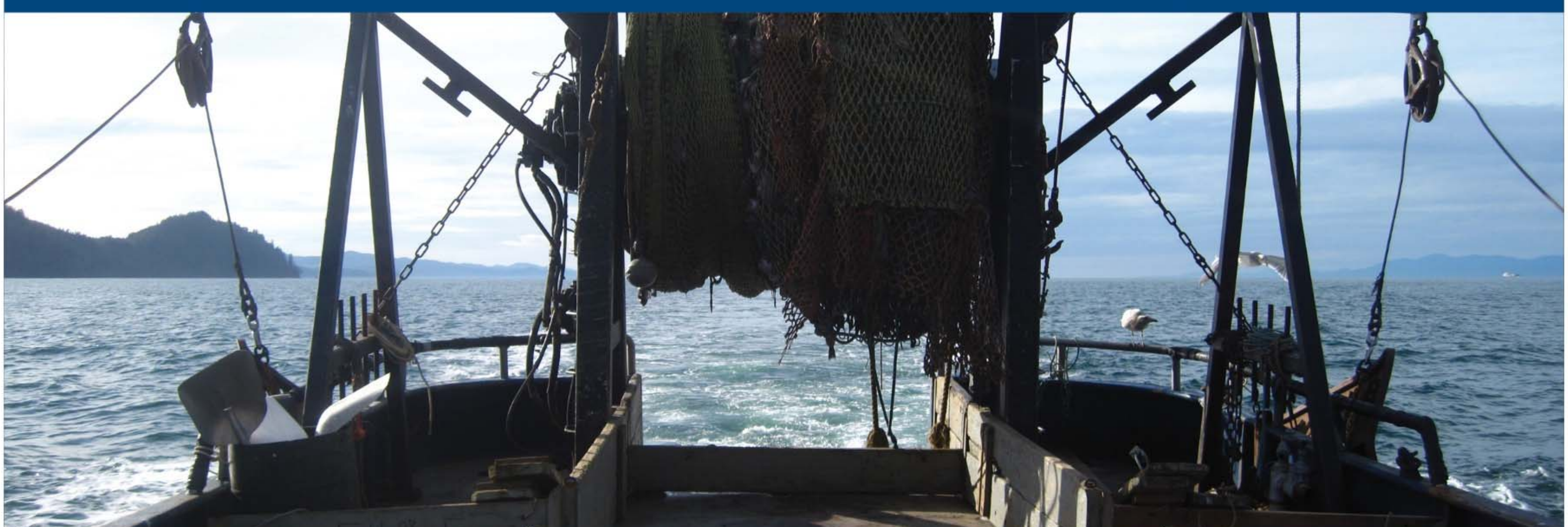
Science, Service, Stewardship

Agenda Item I.4.a
NMFS Report 1 (Electronic Only)
June 2019

NOAA
FISHERIES
SERVICE

Fishing Effort in the 2002-2017 Pacific Coast Groundfish Fisheries



Kayleigh Somers
Curt Whitmire
Kate Richerson
Jason Jannot
Vanessa Tuttle
Jon McVeigh

Publication date: June 2019

This document should be cited as follows:

Somers, K.A.[1], C.E. Whitmire[2], K. Richerson[1], J.E. Jannot[1], V.J. Tuttle[1], and J.T. McVeigh[1]. 2019. Fishing Effort in the 2002-2017 U.S. Pacific Coast Groundfish Fisheries. West Coast Groundfish Observer Program. National Marine Fisheries Service, NWFSC, 2725 Montlake Blvd E., Seattle, WA 98112.

[1]Fisheries Observation Science Program
National Marine Fisheries Service
Northwest Fisheries Science Center
Fishery Resource Analysis and Monitoring Division
2725 Montlake Blvd. E.
Seattle, WA 98112

[2]Population Ecology Program
National Marine Fisheries Service
Northwest Fisheries Science Center
Fishery Resource Analysis and Monitoring Division
99 Pacific Street; Bldg. 255-A
Monterey, CA 93940

Table of Contents

List of Figures

LIST OF TABLES

EXECUTIVE SUMMARY

This report analyzes trends in fishing effort in the U.S. west coast groundfish fisheries for the period 2002-2017. We describe changes in the amount, timing, location, and depth of fishing effort by analyzing landed weight of targeted species, number of hauls, and tow duration or fixed gear units. We focus on changes that have occurred since the 2011 implementation of an individual fishing quota (IFQ) program, especially developments from the two most recent years of data, 2016 and 2017.

Bottom trawl effort, measured as tow hours, continued to decrease from 2015 through 2017, but landings increased and, when accounting for groundfish retained by other gears fishing bottom trawl quota, reached ~27,000 mt in 2017, the greatest since at least 2002. Median haul duration stabilized in 2016-2017 at around 3.2 hours. The spatial distribution of landings and fishing effort in 2016-2017 was similar to that of 2011-2015, with landings at 46° N. latitude, near Astoria, OR, remaining high, and fishing activity continuing to concentrate off the northern coast and in deeper waters than in 2002-2010. Temporal patterns of landings were consistent between 2011-2015 and 2016-2017 and, in both time periods, occurred evenly across bimonthly periods other than March/April, when a greater proportion was landed.

The shoreside midwater trawl rockfish fleet has continued to develop as quota for yellowtail and widow rockfish increases. Landings and effort grew in 2016 and 2017, and median haul duration remained around 1-1.5 hours. The majority of landings and fishing activity continued to occur in Oregon. Landings were greater in the later months of the year throughout 2011 to 2017, but were more consistent across months in 2016-2017 than in 2011-2015. Effort continued to occur primarily in 50 to 150 fm depths, with deeper tows almost nonexistent after 2015.

The shoreside midwater hake trawl fishery in 2016-2017 showed high variability in landings and effort metrics, similar to 2011-2015. In 2017, both landings and effort by the shoreside fleet were the highest since at least 2002 and were greater than in either at-sea sector. Haul duration decreased in variability and magnitude from 2015 to 2017. In 2016-2017, the majority of landings continued to occur in the 46° N. latitudinal bin, but effort was more evenly distributed along the northern part of the west coast. The seasonal nature of the fleet continued, with the majority of landings occurring in July/August. In 2016-2017, effort was concentrated in depths between 50 and 250 fm.

At-sea catcher-processors (CPs) and mothership catcher vessels (MSCVs) had highly variable landings, reflecting annual changes in quota. The CP subsector showed a mostly increasing trend in both fleet-wide landings and fishing effort from 2002 to 2017, while the MSCV sector showed more stability in both metrics. In 2016 and 2017, landings were greater than since at least 2002. Haul duration in both sectors has generally increased and was similar across CPs and MSCVs in most years. In 2016-2017, CPs focused fishing effort in the southern part of their range, while fishing effort by MSCVs intensified in the northern part of the coast. During this time period, both sectors also moved further seaward than observed since at least 2002. In both 2011-2015 and 2016-2017, the CP and MSCV portions of the fleet fished primarily in May/June and

September/October, with almost no catch in July/August. Nearly all midwater at-sea hauls occurred in depths between 50 and 250 fm (Table 4, Figure 24).

Catch shares (CS) and non-catch shares (NCS) pot fleet sablefish landings have mostly increased through 2017, after declining from 2011 to 2013. CS pot vessels as a whole continued to land more sablefish than the NCS fleet, with that difference increasing from 2013 to 2017. Fleet-wide pots used by both the CS and NCS fleets increased from 2013 to 2017, and the number of pots per set was highly variable, with the median number ranging from 16 to 49 across all years. Landings by the NCS pot fleet occurred primarily between 46° and 39° N. latitude in both 2011-2015 and 2016-2017, while CS pot landings shifted northward in 2016-2017. CS pot effort became more concentrated in 2016-2017 and was most intense between 47° and 44° N. latitude and in a hotspot around 36° N. latitude. Fishing effort in the NCS and CS pot fleets occurred primarily in depths between 0 and 750 fm, with bimodal peaks likely reflecting the depths of shelf and slope fishing.

Sablefish landings by the NCS hook-and-line fleet increased from a nearly historic low in 2014, while CS hook-and-line landings were extremely variable. Fleet-wide NCS hooks increased slightly from 2015 to 2017, while CS hooks decreased slightly from 2011 to 2017. The median number of hooks per set in the NCS fleet has increased to ~2,500 hook per set, while CS has stabilized at ~3,200 hooks since 2015. Landings by the NCS hook-and-line fleet were more uniform along the coast in 2016-2017 than in 2002-2010 or 2011-2015, and spatial patterns in fishing intensity were similar across all three time periods. The CS hook-and-line fleet landed nearly all catch in two locations: more than 70% of catch near Astoria, OR and ~20% around 44° N. latitude. Effort by the CS fleet largely overlapped the range of observed NCS fishing activity in the northern portion of the coast, while in the south, CS effort occurred where minimal or no NCS effort had been observed. Landings by the NCS hook-and-line fleet were less variable throughout the year in 2016-2017 than in previous time periods but continued to peak in September/October. Landings by the CS fleet were also typically highest in September/October, but were much more variable than the NCS fleets. Both the NCS and CS hook-and-line fleets fish in waters ranging from 0 to 700 fm depths. NCS hook-and-line hauls were more common in deeper waters in the 2011-2015 time period than in the earlier time periods; this trend partially reversed in 2016-2017. In 2016-2017, most effort by the CS fleet occurred in depths 150 to 300 fm, with additional, evenly distributed effort in depths 300 to 600 fm.

Introduction

The Pacific Fishery Management Council (PFMC) designs and adapts the groundfish Fishery Management Plan (FMP) with the goals of achieving maximum sustainable yield (MSY) and promoting year-round fishing opportunities to support domestic consumer markets and the economies of coastal communities. In 2011, the PFMC implemented a major management shift by introducing IFQs to the federal trawl fleets. This report assesses differences before and after this implementation and is mandated by the National Marine Fisheries Science (NMFS) Biological Opinion on Continuing Operation of the Pacific Coast Groundfish Fishery (NMFS 2012). We are, however, cautious in definitively attributing differences to IFQ implementation, because many other factors, including variations in weather, market price, stock size, quota leasing, and catch limits, are at play in the 16-year data set. Additionally, many management shifts and changes occurred prior to IFQ implementation and provide important background and context in understanding and analyzing current fleet dynamics.

In the shoreside bottom trawl fleet, the number of commercial vessels participating was first limited in 1994, with the implementation of a federal licensing program. Rather than allow trawl seasons to shorten, the effort expended by individual vessels was constrained through a system of periodic (usually 1- or 2-month) cumulative landing limits. Beginning in the late 1990s, it became apparent that several species were depleted and in need of rebuilding. The severity and scope of management actions required to promote rebuilding led the Department of Commerce to declare the fishery a disaster in 2000, making it eligible for federal relief. Allocations for rebuilding species were reduced by more than 90% from levels of the 1990s, resulting in the need for development and implementation of new management approaches to ensure fishing opportunities for healthy stocks throughout the year.

One of the first new developments was the introduction of explicit modeling of fleet catch and bycatch in order to evaluate the effects of management alternatives. To collect the needed data, the West Coast Groundfish Observer Program (WCGOP) began to place trained scientists aboard fishing vessels operating in sectors that target and incidentally catch groundfish off the U.S. Pacific coast. The WCGOP observed 20-30% of bottom trawl landings using a random stratified sampling design from 2002 through 2010, providing critical information that supported reliable fishery modeling and estimation of fishing mortality, especially for rebuilding species.

Using this increased dataset and refined modeling tools, scientists and managers found in the early 2000s that average bycatch rates for rebuilding species, across all fishing areas, would not support year-round fishing with viable cumulative limits for target species. One response to this situation was the designation of closed areas. By preventing fishing from occurring in many of the areas where bycatch of rebuilding species was highest, average fleet bycatch rates could be lowered. Some closures, such as the Cowcod and Yelloweye Rockfish Conservation Areas, had fixed boundaries, while the rockfish conservation area (RCA) combined fixed, minimum boundaries (for example, lines approximating the 100- and 150-fm contours) with the ability to extend the closed area, in shoreward or seaward directions. Differential cumulative limits for target species were frequently set for areas shoreward and seaward of the RCA, with limitations on fishing in both areas during the same cumulative period. To assure that fishing did not occur in closed areas, all trawl vessels were required to install an approved vessel monitoring system (VMS). This requirement was later extended to cover other sectors of the groundfish fleet. On June 12, 2006, Amendment 19 to the FMP closed additional areas to bottom trawl fishing, and other areas to all bottom contact gears, in order to protect groundfish essential fish habitat (EFH).

In addition to area closures, gear restrictions were also implemented. Throughout the 1980s and 1990s, bottom-trawl fishing on the continental shelf was characterized by two very different strategies. The targeting of flatfish was conducted over flat gravel or mud substrate, using nets with footropes whose bobbins were typically less than 12.7 cm in diameter, to minimize fish escaping under the footrope (Rogers and Pikitch 1992, PFMC 2000). The other strategy targeted rockfish, or a mix of rockfish and flatfish, using much larger footropes, including some that employed commercial truck tires to allow fishing in very rocky substrate. Concurrent with the implementation of the RCA, bottom trawl fishing shoreward of the RCA was required to use footropes no larger than 20.32 cm in diameter and to restrict chafing gear, which protects the under-side of the net but can damage habitat. Combined with the minimal landing limits provided for all shelf rockfish, these restrictions removed economic incentive for vessels to trawl in rocky shelf habitats. Subsequently, based on fishery testing of innovative gear designs, a new, more selective flatfish trawl net was required in waters shoreward of the RCA, north of 40° 10’ N. latitude. This design featured a headrope that was longer than the footrope, which increased selectively by exploiting the behavior of many rockfish to swim upwards and escape the net in response to encountering the footrope.

At the dawn of this fishery transformation in 2000, the economic sub-committee of the PFMC’s Scientific and Statistical Committee released a report on overcapitalization in the groundfish fleet, which concluded that shore-based trawl capacity was 2-4 times the amount needed to harvest the available resource. With the help of NMFS analysis, the trawl industry developed its own proposal to reduce capacity and saw it enacted by the United States Congress. A buyback of trawl permits, along with the crab and shrimp permits of participating vessels, was initiated in late 2003 and permanently removed 91 vessels and 239 groundfish, crab, and shrimp permits from the fishery. The buyback was funded through both a grant from the federal government and a government-guaranteed loan, which is repaid by the fleet through landings fees.

Around the same time, the PFMC adopted a control date of November 6, 2003 to serve as a cutoff for landings histories to qualify for initial allocation of fishing privileges under a new form of management: individual quotas. In 2011, the prior management regime of landing limits for trawl vessels was replaced by a catch share program. The goal of the program, as defined in Amendment 20 of the FMP, is to:

> *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.*

The program’s objectives include promoting a viable, profitable, and efficient groundfish fishery that provides participants with increased operational flexibility and safety, while promoting practices that reduce bycatch, discard mortality, and minimize ecological impacts. To accomplish these goals, shares of overall trawl sector allocations of numerous species are distributed among trawl permit owners, on a continuing basis. Each year, owner's Share percentages are converted to poundage amounts that limit their catch of those species. Transfers of Share Pounds (and more recently the Shares themselves) are allowed, but subject to accumulation restrictions. To provide full accounting of catch against these quota, each vessel is now required to be monitored on all trips, either via a federal observer or, starting in 2015, via electronic monitoring (EM).

IFQ management has altered three major aspects of the shoreside trawl fishery. First, accountability for discards has been shifted from the fleet as a whole to individual operations, which has resulted in a rapid and substantial reduction in discards of most species. Second, the elimination of artificially low landing limits for some healthy species has shifted effort away from rebuilding species and provided greater opportunities for individual operations to find ways to target those healthy stocks while reducing bycatch. Over time, the markets for shares should provide another means of addressing remaining excess capacity in this fishery. Third, IFQ management allowed for gear switching, which occurs when permit holders with IFQ and a trawl endorsement can use multiple gear types (although not within the same trip), including trawl (bottom and midwater) and fixed gear (pot and hook-and-line). These management changes could impact fishing effort in bottom trawl and shoreside midwater sectors, as well as alter fixed gear fishing effort by providing a new opportunity for fixed gear fishing activity and potential competition between IFQ and other fixed gear sectors. Throughout this report, we aggregate the limited entry sablefish primary, open access, and daily trip limit sectors into a single NCS fixed gear fleet. These fisheries are similar to the catch shares fixed gear fishery and thus likely to be impacted by catch shares implementation. We include them here both for a reference with which to compare the IFQ fixed gear fleet and a broader understanding of catch shares impacts to the groundfish fleet as a whole.

The at-sea hake midwater trawl fishery had been observed by the North Pacific Groundfish Observer Program from the 1970s to 2001, when the At-Sea Hake Observer Program (A-SHOP) began to manage observer coverage. Under both organizations, observer coverage has been at or near 100% of fishing days, so little change in monitoring requirements occurred with IFQ implementation. Similarly, to achieve PFMC goals, the fishery changed primarily by developing cooperatives. The CPs had already done so before the implementation of IFQs, and the MSCVs did so in response to IFQ implementation. The shift to IFQs had ramifications on quota management and bycatch accountability, but potentially very little effect on fishing effort due to the minor changes in monitoring and overall fishery management. The cooperative system relieved the race to fish, but the at-sea hake fishery timing is driven primarily by overlapping participation in the Alaska pollock fishery. The primary driver for change in amount of fishing effort for the at-sea hake fishery has been highly variable allocations over the last 16 years. Effort has at times been dampened by steep quota declines as well as poor fishing conditions.

With this background in mind, we present trends in fishing effort in selected U.S. Pacific coast groundfish fishery sectors from 2002 to 2017. The primary objective of this report is to evaluate changes in fishing effort over time by gear type since implementation of the IFQ management program in the U.S. west coast groundfish fishery. This report updates the previous release and analyzes two additional years of data, 2016 and 2017, which sometimes results in comparing a time period of two years of data to those with four to five years; we note potential issues of doing so where appropriate. We analyze fishing effort in the following sectors of U.S. west coast groundfish fisheries:

- Limited entry (LE) bottom trawl (2002-2010)
- IFQ non-hake bottom trawl (2011-2017)
- IFQ shoreside midwater trawl targeting rockfish (2011-2017)
- IFQ shoreside midwater trawl targeting hake (2011-2017)
- IFQ fixed gear (2011-2017)
- Non-catch shares (NCS) fixed gear, which aggregates sablefish LE fixed gear primary (tier endorsed), open access (OA) fixed gear, and LE fixed gear daily trip or quota limits (2002-2017)
- At-sea midwater trawl targeting hake, utilizing catcher-processors (CPs) (2002-2017)
- At-sea midwater trawl targeting hake, utilizing mothership catcher-vessels (MSCVs) (2002-2017)

This report describes changes in fishing catch and effort overall, as well as subtler changes in timing, spatial location, and depth. We analyze total groundfish, sablefish, and hake landings and total and median tow duration or number of hooks or pots coast-wide, as appropriate for the gear. We also present maps showing fishing effort across different sectors, gears, and time periods to compare and contrast fisheries and management regimes. To further explore changes in fishing effort, we present the proportion of shoreside landings (or catch, in the case of the at-sea midwater fleets) in bimonthly periods and latitudinal and depth bins. Together, this information helps to identify changes and trends in fishing effort over the past 16 years.

Data Sources

Data sources for this report include data from: 1) observers aboard commercial fishing vessels landing catch shoreside (recorded and maintained by the WCGOP), 2) observers aboard commercial fishing vessels processing catch at sea (recorded and maintained by the A-SHOP), 3) state logbooks from Pacific Fisheries Information Network (PacFIN), 4) fish tickets from PacFIN, and 5) EM data from the Pacific States Marine Fisheries Commission (PSMFC).

Observer Data

Fishing effort estimates were derived from independent scientific observation of catch conducted on commercial groundfish vessels at sea by the WCGOP and A-SHOP, which are managed under the Northwest Fishery Science Center's (NWFSC) Fishery Resource Analysis and Monitoring Division's (FRAM) Fishery Observation Science (FOS) program. The WCGOP observes several federally managed sectors of the groundfish fishery, including the LE groundfish bottom trawl, LE and OA fixed gear, IFQ non-hake bottom and midwater trawl, and IFQ shoreside hake. The A-SHOP observes both the CP and MSCV portions of the at-sea hake midwater trawl fishery.

The goal of the WCGOP is to improve total catch estimates by collecting information on at-sea discards of west coast groundfish. The A-SHOP accounts for total catch and documents bycatch by sampling all catch on at-sea processors. For more details about observer program goals, vessel selection, and data collection, see the FOS website at https://www.nwfsc.noaa.gov/research/divisions/fram/observation/index.cfm. The website also provides estimates of observer coverage for each sector. WCGOP, A-SHOP, and fish ticket data quality assurance, quality control, and processing methods are described in detail in Somers et al. 2018.

Logbook Data

Vessel logbook record keeping is a state-mandated requirement for the LE groundfish bottom trawl sector in Washington (WA), Oregon (OR), and California (CA). A common format logbook is used by all three states, and vessel-reported logbook information is entered into state agency databases. The electronic logbook data are then uploaded by state agencies to the PacFIN regional database, which is maintained by the PSMFC.

Bottom trawl logbook data for 2002-2017 were retrieved from the PacFIN database in December 2018. These data were divided into groundfish fishery sectors following procedures described in Somers et al. 2018. Logbook data sometimes differs slightly from observer data, so summaries of fleet-wide vessels, trips, and hauls may be inconsistent with other reports.

Landings Data

Fleet-wide landing receipts are the cornerstone of landed catch information for shoreside sectors of the commercial groundfish fishery operating off the Pacific coast of the United States. These fish tickets are trip-aggregated sales receipts issued to vessels by fish-buyers in each port for each delivery of fish. Fish tickets are designed and issued by each state agency (WA, OR, or CA) and must be returned to the agency for processing. Each state conducts species-composition sampling for market categories (single species or a mix of species) reported on fish tickets. State agencies submit fish ticket and species-composition data to the PacFIN database. For analytical purposes, PacFIN applies the percentage of weight of each species within market categories obtained from species composition sampling to the fish ticket data. In doing so, landed weights from sampled market categories are distributed to individual species whenever possible. PacFIN data for fish ticket landings with state species composition sampling applied was queried in May 2018. As with logbook data, on occasion, estimates of total vessels and trips in a fleet based on fish ticket landings data differ from those recorded in observer data, so slight discrepancies may exist between this and other reports.

Data Usage

We selected the data source for each analysis that ensures both high data quality and consistency for comparisons across sectors and time periods.

In the shoreside sectors, we report total landings of targeted species or species group for each sector: FMP managed groundfish (excluding Pacific hake), hake, or sablefish landings, as recorded on fish tickets. Less than 100% of trips in both the LE bottom trawl and NCS fixed gear sectors are observed, so fish tickets are the primary data source available for fishing effort comparisons. We approximated spatial location of catch using the latitude of the port of landing, although effort occurs at varying distances from landing locations.

We also used fish ticket data to describe the proportional landings in bimonthly periods and in latitudinal bins in the shoreside sectors.

To describe haul duration and proportion of hauls in depth bins for bottom trawl sectors, we use logbook data to account for all fishing effort. In fixed gear and shoreside midwater sectors, we use WCGOP data to explore trends in gear usage and in depth on observed hauls. Although not all trips of the non-catch shares portion of the fixed gear sector are observed, this is the only data source available. For 2015-2017, logbook data for the EM portions of the CS pot and midwater fleets were incorporated. In non-catch share fixed gear sectors, we extrapolated the fleet-wide number of hooks and pots based on observer data; see the Methods section for further details. The use of observer data in these less than 100% covered sectors produced a greater amount of uncertainty in reported trends of total gear usage, gear use per haul, and depth compared to sectors with logbook or observer data for all trips.

All data used to assess fishing effort in the at-sea hake fishery come from A-SHOP. Haul-level information on location and landings are captured directly in the observer data.

METHODS

Many of the data summaries described below aggregate data to explore variation between different time periods. These groupings are consistent across analyses of different metrics. The LE bottom trawl sector was grouped into pre- and post-Amendment 19 periods, to account for changes caused by EFH closures that began on June 12, 2006. Bottom trawl data from 2006 were not included in summaries of annual proportion of bimonthly catch, as the year would be split into two periods; the data were included in all other summaries. The shoreside IFQ fishery was grouped, by gear, into two time periods: 2011-2015 and the most recent data from 2016-2017. A subset of EFH conservation areas, all south of Monterey, CA, also prohibited use of all bottom-contact gears, which may have slightly impacted the distribution of NCS fixed gear effort in these areas. We could not explore these patterns due to the low coverage rates in NCS sectors. Instead, to address changes around the implementation of IFQ management, we grouped the non-IFQ fixed gear sector into the pre-IFQ period (2002-2010), the initial IFQ period (2011-2015), and the most recent data (2016-2017). The at-sea hake fishery was not impacted by the EFH closures, so we grouped years to create approximately equivalent time periods: 2002-2005, 2006-2010, and 2011-2015, as well as the most recent two years' data for 2016-2017.

AMOUNT OF EFFORT

Total landings were estimated coastwide for each sector by year. We calculated total FMP groundfish landings (excluding hake) to provide a unit of effort for the multi-species-targeting bottom and midwater trawl sectors, total hake landings to estimate effort by hake-targeting midwater trawl fisheries, and total sablefish landings to assess fishing effort in the primarily sablefish-targeting fixed gear sectors.

We also calculated effort metrics of tow duration and number of hooks or pots, depending on gear type. This metric provides an estimation of effort that, unlike total catch, is not impacted by fishing efficiency, stock density, and other factors. Expansions were performed in non-catch share sectors to estimate total number of hooks or pots. Estimates were generated for each effort index by year and sector based on the following equation:

$$\hat{E}_{gx} = \frac{\sum_h b_{gx}}{\sum_h r_{gx}} \times F_{gx}$$

where:

E: estimated effort for gear type *g* in stratum *x*
g: gear type (hook-and-line or pot)
x: index strata (year, sector)
b: observed number of hooks or pots, depending on gear type *g*
r: observed retained weight (mt) of sablefish
h: hauls in observer data
F: weight (mt) of retained sablefish recorded on all fish tickets for gear type *g* in stratum *x*

In 2002, no hauls were observed in the non-nearshore pot sector south of 40°10' N. latitude, so the observed ratios north of 40°10' N. latitude were used in combination with landings south of 40°10' N. latitude to estimate effort metrics.

