with reduced diversification." They also point out that catch share programs are often implemented with the intent to increase efficiency through consolidation and create incentives for vessels to specialize according to their comparative advantage, both of which would tend to result in reduced diversification.

Holland et al. (working paper) test for changes in diversification after implementation of the catch share program in 2011 (and for 12 other catch share programs around the United States), as well as for changes in income variability. The Herfindahl-Hirschman Index (HHI) is used as a metric of fishing revenue diversification of vessels (Holland and Kasperski 2016; Holland et al. [working paper]; Kasperski and Holland 2013). Lower levels of the HHI indicate greater levels of diversification. The analysis was done for the non-whiting groundfish trawl, at-sea whiting, and shoreside whiting fisheries. For all three sectors, simple comparisons of the HHI indicate that diversification decreased, both for vessels that remained in the fishery and for those that exited following catch share program implementation. However, when accounting for pre-existing trends (before catch share implementation) in vessel diversification, decreases in diversification were not statistically significant for non-whiting groundfish trawl vessels that exited the fishery, and decreases in diversification were small, but statistically significant (2 percent) for shoreside whiting vessels that exited the fishery. The decline was statistically significant for vessels that remained in the fishery. There were significant decreases in the coefficient of variation of revenue for at-sea and shoreside whiting vessels that remained in the fishery, meaning that revenue became less variable from year to year. However, there was no significant change in the coefficient of variation of revenue for vessels that exited or for non-whiting groundfish trawl vessels (Holland et al. working paper).

One specific example of diversification involves vessels taking advantage of rebuilding rockfish species to participate in non-whiting midwater trawl fishing. Since the groundfish fishery disaster declaration in 2000, midwater trawl gear has primarily been used to target Pacific whiting. More recently, the midwater trawl fishery for pelagic rockfish has re-emerged as part of the catch share fishery, with participation beginning in 2012 (Steiner et al. 2016a). Several Council actions have been completed or are pending with respect to addressing the changes in midwater trawl gear used by IFQ participating catcher vessels, including clarifying which vessels can participate, when, and where (80 Fed. Reg. 77267, December 14, 2015). Table 3-65 shows the number of vessels and level of participation. The non-whiting mid-water trawl fishery is likely to see more growth as the trailing actions continue to be resolved.

Table 3-65. Number of vessels participating in mid-water non-whiting trawl in the catch share fishery, nominal revenue, and pounds landed. Source: EDC and fish ticket data.

	Number of vessels	**Revenue (nominal)**	**Pounds landed**
2012	6	299,496	664,966
2013	6	670,851	1,621,431
2014	10	923,978	2,065,028
2015	13	1,815,594	4,654,891

3.1.2(d)(6) Gear-switching Provision

Highlights:

- Ex-vessel prices of sablefish caught with pots or longline are higher on average than sablefish caught with trawl gear, however DTS trawling is more profitable per pound of sablefish.
- The number of vessels fishing for southern sablefish in the IFQ program has decreased from 12 in 2011 to 8 in 2014-2015.
- The percent of southern quota caught by trawl and fixed gear vessels combined has ranged from 84 percent in 2011 to 13 percent in 2013. Utilization was 19 percent in 2015.
- The number of vessels fishing northern sablefish quota with fixed gear has ranged from 21 in 2012 to 12 in 2013. Fourteen vessels fished northern sablefish quota with fixed gear in 2015.
- In 2015, vessels fishing northern sablefish quota with fixed gear caught 32 percent of the northern sablefish quota, a high for the catch share period.

The gear switching provision allows vessels that historically fished in the limited entry trawl fishery to fish with any other legal groundfish gear, including fixed gear (50 CFR 660.130), and it enables any vessel to enter the IFQ fishery by obtaining a trawl permit and leasing or purchasing trawl quota (50 CFR 660.210). Sablefish caught with fixed gear (pot and longline) is 20 to 60 percent more valuable per pound, on average, than sablefish caught with trawl gear (Table 3-66). Steiner and Holland (working paper), however, found that when revenue from other species caught simultaneously with sablefish in trawl gear is accounted for, on average Dover sole, thornyhead, and sablefish (DTS) trawling was more profitable[44] than using fixed gear to target sablefish per pound of sablefish quota used. The gear-switching provision was intended to allow each vessel to determine its most profitable fishing strategy and to take advantage of the fixed gear price premium if it is individually optimal for them to do so. The provision also provides an opportunity for switching to fixed gear for environmental reasons, as fixed gear was thought to have fewer impacts on ocean-bottom habitat than trawl gear (PFMC and NMFS 2010).

Table 3-66. Average and median sablefish prices within the West Coast Groundfish Trawl Catch Share Program by gear type (2015 $). Source: EDC and fish ticket data.

	Average sablefish price			Median sablefish price		
Year	**Trawl**	**Pot**	**Longline**	**Trawl**	**Pot**	**Longline**
2011	$ 2.55	$ 3.09	$ 2.89	$ 2.58	$ 3.19	$ 2.40
2012	$ 1.77	$ 2.33	$ 2.57	$ 1.73	$ 2.20	$ 2.59
2013	$ 1.56	$ 2.14	$ 2.37	$ 1.59	$ 2.22	$ 2.30
2014	$ 1.85	$ 2.45	$ 2.64	$ 1.91	$ 2.55	$ 2.61
2015	$ 1.80	$ 2.67	$ 2.92	$ 1.94	$ 2.79	$ 3.16

Sablefish in the West Coast groundfish fisheries is managed as two stocks, defined by 36° latitude (northern sablefish and southern sablefish). Quota shares were allocated separately for northern and southern sablefish according to historical catch in the distinct geographic areas and other allocation factors. Leading up to the implementation of the catch share program (2006 to 2010), there was virtually no trawl fishing for sablefish in the Southern Region, primarily as a result of the purchase of 13 limited entry groundfish permits by The Nature Conservancy (TNC) in 2006 (Figure 3-36).

[44] Higher average variable cost net revenue per pound of sablefish was associated with DTS trawling activities than fixed gear.

Table 3-67 shows the number of vessels currently fishing for sablefish in each region, and their ex-vessel revenue.

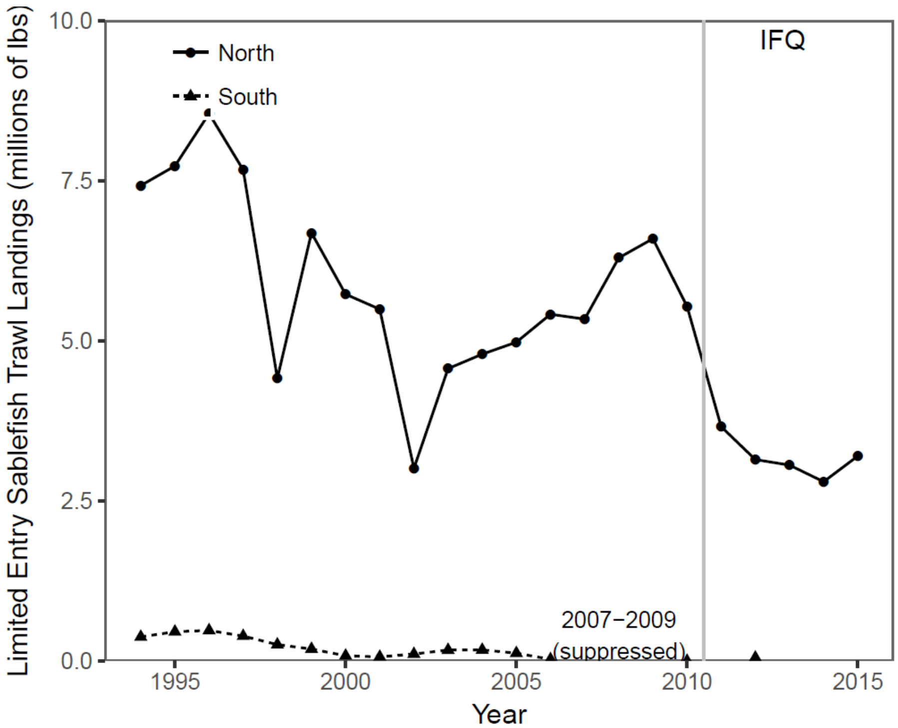


Figure 3-36. Total landings (millions of lbs) by vessels fishing **with trawl gear** in the limited entry trawl fishery, separated into north landings (north of 36°) and south landings (south of 36°). Source: Fish ticket data.

Table 3-67. Number of vessels fishing for sablefish and sablefish ex-vessel revenue (millions 2015 $) with north/south designation in the IFQ program (all gears). Source: Fish ticket data.

	Number of vessels fishing Northern quota	Number of vessels fishing Southern quota	Ex-vessel revenue (millions) from Northern quota	Ex-vessel revenue (millions) from Southern quota
2011	85	12	15.24	2.37
2012	82	10	10.00	1.06
2013	77	7	7.29	0.38
2014	76	8	9.01	1.09
2015	72	8	10.78	0.92

To date, the utilization rates of northern sablefish quota have been among the highest of any quota species in the IFQ program, ranging from 87 percent (2012) to 95 percent (2015). However, utilization rates of southern sablefish quota have been much lower. Southern sablefish quota utilization was highest in the first year of the program (84 percent), but it has not surpassed 50 percent since then. Catch of northern sablefish makes up between 84 percent (2011) and 95 percent (2013) of all sablefish caught in the catch share program (Table 3-68).

Table 3-68. Sablefish quota utilization with north/south designation: landings weight (millions of lbs), percent of landings (percent of catch), total quota allocation (millions of lbs), and percent of quota utilization (percent of quota). Source: Fish ticket data.

	Landings of northern quota	Landings of southern quota	Percent of total catch that was northern quota	Percent of total catch that was southern quota	Northern quota allocation	Southern quota allocation	Percent of northern quota caught	Percent of southern quota caught
2011	5.11	0.98	84%	16%	5.61	1.17	91%	84%
2012	4.74	0.49	91%	9%	5.44	1.13	87%	43%
2013	4.02	0.19	95%	5%	4.29	1.43	94%	13%
2014	4.04	0.43	90%	10%	4.52	1.57	89%	28%
2015	4.77	0.32	94%	6%	5.05	1.72	95%	19%

With the implementation of the catch share program and the gear switching provision, vessels had the choice of continuing to fish their trawl quota with trawl gear or using fixed gear (pot or longline). In order to understand the gear-switching provision, gear-switching vessels are classified into two groups based on their previous activities (from 2000 to 2010):

- Enterers: vessels that had not previously fished in the limited entry trawl groundfish fishery. If a vessel’s only historical participation in the limited entry trawl fishery was in the TNC-exempted fishing permit, they were designated "Enterer.”
- Switchers: vessels that previously fished with trawl gear in the limited entry trawl fishery.

To provide context, information about vessels that only fished with trawl gear is also included. These vessels are not categorized into whether the vessel previously fished in the limited entry trawl program because nearly all trawlers have historical participation in the limited entry trawl fishery.

Table 3-69 details participation of each category of harvesters for northern sablefish quota. Enterers outnumbered switchers in each year of the program, and the first two years of the program had the largest number of fixed gear vessels targeting northern sablefish. Sablefish prices were high in 2011 (Table 3-66), and, during the transition, vessels were likely trying to determine which activities would be most profitable. In 2015, there were nine enterers and five switchers targeting northern sablefish with fixed gear. There were 59 trawlers targeting northern sablefish in 2015. The volume of sablefish caught per vessel is higher for enterers than for switchers or trawlers, on average.

A table similar to Table 3-69 is not available for the southern sablefish vessels because nearly all vessels were classified as enterers; thus, the table would contain confidential information. Between 2011 and 2015, four vessels either were switchers or fished with trawl gear. All other vessels were classified as enterers. Attainment of southern sablefish by all three categories of vessels is summarized in Figure 3-37. See Table 3-67 for counts of vessels fishing southern sablefish by year.

Table 3-69. Northern sablefish: IFQ sablefish vessels split into whether they did not fish in the limited entry trawl fishery prior to 2011 (enterer), switched from using trawl gear in the limited entry trawl fishery prior to 2011 to fishing with fixed gear in the IFQ program (switcher), or fished with trawl gear. Source: Fish ticket and EDC data.

	Type	**Number of vessels**	**Pounds (millions)**	**Revenue (millions $)**	**Percent of catch**	**Percent of quota**
2011	Enterer	12	1.08	4.10	21%	19%
2011	Switcher	7	0.41	1.48	8%	7%
2011	Trawler	70	3.62	9.66	71%	65%
2012	Enterer	13	1.28	3.40	27%	24%
2012	Switcher	8	0.33	0.82	7%	6%
2012	Trawler	64	3.12	5.79	66%	57%
2013	Enterer	7	0.73	1.79	18%	17%
2013	Switcher	5	0.24	0.50	6%	6%
2013	Trawler	66	3.06	5.00	76%	71%
2014	Enterer	11	0.91	2.64	22%	20%
2014	Switcher	5	0.33	0.73	8%	7%
2014	Trawler	62	2.80	5.63	69%	62%
2015	Enterer	9	1.14	3.39	24%	23%
2015	Switcher	5	0.43	0.91	9%	9%
2015	Trawler	59	3.20	6.48	67%	63%

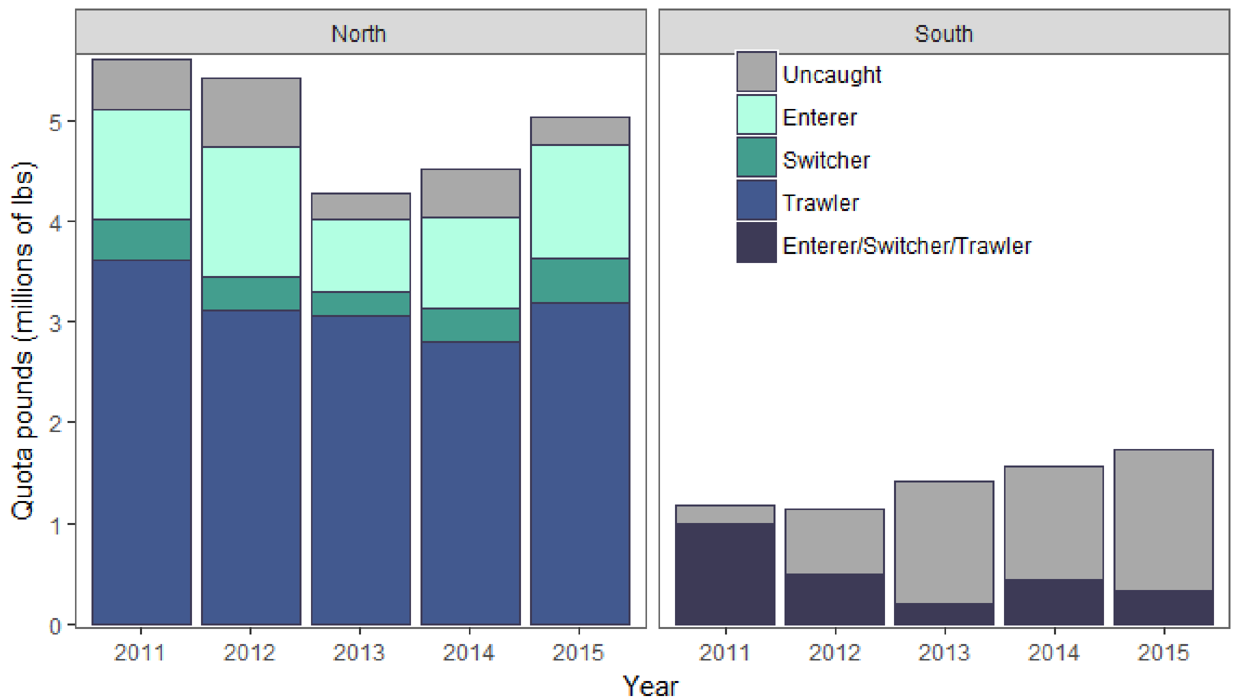


Figure 3-37. Utilization of northern and southern sablefish quota by vessel category. To protect confidential data, the landings of southern sablefish quota are not separated by type. Source: Fish ticket and EDC data.

3.1.2(d)(7) Carryover Provisions

Highlights:

- A large percentage of vessel accounts used the carryover provision at year-end to roll over remaining quota when the species was eligible for carryover.
- Seven vessels have declared out of the fishery citing the overage carryover provision.

The carryover provisions provide flexibility to participants by relaxing the constraint that all QP be used in a calendar year. The FEIS expected that carryover provisions would allow harvesters to avoid penalties associated with a deficit condition, and overall, would create options leading to better economic outcomes (PFMC and NMFS 2010). For example, in addition to selling unused QP, carryover provisions allow harvesters a limited opportunity to decide not to fish at the end of the year to avoid risk (bycatch, weather) or low ex-vessel prices without sacrificing harvest opportunity.

There are two types of carryover: "surplus carryover" and "overage carryover." Surplus carryover allows for up to 10 percent of QP not used in one year to carry over into the following year. In contrast, overage carryover allows overage (catch exceeding an individual's quota holdings) in one year to be covered by up to 10 percent of the following year's QP.

Surplus carryover pounds are credited only for those species deemed eligible.[45] Surplus carryover QP is added to vessel accounts after all catch data for the previous year are finalized, usually around May. Table 3-70 shows the total surplus carryover QP of each species in each year and the percentage of vessel accounts that used the surplus carryover provision for each species in each year (eligible quota is automatically credited to the account in the following year). In general, a large percentage of vessel accounts had quota left over and, thus, used the carryover provision when the species was eligible for carryover.

Table 3-70. Total QP carried over in each year, and the percent of vessel accounts using the surplus carryover provision in each year. Source: Pacific Coast Groundfish IFQ Database (- indicates that no carryovers occurred).

	Total carryover (QP)				**Percent of vessel accounts using carryover**			
IFQ Species	**2012**	**2013**	**2014**	**2015**	**2012**	**2013**	**2014**	**2015**
Arrowtooth flounder	2,122,218	1,046,774	-	-	71%	69%	-	-
Bocaccio rockfish south of 40°10' N.	12,929	13,164	16,190	17,273	29%	33%	34%	30%
Canary rockfish	5,567	5,286	8,665	8,866	57%	57%	58%	56%
Chilipepper rockfish south of 40°10' N.	285,967	271,898	-	-	55%	55%	-	-
Cowcod south of 40°10' N.	375	371	192	187	17%	19%	14%	13%
Darkblotched rockfish	53,448	51,832	57,911	60,158	55%	58%	63%	59%
Dover sole	4,737,054	4,786,648	4,727,969	4,788,683	72%	71%	72%	69%
English sole	2,110,517	1,365,357	-	-	68%	67%	-	-
Lingcod	391,885	-	-	-	63%	-	-	-
Lingcod north of 40°10' N.	-	261,631	-	-	-	67%	-	-
Lingcod south of 40°10' N.	-	99,349	-	-	-	67%	-	-
Longspine thornyheads north of 34°27' N.	372,551	355,537	372,748	384,413	65%	63%	67%	61%
Minor shelf rockfish north of 34°27' N.	114,729	113,037	113,895	-	59%	61%	67%	-
Minor shelf rockfish south of 40°10' N.	18,927	18,317	17,176	2,196	60%	56%	55%	50%
Minor slope rockfish north of 34°27' N.	178,456	172,213	169,981	-	60%	59%	67%	-

[45] Eligibility is determined based on whether the issuance of the additional QP would result in the issuance of quota in amounts of overfishing levels (ABCs) or otherwise create conservation problems.

Table 3-70. Total QP carried over in each year, and the percent of vessel accounts using the surplus carryover provision in each year. Source: Pacific Coast Groundfish IFQ Database (**-** indicates that no carryovers occurred) (continued)

	Total carryover (QP)				**Percent of vessel accounts using carryover**			
IFQ Species	**2012**	**2013**	**2014**	**2015**	**2012**	**2013**	**2014**	**2015**
Minor slope rockfish south of 40°10' N.	82,759	81,022	-	26,453	59%	59%	-	52%
Other flatfish	893,114	902,082	889,807	-	67%	65%	69%	-
Pacific cod	229,296	203,421	256,143	223,576	59%	57%	66%	64%
Pacific halibut (IBQ) north of 34°27' N.	22,661	17,131	20,496	19,421	53%	60%	61%	61%
Pacific ocean perch north of 34°27' N.	23,720	19,478	21,086	23,921	55%	58%	58%	56%
Petrale sole	62,222	-	-	-	42%	-	-	-
Sablefish north of 36° N.	188,422	256,838	141,890	198,725	43%	58%	51%	46%
Sablefish south of 36° N.	46,052	97,931	127,704	137,010	20%	31%	56%	45%
Shortspine thornyheads north of 34°27' N.	291,794	286,681	262,339	296,304	65%	67%	70%	66%
Shortspine thornyheads south of 34°27' N.	10,269	10,771	10,330	10,244	60%	58%	53%	50%
Splitnose rockfish south of 40°10' N.	301,778	312,109	-	-	62%	59%	-	-
Starry flounder	147,025	139,500	-	-	66%	64%	-	-
Widow rockfish	70,193	68,882	201,881	167,354	56%	56%	64%	53%
Yelloweye rockfish	99	98	183	172	23%	25%	37%	34%
Yellowtail rockfish north of 34°27' N.	667,675	594,333	-	-	58%	57%	-	-

Overage carryover can also provide flexibility as it allows for an overage in one year to be covered by up to 10 percent of the following year's QP. However, the vessel account owner must declare out of the shorebased IFQ program with the Office of Law Enforcement (OLE) and the West Coast Regional Office (WCRO) for the year in which the deficit occurs if the deficit occurs more than 30 days before the end of the year. If the deficit occurs less than 30 days before the end of the calendar year, exiting out of the Shorebased IFQ Program for the remainder of the year is not required. Three vessels declared out of the fishery in 2011, two in 2015, and two in 2016, citing the overage carryover provision.[46]

[46] Joe Albert, Office of Law Enforcement, pers. comm., December 23, 2016.

3.1.3 Other Economic Goals and Objectives

3.1.3(a) Utilization

Provide for full utilization of the trawl sector allocation (Amendment 20 Goal).

Within the constraints of overfished species rebuilding requirements, achieve the maximum biological yield of the overall groundfish fishery, promote year-round availability of quality seafood to the consumer, and promote recreational fishing opportunities (FMP Goal).

3.1.3(a)(1) Utilization of Non-whiting Species Allocations

Highlights:

- Numerous socioeconomic factors contribute to under harvest of the trawl allocation for many quota species in the non-whiting sector of the trawl fishery.
- Utilization of annual allocations for many species of rockfish, roundfish, and flatfish is less than 50 percent.
- The trawl fleet has used less than 50 percent of its annual Dover sole allocation since the implementation of catch shares, and this decreased to only 13.5 percent in 2015 after the Dover sole catch limit doubled.
- Sablefish quota is increasingly scarce due to full catch accounting, the demand for sablefish quota by trawl fishermen targeting sablefish and co-occurring species, the demand for sablefish quota by fixed gear fishermen, the ACL for sablefish, market prices for sablefish, and the price of fishing inputs.
- If all sablefish were caught with trawl gear, utilization of Dover sole, longspine thornyheads, and shortspine thornyheads would likely increase from current levels.
- Utilization is not significantly constrained by vessel use limits.

One of the goals of the Groundfish Trawl Catch Share Program (Amendment 20) is to “provide for full utilization of the trawl sector allocation.” For many species in the program, this goal is far from being met (Figure 3-38; Appendix B, Annual Catch Limits and Catches and Percent Attainment by Species). In particular, the trawl fleet has used less than 50 percent of its Dover sole allocation since the implementation of catch shares, and this decreased to only 13.5 percent in 2015 with the doubling of the Dover sole annual catch limit. Utilization of allocations for many species of rockfish, roundfish, and flatfish is also far less than 50 percent. Numerous economic factors contribute to the current and ongoing under-harvest of the trawl allocation for many species included in the non-whiting sector of the trawl fishery. Some of these factors will be analyzed quantitatively. Those factors lacking relevant quantitative data will be discussed qualitatively.

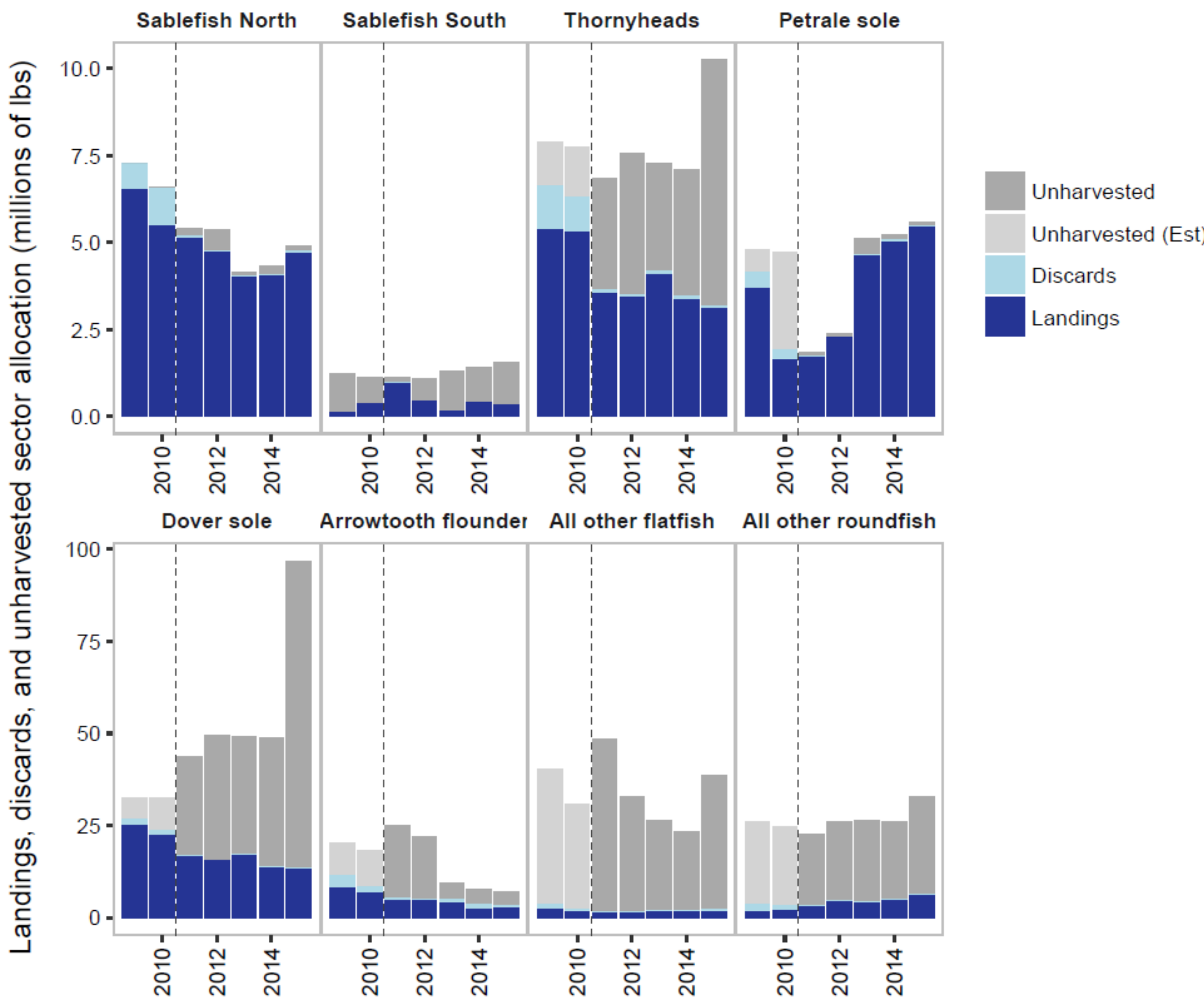


Figure 3-38. Landings (dark blue), discards (light blue), and unharvested (grey) trawl sector allocation of non-whiting groundfish species (millions of lbs). If carryover was made available for a specific quota category, the total weight was deducted from the original year and added to the following year. Except for sablefish, there was no trawl-specific quota in 2009 and 2010; for context, Unharvested (Est) (light grey) was calculated for 2009 and 2010 as the annual OY * (2011 Trawl Sector Allocation)/(2011 ACL) by stock or complex. Source: Observer program mortality database, Somers et al. 2016, IFQ Program database.

Figure 3-38 summarizes the under-attainment for groups of non-whiting species in the trawl IFQ program (full annual utilization tables are provided in Appendix A). Utilization of Dover sole has been a fraction of the trawl sector total allocation of the ACL, especially in 2015 when the allocation doubled, and catches remained constant. Rockfish landings have been steadily increasing, but are still less than a third of the aggregate catch limits.[47] Low utilization and high trawl sector allocations of English sole, arrowtooth flounder, and starry flounder are the principal reasons for the unutilized catch limit in the “all other flatfish” category. Northern sablefish is nearly fully utilized, while the southern allocation is not in most years.

The multispecies nature of this fishery means that full utilization of all species in the program may be an unrealistic goal. The current management system is based on the concept of optimum yield, determined using maximum sustainable yield (MSY) as the upper limit. When applied to multispecies fisheries with relatively unselective gear, such as trawl gear, efforts to achieve MSY-based optimum yields are met with several fundamental challenges. First, productivity of target stocks differs. The fishing effort that would sustain maximum yields from one stock would leave others under harvested or drive them to an overfished condition. At best, a concept of multispecies MSY based on the maximum possible yield from the system as a whole could be defined (e.g., Guillen et al. 2013). However, doing so would present fundamental tradeoffs among species of interest, fishing sectors, and societal goals. The second challenge with MSY-based OYs in a multispecies fishery is that fish stocks may interact ecologically, which links their potential productivities and makes the definition of MSY challenging (May et al. 1979).

There can be tradeoffs between fishing targets where fishing heavily on forage species can decrease the abundance of predators. These complexities become even more confounding when considering the dynamic nature of ACL constraints, particularly for rebuilding species. When ACLs for constraining species increase, opportunities to catch more of other species that are taken simultaneously with trawl gear are likely to rise as a result. For example, the 2015 assessment found canary rockfish to be rebuilt, which would potentially lead to a larger ACL for 2017 and 2018 and would create additional fishing opportunities beyond those currently constrained by canary bycatch (Matson 2016).

The less-than-annual frequency of many stock assessments, along with the Council biannual harvest specification process, means that it may take several years before the benefits from a rebuilt stock are actualized. Finally, natural variability in stocks, or in the ecosystem as a whole, can also impact attainment rates. Stock abundance depends on environmental conditions, as well as on interactions with other species. Changes in temperature, currents, recruitment, predators, or competitors can positively influence some species and negatively impact others. Model error and time lag in stock assessments can lead to inefficiencies in the fishery if the harvest targets do not reflect the current state of the population. Several studies have shown that sustainable yield for an ecosystem is less than the sum of the sustainable

[47] The rockfish category includes all rockfish species; other flatfish includes arrowtooth flounder, sanddab, English sole, starry flounder, and other flatfish; other roundfish includes Pacific cod and lingcod.

yields for each species within that ecosystem (May et al. 1979, Link et al. 2013). Given this finding, full attainment for all species could lead to removal rates that are unsustainable for the ecosystem as a whole.

Another important factor affecting the potential to attain the full utilization goal is that trawl allocations for many of the species included in the catch share program are higher than historical catch within the trawl sector (Matson 2016; Steiner et al. 2016a). Matson (2016) plots landings, harvest specifications (ACL, OY, or harvest guideline, depending on which is consistent over time), and attainments for eight stocks from 1995 to 2015. The stocks include Dover sole, lingcod, arrowtooth flounder, English sole, widow rockfish, canary rockfish, petrale sole, and northern sablefish. Under-harvested stocks of primary concern include Dover sole, lingcod, English sole, and arrowtooth flounder. These stocks show significant decreases in attainment that are driven by both steady increases in harvest limits and decreases in landings. The highest landings of Dover sole occurred in 1996 (12,000 mt), but they were still only about 26 percent of the 2015 ACL (46,986 mt). Both canary rockfish and widow rockfish were declared overfished during the time period included in the analysis (2000 and 2001, respectively), leading to large decreases in harvest specifications and landings.

Various market or demand-side issues also affect utilization rates. These have been discussed in public comments at PFMC meetings, several community hearings, and the Pacific Groundfish Quota Program Workshop (2016). Figure 3-50 illustrates how processors, catcher vessels, and markets are connected in a cycle that includes low utilization of groundfish stocks.[48] Low utilization contributes to low and/or inconsistent supply to processors. Without a predictable supply, processors have a difficult time securing premium markets (fresh, for example) and, instead, may have to rely on less discriminating protein markets (Pacific Groundfish Quota Program Workshop 2016). Compared to the pre-catch share management strategy of trip limits, the catch share program provides more flexibility to individual vessels in terms of when to prosecute the fishery (see Section 3.1.2(d) for more information). However, this flexibility can contribute to the issue processors have raised regarding inconsistent supply by allowing vessels to choose to participate in higher value fisheries before fishing for groundfish. Exercising this choice results in low demand from processors and lower prices for the vessels that fish and supply groundfish to the processors because of the impact on consumer markets. Some processors have imposed trip limits on vessels that deliver to them to limit deliveries of species for which they lack processing capacity. Low demand and corresponding lower prices from processors, in turn, make fishing less profitable and result in fewer trips, lower landings, and ultimately, low utilization. It is extremely difficult

[48] See agenda items F.6.b and F.6.d in the November 2016 Briefing Book:
http://www.pcouncil.org/resources/archives/briefing-books/november-2016-briefing-book/

to quantify the effect of these factors on utilization, as they are all related in a cyclical (endogenous) way (Figure 3-39).

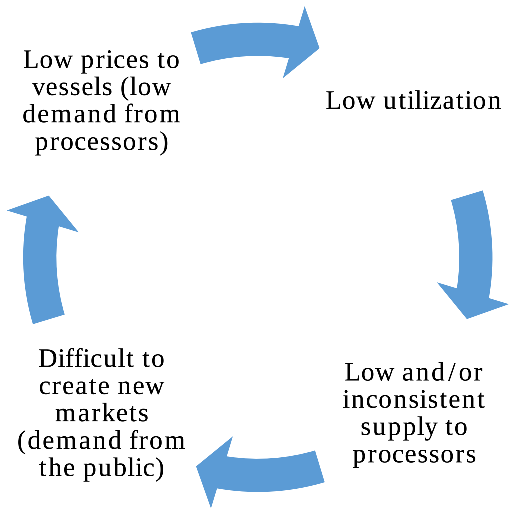


Figure 3-39. Illustration of cycle of low demand and low utilization.

In addition to the challenges of the vessel-processor marketing relationship, global markets influence the demand for groundfish products. The long rebuilding periods for the overfished species in this fishery may have caused a loss of historical markets.[49] Landings of lingcod, canary rockfish, widow rockfish, petrale sole, and others fell precipitously after each was designated as overfished. Petrale sole rebuilt relatively quickly (six years), but the annual catch limits for others have been restricted for more than 10 years. During this time, markets have adjusted through substitution with other species, foreign imports (e.g., tilapia or Canadian rockfish), or even other forms of protein. The Russian market, which historically purchased up to a quarter of West Coast Pacific whiting exports, has been closed since trade sanctions were implemented against Europe and the United States in 2014 (Warlick et al. 2016).

The characteristics of the quota market can also affect utilization rates. A quota market is an essential part of an IFQ program and often takes time to operate efficiently. It may take time for participants to learn effective use of the system, reduce transaction costs, and obtain price information. The structure and function of the quota market also have the potential to affect utilization, especially in a multispecies fishery where participants have limited ability to control the species composition of their catches and must own or obtain quota to cover what they catch (Holland 2016). One aspect of this multispecies IFQ market that can affect utilization is the challenge of predicting how much of a particular species' QP

[49] See agenda items F.6.b and F.6.d in the November 2016 Briefing Book: http://www.pcouncil.org/resources/archives/briefing-books/november-2016-briefing-book/

a vessel will need for a particular trip and throughout the year. QS of the species that were overfished at the time of initial allocation (bocaccio, canary rockfish, cowcod, darkblotched rockfish, POP, widow rockfish, yelloweye rockfish) and Pacific halibut were allocated by applying bycatch rates to the allocations of target species, which resulted in allocations for these species being broadly distributed but in very small amounts. Holland (2016) describes the problem:

> …there was widespread concern that very small total quotas for several overfished rockfish species might constrain catches of other IFQ species. These concerns were due, in part, to worries that overall catches of some bycatch species would exceed available QP, but also that individuals who exceeded their initial allocations would be unable to acquire QP from others who would be holding back their own QP in case they needed it themselves. Catches for many of these "bycatch" species tend to be rare, highly uncertain, and concentrated, creating the potential for mismatches between allocations and catches and the need to redistribute and aggregate dispersed QP holdings.

A number of quota risk pools were formed between groups of fishermen to reduce the risk that any individual would be shut down due to an unexpected catch event (Holland and Jannot 2012). "Lightning strike" catch events can put vessels over the annual vessel limit for that species. Under such circumstances, even if quota were available on the market, the vessel would not be allowed to purchase the amount needed to cover its catch. A number of "lightning strike" catch events have occurred in the first five years of the program, Events like these tend to encourage fishermen to be extremely risk-averse in their fishing location choices. As overfished species rebuild and become more abundant, the risk of an unexpected catch increases. If the risk, even if only perceived, of exceeding the quota pounds that a fisherman is able to acquire is large, conservative fishing behavior is likely to decrease attainment of other species.

Another potential inefficiency in the functioning of the quota market results from flexibility in the timing of fishing provided by the catch share program. Because vessels can fish any time during the year, there can be a mismatch between when vessels put unneeded QP on the market and when vessels that are actively fishing want to purchase quota. Vessels that plan to fish late in the year are likely to hold quota for a longer time. A vessel fishing early in the year may have a hard time acquiring the quota they need or want. To illustrate the possible influence of this factor, the percentage of catcher vessels actively fishing in the groundfish IFQ program in each quarter is shown in Table 3-71. There has been a considerable decrease in the percentage of vessels fishing in the first two quarters of the year, a smaller decrease in the third quarter, and a small increase in the percentage of vessels fishing in the last quarter.

Table 3-71. The percentage of shoreside catcher vessels actively fishing in the groundfish trawl fishery in each quarter versus those declared into the fishery. Source: EDC and Fish ticket data.

Quarter	2009	2010	2011	2012	2013	2014	2015
Jan-Mar	77%	72%	39%	51%	52%	55%	56%
Apr-Jun	99%	92%	65%	57%	70%	64%	55%
Jul-Sept	92%	89%	80%	79%	73%	70%	66%
Oct-Dec	82%	80%	82%	86%	85%	86%	74%

Effects of the gear switching provision and the decrease in trawl discards on attainment while targeting DTS

The DTS complex is one of the most economically important fishing strategies for the non-whiting groundfish trawl fleet (Steiner and Holland working paper). In the DTS trawl complex, sablefish is targeted along with Dover sole, longspine and shortspine thornyhead rockfish, and other rockfish and flatfish in smaller volumes. Sablefish quota is the principal constraint on DTS trawl fishing because it is the only target stock that approaches full utilization (Appendix B) and is higher value than the other species (Appendix A).

The catch share program was implemented with two features that have increased the importance of sablefish quota constraints in the DTS fishery. The first was complete catch accountability through 100 percent observer coverage and individual catch shares based on catch, rather than landings. Previously, under trip limits, limits were applied to landings, and discards were estimated based on partial observer coverage and accounted for in aggregate when setting allowable catches. The new system, which holds individuals accountable for their discards, has successfully created a disincentive and led to decreased discards (Somers et al. 2015b). Under trip limit management, vessels could maximize combined landings from the DTS complex by discarding overages of one or more species to allow them to continue to fish others. While discards have decreased for each of the DTS species (Figure 3-39), the rate and volume of sablefish discards as an important constraining species are principal measures of the impact of the catch share program.

Figure 3-40 documents the decline in total discards of Dover sole, sablefish north of 36˚ N. latitude, longspine thornyheads north of 34˚ 27’ N. latitude, and shortspine thornyheads north of 34˚ 27’ N. latitude from 2006 to 2015. Only the northern allocations of each species are shown because there is almost no trawling targeting the DTS complex trawl south of 36˚ N. latitude. Figure 3-41 presents these discards as rates, i.e., the mt of discards as a percentage of total catch of each species. Mean sablefish north of 36˚ N. latitude discards as percentage of total catch fell from 12 percent (2006 to 2010) to 1 percent (2011 to 2015). Mean Dover sole discards as percentage of total catch fell from 8 percent (2006 to 2010) to 1 percent (2011 to 2015). Mean longspine thornyheads north of 34˚ 27' N. latitude discards as percentage of total catch fell from 18 percent (2006 to 2010) to 4 percent (2011 to 2015). Finally, mean shortspine thornyheads north of 34˚ 27' N. latitude discards as percentage of total catch fell from 9 percent (2006 to 2010) to 1 percent (2011 to 2015).

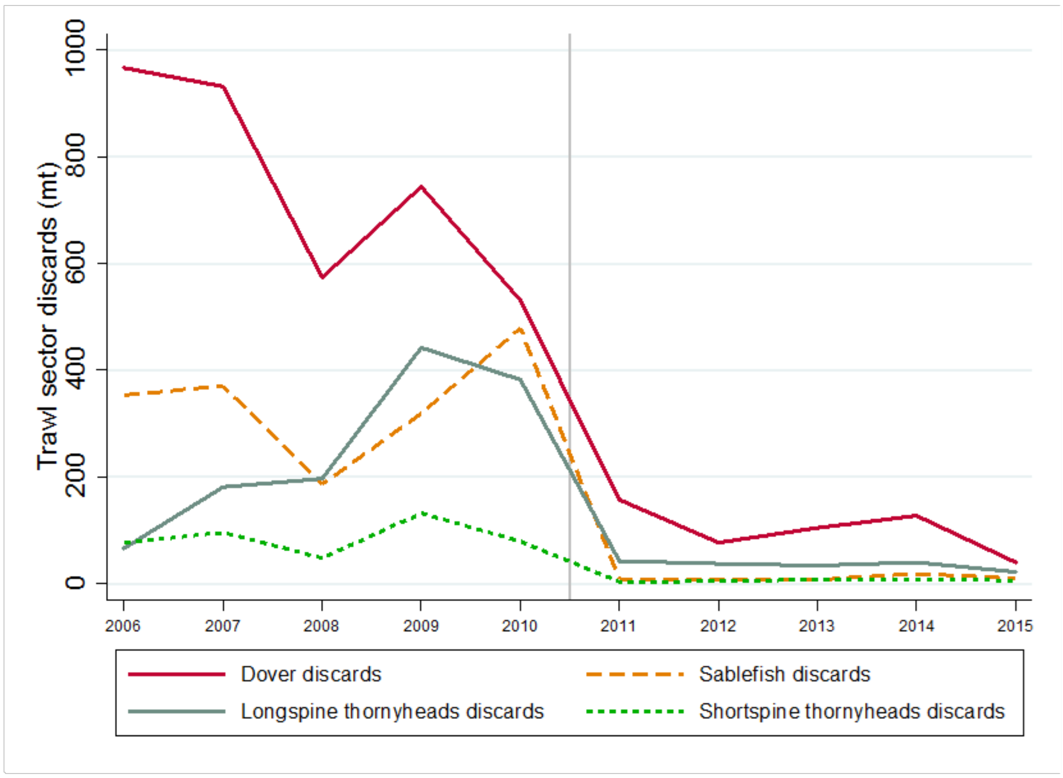


Figure 3-40. Discards of Dover sole, sablefish north of 36˚ N. latitude, Longspine thornyheads north of 34˚ 27' N. latitude, and shortspine thornyheads north of 34˚ 27' N. latitude (mt) by the trawl sector. Discards by fixed gear vessels using trawl quota after 2011 are not shown in this figure. Source: West Coast Groundfish Observer Program data (Somers et al. 2015c).

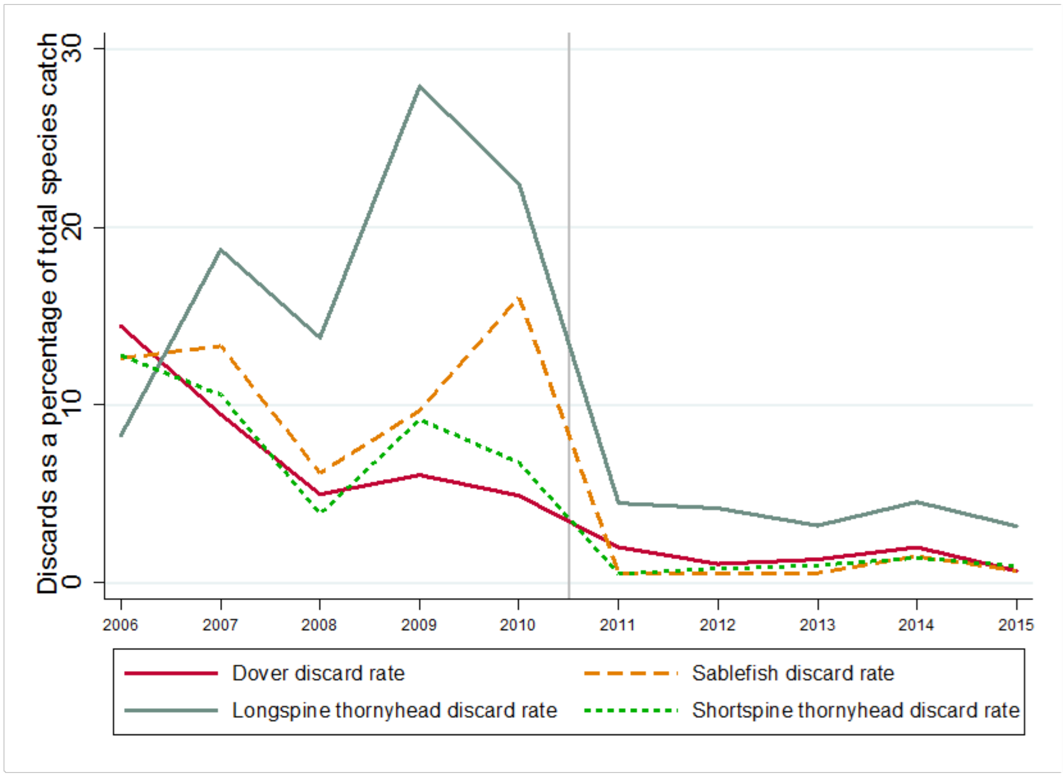


Figure 3-41. Discard rate of Dover sole, sablefish north of 36˚ N. latitude, longspine thornyheads north of 34˚ 27’ N. latitude, and shortspine thornyheads north of 34˚ 27’ N. latitude (mt per mt caught) by the trawl sector. Source: West Coast Groundfish Observer Program data.

The second feature of the catch share program that increased the importance of sablefish quota constraints was the gear switching provision (PFMC and NMFS 2010). This provision allows vessels that historically fished in the limited entry trawl fishery to fish with fixed gear (50 CFR 660.130); it also allows any vessel to enter the IFQ fishery by obtaining a trawl permit and leasing or purchasing trawl quota (50 CFR 660.210). This flexibility allows each vessel to determine its most profitable fishing strategy and to take advantage of the fixed gear price premium if it is individually optimal for them to do so; it also provides an opportunity to switch to gear that may have fewer impacts on ocean bottom habitat (Steiner and Holland working paper). Several vessels that historically fished in the limited entry fixed gear sablefish fishery have entered the trawl IFQ program in this way (Section 3.1.2(d)(7)). Vessels targeting sablefish with fixed gear catch almost exclusively sablefish.

Steiner and Holland (working paper) investigate how input and output prices affect the relative profitability by gear type to understand the distribution of catch between gear types. They found that even though the ex-vessel prices of sablefish caught with fixed gear were higher than sablefish caught with trawl gear (Table 3-66, Section 3.1.2(d)(6)), the net revenue (a measure of profitability) per pound of sablefish quota was highest for trawl gear in 2011 and 2012. That is, when the revenue from all species caught on DTS trips with trawl gear and the differences in costs between gear types were considered, DTS trawling was, on average, more profitable per pound of sablefish quota than using fixed gear to target sablefish. These results highlight the importance of input costs (such as fuel, labor, and the cost of sablefish quota) and output prices (including ex-vessel sablefish, Dover sole, and thornyhead prices), which may also vary considerably among vessels, in determining the amount of sablefish quota flowing to the fixed gear sector of the trawl catch share program in each year. Figure 3-42 shows the allocation of sablefish QP to the trawl sector, as well as how much of the trawl allocation has been fished with trawl gear versus fixed gear in each year (with fixed gear beginning in 2011 with the catch share program).

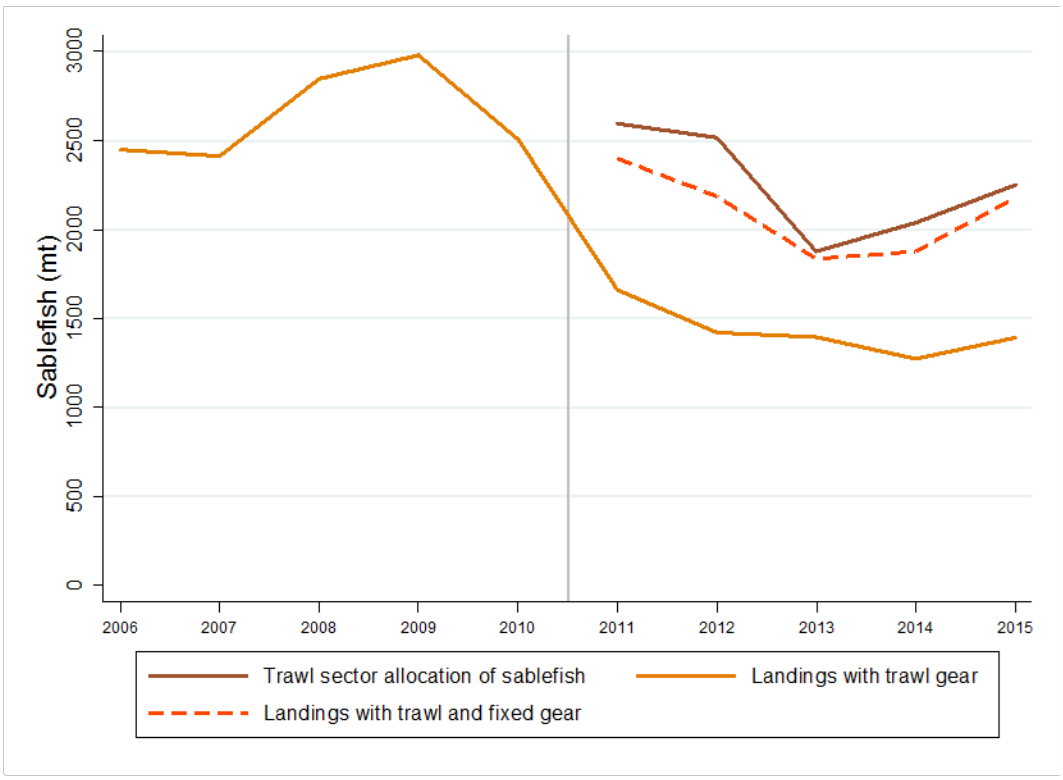


Figure 3-42. Trawl sector allocation of sablefish and sablefish landings with trawl gear and fixed gear. Source: West Coast Groundfish Observer Program data.

These two features of the catch share program—full catch accountability and gear switching provisions—have increased the degree to which sablefish is a constraining species for trawl vessels targeting DTS. The two features have also potentially affected attainment rates of the major species caught in conjunction with sablefish in trawl gear: Dover sole, longspine thornyheads north of 34˚ 27’ N. latitude, and shortspine thornyheads north of 34˚ 27’ N. latitude. The degree to which these two factors have affected the attainment of other species can be analyzed by the following measures:

1) Applying the observed catch ratio (including discards) of Dover-to-sablefish, longspine thornyhead-to-sablefish, and shortspine thornyhead-to-sablefish to sablefish removed from the trawl fishery with fixed gear to estimate the hypothetical catches of each species if all sablefish were caught with trawl gear
2) Applying the pre-catch shares rate of sablefish discards to the post-catch shares level of hypothetical sablefish landings calculated in 1) to obtain a second estimate of hypothetical sablefish catches if discards were not counted against vessel quota, and all sablefish were caught with trawl gear

Full catch accountability creates a strong incentive to discover and implement fishing practices that increase the amount of other co-occurring target species caught per pound of sablefish. Results indicate that targeting behavior of vessels has changed as expected (Figure 3-42), such that the amount of each species caught per pound of sablefish has increased. The ratios have decreased somewhat since 2013 (but remain above pre-catch share levels), likely due to the increase in sablefish annual catch limits since 2013 (Figure 3-42) that made sablefish quota less scarce.

Given the shift depicted in Figure 3-43, the degree to which elimination of regulatory discards and the gear switching provision have affected attainment rates of other species can be estimated. Estimates apply average pre-catch shares catch ratios as the lower bounds (Dover-to-sablefish = 3.42:1; longspine-to-sablefish = 0.43:1; shortspine-to-sablefish = 0.36:1) and the average post-catch share catch ratios as upper bounds (Dover-to-sablefish = 4.95:1; longspine-to-sablefish = 0.63:1; shortspine-to-sablefish = 0.50:1).

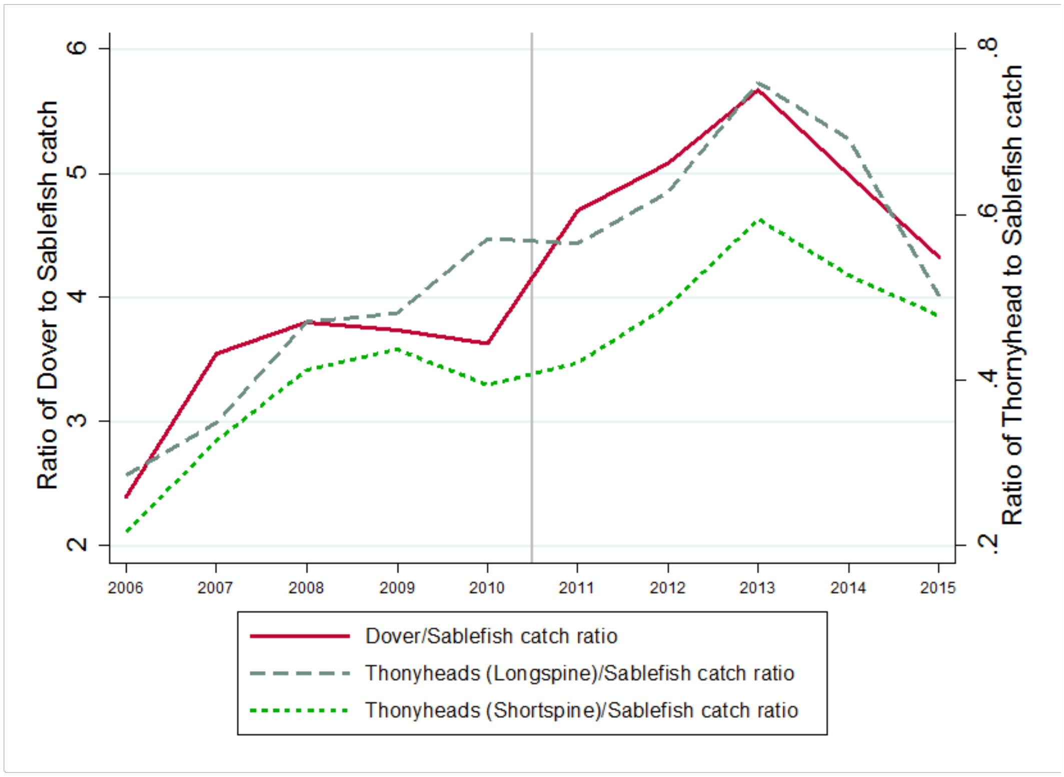


Figure 3-43. Catch ratios (including discards) of Dover sole to sablefish (left axis), longspine thornyhead to sablefish (right axis), and shortspine thornyhead to sablefish (right axis) in the non-whiting trawl fishery. Source: West Coast Groundfish Observer Program data.

Figure 3-44 shows the results of the application of the average pre- and post-catch share Dover sole to sablefish catch ratios to illustrate the range of hypothetical Dover sole landings if all of the sablefish caught in the trawl sector were caught with trawl gear (black-bounded bars seen in Figure 3-43). Figure 3-43 also shows the hypothetical Dover sole landings if all sablefish caught in the trawl sector were caught with trawl gear and if trawl vessels were allowed to discard sablefish at the same average rate as they did from 2006 to 2010 (gray bounded bars). The upper bound is unrealistic, because the other two factors (movement of sablefish quota into the fixed gear fishery and vessel accountability for discards) pushed vessels to change their behavior to obtain higher catch ratios. This change in behavior would be unlikely to have occurred to the same extent if the gear switching provision did not exist, or if discards were not counted against individual quotas.

Figure 3-45 and Figure 3-46 show parallel results for longspine thornyheads and shortspine thornyheads, respectively.

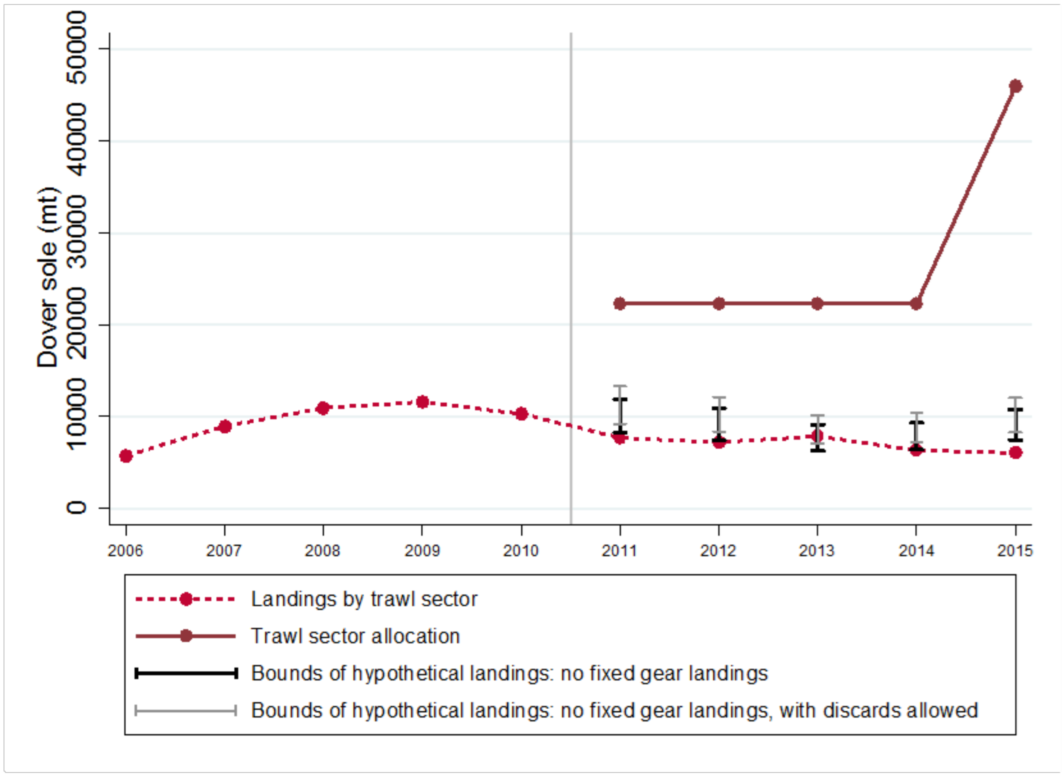


Figure 3-44. Bounds of hypothetical landings of Dover sole if all sablefish were caught with trawl gear (black) and if all sablefish were caught with trawl gear and were discarded at the same rate as they were from 2006 to 2010 (gray). Source: Analysis using West Coast Groundfish Observer Program data.

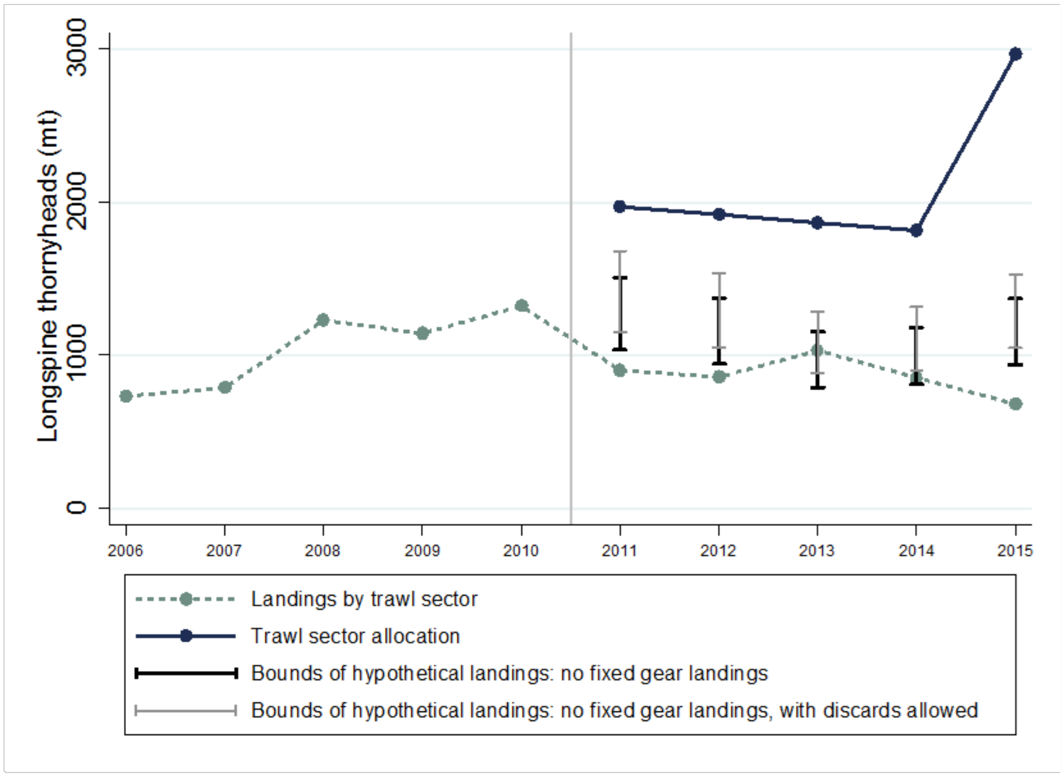


Figure 3-45. Bounds of hypothetical landings of longspine thornyheads if all sablefish were caught with trawl gear (black) and if all sablefish were caught with trawl gear and were discarded at the same rate as they were from 2006 to 2010 (gray). Source: Analysis using West Coast Groundfish Observer Program data.

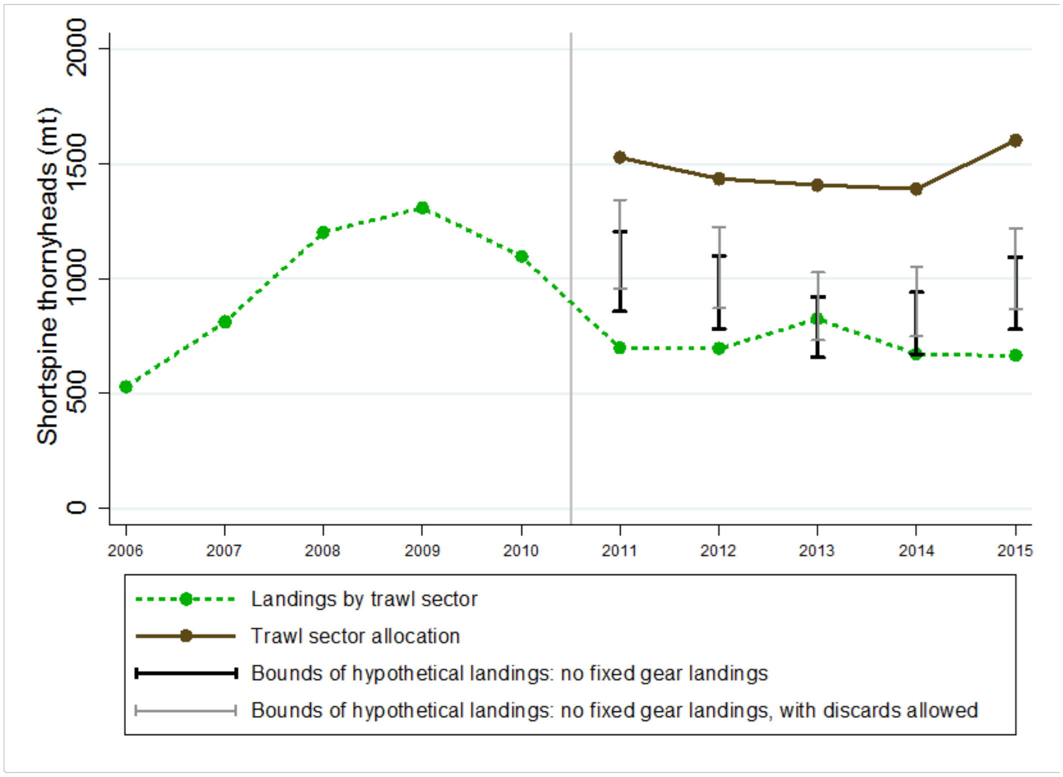


Figure 3-46. Bounds of the hypothetical landings of shortspine thornyheads if all sablefish were caught with trawl gear (black) and if all sablefish were caught with trawl gear and were discarded at the same rate as they were from 2006 to 2010 (gray). Source: Analysis using West Coast Groundfish Observer Program data.

This analysis shows that if 100 percent of the trawl allocation of sablefish were caught with trawl gear, Dover sole utilization would potentially have been 31.9 percent to 46.2 percent from 2011 to 2014 (Table 3-72), compared to what it actually was (29 percent to 36 percent, Appendix B). In 2015, however, the trawl sector allocation of Dover sole doubled to nearly 46,000 mt. Actual utilization of Dover sole was 13.1 percent, and the bounds of the estimated potential utilization with no fixed gear were 16.2 percent to 23.5 percent. Similar patterns are calculated for longspine and shortspine thornyheads, although the quota for shortspine thornyheads did not increase as much in 2015 as it did for the other two species. Again, the upper bounds of these estimates are unrealistic, as they are calculated using the post-catch share implementation catch ratios that increased because of the demand for sablefish from the fixed gear fishery and the 100 percent catch accounting. The bounds shown are arithmetic rather than statistical bounds.

Table 3-72. For the three species targeted along with sablefish in the trawl DTS target fishery, actual utilization (percent of trawl allocation landed), the lower bound of estimated utilization if no sablefish were caught with fixed gear, and the upper bound of estimated utilization if no sablefish were caught with fixed gear, from 2011 to 2014 and in 2015. Source: Analysis using West Coast Groundfish Observer Program data.

	2011-2014			**2015**		
	Actual utilization	**Hypothetical utilization**		**Actual utilization**	**Hypothetical utilization**	
		Lower bound	**Upper bound**		**Lower bound**	**Upper bound**
Dover sole	32.6%	31.9%	46.2%	13.1%	16.2%	23.5%
Longspine thornyhead	48.2%	47.1%	68.8%	23.0%	31.6%	46.1%
Shortspine thornyhead	50.3%	51.3%	72.1%	41.5%	48.6%	68.2%

The utilization of sablefish by the fixed gear fishery has contributed to the decrease in attainment of Dover sole and thornyheads by vessels fishing with trawl gear. However, this analysis shows that, even without any participation by fixed gear vessels in the trawl sector, utilization rates for these species are not likely to be close to full, especially when the higher quotas starting in 2015 for Dover sole and longspine rockfish are considered (Table 3-72). Instead, the DTS complex may simply illustrate that multispecies fisheries are likely to be constrained by the weaker stocks without precisely targeting gear.

Effect of vessel use limits on attainment

The vessel use limits meant to limit consolidation (Section 3.1.1(b)(1)(A)) may constrain attainment because vessels that are near their limits (hereafter "use limit-constrained") must cease targeting the constraining species and other species that are caught concurrently with the constraining species. A vessel that exceeds vessel limits for one or more quota species would be required to cease fishing for the remainder of the year, regardless of whether it could acquire QP to cover its catch. If a vessel is use-limit-constrained, the impact on total attainment will depend on the availability of other vessels to harvest the QP and the amounts of fish demanded by processors.[50]

Two methods to analyze the constraining effect of QP vessel use limits are presented in this section. The first considers the ratios of non-whiting species that are generally caught together (*catch ratio method*). The potential increase in catch and attainment is calculated assuming that vessel use limits for each constrained vessel-species combination were increased by 10 percent, holding catch ratios among co-

[50] Liquidity of QP markets may also impact sector attainment of total allocations, however, control limits are less than use limits; therefore, any additional QP acquired by vessels over and above their use limits would have to come from QP leasing.

occurring species constant at their observed rates. The second uses a bootstrap analysis stratified by latitude and depth. It is designed to evaluate whether there is a significant probability that a vessel operating normally (i.e., with an average level of due care in avoiding catch of seven rockfish species and Pacific halibut) would exceed the vessel use limits for those species (*bootstrap probability method*).

Catch ratio method

Table 3-7 of Section 3.1.1(b)(1)(A) shows the number of vessel accounts that were at 90 percent or greater of their annual vessel use limits for each species in each year. The effect that the vessel use limits have on attainment of non-constraining species is estimated by the approximate increase in catch if the vessel use limits for each constrained vessel-species combination were increased by 10 percent. It was assumed that the 10 percent increase in the limit would result in a 10 percent increase in landings of species constrained by vessel use limits and would increase landings of other species often caught along with each constraining species at the same ratio as that vessel caught them in each year. It was assumed that landings of quota-constrained species (sector attainment of over 90 percent; see Appendix B) would not increase; if the use limit-constrained vessels were limited by quota-constrained species, they were excluded from the analysis. The calculation was performed for six fishing activities. These groups are not meant to capture all possible fishing activities of an IFQ participant, but to represent the majority of non-whiting fishing activities in the IFQ program.[51] These assemblages could be justified quantitatively using ordination or hierarchical classification techniques (Rogers and Pikitch, 1992), but are not for this analysis. The activities include the following:

1. Northern midwater trawl (widow rockfish, yellowtail rockfish, canary rockfish)[52]
2. Lingcod target (lingcod, canary rockfish, and yelloweye rockfish)
3. Shallow benthic soft bottom (English sole, starry flounder, arrowtooth flounder, other flatfish, Pacific halibut, and canary rockfish)
4. Deep benthic soft bottom (petrale sole, Dover sole, darkblotched rockfish, POP, and thornyheads)
5. California trawl (chilipepper rockfish, widow rockfish, canary rockfish, boccaccio rockfish, darkblotched rockfish, and cowcod)
6. Southern sablefish fixed gear

[51] These groups were identified with the help of Patrick Mirick (Oregon Department of Fish and Wildlife and the Council Groundfish Management Team) and Dan Erickson (Ocean Associates, in support of the West Coast Region).

[52] Northern canary rockfish is excluded from activity 1 in 2015 because it was quota-constrained, and this may cause an overestimate of the true effect of increasing the vessel use limits for the species in activity 1 in 2015.

DTS trawl is excluded because northern sablefish was quota-constrained in all years except 2012; in 2012, the only vessel that was use limit-constrained for northern sablefish targeted it with fixed gear. Petrale sole was quota-constrained from 2011 to 2015, so the results from activity 3 should be interpreted with caution. The calculations were performed anyway for vessels that are use-limit-constrained on one of the other species, but the vessels may also be constrained by the petrale sole quota. Finally, although it is basically a single-species fishery, the increase in southern sablefish caught with fixed gear if the vessel use limit were to increase is also calculated. Southern sablefish is not quota-constrained, but a number of vessels were use-limit-constrained in each year.

Table 3-73 summarizes the potential increase in pounds landed, as well as the potential increase in percent attainment. The highest potential increases in attainment are for widow rockfish, Bocaccio rockfish south of 40°10' N. latitude, and sablefish south of 36º latitude, but even these are very small (never more than 3 percent). For most species in most years, the potential increase in landings if the vessel use limits were increased by 10 percent is less than 1 percent, given the catch ratios observed from 2011 to 2015. This analysis also assumes that other unconstrained vessels are not serving as substitute suppliers of fish to processors (i.e., that other vessels do not “take up the slack” for limit-constrained vessels).

Table 3-73. Estimated potential increase in landings if the vessel use limits were increased by 10 percent (in pounds and percent attainment).

IFQ Species	**2011**	**2012**	**2013**	**2014**	**2015**	**2011**	**2012**	**2013**	**2014**	**2015**
	Potential increase in pounds landed					**Potential increase in % attainment**				
Northern midwater trawl										
Canary rockfish	15	307	592	266		0.0%	0.5%	0.7%	0.3%	
Widow rockfish	5,226	4,383	30,150	37,589	70,397	0.7%	0.6%	1.4%	1.7%	2.4%
Yellowtail rockfish north of 40°10' N.	8,672	99,399	91,773	90,981	144,964	0.1%	1.5%	1.4%	1.4%	1.4%
Lincod target										
Lingcod	12,998	35,599				0.1%	1.1%			
Canary rockfish	36	602				1.7%	4.7%			
Yelloweye rockfish	0	1				0.0%	0.1%			
Shallow benthic soft bottom										
Arrowtooth flounder	4,753	2,925	5,723	863	959	0.0%	0.0%	0.1%	0.0%	0.0%
Canary rockfish	35	12	40	8	4,817	0.1%	0.0%	0.0%	0.0%	0.0%
English sole	5,655	4,920	7,236	7,225	6,333	0.0%	0.0%	0.1%	0.1%	0.0%
Other flatfish	18,805	13,263	8,659	20,700	17,524	0.2%	0.1%	0.1%	0.2%	0.1%
Pacific halibut (IBQ) north of 40°10' N.	101	67	85	151	51	0.0%	0.0%	0.0%	0.1%	0.0%
Starry flounder	843	786	71	495	804	0.1%	0.1%	0.0%	0.0%	0.0%
Deep benthic soft bottom										
Darkblotched rockfish	1,217	1,769		2,105	1,290	0.2%	0.3%	0.0%	0.3%	0.2%
Dover sole	41,704	111,950		28,625	14,457	0.1%	0.2%	0.0%	0.1%	0.0%
Longspine thornyheads N of 34°27' N.	3,980	5,418		7,718	2,128	0.1%	0.1%	0.0%	0.2%	0.0%
Pacific ocean perch N of 40°10'	1,580	2,190		1,079	1,130	0.5%	0.7%	0.0%	0.4%	0.4%
Shortspine thornyheads N of 34°27' N.	4,776	10,918		7,745	1,665	0.1%	0.3%	0.0%	0.3%	0.0%
California trawl										
Bocaccio rockfish south of 40°10' N.	603	672	1137	516	3,524	0.5%	0.5%	0.7%	0.3%	2.0%
Canary rockfish	24	21	127	49	797	0.0%	0.0%	0.1%	0.1%	0.8%
Chilipepper rockfish south of 40°10' N.	30,117	27,705	48,801	8,659	18,046	0.9%	0.9%	2.0%	0.4%	0.7%
Cowcod south of 40°10' N.	0	4	4	6	30	0.0%	0.1%	0.2%	0.2%	0.9%
Darkblotched rockfish	57	390	209	2,216	1,897	0.0%	0.1%	0.0%	0.4%	0.3%
Minor shelf rockfish aouth of 40°10' N.	198	955	2564	819	643	0.1%	0.5%	1.4%	0.5%	0.2%
Minor slope rockfish south of 40°10' N. latitude	3,740	11,674	12,735	12,974	10,926	0.4%	1.4%	1.5%	1.6%	1.2%
Widow rockfish	5,409	375	1,556	19,946	64,817	0.7%	0.0%	0.1%	0.9%	2.1%
Southern sablefish fixed gear										
Sablefish south of 36° N.	34,759	15,300		17,517	28,317	3.0%	1.4%		1.2%	1.8%

Bootstrap probability method

Vessel use limits for several species have increased as stocks and ACLs have increased. In a few cases, the increases have been large because the species have been declared rebuilt, and the ACL has increased substantially (Table 3-74). However, for a few species such as cowcod and Pacific halibut, limits have been reduced. This analysis considers the risk of exceeding the 2017 Quota Pound Vessel Limit (QPVL), but it relies on observer data on groundfish trawl from 2013 to 2015 to quantify the probability that a vessel will exceed those QPVLs. The analysis suggests that there is little risk that vessels will be constrained by QPVL for non-target species.

Table 3-74. QPVLs of selected IFQ species in 2011, 2016, and 2017.

	Vessel Annual Limits		
IFQ Species	**2011**	**2016**	**2017**
Bocaccio rockfish south of 40°10' N. latitude	20,371	28,865	102,668
Canary rockfish	5,710	9,806	223,571
Cowcod south of 40°10' N. latitude	702	562	546
Darkblotched rockfish	37,604	43,896	76,096
Pacific halibut (IBQ) north of 40°10' N. latitude	37,083	22,240	25,186
POP north of 40°10' N. latitude	15,789	16,422	26,231
Widow rockfish	64,205	266,214	2,134,911
Yelloweye rockfish	151	271	276

A methodology used by Holland and Jannot (2012) to evaluate risk of vessels exceeding QP allocations was adapted to evaluate the risk of vessels exceeding QPVL. The analysis makes use of tow-level observer data for nearly 25,000 bottom trawl tows between 2013 and 2015. Tows are stratified into eight latitudinal strata corresponding with primary fishing ports or groups of ports along the West Coast. Vessels participating in the bottom trawl fishery tend to fish mostly in one of these areas, although there is overlap in the fleets fishing in each area. Tows are also stratified according to whether they occur on the shelf (<150 fathoms) or on the slope (>150 fathoms) to enable comparison of catches from strategies that concentrate on shelf or slope species. The stratified data include at least six vessels fishing in each zone (Table 3-75). The most recent three years of data are used rather than the five years of IFQ data, as some species populations and corresponding catch rates have grown over that period.

Table 3-75. Summary statistics on area fleets and number of observed tows. Source: Fish ticket data.

	Number of Vessels	Average Tows/Year	Avg of Maximum Annual Tows from Top Three Vessels	Total Slope Tows	Total Shelf Tows	Percent Slope Tows
Bottom Trawl Areas						
North of 47°	7	182	362	2612	1971	57%
45°20' to 47°	13	230	450	3700	3906	49%
44°to 45°20'	8	89	185	1546	49	97%
42°30' to 44°	14	58	126	2286	706	76%
40°10' to 42°30'	15	90	249	3194	534	86%
38° to 40°10'	6	144	235	1554	898	63%
36° to 38°	6	139	231	860	934	48%
Pacific Whiting (midwater trawl)	25	68	107	967	2683	26%

For each latitudinal stratum, a specified number of tows is randomly drawn with replacement from the slope and the shelf. This is referred to as a "fishing pattern." An example would be 100 tows from the shelf and 300 tows from the slope from the area between 36° N. latitude and 38° N. latitude. The catch from the 400 tows is then summed and represents the annual simulated catch for a vessel with that fishing pattern in that area. This process is repeated 10,000 times to get a distribution of potential outcomes for each fishing pattern. The 95th percentile tail conditional expectation (TCE)[53] is calculated for each IFQ species of concern. This calculation is done by sorting the total catch by species from 10,000 different realizations of each fishing pattern from lowest to highest and then taking the average of the catch from the top 5 percent of realizations (e.g., the average canary catch of the 500 realizations with the highest canary catch). The median catch for each fishing pattern is also calculated. The 95th TCE and the median catch are compared to the QPVL. If the 95th percentile TCE exceeds the QPVL for a species, it suggests that there is more than a 5 percent chance that a vessel would exceed the QPVL while operating with the simulated fishing pattern. If the ratio of median catch to the QPVL exceeds 1.0, this suggests that 50 percent or more of the vessels fishing this fishing pattern in this area would likely exceed the QPVL.

A separate analysis is done for shoreside whiting trips. Since vessels targeting whiting move up and down the coast following the fish, the data are not stratified spatially. Fishing patterns are a set number of tows drawn randomly from all observed tows from 2013 to 2015.

[53] TCE has been shown to be a coherent risk measure satisfying a number of desirable axioms (Artzner et al. 1999) and has become popular with insurance actuaries in recent years (Landsman and Valdez 2005).

There is a great deal of variation across vessels in terms of the number of tows they make in a year and in the distribution of tows between slope and shelf areas (Table 3-75), making it not meaningful to simulate results for a typical or average vessel. Rather, results from a range of fishing patterns with different total numbers of tows and concentrations on shelf or slope are presented. The results presented focus on fishing patterns with 400 tows distributed between the shelf and slope in each latitudinal stratum. Very few vessels fish this many tows in any given year, so these results are conservative in the sense that they likely overestimate the risk of exceeding the QPVL for most vessels. Only in the zone between 45°20' N. latitude and 47° N. latitude and the zone north of 47° N. latitude are there vessels fishing more than 300 tows in a year. The 95th percentile TCE and median catch, as well as the ratios of those measures to QPVL, are presented for each fishing pattern and area in Table 3-76 and Table 3-77.

Table 3-76 shows results for a fishing pattern with 200 tows fished on the shelf and 200 tows on the slope. Section (a) of Table 3-77 shows the 95th percentile TCE for each stratum for selected rockfish species (overfished and recently rebuilt) and Pacific halibut (which is not a target). Section (b) shows the median catch for fishing patterns by strata and species. Section (c) shows the 2016 QPVL for each species. Section (d) shows the ratio of the 95th percentile TCE to the QPVL. This measure is an indicator of the risk that vessels would be constrained by QPVL due to incidental catch of these species. Section (e) shows the ratio of median simulated catch to QPVL. Notably the ratios in section (d) do not exceed 0.6 for any of the rockfish species, and they do not exceed 0.9 for Pacific halibut. This suggests that vessels fishing this number of tows in each stratum would be unlikely to be constrained by QPVL.[54]

Table 3-77 shows results for fishing patterns with 100 tows on the shelf and 300 tows on the slope. Most vessels in the groundfish trawl IFQ tend to have a higher proportion of effort on the slope (presumably targeting DTS, and this pattern is more representative of the overall fleet, though most vessels fish far fewer than 400 tows per year). For this pattern, the ratio of the 95th percentile TCE to the QPVL is just below 1.0 (at 1.1) for Pacific halibut in the area north of 47° N. latitude, but it does not exceed 0.7 for any other species in any area.

[54] Note: For Pacific halibut, catch must be discarded and, if the fish is still alive, fishers are not charged the full weight of the fish against QP. Coastwide, approximately 75 percent of Pacific halibut are discarded in excellent condition (Jannot et al. 2016), and fishers are only charged QP for 20 percent of the fish weight for those fish on the assumption that 80 percent will survive. The TCE and median catch presented here are not reduced to account for this; thus, they can be expected to overestimate the amount of catch that would actually be counted against the QPVL.

Table 3-76. 95th percentile tail conditional expectation (TCE) and median catch by strata for 200 tows each on shelf and slope.

Area	Bocaccio	Canary	Cowcod	Dark-blotched	Pacific halibut	POP	Widow	Yelloweye
(a)	95th Percentile TCE							
North of 47°	-	1,976	-	8,857	22,261	8,553	2,952	29
45°20' to 47°	-	1,960	-	14,968	7,671	11,484	31,738	21
44°to 45°20'	-	794	-	28,325	20,698	15,130	5,277	-
42°30' to 44°	-	5,660	-	39,854	7,229	3,510	32	17
40°10' to 42°30'	-	16,614	-	8,570	12,434	170	232	-
38° to 40°10'	33,911	2,619	243	4,116	-	-	11,583	18
36° to 38°	10,914	2,340	300	617	-	-	4,804	81
(b)	Median Catch							
North of 47°	-	691	-	4,963	16,297	5,222	682	3
45°20' to 47°	-	729	-	8,435	5,351	4,711	9,270	5
44°to 45°20'	-	425	-	16,116	18,162	7,965	1,318	-
42°30' to 44°	-	2,853	-	20,793	5,665	1,896	18	4
40°10' to 42°30'	-	2,290	-	1,456	9,986	78	147	-
38° to 40°10'	13,571	1,600	96	1,707	-	-	3,591	6
36° to 38°	6,109	263	166	272	-	-	630	20
(c) Vessel QP Limit	102,668	223,571	546	76,096	25,186	26,231	2,134,911	276
(d)	Ratio of 95th Percetile TCE/Vessel QP Limits							
North of 47°	-	0.0	-	0.1	0.9	0.3	0.0	0.1
45°20' to 47°	-	0.0	-	0.2	0.3	0.4	0.0	0.1
44°to 45°20'	-	0.0	-	0.4	0.8	0.6	0.0	-
42°30' to 44°	-	0.0	-	0.5	0.3	0.1	0.0	0.1
40°10' to 42°30'	-	0.1	-	0.1	0.5	0.0	0.0	-
38° to 40°10'	0.3	0.0	0.4	0.1	-	-	0.0	0.1
36° to 38°	0.1	0.0	0.6	0.0	-	-	0.0	0.3
(e)	Median Catch/Vessel QP Limits							
North of 47°	-	0.0	-	0.1	0.6	0.2	0.0	0.0
45°20' to 47°	-	0.0	-	0.1	0.2	0.2	0.0	0.0
44°to 45°20'	-	0.0	-	0.2	0.7	0.3	0.0	-
42°30' to 44°	-	0.0	-	0.3	0.2	0.1	0.0	0.0
40°10' to 42°30'	-	0.0	-	0.0	0.4	0.0	0.0	-
38° to 40°10'	0.1	0.0	0.2	0.0	-	-	0.0	0.0
36° to 38°	0.1	0.0	0.3	0.0	-	-	0.0	0.1

Table 3-77. 95th percentile TCE and median catch by strata for 100 shelf tows and 300 slope tows.

Area	Bocaccio	Canary	Cowcod	Dark-blotched	Pacific halibut	POP	Widow	Yelloweye
(a)				95th Percentile TCE				
North of 47°	-	1,388	-	10,136	24,113	11,611	3,372	22
45°20' to 47°	-	1,310	-	19,732	8,140	14,789	25,295	16
44°to 45°20'	-	487	-	38,149	13,901	15,511	5,074	-
42°30' to 44°	-	3,461	-	53,020	6,258	4,779	28	12
40°10' to 42°30'	-	10,314	-	10,070	9,658	225	157	-
38° to 40°10'	30,621	1,577	210	5,374	-	-	8,019	12
36° to 38°	7,188	1,729	275	805	-	-	3,797	74
(b)				Median Catch				
North of 47°	-	361	-	5,565	17,300	7,612	688	2
45°20' to 47°	-	339	-	11,918	5,455	7,087	6,047	2
44°to 45°20'	-	211	-	23,816	11,488	8,097	712	-
42°30' to 44°	-	1,348	-	30,818	4,598	2,847	14	2
40°10' to 42°30'	-	1,011	-	2,018	7,188	119	86	-
38° to 40°10'	9,473	773	54	2,574	-	-	1,734	3
36° to 38°	3,398	125	137	405	-	-	433	11
(c) Vessel QP Limit	102,668	223,571	546	76,096	25,186	26,231	2,134,911	276
(d)				Ratio of 95th Percetile TCE/Vessel QP Limits				
North of 47°	-	0.0	-	0.1	1.0	0.4	0.0	0.1
45°20' to 47°	-	0.0	-	0.3	0.3	0.6	0.0	0.1
44°to 45°20'	-	0.0	-	0.5	0.6	0.6	0.0	-
42°30' to 44°	-	0.0	-	0.7	0.2	0.2	0.0	0.0
40°10' to 42°30'	-	0.0	-	0.1	0.4	0.0	0.0	-
38° to 40°10'	0.3	0.0	0.4	0.1	-	-	0.0	0.0
36° to 38°	0.1	0.0	0.5	0.0	-	-	0.0	0.3
(e)				Median Catch/Vessel QP Limits				
North of 47°	-	0.0	-	0.1	0.7	0.3	0.0	0.0
45°20' to 47°	-	0.0	-	0.2	0.2	0.3	0.0	0.0
44°to 45°20'	-	0.0	-	0.3	0.5	0.3	0.0	-
42°30' to 44°	-	0.0	-	0.4	0.2	0.1	0.0	0.0
40°10' to 42°30'	-	0.0	-	0.0	0.3	0.0	0.0	-
38° to 40°10'	0.1	0.0	0.1	0.0	-	-	0.0	0.0
36° to 38°	0.0	0.0	0.3	0.0	-	-	0.0	0.0

For the most part, catch rates of the selection rockfish species have decreased in the catch share period, though there are exceptions. Table 3-78 shows the 95th TCE from 200 tows on the shelf and 200 tows on the slope in each area using both sets of data. In the areas north of 44° N. latitude, the 95th percentile TCE is lower from 2013 to 2015 for all of the overfished rockfish and Pacific halibut, except for widow rockfish from north of 44° N. latitude to 45°20' N. latitude. Widow rockfish is rebuilt, and some targeting has been occurring. In the areas south of 40°10' N. latitude, the 95th TCE increased for canary rockfish and also increased for bocaccio and widow rockfish from north of 38° N. latitude to 40°10' N. latitude. The 95th TCE for darkblotched rockfish also increased from north of 42°30' N. latitude to 44° N. latitude.

A comparison of median catches from 200 tows each on the shelf and slope for the two periods shows similar results (Table 3-79). The primary difference is a more prevalent rise in catch rates for widow rockfish, which reflects the fact that fishers no longer have to avoid widow and some are targeting it.

Table 3-78. Comparison of 95th TCE from 200 tows each on shelf and slope for pre-IFQ observed tows (2002 to 2009) versus IFQ tows (2013 to 2015).

Area	Bocaccio	Canary	Cowcod	Dark-blotched	Pacific halibut	POP	Widow	Yelloweye
	95th TCE from 200 Tows on Shelf and 200 Tows on Slope							
2013-2015 Tows								
North of 47°	-	1,976	-	8,857	22,261	8,553	2,952	29
45°20' to 47°	-	1,960	-	14,968	7,671	11,484	31,738	21
44°to 45°20'	-	794	-	28,325	20,698	15,130	5,277	-
42°30' to 44°	-	5,660	-	39,854	7,229	3,510	32	17
40°10' to 42°30'	-	16,614	-	8,570	12,434	170	232	-
38° to 40°10'	33,911	2,619	243	4,116	-	-	11,583	18
36° to 38°	10,914	2,340	300	617	-	-	4,804	81
2002-2009 Tows								
North of 47°	2,480	8,166	-	20,508	71,141	70,295	21,536	408
45°20' to 47°	78	2,772	-	17,850	11,128	58,917	46,502	102
44°to 45°20'	108	2,343	-	47,006	34,195	33,443	2,093	121
42°30' to 44°	261	9,069	12	33,174	14,564	5,358	510	226
40°10' to 42°30'	328	25,019	-	25,137	13,582	2,170	59,736	31
38° to 40°10'	20,024	2,467	945	11,686	8,098	278	4,987	127
36° to 38°	19,079	2,185	570	4,776	746	1	10,542	62
Ratio (2013-2015)/(2002-2009)								
North of 47°		24%		43%	31%	12%	14%	7%
45°20' to 47°		71%		84%	69%	19%	68%	20%
44° to 45°20'		34%		60%	61%	45%	252%	0%
42°30' to 44°		62%	0%	120%	50%	66%	6%	8%
40°10' to 42°30'		66%		34%	92%	8%	0%	0%
38° to 40°10'	169%	106%	26%	35%	0%	0%	232%	14%
36° to 38°	57%	107%	53%	13%	0%	0%	46%	131%

Table 3-79. Comparison of median catch from 200 tows each on shelf and slope for pre-IFQ observed tows (2002 to 2009) versus IFQ tows (2013 to 2015).

Area	Bocaccio	Canary	Cowcod	Dark-blotched	Pacific halibut	POP	Widow	Yelloweye
	Median Catch from 200 Tows on Shelf and 200 Tows on Slope							
2013-2015 Tows								
North of 47°	-	691	-	4,963	16,297	5,222	682	3
45°20' to 47°	-	729	-	8,435	5,351	4,711	9,270	5
44°to 45°20'	-	425	-	16,116	18,162	7,965	1,318	-
42°30' to 44°	-	2,853	-	20,793	5,665	1,896	18	4
40°10' to 42°30'	-	2,290	-	1,456	9,986	78	147	-
38° to 40°10'	13,571	1,600	96	1,707	-	-	3,591	6
36° to 38°	6,109	263	166	272	-	-	630	20
2002-2009 Tows								
North of 47°	677	4,151	-	10,025	52,894	44,616	198	111
45°20' to 47°	-	756	-	9,378	8,473	26,808	1,168	13
44°to 45°20'	21	1,245	-	18,018	24,297	12,311	352	18
42°30' to 44°	74	4,991	-	16,407	9,698	1,743	110	70
40°10' to 42°30'	98	7,656	-	7,385	10,549	108	13,630	-
38° to 40°10'	10,624	1,658	330	4,261	5,853	88	2,200	31
36° to 38°	9,055	381	231	549	262	-	699	-
Ratio (2013-2015)/(2002-2009)								
North of 47°	0%	17%		50%	31%	12%	344%	3%
45°20' to 47°		96%		90%	63%	18%	794%	41%
44°to 45°20'	0%	34%		89%	75%	65%	374%	0%
42°30' to 44°	0%	57%		127%	58%	109%	16%	5%
40°10' to 42°30'	0%	30%		20%	95%	73%	1%	
38° to 40°10'	128%	97%	29%	40%	0%	0%	163%	18%
36° to 38°	67%	69%	72%	50%	0%		90%	

For the analysis of the shorebased Pacific whiting fleet, tows were not stratified by area or depth, as most vessels fish in a range of areas following the distribution of fish. Fishing patterns with either 75 tows or 100 tows are evaluated with tows drawn randomly from all 2013 to 2015 midwater trawl tows targeting whiting by the shorebased IFQ fleet. The 95th TCE and even the 99th TCE are well below QPVL for all species of concern modeled, suggesting that for vessels fishing in the whiting fishery, there is little risk of vessels being constrained by QPVL (Table 3-80).

Table 3-80. Median catch 95th TCE and 99th TEC for 75 and 100 Pacific whiting midwater trawl tows.

Meaure	Annual Tows	Canary	Darkblotched	Pacific halibut	POP	Widow
Median Catch	75	195	378	115	501	21,916
95th TCE	75	841	3,263	312	4,853	70,045
99th TCE	75	1,179	4,446	384	6,673	89,264
Median Catch	100	271	590	157	725	29,871
95th TCE	100	980	3,681	376	5,444	84,750
99th TCE	100	1,322	4,945	452	7,175	106,461
Vessel QP Limit		223,571	76,096	25,186	26,231	2,134,911

Because the analysis uses fishery-dependent data, it reflects the behavior of the vessels, as well as the distribution of the bycatch species in each area. Thus, these estimates of median and 95th percentile TCE reflect expectations that vessels will continue operating with this same level of care. Were vessels to begin targeting some of the included rockfish species (as some already are for widow rockfish) or making less effort to avoid them, the TCE or median catch measures may rise, along with the risk of QPVL being binding. However, if vessels were to make less effort to avoid these species or target them, this would also imply that were they concerned with reaching a vessel QP limit, they could increase efforts at avoidance. Thus, this analysis does not provide reason for concern that vessel QP limits for these species are likely to be a widespread problem. Of the evaluated species, only Pacific halibut equaled or exceeded the vessel QP limit at the 95th percentile TCE, and even then only in a few areas and assuming 400 tows, which is well above the average. Also, since much of the Pacific halibut is discarded in good condition, fishers are not charged the full weight of the catch against QP, and the risk of exceeding the 95th TCE may be substantially lower than this analysis suggests, since a substantial portion of this catch would probably not be counted against QPVL. The increases in ACLs and consequently vessel QP limits in the last few years have considerably reduced the risk of exceeding vessel QP limits for several species.

3.1.3(a)(2) Pacific whiting Allocation Utilization

Highlights:

- Catches of Pacific whiting may be affected by fishing opportunities in Alaska because all motherships and catcher-processors, and many catcher vessels also fish in Alaska.
- Bycatch quota likely directly constrained whiting catch when limits were reached (mothership sector in 2014), and it may implicitly constrain catch if the risk of bycatch changes fishing behavior (all sectors in 2015).
- Russian import demand affected exports beginning in 2014.

- Anomalous ocean conditions (“the blob”) affected fishing conditions in 2015.

Quota for Pacific whiting is allocated across three sectors: vessels that make shoreside deliveries, catcher vessels that deliver to at-sea mothership processors, and catcher-processors. The whiting fleets have generally caught the majority of their allocations (Table 3-81 and Figure 3-48). In 2014, however, attainment fell in the mothership and shoreside sectors. In 2015, attainment fell again, but in all three sectors.

Economic outcomes for the whiting sectors were covered in Section 3.1.2, but are briefly summarized here for context. All sectors experienced varying net revenue between 2011 and 2014, influenced by a variety of factors: total annual catch limits for Pacific whiting, changes in variable and fixed costs, bycatch conditions, market conditions, and attainment of each sector’s quota. In 2015, however, net revenue decreased across all whiting sectors, corresponding with the lowest rates of sector allocation utilization since well before the beginning of the catch share program (Section 3.1.2(a)). The number of participating catcher vessels and motherships decreased slightly between 2013 and 2014 (approximately one vessel less in each sector each year) but more sharply between 2014 and 2015 than in any other year except in 2011 (directly following the implementation of the catch share program) (Section 3.1.(b)(1), Figure 3-47).

This section will assess factors that may have contributed to the observed changes in the whiting sector allocation utilization in the mothership and shoreside sectors in 2014, and in all sectors in 2015 (Figure 3-48). A Russian ban on Pacific whiting imports from the United States and anomalous ocean conditions may have interacted with ongoing adjustments resulting from the transition to catch share management, which was expected to provide more flexibility for portioning efforts between Alaska and West Coast fishing operations (PFMC and NMFS 2010). How these factors may have impacted the fishery by affecting participants’ choices of when, where, and what species to fish based on their expectations of environmental and market conditions are discussed. Catch shares have created new flexibility that also may have affected utilization rates.

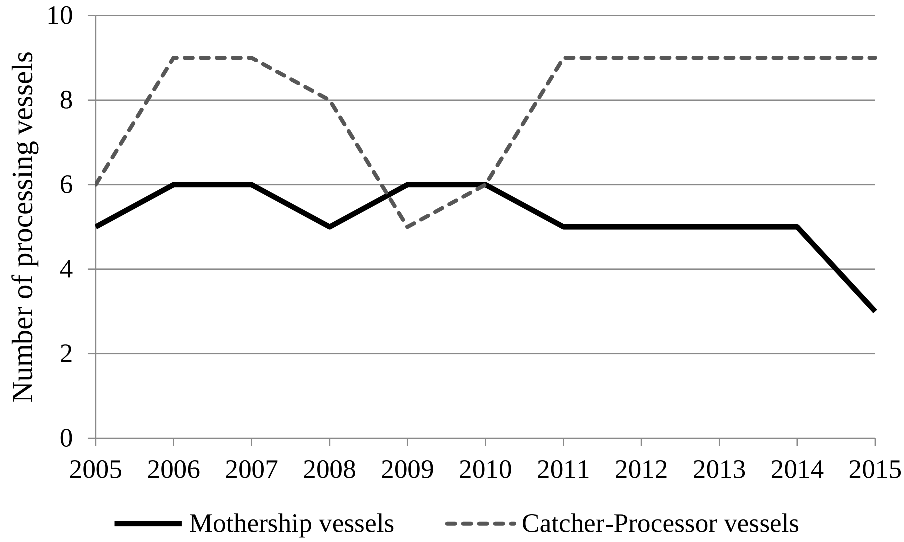


Figure 3-47. Number of motherships and catcher-processors participating in the West Coast Pacific whiting fishery. Source: FISHEyE.

Table 3-81. Initial and final whiting allocations (mt), catches (mt), and utilization (percent used), by sector. Final allocations are a result of in-season reallocations when predictions of tribal catches fall below their annual allocation or if an at-sea sector declares it has ended fishing for the year. Source: F.4.a, Attachment 2, April 2017 Briefing Book.

	Catcher-Processor				Mothership				Shoreside			
Year	**Original**	**Final**	**Catch**	**% used**	**Original**	**Final**	**Catch**	**% used**	**Original**	**Final**	**Catch**	**% used**
2005	78,903	78,903	78,890	100%	55,696	55,696	48,571	87%	97,469	97,469	97,381	100%
2006	78,903	78,903	78,864	100%	55,696	55,696	55,355	99%	97,469	97,469	97,297	100%
2007	64,751	70,751	73,263	104%	49,942	49,942	47,809	96%	93,398	87,398	73,280	84%
2008	79,065	115,789	108,121	93%	55,811	58,087	57,432	99%	97,669	58,669	50,423	86%
2009	27,859	35,376	34,620	98%	19,665	24,034	24,091	100%	34,414	40,738	40,771	100%
2010	47,939	53,379	54,285	102%	33,839	37,679	35,714	95%	59,218	65,938	62,319	95%
2011	75,138	75,138	71,522	95%	53,039	53,039	50,050	94%	92,818	92,818	91,186	98%
2012	46,046	55,584	55,695	100%	32,515	39,235	38,215	97%	56,902	68,662	65,662	96%
2013	69,373	79,573	78,041	98%	48,970	56,170	52,522	94%	85,697	98,297	97,621	99%
2014	88,186	103,486	103,266	100%	62,249	73,049	62,038	85%	108,935	127,835	98,714	77%
2015	90,673	100,873	68,484	68%	64,004	71,204	27,660	39%	112,007	124,607	58,384	47%

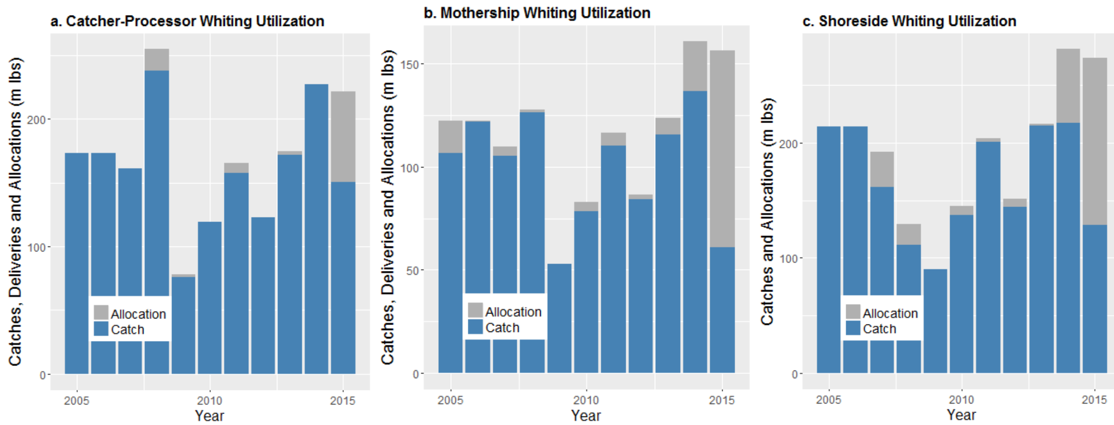


Figure 3-48. Landings and unutilized catch allocations for the (a) catcher-processor; (b) mothership; and (c) shoreside Pacific whiting sectors. The allocation includes any reapportionment among sectors that may have occurred during the season. Source: Table 3-81.

Flexibility and Fishing Activity in Alaska

Vessels participating in the West Coast trawl groundfish fishery often also fish in other fisheries. Catch share management was expected to allow greater flexibility for participants to maximize profits from multiple fisheries. Catcher-processor vessels, motherships, and most of the catcher vessels participating in the at-sea and shoreside whiting sectors focus on high-volume production of Alaska pollock in the Bering Sea and Aleutian Islands off Alaska and Pacific whiting on the West Coast. All catcher-processors and motherships fish both in Alaska and along the West Coast, although the majority of effort for both sectors takes place in Alaska (Figure 3-49). Even under productive Pacific whiting conditions, effort in the mothership and catcher-processor sectors along the West Coast may be affected by Alaska fishing opportunities (Hsueh In press). Under catch shares, participants were expected to allocate resources more effectively to prosecute both fisheries with higher returns, such as delaying whiting harvests until later in the year following the pollock season in Alaska (PFMC and NMFS 2010).

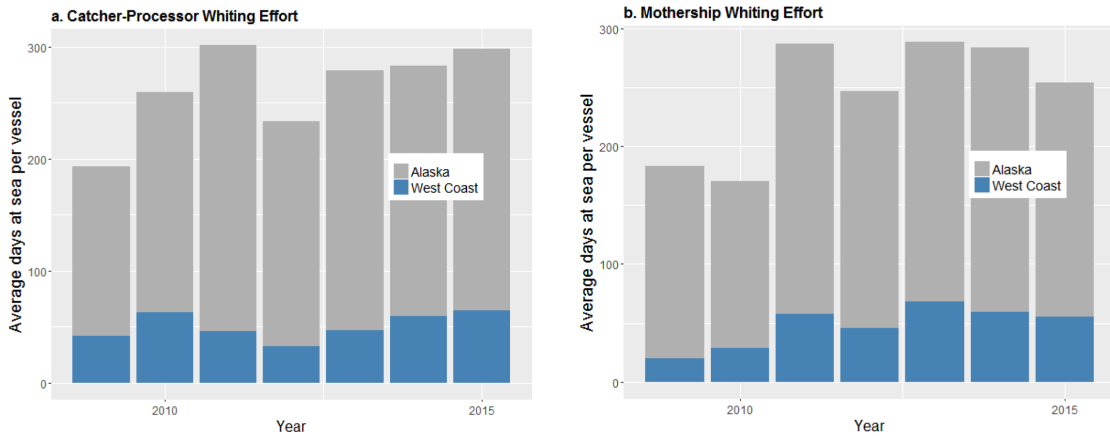


Figure 3-49. Average days at sea per vessel by sector, West Coast and Alaska. Source: Data from FISHEyE.

Expectations with respect to flexibility were informed by the experience of the catcher-processor sector. There is evidence that the catcher-processor sector has experienced increased flexibility under rationalization, which occurred with the formation of the Pacific Whiting Conservation Cooperative (PWCC) in 1997. Prior to that date, the entire Pacific whiting fishery was a derby. The FEIS noted that prior to the formation of the PWCC, nearly all West Coast catcher-processor effort took place in May. After 1997, it was more evenly distributed throughout the year, from May through November. Most catcher-processors started to leave the whiting fishery for the pollock season in the spring, but would return to the West Coast to harvest any remaining whiting quota allocation (PFMC and NMFS 2010). Derby-style fishing practices continued in the mothership and shorebased sectors until catch shares were implemented in 2011 (Hsueh In press), and seasonal participation information for the mothership and shorebased sectors illustrates that effort is now more evenly distributed throughout the year. Prior to the catch share program, effort was concentrated in May (June for the shorebased sector), before the start of the pollock season (Table 3-82). Starting in 2011, participation has increased beginning in August when vessels return to the West Coast.

Table 3-82. Number of participating mothership vessels in the West Coast Groundfish Fishery by month. Note: Number of vessels are not additive as values do not represent unique values. Source: PacFIN.

Year	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2004	4	1	0	0	0	0	0	0
2005	5	4	0	0	0	1	1	0
2006	6	5	0	1	2	0	0	0
2007	6	5	1	0	0	0	0	0
2008	5	5	1	1	0	1	1	0
2009	6	3	0	0	0	0	0	0
2010	6	6	0	0	1	1	0	0
2011	3	3	0	0	2	3	4	1
2012	3	1	1	2	2	4	1	0
2013	3	2	1	1	2	4	1	0
2014	4	2	0	1	4	4	3	0
2015	3	2	0	0	3	2	0	0

Monthly participation illustrates that 2015 was different than other years in the catch share period. In 2014, four mothership vessels fished on the West Coast in both September and October. In 2015, although the whiting TAC was similar to 2014, only three motherships re-entered in September, and only two participated in October (compared to four participating in October of 2014). Additionally, 2015 was the first year since 2011 that no vessels participated in November. While it is not clear why no mothership vessels participated in the late season, without mothership processor participation, at-sea catcher vessels had no one to deliver to, which may further explain low quota attainment (Table 3-82). The number of catcher vessels targeting non-whiting species using mid-water trawl gear in October to November increased from four vessels in 2014 (only one of which had a mothership/catcher vessel-endorsed permit) to nine vessels in 2015 (seven of which had mothership/catcher vessel-endorsed permits). This could indicate that catcher vessels decided to target non-whiting species late in the year in the absence of a mothership processor to take catch.

Bycatch constraints

In the catch share program, participants must have enough quota to cover the catch of both target and rebuilding species. For the shoreside IFQ sector, bycatch quota limits are managed individually, whereas bycatch quota in the mothership and catcher-processor sectors is pooled among participants and managed with internal cooperative rules (Pacific Whiting Conservation Cooperative 2011, 2015, Whiting Mothership Cooperative 2016). For the mothership cooperative, there are rules that require vessels to relocate if bycatch rates exceed certain thresholds, called triggers. The mothership co-op also divides the whiting allocation into multiple pools that each receive a pro rata bycatch allocation, and can implement in-season ‘hot spot’ closures (Fraser 2011). Bycatch quota may directly constrain catch if limits are reached, and it may implicitly constrain catch if the risk of bycatch changes fishing behavior and/or increases costs.

In 2014, the mothership sector exceeded its allocation for darkblotched rockfish (PFMC 2016b). After hitting the sector bycatch limit in June, the mothership sector ceased fishing until the Council took emergency action to reallocate three mt of darkblotched rockfish from the catcher-processor to the mothership sector (NMFS 2014). Industry representatives reported that by October when the Council made these changes, Pacific whiting was no longer concentrated enough to be considered fishable (PFMC 2016b, p. 101). The under-harvest of whiting quota in the mothership sector in 2014 was likely due to this interruption of fishing activities. In response to observed bycatch constraints, the Council included provisions in its 2017 biennial control rules to change the harvest control rules for darkblotched rockfish and POP in its rebuilding plans (PFMC 2016b). For darkblotched rockfish, harvest specifications were adjusted based on an updated stock assessment that predicted the stock would be rebuilt in 2016, 10 years earlier than the rebuilding target of 2025. For POP, the catch ACL was made constant for 2017 to 2018 to support coastal communities that “rely on revenue from fisheries on healthy stocks that take [POP] incidentally.” (81 Fed. Reg. 75266, October 28, 2016).

Harvesters also may have been indirectly constrained by bycatch in 2014 and 2015. Evidence suggests that relocation triggers have become increasingly common (PFMC 2016b). Relocation of the fleet may increase operational expenses (PFMC 2016b Tables 35-36) and, thus, can place constraints on fishing and quota utilization even before overall bycatch limits are reached. Catcher-processors achieved full attainment and had relatively low levels of bycatch in 2014, but had increased levels of bycatch of both darkblotched rockfish and POP in 2015, which may have contributed to reduced attainment. The shoreside whiting fishery may have been particularly constrained, since individual accountability of bycatch may have led to more risk-adverse behavior to avoid the chance of a disaster tow. Bycatch has been a bigger issue in recent years because rebuilding of overfished stocks has increased encounter rates and contributed to a perceived risk of a “lightning strike,” or a single tow that would send a vessel over its limit. For example, in 2014, widow rockfish bycatch more than tripled, and in 2015, bycatch of several species spiked (Table 31 in PFMC 2016b). Although aggregate shoreside sector bycatch limits were not exceeded in any of the years since the implementation of catch shares, there have been several lightning strike cases in which individual limits were exceeded (one while targeting whiting and two in the non-whiting midwater trawl fishery), and participants indicated that bycatch concerns were an important consideration in the Pacific whiting fishery in recent years.

Russian Import Ban

In August 2014, Russia banned the import of most seafood products from the United States, including frozen fish. This sanction directly affected the West Coast seafood industry, which supplies significant exports of Pacific whiting ($8 million total export value in 2013) (Sackton 2014). In the first two months following the ban, some industry representatives reported that prices fell by 10 percent for headed and gutted (HG) whiting (Parker 2014). West Coast producers reported shifting away from HG whiting production in favor of surimi when troubles with Russia were first signaled (Stewart 2014). Following the ban, harvesters may have made decisions about their participation in the whiting fishery versus other fisheries, or whether to reduce their effort in accordance with reduced demand.

Anomalous Ocean Conditions

Beginning in late 2013 and continuing until late 2015, a region of unusually warm water occurred along the West Coast from the Gulf of Alaska to California, dubbed the "warm blob." These unusual ocean conditions caused weakened currents and other oceanographic changes, which have been implicated in a number of ecological outcomes including auklet and sea lion die-offs (Kintisch 2015). Initially, the warm blob did not appear to affect the Pacific whiting fishery, which reported strong harvests at the start of the 2015 season (Stewart 2015). Because of this, harvesters may not have anticipated the poor harvest conditions that resulted in late 2015 based on these early season conditions and instead participated in other fisheries, such as Alaska pollock, expecting to harvest whiting later in the year. As previously discussed, there is evidence that motherships and catcher-processors increasingly rely on fishing later in the year, as opposed to the pre-rationalization pattern of reaching full attainment in the spring (Table 3-82). In 2015, low attainment across the sectors was attributed to low aggregations of Pacific whiting potentially leading to unfishable conditions for harvesters (PFMC 2016b). The decrease in catch per day from previous years is notable in all of the whiting sectors (Figure 3-50). NOAA NWFSC conducted the first winter Pacific whiting survey in 2016 and found higher-than-normal temperatures and relatively low whiting abundance. Water temperatures were 2°F to 4°F above recent conditions in the normally highly productive areas off the Oregon and Washington coast, potentially providing an explanation for low catch per unit effort in the whiting sector in the fall of 2015 (EO Media Group, 2016).[55]

[55] Analyses examining the extent and nature of observed abundances with respect to 2015 conditions are expected, but are not yet available.