We also calculated the number of sets or hauls where lost gear was observed and where derelict gear was recovered in each sector, gear, and year. Derelict gear could consist of crab pots, other fixed gear, and even trawl nets which were recovered in a haul; however, it would on no occasion include hauls where trawl gear was lost and immediately recovered in the same haul. We report only observed occurrences and do not attempt to expand observations to create fleet-wide estimates of gear lost or derelict gear recovered in sectors with less than 100% observer coverage. These data for the shoreside fleet recently underwent additional quality control procedures, decreasing the incidences of hauls with lost gear and changing the years in which we are able to report both lost and recovered derelict gear. Hauls with recovered derelict gear are reported for all years in trawl fisheries, and all years except 2002 in fixed gear fisheries. In the catch share fixed gear fisheries, estimates of gear units lost are reported for all years, while those data were only available from 2010 to 2017 in the non-catch share fixed gear fisheries. This report summarizes the most recent data and should be considered the best source of data for this information.

Timing of Effort

To assess trends in the timing of fishing effort, we calculated the proportion of annual targeted landings in the shoreside fishery or catch in the at-sea fishery by each fleet and gear occurring in bimonthly periods over each year. We then calculated the median and first and third quartiles of that proportion across years in each time period. Due to fewer than three vessels fishing in each bimonthly period and in order to maintain confidentiality, we do not report these summaries for the catch shares fixed gear fleets in the 2016-2017 time period.

Location of Effort

To assess trends in the location of fishing effort, we explored patterns in landings in the shoreside fishery or catch in the at-sea fishery by one degree latitudinal bins. Similar to the methods used for timing above, we calculated the proportion made in each latitudinal degree and then calculated the median and first and third quartiles across years in each time period.

Depth of Effort

Patterns in fishing effort by depth were explored by calculating the proportion of hauls in 50-fm depth bins. Similar to timing and location, we calculated the median and first and third quartiles across years in each time period.

Geospatial Analysis

In addition to describing broad trends in the location of landings and catch and the depth of fishing effort, we also attempted to assess more discrete spatial patterns by plotting individual fishing locations. We used a straight line connecting the start and end points of trawl hauls or fixed gear sets to represent each fishing event. We excluded hauls that intersected land, that occurred outside the U.S. EEZ or in waters deeper than 2,000 m, or that fished bottom trawl at greater than fives knots (as calculated from straight line distance divided by recorded tow duration). From these line features, we created an effort density layer that depicts the relative intensity of fishing effort within relevant gear types and time periods. The following description of methods closely matches those used for development of fishing intensity layers created for the PFMC's review of groundfish EFH (GEFHRC 2012).

Fishing intensity was calculated as the total length of all lines intersecting a standardized area. To calculate this metric, we used a line density algorithm in ArcGIS™ v. 10.5 geographical information system software (Environmental Systems Research Institute, Incorporated, Redlands, California). The line density algorithm calculates density within a circular search area centered at a grid cell of specified size (see http://desktop.arcgis.com/en/arcmap/10.5/tools/spatial-analyst-toolbox/how-line-density-works.htm). Effort values were standardized for each time period by dividing per-cell density values by the total number of years in each period. The value (units: $km/km^2/yr$) for each grid cell is the quotient of total line portions intersecting the circular area per grid cell area per year. Because density outputs are highly sensitive to the specified radius and cell size, relative values are more informative than absolute values. Relative density identifies areas where fishing effort is concentrated, while still ensuring confidentiality of individual fishing locations and is thus superior to depicting confidential tow lines. The initial density output was more spatially extensive than those shown in the map figures, because it included confidential cells where density values were calculated from tows or sets made by less than three vessels. Confidential cells, representing less than three vessels, were removed from the maps presented in this report. Density parameters were chosen to minimize data exclusion but maintain confidentiality while still providing a high spatial resolution (500 m cell size). A larger search radius (5,000 m) was used to develop shoreside processing midwater trawl and fixed gear density outputs as compared to trawl densities (3,000 m), because effort in those sectors was generally patchier compared to the bottom and at-sea processing midwater trawl sectors. Because the density outputs cannot fully capture the entire footprint of fishing, we summarized length of all lines intersecting 10-minute rectangular cells. Cumulative lengths were divided by the total length of all lines for each gear sector and time period, and reported as relative coastwide effort (%).

RESULTS

TRAWL SECTORS

BOTTOM TRAWL

The bottom trawl sector retained ~16,700 mt of groundfish in 2016 and ~17,500 mt in 2017, continuing to rebound from low catch in 2014 and 2015 (Table 1, Figure 1). Further, when accounting for groundfish retained by other gears fishing bottom trawl quota, 2017 landings reached a high of ~27,000 mt. Fleet-wide bottom trawl effort continued to decrease from 2015 to 2017, but at a lower rate than observed from 2013 to 2015 (Table 1, Figure 2). Median haul duration decreased from 2011 to 2015, but stabilized around 3.2 hours in 2016 and 2017 (Table 1, Figure 3).

The spatial distribution of landings in 2016-2017 was similar to that of 2011-2015, although landings around 44° N. latitude increased. The proportion of coastwide landings made at 46° N. latitude, near Astoria, OR, remained high in 2016 and 2017 (Table 2, Figure 4). The proportions of landings north of 46° N. latitude and south of 39° N. latitude remained low, while the proportions of landings between 45° and 39° N. latitude (Newport, OR to Fort Bragg, CA) were consistent with the previous time period.

Maps of average annual fishing intensity illustrated these patterns in more detail and revealed the similarity of spatial distribution and intensity patterns between 2011-2015 and 2016-2017 (Figure 5). The 2016-2017 time period also illustrates the continued trend of effort concentrating in the more northern parts of the coast and in deeper waters. Effort in the southern parts of the coast is relatively low and patchy in the few places that bottom trawl fishing occurs.

The temporal pattern of landings in 2016-2017 was similar to that of 2011-2015, with less variation likely due to the smaller number of years in the later time period (Table 3, Figure 6). ~23% of landings occurred in March/April, with the median for all other bimonthly periods ranging from ~13.5-17.5%.

The proportion of hauls in the 0-50 fm depth bin continued to decrease, while activity in the 50-100 fm waters increased slightly (Table 4, Figure 7). Across other depth bins, the distribution of effort was similar across all time periods.

SHORESIDE MIDWATER TRAWL

As quota for widow and yellowtail rockfish has increased, the shoreside midwater trawl rockfish fleet has continued to develop. Groundfish landings and effort have steadily increased from 2011 to 2015 and in 2017, after a slight decrease, reached the highest levels observed in this emerging fishery (Table 1, Figures 1 and 8). Hake landings and effort measured by tow duration in the shoreside midwater trawl hake fleet have been much more variable, but were very similar to trends in the at-sea hake fishery and likely reflect quota, price, and abundance of hake (Table 1, Figure 9). In 2017, both landings and tow duration by the shoreside fleet reached historic highs and were greater than in either at-sea sector. Median tow duration per haul in the rockfish fleet in 2016-2017 was similar to that of 2011-2015 and was typically lower and less variable than the shoreside hake fleet, with a median around 1.5 hours. The duration of shoreside midwater trawls targeting hake decreased in variability and magnitude from 2015 to 2017, with a median of between 2 and 2.5 hours (Table 1, Figure 10).

In 2016-2017, the majority of landings by the midwater rockfish trawl fishery occurred along the OR/WA border and in OR, similar to 2011-2015 (Table 2, Figure 11). The proportion of landings near Astoria, OR at 46° N. latitude decreased slightly from 72 to 67% and increased near Newport, OR in the 44° N. latitudinal from 23 to 33%. From 2011-2015, about a quarter of midwater rockfish trawl catch was landed near Bellingham, WA at 48° N. latitude, but no landings occurred in that area in 2016-2017. Finally, a minute proportion of landings were made in CA for the first time in 2016-2017 as part of an exempted fishing permit (EFP). Due to the developing nature of the fishery, a small but increasing number of vessels have participated in this fishery, particularly in three areas of concentration that persisted from 2011-2015 to 2016-2017 (Figure 12). The spatial distribution of fishing effort in 2016-2017 was similar to that in 2011-2015, although annual effort was greater in the more recent time period. Hotspots also became more intense, especially off the coast of Astoria, OR and north of Newport, OR.

In the shoreside midwater hake trawl fishery in 2016-2017, the majority of landings continued to occur in the 46° N. latitudinal bin, where the median proportion increased from 61% in 2011-2015 to 73% in 2016-2017 (Table 5, Figure 13). The remainder occurred near Newport, OR in the 44° N. latitudinal bin; unlike in 2011-2015, no landings occurred south of 44° N. latitude in 2016-2017. Due to a higher number of vessels and more concentrated fishing, minimal effort was excluded from the map of fishing intensity in the primary areas of fishing, north of 42° N. latitude (Figure A-4). Although landings occurred primarily in Astoria, OR, effort occurred throughout the northern part of the coast. In both time periods, fishing effort was particularly intense off of Newport, OR, but in 2016-2017 was most intense further north. Effort was more dispersed in 2011-2015 than in 2016-2017, which may reflect lower annual variability in two years compared to five years of data (Figure 14).

The shoreside midwater season starts in mid-May, so landings are restricted from May to December. However, in 2016-2017, an EFP resulted in the rockfish fleet landing 7.5% of landings in March/April (Table 3, Figure 15). The rockfish fleet was more seasonally consistent in 2016-2017 than in 2011-2015, but continued to show a greater proportion of landings in September through December than earlier in the year. The bimonthly pattern of the midwater hake fleet from 2016-2017 was similar to that of 2011-2015, although variability was lower in 2016-2017, again potentially reflecting fewer data points in the more recent period (Table 6, Figure 16). This seasonal pattern is likely explained primarily by vessels balancing their effort in this fishery with that in Alaskan and at-sea processing fisheries.

Midwater rockfish trawl effort in 2016-2017 was similar to that of 2011-2015 and was most intense in shallow water in the 50 to 150 fm depth bin (Table 4, Figure 17). However, within those depths, the percentage of effort in the 50 to 100 fm depth bin decreased by about 10% and, in the 100 to 150 fm, bin increased by about 11%. Tows deeper than 150 fm all but disappeared in 2016-2017. The depth range of midwater hake hauls was greater than those in midwater rockfish, from 0 to 550 fm in 2011-2015 and from 0 to 400 fm in 2016-2017 (Table 4, Figure 18). In 2016-2017, effort was even more concentrated between 50 and 250 fm, with the effort in 50 to 100 fm increasing by 5% and in 100 to 150 fm by 10% compared to 2011-2015.

At-Sea Midwater Trawl

The variability in hake landings by both the CP and MSCV portions of the at-sea fleet reflects annual quota changes (Table 1, Figure 9). Landings by CPs showed a mostly increasing trend, with two years of sharp decreases in 2008 and 2015. Annual catch increased in 2016 and 2017, to more than 137,000 mt, a level not seen since at least prior to 2002. The MSCV portion receives less hake quota than CPs, resulting in lower catch by MSCVs. Landings by MSCVs followed the same pattern as that of CPs, but with lower inter-annual variability. However, while the CPs showed a large increase in retained hake from 2016 to 2017, MSCVs landed an almost equivalent amount (~65,000 mt) in both years. Nonetheless, these years represent the greatest annual catch since at least 2002. Similar to trends in catch, fleet-wide effort by CPs rose steadily from 2002 to 2008, with a large decrease in 2009 (Table 1, Figure 8). However, from 2009 to 2016, tow duration mostly increased, with 2016's ~7,300 fleet-wide tow hours the greatest since at least 2002, before decreasing to ~5,700 hours in 2017. The MSCV portion of the fleet again followed a similar pattern as CPs but with lower variability and range; in 2015, MSCVs diverged from CPs with a large decrease in tow duration compared to previous years. The median and quartiles of duration per haul were similar for CPs and MSCVs in most years, although median tow duration by CPs was greater in nearly all years (Table 1, Figure 19). Tow duration in both sectors has generally increased, from a low of ~1 hour in 2003 and 2004 to a median between 2 and 3 hours since 2007.

Fishing effort in the at-sea midwater hake trawl fishery was focused on the northern part of the coast, off central OR across all time periods (Table 5, Figure 20). In 2006-2010, the proportion of catch by the CPs was evenly distributed in that area, but in 2011-2015, catch mostly occurred in the southern portion of the range, from 44° to 42° N. latitude. Variability in catch location also increased, especially in the 47°, 43°, and 42° N. latitudinal bins. Both of these trends continued in 2016 and 2017, with much greater variability potentially reflecting extremes in the two years of data. MSCVs in 2002-2005 focused the majority of effort in the 44° N. and 43° N. latitudinal bins, but have been more variable in more recent time periods. In 2011-2015, the largest median proportion of catch occurred in the 43° N. latitudinal bin, while in 2016-2017, around a quarter of catch occurred in each of the 47°, 43°, and 42° N. latitudinal bins.

Maps of fishing intensity in the CP portion of the at-sea midwater hake fishery emphasized the movement of the fleet to the southern part of their range from 2002 to 2017 (Figure 21). Around 42° N. latitude, effort has increased, and vessels in 2016-2017 continued to fish further seaward than observed in prior periods. A hot spot of effort around 43° N. latitude has steadily intensified over the three periods. In the north, a hot spot of effort around 48° N. latitude was present to varying degrees across all time periods. In 2016-2017, the most intense hotspot occurred where little effort had occurred in previous time periods, off of Newport, OR, around 44° N. latitude.

Geospatial analysis illustrates a concentration of effort over time into two distinct areas, one off northern WA and another off southern and central OR (Figure 22). A hotspot around 44° to 43° N. latitude expanded from 2011-2015 to 2016-2017, and fishing effort became more intense in the northern part of the coast around 48° N. latitude. In 2016-2017, the fleet also moved more seaward than ever before around 43° N. latitude.

The midwater at-sea fleet's season begins on May 15; in 2015, the shoreside fleet's opening date shifted from June 15 to May 15 to coincide with the at-sea sector. In the CP portion, in 2002-2005, the fleet processed nearly all catch evenly from May to October, and, in 2006-2010, the fleet processed a majority of catch in May/June and the rest evenly between the three bimonthly periods from July to December. In the MSCV portion, however, nearly all catch was processed in May/June from 2002 to 2010. This pattern changed in the more recent time periods and became more similar across sectors. Specifically, in both 2011-2015 and 2016-2017, the CP and MSCV portions of the fleet fished primarily in May/June and September/October, with almost no catch in July/August (Table 6, Figure 23).

Nearly all midwater at-sea hauls occurred in depths of 50 to 250 fm (Table 4, Figure 24). Over the three time periods summarized, the proportion of both CP and MSCV hauls in deeper waters increased. In 2011-2015, more than half of CP's hauls occurred in waters of 150 to 200 fm depth, and almost 80% of hauls by the MSCV sector occurred between 100 and 200 fm. In 2016-2017, both fleets focused their efforts in 100 to 200 fm. The CPs did so by decreasing effort in 200 to 250 fm, while the MSCVs simultaneously decreased hauls in 250-300 fm and increased them in 50-100 fm.

Fixed Gear Sectors

Pot

After declining from 2011 to 2013, sablefish landings by both the CS and NCS pot fleet have mostly increased through 2017, although landings by the NCS pot sector was relatively consistent from 2015 to 2017 (Table 7, Figure 25). CS pot vessels continued to land more sablefish than the NCS fleet, with the difference increasing from 2013 to 2017. The fleet-wide estimate of pots calculated using observer data varied annually, but the NCS fleet has increased from 2013 through 2017 (Tables 7 and 8, Figure 26). The number of pots in the CS fleet has shown a slight increasing trend from 2013 to 2017. A greater number of pots were fished by the CS than the NCS fleet in all years but 2014, when they were nearly equal, and 2016, when there were slightly more NCS pots. In most years, and in both the CS and NCS pot fleets, the median estimated number of pots per set has fluctuated annually between ~16 and ~50 (Tables 7 and 8, Figure 27). In the CS pot fleet between 2011 and 2015, all years showed a median ~30 pots per set, but in 2016 and 2017, that median dropped to ~20; across all years the quartiles showed a large range. In the NCS pot fleet, the median pots per set from 2011 to 2017 was between 30 and 35 in all years except 2013, when the historic low of ~16 pots per set was observed.

The proportional distribution of sablefish landings coastwide by the NCS pot fleet was consistent between 2002-2010, 2011-2015, and 2016-2017 (Table 9, Figure 28). In all three time periods, ~80% of landings were made between 46° and 39° N. latitude, with the greatest proportions in the 46°, 44°, and 39° N. latitudinal bins (near Astoria, OR; Newport, OR; and Fort Bragg, CA, respectively). Landings south of 39° N. latitude were more evenly distributed between 38° and 35° N. latitude in 2011-2015 than in 2002-2010 or 2016-2017. Landings in the 48° and 39° N. latitudinal bins were greater in 2016 and 2017 than in either earlier period. The high dispersion of fishing effort by different vessels made it difficult to accurately display fishing intensity while maintaining confidentiality (Figure 29). However, comparing the primary areas where fishing by three or more vessels occurred consistently across time periods revealed similar spatial distribution across the three time periods and little change after CS implementation (Figure 29).

CS pot landings were less uniform across the coast than NCS. In 2011-2015, almost 30% of landings occurred in the 35° N. latitudinal bin, which decreased by half to almost 15% in 2016-2017 (Figure 28). In the northern portion of the coast, most landings in 2011-2015 occurred in the 46°, 44°, and 42° N. latitudinal bins; in 2016-2017, almost one-third of landings occurred in both the 46° and 44° N. latitudinal bins. While landings around 43° N. increased between 2011-2015 and 2016-2017, landings around 42° N. latitude decreased to almost zero. Due to lower observer coverage in the NCS fishery, direct comparisons of magnitude of effort between the NCS and CS maps are inappropriate. CS effort in both 2011-2015 and 2016-2017 was most intense between 47° and 44° N. latitude, overlapping with observed NCS pot effort (Figure 30). Fishing in the southern part of the coast was greatly reduced in 2016-2017, but one intense area of fishing effort occurred around 36° N. latitude. This new area of fixed gear fishing may represent initiatives introduced with catch shares implementation that supported a shift from trawl to fixed gear fishing near Morro Bay, CA.

Landings by the NCS pot fleet peaked in May/June prior to IFQ implementation, with high proportions of catch from May to October (Table 10, Figure 31). In 2011-2015 and 2016-2017, this peak shifted to September/October and was more pronounced. The CS pot fleet also peaked in September/October in 2011-2015, with half of landings occurring in that single bimonthly period. To maintain confidentiality, we cannot report bimonthly landings in 2016-2017.

Fishing effort in the NCS and CS pot fleets occurred primarily in depths from 0 to 750 fm (Table 11, Figure 32). Both NCS and CS fleets showed bimodal peaks, likely reflecting the depths of shelf and slope fishing. In 2011-2015, the proportion of hauls by the NCS pot fleet in depths 0 to 250 fm decreased, and the proportion in 500 to 600 fm increased; this trend reversed in 2016-2017. Effort in the CS pot fleet was more evenly distributed than in the NCS fleet, but the proportion of hauls showed small peaks around 150 to 300 and 450 to 650 fm in both time periods.

Hook-and-Line

Sablefish landings by the NCS hook-and-line fleet in 2014 were almost the lowest since prior to 2002, but have since increased through 2017 to the middle of the observed range (Table 7, Figure 25). Landings by the CS hook-and-line fleet were similar across 2013 to 2017 and remained considerably lower than NCS landings. The estimated number of NCS fleet-wide hooks declined from 2009 to 2015, but have increased slightly in 2016 and 2017 (Table 8). The total number of hooks fished by the CS hook-and-line fleet slowly decreased from 2011 to 2017 (Tables 7 and 8, Figure 33). The median number of hooks per set in the NCS fleet was stable from 2002 to 2010 at ~2,000 hooks; this rate increased in 2012 and has been closer to ~2,500 hooks per set through 2017 (Tables 7 and 8, Figure 34). In the CS fleet, hooks per set decreased from 2011 to 2013 and have remained ~3,200 since 2015. The variability in hooks per set by the NCS fleet was similar across all years. In the CS fleet, this variability was much greater in 2013 and 2014 than in other years or in the NCS fleet, while, from 2015 to 2017, variability decreased and was more similar to that in the NCS fleet.

Hook-and-line sablefish landings ranged from 48° to 32° N. latitude. Landings by the NCS hook-and-line fleet were more uniform along the coast in 2011-2015 and 2016-2017 than in 2002-2010 (Table 9, Figure 35). After IFQ implementation, landings by the NCS fleet decreased in the 48° and 46° N. latitudinal bins and increased south of 36° N. latitude, around Monterey Bay, CA. Patterns in 2016-2017 were similar to those in 2011-2015, but landings were even more evenly distributed along the coast. Spatial patterns in fishing intensity were similar across all three time periods, although effort has generally concentrated over time (Figure 36). Almost no effort was observed south of 34° N. latitude in 2016-2017.

The CS hook-and-line fleet showed a very different spatial distribution of landings in 2016-2017 than in 2011-2015. In 2011-2015, ~70% of catch occurred near Astoria, OR in the 46° N. latitudinal bin, while in 2016-2017 this had decreased to ~30% (Figure 35). Conversely, the percent of coastwide landings in the 48° N. latitudinal bin increased from ~8 to 40%. In both time periods, ~20% of landings occurred in the 44° N. latitudinal bin, with smaller percentages of landings occurring south of this area. Due to a small number of vessels participating in the CS fleet, intensity could not be shown at a meaningful spatial scale, making it difficult to assess the full distribution of fishing. Non-confidential data show that fishing by the CS hook-and-line fleet largely overlapped the range of fishing by the NCS fleet in the northern portion of the coast (Figure 37).

Landings by the NCS hook-and-line fleet peaked in September/October both before and after IFQ implementation, but this was more prominent in 2011-2015 than in 2016-2017, when the proportion of landings in May to August increased (Table 10, Figure 38). Landings by the CS hook-and-line fleet showed extreme annual variability, but typically peaked in September/October, with some years showing very high catch in July/August and November/December as well. To maintain confidentiality, bimonthly landings in 2016 and 2017 cannot be reported.

Both the NCS and CS hook-and-line fleets fish in depths ranging from 0 to 700 fm (Table 11, Figure 39). NCS hook-and-line hauls were more common in deeper waters in 2011-2015 than in 2002-2010; this trend partially reversed in 2016-2017. The CS hook-and-line effort focused on shallower waters than the NCS fleet in 2011-2015, especially 50 to 100 fm and 200 to 250 fm. In 2016-2017, the CS fleet shifted most of its effort into depths from 150 to 300 fm, with additional, evenly distributed effort in 300 to 600 fm.

Lost Gear and Recovered Derelict Gear

Gear loss in the west coast groundfish fleet is uncommon. Gear loss was observed the least in trawl fisheries. In shoreside bottom trawl fleets, gear loss occurred on ~0.1% of observed hauls annually and was never observed in shoreside midwater trawl fleets (Table 12). On average, in at-sea midwater fleets, 0.02% of hauls lost gear annually, with a maximum of less than 0.2% (Table 13). Gear loss was observed more often in fixed gear fisheries than in the trawl fleet. Lost gear was observed in the catch shares and non-nearshore hook-and-line fisheries on ~2% of hauls on average annually, representing 0.6% of observed hooks. In the catch shares and non-nearshore pot fisheries, gear loss incidents were observed more often (3.8% of hauls) than in the hook-and-line fisheries, but the proportion of gear units lost was similar.

The percentage of hauls recovering derelict gear was typically greater than those losing gear, likely reflecting gear loss in unobserved fisheries. Gear recovery was observed most frequently in fisheries using bottom trawl gear, when ~5.4% of hauls annually on average recovered gear. Gear recovery in the LE and CS bottom trawl fleet was less variable, ranging from ~2 to 8% of hauls annually and averaging 4%. Midwater gears rarely contact the ocean floor, so derelict gear recovery is exceedingly rare. Less than 1% of observed shoreside midwater hauls recovered derelict gear, and no recovered gear has been observed in the at-sea midwater fleet. Fixed gears are less likely than bottom trawl gear to recover derelict gear due to differences in deployment and the gear itself. Hook-and-line fleets recovered derelict gear on less than 0.2% of observed hauls on average annually, with 0% typical in most years and a maximum of 1.9% observed in the OA sector in 2010. On average, 0.1% of observed pot hauls recovered gear per year, with a maximum of 0.8% of hauls in the CS EM fleet in 2016.

ACKNOWLEDGEMENTS

The authors are grateful to the many A-SHOP and WCGOP observers who work hard under sometimes extreme conditions to collect these valuable data. The authors would also like to thank members of the Groundfish Endangered Species Work Group for helpful feedback and suggestions.

REFERENCES

Groundfish Essential Fish Habitat Review Committee (GEFHRC). 2012. Pacific Coast Groundfish 5-Year Review of Essential Fish Habitat Report to the Pacific Fishery Management Council Phase 1: New Information. Pacific Fishery Management Council, Portland, OR, USA. Available at: http://www.pcouncil.org/wp-content/uploads/H6b_EFHRC_RPT_1_SEP2012BB.pdf

NMFS (National Marine Fisheries Service). 2012. Continuing Operation of the Pacific Coast Groundfish Fishery - Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion and Section 7(a)(2) "Not Likely to Adversely Affect" Determination. PCTS Number: NWR-2012-876. 194 p.