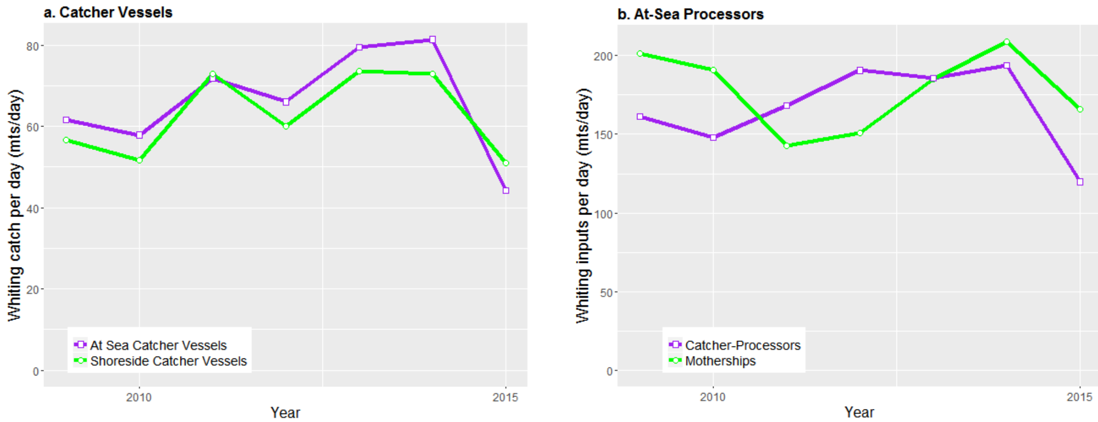


Figure 3-50. Changes in catches rates for harvesting vessels and delivery rates for processing vessels per day at sea, by sector. Source: EDC data.

Summary

Many of the factors contributing to Pacific whiting quota utilization discussed here are not directly attributable to the implementation of catch shares. Bycatch limitations and increased encounters with rebuilding bycatch species are the result of managing rebuilding populations, the warm blob was the result of anomalous oceanographic conditions, and geopolitics influenced the uncertainty in the whiting export market. However, the flexibility that the catch share program provides allows vessels to apportion their effort strategically between West Coast Pacific whiting, Alaska pollock, and other fisheries to maximize returns. This flexibility existed for catcher-processors prior to catch shares through the PWCC. This flexibility can benefit vessels by allowing them to minimize effort in a location experiencing unfavorable conditions, such as the high bycatch or low catch per unit effort conditions of 2014 and 2015. However, the at-sea catcher vessels depend on motherships to purchase and process their catch, and the decision for motherships not to return to the West Coast in 2015 may have been detrimental if the catcher vessels preferred to continue to fish for whiting. These negative impacts were possibly mitigated if vessels chose to diversify. As previously discussed (Section 3.1.2(d)(5)), a non-whiting mid-water trawl fishery has emerged since 2012, the number of vessels using mid-water trawl gear to target non-whiting species has more than doubled since 2012, and the harvest volume more than doubled between 2014 and 2015. The number of mothership/catcher vessel-endorsed catcher vessels targeting non-whiting with mid-water trawl gear in October and November increased from one in 2014 to seven in 2015 (when there were no motherships processing on the West Coast).

3.1.3(b) Income and Employment Impacts through Associated Sectors of the Industry

Promote measurable economic and employment benefits through seafood catching, processing, distribution elements, and support sectors of the industry (Amendment 20 Objective).

Highlights:

- Income and employment impacts generated by all sectors of the fishery increased, with the exception of motherships and whiting catcher vessels in 2015.

This section details the income and employment impacts of West Coast groundfish fishing between 2009 and 2015. The following is not intended to describe the economic impact of catch share program implementation. Such an estimate would require a more complex research design that included a counterfactual to represent conditions that would have existed had implementation not occurred. The following should be interpreted as the number of jobs and income that are generated from groundfish revenue through time, rather than a net change in jobs and income that occurred due to implementation.

Economic impacts are derived using the input-output model for Pacific Coast Fisheries (IO-PAC model) (Leonard and Watson 2011). Total economic impacts estimated using IO-PAC are the sum of the direct, indirect, and induced effects of groundfish revenue (Miller and Blair 1985). In this context, direct effects are the income and employment of people directly involved in vessel operations. Direct income effects are the wages and salaries of captain, crew, and payments to vessel and quota proprietors. Direct employment effects represent the number of captain and crewmember positions on vessels. Indirect effects are income and employment in sectors of the economy that supply goods and services to fishing vessels. Induced effects are the income and employment resulting from household spending. Higher direct income effects result in both higher induced income and employment effects because those receiving higher incomes are expected to spend more money. Higher indirect income effects may also result in higher induced effects, depending on whether the higher indirect income comes at the expense of lower direct income. Increases in efficiency will initially reduce indirect income while increasing direct income. While the estimates that follow are the total impacts, the discussion includes some distinction of direct and induced effects.

The impact estimates herein are done only at the coastwide level. The assumption is that payments for the lease or use of quota are made to quota holders residing in Washington, Oregon, or California. This is an important assumption, as the quota lease and purchase payments are considerable. Leonard and Steiner (working paper) indicate that assumptions regarding the distribution of quota payments can substantially change conclusions about the economic impacts of the catch share program. The assumption used here is likely more accurate the larger the study area for which impact estimates are made, because proprietors of quota are more likely to reside in one of the three states than in one particular port area. Given the current uncertainty regarding the residence of quota proprietors, coastwide estimates are more accurate than similar estimates made for particular ports.

Income and employment are related, so the same factors that affect income also affect employment. For employment, however, an additional consideration is the number of vessels that remain active in the fishery. As discussed above, the direct employment effect is the number of captain and crew working directly on the fishing vessels. Hence, a negative direct employment effect indicates that the number of captain and crew for active vessels declined. If income increases, it will boost employment due to a higher level of household spending. While the number of employees directly involved in the fishing industry may decline due to reduction in the number of active vessels, a higher level of income may offset some or all the decline. The type of jobs created due to increases in income reflects increases in industries that comprise a relatively large share of household income such as food services, health practitioners, retail trade establishments, and wholesale trade businesses.

The total income and employment estimates of West Coast groundfish revenue are presented in Table 3-83. For non-whiting catcher vessels in the first year of implementation, total West Coast income was about 40 percent higher than the average of 2009 and 2010. This is the result of higher direct income payments (to captain, crew, and vessel and quota proprietors) and higher induced effects. The higher direct effects in 2011 are primarily the result of higher non-whiting groundfish revenue and slightly lower payments, as a share of revenue, to other non-income factors of production such as maintenance, fuel, insurance, etc. After some income decline in 2012, non-whiting vessel incomes climbed steadily back to the 2011 level by 2015. For non-whiting groundfish vessels, total employment increased slightly over the 2009 to 2015 period. While the number of employees directly working on vessels decreased, the increase in income offset the decline in total employment. The number of employee positions on vessels fell by 18 in 2015 from the average in 2009 and 2010, but the increase in income led to an overall increase in employment by 50 jobs in 2015 from the 2009 and 2010 average.

Total West Coast income from whiting catcher vessels rose sharply in 2011 compared to the average for 2009 and 2010. This is largely the result of a sharp increase in whiting revenue, but like non-whiting vessels, whiting vessels also experienced lower payments as a share of revenue compared to other non-income factors of production, with factor payments other than income as a percentage of revenue from 2009 to 2011 of 67 percent, 65 percent, and 50 percent, respectively. Higher incomes also led to a boost in induced income effects. However, the lower level of whiting revenue in 2015 resulted in a substantial reduction in income back to a level lower than the 2009 and 2010 average. Direct employment fell over the period from 2011 to 2015; there were about 37 fewer direct employees from the 2009 and 2010 average. However, employment generated by increased income offsets the direct decline in all years except 2015.

Income trends for the mothership and catcher-processor sectors exhibit volatility due largely to fluctuations in revenue (Section 3.1.2(a)(1)). Total income generated by the mothership sector increased in 2010 over 2009, dropped in 2012, rose sharply in 2014, then plummeted in 2015. Total mothership generated income in 2015 was slightly higher than it was in 2009. From a high in 2010, employment from motherships has trended down. This is partially the result of the trend in income, but also because of a reduction in motherships active in the fishery. The downturn in 2015, in terms of both revenue and the decrease in the number of vessel participating, is a result of poor conditions in the whiting fishery in that year.

Catcher-processor generated income rose in 2010 over 2009, although not nearly as sharply as that of motherships. Catcher-processor income remained relatively flat for a few years, then rose in 2014 and fell in 2015. Employment trended up over the period. Like motherships, catcher-processor employment has been affected by changes in income, but, unlike motherships, direct employment has increased for catcher-processors. Despite the downturn in revenue for catcher-processors in 2015, direct employment was still 718 employees higher than the 2009 and 2010 average.

Table 3-83. Income and employment impacts of groundfish revenue from 2009 to 2015.

Income ($2012 thousands)				
	Catcher Vessels			
	Non-whiting	**Whiting**	**Motherships**	**Catcher-processors**
2009	29,294	20,998	16,724	42,109
2010	27,703	29,111	50,510	77,029
2011	39,708	49,828	41,581	77,551
2012	34,317	40,777	23,202	66,945
2013	35,470	55,525	28,355	88,086
2014	37,058	53,222	39,095	139,175
2015	40,473	22,370	17,485	82,256
Employment				
	Catcher Vessels			
	Non-whiting	**Whiting**	**Motherships**	**Catcher-processors**
2009	487	318	895	857
2010	455	382	1,259	1,129
2011	543	472	901	1,563
2012	524	434	731	1,537
2013	498	494	731	1,685
2014	498	505	951	1,913
2015	521	305	477	1,711

First Receivers

The total income and employment estimates of revenue from first-receivers and processors generated through groundfish revenue are presented in Table 3-84. The overall trend in income and employment is driven by relatively large fluctuations in revenue from processing whiting. Figure 3-51 shows the revenue generated by first-receivers and processors from handling and/or processing groundfish. Additionally, it shows the total income impacts derived from this revenue. While the overall trend in income tends to follow the whiting fluctuations, it is relatively more stable due to the inclusion of the non-whiting landings. This is particularly evident in 2015 in which the sharp decline in whiting revenue is partially countered by an increase in sablefish and other-groundfish revenue (Figure 3-51).

Table 3-84. Income and employment impacts of groundfish handling and processing, 2009 to 2015.

	Income ($2012 thousands)	**Employment**
2009	77,967	1,636
2010	66,942	1,467
2011	95,810	1,515
2012	86,628	1,278
2013	105,066	1,508
2014	97,074	1,336
2015	87,800	1,258

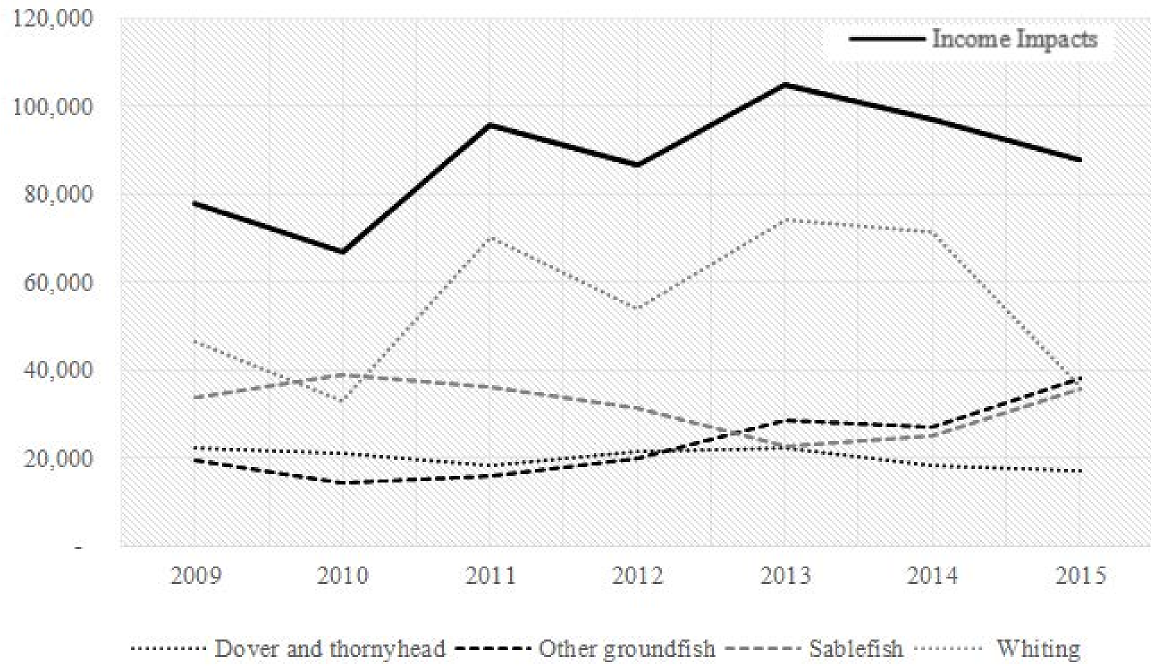


Figure 3-51. Groundfish revenue and income impacts for first receivers and processors 2009 to 2015 ($2012 thousands).

3.1.3(c) Interdependencies with Other Fisheries

Discuss interdependencies with other fisheries (Headquarters Guidance). Minimize adverse effects on other fisheries to the extent practical (Amendment 20 Objective). Minimize negative impacts resulting from localized concentrations of fishing effort (Amendment 20 Objective).

Highlights:

- Nearly all non-whiting vessels that exited the catch share fishery now operate similar to the way they did before the program was implemented, fishing primarily in the crab and shrimp fisheries and in Alaska.
- Effort by all sectors (including the IFQ, limited entry fixed gear daily trip limit, and open access fisheries) in the southern sablefish fishery has increased since 2009 when the basis for apportionment of the coastwide sablefish quota was changed, resulting in higher limits south of 36 degrees.

Catcher vessels in the catch share program earn only about 50 percent of their annual revenue from the catch share fishery (data available on FISHEyE). They participate in a wide variety of other activities, meaning that the catch share program and other fisheries are interdependent. This section describes several sources of interdependency that have been identified in the program.

The Amendment 20 FEIS (PFMC and NMFS 2010) predicted increased pressure on pink shrimp, Dungeness crab, and other operationally similar West Coast fisheries due to spillover of excess vessels (vessels that ceased participation in the catch share program). Section 3.2, Community Performance, identifies vessels that have left the catch share program and describes what they are doing now (33 vessels). Almost all of the vessels that still fish on the West Coast participate in the Dungeness crab fishery, several participate in non-IFQ sablefish fisheries, and several participate in other miscellaneous fisheries on the West Coast. Nearly all of the vessels had participated in these activities before their exit from the catch share program. In the first five years of the program, there has also been somewhat less consolidation than originally predicted by the FEIS (Section 3.1.1(b)(1)), meaning that these spillovers likely have less impact than predicted.

Alaska fisheries are important to many vessels in the fishery (Strong and Criddle 2013). Anecdotes from fishing companies involved in the Pacific whiting fishery suggest that the whiting fishery would likely not exist in its current state if not for the Alaska pollock fishery. While the number of catcher-vessel catch share participants traveling to Alaska to fish has declined somewhat (from an average of 28 in 2009 and 2010 to an average of 24 from 2011 to 2015), the percentage of catch share participants traveling to Alaska has not changed (about 22 percent from 2009 to 2015). Section 3.2, Community Performance, found that approximately half of the vessels that fished whiting on the West Coast but no longer do so now fish in Alaska. Overall, this means that while West Coast and Alaska fisheries are interdependent, minimal changes occurred after the institution of the catch share program. Alaska fisheries continue to be an integral component of catch share vessels' portfolios.

Conflicts with Other Fisheries

Minimize adverse effects on other fisheries to the extent practical.
Minimize negative impacts resulting from localized concentrations of fishing effort.

One issue that has recently been raised in the Council and in the community hearings[56] is spatial conflict between catch share harvesters (catch share gear switching vessels targeting sablefish using fixed gear fishing south of the 36˚ N. latitude line) and vessels fishing in the open access and daily trip limit sablefish fisheries. This conflict was presumably unanticipated, as there was no discussion of it in the FEIS (PFMC and NMFS 2010), and it relates to the following Amendment 20 Objectives:

The conflict is, in a sense, created by the existence of the 36˚ line that separates northern and southern trawl sablefish quota. Northern sablefish quota is nearly fully utilized, while the southern sablefish quota

[56] See agenda items F.6.b and F.6.d in the November 2016 Briefing Book: http://www.pcouncil.org/resources/archives/briefing-books/november-2016-briefing-book/

has been between 14 percent (2013) and 50 percent (2011) utilized. This means it is likely that a vessel permitted in the catch share fishery and willing to fish south of 36˚ N. latitude can relatively easily acquire quota to do so. Section 3.3, Environmental Performance, contains maps and discussion of the spatial overlap in effort. Section 3.1.2(d)(6) also shows that sablefish mortality by limited entry trawl vessels south of 36˚ N. latitude was extremely low in the time period depicted (Figure 3-36). It was higher in the 1990s, prior to the fishery-disaster declaration in 2000, the purchase of a number of permits by The Nature Conservancy in the early 2000s, and the industry-funded capacity reduction buyback in 2003. Intersector allocations were determined using historical landings from 1995 to 2005.[57]

Participants in public hearings and public comments have also been concerned with the impact that increased deliveries from catch share participants are having on demand from local processors (and, thus, prices). Landings by permit type are provided in Figure 3-52 to illustrate how deliveries from catch share participants compare to deliveries from other sectors.

Figure 3-52 shows sablefish landings to ports in the Morro Bay area by year and permit type. Total landings in the Morro Bay area increased from less than 400,000 lbs from 2005 to 2008 to nearly 1.5 million lbs in 2009. This was driven by a fourfold increase in landings in the open access sablefish fishery, which lasted through 2010, but decreased again in 2011. Limited entry trawl permit landings increased in 2009 and 2010 from very low levels from 2006 to 2008. Most of these vessels were fishing under The Nature Conservancy's Exempted Fishing Permit. Limited entry fixed gear permit daily trip limit landings increased in 2009, as well, and they have remained high through 2016. Small amounts of limited entry fixed gear primary sablefish were landed from 2011 to 2015. Finally, IFQ sablefish landings were at their maximum in the first year of the catch share program (2011). Total IFQ landings have decreased since then, and they make up a quarter to a half of total sablefish landings in the Morro Bay area (Figure 3-52).

The increase in landings in 2009 was driven by a large increase in the annual catch limits for sablefish south of 36˚ N. latitude, which resulted from the change in apportionment of the coastwide biomass estimates. Prior to 2009, the annual catch limit was apportioned based on catch. In 2009, it began to be apportioned using the relative biomass north and south of 36˚ N. latitude.

The pattern is very similar if southern California as a whole is considered (United States/Mexican border to Morro Bay area, not shown). The individual port areas cannot be shown to maintain confidentiality. However, nearly all of the IFQ sablefish is landed at ports in the Morro Bay area.

[57] As detailed in the Amendment 21 intersector allocation language approved August 9, 2010

Figure 3-53 shows per pound sablefish prices by fleet delivered to Morro Bay area ports, from 2005 to 2016. Prices cannot be separately shown for each gear type to maintain confidentiality, but most of the landings were caught with fixed gear. Prices for sablefish are mostly higher than they were prior to the catch share program, with the possible exception of 2016, when the median price open access sablefish was the lowest since 2011.

Overall, it is clear that landings of sablefish in Morro Bay and other parts of southern California have increased substantially. However, the increase began in 2009, two years before the start of the catch share program. The increase in 2009 and 2010 was driven by increases in open access and limited entry fixed gear permit daily trip limit landings. The decrease in open access landings in 2011 was made up for by IFQ landings and further increases in limited entry fixed gear permit landings. Total landings decreased somewhat from 2012 to 2016, but remained higher than historical levels (1994 to 2008). It is difficult to determine the effect that the increased landings had on sablefish prices. Overall, prices were higher from 2011 to 2016 for all permit types than they had been from 2005 to 2010.

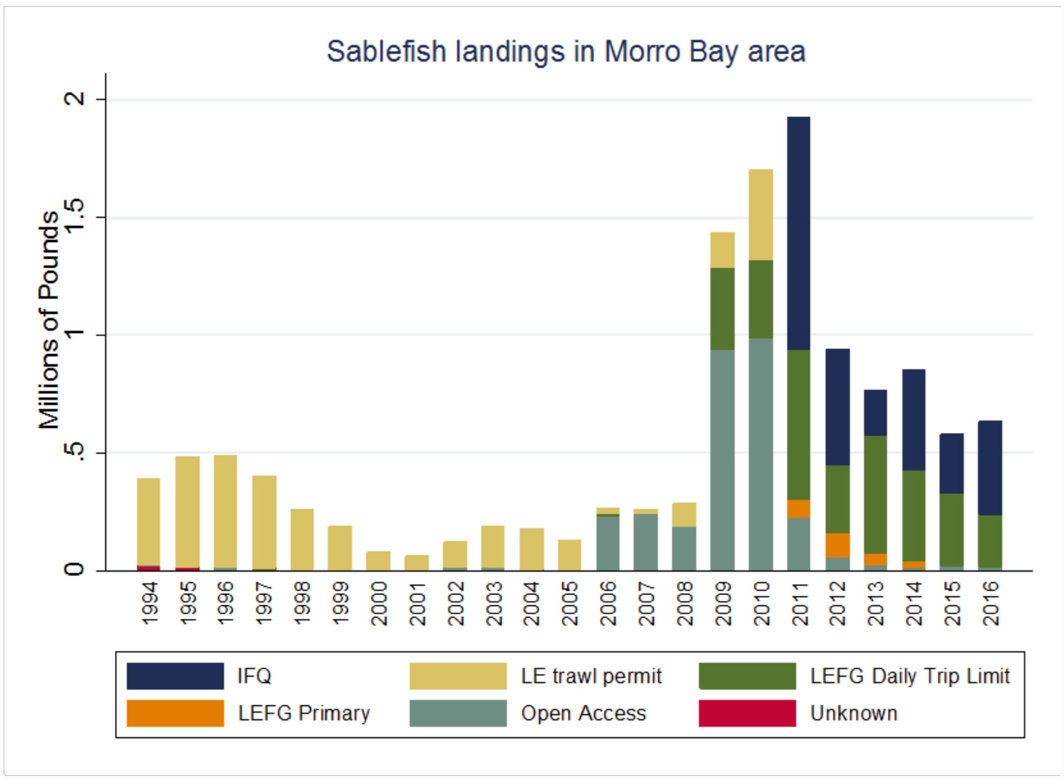


Figure 3-52. Sablefish landings (millions of lbs) at ports in the Morro Bay area of California by permit type. Some data are suppressed to maintain confidentiality. Source: Fish ticket data.

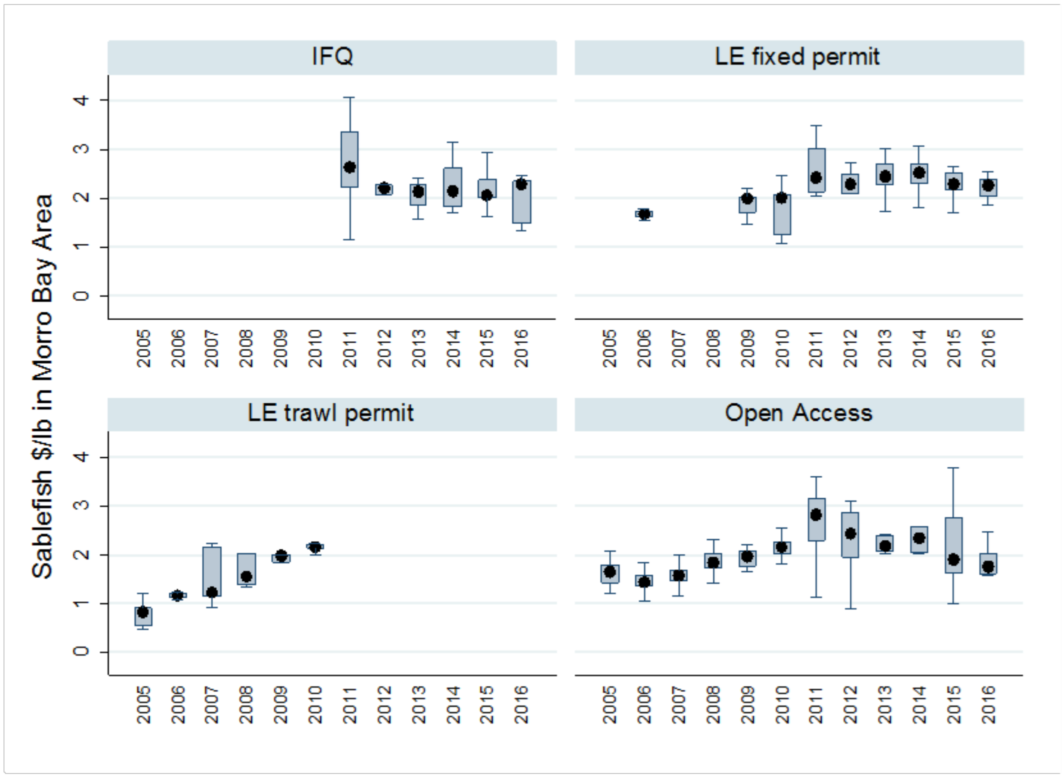


Figure 3-53. Distribution of prices (2015 $/lb) for sablefish landed in Morro Bay area ports, by permit type. Dot represents the median, boxes represent the 25th and 75th percentiles, and whiskers represent the upper and lower adjacent values. Source: Fish ticket data.

3.1.3(d) Safety

Increase safety in the fishery (Amendment 20 Objective). Conservation and management measures shall, to the extent practicable, promote the safety of human life at sea. (National Standard 10). Promote safety (MSA LAPP requirement).

Highlights:

- 52 percent of whiting fishermen and 41 percent of non-whiting fishermen interviewed say that safety has improved because of the catch share program.
- There has been no change in the rate of USCG-reported vessel incidents since the beginning of the catch share program.
- There have been 11 fatalities in the fishery from 2005 to 2015.
- There has been an increase in the proportion of trips beginning between midnight and 2:00 am as vessels try to minimize observer costs that are charged on a 24-hour time clock beginning at

midnight. While no correlation to accident rates has been observed, the incentive to begin a trip at a specific time could result in more dangerous fishing conditions.

In general terms, rationalization is expected to increase safety onboard fishing vessels (PFMC and NMFS 2010; Pfeiffer and Gratz 2016; Woodley 2002). This generalization is expected to be somewhat less relevant to the non-whiting portion of the shoreside fishery, as it was managed with a variety of effort limits, including bimonthly trip limits that precluded the development of a derby fishery. Derby fishing conditions often contribute to dangerous conditions. In the shoreside and at-sea whiting fisheries (with the exception of the catcher-processor sector, which was already operating as a cooperative), safety improvements related to the elimination of the race for fish were expected with the implementation of catch shares.

The PCGFSS included questions to capture trawl participants' perceptions of how the catch share program has impacted safety in the fishery. Approximately 52 percent of whiting fishermen and 41.2 percent of non-whiting fishermen agree that safety has improved because of the catch share program (Table 3-85). Interview data suggest that this can be attributed to eliminating the race for fish and pre-trip safety checks by observers. Examples of these perspectives are as follows:

> "The race for fish isn't there. The having to fish weather that you would have to fish before, the safety margin is much better." —Industry Participant, Fort Bragg Area, 2012

> "Well yeah, the observers come on and they can't go fishing without a safety inspection, so they're always keeping our stuff up to date, making sure that things are not expired." —QS permit owner, Coos Bay Area, 2015-2016

However, 48 percent do not think safety has improved because of the catch shares program (Table 3-85). These fishermen discussed several reasons for disagreeing with this statement, including the following: 1) safety has improved, but not due to catch shares, 2) safety has not changed, 3) safety has declined, and 4) there have been mixed impacts on safety. Those who thought safety had not improved or declined highlighted the pressure to avoid observer fees and constraints of plant delivery schedules as primary factors. Interviewees explained the following:

> "It's $500. But it's more than that because…well like last year. I take off, I don't want to pay the stupid $500, because if you go leaving at 11 o'clock at night you get $500 for the day prior. Ok so fine. Otherwise I'd be leaving at 10:30, as far as timing the tide with the bar and everything. Well I don't want to pay the $500 for that day, so fine I'm just going to leave at 12. The weather is pretty good so I should be ok. Well the swell had come up

> in the night. So now all the sudden it's just an absolute shit bar-crossing because I'm trying to save $500 on the stupid observer, you know?" —Fisherman, Astoria, 2015-2016

> "… In our situation …at the plant that we're having to fish weather, sometimes having to fish weather we'd rather not. But we don't have a choice, because that's the slots you're going to get. …You got to fish. …The plant's got….say they got, ah, 7 boats that they run 1 boat a day, 7 days a week…you got no choice. You got to fish." —Fisherman, Brookings Area, 2012

One participant discussed how the race to fish—one of the factors contributing to dangerous fishing conditions—has changed in nature:

> I never looked at it as danger, but yeah, I fished a lot of bad weather. A lot, and I still do because, I mean, you know, when you condense things down, we took a whole bunch of…now we got more permits back on boats, and so yeah, we're not racing; now we race that fishery to go to another fishery. It really didn't change the race in my mind. —Fisherman, Astoria, 2015-2016

These results suggest that the catch shares program may be influencing fishermen in different ways, and that there may be other influential factors at play. For instance, one interviewee explained the following:

> "It's good stuff, boat safety and all these things are good, but at the end of the day, only large entities are able to execute this stuff and comply with all the stuff you have to comply with." —Processor, Washington, 2016/2016

Table 3-85. Percentage of fishermen who agree (or do not agree) that safety has improved as a result of catch shares. Source: PCGFSS 2017.

Response Category	All fishermen	Whiting	Non-whiting
Agree	43.2	52.4	41.2
Disagree	48.3	47.6	48.5
NA	8.5	0.0	10.3
Response Rate	95.93	87.50	97.98

A variety of safety-related regulations apply to vessels in the groundfish trawl fishery. Broadly, regulations for fishing vessel safety stem from the Commercial Fishing Industry Vessel Safety Act of 1988 (46 United States Code [USC] Chapter 45). Regulations for fishing vessel safety are developed, implemented, and enforced by the USCG (46 CFR parts 25 and 28). The regulations cover mandatory onboard equipment, Emergency Position Indicating Radio Beacons (EPIRBs), work vests, rules to ensuring proper stability and ventilation, as well as specific requirements for fish processing vessels.

In addition to the catch share program, changes to fishing vessel safety regulations have occurred since the program was implemented. The Coast Guard Authorization Act of 2010 and the Coast Guard and Maritime Transportation Act of 2012 (hereafter referred to as "Acts") made significant changes to Chapters 45 and 51 of Title 46 USC. The Acts resulted in a range of immediate and impending changes, following rulemaking. At present, rulemaking is complete for a number of these changes, while some are still impending. The following is a summary of the changes:

As of July 31, 2016, the following regulations have been put into effect. Other changes are in the Notice of Proposed Rulemaking (NRPM).[58]

- Replaces the Boundary Line with the three nautical mile line as the demarcation line for operating areas and certain equipment carriage standards (currently applicable only to mandatory exams, see the NPRM for future changes).
- Requires periodic mandatory examinations for all commercial fishing vessels operating beyond 3 nautical miles (implemented October 15, 2015). Exams are to be conducted at least once every five years beginning January 1, 2013.
- Establishes design, construction, and maintenance standards on new fishing vessels built after July 1, 2013 (implemented July 1, 2013).
- Requires a load line on new fishing vessels over 79 feet built after July 1, 2013 (implemented July 1, 2013).
- Establishes two grant programs for training and research regarding safety in commercial fishing (implemented in 2010).
- Changes the name of the Commercial Fishing Industry Vessel Safety Advisory Committee to the Commercial Fishing Safety Advisory Committee (implemented in 2010).
- Requires an alternate safety compliance program (ASCP) plan for certain older fishing vessels. This was suspended July 20, 2016 and changed to a voluntary Enhanced Oversight Program (EOP), also referred to as voluntary safety initiatives (implemented January 1, 2017).
- Establishes parity for all commercial fishing vessels operating beyond 3 nautical miles. All vessels must carry the same safety equipment. At present, complete parity between state and documented commercial fishing vessels has not been implemented (see NPRM for details).

[58] Comment period of the Notice of Proposed Rulemaking closed December 19th 2016 but can be found at: https://www.regulations.gov/document?D=USCG-2012-0025-0001

- Requires periodic safety training of commercial fishing vessel operators operating beyond 3 nautical miles (Pending the development of a national standard).
- Requires all commercial fishing vessels operating beyond 3NM to maintain a “Safety Log Book” or a written record of all equipment maintenance, emergency drills and instruction conducted onboard a vessel (in the June NPRM for comment by December 18, 2016, final rulemaking).
- Requires all commercial fishing vessels operating beyond 3NM to carry survival craft that keeps all parts of the body out of the water. Life floats and buoyant apparatus’ will no longer be accepted as survival craft (in the June 2016 NPRM for comment by December 18, 2016 and final rulemaking).
- Eliminates exemptions for survival craft on commercial fishing vessels less than 36 feet operating inside 12NM with less than 3 persons onboard (in the NPRM for comment by December 18, 2016 and final rulemaking).
- Clarifies some existing safety equipment requirements (such as “marine” radio) (in the NPRM for comment by December 18, 2016 and final rulemaking).
- Requires fishing vessels less than 50 feet in length, built after January 1, 2010, to meet equivalent construction and safety standards for recreational vessels (in the NPRM for comment by December 18, 2016 and final rulemaking).

Safety-related incidents in the West Coast groundfish trawl fishery

One measure of safety is the number of reported incidents. The USCG collects and maintains data on incidents at sea in the commercial fishing industry. Safety-related incidents include injuries, falls overboard, vessel collisions, deaths, and equipment failures that require USCG intervention. These data from the USGC were combined with fishing permit, landings, and observer data to determine if the vessel was participating in the West Coast groundfish trawl fishery at the time of the incident to obtain annual incident counts.[59] Incident rates were calculated as incidents per annual days at sea to estimate risk exposure and investigate trends (Pfeiffer 2016). The figures below show incidents that occurred only while actively participating in the groundfish trawl fishery and not any other fishery that the vessel may participate in annually.

[59] Based on feedback from the Groundfish Advisory Panel, a few of the incidents (that did not involve a vessel disaster designation) may have occurred while in port. The location information provided by the USCG was not thorough enough to confirm this, so the numbers provided here represent a comprehensive list of incidents reported to the USCG while active in the groundfish fishery, regardless of whether fishing was occurring at the time.

Forty-five USCG-reported, safety-related incidents were matched to the West Coast limited entry groundfish trawl fishery from 2002 to 2015 (Figure 3-54). These included 5 allisions[60], 6 collisions, 6 fires, 7 floodings, 15 groundings, 4 sinkings, and 2 falls overboard. Eight events were "vessel disasters," defined as events where fatalities occurred, the crew needed to abandon ship, or a vessel was destroyed. Nineteen were events in which damage occurred, and eighteen were events in which no damage occurred. There were 11 fatalities, 1 non-fatal injury, and $2,514,540 in total property damage reported to the USCG. The number of incidents that occurred in each year ranged from zero in 2011 to seven in 2003 and 2009, if all incident types are included. Incidents include only those reported to the USCG, but such incidents are known to be under-reported, especially for smaller vessels and incidents in which injuries occurred but did not require a rescue.

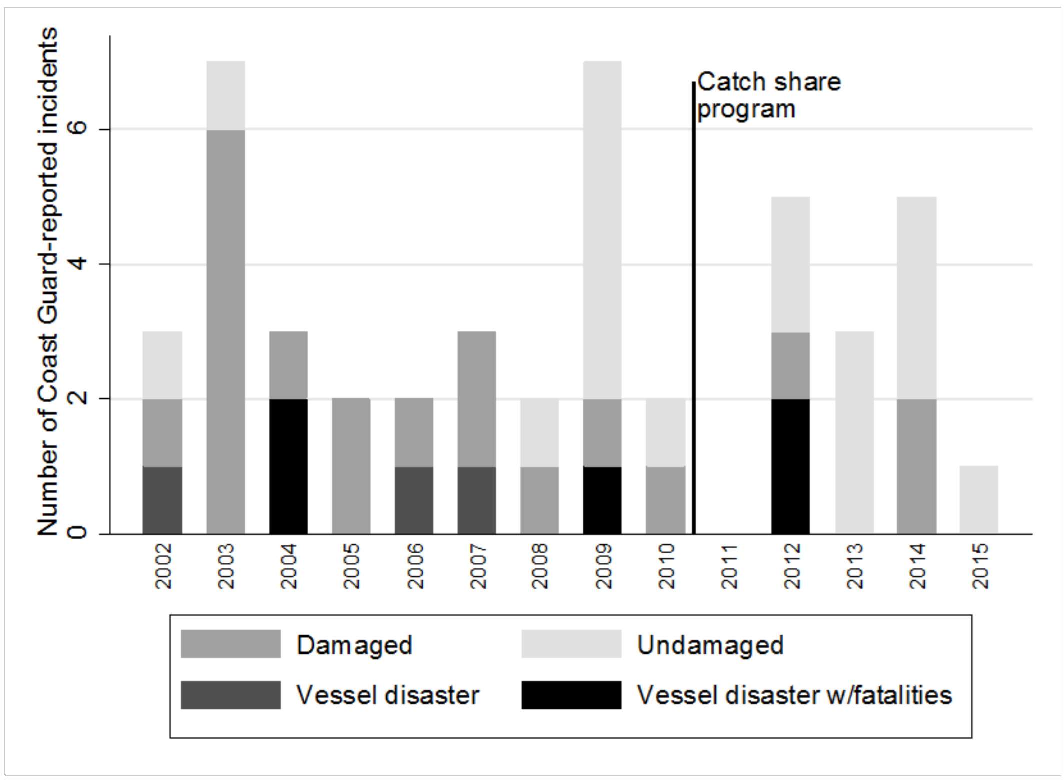


Figure 3-54. Number of safety-related USCG-reported incidents in the limited entry West Coast Groundfish trawl fishery per year, by type. Source: Updated from Pfeiffer 2016.

The National Institute of Occupational Health and Safety (NIOSH) has conducted more comprehensive analyses of vessel disasters and incidents involving fatalities, serious injuries, or rescues at sea. For the West Coast, the NIOSH dataset starts in 2005. There have been five vessel disasters in the West Coast

[60] A collision between two vessels in which one vessel is stationary.

groundfish trawl fishery since 2005 (Figure 3-54). NIOSH concluded that of the five incidents, weather was a contributing factor in three of them (one involving a fatality). Of the three incidents involving fatalities, personal flotation devices (PFDs) were not worn in two cases, and it is unknown if PFDs were worn in the third.[61]

The incident rate over time is shown in Figure 3-55. In this figure, the two vessel disaster categories are combined (vessel disaster and vessel disaster with fatalities), and the two remaining categories are combined (vessel was damaged or undamaged). The incident rates allow the examination of trends over time, because they control for risk exposure (defined as the total number of days spent at sea by vessel participating in the sector). Figure 3-54 begins in 2005 rather than 2002, because higher quality data with which to estimate days at sea are available beginning in 2005. Days at sea have decreased since the catch share program was instituted in 2011, resulting in a higher incident rate relative to the number of incidents shown in Figure 3-55 after the implementation of the catch share program. A two-sample t-test used to determine that the difference in the rate of vessel disasters before and since catch shares implementation is not significant (p=0.697), nor is the rate of non-disaster incidents (p=0.220).

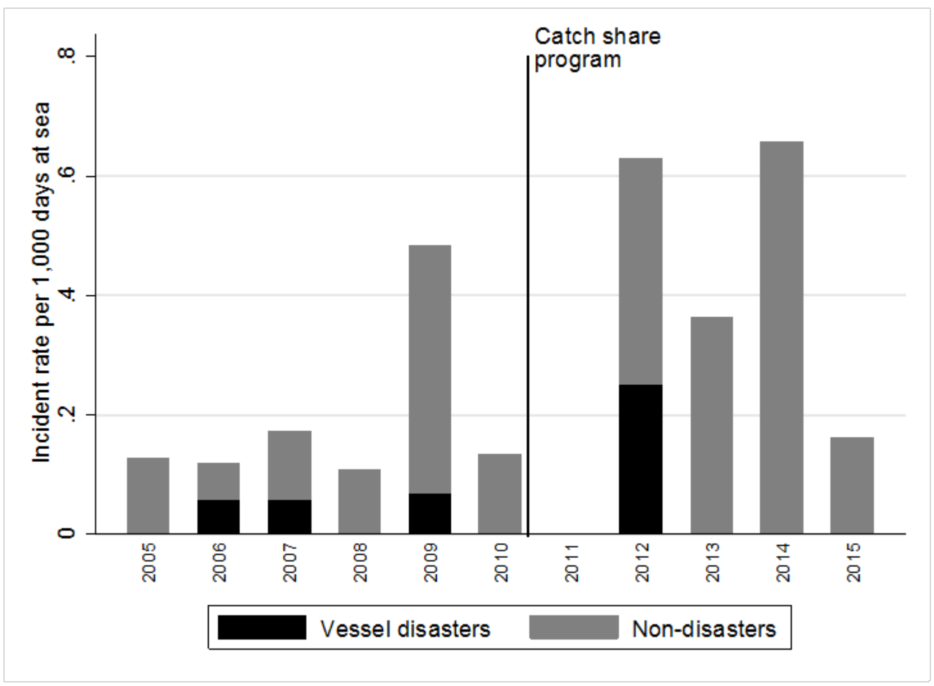


Figure 3-55. Incident rate (number of USCG-reported incidents per 1,000 days at sea) in the limited-entry, West Coast, groundfish trawl fishery, for incidents classified as vessel disasters and those that were not. Source: Updated from Pfeiffer 2016.

[61] Information and data courtesy of Samantha Case, Center for Disease Control (CDC)/NIOSH/WSD.

Alternative measures of risk-taking and safety

Trends in incident rates may not fully characterize the risky nature of fisheries, nor the changes that have taken place due to catch shares. Obtaining robust, causal statistical estimates of the effect of policy on events that are rare (such as deaths, vessel disasters, or search-and-rescue missions) is difficult (King and Zeng 2001). These rates also do not capture near misses and non-fatal injuries that tend to be underreported (Lucas and Lincoln 2007). One way to overcome this problem is to investigate the effects of the program on risky behavior. Behavior that is generally accepted to be higher risk (such as fishing in poor weather, overloading vessels, or delaying maintenance) is likely related to adverse outcomes such as safety incidents. Even when fishery participants are inherently risk-averse, regulations can create a misalignment of economic incentives that can escalate the risks associated with fishing. For example, the season length restrictions resulting in a derby-style fishery provide incentive to fish no matter the weather, as any delay translates to lost profits. If this behavior is observable (i.e., if there is a source of data) and if the decision-making process happens often (e.g., a captain considers the weather every time he or she decides to start a trip), then the effect of the policy change can be more robustly identified.

Two types of potentially risky behavior are examined here. The first is the propensity to start a fishing trip in poor weather, generally following the analysis in Pfeiffer and Gratz (2016). The model's dependent variable is a share of trips that began on days with high winds (high-wind days are defined to correspond roughly with small craft warnings (see Pfeiffer and Gratz 2016 for details and data sources). The share of trips that began on days with high winds was modeled as a logistic function (Papke and Wooldridge 1993). The model includes homeport state and vessel fixed effects, and it includes the years from 2005 to 2015. Vessel fixed effects control for unchanging vessel characteristics, such as size and horsepower. All fisheries in which catch share vessels participate are included in the model. Because vessels likely make tradeoffs between participating in one fishery versus another, including all activities allows the investigation of spillover effects between the catch share program and other fisheries. For trips that were not observed (and thus have no information about the date when the trip started), trip length is estimated using Observer data and start data is estimated using estimated trip length subtracted from fish ticket delivery date.

For the shoreside non-whiting fishery, little effect of the catch share program on the propensity to fish in poor weather was expected, because the fishery was not a derby due to bimonthly trip limits. A greater effect was expected for the shoreside whiting fishery. The analysis cannot be done for the at-sea whiting fleet, because no data are available about when trips began prior to the 100 percent observer requirement instituted by the catch share program.

Figure 3-56 shows that there has been no significant change in the proportion of trips beginning on high-wind days for IFQ non-whiting or whiting activities.[62] Nor have there been spillover effects into the two main alternative activities, Dungeness crab and shrimp. While the non-whiting results are not particularly surprising, the results for participation in the whiting fishery are surprising because the fishery had some characteristics of a derby fishery prior to implementation of the catch share program. The lack of a difference may mean that shoreside whiting vessels had enough flexibility in timing their fishing, even before the catch share program, to avoid fishing in risky weather. They also tend to be larger and, thus, less at risk in bad weather. Alternatively, the seasonal shift to later in the year may expose vessels to a higher frequency of risky weather than during the pre-catch shares derby period, which occurred earlier in the summer. The catch share program has neither significantly improved, nor has it decreased risk-taking and safety along this dimension.

The higher proportion of trips in high winds in California, both pre-catch shares and catch shares, compared to the other two states, is due to the higher preponderance of high-wind days in northern California. For example, an annual average of about 40 percent of days in each year were classified as “high winds” in Fort Bragg and other Sonoma and Marin County ports, using data from 1994 to 2015. This dropped to about 20 percent in Brookings and Coos Bay, and 10 percent in Newport and Astoria. Washington and southern California are more similar to northern Oregon, with an annual average of 10 percent of days classified as high winds in Westport, Ilwaco, and Morro Bay.

[62] A statistically significant change would be represented in this figure by confidence interval lines (whiskers) that do not overlap.

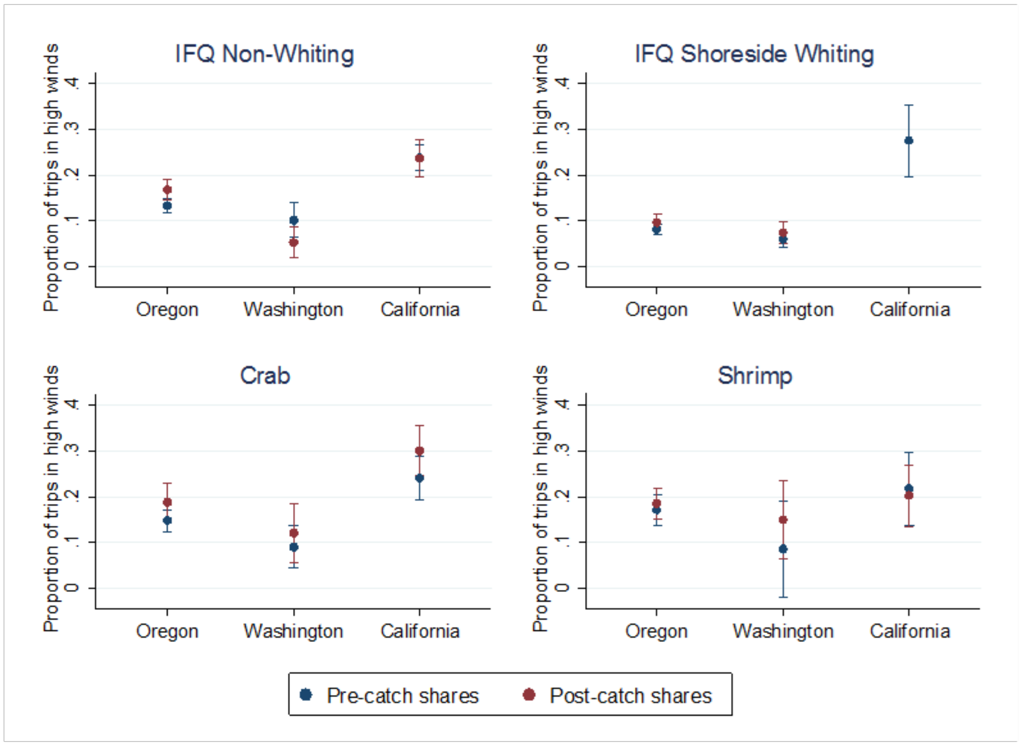


Figure 3-56. Predicted proportion of fishing trips beginning on high-wind days, pre- and post-catch shares implementation, by fishing activity. Source: Observer, EDC, and fish ticket data.

The second type of potentially risky behavior that can be examined with this method is the propensity to start fishing trips just after midnight. An increase in the number of trips starting just after midnight has been observed (Figure 3-57 and Figure 3-58) and discussed as a safety issue.[63] It is hypothesized that the way that the companies providing observers to the fleet charge for their services is contributing to the safety issue. Both Alaskan Observers and Saltwater (the two main companies employing observers) charge by the 24-hour day, and they start charging for a "day" at midnight. Thus, to minimize observer costs, a vessel has the incentive to start its trip just after midnight. This could be more dangerous for vessels if that period does not align with ideal tide and weather conditions leaving port.

[63] See agenda items F.6.b and F.6.d in the November 2016 Briefing Book: http://www.pcouncil.org/resources/archives/briefing-books/november-2016-briefing-book/

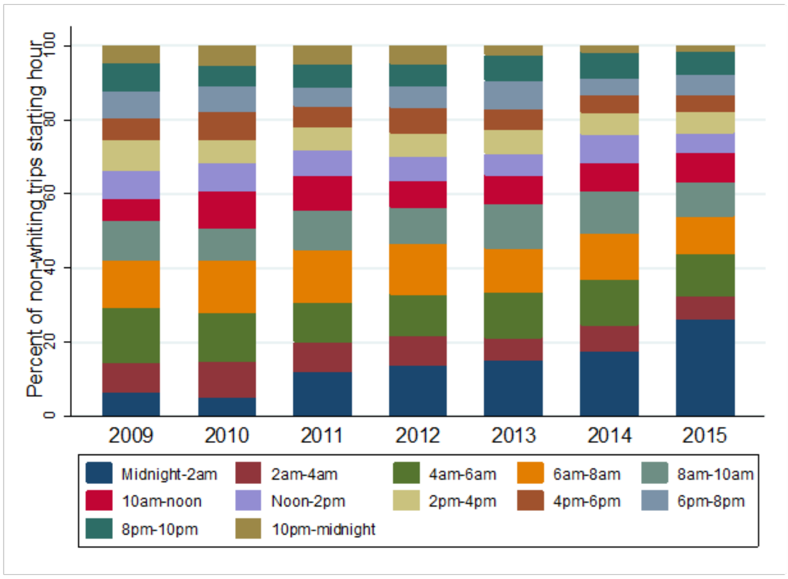


Figure 3-57. Annual percent of non-whiting trips that departed port in each 2-hour period. Source: Observer and EDC data.

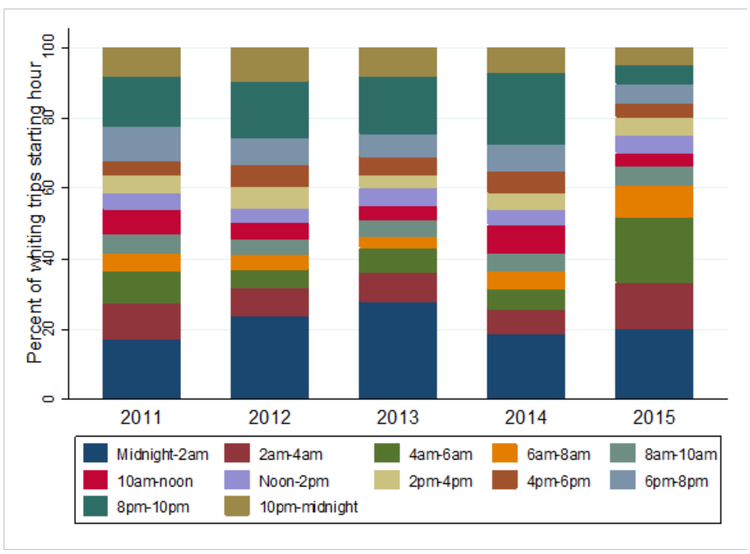


Figure 3-58. Annual percent of shoreside whiting trips that departed port in each 2-hour period. Source: Observer data; there was no observer coverage of the shoreside whiting fleet prior to the catch share program.

Figure 3-57 indicates that the proportion of non-whiting trips starting between midnight and 2:00 a.m. has steadily increased since the beginning of the catch share program. If the hypothesis that vessels are leaving just after midnight to avoid paying for extra observer time is correct, the increase may be due to the rising cost of observers over time. The share of daily observer costs paid by vessels has increased mostly because of a NMFS subsidy that decreased over the first five years of the program.[64] Daily observer costs also vary somewhat along the West Coast. There are two major observer providers, and their rates may differ somewhat. In addition, providers generally charge travel costs to vessels leaving from ports where no observer is stationed. No travel costs are charged for ports north of Eureka, California, because observers are stationed close enough to all catch share ports. However, south of Eureka, observers are stationed more sparsely. Travel costs are charged at the federal reimbursement rate for mileage and are split 50/50 with the first receiver (because the observer can also serve as a shoreside catch monitor). This amounted to about $75 of extra observer cost per trip for vessels in Fort Bragg and Bodega Bay, $60 in Santa Barbara, $40 in the San Francisco area, and $25 in Monterey in 2015.[65] If observers are not available at the nearest station (if they are out on a different vessel, for example) a vessel may have to pay additional travel costs for an observer to come from a more distant location. This variation, both over time and among vessels in different ports, allows the relationship between observer costs (those charged on a 24-hour basis starting at midnight) and the proportion of trips starting at 2:00 a.m. for non-whiting vessels to be modelled.[66]

The results are depicted in Figure 3-59. When observer costs were zero (prior to the catch share program, the federal government fully subsidized observers that covered approximately 20 percent of trips), and, thus, the same regardless of the hour of a vessel's departure, about 7 percent of [observed] trips started between midnight and 2:00 a.m. Because there was no external incentive to start trips at that time, it can be inferred that the ideal tide and weather conditions for about 7 percent of trips occurred and caused vessels to decide to leave port between midnight and 2 a.m. Figure 3-58 shows that, as average daily observer costs increased, the predicted proportion of trips starting before 2:00 a.m. increased to nearly 25 percent at a cost of $400/day. If deviations from ideal tide and weather conditions make leaving port more risky, this means that the 24-hour time clock beginning at midnight that the observer providers use to

---

[64] The observer subsidy was $328.5/day in 2011 and 2012, $256/day in 2013, $216/day in 2014, $108/day in 2015, and zero in 2016. (Dave Colpo, Pers. Comm., Pacific States Marine Fisheries Commission.)

[65] These numbers assume the observer coverage provided by Alaska Observers in California in 2015. Observer coverage is likely to become sparser because of decreasing demand by non-whiting vessels, which are taking fewer trips, and by whiting vessels, which are increasingly utilizing electronic monitoring. (David Edick, Pers. Comm., Alaska Observers.)

[66] The dependent variable is a share in the interval [0,1], so a fractional logit model was used, where E(y|x) was modeled as a logistic function (Papke and Wooldridge 1993), $E(y|x) = \exp(x\beta)\,/[1+\exp(x\beta)]$. The model includes a quadratic function of port- and annual-level average daily observer costs and controls for total effort by each vessel.

charge for days at sea has real consequences for fishing vessel safety, especially as the subsidy for observer coverage has decreased.

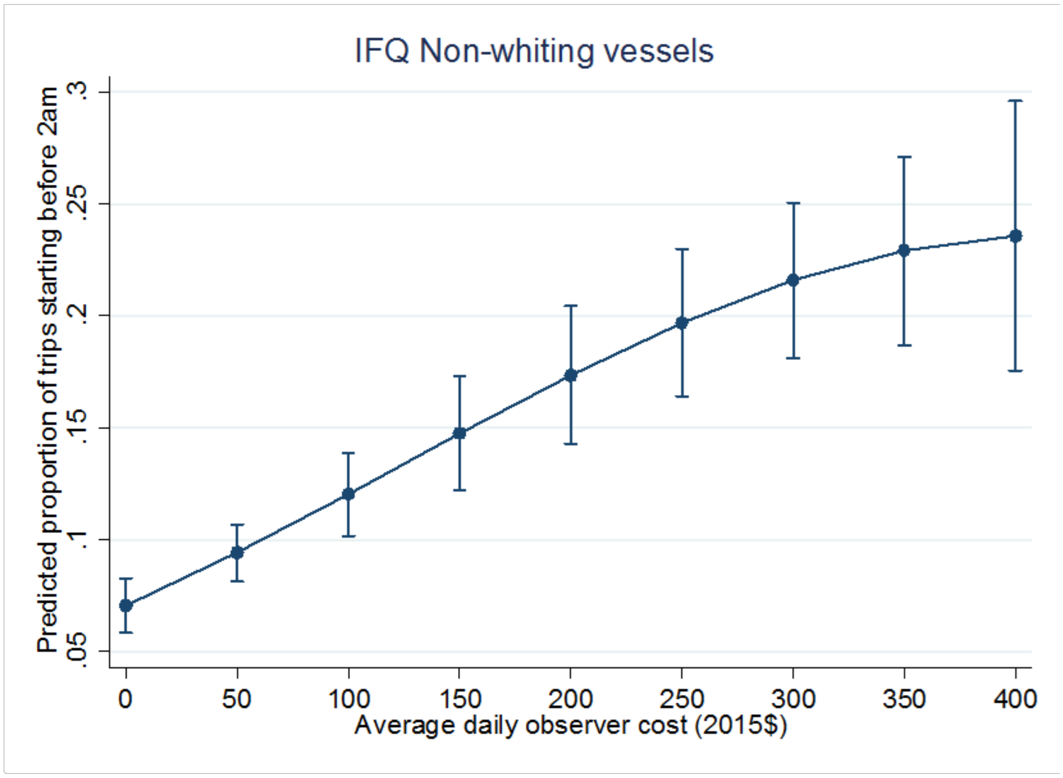


Figure 3-59. Predicted proportion of non-whiting trips starting between midnight and 2:00 a.m. as a function of average daily observer costs that are charged on a 24-hour timeclock starting at midnight. Source: Observer, EDC, and fish ticket data.

A similar analysis cannot be done for whiting vessels, because there was no observer coverage (and, thus, no information on departure times) prior to the catch share program. Visual inspection of Figure 3-57, however, shows that whiting vessels are likely responding to the 24-hour time clock as well. The proportion of trips starting between midnight and 2:00 a.m. decreased in 2014 and 2015. In 2015, the decrease was potentially a result of adopting electronic monitoring by some vessels, which is not charged on a 24-hour clock starting at midnight. Some vessels used electronic monitoring in 2014 under a trial program in which they had to carry both an observer and electronic monitoring equipment to allow the scientific comparison of the resulting data.

3.2 Community Performance

3.2.1 Introduction

This section describes and analyzes the effects of Amendment 20 on communities. It is included to provide context to program impacts discussed in other portions of this document, as well as to describe changes in coastal communities following the switch to catch share management.

Community impacts were a primary concern during the development of the trawl catch share program. However, they are difficult to separate from larger economic and social trends, and from the impacts of management decisions made before the catch share program. Indeed, some of these previous management decisions may have initiated some of the trends that continued through the first years of the program. Social data on community impacts are not collected frequently enough to provide a definitive time series of changes attributable to the implementation of Amendment 20, but they are reported here to provide insights into the effects of the catch share program to the extent possible.

3.2.2 Fishing Communities

This section focuses mainly on communities where trawl sector landings occurred in the five years before the catch share program was put in place and where catch share landings (including landings from gear switching) occurred after the program was implemented. These ports are listed in

Table 3-86.· Ports that received limited entry trawl landings from 1994 through 2005, but only minimal landings thereafter, are listed in the first column. Some ports in this column had limited landings after 2006. Footnotes indicate the degree of activity in these ports.

EDC and USCG data are used to identify fishing communities associated with at-sea fisheries (catcher vessels delivering to motherships, mothership processors, and catcher-processors). Motherships and catcher-processors are generally associated with Bellingham, Seattle, and Tacoma.

In addition to ports where trawl deliveries are made or vessels are home ported, the trawl program may have affected communities that have not received any trawl landings. To date, however, few mechanisms have been identified to assess measurable impacts that may have occurred in nontrawl communities. One such mechanism is conflict on the fishing grounds resulting from gear switching in the Morro Bay port area. These impacts have affected the limited entry fixed gear open access fleets in the area; however, this port area is already identified as a trawl port area and so is within the scope of the analysis.

Table 3-86. West Coast fishing communities with a history of limited entry shoreside trawl sector landings.[1] Source: PacFIN.

WASHINGTON		
Minimal landings after 2005	Active 2006 to 2010	Active after Catch Share Implementation (2011 on)
Puget Sound Area		
Anacortes Blaine [2] Everett La Conner Seattle		Bellingham Bay
Northern Washington Coast		
La Push[3] Port Angeles Port Townsend	Neah Bay	
South/Central Washington Coast		
Aberdeen Chinook Long Beach		Ilwaco Westport
OREGON		
*Stand-Alone Areas**		
	Garibaldi (Tillamook)	Astoria Newport
Coos Bay Area		
Florence Winchester Bay		Charleston (Coos Bay)
Brookings Area		
Port Orford		Brookings
CALIFORNIA		
Minimal landings after 2005	Active 2006 to 2010	Active after Catch Share Implementation (2011 on)
Crescent City Area		
		Crescent City
Eureka Area		
Humboldt Loleta		Eureka (including Fields Landing)
Fort Bragg Area		
Albion Little River Caspar Point Arena Elk		Fort Bragg
Bodega Bay Area		
Inverness [4] Novato Marshall Tomales Bay5	Bodega Bay	
San Francisco Area		

Table 3-86. West Coast fishing communities with a history of limited entry shoreside trawl sector landings. Source: PacFIN (continued)

Alameda Pacifica Alviso[6] Pinole [7] Berkeley [8] Richmond China Camp Rodeo Oakland [9] Vallejo		Princeton/Half Moon Bay San Francisco
Monterey Area		
Santa Cruz [10] Watsonville		Monterey Moss Landing
Morro Bay Area		
		Avila Morro Bay
Santa Barbara Area		
Conception Oxnard [11] Ventura		Santa Barbara
Los Angeles Area		
San Pedro and Other LA Ports		
San Diego Area		
San Diego		

1. All port areas (in shaded headers) are IOPAC port areas that received shorebased limited entry trawl or catch share landings in at least one year from 1994 through 2015.
2. Blaine: A number of landings occurred in 2006, but none occurred thereafter.
3. La Push: Five or fewer landings in one year during the five years before the catch share program, and none occurred thereafter.
4. Inverness: Five or fewer landings occurred, spread across two years during the catch share program.
5. Tomales: Five or fewer landings in one year during the five years before the catch share program and none thereafter.
6. Alviso: Five or fewer landings occurred in one year during the catch share program.
7. Pinole: Five or fewer landings occurred in one year during the catch share program.
8. Berkeley: Five or fewer landings occurred in one year during the catch share program.
9. Oakland: Five or fewer landings occurred in one year in the five years prior to the catch share program and none thereafter.
10. Santa Cruz: Five or fewer landings occurred in 2006, five or fewer in 2007, and none thereafter.
11. Oxnard: Five or fewer landings in one year during the catch share program.

3.2.2(a) Community-Related Criteria and Program Evaluation Guidance

The Amendment 20 goals and objectives and the National Standards of the MSA emphasize minimizing adverse impacts on communities and providing for their sustained participation.

> Amendment 20: Objective 5. Minimize adverse effects from an IFQ program on fishing communities and other fisheries to the extent practical.

> National Standard 8. Conservation and management measures shall, consistent with the conservation requirements of this Act (including the prevention of overfishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities by utilizing economic and social data that meet the requirements of paragraph (2), in order to (A) provide for the sustained participation of such communities, and (B) to the extent practicable, minimize adverse economic impacts on such communities.

“Impacts” is a broad term on which to base an analysis, since almost every impact on the fishing industry and its participants can be characterized as an impact on communities. With this in mind, this assessment is limited to some of the most salient indicators.

The draft National Guidance for Conducting Reviews of Catch Share Programs provides the following additional guidance relevant to communities:

> When analyzing effects on communities per National Standard 8, analysts should adapt the social indicators developed by Jepson and Colburn (2013) to assess community vulnerability, resilience, and dependency on the catch share program to the extent possible (p. 8).
>
> Restrictions on transferability may serve to meet other objectives, such as equity, per National Standard 4, providing for the sustained participation of and minimizing adverse economic effects on fishing communities, per National Standard 8, . . . The review should determine whether existing transferability provisions are conducive to achieving the specified objectives, keeping in mind that trade-offs often exist between objectives. (p. 11)

These transferability provisions are particularly relevant to a community’s ability acquire quota, relations among fishing community members, and entry-level participants.

In the Amendment 20 FEIS, two provisions in particular were identified as potentially mitigating the impact of the catch share program on communities. One was the possibility that control limits might indirectly create more geographic dispersion of quota, and the other was the ability of communities to buy quota. The effects of control limits and the distribution of quota among communities are addressed in Section 3.2.2(d). Community acquisition of QS is addressed in Section 3.2.2(d). A third provision, use of adaptive management quota to benefit communities, has yet to be implemented, but it is discussed in Section 3.4.6.

3.2.2(b) Geographic Trends in Landings and Participation

This section examines how patterns of landings have shifted geographically over time and during the catch share program.

3.2.2(b)(1) Trends in Volume of Landings

Highlights:

- In terms of volume, the South/Central Washington Coast, Astoria, and Newport port areas receive the most landings. This has not changed under catch shares.
- Comparing the five years before the catch share program with the first five years of the program, the weight of whiting landings increased for Astoria/Tillamook and Newport while decreasing in other port areas where whiting was landed in significant quantities.
- For the same period, the weight of nonwhiting landings decreased for most ports, increasing only slightly in Astoria/Tillamook, Monterey, and Brookings and increasing substantially for Morro Bay, which benefited from vessels that switched gears to land sablefish.

After the catch share program began, the volume of groundfish landed in California continued a declining trend. Landings in Washington also decreased, while landings in Oregon increased. Figure 3-3 shows fish landings by state from 1994 to 2015. The changes reflected in this figure were largely influenced by whiting, which is caught in much higher volumes than other groundfish species, primarily in Oregon and Washington. A comparison of the annual average for the five years preceding the catch share program to the first five years of the catch share program shows declines in total volume of nonwhiting landings (including gear switched landings) that were evenly distributed across the states on a percentage basis (Table 3-87).

Table 3-87. State and total average annual landings (mt) by species group by the shoreside trawl sector, 2006 to 2010 and 2011 to 2015. Source: PacFIN.

	Pacific Whiting	**Non-whiting**	**Total**
	2006 to 2010		
Washington	22,950	2,189	25,138
Oregon	38,412	14,458	52,870
California	3,512	5,956	9,468
Total	64,873	22,603	87,476
	2011 to 2015		
Washington	19,668	1,835	21,503
Oregon	62,043	12,338	74,381
California	5	5,034	5,039
Total	81,716	19,208	100,924
	Percent Change		
Washington	-14%	-16%	-14%
Oregon	62%	-15%	41%
California	-100%	-15%	-47%
Total	26%	-15%	15%

3.2.2(b)(1)(a). Shoreside Trawl Sector Landings in Aggregate

In terms of volume, the South/Central Washington Coast, Astoria, and Newport port areas receive the most landings (Table 3-88). This has not changed under catch shares. In the following section, landings are further disaggregated into a variety of species groups by port.

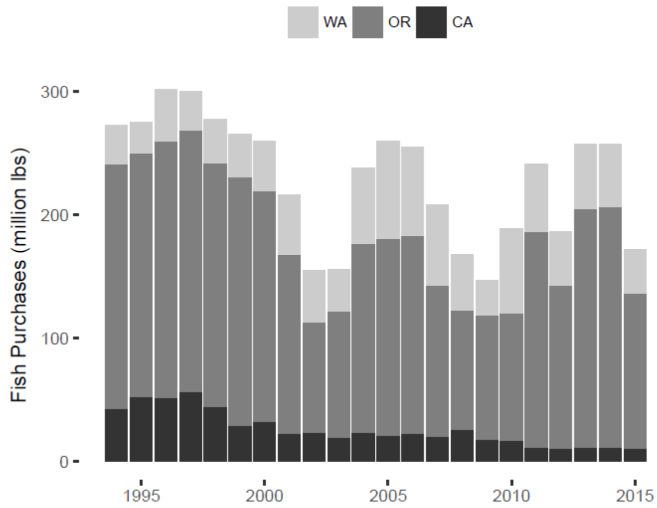


Figure 3-60. Total volume of shoreside trawl sector catch (whiting and non-whiting groundfish) purchases (millions of lbs) in each state by year. Source: Fish tickets.

Table 3-88. Total volume of shoreside trawl sector landings (mt, whiting and non-whiting groundfish, including gear switched) in each port area per year. Source: Fish tickets.

Port	1994	2001	2008	2015
Puget Sound	3,421	2,262	***	***
North Washington Coast	***	728	***	
South and central Washington Coast	9,638	19,019	19,605	15,727
Astoria	31,375	24,931	18,452	33,894
Tillamook	***	***	***	
Newport	50,444	34,063	18,803	20,922
Coos Bay	5,992	6,027	5,603	***
Brookings	1,716	882	***	1,083
Crescent City	4,757	3,195	4,111	-
Eureka	4,535	2,683	4,542	***
Fort Bragg	3,117	1,561	1,534	1,598
Bodega Bay	1,086	162	***	
San Francisco	1,883	1,328	950	141
Monterey	1,418	912	286	***
Morro	2,579	368	165	***
Santa Barbara	37	***	***	***

*** = suppressed to protect potentially confidential data.

3.2.2(b)(1)(b). Shoreside Trawl Sector Landings by Species and Species Group

Comparing the annual average of the first five years of the catch share program to the five years immediately preceding the program, the weight of whiting landings increased for Astoria/Tillamook and

Newport while decreasing in other port areas where whiting was landed in significant quantities (Table 3-89, Table 3-90, and Table 3-91). For the same comparison period, the weight of nonwhiting landings went down for most ports, increasing only slightly in Astoria/Tillamook, Monterey, and Brookings, and increasing substantially for Morro Bay, which benefited from the vessels that switched gears to land sablefish. In addition to Morro Bay, sablefish landings increased in Washington ports (and slightly in Brookings); all other port areas saw a decline. Flatfish landings were also down across all ports except Brookings and Morro Bay, while rockfish landings increased in a number of ports: the Washington port area, Astoria/Tillamook, Newport, Brookings, Fort Bragg and Morro Bay.

Table 3-89. Average annual landings (mt) by species group and port for the shoreside trawl sector, 2006 to 2010. Source: PacFIN.

Port	P. Whiting	Sablefish	Flatfish	Rockfish and Thorny-heads	Other Roundfish	Other Groundfish	Non-whiting Total	Total
Washington	22,950	154	1,549	236	67	183	2,189	25,138
Astoria/Tillamook	16,557	668	5,451	643	101	423	7,286	23,843
Newport	19,740	506	1,601	401	7	237	2,752	22,493
Coos Bay	2,114	405	2,258	348	14	281	3,306	5,420
Brookings	***	***	***	***	***	***	1,114	***
Crescent City	1,882	83	464	87	2	11	647	2,529
Eureka	***	323	1,776	383	7	112	2,601	4,230
Fort Bragg	-	227	790	386	14	37	1,455	1,455
San Francisco	<0.5	72	531	140	4	15	762	762
Monterey	***	44	129	154	2	31	361	361
Morro	***	11	31	24	<0.5	***	66	66

*** = suppressed to protect potentially confidential data.

Note: Ports combined and Bodega Bay and Santa Barbara omitted due to confidentiality concerns.

Table 3-90. Average annual landings (mt) by species group and port for the shoreside trawl sector (trawl and gears switched), 2011 to 2015. Source: PacFIN.

Port	P. Whiting	Sablefish	Flatfish	Rockfish and Thorny-heads	Other Roundfish	Other Groundfish	Non-whiting Total	Total
Washington	19,668	270	884	455	78	148	1,835	21,503
Astoria/Tillamook	31,059	504	4,703	1,241	427	653	7,527	38,587
Newport	30,675	356	995	423	4	105	1,882	32,558
Coos Bay	308	206	1,235	199	5	104	1,748	2,056
Brookings	<0.5	182	791	160	1	46	1,181	1,181
Crescent City	***	14	84	24	***	4	126	126
Eureka	***	245	1,499	340	12	120	2,215	2,215
Fort Bragg	2	193	652	517	10	60	1,432	1,435
San Francisco	<0.5	70	224	71	1	17	383	383
Monterey	1	40	190	105	1	32	368	369
Morro	1	213	147	125	2	9	497	498

*** = suppressed to protect potentially confidential data.

Note: Ports combined and Bodega Bay and Santa Barbara omitted due to confidentiality concerns.

Table 3-91. Percent change from 2006 to 2010 to 2011 to 2015 by species group and port for the shoreside trawl sector (trawl and gear switched).

Port	P. Whiting	Sablefish	Flatfish	Rockfish and Thorny-heads	Other Roundfish	Other Groundfish	Non--whiting Total	Total
Washington	-14%	75%	-43%	93%	16%	-19%	-16%	-14%
Astoria/Tillamook	88%	-25%	-14%	93%	324%	54%	3%	62%
Newport	55%	-30%	-38%	6%	-43%	-56%	-32%	45%
Coos Bay	-85%	-49%	-45%	-43%	-61%	-63%	-47%	-62%
Brookings	-71%	2%	2%	22%	-65%	77%	6%	6%
Crescent City	-100%	-83%	-82%	-73%	-100%	-62%	-81%	-95%
Eureka	-100%	-24%	-16%	-11%	66%	7%	-15%	-48%
Fort Bragg	+++	-15%	-17%	34%	-31%	63%	-2%	-1%
San Francisco	-32%	-2%	-58%	-49%	-71%	9%	-50%	-50%
Monterey	305%	-9%	48%	-32%	-73%	4%	2%	2%
Morro	1,159%	1,855%	371%	428%	3,230%	10,880%	652%	653%

*** = suppressed to protect potentially confidential data.

+++ = percent change cannot be calculated because there was a zero value in the previous period.

Note: Ports combined and Bodega Bay and Santa Barbara omitted due to confidentiality concerns.

3.2.2(b)(2) Trends in Value of Landings

Highlights:

- Trawl ex-vessel value has generally declined in most ports since the 1990s; however, in more recent years trawl sector revenue has increased in Ilwaco/Westport, Astoria, Newport, and Morro Bay.
- Trawl ex-vessel value has continued to concentrate in a smaller number of ports, with a trend towards increasing concentration in recent years, particularly in the non-whiting sector.
- Astoria had the largest relative gain in revenue, and Coos Bay had the largest decline.

3.2.2(b)(2)(a) Aggregate Shoreside Landings

This section explores changes in the geographical distribution of ex-vessel value of landings by the trawl sector.[67] Ports south of Morro Bay were excluded from this analysis because trawl sector landings are negligible in those ports (less than 0.01 percent of the coastwide total for the period examined), and confidential data restrictions apply due to the small number of vessels and/or processors involved.

The regional distribution of ex-vessel value (Figure 3-61) follows a pattern somewhat similar to the distribution of fish purchase volume.

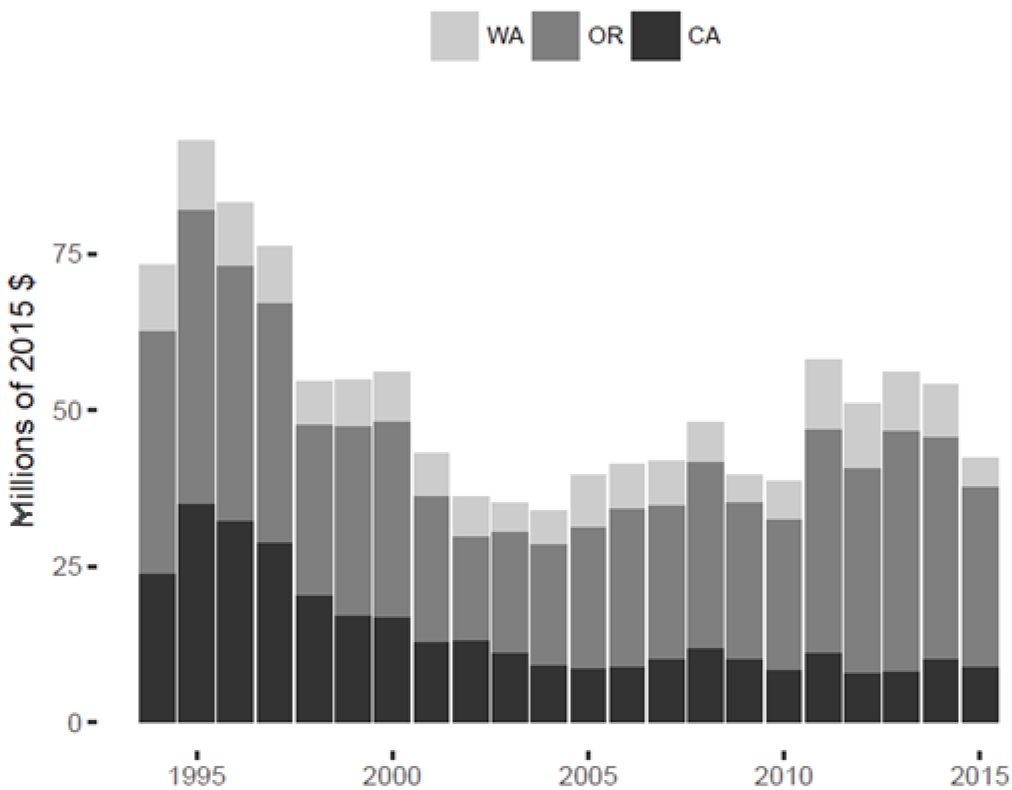


Figure 3-61. Total trawl sector ex-vessel value (millions of 2015 $, whiting and Non-whiting, including gear switched) in each state. Source: Fish ticket data.

[67] The trawl sector includes whiting and non-whiting shoreside trawl and, from 2011 on, nontrawl shoreside IFQ (PacFIN groundfish fishery sector Dahl codes ’03,’ ’04,’ and ‘20’). Ports defined as those used in the NWFSC IOPAC input/output model; see Table 9 in Jerry Leonard and Philip Watson, Description of the Input-Output Model for Pacific Coast Fisheries, June 2011, U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-111.

Table 3-92. State and total average ex-vessel value of annual landings (thousands of 2015 $) by the shoreside trawl sector 2006 to 2010 and 2011 to 2015. Source: PacFIN.

	Pacific Whiting	**Non-whiting**	**Total**
	2006 to 2010		
Washington	3,760	2,186	5,945
Oregon	6,629	18,393	25,023
California	588	9,133	9,721
Total	10,977	29,712	40,689
	2011-2015		
Washington	5,055	3,156	8,210
Oregon	15,259	18,028	33,288
California	4	9,112	9,116
Total	20,318	30,296	50,614
	Percent Change		
Washington	34%	44%	38%
Oregon	130%	-2%	33%
California	-99%	0%	-6%
Total	85%	2%	24%

Across all ports, trawl revenue has declined from the 1990s into the 2000s; however, revenue has increased in a few ports, primarily those in the north, during recent years. In general, ports in California (Crescent City, Eureka, Bodega Bay, San Francisco, and Monterey) and Coos Bay, Oregon, have experienced a downward trend (Table 3-93 and Figure 3-62).

To examine these trends more closely and reduce the need to omit data due to confidentiality, annual inflation-adjusted, ex-vessel revenue by port area was divided into five-year periods, the share of coastwide trawl revenue for each port during each time period was computed, and a rank assigned based on that share (Table 3-94). Most ports maintained a relatively consistent ranking across the five-year periods, including the top two ports (Astoria and Newport). The third ranked port (Coos Bay) dropped to fifth during the catch share period (2011 to 2015), and Crescent City dropped from ninth to twelfth, while Morro Bay increased from twelfth to seventh (comparing the five-year period immediately preceding catch shares to catch shares). Over the course of the catch share period, landings in Morro Bay have varied with participation of vessels and first receivers in the gear-switched component of the fishery targeting sablefish.

Table 3-93. Total ex-vessel value for catch share (whiting and non-whiting groundfish millions of 2015 $) in each port per year. Some data are suppressed to protect confidential data. Source: Fish ticket data.

Port	1994	2001	2008	2015
Puget Sound	3.1	2.7	***	***
North Washington Coast	***	1.0	***	-
South and central Washington Coast	6.2	3.0	5.1	3.3
Astoria	14.7	9.7	12.4	17.0
Tillamook	***	***	***	-
Newport	13.0	6.9	9.3	8.0
Coos Bay	7.9	5.0	5.9	***
Brookings	2.6	1.5	***	2.0
Crescent City	2.7	2.2	1.9	-
Eureka	7.0	3.8	4.8	***
Fort Bragg	4.6	2.4	2.5	2.9
Bodega Bay	1.4	0.3	***	-
San Francisco	2.6	2.2	1.7	0.3
Monterey	2.0	1.4	0.6	***
Morro	3.5	0.7	0.4	***
Santa Barbara	0.1	***	***	***

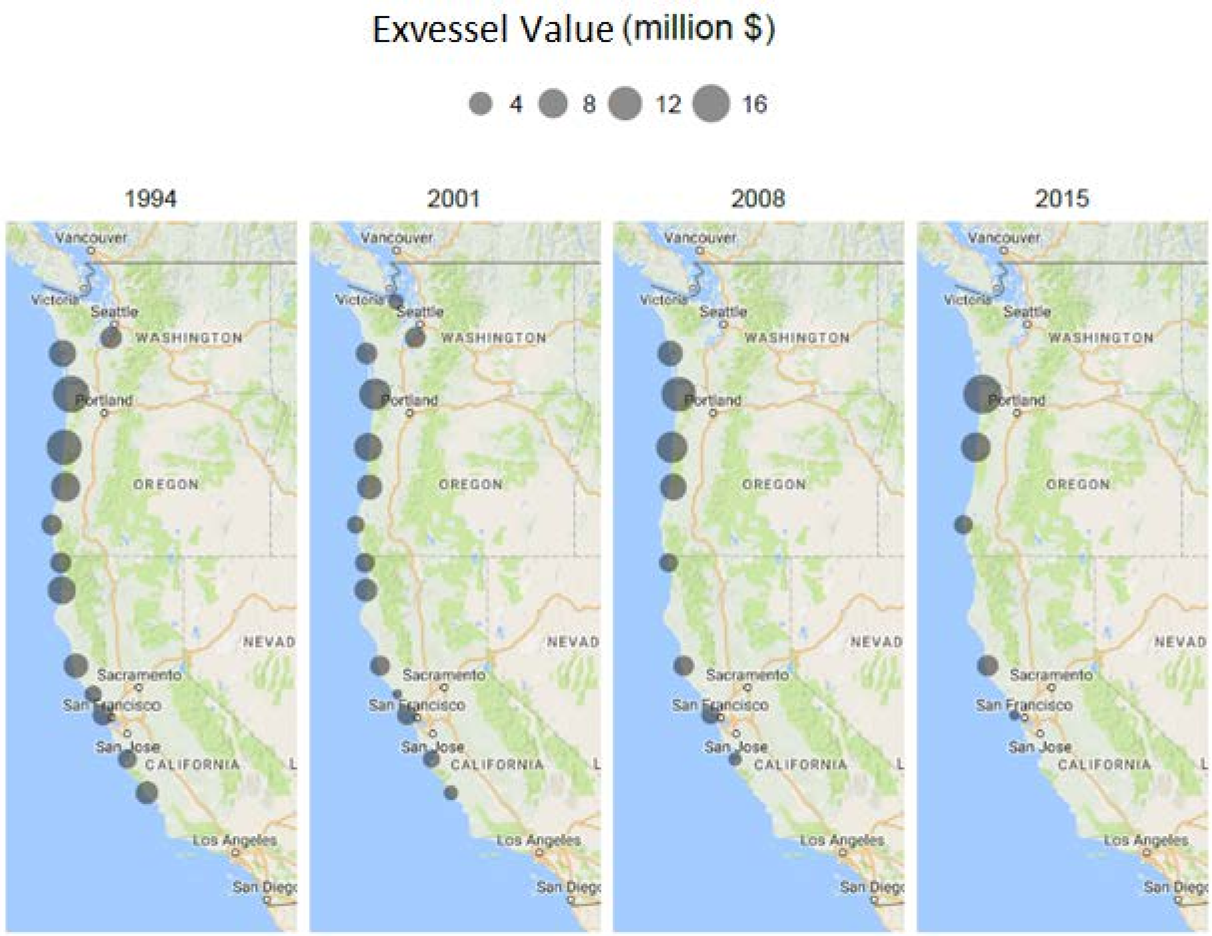


Figure 3-62. Map displaying the shoreside trawl sector ex-vessel value (whiting and non-whiting groundfish) in selected years over time, with the size of symbols representing the value. Some data are suppressed to protect confidential information (see Table 3-61). Source: Fish tickets.

Table 3-94. Proportion of coastwide trawl revenue and rank for each port during five-year periods. (Values do not sum to 100 percent because of excluded ports.) Source: PacFIN, December 2016.

	1996 to 2000		2001 to 2005		2006 to 2010		2011 to 2015	
Port	**Percent**	**Rank**	**Percent**	**Rank**	**Percent**	**Rank**	**Percent**	**Rank**
Puget Sound	3.97%	9	5.57%	7	2.96%	10	1.56%	10
North Washington Coast	2.26%	13	2.69%	12	0.30%	14	0.00%	13
South and central Washington Coast	6.20%	6	8.19%	5	11.37%	4	14.75%	3
Astoria	21.84%	1	23.00%	1	26.82%	1	34.60%	1
Tillamook	0.35%	15	0.30%	15	0.06%	15	0.00%	13
Newport	14.93%	2	16.86%	2	18.55%	2	22.05%	2
Coos Bay	11.59%	3	10.71%	3	11.79%	3	5.20%	5
Brookings	3.06%	12	3.02%	11	4.09%	7	3.80%	7
Crescent City	5.93%	7	3.95%	9	3.13%	9	0.34%	12
Eureka	9.25%	4	8.78%	4	9.78%	5	6.69%	4
Fort Bragg	6.32%	5	6.13%	6	5.65%	6	4.82%	6
Bodega Bay	1.78%	14	0.50%	14	0.33%	13	Conf	Conf
San Francisco	4.90%	8	4.21%	8	3.26%	8	1.58%	9
Monterey	3.87%	10	3.39%	10	1.55%	11	1.22%	11
Morro Bay	3.74%	11	2.68%	13	0.36%	12	3.17%	8

Table 3-95. Absolute change in the share of coastwide revenue from the previous period (first period is 1996-2000, upper-middle ranked ports, ports ranked three through seven, in bold). Source: PacFIN 2016.

	Ranking for the 2006 to 2010 Period	**Change from the previous period for the following:**		
Port		**2001 to 2005**	**2006 to 2010**	**2011 to 2015**
Puget Sound	10	1.60%	-2.61%	-1.40%
North Washington Coast	14	0.43%	-2.39%	-0.30%
South and central Washington Coast	4	1.99%	3.17%	3.38%
Astoria	1	1.16%	3.82%	7.78%
Tillamook	15	-0.06%	-0.23%	-0.06%
Newport	2	1.93%	1.70%	3.49%
Coos Bay	3	-0.87%	1.08%	-6.59%
Brookings	7	-0.04%	1.08%	-0.29%
Crescent City	9	-1.97%	-0.82%	-2.79%
Eureka	5	-0.48%	1.00%	-3.08%
Fort Bragg	6	-0.19%	-0.48%	-0.83%
Bodega Bay	13	-1.27%	-0.17%	-0.33%
San Francisco	8	-0.70%	-0.95%	-1.68%
Monterey	11	-0.49%	-1.84%	-0.33%
Morro Bay	12	-1.06%	-2.33%	2.81%
Average Decline	10	**-0.71%**	**-1.31%**	**-1.61%**
Average Gain	14	**1.42%**	**1.97%**	**4.37%**

The percentage values displayed in Table 3-95 were used to calculate the change in percentage by port from one five-year period to the next (Table 3-94). The only port areas that showed gains in the share of coastwide revenue are south and central Washington, Astoria, Newport, and Morro Bay. Astoria shows the largest gain, just over 8 percent, while Coos Bay shows the largest decline at 6.5 percent. The north Washington coast (including Neah Bay) and Tillamook (including Garibaldi) had no trawl sector landings after catch share implementation. For ports where revenue declined, the average drop was -2.7 percent for the 2011 to 2015 catch share period. For ports whose share of coastwide revenue declined, the average decline was -1.6 percent.[68] This may indicate an acceleration in the trend towards concentration of trawl ex-vessel revenue in a relatively small number of ports since the catch share program was put in place.

To assess the distribution of revenue across ports, the Gini coefficient was computed for each period. The Gini coefficient is a measure of statistical dispersion; it is a common metric for evaluating income

[68] The ports that declined (in rank order by coastwide share) are Coos Bay, Eureka, Fort Bragg, and Brookings.

distribution. It is used here in a similar fashion to assess revenue distribution[69] (see Section 3.1.1(b)(1) for related discussion). The Gini coefficient has increased over time (Table 3-96), indicating that trawl ex-vessel revenue has become more concentrated in a smaller number of ports. The change in the Gini coefficient is greatest between the 2001 to 2005 and 2006 to 2010 periods, indicating a greater distributional shift between those periods than between the period pre-catch shares (2006 to 2010) and post-catch shares (2011 to 2015). The data in Table 3-97 show that the harvest shares of upper-middle ranking ports have declined the most under catch shares as compared to the immediately preceding periods. Of the five upper-middle ranked port areas (ranked between third and seventh in terms of share of 2006 to 2010 ex-vessel revenue), all declined except for the south and central Washington area (ranked fourth in terms of 2006 to 2010 share).

Table 3-96. Gini coefficients for distribution of trawl revenue over ports by time period. Source: PacFIN.

Time Period	**Gini coefficient**
1996-2000	0.4202
2001-2005	0.4590
2006-2010	0.5723
2011-2015	0.6605

3.2.2(b)(2)(b) Shoreside Landings in by Species and Species Group

While volumes landed were generally lower under catch shares than during the five previous years, there were some notable differences with respect to ex-vessel values. For the comparison periods, volume in Washington area ports was down 14 percent for whiting and 16 percent for non-whiting, but related ex-vessel values were up 34 percent and 44 percent, respectively. Small increases in the volume of non-whiting landings in Astoria/Tillamook and Brookings (3 percent and 6 percent, respectively) were modestly greater in terms of ex-vessel value (21 percent and 15 percent, respectively). A few other notable swings between volume and value were a 15 percent decrease in volume of flatfish landed in Astoria, which converted to a 14 percent increase once value was taken into account, and, conversely, a 6 percent increase in volume of rockfish in Newport, which converted to a 10 percent decrease in ex-vessel value.

[69] A value of 0 represents a perfectly even distribution, while a value 1 would mean that all revenue is concentrated in one port.

Table 3-97. Average ex-vessel value of annual landings (thousands of 2015 $) by species group and port for the shoreside trawl sector, 2006 to 2010. Source: PacFIN.

Port	P. Whiting	Sablefish	Flatfish	Rockfish and Thorny-heads	Other Roundfish	Other Groundfish	Non-whiting Total	Total
Washington	3,760	689	1,135	210	84	68	2,186	5,945
Astoria/Tillamook	2,759	2,746	4,390	741	129	196	8,202	10,960
Newport	3,426	2,112	1,419	478	9	134	4,152	7,578
Coos Bay	445	1,667	2,113	395	21	166	4,363	4,808
Brookings	***	***	***	***	***	***	1,677	***
Crescent City	348	319	483	122	4	4	932	1,279
Eureka	***	1,314	1,852	525	10	46	3,747	3,987
Fort Bragg	-	805	931	517	39	20	2,311	2,311
San Francisco	<0.5	241	760	222	8	8	1,240	1,240
Monterey	***	132	191	278	5	18	625	625
Morro	***	33	64	50	<0.5	***	147	147

*** = suppressed to protect potentially confidential data.
Note: Ports combined and Bodega Bay and Santa Barbara omitted due to confidentiality concerns.

Table 3-98. Average ex-vessel value of annual landings (thousands of 2015 $) by species group and port for the shoreside trawl sector, 2011 to 2015. Source: PacFIN.

Port	P. Whiting	Sablefish	Flatfish	Rockfish and Thorny-heads	Other Roundfish	Other Groundfish	Non-whiting Total	Total
Washington	5,055	1,597	860	471	132	95	3,156	8,210
Astoria/Tillamook	7,599	2,484	4,994	1,312	603	548	9,941	17,539
Newport	7,593	1,975	1,118	428	4	68	3,594	11,187
Coos Bay	68	803	1,470	212	10	63	2,558	2,625
Brookings	<0.5	870	839	193	1	32	1,936	1,936
Crescent City	***	61	82	28	***	3	174	174
Eureka	***	1,128	1,671	491	16	97	3,404	3,404
Fort Bragg	2	843	853	692	21	39	2,450	2,452
San Francisco	1	166	223	208	1	16	615	616
Monterey	1	1,042	208	332	6	8	1,596	1,597
Morro	5,055	1,597	860	471	132	95	3,156	8,210

*** = suppressed to protect potentially confidential data.
Note: Ports combined and Bodega Bay and Santa Barbara omitted due to confidentiality concerns.

Table 3-99. Percent change from 2006 to 2010 to 2011 to 2015 by species group and port for the shoreside trawl sector (trawl and gear switched).

Port	P. Whiting	Sablefish	Flatfish	Rockfish and Thorny-heads	Other Roundfish	Other Groundfish	Non-whiting Total	Total
Washington	34%	132%	-24%	125%	57%	41%	44%	38%
Astoria/Tillamook	175%	-10%	14%	77%	367%	180%	21%	60%
Newport	122%	-7%	-21%	-10%	-51%	-49%	-13%	48%
Coos Bay	-85%	-52%	-30%	-46%	-55%	-62%	-41%	-45%
Brookings	***	***	***	***	***	***	15%	***
Crescent City	***	-81%	-83%	-77%	-100%	-34%	-81%	-86%
Eureka	***	-14%	-10%	-6%	60%	111%	-9%	-15%
Fort Bragg	+++	5%	-8%	34%	-45%	101%	6%	6%
San Francisco	-64%	24%	-55%	-52%	-69%	59%	-39%	-39%
Monterey	***	26%	17%	-25%	-77%	-12%	-1%	-1%
Morro	***	3036%	226%	563%	2666%	***	983%	983%

*** = suppressed to protect potentially confidential data.
+++ = percent change cannot be calculated because there was a zero value in the previous period.
Note: Ports combined and Bodega Bay and Santa Barbara omitted due to confidentiality concerns.

Participation of trawl-permitted vessels targeting sablefish with fixed gear (gear-switched vessels) has most benefited Morro Bay and Newport. The weight of such landings was highest in Morro Bay, averaging 217 mt per year, and second (behind Newport) in terms of value at $1.1 million per year (nominal dollars) (Table 3-100). The difference between Morro Bay's rank with respect to landings weight and values appears to result from the lower price paid for sablefish compared to Newport. The 2011 to 2015 average sablefish price in Newport was $3.04/pound, compared to $2.23/pound in Morro Bay. Coastwide, the average price was $2.67/pound. Morro Bay is also distinct because thornyhead and rockfish make up a higher proportion of landings than elsewhere.

Table 3-100. Average annual landings (mt) and ex-vessel revenue (nominal dollars) from 2011 to 2015 for the nontrawl shoreside IFQ sector, ranked by ex-vessel revenue.

Port	Metric Tons	Dollars
Newport	171	$1,128,271
Morro Bay	217	$1,059,504
Astoria	155	$943,510
South and central Washington Coast	161	$938,443
San Francisco	54	$244,422
Coos Bay	13	$71,935
Monterey	8	$42,415
Puget Sound, Brookings, Eureka, Fort Bragg, Santa Barbara	103	$611,297

Note: Puget Sound, Brookings, Eureka, Fort Bragg, and Santa Barbara are grouped to maintain confidentiality.

3.2.2(b)(3) Shoreside IFQ Vessel Participation

The number of vessels participating in the non-whiting shoreside trawl sector has declined substantially since 1994. Most of the decline was due to the trawl permit buyback that occurred at the end of 2003 (Table 3-88). From 2011 through 2015, no trawl permitted vessels made landings in the north Washington coast and Tillamook port areas. Conversely, there was a large increase in the number of vessels landing in Morro Bay—from four in the 2006-to-2010 period to 24 in the 2011-to-2015 period—due to participation by vessels with trawl permits gear switching. Of ports with active fleets after the catch share program was implemented, Newport, Crescent City, and Eureka show the largest absolute declines in non-whiting vessels making landings, relative to the five years prior to implementation.

With northern California's shift away from the whiting fishery, 14 vessels stopped delivering whiting to Crescent City and eight stopped whiting deliveries to Eureka (comparing 2006-2010 to 2011-2015, Table 3-101). Overall, the number of whiting vessels declined by 14 after the catch share program was implemented (same comparison period). In relative terms, the post-implementation decline in whiting vessels coastwide—33 percent—is much greater than for the non-whiting sector. As shown in Table 3-101, the number of vessels participating in the non-whiting shoreside trawl/IFQ fishery has declined substantially since 1994, with most of the decline happening before implementation of the catch share program in 2011. Coastwide, the number of vessels declined from 133 to 129. Although this is a relatively modest change, it masks substantial losses in some ports; of ports with active fleets post-implementation, Newport, Crescent City, and Eureka show the largest absolute declines in non-whiting vessels making landings. Additionally, no trawl/IFQ vessels made landings in the north Washington coast and Tillamook post-implementation. Conversely, Morro Bay saw a large increase in vessels landing there—from 4 to 24—likely due to non-trawl IFQ vessels.

Table 3-101. Count of vessels by fishery sector making groundfish landings by time period. Source: PacFIN.

	Non-whiting Trawl*				Shoreside Whiting Trawl			
Port	**1996 to 2000**	**2001 to 2005**	**2006 to 2010**	**2011 to 2015**	**1996 to 2000**	**2001 to 2005**	**2006 to 2010**	**2011 to 2015**
Puget Sound	16	25	9	11	2			
North Washington Coast	26	19	7		1			
South and central Washington Coast	44	15	13	18	14	17	21	14
Astoria	60	54	41	40	31	14	22	23
Tillamook	7	7	3		1			
Newport	52	47	31	19	28	18	20	21
Coos Bay	46	33	31	22	7	7	4	2
Brookings	28	18	14	13	1			
Crescent City	53	29	15	4	12	4	14	
Eureka	56	46	21	11	17	3	8	
Fort Bragg	29	37	9	8				
Bodega Bay	37	11	2	1				
San Francisco	50	36	17	13				
Monterey	34	24	9	11	1	2		
Morro Bay	30	22	4	24				
Coast-wide Total	**283**	**235**	**133**	**129**	**70**	**41**	**42**	**28**
Average Number of Ports a Vessel Delivers To	**2.01**	**1.80**	**1.70**	**1.51**	**1.64**	**1.59**	**2.12**	**2.14**

*Non-whiting trawl includes shoreside IFQ fixed gear, 2011 to 2015.

Numbers for ports do not sum to coastwide value due to excluded ports and vessels making landings in more than one port.

For the non-whiting trawl fishery, across the periods shown, vessels on average have decreased the number of ports where they make deliveries from 2.0 for 1996 to 2000 to 1.5 for 2011 to 2016, providing another indicator of possible geographic contraction in fishing activity. The whiting fishery has shown the opposite trend; the 1996 to 2000 ratio was 1.6, while it was 2.1 from 2011 to 2015.

Table 3-102. Average declines and increases in average inflation-adjusted revenue per vessel by port and time period, grouped by ports with declines and increases, respectively.

	2006 to 2010[1]	**2011 to 2015**	**2011 to 2015**
Number of ports with declining average revenue per vessel	13	4	4
Average decline in	***-24%***	***-33%***	***-34%***
Number of ports with increasing average revenue per vessel	2	11	9
Average gain	27%	53%	48%

[1] First time period in the comparison is 2001 to 2005.

3.2.2(b)(4) Impacts on First Receivers

Sustained community participation in the shoreside fishery depends on the presence of first receivers (buyers) to purchase fish from the shoreside trawl sector and other vessels landing in the port. The total number of buyers of trawl-caught groundfish across the West Coast has decreased steadily since 1994 (Figure 3-63). This decline is largest in number in California.

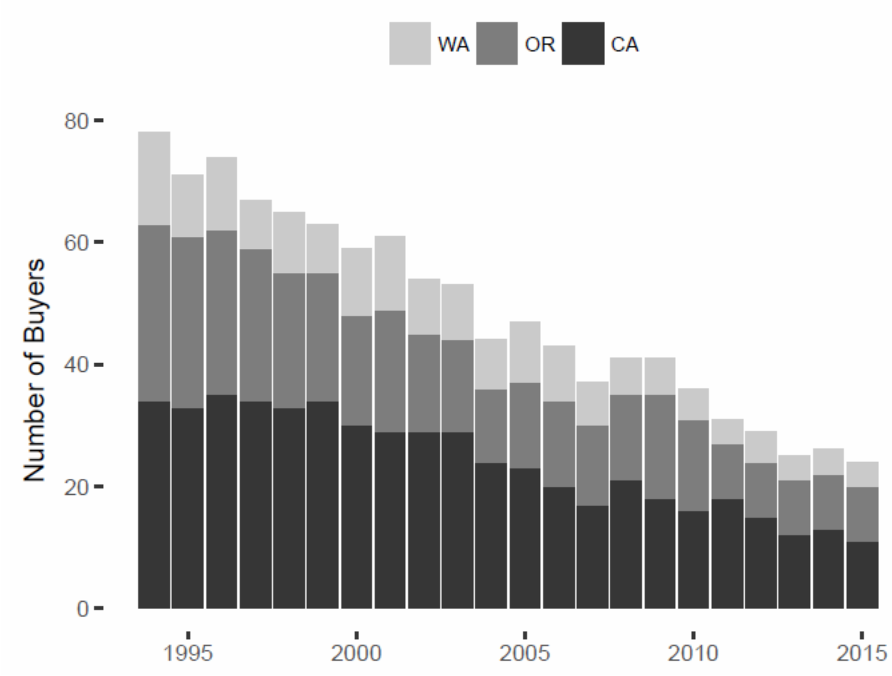


Figure 3-63. Number of unique buyers purchasing trawl-caught groundfish by state. Source: Fish ticket data.

There was a general decline in the number of both whiting and non-whiting buyers along the coast. Table 3-103 shows the counts of first receivers receiving at least three deliveries of groundfish from the trawl sector. The table shows the total number of buyers in each five-year period (rather than the average number of buyers present across years). Most port communities experienced a loss of buyers before 2006.

There appears to be a general downward trend in the number of non-whiting first receivers/buyers across all periods, with the greatest decline occurring from 2006-2010 and from 2011-2015. The number of whiting buyers was generally stable across periods, but dropped substantially between 2006-2010 and 2011-2015. During the catch share period compared to the immediately preceding five years, Coos Bay, Fort Bragg, San Francisco, and Monterey show the greatest decreases for non-whiting buyers, while Morro Bay showed the greatest increase, again due to vessels switching gears. For the same comparison periods, Coos Bay and Crescent City showed the greatest declines in whiting buyers, and purchases from whiting trips ended for Crescent City and Eureka. The number of buyers (whiting and non-whiting) for selected individual years is displayed in Figure 3-64.

Table 3-103. Count of first receivers receiving groundfish by fishery sector and time period with at least three landings. Source: PacFIN.

	Non-whiting Trawl*				**Shoreside Whiting Trawl**			
Port	**1996-2000**	**2001-2005**	**2006-2010**	**2011-2015**	**1996-2000**	**2001-2005**	**2006-2010**	**2011-2015**
Puget Sound	6	6	3	2	1			
North WA coast	6	8	2		1			
South and central Washington Coast	6	4	5	3	4	2	2	2
Astoria	8	6	5	4	3	3	5	4
Tillamook	3	5	3		1			
Newport	7	5	5	5	6	3	4	3
Coos Bay	11	10	10	3	3	2	3	1
Brookings	8	8	2	3	1			
Crescent City	15	8	2	1	4	4	6	
Eureka	9	6	2	2	2	2	1	
Fort Bragg	8	5	10	4				
Bodega Bay	11	6	2	1				
San Francisco	27	21	13	6				
Monterey	22	18	10	4		2		
Morro Bay	13	11	7	11				
Santa Barbara	3	1	1	2				
Coast-wide Total (Unique Buyers)	94	74	57	32	19	16	17	8

*Non-whiting trawl includes shoreside IFQ fixed gear, 2011 to 2015. Note: Numbers for ports do not sum to coastwide value due to excluded ports and buyers that purchase in multiple ports. These counts may be loosely related to ownership of processing firms, because one firm may obtain more than one license for its different operations.

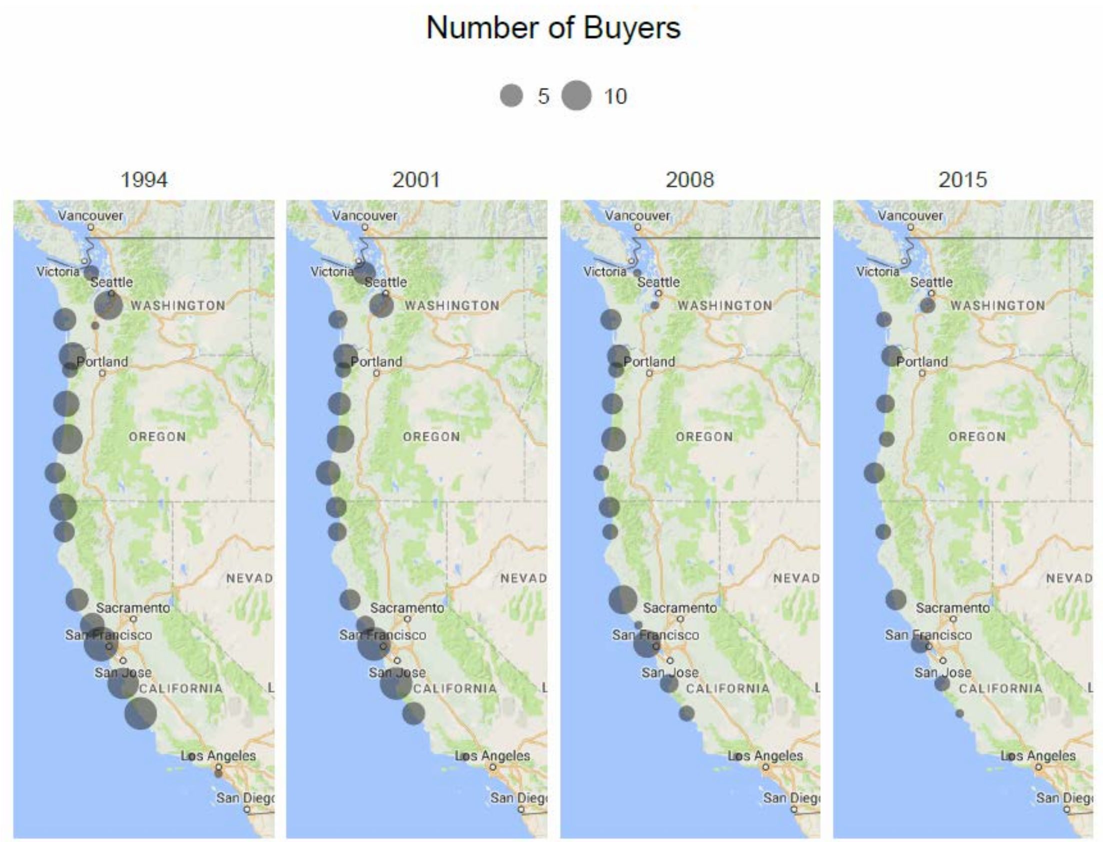


Figure 3-64. Map displaying the number of limited entry trawl groundfish buyers in each period over time, with the size of symbols representing the number of buyers in each port. Source: Fish ticket data.

One concern related to decreases in the number of groundfish buyers is that these buyers may no longer be available to purchase fish from other fisheries. The tables cited below address a number of questions on a port-by-port basis: whether buyers who participated prior to 2011 continued to participate in individual ports (Table 3-104); whether it appears that new buyers entered a port (Table 3-104); for buyers who stopped buying trawl sector groundfish, whether they continued to make purchases from other sectors (Table 3-105); and whether there are substantial numbers of non-trawl buyers still remaining active in the port (Table 3-105).

Table 3-104. Number and disposition of shoreside IFQ groundfish buyers by port area before and following implementation of the trawl catch share program (includes only buyers who received at least three deliveries in one year from 2006 to 2010). Source: PacFIN.

Port Area	Trawl Buyers During 2006 to 2010[2]	Trawl Buyers that Stopped Trawl Purchases After 2010	Trawl Buyers That Continued IFQ Purchases After 2010				Buyers Not Active During 2006 to 2010 That Made IFQ Purchases During 2011 to 2016				Total Current IFQ Buyers (Active in 2015 and/or 2016)
			Total	Consistent Participants (Every Year)	Intermittent Participants[5]	No Trawl/IFQ Purchases in 2015 and 2016[3]	Total	Consistent Participants	Intermittent Participants (at least one year from 2011-2014)	No IFQ Purchases in 2015 and 2016[3]	
Washington	10	7	3	3	-	-	3	-	3	-	6
Astoria/ Tillamook	8	3	5	4	-	1	1	-	-	1	4
Newport	8	5	3	2	-	1	4	1	1	2	4
Coos Bay	10	7	3	2	-	1	-	-	-	-	2
Brookings	2	-	2	-	2	-	2	-	2	-	4
Crescent City	6	5	1	-	1	-	-	-	-	-	1
Eureka	2	-	2	2	-	-	-	-	-	-	2
Fort Bragg	9	4	5	4	-	1	-	-	-	-	4
San Francisco[4]	12	7	5	1	1	3	9	-	3	6	5
Monterey	10	6	4	1	1	2	2	-	1	1	3
Morro Bay	6	4	2	1	-	1	15	-	-	15	1
Santa Barbara	-	-	-	-	-	-	2	-	1	1	1

[1] Includes buyers from vessels that used non-trawl gear to harvest IFQ fish (gear-switching vessels).
[2] "Original Trawl Buyers" received at least two landings from trawl vessels during 2006 to 2010.
[3] There is some intermittency in buying activity such that failing to buy in 2015 or 2016 does not necessarily indicate that a buyer has permanently exited a community or fishery sector.
[4] San Francisco Port Area includes Bodega Bay.
Note: Columns are not totaled because a buyer may participate in more than one port. A buyer that exited one port may remain active in another. This analysis only assesses the presence and activity over time of particular port/buyer/ combinations.
[5]. An intermittent participant is one that was not present in every year and does not fall into the category of not having received deliveries in 2015/2016 (the latter of which may be buyers who have chosen to stop participating).

Of the buyers who continued to make purchases after 2010, most were consistent participants, but a number stopped making purchases in certain ports in 2015 and 2016. In particular, two or more previously active buyers stopped making purchases in 2015 and 2016 in San Francisco and Monterey. The latter group may have exited the fishery or may be intermittent participants who will return in a coming year. For those buyers who were not active from 2006 to 2010, but who have been purchasing trawl/IFQ groundfish, one was a consistent participant, buying every year from 2011 through 2016. A number entered, but were not active in 2015 and 2016, including all of the apparent new entrants in Morro Bay.

In the nine port areas where some 2009 and 2010 buyers stopped making purchases from trawl/IFQ sector vessels, several of the buyers continued purchasing from non-trawl/non-IFQ sectors (third column in Table 3-105). Following 2010, the number of non-IFQ groundfish buyers decreased in 2011 in five ports and increased in seven ports. The combined number of Non-IFQ groundfish and other fishery buyers decreased in eight port areas (Washington, Astoria/Tillamook, Newport, Coos Bay, Brookings, Eureka, Morro Bay, and Santa Barbara) and increased in four port areas (Crescent City, Fort Bragg, San Francisco, and Monterey).

Table 3-105. By port area, number of buyers that stopped receiving shoreside IFQ deliveries after 2010, but continued buying from non-trawl/non-IFQ fishery sectors, and numbers of other buyers that purchased from non-trawl/non-IFQ fishery sectors during selected periods. Source: PacFIN.

Port Area	Buyers[1] Who Stopped Buying from Trawl/IFQ Vessels (No Trawl/IFQ purchases from 2011 through 2016)			Number of Buyers[2] Receiving at least $5,000 Deliveries from Non-Trawl/Non-IFQ Vessels During Selected Years: 2006		2010		2011		2016	
	Did not Make Trawl/ IFQ Purchases After 2010	Initially Continued but No Trawl/IFQ Purchases in 2015 and 2016[4]	Stopped Trawl/IFQ Purchases but Continued Buying from Other Sectors	Non-Trawl/ IFQ Directed Ground-fish	Other Fisheries	Non-Trawl/ IFQ Directed Ground-fish	Other Fisheries	Non-Trawl IFQ Directed Ground-fish	Other Fisheries	Non-Trawl IFQ Directed Ground-fish	Other Fisheries
Washington	7	-	5	10	209	9	206	8	198	11	180
Astoria/Tillamook	3	1	1	10	49	12	54	14	49	13	44
Newport	5	1	2	13	51	14	58	12	50	9	51
Coos Bay	7	1	6	9	56	5	64	10	49	14	43
Brookings	-	-	-	6	17	10	12	12	9	15	9
Crescent City	5	-	3	5	22	6	7	7	11	9	12
Eureka	-	-	-	12	32	5	38	3	27	10	19
Fort Bragg	4	1	1	6	28	5	19	7	27	12	24
San Francisco[3]	7	3	6	28	119	25	93	36	91	45	85
Monterey	6	2	4	12	26	21	23	16	35	24	28
Morro Bay	4	1	4	23	29	21	13	12	16	11	32
Santa Barbara	-	-	-	19	86	20	79	23	73	31	71

[1] "Original Buyers" had at least $5,000 in purchases from trawl vessels during 2006 to 2010.
[2] These are Incremental Buyer Counts: A buyer in a given port that purchases from more than one fishery sector category is counted only once. Counting priorities: 1st = purchases from TWL/IFQ vessels. 2nd = purchases from other Directed Groundfish sectors. 3rd = purchases from Other Fisheries.
[3] San Francisco Port Area includes Bodega Bay.
[4] There is some intermittency in buying activity such that the absence of purchases in 2015 or 2016 does not necessarily indicate that a buyer has permanently exited a community or fishery sector.
Note: Columns are not totaled because a buyer may participate in more than one port. A buyer that exited one port may remain active in another. This analysis only assesses the presence and activity over time of particular port/buyer/ combinations.

Of the seven port areas where some buyers stopped purchasing from trawl/IFQ vessels following 2010, many buyers continued purchasing from non-IFQ sectors in four port areas: Washington, Newport, Crescent City, and San Francisco (Table 3-105). Following 2010, the number of non-IFQ buyers increased during 2011 to 2014 in all port areas.