Northwest Fisheries Science Center (NWFSC). 2018. 2018 Training Manual West Coast Groundfish Observer Program. Northwest Fisheries Science Center, 2725 Montlake Blvd E, Seattle, WA. 98112. Available at: http://www.nwfsc.noaa.gov/research/divisions/fram/observation/data_collection/training.cfm

Pacific Fishery Management Council. 2000. Status of the Pacific Coast Groundfish Fishery Through 2000 and Recommended Biological Catches for 2001: Stock Assessment and Fishery Evaluation. (Document prepared for the Council and its advisory entities.) Pacific Fishery Management Council 2130 SW Fifth Avenue, Suite 224, Portland, Oregon 97201.

Rogers, J.B., and E.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 49:2648-2656.

Somers, K.A., J. Jannot, V. Tuttle, K. Richerson, N.B. Riley, and J. McVeigh. 2018. Estimated discard and catch of groundfish species in the 2017 U.S. west coast fisheries. NOAA Fisheries, NWFSC Observer Program, 2725 Montlake Blvd E., Seattle, WA 98112.

FIGURES

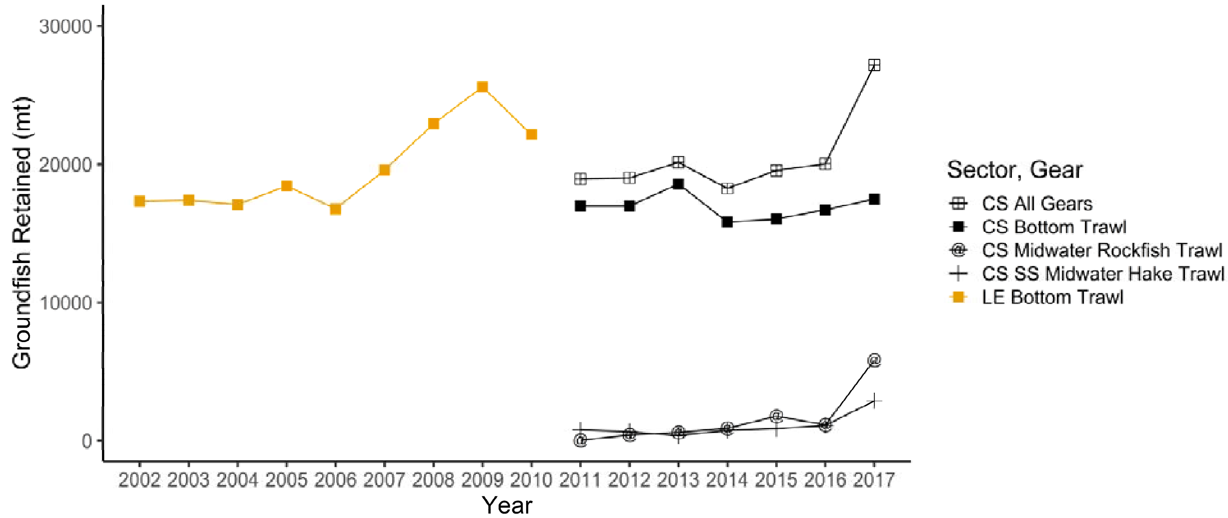


FIGURE 1. Annual total fleet-wide FMP groundfish (not including hake) landings (mt) in shoreside trawl sectors.

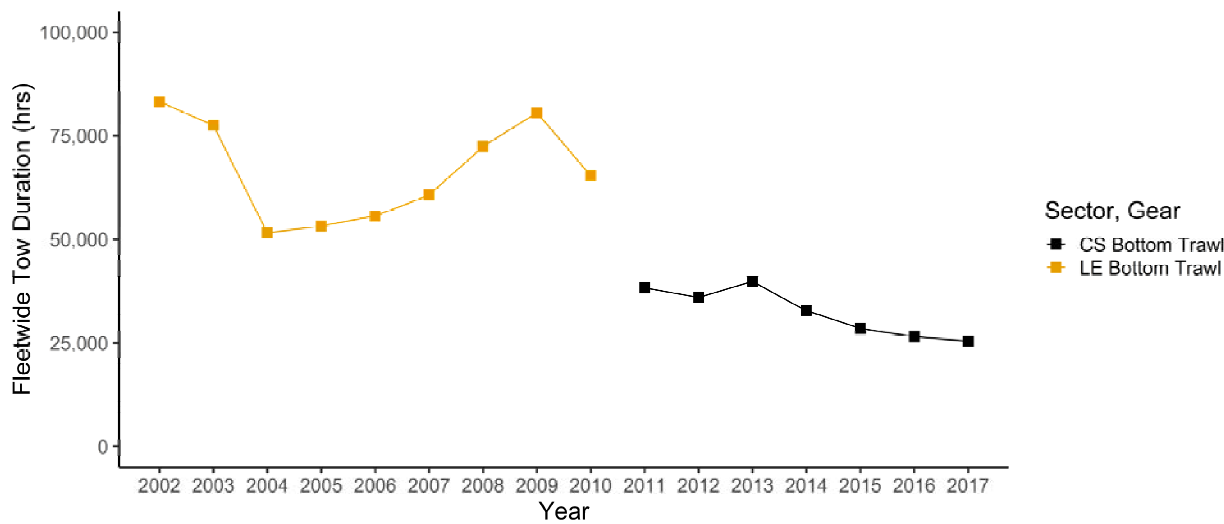


FIGURE 2. Annual total fleet-wide tow duration (hours) in the bottom trawl sector.

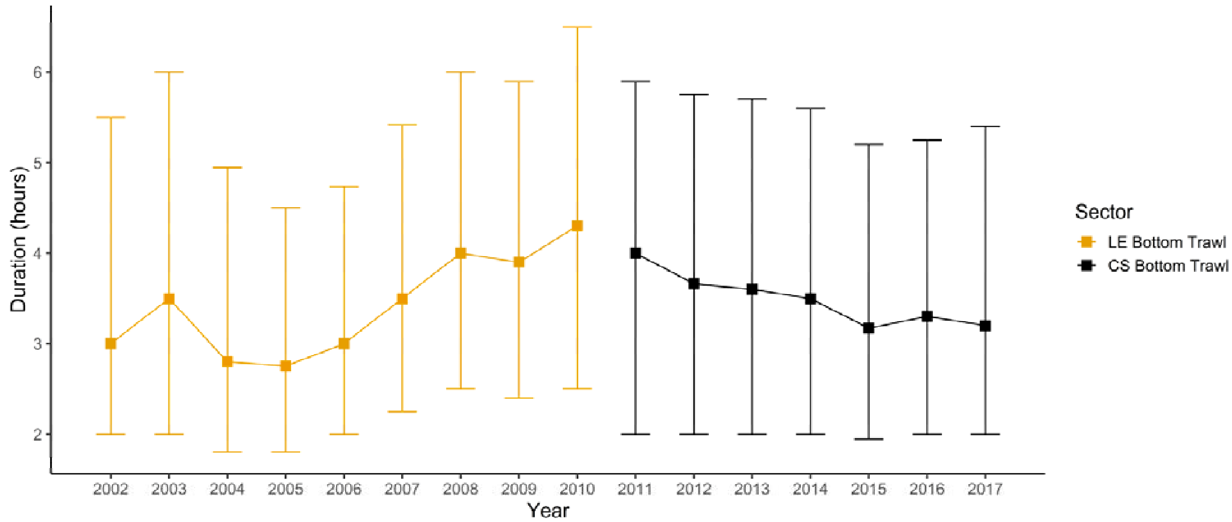


FIGURE 3. Tow duration (hours) per haul in the bottom trawl sector. Medians and first and third quartiles for each year are shown.

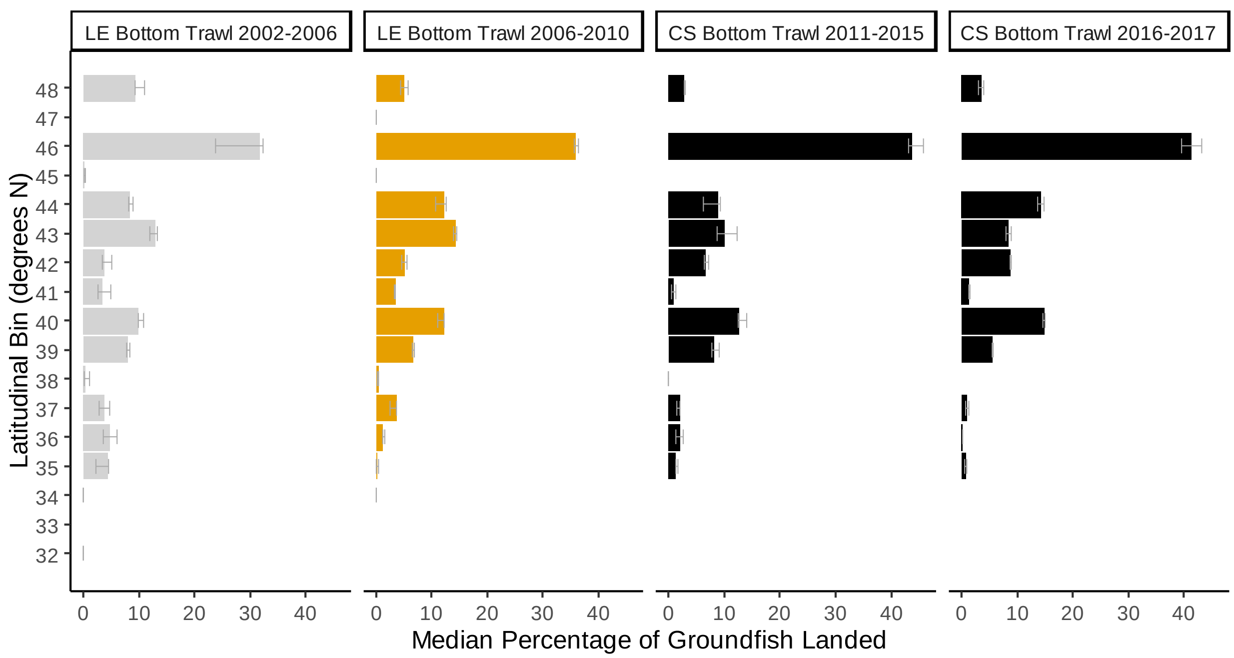


FIGURE 4. Percentage of retained FMP groundfish landed in latitudinal bins by bottom trawl. Medians and first and third quartiles for each time period are shown.

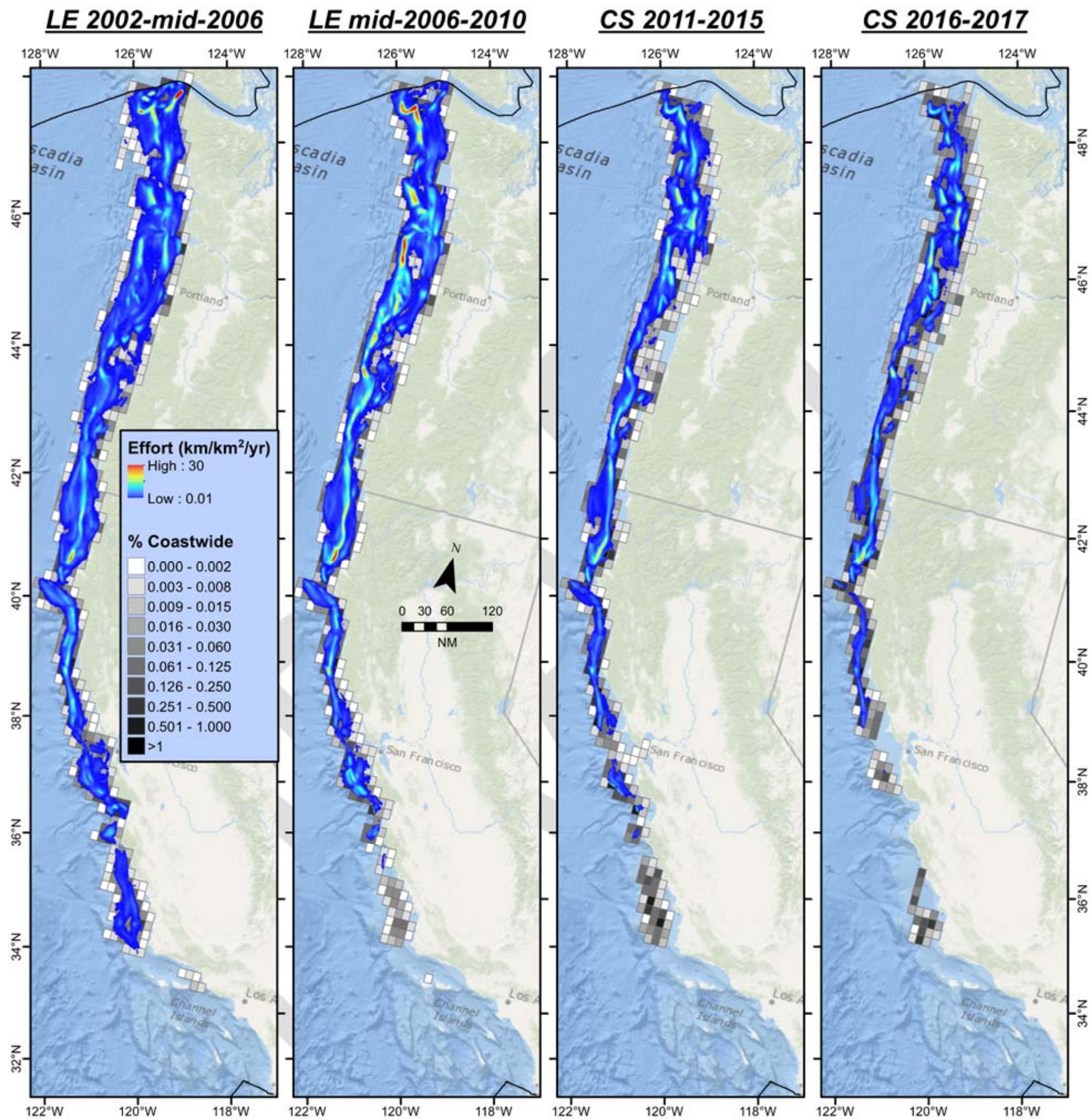


FIGURE 5. Spatial distribution and intensity of bottom trawl fishing effort. Intensity (units: km/km²/yr) is depicted by a color ramp of cool (low) to warm (high) colors. The overall footprint of fishing for each time period is depicted in grayscale, with darker (black) tones depicting a higher relative contribution to the coastwide effort within 10x10 min cells.

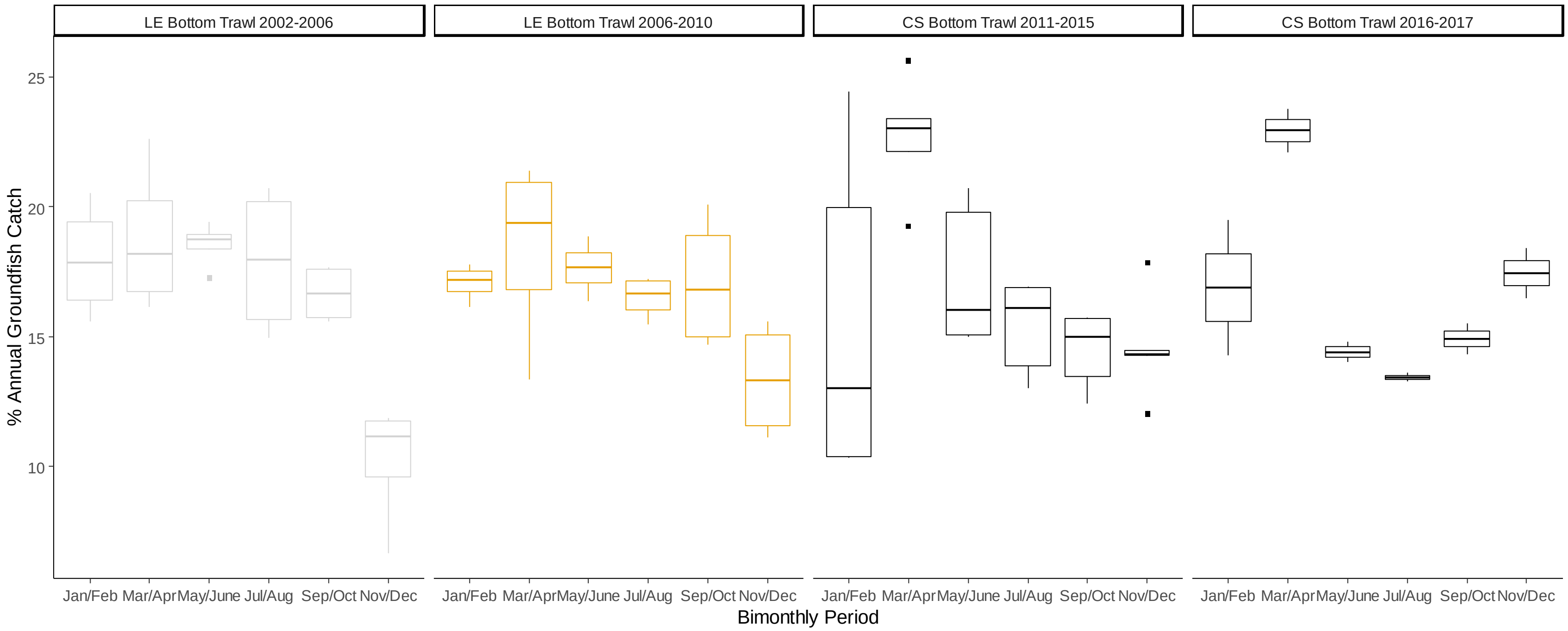


FIGURE 6. Percentage of retained FMP groundfish landed in bimonthly bins by the bottom trawl sector. Medians and first and third quartiles for each time period are shown.

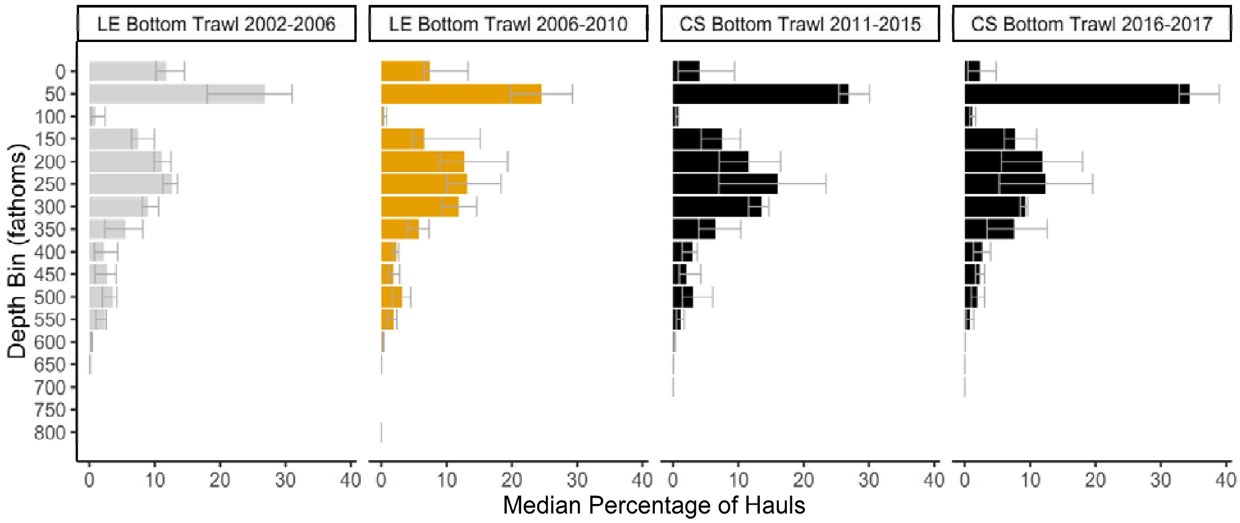


FIGURE 7. Percentage of bottom trawl hauls in 50-fathom depth bins. Medians and first and third quartiles for each time period are shown.

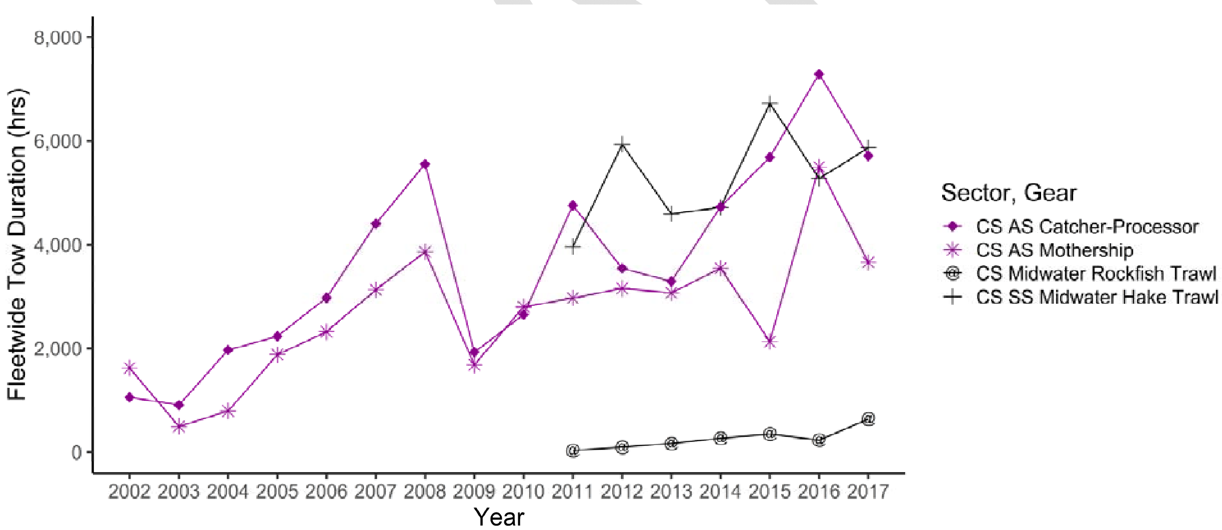


FIGURE 8. Annual total fleet-wide tow duration (hours) in shoreside and at-sea midwater trawl sectors.

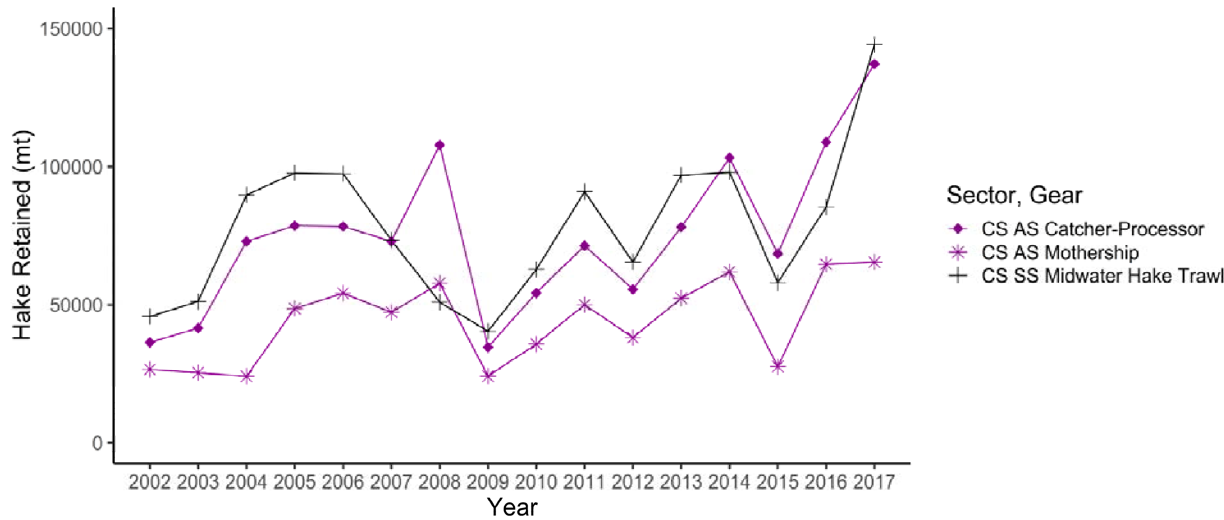


FIGURE 9. Annual total fleet-wide hake landings (mt) in shoreside bottom and midwater and at-sea midwater trawl sectors.

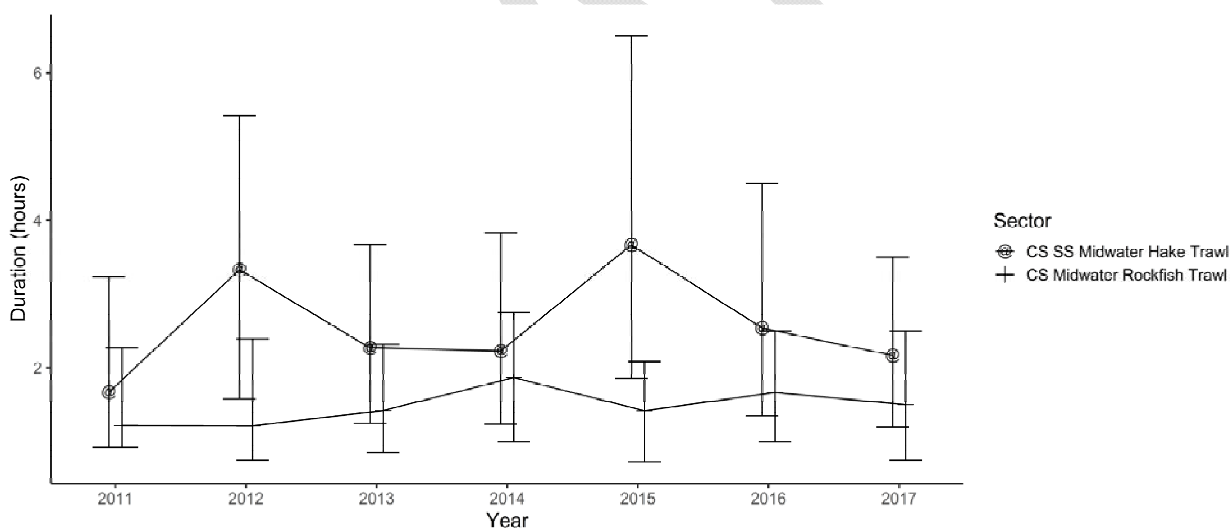


FIGURE 10. Tow duration (hours) per haul in shoreside midwater trawl sectors. Medians and first and third quartiles for each year are shown.

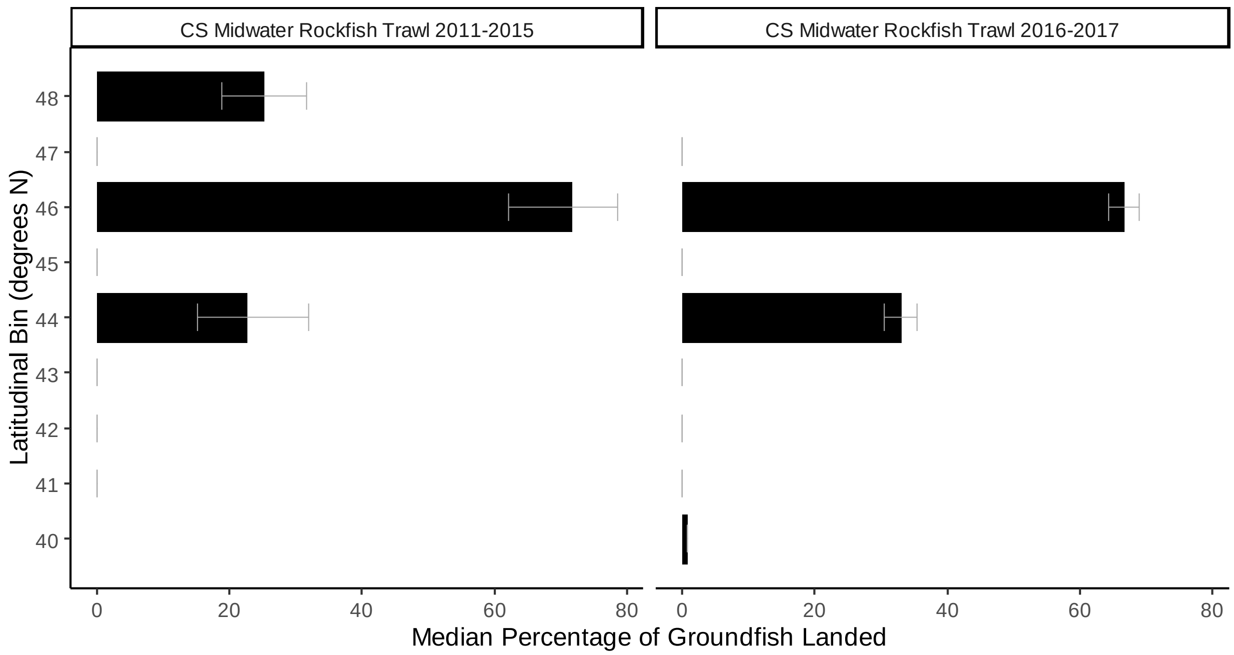


FIGURE 11. Percentage of retained FMP groundfish landed in latitudinal bins by shoreside midwater trawl targeting rockfish. Medians and first and third quartiles are shown.

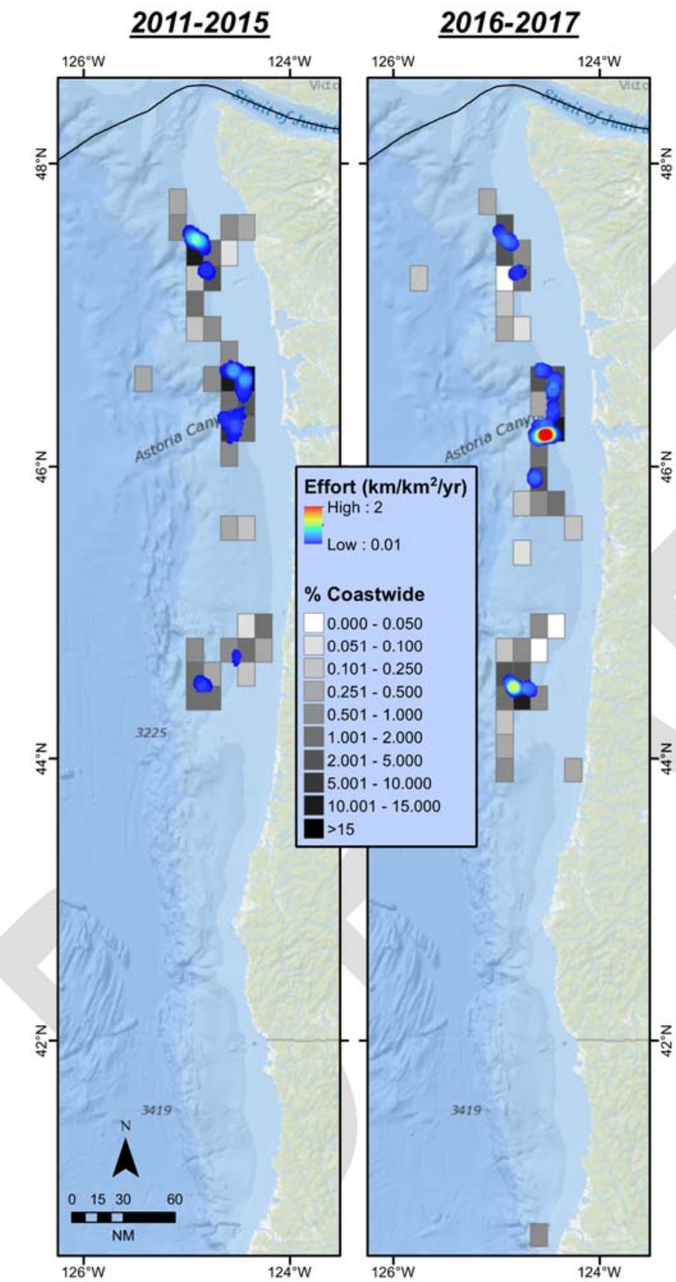


FIGURE 12. Spatial distribution and intensity of fishing effort by shoreside midwater trawl targeting rockfish. Intensity (units: km/km^2/yr) is depicted by a color ramp of cool (low) to warm (high) colors. The overall footprint of fishing for each time period is depicted in grayscale, with darker (black) tones depicting a higher relative contribution to the coastwide effort within 10x10 min cells.

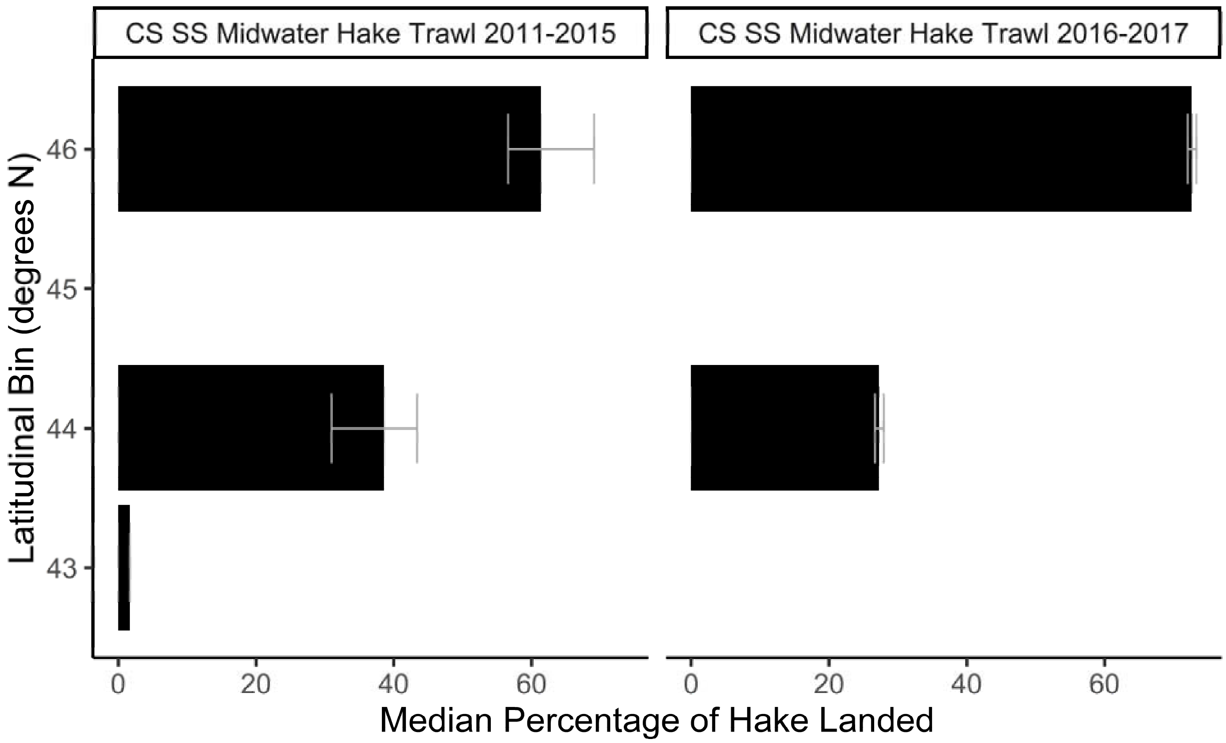


FIGURE 13. Percentage of retained hake landed in latitudinal bins by shoreside midwater trawl targeting hake. Medians and first and third quartiles are shown.

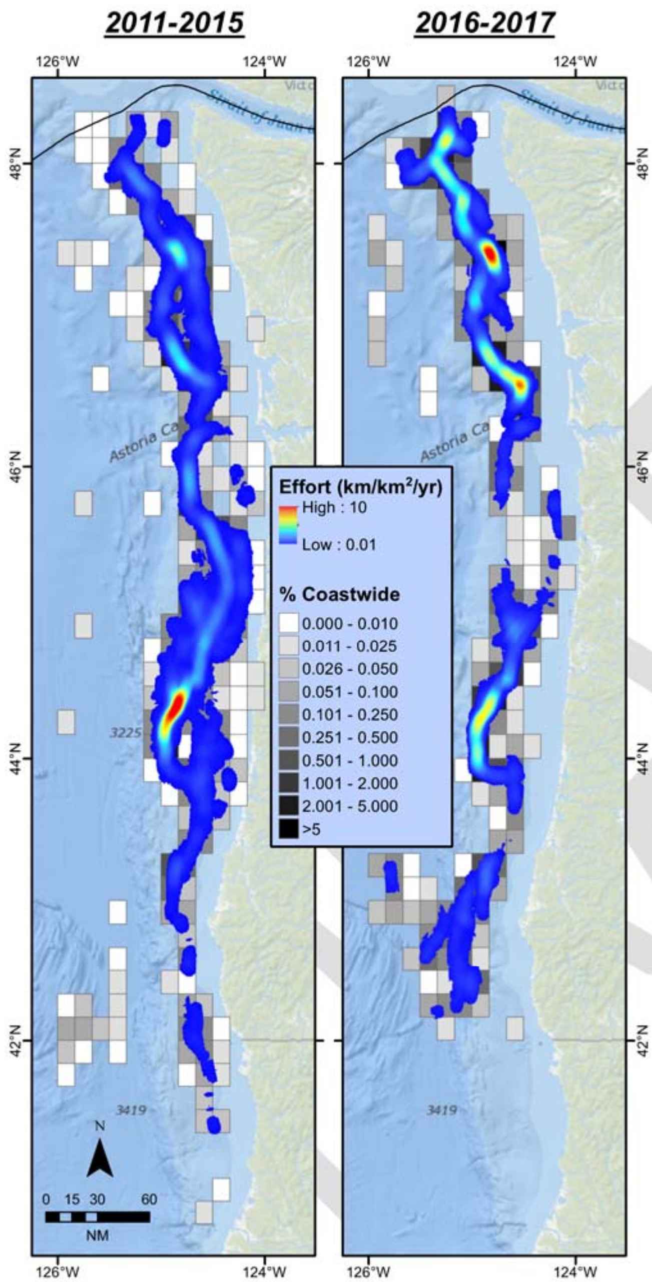


FIGURE 14. Spatial distribution and intensity of fishing effort by shoreside midwater trawl targeting hake. Intensity (units: km/km^2/yr) is depicted by a color ramp of cool (low) to warm (high) colors. The overall footprint of fishing for each time period is depicted in grayscale, with darker (black) tones depicting a higher relative contribution to the coastwide effort within 10x10 min cells.

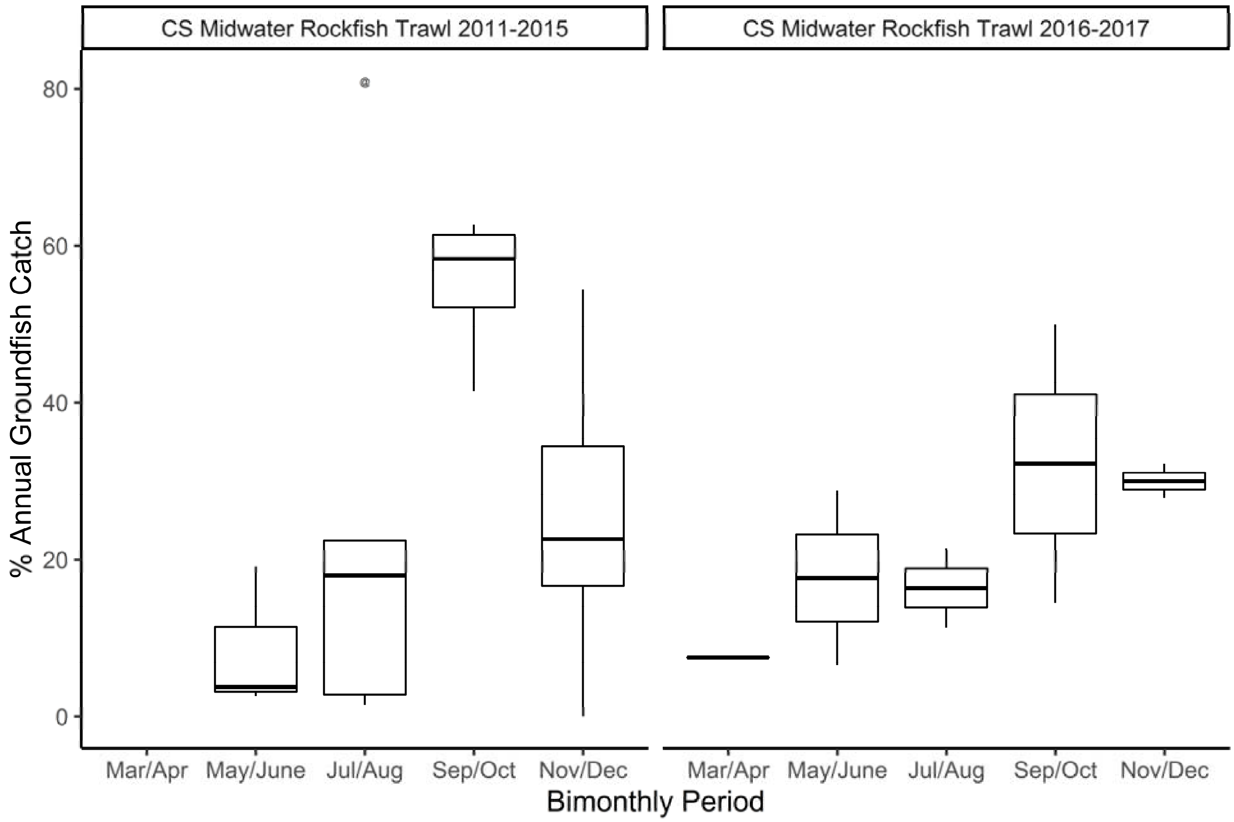


FIGURE 15. Percentage of retained FMP groundfish landed in bimonthly bins by shoreside midwater trawl targeting rockfish. Medians and first and third quartiles for each time period are shown.

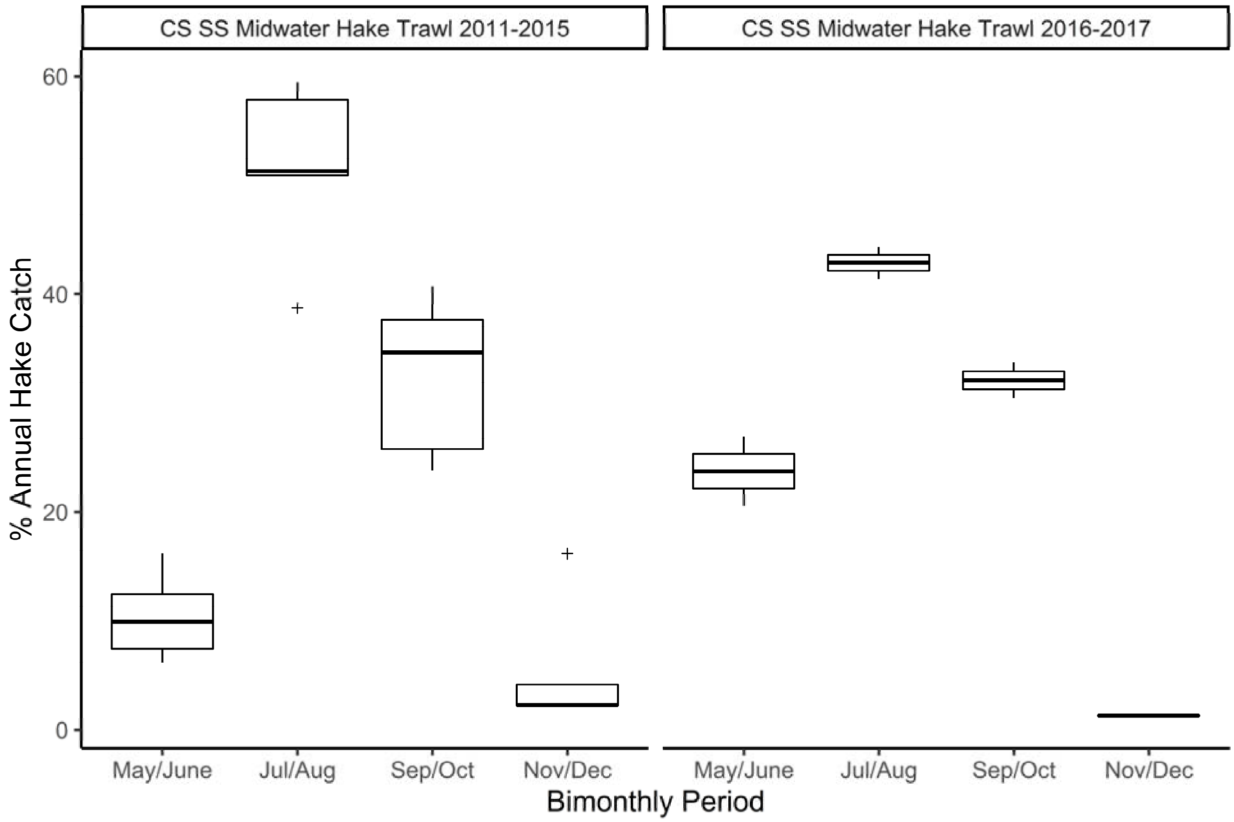


FIGURE 16. Percentage of retained hake landed in bimonthly bins by shoreside midwater trawl targeting hake. Medians and first and third quartiles for each time period are shown.

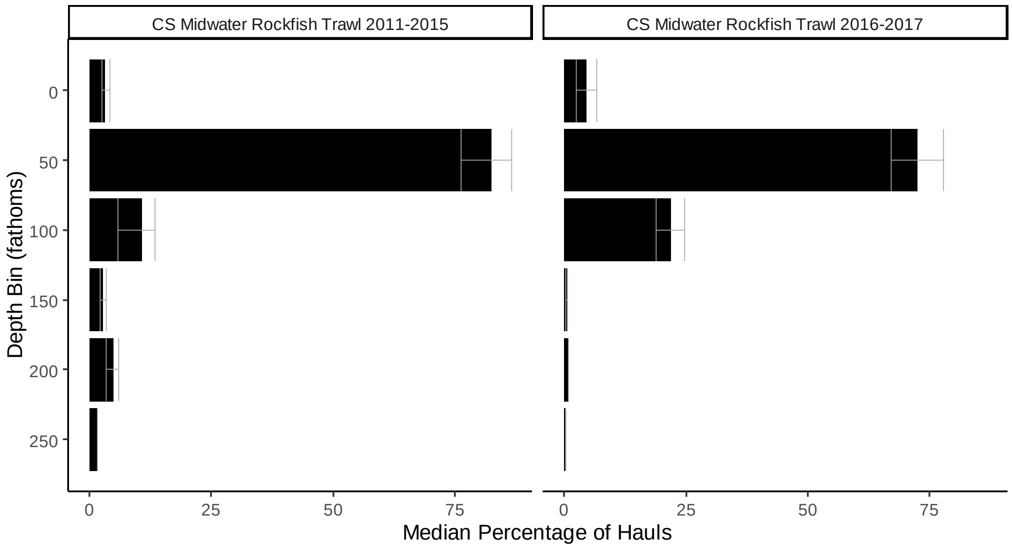


FIGURE 17. Percentage of shoreside midwater trawl targeting rockfish hauls in 50-fathom depth bins. Medians and first and third quartiles for each time period are shown.

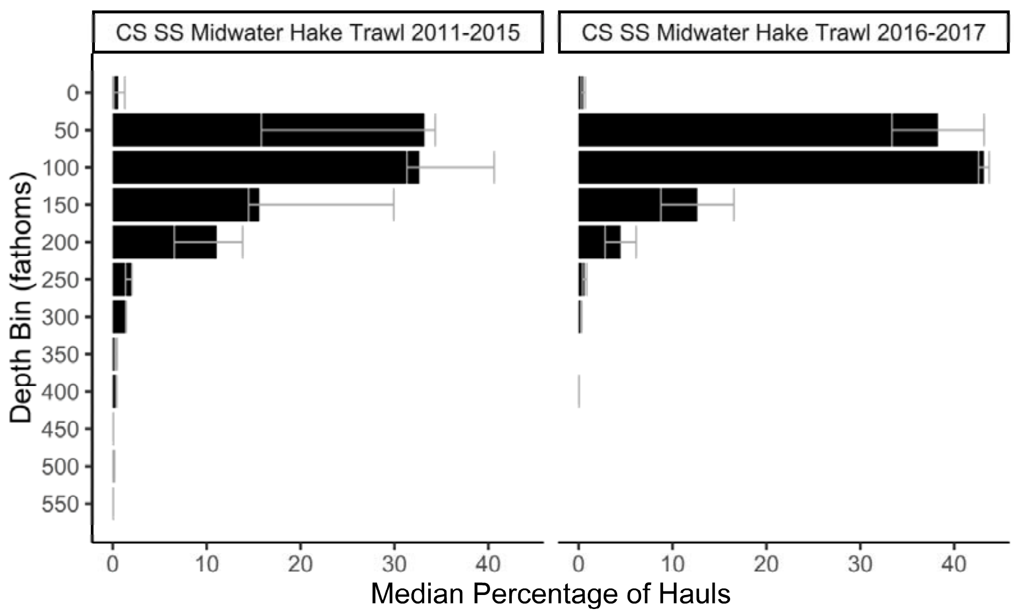


FIGURE 18. Percentage of shoreside midwater trawl targeting hake hauls in 50-fathom depth bins. Medians and first and third quartiles for each time period are shown.

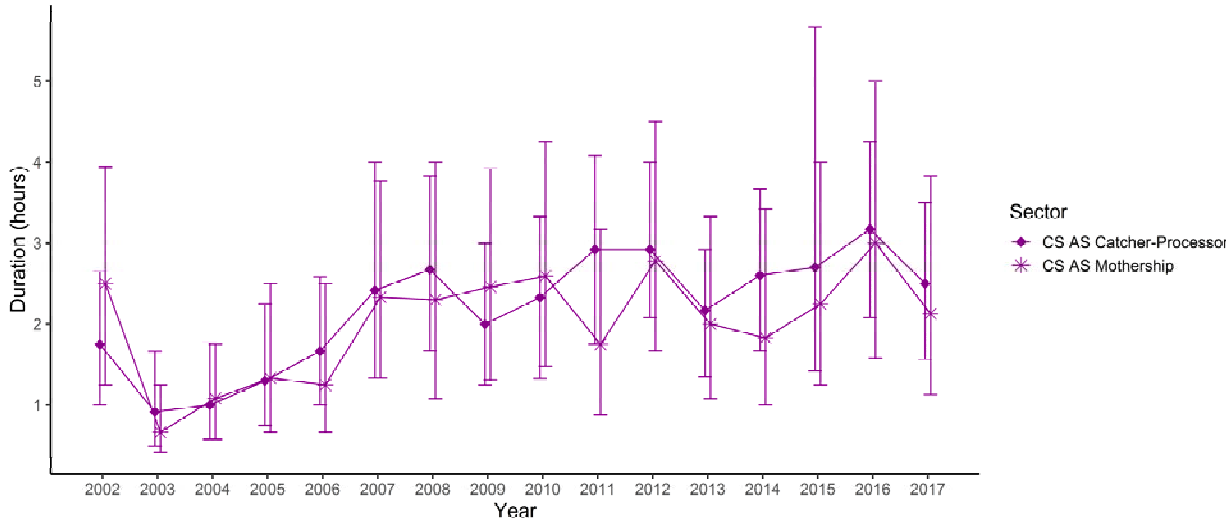


FIGURE 19. Tow duration (hours) per haul in at-sea midwater trawl sectors. Medians and first and third quartiles for each year are shown.