3.2.2(b)(5). At-Sea Mothership Catcher Vessels and Catcher-Processors

The at-sea mothership and catcher-processor co-op sectors targeting Pacific whiting offload in Bellingham, Tacoma, and Seattle. All of the processing vessels report Seattle as a homeport; however, catcher vessels participating in the mothership fishery have homeports across the coast, and they may make landings to West Coast ports in other fisheries. From 2006 to 2015, 30 vessels participated in the at-sea mothership fishery as catcher vessels; 22 of the 30 vessels made landings in West Coast ports. Table 3-106 shows ex-vessel value of landings (all species) from these vessels for the two five-year periods before and after implementation of the catch share program at the start of 2011. Ex-vessel revenue by mothership catcher vessels increased in Astoria and Newport after the catch share program. In ports south of Newport, landings largely disappeared after implementation.

Table 3-106. Number of catcher vessels participating in the mothership whiting fishery that also made shorebased landings in West Coast ports and the nominal ex-vessel revenue from those landings for two time periods. Source: PacFIN.

	2006 to 2010		**2011 to 2015**	
Port	**Number of Vessels**	**Inflation-adj. ex-vessel revenue ($mil. 2016)**	**Number of Vessels**	**Inflation-adj. ex-vessel revenue ($mil. 2016)**
Washington	7	$9.8	7	$19.5
Astoria	11	$8.2	14	$25.3
Newport	12	$17.1	13	$28.7
Coos Bay	3	$0.8	1	***
Brookings	2	***	1	***
Crescent City	2	***		
Eureka	2	***		
San Francisco (incl. Bodega Bay)	1	***		
Morro Bay	1	***		
Coastwide	20	$38.3	16	$74.4

Note: *** signifies information is excluded due to confidential data restrictions (less than three vessels or first receivers).

While mothership whiting vessels made shoreside IFQ landings in nine ports in the five years preceding catch shares (Table 3-106), they predominantly landed in only three principal ports (Table 3-107). Table 3-107 shows counts of vessels by principal port, defined as the port where a vessel made the largest proportion of its landings (measured in terms of nominal ex-vessel revenue). After the catch share program was implemented, the shoreside IFQ landings of these mothership catcher vessels continued primarily in those same three ports (south and central Washington, Astoria and Newport, Table 3-107). This geographic contraction of mothership/catcher-vessel landings under catch shares corresponds to the geographic contraction of landings in the entire shoreside whiting fishery (Table 3-103). These are the same three port regions that, as discussed above, dominate the shoreside non-whiting IFQ fishery.

Table 3-107. Number of mothership catcher vessels by principal port for two periods. Source: PacFIN.

Port	2006 to 2010	2011 to 2015
South and central Washington Coast	6	3
Astoria	7	6
Newport	9	7
Total	22	16

3.2.2(c) Changes in Infrastructure

Highlights:

- Interviews indicate a loss of infrastructure in most ports. The 2003 buyback program was a contributing factor in some ports, as was the catch share program.
- Respondents report that southern California communities have lost the most infrastructure of the three West Coast states.
- Newport, Oregon, appears to have a relatively stable infrastructure. Washington interview and survey respondents also reported less infrastructure loss than in southern California communities.
- Processing plants have closed, diversified, and consolidated.

A functioning fishing industry requires adequate infrastructure, including harbor facilities, routine dredging, providers of fishing gear and vessel maintenance, access to ice and bait, buyers and processors, and the providers and services required in turn by those buyers and processors. The fishing fleet and processors are interdependent, making it important to assess changes to infrastructure that affect both. (See Chapter 3.1 on program impacts to processing plants.)

Changes to infrastructure specifically linked to catch share programs around the world have been reported in academic literature. In the mid-Atlantic region, McCay and Brandt (2001) reported impacts on industry supply businesses as fewer boats could not support ancillary businesses. Overviews of other IFQ fisheries around the world (Copes 1996; Copes and Charles 2004) report that as shorebased resources concentrate in locations where larger companies thrive, smaller companies in smaller communities are more likely to fail. If the number of fishers declines to such an extent that infrastructure collapses, "fishing" communities may lose their fishing heritage altogether (Wingard 2000). As quota consolidates and infrastructure resources move to fewer centers of activity, travel distances to access resources create difficulties for smaller vessels (Olson 2011; Copes 1996). See Section 3.2.2.(d), Control of Quota Share by Community Residents and Section 3.2.2(g)(3)(c)), Consolidation Impacts, for more information.

Changes in infrastructure were identified in the interviews and surveys conducted by the NMFS PCGFSS that were used to develop this and following sections. The goal of the PCGFSS is to measure sociocultural changes to the groundfish fishery, the associated industry, and related communities resulting from the catch share program. The study is specifically designed to collect data over time in association with catch share programmatic events, such as the release of QS trading. To provide a baseline, data were collected between June and December 2010, prior to implementation of the catch share program. Between June 2012 and February 2013, one year after implementation, a second round of data collection was conducted. One year after the authorization of QS trading, between November 2015 and May 2016, a third round of data collection was conducted. The intent of the third collection was to understand impacts of QS trading, as well as to compare information after several years of operation under the catch share program.

To analyze changes infrastructure, the PCGFSS study analyzed and coded participant interviews using the “infrastructure” code and its subcodes, “industry suppliers/services” and processors/buyers,” following the methodology detailed in Appendix C.[70] In addition to PCGFSS data, Appendix D includes pairs of tables that summarize infrastructure information from the text of *Community Profiles for West Coast and North Pacific Fisheries Washington, Oregon, California, and other U.S. States* (NMFS 2007) and derived from interviews of enforcement personnel and port samplers and members of industry. The first table in each set of two tables per community covers infrastructure (fuel docks, ice plants, cold storage, processors, berths and moorage, gear storage yards, boat hoists/lifts/cranes and shipyards, marine supply stores, dredging, and local USCG stations).

[70] The code “Infrastructure” was applied to 360 segments of transcribed interviews and ranked 10 of 22 codes in terms of frequency of appearance. The subcode “industry suppliers/services” under infrastructure occurred 164 times (45.6 percent of the parent code). “Percent of parent code” refers to the proportion of segments coded with the parent code that was further sub-coded with the sub-code in question. Two rounds of coding were conducted; the first round focused on general concepts such as “groundfish” parent codes, and the second round re-coded the same interview material more specifically with sub-codes such as “whiting” or “black cod.” If “groundfish” was coded 100 times, “black cod” 40, and “whiting” 50, then the “percentage of parent code” would be 40 percent and 50 percent for black cod and whiting, respectively. For further detail, see Appendix C. The subcode “processors/buyers” occurred 98 times (27.2 percent of the parent code). The primary codes were “accumulation and consolidation,” “adaptability,” “California v. Oregon boats,” “community,” “cost,” “cost recovery,” “exit,” “fish stocks,” “fishery reputation,” “fleet variation,” “gear switching,” “geographic shift,” “impacts on other fisheries,” “infrastructure,” “management process,” “markets,” “new entrants,” “observers,” “ownership dynamics,” “safety,” “small vessels,” and “working in the industry.” See Appendix C for subcodes and a description of each code.

The second table in each pair covers the following:

- Number of buyers active in the ports
- Vessels owned by port residents and numbers of vessels active in the ports
- Groundfish limited entry permits and quota owned by port residents
- Indicators of the importance of groundfish to the fishing industry in the port (groundfish ex-vessel revenue as a percent of all ex-vessel revenue)
- Importance of the port to West Coast fishery production (port ex-vessel revenues as a percent of coast wide ex-vessel revenues)

Many of these data elements are included elsewhere in the review, but they are brought together for each port in a single location in Appendix D.

PCGFSS interviews indicate that there has been a loss of infrastructure in most West Coast ports both before and after catch share implementation. Some reasons for this loss include retiring industry suppliers, loss of vessels to support infrastructure, and changes in processing. Participants distinguished infrastructure changes that began before the catch share program and those linked to the catch share program itself. For example, the 2003 buyback appears to have influenced infrastructure changes in some ports. Additionally, respondents both inside and outside California discuss higher levels of infrastructure loss in the state. Changes in processing infrastructure were widely noted. The data indicate that the number of processing companies has been relatively stable while there has been a downward trend in the number of buyers in particular ports (Section 3.2.2(b)(4)). Newport, Oregon, appears to have a relatively stable infrastructure. Although changes have occurred, respondents indicated that services continue to be available.

When discussing infrastructure, PCGFSS interviewees acknowledged the direct link between boats and infrastructure:

> "We have a catch-22 here, because the city wants to support the economy, and that means supporting the fishermen and the infrastructure they need to keep working, but the fishermen have to be landing enough so that there is demand for the infrastructure." —Industry Participant, Monterey, 2015/2016.

> "First it starts with the boats. It doesn't start with the infrastructure. There's boats that need things, and then there's infrastructure that supports the boats. The boats have whittled down to literally nothing so a business just can't stay in business to sell products

> without boats. In San Francisco they sell t-shirts and sweatshirts and baseball caps. …It's not Fisherman's Wharf anymore, it's a tourist port." —QS Permit Owner, San Francisco Area, 2015/2016

Several interviewees said some infrastructure loss had occurred before the catch share program began. The following quotes were preceded by researchers asking if there had been a loss of infrastructure.

> "The buyback obviously was a big influence for a certain amount of the…harvesters went away then. So that, that was, that was a major influence." —Processor, Oregon, 2012.

> "Not measurable. But there's been a steady erosion."—Processor, Oregon, 2015/2016.

> "It wasn't just the catch shares, because the groundfish fleet needed some kind of new management because it was such a small quota that they weren't using the nets long enough to do anything bad to them really. Now when they do go groundfish fishing, they hit it hard and they're just grind, grind, grind, go, go, go. And they wear their little nets out. But there's fewer boats. There just weren't enough in each port to keep a net shop there when every port had a net shop, and they all just kind of disappeared because there wasn't… they'd lost their infrastructure before the catch shares."—Industry Participant, Newport, 2015/2016.

> "…It's just been happening over the years, not even exactly because of IFQ, but we used to have more processors, we used to have more boats, more, we're just, you know, there's not a lot of infrastructure around here anymore."—Fisherman, Half Moon Bay, 2015/2016.

Alternatively, some people commented on changes to infrastructure that are directly linked to the catch share program.

> "There are less boats on the water; there's less boats that need supplies, so yeah"—Fisherman, Newport, 2015/2016.

> "I watched Garibaldi just completely turn into a ghost town." QS Permit Owner, Astoria Area, 2015/2016.

While trawl sector landings and Garibaldi have disappeared, the data indicate that residents of the Garibaldi area have not sold their permits. At the same time, when the researcher asked whether this observation about Garibaldi was related to catch shares, the interviewee responded with his perspective:

> "… Yup …people started selling their permits off."—QS Permit Owner, Astoria Area, 2015/2016.

> "…That's one other thing that we have lost in this area is lending institutions that are involved with or knowledgeable about fisheries. That's a big loss, actually since fisheries have changed."—Industry Participant, Crescent City, 2015/2016.

California was identified by both residents and non-residents as experiencing the most dramatic changes to infrastructure. As previously noted, most of this change occurred before the catch share program began, with some attributed to the trawl buyback program. For many California respondents, the buyback was a significant event when numerous vessels in their communities left the trawl sector. This may be the lens through which these respondents judge the catch share program. Southern California communities reported losses across all three categories (general state of infrastructure, suppliers/service providers, and processors/buyers), indicating that many facilities and services were already gone by the time the catch share program was put in place. This is echoed by industry members:

> "There's no longer a customer base and the further you get south, the worse it gets. Fort Bragg is hangin' in there, a little bit done in Eureka but you get down to San Francisco, you're talking one boat left."—Industry Participant, Eureka Area, 2016.

> "I mean, besides me, we don't have a marine electrician anymore. The mechanics are down to nothin'. Electronics are down to nothin'. That's sad. That's a reason for nobody to come here anymore. But it's also, it's hard to survive."—Industry Participant, Eureka, 2015/2016.

> "California's remote fishing ports result in limited and unreliable access to affordable industry resources for observers, monitors, and processors in some instances. Fishermen south of the 40-10' simply have higher costs of doing business than their counterparts up north. There was hope that with the catch shares the tide would turn in this fishery, and participants would see economic stability and growth, and infrastructure would stabilize, but that hasn't been the case."—Industry Participant, Fort Bragg Public Hearing, 2016.

Northern California, on the other hand, retained the infrastructure lost in southern California, although they were reduced after the buyback, but respondents anticipated further losses as suppliers and service providers reached retirement age with no new entrants taking their place.

> "But what are they gonna get replaced with? The training ground is gone. The industrial base of the community no longer exists. The millwrights that once were out here that could transition into fabrication businesses and things like that and have the work experiences and the desire to do hands-on kind of mechanical trades no longer exists to a big degree."—Industry Participant, Eureka Area, 2016.

Processing impacts have changed coastwide; changes range from diversifying the species processed to closing down all together. Participants provided examples of difficulties in maintaining a processing workforce:

> "…They can't keep steady workers long enough to be able to. In the days that they can go through a phenomenal amount of fish in a day, you had 20-30 filleters, now they're all down to 10-15. I don't know one of our plants that has over 15 filleters. They might in Astoria, but I don't know. If it is more, it isn't much more than that, and like I said, the one in Eureka went from 30 to 10, and they're hiring crewmen off the boat to come in and fillet."—Fisherman, Newport, 2015/2016.

> "…We've lost 50% of our filleters and our workforce. I can't keep a truck driver 'cause I can't keep him busy. I have two semis I operate."—Processor, CA, 2015/2016.

Fishermen also commented on changes to processing capacity and the market changes:

> "I wouldn't say there's an increase in market competition. The problem is with the market is when you're only bringing 26-30% of the total groundfish to the dock, this is what I've seen on the fish plant side. . . . the filleters, they can't keep up with it to do a good job with the fillets because they don't have the experience. When you lose the opportunity for personnel to work steadily, they go away."—Fisherman, Newport, 2015/2016.

> "Right now I struggle selling enough groundfish because the plant can't keep filleters in there. I mean I go get 50 or 60,000 pounds of fish into Hallmark's and that ties them up for three days because they've lost all their filleters. So I think jobs have gone away in that respect. You know I mean I haven't lost any jobs on my boats, but I've seen infrastructure go away and that's hurt my business because I can't get the product out as quick as I'd like to. I'm only one boat going, so then if you get three or four draggers going to that plant, then we're backed up to where we're only making a trip every 10 or 12 days, instead of every time the weather is good. So it's hurt."—QS Permit Owner, Coos Bay Area, 2015/2016.

Other fishermen spoke of processing plants closing, diversifying, and buying up other plants:

> "Seven years ago, we had seven-eight processors on the river here doing shrimp, and then there was several groundfish plants. Now there's just Pacific and Bornstein there on the river…"—QS Permit Owner, Astoria Area, 2015/2016.

> "There's nobody processing in Crescent City or Brookings. There used to be. The company's—Pacific Choice—consolidated. They bought, they been buyin' out different companies and then just sending everything here."—Fisherman, Eureka, 2015/2016.

> "Da Yang is putting in, they started in sardines and then they went to hake and they went to shrimp and now they're getting into the trawl industry. Supposedly, they're gonna be buying out of Newport here in the next couple years."—QS Permit Owner Owner, Newport, 2015/2016.

> "It was starving all those processors out just like it was the boat owners. They'd gobble each other up, gobble each other up, gobbled each other up. Pretty soon you had two left."—Fisherman, Astoria Area, 2015/2016.

Newport, Oregon, study participants reported changes to industry suppliers/services and processors/buyers, but reported an equal number of increases and decreases after catch share implementation. Participants spoke of companies adapting by accommodating the needs of fishermen under the catch share program:

> "I haven't seen a lot of changes in infrastructure, but what I have seen…are changes in the services that the infrastructure is providing. … Our net shop used to be a net shop, you know, that's what it did. It built trawl nets. Now it's building…excluder devices, you know? … So, I see those services within our own infrastructure…changing to meet a changing fleet."—Industry Participant, Oregon, 2012.

Another fisherman suggested the following:

> "The infrastructure is just serving a smaller segment of the people than it what it was before, but I think it's similar to what it was."—Fisherman, Newport, 2015/2016.

Unlike other locations along the coast, the Newport area has also witnessed expansion on some fronts:

> "The Port of Toledo is great. We've used their facility for lots of different things. We get hauled out there, and I know they're working on getting a new haul out facility for the bigger boats, and so they're expanding to fit our needs the better…"—Fisherman, Newport, 2015/2016.

In addition to consolidation (Section 3.2.2(g)(3)(c)) and infrastructure changes, respondents noted broader changes in services with regard to aging service providers (Section 3.2.3(c), Fishing Heritage; Russell et al. 2014). The lack of next-generation succession in certain industry services result in fishermen, at times, having to travel great distances to obtain services in a different port.

> "We used to have our own net shop here that we don't have any more but we do have that in Oregon…You just have to go farther out of your way… But that was not because of the industry. That guy retired because he was too old."—Fisherman, Crescent City, 2015/2016.

Infrastructure loss has occurred along most of the Pacific Coast, beginning well before the catch share program was put in place. Section 3.1.1(b)(1) shows that on a coastwide basis there was a coastwide decline in whiting processors and fluctuating numbers of non-whiting processors. Washington respondents reported fewer infrastructure losses, but identified a reduction in the number of processors. Oregon respondents identified losses that occurred after catch share implementation, but these may have stabilized through consolidation and centralization of fish activity in locations such as Newport. In California, the buyback program led to loss of infrastructure, particularly in the south. Infrastructure loss appears to be spreading north in California as industry members enter retirement.

3.2.2(d) Control of Quota Share by Community Residents

Highlights:

- Seattle, Newport, and Charleston/Coos Bay have the highest percentage of QS owners since implementation of the catch share program.
- Consolidation and absentee ownership are concerns for many fishermen. There has been a slight shift in QS owners away from coastal communities, while the relative distribution of QS owners by state has remained constant.
- The top four locations in terms of control over quota share are Newport, the Portland area, the Seattle area, and other locations in the Newport area.
- After divestiture was completed, an analysis of individual ownership interests showed that 15 individuals controlled 90 percent or more of the quota for at least one species.

This section explores location of QS owners and trends in their location over time. It also looks at the amount of QS associated with communities, the flow of QS among communities as QS is traded, the geographic redistribution of QS that was traded to come into compliance with the control limits by the divestiture deadline, and the geographic distribution of individuals who hold amounts of QS within 10 percent of the control limit. The section concludes with perspectives on QS ownership and absentee owners collected through the PCGFSS.

The academic literature indicates that QS owners benefit enormously from initial allocations, and, depending on how they choose to manage those allocations, they may benefit their local communities as well (Ecotrust 2011; Russell 2016). Local benefits accrue if QS owners use their profits to purchase goods and services in their local communities. When multiple QS owners consolidate their operations, they typically end up supporting more community infrastructure (Copes and Charles 2004; Olson 2011; Russell 2016). The benefits from the QP related to the QS depend on the community from which QS owners fish their QP, or the communities to which they lease the QP (sell the QP issued annually to QS holders).

In the following sections, two different approaches are used to associate quota ownership with geographic areas. One is based on the ownership interest behind the QS permit (and associated QS account), and the other is based on the owners as named on the QS permit. In order to buy, own, and trade quota shares, prospective owners must first acquire a QS permit, which must be renewed annually. Some QS permits have been established for which the owners have yet to acquire QP. This study excludes those permits.

From 2014 onward, the number of QS owners has increased and changed over time. Distribution of QS permit ownership, which is based on the "Permit Owner City" listed for each permit in the NMFS West Coast Regional Office Permits Branch/database, was analyzed by sorting the data by the community aggregations listed in Table 3-108. A caveat for the use of address data is the level of accuracy of the address information used to assign permits to communities. Some address information on the permits may vary and can represent business locations, rather than permanent residences. However, this is consistent across all years, and these data are still the best available to compare all QS permit owners. Because the PCGFSS is voluntary, NMFS only has a representation of all QS owners for comparison.

3.2.2(d)(1) Location of QS Owners and Trends in Ownership over Time

Since program implementation, the communities of Seattle (Puget Sound Area), Newport, and Coos Bay have consistently had the highest percentage of QS owners (Table 3-108). Since 2014, Newport has increased the percentage of QS owners in that community, and Coos Bay has declined in the percentage of QS owners. Seattle increased the percentage of QS owners in 2016. Newport has a more stable infrastructure (relative to other ports) (Section 3.2.2(c), Changes in Infrastructure), and it also has the highest number of QS owners. At the same time, it seems to be one of the only ports with new generations of younger fishermen entering the fleet (Fishing Heritage, Section 3.2.3(c)). A small percentage of QS owners live in California communities. Some of these communities have experienced a small increase in percentage of QS owners; this may be directly related to community trusts and/or risk pools located in communities such as Fort Bragg, Half Moon Bay, Morro Bay, and Monterey. Section 3.2.2(g)(1) contains more information on community trusts and risk pools.

Table 3-108. Percentage of QS owners that reside in each community area. Shaded areas are QS trading years. Portland and Alaska are communities outside of community aggregation listed in Table 3-86. Source: NMFS West Coast Regional Office Permits Branch/database.

Community	2011	2012	2013	2014[1]	Divestiture Deadline[2] 2015	2016
Puget Sound Area	13.8	13.7	13.8	13.7	13.5	15.7
South and Central WA Coast	9.4	9.4	9.4	9.2	9.0	7.0
Garibaldi	2.9	2.9	2.9	2.6	2.6	2.3
Astoria	8.7	8.6	8.7	8.5	9.0	8.1
Newport	16.7	16.5	16.7	17.6	18.1	18.0
Coos Bay Area	19.6	19.4	19.6	17.6	17.4	16.3
Brookings Area	3.6	3.6	3.6	3.3	3.9	3.5
Crescent City	1.4	1.4	1.4	2.0	1.3	1.2
Half Moon Bay/Princeton*	2.9	3.6	2.9	2.6	2.6	2.9
Eureka Area	5.8	5.8	5.8	5.2	5.2	4.7
Fort Bragg Area	5.1	5.0	5.1	5.2	5.2	5.8
Bodega Bay Area	0.7	0.7	0.7	0.7	0.6	0.6
San Francisco Area	2.2	2.2	2.2	2.0	1.9	1.7
Morro Bay Area	0.7	0.7	0.7	1.3	1.3	1.7
Santa Barbara Area						0.6
Monterey	2.9	2.9	2.9	4.6	3.9	4.1
Portland	2.9	2.9	2.9	3.3	3.9	5.2
Alaska	0.7	0.7	0.7	0.7	0.6	0.6
Total number of Quota Share Permits	138	139	138	153	155	172

[1] Trading was allowed, beginning at the start of 2014, with the exception of widow rockfish.
[2] November 30, 2016, with the exception of widow rockfish

3.2.2(d)(2) Ownership Interests and Community Ties

In contrast to the assignment of QS permits to communities based on the addresses listed on the permit, the amount of QS associated with particular communities is assessed based on the individual ownership interests behind the names listed on the QS account, as provided by the NMFS West Coast Regional Office Permits Branch/database. Using the ownership interest approach, [71] each QS permit was divided

[71] The ownership interest approach provides only a partial assessment of the degree to which QSs may be associated with a particular community and to which any entity may be close to or at a control limit. On one hand, using this approach provides an assessment of the amount of QS a single entity may control based on ownership interest in a variety of businesses that own QS. On the other hand, entities organized at higher levels of aggregation also have to be evaluated across QS accounts to identify the total amount of QS held at or close to control limits. For example, if

into its various ownership interests until each individual person's ownership interest was identified. Then each individual's total ownership across permits was determined, and the addresses of those individuals were used to associate their QS with a community. To the degree that the listed addresses reflect the community of residents of QS owners, this approach provides insights into where the profits from QS ownership ultimately flow; profits that are not reinvested into the business are personal income for the individuals behind the listed businesses. However, only the most recent data were readily available for this approach (end of 2016, start of 2017). There is an ongoing effort to augment this snapshot with 2013 data, before trading of QS was allowed. Once data are available, they may be used to supplement the current analysis.

The top five locations for non-whiting QS holdings, in descending order, are Fort Bragg, the Seattle area, Coos Bay, the Portland area, and Astoria. These locations accounted for 59 percent of non-whiting QS. For whiting, the top five locations are Newport, the Portland area, the Seattle area, other locations in the Newport region, and "None" (no address information provided). These locations accounted for 50 percent of whiting QS. Table 3-109 shows the geographic distribution of end-of-2016/start-of-2017 QS holdings by species/species group assessed assigned on individual ownership interests.[72.] Each column in Table 3-109 sums to 90 percent; the remaining 10 percent is reserved as part of the Adaptive Management Program. While Adaptive Management Program quota has been passed through to QS accounts thus far, these shares are not owned. The last two columns in the table show how each city/region ranks non-whiting.

Person A and Person B each have their own QSs and also own Corporation Z, which holds QS, then a complete evaluation includes not only totaling the QS amount each individual holds, plus that individual's share of Corporation Z's quota, but also an evaluation of Corporation Z's QSs compared to the control limits. For this analysis, an evaluation of both higher and lower levels of aggregation in a single summary would have resulted in double counting and the erroneous geographic assignment of quota communities in amounts in excess of the QSs actually held.

[72] In general, data were grouped into regions using the IOPAC port areas (including the entire county(ies) associated with each port area [first column in Table 3-109]). A listing of relevant IOPAC port areas is provided in

Table 3-86. These regions were then subdivided by ports within the region, using the city boundaries of the individual ports. Addresses were assigned to a port if they were within the area of the city associated with the port (second column Table 3-109). If an address was within the county of the port, it was assigned to an "other" category associated with that port. For example, Westport is within Greys Harbor County, so any QS holder with an address outside of Westport but within Greys Harbor was assigned to "Other Westport." There are two exceptions: (1) for Seattle, King County was used as the geographic boundary, rather than the city limits, and (2) Portland is included as a region (column 1), and the tri-county area is used as the boundary (Clackamas, Multnomah, and Washington Counties). Addresses outside the identified counties were assigned to an "other" category for the state. Addresses outside the three West Coast states are grouped separately, with Alaska given its own category. Some QS holders, while appearing in the address file, did not provide a city or zip code (listed as "None"), while no corresponding address was found in the address file for a small amount of quota (listed as "Not Found").

QS owner addresses in the three West Coast states represented 82 percent of non-whiting QS and 81 percent of whiting QS. Of the three states, QS holdings are greatest in Oregon for both whiting and non-whiting, at 40 percent and 55 percent, respectively. California is second for non-whiting at 25 percent, and Washington is third at 17 percent. For whiting QS, Washington is second at 22 percent, while California accounts for only 4 percent of the holdings.

Table 3-109. Distribution of QS holdings among QS ownership interests by town of port and surrounding areas in 2017. Source: NMFS West Coast Regional Office Permits Branch/database.

IOPAC Region/ Metro Area	Port/Port Area	Dover Sole	Petrale Sole	Other Flatfish	Rockfish	Sablefish	Other Roundfish	Non-whiting Totali	P. Whiting	Non-whiting Rank	Whiting Rank
Puget Sound Area	Bellingham	1.5%	2.7%	3.1%	1.3%	1.6%	3.3%	1.9%	0.1%	17	25
	Other Puget Sound	0.5%	0.8%	0.5%	0.5%	0.7%	0.8%	0.5%	0.5%	27	17
	Seattle Metro	6.6%	7.2%	9.3%	7.4%	7.0%	14.6%	7.7%	10.9%	2	3
South and central Washington Coast	Westport	0.4%	0.3%	0.3%	0.8%	0.4%	0.3%	0.5%	4.3%	28	9
	Other Westport	0.3%	0.3%	0.3%	0.9%	0.4%	0.4%	0.5%	3.7%	29	10
	Other Ilwaco	1.3%	1.8%	2.1%	1.4%	1.2%	2.3%	1.6%	0.1%	20	26
Other Washington		4.3%	3.8%	4.5%	5.1%	3.7%	3.5%	4.5%	2.7%	9	12
Astoria	Astoria	5.9%	6.5%	8.2%	5.1%	5.2%	5.5%	6.2%	0.3%	5	21
	Other Astoria	2.5%	2.1%	3.1%	2.1%	2.1%	2.3%	2.5%	0.4%	14	20
Portland	Portland Metro	6.2%	6.3%	5.9%	7.2%	5.9%	9.3%	6.5%	13.5%	4	2
Garibaldi	Garibaldi	2.8%	2.5%	1.9%	2.4%	2.1%	2.0%	2.4%	1.5%	15	14
Newport	Newport	5.4%	6.3%	4.8%	8.5%	6.1%	5.4%	6.1%	15.5%	6	1
	Other Newport	1.5%	2.1%	1.3%	3.4%	1.9%	1.5%	1.9%	10.6%	18	4
Coos Bay Area	Coos Bay	8.8%	10.2%	7.0%	4.9%	7.4%	6.3%	7.3%	1.3%	3	15
	Other Coos Bay	1.1%	0.7%	0.8%	0.4%	0.9%	0.9%	0.8%	0.1%	21	28.5
Brookings Area	Brookings	5.5%	5.2%	4.3%	3.7%	5.7%	4.2%	4.7%	4.8%	8	8
Other Oregon		2.7%	2.3%	2.5%	3.7%	3.0%	3.4%	2.9%	6.6%	12	6
Crescent City	Crescent City	1.1%	0.8%	0.8%	0.5%	0.9%	0.8%	0.8%	0.1%	22	28.5
Eureka Area	Eureka	3.0%	2.3%	2.2%	1.5%	2.4%	1.8%	2.4%	0.7%	16	16
Fort Bragg Area	Fort Bragg	9.8%	5.8%	6.6%	7.6%	7.8%	5.4%	8.2%	0.3%	1	22
Bodega Bay San Francisco Area	Bodega Bay/ San Franciscoii	3.6%	4.8%	3.1%	2.7%	3.5%	3.1%	3.2%	2.2%	11	13
Half Moon Bay/Princeton	Half Moon Bay	1.3%	2.8%	2.0%	1.6%	2.3%	1.7%	1.7%	0.1%	19	24
Monterey	Monterey	4.2%	3.5%	4.7%	8.2%	5.2%	2.1%	5.3%	0.1%	7	27
	Other Monterey	0.4%	0.5%	0.7%	0.9%	0.4%	0.5%	0.6%	0.0%	25	30
Morro Bay Area	Morro Bay	2.6%	2.0%	3.3%	2.0%	6.3%	2.2%	2.7%	0.4%	13	18
Other California		0.8%	0.7%	0.6%	0.8%	0.6%	0.3%	0.7%	0.4%	24	19
Alaska	Alaska	0.9%	0.4%	0.7%	1.0%	0.5%	0.9%	0.8%	2.8%	23	11
	Not West Coast	4.3%	4.6%	5.0%	3.7%	4.2%	4.7%	4.3%	5.9%	10	7
	None	0.6%	0.5%	0.5%	0.7%	0.6%	0.5%	0.6%	10.0%	26	5
	Not Found	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.2%	30	23

The amount of non-whiting QS[73] traded totaled 18.5 percent (5.0 percent in 2014, 11.5 percent in 2015, and 1.9 percent in 2016). These totals are based on a summation of all transactions such that some QS may be counted more than once if it was traded more than once. In general, of the QS that has traded, approximately 32 percent appears to have stayed within the same port town, while 63 percent has traded from one port area to another (as illustrated in Table 3-110, where non-whiting QS has been translated into QP equivalents based on trawl allocations in the year of the transaction). Table 3-110 shows transactions within ports (defined as the city associated with the port), together with within area transactions (32 percent of the total), transactions between those ports and the areas immediately surrounding the port (generally defined as the port's county, 5 percent of the total), and transactions between outside areas (other port areas and noncoastal areas of the three West Coast states) and the port, including its area (63 percent of the total). This summary of the amount flowing between communities is likely strongly influenced by divestments of QS by The Nature Conservancy out of its listed address in Monterey.

Table 3-111 provides the same information in terms of percent of non-whiting QS equivalents. The percent changes displayed in Table 3-111 vary slightly, because the different approaches result in slight changes in the between-year weighting. With respect to the individual ports listed, owning entities based in the Fort Bragg area have had the greatest net increase, while those in Monterey have experienced the greatest net decrease.

Similar information for non-whiting QS, but summarized by state, is provided in Table 3-112 and Table 3-113. These tables show that approximately 85 percent of QS trade occurs within state, while 15 percent takes place between states.

The number and distribution of whiting buyers and sellers were such that it is not possible to display information informatively regarding movement of QS among ports. Table 3-114 and Table 3-115Table 3-109 show the movement of whiting QP equivalents and QS between states. In general, approximately 64 percent of the transactions stayed within the states.

[73] For these calculation, all individual species QS were converted to a non-whiting QS equivalent based on the 2017 QP allocations.

Table 3-110. Non-whiting QS (in QP equivalents) moving between and staying within ports and areas[1] (2014 to 2016, QP equivalents based on the year of the trade, locations based on reported addresses of the permit owners). Source: NMFS' West Coast Regional Office Permits Branch/database.

	Amount of QS Moving Between Areas (QP equivalent)							
	To Port or Area	**To Port**		**From Port**	**From Port or Area**		**Number of the following:**	
	From Outside	**From the Area**	**Within Port/ Within Area Transactions**	**To the Area**	**To Outside**	**Net**	**Buyers**	**Sellers**
Seattle Metro	1,956,874		5,986	73,984		1,882,890	7	3
Astoria	51,390		97,211		1,604,536	(1,553,146)	3	3
Newport	2,029,374		883,628		369,025	1,660,349	6	4
Fort Bragg	4,133,847		2,121,270		6,283	4,127,564	5	4
Monterey	12,783	454,853	4,517,515	1,134,443	8,728,871	(9,395,677)	3	3
Other Communities[2]	12,675,086	1,208,427	3,079,788	454,853	10,150,640	3,278,020	23	27
Totals	20,859,354	1,663,280	10,705,398	1,663,280	20,859,354	0	47	44
QS traded as a percent of all QS traded (in QP equivalents)[3]	63%	5%	32%	5%	63%			
Total QS traded (QP equivalents)						33,228,032		

1 An area immediately surrounds a port or port complex. For example, Astoria includes the ports of Astoria, Hammond, and Warrenton, and the area includes all of Clatsop County. See Appendix D for a description of the areas around each port.
2 Communities are aggregated to preserve confidentiality.
3 The percent changes vary slightly between this table and the next because the different approaches result in slight differences in the between-year weighting.

Table 3-111. Non-whiting QS equivalents moving between and staying within ports and areas[1] (2014 to 2016, equivalents based on the year of the trade, locations based on reported addresses of the permit owners). Source: NMFS' West Coast Regional Office Permits Branch/database.

	Amount of QS Moving Between Areas							
	To Port or Area	**To Port**		**From Port**	**From Port or Area**		**Number of the following:**	
	From Outside	**From the Area**	**Within Port/ Within Area Transactions**	**To the Area**	**To Outside**	**Net**	**Buyers**	**Sellers**
Seattle Metro	1.1%	0.0%	0.0%	0.1%	0.0%	1.0%	7	3
Astoria	0.0%	0.0%	0.0%	0.0%	0.8%	-0.8%	3	3
Newport	1.0%	0.0%	0.7%	0.0%	0.3%	0.7%	6	4
Fort Bragg	2.0%	0.0%	1.3%	0.0%	0.0%	2.0%	5	4
Monterey	0.0%	0.2%	2.2%	0.6%	5.5%	-5.8%	3	3
Other Communities[2]	7.4%	0.6%	1.7%	0.2%	5.0%	2.8%	23	27
Totals	11.6%	0.8%	6.0%	0.8%	11.6%	0	47	44
QS traded as a percent of all QS traded [3]	62.8%	5.0%	32.2%	5.0%	62.8%			
Total QS traded						18.5%		

1 An area immediately surrounds a port or port complex. For example, Astoria includes the ports of Astoria, Hammond, and Warrenton, and the area includes all of Clatsop County. See Appendix D for a description of the areas around each port.

2 Communities are aggregated to preserve confidentiality.

3 The percent changes vary slightly between this table and the next because the different approaches result in slight differences in the between-year weighting.

Table 3-112. Non-whiting QS (in QP equivalents) moving between and staying within states (2014 to 2016, QP equivalents based on the year of the trade, locations based on reported addresses of the permit owners). Source: NMFS' West Coast Regional Office Permits Branch/database.

	Amount of Non-whiting QS Moving Between Areas (QP equivalent)				**Number of the following:**	
	Into State	**Within State**	**Out Of State**	**Net**	**Buyers**	**Sellers**
Washington and Alaska	3,721,656	96,017	128,734	3,592,922	12	8
Oregon	1,270,239	11,086,869	1,948,275	-678,035	25	23
California	6,283	17,046,967	2,921,170	-2,914,887	10	13
	4,998,178	28,229,853	4,998,178			
QS traded as a percent of all QS traded (QP equivalents)*	15.0%	85.0%	15.0%		47	44

*The percent changes vary slightly between this table and the previous table because the different approaches result in slight differences in the between-year weighting.

Table 3-113. Non-whiting QS equivalents moving between and staying within states (2014 to 2016 equivalents are based on the year of the trade; locations are based on reported addresses of the permit owners). Source: NMFS' West Coast Regional Office Permits Branch/database.

	Amount of Non-whiting QS Moving Between Areas (QP equivalent)				**Number of**	
	Into State	**Within State**	**Out Of State**	**Net**	**Buyers**	**Sellers**
Washington and Alaska	2.0%	0.1%	0.1%	1.9%	12	8
Oregon	0.6%	5.9%	1.1%	-0.5%	25	23
California	0.0%	9.9%	1.4%	-1.4%	10	13
	2.6%	15.9%	2.6%	0.0%		
QS traded as a percent of all QS traded*	14.1%	85.9%	14.1%		47	44

*The percent changes vary slightly between this table and the previous table because the different approaches result in slight differences in the between-year weighting.

Table 3-114. Whiting QS (in QP equivalents) moving between and staying within states (2014 to 2016 QP equivalents are based on the year of the trade; locations are based on reported addresses of the permit owners). Source: NMFS' West Coast Regional Office Permits Branch/database.

	Amount of whiting QS Moving Between States (QP equivalent)				**Number of the following:**	
	Into State	**Within State**	**Out Of State**	**Net**	**Buyers**	**Sellers**
Washington and Alaska	Combined with Oregon for Confidentiality				5	2
Oregon	20,787,951	36,389,185	20,160,303	627,649	12	22
California	-	1,402,384	627,649	-627,649	5	8
Total	20,787,951	37,791,569	20,787,951			
					22	32
QS traded as a percent of all QS traded	35. 5%	64.5%	35.5%			
Total QS Traded (QP equivalents)				58,579,520		

*The percent changes vary slightly between this table and the previous table because the different approaches result in slight differences in the between-year weighting.

Table 3-115. Whiting QS equivalents moving between and staying within states (2014 to 2016—QP equivalents are based on the year of the trade; locations are based on reported addresses of the permit owners). Source: NMFS' West Coast Regional Office Permits Branch/database.

	Amount of whiting QS Moving Between States				**Number of the following:**	
	Into State	**Within State**	**Out Of State**	**Net**	**Buyers**	**Sellers**
Washington and Alaska	Combined with Oregon for Confidentiality				5	2
Oregon	7.9%	13.4%	7.7%	0.2%	12	22
California	-	0.5%	0.2%	-0.2%	5	8
Total	7.9%	13.9%	7.9%			
QS traded as a percent of all QS traded*	36.2%	63.8%	36.2%		22	32
Total QS Traded				21.8%		

*The percent changes vary slightly between this table and the previous table because the different approaches result in slight differences in the between-year weighting.

3.2.2(d)(3) Redistribution of QS to Comply with Divestiture

The IFQ program's control limit was adopted with a number of expectations, including that it might contribute to distribution of quota among more communities. Whether the control limits have had an impact in that regard is difficult to assess. Information below addresses trades made to comply with the QS control limit by the November 30, 2015, deadline from the perspective of the associated geographic redistributions. As noted in Section 3.1.1(b)(1)(A), nine entities held quota in excess of the control limits for one or more individual species, and three or less exceeded the aggregate species limit. When QS owners divested to comply with control limits, most transactions resulted in a shift in ownership between communities (77 percent shifted between communities, as displayed in Table 3-116). Ninety-six percent of the QS transferred involved community quota funds and holding companies not related to community quota funds. Fifty-nine percent of the QS divested by other types of entities was transferred to others within the same communities.

Table 3-116. Geographic distribution of QS transactions by those over the QS control limits as of June 15, 2015. Source: NMFS' West Coast Regional Office Permits Branch/database.

	Amount of QS Moving Between Areas (QP equivalent)		
	Into the Port/Area	**Within Port/Area**	**Out Of the Port/Area**
All transactions	9,551,859	2,848,696	9,585,291
Percent of total	77%	23%	77%
Transactions not involving community quota funds or holding companies	203,933	292,128	203,933
Percent of total	41%	59%	41%

3.2.2(d)(4) Owners Close to Control Limit

The number of individuals within a community who hold amounts of QS that are close to control limits is another indicator of a possible impact of control limits on the distribution of QS among communities. If there were a large number of individuals within a single community holding QS close to the limits, that might indicate that the limits were having an impact on limiting geographic concentration (without the control limits, individuals would acquire even more QS, and that QS might be purchased from other communities). After divestiture, the analysis of individual ownership interests discussed above showed that 15 people controlled 90 percent or more of the control limit for at least one species. The addresses for these individuals were spread among 11 coastal communities and other geographic areas, with no more than two individuals in any single geographic locale.

3.2.2(d)(5) Perspectives on QS Ownership

During PCGFSS interviews, discussion about quota ownership largely centered around the issues of consolidation and absentee ownership, both of which were seen as impacting the distribution of quota control within and across fishing communities [See Section 3.2.2(g)(3)(c)), Consolidation Impacts, and the subsection on Absentee Owners for more information on those topics]. Some interviewees help describe this activity:

> "They moved to other states where fishing may be more lucrative. There's more support businesses still located. We're kind of an outpost for trawling here. There's a few trawlers that work out of the San Francisco Bay area and Fort Bragg area but the bulk of the trawling industry on the West Coast is Oregon and Washington." —Industry Participant, Eureka Area, 2015/2016.
>
> "Sure they're gonna go north. It's already trended, they've gone north. You live in Oregon, Oregon gets the majority of the groundfish. They got the majority of boats."—Processor, California, 2015/2016.
>
> "And that's what a lot of guys are doin', sellin' their quota and not goin' fishin'. You know, there's guys with quotas and no boat."—QS Permit Owner, Fort Bragg Area, 2015/2016.
>
> "I'm all for having the product all the time. Locally. You know what I mean? And that's where I'm really at. It…your closures and your different things have happened with the groundfishing in California has made me shop other places, or, or,…in Washington, Oregon are on the same plan, but there's just different boats, there's more boats and, and there's bigger buyers up there and they spend more time at sustainability and they spend more time on buying quotas too."—Processor, California, 2015/2016.

3.2.2(e) Community Engagement in the Groundfish Trawl Fishery

Highlights:

- Astoria and Newport have had the highest levels of commercial fishing engagement with the shoreside groundfish trawl fishery during the catch share program. The Ilwaco area experienced a large relative increase in engagement, while Seattle, Brookings, and Eureka have retained or seen slightly increasing engagement.
- Coos Bay shows the greatest decrease in engagement with the shoreside groundfish trawl fishery, followed by Westport and Fort Bragg.
- During the baseline period (2008 to 2010), Newport and Westport accounted for more than 80 percent of the regional shoreside trawl groundfish pounds landed. Astoria, Newport, and Westport together represent more than 70 percent of the regional value landed.

A fishing engagement index is a measure of the importance of a given community to commercial fishery resources and activities (Jepson and Colburn 2013). To develop this index, several annually reported commercial fishing variables are considered together, and a factor analysis is applied to these variables to produce a single index score. This index is reported as a community's fishery engagement index score in the NMFS *State of the California Current Report* presented annually to the Council. This index provides a way to compare commercial fisheries engagement for each West Coast community reporting commercial fisheries activity data for a given year (Levin et al. 2013). The variables (for example, landings, revenue, buyers, and permits) are co-indicators of community-level fishing activities.[74] They are provided in Table 3-117.

Table 3-117. Commercial fisheries variables used in development of the factor analysis approach to community-level fisheries engagement index, the factor loading results, and variance explained by the "fisheries engagement" single-factor solution. For an index to be reported, the percent variance explained should be at least 45 percent, and the measure should describe the percent variance among the variables explained by the single index.

Commercial Fishing Engagement Index	Factor Loadings	% Variance explained
Commercial fishery landings	0.819	76.1
Commercial fishery revenue	0.951	
First receivers (buyers)	0.879	
Permits	0.834	

For this report, a commercial fishing engagement index was generated specific to the shore-based groundfish trawl fishery. This groundfish trawl-specific index demonstrates the importance of a given community to the shoreside groundfish trawl fishery compared to other communities on the West Coast. The index consists of the pounds and value of shoreside trawl sector landings, the number of first receivers/processors for those landings, and the number of QS permits within a community. These variables are again subjected to a factor analysis to create a single standardized index score.

The use of multiple variables to generate the index provides a more inclusive measure of community engagement with the shoreside trawl fishery than would landings or landed value alone. For example, a community whose only connection to the fishery is ownership of permits by residents would be included. Using these indices, communities may be classified as highly engaged, moderately engaged, or having low engagement with the trawl-caught groundfish fishery (Colburn 2017 in press).

The community index scores were then categorized from high to low based on standard deviation (std) from the mean (or average[75]), with the mean being zero (high – 1 std or above; medium high –.50 to .99 std; medium – 0.00 to .49 std; and low – below 0.00). A standard deviation can be roughly thought of as the average of the difference between the results of each port and the mean for all ports. Thus, a port

[74] Because they statistically cluster together in this approach

[75] The mean is the average of the numbers, which is calculated by adding all the numbers, then dividing by the total.

that is one standard deviation from the mean differs from the mean roughly by the average amount that all ports differ from the mean.

Sixteen communities were identified as "highly engaged" (exhibiting 1.0 std or more above the mean engagement result) in the shoreside groundfish trawl fishery for at least one year from a baseline period (the three-year period before implementation of the catch share program) through 2013. These communities include all port listed in Table 3-86 as having some landings by trawl vessels between 2006 and 2015 except Neah Bay, Garibaldi, Bodega Bay, Moss Landing, Avila, and Santa Barbara.[76] Communities that were highly engaged in a catch share program for at least one year between the baseline and 2013 are presented in Table 3-118. The years in which these communities exhibited highly engaged results are highlighted in yellow.

Table 3-118. Fishing Engagement Index scores of communities highly engaged in the shore-based West Coast groundfish trawl IFQ program for one or more years from the baseline (2008 to 2010) through 2013. Source: Colburn, et al. 2017 (in press).

Community	**Baseline (2008 to 2010)**	**2011**	**2012**	**2013**
Astoria, Oregon	9.729	12.112	11.207	10.549
Newport, Oregon	9.021	8.158	9.554	10.499
Coos Bay, Oregon	6.439	4.204	4.062	3.421
Westport, Washington	4.526	3.687	4.007	3.412
Fort Bragg, California	3.938	2.789	2.783	3.145
Eureka, California	3.105	2.367	2.347	3.656
Crescent City, California	2.443	1.187	0.842	0.793
Seattle, Washington	2.290	2.448	2.269	2.394
Monterey, California	2.240	2.055	2.129	2.080
Morro Bay, California	1.920	3.663	3.087	1.630
San Francisco, California	1.892	1.330	1.743	1.855
Brookings, Oregon	1.720	1.421	1.516	1.872
Half Moon Bay, California	1.423	1.329	1.021	1.405
Bellingham, Washington	1.052	1.023	1.158	0.606
Chinook, Washington	0.433	1.099	0.961	0.814
Ilwaco, Washington	0.433	1.099	0.961	0.814

Note: Shaded cells indicate high engagement.

[76] The following is a list of the other communities which were encompassed by the fishing engagement index: Aberdeen, WA; Avilla Beach, CA; Bandon, OR; Berkeley, CA; Blaine, WA; Centralia, WA; Clackamas, OR; Comptche, CA; El Granada, CA; Ferndale, CA; Fields Landing, OR; Hammond, OR; Harbor, OR; Lake Oswego, OR; Lynnwood, WA; McKinleyville, CA; Mercer Island, WA; Mount Vernon, WA; WA; North Bend, WA; Oregon City, OR; other Sonoma orts; Port Orford, OR; Portland, OR; San Jose, CA; Santa Cruz, CA; Siletz, OR; South Bend, WA; Toledo, OR; Warrenton, OR; and Watsonville, CA.

As presented in Figure 3-65, engagement has remained stable or increased over the years of the catch share program for communities with the highest groundfish trawl engagement index scores. Other communities, particularly in California, have seen their engagement decrease. However, for most highly engaged communities, engagement scores appear stable.

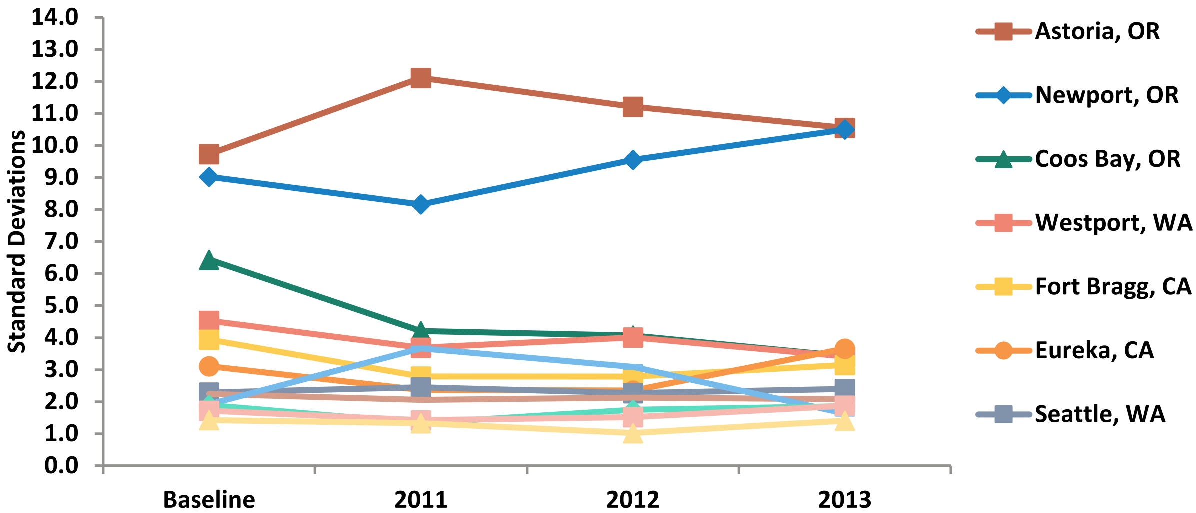


Figure 3-65. Fishing Engagement Index scores of communities highly engaged in the shore-based West Coast groundfish trawl IFQ program for all years from the baseline (2008 to 2010) through 2013. Source: Colburn, et al. 2017 (in press).

Communities with relatively stable or increased participation in the shoreside groundfish trawl commercial engagement index score between the baseline period and 2013 are depicted in Figure 3-66. Astoria and Newport have the highest levels of commercial engagement, with both communities showing a slight increase between the two periods. Seattle, Brookings, and Eureka have also retained or seen slightly increasing engagement with the groundfish trawl fishery through 2013.

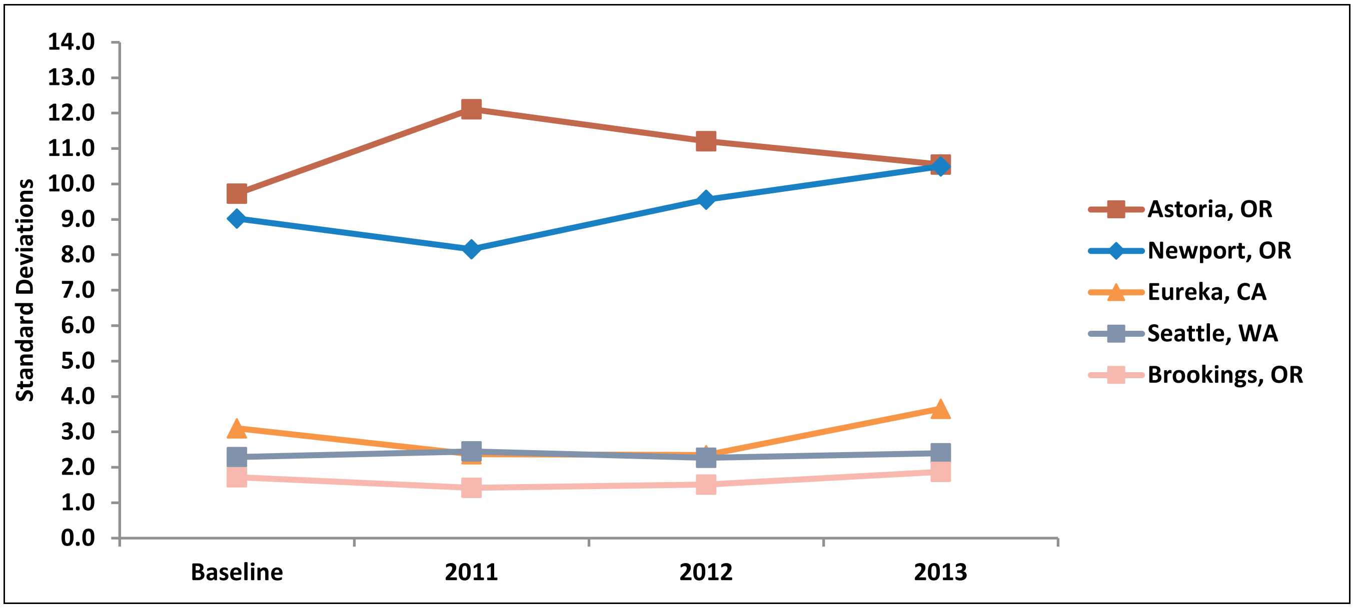


Figure 3-66. Fishing Engagement Index scores of communities highly engaged in the shore-based West Coast groundfish trawl IFQ program for all years with increasing engagement between the Baseline (2008-2010) and 2013. Source: Colburn, et al. 2017 (in press).

Highly engaged communities (Table 3-118) with a decreasing Shoreside Groundfish Trawl Engagement Index score from the baseline through 2013 are depicted in Figure 3-67. These decreasing scores highlight the declining involvement of smaller Oregon and California communities as the program has developed.

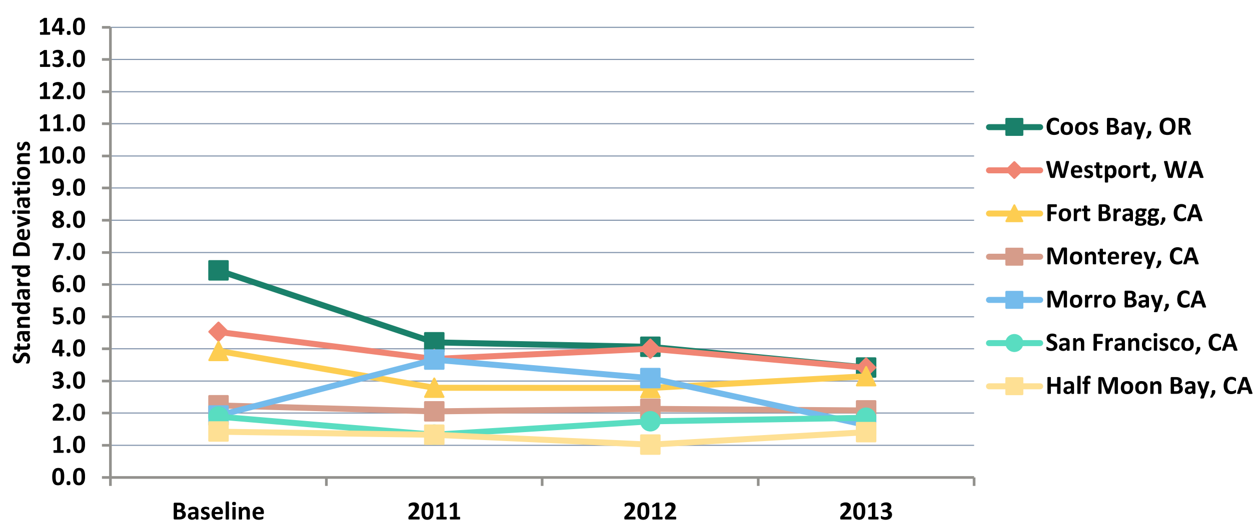


Figure 3-67. Fishing Engagement Index scores of communities highly engaged in the shore-based West Coast groundfish trawl IFQ program for all years with decreasing engagement between the baseline (2008 to 2010) and 2013. Source: Colburn, et al. 2017 (in press).

Communities with high engagement in the shoreside groundfish trawl fishery for only some years of the study period are depicted in Figure 3-68. These communities have shown flat levels of engagement as the catch share program has evolved. Most of these communities are located in Washington.

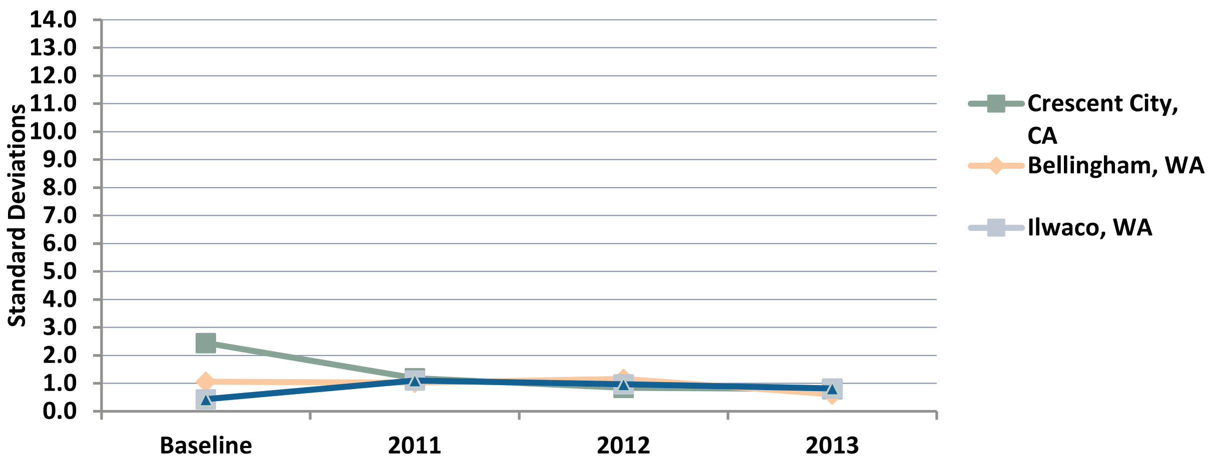


Figure 3-68. Fishing Engagement Index scores of communities highly engaged in the shorebased West Coast groundfish trawl IFQ program for fewer than all years between the baseline (2008 to 2010) and 2013. Source: Colburn, et al. 2017 (in press).

3.2.2(e)(1) Community Social Vulnerability Indicators for Communities Engaged in the Trawl Groundfish Fishery

Table 3-119 presents the Community Social Vulnerability Indicators for the 16 communities identified as highly engaged in the shore-based groundfish catch share program for at least one year from the baseline to 2013. These indicators are a set of quantitative measures of community wellbeing, calculated for communities in coastal counties from 19 states in the eastern United States and Gulf Coast, as well as for communities from the states of Washington, Oregon, California, Alaska, and Hawaii (Colburn and Jepson, 2012; Himes-Cornell and Kasperski, 2016; Jepson and Colburn, 2013)[77]. Communities that were

77 In an effort to maintain nationally consistent measures, the Community Social Vulnerability Indicators (CSVIs) are developed at the community level for application to United States fisheries in all NMFS regions. To monitor place-based communities, 12 indices were developed at the Census-Designated Place Level using secondary data sources, primarily the United States Census American Community Survey five-year estimates. Following the same methods used to calculate and report the Catch Share Program-Specific Fishing Engagement Index, the CSVIs were calculated using factor analysis to achieve a single factor solution. Each CSVI represents a different aspect of community well-being and vulnerability (Colburn 2017 in press; Jacob et al. 2010, 2012). The Personal Disruption Index includes variables that affect individual vulnerability (e.g., low education levels or unemployment) that may then influence overall community wellbeing. A higher Personal Disruption Index score can be associated with lower levels of wellbeing as communities show higher unemployment rates, higher number of residents without a high school diploma, more residents in poverty, and more separated or divorced female residents. The Population

highly engaged for all years are bolded. These communities tend to have less vulnerable populations (as measured by the Population Composition Index; see footnote), with the exceptions of Fort Bragg and San Francisco. Communities that were highly engaged in fishing for all years (baseline 2013) were more vulnerable (as shown by poverty and housing characteristics) than communities that were highly engaged for fewer years. These highly engaged communities include important centers of fishing activity in Washington, Oregon and California.

Table 3-119. Social vulnerability indices for communities highly engaged in the shore-based West Coast groundfish trawl IFQ Program for one or more years from the baseline (2008 to 2010) through 2013. Source: Colburn, et al. 2017 (in press)

Community		**Population Size (2013)**	**Personal Disruption**	**Population Composition**	**Poverty**	**Labor Force Structure**	**Housing Characteristics**
Astoria, OR		9,518	Moderate	Low	Med High	Low	Med High
Brookings, OR		6,334	Low	Low	Low	Med High	Med High
Coos Bay, OR		15,982	Moderate	Low	Moderate	Med High	Med High
Eureka, CA		27,037	Med High	Low	Med High	Low	Med High
Fort Bragg, CA		7,259	Med High	Med High	Med High	Low	Moderate
Half Moon Bay, CA		11,555	Low	Moderate	Low	Low	Low
Monterey, CA		27,939	Low	Low	Low	Low	Low
Morro Bay, CA		10,322	Low	Low	Low	Moderate	Moderate
Newport, OR		10,013	Moderate	Low	Moderate	Moderate	Med High
San Francisco, CA		817,501	Low	Med High	Moderate	Low	Low
Seattle, WA		624,681	Low	Low	Low	Low	Moderate
Westport, WA		1,701	Moderate	Low	Moderate	Moderate	High
Bellingham, WA		81,576	Moderate	Low	Moderate	Low	Med High
Chinook, WA		224	Low	Low	Moderate	Med High	N/A
Crescent City, CA		7,470	High	Moderate	High	High	Med High
Ilwaco, WA		1,074	Low	Low	Med High	Med High	Med High

Note: Rows with shaded cells indicate communities that were highly engaged for all years between the baseline and 2013.

Composition Index measures the presence of vulnerable populations within a community. A higher score indicates a more vulnerable population and higher vulnerability within the community, thereby suggesting lower community wellbeing levels, with households frequently headed by adult females alone, more dependents, and more residents who do not speak English well. The Poverty Index is a measure of poverty that looks at different groups experiencing hardship (e.g., receiving social assistance). A higher Poverty Index score implies higher vulnerability, as more residents receive public assistance and are considered to be below national poverty lines. The Labor Force Structure Index measures the stability and overall makeup of the labor force by gauging the number of people in the labor force. It is reverse-scored, so a higher rank means fewer opportunities and a population that relies more on self-employment and is more vulnerable. The Housing Characteristics Index is a measure of infrastructure vulnerability; it includes factors that indicate housing that is vulnerable to coastal hazards. It is also reverse-scored, so a high rank means a more vulnerable infrastructure and a more vulnerable population.

A separate set of indices measure community vulnerability with respect to gentrification, specifically as it relates to the challenge of maintaining commercial waterfronts in competition with non-fishing businesses and new residents.[78] Gentrification Pressure Vulnerability Indices for communities that were highly engaged in the groundfish catch share program for at least one year between the baseline (2008 to 2010) and 2013 are included in Table 3-120. Again, communities that were highly engaged for all years are bolded. The Housing Disruption Index (also Table 3-120) shows moderate to moderate-high vulnerability for many of the communities that were highly engaged in the fishery for at least one year. The Retiree Migration Index shows a wide range of vulnerability for communities participating in this fishery, though Morro Bay, California, and Coos Bay, Oregon, show moderate to medium-high retiree migration vulnerability, respectively. The Urban Sprawl Index generally shows low vulnerability for this fishery's communities, though California communities and Seattle show moderate to high urban sprawl vulnerability.

Table 3-120. Gentrification pressure vulnerability indicators for communities highly engaged in the West Coast groundfish trawl IFQ Program for one or more years from baseline (2008 to 2010) through 2013. Source: Colburn, et al. 2017 (in press).

Community	**Housing Disruption**	**Retiree Migration**	**Urban Sprawl**
Astoria, OR	Moderate	Low	Low
Brookings, OR	Low	Med High	Low
Coos Bay, OR	Moderate	Med High	Low
Eureka, CA	Med High	Low	Low
Fort Bragg, CA	High	Low	Low
Half Moon Bay, CA	Low	Low	High
Monterey, CA	Low	Low	Med High
Morro Bay, CA	Med High	Moderate	Moderate
Newport, OR	Low	Moderate	Low
San Francisco, CA	Med High	Low	High
Seattle, WA	Low	Low	Med High
Westport, WA	Low	Moderate	Low
Bellingham, WA	Low	Low	Moderate
Chinook, WA	N/A	Moderate	Low
Crescent City, CA	Low	Med High	Low
Ilwaco, WA	Low	Moderate	Low

Note: Rows with shaded cells indicate communities that were highly engaged for all years between the baseline and 2013.

[78] The Retiree Migration Index reflects the concentration of retirees and elderly people in the population. Retirees often bring higher rents and home values and an increased need for non-fishery services and infrastructure. A high score indicates more vulnerability to gentrification. The Urban Sprawl Index reflects population growth and the higher costs of living that can lead to gentrification. A high score indicates more vulnerability to gentrification. The Housing Disruption Index reflects fluctuations in the housing market, as when rising home values and rents cause displacement. A high score means more vulnerability for those in need of affordable housing.

3.2.2(f) Changes in Employment

Highlights:

- Full-time employment in the groundfish fishery has decreased, while part-time employment has slightly increased since 2010.
- The strong (though not unanimous) general sentiment among PCGFSS respondents was that fewer jobs are connected to the groundfish fishery now than there were prior to catch shares. The buyback program also influenced the number of jobs.
- Many respondents felt that the jobs that are still around are more stable and higher paying, while others reported a decrease in earnings from the groundfish fishery. Increased lease and observer fees may be partly responsible for lowered crew wages.
- Some quota owners lease out their groundfish quota rather than fishing it themselves, which helps them avoid some of the costs of participation (see Section 3.1.2(d)(3)). Others see this as destabilizing the fishery.
- In general, respondents perceived a link between the catch share program and changes in the availability, stability, and compensation of jobs in the groundfish trawl fishery.
- While there was general agreement that the number of employment opportunities tied to the groundfish trawl fishery have decreased, there were varied perspectives regarding impacts on job stability and compensation. Quota allocations, quota ownership status, and quota leasing dynamics play a key role in the distribution of employment-related changes.

In order to assess changes in the number and seasonality of jobs in the groundfish trawl fishery resulting from catch shares, this section incorporates both survey and interview data from the PCGFSS. In all three rounds of the survey (2010, 2012, and 2015/16), respondents were asked to indicate their level of employment in the groundfish fishery and all other fisheries. In addition to these survey responses, recorded and transcribed interviews offer insights into respondents' perspectives regarding the reasons behind any changes in employment in groundfish and other fisheries on the West Coast.

Figure 3-69 presents the percentage of respondents that indicated full-time, part-time, seasonal full-time, seasonal part-time, and self-employment for groundfish and other fisheries, as well as non-fishing, for all three years using "return respondent" data only.[79] Appendix C contains a detailed description of return respondents.

[79] A "return respondent" is someone who has participated in all three rounds of the survey. This is explained in detail in Appendix C.

Figure 3-69. Level of employment in groundfish, other fisheries, and non-fishing (multiple response question). Return respondents only. Source: PCGFSS 2017.

Full-time employment in the groundfish fishery has decreased, while part-time employment has slightly increased since 2010, both to statistically significant degrees.[80] Comparisons for part-time employment in all other fisheries was statistically significant at a lower confidence level.[81]

The PCGFSS survey also asked respondents whether they maintained multiple jobs within or outside the commercial fishing industry. As seen in Table 3-121, results for return respondents reveal a dip in 2012 in the proportion of respondents who indicated that they "do not have multiple jobs" (76.8 percent in 2010 and 65.7 percent in 2012) and an increase in the proportion of respondents who indicated they work "multiple full time jobs" (2.9 percent in 2010 and 17.1 percent in 2012). Both proportions were closer to their baseline (2010) levels in 2015/2016 (82.9 percent for "do not have multiple jobs" and 4.3 percent for "multiple full time jobs"). This indicates that there may have been an initial post-implementation period of adjustment, which, for some, involved taking on an additional full-time job. The return of these proportions to near baseline levels in 2015/2016 indicates that this adjustment strategy may have been temporary.

---

[80] This finding is based on results of Cochran's Q tests, which revealed significant differences for full-time employment in the groundfish fishery (Q=8.75, df=2, p-value=0.013). Post hoc analysis using McNemar's test yielded significant differences between 2010 and 2015/2016 (p=0.018).

[81] (Q=5.43, df=2, p-value=0.066)

When considered alongside the results for the "level of employment" survey item (shown in Figure 3-69), as well as interview analysis, these results suggest a twofold reason for the temporary nature of the 2012 uptick in those reporting multiple full-time jobs. On one hand, respondents who took on an additional full-time job after implementation may have done so as an initial adaptation strategy, and they may eventually have been able to secure a more stable income from the groundfish fishery, thus eliminating the need to maintain the additional job(s). Alternatively, others may have decided to focus primarily on non-groundfish fisheries, or exit the groundfish fishery altogether (or decided to lease out their quota instead of harvest it), thus relying on full-time employment outside the fishery.

Table 3-121. Percentage of respondents maintaining multiple jobs and/or a job outside the commercial fishing industry (multiple-response question). Return respondent data only. Source: PCGFSS 2017.

Job Description	**2010**	**2012**	**2015/2016**
Do not have multiple jobs.	76.8	65.7	82.9
Have multiple part-time jobs.	5.8	8.6	8.6
Have multiple full-time jobs.	2.9	17.1	4.3
Have multiple full-time and part-time jobs.	14.5	8.6	4.3
NA/PNA	*0*	*0*	*0*
RR	*98.6*	*98.6*	*100*
Maintain job outside commercial fishing industry.	17.9	14.3	15.9
NA/PNA	*0*	*1.4*	*0*
RR	*95.7*	*98.6*	*98.6*

Note: NA/PNA is not applicable/prefer not to answer. RR is the response rate.

The strong, though not unanimous, general sentiment among PCGFSS respondents was that there are fewer jobs connected to the groundfish fishery now than there were prior to catch shares (see Section 3.1.2(a)(3) for a summary of data on actual estimates of changes in total numbers of jobs and compensation). In general, available data also indicate a reduction in the number of crew positions, primarily in southern ports. Table 3-122 provides a rough estimate of the number of at-sea positions on catcher vessels by port. These data are generated by taking the average number of positions per vessel from the EDC FISHEyE explorer and applying those averages to the information on vessel activity by port retrieved from the PacFIN data system. The averages used here varied by port, but not across time; they are, therefore, estimates of the number of positions driven by the number of vessels active in the fishery. Overall, the number of crew positions coastwide appears to have declined from an average of 482 per year for 2009-2010 to an average of 372 per year for 2015-2016.

Table 3-122. Estimates of number of at-sea positions by port, pre-catch shares and during the catch share program. Sources: PacFIN landings data and selected data from FISHEyE Performance Metrics for West Coast trawl Catch Share Program Catcher Vessels https://dataexplorer.northwestscience. fisheries.noaa.gov/fisheye/PerformanceMetrics/.

	2009 to 2010		**2011 to 2014**		**2015 to 2016**	
Port Group	**# of Vessels**	**Total # of Positions on Vessels While At Sea**	**# of Vessels**	**Total # of Positions on Vessels While At Sea**	**# of Vessels**	**Total # of Positions on Vessels While At Sea**
Washington	15	67	19	84	11	49
Astoria/Tillamook	34	115	29	98	28	95
Newport	20	87	17	74	17	74
Coos Bay	18	66	14	52	14	52
Brookings	5	20	5	20	4	16
Crescent City	7	26	a/	a/	a/	a/
Eureka	10	37	11	41	9	33
Fort Bragg	7	26	7	26	6	22
San Francisco (including Bodega Bay)	8	28	5	17	a/	a/
Monterey-Morro Bay-Santa Barbara	3	9	18	54	10	31
	127	482	125	467	99	372

[a/] Value combined with Eureka due to possible confidentiality concerns.

Study respondents reported substantial decreases in the number of fishing positions, processing positions, and service and supply positions. Notably, some respondents attributed part of the reduction in employment opportunities in the groundfish fishery to the buyback program (NMFS 2003). This relatively long-term trajectory of fewer jobs in the groundfish fishery is noted by one Astoria fisherman:

> "It started like 10 years [ago] and it just slowly ate, ate, ate, ate, down, down, down until the point where it was like two people were going out on the boats to make a damn living."—Fisherman, Astoria, 2015/2016

While relatively consistent in their view that there are fewer employment opportunities in the fishery than previously, study respondents differed in their opinions about the stability and compensation rates of the jobs that do remain. On one hand, many believed that the jobs that are still around are more stable and higher paying (Section 3.2.2(h), Changing Nature of Fishery Businesses and Jobs). This view echoes Abbott et al.'s (2010) finding that remuneration increased for many crewmembers after rationalization in the Bering Sea/Aleutian Island crab fisheries. Abbott et al. (2010) also found a decrease in remuneration per unit of landings, a result they attribute to increased crew productivity and the cost of paying for quota (2010). Many PCGFSS respondents' views resonate with this finding. As one Astoria-based fisherman put it, "…Well, we have to catch more fish to make the same amount of money…"— (2016).

In contrast to this view and Abbot et al.'s (2010) findings, many study respondents reported a decrease in earnings from the groundfish fishery. Those who felt this way often pointed to cost increases—largely in the form of lease and observer fees—in tandem with relatively stable ex-vessel prices as the reason behind lowered crew wages. The quote below illustrates this perspective:

> "We all pay lease fees now. I mean, the deductions are unbelievable. I mean, basically, we're being paid on between 50% and 70% of the trip values, and the money's not there anymore."—Fisherman, Astoria, 2015/2016

Pinkerton and Edwards (2009) draw on their interview and survey data from the British Columbia halibut IFQ fishery to argue that high lease fees have undermined the profitability of smaller operations who received lower initial allocations than larger-scale operations. In a rejoinder to Pinkerton and Edwards' article, Turris (2010) questions their findings and subsequent argument, putting forth a more positive assessment of the effects of quota leasing in the British Columbia halibut fishery. Pinkerton and Edwards' response to Turris' critique similarly questions his data and argument (Pinkerton and Edwards, 2010). The authors each accuse the other(s) of subjective biases and misunderstandings, with no satisfactory consensus emerging. Perhaps more than anything, these disagreements highlight the differences between a social science approach driven by primary data collection (i.e., interviewing and surveying industry members), and an economic approach driven by secondary data and modeled projections. Keeping in mind the differing views offered by these authors, the observation above by an active fisherman in the groundfish trawl fishery does suggest that lease fees may be having a detrimental effect on some fishing operations in the West Coast groundfish trawl fishery. That said, the view expressed in the quote is not unanimous. As the quotes below illustrate, some participants would likely side with Turris in the debate over the effects of quota leasing:

> "Without the leasing, a lot of us would be out of business. So, therefore the leasing part of it has got to be a good thing. Two, when my net comes up I'm not really worried about any of the lease fees or any of that, I'm just worried about the constricted species and what am I gonna catch that is going to put my friends out of business and me out of business. I'm more worried about putting the other guy out of business than me."—Fisherman, Astoria, 2015/2016.

> "I started figuring out, well, if I lease out, I can use my resources better, and it's made me more money."—QS Permit Owner, Coos Bay Area, 2015/2016.

Another oft-mentioned reason for lowered crew wages was that quota owners had decided to lease out their groundfish rather than to fish it themselves or have their hired captain/crew fish it (for more on absentee ownership, see Section 3.2.2(g)(3)(b)). From the quota owner's point of view, this strategy offers a means of avoiding some of the costs of participation in the fishery, while still providing a consistent income. One quota owner describes the advantage of this strategy in terms of stability:

> "Certain strategies are more kind of stable than others, and of course the more you own the more stable at it. You know, because you can just go lease out your fish and get a big check."—QS Permit Owner, Astoria, 2015/2016.

Many study respondents, quota owners and non-owners alike, viewed (or directly experienced) this strategy of stabilization for quota owners as a source of destabilization for fishing crews and hired captains, as this California-based fisherman points out:

> "The boat owner releasin' all the fish and not havin' no fish to go catch. That was very unexpected. Yeah, cut our income, me and my crew, for about two-thirds of our income that year."—Fisherman, Fort Bragg Area, 2015/2016.

Overall, study respondents perceived a tight link between the implementation of catch shares and changes in the availability, stability, and level of compensation for jobs in the groundfish trawl fishery. While there was notable agreement across the entire collection of 2015/16 PCGFSS interviews that fewer jobs were available, perspectives on job stability and compensation were more varied, as described above. Sweeping generalizations about the determining variables behind these different perspectives would risk obscuring much of the diversity of experiences within role, community, age, and other groupings. With that said, the analysis indicates that quota allocations and quota leasing dynamics play a key role in determining the distribution and nature of changes to job stability and compensation in the groundfish fishery. See Section 3.1.3 (a) (1), Utilization of Non-whiting Species Allocations, for more information.

3.2.2(g) Community Perceptions and Relations

Highlights:

- Among the variety of factors that PCGFSS respondents acknowledged as important determinants of community performance under catch shares, the amount of groundfish being landed in the community was viewed as a primary consideration. Various processor struggles, (e.g.., keeping people steadily employed and providing a steady supply of groundfish to retailers and consumers) were also attributed to insufficient groundfish being landed in a community. Some viewed the catch share program as a solution to these issues; others believed the program had made these problems worse.

- Study participants believed Oregon was adapting most successfully to the catch share program, followed by Washington, with California the least successful under catch share management.
- Newport, Oregon, appears to be adapting well to the catch share program, in part because the diversity of its fisheries and its robust infrastructure.

This section focuses on community perceptions and whether and how the catch share program has affected these perceptions. It examines community identity, connections within and among communities, and formation of risk pools and co-ops. In addition, this section covers direct sales, gifting, and personal use of harvested fish, which are avenues for coastal community members to connect with their local fisheries. Finally, stressors within communities, such as gear switching, grounds preemption, absentee quota holders, mothership processors, and impacts from consolidation, are analyzed.

The combined coastline of Washington, Oregon, and California stretches about 1,300 miles. Land-based industry supporting the groundfish trawl sector contributes economically and socially to more than a dozen communities along this coastline. Each of these communities has unique historical and contemporary ties to the groundfish fishery and to commercial fishing in general, making generalizations about community-level impacts of the catch share program difficult. While coastwide trends are apparent, they manifest differently in each community.

Many of the coastal communities that have been impacted by the trawl catch share program have historical ties to commercial fishing that go back over a century. In general, PCGFSS respondents were aware of, and took pride in, their community's traditional ties to commercial fishing. However, respondents coastwide reported a long-term decline in commercial fishing activities in their ports. Industry members pointed to reductions in the numbers of active vessels, processing facilities, shoreside support businesses, and up-and-coming young fishermen, as evidence for the decline.

In his study of ITQ fisheries in Iceland, Eythorsson (2000) notes an ideological shift within the fishing industry characterized by a movement away from the notion that fisheries and fish processing should be locally anchored in fishing communities. He also reports that some fishing communities, particularly small communities (500 residents or less) with limited alternative employment opportunities, have been marginalized by changes in quota distribution brought about by ITQ management in that country (Eythorsson, 2000).

While the United States and Iceland do not have parallel management and industry structures, the PCGFSS data indicate some similarities in community impacts. In the most recent round of surveys and interviews, PCGFSS respondents discuss a range of community-level impacts of the catch share program. These changes are not seen as having uniform effects across communities. Rather, each community's response to change depends on various factors. For example, study respondents reported that communities with more economic diversity were better able to withstand the decrease in fisheries employment opportunities many believed the catch share system (and the 2003 buyback) had brought about.

In addition to economic diversity, respondents touched on other conditions that have influenced the distribution of the catch share program's impacts on coastal communities. These included the size of communities, the number and size of participating vessels, the number of groundfish buyers and processors, the state of local fishing infrastructure, and the amount of quota held by members of the community (see Russell et al. 2016, for more on this last factor). According to one Half Moon Bay fisherman, "The smaller the boat, the smaller the community, the less [the catch share system] worked." —(2015/2016). In addition to helping determine what sorts of effects catch shares have had in different communities, these factors were also seen as being subject to change as a result of catch shares.

Among the variety of factors that PCGFSS respondents acknowledged as important determinants of community performance under catch shares, the amount of groundfish being landed in the community was viewed as a primary consideration. This was sometimes discussed directly, but more often it was inferred by reference to the number of trawl vessels actively delivering to the port. Various processor struggles—keeping people steadily employed and providing a steady supply of groundfish to retailers and consumers—were also attributed to not enough groundfish being landed in a community. The success of industry suppliers and service providers was also seen as strongly linked to consistent groundfish landings. Some viewed the catch share program as a solution to these issues; others felt it had exacerbated these issues:

> "I think with the ownership of QS and that it's a transfer of QS now, has given more opportunity to I hope shape fishing in the future in our community in terms of, like furthering our goals for a sustainable fishery and for increasing our port's stability and infrastructure."—QS Permit Owner, Fort Bragg Area, 2015/2016.

> "The fish ain't coming in steady here. Albers, they got one drag boat working for them now out of the whole coast. The stability for the dock workers and the plant workers and the crews is not there like it was."—Fisherman, Crescent City, 2015/2016.

Generally, 2015/2016 PCGFSS respondents viewed Oregon as making the most successful transition to catch shares, followed by Washington, and then California. There was particular concern over the state of the groundfish fishery, and the fishing industry in general, in California, centered primarily around the lack of adequate infrastructure and groundfish processing activities in the state, and the logistical difficulties of observer availability (Section 3.3.2(a)). As the quotes below indicate, respondents had a number of theories to explain the differential outcomes in the West Coast states:

> "Oregon values their commercial fishermen as well as their sport fishermen, but I don't think they play one against the other like they do here in California. California much more values their sport fishery."—Industry Participant, Fort Bragg Area, 2015/2016.

> "California and Oregon and Washington might as well be different planets. Just in terms of … the amount of fishermen, the amount of activity, so, it's not one size fits all. And there's just a handful of guys holding on in small port California … that's what the people that screamed against catch shares—that was their rallying cry, right? …Catch shares is going to put out the small California guys—and I don't think that's come to pass, but the guys that are remaining are committed and want this to work, but …if decisions made continue to focus around the larger ports and not take into consideration maybe some mitigating circumstances down here, no matter how hard they try, they're not going to be able to survive it. …I mean, I don't know how that fits in, but I think … NMFS recognizes this, but it's just, California is a very different place."—Industry Participant, Half Moon Bay, 2015/2016.

> "There are some big boats from Oregon that are coming down [to Morro Bay] and catching lots of black cod, but of course the revenue all goes back to Oregon—it's not helping the economy in Morro Bay at all."—Industry Participant, Morro Bay Area, 2015/2016.

Although each coastal community is unique, Newport, Oregon, appears to be an outlier regarding how it has been impacted by catch shares. While PCGFSS participants in Newport reported a substantial decrease in the number of active trawl vessels, Newport residents and non-residents alike portrayed the town as a vibrant fishing community. They cited several facets of Newport's fishing industry as evidence of its vibrancy: its heavy involvement in multiple fisheries (including the whiting sector of the groundfish fishery), its large variety of industry service and supplies providers, its robust fishing infrastructure, and the presence of marine research activity. Study participants in 2015/2016 seemed to regard Newport as being buffered from the consolidation that many feel has characterized the West Coast groundfish trawl fishery for the last couple decades. Although Newport has experienced changes due to the implementation of catch shares (and other changes in management, including the buyback), the factors discussed above have provided a degree of stability.

The following quotes from Newport-based respondents help make sense of what it is about the community that has helped it remain relatively stable since catch share implementation:

> "The fleet is moving around more. They move around to different ports more, especially the guys that have lost their infrastructure. They find a way to come here to deliver. So I've seen that and that helps us a lot. That they're in the area more, even if they've never met me. They lost their last guy up in Astoria (George) just this year, who fixed nets, he's retired and so we're getting that whole fleet coming our way, that we haven't had." —Industry Participant, Newport, 2015/2016.

> "Because of whiting, have had more money to spend and it's gone directly, and I mean directly to businesses in the community."—Industry Participant, Newport, 2015/2016.

> "I think competition is a good thing. We have other businesses here that our customers frequent and I think that's good. We have our niche where we really dominate certain things, or we don't quite on some others. We have other people that are good at this. It creates more for like the Port of Newport for instance, we have all the different aspects of the business so we attract more boats to come here because they can get whatever the hell they need here, in Newport. We have varied services here."—Industry Participant, Newport, 2015/2016.

In sum, every coastal community with ties to the groundfish trawl fishery has unique historical and contemporary conditions relative to the nature, scale, and diversity of its connections to commercial fishing on the West Coast. These conditions are not constant; they are shaped by a variety of biological, economic, and regulatory forces, all of which affect communities differently. Thus, despite the coastwide implementation of the catch share program (i.e., a common set of rules to which participants in every community must adhere), the impacts of the program, even large-scale trends, play out uniquely in each community.

3.2.2(g)(1) Cooperation: Cooperatives, CFAs, Risk Pools, and Community Quota Funds

The catch share program has provided direct and indirect incentives and opportunities for fishermen to work together and with their communities to organize harvesting activities better. These efforts have manifested in cooperatives, risk pools, community quota funds, and other community-based organizations. This section summarizes information about these types of organizations.

Coastal communities in California have been particularly active in their efforts to secure groundfish quota locally. As discussed above, study participants regarded a consistent supply of groundfish as vital for the overall health of a fishing community. Respondents in Fort Bragg, San Francisco, Half Moon Bay, Monterey, Santa Barbara, and Morro Bay have addressed this need to secure a consistent supply of groundfish by establishing community fishing associations (CFAs) and community quota funds (CQFs). Many see these collective entities as a practical way to ensure the sustainable involvement of small coastal communities in the groundfish trawl fishery This section covers the catcher-processor co-op, whiting mothership co-ops, community fishing and seafood marketing associations.

3.2.2(g)(1)(a) Catcher-Processor Cooperative (Pacific Whiting Conservation Cooperative)

As noted in Section 2.0, History of the West Coast Groundfish Trawl Fishery, the PWCC was formed in 1997. The cooperative is a Washington nonprofit corporation consisting of catcher-processor companies harvesting Pacific whiting. It was established to promote rational harvest, optimal utilization, and minimal waste in the whiting fishery (PWCC 2017). The PWCC served as the model for fishery harvest cooperatives under the American Fisheries Act of 1998, which led to the development of two pollock cooperatives in the Bering Sea (Sullivan 2000; Criddle and Macindo 2000; Kitts and Edwards 2003; and; Sylvia et al. 2008;). Since its development, the PWCC has been widely recognized for its successes, including ending the Olympic-style fishery, improving product recovery rates, increasing season length, and reducing bycatch of salmon and rockfish species (Sylvia et al. 2008).

The PWCC operates under a contractual membership agreement and a harvest agreement (PWCC 2015). The board of directors, consisting of a representative of each member company, oversees the membership agreement. Since 2011, three companies have participated in the catcher-processor cooperative including American Seafoods Company LLC, Glacier Fish Company LLC, and Trident Seafoods Corporation (PWCC 2011; PWCC 2012; PWCC 2013; PWCC 2014; PWCC 2015).

Under the catch share program, a single co-op must be formed in the whiting catcher-processor co-op sector; if such a co-op is not formed, the system will convert to IFQs with each vessel catcher-processor permit receiving an equal allocation (PFMC 2010a). As such, the PWCC receives 100 percent of the Pacific whiting and non-whiting groundfish allocated to that sector. Catch of Pacific whiting and non-whiting groundfish allocations of four rockfish species (canary rockfish, widow rockfish, darkblotched rockfish, and POP) is monitored and reported by NMFS-certified observers and SeaState, Inc. SeaState Inc. calculates catch and bycatch rates and shares these reports, which include cumulative fleetwide and vessel-level catch data and tow-by-tow summaries, with co-op members.

In addition to managing whiting harvests, the PWCC assigns individual limits (i.e., hard caps) on incidental catch proportional to members' Pacific whiting allocations and employs techniques to minimize bycatch of non-whiting species. If the hard caps on incidental catch of overfished species and Chinook salmon are exceeded, the catcher-processor sector ceases fishing (PWCC 2015).

According to PWCC's annual reports, no co-op member vessels have exceeded their allowed catch or bycatch amounts since implementation of the catch share program. Additional details on operations and performance are available in PWCC's annual report submitted to NMFS and PFMC (PWCC 2011; PWCC 2015).

3.2.2(g)(1)(b) Whiting Mothership Cooperative

Under the mothership/catcher vessel program, those who hold whiting-endorsed permits for catcher vessels in the mothership sector choose each year whether to be part of the co-op or to register to fish in the non-cooperative portion of the fishery. The Whiting Mothership Cooperative was formed in 2011 as a nonprofit corporation under the Washington Fishing Marketing Act to coordinate harvesting efforts and manage bycatch of four allocated overfished rockfish species and Chinook salmon. It is the only co-op that formed in the mothership/catcher vessel sector. Since 2011, all owners of trawl limited entry catcher vessel permits endorsed for operation in the mothership sector of the Pacific whiting fishery have been members. As such, the co-op has received 100 percent of the quota for the whiting mothership sector. Membership and the number of vessels operating in the co-op have been stable over the past five years, with a slight decline in 2015 due to the transfer of permits and consolidation of CHA onto fewer catcher vessel permits (see Chapter 2 for a description of CHAs) (Table 3-123).

Table 3-123. Whiting Mothership Cooperative and mothership catcher vessels. Source: (WMC 2011; WMC 2012; WMC 2013; WMC 2014; WMC 2015; WMC 2016)

	Number mothership/CV LEP Holders	Number mothership/CVs harvesting
2011	37	18
2012	37	17
2013	37	18
2014	37	19
2015	34	14
2016	34d	17

The Whiting Mothership Cooperative operates under a co-op membership agreement, an annual contract that defines membership, apportions the co-op's allocation from NMFS to individual members based on each member's whiting catch history allocations, and defines the rules of harvesting whiting, including the establishment, timing, and duration of a series of five seasonal pools (WMC 2011). The Whiting Mothership Cooperative Membership Agreement requires members to declare the amount of whiting to be harvested within each seasonal pool, and bycatch limits are apportioned to each pool in proportion to the amount of whiting declared. Each year, the board of directors, consisting of co-op members, reviews and approves the co-op agreement. The board has made one substantive change to the agreement since 2011; it added a fifth seasonal pool (WMC 2015).

In addition to coordinating the harvest of Pacific whiting, the Whiting Mothership Cooperative manages the bycatch of overfished rockfish species and Chinook salmon as a common pool resource as specified in a bycatch agreement. The agreement defines measures to mitigate against the possibility of exceeding allowed catch and bycatch limits; it includes precautionary closures of past bycatch hotspots, night fishing restrictions, test tows when entering a new fishing area, fleet relocation triggers, fleet-to-fleet reporting, in-season hot spot closures, and sanctions against vessels that have exceed a bycatch rate within a seasonal pool (WMC 2011).

As with the PWCC, NMFS-certified observers and SeaState Inc. monitor catch for the Whiting Mothership Cooperative, including whiting and bycatch. Co-op members and captains receive daily reports that include information on catch, bycatch rates, maps of bycatch hotspots, and other useful data aimed at avoiding bycatch.

The co-op's Bycatch Committee, which is open to all captains and skippers harvesting in the co-op, reviews bycatch rates at the start of each seasonal pool, makes modifications to closure areas, and institutes other measures needed to avoid and mitigate bycatch encounters. In general, a seasonal pool is closed if the bycatch apportioned to that pool is exceeded. Additional rules and restrictions apply if member vessels exceed certain thresholds of their pro-rata amount assigned to that seasonal pool.

According to annual reports of the co-op, members have not exceeded their allowed catch amount of whiting under the co-op agreement (WMC 2011; WMC 2012; WMC 2013; WMC 2014; WMC 2015). Members have exceeded their pro-rata share of the bycatch limit and, therefore, triggered closures of seasonal pools, but there have been no violations of the co-op's bycatch agreement, and the co-op has not exceeded its annual allocations.

According to interview data, there are many benefits of the whiting co-ops, but one of the most critical components is management of the sector's allocation of bycatch species with individual accountability. The structure of the Whiting Mothership Cooperative seasonal pools and bycatch agreement allows members flexibility to plan their participation in the fishery while reducing the risk that the sector's allocation of bycatch species will be fully harvested and, therefore, closing the fishery early.

3.2.2(g)(1)(c) Community Fishing and Seafood Marketing Associations Supporting West Coast Groundfish Fisheries

Fishing and seafood marketing associations provide opportunities for community members to collaborate and identify solutions to regional challenges. They also allow members to act collectively under the Fishermen's Collective Marketing Act (FCMA) of 1934.

Various community fishing and seafood marketing associations support fishermen and fishing communities as they transition to the groundfish trawl catch share program. Some of these organizations formed in response to the program. For example, the Fort Bragg Groundfish Association was established in 2011 to identify changes caused by the catch share program and to create new opportunities for local commercial fishermen. Similar organizations have been established in Half Moon Bay (Half Moon Bay Groundfish Marketing Association), Morro Bay (Central California Seafood Marketing Association), and Bolinas (Bolinas Community Fishing Association). In addition, community fishing organizations such as Commercial Fishermen of Santa Barbara, West Coast Seafood Processors Association, Coos Bay Trawlers, and Mid-Water Trawlers Cooperative have continued their efforts to support commercial fishing in their communities of place and of interest.

A comprehensive description of all community fishing and marketing associations supporting West Coast groundfish fisheries and coastal communities is beyond the scope of the catch share program review. However, the list below identifies the community fishing and seafood marketing associations and related entities that had representatives at the coastal community hearings on the catch share program and intersector allocations held between August 31 and September 29, 2016.

Table 3-124. Community and Regional Fishing Association represented at the IFQ Community Hearings. Source: PFMC.

San Luis Obispo, California	Morro Bay Community Quota Fund and Monterey Bay Fisheries Trust
Half Moon Bay, California	Monterey Bay Fisheries Trust, Half Moon Bay Groundfish Marketing Association, Half Moon Bay Community Fisheries Trust, California Groundfish Collective, and Bolinas Community Fishing Association
Fort Bragg, California	Fort Bragg Groundfish Association and California Groundfish Collective, West Coast Seafood Processors Association, Noyo Women for Fisheries
Eureka, California	Oregon Trawl Commission
Coos Bay, Oregon	West Coast Seafood Processors Association, Coos Bay Trawlers Association
Westport, Washington	No community fishing organizations were represented.
Seattle, Washington	Fishing Vessel Owners Association, United Catcher Boats, and Pacific Whiting Conservation Cooperative
Astoria, Oregon	West Coast Seafood Processors Association
Newport, Oregon	Midwater Trawlers Cooperative

3.2.2(g)(1)(d) Risk Pools

Since implementation of the catch share program, three formal risk pools have formed to manage bycatch of overfished rockfish species: the Shorebased Whiting Cooperative (SWC), the California Groundfish Collective (CGC), and the Ilwaco Fishermen's Marketing Cooperative (IFMC). As of December 2016, the SWC and CGC are still operating, but the Ilwaco Fishermen's Marketing Cooperative has ceased risk pool operations. In addition to these formal risk pools, there are informal arrangements that act as risk pools and are discussed in this section.

Shorebased Whiting Cooperative

The SWC formed in 2012 as a nonprofit corporation under the Washington Fish Marketing Act to ensure that members had access to quota of constraining species including darkblotched rockfish, POP, yelloweye rockfish, canary rockfish, widow rockfish, and Chinook salmon during their harvest of shorebased Pacific whiting. The SWC has a board of directors consisting of cooperative members, and it operates under an annually renewed formal membership agreement. Membership is voluntary and open to quota shareholders who own trawl vessels with a NMFS QP vessel account, have whiting as their primary IFQ fishery, and agree to fish their whiting harvest under the rules outlined in their membership agreement. Seventeen members currently participate in this cooperative with homeports primarily located in Seattle and Newport. Twenty-two vessels participated in the shoreside whiting fishery in 2015, and 23 vessels fished in 2016.

The SWC rules of operation are similar to an insurance policy, using a combination of "deductibles" and "premiums," along with harvesting rules. Members contribute a pro-rata portion of their constraining species QPs into an individual account entitled "Restricted QP Account," which is used as the deductible. Members also contribute a portion of their individual allocations of overfished species quota in the "Cooperative Reserve Account," which is used as the premium. Initial encounters of constraining species are covered through the QPs held in the individual member's Restricted QP Account. After members have exhausted their individual reserves, they can access the pooled quota for constraining species held in the Co-op Reserve Account. If members exhaust both their deductible and their premium accounts, they may choose either to stand down for a specified time or to buy QPs off the open market to cover their overage. Additional rules prevent any single member from exceeding a certain threshold of overfished QPs.

Members harvesting whiting under the SWC Membership Agreement operate under fishing rules that are similar to, but less rigid than, those developed and implemented in the Whiting Mothership Cooperative, as many of the SWC members also participate in the whiting mothership sector. These rules include cautionary and closed areas, requirements for data sharing, including use of Sea State Inc., move-on rules, and stand-down requirements. Failure to comply with the fishing rules may constitute a breach in the risk pool agreement, although there have been no violations or withdrawals to the agreement to date.

Interview data suggest that the whiting co-ops and risk pool contribute to timely sharing of information and reduce the risk of being unable to access quota of overfished species (PCGFSS 2017).

> "You need the information sharing. There is total transparency where members are and what they do, and you need that to avoid stumbling into something. Inevitably, someone is going to stumble into something, so you need to pool the risk." —Industry participant, Puget Sound Area 2015/2016.

The California Groundfish Collective

The CGC is a risk pool operating in California under an annual contractual agreement of community fishing associations, with support and scientific advice from The Nature Conservancy. The goals of the CGC are "to maximize conservation and economic opportunities and to retain local access to fish" (Kauer et al. 2016). As of December 2016, two community fishing associations are members of the CGC Agreement: the Fort Bragg Groundfish Association and the Half Moon Bay Groundfish Marketing Association.

The CGC is governed by an advisory committee consisting of one representative from each member community fishing association. As of December 2016, seven fishing vessels using a variety of gear types, including trawl, fixed gear, and Scottish seine, were operating under its agreement.

Those fishing under the CGC Agreement collaborate with members and scientific advisors to develop regional, spatially explicit fishing plans that identify risk zones and voluntary closed areas. The fishing plans are area- and gear-specific, and they may include precautionary rules such as test tows or reduced tow duration based on the perceived risk of encountering overfished species and habitat sensitivity in a particular area (Kauer et al. 2016). The CGC uses eCatch technology The Nature Conservancy developed to capture and share spatial details and catch information when overfished species are encountered and to monitor compliance with the risk pool agreement. If overfished species are encountered above an agreed-upon threshold, fishing plans may specify move-on rules (Kauer et al. 2016).

According to interview data, CGC members contribute their individual allocations of overfished species QPs to the CGC's pooled vessel accounts at the start of the fishing year, and the accounts are managed by the risk pool manager. Contributions of overfished species QPs to the risk pool by members varies, but individual members are fully covered when overfished species are encountered, as long as they are fishing under the agreed-upon terms of their regional fishing plans.

In 2015, the CGC reported managing 12 percent of the shorebased groundfish non-whiting sector's allocation of overfished species QPs, accounting for a total of 140,370 lbs (Kauer et al. 2016). Most of this quota was for bocaccio rockfish, followed by darkblotched rockfish, canary rockfish, cowcod, and yelloweye rockfish (Kauer et al. 2016). In addition to contributions of overfished species QPs by member associations, the CGC manages overfished species QPs contributed by The Nature Conservancy, Morro Bay Community Quota Fund, and, more recently, the Fort Bragg Groundfish Conservation Trust.

The community fishing associations participating in the California risk pool, as well as the number of individuals and vessels affiliated with each of the member associations, have changed since its 2011 initiation. In the first year, the risk pool was called the Fort Bragg-Central Coast Risk Pool, and it operated as an agreement between the Central Coast Sustainable Groundfish Association (later the Central California Seafood Marketing Association) and the Fort Bragg Groundfish Association. Fourteen individuals from the two member associations participated in 2011, pooling 228,812 pounds of overfished rockfish (Ft. Bragg et al. 2012). During 2013, the Half Moon Bay Groundfish Marketing Association was formed; it participated informally to learn how the risk pool operated (Labrum and Oberhoff 2014). In 2014, the California Risk Pool changed its name to the California Groundfish Collective, and it operated under an agreement between the three community fishing association members: Central California Seafood Marketing Association, Fort Bragg Groundfish Association, and Half Moon Bay Groundfish Marketing Association (Kauer and Oberhoff 2015). At that time, 10 vessels were harvesting shoreside groundfish using a variety of gear types under the risk pool agreement. In May 2016, the Central California Seafood Marketing Association withdrew from CGC membership (Kauer et al. 2016). Additional details regarding CGC membership, operations, overfished species quota holding and utilization rates, compliance and monitoring of operations can be found in the risk pool's annual reports (FBGA et al. 2012; Labrum and Oberhoff 2013; Kauer and Oberhoff 2014; Kauer and Oberhoff 2015; Kauer et al. 2016).

Ilwaco Fishermen's Marketing Cooperative

The Ilwaco Fishermen's Marketing Cooperative, or IFMC, was registered as a nonprofit corporation in Washington in 2010. According to interview data, members of the IFMC were relatively homogenous in that they used trawl gear, had similar fishing operations, similar allocations of QS for both target and overfished species, and prior experience fishing under catch share programs. The co-op began by collaborating on efforts in California to develop a risk pool for overfished species quota, including partnering with The Nature Conservancy and receiving funding support from the National Fish and Wildlife Foundation (NFWF 2017). In 2011, it split from the California risk pool to pursue a northern risk pool. According to interview data, members agreed to pool both target and overfished species QPs, and they developed formal rules of operation to fit their fishing operations and opportunities. In 2014, the IFMC ceased operating as a formal co-op/risk pool, although many of the former members continued fishing within the shoreside groundfish catch share program. Currently there are efforts by the Port of Ilwaco, the Ilwaco community, and the NFWF to assess the feasibility of establishing a community fishing association (NFWF 2016), as well as efforts by Ilwaco Landing Station, Columbia River Crab Fisherman's Association, the Oregon Community Foundation, and the Port of Ilwaco to establish a community quota fund (LWC 2016).

Informal Risk Pools

Interview data suggest that there have been fewer incentives and perhaps less necessity to set up formal risk pools north of 40^0 10' N. latitude, particularly in Oregon fishing communities. QS owners may have received overfished species quota as part of their initial allocations or been able to access overfished species QPs through a combination of social networks, informal agreements, and open markets where needed. Interviewees stated that, overall, there has been cooperation and sharing of bycatch information, as no one wants to catch more than they can cover (PCGFSS).

> "The whole fleet is a cooperative to a certain extent, right, so communication is better because we're all in this together."—QS permit owner, Brookings Area, 2016.

Further research would be needed to achieve a better understanding of how fishermen use de facto risk pools to pool the risk of encountering overfished rockfish species.

Participant Perspectives

Perspectives on the success and challenges of risk pools vary among fishery participants. According to interview data collected during the PCGFSS, some respondents have reported that risk pools have provided greater access to overfished species quota and have successfully pooled the risk among participating members:

> "It's worked pretty good for us, in all honesty. I mean, we have some stuff that we had zeros on, you know some of our boats wound up with a zero on yelloweyes and other boats actually got quite a few yelloweyes. It just, really, what would you call it…buffered the risk, so to speak, for everybody by havin' that, you know, that risk pool." —Fisherman, Fort Bragg, 2015/2016.

In addition to reducing risks of encountering overfished species, the risk pools have engaged in efforts to avoid bycatch as well as improve market conditions for target species:

> "Our risk pool, what we've done is voluntarily imposed closed areas to protect overfished species." —Fisherman, Fort Bragg, 2015/2016.

> "California Groundfish Collective, the organization that is our risk pool that has the 10 boats, we actually, with the help of TNC and their money and everything, you know, their influence, we gained a green rating with Monterey Seafood Watch." —Fisherman, Half Moon Bay, 2015/2016.

Other respondents have reported challenges of participating in risk pools:

> "The risk pool has fishing plans designed to avoid species of concern: in all my fishing in the last five years, I've not had one species of concern—so perhaps this is another big bureaucratic cost for little to no benefit." —Fisherman, Morro Bay Area, 2012.

Other fishermen have chosen not to participate in risk pools for a variety of reasons:

> "I didn't want to belong to any risk pool. I wasn't concerned about me going over or anything, but you know if the three of us are in a pool and you guys keep going over and I never do, I don't want in the pool." —Fisherman, Astoria, 2015/2016.

3.2.2(g)(1)(e) Community Quota Funds

As of January 1, 2017, several community-based entities own QSs in the catch share program (Table 3-125). These organizations include CQFs (also known as quota banks, fisheries trusts, and conservation trusts), as well as other community fisheries organizations, such as the Commercial Fishermen of Santa Barbara and Central California Joint Cable/Fisheries Liaison Committee, that are preparing to acquire or have acquired QSs and are establishing quota funds as part of their mission to provide sustained fishing opportunities in their community.

Table 3-125. Acquisition of QSs by community-based organization. Source: NMFS' West Coast Regional Office Permits Branch/database.

Organization	**QS Permit Owners**					
	2011	***2012***	***2013***	***2014***	***2015****	***2016***
Central California Joint Cable / Fisheries Liaison Committee *(principal office located in Morro Bay)*						X
City of Monterey						X
Commercial Fishermen of Santa Barbara, Inc.						X
Fort Bragg Groundfish Conservation Trust						X
Half Moon Bay Commercial Fisheries Trust						X
Monterey Bay Fisheries Trust					X	X
Morro Bay Community Quota Fund				X	X	X
The Nature Conservancy	X	X	X	X	X	X

* Transfer and sale of quota shares began in 2014, and divesture to levels below the control limit was required by November 30, 2015.

The CQFs were established as public benefit non-profit corporations under California's Nonprofit Corporation Law. While each CQF has a unique organizational structure and adopted bylaws to meet its individual mission, the CQFs generally have formed to secure fishing rights to anchor economically and environmentally sustainable commercial fisheries in their respective port communities.

The Morro Bay CQF was the first community fisheries quota fund established in California; it was followed the next year by the Monterey Bay Fisheries Trust. Since the beginning of 2015, three additional CQFs have formed in Half Moon Bay (Half Moon Bay Commercial Fisheries Trust), Fort Bragg (Fort Bragg Groundfish Conservation Trust), and Santa Barbara (Commercial Fishermen of Santa Barbara, Inc.). Most QSs held by the CQFs were acquired from The Nature Conservancy, largely during the divestiture of QSs that exceeded the control limits. Control limits, or the maximum amount of QS or individual bycatch quota that a person may own or control, required that any QS permit owners who were initially allocated excess shares had to divest of any excess completely by November 30, 2015.

NMFS' Southwest Fisheries Science Center is conducting a preliminary study on the structure and economics of community quota funds. The study focuses on the Morro Bay CQF and the Monterey Bay Fisheries Trust as the first two community quota funds established and operating in California (LWC 2016). However, researchers also interviewed participants from CQFs more recently established in Half Moon Bay, Fort Bragg, and Santa Barbara, as well as participants who are working to establish a CQF in Ilwaco, Washington. Details regarding the development and operation of the CQFs, as well as perceived benefits and challenges, are summarized in LWC 2016. NMFS' Southwest Fisheries Science Center is currently analyzing study results.

3.2.2(g)(1)(f) Summary

The number of community quota funds and other fishermen's organization acquiring quota to benefit their participants and communities has increased over the last three years, since QS trading started in 2014. Risk pools are a type of fishermen's organization that help fishermen deal with the challenges of adhering to the limited amounts of quota available for constraining species. Overfished rockfish species are key constraining species, and they present particular challenges as rockfish stocks continue to recover and encounter rates increase faster than the OFLs for these stocks.

Overall, such risk pools appear to have reduced the danger of some members encountering a disaster tow or lightning strike of overfished species. They have increased members' ability to access quota for overfished species where needed, improved information about bycatch hotspots, and made it easier quickly to share such information. In some cases, this information sharing has increased access to fishing areas that may otherwise have been avoided for fear of encountering overfished species. Reported ongoing challenges include limited amounts of quota available for constraining species, potential limitations to fishing areas due to risk pool closures, market conditions for some target species, and, in general, high costs of operating in the groundfish fishery. However, some of these challenges may not be limited to members of risk pools. Further research is needed to inform managers regarding how risk pools impact fishing operations and behavior, particularly in terms of avoiding bycatch, and how communities may be impacted by risk pool operations.

3.2.2(g)(2) Direct Marketing, Gifting, and Personal Use

One way coastal communities connect to their ocean and fishing industry is through fish brought in and sold by fishermen. Commercially caught fish flows to communities through intermediaries such as fish buyers, but some also flows through direct sales from the vessel to consumers (for example, over-the-side sales, or selling at farmers markets), or through informal relations between harvesters and community members (for example, crewmembers taking fish home or offering them for charitable use). At the catch share review hearing in Half Moon Bay, participants expressed concern about the impact of the program on direct sales and informal relations that tie the fishing community with local geographic communities. This section assesses regulatory changes that may have affected these activities and discusses the degree to which changes in the disposition of fish have occurred, as reflected in fish ticket records.

Both before and during the catch share program, there have been requirements that all landings be recorded on fish tickets filled out by state licensed buyers (fish sellers), including direct sales and take-home fish. These state requirements did not change under the catch share program. However, fish buyers must now acquire a first receiver license for each site at which fish are offloaded, and all offloads must be monitored by a certified catch monitor (often the observer getting off the vessel). Finally, when the offloading is complete, a Federal electronic fish ticket must be filed, in addition to the state fish ticket. This is done through a web-based interface. For Oregon, printed copies of the electronic tickets may serve as state fish tickets. These additional burdens apply to vessels seeking to act as their own fish buyer.[82]

3.2.2(g)(2)(a) Personal Use

In general, fish taken home for personal use may be given away or donated to a charity (such as a church) but cannot be sold, and must be reported on fish tickets. The following is a general description of the process for each state.

[82] Information for this and following section came from the following key informant interviews and PacFIN data: Oregon: Tim Schwartz, November 16, 2016; California: Robert Puccenelli, November 16, 2016; Washington: Dan Chadwick, November 16, 2016, and February 14, 2017.

- Washington: Individuals may take home fish (up to the recreational limit) for personal use. Personal-use fish are identified on state fish tickets, but no landings taxes are paid.
- Oregon**:** Personal-use fish must be delivered to a "Wholesale Fish Dealer," recorded on the fish ticket, then "bought back" from the fish buyer. Landings taxes are paid on these fish.
- California**:** Personal-use fish must be delivered to a first receiver and recorded on a landing receipt. Landings taxes are assessed on personal use fish.

While all three states require that fish kept for personal use be documented as such on the fish ticket, only Washington and California pass the notation on personal usage to the central PacFIN system (Oregon provides information on landings to PacFIN, but not the notation on personal use). PacFIN data indicate that there was a substantial increase in the amount of fish recorded as personal use with the start of the catch share program (Table 3-126). This may have been due to an increase in actual personal usage, though there is no particular reason that the catch share program would be expected to result in such an increase. Alternatively, there may have been an increase in the reporting of personal usage fish on fish tickets because of the increased presence of catch monitors.

Table 3-126. Pounds of fish reported as personal use for the trawl sector in California and Washington (all species). Source: PacFIN.

State [1/]	**Pre-catch Share Average (1994 to 2010)**	**Catch Share Average (2011 to 2016)**
	Shoreside Non-Whiting Trawl	
California	5,926	67,976
Washington	1,015	6,561
	Shoreside Whiting Trawl	
California	4,545	9,089
Washington	**5,246 (79)**[2/]	**6,918**
	Shoreside Fixed Gear (no formal gear switching prior to catch shares)	
California	n/a	4,239
Washington	n/a	793

[1/] Personal use codes are not passed from ODFW to the central PacFIN system, which was used to develop this summary.
[2/] In 2010, more than 30,000 pounds of squid delivered in Washington were reported as "personal use." If 2010 is omitted from the time series, then the average is 79 pounds a year.

3.2.2(g)(2)(b) Direct Sales

In all three states, some form of state fish seller/buyer license is required for a vessel to sell directly to consumers. These requirements have not changed since the catch share program was put in place. As noted above, the catch share program added a requirement that buyers obtain a Federal first receiver site license.

Fish tickets are not consistently coded as direct sales to consumers. However, as an indicator of the number of vessels that may have been engaged in such operations, Table 3-127 provides the number of single-vessel/single-buyer situations (buyers with only one trawl sector vessel delivering, including gear switched vessels) that occurred in each year from 1994 through 2016. These single-vessel/single-buyer occurrences may be situations where a vessel is acting as its own buyer so that it can sell directly to the public or other markets. These data indicate a decline in single-vessel/single-buyer situations, possibly indicating a reduction in the number of trawl vessels engaging in direct sales.

Table 3-127. Count of buyers with only one trawl sector vessel delivering (including gear switched vessels), Washington, Oregon, and California. Source: PacFIN data retrieved December 19, 2016.

Year	Count	Year	Count	Year	Count	Year	Count
1994	12						
1995	14						
1996	10	2001	16	2006	13	2011	8
1997	10	2002	16	2007	13	2012	9
1998	19	2003	11	2008	13	2013	6
1999	14	2004	15	2009	12	2014	6
2000	12	2005	21	2010	11	2015	5
						2016	3

3.2.2(g)(3) Stressors within Communities

Changes in government regulations and accompanying fishing practices have the potential to bring about divisions within and between fisheries, users of different gear types, and fishing communities. What may be regarded as an improvement from one perspective can be experienced as a step in the wrong direction from another. The West Coast commercial fishing industry is characterized by a high degree of gear and target species diversity. Therefore, changes in one fishery, community, or gear-species complex are likely to have spillover effects. These issues often reflect individuals' beliefs about what is fair and equitable in their dealings with one another, which are grounded in both personal experiences and the cultural environments of different fisheries, gear groups, and communities.