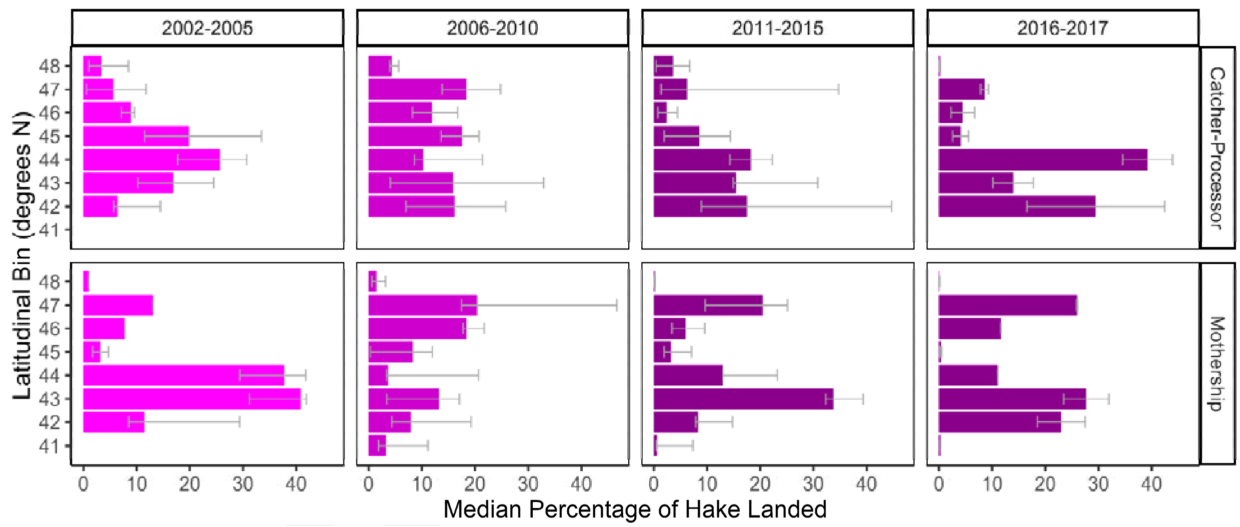


FIGURE 20. Percentage of retained hake caught in latitudinal bins by at-sea midwater trawl sectors. Medians and first and third quartiles are shown.

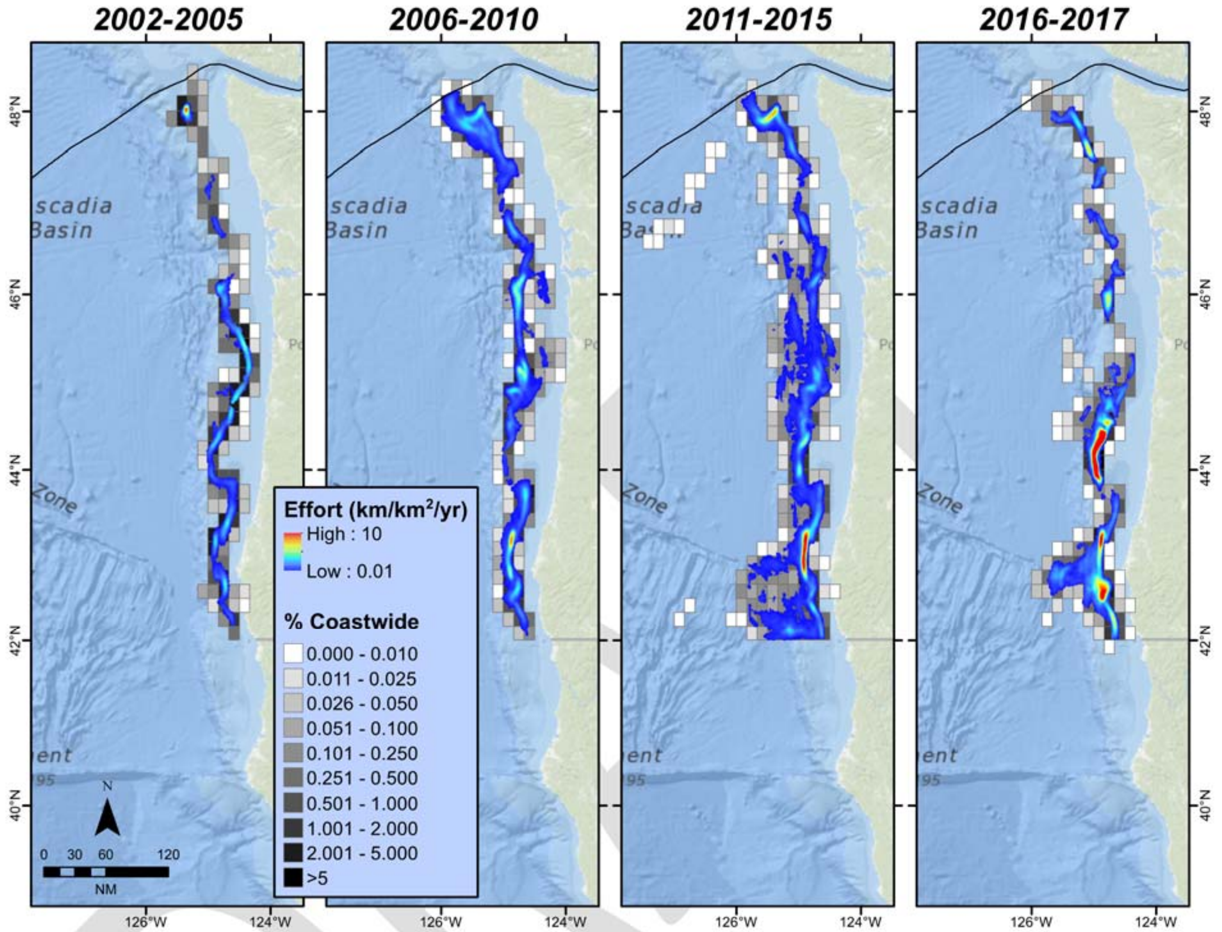


FIGURE 21. Spatial distribution and intensity of fishing effort by at-sea midwater trawl catcher-processors. Intensity (units: km/km^2/yr) is depicted by a color ramp of cool (low) to warm (high) colors. The overall footprint of fishing for each time period is depicted in grayscale, with darker (black) tones depicting a higher relative contribution to the coastwide effort within 10x10 min cells.

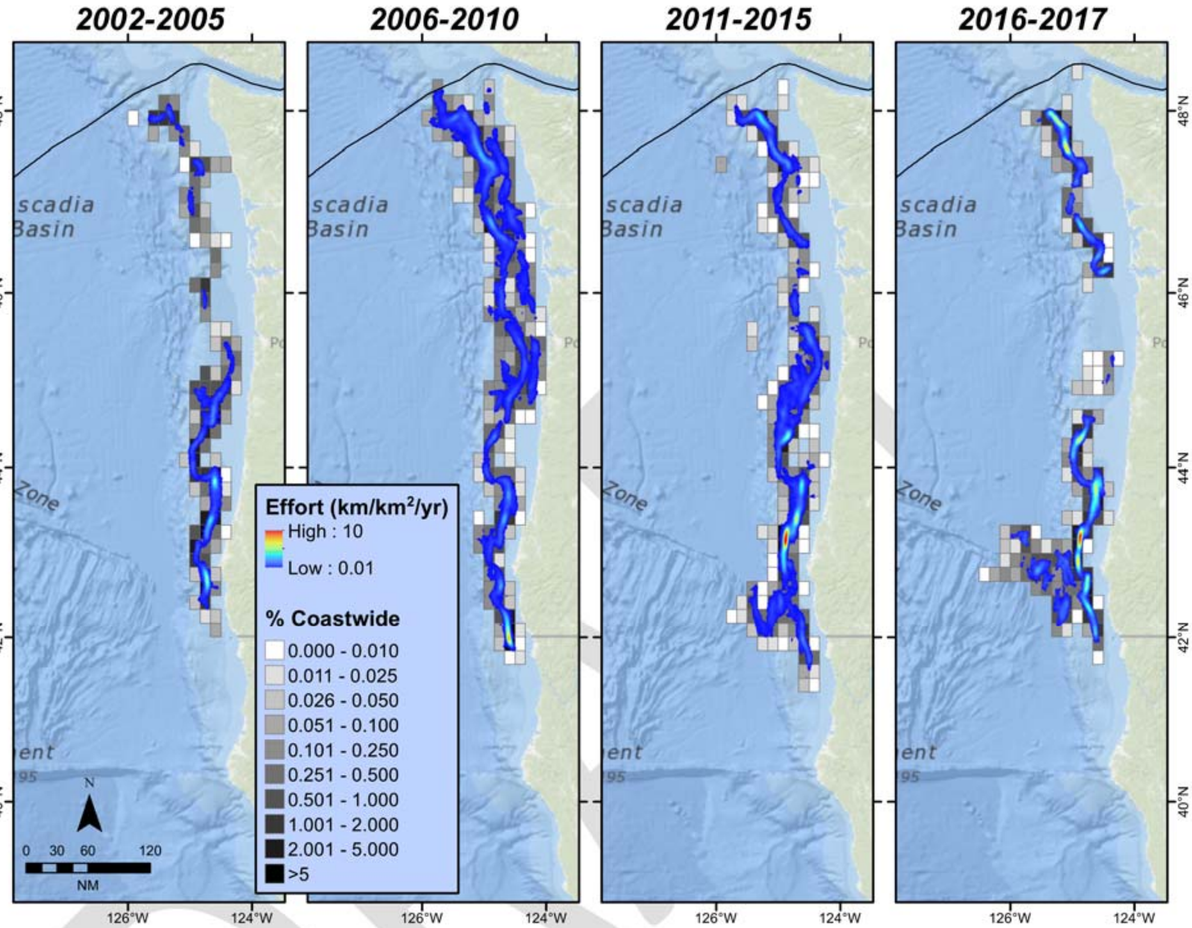


FIGURE 22. Spatial distribution and intensity of fishing effort by at-sea midwater trawl mothership catcher-vessels. Intensity (units: km/km^2/yr) is depicted by a color ramp of cool (low) to warm (high) colors. The overall footprint of fishing for each time period is depicted in grayscale, with darker (black) tones depicting a higher relative contribution to the coastwide effort within 10x10 min cells.

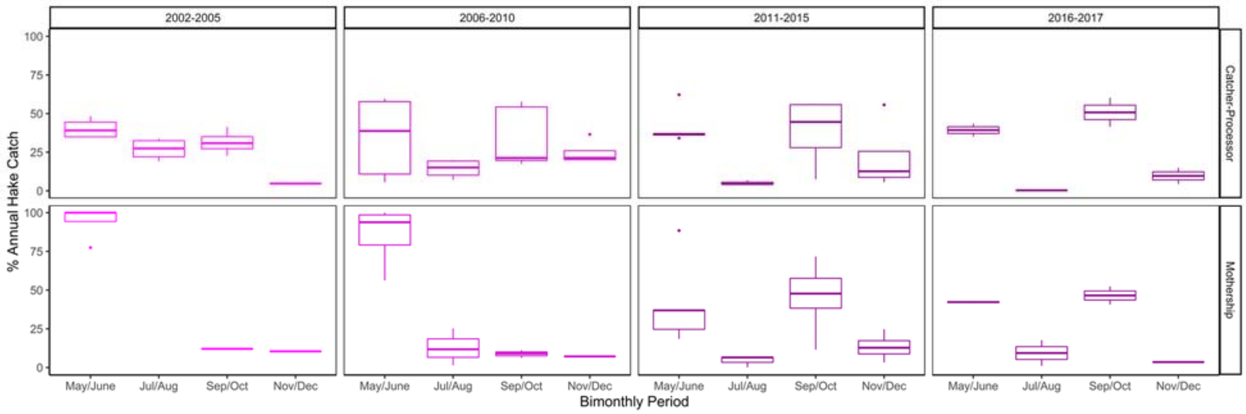


FIGURE 23. Percentage of retained hake caught in bimonthly bins by at-sea midwater trawl sectors. Medians and first and third quartiles for each time period are shown.

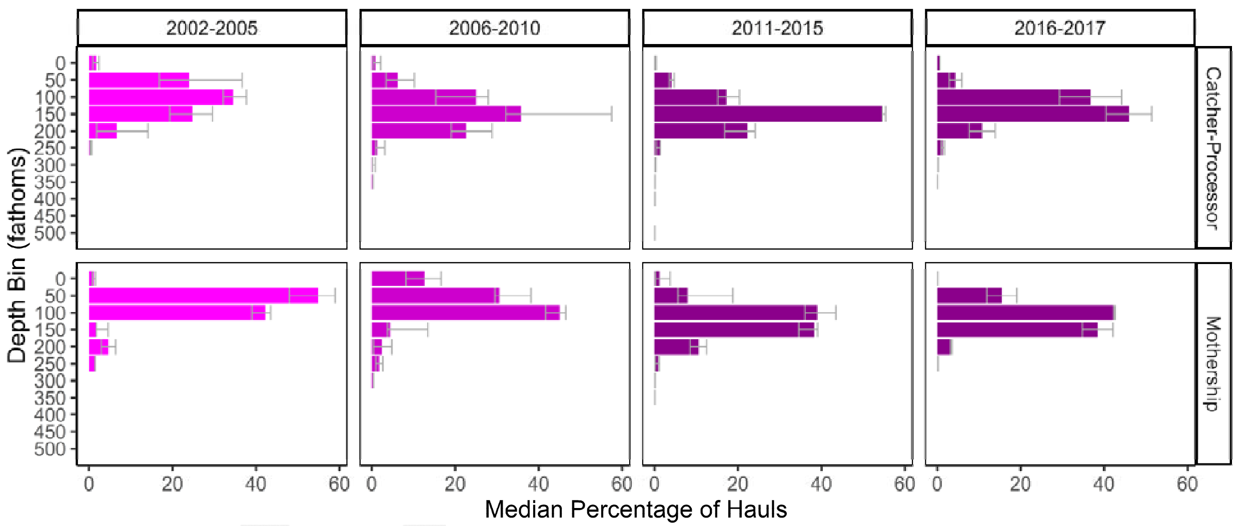


FIGURE 24. Percentage of at-sea midwater trawl hauls in 50-fathom depth bins. Medians and first and third quartiles for each time period are shown.

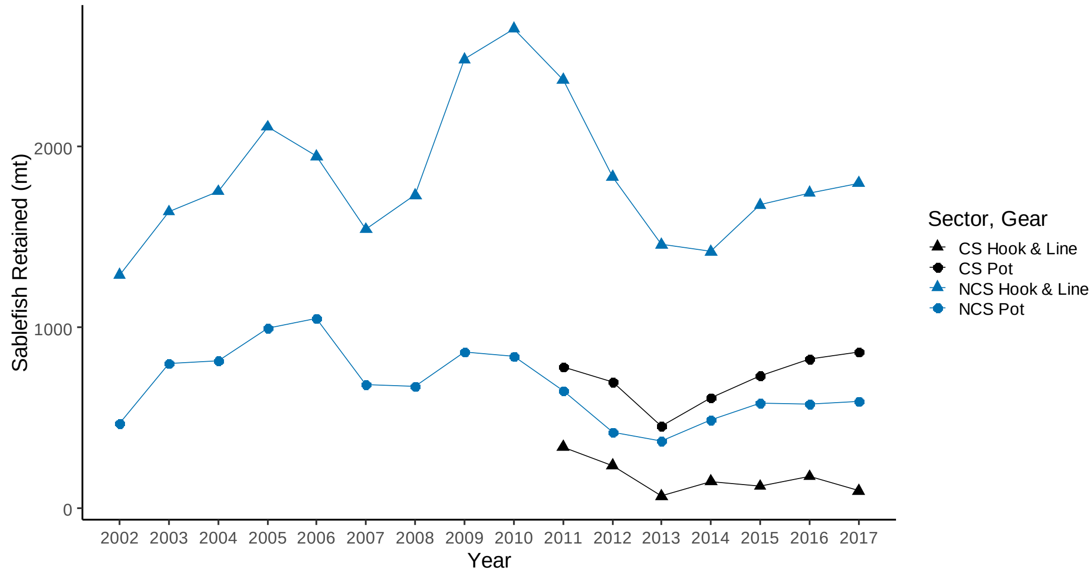


FIGURE 25. Annual total fleet-wide sablefish landings (mt) in fixed gear sectors.

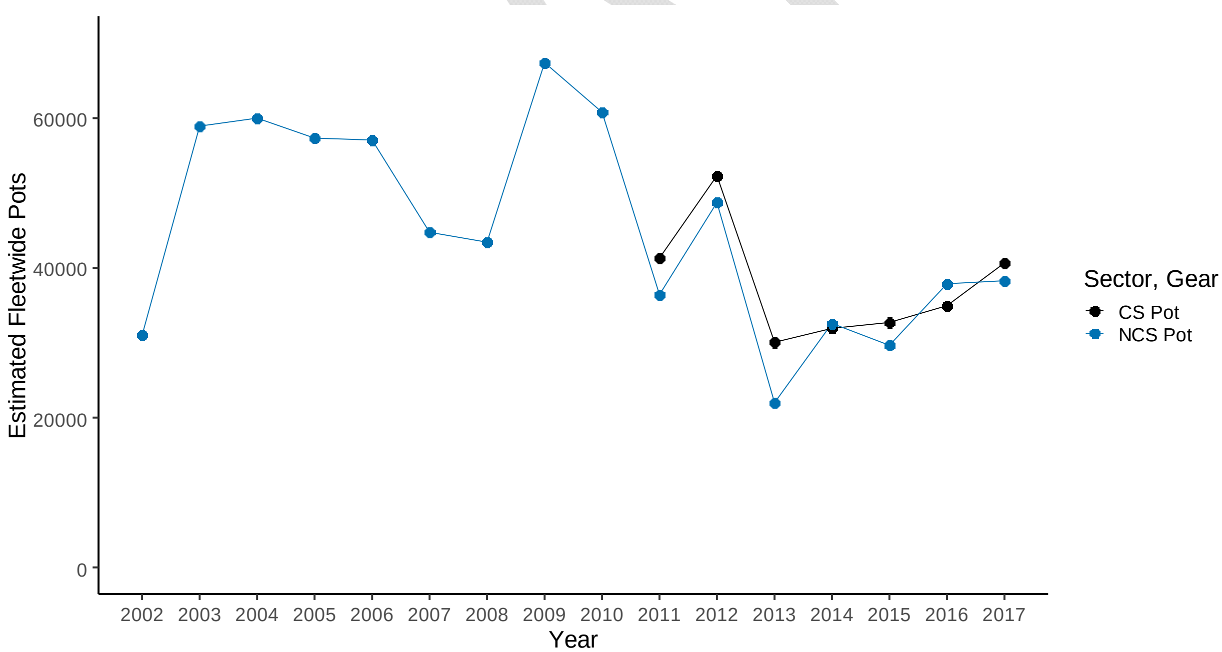


FIGURE 26. Annual total fleet-wide gear units in pot sectors.

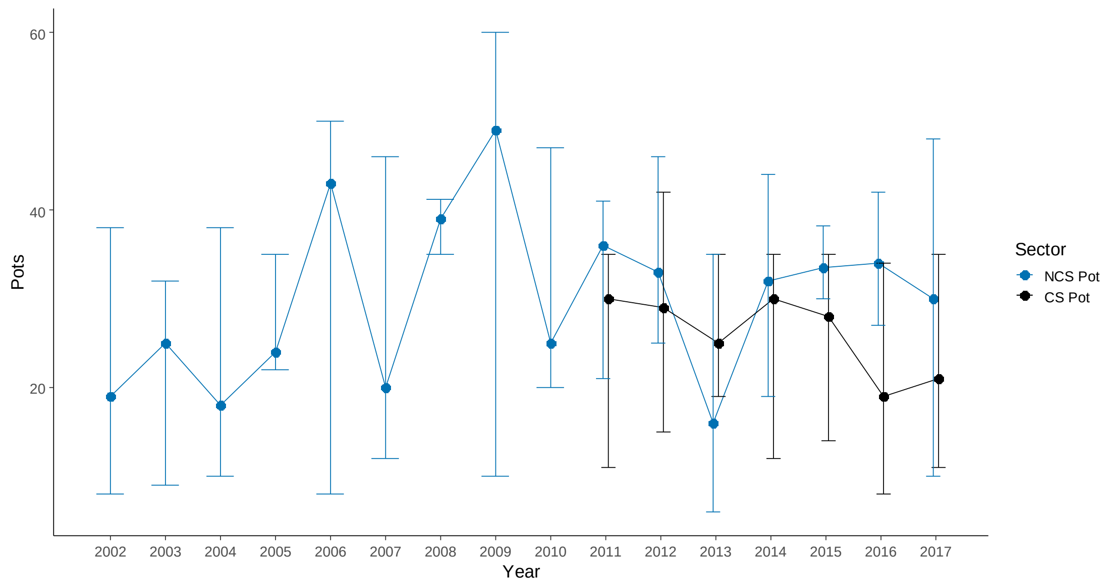


FIGURE 27. Gear units per haul in pot sectors. Medians and first and third quartiles for each year are shown.

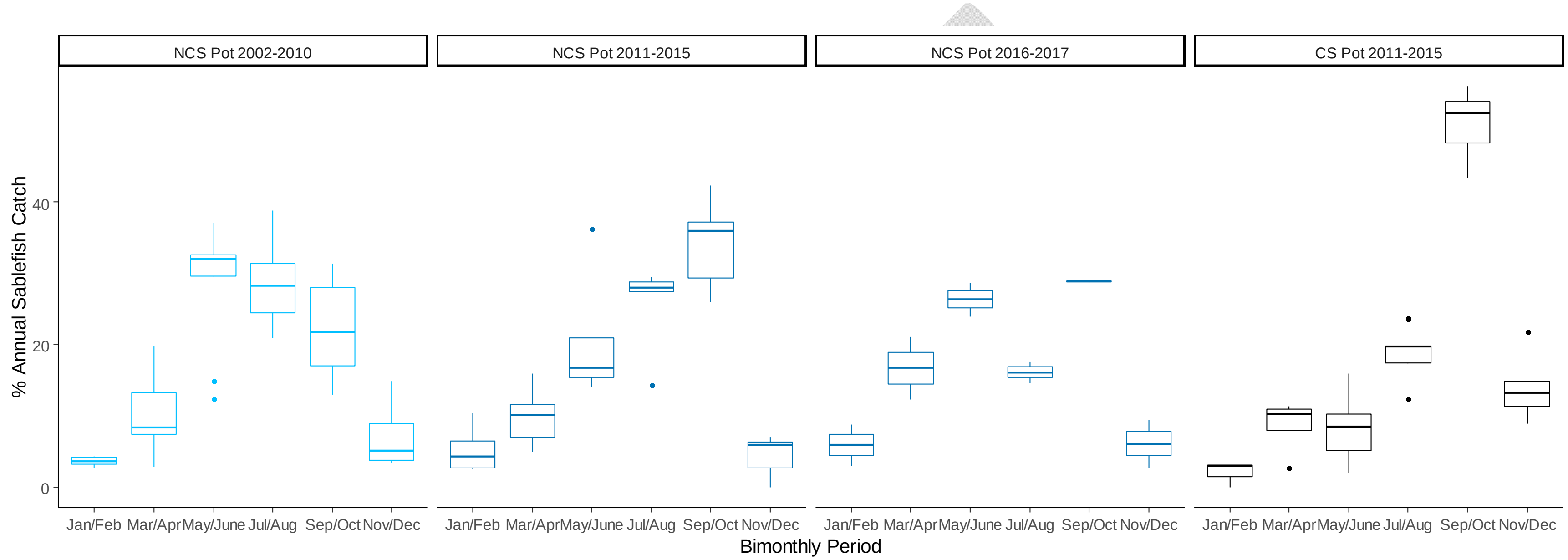


FIGURE 28. Percentage of retained sablefish landed in latitudinal bins by pot sectors. Medians and first and third quartiles are shown.

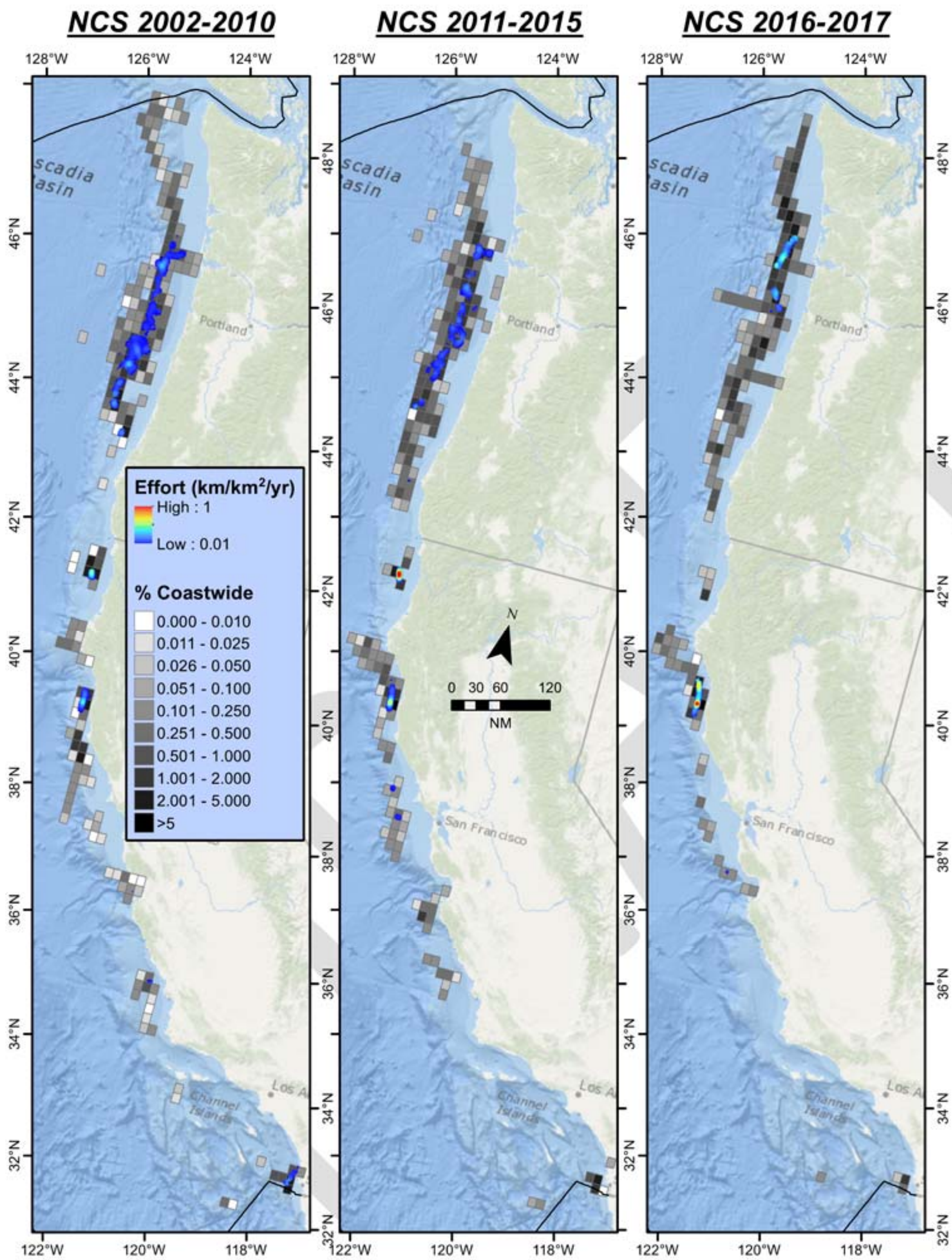


FIGURE 29. Spatial distribution and intensity of fishing effort by the non-catch shares pot sector. Intensity (units: km/km^2/yr) is depicted by a color ramp of cool (low) to warm (high) colors. The overall footprint of fishing for each time period is depicted in grayscale, with darker (black) tones depicting a higher relative contribution to the coastwide effort within 10x10 min cells.