This section uses PCGFSS data to explore perspectives on the potentially divisive changes associated with catch share management. Industry members' views on these issues are explored both qualitatively and quantitatively wherever possible, as each form of data complements the other.

3.2.2(g)(3)(a) Participating in Multiple Fisheries

Highlights:

- There has been an increase in the percentage of PCGFSS respondents using midwater trawl, troll, shrimp trawl, and double-rigged shrimp gear and a decrease in the percentage using groundfish trawl (both large and small footrope).
- PCGFSS interviewees commonly discussed using fixed gear to target sablefish and expressed the belief that gear switching could impact the value and availability of sablefish quota.
- Fixed-gear fishermen who were contemplating obtaining fishing trawl quota expressed concerns about the cost of observer coverage, which they saw as a significant barrier to profitable participation in the groundfish trawl fishery.

The catch share program allows trawl fishermen to switch between trawl and non-trawl groundfish gears to catch their quota (PFMC and NMFS 2010). For the purposes of this section, gear switching refers to a trawl permitted vessels use of non-trawl gear to fish groundfish trawl quota. Compared to pot and longline gear, trawl gear has the highest bycatch rates, as well as adverse habitat impacts (Jenkins and Garrison 2013); thus, gear switching may reduce waste and environmental degradation in the fishery. Additionally, gear switching may increase trawlers' business options and, in some cases, may provide economic benefits (Jenkins and Garrison 2013). However, gear switching may also have adverse effects (i.e., overcrowding of fishing grounds) and lead to changes in behaviors and relationships of resource users (Jenkins and Garrison 2013). In this section, PCGFSS data are used to summarize the percentage of respondents using particular gear types, the primary reasons for gear switching, and potential impacts.

Summary of gear use by PCGFSS respondents

PCGFSS researchers asked fishermen to report the gear types that they commonly use to fish.[83] This information provides an overview of respondents' participation in groundfish and other fisheries, and in conjunction with information in Section 3.1.2(d)(6), it aids in characterizing the amount of gear switching survey respondents engaged in relative to the use of other gear types. Figure 3-70 summarizes the percentage of fishermen in the PCGFSS study who reported using a particular gear type. Although this is not directly indicative of gear switching, it does provide context for interpreting the comments of respondents. Gear switching is not be the only business strategy used to adapt to changes related to catch shares; for instance, about 30 percent of respondents reported using shrimp trawl (double-rigged) in 2012

[83] All fishermen's data included in this analysis represents trawl fishermen, unless otherwise noted. Fishermen include captains, crew, and any vessel owners or quota owners involved in harvesting operations.

and 2015/2016. This is an increase over the pre-catch share level of participation that may also be related to increased opportunities in the shrimp fishery.

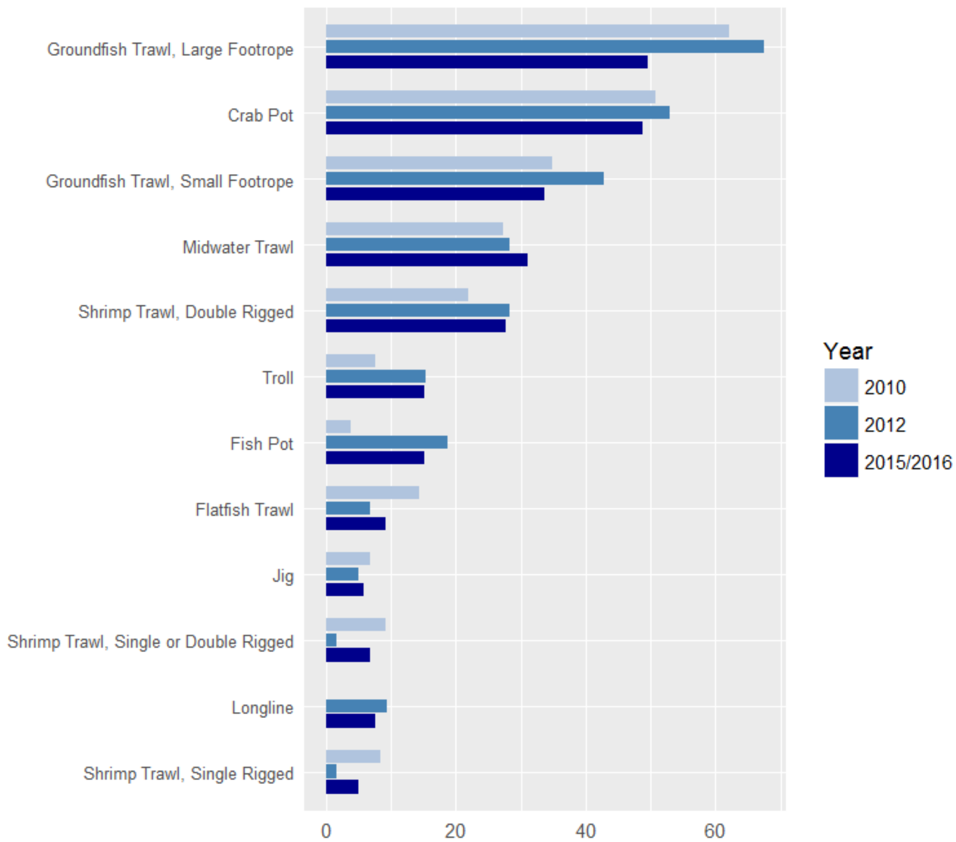


Figure 3-70. Percentage of fishermen indicating that they commonly use a particular gear to fish. “Longline” was not listed as an option in 2010. Not applicable/Prefer not to answer: 2012=1.7 percent; Response Rate: 2010=97.8 percent, 2012=100 percent, 2015/2016=96.7 percent. Source: PCGFSS 2017.

Amount of Gear Switching

Section 3.1.2(d)(6) uses fish ticket and EDC data to determine the amount of gear switching occurring. Between 2011 and 2015, the number of gear switching vessels ranged from five to eight, and the amount of sablefish quota caught by these vessels ranged from 6 percent to 9 percent (Table 3-67, Table 3-69).

The discussion of gear in the PCGFSS survey starts in a section targeted towards fishermen (as opposed to processors or others). Although this limited the number of people commenting on this subject, enough information was provided to gain insight into the complexity of the issue.[84]

The use of fixed gear to catch trawl quota was discussed in every community in the 2015/2016 PCGFSS. More specifically, respondents identified sablefish (black cod) as the species most frequently targeted by gear switchers. This is consistent with Jenkins and Garrison (2013), who interviewed key informants in the West Coast sablefish fishery, and with data provided here in Section 3.1.2(d)(6). As fixed gear has lower rates of bycatch than trawl gear, when targeting sablefish, it may be an attractive option for participants. Furthermore, fishermen may benefit from a higher return on sablefish quota caught with fixed gear (Section 3.1.2(d)(6)). Jenkins and Garrison (2013) also discussed the economic benefit of gear switching in regard to a higher market value for sablefish caught with fixed gear, because fixed-gear-caught sablefish may be larger than those caught with trawl gear. In the PCGFSS study, fishermen related the following:

> "The bigger fish command a little higher price. So their size, their grade is bigger than the trawl fisheries. So they get more money for the fish and they can afford to pay more in lease rates than the groundfish fleet can and still come out." —Fisherman, Fort Bragg, 2015/2016.

> "Because of the economics of pot fishing vs. trawling, they [fixed gear fishermen] are able to pay a higher lease rate. They're able to purchase at a higher price per quota share than others. Now, they're not really interested in the rest of the fish. But, sablefish is a big driver of our trawl industry from profit too and you need it for…not just bycatch, but it's a target you know. It's the highest paid thing we catch…. But the thing is, when you cut everybody down to a third of what they were catching, I *have* to get it. Not just for bycatch for other species, cause you're catching them all at once, but also for the profit. Well, profit's gone, because you gotta lease it, and whoever owns it ends up getting 90% of the profit. But the other thing is, I need it just to go access all these other fish. So what happens then, when you have to lease? I can't compete. I either end up losing money on it, on something that I used to make money on when it used to be one of the bigger money

---

[84] The 2015/2016 code "gear switching" appeared 240 times, a rank 15 of 22. See Appendix C for subcodes and a description of each code.

> makers….I either end up losing money or I can't even get it and I can't even access the rest of it." —Fisherman, Astoria, 2012.

Potential Impacts of Gear Switching

Gear switching may have impacts on the value and availability of sablefish quota. One participant explains the impact of gear switching on trawlers:

> "You can't get your hands on those species, you know? So it's…and competing against the longliners and the pot boats for that black cod—in my mind—is not right. Because they can put escape rings in their pots and catch the big ones, and therefore bring in a $7 black cod a pound average. I can't compete with that with my groundfish. We're lucky if we average $1.50 a pound. So I can't compete in the open marketplace trying to lease that fish, when he can gobble up for $2 a pound, I can't do it because I'm going backwards at that rate. So I mean if we even all that out that will help the fishery too." —QS Permit Owner, Coos Bay, 2015/2016.

> "The price of sablefish or black cod got so high that people were leasing them going fixed gear fishing and then buying quota pounds for black cod well beyond the reasonable price for somebody trawling for black cod would pay. Because they tended to catch larger fish. Larger fish have a larger ex-vessel price than smaller fish. Trawlers catch ocean run, all sizes. They aren't high-grading. And so, access to black cod became limiting and that, it's related to consolidation, but that becomes an issue of, if you can't access it then you can't access black cod through quota you can't access all the other mix of fish that you have quota for. And therefore then your fishing operations starts to change. And in which case if you can't access it, then you're more inclined to liquidate your quota because you couldn't fish anyway. And so, it's, you know, it's one of these things that sort of snowballs." —Industry Participant, Eureka, 2012.

Some respondents expressed the belief that the increase in the value of sablefish on the quota market and the increased difficulty in obtaining enough sablefish quota were due to processors acquiring most of the sablefish quota and using it to incentivize deliveries. However, Table 3-48 shows that in 2015, shorebased processors owned only 0.309 percent of sablefish quota north of 36° N. latitude.

Some study respondents believe that processors can afford to pay more than smaller operators can for the quota, thus driving the price. For instance, one fisherman describes the challenge of obtaining sablefish quota as follows:

> "It's the processors that are leasing it at the high price, not the fixed gear guys… I haven't leased any yet this year because the price is so high, and that's the processors that are paying the high price. I can't compete with it. Because in the beginning, it was the fixed gear guys were paying more for (quota) than the draggers wanted to, and now the processors have bumped that up and paid more than we want to…." —QS Permit Owner, Astoria 2015/2016.

Some fishermen have stated that the ability to fish trawl quota with fixed gear was an expected result of the catch share program, as is documented in the groundfish FMP. Accordingly, some made business plans based on the ability to gear switch. For instance, a permit holder indicated the following:

> "When we purchased the boat, we bought the vessel and its crab, shrimp, and trawl permits. We bought the boat and these permits with the intent, and in reliance, on the ability to gear-switch, as provided for in the rules of the trawl IQ program…It's important to state that in the 2008 decision document for the rationalization of the limited-entry trawl fishery, this outcome of trawl vessels converting to fixed-gear was both specifically provided for, anticipated, and analyzed..." —QS Permit Owner, Newport Public Hearing, 2016.

Responses from Non-IFQ Fixed Gear Fishermen

Non-IFQ fixed gear fishermen were not initially targeted for the PCGFSS. However, they approached the PCGFSS team on their own initiative to provide insights to the study, and are discussed separately here for that reason. These fishermen accounted for 45 of 258 total interviews collected and analyzed for the 2015/2016 round of the PCGFSS.[85]

The cost of observer coverage emerged as a central theme for this group of respondents. Echoing concerns present in the 2015/2016 qualitative data as a whole, the cost of observers was viewed by many fixed-gear fishermen as a significant barrier to profitable participation in the groundfish trawl fishery, particularly for small vessels. Rather than benefitting from the gear-switching component of the catch share program, many respondents with small fixed-gear vessels reported being priced out of the program, largely due to the high cost of observers. This problem is especially striking in California, where fixed-gear fishermen can theoretically lease groundfish quota from community quota funds, but are not doing so because they cannot afford to pay for the observer coverage required to fish the quota. Those in small ports without resident observers (for example, Morro Bay) are further disadvantaged by having to pay

[85] Thirty participated in California, 12 in Oregon, and three in Washington.

additional travel costs. Without local lessees, community quota funds often end up leasing quota to non-local fishing operations, according to these Morro Bay fishermen:

> "The biggest problem in our community quota fund is this: observer costs make it impossible for local guys to get into the fishery, so the community quota fund has to lease to someone else, so they lease to northern boats, who come down here with truckloads of pots and compete with our local longline fishermen. Every year since I started fishing, we have seen declines in the local fishery." —Fixed-gear fisherman, Morro Bay Area, 2015/2016.

> "The big problem for the Community Quota Fund in Morro Bay is that people can't get observers, and observers cost so much. If we could solve that, we could probably get guys to lease that quota, and have it landed here." —Fixed-gear fisherman, Morro Bay Area, 2015/2016.

> "If I could lease 10,000 pounds from the CQF and go out and fish it and not have the observer fees, I could maybe get above the poverty line." —Fixed-gear fisherman, Morro Bay Area, 2015/2016.

These quotes suggest that the current structure of the groundfish trawl observer program promotes consolidation by placing disproportional cost on small vessel operations, which in turn causes quota to flow to larger vessels that can remain profitable while paying for observer coverage. For more information on issues related to small vessels and consolidation, see Section 3.2.4, Small Vessels, and Section 3.2.2(g)(3)(c)), Consolidation Impacts.

Apart from the catch share program, there are other reasons why fishermen have increased their efforts in alternative fisheries, for example, prices and abundance. In addition, the catch share program may not be the sole source of conflict between fisheries. A participant from Newport stated the following:

> "There's always been gear conflicts and fishery conflicts, so I don't know if catch shares has necessarily changed that." —Participant, Newport, 2015/2016.

Further data are needed to determine how much correlation equals causation, but it is essential to understand how catch shares may affect the use of other fisheries and conflicts between the sectors.

3.2.2(g)(3)(b) Absentee Quota Holders

Highlights:

- The number of absentee owners responding to the PCGFSS study (defined below) remained relatively constant between 2012 and 2015/2016. However, due to the small increase in the number of QS owners/co-owners, the percentage of respondent-owners who are absentee owners slightly decreased.
- The quality of relationships between processors and both QS and vessel owners appears to have declined in 2012 and improved again in 2015/2016.
- The data identified three different types of absentee owners: virtual owners, owners involved in the business who do not fish, and owners who are no longer active in groundfish, but who participate in other fisheries.

QS ownership trends since catch share implementation reflect how quota owners have used their permits under the new management program and how that use has affected their businesses, relationships with vessel crews, and related aspects of the fishing industry. Examining the nature of participation by absentee QS owners who do not fish their quota is one way to assess how owner-crew relations may have changed and to identify to what extent owners go onboard vessels. The qualitative data generated by the PCGFSS identified different types of absentee quota owners and the direct and indirect impacts they have on the industry.

PCGFSS survey data were used to determine the extent to which owners are not going out on vessels, i.e., absentee owners. "Absentee owners" were defined as study respondents who identified themselves as QS owners and/or co-owners and who did not identify as captains/operators or crewmembers.[86] Based on this definition, the number or frequency of absentee owners remained constant between 2012 and 2015/2016. However, due to the small increase in the number of QS owners/co-owners, the percentage of QS owners who are absentee owners slightly decreased (2012=50 percent, 2015/2016=47.3 percent).

The qualitative data identified three different types of absentee owners. They include virtual owners, owners involved in the business who do not fish, and owners who are no longer active in groundfish, but who participate in other fisheries.

[86] Note: Many of those categorized as absentee owners identified as vessel owners/co-owners (2012=80 percent, 2015/2016=74.3 percent). These vessel owners/co-owners were categorized as absentee owners because they did not identify as captains/operators or crews, suggesting that they were asset owners who do not go out on the vessel.

Virtual owners are described as QS permit owners with little to no active involvement in the fishery beyond leasing out QPs or having a hired captain and crew to fish the quota-allotted fish. Retired fishermen who live on the income from leased quota may also be virtual owners.

> "I know a lot of people just use it to sell their fish, kind of like a stock market, right, and that's hurt too because a lot of boats who fish for us that are smaller boats, they just sell their quota, so I got six boats that should be fishing, but instead they stay at home and dialed it up and sold it and put the check in the bank, and that's it." —Processor, Oregon, 2015/2016.

> "Permits need to go to the boats and the people fishing, not the people sitting on the beach with a retirement income." —QS Permit Owner, Fort Bragg, 2015/2016.

> "I'd like to help figure out a way to fix the risk that 20 years from now there will be a whole lot of armchair fishermen—vessel and quota owners who never fish. I'd like to promote owner-operators, so big companies aren't finding ways around the rules." —Industry Participant, Monterey Area, 2015/2016.

> "I go to these guys that hadn't been trawl fishin', had no landings whatsoever, had never paid a cent for the buyback. I'm havin' to go to them and I'm having to lease sablefish from them, I'm having to lease petrale sole from them and they have no expense whatsoever. None. Zero. They're not payin' for the observer, they're not paying the 3% for the program, they're not paying the 5% from the buyback. They're collecting pure cash from a fishery they never even participated in. All they had was the permit." —QS Permit Owner, Fort Bragg Area, 2015/2016.

The second type of owner is the actively involved quota permit owner who hires out a captain and crew to fish the quota, but who does not spend time aboard the vessel. This type of permit owner may be a single owner or a business entity like a processor with several crewed vessels fishing several quotas.

> "When guys are getting out, they're getting huge bucks for their boats and quota. And the processors are buying them. And then we're still the hired grunts to drive their boats. Then there's a whole other level of crap you have to deal with because now you have a processor that owns it, that really doesn't have a connection to the fishing end of it. Right now I work for a guy that used to fish so he understands when I call him up and say, this is what's going on. When you're calling a corporation in Seattle, and you tell them, hey I need this… Well, first of all, you won't even talk to them, you're like 10 tiers down is who you talk to,

> even though they make all the rules from up there. That's where the business is going. And catch shares are a total contributing factor to that." —Fisherman, Newport, 2015/2016.

The third type of absentee owner is one who has a QS permit, but who leases out the entire quota while shifting fishing efforts to other fisheries. This type is, technically, an absentee relative to the QS permit, while still actively fishing on their vessels in non-groundfish fisheries.

> "We own quota and a trawl permit. As we speak, both the permit and the quota is leased out right now. We can't afford; we're too scared; we can't afford to fish it. Those two reasons: the fear and can't afford it. … I'm leasing my groundfish… so I have a guaranteed shrimp market." —Fisherman, Astoria Area, 2015/2016.

These three types of owners reflect differing trends when it comes to quota ownership, and they highlight some of the issues associated with absentee ownership. Additional information regarding quota owners is located in Section 3.2.2(f), Changes in Employment. More information on changing relationships is located in Section 3.2.2(h), Changing Nature of Fishery Businesses and Jobs.

3.2.2(g)(3)(c) Consolidation Impacts

Highlights:

- While the proportion of PCGFSS respondents who indicated they either had exited or had plans to exit the groundfish fishery was relatively small in both the 2012 and 2015/2016 surveys, a trend toward greater consolidation in the fishery was widely reported.
- Small-scale fishing operations are seen as disadvantaged relative to larger, more capital-heavy operations, due primarily to increased participation costs under catch shares.
- Despite accumulation and vessel limits on quota ownership and control, respondents reported a high degree of consolidation toward processing companies and other multi-vessel entities.
- The catch share program has played a role in most future-oriented decisions about participation in the groundfish fishery, including the decision to exit.
- While exiting the groundfish fishery was not uncommon, exiting the fishing industry altogether was rare.

Consolidation in the groundfish fishery was a widely recognized trend among 2015/2016 PCGFSS respondents[87]. Industry members recognized several forms of consolidation, including consolidation within individual fishing businesses, consolidation of quota ownership and/or control within the fishery at large, consolidation of processing efforts, and consolidation of shore-side support businesses and

[87] The 2015/2016 code "accumulation and consolidation" appeared 240 times (rank 15 of 22).

infrastructure. Participants used the term "consolidation" in two subtly different ways. On one hand, respondents spoke frequently about processors, community quota groups, and other multi-vessel fishing operations accumulating quota, permits, and vessels. In fisheries literature, researchers usually refer to this aspect of consolidation as concentration or *aggregation* (McCay 2004; Yandle and Dewees 2008). On the other hand, respondents also used the term "consolidation" to refer to boats, processors, and industry suppliers/servicers going out of business or leaving the groundfish fishery. This reduction in boats, processors, and other infrastructure is noted in the literature as concentration or *consolidation* (Karlsdottir 2008, Apostle et. al. 2002). As such, this section will present the major themes and perspectives tied to both sides of the phenomenon of consolidation.

Aggregation

Study respondents generally viewed consolidation as one of the primary goals of the catch share program. Thus, they were not surprised that fewer boats, particularly smaller vessels, now participate in the groundfish fishery. Increased entry and participation costs, namely the costs of observer coverage and quota leasing (or buying), were the most frequently suggested causes of consolidation, and respondents linked both sources of cost increases directly to catch shares. These cost increases are said to be pushing the fishery into a more corporate direction, since only larger operations have the resources and market avenues necessary to sustain profits. One Newport-based fisherman noted the following:

> "It's going to turn into a fishery dominated by just a very few players that have the money to do it" — Fisherman, Newport, 2015/2016.

This prediction for the future of the fishery was prevalent, and it was met with a mix of responses ranging from support to serious concern. The following quotes offer windows into the "support" and "concern" perspectives in turn:

> "It was always meant to be consolidated. I mean, you gotta start with the original problem. The original problem was we had too many boats and not enough fish, we had a fishery in severe decline. That's reversing." —QS Permit Owner, Half Moon Bay, 2015/2016.

> "It makes it harder to become…to have ownership, and it's created a wealth gap. I've noticed that. It's created an elite group of boat owners and fish owners that basically control everything now." —Fisherman, Newport, 2015/2016.

> "It seems like the trend has been for more boats to be owned by the processor, but that's unavoidable, I guess." —Fisherman, Newport, 2015/2016.

While quota and control limits have no doubt been effective in limiting some accumulation of QS control and QP usage on vessels, PCGFSS respondents expressed concern that entities could find ways to circumvent these constraints. The possibility that an individual might establish indirect control over more QS than allowed under control limits (for example through business relationships that entail some form of long-term commitment to supply QP) was anticipated by Amendment 20 and the attendant regulations. Those regulations attempt to prohibit such indirect control, which can be difficult to detect and monitor.[88] The following quotes are examples of these concerns about circumvention of control limits.

> "Pacific Seafood group, Trident Seafood, they're buying up boats and quota shares... It's happening and I'm concerned about the future." —Industry Participant, Newport, 2015/2016.

> "You have boats now—our cannery has 11 permits, or 12 permits—12 boats. They're actually supposed to divest. Get rid of some stuff. They're fighting it." —Fisherman, Astoria, 2015/2016.

> "I don't wanna just rail against processors, but on the other hand I would hate to see him buy up all the boats and quota and not have the family-owned boats." —Industry Participant, Newport, 2015/2016.

Consolidation (Exiting)

In light of the consolidation predicted in the Amendment 20 FEIS and observed by PCGFSS respondents, the following two questions arise: Since the implementation of catch shares in 2011, how common is exiting the groundfish trawl fishery? To what extent are exits being attributed to changes caused by the catch share program? PCGFSS data help address these questions.

As Table 3-128 indicates, only a small proportion of those surveyed in both post-implementation rounds of the PCGFSS reported that they had exited the groundfish fishery (6.1 percent in 2012 and 4.9 percent in 2015/2016). One consideration when interpreting these results is the ambiguous status of those who own a QS permit and/or groundfish quota, but who have decided to lease out their access to fish rather than harvest it themselves. There may be inconsistencies in the interpretation of what it means to "exit" the fishery. For instance, respondents who have decided to lease out their groundfish quota exclusively could mark "Decreased level of activity in the groundfish fishery" or "Exited the groundfish fishery."

---

[88] For example, the regulatory definition of control includes the following: "The person, has the right to restrict, or does restrict, any activity related to QS or IBQ or QP or IBQ pounds, including, but not limited to, use of QS or IBQ, or the resulting QP or IBQ pounds, or disposition of fish harvested under the resulting QP or IBQ pounds. . ." 660,140,(d)(4)(iii)(E)

While this technically does not constitute a total exit from the fishery, the respondents may view it as such, particularly if they lease out the entirety of their quota every year as a source of retirement income (this is further discussed below, as well as in the Absentee Quota Holders Section above). In light of these potential inconsistencies, PCGFSS qualitative data helps unpack these different forms of exit from the groundfish fishery. The “After Exiting” Section below will explore some of these nuances.

Concurrent changes in market structure, shifting ocean conditions, opportunities in other fisheries, and impacts of other management actions all influence respondents’ decisions to exit the groundfish catch share program. The 2003 buyback program, for instance, came up frequently in interviews when respondents were discussing the current state of the groundfish trawl fishery. These other potential sources of change are a reminder that the catch share program was not introduced in a vacuum; its implementation in 2011 overlaid a set of existing biological, social, and economic conditions in the fishery. As such, the effects of catch shares cannot be fully understood without considering the suite of other factors that may affect community outcomes. Similarly, fishery participants’ perspectives on catch shares are influenced not only by the program itself, but also by these other factors.

Table 3-128. Level of activity in Pacific Coast groundfish trawl fishery after implementation of catch shares. Source: PCGFSS 2017.

	2012	**2015/2016**
No change in groundfish fishery activity	22.3	14.7
Increased level of activity in the groundfish fishery	11.2	24
Decreased level of activity in the groundfish fishery	43.1	37.8
New to the groundfish fishery	4.1	4.9
Exited the groundfish fishery	**6.1**	**4.9**
Other	21.3	13.8
NA/PNA	11.2	11.1
RR	98	97.8

RR = response rate; NA/PNA = not applicable/prefer not to answer

PCGFSS respondents were also asked to indicate plans for future participation in groundfish and other fisheries. Though there was a slight increase in those indicating that they planned to exit the fishery in the 2015/2016 survey, only a relatively small proportion (4.1 percent in 2012 and 6.0 percent in 2015/2016) of respondents had immediate plans to exit the fishery in both 2012 and 2015/2016 (Table 3-129).

Table 3-129. Plans for participation in the fishing industry. Source: PCGFSS 2017.

	2012	2015/2016
Keep current activity levels in the groundfish fishery	40.3	38.9
Increase current activity levels in the groundfish fishery	27	33.8
Decrease current activity levels in the groundfish fishery	6.6	6.5
Exit the groundfish fishery	**4.1**	**6.0**
Keep current activity levels in non-groundfish fisheries	36.7	38.9
Increase current activity levels in non-groundfish fisheries	28.6	24.1
Decrease current activity levels in non-groundfish fisheries	1.5	3.7
Exit some but not all non-groundfish fisheries	0.0	0.5
Exit all non-groundfish fisheries	1.0	2.8
Do Not Know	9.7	5.6
Other	13.8	0.0
NA/PNA	11.2	10.6
RR	97.5	96.9

RR = response rate; NA/PNA = not applicable/prefer not to answer

Despite the difficulty of determining the influence of catch shares compared to other factors, PCGFSS survey data give some indication of the influence of the program on respondents' plans for the fishery. In 2012 (the first year the question was asked), 64.6 percent of respondents indicated that their plans for the groundfish trawl fishery had been influenced by the transition to catch share management. This dipped slightly in 2015/2016, with 59.9 percent indicating that the catch share program had influenced their plans for the fishery. While these proportions do not directly reveal how much of a factor catch share management has been in the decision to exit the groundfish fishery, they suggest that catch shares have played a role in the majority of future-oriented decisions about participation in the groundfish fishery. This interpretation finds support in the qualitative data, as the following quote illustrates:

> "Now my plan is to not even deal with dragging [bottom trawling] at all. It's not worth it to me. As a crew, I was on a good boat. It was a good year round boat. Stable job and it just wasn't for me after that. Like I was actually aspiring to take over that boat and run it. It was an idea that I had. But once this came into effect—there's not a lot of young guys getting into fishing. That was a dream for me—to have a big boat that I could run year round. In this economy/job market, it was a big deal for someone my age to have that opportunity. And it just went out the window. Now I've got an old, small boat. It takes a lot of my money and time. And I'm not making a lot of money right now. That was a big

> blow to me. I spent a couple years with it. Me and the guy were just fishing by ourselves, which is a lot of work, but I was learning a lot. I feel like I wasted that time in my life because it was something I was going for, and now it's just something I'm not interested in. Too many headaches, too many hassles, and really the payoff just isn't worth it. So I'm going into other fisheries now, trying to come up with other plans." —Fisherman, San Francisco Area, 2012.

PCGFSS participants also discussed consolidation relative to retirement and new entry, generally regarding the catch share program as a hindrance when transferring ownership from one generation to the next. This is discussed in further detail in Section 3.2.3(c), Fishing Heritage.

After Exiting

PCGFSS respondents reported a wide range of post-exit activities that they or others they know have undertaken since exiting the groundfish fishery. For those who were already close to retirement age, leasing out allotted quota was often seen as a sort of retirement plan. This concept is not new. Pinkerton and Edwards (2009), subject to debate as described above, noted similar activities in the British Columbia fishery, where quota holders leased quota for life and passed it on to the next generation as an investment. For others who may not have been ready to retire, shifting efforts into other fisheries—most notably shrimp and Dungeness crab—was common. See the Consolidation Impacts Section, above, for more information on leasing.

Participants rarely reported that they, or anyone they knew, had completely exited the commercial fishing industry upon exiting the groundfish fishery. The following quotes help elucidate a few of the most common activities pursued by PCGFSS respondents upon exiting the fishery:

> "There have been a lot of boats that have left the fishery. The smaller draggers, specifically, I've seen them just go do something else. If they have groundfish permits, they'll lease them out. I know a couple of them that have actually sold their groundfish permit because they couldn't catch enough to make a living on it. I know a lot of those." —Fisherman, Newport, 2015/2016.

> "Some of the smaller guys are not working, and some of them have sold their boats with the vessel buyback, and some of them have leased their groundfish and then shrimp." —QS Permit Owner, Newport, 2015/2016.

> "That oligopoly made it so that we got stranded. Our vessel was pushed aside by the catch share system. It drained us and then I had no money to get back on my feet, so I had to work in construction." —Fisherman, Monterey Area, 2015/2016.

> "It was forecasted that the fleet would be down to forty boats or something in x number of years, and I haven't seen that attrition because we've had good shrimp and good crab. But we may just be on the doorstep of some shake-up and things changing from pre-rationalization." —QS Permit Owner, Puget Sound, 2015/2016.

The tendency for fishermen to continue to pursue employment in other fisheries after exiting the groundfish fishery is recognized in the literature (Campbell et al. 2000; Stuart et al. 2006). Campbell et al. (2000) found that viable alternative fishery options played a major role in the decision by most of those exiting the Australian southern bluefin tuna fishery to remain in the commercial fishing sector. Similarly, the presence of both the shrimp and Dungeness crab fisheries on the West Coast may buffer the number of former groundfish participants exiting the commercial fishing altogether. The increase in full-time employment in non-groundfish fisheries since 2010 provides further evidence.

Consolidation, Retirement, and New Entry

The themes of consolidation, new entry, and retirement are intertwined and relate to concerns about fishing communities. Respondents' concern over greater consolidation was especially strong when it came to how consolidation affects the socioeconomic wellbeing of fishing communities and opportunities for new entrants. A number of respondents saw consolidation as leading to erosion of viable avenues of entry into ownership roles in the groundfish fishery. A few QS owners in Washington and California pointed out differences between the traditional diversity in commercial fishing in West Coast fishing communities and the changes they believe are occurring:

> "The problem is, if it's all giant multinational corporations that are going to own all this stuff, I think the attitude is going to change. I think it's going to change a lot, compared to people who grew up on the water and who parents were on their water and their parents were on the water, and that's what's sad about what I see happening here. Everybody should wake up and see what's going to happen." —QS Permit Owner, Puget Sound Area, 2015/2016.

> "I think a lot of this fish is gonna get bought up by some of the bigger corporations and whatnot. And what's gonna wind up happening is a lot of the, you know, the ma and pop, the businesses like myself, family businesses, they're gonna get ran out. And basically, it's all gonna be owned by some of the bigger fish companies, some of the bigger corporations, and the environmental community. They own some pieces. And that's just how the fisheries are gonna go." —QS Permit Owner, Fort Bragg Area, 2012.

These respondents' concerns about changing access to the resource touches on an important issue that a number of other respondents raised: the effects of catch shares on intergenerational transfers of family-owned fishing operations. The following interview excerpt illustrates the way that the themes of consolidation, new entry, and retirement, are intertwined. According to one fisherman in the Newport area the following is an issue:

> "A lot of the owners that I know—because I know most all of them—they're all getting into that retirement age. So a lot of them are starting to sell, and pretty soon Trident and Pacific Coast Seafoods—Dulich or whoever the owner is there that owns all these fish plants up and down—now he owns some up in Alaska too—they'll end up pretty much monopolizing the whole industry. And that's what's gonna happen here too." —Fisherman, Newport, 2015/2016.

…moments later, in the same interview…

> "Even with the owners that have kids that could maybe take over—most of them have went ahead and sold to the big companies." —Fisherman, Newport, 2015/2016.

This participant goes on to explain that the decision to sell out to a larger company upon retirement is likely driven by the cost and uncertainty associated with participation in the catch share program, both of which are factors that may make cashing out of the fishery an attractive option for retiring fishermen. It is a commonly held view that large corporate entities,often processing companies,have deep pockets and can afford to buy up quota, permits, and/or vessels. Therefore, the flow of assets in the groundfish fishery is seen as a one-way street moving away from independent fishermen and fishing families and towards vertically integrated corporate interests. Movement toward vertical integrated corporate interests is well noted in the literature (Apostle et al. 2002).

Consolidation is a widely recognized phenomenon in the body of scholarly literature on the socioeconomic impacts of fishery privatization (e.g., Bradshaw 2004; Brandt 2005; Campbell et al. 2000; Carothers 2008; Carothers et al. 2010; Dewees 2008; Eythórsson 2000; Helgason and Pálsson 1997; McCay 2004; McCay et al. 1995; Olson 2011). In many instances, consolidation has been found to favor large-scale operations (Brandt and Ding 2008; Campbell et al. 2000; Ethyórsson 2000; McCay 1995; van Putten and Gardner 2010). These studies add weight to PCGFSS respondents' views that the catch share program is hardest on the "little guy."

3.2.2(g)(3)(d) Interactions Between Trawlers and Other Fishery Sectors

Highlights:

- There has been an increase in interactions between gear-switching trawlers and boats using trawl quota from Oregon and Washington and traveling to areas in California to fish. These actions are more likely to have negative consequences for the California fishermen than those from Oregon and Washington.
- Many fishermen indicated that they participate in other fisheries to compensate for costs accrued from the catch share program.

This section focuses on interactions between trawlers and other fishery sectors. Over the last few years, industry participants have commented on interactions between gear-switching IFQ vessels and non-IFQ fixed-gear vessels. In particular, California's fixed-gear fleet has perceived an increase in vessels from Oregon and Washington using their southern sablefish trawl quota to fish fixed gear in California. Trawlers also diversify their activities by participating in other fisheries such as Dungeness crab and shrimp. These changes may be directly related to the catch share program, if, for example, increased costs have driven fishermen to participate more heavily in other fisheries. The flexibility of the catch share program allow vessels an opportunity to more fully participate in other fisheries.

PCGFSS results indicated that 37.5 percent of trawl groundfish fishermen in 2012 and 35.6 percent in 2015/2016 had increased their participation in non-groundfish fisheries since the catch share program was put in place (Table 3-130). In the Morro Bay area, for example, longline fishermen believe that IFQ pot fishermen who are gear switching are overfishing their area and have "wiped out" the resource because they have "absolutely no restrictions on how many pots they can use or where they can put them" (Fisherman, Morro Bay Public Hearing, 2016). While this may not technically be true with respect to the amount of pots that can be deployed, it is a real perception that may have to be addressed. This issue is explored further later in this section. Additionally, see Section 3.3.4(b), Sablefish South of 36° N. Latitude, for more information.

Table 3-130. Percentage of PCGFSS respondents indicating a change in activity levels in non-Pacific Coast Groundfish Fishery after implementation of the catch share program. Source: PCGFSS 2017.

	2012	**2015/2016**
No change	31.8	24.0
Increase	37.5	35.6
Decrease	4.7	9.8
New	2.6	1.8
Exit	1.0	1.8
Other	3.1	6.2
NA/PNA	21.9	25.8
RR	95	97

RR = response rate; NA/PNA = not applicable/prefer not to answer

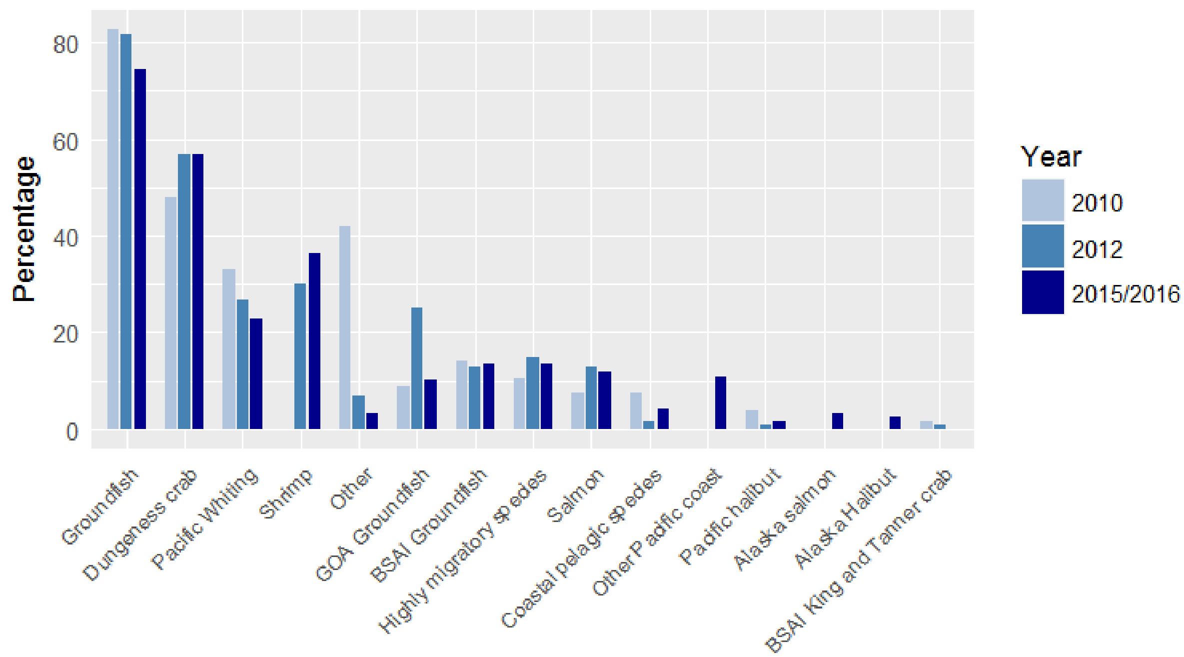
Most fishermen in the groundfish trawl fishery historically have participated in other fisheries, including those in Alaska, and in state-managed fisheries like crab and shrimp (Figure 3-71). For example, the 2015/2016 PCGFSS found that, of the respondents, 36.4 percent of the trawl fishermen also fish shrimp, and 56.8 percent fish for Dungeness crab. Participation in these alternate fisheries may provide a more stable income to fishermen in the catch share program (see Section 3.1.2(d)(1), Participation, and Section 3.1.3(c), Interdependencies with Other Fisheries).

A Coos Bay participant said that the draggers (trawlers) sold their drag boats during both the buyback and the catch share program:

> "But then they turned around and got into crabbing and…it just caused for way over-capitalization in the crabbing." —Participant, Coos Bay, 2015/2016.

Similarly, a Newport PCGFSS participant believes that trawl fishermen are exerting similar additional pressure on the shrimp fishery.

> "It has taken a huge increase in pressure because of the catch share program. Single-handedly the amount of shrimp boats has tripled because of catch shares and it's put a huge load on the shrimp fishery production side, fish plant side." —QS Permit Owner, Newport, 2015/2016.



Note: NA/PNA: 2012=0.9 percent; RR: 2010 = 98.5 percent, 2012=99.1 percent, 2015=95.9 percent.

Figure 3-71. Percentage of IFQ fishermen indicating participation in fisheries since implementation of the catch share program. All respondent data are represented here. Source: PCGFSS 2017.

According to Aguilera et al. (2015), diversification is a strategy fishermen use to respond to environmental, regulatory, and economic variability and change, and this can contribute to the welfare of associated small-scale fishing communities. Echoing this argument, an Oregon processor contends the following:

> "…if it wasn't for shrimp and crab, there would be a lot of guys that would just be out of business." — Processor, public hearing, Astoria, 2016.

PCGFSS respondents generally agree that participating in salmon, crab, shrimp, and other fisheries is a way to continue to make a living in fishing, because of the "…low cost and regulatory ease associated with these fisheries" (industry participant, public hearing, Fort Bragg, 2016). See Section 3.1.2(d)(1), Economic Participation, for more information on vessels participating in other fisheries.

In addition to the shrimp and Dungeness crab fisheries, the catch share program has also affected the limited entry fixed gear and open access longline groundfish fisheries for sablefish. According to a number of 2015/2016 PCGFSS respondents based in southern California, there has been an influx of Oregon- and Washington-based trawl-licensed boats using fixed gear to target southern (south of the 36°

00’ N. latitude line) sablefish trawl quota. Many longline fishermen in southern California felt that this gear/geographic shift has crowded and depleted local fishing grounds:

> “Draggers almost never came to Santa Barbara, they were always in Morro Bay and north of that. But now the big Oregon boats have bought the quota permits and put the permits on their trap boats, and they come down here and fish the place out.” —Fisherman, Santa Barbara, 2015/2016.

> “When we find a big spot of black cod and start to fish them, the big boats from Oregon and Washington come and put hundreds of traps all over, then we can’t fish there at all. The longline gear and trap gear confound each other, and also if they lose traps, that screws up our gear, so it costs us thousands to fix our gear, we lose that trip, and additional cost to go find other grounds.” —Fisherman, Morro Bay Area, 2015/2016.

> “Basically the program created a new fishery in our area, and in the past, there was very, very limited trawl fishery south of the 34°27, and by allowing this gear switching, these ITQ boats come down from Washington or Oregon and basically the last couple years, I think they’ve focused on our area south of the 34°27, and God, it’s just had a huge impact in our area, just in taking fish, especially where there was never one in the past. We feel that’s really unfair… You just cannot concentrate that much fishing pressure in that small of an area, and that’s what wiped out the Georges bank back east, and I can’t believe you guys, not you guys, but I can’t believe it’s not common knowledge that that is a really poor way to fish, and it’s just really affected us, and it’s really affected our fishery.” —Fisherman, Santa Barbara Area, Public Hearing, 2016.

While the ability to use fixed gear to harvest groundfish quota has benefited many, these accounts indicate that there are differing opinions on the issue.

3.2.2.(g)(3)(e) Interactions with the General Public

Highlight:

- Although the public perception of bottom trawling may be improving, it still appears to be somewhat negative.

The MSC certified the West Coast limited entry groundfish trawl fishery as sustainable in 2014 (MSC.org). Despite this certification, qualitative data from the PCGFSS and testimony from public hearings indicated that many fishermen believe that the public has negative views about trawlers and the impacts of trawling on the environment. Trawl fishermen testify that it would be irrational to destroy their habitat and overfish:

> "…Why would I do that? I'm a fourth generation fishermen; I kind of like this business" — QS Permit Owner, Puget Sound Area, 2015/2016.

Because groundfish fishermen want the public to view the fishery in a positive light, many believe that agencies should help market trawl-caught groundfish. Fishermen compared this resource favorably to other proteins that Americans consume. As a fisherman from Newport in a public hearing stated:

> "It's a shame that when you've got product of the USA, MSC certified, and we're giving those markets to tilapia, that don't have the health benefits. We've got the healthiest protein on the planet, and we're giving it [markets] to tilapia and swai." —Fisherman, Newport Public Hearing, 2016.

Public hearings and interviews showed that some fishermen believe the catch share program may help improve the public perceptions of these once "dirty trawlers." An industry participant stated the following in a public hearing testimony in Eureka (2016):

> "Before we embarked upon developing IFQ programs, there was a very loud vocal group of people who were beginning to chant, "Ban bottom trawl!" …We were throwing 40% of the fish away…When we went into the direction of an IFQ program, you don't hear people say "ban bottom trawling" anymore." —Industry Participant, Public Hearing, Eureka, 2016.

Since 2012, articles appearing nationally and internationally in publications such as the *New York Times* (Rowley 2016) and *National Geographic* (Fitzgerald 2014) highlight the successes of the program. Local California newspapers reporting on the MSC certification stated, "In essence, what the trawlers of the West Coast have done under this new system is renew the social contract that they have with the public, by providing assurance that they are harvesting a public resource in a sustainable manner" (Della Sala, Pennisi, and Jud 2014). Other regional newspapers have reported on the challenges, including program costs, of working with the observer program (Wilson 2014) and the struggles of independent fishing families (Wilson 2013).

While bottom trawlers may have improved their image in some ways, concerns still surface in public discourse. For example, an editorial stated, "Scientists have documented long-lasting damage to deep sea environments from bottom trawling, a type of fishing that involves the use of large nets dragging along the seafloor" (Tissot 2015). A 2017 Seafood Watch Facebook post encouraging the modification of fishing gear said: "Fishermen commonly use bottom trawls to catch shrimp and bottom-dwelling fish like halibut and sole. However, the nets can also catch a variety of other ocean life resulting in bycatch (accidental catches) and can damage sensitive seafloor habitat."

These examples provide insight into the information available to the public about the catch share program and the trawl fishery and allow a view into public perceptions.

3.2.2(h) Changing Nature of Fishery Businesses and Jobs

Highlights:

- Constraints created by bycatch (limited quota availability and vessel limits) and observer coverage have changed the experience of fishing in the groundfish trawl fishery.
- Catch shares have led to an increase in business flexibility.
- Study respondents report slight changes in working relationships—most notably, crew relationships, as well as processors' relationships with laborers.
- Compensation amount, job stability, and standard of living have improved relative to roles in the commercial fishing industry since 2010.

Catch share or IFQ programs have had various impacts on the experience of fishing, including changes in fishing season, number and seasonality of jobs; income; quality of life; and job satisfaction (Olson 2011; Copes and Charles 2004; Grimm et al. 2012; McCay et al. 1995). Eliminating the race to fish increases flexibility in fishing schedules and may result in lengthening fishing seasons and making landings more regular (Olson 2011; Grimm et al. 2012). While the introduction of catch share systems may initially result in the loss of jobs, remaining fishermen may benefit from an improvement in job quality and stability (Grimm et al. 2012). Job-related impacts, however, may differ depending on one's position and role in the fishery. For instance, while harvest operation owners may experience increased income, McCay et al. (1995) discuss the decrease in crew shares and incomes following implementation of catch shares in the mid-Atlantic surf clam and ocean quahog and the Nova Scotia fisheries. Binkley (1989) also discussed reduced work satisfaction due to longer work schedules and more time away from home. The goal of this section is to describe how catch shares may be changing the nature of the West Coast fishery businesses and jobs using interview and survey data from the PCGFSS.

3.2.2(h)(1) Concern about Bycatch Limits and Observer Coverage

Interview data suggest that the experience of fishing in the groundfish trawl fishery has changed both positively and negatively since implementation of the catch share program.[89] For example, interviewees discuss how observer and vessel QP regulations (bycatch limits) have changed their fishing experience:

[89]. The PCGFSS study coded qualitative data specifically for discussions of working in the industry. The "working in the industry" code was the most frequently mentioned code throughout the 2015/2016 interviews (2,088 occurrences; a rank 1 of 22). To provide insight into more specific aspects of this code, data were sub-coded

> "You could be checked out, and then you could lose your whole season, basically, in one tow. It's kind of nerve-wracking." —Fisherman, South/Central Washington Coast, 2015/2016.

> "It's harder to go catch your groundfish because you're avoiding stuff all the time. It's like we go fishing not to catch fish now, is what we do." —Fisherman, Newport, 2015/2016.

Concern and frustration about bycatch limits and observer coverage have influenced some fishermen's level of participation in the fishery. One fisherman no longer participates beyond leasing out his quota because of the "…fear, the safety issue, and the fear of the costs…" (San Francisco Area, 2015/2016). This topic is discussed in further detail in Section 3.2.2(g)(3)(c), Consolidation Impacts, which highlights respondents' perspectives on consolidation, and future plans for those who have exited the fishery.

3.2.2(h)(2) Changes in Relationships

To provide insight into changes in relationships, fishermen were asked if their interactions with QS owners, captain/operators, crewmembers, buyer/receivers, processors, and motherships had changed since implementation of the catch share program. Similarly, processors were asked if their relationships with captain/operators, buyers, distributers, marketers, and laborers had changed.[90]

The reported quality of fishermen's relationships with QS owners and vessel (asset) owners was generally positive (Figure 3-72). In 2012, however, a small number of fishermen reported negative relationships with QS owners (2.6 percent) and vessel owners (0.9 percent). Overall, given the small reported change since catch shares' implementation and the relatively small amount of change between 2012 and 2015/2016, the results suggest a level of stabilization in these relationships.

to reflect discussions of "running a business" and "working experience," which represent 31.3 percent (n=653) and 21.1 percent (n=440) of the "working in the industry" code occurrence, respectively.

[90] All processor data included in this analysis represents any processing role linked to the trawl fishery. This includes buyers, shoreside processors, and any at-sea processing participation.

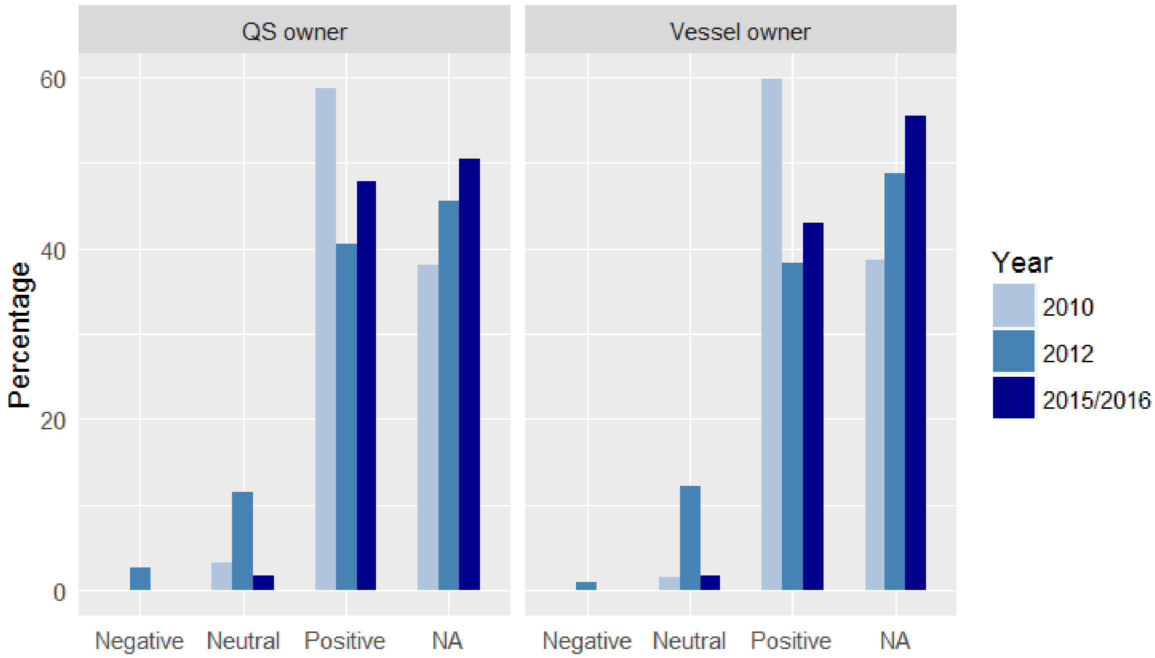


Figure 3-72. Fishermen reported quality of relationships with QS owners ("Permit owners" for 2010) and vessel owners. Note: Fishermen who also identified as QS owners or vessel owners responded as "not applicable" to this question. Fishermen responses only (no processors). Source: PCGFSS 2017.

Although some fishermen thought their relationships with fellow crewmembers had changed as a result of the catch share program, few reported that those relationships were negative.[91] While some respondents expressed the view that crew were getting paid less for the same amount of work than before the catch share program, others stated that relationships with crew had improved due to more stable employment.

The percentage of fishermen reporting negative relationships with processors decreased from 5.3 percent in 2010 to 0.9 percent in 2015/2016. No fishermen reported negative relationships with captain/operators in any of the PCGFSS study years.

Processors were also asked about the quality of their relationships with QS owners and vessel owners. Based on their responses, the quality of these relationships appears to have declined in 2012 and improved again in 2015/2016 (Figure 3-73).

[91] In 2010, 0 percent; in 2012, 1.8 percent; in 2015/2016, 2.7 percent

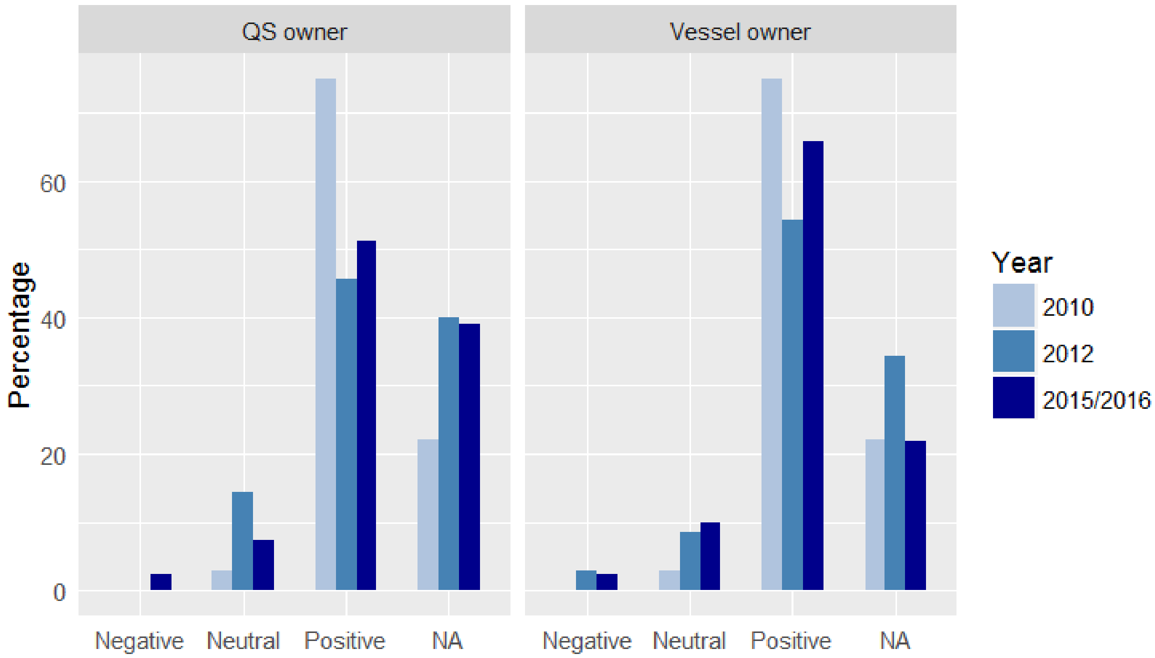


Figure 3-73. Processors' reported quality of relationships with QS owners ("Permit owners" for 2010), and vessel owners. Note: Processors who also identified as a QS owner or vessel owner responded as "not applicable" for this question. Processor responses only (no fishermen). Source: PCGFSS 2017.

In 2010, no processors reported negative relationships with laborers; however, this increased to 12.5 percent in 2012, and it decreased to 5.3 percent in 2015/2016. In 2012, 87.5 percent of those who reported a change in their relationship with laborers explained that the catch share program had led to a lack of work, and that they were losing employees as a result. This was also a concern in 2015/2016, when 66.7 percent of processors reported a change in relationship with laborers. Few processors reported negative relationships with captain/operators (zero percent in 2010 and 2012, and 2.6 percent in 2012).

3.2.2(h)(3) Improvements in Compensation, Job Stability, and Standard of Living

Relative to their role in the commercial fishing industry, respondents were asked to rate, on a four-point scale, ranging from poor to excellent, their job satisfaction, compensation amount, method of compensation, job stability, standard of living, and relationship with co-workers. Figure 3-74 presents the responses to these items for all three years using return respondent data only.[92] Unlike the results in "Changes in relationships" above, these results are not limited to fishermen only or processors only.

[92] Return respondents are survey respondents who participated in all three study years; see Appendix C for more detailed information.

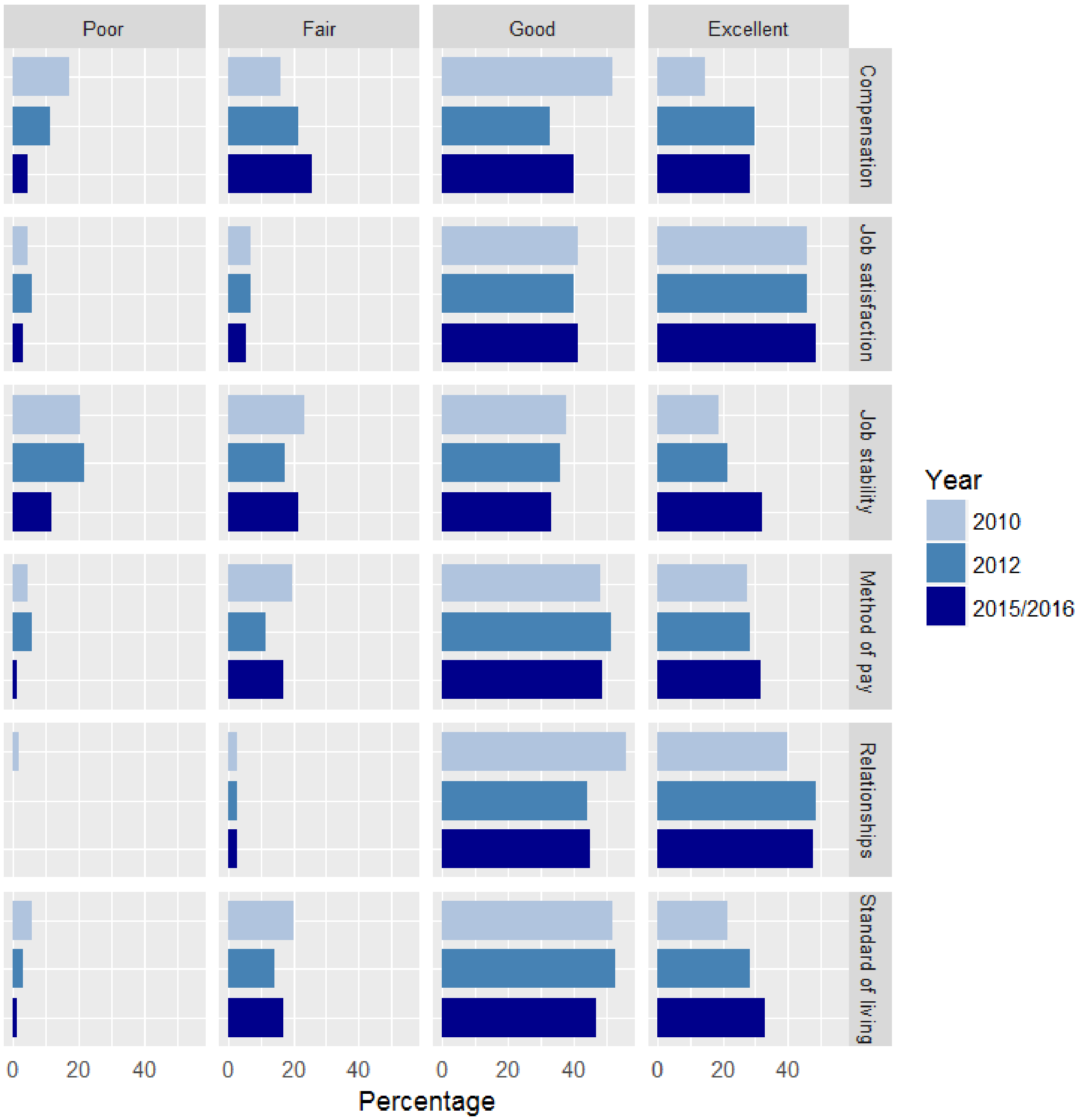


Figure 3-74. Responses to items related to quality of role in the commercial fishing industry. Source: PCGFSS 2017. Note: "Relationships" refers to relationships with co-workers. "Return respondent" data only.

Compensation amount, standard of living, and job stability quality appear to have improved since 2010 to a statistically significant degree.[93] Figure 3-74 illustrates that the percentage reporting "poor" for

[93] To determine the impact of the passage of time on responses related to the changing nature of fishery businesses and jobs, the difference between return respondents (for each item in Figure 3-84) in 2010, 2012, and 2015/2016 was tested using the Friedman test (see Appendix D for full analysis methods). There were significant differences for compensation amount (Friedman=7.85, df=2, p-value=0.02), and standard of living (Friedman=7.20, df=2, p-value=0.03). At a lower confidence level, job stability was also significant (Friedman=4.88, df=2, p-value=0.09).

compensation has decreased since 2010, while the percentage reporting "fair" has increased. Additionally, there has been a shift from "good" to "excellent." For job stability, job satisfaction, and co-worker relationships the percentage reporting "good" has decreased since 2010, while the percentage reporting "excellent" has increased. Job satisfaction has remained relatively constant since 2010, with most respondents reporting "good" or "excellent." Slight improvements in method of pay can also be observed as a greater percentage reported "excellent" in 2015/2016.

These results may differ based on community and role. Section 3.2.2(f), Changes in Employment, indicates that interview respondents report mixed perceptions regarding improvements in job quality. Additionally, Russell et al. (2016) found that communities experienced different results depending on the percentage of QS owners therein, particularly in regard to job satisfaction and standard of living. Furthermore, this analysis was performed on return respondents, who generally have stayed involved through management changes and remained participants in the fishery. Thus, these results suggest that the quality of fishery businesses and jobs (specifically in regards to compensation amount, job stability, and standard of living) has improved for those who have remained in the fishery. To this point, respondents stated the following:

> "The dust hasn't settled yet in this program, but for those of us who have made it this far, I think catch shares will bring some stability. I do think the future's going to be better, but a lot of people had to go away for the last few of us to see a better future, and that's sad." —QS Permit Owner, Monterey Area, 2012.

> "One thing about catch shares is a lot of jobs get lost because the fishery consolidates, and then the jobs that stay are better jobs." —Fisherman, Puget Sound Area, 2015/2016.

This is consistent with Grimm et al. (2012), who indicated that the remaining jobs, after catch share implementation, represent more stable positions with better working conditions.

3.2.2(h)(4) Flexibility

Section 3.1.2(d) discusses flexibility in depth from an economic perspective; flexibility is also discussed by inference in other sections of this review (for example Section 3.2.2.(g)(3)(a), Gear Switching; Section 3.2.2(g)(3)(b), Absentee Quota Holders; Section 3.2.2(h)(3), Improvements in Compensation, Job Stability, and Standard of Living). In general, fishermen said they appreciated the increased flexibility afforded by the catch share program:

> "There is flexibility because you have a whole year to fish that fish, and you can choose whenever you want to fish it." —Fisherman, Newport, 2012.

> "We fish the groundfish when there's not any other opportunity in any other fisheries now. Where before, when it was a month or two month or whatever the length of the trip limit scenario was, you didn't have much flexibility. You had to make your mind up if you wanted to be a groundfisherman or if you're gonna go shrimping, or tuna fishing, or whatever it was you decided to go do, or up in Alaska. You just lost out on those opportunities. Now we can kind of put those opportunities to what would be considered 'dead time' and make a profit those times." —QS Permit Owner, Newport, 2015/2016.

> "I would say, economically, it smooths out the bumps. A big hurdle in business is planning and knowing the future and fishing has always been difficult with that but I would say this program has given them flexibility." —Industry Supplier, Crescent City, 2015/2016.

3.2.3. Entry-Level Participants and New Entrants

Highlights:

- There is a perceived lack of new entrants and young people in the groundfish fishery; new entrants face a cost barrier that may prevent them from entering the fishery.
- Interviewees lamented the extinction of viable avenues to progress from the back deck to owning and running an independent fishing operation. They also expressed concern over a loss of knowledge in the trawl fishery.
- Difficulties in obtaining a loan were among the factors participants believed contributed to the lack of new entrants.
- Interview analysis and quota transaction data indicate that it may be difficult to make and maintain an income by acquiring small amounts of quota. QS transactions usually involve large increments of quota and multiple species (most transactions involved amounts equivalent to over 10,000 quota pounds), thus, there may be little opportunity left in the market for small quota acquisitions.

The sections below contain information on Council policy and entry-level participants, new entry, and retiring fishermen. They also provide information on small vessels and first receivers.

The national guidance on program reviews places special emphasis on new entrants and indicates that the needs of new entrants were to be considered as part of the original program design. The MSA required that "In developing a limited access privilege program to harvest fish a Council or the Secretary shall . . . . include measures to assist, when necessary and appropriate, entry-level and small vessel owner-operators, captains, crew, and fishing communities through set-asides of harvesting allocations, including providing privileges, which may include set-asides or allocations of harvesting privileges, or economic assistance in the purchase of limited access privileges" (MSA 303A(c)(5).

In the development and approval of the trawl catch share program, the Council and the Secretary determined that such assistance was not needed and that a number of program features would likely benefit new and entry-level participants. This section reviews those features in the context of program performance.

3.2.3(a) Council Policy on Entry-Level Participants

The Council has considered entry-level and small vessel owner-operators, captains, and crew. The following elements of the program were designed with impacts on these groups in mind.

- Allocating based on the history of the permit. This allowed new entrants to receive a greater initial allocation than they would if the allocation were based just on their personal history in the fishery (FMP Appendix E, Section A-2.1.1).
- Including an equal allocation component as part of the initial allocation formula for permits. This provision was expected to benefit historically smaller producers (FMP Appendix E, Section A-2.1.3).
- Not including a minimum holding requirement provision. Smaller vessels may have had more difficulty complying with minimum holding requirements than larger vessels (FMP Appendix E, A-2.2.1).
- Specifying a broad class of eligible owners that includes crew and fishing communities. This provided crew and communities with an alternative way to participate in the fishery, invest, and secure income (FMP Appendix E, Section A-2.2.3.a).
- Specifying that the QS/QP be highly divisible. This was intended to facilitate the acquisition of QS/QP in small increments by crewmembers, those who have just entered the fishery, and operators of small vessels (FMP Appendix E, Section A-2.2.3.d).
- Including a set-aside of quota for an adaptive management program. The adaptive management program provided another mechanism for adaptively responding at some future time to address community concerns or create other incentives to benefit the groups listed in 303A(c)(5)(C) or for other purposes (FMP Appendix E, Section A-3).

The first two factors were pertinent for individuals who may have acquired fishing operations, including limited entry permits, just prior to the allocation of quota. Items 3, 4, and 5 have been pertinent since implementation of the program and the start of quota trading January 1, 2014.

3.2.3(b) New Entry

“New entry” is a phrase fishery participants, researchers, and management use frequently, though the definition of new entrant may vary. PCGFSS respondents were not primed with any particular definition of "new entrant" before or during the administration of surveys and interviews; thus, the qualitative analysis of this topic reflects respondents' own definitions.[94] New entry at the level of vessel, permit(s), and quota access and/or ownership was the form most often discussed.

As identified in the qualitative data, the sale and purchase of vessels and limited entry permits have been infrequent since the catch share program was put in place in 2011. Among the three states, there was more discussion of vessel sales in Oregon, followed closely by California, with relatively few mentioned in Washington. While sparse, the most frequent permit and vessel ownership changes appeared to have occurred in Oregon, including one purchase of a California vessel and QS permit. In general, respondents believed that ownership transfers would occur as owners retire. Yet, with a majority identifying unaffordable entry costs, there was concern that large corporate interests would be the only capable buyers (see Section 3.2.2(g)(3)(c)), Consolidation Impacts, and Fishing Heritage, below, for more on this). This prospect of corporatization concerned those who valued the presence of independently-owned fishing businesses.

The cost of QS/catch-history-allocations (CHA[95]) under the catch share program might be considered a new barrier to entry that did not exist before the program. On the other hand, the cost of QS/CHA reflects expected profitability from entry, after considering normal returns expected from any investment. While greater investment is required to enter the fishery, fishermen and businesses have more certainty that they will be compensated for the cost of entry. This certainty was expected to increase new entrants' ability to acquire capital through loans, or to increase their willingness to invest their own capital due to lower levels of risk. Thus, any increase in the barrier to entry caused by the need to acquire QS/CHA would likely be offset, at least partially, by the security of owning the QS/CHA.

To the degree that the cost of QS/CHA is a barrier to entry (independent of accompanying profits), any policy changes that increase profitability in the fishery would likely raise the cost of the QS/CHA and, therefore, would increase that barrier. For example, if electronic monitoring reduces operational costs, the increased profitability would be expected to increase the value of the QS/CHA, benefiting those who had already acquired QS/CHA, while increasing the barrier to new entrants. Long-term increases in ACLs would be expected to have similar impacts.

[94] The code "new entrants" captured discussions about new entrants within the qualitative data (see Appendix C for code definition). The code was applied to 587 segments of transcribed interviews and ranked 8 of 22 codes in terms of frequency of appearance.

[95] CHA is the equivalent of quota shares, but for the mothership fishery.

3.2.3(b)(1) Perception of New Entrants

The scarcity of new entrants in the trawl groundfish fishery was widely viewed as a serious problem by PCGFSS participants. Talk of new entrants focused on the perceived lack of new entrants and young people in the groundfish fishery and the increased costs new entrants face under catch share management. Participants attributed the lack of "new blood" in the fishery to a combination of factors, though the prohibitive cost of vessels, permits, and quota was the most widely recognized. Closely related to costs, the declining prospect of upward mobility (for example, from crew to vessel/permit/quota owner) was seen as another primary deterrent of new entrants, a finding with precedence in the academic literature (Carothers 2015). Other recurring explanations offered by respondents included a perceived weak work ethic among young people and instability of the groundfish fishery (and the fishing industry in general). These explanations echo previously published research on IFQ fisheries (Carothers 2015; Christopher 2008). The following quotes reflect how limited opportunities for upward mobility are seen to have affected the ability to recruit new entrants into the groundfish fishery:

> "It's been something we talk about here all the time. How do we get crew? How do we continue to man these boats? Well …most of the guys on these boats are people I went to high school with, and they're my best friends, and they've been here since the 1970s, and they'll never leave, because we've already paid them well, and they're great guys. When they retire, how do I incentivize new people to come into the fishing industry to live in a little tin can with a bunch of guys, where they can't see their families and they can't go to the movies and they can't have a sick day and they work their asses off and they'll never own the boat?" —QS permit owner, Puget Sound, 2015/2016.

> "Nobody wants to do this anymore. They see the problems, and they see what's happening. It's gone from, like I said, buying a $200,000 boat and going to state and getting a permit, now the boats cost two, three, four million dollars, and the fish also costs a couple two, three million dollars, so who would want to put that much money into something that National Marine Fisheries could say, 'Hey this species is done, and this one's done,' they can take all your fish away." —Fisherman, Astoria, 2015/2016.

PCGFSS respondents expressed concern and empathy toward new entrants, given the struggles associated with new entry and upward mobility in the groundfish fishery. Some remained hopeful that steps could be taken, through management action, industry ingenuity, or market forces, to ease the cost burden of new entry. Others were not as hopeful, for example:

> "The people that have these catch shares, they're either gonna divest or they're gonna lease them. But what's gonna drive the market for that eventually is you need a second generation. So it's something that kind of has to work itself out. Like, sure there's people that see how much the shares are worth and they're gonna complain that they can't just get in, but the market forces are going to by necessity make that have to happen, or else what? There's just gonna be no second generation of fishermen? What are they going to do with their shares, then, these guys that aren't fishing? So the price is going to have to come down for them. You know?" —Fisherman, Puget Sound Area, 2015/2016.

> "There's no way a young person could walk in here and start in this industry. We're watching a kid try to do it right now. He's leasing all his quota and he's not gonna make any money doing it. There's just no way." —Fisherman, Astoria, 2015/2016.

Another reason for concern over the difficulties facing new entrants was the potential for a substantial loss of knowledge about executing the trawl fishery. Captaining a trawl vessel is seen as a challenging job, requiring a set of skills that takes years of experience to develop. The idea of a novice captain in the catch share-managed trawl fishery is potentially frightening for fishing business owners:

> "It's really hard to put a guy on there that doesn't know what he's doing with the way the quotas are too, because he's gotta know the grounds, where things live. Can't ask for a scarier situation than that as a boat owner. It could put the boat out of business just like that." —Fisherman, Astoria, 2015/2016.

> "This has decimated the industry and shut off access to young people. West coast groundfish is not a fishery where a guy can buy a boat, buy a pole, get a license and go out and get something. Knowledge is very important in groundfish, and knowledge about fishing grounds and methods is not being passed down under the current situation. It used to be." —Fisherman, Morro Bay Area, 2015/2016.

Participants expressed the belief that the number of deckhands training to operate trawl vessels has decreased, and some were concerned about a problematic loss of knowledge in the fishery, as noted elsewhere in this report.

3.2.3(b)(2) Cost of New Entry

Interview data suggest that the cost of entry into the groundfish trawl fishery, including the cost of purchasing quota, is high. Participants often depicted it as a serious barrier to attaining ownership status in the fishery. Their guesses regarding the sum required to purchase a trawl-capable vessel, a QS permit, and any additional quota required ranged from approximately $1 million to tens of millions. Although this guess ranged widely, respondents consistently expressed the notion that this cost was a virtually insurmountable hurdle. The following quote from a fishery participant in Newport illustrates the high financial burden of accessing ownership in the trawl groundfish fishery:

> "When we came into the fishery I think it probably affected us negatively in a way. For one, it's hard to acquire. You can't just buy a boat with a trawl permit and go fishing anymore unless you want to spend $2 million. You know? So the cost has gone up a lot. So that creates less opportunity for younger fishermen. I believe that." —Fisherman, Newport, 2015/2016.

Participants tended to focus on the ability to enter the fishery being increasingly limited to those with "deep pockets." Fishing operations with greater access to capital were seen as increasing the market value of permits and quota to a prohibitive degree for fishermen who operate independently. Some study respondents also linked absentee ownership of permits and quota with increased prices and decreased access for new entrants. In the quote below, one Oregon participant contrasted the owner-on-board requirement of the tiered fixed-gear groundfish fishery with opportunity that quota owners in the trawl groundfish fishery have to maintain quota ownership, even after they are no longer active fishery participants, as it relates to new entry opportunities:

> "The idea of catch shares was to make all those fish accessible, but, as implemented, the big players who own catch shares lease them out. These Oregon boats have hired captains and crews—so a person can only be a sharecropper all his life, unless he can come up with $500,000 to $1 million to get into catch shares. At least with the tiered permits, the pounds that go with each tier have an owner-on-board requirement, so when a fisherman gets ready to leave the business, he can sell his permit. That puts permits on the market, and guys can get in." —QS Permit Owner, Coos Bay Area 2015/2016.

The term "sharecropper" was used multiple times to describe the status of non-permit/quota-owning fishermen. As this Coos Bay Area permit owner explains, the status of "hired captain" has become the realistic career ceiling for fishermen without considerable financial backing. A recent study by Szymkowiak and Himes-Cornell (2015) finds the use of hired skippers prevalent in both the Seattle and the Alaska-based Alaska halibut and sablefish IFQ fleets, lending credence to PCGFSS respondents' accounts of this phenomenon in the West Coast groundfish trawl fishery.

Few PCGFSS respondents' involvement in fisheries was limited to just the groundfish fishery, a reality that some took into account when discussing the cost barrier for new entrants. For instance, one Coos Bay participant included the costs of crab and shrimp permits when discussing the overall cost of entry for aspiring fishing business owners:

> "If I was a new entrant, honestly trying to get into this, it would be very scary. A crab permit costs you—for a 65 foot boat—a crab permit could easily cost you $300,000. Easily. And maybe even $400,000, depending on what you find. And then you go tack a $6 or $700,000 groundfish permit on that, and a measly little shrimp permit of $50,000. So I mean that's just for the permits, then you've gotta buy a boat for it to go on. So it's really gonna be difficult for new entrants—I think—to get into this game." —QS Permit Owner, Coos Bay Area, 2015/2016.

In addition to practical concerns, the financial barrier to entry in the groundfish fishery elicited a moral objection among many interviewees. QS owners and non-owners alike lamented the extinction of viable avenues of progression from the back deck to owning and running an independent fishing operation. Many study respondents idealized this progression, and some saw its erosion as a dire sign for the future of the groundfish fishery and commercial fishing in general.[96] The following quotes reflect these concerns:

> "The 10% that are still fishing are safer because they got a lot of money to buy all this shit, but for the guy that wants to get into this fishery, the implementation of catch shares has made it so that the boat that used to be worth $200,000 and the permit worth $75,000, is now worth $2.7 million, and the person who wants to get into the fishery needs to have a millionaire backing to get into the fishery because the fishery is locked out to everybody now except for the people who are already in the fishery and who have been handed the rights to these natural resources. It's a crime." —Fisherman, Newport, 2015/2016.

> "I am a strong believer in equal opportunity, and what happens is over a period of time, resources become more restricted for others to get into it, to have an opportunity. It's not your fault you're 25 years younger than me and want to be in the fishing industry. You should have that right to an opportunity, as I did." —Processor, Oregon, 2015/2016.

The concern over the cost of new entry in the trawl fishery finds parallels in the academic literature, as does the concern over decreasing entry opportunities (e.g., Donkersloot and Carothers 2016; St. Martin 2007; Bromley 2009). In their review of literature on catch share fisheries, Carothers and Chambers

[96] Though the focus of the PCGFSS was the West Coast Groundfish Trawl Fishery, respondents were often either involved in, or aware of, other IFQ-managed fisheries, and they recognized rationalization (and the accompanying dynamics of quota ownership) as a growing trend in United States fishery management.

(2012) found that rationalization tends to diminish career options severely for crewmembers and new entrants who lack capital. In a more recent study, Carothers found that in-community access for young/new entrants is greatly limited by a financial barrier in Alaska IFQ fisheries (Carothers 2015). Lowe and Wilson's findings echo this concern about losing local participation (Lowe and Wilson 2012).

3.2.3(b)(3) Entry Investment: Loans and Debt

Along with the high cost of entry described by interviewees up and down the coast, some brought up the related issue of loan procurement. Difficulties in obtaining a loan were among the factors respondents believed were contributing to the lack of new entrants. Apart from the sheer size of a loan required to obtain the necessary assets, respondents, like the Astoria fisherman quoted below, also highlighted the uncertainty and risk associated with commercial fishing as a deal-breaker for financial lending institutions.

> "Who wants to go in debt like that? That's like buying a new car and not buying insurance, then wrecking your car. The financer, he doesn't understand why you're not paying the payment. When you buy a $2 million boat, $3 million dollars-worth of buying [inaudible], and some little red fish swims in and you're out of business, the bank doesn't understand why you're not paying the payments, so, you know. It's scary for the younger generations." —Fisherman, Astoria, 2015/2016.

Study respondents viewed commercial fishing as an inherently risky industry, and many saw the level of individual accountability introduced by catch shares as increasing that risk. As the quote above indicates, there are two new sources of risk involved with participation in the trawl groundfish fishery under catch shares: the need to attain (through lease or purchase) fish quota without a guarantee of a return on the investment and the possibility of income loss due to catch-quota imbalances. Considering these risks, as well as concern voiced over young fishermen not learning requisite captaining skills, the uncertainty surrounding new entry may be excessive for would-be new entrants and lending institutions alike. In line with this conclusion, Carothers (2015) and Lowe and Wilson (2012) identify uncertainty and risk as key deterrents of new entrants in their studies of Alaska IFQ fisheries.

While the economic assessment of the fishery finds that vessels are making a profit (see Section 3.1.2(a)), a number of study respondents suggested that the trawl groundfish fishery is not profitable enough for new entrants to justify buying into it. This assertion was influenced by several factors outlined in the rest of this section, with rising costs and instability, particularly relative to quota allocations and the potential for disaster tows, being chief among them. The following quotes highlight this sentiment:

> "All of these rules and regulations all cost money; the observers cost an insane amount of money. Those guys are making more money watching than the crew is working, and that's become a huge issue." —Processor, California, 2015/2016.

> "It's unstable for the fishermen too. In the last few years a couple of the younger guys, deck hands, bought boats and now they can't make the payments. When that happens, in any fishery, a richer guy buys the permit of the poor guy, stacks it, and the rich get richer and the poor get poorer." —Industry Participant, Morro Bay, 2015/2016.

Findings from the 2012 round of the PCGFSS indicate that concerns about the profitability and stability of the trawl fishery pre-date the implementation of catch shares (Russell et al. 2014). Participants associated this lack of stability with management actions aimed at reducing harvesting pressure, such as the 2003 buyback and quota reduction for various species.

3.2.3(b)(4) AcquiSition of Small Amounts of Quota as a Way to Make an Income

Since the implementation of catch shares, there was an expectation, described in the Amendment 20 EIS, that the shoreside IFQ system might provide crewmembers and others with an opportunity to work their way up and become owners through the gradual acquisition of QS. This expectation was based on at least two assumptions: first, QS might be acquired in small increments; second, the purchasers of such QS would be able to make money and speed their accumulation of capital by leasing QPs.

In summary, PCGFSS participants' comments about new entrants revealed significant challenges for those seeking to access the groundfish trawl fishery, resulting in some respondents exploring alternative avenues to entry. Given that study respondents reported high costs associated with the purchase of a QS permit, it is necessary to reassess the expectation that one could make and maintain an income by acquiring small amounts of quota. See Section 3.1.1(b)(4), Quota Market Performance, and Section 3.1.2 (a)(2), Quota Leasing Activity, for more information on the cost of quota. While this question was not specifically asked during the PCGFSS study, a related query into whether a person could accomplish the same ends by acquiring a trawl permit without quota and leasing QPs is worth exploring.

The potential for purchase of small amounts of QSs was not specifically identified as a path to ownership or entrance into the groundfish fishery. However, a vessel captain investing in a business or could be a possible alternative to purchasing small amounts of QS on an individual level.[97]

[97] The quota acquisition theme occurred across all communities through analysis of the "cost," "new entrants and graying" codes and the subcodes "leasing" and "transfer of ownership." "Cost" occurred 962 times (rank 3 of 22), and "new entrants and graying" occurred 587 times (rank 8 of 22). See Appendix C for full methodology.

> "Usually they'll buy a minority ownership so that they're part of the system. Maybe five to ten percent ownership of some of the boats or something like that…" —Industry Participant, Puget Sound Area, 2015/2016.

Affordability of QS, along with its availability (coded within "Cost" and "New Entry"), was one of the most frequently discussed topics throughout the field research, with most respondents reporting that shares were unaffordable for new entrants or individuals. Similar perceptions of financial barriers for the next generation or upwardly mobile crew were also reported in Alaska by Carothers (2015).

Complicating affordability issues for crewmembers is the fact that QS transactions generally occur in large increments. Most transactions involve multiple species, and most transactions from 2014 through 2016 (87 out of 91, or 96 percent) involved amounts of QS equivalent to more than 10,000 pounds of QPs (when the QS each species is converted to a QP equivalent, based on the trawl allocation for the year, Table 3-131). When species within each transaction are individually evaluated, the proportion exceeding 10,000 pounds declines to just under 90 percent (779 out of 876). Additionally, for most species, the trawl allocation is under-harvested by more than 50 percent, with only four species accounting for greater than 50 percent of the trawl allocation taken in more than one year: whiting, arrowtooth, sablefish north, Petrale sole, and shortspine north (see Section 3.1.3(a), Utilization, for more discussion on allocation attainment). This situation creates higher market demand for these species, which influences their price and availability. The minimum size of a QS transaction involving at least one of these species was the equivalent of 134,668 QPs (including all species that were part of the transaction). Within the multispecies transactions, the minimum QS transfer of any one of these species was the equivalent of 3,487 QPs. Thus, for the species most likely to be needed by harvesters, the trading blocks are much larger than trading blocks that do not include those species.

Table 3-131. Non-whiting QS transactions[1] converted to poundage equivalents based on each year's trawl allocations. Source: PCGFSS 2017.

	Single Transactions				**Single Species Within Transaction 2014 to 2016**
	2014	**2015**	**2016**	**2014 to 2016**	
	Counts				
Total Transactions/Transfers[2]	11	58	22	91	876
Total > 5,000 lbs					837
Total > 10,000 lbs	11	54	22	87	779
	Poundage Equivalents for All Species in the Transaction				
Minimum	153,591	3,019	10,632	3,019	2
	Poundage Equivalents for Species With >50% Attainment in >1 Yr (Arrowtooth, Sablefish North, Petrale, or Shortspine North)				
Minimum Pounds	3,607,781	134,668	899,953	134,668	3,487
Average	67,893,149	71,444,177	43,789,578	66,169,260	273,699

[1] A single transaction may include multiple species
[2] Minimum poundage equivalent was more than 3,000 pounds.

Vessels that are using more QP than they can acquire from their own QS holdings (because of QS control limits) must acquire QP from others, and, therefore, might be more likely to provide a market for crew-owned QS. QP limits are generally set between half and twice the control limits (Council and NMFS 2010). The number of vessels achieving 90 percent of their QP limits provides an indicator of the species for which vessels are most likely to need more QPs than a single entity could secure through QS ownership. Section 3.1.1(b)(1)(A) shows that the most instances of vessels achieving 90 percent of their use limit (10 or more instances) occur for two of the most fully utilized species (sablefish north and Petrale sole) and for shortspine south.

If these transactions reflect what is offered on the market, then opportunities to acquire small amounts of quota would be limited. Yet one Washington fisherman foresees other market forces' eventual influence on quota prices:

> "Sure there's people that see how much the shares are worth and they're gonna complain that they can't just get in, but the market forces are going to by necessity make that have to happen, or else what? There's just gonna be no second generation of fishermen? What are

> they going to do with their shares, then, these guys that aren't fishing? So the price is going to have to come down for them." —Fisherman, Puget Sound Area, 2015/2016.

3.2.3(b)(5) Leasing QPs

While the viability of acquiring small amounts of QS may be in question, purchasing a trawl permit without quota and leasing QPs might be a feasible alternative. Participants' assessments of this alternative were mixed. Some believed leasing prices were too high to sustain an income, while an industry participant from California shared a contrary perspective:

> "Permit values have come down. And quota pounds' values are pretty low. So somebody can, actually, enter the fishery fairly easily now if they can acquire a permit and buy some quota pounds. They may not have shares." —Industry Participant, Eureka, 2015/2016.

For others, the overall catch shares costs were prohibitive for new entrants:

> "The high costs of participation in the IFQ fishery make it tough for existing fishermen to stay in, and drives away potential new entrants." —Industry Participant Fort Bragg Area Public Hearing, 2016.

> "The way it's set up now, no new people can get into the business because it's too damn costly because you've gotta buy permits and so on." —Processor, Oregon, Public Hearing 2016.

The challenges of entering into the groundfish trawl fishery by way of purchasing small amounts of QS may be more than new entrants are willing to take on, but taking advantage of the gear switching option could be a more feasible strategy as one Oregon fisherman has done:

> "We don't own trawl quota. We just bought a trawl permit so we can lease trawl quota. So we don't own any, basically. We just lease the trawl quota. But we own a trawl permit." —Fisherman, Coos Bay Area, 2015/2016.

This analysis identified alternate paths for entry into the Pacific Coast groundfish trawl fishery that have evolved over the five years since implementation of the catch share program. While there are possible entry points into this fishery, the main barrier to ownership and entry identified by respondents across all research communities was cost, cost of QS acquisition, and cost of operating within the program itself.

3.2.3(c) Fishing Heritage

Highlights:

- Across all years, over half of interviewees came from families with multiple generations of fishing activity.
- The rise in average age of the fishing workforce (commonly referred to as "graying of the fleet") is seen as a threat to the future of the fishing industry on the West Coast. Coupled with low recruitment rates of young entrants into fishery-related careers, there is concern about how this might change the groundfish fishery.
- Many QS owners intend to keep their permits and lease out QPs as a means to secure a retirement income, as opposed to selling their QSs outright for a one-time payment.
- A family connection appears to contribute strongly to success in the industry.
- The whiting fishery and fisheries in Newport, Oregon, appear to be exceptions to the increase in average age of the fishing workforce.
- Study respondents discussed consolidation relative to retirement and new entry, and they generally regarded the catch share program as a hindrance when transferring ownership from one generation to the next.

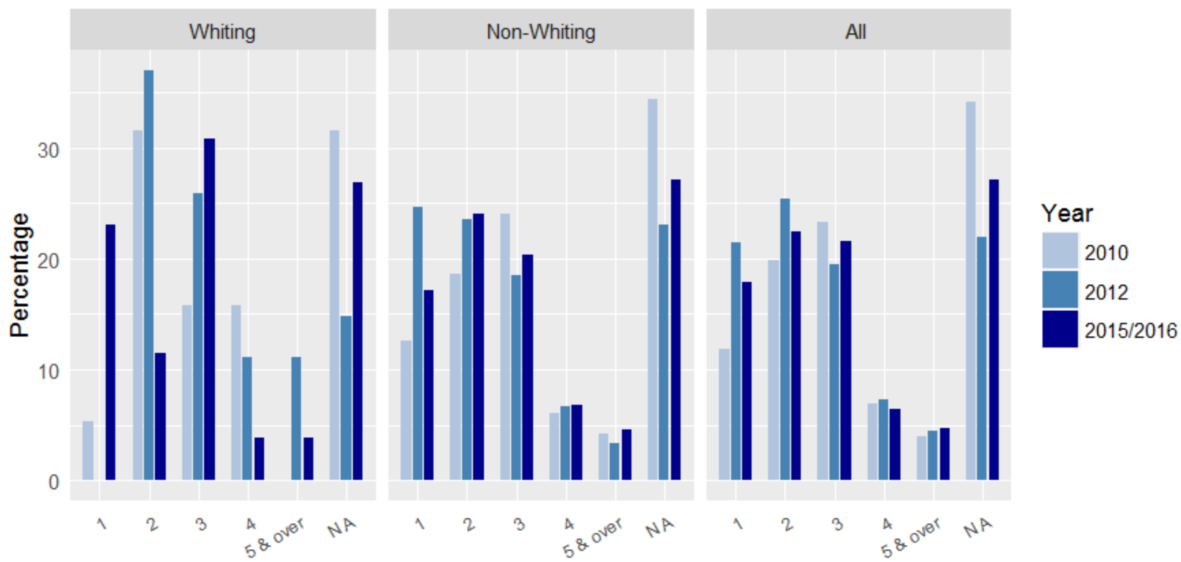
Many fishermen come from generations who were trained by their elders (Miller and Van Maanen 1979). As fisheries management has changed, commercial fishing as a livelihood has changed. This section explores generational fishing history, including differences between the whiting and non-whiting sectors. This can be cross-referenced with Section 3.2.2(g)(3)(c)), Consolidation Impacts, which discusses exit from the catch share fishery, as well as Section 3.2.2(c), Changes in Infrastructure, which touches on losses of suppliers with no succession planning.

3.2.3(c)(1) Generational Fishing History

Miller and Van Maanen (1979) discuss "intergenerational continuity" in fishing families and how, in the past, fishing was seen as a family tradition, where younger family members were trained to replace older generations. The PCGFSS collected information on family fishing history during all years of data collection to explore whether commercial fishing is still a tradition in some families. Across all years, more than half of the respondents came from fishing families that had been active for multiple generations (Table 3-132). Figure 3-75 shows the number of generations respondents reported their families had been fishing. Understanding this history is important when looking forward to the next generation of fishermen.

Table 3-132. Percentage of respondents reporting that their family had participated in commercial fishing for more than two generations. Source: PCGFSS 2017.

Description	**2010**	**2012**	**2015/2016**
All respondents	57.1	76.2	57.7
Whiting	66.7	85.2	53.8
Non-whiting	56	74.9	58.2
NA/PNA	0	0.5	0
RR	98.5	98.1	99.1



Notes: Sorted by whiting and non-whiting. All respondent data. Response Rate (RR): 2010= 98.1 percent, 2012=97.6 percent, 2015/2016=97.3 percent.

Figure 3-75. Number of generations that respondents' families have participated in commercial fishing (horizontal axis). Frequency on vertical axis. Source: PCGFSS 2017.

3.2.3(c)(2) Aging of the Fishing Workforce

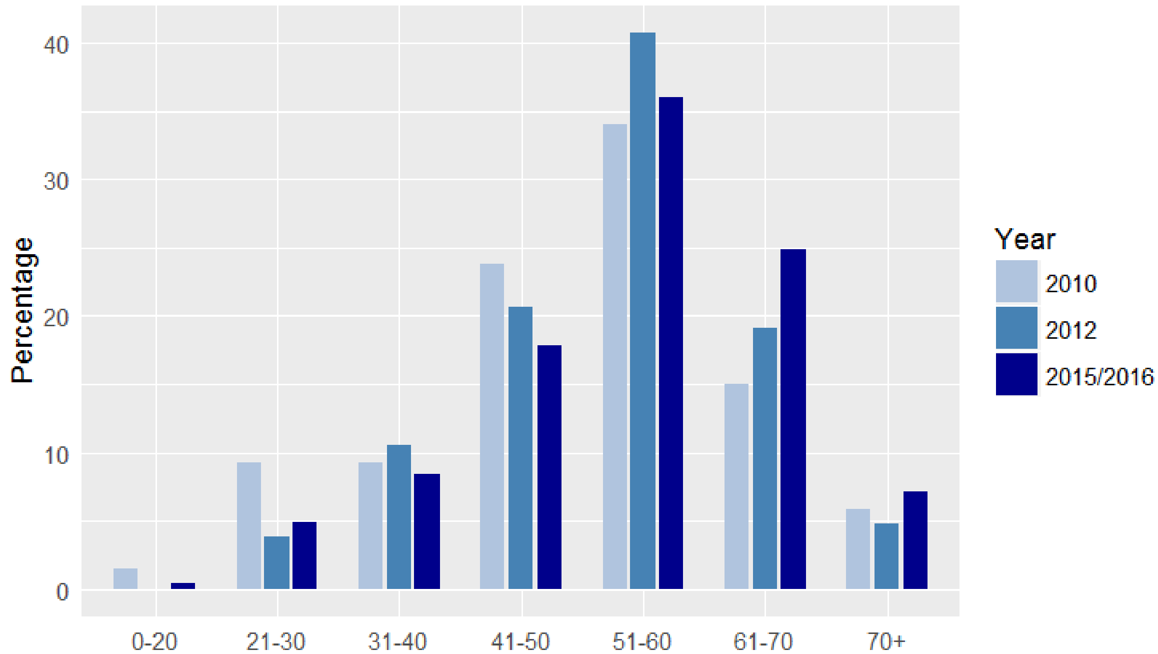
The rise in the average age of the fishing workforce is seen as a threat to the future of the fishing industry on the West Coast. Coupled with low recruitment rates of young entrants into fishery-related careers, stakeholders are concerned about the changing nature and future form of the groundfish fishery (Russell et al. 2014).

In general, reasons for graying of the fleet may include an ongoing decline in the number of small-scale fishing operations (Andreatta and Parlier 2010), shifts in the relative attractiveness of fishery-related jobs in comparison to other careers (Stimpfle 2012; Pascoe et al. 2015), weakening traditions of family succession into the fishery (Russell et al. 2014; Messick 2015), and higher entry costs due to limited entry approaches to fishery management (Rosvold 2006).

The conclusions presented in this section build upon results shared in *An Initial Theme Report* (Russell et al. 2014), in which the increase in average age of the fishing workforce was a major theme. The study indicated that most harvesters in the Pacific Coast groundfish fishery are approaching retirement age and may exit the fishery in the next 10 to 15 years. Further, there does not appear to be an equivalent population of younger fishermen to replace those retiring (Russell et al. 2014), with the exception of the whiting fishery, explored later in this section.

Conclusions from the 2015/2016 PCGFSS support results of the 2010 and 2012 surveys. If respondents within each study year had been the same, it would be expected that they would age with each successive study year. However, not all respondents within each study year are the same. The PCGFSS methodology (Appendix C) targeted all groundfish trawl respondents in order to track changes in the social composition of the fishery over time. This allows analysts to capture variances in age distribution, such as younger people entering the fishery.

Most respondents are more than 50 years old (Figure 3-76). For 2015/2016 respondents, a greater percentage of respondents are in the 61 to 70 age range than in other years (24.9 percent). Few respondents are younger than 31 years old (2010=10.7 percent; 2012=3.8 percent; and 2015/2016=5.3 percent). For all respondents, there has been a slow but steady increase in the number of respondents falling into the over-50 category with each data collection effort (2010=54.8 percent; 2012=64.6 percent; and 2015/2016=68 percent). Additionally, most reported that they have been fishing since they were younger than 20 years old (2010=61.4 percent; 2012=61.6 percent; and 2015/2016=57.7 percent). Data indicate few respondents younger than 20 (Figure 3-76). This trend is supported by interview data as the correlating code occurred above average in the interviews (see Appendix C for full analysis methods).



Notes: NA/PNA: 2010=1.5 percent, 2012=01.0 percent, 2015/2016=0.4 percent; RR: 2010/2012=100 percent; 2015=99.6 percent.

Figure 3-76. Age distribution of respondents. Source: PCGFSS 2017.

One participant described the future of the groundfish trawl fishery:

> "Fishermen that are usually trawlers end up just going away or getting old, and they get old and they retire, and there's no one willing to step up and take over. There's no new blood coming into the industry the way it's set up now because trawling is the least profitable of the fishing for the fishermen because of all of these things that exist." —Processor, California, 2015/2016.

> "Another thing I don't like about the IFQ is there's no young kids coming into the industry. Most of the captains are in their 50's and 60's and the crew are in their 30s-50s. There's not many young kids." —Fisherman, Astoria, 2012

While these responses are consistent coastwide, some respondents indicate that one community, Newport, appears to vary from the majority. These respondents state the following:

> "If you just look at the owner, yeah maybe the owners are getting a year older every year. But if you go down to the docks, you're gonna see tons of young guys. On our boats the relief captain is a young guy. He's got two little kids and you know the plan is he'll be the next captain. There's young guys on both boats. There's young guys at all the support businesses that we mentioned. There's young guys in every one of those businesses,

> whether they're sons of the owners or they're not, there's young guys in every one of those businesses… The plant manager at Pacific, he's on a path to retirement at some point and there's kind of a guy they've pegged, a young guy. So I don't see – there's kind of a big deal made of this graying of the fleet but not in our port, I don't see that. I see lots of young guys." —Industry Participant, Newport, 2015/2016.

> "We're dealing with young people all the time now, and anybody under 30 is young to me. Some of them are experienced in fishing, and a lot of them aren't, but they want a chance to fish, so I try to explain what it involves." —Fisherman, Newport, 2015/2016.

For most, however, these results suggest the view that there may be barriers to entry for new participants and younger generations. In a mixed-methods study of fishery participants in Kodiak, Alaska, Carothers (2015) also reported such a situation. For instance, one quota owner in Carothers (2015) stated the following,

> "We're an aged, aging fleet. When a bunch of us die, I don't know if turning over that QSs is going to be a positive effect cause I think it's gonna have to disperse—I don't know how many young guys have a cash flow to buy into it" (Carothers 2015, p. 317).

Participants in New Zealand also thought that the quota management system made it more difficult for the young to enter (Dewees 2008). Symes and Phillipson (2009) explain that young people are turning to other forms of employment to avoid the insecurity of the fishing industry. Barriers to entry are discussed in more detail in Section 3.2.3 (b), New Entry. These barriers may contribute to the graying fleet; conversely, graying of the fleet may reinforce barriers to entry. To elaborate on this, 2015/2016 interview data suggest that many QS owners intend to keep their permits and lease out QPs as a means to secure a retirement income as opposed to selling their QSs outright for a one-time payment:

> "I don't see the quota turning over. I see it evolving into, sort of, a renter's fishery." —Industry Participant, Puget Sound Area, 2015/2016.

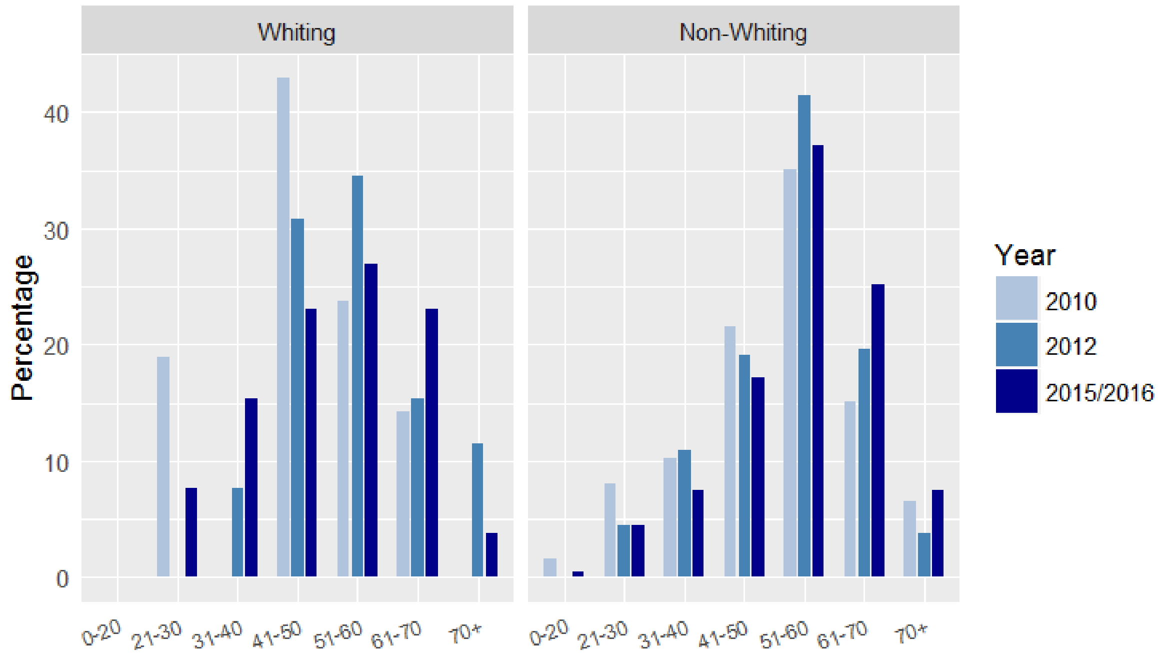
> "I see people getting older, and from my experience—hopefully we can limit this—but it looks like it's gonna be—people getting older and leasing out their quota. They're not gonna sell it; they're gonna lease it of course. …They're older, and that's their retirement. And I understand that, because they've paid millions and millions, so they're gonna lease it." —Fisherman, Half Moon Bay, 2015/2016.

The lack of a younger replacement generation may have substantial impacts on the fishery, particularly in regards to a loss of knowledge and experience (Russell et al. 2014). For instance, one participant states the following:

> "It was a process of learning by doing, but now, we don't even have the people to pass it on to! You know, we had people that were on deck for 15-20 years, and worked their way up to being a skipper if somebody else's boat or even bought their own boat. But we don't have those people in the industry today. And how in the hell, and that's the saddest thing about the whole thing!" —QS Permit Owner, Fort Bragg Area, 2012.

Although the loss of knowledge was frequently mentioned in interviews, in 38 instances, fishermen reported plans to pass along their knowledge or assets to family members or to encourage their children to pursue a career in the fishing industry.

The whiting fishery appears to be an exception to the aging of fleet (Figure 3-77). This figure compares whiting to non-whiting participant data. The percentage of those over 50 years old in the whiting sector increased from 2010 (38.1 percent) to 2012 (61.5 percent) and decreased in 2015/2016 (53.8 percent). Conversely, the percentage of those in the whiting sector who are younger than 50 years old decreased from 2010 (61.9 percent) to 2012 (38.5 percent) and increased again in 2015/2016 (46.2 percent). In contrast to the non-whiting sector, these observations reflect an increase in younger participants. For the non-whiting sector, in all years, the percentage of participants older than 50 years of age consistently rose (2010= 56.7 percent, 2012=65 percent, and 2015/2016=69.8 percent). In 2010 and 2015/2016, the average age of participants is lower for whiting than non-whiting (Table 3-133).



NA/PNA: 2010=1.5 percent, 2012=01.0 percent, 2015/2016=0.4 percent; RR: 2010/2012=100 percent; 2015=99.6 percent.

Figure 3-77. Comparison of age distribution by whiting and non-whiting sectors. Source: PCGFSS 2017.

Table 3-133. Mean age of study participants by sector. Source: PCGFSS 2017.

	Mean	Median	SD
2010			
All respondents	50.79	52	13.71
Whiting	47.95	48	12.52
Non-whiting	51.12	52	13.84
2012			
All respondents	52.88	55	11.46
Whiting	52.46	54	10.86
Non-whiting	52.66	55	11.55
2015/2016			
All respondents	54.24	57	12.23
Whiting	51.46	52.5	13.49
Non-whiting	54.61	57	12.05

Therefore, while the whiting fishery still has challenges under the catch share system, it may be more appealing for younger people. A whiting fisherman said the following:

> "I've actually got a pretty young crew. Let's see...they're from 29-49. Okay, so there's a little bit of a range obviously, yeah. Three of the guys are 34 and under." —QS Permit Owner, Astoria, 2015/2016

Some non-whiting respondents said:

> "The Washington, the Oregon boats they got more young people, they have more business than we have over here...." —QS Permit Owner, San Francisco, 2015/2015

> "I'm not encouraging my kids… My kids are going and doing something else."—Fisherman, Crescent City, 2015/2016.

> "I think they are just getting out of the industry, and they're …it's dying out because they aren't putting their kids into it. They say to their kid: 'No, no, you don't want to do this. You want to do something else.'" —Industry Participant, San Francisco, 2015/2016.

A researcher working with another participant clarified: "…you're a second generation fisherman?" The participant responded as follows:

> "Yeah. And my son will not be. I took him…he fished with me for two or three years in the summer, and it didn't bother him any. I just said, 'the future isn't looking real good.'" —QS permit owner, Astoria area, 2015/2016.

The researcher further clarifies "so you kind of advised him to look elsewhere?" The participant responded:

> "Yep, to pursue something else."—QS Permit Owner, Astoria Area, 2015/2016.

> "This is the third generation. Our nephew is running one of our boats right now. None of my kids…I have four kids, and none of them are interested except for my daughter. …(she works with) the paperwork side. That's what it has gotten to be. It didn't used to be like that, but it takes quite a bit to keep up when the permits come out and the shares." —QS Permit Owner, Astoria Area, 2015/2016.

A smaller group of respondents have indicated otherwise, as follows:

> "We're a fishing family. We invest together. I'm lucky I got my father and mother, you know they were willing to invest in us and go in partners, take that risk and go in partners with me and [name omitted] and buyin' a boat. And besides the cost of everything, I mean to get into this fishery for a young guy, you know it's almost imposs— it's impossible

> unless you have, unless you have already had one foot in the door, which we did." —QS Permit Owner, Newport, 2015/2016.

> "My son-in-law is working for me. He is managing our IQ's and going to meetings and stuff, so he's the next generation. He's not fishing; he's doing the administrative stuff, so he's participating in that way." —QS Permit Owner, Newport, 2015/2016.

Two Newport fishermen (2015/2016) were interviewed, and they make some interesting points that may provide clarification:

> Fisherman 1: "Almost every young person I know has their parent buying them a boat."
>
> Fisherman 2: "Yeah, I mean, you can't get a boat and go fishing nowadays."
>
> Fisherman 1: "Yeah, you can't even really work hard on a boat, save up your money, and buy a boat like you used to."
>
> Fisherman 2: " …you need the money. It's just too expensive."
>
> Fisherman 1: "So unless you have a connection, you're kind of screwed… a family connection or somebody that has a lot of money that trusts you."

A family connection appears to be key to success in the industry. Whether quota, vessels, or other resources are passed down through familial ties to help buffer costs, or just familial support, the mere relationship to, and knowledge of, fishing may be vital to future generations staying in the industry.

3.2.4. Small Vessels and Vessels Leaving the Fishery

Highlights:

- Observer and leasing fees present a challenge to small vessel owners. Therefore, small vessels may no longer be an avenue to new entry.
- Participants discussed small vessels as becoming more reliant on other fisheries, such as crab and shrimp, in order to offset their diminished revenue in the groundfish fishery. Some also mentioned that small vessels have left the fishery, either by leasing out their quota, or by selling outright.
- Astoria /Tillamook lost the greatest number of large and small vessels that were active in the trawl fishery during 2009 and 2010, followed by Washington.

The MSA requires consideration of entry-level fishermen, specifically small vessel owners, and crewmembers (NMFS 2007). This section discusses small vessels as an avenue for new entry. As the loss of small vessels may affect new entry opportunities, this section also highlights impacts on small vessels related to catch shares.

Exit and rationalization are expected outcomes of IFQ systems; however, the academic literature has suggested that impacts are not evenly distributed among all fishery participants, and they may result in excessive reduction in capacity (Allen 2014; Carothers 2008; Stewart 2006; Yandle and Dewees 2008; Copes and Charles 2004). For instance, following ITQ implementation in Iceland, many vessel owners dropped out, most of which were the smallest operators (NRC 1999). Stewart et al. (2006) also found a similar trend when surveying those who had exited the New Zealand fishery. Many QS programs, including program analyzed here, have included provisions to protect small vessels and businesses (NRC 1999).

In the 2015/2016 interviews, respondents discussed impacts of the catch share program on small vessels.[98] Participants mentioned that observer and leasing fees presented a challenge to small vessel owners. One fisherman explained as follows:

> "…$500 to a smaller dragger is a whole lot different than $500 to a guy bringing in 70,000 pounds…" — QS permit owner, Astoria, 2015/2016.

An observer also noted the impact on small boats, stating the following:

> "Every little bit mattered to him, and it was a small 45-foot trawler, maybe 52, but little for a trawler, maybe our smallest. …. only two deckhands. One of them sleeps on the floor because they only have two bunks… he can't go out when the weather's bad, so he tried to keep everything in proportion and quit, and now he's got to pay for an observer, and I don't know how much longer he'll be able to make it. If he has a good season and he guesses right, and he keeps maximizing that paycheck, it's great, but if there's a drop in black cod percentage or if the price of Dover goes down, then he has a hard time, and it would be a real shame to see those guys with the little boats go out of business." — Observer, Oregon, 2015/2016.

> "Catch shares are generally nice for the guys who get a large quota allocation, but not for anyone else. The whole program is geared to put the small guy under. Even in a small community, fisheries are a big employer, and in some cases the backbone of the community. That means the damage is done not to the fishing industry but to the community as a whole." —Morro Bay Area, Fisherman, 2012.

[98] While "small vessels" was not one of the most prevalent codes, respondents provided enough information to gain insight into the complexity of the topic. The 2015/2016 code "small vessels" was applied 248 times (rank 14 out of 22 codes).

These results suggest that small vessel owners may find it more difficult to remain profitable in the fishery. Therefore, small vessels may no longer be an avenue to new entry. One fisherman explains, as follows:

> "I can go up as far as I can go and run a boat, but after that, it's very difficult to become an owner of your own business in this industry now, unless you downsize, buy a smaller vessel, but you do that, and you're not going to make as much money. In a smaller boat, you might salmon fish, tuna fish it." —Fisherman, Newport, 2015/2016.

Despite the costs and barriers, it was mentioned that there are a few entry-level small vessel owners:

> "There's a couple guys. …There are a few that are up for the challenge or whatever you want to call it. They're getting into it, but it's not as easy because of the costs and you have to have a license for just about everything. Except for tuna, you don't really…you could buy a boat and start tuna fishing." —Fisherman, Westport, 2015/2016.

As a result of the catch share program, small vessel owners may increase vessel size, reduce their activity in the groundfish fishery, lease out their entire quota, or sell out of the fishery completely. Although respondents rarely mentioned purchasing larger boats, some felt the pressure to do so in order to remain viable:

> "I'm currently in the process of trading, bartering the other boat because they say to stay in the trawl business, you gotta get bigger. So that means to get bigger, I have to put a mortgage on my home in order to get bigger, so I'm gambling there. This is not right. This is not right, so I feel that, you know, the…when I'm a small dragger trying to do a $1000 a day, fishing with 25-year old fish prices. Twenty-five-year-old prices, when I'm out doing a grand a day, I can make a few bucks a day as an operator. So why do I have to give 50% of that, $500, to an observer fee? Do the math. You know, it's just not right. It's just not right." —QS Permit Owner, Astoria 2015/2016.

More often, respondents discussed small vessels as becoming more reliant on other fisheries, such as crab and shrimp, in order to offset their diminished revenue in the groundfish fishery. Some also mentioned that small vessels have left the fishery, either by leasing out their quota, or by selling outright:

> "There have been a lot of boats that have left the fishery. The smaller draggers, specifically, I've seen them just go do something else. If they have groundfish permits, they'll lease them out. I know a couple of them that have actually sold their groundfish permit because they couldn't catch enough to make a living on it. I know a lot of those." —Fisherman, Newport 2015/2016.

To supplement PCGFSS interview data, NMFS analyzed PacFin vessel data between 2010 and 2016 with the goal of identifying potential changes in the number of small (59-foot or less) vessels participating in the fishery.[99] Data were sorted by type of participation in the fishery, including shoreside whiting, shoreside non-whiting, and gear switching. These categories are not mutually exclusive; some vessels may appear in multiple categories, though the amount of overlap is generally small (Table 3-134). When considering all vessels, regardless of participation type (coded as "All" in Figure 3-89), the number of small vessels fluctuates between 30 and 40. When grouped by the type of participation (i.e., shoreside whiting, shoreside non-whiting, or gear switching) there is a noticeable drop (61.8 percent decrease) in the number of small shoreside non-whiting vessels between 2010 and 2011; the number of vessels does not return to 2010 levels in the years following 2011 (Figure 3-78). This trend, however, is not unique to small vessels. The number of 60-foot to 79-foot and 80-foot to 99-foot non-whiting vessels also drops between 2010 and 2011 [75.5 percent decrease for 60-foot to 79-foot vessels; 50 percent decrease for 80-foot to 99-foot vessels.]

99PacFin fish ticket data was accessed February 2, 2017. Pacific States Marine Fisheries Commission, Portland, Oregon, (www.psmfc.org). Kit Dahl provided fishery codes per the March 28, 2013, PacFin Groundfish Sector Criteria (http://pacfin.psmfc.org/wp-content/uploads/2015/10/PacFIN_groundfish_sector_codes.pdf). Abbreviated fishery definitions are as follows: Shoreside Whiting Sector = Whiting (PWHT) RWT >= 50 percent% total vessel-day-gear RWT, valid trawl endorsement. Shoreside Non-whiting Sector = Whiting (PWHT) RWT < 50% total vessel-day-gear RWT, non-whiting groundfish (sp.mgrp=GRND and sp.spid <> PWHT) RWT >= 50% total vessel-day-gear RWT, Groundfish (sp.mgrp=GRND) RWT > California halibut (CHLB, CHL1) RWT, Pink shrimp, ridgbeback prawn, or spot prawn (PHSP, RPRW, SPRW) RWT < 100 lbs., and valid trawl endorsement. Gear switching = Gear Group not TWL, IFQ landing flag (ifq_landing) = 'Y'. RWT= round weight tons. See http://pacfin.psmfc.org/wp-content/uploads/2016/06/PacFIN_Comprehensive_Fish_Tickets.pdf for full descriptions of acronyms.

Notes: "All" represents all boats in the fishery and does not distinguish between type of vessel. Shoreside whiting, shoreside non-whiting, and gear switching are not mutually exclusive categories.

Figure 3-78. PacFin vessel data from 2010 to 2016 by vessel size and type.

As noted above, the number of vessels active in a fishery are expected to diminish in a catch share based fishery. Vessels that stop participating in the fishery may continue to fish in other fisheries, may lease out their groundfish quota to others, or may combine these strategies. These efforts can help compensate for the loss of income from the trawl program and maintain activity in communities that depend on them.

Table 3-135 shows that, of the 127 vessels that made shorebased trawl landings in 2009 and 2010 (including whiting), 92 vessels also made trawl/IFQ landings during 2011 to 2016, 26 made only non-IFQ landings after 2010, and nine made no landings in West Coast ports after 2010. The count of all vessels making IFQ landings is higher than the base, in part because the six-year period is longer than the two-year base period, so it includes more vessels moving in and out of the fishery than the base period. More relevant is the fact that of nine of the 26 vessels that exited the shoreside trawl fishery stopped fishing in any West Coast shoreside fishery. In turn, this would affect the communities associated with these vessels.

Sixteen of the 26 vessels that stopped fishing in the shoreside trawl fishery tended to rely solely on the crab fishery, and all but one relied on a mix of crab and some other fishery (including participation in Alaska). These vessels continued to benefit their local communities through these activities, but they may also have adversely impacted other fisheries if they increased effort in those fisheries to compensate for their reduced groundfish trawl activity. Five of these vessels continue to maintain trawl permits (as of 2016) and, thus, have an ongoing option to re-enter the shoreside trawl fishery (Table 3-136). Of the nine vessels that left West Coast shoreside fisheries, two participated in the mothership fishery. Two left that fishery as well, while three entirely disappeared from West Coast and Alaska fishery landing and delivery databases (Table 3-136).

Table 3-134. By port area, disposition post-2010 of vessels that made trawl landings[1] by port area during 2009 and 2010, counts of all vessels that made IFQ landings during 2011 to 2016, and the number of those vessels that were not active in 2009 or 2010 but participated in the IFQ fishery. Source: PacFIN data.

	Counts for Vessels that made Trawl Landings in 2009-2010					
		Activity of those vessels in 2011 to 2016[2]				
Port Area	**Total vessels making Trawl Landings 2009 and 2010**	**IFQ Landings**	**Non-IFQ Landings Only**	**No Record of West Coast Landings**	**Counts of All Vessels that made IFQ Landings in 2011 to 2016[3]**	**Counts of All Vessels that made IFQ Landings in 2011-2016 but not during 2009 and 2010[3]**
Washington	24	17	3	4	37	26
Astoria/Tillamook	45	36	7	2	54	24
Newport	30	24	6	-	35	14
Coos Bay	28	24	4	-	29	9
Brookings	12	9	3	-	15	7
Crescent City	17	12	5	-	7	5
Eureka	15	12	2	1	11	1
Fort Bragg	7	7	-	-	9	2
San Francisco[4]	12	8	2	2	15	8
Monterey	3	2	-	1	12	10
Morro Bay	1	1	-	-	24	23
Santa Barbara	-	-	-	-	4	4
Los Angeles	-	-	-	-	-	-
San Diego	-	-	-	-	-	-
Coast-wide Vessel Counts	**128**	**93**	**25**	**10**	**145**	**52**

1/ Includes shorebased whiting.
2/ Vessels that made both IFQ and non-IFQ landings during 2011 to 2016 were counted in "IFQ Landings."
3/ Includes vessels using fixed gear to land IFQ catch.
4/ San Francisco Port Area includes Bodega Bay.

Table 3-135. Vessels remaining active in some shoreside fisheries: disposition of 26 vessels that made trawl landings during 2009 and 2010, but made only non-IFQ landings in West Coast ports during 2011 to 2016. Source: PacFIN and AKFIN data.

	Vessels' Fishing Strategy in 2011 to 2016						Counts of Vessels with WC GF TWL Permits in Years Below:		
Vessels' Fishing Strategy in 2009 and 2010	**Crab only**	**Crab and Misc**	**Crab and Fixed Gear Sablefish**	**Crab, Misc and Fixed Gear Sablefish**	**Crab and Alaska**	**Fixed Gear Sable-fish and Alaska**	**2011**	**2016**	**2011 and 2016**
Trawl only	1	1	1	-	-	-	1	-	-
Trawl and Crab only	14	1	1	1	-	-	9	2	2
Trawl, Crab and Miscellaneous	1	2	-	-	-	-	2	2	2
Trawl, Crab, Miscellaneous and Fixed Gear Sablefish	-	-	1	-	-	-	-	-	-
Trawl and Alaska only	-	-	-	-	1	-	1	1	1
Trawl, Fixed Sablefish and Alaska	-	-	-	-	-	1	1	-	-
Vessel Counts	16	4	3	1	1	1	14	5	5

Note: None of the 26 vessels that left the shoreside trawl sector were participants in the mothership Sector from 2009 through 2016.

Table 3-136. Vessels leaving all shoreside fisheries: disposition of nine vessels that made trawl landings during 2009 and 2010, but made no shorebased landings in West Coast ports during 2011 to 2016. Source: PacFIN, NORPac, and AKFin data.

	Vessels' Fishing Strategy in 2011 to 2016			**Counts of Vessels with WC GF TWL Permits in Years Below:**		
Vessels' Fishing Strategy in 2009 and 2010	**Mothership Whiting and Alaska**	**Alaska Only**	**Neither**	**2011**	**2016**	**2011 and 2016**
Non-whiting Trawl only	-	-	3	2	1	1
Non-whiting Trawl and Alaska	-	1	-	-	-	-
Shorebased whiting and Alaska	-	1	-	-	-	-
Shorebased whiting, Mothership whiting and Alaska	2	2	-	2	2	2
Vessel Counts	2	4	3	4	3	3

3.3 Environmental Performance

Considers environmental impacts (Amendment 20 goal); promotes practices that minimize ecological impacts (Amendment 20 objective).

One of the primary expectations for Amendment 20 was to reduce the incidental catch of overfished groundfish species to assist in rebuilding these stocks. Multi-species fisheries can be complicated, as productivity can vary among the stocks captured together in a fishery. This can result in situations where access to high-productivity stocks is constrained by the need to keep mortality of the lower productivity stocks within catch limits. If the low-productivity stocks are overfished, mortality limits often become even more constraining. Rebuilt stocks can translate to increased catch levels and, in some cases, to resumption of target fisheries.

The West Coast Groundfish Fishery is a multi-species fishery that includes more than 100 species of fish of varying productivity levels. The low productivity associated with some species, especially rockfish species from the genus *Sebastes*, can constrain catches of target species. Prior to Amendment 20, there was "little direct incentive for individual vessels to do everything possible to avoid take of species for which there are conservation concerns, such as overfished species" (Amendment 20 EIS). Lower observer coverage rates also created uncertainties about the bycatch rates that were estimated from the subset of trips that were observed. There was pressure to be less conservative in the bycatch estimates (Amendment 20 EIS). However, underestimation of bycatch rates could result in inaccurately low estimates of mortality and misspecifications of appropriate target limits, ultimately negatively affecting the status of some species and reducing management effectiveness.

The trawl rationalization program was created to provide participants with more individual accountability for their impact on groundfish species. This was done by making fishermen accountable for their entire catch (not just the landed species) and by implementing 100 percent observer coverage on the trips. The program was designed to increase fishermen's flexibility as to when, where, and how he/she fishes and to incentivize practices that decrease the catch of constraining stocks. Surveys of fishermen in 2010 and 2012 showed that they believed the top reason to support the trawl rationalization program was the benefits of decreased bycatch (NMFS 2015). While flexibility has increased within this catch share program, comments received from fishermen highlight additional changes that could add even more flexibility (e.g., reducing rockfish conservation area size and gear restrictions [Fisheries Leadership and Sustainability Forum (FLSF) 2016]).

This section of the West Coast Groundfish Trawl Catch Program Five-year Review will assess the progress of the program toward Amendment 20 and MSA goals concerning environmental performance.

It includes impacts on low productivity, overfished, and/or constraining stocks as well as other aspects of the ecosystem, such as the status of stocks, habitats, and protected species.

The results below document changes in catch, discards, and landings, etc., through time. However, the methodology used does not allow determination of cause and effect or definitive conclusions that documented changes are a direct result of the catch share program (i.e., the changes documented could be due to confounding factors that occurred at the same time).

3.3.1 Sources of Data

Highlights:

- Most of the analyses in this section use discard and landings data for 2002-2015 from NWFSC West Coast Groundfish Observer Program.

Most analyses included in this report are based on data and reports provided from the NWFSC West Coast Groundfish Observer Program (WCGOP).[100] Additional information for subsections was provided by Council staff on historical ACL/OY catch limits, by NMFS staff on marine mammal interactions, GMT and Washington Department of Fish and Wildlife reports on large bycatch events, Status of Stocks reports, and the condition of stocks through NMFS Species Information System[101] database. Since much of the data is from the observer program, a brief outline of the program and the data is provided in Appendix E. Additionally, the observer website provides more information[102] for interested readers.

3.3.2 Discards and Total Mortality

Promote practices that reduce bycatch and discard mortality (Amendment 20 objective). Account for total groundfish mortality (Amendment 20 constraint). Minimize bycatch and bycatch mortality (MSA National Standard 9).

Highlights:

- Total discards (all sectors all species) have dropped significantly after implementation of the catch share program (total annual discards decreased 68 percent between pre-catch share fisheries (2002 to 2010) and post catch share fisheries (2011 to 2015).

[100] https://www.nwfsc.noaa.gov/research/divisions/fram/observation/

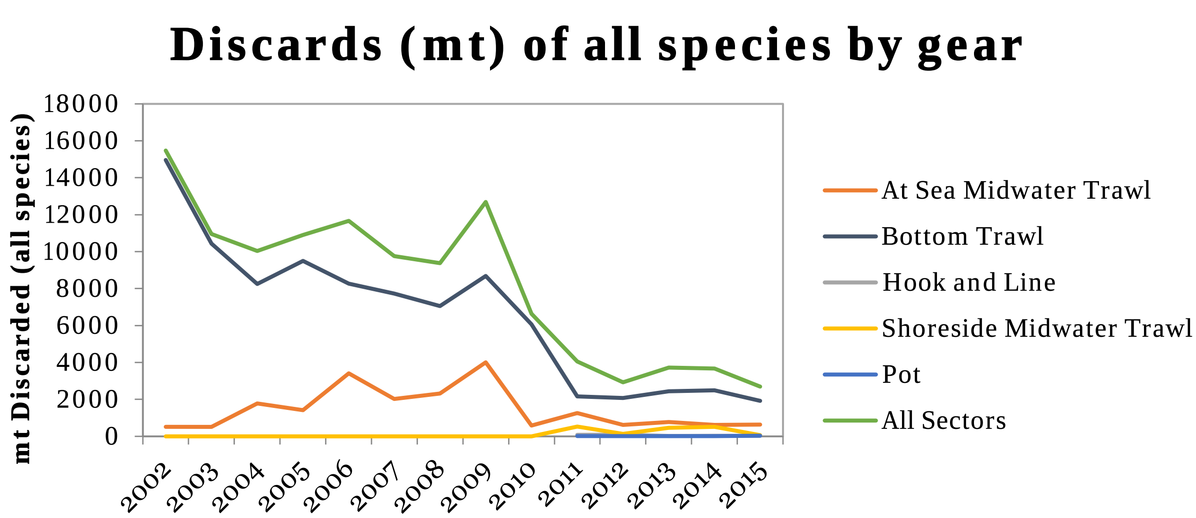
[101] https://www.st.nmfs.noaa.gov/sis/#no-back-button

[102] https://www.nwfsc.noaa.gov/research/divisions/fram/observation/

- The greatest drop was in discards associated with bottom trawls, which declined 75 percent from an average of 8.994 mt per year before implementation (2002 to 2010) to 2,219 mt per year after implementation (2011 to 2015).

One Amendment 20 objective was to promote practices that reduce discard mortality, especially related to overfished and rebuilding species. In addition, Amendment 20 also documented intent to ensure continued accountability for total groundfish mortality. This section applies WCGOP data[103] to review trends in discards and total fishing mortality (discards plus landings) for the following sectors: at-sea (includes motherships and catcher-processors), limited entry bottom trawl, and shoreside midwater trawl. The majority of this report will use the term “discards” rather than “bycatch,” as the use of the term “bycatch” varies. Some people equate bycatch with all incidental catch (i.e. non-target catch that can be retained or discarded). Alternatively, the current definition of bycatch in MSA is as follows: “fish which are harvested in a fishery, but which are not sold or kept for personal use.”

The observer program data show that discards of all species combined have dropped significantly after the catch share program was put in place (Figure 3-79), with average annual discards falling from 10,834 mt before the CS program to 3,417 mt after program implementation. The greatest drop was in discards associated with bottom trawls, which declined from an average of 8.994 mt per year before implementation (2002 to 2010) to 2,219 mt per year after implementation (2011 to 2015) (Figure 3-79). Results for midwater trawls include trawls targeting whiting (also known as Pacific hake) and pelagic rockfish.



[103] https://www.nwfsc.noaa.gov/research/divisions/fram/observation/index.cfm

Figure 3-79. Total discards through time (FMP and non-FMP species) by gear for the at-sea (includes motherships and catcher-processors), limited entry bottom trawl, and shoreside midwater trawl fisheries. Note: Midwater trawl includes trawls targeting pelagic rockfish and whiting, as these were not differentiated until 2015. Shoreside midwater trawls from 2002 to 2010 have near zero discards, as this fishery operated under an exempted fishing permit that required full retention and did not use observers (there were a minimal amount of operational discards for which species composition were estimated based on landed fish species composition, but these are not included here). Source: WCGOP data.

These results show discards have declined during the time the catch share program has been in place. This reduction in discards could have multiple causes, including decreases in overall fishing effort, landing species rather than discarding them, changes in gear (for example, using halibut excluder gear), and changes in fishing behavior (when and where fishing effort occurs, as well as adjusting fishing to respond to bycatch by individuals or groups).

Reviewing species groups indicates that the amount of flatfish and roundfish discarded varied through time, but dropped around the time the catch share program was started (Figure 3-80). The amount discarded for ecosystem species[104] and rockfish were much higher in 2002 and 2003, dropped some between 2004 and 2010, and decreased further with the implementation of the catch share program. Discards of the three elasmobranch species included in the groundfish FMP (leopard shark, spiny dogfish, and longnose skate) peaked in 2005 and 2008, followed by a steady decrease in discards from 2009 to the present. Totaling discards in Figure 3-79 and Figure 3-80 are not equal because all species (including non-FMP species are included in the former) but only FMP and ecosystem species are included in the later.

Comparing the amount discarded to the amount landed provides an estimate of the percentage of fish discarded (Figure 3-81). Figure 3-81 indicates that ecosystem species and elasmobranchs are still discarded more than 40 and 25 percent of the time, respectively.

[104] Note: Species included are those currently identified as ecosystem species. Data were retroactively updated to apply current species groups.

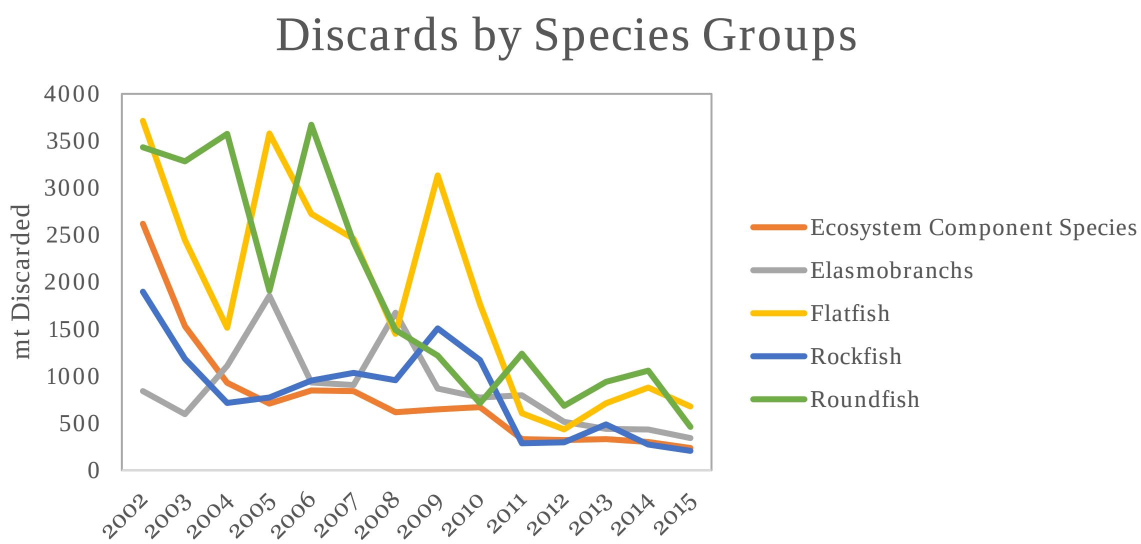


Figure 3-80. Total discards (includes at sea, and limited entry trawl) by species groups. Species included in the figure are those found within the groundfish FMP, including those designated as ecosystem species. Source: WCGOP data.

The WCGOP has analyzed impacts of the catch share program on all elasmobranchs (Jannot et al. in review). Thirty-seven species and seven categories (identification was not to species) of elasmobranchs not included in the FMP were reviewed.[105] For the most part, incidental catch of elasmobranchs decreased with implementation of the catch share program, suggesting that management changes could have impacts on species outside the FMP. The catch of deep-slope skates and sharks has increased, most likely due to changes in depths fished through time. The WCGOP also found that more sharks have been retained since program implementation, which may impact overall shark mortality if sharks previously caught and released had survived.

[105] The six elasmobranch species included in the groundfish FMP were removed for this analysis, but the five sharks managed under the highly migratory species FMP were included.

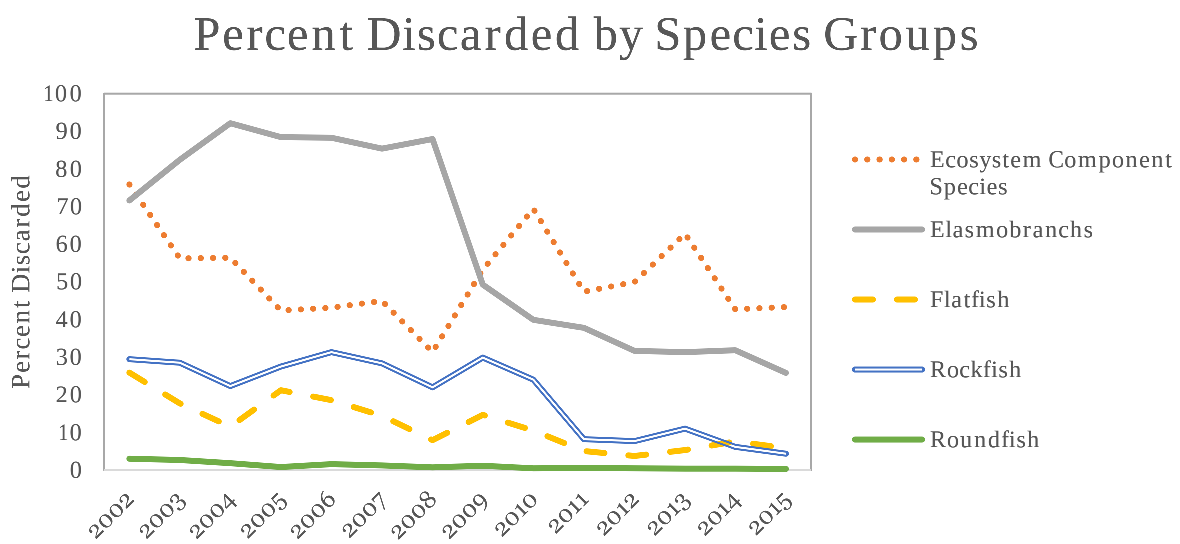


Figure 3-81. Percent discarded through time for species groups. Includes discards for at sea and limited entry trawl sectors. Species included in the figure are those found within the groundfish FMP, including those designated as ecosystem species. Source: WCGOP data.

3.3.2(a) Overfished and/or Constraining Stocks

Highlights:

- When Amendment 20 was put in place, eight stocks were considered overfished and rebuilding: bocaccio, canary rockfish, cowcod rockfish, darkblotched rockfish, POP, petrale sole, widow rockfish, and yelloweye rockfish.
- Discards of six of the seven overfished rockfish species dropped at least 90 percent with implementation of the catch share program. The exception, widow rockfish, had discards that varied highly between years. The mean discard rate of widow rockfish dropped from 54 mt per year (from 2002 to 2010) to 30 mt per year (2011 to 2015).
- After implementation of the catch share program, total fishing mortality (discards plus landings) decreased for darkblotched rockfish, POP, and cowcod rockfish. Total fishing mortality of bocaccio, widow rockfish, and canary rockfish has increased slightly in recent years, though discards have decreased, showing that these fish are now being landed and possibly even targeted. Total fishing mortality for yelloweye rockfish has remained less than 2 mt for all years.
- Petrale sole was identified as overfished in 2009 and 2010. Annual catch limits for petrale sole were reduced from approximately 2,400 mt to 946 mt in 2009. A spike in discards in 2009 and 2010 coincided with the very low catch limits for this species. This spike was followed by a significant

decrease to a consistent level since the start of the catch share program. Petrale sole was no longer considered overfished by 2011, and it was declared rebuilt in 2015.

- Pacific halibut is not a target stock for the West Coast groundfish fishery, and landing this species is prohibited by regulations. Fisherman are provided a limited amount of halibut individual bycatch quota (IBQ) to account for discards. After implementation of the catch share program, halibut discards decreased significantly from an annual mean of 319 MT before the program (2002 to 2010) to 76 mt after the program (2011 to 2015).

There are many possible reasons for the decrease in discards of all species and, specifically, for overfished and rebuilding species. These reasons include decreases in overall fishing effort, changes in gear (e.g., switching to halibut excluder gear), landing species rather than discarding them, and changes in fishing behavior.

When Amendment 20 was put in place, eight stocks were considered overfished and in rebuilding: bocaccio, canary rockfish, cowcod rockfish, darkblotched rockfish, POP, petrale sole, widow rockfish, and yelloweye rockfish. The current status of these species is discussed in Section 3.3.4. For these analyses, petrale sole is presented separately from the other stocks as landings for this stock can overwhelm information on the rest of the stocks.

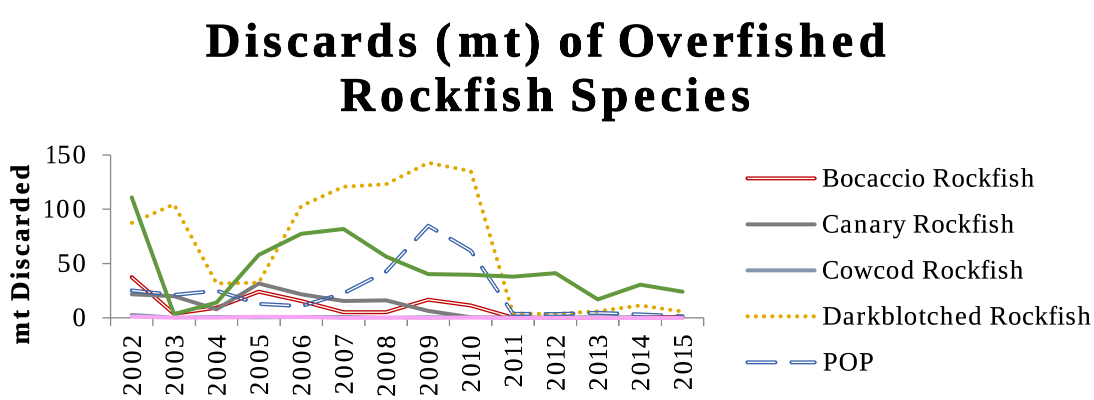


Figure 3-82. Discards of constraining rockfish species through time in the at sea and limited entry trawl sectors. Species included are those that were overfished at the time of implementation of the catch share program. Source: WCGOP data.

Discards of six of the seven overfished rockfish species dropped at least 90 percent with implementation of the catch share program (Figure 3-82 and Figure 3-83). The exception, widow rockfish, had discards that varied highly between years. The mean discard rate of widow rockfish dropped from 54 mt per year (from 2002 to 2010) to 30 mt per year (2011 to 2015).

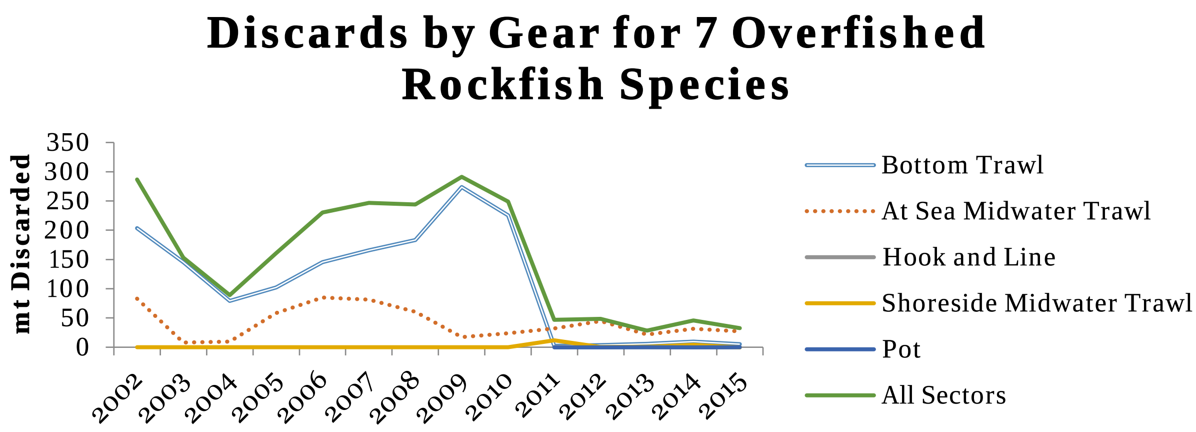


Figure 3-83. Discards of the seven overfished rockfish species listed in Figure 3-82 for each sector. Source: WCGOP data.

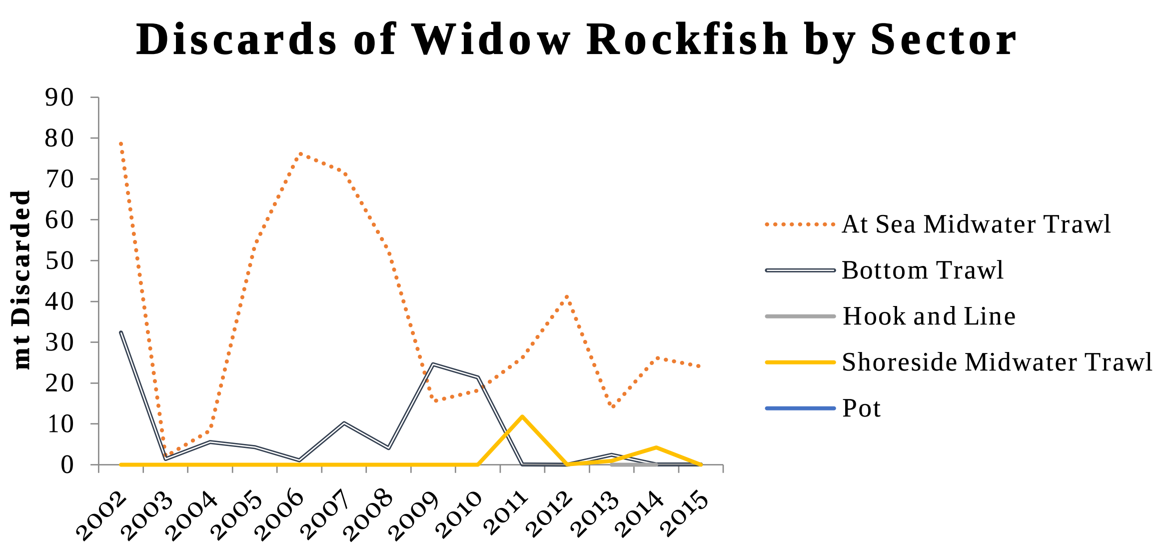


Figure 3-84. Discards of widow rockfish through time for each sector. Source: WCGOP data.

Most of the decreases in discards occurred in the bottom trawl sector. For all but widow rockfish, bottom trawl gear accounted for 90 percent or more of the discards prior to the catch share program. Widow rockfish are more pelagic than the other seven rockfish species and, thus, can commonly be caught (and even targeted) in midwater trawl gear, especially in the whiting directed fishery. Discards for widow rockfish by sector are available in Figure 3-84; discards for other species by sector can be found in Appendix F.

The effect of any changes in effort on discards can be assessed by analyzing discards of species per mt of groundfish landed. Total groundfish landings have varied between years (Figure 3-85). Accounting for this effort does not remove the pattern showing a sharp drop in discards in 2011 with the start of the catch share program (Figure 3-86).

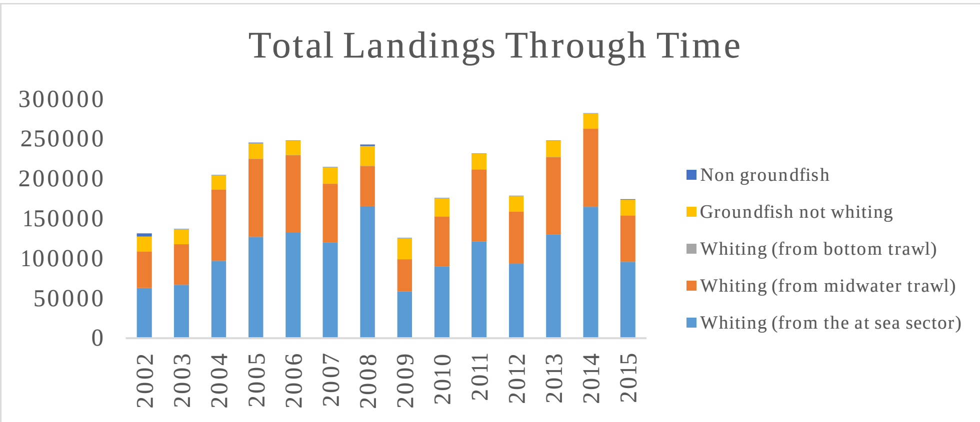


Figure 3-85. Total landings through time by sector. Source: WCGOP data.

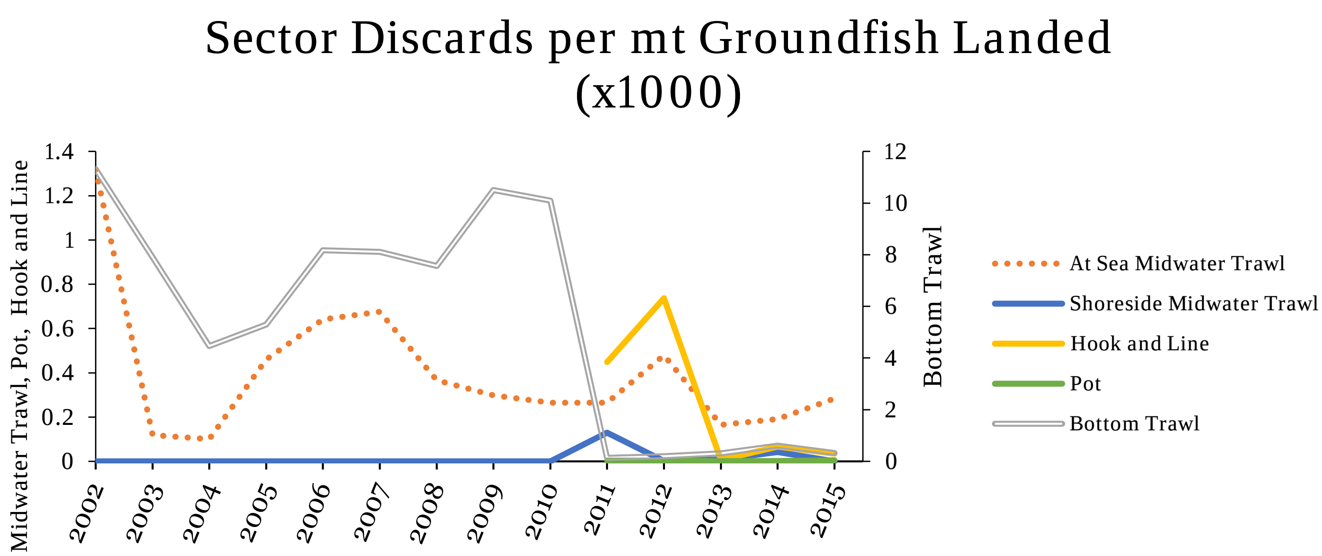


Figure 3-86. Summed discards of the seven historically overfished rockfish species per mt of groundfish landed for each sector. Right axis is for bottom trawl. Numbers were multiplied by 1,000 to allow easier visualization. Source: WCGOP data.

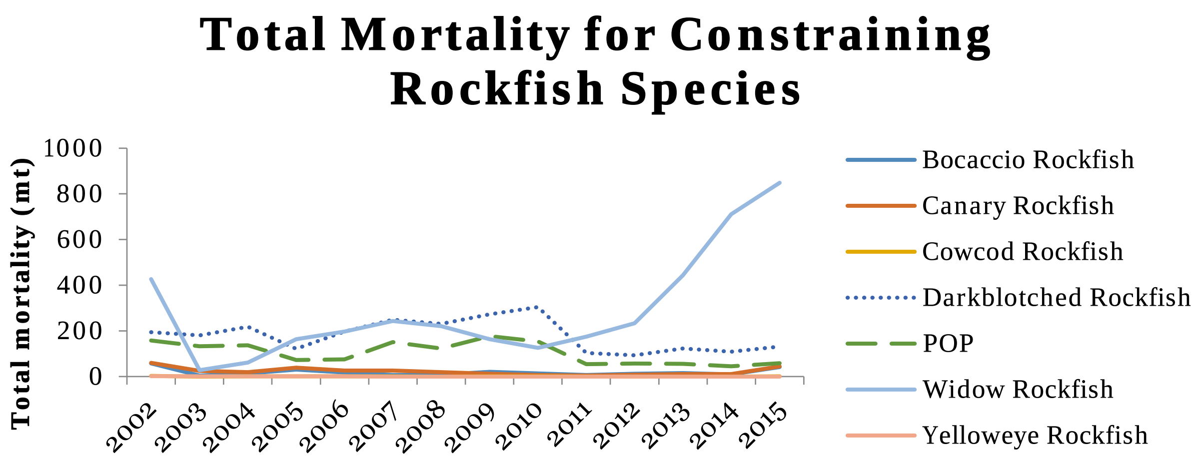


Figure 3-87. Total mortality (estimated discards plus landings) through time for seven historically overfished rockfish species. Source: WCGOP data.

Total fishing mortality (Figure 3-87) sums the mortality from estimated discards with the mortality from landings. For information on total mortality between gears, see Appendix G. Total fishing mortality decreased for darkblotched rockfish, POP, and cowcod rockfish with the implementation of the catch share program (Figure 3-88), suggesting that fishermen may have either adjusted fishing methods to decrease catches of these species, or decreased effort using gears that catch these species. Possible explanations include changes in location, timing, gears, excluder devices, move-on rules, etc.

For some species, the reduction in discards is due to an increase in the percentage of fish landed instead of discarded.[106] Total fishing mortality of bocaccio, widow rockfish, and canary rockfish has increased slightly in recent years, though discards have decreased, showing that these fish are now being landed and possibly even targeted (Figure 3-89). Total fishing mortality for yelloweye rockfish has remained less than 2 mt for all years.

[106] Since the observer program is primarily focused on at-sea discards, there is a chance that these fish are being discarded shoreside after being landed.

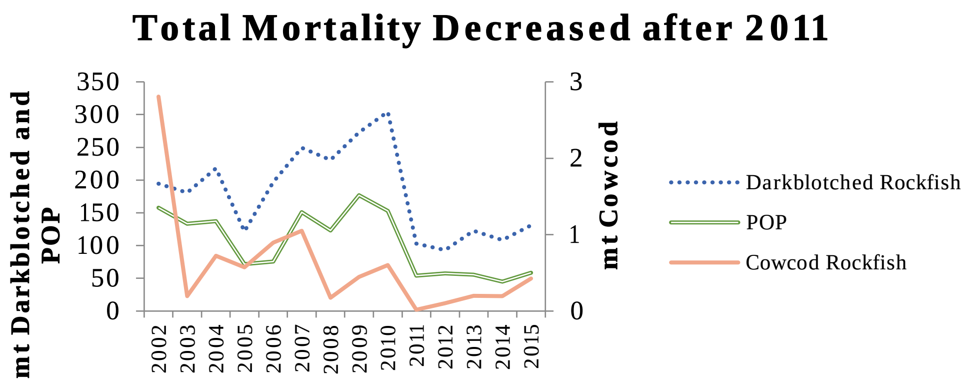


Figure 3-88. Total mortality (estimated discards plus landings) through time for darkblotched rockfish, cowcod rockfish, and POP. Mortality for cowcod rockfish is shown on the right vertical axis as it was more than an order of magnitude lower than mortality of the other species. Results include information from the at-sea and limited entry trawl sectors. Source: WCGOP data.

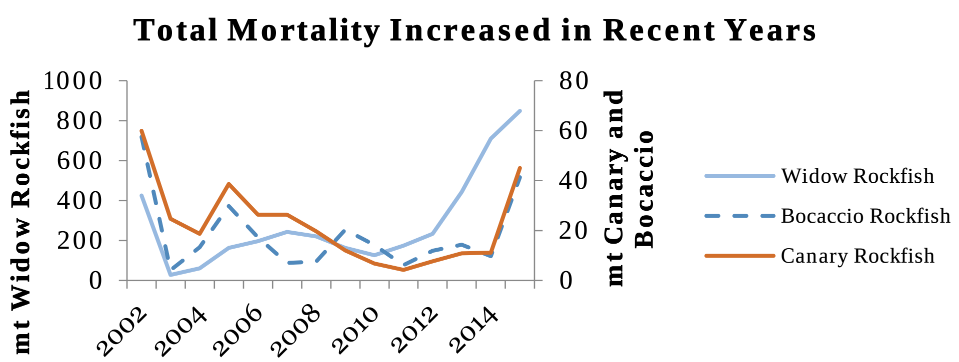


Figure 3-89. Total mortality (estimated discards plus landings) through time for widow rockfish, canary rockfish, and bocaccio rockfish species. Mortality for canary and bocaccio rockfish are shown on the right vertical axis. Results include information from the at-sea, and limited entry trawl. Source: WCGOP data.

Petrale sole is a target species by bottom trawl gear, and it was identified as overfished in 2009 and 2010. By 2011, it was no longer overfished, but it was still under rebuilding status. It was declared rebuilt in 2015. Annual catch limits for petrale sole were reduced from approximately 2,400 mt to 946 mt in 2009, which impacted total fishing mortality (Figure 3-90). Trawlers were able to respond to the lower ACL by avoiding known winter concentration areas (D. Erickson, NMFS WCR, pers. comm.). Most petrale sole discards come from bottom trawl gear. A spike in discards in 2009 and 2010 coincided with very low catch limits for this species. This spike was followed by a significant decrease to a consistent level since the start of the catch share program.

Pacific halibut is not a target stock for the West Coast groundfish fishery, and landing this species is prohibited by regulation. Each fisherman has a limited amount of halibut IBQ to account for discards. After implementation of the catch share program, halibut discards decreased significantly from an annual mean of 319 mt before the program (2002 to 2010) to 76 mt after the program (2011 to 2015) (Figure 3-91). This decrease in halibut bycatch could be due to changes in fishing methodology (e.g., locations fished, etc.). Around the same time as the start of the catch share program, many fishermen also started using new gear designed to exclude Pacific halibut from bottom trawls (J. Jannot, pers. comm. NWFSC). An attempt to look at the influence of latitude, depth, duration, and take of correlated species on the catch of Pacific halibut was inconclusive, as the relationship of halibut catch to these factors shifted with implementation of the catch share program (Hamilton et al. in prep). Regardless of the reason for the reduced total (legal and sublegal sizes) halibut bycatch mortality in the trawl fishery, the net effect has been an increase in the amount of legal size halibut available for allocation among retention fisheries such as the recreational and long-line sectors (pers. comm. Michele Culver WDFW and Phil Anderson Council member).

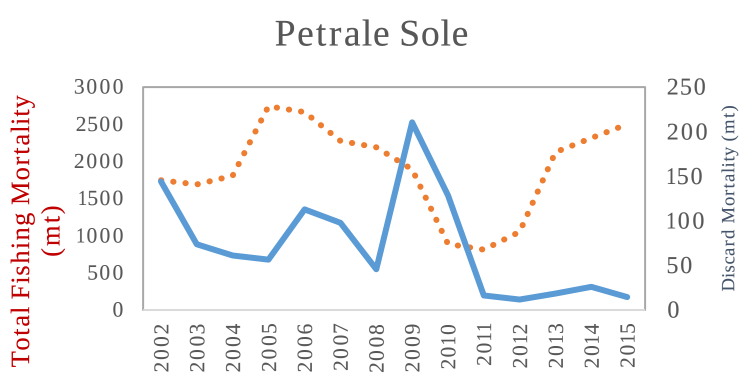


Figure 3-90. Estimated discard (blue line, right axis) and total fishing mortality (red line, left axis) for petrale sole through time. Results include information from the at-sea and limited entry trawl sectors. . Source: WCGOP data.

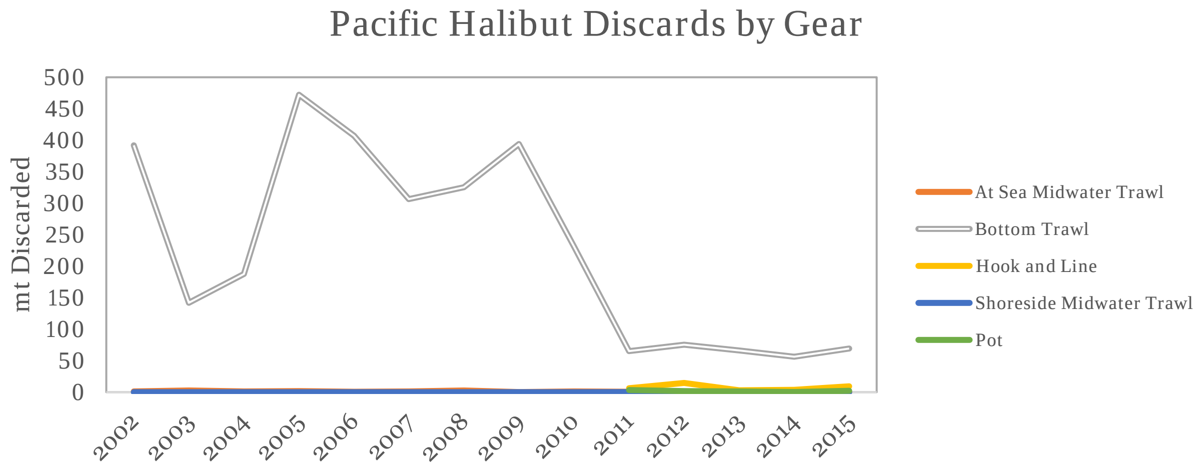


Figure 3-91. Discards of Pacific Halibut through time. Results include information from at-sea and limited entry trawl sectors. Source: WCGOP data.

Limitations in the availability of sablefish quota may also constrain a fisherman's ability to target other species. For example, it was hypothesized that allowing fishermen to switch from trawl to pot fishing could increase demand for sablefish quota and decrease available quota for trawl fishing, constraining catches that co-occur, such as Dover sole and thornyheads (Amendment 20 EIS). Dover sole and thornyhead total fishing mortality has decreased with implementation of the trawl rationalization program (Section 1.1.2). Dover sole landings were near the annual catch limit up to 2007, when Dover sole annual catch limit increased from approximately 7,500 mt to 16,500 mt. Mortality increased slightly from 2007 to 2010 (Average fishing mortality was 11,138 mt), then dropped again starting in 2011 (average of 7,150 mt between 2011 and 2015). See Section 3.1.3(a) and Section 3.3.3(c) for discussions of utilization.

In summary, there has been a dramatic decline in discarded fish during the first five years of the catch share program compared to the previous nine years. The discards have decreased for all overfished species, meeting one of the goals of the catch share program. There are many possible reasons for the decrease in discards of all species and, specifically, for overfished and rebuilding species. These reasons include decreases in overall fishing effort, changes in gear (e.g., switching to halibut excluder gear), landing species rather than discarding them, and changes in fishing behavior. Some of the species analyzed show that this decrease in discards is concurrent with an increase in landings.

3.3.3 Catch limits and Optimum Yield

Provide a mechanism for total catch accounting (Amendment 20 objective). Prevent overfishing and achieve OY (MSA National Standard 1).

Through National Standard 1, MSA creates a dual requirement to "prevent overfishing while achieving, on a continuing basis, the OY from each fishery for the U.S. fishing industry." Achieving a balance between the economic and social interests of fishermen and the ecological needs of the fish stocks and ecosystem can be difficult. This subsection will look at how the trawl rationalization program is addressing the conservation side of these dual objectives by describing the program's ability to adhere to catch limits, and to achieve OY.

3.3.3(a) Background on Optimum Yield

MSA defines the term "optimum," with respect to the yield from a fishery as follows:

> . . . the amount of fish which will provide the greatest overall benefit to the Nation, particularly with respect to food production and recreational opportunities, and taking into account the protection of marine ecosystems; is prescribed as such on the basis of maximum sustainable yield from the fishery, as reduced by any relevant economic, social, or ecological factor; and, in the case of an overfished fishery, provides for rebuilding to a level consistent with producing the maximum sustainable yield in such fishery (16 USC 1802, 104-297 (33)).

OY may be established at the stock level, the stock complex level, or the fishery level. Achieving OY from each fishery on a continuing basis means producing a long-term series of catches from each stock, stock complex, or fishery such that the average catch is equal to the OY, overfishing is prevented, the long-term average biomass is near or above B_{MSY}, and overfished stocks and stock complexes are rebuilt consistent with timing and other requirements of MSA section 304(e)(4). OYs are considered long-term harvest objectives and are not necessarily set every year or during every biennial management cycle. MSA also specifies that OY is based on MSY and may be equal to or less than MSY.

The groundfish FMP authorizes establishment of a numerical or non-numerical OY for any groundfish species or species group and lays out the procedures the Council will follow in determining appropriate numerical OY values. An OY may be specified for the fishery management area as a whole or for specific subareas. Full utilization of quota should not be confused with achieving OY; OY involves consideration of many other factors, including available harvesting capacity.

Fishery Management Definitions:

MSY: *The largest long-term average catch that can be taken from a stock under prevailing environmental and fishery conditions*

Overfishing: *A stock that has a harvest rate higher than the rate that produces its MSY*

Overfished: *A stock that has a population size that is too low and that jeopardizes the stock's ability to produce its MSY*

Rebuilt: *A stock that was previously overfished and that has increased in abundance to the target population size that supports its MSY*

3.3.3(b) Annual Catch Limits

Highlights:

- Before and after the start of the catch share program, management of West Coast groundfish has been successful at keeping fishing mortality under catch limits. Since 2006, no groundfish stock has been subject to overfishing.

Management of West Coast groundfish has been successful at keeping fishing mortality under catch limits (Figure 3-92, Figure 3-93, and Figure 3-94), and preventing overfishing. This was true before and after the catch share program. The catch share program increased individual accountability and thus improved confidence in the annual catch estimates. Attainment rates provided are for all West Coast fisheries and not just for catch share fisheries. Landings were calculated with WCGOP data and compared to catch limits provided by PFMC staff (John DeVore, pers. comm., Council). Since 2006, no groundfish stock has been subject to overfishing. Further discussion of attainment rates, including reasons for under attainment can be found in Section 3.1.3(a)(1).

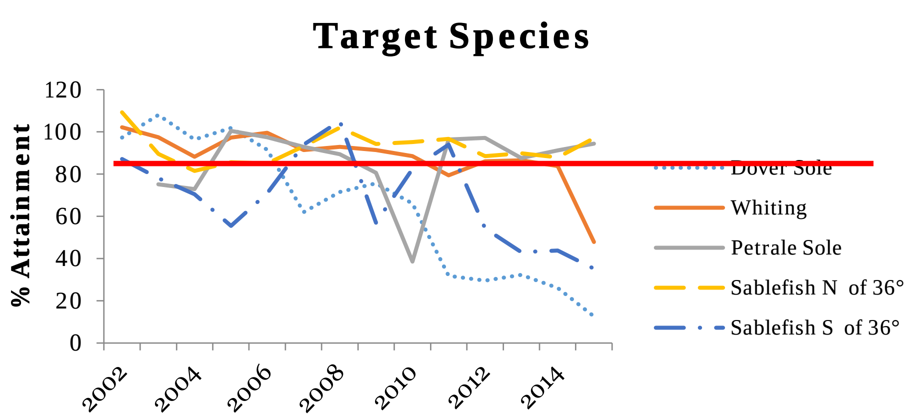


Figure 3-92. Percent attainment for four target stocks: Dover sole, whiting, Petrale sole, and sablefish. Sablefish has separate catch limits north and south of 36°, so it is presented separately for these areas. Attainment rates are for the entire groundfish fishery, not just for catch share sectors. Red line represents target catch limit. Source: WCGOP data.

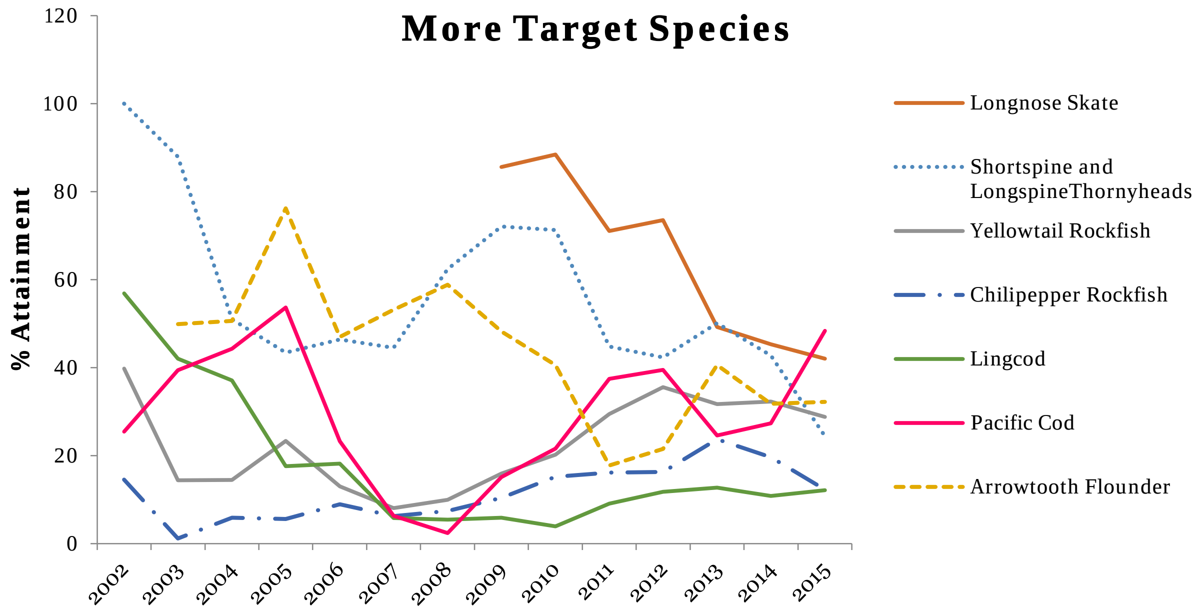


Figure 3-93. Percent attainment for seven more target stocks: longnose skate, thornyheads, yellowtail rockfish, chilipepper rockfish, lingcod, Pacific cod, and arrowtooth flounder. Attainment rates are for the entire groundfish fishery, not just catch share sectors. There is no information on attainment rates for longnose skate prior to 2009, when sorting requirements were implemented. Source: WCGOP data.

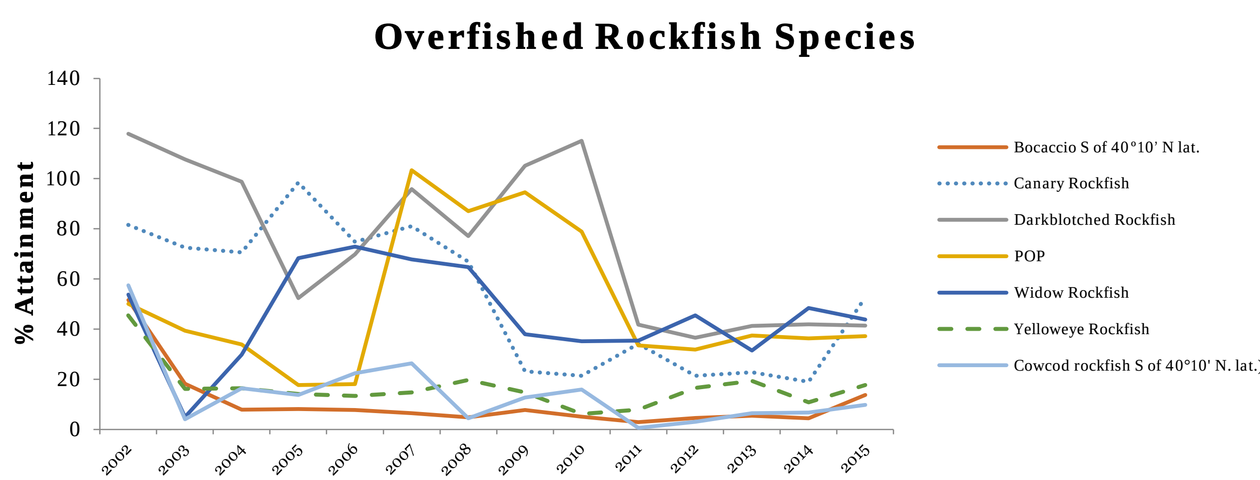


Figure 3-94. Percent attainment for seven historically overfished rockfish stocks: bocaccio, canary, darkblotched, POP, widow, and yelloweye rockfish. Attainment rates are for the entire groundfish fishery, not just catch share sectors. Cowcod rockfish and bocaccio rockfish attainments are shown south of 40° 10' N. latitude only, as the catch limit is specific for this area. Source: WCGOP data.

3.3.3(c) Large Bycatch Events (Lightning Strikes)

Highlights:

- Large bycatch events did not start with catch share program implementation. In the at-sea fleets, darkblotched rockfish and POP have been a great concern in recent years. From 2000 to 2015, the majority of days had no landings of either species; for 99 out of 100 days, landings were less than one mt. However, historical data show that each sector can take multiple tons within a day.
- Even though catches of overfished stocks have been well below catch limits since the start of the catch share program, these species can still be constraining. Fear associated with the chance of catching large amounts of constraining species may limit the fleet's ability to attain the full ACL of other abundant target species.

Large bycatch events (or lightning strikes) can have direct and indirect impacts on fishermen. For example, they can limit fishermen's ability to fish, sometimes for entire seasons, or they may lead them to alter fishing methods, location, or frequency in response to a perceived risk of a large bycatch event.

> The available quota for many overfished species is low, and quota for other constraining stocks can be expensive or difficult to acquire; as a result, participants perceive a significant risk of encountering species for which they do not hold or cannot acquire quota. ...This risk calculation may result in conservative decision-making that can contribute to underutilization of a fishery (FLSF 2016, pgs. 6-7).

Some rockfish species aggregate into schools or shoals, creating conditions that can result in unexpected and large bycatch events. The species of concern can vary between years, depending on the condition of the stocks and their propensity to aggregate. For example, aggregation and schooling behaviors are more common in widow rockfish and canary rockfish than in bocaccio rockfish (Bjorkland 2015), leading to an increased chance of high bycatch events in the schooling species. Large bycatch events did not start with catch share program implementation. They also occurred before the program began, but the consequences were much different. Prior to catch share implementation, fishermen were only accountable for landings. With the start of the catch share program, fishermen became directly accountable for their catch of these fish. They must now lease quota to cover the amount of fish caught. Even though catches of overfished stocks have been well below catch limits since the start of the CS program (3.3.3(b)), these species may still be constraining. Fear associated with the chance of catching large amounts of constraining species may limit the fleet's ability to attain the full ACL of other abundant target species. Discussions leading up to the implementation of the catch share program included options for mitigating the impacts of these high bycatch events on individual fishermen (Element 6[107] in the FEIS); however, these were not included as part of the final catch share program as some believed it would decrease incentives to avoid these species.

The IFQ program created vessel caps that determined the amount of quota per species that a vessel could acquire through a year. Individual accountability by each participant requires that all catch be covered by quota in a vessel account before resuming fishing under the catch share program (i.e., a vessel cannot be in deficit for a species). With this system, however, there have been examples where high bycatch events have led to vessels being unable to acquire enough quota to continue fishing. For example, in November 2015, a vessel caught approximately 47,000 pounds of canary rockfish in one tow. In another example, in June of 2016, a different vessel caught a lightning strike of POP. In both cases, the catch exceeded the vessel limit for the year, so the boats had to stop fishing in that fishery for the remainder of the year. In the first example, the bycatch event was so large that it limited that vessel's ability to participate the following year (GMT report, March 2016). However, like most lightning strikes, the GMT determined that the tow "appeared to be a random, low probability event that could not be foreseen by the captain" as the boat "exhibited no unique behavior in terms of fishing location, haul time, or depth compared to other non-whiting midwater hauls."

In the at-sea fleets, darkblotched rockfish and POP have been great concerns in recent years. An analysis of past catch histories found that 83.1 percent and 87.3 percent of tows from 2000 to 2015 contained no bycatch of darkblotched rockfish and POP, respectively. In addition, 75 percent of the at-sea positive tows for darkblotched rockfish caught fewer than 15 fish; the majority caught only two fish. Visual representation of 33,386 hauls from 2001 to 2015 for the catcher-processor and mothership sectors shows these high bycatch hauls are rare (Figure 3-95, from Mirick et al. 2015). Most of the time, there were no landings of either species; for 99 out of 100 days, landings were less than 1 mt. "However, historical data does show that each sector can take multiple tons within a day, albeit infrequently" (PFMC 2016a, pgs. 3-4). Another way to visualize the rarity of large bycatch events is to review how fast the cumulative catch of these species can occur (

Figure 3-96, from PFMC 2016a). Analysis of the fishery prior to sector-specific bycatch caps (1997 to 2009) shows the distribution of the daily cumulative catch of darkblotched rockfish and POP, respectively. There are some options for decreasing risk associated with large bycatch events, such as

[107] A list of Element 6 options considered. Vessel can continue fishing by voluntarily surrendering QS of other species. Vessel can continue fishing by voluntarily posting a bond. Vessel can continue fishing by voluntarily making a payment based on the amount of target species typically associated with the amount of overage species taken. Vessel can continue fishing by voluntarily paying an amount based on the fish on board.

switching or modifying gears, avoiding areas that typically contain these species, and joining co-op groups or risk pools (Sections 3.1.3(a) and 3.2.2(g)).

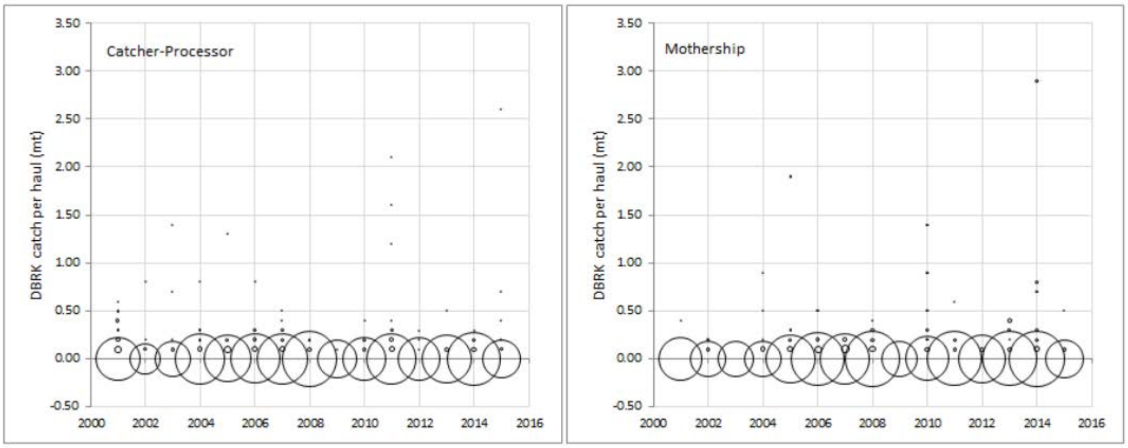


Figure 3-95. Darkblotched rockfish catch per haul from 2001 to 2015 by the at-sea whiting fishery. The size of the circle denotes the number of hauls; the large circles at the bottom of the graph depict the large number of trawls with zero darkblotched rockfish caught. Source: Mirick et al. (2015).

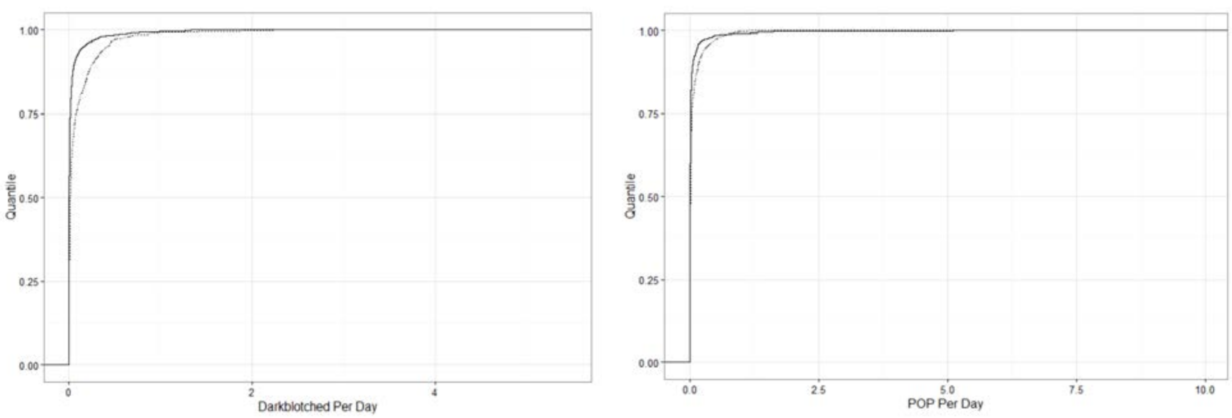


Figure 3-96. Distribution of the daily cumulative catch of darkblotched rockfish and POP by at-sea whiting fisheries. The solid line represents the catcher-processor, and the dotted line shows the mothership sectors. Source: PFMC (2016a).

3.3.4 Status of stocks

Assist in rebuilding overfished species. Promote Fishery Conservation and Management (MSA LAPP requirements).

Highlights:

- The number of groundfish stocks considered overfished have dropped from nine stocks in 2002 to two stocks in 2016. There have not been any groundfish stocks subject to overfishing since 2004.
- Overall, the status of the West Coast groundfish stocks (documented as a ratio of current biomass to biomass at MSY) have improved through time.

This section reviews changes in the status of stocks (i.e., whether any stocks are subject to overfishing or overfished) with implementation of the catch share program. It will also discuss changes to the spawning stock biomass levels of overfished and rebuilding species and discuss whether continuing to keep total mortality under the limit in overfished species will result in faster rebuilding timelines. Finally, this section examines fishermen's concerns regarding conflict between fishermen fishing IFQ sablefish and the open access and DTL fixed gear sablefish sectors south of 40º10' N. latitude.

The Council and NMFS depend upon results from scientific stock assessments to determine whether a harvest rate on a fish stock is too high (overfishing) or the population size for that stock is too low (overfished). The Council defines these reference points relative to an unfished population. For example, it has set the biomass at MSY ($B_{MSY)}$ for most rockfish stocks at 40 percent of the unfished biomass and the overfished limit at 25 percent of the unfished biomass. In 2011, the Council approved alternative reference points for flatfish stocks based on their higher productivity and a review of recommended reference points in the scientific literature.[108] Flatfish stocks have B_{MSY} set at 25 percent unfished biomass, with the overfished limit set at 12.5 percent unfished biomass.

Council groundfish stocks considered overfished have dropped over the past 15 years from nine stocks in 2002 to two stocks in 2016 (Figure 3-97). The decrease in stocks considered overfished started before introduction of the catch share program, but has continued during the IFQ program. There have not been any Council groundfish stocks subject to overfishing since 2004 (Figure 3-98). The ratio of current biomass (B) to biomass at MSY (B_{MSY}) shows the current status of a stock (Figure 3-99, Figure 3-100, and Figure 3-101). Overall, the status of the West Coast groundfish stocks have improved through time.

[108] http://www.pcouncil.org/bb/2009/0909/E2c_SUP_SSC_0909.pdf

Species	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Lingcod	**Of**	**Of**	*R*												
Whiting	**Of**	**Of**													
Widow Rockfish	**Of**	**Of**	**Of**	*R*	*R*	*R*	*R*	*R*	*R*						
Bocaccio	**Of**	**Of**	**Of**	**Of**	**Of**	**Of**	**Of**	*R*	*R*	*R*	*R*	*R*	*R*	*R*	*R*
Darkblotched	**Of**	**Of**	**Of**	**Of**	**Of**	**Of**	**Of**	*R*	*R*	*R*	*R*	*R*	*R*	*R*	*R*
Petrale Sole								**Of**	**Of**	*R*	*R*	*R*	*R*		
Cowcod	**Of**	**Of**	**Of**	**Of**	**Of**	**Of**	**Of**	**Of**	**Of**	**Of**	**Of**	*R*	*R*	*R*	*R*
Canary Rockfish	**Of**	**Of**	**Of**	**Of**	**Of**			**Of**	**Of**	**Of**	**Of**	**Of**	**Of**		
POP	**Of**	**Of**		**Of**	**Of**					**Of**	**Of**	**Of**	**Of**	**Of**	**Of**
Yelloweye Rockfish	**Of**	**Of**	**Of**	**Of**	**Of**	**Of**	**Of**	**Of**	**Of**	**Of**	**Of**	**Of**	**Of**	**Of**	**Of**
# overfished	**9**	**9**	**6**	**6**	**6**	**4**	**4**	**4**	**4**	**4**	**4**	**3**	**3**	**3**	**2**
# rebuilding	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**3**	**3**	**3**	**3**	**4**	**4**	**3**	**3**
Total	**9**	**9**	**7**	**7**	**7**	**5**	**5**	**7**	**7**	**7**	**7**	**7**	**7**	**6**	**5**

Figure 3-97. Status of previously overfished species through time. "Of" means the stock was considered overfished, while "R" means the stock is no longer overfished, but has not yet fully rebuilt (i.e., the stock is still rebuilding). Source: pers. comm. Karen Greene, NMFS HQ

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Lingcod		**Ovf**	**Ovf**												
Whiting	**Ovf**	**Ovf**													
Shortspine Thornyhead			**Ovf**												
Black Rockfish			**Ovf**												
Petrale Sole					**Ovf**										
Number	**1**	**2**	**3**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Figure 3-98. List of species subject to overfishing through time. "Ovf" means the stock was subject to overfishing that year. Source: pers. comm. Karen Greene, NMFS HQ.

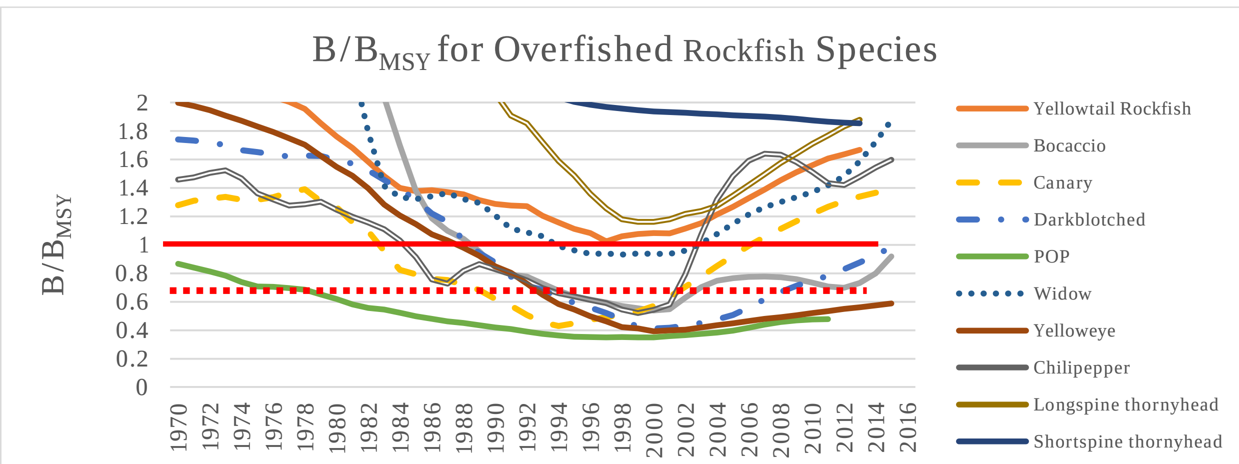


Figure 3-99. Ratio of current biomass to biomass at MSY for rockfish species through time. Data for this figure are based on estimated stock size in the most recent stock assessment as entered into NMFS "Species Information System" database. The line at one represents biomass at maximum sustainable yield, and the red dashed line represents the overfished limit (stocks beneath this line are considered overfished). Source: NMFS "Species Information System database.

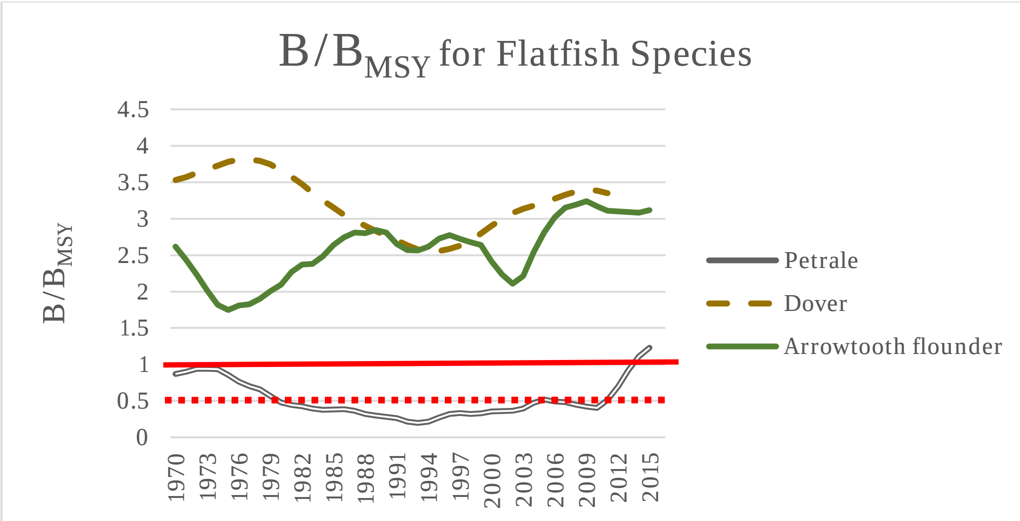


Figure 3-100. Ratio of current biomass to biomass at MSY for flatfish species through time. Data for this figure are based on estimated stock size in the most recent stock assessment as entered into NMFS "Species Information System" database. The line at one represents biomass at maximum sustainable yield, and the red dashed line represents the overfished limit (stocks beneath this line are considered overfished). Source: NMFS "Species Information System database.

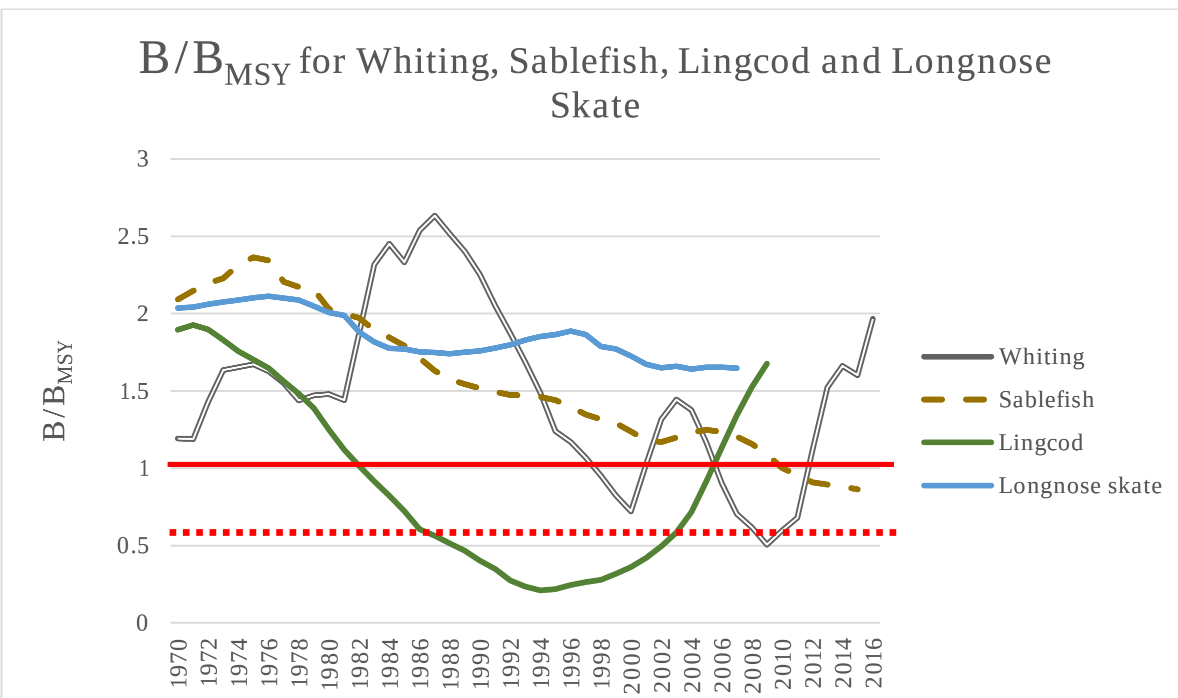


Figure 3-101. Ratio of current biomass to biomass at MSY for whiting, sablefish, lingcod, and longnose skate through time. Data for this figure are based on estimated stock size in the most recent stock assessment as entered into NMFS "Species Information System" database. The line at one represents

biomass at maximum sustainable yield, and the red dashed line represents the overfished limit (stocks beneath this line are considered overfished). Source: NMFS "Species Information System database.

3.3.4(a) Rebuilding Projections

Highlights:

- Total fishing mortality for many overfished species has been below targets in recent years. Intuitively, decreasing mortality on overfished stocks should lead to faster stock recovery.
- Rockfish rely on periodic years of banner recruitment to maintain the stock, and consecutive years of limited recruitment are common. Therefore, any increase in spawning biomass may only result in an increased level of recruitment when environmental conditions are just right.

Total fishing mortality for many overfished species has been below targets in recent years (Section 3.3.3(b)). Intuitively, decreasing mortality on overfished stocks should lead to faster stock recovery. Simulation studies generally uphold this finding; Bensen et al. (2016) and Wetzel and Punt (2016) find a tradeoff between catches during rebuilding and the time required to rebuild. Similarly, a 2011 rebuilding analysis for darkblotched rockfish projected rebuilding to occur faster as the total mortality is reduced (Stephens 2011). In 2013, darkblotched rockfish was projected to rebuild by 2015. However, the 2015 assessment showed it still to have a relative depletion of 39 percent (Gertseva et al. 2015). The 2017 assessment is anticipated to show enough increase in biomass to exceed the 40 percent threshold.

Unfortunately, while rebuilding analyses are clear regarding benefits of decreased mortality, real-world realization of these benefits may not be observable in the short term. Variability in environmental conditions can impact recruitment rates and thus recovery. This is especially true for long-lived species like rockfish that have highly variable recruitment through time. They rely on periodic years of banner recruitment to maintain the stock and consecutive years of limited recruitment are common. Therefore, any increase in spawning biomass may only result in an increased level of recruitment when environmental conditions are just right. Recovery of long-lived species can also be complicated by the age structure of the stock. Overexploitation can result in a truncated age structure. Research has shown that the presence of large, older females can decrease the importance of environmental variation, as these individuals often spawn over longer periods within the year, over different locations, and can produce healthier offspring (Berkeley et al. 2004, Planque et al. 2010; Rouyer et al. 2011).

3.3.4(b) Localized Depletion of Sablefish South of 36ºN. Latitude

Highlights:

- A full analysis of localized depletion was not completed for this report due to complications such as low observer coverage in some sectors and confidentiality requirements. A preliminary analysis of CPUE through time (2011 to 2014) for four vessels fishing in the IFQ fishery south of 36º N. latitude shows high variability in CPUE between years, but no consistent downward trend.
- Maps of fishing effort south of 36º N. latitude show that most catch share pot hauls are between Point Lopez and Point Conception, while the highest concentration of non-catch share hook-and-line and pot gear is farther south. However, for fishermen who fish non-catch share hook-and-line between Point Lopez and Point Conception, there appears to be a high potential for overlap in areas targeted by the catch share pot fishermen.
- For the area between Point Lopez and Point Conception, 65 percent of the location of observed non-catch share, hook-and-line sets directly overlapped with the location of catch share pot sets. However, as the analysis looked only at spatial overlap and combined many years of data, fishing times for the overlapping sets could significantly differ. This is especially true given the years included in the analysis: 2011 to 2015 for catch share pots and 2002 to 2015 for the observed portion of the non-catch share hook-and-line fishery.

During public hearings, many fishermen voiced concerns about localized depletion of sablefish in certain areas south of 36º N. latitude. They commented that fishermen who are using the gear-switching provision of the catch share program to target sablefish with pot gear are now targeting areas historically used by hook-and-line fishermen in the open access (OA) and DTL sablefish fisheries. See Section 3.1.2(d)(6), Table 3-67, and Section 3.1.3(c), Table 3-67, for information on the number of fishermen targeting sablefish south of 36º N. latitude in the IFQ fishery, and the amount of southern sablefish caught from IFQ compared to open access, limited entry fixed permit (DTL), primary sablefish, and limited entry trawl.

Localized depletion occurs when intense fishing reduces the population size of a stock within a specific spatial area. Localized depletion has been shown for Atka mackerel, Pacific cod, and POP off Alaska (Hanselman et al. 2007). These researchers found that documenting localized depletion was only possible when the fishing pressure was temporally or spatially intense (Hanselman et al. 2007).

Scientists have speculated that fisheries such as sablefish would be less likely to experience localized depletion because they tend to be migratory (Hanselman et al. 2007). Recent genetic analyses suggest a single stock of sablefish across the entire range of the species (Alaska to the Baja Peninsula) (Jasonowicz et al. 2017). Sablefish make two types of migrations: long-range migrations along the continental slope, and migrations from the continental slope out to seamounts[109] (Kimura et al. 1997). A tagging study from 1971 to1993 suggests that sablefish off California, Oregon, and Washington are less likely to make long-distance migrations than sablefish off Alaska; fewer than 10 percent of West Coast sablefish were recaptured more than 500 km from where they were tagged (Kimura et al. 1997). While these results suggest that West Coast sablefish may have site fidelity at the 100-plus kilometer scale; scientists do not know whether sablefish could be impacted by strong fishing pressure at scales relevant for localized depletion to occur.

A full analysis of localized depletion was not completed for this report due to complications such as low observer coverage in some sectors and confidentiality requirements. A preliminary analysis of CPUE through time (2011 to 2014[110]) was possible for a small subset (four vessels) of vessels fishing in the IFQ fishery south of 36º N. latitude. Preliminary analysis of CPUE for these four boats shows high variability in CPUE between years, but no consistent downward trend (Figure 3-102). IFQ sablefish landings account for less than half of the sablefish landings south of 36º N. latitude (see Figure 3-52, Sablefish landings at ports in the Morro Bay area of California by permit type). More research is needed as little can be determined from the limited data. Attainment has been poor in this area (Appendix B).

[109] A large underwater mountain, usually conical in shape, and at least 1,000 m (3,280 feet) above the ocean floor (dictionary.com)

[110] In 2015, a large amount of the IFQ pot fishery began to use EM rather than 100 percent observer coverage; when drafting this report, data from those EM hauls were not available in the necessary format. For that reason, NMFS focused analysis from 2011 to 2014, prior to EM.

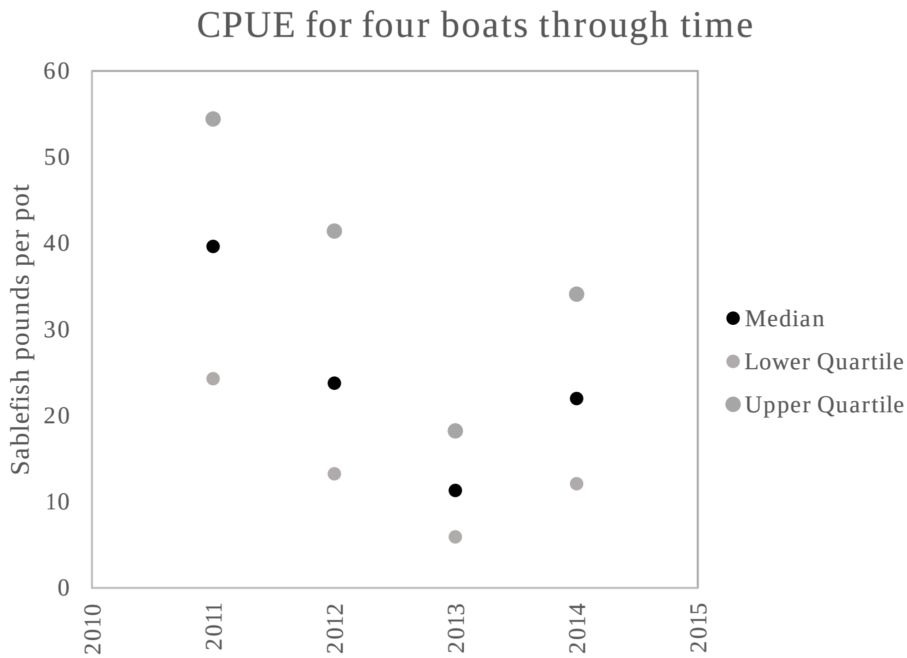


Figure 3-102. CPUE (sablefish pounds caught per pot) for four IFQ boats that have targeted sablefish south of 36° N. latitude during all four years (2011 to 2014). Results show the median (the middle value) and the upper and lower quartiles (i.e., 50 percent of the CPUE numbers measured fall within the two quartiles pictured). Source: WCGOP data.

Even if localized depletion does not impact this species, the comments received from fishermen suggest that there may be some user conflict between gears.[111] Observer data was used to assess overlap in area fished between catch share pot fishermen and non-catch share, hook-and-line fishermen south of Point Lopez (approximately 36° N. latitude). The results include two main outputs: a map showing non-confidential effort in fixed gear fisheries south of Point Lopez (Figure 3-103) and analysis of the potential interaction between observed sets. The map displays effort as a line density raster, showing kilometer of sets per square kilometer based on a search radius of 5,000 km and an output cell size of 200 square km. To maintain confidentiality, any cells in the map where fewer than three vessels were active within the given time period (which varies depending on the fishery) are not shown. The methods follow those in Somers et al. (2015).

The locations of nearly 100 percent of the hauls in the catch share pot fishery were available from observer data (2011 to 2015) and electronic monitoring data (2015). However, a much lower percentage

[111] See public hearing summaries available at the following website: http://www.pcouncil.org/groundfish/five-year-review-trawl-catch-share-program-amendment-20-intersector-allocation-amendment-21/

of the non-catch share fisheries was observed. Non-catch share pot and non-catch share hook-and-line consist of any observed sets from the limited entry sablefish primary, limited entry non-endorsed, and open access fixed gear fisheries from 2002 to 2015. The annual coastwide coverage rate based on landings for these fisheries ranges from one percent to 38 percent.

The maps can be used to understand where high-use areas are for each fishery to suggest where conflicts might exist. For example, south of Point Conception, non-catch share hook-and-line fishermen tend to target nearshore areas, while catch share pot fishermen target areas west of the Channel Islands. This suggests minimal overlap of these fisheries south of Point Conception. Maps also show that the majority of catch share pot hauls are between Point Lopez and Point Conception, while the highest concentration of non-catch share hook-and-line and pot gear is farther south. However, for fishermen who fish non-catch share hook-and-line between Point Lopez and Point Conception, there appears to be a high potential for overlap in areas targeted by the catch share pot fishermen. The third panel of the map also shows that non-catch share pot effort is very low in this area, so the potential for overlap of non-catch share pot with non-catch share hook-and-line prior to catch share implementation was almost nonexistent.

Observer data can be used to assess the number and percentage of observed non-catch share hook-and-line sets that directly intersect catch share pot sets. For the area that lies between Point Lopez and Point Conception, 65 percent of the location of observed non-catch share, hook-and-line sets, representing 72 percent of the observed hooks for that area, directly overlapped with the location of catch share pot sets. In comparison, south of Point Conception, less than 1 percent of the location of observed non-catch share, hook-and-line sets directly overlapped with the location of catch share pot sets. As the analysis looked only at spatial overlap and combined many years of data, fishing times for the overlapping sets could significantly differ. This is especially true given the years included in the analysis: 2011 to 2015 for catch share pots and 2002 to 2015 for the observed portion of the non-catch share hook-and-line fishery. However, the high percentage of spatial overlap matches the reports provided in public testimony and suggests that potential gear conflicts could exist for this area.

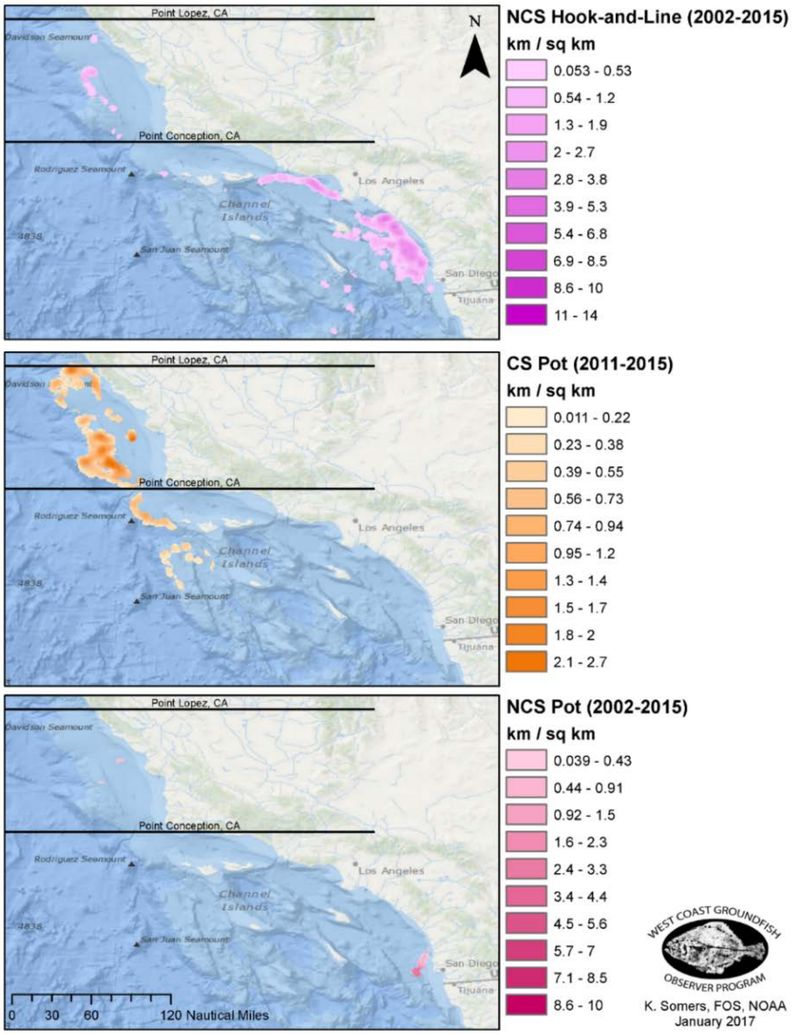


Figure 3-103. Map showing non-catch share (NCS) hook-and-line fishing locations, catch share (CS) pot fishing locations, and non-catch share pot fishing locations. Years included for each sector differ (see above). Effort is not equal between the three maps as the effort in each panel is scaled to the total effort by the sector and gear coastwide. Observer coverage levels and effort are also not equal between the different fisheries. Catch share results are from 100 percent observer coverage (except EM hauls), while non-catch share results are for only the observed trips. For 2015, electronic monitoring logbook data were used for unobserved electronically monitored pot hauls. Source: WCGOP data.

3.3.5 Protected Species

The resilience of marine ecosystems and coastal communities depends on healthy populations of all marine species, including protected species such as marine mammals, sea turtles, marine birds, and endangered fish species. Therefore, it is important to consider how changes in fisheries management impact protected species. Management of these species comes under one or more of the following laws:

the Marine Mammal Protection Act, the Endangered Species Act (ESA), and the Migratory Bird Treaty Act. The Marine Mammal Protection Act protects all marine mammals within the waters of the United States, while the Migratory Bird Treaty Act prohibits possession, transport, or sale of migratory birds, including eggs, nests, and parts. The purpose of the ESA is to protect and recover threatened and endangered species and the ecosystems upon which they depend. The U.S. Fish and Wildlife Service (USFWS) has primary responsibility for terrestrial and freshwater organisms (including marine birds), while NMFS has primary responsibility for marine and diadromous wildlife such as whales and fish.

This section of the report contains information on West Coast groundfish fisheries impacts on marine mammals, marine turtles, marine birds, and fish species listed under ESA. Data for this section come primarily from WCGOP data (Jannot et al. 2016) and reports.[112]

3.3.5(a) Endangered Fish Species

Protected fish species captured incidentally by the West Coast groundfish fisheries include several species of Pacific salmon, green sturgeon, and eulachon. They are discussed in the sections below.

3.3.5(a)(1) Salmon Species

Highlights:

- Chinook salmon have the highest bycatch across West Coast groundfish fisheries. Most Chinook salmon bycatch is from midwater trawls in the whiting sectors. Catch of Chinook salmon within these whiting sectors has increased from an average of 5,727 individuals (2002 to 2010) to 7,064 individuals (2011 to 2013) after catch share program implementation, but Chinook salmon bycatch decreased slightly in 2012 and 2013 compared to 2011.
- Fishermen have noted the “risk of closure [associated with exceeding overfished rockfish limits] has led them to give some degree of priority to darkblotched rockfish and POP over other species, like Chinook salmon, where the consequence of missing the performance standard is less severe” (Washington Department of Fish and Wildlife [WDFW] 2016, pg. 17).
- Bycatch has varied, but it has remained relatively low in the non-whiting sectors since 2005 (less than 900 individual Chinook salmon per year).
- Bycatch of other salmon species was historically low, and has remained low, except for a large amount of pink salmon caught in the shoreside whiting fishery in 2011.

[112] https://www.nwfsc.noaa.gov/research/divisions/fram/observation/index.cfm

Twenty-eight populations of salmon and steelhead on the United States West Coast are currently listed under ESA as threatened or endangered (PFMC 2016b). Salmon are anadromous fish, meaning they reproduce in freshwater streams and then migrate to the ocean to mature before returning to freshwater to finish their lifecycle. The NWFSC observer program has estimated bycatch mortality for salmon species prior to and after the start of the catch share program (Table 3-136; Somers et al. 2014[113]). Overall, pre-catch share fisheries were observed less than 25 percent of the time, which changed to 100 percent in 2011. Estimates prior to 2011 are extrapolations from the observed fishing trips. Groundfish fisheries outside this catch share program are included to provide information on total mortality experienced by the stocks.

Chinook salmon have the highest bycatch across West Coast groundfish fisheries. Most Chinook bycatch is from midwater trawls in the whiting sectors. Catch of Chinook within these whiting sectors has increased from an average of 5,727 mt (2002 to 2010) to 7,064 mt (2011 to 2013)[114] after implementation of the catch share program, but chinook bycatch has decreased slightly in 2012 and 2013 compared to 2011. The West Coast has a bycatch threshold of 11,000 Chinook per year for the whiting fisheries and a threshold of 6,000 to 9,000 Chinook in the bottom trawl fishery. Should the 11,000 threshold be met, NMFS may implement the Ocean Salmon Conservation Zone under automatic authority, in which fishing is prohibited shallower than 100 fathoms.[115] In October of 2014, NMFS estimated that the catch of Chinook in the whiting fishery exceeded 11,000 pounds and, thus, implemented the Ocean Salmon Conservation Zone.[116]

When fishermen decide on fishing locations, there can be a tradeoff between bycatch of constraining rockfish species and bycatch of Chinook salmon. Fishermen have noted the “risk of closure [associated with exceeding overfished rockfish limits] has led them to give some degree of priority to darkblotched and POP over other species, like Chinook salmon, where the consequence of missing the performance standard is less severe” (Washington Department of Fish and Wildlife [WDFW] 2016, pg. 17).

Within the non-whiting sectors, the bycatch of Chinook has decreased through time. There was high bycatch during the first two years of the observer program (14,915 and 16,460 estimated individual fish in

---

[113] An updated assessment of salmon bycatch should be available in 2017, and it will include estimates of bycatch for 2014 to 2016.

[114] Bycatch decreased in 2015 and 2016, at the time of writing data were only available through 2014. New information was presented at the March and April 2017 meetings, including a proposed action that the Council adopted for a salmon ESA consultation with higher bycatch potential in the non-whiting fishery.

[115] 50 CFR 660.60(d), subpart C

[116] http://www.westcoast.fisheries.noaa.gov/publications/fishery_management/groundfish/public_notices/nmfs-sea-14-23.pdf

2002 and 2003, respectively). Bycatch rates decreased starting in 2004. Possible causes for this decrease in mortality include management changes such as implementation of the rockfish conservation areas, small footrope requirements, or cutback, low-rise head rope requirements (PFMC 2016b). Bycatch has varied, but have remained relatively low in the non-whiting sectors since 2005 (less than 900 individual Chinook per year).

Bycatch of other salmon species was historically low, and has remained low, except for a large amount of pink salmon caught in the shoreside whiting fishery in 2011.

Table 3-137. Estimated bycatch count of salmon in all United States West Coast fisheries observed by the West Coast Groundfish Observer Program (WCGOP) and the At-Sea Whiting Observer Program (* = A-SHOP) from 2002 to 2013, as well as salmon bycatch in shoreside Pacific whiting sectors (** = numbers from annual NWR reports). Dashes (--) signify years when the fishery/sector was not observed, or data were not available. Source: Table 30 in Somers et al. 2014.

Species		Sector	Year											
			2002	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Chinook	**Non-Hake Sectors**	Limited Entry Trawl	14534	16340	1729	818	68	193	324	299	53	--	--	--
		Open Access and Limited Entry California Halibut	381	120	492	424	107	124	75	0	17	32	0	25
		Nearshore Fixed Gear in the North	--	41	33	32	20	0	0	22	16	8	64	404
		catch share Non-Hake Bottom Trawl	--	--	--	--	--	--	--	--	--	175	304	323
		catch share Non-Hake Midwater Trawl	--	--	--	--	--	--	--	--	--	*	12	55
	Hake Sectors	catch share Shoreside	--	--	--	--	--	--	--	--	--	3727	2321	1258
		Catcher-processor *	954	570	416	1754	112	733	493	22	257	2693	1928	1758
		Non-Tribal Mothership *	709	2047	387	2204	1080	584	225	296	457	1296	2281	1981
		Tribal Mothership *	1004	3404	3693	3904	660	710	157	824	650	371	0	--
		Shoreside – exempted fishing permit (EFP) **	1062	425	4206	4018	839	2462	1962	279	2997	--	--	--
		Shoreside - Tribal **	0	9	50	76	1271	1690	539	1321	28	535	17	1025
Chum	**Non-Hake Sectors**	Limited Entry Trawl	14	36	4	0	0	0	0	0	0	--	--	--
		catch share Non-Hake Midwater Trawl	--	--	--	--	--	--	--	--	--	*	0	1
		catch share Shoreside	--	--	--	--	--	--	--	--	--	42	3	7
	Hake Sectors	Catcher-processor *	14	8	27	8	8	73	43	0	4	34	51	26
		Non-Tribal Mothership *	10	3	28	12	79	96	17	41	6	12	2	0
		Tribal Mothership *	51	9	11	2	24	0	0	11	1	19	0	--
		Shoreside - EFP **	--	--	--	--	--	113	8	2	8	--	--	--
		Shoreside - Tribal **	--	--	--	--	--	8	11	0	0	4	0	1
Coho	**Non-Hake Sectors**	Limited Entry Trawl	25	31	65	5	0	13	0	0	31	--	--	--
		Limited Entry California Halibut	0	0	0	0	48	0	0	0	--	--	--	--
		Nearshore Fixed Gear in the North	--	0	38	0	0	11	42	71	42	64	16	581
		Limited Entry Sablefish Primary	0	5	0	6	0	4	0	0	0	0	0	0

Table 3-137. Estimated bycatch count of salmon in all U.S. west coast fisheries observed by the West Coast Groundfish Observer Program (WCGOP) and the At-Sea Whiting Observer Program (* = A-SHOP) from 2002-2013, as well as salmon bycatch in shoreside Pacific Whiting sectors (** = numbers from annual NWR reports). Dashes (--) signify years when the fishery/sector was not observed, or data were not available. Source: Table 30 in Somers et al. 2014 (continued)

Species	Sector		Year 2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
		Catch share Non-Hake Bottom Trawl	--	--	--	--	--	--	--	--	--	20	27	49
		Catch share Shoreside	--	--	--	--	--	--	--	--	--	137	15	33
	Hake Sectors	Catcher-processor *	69	0	1	4	2	88	3	0	0	0	13	0
	Hake Sectors	Non-Tribal Mothership *	77	3	0	82	26	138	18	12	0	5	4	6
	Hake Sectors	Tribal Mothership *	23	191	207	344	3	9	0	8	5	10	0	--
	Hake Sectors	Shoreside - EFP **	--	--	--	--	--	141	10	37	16	--	--	--
	Hake Sectors	Shoreside - Tribal **	--	--	--	--	--	98	21	49	0	17	0	91
Pink	Non-Hake Sectors	Limited Entry Trawl	0	0	0	0	0	0	0	2	0	--	--	--
Pink	Non-Hake Sectors	catch share Non-Hake Bottom Trawl	--	--	--	--	--	--	--	--	--	0	2	0
Pink	Hake Sectors	Catch share Shoreside	--	--	--	--	--	--	--	--	--	6113	0	2
Pink	Hake Sectors	Catcher-processor *	0	13	0	48	0	19	0	0	0	10	22	34
Pink	Hake Sectors	Non-Tribal Mothership *	0	4	0	0	0	15	0	2	0	2	0	3
Pink	Hake Sectors	Tribal Mothership *	0	3747	0	383	0	0	0	0	0	382	0	--
Pink	Hake Sectors	Shoreside - EFP **	--	--	--	--	--	47	7	26	0	--	--	--
Pink	Hake Sectors	Shoreside - Tribal **	--	--	--	--	--	513	9	129	0	808	0	5
Sockeye	Non-Hake Sectors	Catch share Non-Hake Bottom Trawl	--	--	--	--	--	--	--	--	--	1	0	0
Sockeye	Hake Sectors	Catch share Shoreside	--	--	--	--	--	--	--	--	--	2	0	0
Sockeye	Hake Sectors	Catcher-processor *	0	0	0	0	0	0	2	0	2	0	0	0
Sockeye	Hake Sectors	Shoreside - Tribal **	--	--	--	--	--	0	0	0	0	2	0	0
Unspecified	Non-Hake Sectors	Limited Entry Trawl	12	3	36	0	0	0	0	0	0	--	--	--
Unspecified	Non-Hake Sectors	Limited Entry California Halibut	147	0	0	0	0	0	0	0	0	--	--	--
Unspecified	Non-Hake Sectors	Nearshore Fixed Gear in the North	--	0	0	0	0	0	0	0	26	0	0	0

Table 3-137. Estimated bycatch count of salmon in all U.S. west coast fisheries observed by the West Coast Groundfish Observer Program (WCGOP) and the At-Sea Whiting Observer Program (* = A-SHOP) from 2002-2013, as well as salmon bycatch in shoreside Pacific Whiting sectors (** = numbers from annual NWR reports). Dashes (--) signify years when the fishery/sector was not observed, or data were not available. Source: Table 30 in Somers et al. 2014 (continued)

Species			Year											
	Sector		2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
		Catch share Non-Hake Bottom Trawl	--	--	--	--	--	--	--	--	--	0	2	0
	Hake Sectors	Catch share Shoreside	--	--	--	--	--	--	--	--	--	0	11	0
		Catcher-processor *	0	0	0	0	0	0	18	0	0	6	0	1
		Non-Tribal Mothership *	3	186	0	0	0	0	0	0	2	0	0	0
		Tribal Mothership *	1	0	9	8	0	0	0	0	0	0	0	--
		Shoreside - EFP **	--	--	--	--	--	0	0	0	2	--	--	--

3.3.5(a)(2) Green Sturgeon

Highlights:

- Observed green sturgeon catches in this fishery have ranged from 0 to 40 individuals per year since 2002, with highest levels occurring after the implementation of the catch share program.
- Green sturgeon catches shown in are much lower than during many years prior to 2002 when green sturgeon could be caught by trawl and sold.
- Other west coast fisheries also catch sturgeon. For example, expanded bycatch estimates for the limited entry and open access California halibut fishery ranged from 29 to 664 individuals per year from 2011 to 2015 (Lee et al. 2017).

Green sturgeon are a slow growing, long-lived species that can reach a length of 8 feet and a weight of 350 pounds (Moser et al. 2016). They are broadly distributed, reaching from the west coast of Mexico north to the Bering Sea in Alaska. They feed on benthic invertebrates such as shrimp, mollusks, amphipods, and small fish. Juvenile sturgeon reside in freshwater, while adults can be found in estuaries, bays, and nearshore oceanic waters when they are not spawning (Moser et al. 2016). There are two genetically distinct populations of green sturgeon, of which the southern population is listed as threatened under the ESA (Moser et al. 2016). The southern population has only one known spawning area in the Sacramento River system, making this population more vulnerable to catastrophic events (Lee et al. 2017).

Most sturgeon have been caught in the bottom trawl fishery off Oregon. All but three observed catches of sturgeon in West Coast bottom trawls have been from bottom trawls off Oregon (Table 3-138; Lee et al. 2017). Observed green sturgeon catches by this fishery have ranged from 0 to 40 individuals per year since 2002 (Table 3-138), with highest levels occurring after the implementation of the catch share program. Green sturgeon catches shown in Table 3-138 are much lower than during many years prior to 2002 when green sturgeon could be caught by trawl and sold. For example, reported catches by the limited entry bottom trawl fleet ranged from 78 to 1,074 individuals annually from 1985 to 1994 (Adams et al. 2007). Trawl catches prior to 2002 typically occurred shoreward of 60 fathoms (110 m) and took place off both the Oregon and Washington coasts (Erickson and Hightower 2007).

Other West Coast fisheries also catch sturgeon. For example, expanded bycatch estimates for the limited entry and OA California halibut fishery ranged from 29 to 664 individuals per year from 2011 to 2015 (Lee et al. 2017). The at-sea whiting sector caught three sturgeon in 2005 and 2006, and none in any other year (2002 to 2015) (Table 3-138).

Table 3-138. Expanded estimate of green sturgeon bycatch in shoreside trawl and at sea whiting sectors through time. Actual observed bycatch was expanded to estimate catch in non-observed trips. The numbers in parenthesis represent estimated catch for the threatened southern population. For this table, the at-sea sector includes catcher-processors, motherships, and tribal motherships. Source: Lee et al. 2017.

	Shoreside Trawl (limited entry/IFQ)			At-Sea Whiting	Total estimated bycatch of S. population
	Washington	Oregon	California		
Year	(S. pop 48%)	(S. pop 48%)	(S. pop 95%)	(S. pop 48%)	
2002	0	13 (6.3)	7 (6.7)	0	13
2003	0	0	0	0	0
2004	5 (2.4)	5 (2.4)	0	0	5
2005	0	5 (2.4)	0	1 (0.5)	2
2006	0	0	0	2 (0.96)	1
2007	0	6 (2.9)	0	0	3
2008	0	0	0	0	0
2009	6 (2.9)	37 (17.9)	0	0	21
2010	0	8 (3.9)	0	0	4
2011	0	38 (20.5)	0	0	20
2012	0	22 (10.7)	0	0	11
2013	0	10 (5.5)	0	0	5
2014	0	40 (14.6)	0	0	15
2015	0	5 (2.5)	1 (1)	0	3

3.3.5(a)(3) Eulachon

Highlights:

- Bycatch of eulachon has increased in recent years. A large bycatch incident occurred in 2011 for the catcher-processor fleet, in 2013 for the shoreside whiting fleet, and in 2014 for the shoreside non-whiting fleet. The incidental take for this species is set at 1,004 fish per year, and it was exceeded in 2011, 2013, and 2014.
- Comparisons between pre- and post- catch share management may not be valid for this species since observers were not required to identify smelts to the species level prior to 2010 (PFMC 2015). However, WCGOP has high confidence in those that were identified and in the smelt bycatch totals in general (R. Shama, pers. comm.).
- Indices of eulachon abundance increased at the same time as the start of the catch share program (2011) which could explain the recent increase in bycatch (Gustafson et al. 2017).

Eulachon are a small, relatively short lived (most live 3 to 4 years, but some have been found to be 9 years old) silvery fish in the smelt family that can be found from Northern California to southern Alaska

(Wilson 2006). Like salmon and green sturgeon, they are anadromous. Large aggregations of eulachon can be found prior to their spring spawning season off the mouth of rivers and streams. The newly hatched larvae are transported out of the rivers to the ocean where they prey on marine plankton. Adults remain offshore, and they can be found near the bottom of the continental shelf at depths between 20 to 200 meters (Wilson 2006).

Bycatch of eulachon has increased in recent years (Table 3-139). Most of the catch occurs off Oregon, but a small amount occurs off Washington (Table 3-139). A large bycatch incident occurred in 2011 for the catcher-processor fleet, in 2013 for the shoreside whiting fleet, and in 2014 for the shoreside non-whiting fleet. The incidental take for this species is set at 1,004 fish per year, and it was exceeded in 2011, 2013, and 2014. Comparisons between pre- and post- catch share management may not be valid for this species. Observers were not required to identify smelts to the species level; therefore, eulachon may not have been identified properly prior to 2010 (PFMC 2015). However, WCGOP has high confidence in those that were identified and in the smelt bycatch totals in general (R. Shama, pers. comm.).

Eulachon is a short-lived species, and population abundance can vary annually. The population has been recovering since it was listed under ESA, and new research suggests that bycatch amounts seem to be a function of eulachon population size. Indices of eulachon abundance increased at the same time as the start of the catch share program (2011), which could explain the recent increase in bycatch (Gustafson et al. 2017). Theoretically, eulachon are small enough to escape from trawls (given current mesh size restrictions), and captures may occur when cod-end of trawls becomes clogged (Gustafson et. al. 2017). Thus, the current incidental take threshold of 1,004 fish may not reflect the appropriate level of bycatch when the species is abundant (WDFW 2016).

Table 3-139. Expanded estimate of eulachon bycatch from shoreside trawls and at-sea whiting sectors through time. Actual observed bycatch was expanded to estimate catch in non-observed trips. Source: Gustafson et al. 2017.

	Shoreside Non-Whiting			Shoreside Whiting	At-Sea Whiting			TOTAL
	Washington	Oregon	California		catcher-processor	mothership	Tribal mothership	
2002	0	783	0	--	0	0	0	783
2003	0	52	0	--	0	0	0	52
2004	0	0	5	--	0	0	0	5
2005	0	0	0	--	0	0	0	0
2006	0	0	0	--	147	0	0	147
2007	0	72	0	--	6	4	0	82
2008	0	0	0	--	37	6	0	43
2009	0	67	0	--	30	6	32	135
2010	0	0	22	--	0	0	0	22
2011	12	127	0	0	1268	54	160	1621
2012	1	167	0	0	16	7	0	191
2013	137	521	0	4139	39	277	na	5113
2014	292	2516	0	0	242	25	na	3075
2015	0	641	2	0	56	0	na	699

3.3.5(b) Marine Mammals and Birds

Observers on fishing boats record interactions with marine mammals and birds (Jannot et al. 2016). Interactions with the fishing sectors can be high if animals are attracted to the boats as a source of prey (PFMC 2016b). While observers document multiple categories of interactions (including boarded vessel, deterrence used, feeding on catch, previously dead, entangled in gear, and killed), this discussion covers only those observations of animals entangled in gear or killed (Kristy Long, NMFS, pers. comm.).

3.3.5(b)(1) Marine Mammals

Highlights:

- Most lethal marine mammal interactions involve California or Stellar sea lions. Documented lethal interactions with Stellar sea lions increased from an average of less than two mortalities observed from 2002 to 2010, to an average of 6.8 mortalities from 2011 to 2014. However, this increase is similar to what would be expected from the increased observer coverage alone. Similarly, lethal interactions with California sea lions increased from an average of 2.5 to 6.8 mortalities per year.

- Large whales can be hurt or killed when they get tangled in lines from fishing pots. Therefore, management that results in fishermen switching from trawl gear to pots could increase interactions with large whales.

Most lethal marine mammal interactions involve California or Stellar sea lions (Table 3-140). The number of trips with observer coverage has increased from around 20 percent before catch shares to 100 percent during catch shares. Therefore, total observed interactions with marine mammals are expected to increase when the observer coverage increases. Documented lethal interactions with Stellar sea lions increased from an average of less than two mortalities observed from 2002 to 2010, to an average of 6.8 mortalities from 2011 to 2014. However, this increase is similar to what would be expected from the increased observer coverage alone. Similarly, lethal interactions with California sea lions increased from an average of 2.5 to 6.8 mortalities per year.

Modifications in fishing behavior can affect interactions with marine mammals. For example, because some large whales can be negatively impacted by lines from fishing pots (NMFS 2016c), management that results in fishermen switching from trawl gear to pots could have a negative effect. In 2014, a humpback whale became entangled in a portion of the ground line between limited entry sablefish pots and drowned (Hansen et al. 2015). From 2010 to 2014, 27 interactions occurred between humpback whales and fishing pots or traps: 5 were non-serious, 4 were lethal, and 18 caused serious injuries (NMFS 2016c). Other modifications in fishing behavior, such as changes to depth, latitude, season, and time of day could affect interactions with marine mammals; however, detailed information matching fishing behavior to interactions with marine mammals are not available at this time.

Table 3-140. Observed serious interactions between marine mammals and at-sea or IFQ fisheries from 2002 to 2014. Source: NMFS 2016d.

			2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Entangled in Gear	Catcher-processor	Midwater Trawl									2			1	
		Northern Elephant Seal												1	
		Steller Sea Lion									2				
	Limited entry and catch share bottom trawl	California Sea Lion		2		3	2		2	4		8	6	5	2
		Sea Lion/Seal Unid.					1					1		1	
		Steller Sea Lion			10		1	1		14	13	24	17	12	9
	Mothership catcher vessels	California Sea Lion											1		
		Steller Sea Lion													1
Killed	Catcher-processor	California Sea Lion		2	2		1		1			1		1	4
		Harbor Seal				1	1		1						
		Northern Elephant Seal			3			1	5	1	2				
		Steller Sea Lion	1	1		2	2	3	1		8	1	1	2	3
	Limited entry and catch share bottom trawl	California Sea Lion	2	7	1	3	3	2	0	4	0	10	7	1	9
		Northern Elephant Seal						1		1		1			
		Pacific White-sided Dolphin		1											1
		Steller Sea Lion	2	0	0	0	0	2	0	4	7	14	5	4	4
		Harbor Seal						1							
		Rissos Dolphin							1						
		Sea Lion Unid	1												
	Hook-and-line	Northern Elephant Seal										2			
	Whiting midwater trawl	California Sea Lion													1
		Northern Elephant Seal										1			
		Steller Sea Lion										1			1
	Mothership catcher vessels	California Sea Lion	1				1				1			1	
		Northern Elephant Seal						1	2				1		
		Otariid Unid.									1				
		Steller Sea Lion					1				1	1			1
		Grand Total	9	13	17	9	13	12	14	28	35	65	38	28	36
		Observer Coverage	14-25%									100%			

3.3.5(b)(2) Marine Birds

Highlights:

- Increased observer coverage resulted in more observed interactions between fishing boats and marine birds since implementation of the catch share program. The biggest changes were western gull, which had high mortality in the hook-and-line fishery in 2011, and black-footed albatross, which has had a slight increase in hook-and-line mortality since 2010.