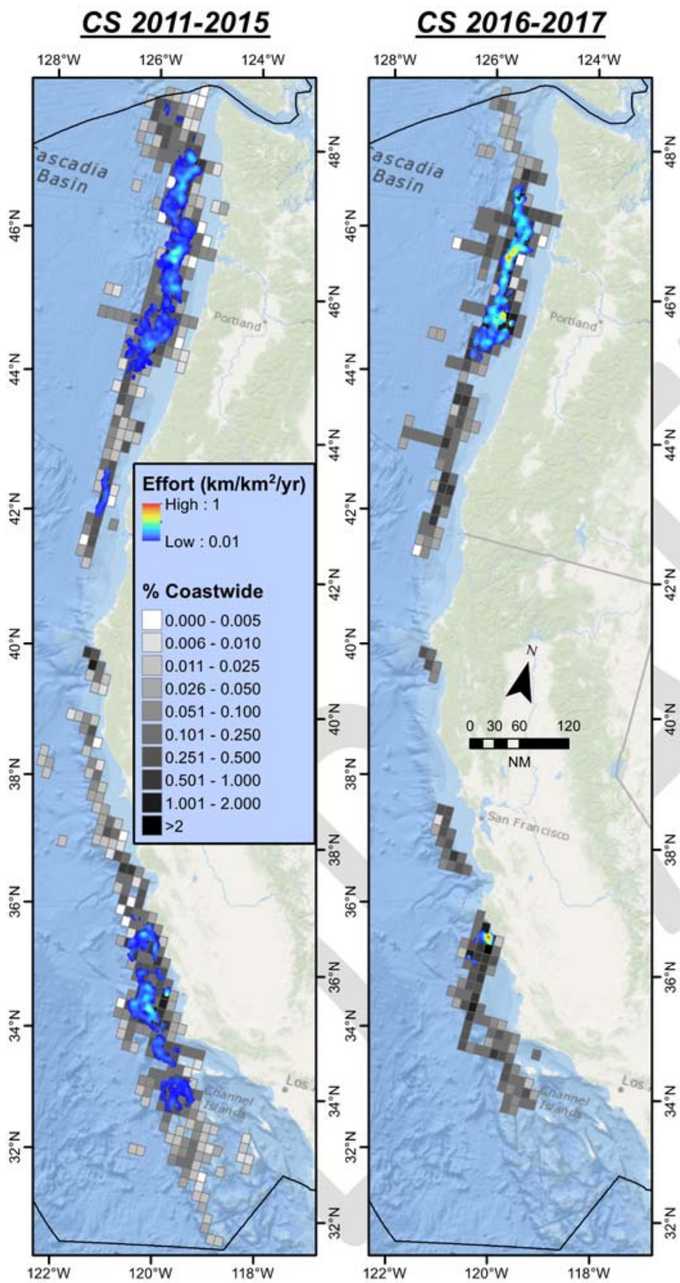


FIGURE 30. Spatial distribution and intensity of fishing effort by the catch shares pot sector. Intensity (units: km/km^2/yr) is depicted by a color ramp of cool (low) to warm (high) colors. The overall footprint of fishing for each time period is depicted in grayscale, with darker (black) tones depicting a higher relative contribution to the coastwide effort within 10x10 min cells.

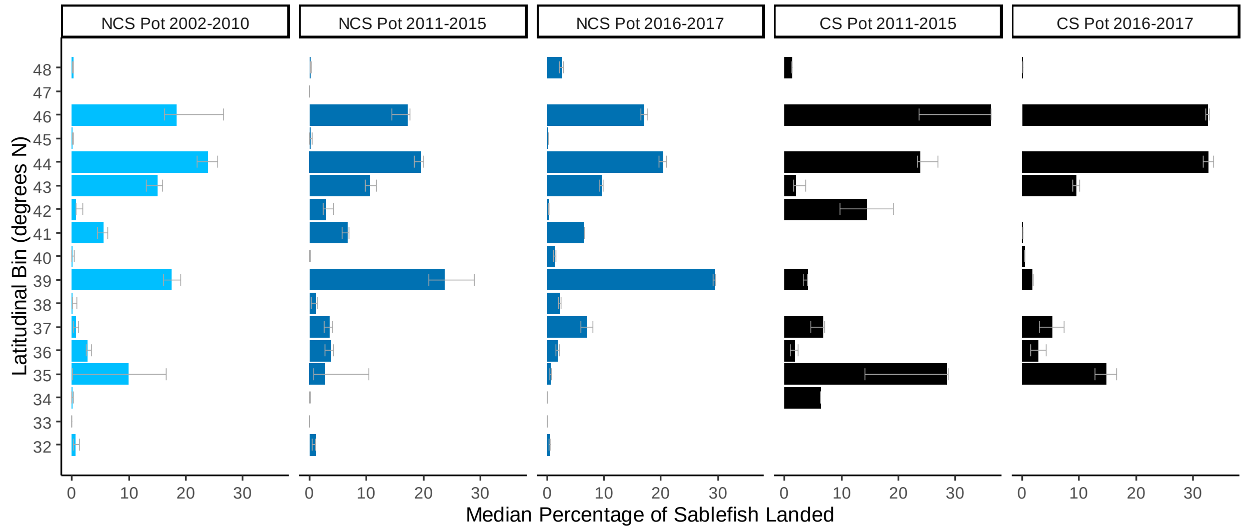


FIGURE 31. Percentage of retained sablefish landed in bimonthly bins by pot sectors. Medians and first and third quartiles for each time period are shown.

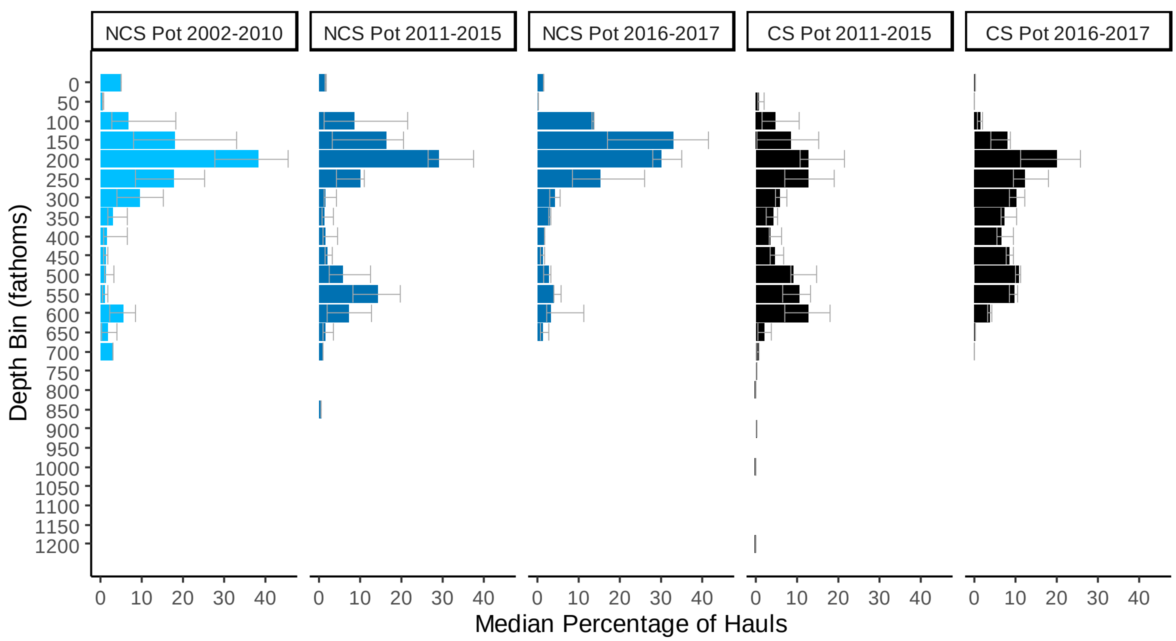


FIGURE 32. Percentage of observed pot hauls in 50-fathom depth bins. Medians and first and third quartiles for each time period are shown.

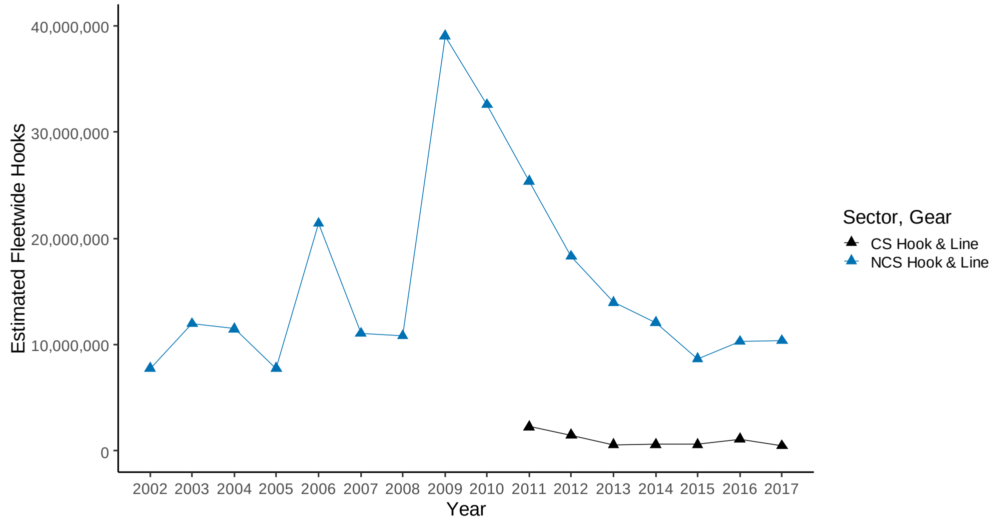


FIGURE 33. Annual total fleet-wide gear units in hook-and-line sectors.

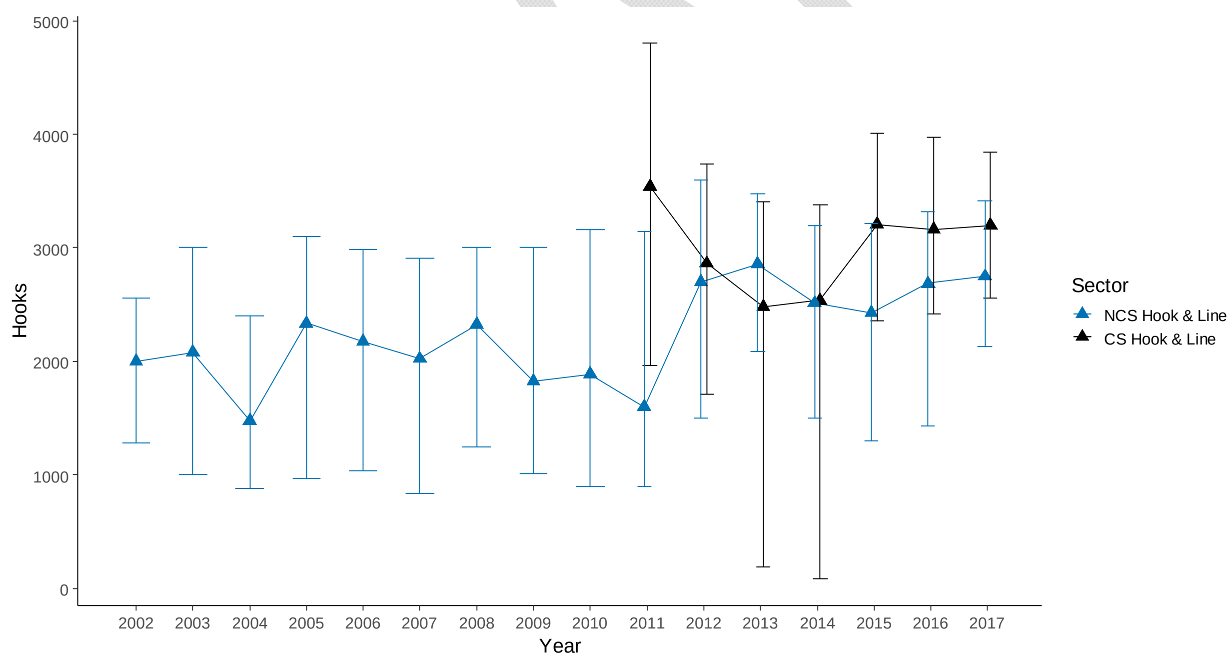


FIGURE 34. Gear units per haul in hook-and-line sectors. Medians and first and third quartiles for each year are shown.

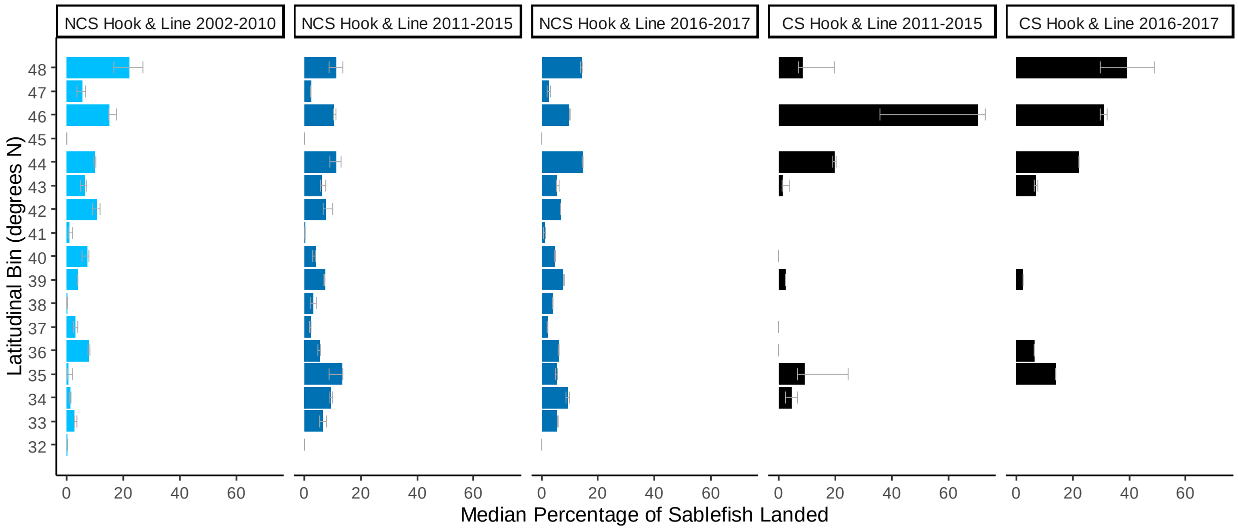


FIGURE 35. Percentage of retained sablefish landed in latitudinal bins by hook-and-line sectors. Medians and first and third quartiles are shown.

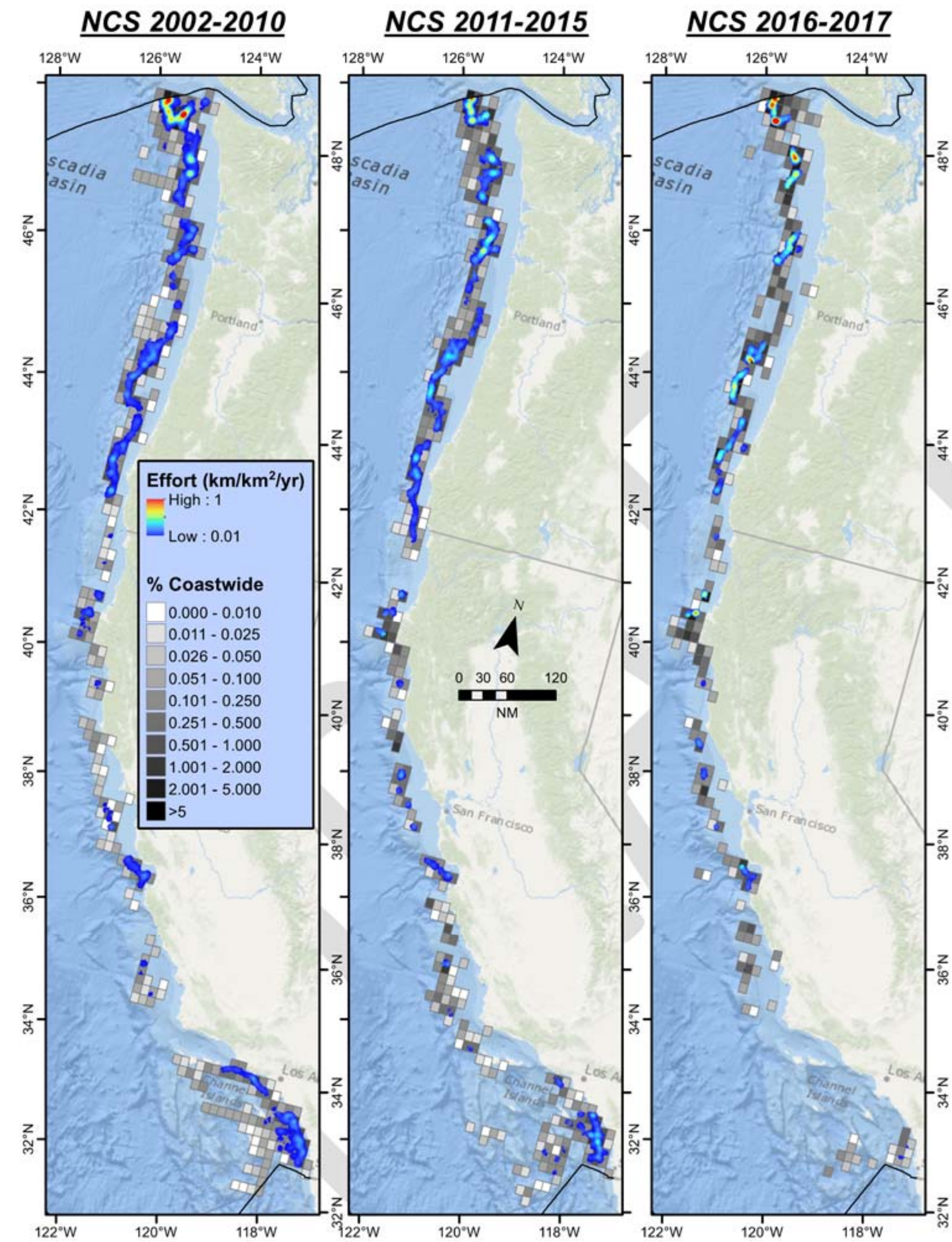


FIGURE 36. Spatial distribution and intensity of fishing effort by the non-catch shares hook-and-line sector. Intensity (units: km/km²/yr) is depicted by a color ramp of cool (low) to warm (high) colors. The overall footprint of fishing for each time period is depicted in grayscale, with darker (black) tones depicting a higher relative contribution to the coastwide effort within 10x10 min cells.

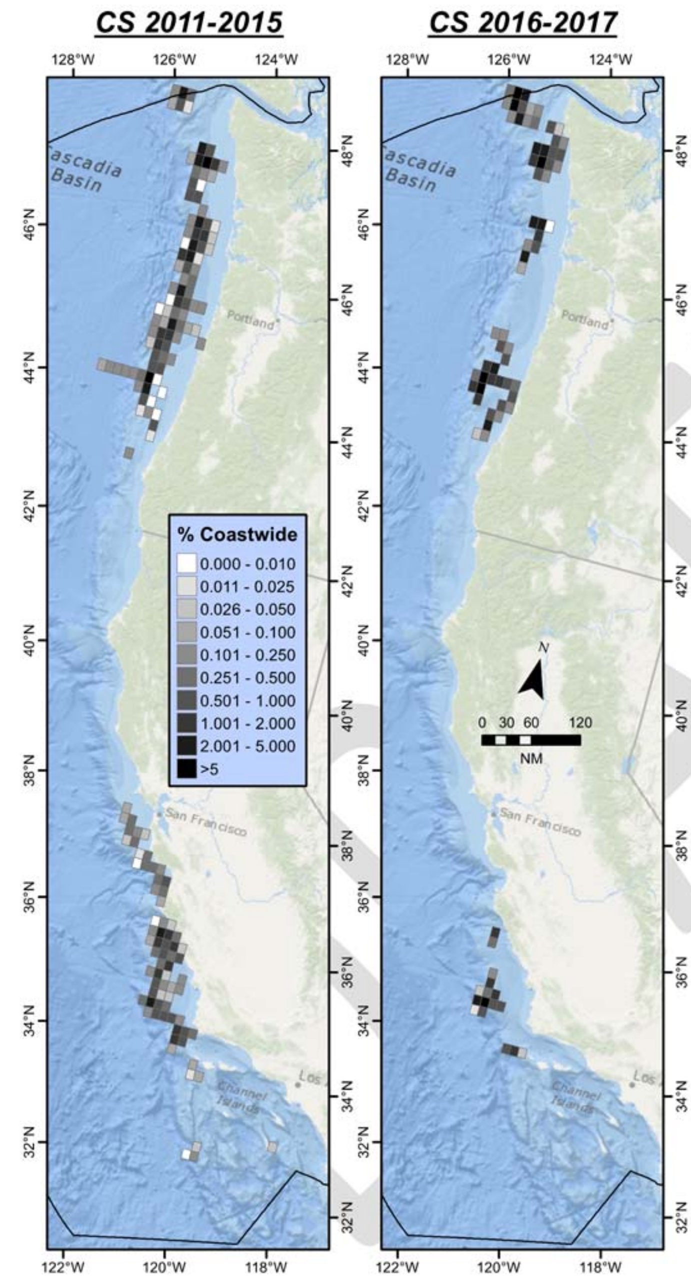


FIGURE 37. Spatial distribution of fishing effort by the catch shares hook-and-line sector. The overall footprint of fishing for each time period is depicted in grayscale, with darker (black) tones depicting a higher relative contribution to the coastwide effort within 10x10 min cells.

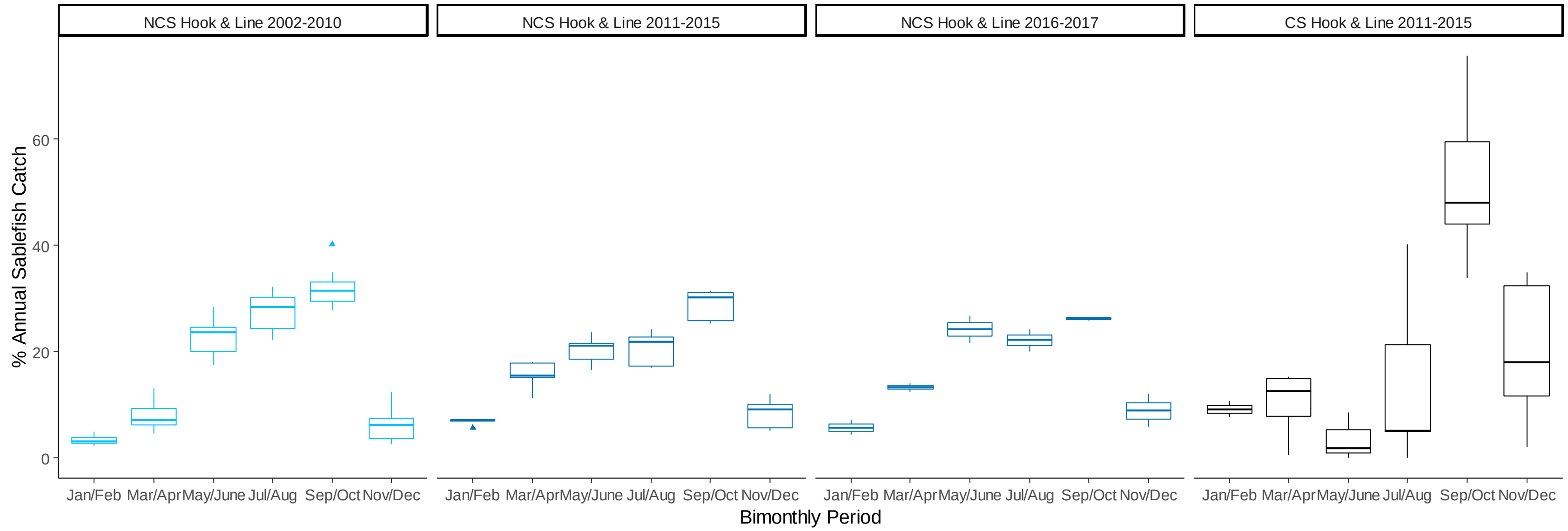


FIGURE 38. Percentage of retained sablefish landed in bimonthly bins by hook-and-line sectors. Medians and first and third quartiles for each time period are shown.