Observed interactions between fishing boats and marine birds have increased since catch share program implementation (Table 3-141). However, because the numbers of observed interactions are expected to increase with higher observer coverage, the increases seen after 2011 may be due to changes in the number of trips observed. The two exceptions may be the western gull, which had high mortality in the hook-and-line fishery in 2011, and the black-footed albatross, which has experienced a slight increase in hook-and-line mortality since 2010. Black-footed albatross impacts have been used to predict effects on short-tailed albatross, a rarely encountered, but endangered, species that shares the same habitat (Good et al. 2017). Therefore, all interactions between fishing gears and black-footed albatross are provided (Table 3-142). However, the 2017 report on short-tailed albatross used Bayesian models to predict estimated bycatch of short-tailed albatross without information on black-footed albatross (Good et al. 2017).

3.3.5(c) Marine Turtles

Highlights:

- Only one marine turtle mortality has been observed in any of the West Coast fisheries; in 2008, one leatherback turtle was killed in the open access pot fishery.

Four species of marine turtles spotted off the West Coast are protected under ESA: green sea turtle, olive Ridley, loggerhead, and leatherback (PFMC 2016b). Between 2006 and 2015, only one marine turtle mortality has been observed in any of the West Coast fisheries (PFMC 2015, Bjorkland 2014). In 2008, one leatherback was killed in the open access pot fishery. At this time there is not enough information to determine if the implementation of the catch share program will have any impact on marine sea turtles compared to previous management.

Table 3-141. Observed serious interactions between seabirds at-sea sectors, midwater trawl, or IFQ fisheries from 2002 to 2014. Source: NMFS 2016d.

			2002	2003	2004	2005	2006	2007	2008	2009	2010		2011	2012	2013	2014
Entangled in Gear	Limited entry and catch share bottom trawl	Black-footed Albatross			1	1										
		Storm-Petrel Unid.		1									1		1	
	Midwater trawl	Shearwater Unid.											1			
	Pot	Storm-Petrel Unid.													1	
Killed	Limited entry and catch share bottom trawl	California Gull														1
		Common Murre			2											
		Herring Gull											1			
		Leachs Storm-Petrel	1					1								
		Murre Unid.												1		
		Northern Fulmar	1											1		
		Sooty Shearwater													2	
		Storm-Petrel Unid.			1											
	Hook-and-line	Black-footed Albatross											5	4		2
		Gull Unid.				1							1	1		
		Mew Gull											1			
		Northern Fulmar														2
		Western Gull											1	29		
		Grand Total	2	1	4	2	0	1	0	0	0		12	36	4	5
		Observer Coverage	14-25%										100%			

Table 3-142. All observed interactions between black footed albatross and limited entry, IFQ and midwater trawl fisheries (NMFS 2016d).

		2002	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Bottom Trawl (limited entry or IFQ)	Boarded vessel					1				40		8	
	Deterrence used											36	
	Entangled in gear		1	1									
	Feeding on catch	130	40	50	1	50	27	261	65	122		176	253
	Other												25
Hook & Line IFQ	Killed by gear									5	4		2
Midwater Trawl	Gear interaction (catcher-processor)					2	1		1	3			
	Third Wire, Paravane, or warp cable contact (catcher-processor)								2	2	1	2	1
	Feeding on catch (mothership)											75	
	Feeding on catch shoreside whiting)									242			
	Total	130	41	51	1	53	28	261	68	414	5	297	281

3.3.6 Habitat Impacts

Highlights:

- The bottom trawl effort across gears dropped significantly with catch share program implementation; the total number of hauls significantly decreased from an average of 16,095 (2002 to 2010) to 11,076 (2011 to 2014). Bottom trawl effort is higher in the north than in the south, with nearly all effort occurring over the shelf and slope in soft-bottom areas (NMFS 2013).
- Comparison of trawled areas before and after the catch share program show areas that are no longer trawled. However, changes in habitat structure due to reductions in trawling depends on the type of bottom habitat, (i.e., soft bottom, hard bottom, or reef), previous trawl intensity, as well as the gear type used (footrope size, chafing gear). In general, trawl impacts are held to be most severe when used on hard-bottom habitats and with gear that has a high degree of contact with the bottom surface (NRC 2002).

- The switch from trawl to fixed gears could have resulted in a decrease in habitat impacts on trawlable habitats. However, should the switch to fixed gear result in increased effort on sensitive hard or mixed bottom habitats, then the overall habitat impact from switching to pots or longline could be negative.

Habitat affects the survival and productivity of all marine fish life-stages through provision of shelter, food, and spawning areas. Human activities, both on the water and land-based, can negatively affect the quality and quantity of marine habitat. Degraded habitat can reduce the productivity and diversity of fish stocks, potentially resulting in negative social and economic impacts for commercial and recreational fishermen. The Council sought to address and minimize impacts to habitat while implementing Amendment 20, including consideration of impacts on essential fish habitat (EFH). The FEIS for Amendment 20 discussed potential habitat impacts, expected as a result of both gear-switching and geographic changes in fishing activities (PFMC and NMFS 2010). While trawling has been demonstrated to have potentially severe consequences for marine bottom habitats (citations), prior Council actions had sought to minimize such impacts (see Amendment 19 for more information), including gear restrictions and gear-specific closures (PFMC and NMFS 2010, 2012). In addition, while Rockfish Conservation Areas (RCAs) are not designed to mitigate habitat impacts, trawl RCAs likely also have mitigation effects (PFMC and NMFS 2010).

Marine habitats may be affected by fishermen adjusting fishing effort and methodologies in response to the new catch share program. This section uses results from previous WCGOP analysis (NMFS 2013, Somers et al. 2015) to review shifts in fishing effort before and after catch share program implementation and for a general discussion of how Amendment 20 may have impacted marine habitats off the West Coast.

3.3.6(a) Changes in Magnitude and Location of Effort

Overall fishing effort can be summarized by the total number of hauls/sets across gears/sectors through time (the sum across gears is a gross estimate of total effort as hauls are not directly comparable between gears). For habitat impacts, the sector and type of gear are important as some gears have more impact on habitat than others (Auster and Langton 1999; NRC 2002; Chuenpagdee et al. 2003; Jenkins and Garrison 2012). For example, trawling has been shown to impact ocean floor habitats by altering and/or removing the biological and physical characteristics, as well as affecting the food and shelter available for juvenile and adult fish (Auster and Langton 1999; Chuenpagdee et al. 2003; Jenkins and Garrison 2012). In comparison, midwater trawl gear is not designed for constant contact with the bottom (WDFW 2016); thus, even though it occasionally contacts the bottom, midwater trawls are expected to have minimal impact on habitat.

3.3.6(b) Changes in Midwater Trawl Effort

The effort in the mothership and catcher-processor midwater sectors has varied through time and with the whiting TAC, with no clear change in the overall magnitude of effort after implementation in 2011 (Figure 3-104). Information on effort in the shoreside midwater trawl sector is not discussed as habitat impacts are expected to be minimal, and trawls from 2002 to 2010 were under an exempted fishing permit and not observed. Most trawls targeted whiting, with a minimal but increasing number targeting rockfish.

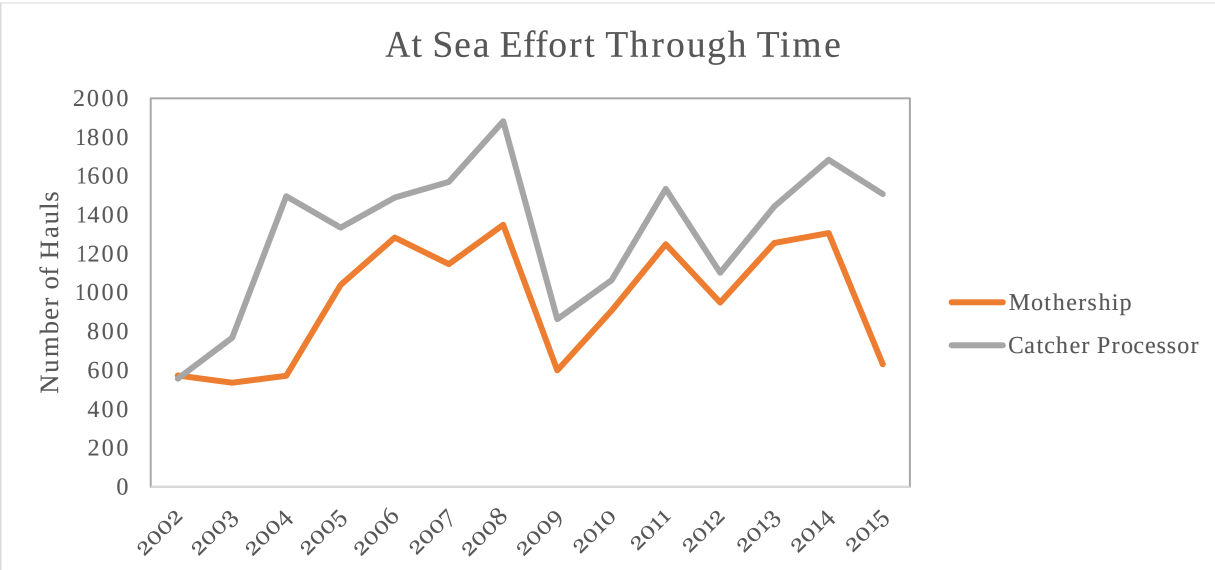


Figure 3-104. Annual effort in the at-sea sector as measured by number of hauls completed in the mothership and catcher-processor sectors. Source: WCGOP data.

3.3.6(c) Changes in Bottom Trawl Effort

The bottom trawl effort across gears dropped significantly with catch share program implementation (Figure 3-105); the total number of hauls significantly decreased from an average of 16,095 (2002 to 2010) to 11,076 (2011 to 2014). Bottom trawl effort is higher in the north compared to the south, with nearly all the effort occurring over the shelf and slope in soft-bottom areas (NMFS 2013).

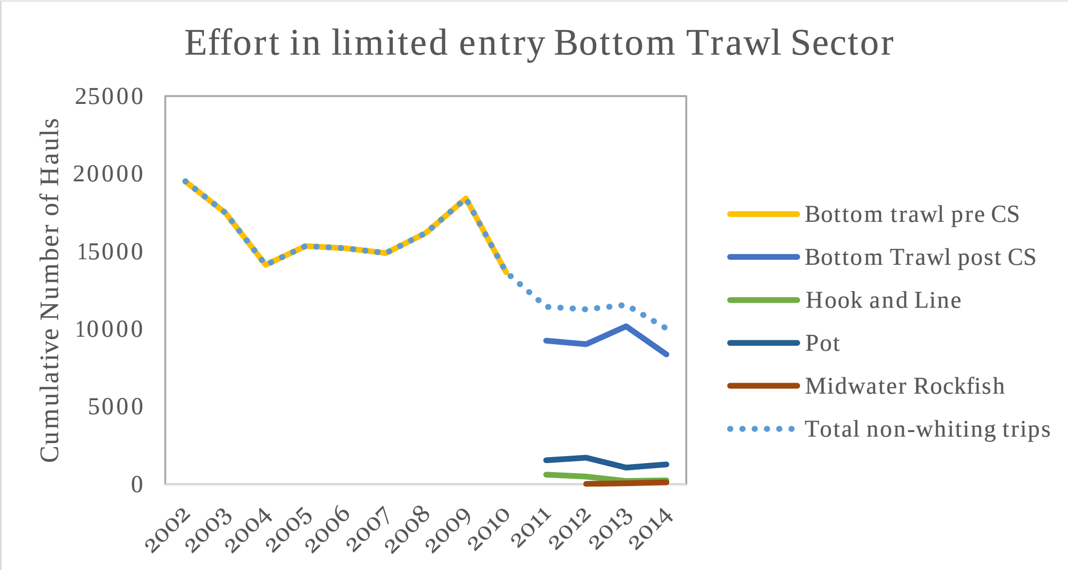


Figure 3-105. Effort (measured as number of hauls) in the limited entry bottom trawl sector through time. Source: WCGOP data.

Gear switching between trawl and fixed gear can have an impact on habitat. As part of the catch share program, fishermen were allowed to switch to fixed gear (pots or hook-and-line) to fish their quota. In addition to switching to fixed gear, some fishermen recently started using midwater trawls to target rockfish. Even though switching gears was allowed, more than 80 percent of the limited entry bottom trawl hauls from 2011 to 2014 still used bottom trawl gear (Figure 3-105). For information on the number of fishermen switching to fixed gear, or entering the fixed gear fishery, see Section 3.1.2(d)(6). In general, fixed gear types are thought to have a lower impact on bottom habitat than bottom trawls (Auster and Langton 1999; Chuenpagdee et al. 2003; Jenkins and Garrison 2012). However, the EFH EIS notes that pot and longline gear may impact bottom habitat when pots and lines are retrieved, particularly in areas with biogenic structures such as corals or sponges (PFMC and NMFS 2005). The Amendment 20 FEIS was not able to predict specific impacts on habitat based on gear switching, since effects depend highly on distribution of fishing patterns on sensitive habitats and the manner of gear deployment (PFMC and NMFS 2010). The switch from trawl to fixed gears could have resulted in a decrease in habitat impacts on trawlable habitats. However, should the switch to fixed gear result in increased effort on sensitive hard or mixed bottom habitats, then the overall habitat impact from switching to pots or longline could be negative. For all groundfish fisheries (not just this catch share program), fixed gear is most often set in the upper slope in soft sediments. However, in all regions, at least 5 percent of observed fishing effort on the shelf and upper slope occurred over hard habitat. In the central shelf area, 23.7 percent of fixed fishing effort was on hard habitat (NMFS 2013).

In order to quantify trawl intensity, the total time spent bottom trawling or the entire area trawled can be calculated for each year. Because of the large difference in fishing methods between areas, cumulative hours spent trawling are split into north and south of 40º10’ N. latitude. As shown in Figure 3-106, there was a slight decrease in the cumulative bottom trawl duration south of 40º10’ N. latitude following implementation of the catch share program. The drop in cumulative bottom trawl duration in the north was much more dramatic; there was an approximate 38 percent drop in trawling hours following implementation of the catch share program (an average of 54,000 hours from 2002 to 2010 compared to 34,000 hours from 2011 to 2013). Analysis of cumulative weighted distance of fishing gear contact shows a similar decrease from 2011 to 2015 (NMFS 2017; Figure 5.2.1). Gear innovations implemented by some vessels to reduce drag and save fuel may have caused some of the drop in trawl duration (J. Doerpinghaus, pers. comm.).

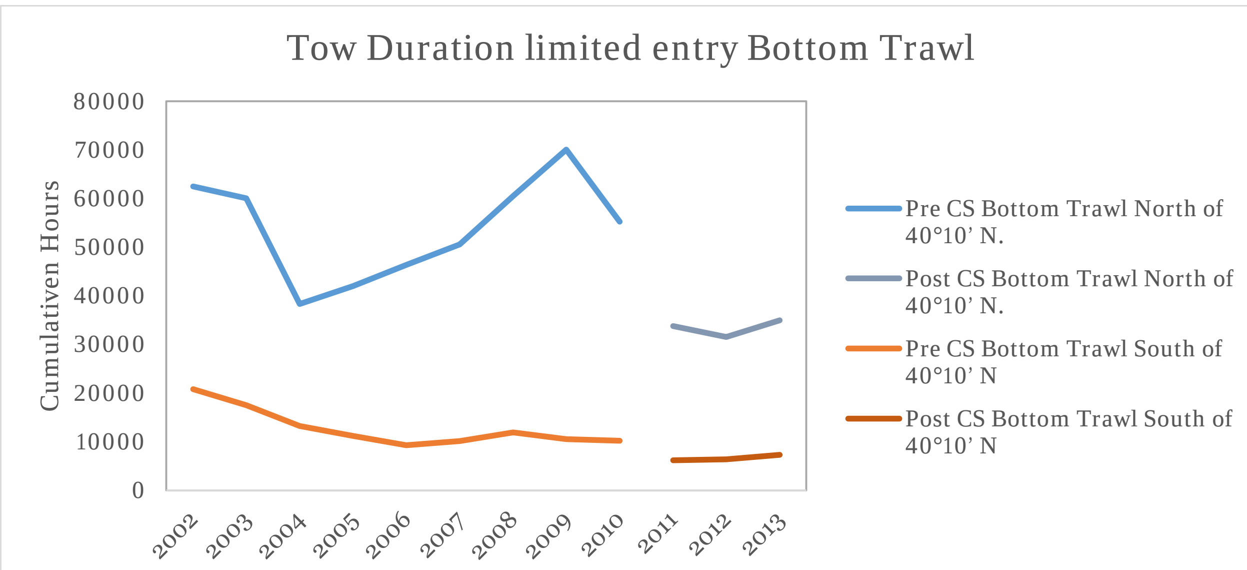


Figure 3-106. Effort (measured as total bottom trawl duration, hours) in the limited entry trawl fishery pre (prior to 2011) and post (2011 to 2013) catch share program for areas north and south of 40º 10’ latitude. Source: WCGOP data.

Trawling effort decreased for most habitats of the West Coast after implementation of the catch share program. This can be visualized through a map (Figure 3-107) showing trawl locations within three periods covering pre-implementation of EFH closures, post-implementation of EFH area closures, and post-implementation of the catch share program, respectively. Trawl effort has increased in a few areas (colored red), but these are small pockets within a map that largely shows decrease (colored green) to no change (colored yellow).

Comparison of trawled areas before and after the catch share program (Figure 3-108, Period 3 to Period 2) show areas that are no longer trawled. However, changes in habitat structure due to reductions in trawling depends on the type of bottom habitat, (i.e., soft bottom, hard bottom, or reef), previous trawl intensity, as well as gear type used (footrope size, chafing gear) (NRC 2002). In general, trawl impacts are held to be most severe when used on hard-bottom habitats and with gear that has a high degree of contact with the bottom surface (NRC 2002). Most identified West Coast habitat is soft substrate, with hard and mixed substrates covering 7.2 percent and 3.3 percent of defined area, respectively (Table 3-143; NMFS 2013). Hard and mixed areas on the shelf and upper slope are prime habitat for the majority of FMP groundfish species, including rockfish and lingcod.

Maps that overlay trawl effort and habitat are being created for ongoing review of essential fish habitat, and would be useful to enable better understanding of habitat impacts from the catch share program. However, these maps were not yet available when writing this five-year review. Maps quantifying a cumulative fishing pressure index (based on weighted scheme applied for the sensitivity of habitat and gear impacts) are available for 2002 to 2010 (NMFS 2013). Similar maps for the period after 2010 are not yet available.

In addition, while impacts on hard bottom and biogenic substrates have been well illustrated, impacts and recovery time on soft substrates (such as unconsolidated sediment) are less common, and even fewer have been conducted off the West Coast. Of these, there have been mixed conclusions concerning the impact of trawling on soft substrate habitats (Lindholm et al. 2015; de Marignac et al. 2009), ranging from no impact (Lindholm et al. 2015) to significant reductions in microhabitat structure, as well as composition and abundance of associated species at trawled sites (de Marignac et al. 2009).

Table 3-143. Amount of hard, mixed, soft, and undefined substrate present on the shelf, upper slope, and lower slope. Source: NMFS 2013.

Depth Zone	Substrate	Area (ha)	%
shelf	Hard	342655	0.4
	Mixed	122230	0.1
	Soft	5424760	6.6
	undefined	745846	0.9
upper slope	Hard	613257	0.7
	mixed	127226	0.2
	soft	9319442	11.3
	undefined	20125	0
lower slope	hard	1046598	1.3
	mixed	0	0
	soft	7326361	8.9
	undefined	57503645	69.6

Changes to depth, latitude, and seasons fished within sectors and gears have occurred since implementation of the catch share program (Appendix H; Somers 2016a), and these changes could impact habitat. Graphs showing general changes in effort are provided in Appendix H, but no inference as to impacts on habitat is included here.

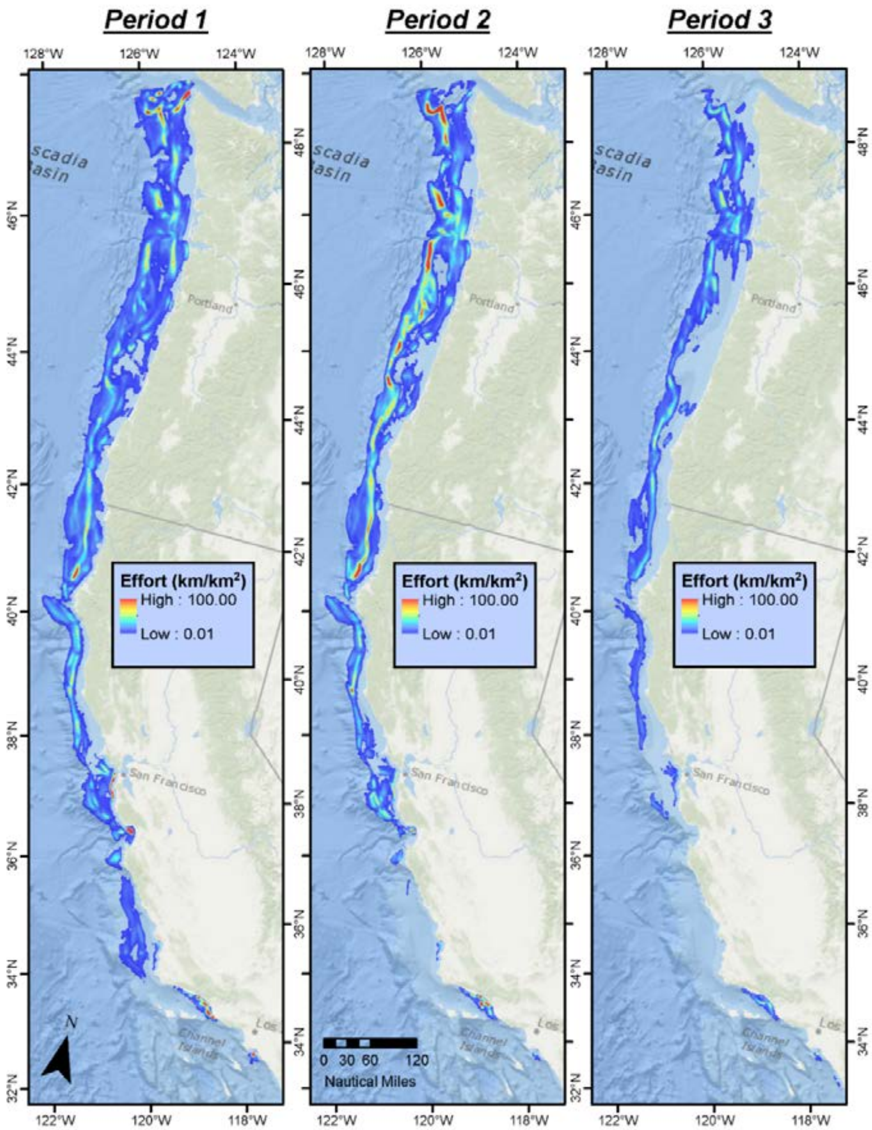


Figure 3-107. Map of limited entry and IFQ bottom trawl effort for three relevant periods. Period 1 covers January 1, 2002, to June 11, 2006; period 2 covers June 12, 2006, to December 31, 2010; period 3 covers January 1, 2011, to December 31, 2013. The first period is prior to implementation of EFH closures; the second period is after EFH area closures; the third period is after implementation of the catch share program. Period 3 includes only three years of data compared to approximately four and a half years of data for period 1 and period 2. Due to confidentiality mandates, small amounts of effort were excluded

from the maps. For example, due to a small number of trawl vessels operating off Morro Bay, California, much of the effort in the latter two periods for that area was excluded from map figures. Source: Somers, 2016.

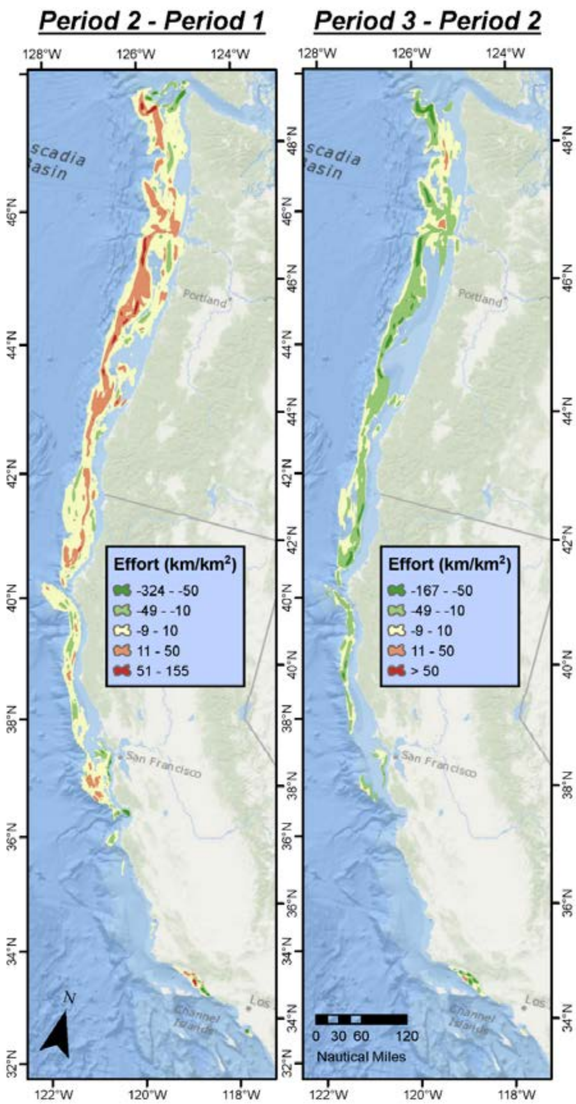


Figure 3-108. Map showing the change through time of bottom trawl effort for three relevant periods. Period 2 to Period 1 includes changes that occurred with implementation of EFH closures. Period 3 to Period 2 represents changes that occurred after implementation of the IFQ program. As in Figure 3-107, the time used for period 3 includes only three years of data compared to approximately four and a half years of data for period 1 and period 2. Source: Somers, 2016.

3.3.6(d) Lost Gear

Lost gear can have impacts on fish and habitat. Lost gear can keep "ghost" fishing, as when a lost pot attracts fish that then die and become bait, entrapping more fish or entangling protected species. Lost gear can also damage habitat when its movement through waves and currents disturbs the bottom.

WCGOP has recorded observed hauls losing and recovering gear (Table 3-144; Somers et al. 2017), but these numbers are available for observed trips only, so fisheries with lower observation rates are less likely to be observed losing gear. Since 2011, pot sets had the highest incidence of lost gear (3 percent to 5 percent) in catch share fisheries. Only 1 percent to 2 percent of observed hook-and-line lost gear, while trawl hauls lost gear less than 1 percent of the time. Recovery of lost gear was highest in trawl hauls, with 3 percent to 4 percent of observed hauls bringing in derelict gear, typically pots (Somers et al. 2017).

Table 3-144. Observations of lost and recovered gear in the IFQ fishery. Hauls with recovering gear represent hauls recovering derelict gear, not gear lost and then recovered in the same haul. N/A represents no available data. Source: WCGOP data.

Sector	**Year**	**Hauls**	**% Landings Observed**	**Hauls with Lost Gear**	**% Observed Hauls with Lost Gear**	**Hauls Recovering Derelict Gear**
Limited Entry/IFQ Non-whiting Bottom Trawl	2002	3223	15%	N/A	N/A	64
	2003	2318	14%	N/A	N/A	73
	2004	3501	24%	N/A	N/A	102
	2005	3527	22%	N/A	N/A	169
	2006	3039	19%	N/A	N/A	250
	2007	2550	17%	N/A	N/A	138
	2008	3226	20%	N/A	N/A	162
	2009	4457	23%	N/A	N/A	239
	2010	2640	18%	3	0.11%	87
	2011[1]	9197	99%	12	0.13%	404
	2012	8967	99%	4	0.04%	363
	2013	10016	100%	6	0.06%	301
	2014	8321	99%	2	0.02%	262
	2015	7479	100%	3	0.04%	281
Shoreside Midwater Trawl[2]	2011	1717	100%	0	0.00%	17
	2012	1636	100%	0	0.00%	1
	2013	1812	100%	0	0.00%	8
	2014	1858	100%	0	0.00%	9
	2015	436	100%	0	0.00%	0
IFQ Hook and Line	2011	629	100%	--	--	--
	2012	506	100%	--	--	--
	2013	215	100%	4	1.86%	--

Table 3-144. Observations of lost and recovered gear in the IFQ fishery. Hauls with recovering gear represent hauls recovering derelict gear, not gear lost and then recovered in the same haul. N/A represents no available data (continued). Source: WCGOP data.

	2014	227	90%	5	2.20%	--
	2015	185	100%	1	0.54%	0
IFQ Pot	2011	1550	100%	--	--	--
	2012	1708	100%	--	--	--
	2013	1085	100%	36	3.32%	--
	2014	1287	100%	56	4.35%	--
	2015	583	100%	33	5.66%	4
Catcher-processor	2002	559	100%	0	0.00	0
	2003	768	100%	1	0.13	0
	2004	1501	100%	1	0.07	0
	2005	1337	100%	0	0.00	0
	2006	1497	100%	0	0.00	0
	2007	1577	100%	0	0.00	0
	2008	1886	100%	0	0.00	0
	2009	868	100%	0	0.00	0
	2010	1068	100%	0	0.00	0
	2011	1549	100%	0	0.00	0
	2012	1107	100%	0	0.00	0
	2013	1459	100%	0	0.00	0
	2014	1696	100%	1	0.06	0
	2015	1519	100%	1	0.07	0
Mothership Catcher Vessel	2002	1207	100%	0	0.00	0
	2003	1076	100%	0	0.00	0
	2004	1203	100%	0	0.00	0
	2005	1673	100%	1	0.06	0
	2006	1443	100%	0	0.00	0
	2007	1303	100%	0	0.00	0
	2008	1731	100%	1	0.06	0
	2009	1004	100%	0	0.00	0
	2010	1424	100%	0	0.00	0
	2011	1476	100%	0	0.00	0
	2012	953	100%	0	0.00	0
	2013	1256	100%	1	0.08	0
	2014	1308	100%	0	0.00	0
	2015	640	100%	0	0.00	0
Electronic Monitoring Trawls	2015	57	33%	0	0.00%	0
EM Pot	2015	184	30%	8	4.35%	--

[1]2011 included some results from midwater trawl.

[2]The majority of trips targeted whiting, the few that targeted rockfish were not separated.

3.3.6(e) Fuel Use

Changes in fisheries management can have impacts on the larger environment as a whole. For example, implementation of the Ocean Salmon Conservation Zone may force fishing boats to fish farther offshore, use more fuel, and emit more pollution than they would if they were fishing closer to shore. The catch share program provides the incentives for more efficient use of resources—fewer active vessels taking fewer trips. This may decrease fuel use as well. Fuel usage through time was summarized from EDC data (Figure 3-109). Carbon dioxide is a greenhouse gas; as fuel usage increases, carbon dioxide pollution rises. Climate variability and change can impact fisheries through changes in species productivity, species distribution, habitat condition, and species interactions (e.g., predation and competition).

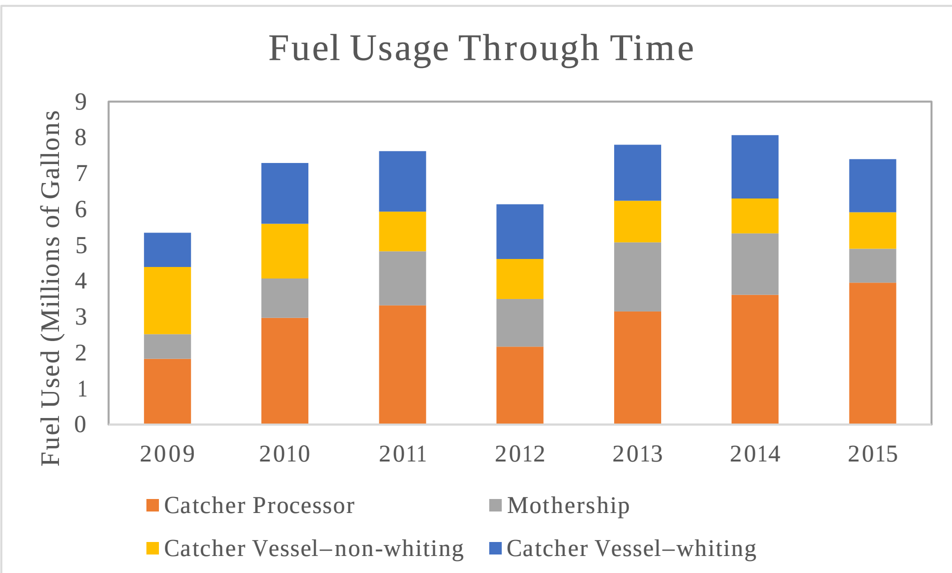


Figure 3-109. Fuel use by different sectors through time.

3.4 Program Management Performance

Due to the complexity of Amendments 20 and 21, NMFS pursued program implementation through multiple rulemakings. The "Initial Issuance" rule was published on October 1, 2010[117]. It restructured and clarified the Pacific Coast groundfish regulations to track the organization of the proposed management measures more closely, established allocations set forth under Amendment 21, and established procedures for the initial issuance of permits, endorsements, QS, and catch history assignments under the IFQ and co-op programs. The "Program Components" rule established the program elements required for implementation of the rationalized trawl fishery in 2011. It included IFQ gear switching provisions,

[117] See 75 FR 60868.

details of observer requirements and the first receiver catch monitor program, first receiver site licenses, equipment requirements, catch weighing requirements, retention requirements, QS accounts, vessel accounts for use of QP, requirements for co-op permits and co-op agreements, further tracking and monitoring components, and economic data collection requirements to support management and ongoing program review[118]. Cost recovery was implemented through subsequent Council actions[119], which requires the Secretary of Commerce to collect a fee to recover the agency's costs of management, data collection, analysis, and enforcement activities.

The MSA LAPP provisions, as well as Amendment 20, emphasize the importance of efficient and effective enforcement, monitoring, and management of the catch share program. The transition to the new management system involved cooperative enforcement by state agencies, the USCG, and the NOAA Office of Law Enforcement. Litigation, both directly related to various aspects of the West Coast groundfish trawl catch share program and in other programs across the country, has also shaped the early years of program management. This section will present indicators of management performance, and qualitative assessments informed by public comment.

3.4.1 Program Management Costs

Highlights:

- In 2016, the Northwest Fisheries Science Center accounted for more than half of tracked incremental costs, and the regional office for more than one-third, with the Office of Law Enforcement the remainder.
- On August 10, 2016, the U.S. Court of Appeals for the Ninth Circuit issued its opinion in a case involving a challenge to NMFS' authority to recover cost recovery fees from members of the C/P Coop Program and the reasonableness of NMFS' calculation of the C/P Coop Program's 2014 fee percentage. NMFS elected to apply a revised methodology for all sectors for all years, resulting in a reduction in each sector's recoverable costs.

This section summarizes the annual cost recovery reports, including information about costs of the program. Direct program costs (DPC)[120], are the actual incremental costs for the previous fiscal year

---

[118] See 75 FR 78344, December 15, 2010 and http://www.westcoast.fisheries.noaa.gov/publications/fishery_management/trawl_program/catch-shares-guide-progr.pdf.

[119]Consistent with MSA (Section 303A(e)(1)(2)) and Public Law 109–479.

[120] Defined in regulation at §660.115(b)(1)(i)

directly related to the management, data collection, and enforcement of each sector. Actual incremental costs are those net costs that would not have been incurred but for implementation of the trawl rationalization program, including both increased costs for new requirements of the program and reduced costs resulting from any program efficiencies. The section then provides information about fees recovered for those costs as required under MSA.

3.4.1(a)(1) Incremental costs associated with the catch share program

Take into account the management and administrative costs of implementing and overseeing the IFQ or co-op program and complementary catch monitoring programs, as well as the limited state and Federal resources available (Amendment 20 objective). Minimize costs and avoid unnecessary duplication (MSA National Standard 7).

NMFS tracks catch share program management costs to recover a portion of the fees associated with operating the catch share program by sector. Since 2014, the first year of cost recovery, NMFS has only recovered the costs of employees' time (salary and benefits) spent working on the program in the calculation of DPC, rather than all incremental costs of management, data collection, and enforcement. Because NMFS is continuing this policy and only including some costs, the DPC for 2017 fee percentage calculations is likely an underestimate of costs compared to all incremental costs of management, data collection, and enforcement. In addition, NMFS has not included any Federal costs resulting from duties performed by the states of Washington, Oregon, or California in the calculation of DPC. Table 3-145 presents nominal costs associated with managing each of the three catch share program sectors from 2013 to 2016.

Table 3-145. Total incremental costs[1] by year and sector (2013 to 2016). Source: Revised Cost Recovery Report 2017.

	2013	**2014**	**2015**	**2016**
IFQ	$1,599,610.25	$1,936,907.83	$ 1,887,535.24	$ 2,021,490.55
Mothership	$77,659.47	$129,565.98	$185,814.34	$167,549.51
Catcher-processor	$12,931.29	$40,487.70	$45,080.17	$63,448.85

[1]Values in nominal dollars

In 2016, the most recent year for which costs are available, the NWFSC accounted for more than half of tracked incremental costs, and the regional office for more than one-third, with the Office of Law

Enforcement the remainder. For detailed information about costs, including description of types of activities considered in calculations, see "Trawl Rationalization Program Cost Recovery Annual Report" (NMFS, 2017).[121]

3.4.1(a)(2) Cost Recovery

Recover costs (MSA LAPP requirement).

The MSA requires NOAA's National Marine Fisheries Service (NMFS) to collect fees to recover the costs directly related to the management, data collection, and enforcement of an LAPP (16 U.S.C. 1854(d)(2)), also called "cost recovery." The Pacific Coast groundfish trawl rationalization program is an LAPP and consists of three sectors: the Shorebased IFQ Program, the Mothership Co-op Program, and the Catcher-processor Co-op Program. At its June 2011 meeting in Spokane, Washington, the Council established an ad hoc Cost Recovery Committee charged with making recommendations for a program to recover some of the new costs associated with implementing the catch share program for the groundfish trawl fishery.[122,123]

In accordance with MSA, and based on a recommended structure and methodology developed in coordination with the Council in September 2011,[124] NMFS collects mandatory fees of up to 3 percent of the ex-vessel value of groundfish by sector (Shorebased IFQ Program, Mothership Co-op Program, and Catcher-processor Co-op Program). NMFS collects the fees to cover the incremental costs of management, data collection, and enforcement of the trawl rationalization program. Cost recovery for the trawl rationalization program was implemented in January 2014. The details of cost recovery for the trawl rationalization program are in regulation at 50 CFR 660.115. Amendment 20 provides for assessment of cost recovery fees up to 3 percent of ex- vessel value, consistent with MSA section 303A(e).

[121] http://www.pcouncil.org/wp-content/uploads/2017/04/F4a_REVISED_NMFS_Rpt_2016-2017_CR_annual_rpt_final_Apr2017BB.pdf

[122] http://www.pcouncil.org/2011/07/14999/chairman-makes-cost-recovery-committee-appointments/

[123] Following the most recent (April 2017) presentation of the annual cost recovery report that NMFS provides to the Council, stakeholders on the GAP recommended that the Council "provide more detail and guidance to NMFS in order to bring the cost recovery process in line with the original 2011 directives (to provide detail and transparency about incremental cost activities and any savings or efficiencies generated by the program)". http://www.pcouncil.org/wp-content/uploads/2017/04/F4b_Sup_GAP_Rpt_Apr2017BB.pdf

[124] http://www.pcouncil.org/wp-content/uploads/CR_Council_Sept2011_Action_Fin.pdf

3.4.1(a)(2)(A) Redetermination of Past DPCs

"Trawl Rationalization Program Cost Recovery Annual Report" (NMFS, 2017) provides the following explanation and context for determination of DPCs.

> On August 10, 2016, the U.S. Court of Appeals for the Ninth Circuit issued its opinion in Glacier Fish Co. LLC v. Pritzker, 832 F.3d 1113 (9th Cir. 2016), a case involving a challenge to NMFS' authority to recover cost recovery fees from members of the C/P Co-op Program and the reasonableness of NMFS' calculation of the C/P Co-op Program's 2014 fee percentage. The court upheld NMFS' authority to recover cost recovery fees from members of the C/P Co-op Program because the C/P co-op permit is a limited access privilege and Glacier Fish Co. and other C/P co-op members are reasonably considered a "holder" of that privilege. The court also concluded that NMFS' cost recovery regulations were consistent with statutory requirements. However, the court held that the calculation of the 2014 Catcher-processor Co-op Program fee was inconsistent with NMFS' cost recovery regulations and the court remanded to NMFS to re-determine the 2014 fee. In response, NMFS has revaluated and modified the methodology used to determine the C/P Co-op Program's DPC for the 2014 fee calculation. The redetermination of the C/P Co-op Program's 2014 fee also took into consideration discussions with Glacier Fish Co. and other representatives of C/P Co-op members with respect to what costs should be considered actual incremental costs. One key change to the C/P Co-op program's 2014 fee is the elimination of all time that was originally coded as "general" time and split evenly among the three sectors. Additional costs that NMFS determined to be more appropriately categorized as non-incremental were also removed. NMFS also made some adjustments to ensure contractor and employee time was appropriately distributed among the sectors to reflect the actual incremental costs. Finally, NMFS elected to apply a similar revised methodology for all sectors for all years, resulting in a reduction in each sector's DPCs. However, the shorebased IFQ program DPC remained above the 3 percent cap. NMFS' internal process for categorizing and tracking employee time in the trawl rationalization program has been refined over the years. For example, the use of the "general" time coding option was phased out by the West Coast Region and, with the exception of limited use by the Northwest Fisheries Science Center, was no longer used as of fiscal year 2015. NMFS will continue its efforts to ensure that employee time is only tracked for time spent on tasks that that would not have been incurred but for the implementation of the trawl

rationalization program, taking into account reduced costs resulting from any program efficiencies. A comparison of the original DPCs and the recalculated DPCs is below.

The DPC values used to determine the 2017 fee percentages reflect the re-determined DPCs and any adjustments for past over or under payment. The increases in DPC reflect better NMFS accounting of time and improved sector accounting, rather than increases in agency sector expenses. Table 3-146 presents these re-determined direct program costs as a percentage of the previous year's ex-vessel value; in 2014, for example, NMFS incurred direct program costs of $1,936,908, recoverable in 2015, which accounted for 3.8 percent of the IFQ sectors' revenue in 2014.

Table 3-146. Costs/ex-vessel value. Source: Draft Cost Recovery Report 2017.

	IFQ		**Mothership**		**Catcher-processor**	
Year	Prior-Year DPC	% DPC of Prior-Year Ex-vessel Value	Prior-Year DPC	% DPC of Prior-Year Ex-vessel Value	Prior-Year DPC	% DPC of Prior-Year Ex-vessel Value
2013	$1,599,610	3.30%	$77,659	0.70%	$12,931	0.10%
2014	$1,936,908	3.80%	$129,566	0.90%	$40,488	0.20%
2015	$1,887,535	3.60%	$185,814	1.20%	$45,080	0.20%
2016	$2,021,491	4.90%	$167,550	3.80%	$63,449	0.60%

Mothership and catcher-processor sector direct program costs were higher in 2015 and 2016 than in the first two years of the cost recovery program. Relative to ex-vessel value, however, these percentages increased dramatically for all sectors in 2016 due to the low-volume, low-revenue Pacific whiting fishing season in 2015 (Table 3-146). See the discussion in Section 3.1.3(a)(2) Pacific whiting Allocation Utilization, for more information).

3.4.1(a)(2)(B) Public Feedback on Cost Recovery Fee

There were comments that specifically addressed the cost recovery fee during the Groundfish Trawl Five-Year Review public hearings that took place in August and September of 2016.

> "The second issue is NMFS workload and cost recovery. For those people familiar with the Pacific Council, and maybe even those not so much, we know that NMFS has trouble getting regulations through, but yet we still get charged 3% cost recovery. It's hard to see where that is valid, that we're being charged that for the amount of work that's getting done. They have people quitting at a high rate. There's just something going on there. I write the checks for two vessels, and when I write those checks, a lot of those checks go to local businesses on the coast. And a lot of times when you speak of MSA and national

standards you'll hear a lot about coastal communities. Well, that 3% gets sucked right out of the coastal communities. That 3% isn't something that goes into somebody's profit; that's something that comes out of everybody's pocket, because the vessels are a conduit for economic activity on the coast. So when I write those checks, most of those checks go to the coast, but that 3% goes straight away from the coast. So we would at least like to get the workload that it represents through NMFS" —Industry Participant, Newport Public Hearing, 2016.

"Another area is cost-recovery; we need transparency into cost-recovery, specifically with new costs that are being recovered, and how those funds are benefitting industry in the program. Is cost recovery necessary?" —Industry Participant, Fort Bragg Public Hearing, 2016.

As these comments indicate, participants in the groundfish trawl catch share program perceive a lack of transparency with the cost recovery fee. Cost recovery has also been an ongoing issue of concern for the Council's GAP.

3.4.2 Monitoring, Accountability, Catch Accounting, and Enforcement

Provide effective enforcement, monitoring, and management (MSA LAPP requirement). Provide efficient and effective monitoring and enforcement (Amendment 20 constraint).

Highlights:

- Before implementation of the catch share program (2002 to 2010), observers had an average coverage rate of 19 percent in the non-whiting groundfish fishery and 99 percent to 100 percent in the at-sea whiting fishery. From 2011 to 2014, 99 percent (in rare instances an observer is on board, but cannot sample haul) to 100 percent of trawl sector groundfish catch was sampled by observers.
- The cost of procuring 100 percent observer and catch monitor services was partially defrayed by the Federal government for the early years of the program.
- Coastwide average submission times for electronic fish tickets were less than one day from 2014 to 2016.
- In 2011 and 2012, many vessel accounts incurred some deficit by the end of the year. However, the number of vessels ending the year in deficit has declined substantially, by about 93 percent, from 2012 to 2016.

The trawl fishery is a multispecies fishery in which the allowable harvest levels for some stocks (potentially including overfished species) constrain total harvest. If a vessel were not monitored on each trip, the lack of individual accountability would generate an incentive to alter fishing behavior. Some skippers might elect to target stocks or areas with higher levels of associated constraining species. Without complete shoreside and at-sea monitoring, individual vessel operators or buyers could potentially discard overfished species when they reached their quotas, which would likely exacerbate bycatch and overfishing issues. With these concerns in mind, the Council selected 100 percent monitoring for both fishing and offloads as a core element of the program. The Council designed this monitoring system to allow for management of the fishery on an individual vessel basis. This strategy replaced the fleetwide, in-season management measures that characterized the fishery prior to catch shares implementation.

Various monitoring, accountability, and enforcement measures were implemented with the program rule, including the following[125]:

- Requirement for observers (subsequently, the option to replace observers with electronic monitoring for catcher vessels) aboard catcher vessels, catcher-processors, and mothership vessels
- Requirement for catch monitors at all shorebased IFQ first receivers
- Requirement for the weighing of all catch on scales meeting NMFS requirements
- Requirement that IFQ first receivers, motherships, and catcher-processors follow specified procedures when handling catch prior to processing
- Requirement that shorebased IFQ first receivers use electronic fish tickets and related computer software (administered by PSMFC), and adopt and comply with catch monitoring plans for each site.

3.4.2(a) Monitoring

Observer coverage in the at-sea fishery dates to the Fishery Conservation and Management Act of 1976, which required foreign vessels to hire United States observers while fishing off the coasts of Washington, Oregon, and California. Motherships and catcher-processors have historically had two observers on board each vessel while operating in the West Coast Pacific whiting fishery, however catcher vessels delivering to motherships were not required to have observer coverage. The shoreside whiting fishery began using electronic monitoring of incidental catch as part of an exempted fishing permit beginning in 2004; this permit ended with the implementation of the catch share program. In 2009 and 2010, all deliveries of Pacific whiting to a first receiver were verified by catch monitors, which were funded entirely by industry.

[125] For more information on observer, observer provider, catch monitor, and catch monitor provider requirements, see the Compliance Guide: http://www.westcoast.fisheries.noaa.gov/publications/fishery_management/trawl_program/catch-shares-guide-progr.pdf

The catch share program includes an improved monitoring system, with 100 percent observer or electronic monitoring coverage at sea and 100 percent catch monitor monitoring of landings on shore, to ensure that all catch, including discards, is matched against QP. Those participating in the mothership and catcher-processor co-op programs must have observers onboard the vessel at all times the vessel is fishing or at sea under the program rules and authority. Vessels participating in the Shorebased IFQ Program must have an observer or electronic monitoring system onboard the vessel from when the vessel is fishing until all fish from that trip have been offloaded. This includes during any transit between delivery points if the vessel delivers fish from an IFQ trip to more than one IFQ first receiver. In addition, catch monitors must be present at an IFQ first receiver during the duration of an IFQ landing to witness the offloading of catch by IFQ first receivers. The term "catch monitors" is generally applied to distinguish shorebased monitoring of offloads from on-the-water observers or electronic monitoring systems. In contrast to observers, catch monitors are land-based at first-receiver facilities, and they confirm that total landings are accurately recorded on fish tickets (landing receipts). Catch monitors perform compliance roles, rather than acting as biologists. The key differences between the observer/electronic monitoring system and catch monitoring programs include physical location where duties are performed, tracking of discards aboard vessels versus monitoring landings, catch sorting at shoreside facilities, and eligibility requirements for observer and catch monitor candidates. Often, the same individual will serve as both an observer and a catch monitor, if the individual meets the qualifications and has been certified in both capacities.

The catcher vessel fleet did not pay for scientific observer costs prior to the catch share program. As part of the program implementation, at-sea and delivery monitoring coverage was increased to 100 percent, with the costs to be charged to industry. To ease the transition to 100 percent coverage, a federal subsidy was implemented in 2011 ($328 per day), which decreased each subsequent year (ending at $108 per day in 2015) (Dave Colpo, pers. comm., Pacific States Marine Fisheries Commission Starting in 2016, operators began paying the full cost for their monitoring. The average at-sea monitoring cost (observer costs and electronic monitoring) was $402 per day in 2015, which was about 4 percent of the revenue in 2015). See Section 3.1.1(a) Net Economic Benefits, Section 3.1.2 Individual Economic Outcomes, and Section 3.1.3(d), Safety for further discussion of observer and catch monitoring costs to participants.

To address industry concerns about difficulties securing timely, consistent observer coverage, and the associated cost, NMFS and the Council began exploring options for an electronic monitoring system in 2012. The system would complement traditional observer coverage as an alternative way to satisfy the 100 percent monitoring requirement. Responding to these concerns, NMFS implemented EFPs to allow a limited number of vessels to replace observers with electronic monitoring. Thirty-four percent of vessels started using electronic monitoring under an exempted fishing permit in 2015, this number increased to 42 percent in 2016.

Table 3-147. Electronic Monitoring Participation 2015 to 2016. Source: Electronic Monitoring Program Coordinator (Pers. Comm. Melissa Hooper)

	2015	**2016**
Whiting vessels	22	25
Bottom trawl vessels	4	10
Fixed gear vessels	7	7
Total vessels	**33**	**42**

NMFS expects to publish a final rule implementing regulations permitting electronic monitoring in the whiting midwater and fixed gear sectors of the catch share program in 2017.

Before implementation of the catch share program (2002 to 2010), observers had an average coverage rate of 19 percent in the non-whiting groundfish fishery, and 99 percent to 100 percent in the at-sea whiting fishery. From 2011 to 2014, 99 percent (in rare instances, an observer is on board but cannot sample haul) to 100 percent of trawl sector groundfish catch was sampled by observers, with the exception of IFQ-hook-and-line fish in 2014, which were 100 percent monitored and sampled at a rate of 90 percent. With the start of the electronic monitoring EFP in 2015, observers continued scientific sampling of about a third of catch in the bottom trawl and pot fishery.[126]

3.4.2(a)(1) Social survey information and public feedback on monitoring provision

Observers have been a frequent topic of discussion in all three rounds of PCGFSS data collection, and 2015/2016 was no exception. The issue of cost dominated all observer-related discussions along the entire coast, though this concern was especially prevalent in California and Oregon. The following three fishermen detailed their observer expenditures by illustrating their significance in relation to vessel operations and the efforts they are forced to take to compensate for the fees. All three quotes allude to the cost of observers cutting into the overall profitability of fishing operations:

> "Observers are a terrible system. It took us $1000 to fly an observer down here, then another $1000 for 2 observer days, because the starter broke, and we had the observer waiting for 2 days to fix it. So now I'm $8000[127] in the hole, and even though there was high seas, I had to go out in the bad weather. We did 2 tows and got 16,000 pounds so I could break even, once that was done, I ran in

[126] For detailed information about historical observer coverage and sampling rates through 2015, see: https://www.nwfsc.noaa.gov/research/divisions/fram/observation/xls/FOS_Coverage_YearsObserved02-15.xlsx

[127] Most likely the $8000 referred to by the participant includes the costs of repairs beyond the $2000 (plus $500 for the actual at-sea fishing day) for the observer.

> to the dock to unload. That might be this boat's last commercial fishing trip." – Fisherman, Monterey Bay Area, 2015/2016

> "Last year was like $42,000 in observer costs for the year, and that's huge. That's an annual wage, and then knowing that the observer gets a slim portion of that ($160 a day instead of the $485 or whatever it is now), and then trying to understand why the cost has to be that high." – Fisherman, Newport, 2015/2016

> "My last two trips for observers was $2750 and that was for three days. 'Cause of travel time. One came from Brookings. Twenty-seven hundred and fifty bucks. And that comes off the top, see…" – Fisherman, Fort Bragg Area, 2015/2016

The issue of observer cost was commonly reported as being especially difficult for small vessels to deal with. Many viewed the flat coverage rate as disproportionately burdensome to smaller vessels (See section 3.2.3 (e) small vessels for more information). This high cost burden was sometimes a deciding factor for small vessel operators contemplating a shift to other fisheries, as indicated by the following quote from a fisherman comparing operating costs in the shrimp and groundfish fisheries:

> "But, you know, we don't have an observer so it's not costing me $520 a day. I mean we're looking at over $50,000 a year to have a guy. So anybody that can shrimp is shrimping. And that's the only reason." – QS Permit Owner, Astoria, 2015/2016

Participants reported that observer costs have also influenced fishing practices, sometimes in very drastic ways, as the example in the following quote details:

> "Besides the price is getting out of reason with the $500 a day, but it changes our fishing practices because we're stuck on a midnight to midnight rotation. I used to leave at 9:00 PM, run until midnight, shut down, get up with a good night's rest, and go to work the next day. Now we're forced to leave at midnight. We leave at midnight. I run the boat until 2:30 AM. I put the crew on the wheel until 6 AM. Then we go to work again after 2-2.5 hours of sleep for the night, and I run the wheel about 20 hours a day consistently. […] Well, then I used to fish until midnight, run home, and get in…the crew gets a couple hours of sleep before we start offloading at 8 AM. Now we're forced to quit in the middle of the afternoon, so we can be in by midnight because if we run over by 12:30, that's another day. That's another $500." – Fisherman, Coos Bay Area, 2015/2016

Participants also discussed the observer program's impacts vessel safety, as is discussed in 3.1.3.c (Safety).

For some participants (particularly those in the whiting sector), EM (electronic monitoring) is an attractive alternative to human observers. This appeal was largely cost-based, as this Puget Sound Area permit owner indicates:

> "Observer coverage is problematic. It absolutely is. I spent $48,000 last year on an observer, more than my crew mate, so now we're running a camera. It cost me $18,000 to put it on, but that is still a heck of a lot less than 48." – QS Permit Owner, Puget Sound Area, 2015/2016

Cost was the most often identified observer-related challenge, but observer coverage and availability was another frequently mentioned issue. Study participants often framed this issue in relation to cost as well, as coverage and availability difficulties sometimes result in missed fishing trips and market opportunities. The following quotes from southern California-based participants illustrate this problem:

> "Many times, we've got requests for trips, with the market chomping at the bit for fresh fish, and we could not go to sea due to lack of observer availability." – Fisherman, Monterey Area, 2015/2016

> "A lot of times I can't even get observers, or I have to pay $1,000 for them to show up at my boat. And generally the timing is off because they can't get there when I need them. So you know, it's kind of a double penalty. And then the market is requesting that I deliver on a certain date, but if I can't get the observer early enough to go fishing, and I wind up not making any money that trip." – Fisherman, Princeton/Half Moon Bay Area, 2015/2016 Public Hearing

Despite the reported issues, some saw benefits of having an observer onboard both for themselves and the industry as a whole.

> "I mean he was a dang good observer. I mean he was, really he was good. He was a by-the-book guy, which is fine. It makes me a better fisherman, that's for sure." – Fisherman, Puget Sound Area, 2015/2016

> "I think if the observers aren't, if we didn't have the observers I think we'd be tied up. I think they're, they show what truly happens out there." – Fisherman, Eureka Area, 2015/2016

Moreover, while discontent with the observer program was widespread, participants frequently reported positive working relations with the observers themselves, as exemplified in the following quotes:

> "We're just getting higher quality observers. A couple of them they've…two of them were going to come up to Seattle and come hang out with us. This year has been our best year for observers. We had…everyone was all up to date on their date and there were no major mistakes. They all got along with our crew really well. And they are…this was the first year ever where I don't think an observer took a set off to go to sleep." – Fisherman, Puget Sound Area, 2015/2016

> "Yeah. And so having somebody on the boat now, I think when catch shares first started the relationship between observers and fishermen were different that they are now because we see the same faces over and over again so you kinda get to know the people. […] Where at first it was like, who's this? They're just comin' out here to keep an eye on us, type of thing. Now, yeah, most of the observers that come on the boats we are, they're positive. We see 'em in town, you know, "Hey, how's it goin'?" They'll come down to the boat and say, hi or whatever." – Fisherman, Newport, 2015/2016

To provide further insight into relationships with observers, the PCGFSS survey asked fishermen about the quality of their relationships with observers, and if these relationships have changed since the implementation of catch shares. In 2012, 25.3% of fishermen reported a change in their relationships with observers, whereas 12.3% reported a change in 2015/2016. Interestingly, more fishermen reported negative or neutral relationships with observers in 2012 than in 2010 and 2015/2016. (Figure X). In 2012, relationships with observers were just developing, which might account for the higher percentage of negative and neutral relationships. Over time, however, it appears that relationships have improved.

.

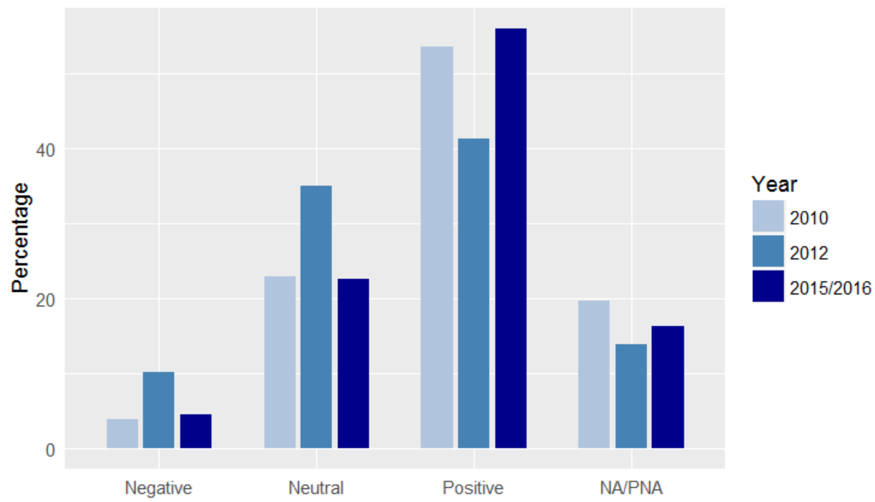


Figure 3-110. Reported quality of relationships with observers. Fishermen only. Source: PCGFSS

By and large, participants viewed the cost of the observer program as a significant burden for their fishing operations, particularly for the small vessel, owner-operator businesses. It was a key factor in decisions to shift to other fisheries or to exit the groundfish trawl fishery altogether. For smaller, isolated communities, or for ports with lower trawl activity, observer availability and additional travel expenses created an added financial burden. This has lead many in those areas to conclude that participation in the Groundfish Trawl Fishery is no longer fiscally sustainable.

3.4.2(b) Accountability

Achieves individual accountability of catch and bycatch (Amendment 20 goal).

Individual accountability was built into the catch share program through full monitoring of discards and landings. This section will evaluate the program's monitoring provisions as a mechanism for total catch accounting.

3.4.2(b)(1) One hundred percent observer and catch monitoring coverage

As described in the monitoring discussion above, 100 percent monitoring is essential for full catch accountability to ensure that all catch, including discards, is matched against allocations to the co-op or non-co-op fishery. Collection of accurate estimates of discards from observers, collection of data from catch monitors at licensed IFQ first receivers, and collection of data from electronic fish tickets make up the estimate of an individual vessel's use of QP or IBQ pounds. Observer data undergo a rigorous debrief and quality assurance/quality control (QA/QC) process, described in Figure 3-111 below. The review process may result in adjustments to trip deficits after initial deductions. The average time to finalize debits from accounts in 2016, the most recent year available, was approximately nine days, with 95 percent of trips finalized within 15 days.

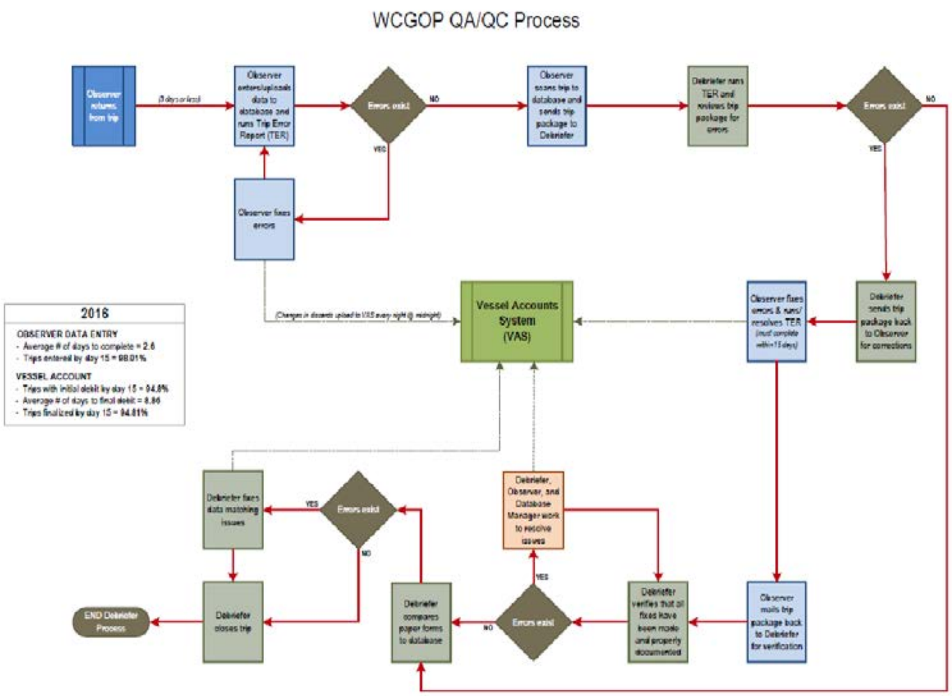


Figure 3-111. WCPOG and Debrief QA/QC process. Source: Jon McVeigh, pers. comm.

Virtually all IFQ deliveries were monitored under the catch monitor program in the first six years, as shown in Table 3-148.

Table 3-148. Catch Monitor Coverage of IFQ Deliveries 2011 to 2016. Source: PSMFC Catch Monitor Program Coordinator (Pers. Comm. Lori Jesse)

	2011	**2012**	**2013**	**2014**	**2015**	**2016**
Total delivery count	2462	2191	2345	2166	1739	1853
NOT verified (missed)	3	1	0	0	3	1

3.4.2(b)(2) Online IFQ system

All permit owners and vessel owners must use an online system to account for the transfer of QS and QP. This system allows both participants and managers to track QP use easily throughout the year. Vessel and quota share account holders can use the system to estimate QS prices based on reported QP price data, see account balances, and initiate trades of both QPs (from vessel accounts) and QSs (share accounts). The IFQ system also allows vessel owners to track their landings and account balances and to plan the need to procure/obtain additional QP. This is important as individuals are accountable for curing deficits and complying with QS and vessel limits (annual and daily).

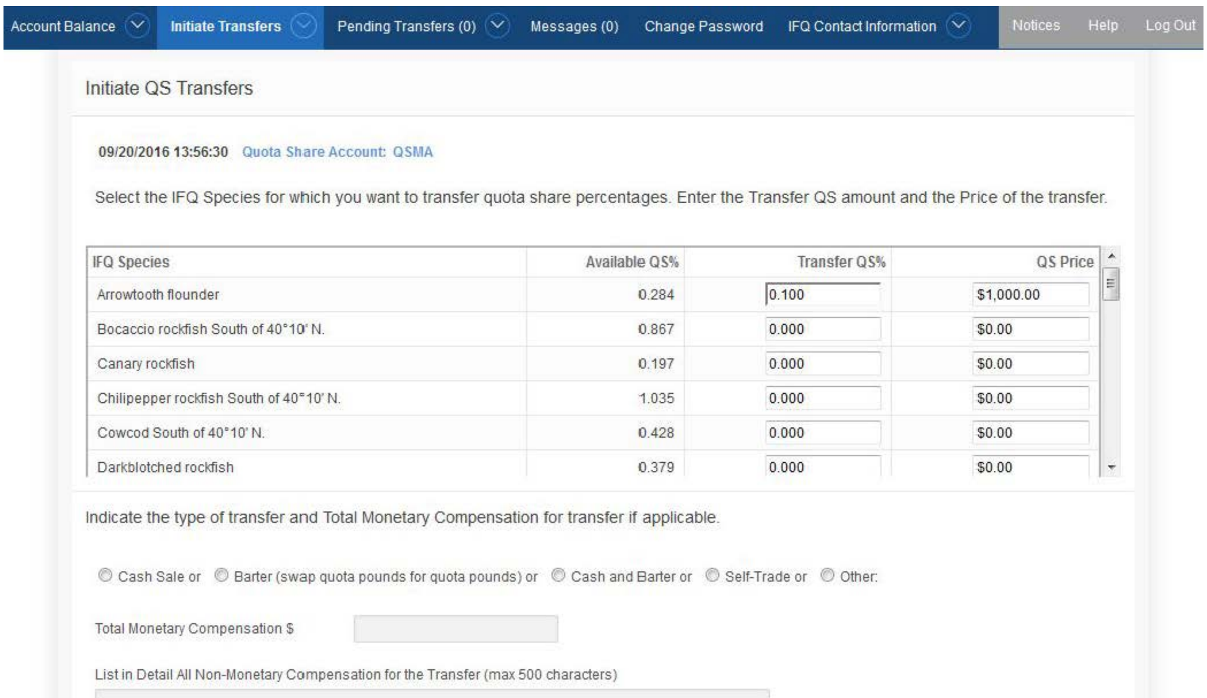


Figure 3-112. Screenshot from the online IFQ system. Source: IFQ User Help Guide 2017.

The vessel account system automatically sends an email to vessel owners who have a deficit to warn them of the need to act within 30 days. Account managers who monitor the system routinely have found errors in debiting from their accounts and were able to report these to NMFS for correction. The individual's online system supports accountability at multiple levels, for fisherman, but also for observers, catch monitors, and buyers (Figure 3-112).

NMFS recently updated this system to be smartphone and tablet compatible after user feedback; during public comment periods, users reported that both the quota share and vessel account interfaces were simple and easy to use. For detailed information on the online system, see the IFQ User Help Guide (2017). [128]

3.4.2(b)(3) Vessel Monitoring System/Declarations

Vessels possessing a limited entry permit and fishing in state or Federal waters seaward of the baseline from which the territorial sea is measured must use an approved type of vessel monitoring system (VMS). The VMS provides position data at regular intervals to identify the location of the fishing vessel relative to groundfish conservation areas, and it is not applicable to motherships. Groundfish vessels must submit declarations to NMFS (as specified at § 660.13(d)(5)) that are used to establish the fishery in which a vessel participates (including whether the vessel intends to gear-switch for those declaring into the IFQ fishery). This declaration supports catch accounting and identifies what other requirements (conservation areas, vessel monitoring system, observer coverage, etc.) are applicable to that specific vessel for a trip.

3.4.2(b)(4) First receiver site license

Catch share program harvested fish must be delivered to a first receiver holding a first receiver site license, specific to an entity and physical location. To receive a first receiver site license, the application must include a catch monitoring plan. The *Program Details Compliance Guide* outlines the requirements that ensure processor accountability under the monitoring plan.[129] All fish landed in an IFQ landing at an IFQ first receiver site (including shoreside processing facilities and buying stations that intend to transport catch for processing elsewhere) must be sorted prior to first weighing after offloading from the vessel and prior to transport away from the point of landing (as specified at § 660.130). This applies to all vessels participating in the non-whiting fishery; vessels declared into (see VMS declaration discussion above) the whiting fishery may weigh catch on a bulk scale before sorting. The site license requires that equipment and reporting measures be followed, supports individual accountability for landings, and ensures that data feed into the total catch accounting system in a timely way. First receivers must submit landings information via electronic fish ticket within 24 hours of receipt (Table 3-149). The web service allows first receivers to summarize landings information for vessels and for buyers with multiple locations to summarize by offload location, thus, providing vessel information about the landings that will be debited from vessel accounts.

---

[128] http://www.westcoast.fisheries.noaa.gov/publications/fishery_management/trawl_program/ifq-help-guide.pdf

129 http://www.westcoast.fisheries.noaa.gov/publications/fishery_management/trawl_program/catch-shares-guide-progr.pdf

Table 3-149. Average length of time (days) for electronic fish ticket submission from landing date. Source: Dave Colpo, pers. comm.

Agency	2011	2012	2013	2014	2015	2016
CA	2.2	1.6	1.3	0.8	0.9	1.3
OR	1.1	1.7	1.2	0.6	0.6	0.8
WA	1.8	2.1	0.9	0.9	1.2	1.1
Total	**1.5**	**1.7**	**1.2**	**0.7**	**0.7**	**0.9**

Comparing 2015/2016 with the initial two years of the catch share program, the number of electronic fish tickets submitted declined in each state since the implementation of the program, with the highest number of electronic fish ticket submissions in Oregon (Table 3-150). From 2014 to 2016, Oregon first receivers had the lowest percentage of tickets submitted more than 48 hours after the delivery of the three states. First receivers in Washington, Oregon, and California had an average time of less than two days for ticket submissions from 2013 to 2016. The average time for electronic fish ticket submission declined by about half in Oregon, for 2014 to 2016 compared to 2011 to 2013. Since about 70 percent of deliveries occur in Oregon, the shortening window for submission there contributed to coastwide average submission times of less than one day from 2014 to 2016.

Table 3-150. Total number of electronic fish tickets submissions by year and state, and percentage of submissions occurring later than two days after delivery. Source: Dave Colpo, pers. comm.

	Washington		**Oregon**		**California**	
Year	**% >2 days**	***Total Tickets***	**% >2 days**	***Total Tickets***	**% >2 days**	***Total Tickets***
2011	2%	*403*	4%	*1869*	12%	*776*
2012	1%	*283*	3%	*1585*	9%	*680*
2013	0%	*260*	3%	*1873*	4%	*579*
2014	3%	*231*	1%	*1932*	6%	*535*
2015	10%	*160*	3%	*1476*	7%	*430*
2016	5%	*277*	2%	*1488*	19%	*331*

3.4.2(b)(5) Deficit remediation

A deficit occurs when a debit of QP or IBQ pounds for an IFQ species results in a negative balance for that species. If a vessel account incurs a deficit (a negative balance for any IFQ species), the account owner has several options during the year in which the deficit is incurred: either transfer enough QP or IBQ pounds into the account to cover the deficit within 30 days of the day and time the poundage was debited from the account, or, if the deficit occurs more than 30 days before the end of the year, elect to declare out of the fishery for the remainder of the year and cover the deficit with QP issued the following year. If a vessel declares out of the fishery and wishes to reenter, operators can pay a fine in addition to covering the deficit to do so.

3.4.2(b)(6) Discards

All vessels can discard fish at sea, provided the discard is officially accounted for by electronic monitors or observers and deducted from QP in the vessel account. Some whiting vessels choose to operate as maximum retention vessels to be allowed to bring in unsorted fish for delivery (included prohibited and some protected species) participate in electronic monitoring EFPs. In the at-sea fishery, discards must be accounted for by the observer or electronic monitoring system, and applied against allocations. Except for vessels that choose to make whiting maximized retention trips, IFQ vessels must discard Pacific halibut, and the discard mortality must be accounted for and deducted from IBQ pounds in the vessel account.

3.4.2(b)(7) Co-op agreement (Mothership and Catcher-processor Sectors)

To participate in an at-sea fishery co-op program, a designated co-op manager must submit a complete permit application each year, which includes a copy of the co-op agreement signed by all its members and an annual report describing the co-op’s activities/performance in the prior year. This agreement must include a description of the co-op’s plan to monitor and account for the catch of Pacific whiting and non-whiting groundfish allocations adequately, as well as to monitor and account for the catch of prohibited species, along with the co-op’s enforcement and penalty provisions.

3.4.2(b)(8) Cease fishing (Mothership and Catcher-processor Sectors)

When a mothership sector allocation is reached, or is projected to be reached, vessels must cease fishing, and a mothership is prohibited from receiving further deliveries. Requirements for a cease-fishing report are specified at § 660.150(c)(4)(ii). When the catcher-processor sector whiting allocation is reached, or is projected to be reached, fishing within the sector must also cease. If the catcher-processor sector’s whiting allocation is reached, or if participants in the sector do not intend to harvest the remaining whiting allocation, unused non-whiting allocations that remain after the catcher-processor co-op ceases fishing may be reapportioned to the mothership sector. Requirements for a cease-fishing report are specified at §660.160(c)(5).

3.4.2(b)(9) Potential use-or-lose provision for QP

During the program design phase and subsequent public testimony, participants have expressed concern about QP of constraining species being stranded, or not put on the market for purchase and use by others (Pacific Groundfish Quota Program Workshop 2016). Amendment 20 did not specify a use-or-lose provision for quota pounds. It did, however, suggest that the need for such a provision would be evaluated as part of the program review process and added later, if necessary.

The non-whiting portion of the catcher vessel sector in particular raised concerns about QP of constraining species held by vessels that primarily fish for whiting (although some vessels fish for both whiting and non-whiting species in the IFQ fishery). The following analysis presents the amount of constraining species (net of any carryover to the next year) left in the following three categories of vessel accounts[130]:

- Accounts associated with vessels that only fished for whiting
- Accounts associated with vessels that fished for non-whiting groundfish[131]
- Accounts associated with vessels that did not fish (these could be accounts used for holding and transferring QP, or inactive vessels)

For low attainment species, QP could have been on the market with no buyers, or the owner unwilling to sell, or not needed. For species that are nearly fully attained, it is more likely that any additional available QP would have been purchased. Table 3-151 shows most of the QP for petrale sole left in vessel accounts at the end of the year in non-whiting vessel accounts. Similarly, for sablefish north of 36° N. latitude, there was generally much more QP left in the accounts associated with non-whiting vessels than accounts associated with whiting-only vessels. The amount of stranded QP of these two species has steadily decreased since 2012, and it is small relative to the sector allocation (about 1 percent in 2015). Non-whiting vessel accounts and whiting-only vessel accounts held approximately the same amount of canary rockfish in 2015, and non-whiting vessel accounts held the majority of unused quota in other years.

This analysis shows that QP unused in accounts of whiting-only vessels is likely not a major contributor to under harvest of non-whiting species. However, there may be other unknown reasons that the QP of petrale sole, sablefish north of 36° N. latitude, and canary rockfish cannot be purchased by non-whiting vessels that would be willing to purchase it. These reasons cannot be addressed with this analysis.

[130] Also see Section 3.1.2(d)(8).

[131] The vessels in this category could be fishing for both whiting and non-whiting groundfish.

Table 3-151. Quota pounds of constraining species, net of carryover left in vessel accounts at end of year. Note: Attainment of canary rockfish was less than 90 percent from 2011 to 2014 and attainment of sablefish north of 36° N. latitude was less than 90 percent in 2012. Source: NOAA Fisheries Vessel Accounts Balance Database[132] Shorebased IFQ Sector Balances and fish tickets.

IFQ Species	Vessel account category	2011	2012	2013	2014	2015
Canary rockfish	Non-fishing	8,502	4,995	15,032	15,635	7,625
	Non-whiting	26,887	27,062	27,316	32,598	14,783
	Whiting-only	8,223	10,344	19,848	18,481	13,327
	Sector allocation	**57,100**	**57,761**	**87,964**	**90,610**	**95,372**
Petrale sole	Non-fishing	3,336	2,097	129,361	782	2,890
	Non-whiting	69,470	75,348	223,552	107,248	62,807
	Whiting-only	3,652	2,444	53,082	3,853	8,229
	Sector allocation	**1,920,226**	**2,324,995**	**5,110,315**	**5,242,593**	**5,598,419**
Sablefish north of 36° N. latitude	Non-fishing	35,752	40,022	10,890	6,397	8,948
	Non-whiting	106,841	366,699	53,941	154,286	28,351
	Whiting-only	8,819	37,439	5,646	10,325	7,059
	Sector allocation	**5,613,719**	**5,448,797**	**4,030,050**	**4,382,790**	**4,848,781**

3.4.2(b)(10) Potential accountability shortfalls

Non-groundfish FMP species may not be accounted for as accurately as IFQ species (and species categories) due to a lack of consistency in shoreside monitoring for non-FMP, non-protected species. Many of those species can be discarded shoreside with no record, and operating procedures vary between states, ports, and plants. In addition, see discussion of lost gear impacts in Section 3.3.4, Environmental Performance.

3.4.2(c) Total Catch Accounting

Provide a mechanism for total catch accounting (Amendment 20 objective).

A complex process for rapidly integrating companion data streams—while performing extensive QA/QC—ensures accurate and timely catch accounting. The data flow for each fish taken on an IFQ trip is different depending on whether the trip is monitored electronically or by an observer, and whether the fish is discarded or retained. Discarded fish are recorded either by an observer or through video equipment for vessels using EM. After WCGOP QA/QC, data recorded by observes is transferred to the WCR IFQ Database where it is debited against individual vessel accounts. For discard data captured through video recordings, logbook snapshots are data-entered, then reconciled with video review within a few days after a set number of trips (Figure 3-113).

[132] https://www.webapps.nwfsc.noaa.gov/ifq/

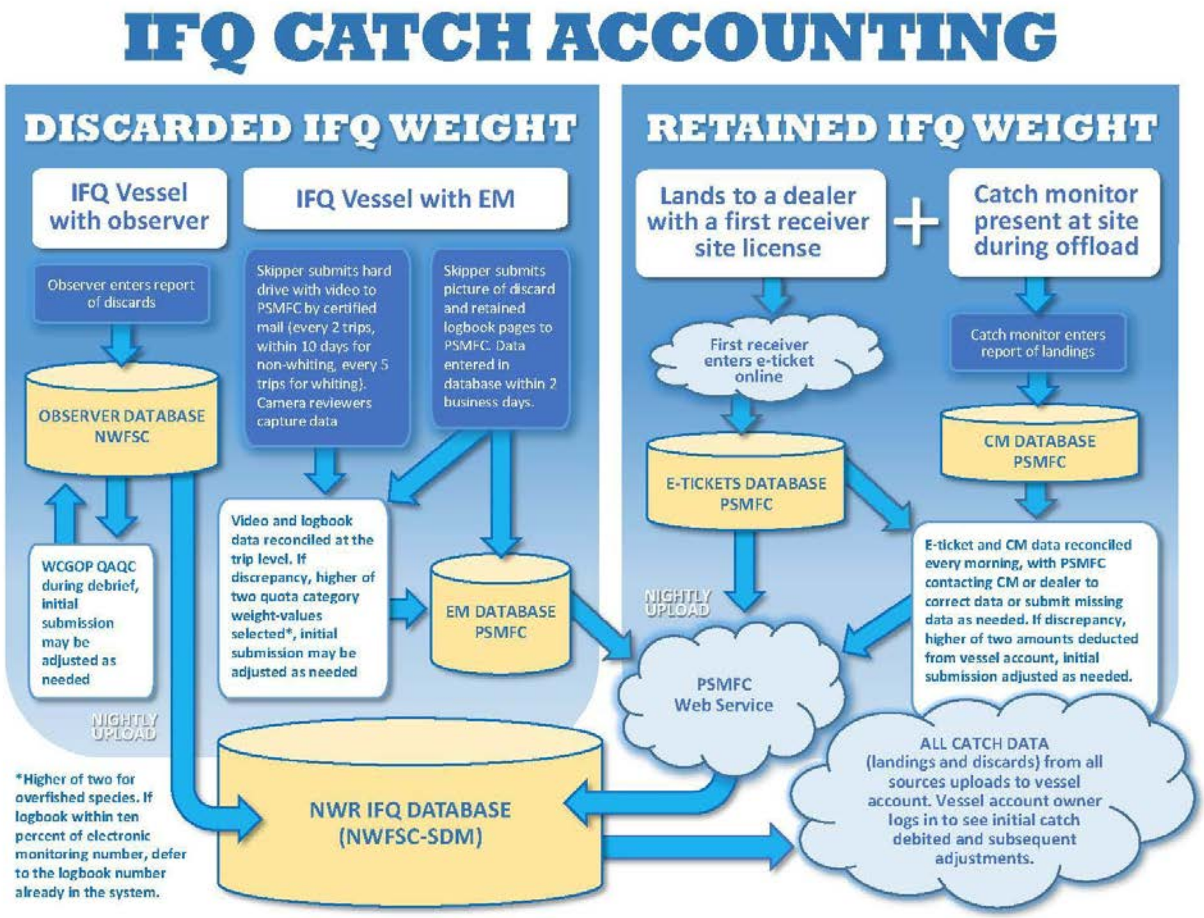


Figure 3-113. IFQ catch accounting. Source: Dave Colpo, pers. comm (PSMFC); Jon McVeigh (NWFSC West Coast Groundfish Observer Program); Melissa Hooper (WCR Electronic Monitoring); graphic by WCR NMFS Fisheries Communications.

In meetings with NMFS and state officials, managers reflected on expenses and benefits of managing the influx of new data streams resulting from catch accounting data streams. Sophisticated observer, electronic fish ticket, catch monitor, EM, and quota tracking data feeds have improved management and helped achieve conservation goals, among many other benefits. These systems also require substantial agency investment in technology and database management, much of which was supported by non-cost-recoverable funding. This increased administrative burden to states (who do not receive cost recovery money) and NMFS for the storage and processing of data confers management benefits, such as improving precision and timeliness of in-season management, as well as reduced paperwork and data entry associated with the paper tickets in states that have transitioned entirely to electronic fish tickets.

3.4.2(c)(1) Vessel requirements

The following mechanisms ensure accurate catch accounting at the vessel level.

3.4.2(c)(1)(A) Vessel account

A vessel account is registered to a specific vessel and a specific vessel owner. A vessel account is an online accounting system, like an online banking account. The online system prevents a vessel from transferring in more than the annual or daily limits for each IFQ/IBQ species. It allows vessel owners and other designated parties to view current balances of the QP and IBQ pounds assigned to the vessel. A vessel must have QP (or, as applicable, IBQ pounds) to cover all catch of IFQ species. Account owners use the system to monitor activity and balances and to remedy accounts in deficit, generally within 30 days. The vessel account allows a vessel owner to obtain QP or IBQ pounds, either from a QS account, or from another vessel account through electronic transfers. Every IFQ landing has an electronic fish ticket reflecting the species and amount (in whole pounds) of IFQ fish landed. The amount of the landing is debited against the vessel account. Similarly, any discards recorded by an observer are debited from the vessel account. Vessel accounts must be renewed each year, and owners must submit economic data collection surveys and ownership interest forms in order to have accounts renewed.

Regulations provided a means to opt out for vessels incurring a deficit (when catch exceeds available balance and results in a negative balance for that species). The vessel has two options: either transfer sufficient QP/IBQ into the vessel account, or opt out (if the deficit occurs more than 30 days before the end of the year).[133]The latter means that the vessel account owner declares out of the Shorebased IFQ Program for the year in which the deficit occurred and states the intent to cover the deficit under the carryover provision. There were one to three opt-outs in 2011, 2013, 2015, and 2016; in 2012 and 2014, no vessel opted out of the program. Vessels now additionally have the option of paying a fine, covering deficit, and “opt-in.”

For any vessel account with a deficit, the vessel may not go out on an IFQ fishing trip again until the deficit is covered. In 2011 and 2012, the first two years of the program, many vessel accounts had incurred some deficit by the end of the year (Figure 3-114). Some of these end-of-year deficits occurred because of the lag between when a delivery was made and when discard information from the WCGOP was entered into the accounting system. However, the number of vessels ending the year in deficit has declined substantially, by about 93 percent, from a high of XX vessels in 2012 to a low of seven vessels in 2016. The average pounds-per-vessel deficit, which was fairly consistent from 2011 to 2014, increased substantially in 2015 and 2016, driven by one high bycatch event in 2015.

[133] If the deficit occurs less than 30 days from the end of the year, then the vessel may simply cease fishing and cover its deficit once QPs become available in the following year.

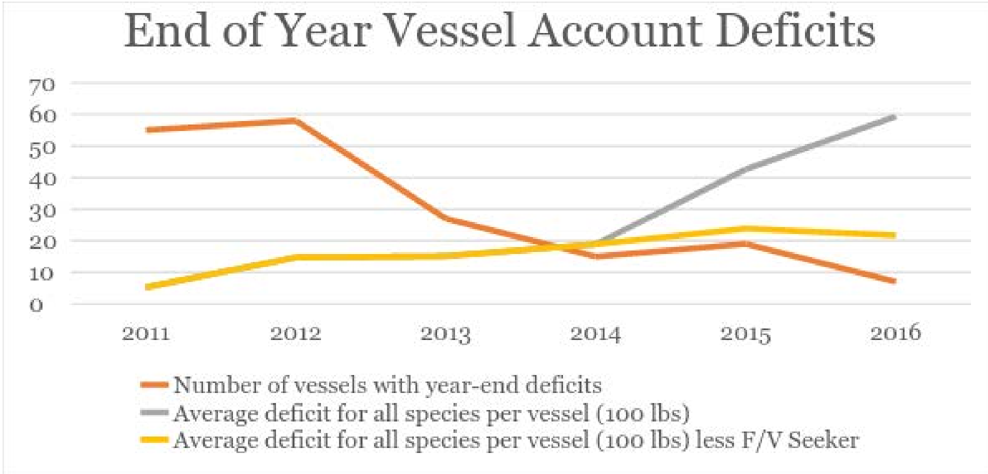


Figure 3-114. Instances of vessel accounts exceeding quotas by year (2011 to 2016, Permit Quota Data). Source: Permit Quota Data.

Table 3-152 lists the top end-of-year deficits, meaning those that were not covered with enough QP/IBQ during the quota year. In many cases, overages are covered by carryover received in the next calendar year. If a deficit exceeds the subsequent annual vessel limit(s), the vessel is barred from the IFQ sector for the following year(s).

Table 3-152. Aggregate vessel account end-of-year deficits by species (top ten). Source: Permit Quota Data.

Quota Species Category	2011	2012	2013	2014	2015	2016
Petrale sole	-7,205	-32,076	-23,863	-16,333	-10,868	-1
Canary rockfish		-21			-38,335	-32,226
Arrowtooth flounder	-350	-267	-11,838	-4,560	-25,081	
Pacific whiting	-9,906	-12,410		-1	-1,782	
Sablefish north of 36° N. latitude	-8,940	-2,889	-2,106	-706	-4,835	-2,416
Widow rockfish		-3,001		-6,753		-6,393
POP north of 40°10' N. latitude	-797	-11,534	-2,844			-500
Pacific halibut (IBQ) north of 40°10' N. latitude	-910	-9,405		-3	-4	-4
Longspine thornyheads north of 34°27' N. latitude	-3	-6,706				
Minor slope rockfish north of 40°10' N. latitude		-4,915				

3.4.2(c)(1)(B) QS account

A QS account is an online accounting system. A QS permit owner's allocation (expressed as a percent) for each species will appear in a QS account, along with the associated annual QPs. QS permit owners are able to see their QS amounts and QP balances, as well initiate transfers of QPs to vessel accounts using this system. QS accounts have a functionality that allows users to transfer QS to other QS holders and track QS balances for compliance with limits. This supports accountability, and it ensures that transfers remain within the QS accumulation limits (built-in checks).

3.4.2(c)(1)(C) QS/QP account to vessel account

In order to use QP or IBQ pounds, QS permit owners must transfer their associated QP and IBQ pounds from their QS account to a vessel account by September 1 of each year. The QS permit owner must also select a vessel to receive the QP or IBQ pounds. Once the transfer is submitted to the online system, the system will determine if the transfer will exceed the vessel limits (annual and daily). If the transfer does not exceed the vessel limits for any of the species named in the transfer, a pending transfer will be displayed in the vessel account. The vessel owner must either accept or decline the transfer to complete the transaction. The vessel owner may only accept the entire transaction as initiated and does not have the option of accepting certain species and amounts and not others offered in the transfer. Once the transaction is complete (either accepted or not accepted), the system provides a transaction confirmation number and describes the nature of transaction (approved/disapproved). If the transaction is accepted by the vessel owner, the designated species/amounts of QP or IBQ pounds is debited from the QS account and credited into the vessel account. Transfers can include more than one species.

QP or IBQ transfers that are not completed and approved by the September 1 deadline expire and are deleted from accounts; they are not eligible for use for the remainder of the year, or for carryover. In the first five years of the program (2011 through present), WCRO permit staff have tried to communicate with participants with expiring pounds; however, in some cases, transfers either are not initiated or are not completed before the deadline. Each year, QP or IBQ have expired in quota accounts as a result. Table 3-153 presents for a breakdown of expiring QP or IBQ by quota species category over the past five years. For more discussion of stranding and attainment, see 3.1.3(a)(2), 3.1.3(a)(1), and Table 3-151.

QP transfers are one-way from the quota account to vessel accounts, but they can then be transferred among different vessels to reconcile accounts for the next year.

Table 3-153. Expiration of QPs left in QS accounts after transfer deadline. Source: Permit Quota Data.

	Quota-Year Pounds Expired				
Quota Species Category	**2012**	**2013**	**2014**	**2015**	**2016**
Arrowtooth flounder	56,524	283	127,817	69,544	
Canary rockfish		73	431	1,276	
Chilipepper rockfish South		1	3,084	8,043	3,164
Cowcod South				1	
Darkblotched rockfish		228	5,913	3,591	
Dover sole	142,154	1,090	724,387	1,736,809	778,298
English sole	71,060	469	206,922	271,058	40,154
Lingcod	7,984				
Lingcod North		211	59,629	28,624	9,341
Lingcod South		12,366	24,481	14,156	3,636
Longspine thornyheads North		91	34,787	65,048	
Minor shelf rockfish North		113	37,356	19,461	
Minor shelf rockfish South	293	498	771	1,626	
Minor slope rockfish North		96	28,583	29,274	
Minor slope rockfish South	1,673	1,990	3,440	3,892	
Other flatfish		309	66,006	187,520	40,530
Pacific cod		56	105,488	34,548	8,059
Pacific halibut (IBQ) North		2,062	28,414	3,007	7,573
Pacific ocean perch North		40	4,843	2,058	
Pacific whiting	34,133		185,408	2,227,185	5,178,221
Petrale sole		115	22,659	9,096	
Sablefish North		135		7,660	
Sablefish South		2,951	6,206	7,000	3,742
Shortspine thornyheads North		171	25,387	27,688	
Shortspine thornyheads South		300	2,384	13,052	298
Splitnose rockfish South	4,810	5,392	10,649	13,286	5,371
Starry flounder	3,717	5,101	4,570	10,139	2,194
Widow rockfish		316	12,707	20,767	
Yelloweye rockfish		1	134	33	20
Yellowtail rockfish North		777	137,761	135,512	
Total lbs	**322,348**	**35,235**	**1,870,217**	**4,950,954**	**6,080,601**
QS accounts with expired pounds	n=2	n=6	n=13	n=15	n=6

Data on QS and QP account balances are publicly available on the WCRO website.

3.4.2(c)(2) First receiver requirements

The subsections below provide information on first-receiver requirements that support total catch accounting.

3.4.2(c)(2)(A) Electronic fish tickets

Landings in the Shorebased IFQ Program are reported through an electronic fish ticket system. Shorebased IFQ first receivers must submit landing information through electronic fish tickets, as specified at § 660.113(b)(4). If a data error occurs, electronic fish ticket submissions may be revised by resubmitting the revised form.

3.4.2(c)(2)(B) Catch monitor data submission

Processors must provide internet access to catch monitors to ensure timely data submission. This is a requirement of the mandatory first receiver site license.

3.4.2(c)(2)(C) Scale reports

Reports are required for scales used on mothership and catcher-processor vessels and IFQ first receivers, as specified at §§ 660.15(b) and 660.113 (c) and (d). Scales used to weigh catch on vessels must be inspected annually and tested daily.

3.4.2(c)(2)(D) Weight derivation

Groundfish allocations, harvest guidelines, and quotas are expressed in round weight. The electronic fish ticket records the actual weight and condition of the fish landed. In cases where fish are landed dressed (headed and gutted, or, in the case of Pacific whiting, headed and gutted with tails removed), catch weight conversion factors are applied to the electronic fish ticket to determine actual round weight of the harvested fish.

3.4.2(c)(2)(E) Annual co-op report

This mandatory report details the co-op allocation, the total catch (both retained and discards) of the co-op, inseason catch history reassignments, monitoring, and other significant co-op activities during the year, as specified at § 660.113 (c) and (d).

3.4.2(c)(2)(F) Cease fishing report

When a mothership or catcher-processor co-op has completed fishing for a given year, it must submit a cease fishing report to NMFS, as specified at §§ 660.113(c) and (d), at 660.150(c)(4), and at 660.160(c)(5).

3.4.2(d) Enforcement

The subsections below detail enforcement activities. They cover agencies and actions involved in enforcement.

3.4.2(d)(1) United States Coast Guard

District 13 and District 11 United States Coast Guard (USCG) patrol boats conduct dedicated fisheries management patrols along the West Coast in support of their mission to protect living marine resources. Violations in Federal fisheries are forwarded to NMFS for adjudication. In addition to offshore living marine resource patrols, USCG units enforce federal safety regulations. According to USCG annual reports to the Council, some of the USCG's most effective efforts are the result of working collaboratively with partners from NMFS' Office of Law Enforcement (OLE), Treaty Tribes, and California, Oregon, and Washington State fisheries enforcement personnel.

USCG reported incidents from 2011 to 2016 included documented failure to carry a valid permit, missing official numbers, missing marking on longline gear (marker buoys), 12 safety violations (see 3.1.3 (d) for further discussion), an illegal drug-related violation, failure to carry VMS, fishing in the Cow Cod Conservation Area, and retaining undersized lingcod. See Table 3-154, below for details.

Table 3-154. Coast Guard Groundfish Boarding 2009 to 2016. Source: Brian Corrigan, pers. comm., USCG.

Year	All Groundfish Boardings	Commercial Groundfish Boardings	Hours expended on Living Marine Resource Mission	Trawl Catch Share Related Violations
2009	127	58	--	--
2010	116	74	--	--
2011	91	78	Not available	Not available
2012	95	80	14%	--
2013	244	87	9%	2
2014	385	99	7%	6
2015	388	58	4%	2
2016	305	57	Not available	Not available

3.4.2(d)(2) Office of Law Enforcement

Early enforcement issues included accounts management and software. The most problematic issue in the early years of the program was fishing while in deficit, for which OLE would issue verbal and written warnings (Table 3-155). Other issues included observer harassment and deviation from catch monitoring plans by first receivers, which also resulted in written warnings from OLE.

Throughout the early years of the program implementation, OLE prioritized communication and education to achieve compliance, implementing the following process to resolve issues:

- Phone calls (up to three per violation)
- Correction letter documenting all alleged violations
- In person dockside meeting/interview (state or Federal officer/agent)
- Referral to states
- Summary Settlement (Federal)
- Notice of Violation (Federal Notice of Violation)

In 2015, OLE logged 3,330 calls for compliance assistance, largely in response to non-reporting VMS units, with 149 calls informing participants in deficit about the 30-day clock. Continuing education and communication throughout program implementation have led to a decline in declaration violations, as well as fishing in deficit in 2014 and 2015, when compared to the first three years of the program (Table 3-155).

Table 3-155. OLE Violations by Type and Year. Source: OLE Annual Reports 2012 to 2015.[134]

	2011	**2012**	**2013**	**2014**	**2015**
At-sea Discard	0	0	1	1	0
Gear Violations (minimum mesh size)	1	0	0	1	0
Declaration Violations (including mothership/CV/Shoreside)	11	7	14	2	1
Fishing in Multiple Management Areas	2	1	0	1	1
Fishing Prior to Establishing Vessel Account	2	0	1	0	0
Fishing in Deficit	60 (30 vessels)	13 (9 vessels)	6 (3 vessels)	8 (8 vessels)	1

[134] http://www.pcouncil.org/wp-content/uploads/2016/03/F1a_NMFS_Rpt4_TRAT_Compliance_Report_2015_APR2016BB.pdf
http://www.pcouncil.org/wp-content/uploads/2015/04/E1a_SupNMFS_Rpt3_Trat_APR2015BB.pdf
http://www.pcouncil.org/wp-content/uploads/C3b_NMFS_Rpt2_TRat_APR2014BB.pdf
http://www.pcouncil.org/wp-content/uploads/D2c_NMFS_OLE_PPT_MAR13_APR2013BB.pdf

The Council Enforcement Consultants Committee (state and NMFS OLE agents) noted a general catch share trend towards increasing technological dependence and complexity in management and enforcement of catch share fisheries. OLE now requires a staff capable of addressing violations related to electronic fish ticket submissions and VMS use, as well as analyses of ownership interest information to enforce the hold- and- control QS accumulation restrictions (caps), all primarily dealt with in an office, rather than enforced on the water. The previous trip limit management system in place prior to the catch share program required more on-the-water agent enforcement of vessel actions. Now, enforcement agents have access to instantaneous, high-quality monitoring data to ensure compliance, compared to the management in place before the catch share program.

3.4.2(d)(3) Joint enforcement efforts

From May 9 to May 20, 2011, OLE agents, WDFW officers, Oregon State troopers, California Department of Fish and Wildlife wardens, and the USCG completed "Operation Catch Shares Compliance" from the United States/Canada border to Morro Bay, California, focused on participants in the shoreside IFQ program. A joint report[135] noted this joint compliance assistance operation was the first of its kind on the coast, and "reinforced the positive working relationship between the fisheries enforcement partners and the fishing industry."

The objectives, designed to assist the industry with compliance with the new regulations, included the following:

- Achieve local familiarization of trawl rationalization program operations.
- Analyze industry understanding of the trawl rationalization program requirements.
- Inspect local offload sites for Federal and state regulation compliance.
- Rectify industry misunderstandings of trawl rationalization program requirements.
- Make contact with and support observers and catch monitors.
- Respond to detected violations as appropriate.

The Southwest Division did not detect any significant violations on five boarded vessels and nine first receiver inspections during the period. The Northwest Division inspected 15 vessels and 8 first receivers, and issued one written and one verbal warning for fishing in deficit and fishing in groundfish conservation areas, respectively.

The report also noted the following:

[135] http://www.pcouncil.org/wp-content/uploads/E5b_SUP_EC_JUN2011BB.pdf

"Throughout the operation managers, owners, and operators expressed the view that the catch share program was working more smoothly then they expected. As the operation progressed it was noted with appreciation that enforcement was attempting to resolve misconceptions before they became violations."

3.4.2(d)(4) Supporting compliance through administrative process

Officials tasked with administering the catch share program have frequent communication and contact with participants via phone, email, and mail. NMFS staff members have emphasized education and reminders in the implementation period of the program, particularly with respect to potential violations. In addition to these outreach efforts, OLE and permit officers point to the use of regulations and administrative processes in Amendment 20 to achieve compliance goals as a unique feature in the design of the program. For example, submittal of both Ownership Interest Information Form(s) and EDC Form(s) are required to initiate QS and vessel account and permit renewals, as well as other administrative actions. Therefore, participants who fail to submit the required forms by the deadline for permit renewals will not be eligible for QPs in the following year, and they are not eligible to trade QSs in the following year until the requisite forms are submitted.

3.4.2(d)(5) Other enforcement considerations

Provide an information collection and review process to provide any additional information needed to determine whether any illegal acts of anti-competition, anti-trust, price collusion, or price fixing (MSA LAPP requirement).
Monitor transfers of privileges (including sales and leases) (MSA LAPP requirement).
Require fish harvested under LAPP to be processed on U.S. vessels or on U.S. soil (MSA LAPP requirement).

The WCR Permit Office collects ownership interest information from QS owners. The information aids OLE in determining whether divestiture requirements have been met. This information was used to carry out divestiture in 2015 for all species except widow. NMFS will again determine if there is a need for a QS owner to divest once widow rockfish is reallocated in 2017 (the IFQ system caps transfers at the limit, except for reallocations).

The WCR Permit Office monitors the required forms for transfers of permits and QSs. Changes in permit ownership typically are based on a sale of the permit, but there can be changes in permit ownership that do not involve a sale (i.e., divorce, death/inheritance, gifting). The EDC collects information on expenses and revenues from sales and leases of QS and permits.

Fish harvested in the shoreside IFQ program must be landed at a site-specific, licensed first-receiver site, which must have a United States address. Once fish are landed to a United States address, there is no tracking mechanism to determine where the fish are ultimately processed. When a transfer form is submitted requesting that a vessel be registered to a permit, WCR either receives a copy of the USCG Certificate of Documentation (COD), or checks the USCG data feed to see if the COD is current and has a fishery endorsement. Once the vessel is registered to the permit and vessel has continuous registration to the permit into the future, the COD is not checked each year. The USCG requires that vessels over five tons (including all motherships and catcher-processors) have a COD form. The COD form requires providing information on the vessel build site, endorsements (including the fishery endorsement), primary service (including commercial fishing or fish processing), and certification of United States control of the partnership, corporation, or other owning entity.

3.4.3 Program Review and Modification

Design a responsive mechanism for program review, evaluation, and modification (Amendment 20 constraint). Require regular monitoring and review of program (MSA LAPP requirement).

Highlights:

- PCGFSS and public hearing participants expressed frustration with what they view as inefficiencies in NMFS and Council management actions. In general, public comment at these forums focused on a perceived “lack of urgency” in removing existing regulations that participants view as obsolete under the catch share program.

- As mandated by MSA and in supported in Amendment 20 objectives, various data collections support annual program review and management, as well as this and subsequent 5-year reviews. These data collections include routine permit applications, ownership information used to calculate cumulative share ownership, mandatory and voluntary social science surveys, and cost recovery information needed to calculate incremental costs.

This section starts with a discussion of program modifications that have been ongoing since the start of the program. Program modifications have been based on continuing implementation and enhancing performance. Perceptions of how the program is functioning are discussed, followed by a summary of, and references to, existing annual review documents, as well as a qualitative description of other review and evaluation mechanisms currently in place.

3.4.3(a) Industry Perspectives on the Efficiency of Management

PCGFSS and public hearing participants expressed frustration with what they view as inefficiencies in NMFS and Council management actions. In general, public comment at these forums focused on a perceived “lack of urgency” in removing existing regulations that participants view as obsolete under the catch share program. Participants often comment that gear restrictions and the RCA are particularly important issues for the Council to address, although there has not been unanimous agreement as to how.

3.4.3(a)(1) Efficiency of Process

There have been numerous discussions of the timeliness of the management process. Some comments are presented below:

> "The fact that the Council and NMFS process for making these rule-changes, although I certainly appreciate the legal problems that you have, and realities that you have, they just take forever. You know, a grim joke I've heard in Monterrey is that by the time some of these things get figured out, they're gonna be these skeletons tied to the helms of their boats." —Industry Participant, Half Moon Bay Public Hearing, 2016.

> "You know, the Council process is so slow. You know it is so slow to get changes in place. By the time we'll get changes I'll be, I'll be in my 60's. It could be 4, 5, 6 years, you know, and that'll put me about 64 years old and I'm not gonna work after that." —Fisherman, Fort Bragg Area, 2015/2016.

> "It takes a while for the Council to do anything." —Processor, Oregon, 2015/2016.

Not all participants saw the slowness of management as a problem:

> "No, no, it's, you know, the government will move slow, but you know, slow isn't always bad. It keeps you from making knee-jerk reactions and doing something stupid that causes you to go backwards then." —QS Owner, Astoria Area, 2015/2016.

3.4.3(a)(2) Pre-existing Regulations

As the quotes below reflect, some believe that the pre-existing regulations make it difficult to determine how the catch share system itself is performing, or how it can be improved:

> "So this lack of flexibility, that we can't even get a rule passed and into existence that we need, is just a demonstration of almost—I don't know how many; Dorothy, you tell me: how many are still undone, trailing amendments, after five years. We haven't implemented this program fully yet. We don't even know if it really works or doesn't work, because we don't have everything we need in place to find out if it could work, five years after we said we implemented it." —Industry Participant, Astoria Public Hearing, 2016.

> "I think there are some archaic regulations that need to be weeded out." —QS Owner, Fort Bragg Area, 2015/2016.

> "The question is, is now that we're already in rationalization and the change in industry and power and everything has taken place, how do we better it from this point? And

that's, I think, one thing would be higher hard cap bycatch limits. I think the other thing would be to remove some of the RCA lines. We're one hundred percent accountable for our bycatch; it don't matter whether we're in there at 100 fathoms or out at 300 if we catch them, and we're not supposed to catch them. We're gonna be accountable for them. So I'd like to see the RCAs lifted and let us, the people that have the knowledge, be able to target fish that are…but I think we're long ways from those procedures still."
—Fisherman, Astoria, 2015/2016.

Table 3-156. Trailing Actions with Date of Council Action, Rulemaking, and Implementation. Source: PFMC website.[136]

Action	**Final Council Action**	**Rulemaking**		**Implementation**
		Proposed	**Final**	
Council Deliberations In Progress				
Area Modifications (EFH/RCA)	Ongoing, final action tentative March 2017			
Allow Between Sector Trading of Quota	On hold until after 5 Year Review			
Discard Survival Credits and Conversion Rates	Tentative start June 2017			
Surplus QP Carryover for Non-whiting (Multi-Year Catch Policy)	Tentative start June 2017			
Surplus QP Carryover for Whiting (Multi-Year Catch Policy)	On hold until after 5 Year Review			
Year Round Non-Whiting Fishery for Midwater Target Species	EFP Consideration June/ September 2017			
Final Council Action Taken, NMFS Approval and Implementation Pending				
Electronic Monitoring	Tentatively Sep-2017	Sep-2016 81 FR 61161		Tentative Jan-2018
Widow Rockfish QS Reallocation and Divestiture Deadlines	Apr-2015	Jun-2016	Tentative Aug-2017	

[136] http://www.pcouncil.org/groundfish/trawl-rationalization-amendment-20-and-intersector-allocation-amendment-21-trailing-actions/

Table 3-156. Trailing Actions with Date of Council Action, Rulemaking, and Implementation. Source: PFMC website (continued).

Action	**Final Council Action**	**Rulemaking**		**Implementation**
		Proposed	**Final**	
		81 FR 42295		
Removal of Blackgill in the Slope Complex	Nov-2015			Tentative Jan-2018
Vessel Movement Monitoring	Apr-2016	Tentative Aug-2017		Tentative 2017
Trawl Gear Regulations: Multiple trawl gears, eliminating min. mesh sizes, eliminating chafing gear restrictions; allowing multiple-walled codends; measuring mesh size to include measuring between knots or corners; allowing a new haul to be brought onboard and dumped before all catch from previous haul has been stowed; and changing the selective flatfish trawl gear definition and restrictions	Mar-2016	Current EFP ends Dec-2017; NMFS update at Jun-2017 Council meeting		
Multiple management areas per trip	Jun-2016			
Amendment 21 At-Sea Sector Set-Asides for darkblotched rockfish and Pacific Ocean perch		Tentative Aug-2017	Tentative Fall 2017	
Final Council Action Taken, NMFS Approval and Implementation on Hold				
QS/QP Control Rules – Safe Harbors for Risk Pools.	Sep-2011	On hold until after 5 Year Review		
Completed Trailing Actions				
Trawl Rationalization Regulatory Amendments; Program Improvement and Enhancement (PIE I); Amendment 21-1	Jun-2011	Sep-2011 76 FR 54888	Dec-2011 76 FR 74725	Jan-2012
Change of renewal dates from September 1 to September 15			Final Correcting Amendment: Sept-2012 77 FR 55153	Sep-2012

Table 3-156. Trailing Actions with Date of Council Action, Rulemaking, and Implementation. Source: PFMC website (continued).

Action	Final Council Action	Rulemaking		Implementation
		Proposed	Final	
Whiting Catch Share Reallocation	Sep-2012	Jan-2013 78 FR 72	Mar-2013 78 FR 18879	Apr-2013
Program Improvements and Enhancement Rule 2 (PIE II)	Apr-2012	Jul-2013 78 FR 139	Nov-2013 78 FR 68764	Jan-2014
Cost Recovery	Sep-2011	Feb-2013 78 FR 7371	Dec-2013 78 FR 75268	Jan-2014
Chafing Gear	Nov-2012	Mar-2014 79 FR 15296	Dec-2014 79 FR 71340	Jan-2015
Continue Adaptive Management Program Pass-through	Jun-2014	Oct-2014 79 FR 61272	Dec-2014 79 FR 75070	Dec-2014
Change the Shorebased Whiting Season Opening Date	Nov-2012	Feb-2015 80 FR 8280	Apr-2015 80 FR 19034	May-2015
Observer/Catch Monitoring Rule	Apr-2012	Feb-2014 79 FR 9592	Apr-2015 80 FR 22270	May-2015
QS Divestiture Rule	Apr-2015	Sep-2015 80 FR 53088	Nov-2015 80 FR 69138	Nov-2016
Whiting and Midwater Trawl Cleanup Rule	Nov-2014	Aug-2015 80 FR 52015	Dec-2015 80 FR 77267	Jan-2016
Allow Fixed Gear and Trawl Joint Registration	Apr-2012	Jun-2016 81 FR 34947	Nov-2016 81 FR 84419	Jan-2017

(***Not included: Longer-term planning, Issues for future scoping)

3.4.3(a)(3) Gear Rules

Gear flexibility was a key concern for many participants, especially the inability to use multiple gear types on a single trip. Industry members expressed concerns about this lack of flexibility, as well as the uncertainty of the timeline for supposed changes to gear regulations:

> "Some of the most important parts of a rationalized program is having some flexibility in gear and in the areas you fish, and I think that we don't have that. I think when we can use the gear we want to use and fish in the areas, non-essential fish habitat areas, with the rebuilt stocks that are coming on line this next year, then you'll have a true idea of what the fishery really can do as far as attainment of species." —Industry Participant, Eureka Public Hearing, 2016.

> "Unless they hire outside help to do some contracting, our gear package isn't gonna go through, which was to allow us to fish on the shelf with a hooded net." —Fisherman, Astoria Public Hearing, 2016.

> "That was one of those promises. The gear regulations have to change before you can change your gear. They haven't changed yet. That's a sore spot with a lot of people. […] So, you know, people are hamstrung and have been. It should have been something that started with day one and we're in our sixth year. […] And certainly you can use excluders but it has to be used in compliance with the existing gear regulations. There's all sorts of things that you could do if the gear regulations would change but you can't do it because they haven't changed, yet." —Other Industry Participant, Eureka Area, 2015/2016.

> "…"…Yep, be able to have, you know, the mid-water on there with the other two nets. There's no reason why that shouldn't be allowed to be able to be done. We've got an observer on the boat. That would make not only a big difference for us as a boat, but it would make a big difference for the processors who are able to sell your dover and your flat fishes and find some rock cod fillets, you know, it would all go in a bigger package. So it makes a huge, huge difference to them. That killed a lot of them too, you know. Not being able to have that happen (multiple nets)." —Fisherman, Astoria Area, 2015/2016.

> "You would like to use excluders because it can allow you to fish in a manner so you're not catching certain fish, but you can't do it because the regulations won't.

3.4.3(a)(4) Rockfish Conservation Area

Perspectives on the RCA varied more than perspectives on gear regulations and the speed of the management process. While some argued that the level of accountability brought about by the catch share program renders the RCA obsolete, others felt that the RCA has been a major factor in rebuilding overfished species and should remain a part of the management regime.

In opposition to the RCA:

> "It seems like NMFS is trying to shut trawlers out of the groundfish. When the RCA came in, we were told it was to rebuild stocks. Well, any guy who drives by the RCA meters a lot of fish—when will they open that?" —Fisherman, Monterey Area, 2012.
>
> "The RCA issues—right now they're hindering opportunity in our area for both the trawl and the fixed gear people." —Industry Participant, Half Moon Bay Public Hearing, 2016.
>
> "Yeah, I mean…there is really no reason to have rockfish conservation areas per se, because with individual responsibility, you know, if you get into too much rockfish, you are out of the fishery, just like the [vessel]. So the idea behind the desk-based management, which is what rockfish conservation areas are, is no longer needed." —Processor, Oregon, 2015/2016.

In support of the RCA:

> "If you take away the RCAs you're gonna get more of that 'whoops' factor, where people are gonna go do stuff they aren't supposed to. And then it's just like [name omitted]: you have a problem. Somebody is gonna catch too much. If you keep them out of there…I mean obviously there's no temptation to go in there." —Fisherman, Puget Sound Area, 2015/2016.

In support of the RCA, but with alterations:

> "I think they should keep the RCAs, um; I think they should keep them no-trawl zones, and they should let fixed gear in there, if the yelloweye comes back. If they come back and there is a harvestable amount, or if, you know, there is a small amount of bycatch possible, there are a lot of fish up there." —QS Owner, Puget Sound Area, 2015/2016.
>
> "What we really need is to be able to fish in the RCA with midwater gear when the whiting guys aren't fishing. That would be the best time to hit the market." —Processor, Astoria Public Hearing, 2016.