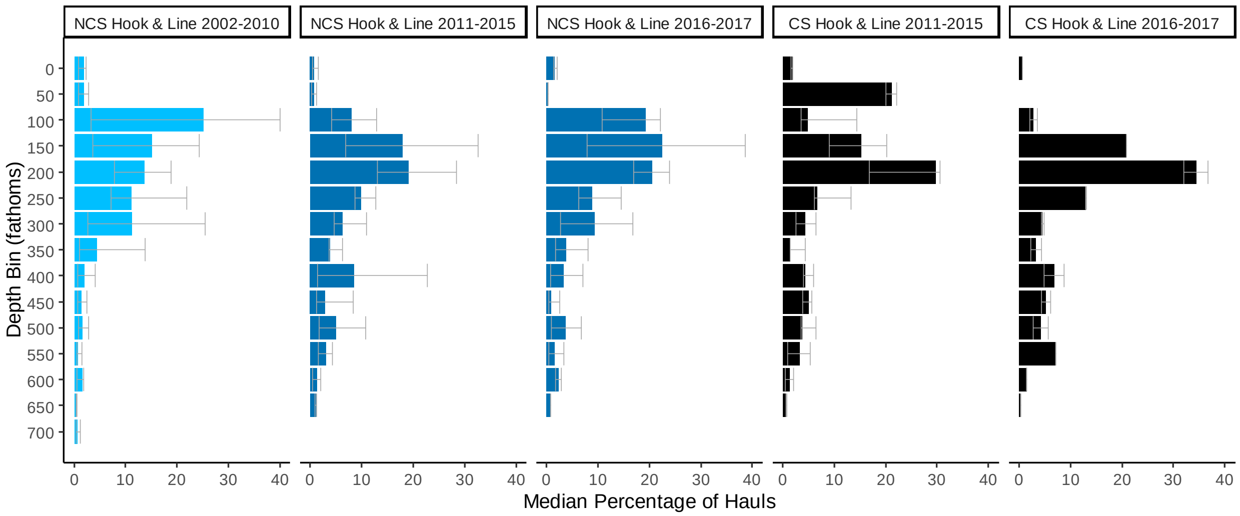


FIGURE 39. Percentage of observed hook-and-line hauls in 50-fathom depth bins. Medians and first and third quartiles for each time period are shown.

Tables

TABLE 1. Effort by trawl gears. Dashes indicate data summaries not applicable to the given sector.

Sector and Gear		Year	Vessels	Trips	Hauls	Fleetwide Retained (mt) Groundfish	Sablefish	Hake	Tow Duration (hrs)	Trawl Hours per Haul Lower Quartile	Median	Upper Quartile
Shoreside	LE Bottom Trawl	2002	198	4125	19518	17314	1382	29	83263	2.00	3.00	5.50
		2003	197	3527	17488	17386	2086	35	77526	2.00	3.50	6.00
		2004	121	2432	14124	17081	2183	21	51559	1.80	2.80	4.95
		2005	123	2563	15354	18421	2312	3	53213	1.80	2.75	4.50
		2006	119	2379	15202	16774	2459	1	55628	2.00	3.00	4.73
		2007	121	2395	14901	19575	2425	2	60692	2.25	3.50	5.42
		2008	118	2387	16191	22922	2864	0	72396	2.50	4.00	6.00
		2009	117	2675	18410	25585	2999	0	80594	2.40	3.90	5.90
		2010	104	1947	13665	22134	2506	10	65393	2.50	4.30	6.50
	CS Bottom Trawl	2011	72	1152	8991	16972	1676	27	38323	2.00	4.00	5.90
		2012	66	1116	8769	16971	1440	19	36037	2.00	3.66	5.75
		2013	68	1217	9716	18563	1399	58	39852	2.00	3.60	5.70
		2014	63	1012	8087	15825	1277	38	32773	2.00	3.50	5.60
		2015	59	913	7394	16046	1458	56	28517	1.95	3.17	5.20
		2016	57	888	6782	16714	1448	40	26554	2.00	3.30	5.25
		2017	61	970	6440	17466	1515	34	25466	2.00	3.20	5.40
	Midwater Hake Trawl	2011	26	901	1715	784	30	90882	3966	0.92	1.67	3.23
		2012	24	702	1580	655	47	65388	5934	1.58	3.33	5.42
		2013	24	916	1715	380	1	96857	4595	1.25	2.27	3.67
		2014	25	938	1723	747	5	97965	4727	1.24	2.23	3.83
		2015	22	578	1467	870	7	57901	6728	1.86	3.67	6.50
		2016	23	743	1618	1095	6	85382	5275	1.35	2.54	4.50
		2017	25	1236	2314	2885	97	144126	5873	1.20	2.17	3.50
	Midwater Rockfish Trawl	2011	4	5	17	29	0	11	31	0.92	1.22	2.27
		2012	7	19	56	419	2	9	100	0.75	1.22	2.39
		2013	5	22	97	609	0	11	171	0.85	1.42	2.32
		2014	9	36	135	889	0	20	275	1.00	1.87	2.75
		2015	14	69	223	1763	0	54	358	0.73	1.42	2.09
		2016	9	46	123	1144	0	78	239	1.00	1.67	2.50
		2017	17	174	349	5829	1	277	642	0.75	1.50	2.50
At-Sea	Midwater Hake Catcher-Processor	2002	5	--	559	--	--	36333	1061	1.00	1.75	2.65
		2003	6	--	768	--	--	41469	911	0.50	0.92	1.67
		2004	6	--	1501	--	--	72859	1973	0.58	1.00	1.77
		2005	6	--	1337	--	--	78497	2239	0.75	1.30	2.25
		2006	9	--	1497	--	--	78246	2981	1.00	1.67	2.58
		2007	9	--	1577	--	--	72898	4404	1.33	2.42	4.00
		2008	8	--	1886	--	--	107754	5558	1.67	2.67	3.83
		2009	5	--	868	--	--	34591	1932	1.25	2.00	3.00
		2010	6	--	1068	--	--	54217	2653	1.33	2.33	3.33
		2011	9	--	1549	--	--	71337	4762	1.75	2.92	4.08
		2012	9	--	1107	--	--	55523	3546	2.08	2.92	4.00
		2013	9	--	1459	--	--	78005	3294	1.35	2.17	2.92
		2014	9	--	1696	--	--	103171	4731	1.67	2.60	3.67
		2015	9	--	1519	--	--	68435	5691	1.42	2.70	5.67
		2016	9	--	2205	--	--	108781	7291	2.08	3.17	4.25
		2017	9	--	2159	--	--	137104	5716	1.57	2.50	3.50
	Midwater Hake Mothership Catcher Vessel	2002	11	--	574	--	--	26503	1625	1.25	2.50	3.94
		2003	12	--	536	--	--	25333	501	0.42	0.67	1.25
		2004	10	--	571	--	--	24010	797	0.58	1.08	1.75
		2005	18	--	1040	--	--	48601	1883	0.67	1.33	2.50
		2006	20	--	1283	--	--	54139	2326	0.67	1.25	2.50
		2007	20	--	1147	--	--	47276	3134	1.33	2.33	3.76
		2008	19	--	1349	--	--	57687	3866	1.08	2.30	4.00
		2009	19	--	600	--	--	24066	1686	1.31	2.46	3.92
		2010	21	--	908	--	--	35727	2805	1.48	2.59	4.25
		2011	18	--	1248	--	--	49971	2976	0.88	1.75	3.17
		2012	16	--	949	--	--	38042	3162	1.67	2.78	4.50
		2013	18	--	1256	--	--	52348	3076	1.08	2.00	3.33
		2014	19	--	1308	--	--	61794	3547	1.00	1.83	3.42
		2015	14	--	640	--	--	27544	2135	1.25	2.25	4.00
		2016	17	--	1565	--	--	64597	5502	1.58	3.00	5.00
		2017	15	--	1309	--	--	65358	3661	1.13	2.13	3.83

TABLE 2. Percentage of retained FMP groundfish, other than hake, landed in latitudinal bins by trawl sectors targeting groundfish other than hake, stratified by trawl type and time period.

Latitude	Bottom Trawl												Midwater Rockfish Trawl					
	2002 - mid-2006			Mid-2006 - 2010			2011-2015			2016-2017			2011-2015			2016-2017		
(deg. N)	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ
48	9.19	9.33	11.08	4.50	5.00	5.68	2.82	2.85	2.99	3.15	3.59	4.03	18.80	25.24	31.68	0.00	0.00	0.00
47	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
46	23.78	31.74	32.26	35.60	35.87	36.39	43.17	43.75	45.78	39.60	41.39	43.19	62.12	71.75	78.51	64.38	66.67	68.97
45	0.17	0.19	0.26	0.05	0.05	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44	8.08	8.42	8.97	10.75	12.28	12.56	6.20	8.96	9.24	13.63	14.20	14.78	15.21	22.72	31.92	30.46	32.97	35.49
43	12.02	12.91	13.32	13.91	14.37	14.49	8.62	10.04	12.25	8.00	8.44	8.88	0.00	0.00	0.00	0.00	0.00	0.00
42	3.29	3.70	5.09	4.67	5.25	5.47	6.31	6.50	7.08	8.73	8.83	8.94	0.00	0.00	0.00	0.00	0.00	0.00
41	2.72	3.36	4.84	3.25	3.42	3.54	0.58	0.81	1.18	1.33	1.40	1.46	0.00	0.00	0.00	0.00	0.00	0.00
40	9.77	9.88	10.88	11.04	12.16	12.24	12.49	12.64	14.08	14.60	14.79	14.99	0.00	0.00	0.00	0.83	0.83	0.83
39	7.71	7.92	8.30	6.51	6.62	6.85	7.76	8.09	9.05	5.47	5.56	5.66	0.00	0.00	0.00	0.00	0.00	0.00
38	0.15	0.25	1.08	0.18	0.35	0.42	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
37	2.75	3.83	4.64	2.47	3.69	3.70	1.49	1.99	2.09	0.78	1.05	1.31	0.00	0.00	0.00	0.00	0.00	0.00
36	3.49	4.77	6.05	1.18	1.25	1.52	1.22	2.05	2.67	0.20	0.20	0.20	0.00	0.00	0.00	0.00	0.00	0.00
35	2.27	4.27	4.57	0.13	0.26	0.48	1.17	1.30	1.55	0.51	0.70	0.90	0.00	0.00	0.00	0.00	0.00	0.00
34	0.03	0.03	0.03	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
32	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TABLE 3. Percentage of retained FMP groundfish, other than hake, landed in bimonthly periods by trawl sectors targeting groundfish, stratified by trawl type and time period.

Bimonthly Period	Bottom Trawl												Midwater Rockfish Trawl					
	2002 - mid-2006			Mid-2006 - 2010			2011-2015			2016-2017			2011-2015			2016-2017		
	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ
Jan/Feb	16.40	17.87	19.42	16.74	17.18	17.51	10.38	13.01	19.99	15.58	16.88	18.19	0.00	0.00	0.00	0.00	0.00	0.00
Mar/Apr	16.72	18.18	20.23	16.81	19.38	20.94	22.13	23.01	23.40	22.51	22.93	23.35	0.00	0.00	0.00	7.51	7.51	7.51
May/June	18.35	18.75	18.94	17.06	17.65	18.22	15.05	16.01	19.79	14.21	14.40	14.60	3.18	3.74	11.43	12.09	17.65	23.22
Jul/Aug	15.65	17.95	20.19	16.03	16.67	17.15	13.86	16.11	16.86	13.35	13.43	13.51	2.83	17.95	22.40	13.85	16.37	18.90
Sep/Oct	15.73	16.67	17.58	15.00	16.80	18.90	13.44	14.98	15.68	14.62	14.92	15.21	52.14	58.32	61.38	23.34	32.21	41.09
Nov/Dec	9.60	11.16	11.76	11.58	13.31	15.06	14.27	14.32	14.47	16.96	17.44	17.91	16.66	22.62	34.46	28.91	30.00	31.09

TABLE 4. Percentage of hauls in 50-fm depth bins by trawl sectors, stratified by trawl type and time period.

	Shoreside																							
	Bottom Trawl												Midwater Rockfish Trawl						Midwater Hake Trawl					
	2002 - mid-2006			Mid-2006 - 2010			2011-2015			2016-2017			2011-2015			2016-2017			2011-2015			2016-2017		
Depth Bin (fm)	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ
0	10.18	11.78	14.57	6.57	7.42	13.30	0.77	4.06	9.38	0.45	2.29	4.79	2.53	3.13	4.15	2.45	4.61	6.78	0.13	0.58	1.28	0.27	0.48	0.70
50	18.01	26.84	31.03	19.77	24.51	29.25	25.39	26.85	30.07	32.82	34.43	38.94	76.29	82.35	86.55	67.12	72.44	77.77	15.82	33.20	34.34	33.37	38.28	43.19
100	0.26	0.93	2.37	0.25	0.45	0.82	0.41	0.80	0.85	0.74	1.14	1.65	5.88	10.76	13.40	18.94	21.84	24.74	31.33	32.65	40.63	42.60	43.16	43.73
150	6.43	7.45	9.94	4.81	6.57	15.14	4.31	7.46	10.33	6.01	7.67	10.98	2.14	2.80	3.46	0.42	0.55	0.68	14.46	15.61	29.94	8.77	12.65	16.54
200	9.90	11.08	12.50	9.02	12.71	19.35	7.07	11.56	16.45	5.58	11.85	18.00	3.54	5.00	6.08	0.81	0.81	0.81	6.56	11.08	13.84	2.82	4.48	6.13
250	11.22	12.64	13.48	9.97	13.15	18.32	6.99	16.02	23.41	5.26	12.35	19.60	1.56	1.63	1.71	0.29	0.29	0.29	1.36	1.98	2.04	0.43	0.64	0.85
300	8.08	8.92	10.57	9.26	11.85	14.61	11.54	13.55	14.65	8.48	9.26	9.61	0.00	0.00	0.00	0.00	0.00	0.00	1.39	1.40	1.46	0.24	0.29	0.34
350	2.34	5.50	8.16	4.04	5.77	7.32	3.94	6.47	10.40	3.40	7.55	12.62	0.00	0.00	0.00	0.00	0.00	0.00	0.23	0.34	0.46	0.00	0.00	0.00
400	0.73	2.19	4.32	1.76	2.34	2.65	1.37	2.95	3.72	1.31	2.66	3.91	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.39	0.43	0.04	0.04	0.04
450	0.84	2.69	4.09	1.18	1.84	2.81	0.96	2.05	4.23	1.63	2.25	3.02	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.06	0.07	0.00	0.00	0.00
500	1.98	3.56	4.16	1.72	3.17	4.51	1.40	3.06	6.09	1.00	1.89	3.02	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.15	0.19	0.00	0.00	0.00
550	1.00	2.31	2.55	0.88	1.90	2.39	0.55	1.13	1.67	0.18	0.78	1.39	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.06	0.06	0.00	0.00	0.00
600	0.25	0.30	0.42	0.21	0.32	0.42	0.14	0.18	0.34	0.06	0.07	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
650	0.03	0.06	0.10	0.03	0.04	0.05	0.02	0.03	0.04	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
700	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
750	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
800	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

	At-Sea																							
	Midwater Hake Trawl Catcher-Processor												Midwater Hake Trawl Mothership Catcher Vessel											
	2002-2005			2006-2010			2011-2015			2016-2017			2002-2005			2006-2010			2011-2015			2016-2017		
Depth Bin (fm)	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ
0	0.92	1.73	2.36	0.38	0.90	2.11	0.07	0.17	0.36	0.64	0.64	0.65	0.77	1.16	1.54	8.19	12.60	16.65	0.25	1.19	3.70	0.08	0.08	0.08
50	16.84	23.93	36.65	3.46	6.20	10.15	3.54	4.04	4.74	2.85	4.39	5.92	47.99	54.91	58.98	29.50	30.55	38.10	5.63	7.95	18.75	11.90	15.50	19.09
100	32.14	34.53	37.73	15.36	24.97	27.90	15.21	17.25	20.36	29.27	36.73	44.19	39.02	42.25	43.50	41.67	45.05	46.48	36.09	38.99	43.47	42.30	42.48	42.67
150	19.30	24.80	29.57	32.13	35.74	57.49	54.56	54.64	55.37	40.46	45.94	51.43	1.73	1.83	4.52	3.74	4.45	13.42	34.56	38.30	39.09	34.77	38.45	42.13
200	1.79	6.65	14.13	19.01	22.57	28.79	16.79	22.25	24.12	7.66	10.77	13.89	2.93	4.65	6.36	0.35	2.42	4.79	8.52	10.63	12.50	3.22	3.38	3.54
250	0.30	0.44	0.59	0.92	1.33	3.09	0.36	1.36	1.37	0.96	1.32	1.68	1.44	1.44	1.44	0.95	1.80	2.64	0.16	0.84	1.12	0.11	0.15	0.19
300	0.00	0.00	0.00	0.19	0.23	0.84	0.16	0.18	0.29	0.16	0.18	0.20	0.00	0.00	0.00	0.37	0.37	0.37	0.10	0.12	0.14	0.00	0.00	0.00
350	0.00	0.00	0.00	0.28	0.28	0.28	0.12	0.12	0.12	0.05	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.08	0.08	0.00	0.00	0.00
400	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.10	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
450	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
500	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.06	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
550	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
600	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
650	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
700	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
750	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
800	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TABLE 5. Percentage of retained hake landed in latitudinal bins by midwater trawl sectors targeting hake, stratified by trawl type and time period.

Latitude	Shoreside Midwater Hake Trawl						At-Sea Midwater Hake Catcher-Processor												At-Sea Midwater Hake Mothership Catcher Vessel											
	2011-2015			2016-2017			2002-2005			2006-2010			2011-2015			2016-2017			2002-2005			2006-2010			2011-2015			2016-2017		
(deg. N)	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ
48	0.00	0.00	0.00	0.00	0.00	0.00	1.03	3.39	8.45	3.96	4.38	5.64	0.42	3.62	6.76	0.18	0.21	0.24	0.96	0.96	0.96	0.63	1.46	3.18	0.17	0.20	0.23	0.05	0.09	0.13
47	0.00	0.00	0.00	0.00	0.00	0.00	0.55	5.64	11.78	13.80	18.37	24.80	1.36	6.27	34.77	7.84	8.57	9.30	13.06	13.06	13.06	17.46	20.42	46.69	9.65	20.49	25.13	25.89	25.98	26.07
46	56.61	61.40	69.06	72.07	72.70	73.34	7.11	8.92	9.62	8.22	11.90	16.78	0.79	2.44	4.43	2.24	4.47	6.71	7.77	7.77	7.77	17.75	18.37	21.75	3.43	5.96	9.57	11.65	11.67	11.69
45	0.00	0.00	0.00	0.00	0.00	0.00	11.49	19.86	33.45	13.61	17.57	20.76	1.95	8.56	14.38	2.59	4.09	5.59	1.71	3.15	4.69	0.35	8.34	11.98	1.94	3.28	7.09	0.21	0.36	0.52
44	30.94	38.60	43.39	26.66	27.30	27.93	17.71	25.67	30.67	8.62	10.28	21.37	14.28	18.25	22.30	34.51	39.22	43.92	29.39	37.77	41.81	3.35	3.65	20.67	13.00	13.00	23.25	11.06	11.07	11.09
43	1.69	1.69	1.69	0.00	0.00	0.00	10.24	16.86	24.47	4.09	15.91	32.91	14.95	15.49	30.84	10.13	13.96	17.79	31.19	40.83	41.93	3.38	13.24	17.08	32.29	33.75	39.37	23.44	27.68	31.93
42	0.00	0.00	0.00	0.00	0.00	0.00	5.69	6.39	14.47	7.02	16.15	25.74	8.97	17.56	44.72	16.52	29.48	42.44	8.51	11.46	29.37	4.36	7.95	19.23	7.85	8.34	14.79	18.50	23.00	27.51
41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.86	3.22	11.16	0.42	0.64	7.35	0.27	0.27	0.27

TABLE 6. Percentage of retained hake landed in bimonthly periods by midwater trawl sectors targeting hake, stratified by trawl type and time period.

Bimonthly Period	Shoreside Midwater Hake Trawl						At-Sea Midwater Hake Catcher-Processor												At-Sea Midwater Hake Mothership Catcher Vessel											
	2011-2015			2016-2017			2002-2005			2006-2010			2011-2015			2016-2017			2002-2005			2006-2010			2011-2015			2016-2017		
	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ
Jan/Feb	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mar/Apr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
May/June	7.46	9.92	12.47	22.14	23.74	25.33	34.94	39.15	44.55	10.87	38.76	57.82	36.13	36.81	36.99	37.20	39.34	41.48	94.37	100.00	100.00	79.15	93.82	98.59	24.72	36.95	37.11	41.97	42.31	42.64
Jul/Aug	50.90	51.29	57.83	42.13	42.87	43.61	21.97	27.43	32.48	10.15	15.11	19.28	4.08	4.46	5.62	0.35	0.35	0.35	0.00	0.00	0.00	6.61	11.80	18.53	3.36	6.54	6.79	5.24	9.37	13.51
Sep/Oct	25.78	34.64	37.63	31.27	32.09	32.91	27.26	30.87	35.06	19.72	21.28	54.31	27.98	44.61	55.81	46.14	50.81	55.48	12.07	12.07	12.07	7.62	9.05	10.14	38.36	47.77	57.61	43.64	46.55	49.46
Nov/Dec	2.26	2.29	4.15	1.28	1.31	1.34	4.76	4.76	4.76	20.23	21.35	25.99	8.74	12.68	25.61	7.05	9.67	12.30	10.47	10.47	10.47	7.21	7.21	7.21	8.80	12.79	17.38	3.54	3.54	3.54

TABLE 7. Effort by fixed gear sectors. Trips in the non-catch shares sectors were estimated based on landings by a vessel on a unique day. See Table 8 for coverage rates.

Sector and Gear		Year	Vessels	Trips	Fleetwide Retained (mt) Groundfish	Sablefish	Estimated Total Gear Units	Observed Gear Units per Set Lower Quartile	Median	Upper Quartile
Pot	Non-Catch Shares	2002	105	1086	475	469	30949	8	19	38
		2003	128	1307	808	798	58830	9	25	32
		2004	99	1097	825	815	59991	10	18	38
		2005	139	1349	1007	996	57276	22	24	35
		2006	233	1926	1065	1051	57050	8	43	50
		2007	170	1423	698	684	44787	12	20	46
		2008	152	1442	686	674	43370	35	39	41
		2009	167	1468	877	862	67381	10	49	60
		2010	144	1260	846	837	60718	20	25	47
		2011	156	1052	659	650	36442	21	36	41
		2012	125	698	426	419	48743	25	33	46
		2013	73	531	374	370	21931	6	16	35
		2014	98	516	493	488	32580	19	32	44
		2015	140	856	601	582	29614	30	34	38
		2016	159	938	587	576	37843	27	34	42
		2017	151	939	605	589	38246	10	30	48
	Catch Shares	2011	19	221	790	779	41310	11	30	35
		2012	22	251	711	699	52248	15	29	42
		2013	11	93	502	452	30097	19	25	35
		2014	14	104	619	612	31876	12	30	35
		2015	13	115	745	732	32734	14	28	35
		2016	16	130	865	823	34946	8	19	34
		2017	15	125	869	863	40645	11	21	35
Hook-and-Line	Non-Catch Shares	2002	448	4385	2093	1290	7753966	1280	2000	2560
		2003	497	4649	2257	1640	11955140	1005	2080	3000
		2004	486	4035	2334	1751	11478572	878	1476	2400
		2005	505	4406	2732	2107	7757634	968	2338	3100
		2006	533	4148	2532	1945	21390897	1035	2175	2988
		2007	508	3991	2101	1541	11053776	842	2025	2908
		2008	471	4613	2350	1731	10824976	1246	2325	3000
		2009	494	5476	2969	2482	39034080	1011	1826	3000
		2010	474	6058	3179	2650	32583905	900	1890	3158
		2011	518	5554	2953	2369	25361029	899	1600	3140
		2012	483	4688	2352	1831	18292067	1500	2700	3600
		2013	487	4102	1890	1457	13977180	2091	2856	3480
		2014	517	4075	1796	1418	12068385	1500	2514	3200
		2015	674	4656	2136	1677	8661148	1300	2432	3215
		2016	612	4352	2194	1742	10297256	1436	2686	3315
		2017	605	4639	2345	1797	10377102	2128	2750	3412
	Catch Shares	2011	14	108	364	337	2265264	1965	3540	4800
		2012	9	37	271	235	1472865	1711	2863	3740
		2013	11	30	82	66	587238	190	2484	3404
		2014	12	43	179	148	601654	90	2537	3382
		2015	5	16	138	121	592919	2357	3208	4009
		2016	8	34	205	174	1110926	2418	3163	3970
		2017	3	12	116	95	476944	2560	3200	3840

TABLE 8. Observed effort in NCS fixed gear sectors.