Overall, flexibility was a key concept around which discussions of the management process revolved. Many participants perceive a lack of flexibility in some of the regulations predating catch shares, especially with respect to the RCA and gear limitations. Participants feel the continuation of inflexible regulations is closely linked to perceived inefficiencies in the management process.

3.4.3(b) Program Review

As mandated by MSA and in supported in Amendment 20 objectives, various data collections support annual program review and management, as well as this and subsequent 5-year reviews. These data collections include routine permit applications, ownership information used to calculate cumulative share ownership, mandatory and voluntary social science surveys, and the cost recovery information needed to calculate incremental costs. In accordance with the Paperwork Reduction Act, each such information collection is permitted every three years (amended in the interim if the collections are modified) and tracked by the Office of Management and Budget (OMB). The total time burden for this reporting, as calculated by OMB, works out to approximately 6,500 hours each year (Table 3-157).

Table 3-157. Paperwork requirements and time estimation associated with the program. Source: reginfo.gov.

	Responses	**Time Burden (Hours)**
Pacific Coast Groundfish Fishery Rationalization Social Study	153	143
West Coast Groundfish Trawl Economic Data (multiple collection)	207	2,208
West Coast Region Groundfish Trawl Fishery Monitoring and Catch Accounting Program (multiple collection)	7,449	1,826
Pacific Coast Groundfish Trawl Rationalization Program Permit and License Information Collection (multiple collection)	3,344	405
Northwest Region, Pacific Coast Groundfish Fishery: Trawl Rationalization Cost Recovery Program (multiple collection)	1,874	1,904

These collections contribute to a great deal of data and information, made available through regular reporting by the EDC and Observer Programs at the NWFSC, as well as reports published by the WCRO, states, and at-sea co-ops.

EDC Reporting

- Catcher Vessel Report (2009 to 2014)
- Catcher-Processor Report (2009 to 2014)
- Mothership Report (2009 to 2014)
- First Receiver and Shorebased Processors Report (2009 to 2014)

- FISHEye is an interactive tool to explore, analyze, and download economic data from the West Coast Groundfish Trawl Catch Share Program.[137]

WCR Annual IFQ report

Observer Reports and Data Products[138]

- Groundfish Mortality Report
- Observer coverage rates
- Observed total catch of individual species (including discards)
    - Depths summary (number of observed hauls in different depth bins by year and fishery/gear).
    - Biological meta-data (length, weight) from individual specimens
    - Marine mammal, seabird, sea turtle observed bycatch (2002 to 2014)
    - Eulachon observed bycatch (2002 to 2014)
    - Green sturgeon observed bycatch (2002 to 2014)
    - A number of reports were created in response to the 2012 NMFS Biological Opinion on Continuing Operation of the Pacific Coast Groundfish Fishery, to document bycatch and fishing effort in the West Coast Groundfish Fisheries. These reports can be found in Agenda Item D.4 of June 2015 Briefing Book.

Annual Cooperative Reports

- Pacific Whiting Conservation Cooperative Amendment 20 Catcher-processor Cooperative Final Annual Reports, 2011 to 2016
- Whiting Mothership Cooperative An Amendment 20 Mothership Catcher Vessel Cooperative Final Report on the Pacific Whiting Fishery, 2011 to 2016

[137] https://dataexplorer.northwestscience.fisheries.noaa.gov/fisheye/

[138] https://www.nwfsc.noaa.gov/research/divisions/fram/observation/data_products/sector_products.cfm

3.4.4 Litigation

Highlight:

- The catch share program has been challenged four times since January 2011. The lawsuits have variously alleged that NMFS violated the MSA when it determined quota allocations, required divestiture to prevent consolidation, and recovered management costs.

The catch share program has been challenged four times since January 2011. The lawsuits have variously alleged that NMFS violated the MSA when it determined quota allocations, required divestiture to prevent consolidation, and recovered management costs. This section summarizes the cases challenging the trawl rationalization program.

Reacting and responding to lawsuits requires the time of the Council, NMFS General Counsel attorneys, and NMFS staff. Some of these suits have resulted in new rulemaking or have required an agency response. Thus, litigation may impede progress on development and implementation of subsequent new or "trailing" groundfish actions, including direct delays to implementation of transferability and control limit deadlines (Iudicello and Lueders 2016). This section will include a summary of plaintiffs, cases, and rulings and outcomes (if available) from court cases related to the catch share program.

Pacific Dawn, LLC v. Bryson (Pacific Dawn I); Pacific Dawn v. Pritzker (Pacific Dawn II) (allocation)

The plaintiffs, harvesters Pacific Dawn LLC and Chellisa LLC, processor Jessie's Ilwaco Fish Company, and Ocean Gold Seafood filed suit December 22, 2011, challenging the initial allocation of Pacific whiting. The plaintiffs argued that because the initial allocation, which occurred for 2011, was only based on individual harvest data for 2003 and earlier, NMFS failed to properly consider present participation in the fishery and did not comply with other provisions of the MSA. NMFS explained that, when development of the catch share program began in 2003, it published a notice in the Federal Register informing fishery participants that post-2003 catch might not be considered when the initial allocations were awarded; i.e., it set a "control date." Control dates are commonly used when developing catch sharing programs to avoid creating an incentive for fishers to maximize their catch during this period and, thereby, to maximize their initial quota allocation. The Federal District Court for the Northern District of California determined that the record before it was insufficient to justify NMFS's decision and remanded it to the agency for further consideration.

On remand, NMFS and the Council conducted an extensive reexamination of the initial allocation decision and determined that no changes should be made. During the review, NMFS published a temporary rule delaying portions of the trawl rationalization program (77 FR 45508, August 1, 2012). NMFS published a proposed rule reflecting the decision to keep the initial control date with opportunity to comment (78 FR 72, January 2, 2013) and a final rule (78 FR 18879, March 28, 2013). The plaintiffs challenged the final rule on March 29, 2013 (Pacific Dawn II). On December 5, 2013, the court upheld NMFS's initial allocation decision, holding that the record developed during the remand fully explained NMFS's rationale for its decision. The plaintiffs appealed to the Ninth Circuit Court of Appeals, which affirmed the decision of the district court.

Pacific Coast Federation of Fishermen's Associations v. Blank (allocation)
The plaintiffs, primarily from the non-trawl sector, Pacific Coast Federation of Fishermen's Associations, Port Orford Ocean Resource Team, and San Francisco Crab Boat Owners Association, challenged Amendment 20 and 21 immediately after they went into effect. The plaintiffs argued that NMFS violated MSA National Standard Eight because it did not provide an initial allocation of QS to fishing communities and because the catch share program allocated quota based on past harvests to those who did not "substantially participate" in the fishery.

NMFS acknowledged that the amendments were likely to result in consolidation, potentially harming communities, but argued that the increase in productivity would benefit those remaining in the fishery and would limit overcapitalization and overfishing. To mitigate hardship faced by the communities, NMFS included set-asides of, a two-year delay of quota transfers, and a control rule, which put a cap on share accumulation by single entities. On August 5, 2011, the district court held that NMFS considered the needs of fishing communities when establishing the program and was not required to allocate quota to fishing communities to meet the requirements of the MSA. In addition, the court agreed with NMFS that the ability to receive and hold quota need not be restricted only to those who "substantially participate" in the fishery. On September 10, 2012, the district court's decision was affirmed by the Ninth Circuit Court of Appeals.

Glacier Fish Company v. Pritzker (cost recovery)
Glacier Fish Company filed suit against NMFS on January 9, 2014, challenging the cost recovery fee of 1.1 percent on revenue. The MSA requires NMFS to collect fees to recover the costs directly related to management, data collection, and enforcement of a LAPP. Glacier Fish Company is a member of a catcher-processor co-op, which NMFS permitted as a type of LAPP. Glacier argued that the co-op was not a LAPP and could not be assessed a cost recovery fee. The Ninth Circuit upheld NMFS's authority to collect fees, agreeing that Glacier was a "holder" of a LAPP permit. However, the court remanded the fee calculation, concluding that NMFS did not properly account for incremental costs attributable to the LAPP. On remand, the parties resolved the outstanding fee issues in a settlement agreement.

Pacific Choice Seafood Company v. Pritzker (divestiture)

The plaintiffs, Pacific Choice Seafood Company, Sea Princess LLC, and Pacific Fishing LLC, challenged the catch share program in December 2015 arguing that the 2.7 percent aggregate control limit (control rule) was arbitrary and capricious. The control rule required that entities that "own or control" more than 2.7 of the total QSs divest of excess shares. This case is currently pending before the district court.

Conservation Law Foundation v. Pritzker (carryover)

On April 4, 2014, the D.C. District Court issued its decision in Conservation Law Foundation's challenge to Framework 50 to the New England FMP. The primary issue in that case was a challenge to NMFS' authority to allow carryover of unused catch in fishing year 2013 that resulted in in a total de facto allocation of catch higher than the ABC recommended by the SSC. The Court ruled that the agency could not rely on 2013 framework carryover measures to authorize a de facto catch in excess of the SSC's recommended ABC, holding that under the plain language of 302(h)(6) of the MSA, 16 U.S.C. § 1852(h)(6), neither the Council nor NMFS may establish a total potential catch level that exceeds the ABCs recommended by the SSC. In light of the court's holding, NOAA General Counsel, Northwest Section has advised the NMFS West Coast Region that 2017 ACLs, including carryover from 2016, should not exceed the ABCs recommended by the SSC. Thus no surplus carryover would be issued in an amount for any IFQ species where adding 2016 carryover onto the 2017 ACL would result in exceeding any IFQ species' ABC.

3.4.5 Science-based Management

Use best scientific information available (MSA National Standard 2).
Conservation and management measures shall take into account and allow for variations among, and contingencies in, fisheries, fishery resources, and catches (MSA National Standard 6).
To the extent practicable, an individual stock of fish shall be managed as a unit throughout its range, and interrelated stocks of fish shall be managed as a unit or in close coordination (MSA National Standard 3). Take into account the biological structure of the stocks including, but not limited to, populations and genetics (Amendment 20 constraint).

Highlight:

- As overfished stocks rebuild and increase their abundance, the probability of capture also rises, increasing the likelihood that the fishery will meet or exceed the catch limit. While recovery of these stocks is positive overall, there can be a lag between stock recovery, NMFS's documentation of the recovery, and resulting higher catch limits. For example, the

2015 canary rockfish stock assessment documented the recovery; however, increases in catch limits did not go into effect until 2017.

This section includes a qualitative description of an assessment of best available science to inform management decisions. The best available science was used in development of stock assessments, rebuilding analyses, and methods for determining management reference points (overfishing limit, acceptable biological catch, annual catch limit, etc.). These areas form the basis for determining harvest levels and evaluation of socioeconomic impacts. The catch share program required an increase in the amount and quality of scientific data in order to support effective monitoring and long-term management. Improvements in observer data (increased coverage) and economic data provide a foundation of high quality scientific information on which to support management of the catch share program. Improved data collection has collateral benefits for other fishery management actions.

On an ongoing basis, the Council receives input from managers, scientists, and the public on the performance of the groundfish fishery, including the catch share programs, and it has a number of avenues by which it makes adjustments. These avenues include a biennial prioritization process that sets the priority for all groundfish related management actions. In general, the catch share program takes into account variations and contingencies through the great flexibility it provides to participants (see 3.1.3(a)(2)). The program itself has provisions that will allow it automatically to adapt to changing sciences and management needs that might change species or geographic groupings to which stocks are managed. The provisions set in place the steps by which quota will be reallocated when such changes occur, obviating the need for difficult allocation discussions that might otherwise take place. Further, the program includes a set-aside of 10 percent of the QS to be used for a variety of purposes, including responding to unexpected outcomes from the program.

Fishery conservation and management require high quality, timely, biological, ecological, environmental, economic, and sociological scientific information to conserve and manage living marine resources effectively (MSA National Standard 2, 50 CFR 600.315). Successful fishery management depends, in part, on the thorough analysis of this information and the extent to which the information is applied when evaluating the impacts that management measures will have on living marine resources, EFH, marine ecosystems, fisheries participants, fishing communities, and the nation. It includes identifying areas where additional management measures are needed. Scientific information used to inform decision-making should include evaluation of uncertainty and identification of gaps in the information. Management decisions should recognize the biological, ecological, sociological, and economic risks associated with sources of uncertainty and gaps in scientific information (MSA National Standard 2, 50 CFR 600.315; Amendment 20 EIS June 2010).

Only a small proportion of more than 100 species monitored or actively managed under the groundfish FMP are regularly assessed because of a combination of factors. For many stocks, there are not enough data to support a full stock assessment (the FMP describes a tiered classification system based on the availability of data). As the quality and quantity of catch data increase with the 100 percent monitoring in the fishery, stocks that were classified in a lower tier, indicating greater uncertainty, may be bumped up with increased precision coming from improved data. While not enough time has passed under the new data and management regime to observe a shift, this would be worth revisiting in future program reviews.

In addition to stock science, the NWFSC has developed a model application, IO-PAC, for estimating personal income impacts of commercial fishing on the West Coast (discussed more in Section 3.1.3(b)). NMFS and the Council used the best available scientific information in developing all of the proposed actions (Amendment 20 EIS June 2010).

Fisheries management requirements change constantly. As management needs arise, the Council and NMFS respond. Amendment 19 addressed habitat issues in the fishery and established extensive habitat protections; Amendment 20 maintained those protections, while specifically addressing a separate management need for rationalization. While amendments must comply with the broad array of policy objectives in the MSA's National Standards and within the FMP, not every FMP amendment will address every management need simultaneously. The Council will continue to review management needs and develop new measures if necessary and appropriate (Amendment 20 EIS June 2010).

Under the groundfish FMP, "individual stock of fish [are] managed as a unit throughout its range, and interrelated stocks of fish shall be managed as a unit or in close coordination" through the management units for which ABCs and ACLs are established. The divisions and grouping of species under the catch share program match these units so that the trawl catch can be controlled to achieve management objectives for each unit. The ABCs/ACLs for many groundfish species are coastwide, but there are latitudinal divisions for a number of species and species groups. Those divisions occur at four lines: 40°10′ N., 36° N., 36°, and 34°27′ N. Some species are managed at the species level both north and south of a management line. Some, like boccaccio, are managed as a single species in one area, and as a component of a species group in another. To address these varying management needs, vessels participating in the Shorebased IFQ Program are prohibited from fishing in different areas during the same trip. This prohibition was intended to ensure that catch was covered with QP for the appropriate management unit. The Council has since determined and recommended to NMFS that, with proper sorting, at-sea monitoring is adequate to monitor catch and allow vessels to fish between areas on a single trip.

While vessels participating in the catch share program can continue to discard groundfish species for which QP is not required and not have those discards count against vessel specific limits, it is likely that these species are better managed. This is because the discards are more fully monitored due to the 100 percent at-sea monitoring required for the catch share program.

The most recent stock assessment of blackgill rockfish in 2011 indicated that the stock biomass south of 40°10’ N. latitude was at 30 percent of unfished biomass, in the precautionary zone (PFMC 2015a).[139] As a result, the Council implemented conservative cumulative landing limits for non-trawl sectors of the West Coast groundfish fishery in 2013. However, a similar strategy for the trawl sector required a change in the management strategy; under the IFQ program, blackgill rockfish were managed within the aggregate Southern Slope Rockfish Complex, for which quota is allocated in aggregate. In November 2015, the Council took final action to remove blackgill rockfish from the Southern Slope Rockfish complex south of 40°10’ N. latitude to allow a more conservative management strategy of the stock. Since this was done at the ABC/ACL level, the new species groupings affected all sectors.

3.4.5(a) Rebuilding Paradox

As overfished stocks rebuild and increase their abundance, the probability of capture also rises, raising the likelihood that the fishery will meet or exceed the catch limit. There can be a lag between stock recovery, NMFS’ documentation of the recovery, and resulting higher catch limits. For example, the 2015 canary rockfish stock assessment documented the recovery; however, increases in catch limits did not go into effect until 2017 (FLSF 2016). Fishermen have pointed out that there is a methodology in the FMP for reducing catch limits after stock assessments show a decrease in stock health, but there is no matching methodology for increasing catch limits mid-season in response to an assessment identifying an increase in stock health (FLSF 2016).

As species rebuild, their reallocation can also become controversial. In the catch share fishery, overfished species were allocated to permit holders based on the QS allocation of target species with which overfished species are incidentally caught. Non-overfished species were allocated according to historical catch. In the case of widow rockfish, which was anticipated to rebuilt within the first few years after implementation, the Council initiated an action to reallocate widow rockfish based on historical use (PFMC 2014).

[139] http://www.pcouncil.org/wp-content/uploads/2015/10/I6_Att1_A26_BGill_Allocation_EA_Nov2015BB.pdf.

3.4.6 Adaptive Management Program

Highlight:

- The Council has not yet developed an alternative model for AMP quota, and, at its June 2014 meeting, elected instead to consider allocation procedures as part of the five-year review, continuing the pass-through procedure in place.

The Council included an adaptive management program provision for the shoreside IFQ component of the catch share program. Adaptive management was not included for either sector of the at-sea whiting fishery. In accordance with IFQ program section A-3, "The set aside of QP for the identified objectives will be reviewed as part of the year five comprehensive review and a range of sunset dates will be considered, including 10, 15, 20 year and no sunset date options."

From IFQ program section A-3:

> Ten percent of the non-whiting QS will be reserved to facilitate adaptive management in the shoreside non-whiting sector. Therefore, each year, 10 percent of the shoreside trawl sector non-whiting QPs will be available for use in adaptive management (adaptive management QP). The set-aside will be used to address the following objectives:

- Community stability
- Processor stability
- Conservation
- Unintended/unforeseen consequences of IFQ management
- Facilitating new entrants

> **Years One and Two.** During the first two years in which the IFQ program is in place, the method to be used in distributing QP in years three through five will be determined, including the following:

- The decision-making and organization structure to be used in distributing the QP set-aside
- The formula for determining community and processor eligibility, as well as methods for allocation, consistent with additional goals
- The division of QP among the states
- Whether to allow the multi-year commitment of QP to a particular project

> **Years Three through Five**. QP will be distributed through the organizational structure, decision process, formulas, and criteria developed in years one and two and implemented through subsequent Council recommendation and NMFS rule-making processes. Consideration will be given to the multiyear commitment of QP to particular projects (three-year commitments).

The "pass-through" method provided AMP QPs for owners, pro-rata to their QS. The Council has not yet developed an alternative model for AMP quota, and, at its June 2014 meeting, elected instead to consider allocation procedures as part of the five-year review, continuing the pass-through procedure in place (see Minutes 224th Session of the Council for more on this decision).[140] In 2011, the Council recommended an extension of the pass-through until the end of 2014 due to concern that, given the other high-priority trailing actions on which the Council was working, alternative criteria might not be developed and implemented by 2013, in which case there would be no procedure in place for distribution of the AMP QP. The Council decision document associated with continuation of the pass-through noted the following:

> "QS prices are likely to vary depending on whether traders anticipate a long-term continuation of the pass-through. If expectation of a long-term continuation of the pass-through is built into QS prices, this would likely generate resistance to future proposals for alternative distributions."

For further Council consideration of adaptive management in the first five years of the program, see April 2011 Agenda Item I.6.a Attachment 4, June 2011 Agenda Item E.6.a, Attachment 6.

3.4.7 Other Program Components

If a program component is required or must be considered under MSA or the NMFS Catch Share Policy, *NMFS Guidance for Conducting 5/7 Year Reviews* requires that it be addressed in a 5/7 year review. Amendment 20 contained additional guidance and constraints that are not directly addressed elsewhere in this review document. The following components, outlined below, meet one or more of these criteria.

3.4.7(a) Allocations

Amendment 21 allocations are being reviewed concurrently but independently in a separate document. Amendment 20 FEIS criteria for the initial QS allocations, evaluated and considered at the start of the program, are presented in below:

[140] The GMT and Council staff provided a report on potential alternatives to the pass-through to better target stated objectives, available as a supplemental PowerPoint to the GMT report on Agenda Item E.12.b in June 2009.

- What groups will be eligible to receive an initial allocation of QS (PFMC and NMFS 2010, Appendix A-2.1.1.a)?
- How much of the initial allocation will go to each group (PFMC and NMFS 2010, Appendix A-2.1.1.a)?
- What criteria must be met for membership in each group and how might the attributes that meet those criteria be passed on or accrue to successors in interest (PFMC and NMFS 2010, June 2010, Appendix A-2.1.1.b, c, and d)?
- Should recent activity or membership in the group be required to receive an initial allocation? (PFMC and NMFS 2010, Appendix A-2.1.2.a, b, and c)
- What amounts of QS should be allocated to each of those qualifying for an initial allocation? (PFMC and NMFS 2010, Appendix A-2.1.3, a, b, c, and d) The following are considered in addressing this allocation question:
    - ➢ Should there be an equal allocation element in the allocation formula?
    - ➢ Should there be a landing history element in the allocation formula?
    - ➢ What time periods should be used for allocation?
    - ➢ Should the allocation formula take hardships into account?
    - ➢ Should the same credit be received for a given amount of catch, regardless of the year in which it is harvested?
    - ➢ Should overfished species be allocated on basis different from that used for other species?
    - ➢ With respect to the allocation formulas, how should various exceptional situations be addressed (e.g., credit for EFP landings in excess of trip limits)? (PFMC and NMFS 2010, Appendix A-2.1.4)
    - ➢ What process should be provided to address disagreements about applications of the provisions and unusual situations that may arise that are not otherwise addressed? (PFMC and NMFS 2010, Appendix A-2.1.5)
    - ➢ If, after QS is issued, direct reallocation appears to be needed to address the redefinition of management units, or if there are substantial changes in the status of a species, how would those reallocations be achieved? How would an initial allocation be made for a groundfish species not currently within the scope of the IFQ program? (PFMC and NMFS 2010, Appendix A-2.1.6)

3.4.7(b) Eligibility

The main requirement to own QS is that an entity must be eligible to own a United States-documented fishing vessel registration. A vessel must be registered to a groundfish limited entry trawl permit in order to harvest groundfish using QPs (Section 2.2.2, Initial Allocation and Qualification, Amendment 20 FEIS and Amendment 20 FEIS Appendix A).

3.4.7(c) Transferability

See Section 1.3.1, The Theory behind Tradable Permits, Amendment 20 FEIS, for a discussion of tradeoffs between unrestricted transferability and consolidation. Tradability is an important feature in terms of economic efficiency and bycatch reduction objectives. It requires each vessel to match the amount of fish caught to QP amount in the vessel account amount. In a competitive market, shares will tend to accrue to the highest valued use. Individuals with higher operational costs, for example, may be better off selling their shares to a person who can use them at lower overall cost (operational cost plus the cost of share purchase) (PFMC and NMFS 2010). See Chapter 3.1.1 of this document for additional information.

3.4.7(d) Duration

The Amendment 20 FEIS (Section 2.2.2, Initial Allocation and Qualification, Amendment 20 FEIS, PFMC and NMFS 2010) states that "QSs would be of long duration, so a transfer represents a long-term or permanent divestment." The Council considered issuing QSs for a fixed period (15 or 16 years), after which all or a portion of the QSs would be periodically reallocated. Council did not include that alternative in the final amendment, partially due to concerns about a "negative effect on stewardship because the returns to stewardship would be partially dissipated by any loss of QS" (SSC November 2008). The SSC cautioned decision makers as follows:

> "The expected number of vessels that will operate in the rationalized fishery may be so large and the percent of the quota owned by a single operator so small (due to accumulation limits) that the private gains to stewardship may not be significant enough to change operations in a meaningful way."

The Council ultimately made the following determination (PFMC and NMFS 2010, Appendix F): "The preferred [no fixed period] option generates greater benefits across almost the entire range of management objectives." Although a fixed duration was not part of the Council's final preferred alternative, the MSA restricts the duration of a fishing privilege to 10 years with conditions for renewal.

3.4.7(e) Auctions and Royalties

The Auctions and Royalties Provision gives notice of the Council's intent to consider implementing an auction if QS must be redistributed. The public, industry, and those who acquire QS should be aware that the program can be changed at any time and an auction implemented, following the appropriate process for amending the FMP. If the Council considers such an auction, a full regulatory amendment and rule-making process would accompany that decision. That process would include a complete analysis of the specific proposal and an opportunity for public comment. Auctions secure a portion of the resource rents for the public that would otherwise go to QS owners. Other impacts would depend on the source of the QS for the auction and other specifics of the proposal (Am. 20 FEIS Appendix A).

3.4.7(f) Marketing power balance

Representatives of the harvesting and processing sectors reached a compromise agreement and recommended that, under an IFQ program, there be a 20 percent allocation of whiting QS to processors. This allocation to processors addressed concerns about the effects of trawl rationalization on the market power balance between the whiting harvesting and processing sectors. Also, contributing to the decision to manage the shoreside whiting sector under IFQs was the opportunity that managing the shoreside whiting and shoreside non-whiting sectors together would enable resolving intersector allocation issues between them. The rationale for the 20 percent allocation of whiting QS to processors and the advantages of managing the shoreside trawl sectors together under a single IFQ program are discussed further in the section on rationale for specific provisions of the IFQ program (Section 2.6.5.2, Choice for the Shoreside Whiting Sector, Amendment 20 FEIS).

4.0 RESEARCH AND DATA NEEDS

Include a summary of any additional research and data needs identified during Council review of the draft report here in the final version of the report.

5.0 COUNCIL RECOMMENDATIONS

Include a summary of Council recommendations here in the final version of the report.

6.0 NEXT STEPS

Include a summary of next steps for NOAA Fisheries and the Council to make take to implement any desired or needed changes to the program in the final version of the report.

7.0 REFERENCES

Artzner, Philippe, Freddy Delbaen, Jean-Marc Eber, and David Heath. 1999. Coherent Measures of Risk. Mathematical Finance. Volume 9, page 203–228.

Berger, A.M., Grandin, C.J., I.G. Taylor, A.M. Edwards, and S. Cox. 2017. Status of the Pa-cific Hake (whiting) stock in U.S. and Canadian waters in 2017. Prepared by the Joint Technical Committee of the U.S. and Canada Pacific Hake/Whiting Agreement, National Marine Fisheries Service and Fisheries and Oceans Canada. 202 p.

Brinson, Ayeisha A., and Eric M. Thunberg. 2016. Performance of Federally Managed Catch Share Fisheries in the United States. Fisheries Research. Volume 179, page 213–223.

EO Media Group. 2015. Warm Ocean Possible Culprit in 2015 Hake Collapse. The Daily Astorian. http://www.dailyastorian.com/Local_News/20160309/warm-ocean-possible-culprit-in-2015-hake-collapse, accessed March 15, 2017.

Fraser, Dave. 2011. Preliminary Whiting Mothership Cooperative Report on the Current Year Pacific Whiting Fishery. Pacific Fishery Management Council Agenda Item E.6.c. November 2011 meeting. 31 pages.

Fraser, Dave. 2016. An Amendment 20 Mothership Catcher Vessel Cooperative Final Report on the 2015 Pacific Whiting Fishery. Pacific Fishery Management Council Informational Report, June 2016 meeting, 31 pages.

Gillis, D.M., R.M. Peterman, and Ellen K. Pikitch. 1995. Implications of trip limit regulations for high-grading; a model of the behavior of fishermen. Canadian Journal of Fisheries and Aquatic Sciences. Volume 52, page 402–415.

Grandin, Chris J., Allan C. Hicks, Aaron M. Berger, et al. 2016. Status of the Pacific Hake (Whiting) Stock in U.S. and Canadian Waters in 2016. Prepared by the Joint Technical Committee of the U.S. and Canada Pacific Hake/Whiting Agreement, National Marine Fisheries Service and Oceans Canada. 165 pages. http://www.cio.noaa.gov/services_programs/prplans/pdfs/ID334_Final_PacHake2016.pdf.

Guillen, Jordi, Claire Macher, Mathieu Merzereaud, et al. 2013. Estimating MSY and MEY in Multi-Species and Multi-Fleet Fisheries, Consequences and Limits: An Application to the Bay of Biscay Mixed Fishery. Marine Policy. Volume 40, page 64–74.

Guldin, M. Working paper. Processor-Allocated Quota in IFQ Programs: An analysis of the shoreside Pacific whiting fishery.

Guldin, M., Steiner, E., Warlick, A., and Leonard, J. 2016. Economic Data Collection Program First Receiver and Shorebased Processor Report (2009-2014). NOAA Fisheries Northwest Fisheries Science Center.

Hastie, J. 2001. Permit stacking as an approach to implementing harvest rights that can be transferred and accumulated. Proceedings of the Tenth Biennial Conference of the International Institute ofFisheries Economics and Trade, July 10-14. Corvallis, Oregon, USA. Compiled by Richard S. Johnston and Ann L. Shriver. International Institute of Fisheries Economics and Trade (IIFET), Corvallis, 2001.

Holland, Daniel S. 2013. Making Cents out of Barter Data from the British Columbia Groundfish ITQ Market. Marine Resource Economics. Volume 28, page 311–330.

Holland, Daniel S. 2016. Development of the Pacific Groundfish Trawl IFQ Market. Marine Resource Economics. Volume 31, 16 pages.

Holland, Daniel S. In prep. 2017. Pacific Groundfish Trawl IFQ Quota Pound (QP) Market Update.

Holland, Daniel S., and Jason E. Jannot. 2012. Bycatch Risk Pools for the US West Coast Groundfish Fishery. Ecological Economics. Volume 78, page 132–147.

Holland, Daniel S., and Stephen Kasperski. 2016. The Impact of Access Restrictions on Fishery Income Diversification of US West Coast Fishermen. Coastal Management. Volume 44, page 1–12.

Holland, Daniel S., Juan Agar, Scott Crosson, et al. In prep. The Impact of Catch Shares on Diversification and Income Variation in Fisheries.

Hsueh, L. In press. Quasi-Experimental Evidence on the "Rights to Fish": The Effects of Catch Shares on Fishermen's Days at Sea. Journal of the Association of Environmental and Resource Economists.

Iudicello, S. and S. B. Lueders. 2016. A survey of litigation over catch shares and groundfish management in the Pacific Coast and Northeast Multispecies Fisheries. Environmental Law Volume 46, page 157-208.

Jacquet, J.L., and Daniel Pauly. 2007. The Rise of Seafood Awareness Campaigns in an Era of Collapsing Fisheries. Marine Policy. Volume 31, page 308–313.

Jannot, J.E., K. Somers, N.B. Riley, V. Tuttle, and J. McVeigh. 2016. Pacific Halibut Bycatch in the U.S. West Coast Fisheries (2002-2015). Seattle, WA. NWFSC Observer Program.

Kasperski, Stephen, and Dan Holland. 2013. Income Diversification and Risk for Fishers. Proceedings of the National Academy of Sciences. Volume 110, page 2076–2081.

King, Gary, and Langche Zeng. 2001. Logistic Regression in Rare Events Data. Political Analysis. Volume 9, page 137–163.

Kintisch, Eli. 2015. "The Blob" Invades Pacific, Flummoxing Climate Experts. Science. Volume 348, page 17–18.

Landsman, Zinoviy, and Emiliano A. Valdez. 2005. Tail Conditional Expectations for Exponential Dispersion Models. Astin Bulletin. Volume 35, page 189–209.

Leonard, Jerry, and Erin Steiner. In prep. Initial Economic Impacts of the U.S. Pacific Coast Groundfish Fishery Individual Fishing Quota Program.

Leonard, Jerry, and P. Watson. 2011. Description of the Input-Output Model for Pacific Coast Fisheries. NOAA Tech. Memo, NMFS-NWFSC-111. U.S. Dept. Commerce.

Lian, Carl, Rajesh Singh, and Quinn Weninger. 2009. Fleet Restructuring, Rent Generation, and the Design of Individual Fishing Quota Programs: Empirical Evidence from the Pacific Coast Groundfish Fishery. Marine Resource Economics. Volume 24, page 329–359.

Lucas, Devin L., and Jennifer M. Lincoln. 2007. Fatal Falls Overboard on Commercial Fishing Vessels in Alaska. American Journal of Industrial Medicine. Volume 50, page 962–968.

Mamula, Aaron, and Trevor Collier. 2015. Multifactor Productivity, Environmental Change, and Regulatory Impacts in the U.S. West Coast Groundfish Trawl Fishery, 1994–2013. Marine Policy. Volume 62, page 326–336.

Matson, Sean E. 2016. Exploration of Landings, Harvest Specification and Attainment Time Series, for Stocks of Interest in the Historical Shorebased limited entry Trawl Fishery and Contemporary IFQ Program. National Marine Fisheries Service.

May, Robert M., John R. Beddington, Colin W. Clark, Sidney J. Holt, and Richard M. Laws. 1979. Management of Multispecies Fisheries. Science. Volume 205, page 267–277.

National Marine Fisheries Service (NMFS). 2003. Environmental Assessment and Regulatory Impact Review for a final notice of a fishing capacity reduction program in the Pacific Coast groundfish fishery. National Marine Fisheries Service, Financial Services Division, Silver Spring, MD 20910.

National Marine Fisheries Service (NMFS). 2004. The after effects of the Pacific groundfish Limited Entry trawl buyback program: A preliminary analysis. Seattle, WA. NWFSC.

National Marine Fisheries Service (NMFS). 2014. Implementation of the Ocean Salmon Conservation Zone and Reapportionment of Darkblotched Rockfish between Catcher-processor and Mothership Sectors. Public notice.

National Marine Fisheries Service (NMFS). 2017. NMFS Guidance for Conducting Reviews of Catch Share Programs (Review Guidance). Public notice. April 13 2017. Office of Sustainable Fisheries. http://www.nmfs.noaa.gov/op/pds/documents/01/121/01-121-01.pdf.

National Oceanic and Atmospheric Administration. 2000. Press release: Commerce Secretary Daley announces West Coast groundfish fishery failure. http://www.publicaffairs.noaa.gov/releases2000/jan00/noaa00r103.html

North Pacific Fishery Management Council (NPFMC). 2016. Ten-Year Program Review for the Crab Rationalization Management Program in the Bering Sea/ Aleutian Islands.

O'Donnell, Christopher J. 2012. Nonparametric Estimates of the Components of Productivity and Profitability Change in US Agriculture. American Journal of Agricultural Economics. Volume 94, page 873–890.

Pacific Fishery Management Council (PFMC). 1998. Status of the Pacific coast groundfish fishery through 1998 and recommended biological catches for 1999: Stock Assessment and Fishery Evaluation. Pacific Fishery Management Council. Portland, OR.

Pacific Fishery Management Council (PFMC). 2000a. Overcapitalization in the West Coast Groundfish Fishery: Background, Issues and Solutions. Report by the Economic Subcommittee of the PFMC Scientific and Statistical Committee, Pacific Fishery Management Council, 16 March 2000. Pacific Fishery Management Council, Portland, OR 97201.

Pacific Fishery Management Council (PFMC). 2000b. Environmental Assessment/Regulatory Impact Review/Initial Regulatory Flexibility Analysis for Proposed Groundfish Acceptable Biological Catch and Optimum Yield Specifications and Management Measures for the 2001 Pacific Coast Groundfish Fishery. Portland, OR.

Pacific Fishery Management Council (PFMC). 2010a Appendix B to the Rationalization of the Pacific Coast Groundfish Limited Entry Trawl Fishery Draft Environmental Impact Statement: Analysis of Componenets, Elements, and Options for the Harvest Cooperative Alternative Cooperative Components Analysis. www.pcouncil.org/wp-content/uploads/3_1005_TRatFEIS_ApdxB_Co-ops.pdf.

Pacific Fisheries Management Council (PFMC). 2010b. Appendix E of the Pacific Coast Fishery Management Plan for the California, Oregon, and Washington Groundfish Fishery. 2010. Portland, OR.

Pacific Fishery Management Council (PFMC). 2010c. Appendix C to the Rationalization of the Pacific Coast Groundfish Limited Entry Trawl Fishery Final Environmental Impact Statement. Portland, Oregon: Pacific Fisheries Management Council. http://www.pcouncil.org/wp-content/uploads/4_1005_TRatFEIS_ApdxC_Analytical_tools.pdf.

Pacific Fisheries Management Council (PFMC). 2012. Agenda Item D.1.b,, Supplemental USCG Report 2. Briefing Book. April 2012.

Pacific Fisheries Management Council (PFMC). 2013. Agenda Item J.1.b., Supplemental USCG Report 2. Briefing Book. March 2013.

Pacific Fisheries Management Council (PFMC). 2014. Agenda Item D.1., U.S. Coast Guard 2014 Annual Report to the Pacific Fishery Management Council. Briefing Book. March 2015.

Pacific Fisheries Management Council (PFMC). 2014. Pacific Whiting Conservation Cooperative Amendment 20 Catcher-processor Cooperative Final Annual Report 2014. Pacific Fisheries Management Council.

Pacific Fisheries Management Council (PFMC). 2015a. Allocation of Harvest Opportunity Between Sectors of the Pacific Coast Groundfish Fishery of Blackgill Rockfish and Other Species Managed in the Slope Rockfish Complex South of 40° 10' N. Latitude Draft Environmental Assessment. Pacific Fisheries Management Council.

Pacific Fisheries Management Council (PFMC). 2015b. Groundfish Management Team Report on Blackgill-Slope Complex Reallocation and Accumulation Limits. Pacific Fisheries Management Council, Portland, OR.

Pacific Fisheries Management Council (PFMC). 2015c. Range of alternatives for managing West Coast Skate species. Pacific Fishery Management Council, Portland, OR.

Pacific Fishery Management Council (PFMC). 2016a. Pacific coast groundfish fishery management plan for the California, Oregon, and Washington groundfish fishery. Pacific Fishery Management Council, Portland, OR.

Pacific Fishery Management Council (PFMC). 2016b. 2017-2018 Groundfish Harvest Specifications and Management Measures Including Changes to Groundfish Stock Designations (Amendment 27 to the Pacific Coast Groundfish Management Plan). Pacific Fisheries Management Council, Portland, OR.

Pacific Fishery Management Council (PFMC). 2016c. Draft Appendix B Additional Management Measure Analysis and New Management Measures Analysis 2017-2018 Groundfish Harvest Specifications and Management Measures Including Changes to Groundfish Stock Designations (Amendment 27 to the Pacific Coast Groundfish Fishery Managment Plan). Portland, OR: Pacific Fisheries Management Council. http://www.pcouncil.org/wpcontent/uploads/2016/06/G4_Att5_DraftAppB_JUN2016BB.pdf.

Pacific Fishery Management Council (PFMC) and National Marine Fisheries Service (NMFS). 2010. Rationalization of the Pacific groundfish Limited Entry trawl fishery: Final Environmental Impact Statement, including regulatory impact review and initial regulatory flexibility analysis. Pacific Fishery Management Council, Portland, OR. June 2010 meeting.

Pacific Groundfish Quota Program Workshop (PGQP). 2016.: Summary of Workshop Themes. Fisheries Leadership & Sustainability Forum.

Pacific Whiting Conservation Cooperative (PWCC). 2011.Pacific Whiting Conservation Cooperative Amendment 20 Catcher-processor Cooperative Preliminary Annual Report 2011. Agenda Item 3.6.c. http://www.pcouncil.org/wp-content/uploads/E6c_CP_CO-OP_NOV2011BB.pdf.

Pacific Whiting Conservation Cooperative (PWCC). 2015. Pacific Whiting Conservation Cooperative Amendment 20 Catcher-processor Cooperative Final Annual Report. Final Annual Report 2015. http://www.pcouncil.org/wp-content/uploads/2015/03/IR3_2014_Co-op_Annual_Rpt_CP_APR2015BB.pdf.

Pacific Whiting Industry's Banner Year Upended by Russian Embargo and Ensuing Uncertainty. Seafood News. http://www.seafoodnews.com/Story/943739/Pacific-Whiting-Industrys-Banner-Year-upended-by-Russian-Embargo-and-Ensuing-Uncertainty, accessed March 15, 2017.

Papke, Leslie E., and Jeffrey Wooldridge. 1993. Econometric Methods for Fractional Response Variables with an Application to 401 (K) Plan Participation Rates. National Bureau of Economic Research Cambridge, Mass., USA. http://www.nber.org/papers/t0147, accessed January 14, 2017.

Pfeiffer, Lisa, and Trevor Gratz. 2016. The Effect of Rights-Based Fisheries Management on Risk Taking and Fishing Safety. Proceedings of the National Academy of Sciences. Volume 113, page 2615–2620.

Pfeiffer, Lisa. 2016. Safety Incidents in the West Coast Catch Shares Fisheries. NOAA Technical Memorandum, NMFS F/SPO-160. NOAA National Marine Fisheries Service.

Pikitch, E.K., D.L. Erickson, and J.R. Wallace. 1988. An evaluation of the effectiveness of trip limits as a management tool. NWAFSC Processed Report 88-27. National Marine Fisheries Service, Northwest Alaska Fisheries Center. Seattle, WA.

Reimer, Matthew N., Joshua K. Abbott, and James E. Wilen. 2014. Unraveling the Multiple Margins of Rent Generation from Individual Transferable Quotas. Land Economics. Volume 90, pages 538–559.

Rogers, Jean Beyer, and Ellen K. Pikitch. 1992. Numerical Definition of Groundfish Assemblages Caught off the Coasts of Oregon and Washington Using Commercial Fishing Strategies. Canadian Journal of Fisheries and Aquatic Sciences. Volume 49, pages 2648–2656.

Roheim, Cathy. 2003. Early Indications of Market Impacts from the Marine Stewardship Council's Ecolabeling of Seafood. Marine Resource Economics. Volume 18, page 95–104.

Russell, Suzanne, Kimberly Sparks, Albert Arias-Arthur, and Anna Varney. 2014. The Pacific Groundfish Fishery Social Study: An Initial Theme Based Report. NOAA Fisheries Northwest Fisheries Science Center. Seattle, WA

Sackton, John. 2014. Russian ban hits us exports of hake, surimi, pink salmon and salmon roe; canned products excluded. Saving Seafood. http://www.savingseafood.org/news/international-trade/russian-ban-hits-us-exports-of-hake-surimi-pink-salmon-and-salmon-roe-canned-products-excluded/, accessed March 15, 2017.

Shaw, W. and F.D.L. Conway. 2007. Responses to the West Coast groundfish disaster: Lessons learned for communities and decision makers. Oregon State University, Corvallis OR.

Somers, K., Jannot, J.E., Hastie, J., Lee, Y.-W., McVeigh, J., and Whitmire, C. 2015. Fishing Effort in the 2002-2013 U.S. Pacific Coast Groundfish Fisheries. West Coast Groundfish Observer Program, Northwest Fisheries Science Center. Seattle, WA.

Somers, Kayleigh, Yong-Woo Lee, Jason E. Jannot, et al. 2015. Estimated Discard and Catch of Groundfish Species in the 2015 U.S. West Coast Fisheries. 2725 Montlake Blvd E., Seattle, WA 98112: NOAA Fisheries, NWFSC Observer Program. https://www.nwfsc.noaa.gov/research/divisions/fram/observation/pdf/Groundfish_Mortality_2015_100516.pdf.

Steiner, E. 2016. Economic Data Collection Program Administration and Operations Report. Northwest Fisheries Science Center. Seattle, WA.

Steiner, E., Pfeiffer, L., Guldin, M., and A. Warlick. 2016a. Economic Data Collection Program Catcher Vessel Report (2009-2014). NMFS Northwest Fisheries Science Center. Seattle, WA.

Steiner, E., Pfeiffer, L., Guldin, M., and A. Warlick. 2016b. Economic Data Collection Program Mothership Report (2009-2014). NMFS Northwest Fisheries Science Center. Seattle, WA.

Steiner, Erin, and Dan Holland. Working paper. The Dynamic Role of Sablefish in a Multispecies, Multigear IFQ Fishery.

Steiner, Erin, and Suzanne Russell. Working paper. Crew Remuneration in the West Coast Groundfish Catch Share Program.

Steiner, Erin. 2016. Economic Data Collection Program Administration and Operations Report. Northwest Fisheries Science Center. Seattle, WA.

Stewart, J. 2014. New Markets, Shift to Surimi Mitigate Russia Ban Impact on Pacific Whiting Prices. Undercurrent News. https://www.undercurrentnews.com/2014/10/09/new-markets-shift-to-surimi-mitigate-russia-ban-impact-on-pacific-hake-prices/, accessed March 15, 2017.

Stewart, J. 2015. Pacific Whiting Catching Unfettered by "warm Blob" Impacts; Market Stable. Undercurrent News. https://www.undercurrentnews.com/2015/06/18/pacific-whiting-catching-unfettered-by-warm-blob-impacts-market-stable/, accessed March 15, 2017.

Strong, J., and K.R. Criddle. 2013. Fishing for Pollock in a Sea of Change: A Historical Analysis of the Bering Sea Pollock Fishery. Alaska Sea Grant, University of Alaska Fairbanks.

Sylvia, G., H. Mann, and C. Pugmire. 2008. Achievements of the Pacific whiting conservation cooperative: rational collaboration in a sea of irrational competition, In Case studies on fisheries self-governance. FAO, 2008. http://www.fao.org/3/a-a1497e/a1497e37.pdf

Terry, J., G. Sylvia, D. Squires, et al. 1996. Fixed Costs and Joint Cost Allocation in the Management of Pacific Whiting-A Workshop Report. Technical Memorandum, NOAA-TM-NMFS-SWFSC-234. National Oceanic and Atmospheric Administration, National Marine Fisheries Service.

Thunberg, E., J. Walden, J. Agar, et al. 2015. Measuring Changes in Multi-Factor Productivity in U.S. Catch Share Fisheries. Marine Policy Volume, 62. page 294–301.

Towne, Sarah E. 2015. Alternatives for the West Coast Groundfish Adaptive Management Program. Master's thesis. University of Washington. Seattle, WA.

Trawl Rationalization Trailing Actions: Season Date Change for Midwater Trawl Fishery (Whiting and Non-whiting). 2015. Final Environmental Assessment. Portland, Oregon.

Walden, J., J. Agar, R. Felthoven, et al. 2014. Productivity Change in U.S. Catch Share Fisheries. NOAA Technical Memorandum. NMFS-F/SPO-146.

Warlick, A., Steiner, E., Pfeiffer, L., and Guldin, M. 2016. Economic Data Collection Program Catcher-Processor Report (2009-2014). NMFS Northwest Fisheries Science Center. Seattle, WA.

Woodley, Chris. 2002. Quota-Based Fishery Management Regimes. Proceedings of the International Fishing Industry Safety and Health Conference. Cincinnati, OH: National Institute for Occupational Health.

Appendix A

Ex-vessel prices in the shoreside limited entry trawl and catch share fishery

Table A.1. Average ex-vessel prices per pound (inflation-adjusted 2015 $) for at-sea Pacific whiting, and all species in the shoreside limited entry trawl and catch share fishery, 2009 to 2015, and all species in the shoreside limited entry trawl and catch share fishery, 2009 to 2015. *indicates data were suppressed to maintain confidentiality. Source: Fish ticket and EDC data.

Species	2009	2010	2011	2012	2013	2014	2015
Arrowtooth flounder	$ 0.11	$ 0.11	$ 0.11	$ 0.13	$ 0.12	$ 0.10	$ 0.10
Aurora rockfish	$ 0.49	$ 0.42	*	$ 0.49	$ 0.67	$ 0.61	$ 0.45
Bank rockfish	$ 0.83	$ 0.73	*	$ 0.99	$ 0.93	$ 0.95	$ 0.82
Blackgill rockfish	$ 0.69	$ 0.75	$ 1.54	$ 1.02	$ 0.76	$ 0.81	$ 0.77
Bocaccio rockfish	$ 0.71	$ 0.67	$ 0.71	$ 0.73	$ 0.83	$ 0.74	$ 0.72
Butter sole	$ 0.35	*	*	*	*	$ 0.39	$ 0.39
Canary rockfish	$ 0.59	$ 0.53	$ 0.58	$ 0.55	$ 0.54	$ 0.57	$ 0.56
Chilipepper rockfish	$ 0.68	$ 0.65	$ 0.68	$ 0.72	$ 0.68	$ 0.76	$ 0.71
Cowcod rockfish			$ 0.74	$ 0.63	$ 0.49	$ 0.89	$ 0.83
Curlfin sole	$ 0.35	$ 0.35	$ 0.44	$ 0.37	$ 0.35	$ 0.33	$ 0.31
Darkblotched rockfish	$ 0.56	$ 0.52	$ 0.51	$ 0.52	$ 0.50	$ 0.46	$ 0.46
Dover sole	$ 0.37	$ 0.33	$ 0.44	$ 0.45	$ 0.47	$ 0.47	$ 0.46
English sole	$ 0.34	$ 0.34	$ 0.35	$ 0.37	$ 0.33	$ 0.33	$ 0.31
Flathead sole	*	*	$ 0.33	*	$ 0.33	*	$ 0.31
Greenblotched rockfish	$ 0.65	$ 0.63		*	*	*	*
Greenspotted rockfish	$ 0.73	$ 0.49	*	*	$ 0.47	$ 0.64	$ 0.54
Greenstriped rockfish	$ 0.46	$ 0.46	$ 0.66	*	*	$ 0.56	$ 0.44
Lingcod	$ 0.80	$ 0.89	$ 0.80	$ 0.78	$ 0.77	$ 0.79	$ 0.98
Longspine thornyhead	$ 0.38	$ 0.40	$ 0.48	$ 0.49	$ 0.47	$ 0.46	$ 0.47
Pacific cod	$ 0.52	$ 0.49	$ 0.61	$ 0.63	$ 0.59	$ 0.55	$ 0.60
Pacific ocean perch	$ 0.52	$ 0.52	$ 0.53	$ 0.51	$ 0.51	$ 0.50	$ 0.52
Pacific sanddab	$ 0.48	$ 0.51	$ 0.63	$ 0.59	$ 0.56	$ 0.56	$ 0.55
Pacific whiting: shoreside	$ 0.08	$ 0.09	$ 0.12	$ 0.15	$ 0.13	$ 0.11	$ 0.08
Pacific whiting: at-sea	$ 0.09	$ 0.12	$ 0.11	$ 0.11	$ 0.09	$ 0.09	$ 0.09
Petrale sole	$ 0.99	$ 1.23	$ 1.53	$ 1.54	$ 1.27	$ 1.12	$ 1.21
Redbanded rockfish	$ 0.58	$ 0.57	$ 0.78	$ 1.05	*	$ 0.77	$ 0.75
Redstripe rockfish	$ 0.51	$ 0.49					
Rex sole	$ 0.37	$ 0.35	$ 0.39	$ 0.40	$ 0.40	$ 0.39	$ 0.38
Rock sole	$ 0.41	$ 0.51	$ 0.66	$ 0.82	$ 0.77	$ 0.35	$ 0.36
Rosethorn rockfish	$ 0.54	$ 0.52	$ 0.41	*		$ 0.38	*
Rougheye and blackspotted rockfish							$ 0.52
Rougheye rockfish	$ 0.54	$ 0.54					
Sablefish	$ 2.14	$ 2.21	$ 3.00	$ 2.22	$ 1.93	$ 2.42	$ 2.49
Sand sole	$ 0.84	$ 0.87	$ 1.01	$ 1.01	$ 0.96	$ 0.91	$ 0.90
Sharpchin rockfish	$ 0.54	$ 0.53					
Shortraker rockfish	$ 0.56	$ 0.54					$ 0.54
Shortspine thornyhead	$ 0.69	$ 0.73	$ 0.81	$ 0.84	$ 0.87	$ 0.94	$ 0.87
Silvergray rockfish	$ 0.53	$ 0.54					

Splitnose rockfish	$ 0.42	$ 0.39	$ 0.35	$ 0.29	$ 0.31	$ 0.35	$ 0.35
Starry flounder	$ 0.45	$ 0.30	$ 0.51	$ 0.46	$ 0.46	$ 0.37	$ 0.36
Stripetail rockfish	$ 0.47	$ 0.42		*	*	$ 0.47	$ 0.45
Vermillion rockfish	$ 0.78	*		*	*	*	$ 0.90
Widow rockfish	$ 0.40	$ 0.43	$ 0.47	$ 0.45	$ 0.48	$ 0.45	$ 0.41
Yelloweye rockfish	$ 0.55	$ 0.54	$ 0.57	$ 0.55	$ 0.60	$ 0.60	$ 0.57
Yellowtail rockfish	$ 0.41	$ 0.40	$ 0.53	$ 0.53	$ 0.51	$ 0.51	$ 0.47

Appendix B

Annual catch limits and catches and percent attainment by species

Table B.1.West Coast Groundfish non-tribal sector allocations and impacts (in mt) since implementation of Amendment 21. Source: Agenda Item F.4, Attachement 2 April 2017: http://www.pcouncil.org/wp-content/uploads/2017/03/F4_Att2_Am21Eval_Apr2017BB.pdf.

	2011			**2012**			**2013**			**2014**			**2015**		
Species	Alloc	Catch	% Attain	Alloc	Catch	% Attain	Alloc	Catch	% Attain	Alloc	Catch	% Attain	Alloc	Catch	% Attain
Arrowtooth Flounder	12,441	2,532	20.3%	9,472	2,394	25.3%	3,867	2,449	63.3%	3,487	1,749	50.2%	3,240	1,727	53.3%
Chilipepper S. of 40°10'	1,475	317	21.5%	1,331	288	21.7%	1,100	393	35.7%	1,067	312	29.2%	1,203	192	16.0%
Darkblotched	265	103	38.8%	263	88	33.6%	281	122	43.5%	294	108	36.9%	301	103	34.1%
Dover Sole	22,240	7,796	35.1%	22,240	7,024	31.6%	22,240	7,956	35.8%	22,240	6,455	29.0%	45,986	6,227	13.5%
English Sole	18,678	138	0.7%	9,548	147	1.5%	6,376	220	3.5%	5,266	237	4.5%	9,158	325	3.6%
Lingcod	1,869	270	14.4%	1,817	358	19.7%	1,737	346	19.9%	1,644	248	15.1%	1,596	203	12.7%
Longspine N. of 34°27'	1,971	944	47.9%	1,919	892	46.5%	1,865	1,056	56.6%	1,816	884	48.7%	2,968	756	25.5%
Other Flatfish	4,217	710	16.8%	4,217	690	16.4%	4,214	810	19.2%	4,214	841	20.0%	7,691	832	10.8%
Pacific Cod	1,140	258	22.6%	1,140	396	34.7%	1,131	154	13.6%	1,131	166	14.7%	1,036	377	36.4%
POP N. of 40°10'	137	54	39.3%	137	53	38.8%	127	55	43.7%	130	45	34.6%	136	40	29.4%
Petrale Sole	865	810	93.7%	1,040	1,033	99.3%	2,240	2,118	94.6%	2,297	2,316	100.8%	2,450	2,498	101.9%
Sablefish N. of 36°[1]	2,597	2,399	92.4%	2,517	2,187	86.9%	1,878	1,835	97.7%	2,038	1,876	92.1%	2,250	2,177	96.8%
Sablefish S. of 36°	531	453	85.3%	514	223	43.3%	602	87	14.4%	653	198	30.4%	720	161	22.4%
Shortspine N. of 34°27'	1,452	730	50.3%	1,435	711	49.5%	1,407	871	61.9%	1,393	718	51.5%	1,602	717	44.7%
Shortspine S. of 34°27'	50	6	12.2%	50	1	1.9%	50	4	7.4%	50	3	5.3%	50	1	1.3%
Slope RF N. of 40°10’	885	235	26.6%	885	293	33.1%	889	240	27.0%	889	209	23.4%	1,319	143	10.8%
Slope RF S. of 40°10’	377	52	13.8%	377	124	32.9%	376	117	31.2%	379	99	26.3%	424	69	16.3%
Splitnose S. of 40°10’	1,381	40	2.9%	1,454	60	4.1%	1,518	46	3.0%	1,575	65	4.1%	1,620	29	1.8%
Starry Flounder	673	12	1.7%	677	8	1.2%	757	3	0.5%	761	15	1.9%	762	6	0.8%
Widow	491	174	35.6%	491	232	47.3%	1,284	443	34.5%	1,284	710	55.3%	1,711	338	19.8%
Yellowtail N. of 40°10'	3,394	820	24.2%	3,407	1,066	31.3%	3,236	989	30.6%	3,239	1,205	37.2%	4,893	993	20.3%

[1] The Fishery HG for sablefish north of 36° N lat. is the commercial fishery HG (recreational impacts are managed as set-asides). Therefore, only commercial allocations and catches are depicted for non-trawl sectors. The allocation percentages are revised from those specified in the FMP to break down the formal allocations for trawl vs. commercial non-trawl sectors.

Table B.2. West coast groundfish trawl sector allocations and impacts (in mt) since implementation of Amendment 21. Source: Agenda Item F.4, Attachement 2 April 2017: http://www.pcouncil.org/wp-content/uploads/2017/03/F4_Att2_Am21Eval_Apr2017BB.pdf.

Year	Stocks	Shoreside IFQ				Catcher-Processors				Motherships			
		Initial Alloc.	Final Alloc.	Catch	% Attain.	Initial Alloc.	Final Alloc.	Catch	% Attain.	Initial Alloc.	Final Alloc.	Catch	% Attain.
	2011												
2011	Pacific Whiting	92,817.8	92,817.8	91,185.8	98.2%	75,138.0	75,138.0	71,522.4	95.2%	53,039.0	53,039.0	50,049.8	94.4%
	Canary Rockfish	25.9	25.9	3.7	14.3%	4.8	8.1	0.5	5.6%	3.4	0.1	0.1	78.6%
	Darkblotched Rockfish	250.8	250.8	90.9	36.2%	8.5	12.8	10.3	80.4%	6.0	1.7	1.7	100.0%
	Pacific Ocean Perch	119.6	119.6	46.7	39.0%	10.2	16.7	6.5	39.0%	7.2	0.7	0.7	94.6%
	Widow Rockfish	342.7	342.7	137.6	40.2%	86.7	135.0	24.1	17.8%	61.2	12.9	12.8	99.6%
	Yellowtail Rockfish[1]	3,094.2	3,094.2	738.6	23.9%	NA	NA	14.6	NA	NA	NA	66.7	NA
	2012												
2012	Pacific Whiting	56,902.0	68,661.9	65,661.5	95.6%	46,046.0	55,584.0	55,694.6	100.2%	32,515.0	39,235.0	38,215.5	97.4%
	Canary Rockfish	25.9	25.9	7.2	27.6%	4.8	4.8	0.3	5.6%	3.4	3.4	0.2	4.4%
	Darkblotched Rockfish	248.9	248.9	85.7	34.4%	8.5	8.5	1.4	16.9%	6.0	6.0	1.3	21.0%
	Pacific Ocean Perch	119.5	119.5	48.6	40.7%	10.2	10.2	3.2	31.0%	7.2	7.2	1.4	19.0%
	Widow Rockfish	342.7	342.7	152.6	44.5%	86.7	86.7	42.0	48.4%	61.2	61.2	37.3	61.0%
	Yellowtail Rockfish[1]	3,107.4	3,107.4	963.3	31.0%	NA	NA	32.0	NA	NA	NA	11.0	NA
	2013												
2013	Pacific Whiting	85,697.0	98,296.9	97,621.3	99.3%	69,373.0	79,573.0	78,041.0	98.1%	48,970.0	56,170.0	52,522.3	93.5%
	Canary Rockfish	39.9	39.9	10.2	25.6%	7.4	7.4	0.2	2.4%	5.2	5.2	0.5	9.2%
	Darkblotched Rockfish	266.7	266.7	116.0	43.5%	8.6	8.6	2.1	24.2%	6.1	6.1	4.2	69.6%
	Pacific Ocean Perch	109.4	109.4	50.0	45.7%	10.2	10.2	4.3	41.9%	7.2	7.2	1.1	15.8%
	Widow Rockfish	994.0	994.0	411.6	41.4%	170.0	170.0	15.7	9.3%	120.0	120.0	15.5	13.0%
	Yellowtail Rockfish[1]	2,935.8	2,935.8	719.3	24.5%	NA	NA	78.5	NA	NA	NA	190.9	NA
	2014												
2014	Pacific Whiting	108,935.0	127,835.0	98,714.0	77.2%	88,186.0	103,486.0	103,266.3	99.8%	62,249.0	73,049.0	62,038.3	84.9%
	Canary Rockfish	41.1	41.1	10.5	25.5%	7.6	7.6	0.3	3.7%	5.4	5.4	0.4	6.5%
	Darkblotched Rockfish[2]	278.4	278.4	97.8	35.1%	9.0	6.0	3.4	56.8%	6.3	9.3	7.2	77.5%
	Pacific Ocean Perch	112.3	112.3	41.0	36.5%	10.2	10.2	0.3	3.1%	7.2	7.2	3.6	50.0%

	Widow Rockfish	994.0	994.0	654.3	65.8%	170.0	170.0	16.6	9.7%	120.0	120.0	39.6	33.0%
	Yellowtail Rockfish[1]	2,939.3	2,939.3	1,163.3	39.6%	NA	NA	0.0	NA	NA	NA	41.9	NA
						2015							
2015	Pacific Whiting	112,007.0	124,607.3	58,383.7	46.9%	90,673.0	100,873.0	68,483.9	67.9%	64,004.0	71,204.0	27,660.4	38.8%
	Canary Rockfish	47.3	47.3	44.8	94.8%	8.0	8.0	0.1	0.9%	5.7	5.7	0.1	2.5%
	Darkblotched Rockfish	285.5	285.5	122.4	42.9%	9.2	9.2	5.6	60.4%	6.5	6.5	2.4	36.6%
	Pacific Ocean Perch	118.5	118.5	49.9	42.1%	10.2	10.2	7.0	68.2%	7.2	7.2	1.7	24.2%
	Widow Rockfish	1,306.2	1,306.2	814.6	62.4%	170.0	170.0	17.4	10.3%	120.0	120.0	17.2	14.3%
	Yellowtail Rockfish[1]	4,592.8	4,592.8	1,449.9	31.6%	NA	NA	0.5	NA	NA	NA	86.3	NA

[1]Yellowtail rockfish is managed as a set-aside species for the at-sea whiting trawl sectors (i.e., Catcher-Processors and Motherships) with an annual set-aside amount of 300 mt for both sectors combined.

[2] The original allocation of darkblotched to the Mothership sector (6.3 mt) was increased to 9.3 mt with a transfer of yield from the Catcher-Processors sector by automatic action on October 17, 2014.

Figure B.1. Annual catch limits, landings, and mortality-adjusted discards for historically overfished groundfish FMP species, by catch share (limited entry groundfish trawl sector pre-2011), commercial non-catch share (non-limited entry groundfish trawl sector pre-2011) and tribal fisheries, 2002-2015. OYs and ACLs shown may not reflect final changes, such as inseason adjustments. Source: Somers et al. 2016.

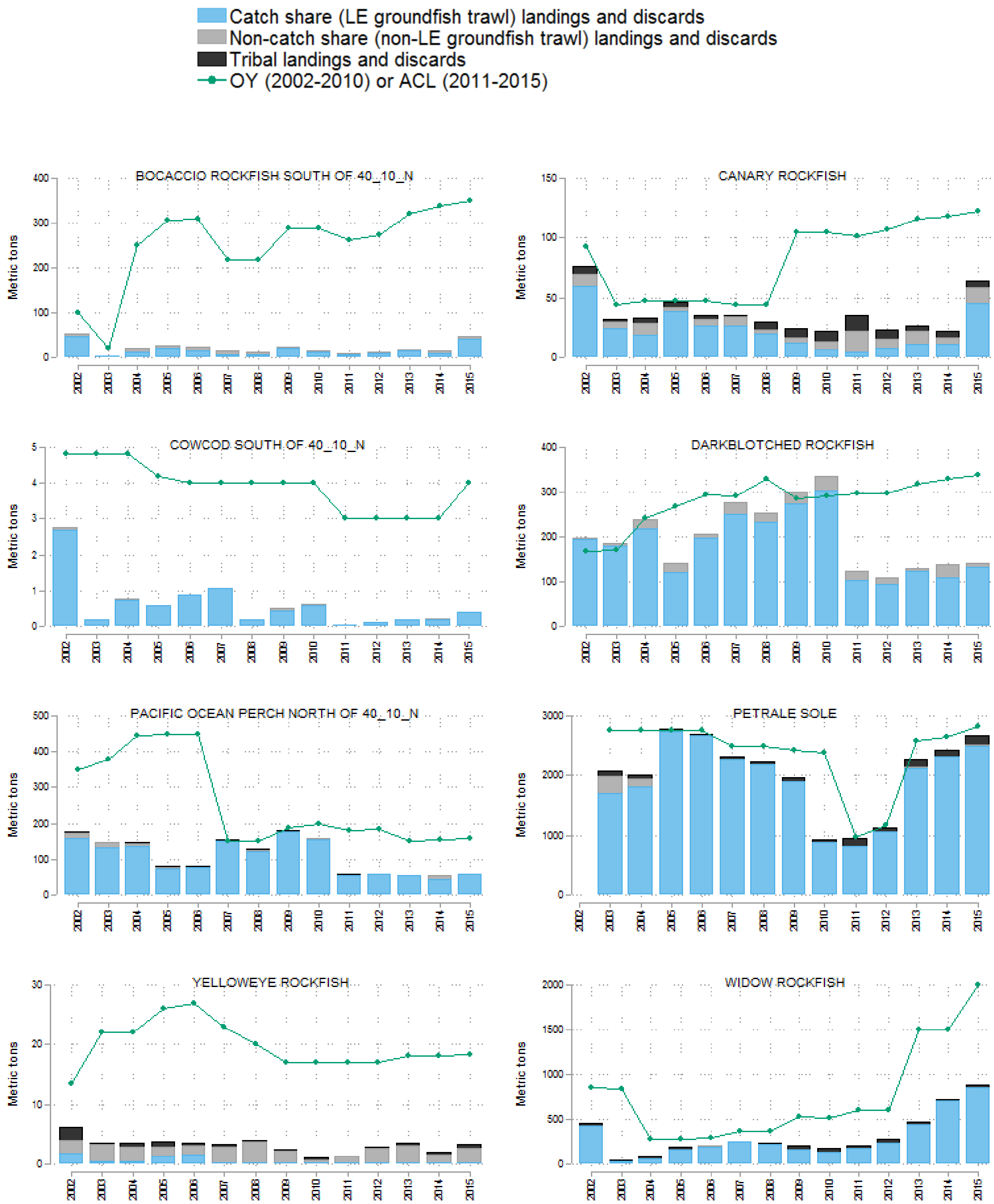
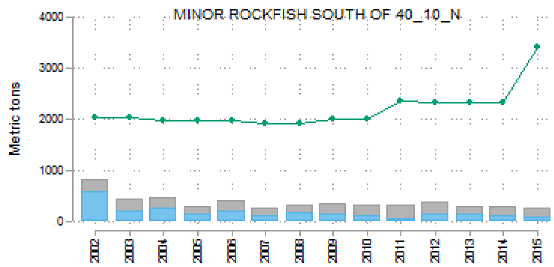
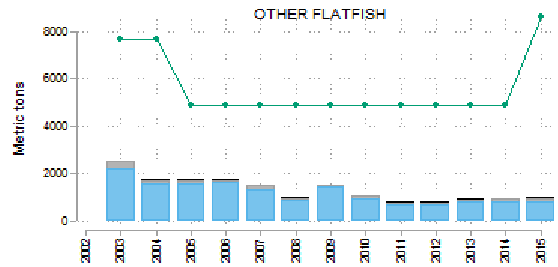
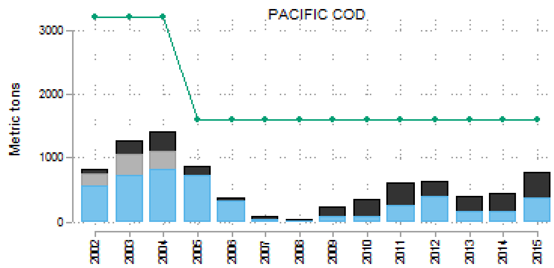
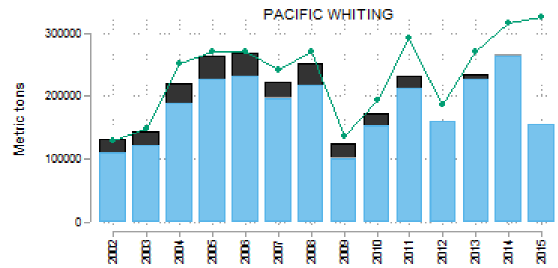


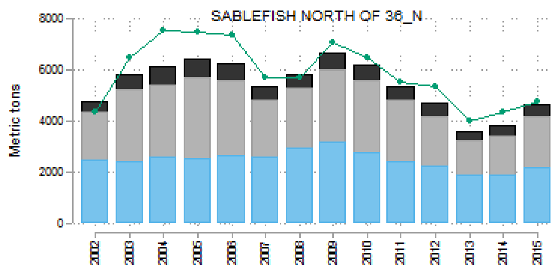
Figure B.2.Annual catch limits, landings, and mortality-adjusted discards for groundfish FMP species, by catch share (limited entry groundfish trawl sector pre-2011), commercial non-catch share (non-limited entry groundfish trawl sector pre-2011) and tribal fisheries, 2002-2015. OYs and ACLs shown may not reflect final changes, such as inseason adjustments. Source: Somers et al. 2016.

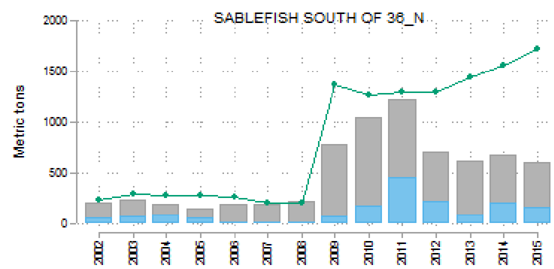

MINOR ROCKFISH SOUTH OF 40_10_N
Metric tons

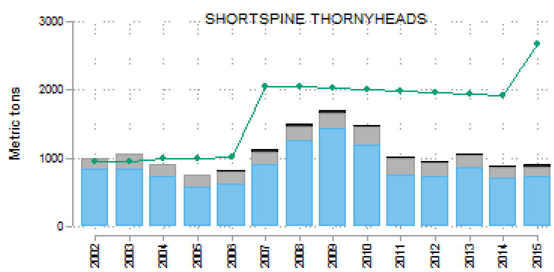

OTHER FLATFISH
Metric tons

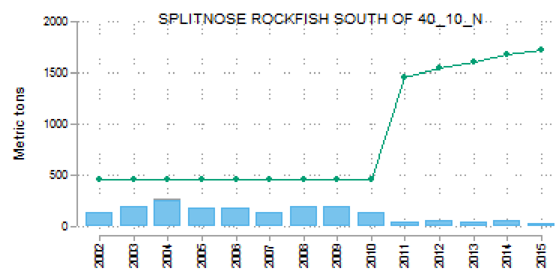

PACIFIC COD
Metric tons

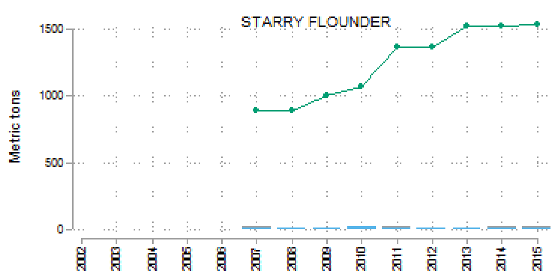

PACIFIC WHITING
Metric tons

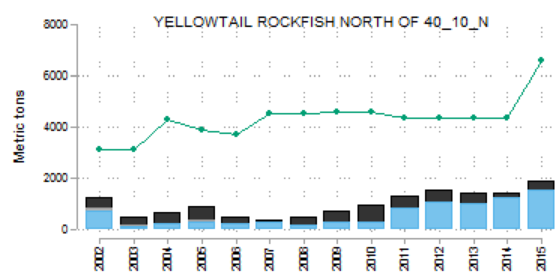

SABLEFISH NORTH OF 36_N
Metric tons


SABLEFISH SOUTH OF 36_N
Metric tons


SHORTSPINE THORNYHEADS
Metric tons


SPLITNOSE ROCKFISH SOUTH OF 40_10_N
Metric tons


STARRY FLOUNDER
Metric tons


YELLOWTAIL ROCKFISH NORTH OF 40_10_N
Metric tons

Appendix C

Pacific Coast Groundfish Fishery Social Survey

(Available separately on Council webpage)

Appendix D

Community Profiles

(Available separately on Council webpage)

Appendix E

Details of the data collection protocol of the Westcoast Groundfish Observer Program (WCGOP)

Appendix E. Details of the data collection protocol of the Westcoast Groundfish Observer Program (WCGOP). Information is adapted from Somers et al. 2016a, pages 6-8.

NMFS established the WCGOP program in 2001. The purpose is to collect information on resources being discarded at sea. The WCGOP combined data from multiple sources to estimate groundfish mortality: landing receipts, onboard observer data, electronic monitoring (EM) data, and discard mortality rates.

Information on landings as well as species composition data are collected by state agencies and submitted to the Pacific Fisheries Information Network (PacFIN) regional database, which is maintained by the Pacific States Marine Fisheries Commission. Fish tickets (fleet-wide landing receipts) provide information on retained catch for shoreside sectors of the commercial groundfish fishery on the U.S. West Coast. Each state has a slightly different fish ticket format and are generally moving in the direction of electronic submissions (Oregon now allows fish tickets to be completed and submitted electronically). Species composition sampling is conducted for market categories (either a single species or a mixture of species). PacFIN then applies the percentage of weight of each species within market categories obtained from species composition sampling to the fish ticket data used in analyses. Additionally WCGOP analysts work to assign landed weights from sampled market categories to individual species whenever possible.

NMFS runs separate observer programs for different sectors of the groundfish fishery. The WCGOP observes IFQ shore-based sectors, limited entry (LE) and open access (OA) fixed gear, state-permitted nearshore fixed gear sectors, as well as several fisheries that incidentally catch groundfish, including the California halibut trawl and pink shrimp trawl fisheries. The A-SHOP Program focuses on the at-sea Pacific whiting fishery.

Observer data from each of these groundfish sectors were used to estimate discards. Total mortality estimates were summarized from the A-SHOP Program data for the both the at-sea catcher-processor (CP) and mothership (MS) sectors. Information on data collection methods used in each observed fishery can be found in WCGOP manuals (NWFSC 2016a, 2016b, 2016c), and estimates of observer coverage, observed catch, and a summary of observed fishing depths for each sector are also available.141

The sampling protocol the WCGOP uses focuses primarily on the portion of catch discarded at sea. Some species are landed, but are ultimately discarded at the dock. For these species or groups, only some are consistently coded in PacFIN fish ticket landings data (and thus are accounted for as possible in landing weights in the WCGOP data). To improve accuracy, haul-level retained catch recorded by the WCGOP observers are reconciled with trip-level fish ticket records. Since observer retained catch weight estimates are often visual estimates, the WCGOP data are adjusted to equal the legally binding measurement from the matching fish ticket(s).

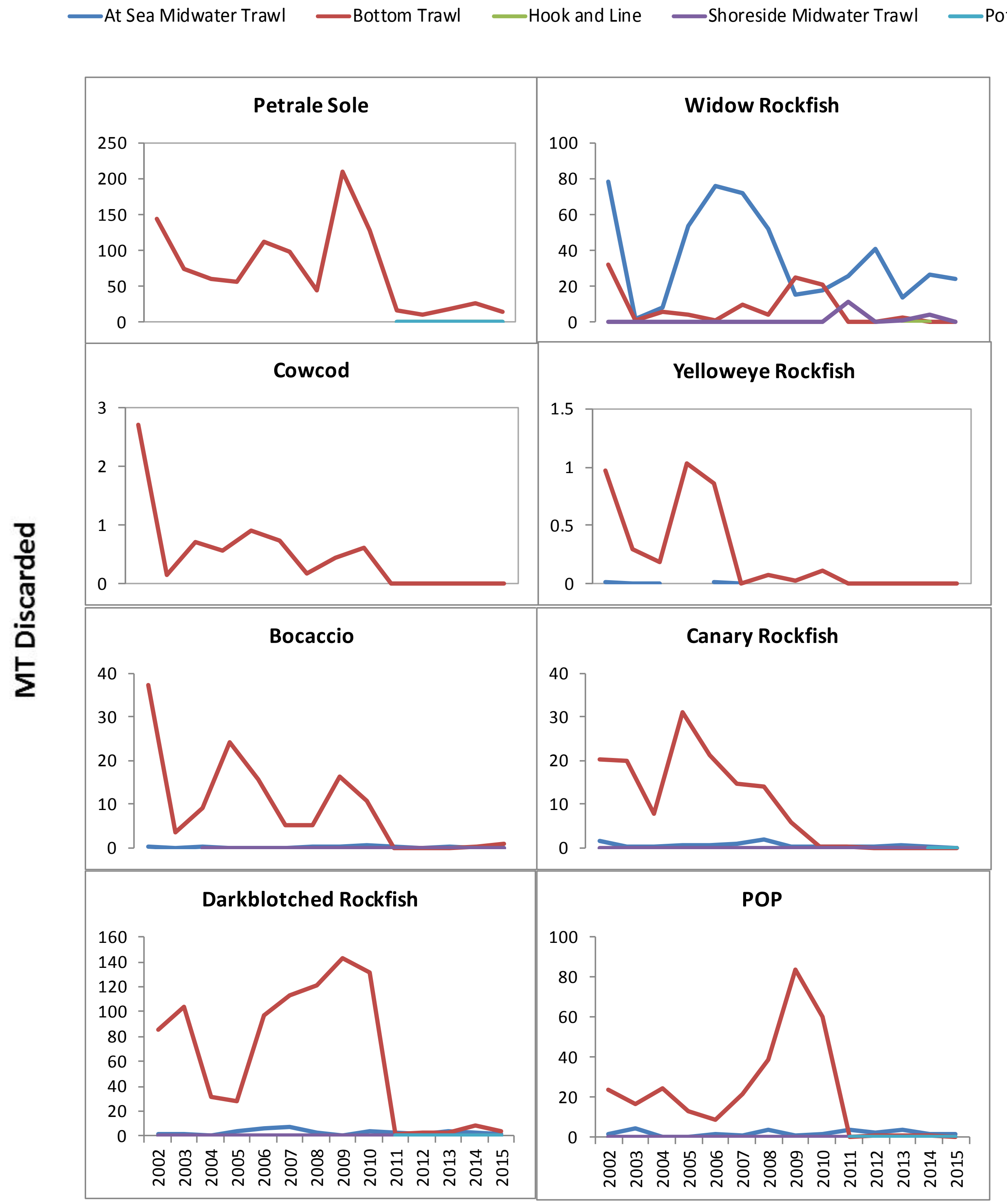
NMFS maintains confidentiality of persons and businesses, per MSA requirements. NMFS guidance recommends the rule of three, which states the following: "Information from at least three participants in the fishery must be aggregated/summarized at a temporal and spatial level to protect not only the identity of a person or a business, but also any business information." Information on QS and QP holdings by a vessel can be released

The percentage of fishing trips that carried an observer has varied between fisheries and through time. The at-sea whiting fisheries have had 100 percent or near 100 percent observer coverage on processing vessels since the mid-1970s through current. Comparatively, the LE trawl had from 14 to 24 percent coverage from 2001 to 2010, which shifted to 100 percent or close to 100 percent observer coverage for all at-sea and shorebased catcher vessels with the start of the catch share program (Somers 2016b). Starting in 2015, for vessels fishing under the EM exempted fishing permit (EFP), discard of IFQ species was recorded by the EM systems. At that time, EM was also used to record small amounts of operational discards by at-sea catcher vessels participating in the EM EFP as part of the mothership co-op fishery.

[141] http://www.nwfsc.noaa.gov/research/divisions/fram/observation/data_products/sector_products.cfm

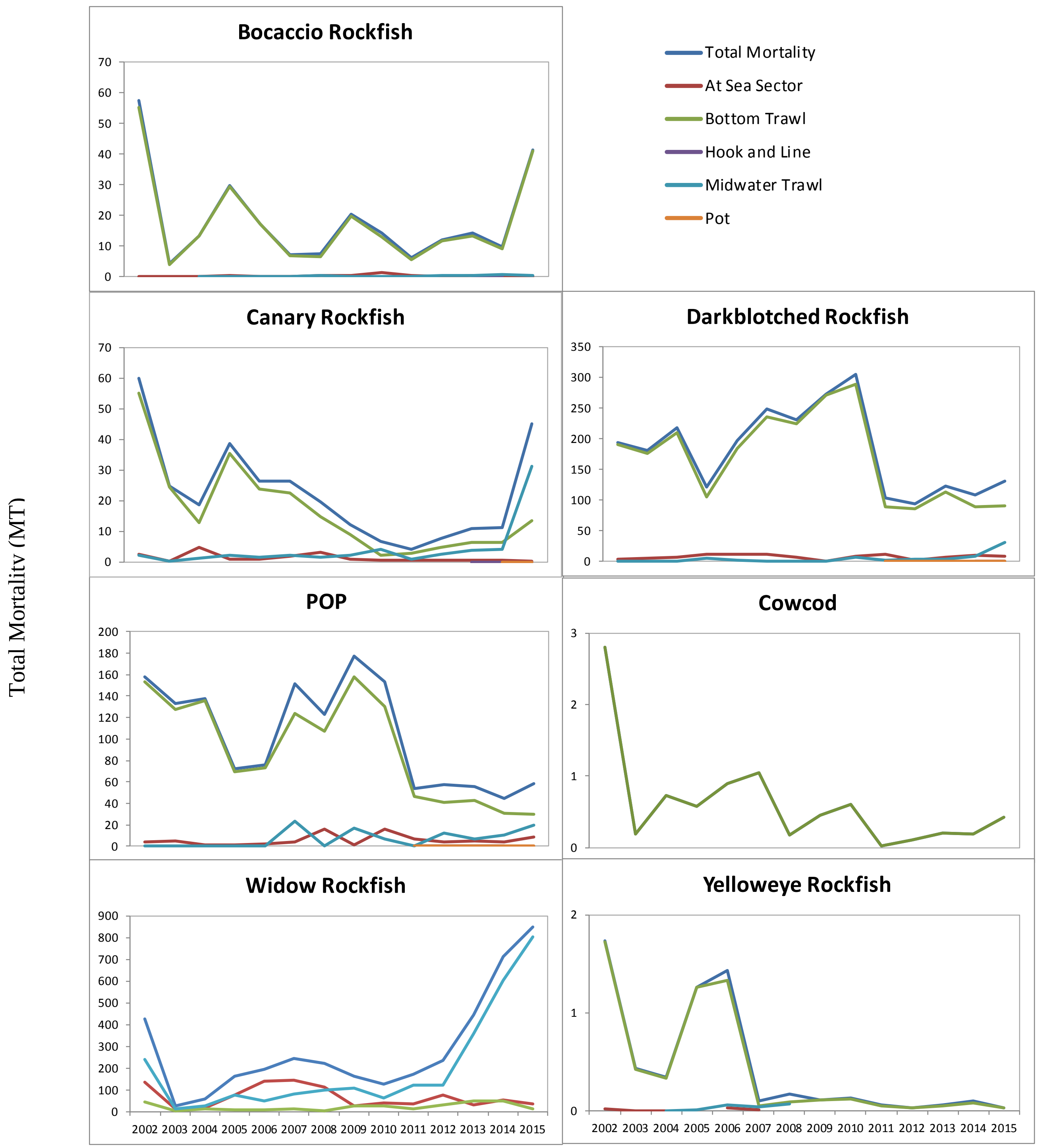
Appendix F

Appendix F. Species-specific discards through time by sector. The at-sea sector includes CPs and MSs. The shoreside midwater trawl included an EFP from 2002 to 2010 that was a full retention fishery and, thus, had no discards.



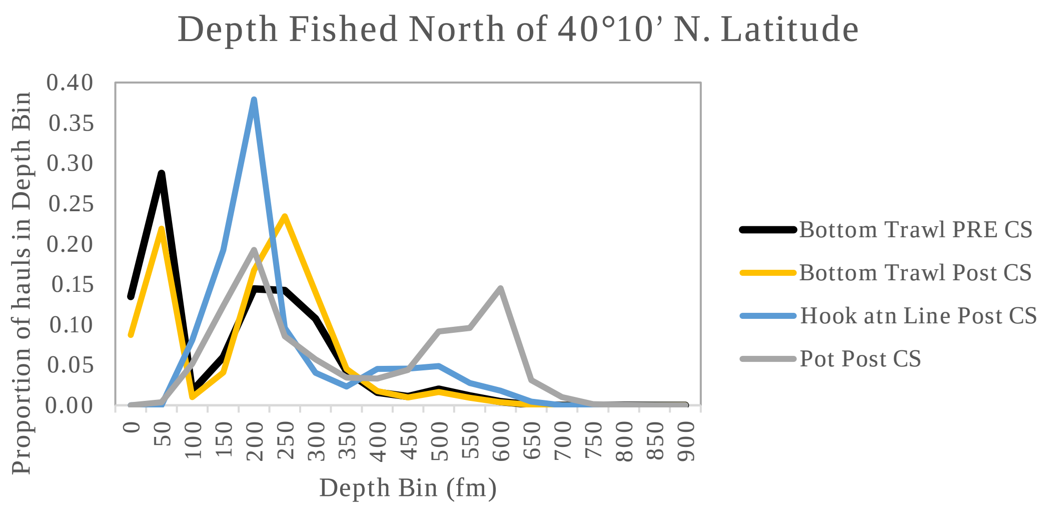
Appendix G

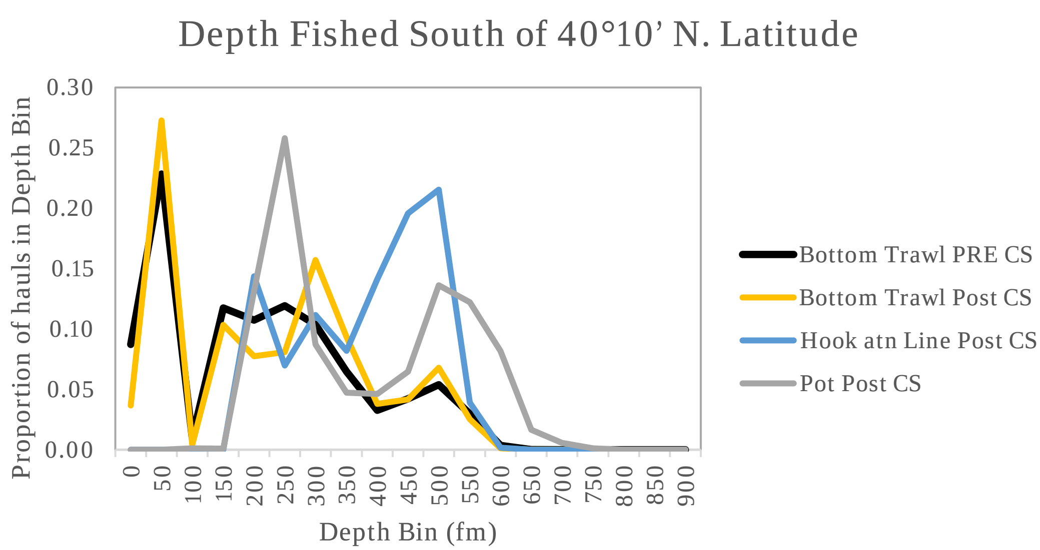
Appendix G. Species-specific total mortality through time by sector. The at-sea sector includes CPs and MSs. The shoreside midwater trawl included an EFP from 2002 to 2010 that was a full retention fishery and, thus, had no discards.

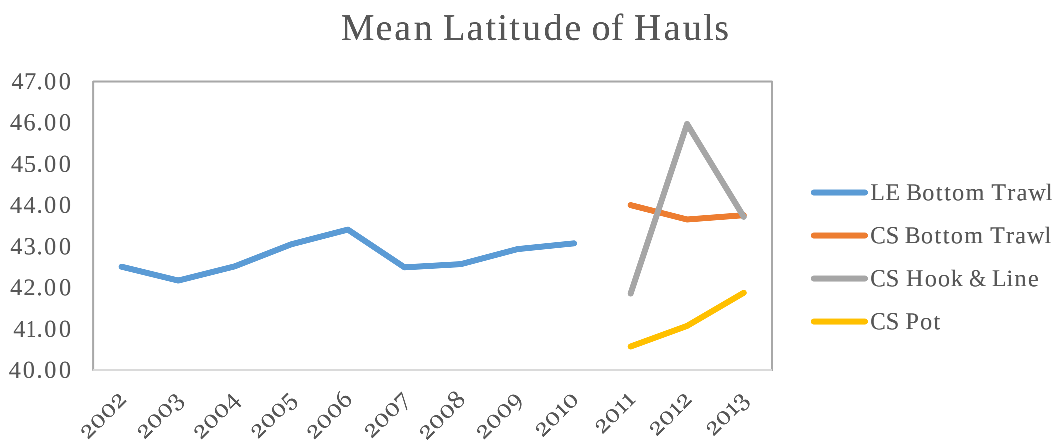


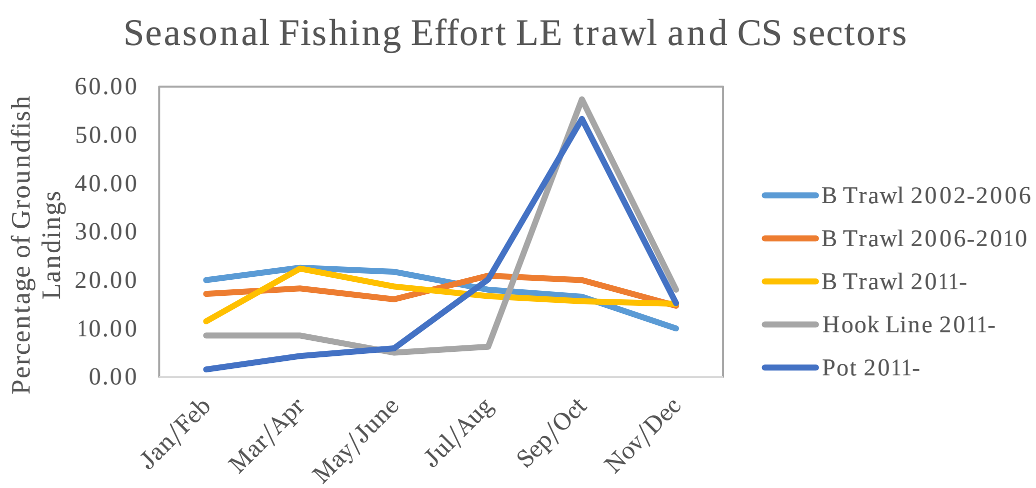
Appendix H

Appendix H. Graphs showing fishing effort changes through time. The first two graphs show how depth fished has changed pre- and post-CS fishery. The third and fourth graphs show changes in latitude and seasons fished through time, respectively.









---

[i] QP allocations for 2017 were used to determine a non-whiting QS equivalent. QP allocations for 2010 are generally used to assess QS holdings for purpose of determining compliance with control limits. 2017 QP allocations were used here because the question was not compliance with the control limits but rather the current fishing opportunity as represented by the QS.

[ii] Combined to preserve confidentiality.

UPDATED May 12, 2017

West Coast Groundfish Trawl Catch Share Program
Five-year Review – Draft

Appendix C & D

June 2017

Draft—Do Not Cite

For further information contact the following:
Jim Seger, Council Staff
Abigail Harley, National Marine Fisheries Service West Coast Region
Lisa Pfeiffer, National Marine Fisheries Service Northwest Fisheries Science Center

Appendix C

Pacific Coast Groundfish Fishery Social Survey

Appendix C: Pacific Coast Groundfish Fishery Social Survey

Contents

Methods

The sections below describe the methods used to conduct the Pacific Coast Groundfish Fishery Social Survey (PCGFSS). The survey was conducted in 2010, from 2012 to 2013, and from 2015 to 2016.

(A1) Data Collection

The goal of the PCGFSS is to measure sociocultural changes to the groundfish fishery, the associated industry, and related communities, resulting from the catch share program. The study was specifically designed to collect data over time in association with catch share programmatic events, such as the release of QS trading. In order to provide a baseline, data were collected between June and December 2010, prior to implementation of the catch share program. Between June 2012 and February 2013, one year after implementation, a second round of data collection was conducted. One year after the authorization of QS trading, between November 2015 and May 2016, a third round of data collection was conducted. The intent of the third collection was to understand impacts of QS trading, as well as to compare information after several years of operation under the catch share program.

Data were collected using a mixed methodology, including a survey instrument and semi-structured interviews. This methodology was used to maximize the amount and type of information gathered from study participants (Bernard 2000; Russell and Schneidler-Ruff 2014; Schensul, Schensul, and LeCompte 1999). The initial survey was designed and reviewed by industry/community members, as well as fisheries management staff both at the Pacific Fishery Management Council (PFMC) and NMFS West Coast Regional office. This review assisted in ensuring that proper terminology was used and that questions were written with appropriate clarity for targeted respondents. In a few circumstances, questions were slightly altered after the 2010 data collection effort. These changes were made to add categories to questions, where appropriate, or further to clarify questions. As a result, a few survey items may be missing data from 2010 results as the question categories were only present in subsequent survey tools. In situations where this occurred, it is specifically noted. Additionally, new sections were added to the 2012 and 2015/2016 surveys to address information/perspectives related to the catch share program after implementation. The survey tools aim to be applicable to the wide range of roles represented by study participants, which range from QS owners and processors to crew and fishermen's wives.

The goal of the survey is to attempt to survey all known participants of the industry (Bernard 2000; Schensul et al. 1999). These known individuals were initially found through the limited entry permits held prior to the catch share program, and they were cross-referenced with the QS permits databases for the 2012 and 2015/2016 data collection efforts1 Additional participants were sought through snowball sampling, a type of purposive sampling, where referrals were obtained from existing participants to locate new participants (Bernard 2002; Robson 2002). This was necessary to approach participants such as crewmembers and fishermen's wives, where no identifying information is available. Participants from the 2010 baseline collection were approached again for participation in the 2012 and 2015/2016 data collection efforts. Any additional or new participants from the 2012 effort were invited to participate in the 2015/2016 effort. Individuals identified through permit databases and snowball sampling were contacted primarily by phone to schedule a meeting time. Individuals were contacted three times, after which no further contact was pursued. The exception to this was if a participant was a permit owner and address information was available. In this case, a letter and flyer were mailed in addition to the three initial contact attempts.

Surveys were conducted primarily as interviews. Interviews supplemented survey questions, and allowed participants to discuss other related topics. Researchers were distributed throughout the West Coast to

---

1 NMFS Fisheries Pacific Coast Fisheries Permit System, West Coast Regional Office. http://www.westcoast.fisheries.noaa.gov/fisheries/groundfish_catch_shares/quota_share_permits_accounts.html. Accessed October 7, 2014.

increase accessibility to local communities (Table A-1). All surveys and interviews were voluntary and confidential. The survey was also available electronically on the study website, and it could be emailed or mailed (hard copy) upon request. The option to conduct the survey in person was preferred to improve response rates and to reach more remote communities that would be less likely to respond to other forms of data collection (Rea and Parker 1997; Russell and Schneidler-Ruff 2014).

Table A-1. Geographic distribution of researchers for data collection. Source: PCGFSS 2017.

Location of Researcher(s)	Responsible Communities*
Seattle, Washington	All Washington State
	Astoria, Oregon
	Garibaldi, Oregon
	Other Oregon as needed
Newport, Oregon	Newport, Oregon
	Florence, Oregon
	Coos Bay, Oregon
	Brookings, Oregon
	Port Orford, Oregon
Eureka, California	Crescent City, California
	Eureka, California
	Fort Bragg, California
San Francisco, California	Bodega Bay, California
	Princeton/Half Moon Bay, California
	San Francisco, California
Monterey, California	Monterey, California
	Moss Landing, California
	Morro Bay, California

*NOTE: Researchers would travel to other communities within a 25-mile radius of these identified communities to capture viable participation.

Study participants include several types of people connected to the fishery and affiliated fishing communities, including the following: fishermen, vessel owners, vessel operators, groundfish limited entry permit owners, quota allocation recipients/permit owners, crew aboard groundfish/whiting vessels, mothership operations, catcher-processor operations, shoreside processors, first receivers/buyers, as well as other individuals who are stakeholders in the fishery, such as partners or spouses and businesses that are directly tied to the groundfish/whiting communities through the supply of commercial items including—but not limited to—net suppliers, fuel suppliers, equipment suppliers, dry docks, etc. Analysts were also approached by fixed gear fishermen who wished to participate in the study. Resources to conduct this effort were limited to trawl fishery participants, but researchers obtained fixed gear participation where possible. As a result, the data set contains a limited representation of the fixed gear fishermen. Fixed gear data is treated differently in analysis (see data analysis methods), and all results that contain fixed gear responses are clearly identified.

Survey Instrument and Administration

The survey instrument is extensive, consisting of six or seven sections (Table A-2). As previously mentioned, the 2010 survey was reviewed and adjusted to provide additional clarity for the 2012 survey. Similarly, the 2012 survey was reviewed and adjusted to provide additional clarity for the 2015/2016 survey. The 2012 and 2015/2016 surveys contain an additional section as noted in Table A-2. In conjunction with the survey, or if a participant declined to take the survey, but would participate in an interview, semi-structured interviews were conducted. These interviews provided the opportunity to capture additional information about survey questions, as well as to pursue lines of questions independent of the survey.

Table A-2. Description of survey sections. Source: PCGFSS 2017.

Survey Data Section	Description
Demographic	Can be compared to United States Census data where not otherwise obtainable for fishermen
Individual Participation	Expands to include individual role information, family participation, and job characteristics information
Connections	Collects information to inform social networks within the fishery and communities
Quota Perspectives	Collects information to gauge perceptions of the catch share program and identify key areas of support and concern
Fishermen	Collects information to understand how fishermen fish, what they fish for, how they work with processors, and how they move between fisheries
Processors	Collects information to understand what species are important to processors and why, how they work with fishermen, and how they market and distribute product
2012 and 2015/2016: Quota Allocation Recipients	Collects information to understand leasing and retaining of pounds, management of QS, and how different people manage their allocation

(A2) Quantitative Data Analysis

Dataset Construction

Analysts compiled two types of datasets for each study year (2010, 2012, and 2015/2016): an “all respondent” dataset, and a “return respondent” dataset. Researchers use return respondent data wherever possible as it allows them to more accurately capture change over time; in some situations, however, sample size is limited and return respondent data cannot be used. Sample size is limited when the analysis necessitates using a smaller subset of the sample (i.e., fishermen only or processors only). In these situations, we use all respondent data. For clarity, where PCGFSS quantitative results are presented, all respondent data are used, unless it is specifically noted otherwise.

Return respondent data

The "return respondent" dataset only includes respondents who participated in the PCGFSS survey in all three years. The goal of using this data is to more accurately capture change over time by eliminating the effects of individual differences, as well as to signal changes within the larger population. Linking the administration of each survey to a programmatic event (for example, the 2012 PCGFSS was administered one year after the catch share program was implemented) allowed us to draw conclusions about the impact of the program on a specific variable.

Where applicable, we conducted significance tests (where "year" was the independent variable) on return respondent data. Such tests were only applied to the "return respondent" data because we determined that this was the most powerful option to capture change over time; thus, all significance tests are paired sample tests (i.e., the sample is the same across years). Significance tests were not run on the entire ("all respondent") dataset. Standard statistical tests require independent samples, meaning that, for instance, people surveyed in one study year are different than those surveyed in other study years (i.e., the samples are independent of one another). The "all respondent" dataset violates this requirement because about one-third of the sample across years contains the same people.

As mentioned before, other advantages of using the "return respondent" dataset and running paired analysis is that it eliminates the effects of individual differences, and functions as a signal for the larger population. For instance, if a significant difference was found between years relative to a specific item, this might signify that a similar association was also occurring in the larger population. This is important because our goal is to characterize the entire population, not just return respondents. However, when "return respondent" analysis is related to the overall population, the composition of return respondents (i.e., role, location of residence) should be considered.

All respondent data

The "all respondent" data set contains data from all survey respondents except those who use fixed gear exclusively (respondents who used fixed gear and also owned or leased groundfish trawl quota are included). When summarizing results for one year (for example, for a question that was only asked during one year of the survey), we used "all respondent" data. When comparing across years, as noted above, we used "all respondent" data when we are unable to use "return respondent data" (see below) due to sample size limitations.

When comparing across years, there are a few limitations in the "all respondent" data, primarily due to the lack of a known sample frame (i.e. a specific list of all individuals of the population of interest from which a sample is obtained), which makes it difficult to tell whether differences between years are due to actual changes in individuals' responses or changes in the sample. For example, changes in the sample may be due to changes in who participates in the fishery, or who participated or refused to participate in the survey. In contrast, "return respondent data" is composed of the same individuals in each study year, which helps address some of these challenges.

Non-IFQ fixed gear data

Non-IFQ fixed gear data were analyzed separately, and they are included when pertinent. Non-IFQ fixed gear participants were welcome to participate; however, due to resource limitations, they were not initially targeted. The sample size of non-IFQ fixed gear participants is much smaller; thus, when this data are presented, confidentiality is protected through aggregation of results.

Variable Construction

New Entrants

We created a new variable in our dataset called "new entrant." This variable is used in Section 3.2.3(b), New Entry. We identified new entrants as respondents who reported receiving a QS permit after program implementation (Section E of the survey asks about QS ownership), including both those who lease quota, and those who own quota. We constructed new entrant variables for both the 2012 and 2015/2016 datasets.

Absentee Owners

We created a new variable in our dataset called “absentee owner.” This variable is used in Section 3.2.2(g)(4) in the Absentee Quota Holders subsection. We identified absentee owners as respondents who reported themselves as QS owners or co-owners and not as captains/operators or crewmembers (Section B of the survey asks respondents to identify their role in the fishery). For those who reported themselves as QS owners or co-owners and captains/operators, we confirmed that the boats they operated were trawl participants (Section F of the survey asks about trawl participation of specific boats).

Descriptive Analysis

Survey data were entered, cleaned, and summarized using IBM SPSS version 19. All graphs were created in R Statistical Software (3.1.1). Data being analyzed were mostly discrete data, both nominal and ordinal, and were summarized as percentages. As previously discussed, two types of datasets were used in the analysis: return respondent and all respondent data. In some cases, data were analyzed at a finer scale (using all respondent data), such as when summarizing responses by fishermen only or processors only. Additionally, in Section 3.2.3(c) (Fishing Heritage) and Section 3.1.3 (d) (Safety) in the Economics Performance section, data were analyzed by sorting all respondents based on their participation in the whiting or non-whiting sector. We are currently working on community-level analysis; however, it is not presented in this version of the report due to time constraints.

Missing Data, Not applicable (NA), and Prefer not to answer (PNA)

“Not applicable” (NA) and “prefer not to answer” (PNA) were listed as response options; thus, percentages for these categories are also presented in tables and graphs. There are only a few PNA responses within each survey item; therefore, for simplicity, PNA and NA response categories are grouped together in the results. We identified a few types of missing data: “marked missing,” meaning that a question was skipped, and “system missing,” meaning that the survey stopped mid-section due to situational limitations. Survey sections that did not apply to a particular respondent (i.e., the Fishermen Section for a respondent who is a processor) were not categorized as missing data or NA. We presented specific response rates for each survey item being summarized in order to communicate the amount of missing responses for that item. We calculated survey item specific response rates (RR) as the total number of respondents—including those responding NA and PNA, but not cases that were marked/system missing—divided by the total number of respondents including NA, PNA, and marked missing.

Significance Tests

All significance tests were performed on return respondent data only. For all significance tests, the null hypothesis being tested was that the differences (relative to the response variable) between 2010, 2012, and 2015/2016 are no greater than would be expected due to random variation, while the alternative hypothesis being tested was that the differences between 2010, 2012, and 2015/2016 were too large to be accounted for by random variation. For all significance tests, alpha=0.05, and post-hoc analysis was conducted when the omnibus null hypothesis had been rejected. All analysis for significance tests was performed in R Statistical Software (3.1.1).

Cochran’s (Q) test (Cochran 1950)

We used Cochran’s Q test to analyze differences between years for dichotomous response variables. Cochran’s Q test is an extension of the chi-squared test for paired samples of three or more. For two samples, Cochran’s is equivalent to McNemar’s test (McNemar 1949); thus, following significant results from Cochran's test, we used McNemar's with false discovery rate p-value adjustment method for post-hoc analysis.

Friedman's test (Friedman 1937, 1940)

We used Friedman's test to analyze differences between years for ordinal response variables. Friedman's test is a non-parametric extension of repeated measures ANOVA. Friedman's test may also be compared to the Wilcoxon matched-pairs signed-ranks test, except that Friedman's test allows for comparison of three or more repeated measurements (Sheldon et al. 1996).

(A3) Qualitative Data Analysis

Qualitative analysis of PCGFSS interview data for the five-year review began with compiling all the transcribed interview recordings from the 2015/2016 round of PCGFSS data collection (n=258). Collected between November 2015 and May 2016, these interviews accompanied the administration of the survey. This simultaneous collection allowed participants to elaborate on their responses to survey items; it also provided a means of conveying comments and concerns about the catch share program that were not addressed in the survey. Once compiled, interview transcriptions were imported into the qualitative data analysis software, MAXQDA.

In qualitative analysis, a "code" refers to "…a word or short phrase that symbolically assigns a summative, salient, essence-capturing, and/or evocative attribute for a portion of language-based or visual data" (Saldana 2015, p. 4). In other words, coding is a means of breaking down speech or text into topical or theme-based categories. Each code then corresponds to a specific topic or theme. Sorting qualitative data into such categories enables the analyst to explore relationships between themes and topics. The interviews were coded using an axial coding approach (Strauss and Corbin 1998). This involved a combination of inductive and deductive thinking in designing a codebook that struck a balance between letting the data speak for itself and highlighting specific areas of interest to industry and the PFMC. The November 2016 annotated outline of the five-year review—which incorporated guidance from public testimony and the Council—was used as a reference to ensure that coding was conducted in a manner that allowed us to address the items therein as directly as possible.

We began by coding a small subset of the interviews. In order to assess inter-coder reliability—or the degree to which an individual researcher's coding of a common text aligns with other researchers' coding (Ryan 1999) — each researcher independently applied the initial codebook to this subset of interviews. Existing methods of agreement estimation (for example, Cohen's kappa) operate on the assumption that each unit of content (i.e., coded segment) is coded with no more than one code. Due to the interconnectedness of themes in the PCGFSS qualitative data, segments frequently were coded with multiple codes to identify the ways in which participants connected various themes. For example, a comment about the difficulty small vessels experience in paying for observer coverage would have been coded with the "observer," "cost," and "small vessels" codes. Thus, while we did use MAXQDA to run Cohen's kappa, the statistic was treated as a rough estimate rather than a definitive measure of inter-coder agreement. The independently coded interview documents were also manually compared to gauge researcher overlap in coding. Based on this assessment, we then discussed, clarified, altered, and augmented our coding scheme, then repeated the inter-coder reliability assessment to ensure that all researchers' understanding and usage of the codes were in accord. Once we reached a reasonable level of inter-coder agreement, the codes were then applied to the rest of the interview collection. Coders communicated regularly, discussing any confusion or inconsistencies that arose during the coding process. A second round of coding followed, which involved applying various sub-codes that captured our initial broad themes on a more fine-grained level. A complete list of codes and sub-codes—and their definitions—can found in Table A-3.

Table A-3. Qualitative Data Codebook. Source: PCGFSS 2017.

Parent Code	Sub-code	Definition
Cost Recovery		Discussion of the cost recovery fee associated with the program
Gear Switching		Discussion of gear switching and how it has impacted specific fishing operations and the fishery in general
Observers		Discussion about observers (for example, costs, the experience of having them on the boat, the people, the data, etc.)
Management Process		Discussion about the management process, including any talk of allocations, the council process, etc.
	Involvement in the process	Discussion about being involved in the management process (attending meetings, filling out required paperwork, etc.)
	Quota allocations	Discussion of quota allocations, both intra- and inter-sector
	Proposed action (by industry)	Discussion of ideas or proposals for changes in any aspect of the management process
	Efficacy	Discussion of the effectiveness and efficiency of management
Markets		Discussion of market conditions, new markets, new competition, extinct markets, extinct competition, prices, etc.
	Quota market	Discussion of buying or leasing quota
Community		Discussion of the ways in which communities have been impacted by catch share and other changing conditions
Infrastructure		Discussion of the state of infrastructure (at all levels: community/communities/coastwide)
	Processors/buyers	Discussion of the number and condition of processors of buyers
	Industry suppliers/services	Discussion of the number and condition of industry supply and service providers
Geographic Shift		Discussion of geographic movements in fishing activity
	Stock-related (target)	Discussion of geographic movements in fishing activity related to target species
	Stock-related (bycatch)	Discussion of geographic movements in fishing activity related to bycatch species
Working in the Industry		Discussion about the number & seasonality of crew and processing jobs (also include industry service/supply jobs); Also: Discussion about the

		experience of working in the industry and how this has been impacted by catch share.
	Income	Discussion of the effects of the catch share program on income
	Running a business	Discussion of the effects of the catch share program on running a fishing business
	Working experience	Discussion of the effects of the catch share program on the on-the-boat experience of harvesting
	Jobs	Discussion of the effects of the catch share program on the number and nature of employment opportunities
Cost		Discussion related to any costs associated with the catch share program
	Leasing	Discussion of any costs associated with quota leasing
Adaptability		Discussion of ways people adapt to catch share and other changes in the fishery/industry
Accumulation & Consolidation		Discussion of consolidation, quota/permit/vessel accumulation, corporate fishing, etc.
Fleet Variation		Discussions that differentiate shoreside vs at-sea, effects of the program on different sizes of boats, gear-switching, etc.
Small Vessels		Discussion of direct and indirect program impacts on small vessels
New Entrants		Discussions related to barriers to entry, high costs to enter, lack of interest due to unstable fishery, general disinterest, etc.
	Graying/retirement	Discussion related to aging of the fishing workforce, retirement, etc.
Impacts on other fisheries		Discussion about any impacts of the program on non-groundfish trawl fisheries, including fishing ground conflicts, increased participation in other fisheries, conflicts between gear-types, etc.
	Other groundfish	Discussion of any impacts to non-catch share groundfish fisheries (open access, tiered black cod) stemming from the catch share program
	Other non-groundfish	Discussion of any impacts to non-groundfish fisheries (shrimp, crab, tuna, etc.) stemming from the catch share program
Exit		Discussion of leaving the fishery/industry (can be the interviewee or others the interviewee is talking about)

Ownership Dynamics		Discussion of relationships between asset owners and fishermen, absentee quota ownership, vessels and permit ownership changing hands or restructuring
	Transfer of ownership	Discussion of transfers of ownership of vessels, permits, and quota, and how these transfers have been impacted by the catch share program
	Collective ownership	Discussion of community quota funds, risk pools, or other forms of asset pooling
	Absentee ownership	Discussion of any situation in which the ownership of some aspect of the fishing business (quota, permit, vessel, etc.) lies with someone/some entity that is not the operator (this includes quota/vessels/permits owned by processing companies)
Fishery Reputation		Discussion about the public perception/market perception/management perception of the fishery
Fish Stocks		Discussion related to the status of (and changes in) fish stocks; also use when allocations/TACs/quota limits/attainment rates are discussed
Safety		Discussion related to safety
CA v. OR Boats		Discussion related to grounds conflicts stemming from Oregon catch share boats going down to California to fish with fixed gear

The 2015/2016 interview data accounts for the bulk of the qualitative data included in this review. There are two reasons for this. First, the timing of this five-year review is such that the 2015/2016 data had not been analyzed prior, thus coding could be carried out in manner that was directly informed by the goals of the review. Interview data from 2010 and 2012 had been previously analyzed and reported on (see Russell et al. 2014, 2016). Due to time constraints, we did not recode 2010 or 2012 data with the codebook developed for the five-year review, though there is naturally a fair degree of overlap with prior years' codebooks. In addition, the participant perspectives in 2015/2016 reflect four or five years of experience under catch share, whereas, in 2012, these perspectives are informed by about one year of working under the new program, and 2010 is baseline data that reflect pre-implementation perspectives. Thus, perspectives put forth in the 2015/2016 data carry the most weight in terms of temporal relevance and familiarity with the program. That said, 2015/2016 data are not utilized exclusively, as various issues discussed in this review have long been on the radar for many PCGFSS participants, and 2012 data are presented where appropriate.

Results

(B1) Response Rates

Response rates have been calculated for the 2010, 2012, and 2015/2016 survey results based on the total response, as well as on the trawl only response rate (Table A-4). Trawl-only responses remove any fixed-gear participation and only reflect participants with any connection to the groundfish trawl industry. Study participants had the option of taking the survey, participating in an interview, or participating in both formats. In 2010, 200 interviews were conducted in total, 24 of which were with two or more respondents. In 2012, 236 interviews were conducted, 26 of which were with two or more people. In 2015/2016, 16 of the 286 total interviews were conducted with two or more people.

Table A-4. Response rates. Source: PCGFSS 2017.

	Survey and Interview	Survey Only	Interview Only	Total Survey	Total Interview	Targeted	Survey Response Rate	Survey + Interview Only Response Rate
Overall								
2010	201	41	32	242	200	379	63.9%	72.3%
2012	235	24	31	259	236	500	51.8%	58.0%
2015/2016	263	14	21	277	286	501	55.3%	59.5%
Trawl Only								
2010	172	38	31	208	171	340	61.2%	70.3%
2012	195	22	25	221	195	386	57.3%	63.7%
2015/2016	225	12	11	237	235	371	63.6%	66.8%

Return Response Rates

This study attempts to understand the impacts of catch share over time. Thus, it targeted many of the 2010 participants in the 2012, and 2015/2016 data collection process. In 2012, 52.4 percent of participants had also participated in 2010 (survey and/or interview). In 2015/2016, 66.2 percent of participants had also participated in either 2010 or 2012 (survey and/or interview). Response rates were also calculated for return survey participation only as some aspects of the analysis focus only on return survey respondents (Table A-5).

Table A-5. Return response rates for surveys only. “Trawl surveys” excludes fixed gear. Source: PCGFSS 2017.

	2010	2012	2015/2016
Total surveys (n)	242	259	278
Total trawl surveys (n)	208	221	236
Total trawl return surveys (n)*		108	71
Return Response Rate*		48.87	30.00

* For 2015/2016 “total return surveys” and “return response rate” include only respondents who participated in BOTH the 2010 and 2012 survey—those who participated in only one of the previous surveys were not categorized as return respondents for 2015/2016.

Non-Response Description

Non-response was recorded by researchers in the participant tracking process. Table A-6 reflects the categories of non-response. The most frequent type of non-response across all years involved situations where there was no response to attempted contacts (primarily by leaving phone messages). Table A-6 has an "other" category, which represents written reasons other than those provided—often reflecting a more in-depth perspective. Where we were able to find some consistency in those descriptions, information provided for the "other" section was further broken down (Table A-7).

Table A-6. Non-response descriptions. Source: PCGFSS 2017.

Reason	Non-response Rate		
	2010	2012	2015/2016
Left messages, No return response	34.2%	36.1%	25.1%
Unable to contact due to bad information	3.4%	16.6%	25.6%
Agreed to participate but unable to arrange	8.5%	13.7%	11.4%
Not applicable to study	-	9.8%	3.8%
Surveys not returned	31.6%	7.3%	3.8%
Immediate decline – Multiple reasons	3.4%	5.4%	12.8%
Immediate decline – No reason	7.7%	2.4%	0.9%
Health Condition Prohibitive/Deceased	0.9%	2.9%	5.7%
Other	10.3%	5.9%	10.9%

Table A-7. Descriptions of the "Other" category of non-response in Table A-6. Source: PCGFSS 2017.

Description	2010	2012	2015/2016
Exit Fishery	-	-	10.0%
Retire	-	-	10.0%
Too Busy	10%	-	13.3%
Participating in a different Fishery	-	15.8%	16.7%
Not Interested	40%	21.1%	23.3%
Other Misc.	50%	63.2%	26.7%

Response rates by state are also provided (Table A-8). This helps determine where the highest levels of participation are located. Oregon shows a steady decline in participation over each year in the "overall" category, which includes anyone who participated including fixed gear participants. However, the "trawl participants only" category has increased in all states, including Oregon.

Table A-8. Response rates by state. Source: PCGFSS 2017.

	WA	OR	CA
2010 Overall	60.0%	60.4%	71.0%
2012 Overall	51.7%	49.0%	54.6%
2015/2016 Overall	54.4%	47.5%	78.8%

2010 Trawl	47.6%	58.7%	68.9%
2012 Trawl	63.6%	51.3%	60.0%
2015/2016 Trawl	76.5%	58.8%	70.7%

(B2) Description of Study Participants

Interview Data: Geographical Distribution of Participants

Table A-9 presents the geographical distribution of 2015/2016 interview participants by community and state. Communities were aggregated based on groupings for the five-year review. The 2010 and 2012 distributions are presented here; however, the focus of the qualitative analysis was on 2015/2016 interviews. More information on 2010 and 2012 interviews can be found in Russell et al. 2014.

Table A-9. Interview respondents' city and state of residence aggregated based on Five-year Review Community Groupings, in percentages. All rounds. Source: PCGFSS 2017.

Community Aggregation	2015/2016	2012	2010
Washington			
Puget Sound Area	6.41	9.87	5.20
Northern WA Coast	0.00	0.00	0.00
South/Central WA Coast	2.49	0.86	1.73
Oregon			
Astoria	10.68	12.02	9.25
Garibaldi	0.36	0.00	0.00
Newport	16.73	11.59	11.56
Coos Bay Area	12.10	9.01	8.67
Brookings Area	3.91	2.58	4.05
California			
San Pedro/LA Port Area	0.00	0.00	0.00
San Diego	0.00	0.00	0.00
Crescent City	2.14	3.00	4.05
Eureka Area	7.12	8.15	13.29
Fort Bragg Area	6.05	9.44	12.72
Bodega Bay Area	1.07	2.58	0.00
San Francisco Area	4.27	4.29	0.00
Half Moon Bay Area	5.34	5.15	7.51
Monterey Area	7.12	7.73	5.20

Morro Bay Area	12.10	13.30	16.76
Santa Barbara Area	2.14	0.43	0.00
Washington	8.90	10.73	6.93
Oregon	43.77	35.20	33.53
California	47.33	54.07	59.54

Survey Data: Comparing Return Respondent and All Respondent Data

To provide clarity for the interpretation of the return respondent analysis, we describe the composition of return respondents compared to all respondents based on their average age, role in the fishing industry, residence location, and support for catch share. Compared to all respondents, return respondents are older (Table A-10).

Table A-10. Mean age (SD) of return respondents in comparison to all respondents across all three study years. Source: PCGFSS 2017.

2010	2012	2015/2016	2010	2012	2015/2016
Return Respondent			All Respondent		
52.74 (10.02)	54.31 (11.61)	58.27 (10.19)	50.79 (13.71)	52.88 (11.46)	54.24 (12.23)

Although the return respondent dataset contains the same sample across years, there are fluctuations in how those respondents describe their role in the commercial fishing industry (Table A-11). These fluctuations may reflect year-to-year variation in respondents' capacity within the fishing industry. For example, those who identify as fishing crew vary widely across years, ranging from 1.4 percent to 23.9 percent. Additionally, these fluctuations reflect shifts in ownership: four respondents who had identified as limited entry permit owners/co-owners in 2010 did not identify as QS owners/co-owners in 2012 or 2015/2016. Three respondents in 2012 and three in 2015/2016 who had not identified as limited entry permit owners/co-owners in 2010, identified as QS owners/co-owners. These variations in ownership may be linked to QS allocations.

Table A-11 compares the percentage of respondents in various roles for 2010, 2012, and 2015/2016, using return respondent and all respondent data. In comparison to all respondent data, more return respondents are QS owners/co-owners, vessel owners/co-owners, vessel account owners/co-owners, and captain/operators. Return respondent data also show a higher percentage of absentee owners than the all respondent data category (Table A-11). These differences should be taken into consideration when relating return respondent analysis to all respondent data.

Table A-11. Respondents' self-identified role(s) within the commercial fishing industry, in percentages. All respondent and return respondent data. Source: PCGFSS 2017.

	2010	2012	2015/2016	2010	2012	2015/2016
Role	Return Respondent			All Respondent		
QS (Permit) Owner/Co-Owner	44.3*	40.8	47.1	33.2*	31.7	31.6
Absentee Owner	NA	16.9	18.6	NA	14.9	14.5
Vessel Owner/Co-Owner	47.1	49.3	50.0	37	36.7	32.9
Vessel Account Owner/Co-Owner	NA	NA	44.3	NA	NA	28.6
QS/QP Manager	NA	NA	34.3	NA	NA	23.8
Risk Pool Manager	NA	NA	10.0	NA	NA	4.7
Broker	NA	NA	2.9	NA	NA	2.6
Captain/Operator	41.4	42.3	48.6	32.2	34.4	33.6
Fishing Crew	7.1	23.9	1.4	18.8	23.5	12.3
Observer	NA	0.0	0.0	NA	5.0	4.3
At-Sea CP/Mothership Owner	2.9	4.2	1.4	1.9	2.7	0.9
At-Sea CP/Mothership Operator	1.4	0.0	1.4	1.0	0.5	0.9
At-Sea CP/Mothership Fisherman	1.4	0.0	0.0	1.0	0.5	0.0
At-Sea CP/Mothership Processing	0.0	0.0	0.0	1.0	0.0	0.0
Vessel Crew (non-fishing/ processing)	0.0	1.4	0.0	0.0	0.5	0.4
Buyer/First Receiver	15.7	12.7	12.9	11.5	10.9	12.8
Shoreside Processor Owner	10.0	9.9	7.1	8.2	5.9	6.4
Shoreside Processor Operator	7.1	11.3	5.7	5.8	7.2	6.0
Shoreside Processor Employee	1.4	2.8	7.1	1.4	5.4	4.7
Fisherman's Wife/Partner/Spouse	1.4	4.2	2.9	4.3	3.6	4.7
Industry Supplier/Service Provider	12.9	14.1	11.4	10.6	15.8	13.2
Business Operations	12.9	23.9	20.0	10.1	17.2	19.1
Other	15.7	12.7	18.6	16.3	22.6	28.5
RR	100	100	100	100	100	100

Notes: "NA" represents a response category that was not listed as an option.

*Ownership in 2010 refers to Limited Entry Permit owners, as this period was prior to the catch share program.

Survey respondents were categorized into communities (groupings reflect Five-year Review Community Groupings) based on the location of their participation in the fishery. In terms of representation at the community level, return respondent and all respondent data reflect similar distributions (Table A-12).

When comparing across years, there are no drastic changes in community representation, though there are slight fluctuations. For return respondents, these fluctuations indicate that some respondents have moved. These values vary slightly from interview participant distribution as not all interview participants completed a survey and vice versa.

Table A-12. Survey respondent community representation based on Five Year Review Community Groupings, in percentages. All respondent and return respondent data. Source: PCGFSS 2017.

	2010	2012	2015/2016	2010	2012	2015/2016
Community Aggregation	Return Respondent			All Respondent		
Washington						
Puget Sound Area	12.9	11.3	11.3	7.7	11.8	9.7
Northern WA Coast	0.0	0.0	0.0	0.0	0.0	0.0
South/Central WA Coast	0.0	0.0	0.0	1.4	0.9	2.1
Oregon						
Garibaldi	0.0	0.0	0.0	1.0	0.0	0.4
Astoria	8.6	8.5	8.5	11.1	14.5	12.7
Newport	15.7	15.5	15.5	13.5	15.4	16.1
Coos Bay Area	10.0	9.9	9.9	12.5	11.8	10.6
Brookings Area	1.4	2.8	1.4	3.8	2.7	2.5
California						
San Pedro/LA Port Area	0.0	0.0	0.0	0.0	0.0	0.0
San Diego	0.0	0.0	0.0	0.0	0.0	0.0
Crescent City	0.0	0.0	1.4	2.4	2.7	2.5
Princeton/Half Moon Bay	4.3	5.6	5.6	6.3	3.6	5.9
Eureka Area	12.9	12.7	12.7	10.6	8.1	8.5
Fort Bragg Area	14.3	14.1	14.1	9.6	9.5	6.8
Bodega Bay Area	2.9	2.8	2.8	2.9	1.8	1.3
San Francisco Area	4.3	5.6	5.6	4.8	4.1	5.5
Morro Bay Area	7.1	7.0	7.0	4.8	8.1	7.6

Santa Barbara Area	0.0	0.0	0.0	0.5	0.0	0.4
Monterey Area	5.7	4.2	4.2	5.8	5.0	7.2
Other	0.0	0.0	0.0	1.4	0.0	0.0
NA/PNA	0.0	0.0	0.0	0.0	0.0	0.0
RR	100	100	100	100	100	100

In terms of representation at the state level, return respondent, and all respondent data reflect similar distributions, though there is a higher percentage in Oregon for all respondent data, and a higher percentage in California for return respondent data (Table A-13). Again, variations in return respondent data may indicate that some respondents have moved.

Table A-13. Survey respondent state representation, in percentages. All respondent and return respondent data. Source: PCGFSS 2017.

	2010	2012	2015/2016	2010	2012	2015/2016
State	Return Respondent			All Respondent		
Washington	12.9	11.3	11.4	10.6	12.7	11.5
Oregon	35.7	36.6	34.3	41.8	44.3	43.2
California	51.4	52.1	54.3	47.6	43.0	45.3
RR	100	100	100	100	100	100

Survey participants were asked whether they support, or do not support, the catch share program. The percentage of both all and return respondents reporting support for catch share has increased since 2010 (Table A-14). In 2010, return respondents were more supportive of catch share than all respondents; however, in 2012 all respondents were more supportive than return respondents. In 2015/2016, all respondents and return respondents reported similar levels of support for catch share. Conversely, results for both categories across all years indicated decreases for those who did not support the program.

Table A-14. Respondents' reported support for the catch share program. All respondent and return respondent data. Source: PGFSS 2017.

	2010	2012	2015/2016	2010	2012	2015/2016
	Return Respondent			All Respondent		
Support	30.9	39.4	48.5	23.8	48.2	47.1

Do not support	47.1	42.4	38.2	43.5	40.7	36.9
Not sure	22.1	15.2	14.7	29	11.6	16.4
NA/PNA	0	3.0	0	3.6	1.5	3.1
RR	98.6	98.5	98.6	97.5	98.5	97.4

Qualitative Data Description

(C1) Qualitative Data Codebook

The codebook is a compiled list of all qualitative codes and their definitions. It served as a common reference for researchers during the qualitative analysis process. The code definitions in the codebook were discussed and agreed upon before being applied to the interview transcriptions. Having all code definitions readily available to each researcher during the coding process helped ensure that codes were applied in a consistent manner.

Note on codebook: In order to minimize the potential for inter-coder variability, the number of unique codes was intentionally limited. Where possible, code combinations took the place of unique codes. For instance, there is no “cost” sub-code of the “observers” parent code (or vice versa), despite the fact that cost was quite often central to participants’ discussions of observers. Instead, comments regarding the cost of observers were coded with both the “cost” and “observers” parent codes. Coding in this manner effectively created built-in sub-codes represented by the co-occurrence of two or more codes. MAXQDA’s Code Relations Browser function enables quick identification of co-occurrence trends among codes, and it was used often during analysis in order to understand the way various themes related to each other within the data set.

(C2) Qualitative Data Frequency Tables

Qualitative code frequency tables provide an indication of the relative prevalence of each of the qualitative codes used to analyze the 2015/2016 PCGFSS interview data. Please note the frequency of the codes does not represent the number of times a word or phrase occurred in the dataset. The code frequency refers to the number of times in the entire dataset that interview participants addressed a subject that aligned with a code definition in our codebook (See Table A-3). The coding scheme consisted of 21 parent (or top-level) codes, plus an additional 20 sub-codes. Parent code occurrences range from 2,088 for the “Working in the Industry” code and 12 for the “CA vs OR boats” code. Table A-17 (below) shows each parent code’s total number of occurrences as well as a rank reflecting its usage relative to all other parent codes. This ranking was limited to parent codes in order to limit comparisons to a single level of analysis, rather than comparing parent codes and sub-codes to each other. For clarification, the rank order is 1 as the highest occurrence rank to 21 as the lowest occurrence rank. Table A-18 (below) provides information on sub-codes. The percentage provided under the header, “Percentage of parent code”, indicates the proportion of the parent code that was further classified with the sub-code in question. Sub-codes were not applied to all coded segments of parent codes (see Table A-3 for code definitions); thus, percentages of parent codes do not add up to 100 percent. Table A-16 provides a snapshot of the number of parent codes and the total number of coded segments in the overall 2015/2016 dataset.

Table A-16. Overall coding overview. Source: PCGFSS 2017.

Number of parent codes	Total coded segments	
21	10940	

Table A-17. Parent Code Occurrences and Rank. Source: PCGFSS 2017.

Code	Total occurrences	Rank
Working in the Industry	2088	1
Management Process	1184	2
Cost	962	3
Observers	959	4
Markets	706	5
Adaptability	696	6
Fish Stocks	628	7
New Entrants	587	8
Ownership Dynamics	436	9
Infrastructure	360	10
Community	328	11
Impacts on Other Fisheries	325	12
Safety	271	13
Small Vessels	248	14
Accumulation & Consolidation	240	15(T)
Gear Switching	240	15(T)
Exit	221	17
Fishery Reputation	198	18
Geographic Shift	182	19
Fleet Variation	69	20
Cost Recovery	14	21
CA v. OR boats	12	22

Table A-18. Sub code occurrences and their proportion to their parent code. Source: PCGFSS 2107.

Parent Code		Sub Code	Total occurrences	Proportion of parent code
	Working in the Industry	Income	217	10.4%
		Running a business	653	31.3%
		Working experience	440	21.1%
		Jobs	242	11.6%
	Management Process	Involvement in the process	119	10.1%
		Quota allocations	290	24.5%
		Proposed action (by industry)	179	15.1%
		Efficacy	154	13.0%
	Markets	Quota pound market	94	13.3%
	Infrastructure	Industry suppliers/services	164	45.6%
		Processors//buyers	98	27.2%
	Geographic Shift	Stock-related (target)	50	42.4%
		Stock-related (bycatch)	14	11.9%
	Cost	Leasing	121	12.8%
	New Entrants/graying	Graying/retirement	84	14.3%
	Impacts on other fisheries	Other groundfish	40	12.3%
		Other non-groundfish	208	64.0%
	Ownership dynamics	Transfer of ownership	59	13.5%
		Collective ownership	41	9.4%
		Absentee ownership	148	34.0%

Supplemental Materials

Information in this section is included to augment any information included in the main body of this document. The tables and figures located in this portion of the appendix may have been deemed too large or extensive to include in the main body of the document. However, we have opted to include these supplemental materials for those who may be interested in more detailed information and additional analysis conducted.

(D1) Section Specific Detailed Results

Absentee Quota Holders (Section 3.2.2(g)(3)(b)

One aspect of the quantitative analysis for Section 3.2.2(g)(4) (Absentee Quota Holders subheading under the Causes of Stress Within Communities Section) involved summarizing responses to survey items F14 (2015/2016), F10 (2012), and E9 (2010), using all respondent data. This survey item was in the Fishermen Section of the survey, and, thus, it only applies to fishermen. The item asked fishermen to rate the quality of their relationships with a variety of people (QS owner/permit owner, vessel owner, vessel account owner (2015/2016 only), captain/operator, crew, and observer) on the most recent groundfish trawl fishery boat(s) that they worked on. In 2012 and 2015/2016, fishermen were also asked if these relationships had changed since implementation of catch share. For the Absentee Quota Holder Section, we considered only relationships with QS owners and vessel owners. Captain/operator and crew relationships are considered in the Changing Nature of Fishery Businesses and Jobs Section.

Additionally, we summarized responses to survey items G9 (2015/2016 and 2012) and F9 (2010), using all respondent data. This survey item was in the Processor Section of the survey; thus, it only applies to processors. Similar to the items in the Fishermen Section, this item asked processors to rate the quality of their relationships with a variety of people (QS owner/permit owner, vessel owner, vessel account owner (only 2015/2016), captain/operator, buyer, distributor, marketer, and laborers) related to the purchasing of trawl caught groundfish. For the Absentee Quota Holder Section, we only considered relationships with QS owners and vessel owners. Captain/operator, buyer, distributor, marketer, and laborer relationships are considered in Section 3.2.2(h), Changing Nature of Fishery Businesses and Jobs.

All tables report percentages for the response options, including NA and PNA, which are grouped together for efficiency. Response rates (RR) are presented as percentages (number of total respondents, not including those marked missing, divided by the number of total respondents, including those marked missing). High instances of NA/PNAs can be attributed to respondents identifying as the role about which they are being queried. For instance, if a respondent identified as a QS owner, they would respond as NA for relationships with QS owner.

Fishermen’s Relationships

Table A-19. Reported change in relationships with QS owner, vessel account owner (only 2015/2016), and vessel owner since implementation of catch share, in percentages. Fishermen only. Source: PCGFSS 2017.

	QS Owner	Vessel Account Owner	Vessel Owner
2015/2016			
Yes	4.6	1.9	0.9
No	46.3	41.7	42.5
NA/PNA	49.0	56.5	56.

RR	87.8	87.8	86.9
2012			
Yes	8.2	NA	5.9
No	41.2	NA	41.6
NA/PNA	50.5	NA	52.5
RR	83.6	NA	87.1

Table A-20. Quality of relationships with QS owner, vessel account owner (only 2015/2016), and vessel owner, in percentages. Fishermen only. Source: PCGFSS 2017.

	QS Owner	Vessel Account Owner	Vessel Owner
2015/2016			
Negative	0	0	0
Neutral	1.8	2.7	1.8
Positive	47.7	42.0	42.9
NA/PNA	50.4	55.4	55.4
RR	90.2	90.2	90.2
2012			
Negative	2.6	NA	0.9
Neutral	11.4	NA	12.2
Positive	40.4	NA	38.3
NA/PNA	45.6	NA	48.7
RR	97.4	NA	98.3
2010			
Negative	0	NA	0
Neutral	3.2	NA	1.6
Positive	58.7	NA	59.8
NA/PNA	38.1	NA	38.6
RR	93.3	NA	94.1

Processors' Relationships

Table A-21. Reported change in relationships with QS owner, vessel account owner (only 2015/2016), and vessel owner since implementation of catch share, in percentages. Processors only. Source: PCGFSS 2017.

	QS Owner	Vessel Account Owner	Vessel Owner
2015/2016			
Yes	9.8	5.3	7.5
No	51.2	50.0	70.0
NA/PNA	39.0	44.7	22.5
RR	97.6	92.7	97.6
2012			
Yes	12.5	NA	15.6
No	43.8	NA	46.9
NA/PNA	43.7	NA	37.5
RR	80.0	NA	80.0

Table A-22. Quality of relationships with QS owner, vessel account owner (only 2015/2016), and vessel owner, in percentages. Processors only. Source: PCGFSS 2017.

	QS Owner	Vessel Account Owner	Vessel Owner
2015/2016			
Negative	2.4	2.6	2.4
Neutral	7.3	7.7	9.8
Positive	51.2	46.2	65.9
NA/PNA	39.0	43.6	22.0
RR	97.6	95.1	97.6
2012			
Negative	0	NA	2.9
Neutral	14.3	NA	8.6
Positive	45.7	NA	54.3
NA/PNA	40.0	NA	34.3
RR	87.5	NA	87.5
2010			
Negative	0	NA	0

Neutral	2.8	NA	2.8
Positive	75	NA	75.0
NA/PNA	22.2	NA	22.2
RR	94.7	NA	94.7

Changing Nature of Fishery Businesses and Jobs (Section 3.2.2(h))

This aspect of the quantitative analysis for Section 3.2.2(h), Changing Nature of Fishery Businesses and Jobs, involved summarizing responses to survey items F14 (2015/2016), F10 (2012), and E9 (2010) by using all respondent data. These survey items were in the Fishermen Section of the survey; thus, they only apply to fishermen. The items asked fishermen to rate the quality of their relationships with a variety of people (QS owner/permit owner, vessel owner, vessel account owner [2015/2016 only]), captain/operator, crew, and observer) on the most recent groundfish trawl fishery boat(s) on which they worked. We also summarize responses to F20 (2015/2016), F16 (2012), and E15 (2010) where fishermen were asked to rate the quality of their relationships with a variety of people (buyer/first receiver, processor, mothership) related to the selling of groundfish that they commercially caught with trawl gear. In 2012 and 2015/2016, fishermen were also asked if these relationships had changed since implementation of catch share. For the Changing Nature of Fishery Businesses and Jobs Section, we considered only relationships with captain/operator, crew, buyer/first receiver, processor, and mothership. Relationships with QS owners, vessel owners, and vessel account owners are described in Section 3.2.2(g)(4), Absentee Quota Holders.

Additionally, we summarized responses to survey items G9 (2015/2016 and 2012) and F9 (2010) using all respondent data. This survey item was in the Processor Section of the survey; thus, it applies only to processors. Similar to the items in the Fishermen Section, this item asked processors to rate the quality of their relationships with a variety of people (QS owner/permit owner, vessel owner, vessel account owner [2015/2016 only], captain/operator, buyer, distributor, marketer, and laborers) related to the purchasing of trawl caught groundfish. For the Changing Nature of Fishery Businesses and Jobs Section, we considered only relationships with captain/operator, buyer, distributor, marketer, and laborers. Relationships with QS owners, vessel owners, and vessel account owners are described in Section (3.2.2(g)(4)), Absentee Quota Holders.

All tables report percentages for the response options, including NA and PNA, which are grouped together for efficiency. RRs are presented as percentages (number of total respondents, not including those marked missing, divided by the number of total respondents, including those marked missing). High instances of NA/PNAs can be attributed to respondents identifying as the role about which they are being asked. For instance, if a respondent identified as a captain/operator, they would respond as not applicable for relationships with captain/operator.

Fishermen’s Relationships

Table A-23. Quality of relationships with captain/operator, crew, buyer/receiver, processor, and mothership, in percentages. Buyer/receiver was not a response option in 2010. Fishermen only. Source: PCGFSS 2017.

	Captain/Operator	Crew	Buyer/Receiver	Processor	Mothership
2015/2016					
Negative	0	2.7	0.9	0.9	2.7
Neutral	3.5	9.7	13.0	14.4	1.8
Positive	38.1	79.6	60.0	58.6	10.6
NA/PNA	58.4	8.0	26.1	26.1	85.0
RR	91.9	91.9	94.3	91.0	92.6
2012					
Negative	0	1.8	0.9	4.6	0
Neutral	3.5	15.8	16.4	18.3	3.9
Positive	41.6	74.6	44.5	44.0	13.7
NA/PNA	54.9	7.9	48.2	33.0	82.4
RR	96.6	97.4	94.8	92.4	90.3
2010					
Negative	0	0	NA	5.3	0
Neutral	1.6	8.4	NA	13.2	3.7
Positive	60.9	85.5	NA	63.2	13.4
NA/PNA	37.5	6.1	NA	18.5	82.9
RR	94.8	97.0	NA	98.3	96.5

Table A-24. Reported change in relationships with captain/operator, crew, buyer/receiver, processor, and mothership since implementation of catch share, in percentages. Fishermen only. Source: PCGFSS 2017.

	Captain/Operator	Crew	Buyer/Receiver	Processor	Mothership
2015/2016					
Yes	1.8	4.6	12.0	11.5	5.4
No	41.8	86.2	61.1	60.6	7.2
NA/PNA	56.5	9.2	26.9	27.9	87.4
RR	89.4	88.6	88.5	85.2	91.0
2012					
Yes	2.9	8.1	13.6	12.2	3.1

No	37.9	81.4	39.8	4.9	10.3
NA/PNA	59.2	10.5	46.6	38.8	86.6
RR	88.8	73.5	76.5	83.8	85.8

Processors' Relationships

Table A-25. Quality of relationships with captain/operator, buyer, distributor, marketer, and laborers, in percentages. Processors only. Source: PCGFSS 2017.

	Captain/Operator	Buyer	Distributor	Marketer	Laborers
2015/2016					
Negative	2.6	0	0	0	5.3
Neutral	5.1	2.4	5.0	5.1	7.9
Positive	71.8	39.0	57.5	33.3	65.8
NA/PNA	20.5	58.5	37.5	61.5	21.1
RR	95.1	100	97.5	95.1	92.7
2012					
Negative	0	0	0	3.1	12.5
Neutral	8.8	12.1	12.1	9.4	15.6
Positive	58.8	36.4	36.4	28.1	46.9
NA/PNA	32.30	51.5	51.5	59.4	25.0
RR	85	82.5	82.5	80.0	80.0
2010					
Negative	0	0	2.9	0	0
Neutral	5.6	8.3	8.6	5.9	5.7
Positive	75.0	55.6	57.1	29.4	74.3
NA/PNA	19.4	36.2	31.4	64.7	20.0
RR	94.7	94.7	90.2	89.5	90.2

Table A-26. Reported change in relationships with captain/operators, buyer, distributor, marketer, and laborers since implementation of catch share, in percentages. Processors only. Source: PCGFSS 2017.

	Captain	Buyer	Distributor	Marketer	Laborers
2015/2016					
Yes	7.7	2.4	5.0	0	18.9
No	71.8	39	57.5	38.5	59.5
NA/PNA	20.5	58.5	37.5	61.5	21.6
RR	95.1	100	97.5	95.1	90.2
2012					
Yes	9.7	2.9	3.2	9.4	26.7

No	54.8	47.1	41.9	31.3	43.3
NA/PNA	35.5	50.0	54.8	59.4	30.0
RR	77.5	85.0	77.5	80.0	75.0

Location of Landings (Section 3.1.2(d)(3)

The Location of Landings Section within the Economic Performance section includes some summary results from the PCGFSS. For those who may be interested, detailed results are included here.

Fishermen's Responses

In order to explore the decision-making process related to selling catch, fishermen were asked about the items they consider when deciding where to sell catch (Table A-27). To determine what factors constrained this decision, fishermen were also asked what limited their choice of where to sell catch (Table A-28). These are multiple response items. Additionally, in order to improve clarity, some categories were added after 2010.

Table A-27. Responses (in percentages) to the question: What items are taken into consideration when deciding where to sell the catch? Multiple response item. Fishermen only. Source: PCGFSS 2017.

Response Categories	2010	2012	2015/2016
Mutual agreement with buyer	44.6	33.3	29.4
Mutual agreement with processor	29.2	28.9	23.5
Contract with buyer	9.2	2.6	3.4
Contract with processor	3.8	4.4	4.2
Only single buyer available	10.8	10.5	10.1
Best price/market	18.5	25.4	25.2
Mothership or Catcher-Processor	3.1	9.6	5.9
Longstanding relationship	NA*	47.4	52.9
Vessel is owned by processor	NA*	3.5	5.0
Do not know	10.8	7.0	7.6
Other	16.2	15.8	19.3
NA/PNA	5.4	3.5	5.0
RR	96.3	97.4	96.7

Note: Categories were added to the 2012 survey based on participants' responses2.

2 These categories were added in order to improve clarity, and were created based on responses to the "other" category in 2010. For instance, in 2010, 41% of those who responded "other" indicated a longstanding relationship as a response. Longstanding relationship is distinct from a mutual agreement due to the value of time. The longstanding relationship refers to individuals whom have stayed with an

Table A-28. Responses (in percentages) to the question: What limits your choice of where to sell your fish? Multiple response item. Fishermen only. Source: PCGFSS 2017.

Response Categories	2010	2012	2015/2016
Market	26.6	28.8	31.6
Limited number of processors	41.4	36.9	41.9
Location of processors	20.3	26.1	23.9
Amount purchased by processor	16.4	21.6	24.8
Amount paid for catch by processor	22.7	27.0	19.7
Species purchased by processor	23.4	20.7	13.7
Multiple species required by processor for purchase of all species	7.0	16.2	7.7
Sell/deliver to a Mothership or Catcher-Processor	2.3	10.8	4.3
Vessel is owned by processor	NA*	4.5	6.8
No limitations	7.8	8.1	9.4
Other	29.7	25.2	23.1
NA/PNA	4.7	8.1	5.1
RR	95.5	94.9	95.1

* Category added to the 2012 survey based on participants' responses.

Processors' Responses

In order to explore the decision-making process related to purchasing fish, processors were asked about the items they considered when deciding where to purchase trawl caught groundfish (Table A-29).

Table A-29. Responses (in percentages) to the question: What items are taken into consideration when deciding where to purchase trawl caught groundfish? Multiple response item. Processors only. Source: PCGFSS 2017.

Response Categories	2010	2012	2015/2016
Mutual agreement with fisherman/boat	78.4	47.5	45.0
Contract with fisherman/boat	2.7	7.5	10.0
Relationship with fisherman	NA	60.0	80.0
Company fishing boats	16.2	15.0	25.0

entity for what they perceive to be a long time; often spoke of in terms of decades, generations, etc. The mutual agreement category has no temporal limit, it refers to an agreement between two entities that is less formal that a "contract" which is defined as a formal written document.

Buyer/first receiver	8.1	12.5	17.5
Contract/agreement with buyer/first receiver	2.7	5.0	10.0
Catcher-Processor	8.1	0.0	0.0
Geographic location (distance from plant)	NA	42.5	32.5
Do not know	2.7	2.5	0.0
Other	37.8	27.5	32.5
NA/PNA	2.7	7.5	5
RR	97.4	100	95.2

(D2) Acronym List

Specific to Pacific Coast Groundfish Social Study Data

PCGFSS – Pacific Coast Groundfish Fishery Social Study

RR – Response rate; reported with PCGFSS data graphs and tables, and refers to question specific response rate

PNA – Prefer not to answer; response option for PCGFSS

NA – Not applicable; response option for PCGFSS

General

IFQ/ITQ/IQ – Individual Fishing Quota, Individual Transferable Quota, or Individual Quota; alternative terminologies for "catch share" often used by industry members and in academic literature

EDF – Environmental Defense Fund

RCA – Rockfish Conservation Area

POP – Pacific ocean perch

OTC – Oregon Trawl Commission

OA – Open access

(D3) Citations Used in Appendix

Bernard, H. R. 2000. Social Research Methods: Qualitative and Quantitative Approaches. Sage Publications, Thousand Oaks, CA.

Bernard, H. R. 2002. Research Methods In Anthropology, Third Edition edition. AltaMira Press, Walnut Creek, CA.

Cochran, W.G. 1950. The comparison of percentages in matched samples. Biometrika 37 (3/4): 256-266.

McNemar, Q. 1949. Psychological statistics. New York: John Wiley and Sons.

Rea, L. M., and R. A. Parker. 1997. Designing and Conducting Survey Research: A Comprehensive Guide, Second Edition edition. Jossey-Bass, San Francisco, CA.

Robson, C. 2002. Real World Research, Second Edition edition. Blackwell Publishing, Malden, MA.

Russell, S. M., Sparks, K., Arias-Arthur, A., & Varney, A. 2014. The Pacific Groundfish Fishery Social Study: An Initial Theme Based Report. Seattle (WA): US Department of Commerce. NWFSC Report, 5, 78.

Russell, S. M., Arias-Arthur, A., Sparks, K., & Varney, A. 2016. West coast communities and catch share: The early years of social change. Coastal Management, 44(5), 441-451.

Russell, S., and M. Schneidler-Ruff. 2014. The U.S. Whale Watching Industry of Greater Puget Sound: A Description and Baseline Analysis. U. S. D. o. Commerce, editor. NOAA, Seattle, WA.

Ryan, G. 1999. Measuring the typicality of text: Using multiple coders for more than just reliability and validity checks. Human Organization, 58(3), 313-322.

Saldaña, J. 2015. The coding manual for qualitative researchers. Sage.

Schensul, S. L., J. J. Schensul, and M. D. LeCompte. 1999. Essential Ethnographic Methods; Observations, Interviews, and Questionnaires, volume 2. AltaMira Press, Lanham, MD.

Sheldon, M.R., Fillyaw, M.J., and Thomson, W.D. 1996. The use and interpretation of the Friedman test in the analysis of ordinal-scale data in repeated measures designs. Physiotherapy Research International 1 (4): 221-228.

Strauss, A., & Corbin, J. 1998. Basics of qualitative research. 1998. Thousand Oaks

Appendix D

Port Profiles

Appendix D: Port Profiles

For each port identified as active after 2005 (Section 3.2, Table 3-82), this appendix provides a pair of tables that summarizes available infrastructure information. Seattle is also included because of its importance as a port for the at-sea fleet, as well as the involvement of area residents in ownership of fishing assets such as QS (see Table D-2b). The first table in each pair covers infrastructure on fuel docks; ice plants; cold storage; processors; berths and moorage; gear storage yards; boat hoists, lifts, cranes, and shipyards; marine supply stores; dredging; and local USCG stations. Pre-catch share information about these infrastructure elements is primarily summarized from the text of Community Profiles for West Coast and North Pacific Fisheries Washington, Oregon, California, and other states of the United States (NMFS 2007). Information on current conditions was derived mainly from interviews of enforcement personnel, port samplers, port managers, and members of industry, many of whom were knowledgeable about the infrastructure in a number of ports. The second table in each pair covers numbers of buyers active in the ports, vessels owned by port residents, numbers of vessels active in the ports, groundfish limited entry permits and quota owned by port residents, and indicators of the importance of groundfish to the fishing industry in the port (port groundfish ex-vessel revenue as a percent of all ex-vessel revenue for the port) and the importance of the port to the West Coast fishery production (port ex-vessel revenues as a percent of coast wide ex-vessel revenues). Many of these data elements are included elsewhere in the Community Performance Section, but they are brought together for each port in a single location in this appendix.

Table D1a. Bellingham Washington, commercial-fishery-related infrastructure.

Bellingham Bay/Whatcom County	Fuel Dock	Ice Plant/ Sales Cold Storage/ Refrig.	Processors	Fishery-related Berths and Moorage (excludes shipping and government, e.g., USCG)	Gear storage/ gear yard	Boat Hoists, Lifts, and Cranes Shipyard/ Boatyards/Dry Dock	Marine/ Vessel Supply Stores	Dredging	USCG
Pre-catch shares.3	Yes (up to 50-foot vessels, larger vessels receive truck deliveries at a lower price than dock).	Ice sales: ice blower system in place Public refrigeration (also some in Mt. Vernon and Burlington, but not used by harvesters).	At least nine in the early 2000s.	Squalicum harbor has several marinas providing berthing for about 1,200 commercial and pleasure. There is additional berthing on the Whatcom Creek Waterway that can accommodate a few 100-foot vessels. Additionally there are three large deep-draft piers 25- to 30-foot MLLW.	Web lockers and outdoor gear and vessel storage.	Mobile and Floating Cranes. Dry docks to handle 300-foot to 400-foot vessels. Two travel lifts that lift and swing. One can swing 100 tons or so. Upwards of a 60- to 70-foot vessel. Shipyards are also available	Two vessel suppliers.	Maintenance dredging in 2003.	USCG Station Bellingham and the cutters Terrapin and Sea Lion (stationed in Fairhaven, WA). Other USCG support in the area includes the cutters Blue Shark (Everett). Also see Neah Bay for additional USCG assets in the area.

3 Data from NMFS (2007) port profiles, unless otherwise noted.

						nearby in Blaine.			
Catch shares (2011 to 2016).4	No Change.	No Change.	At least four remain (some of the decline may have preceded 2011.	No Change.	New indoor facility for gear storage.	No Change.	One vessel supply store remains.	Port requested COE dredging for 2016 to 2017.	No change.5

4 Personal communication, Russ Mullins, February 16, 2017, unless otherwise noted.

5 Personal communication, Brian Corrigan, February 1, 2017: USCG reports no shifts in cutter homeport shifts, air station relocations, or boat station relocations relative to the start of the trawl catch share program.

Table D1b. Bellingham Washington, and northern Puget Sound region, activity and ownership by residents. Source: PacFIN and Pacific Coast Groundfish IFQ Database.

		Numbers of Vessels Owned by Residents		Numbers of IFQ Vessels Delivering			Permits/Quota Held in Community6			Fishery as a Percent of Local Ex-vessel Revenue		Local Area as a Percent of Coastwide Ex-vessel Revenue of the Following: the Following:		
	Trawl-caught-Groundfish Buyers	All	Groundfish Trawl	Nonwhiting Trawl	Whiting Trawl	Gear-switched	LE Trawl Permits	Non-whiting QS	Whiting QS	Nonwhiting	Whiting	Nonwhiting	Whiting	All Species (Groundfish and Other)
1998	2	174	1	5	-	-	2							
2000	2	165	1	7	-	-	2							
2004	2	110	2	6	-	-	3							
2009	1	109	4	5	-	-	2							
2010	1	104	3	7	-	-	2							
2011	1	105	2	4	-	2	2	1.8%	0.1%					
2015	2	89	1	3	-	2	2	1.3%	0.1%					

6 Location assigned based on addresses as listed in permit files.

Northern Puget Sound[7]														
1998	4	443	7	8	1	-	8			5.7%	Conf	4.6%	Conf	9.9%
2000	3	411	9	12	-	-	8			7.3%	-	6.9%	-	8.9%
2004	4	322	3	6	-	-	6			3.4%	-	6.2%	-	9.3%
2009	1	304	4	5	-	-	2			Conf	-	Conf	-	9.2%
2010	1	313	3	7	-	-	2			Conf	-	Conf	-	10.0%
2011	1	318	3	4	-	2	2	3.5%	4.0%	Conf	-	Conf	-	8.2%
2015	2	270	2	3	-	2	2	3.0%	2.7%	Conf	-	Conf	-	10.7%

Conf = not displayed due to confidentiality.

7 Northern Puget Sound includes Bellingham, Blaine, and La Conner and other Whatcom County, Skagit County, San Juan County, Island County, and Snohomish county ports/towns.

Table D2a. Seattle Washington, commercial-fishery-related infrastructure.

Seattle	Fuel Dock	Ice Plant/ Sales Cold Storage/ Refrig.	Processors	Fishery-related Berths and Moorage (excludes shipping and government, e.g., USCG)	Gear storage/ gear yard	Boat Hoists, Lifts, and Cranes Shipyard/ Boatyards/ Dry Dock	Marine/ Vessel Supply Stores,	Dredging	USCG
Pre-catch shares.8	NR.	NR.	Seven processors.	Pier 90 and Pier 91 (12 berths for barges and factory trawlers). Commercial moorage at the Bell Street Pier, Maritime Industrial Center, Terminal 30, and Fishermen's Terminal. Fishermen S Terminal provides moorage for more than 700 workboats and commercial fishing vessels, lineal moorage of 2,500 feet, and 371 stalls.	NR.	NR.	NR.	Naturally deep harbor at Pier 90 and 91. Very occasional dredging to maintain the passage, berthing, and dry docks in the ship canal.9	13th USCG District headquarters

8 Data from NMFS (2007) port profiles, unless otherwise noted.

9 For example, dry dock dredging project for 2017 last dredged in 1976 (http://www.seattle.gov/dpd/LUIB/AttachmentProject3023827ID79863023827.pdf); maintain berthing (http://www.ecy.wa.gov/programs/sea/fed-permit/pdf/201201261WQC10451.pdf).

Catch shares (2011 to 2016).10	Available. No big changes.	Ice readily available. Cold storage and refrigeration facilities are stable.	Many processors of different types. A rapidly growing industry in terms of the number of new processors. A few new processors every year. Adding 12 processors in next month due to commissions classification of king crab as red, brown, and blue.	No change. Difficult time maintaining a tenant in Terminal 25. (Vessels are increasingly going to Tacoma for offloading)	Available. No major changes.	Available. No major changes.	Available. No major changes.	No change.	No change.

10 Personal communication, Eric Olsen, April 26, 2017, unless otherwise noted.

Table D2b. Seattle Washington and southern Puget Sound region, activity and ownership by residents. Source: PacFIN and Pacific Coast Groundfish IFQ Database.

		Numbers of Vessels Owned by Residents		Numbers of Vessels Delivering			Permits/Quota Held in Community11			Fishery as a Percent of Local Ex-vessel Revenue		Local Area as a Percent of Coastwide Ex-vessel Revenue of t Following: the Following:		
	Trawl-caught-Groundfish Buyers	All	Groundfish Trawl	Nonwhtg Trawl	Whiting Trawl	Gear Switched	LE Permits	Non-whiting QS	Whiting QS	Nonwhiting	Whiting	Nonwhiting	Whiting	All Speci (Groundf and Othe
1998	-	140	23	-	-	-	24							
2000	-	134	27	-	-	-	24							
2004	-	102	11	-	-	-	24							
2009	-	88	17	-	-	-	28							
2010	-	85	22	-	-	-	27							
2011	-	78	24	-	-	-	29	9.7%	17.3%					
2015	-	85	24	-	-	-	30	8.7%	23.5%					
Southern Puget Sound														
1998	-	354	28	-	-	-	29			-	-	-	-	-
2000	-	339	31	-	-	-	29			-	-	-	-	-
2004	-	287	12	-	-	-	25			-	-	-	-	-
2009	-	250	19	-	-	-	30			-	-	-	-	-
2010	-	255	24	-	-	-	30			-	-	-	-	-

11 Location assigned based on addresses as listed in permit files.

2011	-	248	28	-	-	-	32	9.7%	17.3%	-	-	-	-	-
2015	-	246	25	-	-	-	32	8.7%	23.5%	-	-	-	-	-

Conf = not displayed due to confidentiality.

Table D3a. Neah Bay, Washington, commercial-fishery-related infrastructure.

Neah Bay Strait of Juan de Fuca (protected by small island and breakwaters)	Fuel Dock	Ice Plant/ Sales Cold Storage/ Refrig.	Processors	Fishery-related Berths and Moorage (excludes shipping and government, e.g., USCG)	Gear storage/gear yard	Boat Hoists, Lifts, and Cranes Shipyard/ Boatyards/Dry Dock	Marine/ Vessel Supply Stores	Dredging	USCG
Pre-catch shares.12	One commercial (Tribal Run).	No.	No.	Neah Bay Marina - 200 commercial and sportfishing vessels (moorage for 30- to 200-foot vessels).	No.	No vessel hoists/lifts.	No.	COE maintenance dredging for fish gap in eastern breakwater. Periodic Tribal dredging of navigation channel.13	USCG Sta. Neah Bay. Other USCG support in the area includes the cutters Osprey (Port Townsend), and Cuttyhunk, Adelie, Wahoo, Swordfish (Port Angeles); USCG Station Port Angeles; Air Station Port Angeles (helicopters); and USCG Station Quillayute River (La Push).

12 Data from NMFS (2007) port profiles, unless otherwise noted.

13 NOAA, Sanctuaries and Reserves Division. Proposed Olympic Coast National Marine Sanctuary: Environmental Impact Statement. US Department of Commerce, 1993.

									Also, see Bellingham for additional USCG assets in the area.
Catch shares (2011 to 2016) .14	Recently upgraded.	New ice plant. No cold storage (trucked out).	No (a startup is being contemplated).	New berthing docks.	No.	No (Pr. Angeles is nearest).	No.	No change.	No change.15

14 Personal communication, Dan Chadwick, February 10, 2017, unless otherwise noted.

15 Personal communication, Brian Corrigan, February 1, 2017: USCG reports no shifts in cutter homeport shifts, air station relocations, or boat station relocations relative to the start of the trawl catch share program.

Table D3b. Neah Bay Washington and northern Washington coast region, activity and ownership by residents. Source: PacFIN and Pacific Coast Groundfish IFQ Database.

		Numbers of Vessels Owned by Residents		Numbers of Vessels Delivering			Permits/Quota Held in Community[16]			Fishery as a Percent of Local Ex-vessel Revenue		Local Area as a Percent of Coastwide Ex-vessel Revenue of the Following: the Following:		
	Trawl-caught-Groundfish Buyers	All	Groundfish Trawl	Non-whtg Trawl	Non-whiting	Whiting	Non-whiting	Non-whiting	Whiting	Non-whiting	Whiting	Non-whiting	Whiting	All Species (Groundfish and Other)
1998	2	4	-	10	-	-	-							
2000	6	4	-	11	-	-	-							
2004	2	4	-	5	-	-	-							
2009	1	3	-	1	-	-	-							
2010	1	2	-	1	-	-	-							
2011	-	3	-	-	-	-	-	-	-					
2015	-	2	-	-	-	-	-	-	-					

16 Location assigned based on addresses as listed in permit files.

Northern Washington Coast[17]														
1998	2	74	2	10	-	-	-			9.8%	-	3.1%	-	3.9%
2000	6	62	2	11	-	-	-			9.9%	-	3.5%	-	3.4%
2004	2	52	2	6	-	-	-			3.0%	-	2.6%	-	4.4%
2009	1	47	-	1	-	-	-			Conf	-	Conf	-	4.0%
2010	1	49	1	1	-	-	-			Conf	-	Conf	-	4.2%
2011	-	44	-	-	-	-	-	-	-	-	-	-	-	3.6%
2015	-	43	-	-	-	-	-	-	-	-	-	-	-	4.2%

17 Northern Washington Coast Area includes Neah Bay, La Push, Port Angeles, Port Townsend, Sequim and other Clallam County and western Jefferson County ports/towns.

Conf=not displayed due to confidentiality.

Table D4a. Westport Washington, commercial-fishery-related infrastructure.

Westport Westhaven Cove, Grays Harbor	Fuel Dock	Ice Plant/ Sales Cold Storage/ Refrig.	Fish Processors	Fishery-related Berths and Moorage (excludes shipping and government, e.g., USCG)	Gear storage/ gear yard	Boat Hoists, Lifts, and Cranes Shipyard/ Boatyards/Dry Dock	Commercial Marine/Vessel Supply Stores	Dredging	USCG
Pre catch shares.18	Yes .	Yes.	At least three.	650-vessel moorage capacity for vessels up to 200 feet. 170-foot moorage dock.	Yes.	No.	Yes.	Annual dredging in the outer harbor.	USCG Sta. Grays Harbor.
Catch shares (2011 to 2016) .19	No change.	Very large new cold storage.	Three.	No change.	No.	No change.	No change.	No change.	No change.20

18 Data from NMFS (2007) port profiles, unless otherwise noted.

19 Personal communication, Dan Chadwick, February 10, 2017, unless otherwise noted.

20 Personal communication, Brian Corrigan, February 1, 2017: USCG reports no shifts in cutter homeport shifts, air station relocations, or boat station relocations relative to the start of the trawl catch share program.

Table D4b. Westport, Washington, and central/southern Washington Coast region, activity and ownership by residents. Source: PacFIN and Pacific Coast Groundfish IFQ Database.

		Numbers of Vessels Owned by Residents		Numbers of Vessels Delivering			Permits/Quota Held in Community[21]			Fishery as a Percent of Local Ex-vessel Revenue		Local Area as a Percent of Coastwide Ex-vessel Revenue of the Following: the Following:		
	Trawl-caught-Groundfish Buyers	All	Groundfish Trawl	Non-whtg Trawl	Whiting Trawl	Gear Switched	LE Permits	Non-whiting QS	Whiting QS	Non-whiting	Whiting	Non-whiting	Whiting	All Species (Groundfish and Other)
1998	5	67	3	13	4	-	4							
2000	3	61	3	12	7	-	4							
2004	3	68	-	4	6	-	1							
2009	3	65	1	7	7	-	1							
2010	2	62	2	4	10	-	1							
2011	1	69	-	1	6	4	1	0.6%	6.8%					
2015	1	58	2	3	6	-	1	0.7%	6.8%					

21 Location assigned based on addresses as listed in permit files.

Central/Southern Washington Coast (same as Ilwaco) 22														
1998	5	270	8	16	6	-	11			4.0%	Conf	4.5%	Conf	14.0%
2000	3	263	6	12	8	-	9			2.0%	Conf	3.0%	Conf	14.4%
2004	3	264	4	4	6	-	7			Conf	Conf	Conf	Conf	15.3%
2009	4	252	7	7	9	-	7			1.5%	Conf	3.8%	Conf	16.5%
2010	3	242	6	4	11	-	6			Conf	Conf	Conf	Conf	17.4%
2011	3	257	4	4	8	9	8	3.9%	10.8%	Conf	Conf	Conf	Conf	19.0%
2015	2	235	7	16	7	1	9	3.7%	10.8%	Conf	Conf	Conf	Conf	20.7%

22 Central/South Washington Coast Area includes Westport, Ilwaco, Chinook, Copalis, Grays Harbor, Willapa , other Grays Harbor County and Pacific County ports/towns, and other lower Columbia River ports.

Conf=not displayed due to confidentiality.

Table D5a. Ilwaco Washington, commercial-fishery-related infrastructure.

Ilwaco Harbor, Baker Bay on Columbia River	Fuel Dock	Ice Plant/ Sales Cold Storage/ Refrig.	Processors	Fishery-related Berths and Moorage (excludes shipping and government, e.g., USCG)	Gear storage/ gear yard	Boat Hoists, Lifts, and Cranes Shipyard/ Boatyards/Dry Dock	Marine/ Vessel Supply Stores	Dredging	USCG
Pre-catch shares.23	Two.	Ice available. Cold storage for bait (processor has cold storage for own use).	One.	54 commercial fishing vessels and 610 pleasure craft (June 2005) 800-slip marina.	No.	Two small boat hoists (recreational) and a 50 ton travel lift for fairly large commercial vessels). Dry boat storage Full service work yard.	Yes.	Periodic entrance dredging by the ACOE. Port maintains the marina area.24	USCG Station Cape Disappointment (largest search and rescue station on the Northwest Coast) is co-located with the USCG National Motor Lifeboat School.
Catch shares	One.	No change.	No change.	Upgrading commercial docks.	No.	No change to hoists.	No change.	Recent COE commitm	No change.26

23 Data from NMFS (2007) port profiles, unless otherwise noted.

24 Whittaker, Luke. "Dredging Underway at Port of Chinook." Chinook Observer. January 31, 2017. http://www.chinookobserver.com/co/local-news/20170131/dredging-underway-at-port-of-chinook.

26 Personal communication, Brian Corrigan, February 1, 2017: USCG reports no shifts in cutter homeport shifts, air station relocations, or boat station relocations relative to the start of the trawl catch share program.

(2011 to 2016) .25						Now three enclosed bays for inside work and an enclosed shop (there has been one for a long time, and two more were added)		ent to several years of dredging.	

25 Personal communication, Dan Chadwick, February 10, 2017, unless otherwise noted.

Table D5b. Ilwaco/Chinook, Washington, and central/southern Washington Coast region, activity and ownership by residents. Source: PacFIN and Pacific Coast Groundfish IFQ Database.

		Numbers of Vessels Owned by Residents		Numbers of Vessels Delivering			Permits/Quota Held in Community[27]			Fishery as a Percent of Local Ex-vessel Revenue		Local Area as a Percent of Coastwide Ex-vessel Revenue of the Following: the Following:		
	Trawl-caught-Groundfish Buyers	All	Groundfish Trawl	Non-whtg Trawl	Whiting Trawl	Gear Switched	LE Permits	Non-whiting QS	Whiting QS	Non-whiting	Whiting	Non-whiting	Whiting	All Species (Groundfish and Other)
1998	2	27	-	5	2	-	-							
2000	1	25	-	2	2	-	-							
2004	1	24	-	-	1	-	-							
2009	1	20	-	-	2	-	-							
2010	1	20	-	-	2	-	-							
2011	2	22	2	4	4	5	3	1.3%	0.7%					
2015	1	21	2	1	1	1	4	1.3%	0.8%					

27 Location assigned based on addresses as listed in permit files.

Central/southern Washington Coast (same as Westport)28														
1998	5	270	8	16	6	-	11			4.0%	Conf	4.5%	Conf	14.0%
2000	3	263	6	12	8	-	9			2.0%	Conf	3.0%	Conf	14.4%
2004	3	264	4	4	6	-	7			Conf	Conf	Conf	Conf	15.3%
2009	4	252	7	7	9	-	7			1.5%	Conf	3.8%	Conf	16.5%
2010	3	242	6	4	11	-	6			Conf	Conf	Conf	Conf	17.4%
2011	3	257	4	4	8	9	8	3.9%	10.8%	Conf	Conf	Conf	Conf	19.0%
2015	2	235	7	16	7	1	9	3.7%	10.8%	Conf	Conf	Conf	Conf	20.7%

28 Central/southern Washington Coast area includes Westport, Ilwaco, Chinook, Copalis, Grays Harbor, Willapa , other Grays Harbor County and Pacific County ports/towns, and other lower Columbia River ports/towns on the Washington side of the river.

Conf = not displayed due to confidentiality.

Table D6a. Astoria (including Hammond and Warrenton) Oregon, commercial-fishery-related infrastructure.

Columbia River, Skipanon Waterway	Fuel Dock	Ice Plant/ Sales Cold Storage/ Refrig.	Processors	Fishery-related Berths and Moorage (excludes shipping and government, e.g., USCG)	Gear storage/ gear yard	Boat Hoists, Lifts, and Cranes Shipyard/ Boatyards/Dry Dock	Marine/Vessel Supply Stores	Dredging	USCG
Pre-catch shares.29	Two.	NR30	At least four seafood processors in Astoria and at least four in Warrenton in 2000.	East Basin (com and rec) 82 slips West Basin Marina 335 slips Warrenton Marina 370 slips for commercial and recreational vessels. Hammond marina (primarily recreational, some commercial).	Yes.	10-acre boatyard. In-water and Upland Vessel Storage. Three boatyards; two have lifts; the third uses a ramp. 88-ton travel lift.	Yes.	Maintenance dredging is required for the Skipanon Channel and in the Hammond Basin as well as the Port of Astoria's piers and boat basins.31	USCG Station Cape Disappointment is located across the river on the Washington side (see Ilwaco). USCG Sector Columbia River and Air Station Astoria (helicopters), as well as the USCG Cutter Fir ("The Bar Tender") are

29 Data from NMFS (2007) port profiles, unless otherwise noted.

30 Not covered in the NMFS (2007) port profiles.

31 http://www.dailyastorian.com/Local_News/20141128/merkley-again-helps-port-of-astoria-dredge; https://www.oregon.gov/LCD/OCMP/docs/Public_Notice/Warrenton_ComprehensivePlan.pdf; https://www.oregon.gov/LCD/OCMP/docs/Public_Notice/Warrenton_ComprehensivePlan.pdf.

									located in Astoria. as well as the
Catch shares (2011 to 2016).32	Two (one affiliated with processor).	Six cold storages and ice plants (one cold storage not in use). All are connected to fish plants.	Eight processors. Three previously active processors no longer have facilities in the area.	Substantial renovations in progress or needed. For example, Astoria's east marine basin dock structure is unsafe for vehicles. Most commercial vessels are in Warrenton marina.	Yes (Warrenton).	One of the boatyards will be closing soon (superfund site).	Yes.	No change.	No change.33

Table D6b. Astoria, Oregon, and Astoria area activity and ownership by residents. Source: PacFIN and Pacific Coast Groundfish IFQ Database.

	Trawl-caught-Groundfish Buyers	Numbers of Vessels Owned by Residents	Numbers of Vessels Delivering	Permits/Quota Held in Community34	Fishery as a Percent of Local Ex-vessel Revenue	Local Area as a Percent of Coastwide Ex-vessel Revenue of the Following: the Following:

32 Personal communication, Sheryl M. Flores, February 17, 2017, unless otherwise noted.

33 Personal communication, Brian Corrigan, February 1, 2017: USCG reports no shifts in cutter homeport shifts, air station relocations, or boat station relocations relative to the start of the trawl catch share program.

http://portofastoria.com/.

34 Location assigned based on addresses as listed in permit files.

		All	Groundfish Trawl	Non-whtg Trawl	Whiting Trawl	Gear Switched	LE Permits	Non-whiting QS	Whiting QS	Non-whiting	Whiting	Non-whiting	Whiting	All Species (Groundfish and Other)
1998	7	159	27	35	16	-	29							
2000	7	177	24	45	17	-	26							
2004	2	179	13	27	6	-	15							
2009	5	162	17	32	12	-	16							
2010	6	168	17	29	15	-	16							
2011	4	167	16	18	17	3	13	9.7%	6.3%					
2015	4	160	11	23	12	4	13	8.8%	6.2%					
Astoria Area[35]														
1998	7	172	28	35	16	-	29			33.1%	10.2%	18.4%	35.4%	6.9%
2000	7	190	24	45	17	-	26			24.8%	10.6%	21.4%	38.8%	8.3%

35 Astoria Area includes Astoria, Hammond, Warrenton, Cannon Beach, Gearhart, other Clastop County ports/towns, and other lower Columbia River ports/towns on the Oregon side of the river.

Conf = not displayed due to confidentiality.

2004	2	19 3	13	27	6	-	15			25.2%	conf	28.5%	conf	5.8%
2009	5	17 4	17	32	12	-	16			24.5%	6.1%	26.3%	36.8%	6.9%
2010	6	18 2	17	29	15	-	16			19.3%	6.1%	27.2%	21.8%	6.5%
2011	4	18 3	18	18	17	3	13	9.7%	6.3%	conf	21.0%	conf	45.8%	7.2%
2015	4	17 4	11	23	12	4	13	8.8%	6.2%	29.4%	10.2%	39.6%	42.1%	7.9%

Table D7a. Garibaldi, Oregon, commercial-fishery-related infrastructure.

Tillamook Bay - shallow draft harbor	Fuel Dock	Ice Plant/ Sales Cold Storage/ Refrig.	Processors	Fishery-related Berths and Moorage (excludes shipping and government, e.g., USCG)	Gear storage/ gear yard	Boat Hoists, Lifts, and Cranes Shipyard/ Boatyards/Dry Dock	Marine/Vessel Supply Stores	Dredging	USCG
Pre-catch shares.36	One.	NR.37	At least one processing company.	Wet/dry moorage.	NR.	NR.	NR.	Periodic maintenance dredging for the boat basin area.38	USCG Station, Tillamook Bay.
Catch shares (2011 to 2016).39	Two (one is small and was not included in previous profile, primarily used by the recreational	No change. Minimal capacity. Two in connectio	Four processors (two operating out of the same building)	Moorage for 277 vessel.40 No significant changes in berths and moorage.	Gear storage available.	Dry dock storage area.	No change. Nearest in Astoria.	Maintenance dredging in marinas. Dredging needed.	No change.41

36 Data from NMFS (2007) port profiles, unless otherwise noted.

37 Not covered in the NMFS (2007) port profiles.

38 http://www.dredgingtoday.com/tag/garibaldi/

39 Personal communication, Sheryl M. Flores, February 17, 2017, unless otherwise noted.

40 Source: http://portofgaribaldi.org/

41 Personal communication, Brian Corrigan, February 1, 2017: USCG reports no shifts in cutter homeport shifts, air station relocations, or boat station relocations relative to the start of the trawl catch share program.

	fishery) Most fuel for commercial vessels is trucked in.	n with processors.		New dock with heavy cranes for moving things on/off vessels.	Gear shed demolished. No other changes.			Challenging bar crossing for smaller vessels (sensitive to weather/ wave conditions).	

Table D7b. Garibaldi Oregon and Tillamook area, activity and ownership by residents. Source: PacFIN and Pacific Coast Groundfish IFQ Database.

		Numbers of Vessels Owned by Residents		Numbers of Vessels Delivering			Permits/Quota Held in Community42			Fishery as a Percent of Local Ex-vessel Revenue		Local Area as a Percent of Coastwide Ex-vessel Revenue of the Following: the Following:		
	Trawl-caught-Groundfish Buyers	All	Groundfish Trawl	Non-whtg Trawl	Whiting Trawl	Gear Switched	LE Permits	Non-whiting QS	Whiting QS	Non-whiting	Whiting	Non-whiting	Whiting	All Species (Groundfish and Other)
1998	2	21	4	3	-	-	2							
2000	2	21	5	2	-	-	4							
2004	3	26	5	3	-	-	4							
2009	1	25	5	2	-	-	4							
2010	1	24	5	1	-	-	4							
2011	-	22	2	-	-	-	4	2.2%	1.5%					
2015	-	13	-	-	-	-	4	2.4%	1.5%					
Tillamook Area43														

42 Location assigned based on addresses as listed in permit files.

43 Tillamook Area includes Garibaldi, Nehalem, and other Tillamook County ports/towns.

1998	2	65	5	3	-	-	4			conf	-	conf	-	0.4%
2000	2	73	6	2	-	-	6			conf	-	conf	-	0.6%
2004	3	81	7	3	-	-	6			1.3%	-	0.2%	-	1.0%
2009	1	77	5	2	-	-	4			conf	-	conf	-	0.6%
2010	1	72	5	1	-	-	4			conf	-	conf	-	0.5%
2011	-	67	2	-	-	-	4	2.2%	1.5%	-	-	-	-	0.5%
2015	-	57	5	-	-	-	4	2.4%	1.5%	-	-	-	-	0.4%

Conf = not displayed due to confidentiality

Table D8a. Newport Oregon (including South Beach and Toledo), commercial-fishery-related infrastructure.

Yaquina Bay	Fuel Dock	Ice Plant/ Sales Cold Storage/ Refrig.	Processor s	Fishery-related Berths and Moorage (excludes shipping and government, e.g., USCG)	Gear storage/ gear yard	Boat Hoists, Lifts, and Cranes Shipyard/Boa tyards/Dry Dock	Marine/ Vessel Supply Stores	Dredgin g	USCG
Pre-catch shares. 44	Yes (full service).	NR.45	Four processin g plants.	Commercial harbor: Moorage for approximately 400 commercial vessels. Facilities for five large transient vessels. South Beach: 540 moorage slips. Four-lane launch ramp.	NR.	220 feet of floating docks for dockside vessel repair.	NR.	-	USCG Helicopter Station. USCG Station Yaquina Bay.51 Other nearby assets include, to the north, USCG Station Depot Bay and, to the south, USCG Station Siulsaw River and USCG Station Umpqua River (Winchester Bay). 51

44 Data from NMFS (2007) port profiles, unless otherwise noted.

45 Not covered in the NMFS (2007) port profiles.

Catch shares46 (2011 to 2016).	One full service fuel dock and another less-used dock associated with a processor. Fuel truck deliveries.	One cold storage (not new). Four ice plants (one new).	Four facilities with processin g capabiliti es (one has separate facilities for groundfis h crab and shrimp).	New/refurbished international dock with berths for larger vessels. Upgrades to existing pilings.	Yes. No change except that there used to be a large in door barn the provided partially weathered in storage for trawl gear.	300-foot, fixed-service dock with four hoists and shipwright.47 Toledo expanded boatyard and dry dock.48 Riverbend for smaller vessels.	One main store.	Periodic maintena nce dredging . 49 50	No change.51

46 Personal communication, Scott Malvitch, February 16, 2017, unless otherwise noted.

47 http://portofnewport.com/commercial-marina/index.php

48 Personal communication, Scott Malvitch, February 16, 2017, and http://www.fishermensnews.com/story/2014/10/01/features/port-of-toledo-enhances-operations-for-commercial-fishermen/278.html.

49 U.S. Army Engineer District. Yaquina Bay and River Channels and Breakwaters O&M: Environmental Impact Statement. Portland OR, 1975. River

50 Gomberg, David. “The Dredge Report.” News Lincoln County, September 24, 2014. http://www.newslincolncounty.com/archives/124935.

51 Personal communication, Brian Corrigan, February 1, 2017: USCG reports no shifts in cutter homeport shifts, air station relocations, or boat station relocations relative to the start of the trawl catch share program.

Table D8b. Newport Oregon (including South Beach and Toledo) and Newport area, activity and ownership by residents. Source: PacFIN and Pacific Coast Groundfish IFQ Database.

	Trawl-caught-Groundfish Buyers	Numbers of Vessels Owned by Residents		Numbers of Vessels Delivering			Permits/Quota Held in Community[52]			Fishery as a Percent of Local Ex-vessel Revenue		Local Area as a Percent of Coastwide Ex-vessel Revenue of the Following: the Following:		
		All	Groundfish Trawl	Non-whtg Trawl	Whiting Trawl	Gear Switched	LE Permits	Non-whiting QS	Whiting QS	Non-whiting	Whiting	Non-whiting	Whiting	All Species (Groundfish and Other)
1998	5	107	48	31	16	-	32							
2000	5	103	44	36	11	-	31							
2004	4	105	28	21	13	-	21							
2009	7	111	35	25	11	-	21							
2010	5	104	32	20	14	-	21							
2011	4	102	27	8	15	5	20	7.6%	32.4%					
2015	3	112	25	9	11	4	17	7.3%	26.0%					
Newport Area[53]														
1998	5	159	56	31	16	-	39			21.5%	15.8%	9.2%	42.0%	5.3%
2000	5	152	52	36	11	-	38			16.2%	11.7%	11.9%	36.8%	7.0%
2004	4	155	35	21	13	-	27			conf	9.9%	Conf	40.6%	7.4%
2009	7	153	43	25	11	-	25			16.4%	5.1%	16.7%	28.8%	6.5%
2010	5	152	39	20	14	-	25			conf	11.0%	conf	34.0%	5.6%

52 Location assigned based on addresses as listed in permit files.

53 Newport Area includes Newport, South Beach, Toledo, Blodgett, Siletz, and other Lincoln County ports/towns.

2011	4	146	33	8	15	5	24	8.8%	40.8%	8.3%	14.1%	11.5%	27.5%	6.5%
2015	3	155	30	9	11	4	21	8.6%	34.4%	14.4%	9.5%	15.1%	30.7%	6.2%

Conf = not displayed due to confidentiality.

Table D9a. Coos Bay Oregon (including Charleston and North Bend), commercial-fishery-related infrastructure.

Coos Bay	Fuel Dock	Ice Plant/ Sales Cold Storage/ Refrig.	Processors	Fishery-related Berths and Moorage (excludes shipping and government, e.g., USCG)	Gear storage/ gear yard	Boat Hoists, Lifts, and Cranes Shipyard/Boatyards/Dry Dock	Marine/ Vessel Supplies Stores	Dredging	USCG
Pre catch shares.54	NR.55	NR.	Five processors in Coos Bay (2000) 3 in Charleston, 2 in Coos Bay.	95-99% of commercial fishing vessels in Charleston boat basin where there are 550 moorages including 200 occupied by commercial fishing vessel.	NR.	NR.	Marine suppliers.	NR.	USCG Group/Air Station North Bend USCG Station Coos Bay (in Charleston) 59 USCG Cutter Orcas in Coos Bay.59
Catch shares (2011 to 2016).c	One fuel dock but arrange for delivery by truck.	Three ice plants: port owns one; another is associated with a processor and may sell to	Lost a few processors. There are two that process	No major changes.	No major changes. Port rents some gear	New 100-ton travel lift (2017),56 otherwise no major changes. 60-ton travel lift;	One major and one smaller store. Another major	Ongoing maintenance dredging and a channel	Changed to USCG Sector, North Bend.

54 Data from NMFS (2007) port profiles, unless otherwise noted.

55 Not covered in the NMFS (2007) port profiles.

56 http://www.portofcoosbay.com/travellift

		vessels depending on quantities available; the third does not sell to vessels. No public cold storage. A few processors have their own.	fish and crustaceans and two that deal with slime eels.		storage space in fenced yard. Most fishermen have their own space.	200-ton marine ways; 7.5-ton forklift. Upland vessel storage; full service boatyard; Charleston: upland vessel area for do-it-yourself vessel repair projects. Floating dry dock.57	store opened, but then closed.	deepening project.58	No other changes.59

Table D9b. Coos Bay, Oregon, (including Charleston and North Bend) and Coos Bay area, activity and ownership by residents. Source: PacFIN and Pacific Coast Groundfish IFQ Database.

	Trawl-caught-Groundfish Buyers	Numbers of Vessels Owned by Residents	Numbers of Vessels Delivering	Permits/Quota Held in Community60	Fishery as a Percent of Local Ex-vessel Revenue	Local Area as a Percent of Coastwide Ex-vessel Revenue of the Following:

57 http://www.portofcoosbay.com/shipyardhome/

58 http://www.portofcoosbay.com/projects/

59 Personal communication, Brian Corrigan, February 1, 2017: USCG reports no shifts in cutter homeport shifts, air station relocations, or boat station relocations relative to the start of the trawl catch share program.

60 Location assigned based on addresses as listed in permit files.

		All	Groundfish Trawl	Non-whtg Trawl	Whiting Trawl	Gear Switched	LE Permits	Non-whiting QS	Whiting QS	Non-whiting	Whiting	Non-whiting	Whiting	All Species (Groundfish and Other)
1998	7	94	29	32	1	-	23							
2000	4	107	24	30	1	-	23							
2004	4	111	17	19	4	-	16							
2009	6	84	29	23	3	-	25							
2010	6	96	30	22	4	-	25							
2011	3	98	22	13	2	3	24	13.7%	5.0%					
2015	2	87	18	12	-	1	24	13.8%	5.0%					
Coos Bay Area[61]														
1998	8	178	32	32	1	-	26			49.6%	conf	14.1%	conf	3.5%
2000	4	192	26	30	1	-	26			29.0%	conf	13.8%	conf	4.6%
2004	5	195	19	19	4	-	18			9.8%	conf	12.9%	conf	6.7%
2009	6	152	31	23	3	-	27			17.5%	conf	13.6%	conf	5.0%
2010	6	171	32	22	4	-	27			16.4%	conf	16.1%	conf	4.6%
2011	3	172	25	13	2	3	26	14.5%	5.1%	8.4%	conf	9.9%	conf	5.6%
2015	2	167	20	12	-	1	26	14.7%	5.1%	conf	-	conf %	-	4.4%

Conf = not displayed due to confidentiality.

61 Coos Bay area includes Coos Bay, Bandon, Florence, Winchester, and other Coos County ports/towns.

Table D10a. Brookings Oregon (including Charleston and North Bend), commercial-fishery-related infrastructure.

Mouth of the Chetco River-Shallow draft harbor	Fuel Dock	Ice Plant/ Sales Cold Storage/ Refrig.	Processors	Fishery-related Berths and Moorage (excludes shipping and government, e.g., USCG)	Gear storage/ gear yard	Boat Hoists, Lifts, and Cranes Shipyard/ Boatyards/Dry Dock	Vessel Supplies Stores	Dredging	USCG
Pre-catch shares.62	Yes.	NR.63	At least one.	Two transient docks. 671 slips. Basin One - recreational. Basin Two - commercial.	NR.	Full service boatyard. Heavy travel-lift services.	NR.	NR.	USCG Station Chetco River.
Catch shares (2011 to 2016). 64	No change – port run (in need of maintenance). 65	One cold storage and ice plant – port run (closed	One.	After 2011 tsunami – all new steel pilings and some new dock – capacity not substantially changed.	Yes (abundant).	Large crane for moving gear. Travel lift – about 50-foot vessel maximum.	No change. Closest in Crescent City.	Maintenance dredging and recent dredging in response to disasters.66	No change.67

62 Data from NMFS (2007) port profiles, unless otherwise noted.

63 Not covered in the NMFS (2007) port profiles.

64 Personal communication, Craig Good, February 19, 2017, unless otherwise noted.

65 www.portofbrookingsharbor.com/fuel--ice--maintenance.html

66 Tsunami - www.currypilot.com/csp/mediapool/sites/CurryPilot/News/story.csp?cid=4307004&sid=919&fid=151; flooding, https://www.fema.gov/news-release/2016/06/20/fema-awards-port-brookings-more-400k-dredging.

67 Personal communication, Brian Corrigan, February 1, 2017: USCG reports no shifts in cutter homeport shifts, air station relocations, or boat station relocations relative to the start of the trawl catch share program.

		Feb, 2017).65							

Table D10b. Brookings, Oregon, and Brookings area, activity and ownership by residents. Source: PacFIN and Pacific Coast Groundfish IFQ Database.

	Trawl-caught-Groundfish Buyers	Numbers of Vessels Owned by Residents		Numbers of Vessels Delivering			Permits/Quota Held in Community68			Fishery as a Percent of Local Ex-vessel Revenue		Local Area as a Percent of Coastwide Ex-vessel Revenue of the Following:		
		All	Groundfish Trawl	Non-whtg Trawl	Whiting Trawl	Gear Switched	LE Permits	Non-whiting QS	Whiting QS	Nonwhiting	Whiting	Nonwhiting	Whiting	All Species (Groundfish and Other)
1998	2	57	11	15	-	-	9							
2000	4	62	7	11	1	-	9							
2004	3	58	4	8	-	-	5							
2009	2	51	8	10	-	-	6							
2010	2	46	8	11	-	-	6							
2011	2	48	6	8	-	-	4	1.8%	3.8%					
2015	3	69	4	5	-	1	4	2.1%	3.8%					
Brookings Area69														
1998	2	125	15	15	-	-	13			20.6%	-	3.8%	-	2.3%
2000	4	140	11	11	1	-	12			20.0%	conf	4.1%	conf	2.0%
2004	3	141	7	8	-	-	8			4.0%	-	2.7%	-	3.5%
2009	2	122	10	10	-	-	9			conf	-	conf	-	2.5%
2010	2	126	10	11	-	-	9			conf	-	conf	-	1.6%

68 Location assigned based on addresses as listed in permit files.

69 Brookings Area includes Brookings, Gold Beach, Port Orford, and other Curry County ports/towns.

Conf = not displayed due to confidentiality.

2011	2	127	8	8	-	-	9	4.8%	4.8%	conf	-	conf	-	1.8%
2015	3	139	6	5	-	1	9	4.9%	4.8%	16.4%	-	6.1%	-	2.2%

Table D11a. Crescent City California, commercial-fishery-related infrastructure.

Crescent Harbor (manmade on Pacific Ocean)	Fuel Dock	Ice Plant/ Sales Cold Storage/ Refrig.	Processors	Fishery-related Berths and Moorage (excludes shipping and government, e.g., USCG)	Gear storage/ gear yard	Boat Hoists, Lifts, and Cranes Shipyard/ Boatyards/Dry Dock	Vessel Supplies Stores	Dredging	USCG
Pre-catch shares.70	NR.71	Ice plant and cold storage.	One processor.	Recreational and commercial.	NR.	Boatyard.	Marine supply store.	NR.	In 2000, the USCG Cutter Dorado was homported in Crescent City; it was part of USCG Group Humboldt Bay.
Catch shares (2011 to 2016).	One (commercial and recreational).	Ice plant and several cold	Two processors.	Tsunami devastated - reconstructed	Several gear storage yards.	Boatyard capable of handling large vessels and a travel	No change.	Yes; (5-year cycle). 72	No change.73

70 Data from NMFS (2007) port profiles, unless otherwise noted.

71 Not covered in the NMFS (2007) port profiles.

72 http://www.spn.usace.army.mil/Missions/Projects-and-Programs/Projects-by-Category/Projects-for-Navigable-Waterways/Crescent-City-Harbor-/

73 Personal communication, Brian Corrigan, February 1, 2017: USCG reports no shifts in cutter homeport shifts, air station relocations, or boat station relocations relative to the start of the trawl catch share program.

		storage facilities.		with major improvements.		hoist for smaller vessels.			

Table D11b. Crescent City, California, and Crescent City area, activity and ownership by residents. Source: PacFIN and Pacific Coast Groundfish IFQ Database.

	Trawl-caught-Groundfish Buyers	Numbers of Vessels Owned by Residents		Numbers of Vessels Delivering			Permits/Quota Held in Community[74]			Fishery as a Percent of Local Ex-vessel Revenue		Local Area as a Percent of Coastwide Ex-vessel Revenue of the Following:		
		All	Groundfish Trawl	Non-whtg Trawl	Whiting Trawl	Gear Switched	LE Permits	Non-whiting QS	Whiting QS	Non-whiting	Whiting	Non-whiting	Whiting	All Species (Groundfish and Other)
1998	6	124	19	29	5	-	12							
2000	6	108	13	24	2	-	12							
2004	2	92	3	3	1	-	1							
2009	3	81	3	7	5	-	2							
2010	4	80	2	5	7	-	2							
2011	1	75	-	2	-	-	2	0.9%	0.1%					
2015	-	69	-	-	-	-	2	0.9%	0.1%					
Crescent City Area[75]														
1998	6	134	19	29	5	-	13			21.7%	conf	7.1%	conf	4.1%
2000	6	113	13	24	2	-	13			15.1%	conf	4.7%	conf	3.0%
2004	2	98	3	3	1	-	2			conf	conf	conf	conf	5.1%
2009	3	86	3	7	5	-	2			conf	conf	conf	conf	3.7%
2010	4	85	2	5	7	-	2			conf	3.9%	conf	4.1%	1.9%

74 Location assigned based on addresses as listed in permit files.

75 Crescent City Area includes Crescent City and other Del Norte County ports/towns.

2011	1	79	-	2	-	-	2	0.9%	0.1%	conf	-	conf	-	1.2%
2015	-	71	-	-	-	-	2	0.9%	0.1%	-	-	-	-	1.2%

Conf = not displayed due to confidentiality.

Table D12a. Eureka, California, (including Fields Landing), commercial-fishery-related infrastructure.

Humboldt Bay Harbor	Fuel Dock	Ice Plant/ Sales Cold Storage/ Refrig.	Processors	Fishery-related Berths and Moorage (excludes shipping and government, e.g., USCG)	Gear storage/ gear yard	Boat Hoists, Lifts, and Cranes Shipyard/ Boatyards/Dry Dock	Vessel Supplies Stores	Dredging	USCG
Pre-catch shares.76	NR.77	NR.	At least one.	Woodley Island Marina - 237 slips Eureka Public Marina 167 berths. Eureka Public Marina 167 berths	NR.	NR.	NR.	NR.	USCG Station at Humboldt Bay.
Catch shares (2011 to 2016).78	One in commercial bay.	One portable ice plant (owned by city). No public	Two processors.	No changes.	Yes, recently relocated to Samoa Peninsula.	Dry docks. 150-ton travel lift (Fields Landing).	Yes.	Yes (annual) bar and entrance	No change.80

76 Data from NMFS (2007) port profiles, unless otherwise noted.

77 Not covered in the NMFS (2007) port profiles.

78 Personal communication: Suzie Howser, February 15, 2017, unless otherwise noted.

80 Personal communication, Brian Corrigan, February 1, 2017: USCG reports no shifts in cutter homeport shifts, air station relocations, or boat station relocations relative to the start of the trawl catch share program.

		cold storage (City or Eureka has a grant to build one).				Marine railway on Samoa Peninsula (recently reopened).		channel. 79	

79 http://humboldtbay.org/dredging

Table D12b. Eureka, California, (including Fields Landing) and Eureka area, activity and ownership by residents. Source: PacFIN and Pacific Coast Groundfish IFQ Database.

	Trawl-caught-Groundfish Buyers	Numbers of Vessels Owned by Residents		Numbers of Vessels Delivering			Permits/Quota Held in Community[81]			Fishery as a Percent of Local Ex-vessel Revenue		Local Area as a Percent of Coastwide Ex-vessel Revenue of the Following:		
		All	Groundfish Trawl	Non-whtg Trawl	Whiting Trawl	Gear Switched	LE Permits	Non-whiting QS	Whiting QS	Non-whiting	Whiting	Non-whiting	Whiting	All Species (Groundfish and Other)
1998	4	83	32	18	1	-	23							
2000	4	74	24	23	5	-	23							
2004	2	52	7	14	3	-	6							
2009	2	41	9	12	2	-	7							
2010	2	45	8	12	3	-	7							
2011	2	39	3	9	1	-	6	2.2%	1.3%					
2015	2	39	3	9	5	-	6	2.5%	1.3%					
Eureka Area/Humboldt County[82]														
1998	5	164	37	37	9	-	27			34.5%	0.7%	10.5%	1.4%	3.8%
2000	4	145	28	34	7	-	27			44.1%	4.1%	11.5%	4.6%	2.5%
2004	2	127	10	14	3	-	8			conf	3.1%	conf	7.3%	4.2%
2009	2	102	11	12	2	-	10			23.4%	0.2%	11.5%	0.6%	3.1%
2010	2	112	9	12	3	-	10			conf	conf	conf	conf	2.1%

81 Location assigned based on addresses as listed in permit files.

82 Eureka Area includes Eureka, Fields Landing, Trinidad, and other Humboldt County ports/towns.

2011	2	110	4	9	-	-	8	3.0%	1.3%	conf	-	conf	-	1.5%
2015	2	130	4	9	-	-	8	3.1%	1.3%	conf	-	conf	-	1.5%

Conf = not displayed due to confidentiality.

Table D13a. Fort Bragg California, commercial-fishery-related infrastructure.

Noyo Harbor (on Noyo River)	Fuel Dock	Ice Plant/ Sales Cold Storage/ Refrig.	Processor s	Fishery-related Berths and Moorage (excludes shipping and government, e.g., USCG)	Gear storage/ gear yard	Boat Hoists, Lifts, and Cranes Shipyard/ Boatyards/D ry Dock	Marine/ Vessel Supply Stores	Dredgin g	USCG
Pre-catch shares.83	Yes.	Ice plant.	Three processor s.	265 commercial vessel berths (fully occupied)	NR.84	10,000 pound hoist with a 8-foot beam.	NR.	Yes (periodic).	USCG Station Noyo River within the harbor.
Catch shares (2011 to 2016) .85	No (gone for around five years). Vessels refuel from fuel company truck.	Ice plant for public. No public cold storage. Cold storage associated with processors .	Two processor s.	No significant changes.	Yes. Harbor district provides and storage available in shipyard.	No changes. There is also a marine way with two ramps capable of handling vessels up to about 60 feet long.	Yes. One small store and dedicated space in another.	Yes (periodic).	No change.86

83 Data from NMFS (2007) port profiles, unless otherwise noted.

84 Not covered in the NMFS (2007) port profiles.

85 Personal communication, Michelle Norvell, February 23, 2017, unless otherwise noted.

86 Personal communication, Brian Corrigan, February 1, 2017: USCG reports no shifts in cutter homeport shifts, air station relocations, or boat station relocations relative to the start of the trawl catch share program.

Table D13b. Fort Bragg, California, and Fort Bragg area, activity and ownership by residents. Source: PacFIN and Pacific Coast Groundfish IFQ Database..

		Numbers of Vessels Owned by Residents		Numbers of Vessels Delivering			Permits/Quota Held in Community87			Fishery as a Percent of Local Ex-vessel Revenue		Local Area as a Percent of Coastwide Ex-vessel Revenue of the Following:		
	Trawl-caught Groundfish Buyers	All	Groundfish Trawl	Non-whtg Trawl	Whiting Trawl	Gear Switched	LE Permits	Non-whiting QS	Whiting QS	Non-whiting	Whiting	Non-whiting	Whiting	All Species (Groundfish and Other)
1998	5	103	13	17	-	-	13							
2000	4	127	13	17	-	-	13							
2004	3	100	7	10	-	-	8							
2009	8	59	7	7	-	-	7							
2010	6	75	7	7	-	-	7							
2011	4	78	7	6	-	1	8	5.6%	0.3%					
2015	4	79	6	6	-	1	8	6.0%	0.3%					
Fort Bragg Area88														
1998	5	158	13	17	-	-	13			39.6%	-	7.2%	-	2.3%
2000	4	192	13	18	-	-	13			24.6%	-	6.6%	-	2.6%
2004	3	142	7	10	-	-	9			17.7%	-	6.9%	-	2.0%
2009	8	90	7	7	-	-	8			35.4%	-	8.7%	-	1.6%

87 Location assigned based on addresses as listed in permit files.

88 Fort Bragg Area includes Fort Bragg, Ablion, Point Arena, and other Mendocino County ports/towns.

2010	6	116	7	7	-	-	8			29.1%	-	8.8%	-	1.4%
2011	4	125	7	6	-	1	9	6.0%	0.3%	20.7%	-	8.1%	-	1.8%
2015	4	142	6	6	-	1	9	6.6%	0.3%	25.7%	-	9.1%	-	2.1%

Conf = not displayed due to confidentiality.

Table D14a. Bodega Bay, California, commercial fishery-related infrastructure.

Bodega Harbor	Fuel Dock	Ice Plant/ Sales Cold Storage/ Refrig.	Processors	Fishery-related Berths and Moorage (excludes shipping and government, e.g., USCG)	Gear storage/ gear yard	Boat Hoists, Lifts, and Cranes Shipyard/ Boatyards/Dry Dock	Marine/ Vessel Supply Stores	Dredging	USCG
Pre-catch shares.89	Yes (two in association with marinas).90	NR.91	One.	Several docks. Four marinas. Spud Point 244 berths (80 % commercial fishery). Mason's 115 berths. Port Bodega 95 berths.	NR.	No boatyard.	NR.	Yes.	USCG Station Bodega Bay.
Catch shares (2011 to 2016).	One remaining. Accessible for commercial vessels.	No change. One ice plant (run by the county).	No change (smokers for recreational fish).	Mason's closed (a couple years back)	No public storage.	No hoists or lifts.	None.	Periodic (11-year cycle). 92	No change.93

89 Data from NMFS (2007) port profiles, unless otherwise noted.

90 http://parks.sonomacounty.ca.gov/Get_Outdoors/Spud_Point_Marina.aspx

91 Not covered in the NMFS (2007) port profiles.

92 http://parks.sonomacounty.ca.gov/About_Us/News/Army_Corps_Funds_Bodega_Bay_Dredging_Studies.aspx

93 Personal communication, Brian Corrigan, February 1, 2017: USCG reports no shifts in cutter homeport shifts, air station relocations, or boat station relocations relative to the start of the trawl catch share program.

		No cold storage.							

Table D14b. Bodega Bay, California, and Bodega Bay area, activity and ownership by residents. Source: PacFIN and Pacific Coast Groundfish IFQ Database.

		Numbers of Vessels Owned by Residents		Numbers of Vessels Delivering			Permits/Quota Held in Community94			Fishery as a Percent of Local Ex-vessel Revenue		Local Area as a Percent of Coastwide Ex-vessel Revenue of the Following:		
	Trawl-caught-Groundfish Buyers	All	Groundfish Trawl	Non-whtg Trawl	Whiting Trawl	Gear Switched	LE Permits	Non-whiting QS	Whiting QS	Non-whiting	Whiting	Non-whiting	Whiting	All Species (Groundfish and Other)
1998	6	59	1	15	-	-	3							
2000	6	56	-	10	-	-	3							
2004	3	46	-	2	-	-	3							
2009	2	26	-	2	-	-	3							
2010	1	30	-	1	-	-	2							
2011	-	33	-	1	-	-	2	0.8%	0.1%					
2015	-	30	-	-	-	-	2	0.8%	0.1%					
Bodega Bay Area														
1998	6	161	1	15	-	-	6			12.2%	-	2.2%	-	2.2%
2000	6	169	-	10	-	-	6			7.6%	-	1.2%	-	1.6%
2004	3	145	-	2	-	-	5			conf	-	conf	-	1.7%
2009	2	77	-	2	-	-	3			conf	-	conf	-	0.4%
2010	1	90	-	1	-	-	2			conf	-	conf	-	1.8%

94 Location assigned based on addresses as listed in permit files.

2011	1	108	-	1	-	1	2	0.8%	0.1%	conf	-	conf	-	2.2%
2015	-	113	-	-	-	-	2	0.8%	0.1%	-	-	-	-	0.7%

Bodega Bay Area includes Bodega Bay, Bolinas, Point Reyes, Tomales, and other Sonoma County and Marin County ports.

Conf = not displayed due to confidentiality.

Table D15a. San Francisco, California, commercial-fishery-related infrastructure.

San Francisco Bay	Fuel Dock	Ice Plant/ Sales Cold Storage/ Refrig.	Processors	Fishery Related Berths and Moorage (excludes shipping and government, e.g., USCG)	Gear storage/ gear yard	Boat Hoists, Lifts, and Cranes Shipyard/ Boatyards/Dry Dock	Marine/ Vessel Supply Stores	Dredging	USCG
Pre-catch shares.95	Yes.	Ice (cold storage, NR).	At least 12.	Berthing at Fishermen's Wharf.	NR.96	Two dry docks. Full service ship repair.	Yes.	NR.	USCG Marine Safety Office.
Catch shares (2011to 2016).	Yes.	No change. Ice and cold storage.	Eight large scale processors and four transitory for wet fish.	Berthing at Fishermen's Wharf. Vessels offload and have permanent berthing at other bay area ports such as Vallejo.97	Crab pot storage on Pier 45.	Haul outs and main Shipyards are in east bay.	Yes.	Naturally deep areas in some part of Port of San Francisco do not require significant dredging.98 Ongoing	No change.100

95 Data from NMFS (2007) port profiles, unless otherwise noted.

96 Not covered in the NMFS (2007) port profiles.

97 Space-intense activities such as shipyards, gear storage, and berthing tend to occur in other parts of the bay away from San Francisco proper due to limited waterfront space and high real estate prices.

98 http://www.bcdc.ca.gov/seaport/seaport.pdf

100 Personal communication, Brian Corrigan, February 1, 2017: USCG reports no shifts in cutter homeport shifts, air station relocations, or boat station relocations relative to the start of the trawl catch share program.

								maintenance dredging throughout the bay.99	

99 https://www3.epa.gov/region9/water/dredging/ltms/

Table D15b. San Francisco, California, and San Francisco area, activity and ownership by residents. Source: PacFIN and Pacific Coast Groundfish IFQ Database.

	Trawl-caught-Groundfish Buyers	Numbers of Vessels Owned by Residents		Numbers of Vessels Delivering			Permits/Quota Held in Community101			Fishery as a Percent of Local Ex-vessel Revenue		Local Area as a Percent of Coastwide Ex-vessel Revenue of the Following:		
		All	Groundfish Trawl	Non-whtg Trawl	Whiting Trawl	Gear Switched	LE Permits	Non-whiting QS	Whiting QS	Non-whiting	Whiting	Non-whiting	Whiting	All Species (Groundfish and Other)
1998	5	54	7	10	-	-	8							
2000	8	56	6	17	-	-	7							
2004	4	41	4	7	-	-	5							
2009	3	30	4	4	-	-	3							
2010	4	26	1	5	-	-	3							
2011	2	28	1	3	-	1	3	1.4%	0.1%					
2015	-	16	-	-	-	-	3	1.5%	0.1%					
San Francisco area (same as Half Moon Bay)102														
1998	11	306	12	18	-	-	16			12.9%	-	4.4%	-	4.2%
2000	14	260	13	24	-	-	17			15.4%	-	5.5%	-	3.4%
2004	10	221	9	14	-	-	14			6.3%	-	6.1%	-	4.9%
2009	6	162	7	8	-	-	7			10.5%	-	3.2%	-	1.9%
2010	6	156	6	9	-	-	9			3.9%	-	3.4%	-	4.0%

101 Location assigned based on addresses listed in permit files.

102 San Francisco area includes San Francisco, Alameda, Berkeley, Oakland, Princeton, Richmond, and other San Francisco County and San Mateo County ports/cities.

2011	5	187	7	6	-	3	9	3.7%	0.3%	2.7%	-	2.8%	-	5.0%
2015	3	205	5	2	-	1	9	3.9%	0.3%	1.7%	-	0.9%	-	3.1%

Conf = not displayed due to confidentiality.

Table D16a. Half Moon Bay/Princeton, California, commercial-fishery-related infrastructure.

Half Moon Bay/Pillar Point Harbor - manmade harbor on the Pacific Ocean	Fuel Dock	Ice Plant/ Sales Cold Storage/ Refrig.	Processors	Fishery Related Berths and Moorage (excludes shipping and government, e.g., USCG)	Gear storage/ gear yard	Boat Hoists, Lifts, and Cranes Shipyard/ Boatyards/Dry Dock	Marine/ Vessel Supply Stores	Dredging	USCG
Pre catch shares.103	Yes.	Ice making facility (cold storage NR).104	One.	Dock with 369 berths.	NR.	NR.	NR.	NR.	Closest in San Francisco.
Catch shares (2011 to 2016). 105	Yes (two; no change).	One ice facility for commercial vessels (recreational vessels can also use).	Two (mainly processing sablefish).	No significant changes.	Several gear storage locations in Princeton.	No hoists for vessels (cargo hoists only). Smaller vessels are pulled out for maintenance and repair.	Yes, one gear store serves commercial vessels.	Yes. 106	No change.107

103 Data from NMFS (2007) port profiles, unless otherwise noted.

104 Not covered in the NMFS (2007) port profiles.

105 Personal communication: James Ober, February 21, 2017, unless otherwise noted.

106 http://www.stormsurf.com/page2/forecast/forecast/hmb_dredge.html

107 Personal communication, Brian Corrigan, February 1, 2017: USCG reports no shifts in cutter homeport shifts, air station relocations, or boat station relocations relative to the start of the trawl catch share program.

		The two main fish receivers also have cold storage.				Local fabrications shops also server commercial fleet.			

Table D16b. Half Moon Bay/Princeton, California, and San Francisco area, activity and ownership by residents. Source: PacFIN and Pacific Coast Groundfish IFQ Database..

	Trawl-caught-Groundfish Buyers	Numbers of Vessels Owned by Residents		Numbers of Vessels Delivering			Permits/Quota Held in Community108			Fishery as a Percent of Local Ex-vessel Revenue		Local Area as a Percent of Coastwide Ex-vessel Revenue of the Following:		
		All	Groundfish Trawl	Non-whtg Trawl	Whiting Trawl	Gear Switched	LE Permits	Non-whiting QS	Whiting QS	Non-whiting	Whiting	Non-whiting	Whiting	All Species (Groundfish and Other)
1998	8	21	3	10	-	-	6							
2000	7	19	5	11	-	-	7							
2004	7	18	5	8	-	-	7							
2009	3	15	3	4	-	-	2							
2010	3	16	3	4	-	-	4							
2011	3	17	4	3	-	2	4	1.2%	0.1%					
2015	3	21	2	2	-	1	4	1.2%	0.1%					
San Francisco Area (same as Half Moon Bay) 109														
1998	11	306	12	18	-	-	16			12.9%	-	4.4%	-	4.2%
2000	14	260	13	24	-	-	17			15.4%	-	5.5%	-	3.4%
2004	10	221	9	14	-	-	14			6.3%	-	6.1%	-	4.9%
2009	6	162	7	8	-	-	7			10.5%	-	3.2%	-	1.9%
2010	6	156	6	9	-	-	9			3.9%	-	3.4%	-	4.0%
2011	5	187	7	6	-	3	9	3.7%	0.3%	2.7%	-	2.8%	-	5.0%
2015	3	205	5	2	-	1	9	3.9%	0.3%	1.7%	-	0.9%	-	3.1%

Conf = not displayed due to confidentiality.

108 Location assigned based on addresses as listed in permit files.
109 San Francisco Area includes San Francisco, Alameda, Berkeley, Oakland, Princeton, Richmond, and other San Francisco County and San Mateo County ports/cities.

Table D17a. Moss Landing, California, commercial-fishery-related infrastructure.

Moss Landing Harbor on Old Salinas River	Fuel Dock	Ice Plant/ Sales Cold Storage/ Refrig.	Processors	Fishery Related Berths and Moorage (excludes shipping and government, e.g., USCG)	Gear storage/ gear yard	Boat Hoists, Lifts, and Cranes Shipyard/ Boatyards/Dry Dock	Marine/ Vessel Supply Stores	Dredging	USCG
Pre-catch shares.110	Yes.	NR.111	Four processing or offloading facilities (two fish buyers with small-scale processing facilities).	743 berths. In 2001, 125 vessels and 175 transient vessels.	NR.	Boatyard with travel lift.	Small supply store.	NR.	Closest in Monterey.
Catch shares (2011 to 2016). 112	Yes (no change).	No ice plants (sent in by truck). No public cold storage (cold storage in connection with processors/first receivers)	One processor.	No major changes.	No changes. Harbor has gear storage yards and sheds available for rent (no change).	No changes.	No changes. Small chandlery at boatyard.	Yes.113	No change.114

110 Data from NMFS (2007) port profiles, unless otherwise noted.

111 Not covered in the NMFS (2007) port profiles.

112 Personal communication: Robert Puccinelli, February 22, 2017, unless otherwise noted.

113 http://content.cdlib.org/view?docId=kt667nb1cg&brand=calisphere&doc.view=entire_text

114 Personal communication, Brian Corrigan, February 1, 2017: USCG reports no shifts in cutter homeport shifts, air station relocations, or boat station relocations relative to the start of the trawl catch share program.

Table D17b. Moss Landing, California, and Monterey area, activity and ownership by residents. Source: PacFIN and Pacific Coast Groundfish IFQ Database.

	Trawl-caught-Groundfish Buyers	Numbers of Vessels Owned by Residents		Numbers of Vessels Delivering			Permits/Quota Held in Community115			Fishery as a Percent of Local Ex-vessel Revenue		Local Area as a Percent of Coastwide Ex-vessel Revenue of the Following:		
		All	Groundfish Trawl	Non-whtg Trawl	Whiting Trawl	Gear Switched	LE Permits	Non-whiting QS	Whiting QS	Non-whiting	Whiting	Non-whiting	Whiting	All Species (Groundfish and Other)
1998	8	18	1	11	-	-	1							
2000	8	26	1	11	-	-	1							
2004	7	20	-	8	-	-	1							
2009	1	11	-	1	-	-	-							
2010	1	8	-	1	-	-	-							
2011	1	10	-	1	-	2	-	-	-					
2015	2	7	-	2	-	2	-	-	-					
Monterey Area (same as Monterey)116														
1998	11	231	6	15	-	-	9			25.6%	-	5.4%	-	2.6%
2000	10	244	8	16	1	-	9			10.8%	conf	3.5%	conf	3.1%
2004	8	211	5	8	-	-	9			8.6%	-	4.2%	-	2.5%
2009	4	109	3	3	-	-	18			7.4%	-	1.7%	-	1.4%
2010	4	140	2	2	-	-	17			3.6%	-	2.1%	-	2.7%
2011	3	175	3	2	-	2	16	10.1%	0.5%	5.2%	-	2.5%	-	2.2%
2015	2	189	2	2	-	2	12	7.9%	0.1%	conf	-	conf	-	3.2%

Conf = not displayed due to confidentiality.

115 Location assigned based on addresses as listed in permit files.

116 Monterey Area includes Monterey, Moss Landing, Santa Cruz, and other Santa Cruz County and Monterey County ports/towns.

Table D18a. Monterey, California, commercial-fishery-related infrastructure.

Monterey Bay	Fuel Dock	Ice Plant/ Sales Cold Storage/ Refrigeration	Processors	Fishery Related Berths and Moorage (excludes shipping and government, e.g., USCG)	Gear storage/ gear yard	Boat Hoists, Lifts, and Cranes Shipyard/ Boatyards/Dry Dock	Marine/ Vessel Supply Stores	Dredging	USCG
Pre-catch shares.117	Yes, at marina.	NR.118	At least one. Field workers identified four processing facilities and fish buyers (combined).	Municipal Wharf II (commercially oriented). Municipal Marina: 413 Slips (20- to 50-foot vessels) 6 end ties for 40- to 75-foot vessels. Breakwater Cove marina: 90-slip private marina and boatyard with fuel dock. 180 private mooring buoys for vessels up to 100 feet.	NR.	Boatyard at marina.	Chandlery by marina office.	NR.	USCG Station Monterey and a 110-foot cutter.
Catch shares (2011 to 2016). 119	No change.	Limited ice making on wharf. Ice blocks trucked in from Salinas, shaved, and blown onto vessels. Some shovel ice onto truck in Salinas. Processors have own cold storage.	No processing facilities.	Breakwater marina has expanded since 2007. Eight 60-foot berths. One 220-foot finger pier tie-up on both sides. City is also working on expansion for commercial fleet in conjunction with USCG facility.	Reduction in covered gear storage space. Now limited to nets on trailers. May be funding a dry storage yard.	Two boatyards (no change). 80-ton travel lift (27-foot beam) (replaced a 60-ton left). Handles vessels up to about 65 feet. Carry deck crane (replaced with newer). Planning to expand dry storage yard.	No commercial vessel suppliers (no change).	City has 8-foot dredge for marina and 10-year permit to return navigation channel to original depth.	No change.120 Also, port has a 30-foot fireboat capable of offshore rescues and tows.

117 Data from NMFS (2007) port profiles, unless otherwise noted.

118 Not covered in the NMFS (2007) port profiles.

119 Personal communication: Steve Scheiblauer, February 14, 2017, unless otherwise noted.

120 Personal communication, Brian Corrigan, February 1, 2017: USCG reports no shifts in cutter homeport shifts, air station relocations, or boat station relocations relative to the start of the trawl catch share program.

Table D18b. Monterey, California, and Monterey area, activity and ownership by residents. Source: PacFIN and Pacific Coast Groundfish IFQ Database.

		Numbers of Vessels Owned by Residents		Numbers of Vessels Delivering			Permits/Quota Held in Community121			Fishery as a Percent of Local Ex-vessel Revenue		Local Area as a Percent of Coastwide Ex-vessel Revenue of the Following:		
	Trawl-caught-Groundfish Buyers	All	Groundfish Trawl	Non-whtg Trawl	Whiting Trawl	Gear Switched	LE Permits	Non-whiting QS	Whiting QS	Non-whiting	Whiting	Non-whiting	Whiting	All Species (Groundfish and Other)
1998	3	69	3	4	-	-	5							
2000	3	57	4	5	1	-	5							
2004	2	50	3	2	-	-	5							
2009	3	29	2	2	-	-	17							
2010	3	35	1	1	-	-	17							
2011	2	47	2	1	-	-	16	10.1%	0.5%					
2015	-	31	1	-	-	-	11	7.9%	0.1%					
Monterey Area122														
1998	11	231	6	15	-	-	9			25.6%	-	5.4%	-	2.6%
2000	10	244	8	16	1	-	9			10.8%	conf	3.5%	conf	3.1%
2004	8	211	5	8	-	-	9			8.6%	-	4.2%	-	2.5%
2009	4	109	3	3	-	-	18			7.4%	-	1.7%	-	1.4%
2010	4	140	2	2	-	-	17			3.6%	-	2.1%	-	2.7%
2011	3	175	3	2	-	2	16	10.1%	0.5%	5.2%	-	2.5%	-	2.2%
2015	2	189	2	2	-	2	12	7.9%	0.1%	conf	-	conf	-	3.2%

Conf = not displayed due to confidentiality.

121 Location assigned based on addresses as listed in permit files.
122 Monterey Area includes Monterey, Moss Landings, Santa Cruz and other Santa Cruz County and Monterey County ports/towns.

Table D19a. Morro Bay, California, commercial-fishery-related infrastructure. Source: PacFIN.

Morro Bay Harbor	Fuel Dock	Ice Plant/ Sales Cold Storage/ Refrigeration	Processors	Fishery Related Berths and Moorage (excludes shipping and government, e.g., USCG)	Gear storage/ gear yard	Boat Hoists, Lifts, and Cranes Shipyard/ Boatyards/Dry Dock	Marine/ Vessel Supply Stores	Dredging	USCG
Pre-catch shares.123	NR.124	NR.	No large processors.	Morro Bay Harbor 150 offshore moorings. 50 slips for commercial vessels and about 400 berths. Morro Bay Marina 24 moorings, 16 slips (recreational).	NR.	NR.	NR.	NR.	USCG Station Morro Bay.
Catch shares (2011 to 2016).	One.	Ice house; no cold storage.	No processors.	Small amount of expansion – added dock space for commercial passenger fishing vessels).	Limited public storage in the harbor.	One small-boatyard (cannot haul out large vessels).	Two small vessel supply stores in the harbor.	Project under way in. Last dredging was 7 years previous. 125	No change.126

123 Data from NMFS (2007) port profiles, unless otherwise noted.

124 Not covered in the NMFS (2007) port profiles.

125 http://morrobayrotary.org/Stories/all-about-dredging

126 Personal communication, Brian Corrigan, February 1, 2017: USCG reports no shifts in cutter homeport shifts, air station relocations, or boat station relocations relative to the start of the trawl catch share program.

Table D19b. Morro Bay, California, and Morro Bay area, activity and ownership by residents. Source: PacFIN and Pacific Coast Groundfish IFQ Database..

		Numbers of Vessels Owned by Residents		Numbers of Vessels Delivering			Permits/Quota Held in Community127			Fishery as a Percent of Local Ex-vessel Revenue		Local Area as a Percent of Coastwide Ex-vessel Revenue of the Following:		
	Trawl-caught-Groundfish Buyers	All	Groundfish Trawl	Non-whtg Trawl	Whiting Trawl	Gear Switched	LE Permits	Non-whiting QS	Whiting QS	Non-whiting	Whiting	Non-whiting	Whiting	All Species (Groundfish and Other)
1998	8	54	3	11	-	-	4							
2000	6	51	2	11	-	-	4							
2004	6	37	3	8	-	-	3							
2009	3	29	-	1	-	-	-							
2010	-	32	-	1	-	-	-							
2011	9	46	4	1	-	2	-	-	-					
2015	1	45	2	2	-	2	5	3.0%	0.4%					
Morro Bay area (same as Avila)128														
1998	8	169	9	17	-	-	7			29.0%	-	5.5%	-	2.4%
2000	6	158	7	15	-	-	7			11.1%	-	1.9%	-	1.6%
2004	6	115	5	7	-	-	5			29.2%	-	5.0%	-	0.9%
2009	3	88	1	1	-	-	1			4.2%	-	0.7%	-	1.0%
2010	-	96	1	-	-	-	1			-	-	-	-	1.0%
2011	10	120	7	1	-	13	1	0.7%	0.0%	30.6%	-	8.1%	-	1.2%
2015	1	135	2	1	-	7	5	3.9%	0.5%	conf	-	conf	-	1.9%

Conf = not displayed due to confidentiality.

127 Location assigned based on addresses as listed in permit files.

128 Morro Bay area includes Morro Bay, Avila, and other San Luis Obispo County ports/towns.

Table D20a. Avila, California, commercial-fishery-related infrastructure.

San Luis Obispo Bay	Fuel Dock	Ice Plant/ Sales Cold Storage/ Refrig.	Processors	Fishery-related Berths and Moorage (excludes shipping and government, e.g., USCG)	Gear storage/ gear yard	Boat Hoists, Lifts, and Cranes Shipyard/ Boatyards/Dry Dock	Marine/ Vessel Supply Stores	Dredging	USCG
Pre-catch shares.129	Yes.	Ice (cold storage NR).130	None.	Three piers. Two piers are open to the public.	Commercial gear storage.	Boat hoist.131 Dry dock and boat repair facilities.	NR.	NR.	Closest in Morro Bay.
Catch shares (2011 to 2016).	Yes.	One ice house no cold storage (fish sold fresh into markets).	?????	No change.	Close to the harbor, there is a harbor-owned storage area.	One shipyard that most vessels in the county use. Can handle up to around a 50-foot vessel. Travel hoist for vessels up to around 30 feet.	No (one in San Luis Obispo).	Maintenance dredging.132	No change.133

Table D20b. Avila, California, and Morro Bay area, activity and ownership by residents. Source: PacFIN and Pacific Coast Groundfish IFQ Database.

129 Data from NMFS (2007) port profiles, unless otherwise noted.

130 Not covered in the NMFS (2007) port profiles.

131 http://www.sanluisobispo.com/news/local/article39131787.html

132http://portsanluis.com/DocumentCenter/View/813

https://documents.coastal.ca.gov/reports/2008/12/W11a-12-2008.pdf

133 Personal communication, Brian Corrigan, February 1, 2017: USCG reports no shifts in cutter homeport shifts, air station relocations, or boat station relocations relative to the start of the trawl catch share program.

		Numbers of Vessels Owned by Residents		Numbers of Vessels Delivering			Permits/Quota Held in Community134			Fishery as a Percent of Local Ex-vessel Revenue		Local Area as a Percent of Coastwide Ex-vessel Revenue of the Following:		
	-Groundfish Buyers	All	Groundfish Trawl	Non-whtg Trawl	Whiting Trawl	Gear Switched	LE Permits	Non-whiting QS	Whiting QS	Non-whiting	Whiting	Non-whiting	Whiting	All Species (Groundfish and Other)
1998	3	13	-	10	-	-	-							
2000	2	5	-	8	-	-	-							
2004	1	2	-	5	-	-	-							
2009	-	1	-	-	-	-	-							
2010	-	3	-	-	-	-	-							
2011	1	2	-	-	-	1	-	0.7%	0.0%					
2015	-	4	-	-	-	-	-	0.9%	0.0%					
Morro Bay area (same as Morro Bay) 135														
1998	8	169	9	17	-	-	7			29.0%	-	5.5%	-	2.4%
2000	6	158	7	15	-	-	7			11.1%	-	1.9%	-	1.6%
2004	6	115	5	7	-	-	5			29.2%	-	5.0%	-	0.9%
2009	3	88	1	1	-	-	1			4.2%	-	0.7%	-	1.0%
2010	-	96	1	-	-	-	1			-	-	-	-	1.0%
2011	10	120	7	1	-	13	1	0.7%	0.0%	30.6%	-	8.1%	-	1.2%
2015	1	135	2	1	-	7	5	3.9%	0.5%	conf	-	conf	-	1.9%

Table D21a. Santa Barbara, California, commercial-fishery-related infrastructure.

134 Location assigned based on addresses as listed in permit files.

135 Morro Bay area includes Morro Bay, Avila, and other San Luis Obispo County ports/towns.

Conf=not displayed due to confidentiality.

Santa Barbara Harbor (manmade) on Santa Barbara Channel	Fuel Dock	Ice Plant/ Sales Cold Storage/ Refrig.	Processors	Fishery-related Berths and Moorage (excludes shipping and government, e.g., USCG)	Gear storage/ gear yard	Boat Hoists, Lifts, and Cranes Shipyard/ Boatyards/Dry Dock	Marine/ Vessel Supply Stores	Dredging	USCG
Pre-catch shares.136	Yes.	NR.137	Three processors.	1,100 mooring space for pleasure and comercial vessels. Loading dock.	NR.	Marine services and repairs.	NR.	NR.	Closest is USCG Station Channel Islands. One USCG Patrol Boat in Santa Barbara.
Catch shares (2011to 2016). 138	No Change.	Ice plant and sales. No public cold storage.	None in Santa Barbara proper.	No changes.	Yes (in town).	Small vessel hoist and shipyard for repair of smaller pleasure and commercial vessels.	Yes.	Maintenance dredging.139	No change.140

136 Data from NMFS (2007) port profiles, unless otherwise noted.

137 Not covered in the NMFS (2007) port profiles.

138 Personal communication: Weston Boyle, February 28, 2017, unless otherwise noted.

139 http://www.thelog.com/local/army-corps-of-engineers-assesses-impacts-of-santa-barbara-harbor-dredging/

140 Personal communication, Brian Corrigan, February 1, 2017: USCG reports no shifts in cutter homeport shifts, air station relocations, or boat station relocations relative to the start of the trawl catch share program.

Table D21b. Santa Barbara, California, and Santa Barbara area, activity and ownership by residents. Source: PacFIN and Pacific Coast Groundfish IFQ Database.

		Numbers of Vessels Owned by Residents		Numbers of Vessels Delivering			Permits/Quota Held in Community141			Fishery as a Percent of Local Ex-vessel Revenue		Local Area as a Percent of Coastwide Ex-vessel Revenue of the Following:		
	Trawl-caught-Groundfish Buyers	All	Groundfish Trawl	Non-whtg Trawl	Whiting Trawl	Gear Switched	LE Permits	Non-whiting QS	Whiting QS	Non-whiting	Whiting	Non-whiting	Whiting	All Species (Groundfish and Other)
1998	-	126	-	-	-	-	-							
2000	-	116	-	1	-	-	-							
2004	-	86	-	1	-	-	-							
2009	-	86	-	-	-	-	-							
2010	-	81	-	-	-	-	-							
2011	-	86	-	-	-	-	-							
2015	1	96	-	-	-	3	-							
Santa Barbara area142														
1998	1	312	1	1	-	-	2			conf	-	conf	-	5.4%
2000	1	278	-	2	-	-	2			conf	-	conf	-	7.8%
2004	1	220	-	1	-	-	1			Conf	-	Conf	-	6.1%
2009	-	207	-	-	-	-	-			-	-	-	-	10.5%
2010	-	192	-	-	-	-	-			-	-	-	-	8.5%
2011	-	210	-	-	-	-	-			-	-	-	-	7.2%
2015	1	243	-	-	-	3	-			Conf	-	Conf	-	6.5%

141 Location assigned based on addresses as listed in permit files.

142 Santa Barbara area includes Santa Barbara, Oxnard, Port Hueneme, Ventura, and other Santa Barbara County and Ventura County ports/towns.

Conf=not displayed due to confidentiality.