Sector and Gear		Year	Observed						Fleetwide		Percentage of Sablefish Landings Observed
						Retained (mt)			Retained (mt)		
			Vessels	Trips	Hauls	Groundfish	Sablefish	Gear Units	Groundfish	Sablefish	
NCS	Pot	2002	6	23	247	83	82	5438	475	469	18%
		2003	13	51	412	153	151	9362	808	798	19%
		2004	20	109	324	102	100	7328	825	815	12%
		2005	21	82	542	294	292	14657	1007	996	29%
		2006	22	77	328	213	208	11374	1065	1051	20%
		2007	25	76	229	102	99	6440	698	684	14%
		2008	26	79	404	258	255	14471	686	674	38%
		2009	21	57	112	76	75	4423	877	862	9%
		2010	33	83	385	154	151	11942	846	837	18%
		2011	32	83	312	157	156	9860	659	650	24%
		2012	24	54	421	111	110	14828	426	419	26%
		2013	20	39	95	48	47	2524	374	370	13%
		2014	25	57	258	117	116	8247	493	488	24%
		2015	26	85	372	240	238	12238	601	582	41%
		2016	34	110	669	275	270	21906	587	576	47%
		2017	47	99	312	142	140	9101	605	589	24%
	Hook-and-Line	2002	29	79	413	217	192	825624	2093	1290	15%
		2003	45	219	619	285	244	1357937	2257	1640	15%
		2004	45	149	508	218	191	895952	2334	1751	11%
		2005	47	170	775	547	490	1712636	2732	2107	23%
		2006	47	198	682	340	306	1503077	2532	1945	16%
		2007	83	284	888	410	325	1813650	2101	1541	21%
		2008	82	257	829	406	360	1949715	2350	1731	21%
		2009	75	252	664	161	128	1437920	2969	2482	5%
		2010	92	439	1339	452	399	3024816	3179	2650	15%
		2011	95	368	1200	375	312	2722104	2953	2369	13%
		2012	66	250	837	305	264	2369109	2352	1831	14%
		2013	53	205	631	226	188	1805223	1890	1457	13%
		2014	55	190	688	275	230	1765919	1796	1418	16%
		2015	62	200	830	487	435	2115187	2136	1677	26%
		2016	65	190	819	412	371	2101392	2194	1742	21%
		2017	77	204	851	480	421	2387457	2345	1797	23%

TABLE 9. Percentage of retained sablefish landed in latitudinal bins by fixed gear sectors, stratified by sector, gear type, and time period.

Latitude	Pot															Hook-and-Line														
	Non-Catch Shares									Catch Shares						Non-Catch Shares									Catch Shares					
	2002-2010			2011-2015			2016-2017			2011-2015			2016-2017			2002-2010			2011-2015			2016-2017			2011-2015			2016-2017		
(deg. N)	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ
48	0.09	0.22	0.23	0.12	0.18	0.25	2.14	2.57	2.99	1.26	1.26	1.26	0.24	0.24	0.24	16.65	22.08	26.99	8.87	11.20	13.56	13.86	14.10	14.34	7.03	8.40	19.76	29.89	39.38	48.88
47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.43	5.26	6.74	2.15	2.31	2.50	2.09	2.56	3.04	0.00	0.00	0.00	0.00	0.00	0.00
46	16.20	18.41	26.64	14.44	17.20	17.64	16.54	17.15	17.76	23.63	36.06	36.25	32.33	32.56	32.79	14.78	15.27	17.43	10.32	10.33	11.36	9.71	9.88	10.05	35.74	70.42	73.12	29.79	31.01	32.24
45	0.16	0.19	0.32	0.09	0.23	0.53	0.19	0.20	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.00	0.00	0.02	0.06	0.08	0.09	0.00	0.00	0.00	0.00	0.00	0.00
44	22.00	23.88	25.59	18.36	19.53	20.08	19.69	20.37	21.04	23.32	23.76	26.87	31.82	32.73	33.64	9.62	9.92	10.32	9.02	11.37	13.14	14.46	14.60	14.75	19.08	19.65	20.22	22.33	22.33	22.33
43	13.08	15.06	15.98	9.76	10.62	11.81	9.25	9.58	9.90	1.59	1.86	3.77	8.93	9.52	10.10	4.71	6.38	6.86	5.77	6.12	7.57	5.15	5.61	6.07	1.07	1.26	4.03	6.49	7.05	7.61
42	0.67	0.79	1.91	2.45	2.81	4.29	0.26	0.30	0.34	9.79	14.45	19.10	0.00	0.00	0.00	9.10	10.43	11.72	6.71	7.51	10.18	6.72	6.82	6.92	0.00	0.00	0.00	0.00	0.00	0.00
41	4.48	5.48	6.32	5.70	6.64	6.87	6.53	6.56	6.59	0.00	0.00	0.00	0.10	0.10	0.10	0.54	0.81	1.99	0.25	0.30	0.35	0.68	1.03	1.38	0.00	0.00	0.00	0.00	0.00	0.00
40	0.03	0.17	0.42	0.05	0.05	0.12	1.16	1.37	1.58	0.00	0.00	0.00	0.48	0.48	0.48	5.32	7.31	7.82	3.22	3.88	3.90	4.67	4.77	4.87	0.00	0.00	0.00	0.00	0.00	0.00
39	16.11	17.44	19.11	20.90	23.65	28.98	29.18	29.40	29.61	3.28	3.97	4.00	1.77	1.90	2.02	3.77	3.82	4.01	7.04	7.23	7.39	7.67	7.85	8.04	2.37	2.37	2.37	2.48	2.48	2.48
38	0.06	0.13	0.85	0.36	1.15	1.44	2.06	2.30	2.55	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.09	0.37	2.16	3.19	4.23	3.80	3.96	4.12	0.00	0.00	0.00	0.00	0.00	0.00
37	0.25	0.74	1.16	2.55	3.45	4.04	5.91	6.99	8.07	4.63	6.81	7.12	3.08	5.24	7.39	2.46	2.91	4.01	1.93	2.10	2.34	2.09	2.23	2.38	0.00	0.00	0.00	0.00	0.00	0.00
36	2.57	2.68	3.48	2.79	3.76	4.18	1.62	1.91	2.21	1.00	1.84	2.34	1.60	2.95	4.29	7.44	7.71	8.26	4.91	5.46	5.76	5.98	6.14	6.30	0.00	0.00	0.00	6.34	6.34	6.34
35	0.04	9.96	16.49	0.79	2.72	10.47	0.56	0.68	0.80	14.20	28.41	28.69	12.89	14.71	16.53	0.13	0.46	1.94	8.99	13.48	13.66	4.98	5.37	5.76	6.55	8.95	24.42	13.95	13.95	13.95
34	0.04	0.13	0.25	0.00	0.00	0.10	0.03	0.07	0.10	6.30	6.30	6.30	0.00	0.00	0.00	0.85	1.17	1.32	9.09	9.55	9.95	8.75	9.30	9.85	2.26	4.46	6.66	0.00	0.00	0.00
33	0.00	0.02	0.04	0.01	0.01	0.02	0.04	0.07	0.09	0.00	0.00	0.00	0.00	0.00	0.00	2.61	2.80	3.66	5.37	6.35	8.00	5.47	5.65	5.83	0.00	0.00	0.00	0.00	0.00	0.00
32	0.20	0.62	1.25	0.50	1.01	1.02	0.36	0.49	0.62	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.28	0.29	0.03	0.04	0.05	0.02	0.04	0.05	0.00	0.00	0.00	0.00	0.00	0.00

TABLE 10. Percentage of retained sablefish landed in bimonthly periods by fixed gear sectors, stratified by sector, gear type, and time period.

Bimonthly	Pot															Hook-and-Line														
Period	Non-Catch Shares									Catch Shares						Non-Catch Shares									Catch Shares					
	2002-2010			2011-2015			2016-2017			2011-2015			2016-2017			2002-2010			2011-2015			2016-2017			2011-2015			2016-2017		
	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ
Jan/Feb	3.20	3.68	4.16	2.68	4.30	6.44	4.41	5.88	7.35	1.48	2.91	3.02				2.70	3.09	3.74	6.84	7.01	7.03	4.95	5.66	6.36	8.36	9.11	9.86			
Mar/Apr	7.46	8.33	13.30	7.03	10.09	11.66	14.49	16.70	18.92	7.98	10.29	10.96				6.17	7.10	9.26	14.97	15.43	17.79	12.78	13.20	13.61	7.70	12.44	14.92			
May/June	29.58	32.05	32.61	15.40	16.81	20.93	25.15	26.34	27.52	5.17	8.45	10.30		Confidential		20.01	23.61	24.56	18.42	21.12	21.45	22.90	24.19	25.48	0.88	1.75	5.17		Confidential	
Jul/Aug	24.51	28.26	31.42	27.49	28.01	28.77	15.36	16.11	16.87	17.42	19.71	19.74				24.39	28.34	30.08	17.18	21.75	22.74	21.02	22.06	23.11	4.95	5.08	21.20			
Sep/Oct	16.96	21.74	28.00	29.29	35.91	37.12	28.80	28.86	28.92	48.21	52.51	54.08				29.48	31.43	33.08	25.73	30.07	30.96	25.91	26.09	26.27	43.95	47.98	59.48			
Nov/Dec	3.77	5.06	8.85	2.74	5.92	6.30	4.41	6.10	7.80	11.40	13.18	14.89				3.65	6.08	7.49	5.58	9.05	9.98	7.26	8.81	10.35	11.58	17.94	32.27			

TABLE 11. Percentage of observed hauls in 50-fm depth bins by fixed gear sectors, stratified by sector, gear type, and time period.

	Pot															Hook-and-Line														
	Non-Catch Shares									Catch Shares						Non-Catch Shares									Catch Shares					
	2002-2010			2011-2015			2016-2017			2011-2015			2016-2017			2002-2010			2011-2015			2016-2017			2011-2015			2016-2017		
Depth Bin (fm)	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ
0	4.88	4.88	4.88	1.56	1.69	1.83	1.60	1.60	1.60	0.00	0.00	0.00	0.27	0.27	0.27	0.86	1.90	2.34	0.35	0.77	1.47	1.34	1.63	2.08	1.60	1.80	2.00	0.68	0.68	0.68
50	0.34	0.49	0.65	0.00	0.00	0.00	0.17	0.17	0.17	0.61	0.89	2.04	0.11	0.11	0.11	0.80	1.79	2.77	0.32	0.75	1.28	0.33	0.33	0.33	20.02	21.10	22.18	0.00	0.00	0.00
100	2.76	6.59	18.08	1.20	8.45	21.36	13.31	13.51	13.71	1.45	4.72	10.57	0.83	1.50	1.99	3.32	25.23	40.01	4.15	7.95	12.93	10.83	19.16	22.16	3.50	4.86	14.42	2.08	2.81	3.54
150	7.92	18.00	32.89	3.28	16.32	20.54	16.87	32.94	41.34	0.22	8.56	15.18	4.07	7.99	8.74	3.55	15.16	24.35	6.81	17.97	32.55	7.93	22.44	38.57	9.06	15.14	20.26	20.83	20.87	20.91
200	27.76	38.08	45.38	26.38	29.04	37.49	27.85	29.89	34.89	10.82	12.77	21.55	11.41	19.98	25.86	7.92	13.75	18.85	13.01	19.10	28.36	17.00	20.56	23.90	16.74	29.73	30.52	32.02	34.41	36.80
250	8.44	17.76	25.27	4.26	10.00	10.96	8.56	15.17	26.00	7.14	12.84	19.13	9.51	12.25	18.06	7.12	11.14	21.92	8.71	9.85	12.65	6.26	8.91	14.51	6.20	6.61	13.24	12.90	12.97	13.04
300	3.90	9.37	15.04	1.13	1.41	4.24	3.06	4.30	5.45	4.69	5.68	7.50	8.55	10.19	12.39	2.66	11.17	25.42	4.61	6.27	10.92	2.64	9.33	16.85	2.64	4.29	6.52	4.32	4.59	4.86
350	1.63	2.89	6.50	0.76	1.12	3.56	2.68	2.96	3.25	2.47	4.29	5.35	6.45	7.27	10.37	1.07	4.45	13.76	3.61	3.89	6.24	1.67	3.78	8.02	1.40	1.43	4.32	2.21	3.27	4.34
400	0.71	1.52	6.51	0.84	1.45	4.41	1.68	1.68	1.68	3.16	3.48	6.26	5.53	6.61	9.67	0.66	1.95	4.19	1.32	8.48	22.73	0.77	3.33	7.10	3.95	4.41	6.04	4.84	6.83	8.82
450	0.60	1.22	1.61	1.35	2.02	3.13	0.73	1.28	1.84	3.42	4.63	6.76	7.90	8.63	9.66	0.65	1.41	2.57	1.27	2.80	8.42	0.45	0.98	2.47	3.78	4.94	5.58	4.31	5.25	6.19
500	0.83	1.20	3.23	2.54	5.71	12.33	1.60	2.70	3.35	8.46	8.91	14.69	10.12	10.71	11.28	0.96	1.50	2.78	1.67	5.03	10.71	0.90	3.63	6.68	3.56	3.72	6.49	2.79	4.24	5.68
550	0.40	0.83	1.61	8.22	14.23	19.79	4.04	4.05	5.63	6.40	10.62	13.22	8.54	9.91	10.58	0.49	0.73	1.60	1.54	2.94	4.31	0.41	1.50	3.36	0.93	3.16	5.25	7.12	7.12	7.12
600	2.23	5.44	8.46	1.96	7.25	12.68	2.27	3.19	11.20	6.94	12.81	17.96	3.41	3.74	4.26	0.59	1.58	1.88	0.48	1.18	2.09	1.80	2.35	2.90	0.52	1.22	2.07	1.42	1.42	1.42
650	0.30	1.65	3.83	0.97	1.39	3.35	0.76	1.35	2.68	0.45	1.95	3.72	0.21	0.28	0.29	0.36	0.44	0.61	0.93	1.02	1.18	0.84	0.84	0.84	0.56	0.63	0.71	0.28	0.28	0.28
700	3.04	3.04	3.04	0.86	0.86	0.86	0.00	0.00	0.00	0.23	0.49	0.79	0.09	0.09	0.09	0.36	0.60	1.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
750	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.37	0.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
800	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.13	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
850	0.00	0.00	0.00	0.42	0.42	0.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
900	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.16	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
950	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.15	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1100	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.15	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TABLE 12. Lost and recovered gear on hauls observed in shoreside federal groundfish fisheries. Dashes represent where data are not available or applicable.

Sector	Gear	Year	Vessel	Trips	Hauls	Observed Effort (hours for trawl; hooks/pots for fixed gear)	Retained Target Species (mt)	Fleetwide Targeted Species or Groups Retained (mt)	% Landings Observed	Observed Hauls with Lost Gear	% Observed Hauls with Lost Gear	Observed Hooks/Pots Lost	% Observed Hooks/Pots Lost	Observed Hauls Recovering Derelict Gear	% Observed Hauls Recovering Derelict Gear
Limited Entry Trawl	Bottom Trawl	2002	132	570	3186	13583.3	2496.3	17314.0	14%	2	0.06%	--	--	64	2.01%
		2003	125	465	2315	11578.8	2433.5	17385.8	14%	7	0.30%	--	--	72	3.11%
		2004	103	616	3483	13914.36	4175.6	17081.1	24%	2	0.06%	--	--	102	2.93%
		2005	105	524	3504	12715.41	4042.8	18420.8	22%	4	0.11%	--	--	167	4.77%
		2006	87	476	3025	11577.61	3247.0	16773.5	19%	4	0.13%	--	--	250	8.26%
		2007	88	374	2550	11457.89	3308.6	19575.5	17%	8	0.31%	--	--	138	5.41%
		2008	100	438	3224	15129.47	4670.5	22922.3	20%	5	0.16%	--	--	162	5.02%
		2009	101	590	4455	19786.54	5947.3	25584.8	23%	5	0.11%	--	--	239	5.36%
		2010	83	348	2640	13151.99	4042.4	22133.8	18%	3	0.11%	--	--	87	3.30%
Catch Shares	Bottom and Midwater Trawl	2011	72	1134	9197	40201.24	16981.3	17076.5	99%	11	0.12%	--	--	404	4.39%
	Bottom Trawl	2012	67	1089	8968	38036.85	16949.4	17054.2	99%	4	0.04%	--	--	363	4.05%
		2013	68	1193	10017	42066.17	18537.6	18588.1	100%	5	0.05%	--	--	301	3.00%
		2014	64	1033	8323	34199.69	15759.2	15844.4	99%	2	0.02%	--	--	265	3.18%
		2015	60	904	7480	28855.21	15589.5	15642.0	100%	2	0.03%	--	--	281	3.76%
		2016	53	802	6623	25050.62	14957.2	14999.9	100%	4	0.06%	--	--	192	2.90%
		2017	54	839	6398	25142.33	15377.6	15391.1	100%	4	0.06%	--	--	195	3.05%
Catch Shares EM	Bottom and Midwater Trawl	2016	7	29	182	918.62	487.2	1730.9	28%	0	0.00%	--	--	3	1.65%
		2017	8	25	152	679.21	330.3	2052.2	16%	1	0.66%	--	--	5	3.29%
Catch Shares	Midwater Trawl	2014	9	34	133	268.46	873.7	873.7	100%	0	0.00%	--	--	1	0.75%
		2015	7	43	147	246.47	968.5	968.5	100%	0	0.00%	--	--	1	0.68%
Shoreside Hake	Midwater Trawl	2011	27	929	1717	3974.59	90777.3	90777.3	100%	0	0.00%	--	--	17	0.99%
		2012	24	744	1601	5960.79	65396.4	65396.4	100%	0	0.00%	--	--	1	0.06%
		2013	24	960	1734	4628.08	96867.8	96867.8	100%	0	0.00%	--	--	8	0.46%
		2014	25	996	1725	4732.66	97925.2	97982.7	100%	0	0.00%	--	--	9	0.52%
Catch Shares	Hook and Line	2011	11	94	630	2265264	335.5	335.5	100%	6	0.95%	4286	0.19%	2	0.32%
		2012	8	32	506	1472865	241.3	241.3	100%	7	1.38%	12057	0.82%	0	0.00%
		2013	8	29	215	587238	79.4	79.4	100%	4	1.86%	4810	0.82%	0	0.00%
		2014	8	31	227	601654	88.6	98.4	90%	5	2.20%	79	0.01%	0	0.00%
		2015	5	16	185	592919	137.8	137.8	100%	1	0.54%	382	0.06%	0	0.00%
		2016	5	30	351	1110926	192.7	192.7	100%	3	0.85%	6172	0.56%	1	0.28%
		2017	4	13	148	476944	115.9	116.4	100%	0	0.00%	0	0.00%	1	0.68%
	Pot	2011	17	233	1536	41310	813.8	817.2	100%	51	3.32%	93	0.23%	0	0.00%
		2012	19	278	1709	52248	740.7	740.7	100%	89	5.21%	322	0.62%	1	0.06%
		2013	10	100	1086	30097	470.8	470.8	100%	36	3.31%	101	0.34%	0	0.00%
		2014	14	118	1288	31876	681.2	681.2	100%	56	4.35%	203	0.64%	0	0.00%
		2015	8	62	584	18808	405.3	405.3	100%	33	5.65%	126	0.67%	4	0.68%
		2016	8	61	584	15785	387.0	387.0	100%	34	5.82%	90	0.57%	2	0.34%
		2017	6	44	574	16288	367.3	367.3	100%	12	2.09%	16	0.10%	0	0.00%
Catch Shares EM	Pot	2015	7	18	184	4272	102.4	339.4	30%	8	4.35%	18	0.42%	0	0.00%
		2016	6	19	249	6275	152.0	470.5	32%	15	6.02%	19	0.30%	2	0.80%
		2017	7	22	270	7147	184.1	504.5	36%	10	3.70%	10	0.14%	0	0.00%

TABLE 12, CONTINUED.

Sector	Gear	Year	Vessel	Trips	Hauls	Observed Effort (hours for trawl; hooks/pots for fixed gear)	Retained Target Species (mt)	Fleetwide Targeted Species or Groups Retained (mt)	% Landings Observed	Observed Hauls with Lost Gear	% Observed Hauls with Lost Gear	Observed Hooks/Pots Lost	% Observed Hooks/Pots Lost	Observed Hauls Recovering Derelict Gear	% Observed Hauls Recovering Derelict Gear
Limited Entry Sablefish	Hook and Line	2003	15	48	351	733602	222.8	1051.6	21%	4	1.14%	--	--	0	0.00%
		2004	17	45	326	492009	180.0	1318.1	14%	27	8.28%	--	--	0	0.00%
		2005	26	101	678	1456102	481.5	1341.6	36%	71	10.47%	--	--	2	0.29%
		2006	19	68	470	939951	295.9	1401.2	21%	10	2.13%	--	--	0	0.00%
		2007	22	75	517	1034046	298.5	1103.9	27%	5	0.97%	--	--	0	0.00%
		2008	18	77	540	1244141	338.1	1103.4	31%	11	2.04%	--	--	1	0.19%
		2009	8	45	287	648980	97.8	1441.5	7%	2	0.70%	--	--	0	0.00%
		2010	21	143	762	1761173	345.8	1304.2	27%	8	1.05%	5801	0.33%	1	0.13%
		2011	23	98	673	1405444	240.7	1153.5	21%	5	0.74%	4205	0.30%	1	0.15%
		2012	17	88	532	1580075	239.3	1079.2	22%	7	1.32%	2104	0.13%	0	0.00%
		2013	18	58	353	1047526	166.4	748.0	22%	6	1.70%	5312	0.51%	0	0.00%
		2014	17	85	495	1200615	203.2	747.1	27%	8	1.62%	10862	0.90%	7	1.41%
		2015	26	97	632	1536820	392.0	939.8	42%	2	0.32%	1224	0.08%	4	0.63%
		2016	21	94	671	1743233	338.1	1031.7	33%	6	0.89%	3511	0.20%	4	0.60%
		2017	25	109	701	2107656	396.9	1060.4	37%	7	1.00%	6675	0.32%	5	0.71%
	Pot	2003	6	35	362	9017	148.3	604.0	25%	13	3.59%	--	--	0	0.00%
		2004	3	13	139	5378	82.7	619.6	13%	6	4.32%	--	--	0	0.00%
		2005	7	39	492	13822	281.2	615.0	46%	15	3.05%	--	--	0	0.00%
		2006	7	39	289	10708	200.5	581.8	34%	25	8.65%	--	--	0	0.00%
		2007	4	30	154	5816	90.0	428.4	21%	12	7.79%	--	--	0	0.00%
		2008	6	24	329	13638	244.9	433.0	57%	4	1.22%	--	--	0	0.00%
		2009	3	27	67	3883	66.5	489.1	14%	5	7.46%	--	--	0	0.00%
		2010	7	43	314	11294	140.4	503.5	28%	9	2.87%	39	0.35%	0	0.00%
		2011	3	22	227	9029	137.4	371.9	37%	2	0.88%	9	0.10%	0	0.00%
		2012	5	19	351	14218	101.1	286.0	35%	5	1.42%	20	0.14%	0	0.00%
		2013	3	14	47	1934	40.5	283.1	14%	3	6.38%	4	0.21%	0	0.00%
		2014	4	16	195	7561	104.0	338.1	31%	6	3.08%	75	0.99%	0	0.00%
		2015	9	36	308	11634	223.2	358.2	62%	9	2.92%	13	0.11%	1	0.32%
		2016	7	55	596	21219	254.3	359.0	71%	10	1.68%	11	0.05%	2	0.34%
		2017	3	14	186	7852	115.5	375.5	31%	13	6.99%	23	0.29%	0	0.00%

TABLE 12, CONTINUED.

Sector	Gear	Year	Vessel	Trips	Hauls	Observed Effort (hours for trawl; hooks/pots for fixed gear)	Retained Target Species (mt)	Fleetwide Targeted Species or Groups Retained (mt)	% Landings Observed	Observed Hauls with Lost Gear	% Observed Hauls with Lost Gear	Observed Hooks/Pots Lost	% Observed Hooks/Pots Lost	Observed Hauls Recovering Derelict Gear	% Observed Hauls Recovering Derelict Gear
Limited Entry Fixed Gear (DTL)	Hook and Line	2003	17	130	219	537817	32.1	355.3	9%	7	3.20%	--	--	0	0.00%
		2004	14	62	130	318048	15.8	313.0	5%	5	3.85%	--	--	0	0.00%
		2006	21	121	201	533830	23.5	333.2	7%	10	4.98%	--	--	1	0.50%
		2007	36	158	304	724389	37.6	311.8	12%	2	0.66%	--	--	0	0.00%
		2008	32	122	221	631689	31.7	367.8	9%	7	3.17%	--	--	0	0.00%
		2009	34	138	273	669091	30.3	510.9	6%	3	1.10%	--	--	0	0.00%
		2010	38	226	472	1103073	57.8	584.4	10%	7	1.48%	8425	0.76%	0	0.00%
		2011	38	201	426	1154241	84.2	829.5	10%	8	1.88%	13662	1.18%	1	0.23%
		2012	26	128	252	706437	27.9	556.3	5%	2	0.79%	3088	0.44%	0	0.00%
		2013	22	124	248	705827	32.1	486.4	7%	4	1.61%	3950	0.56%	0	0.00%
		2014	18	77	154	493845	23.8	470.6	5%	1	0.65%	650	0.13%	0	0.00%
		2015	21	65	144	453472	38.3	514.6	7%	4	2.78%	4600	1.01%	0	0.00%
		2016	16	41	70	247067	23.8	547.3	4%	2	2.86%	882	0.36%	0	0.00%
		2017	12	34	71	183990	15.7	540.6	3%	7	9.86%	6995	3.80%	1	1.41%
Open Access Fixed Gear	Hook and Line	2003	13	41	49	86518	16.5	544.9	3%	6	12.24%	--	--	0	0.00%
		2004	14	42	52	85895	16.2	473.8	3%	7	13.46%	--	--	0	0.00%
		2005	10	34	37	58384	9.8	623.9	2%	3	8.11%	--	--	0	0.00%
		2007	25	51	67	55215	10.4	263.4	4%	1	1.49%	--	--	0	0.00%
		2009	34	69	104	119849	21.8	646.3	3%	4	3.85%	--	--	0	0.00%
		2010	37	70	105	160570	23.1	756.5	3%	1	0.95%	320	0.20%	2	1.90%
		2011	40	69	101	162419	20.1	434.3	5%	3	2.97%	1766	1.09%	0	0.00%
		2015	20	38	54	124895	17.5	363.9	5%	1	1.85%	150	0.12%	0	0.00%
		2017	43	62	79	95811	14.9	348.0	4%	1	1.27%	1990	2.08%	0	0.00%
	Pot	2003	7	16	50	345	2.9	190.3	2%	1	2.00%	--	--	0	0.00%
		2004	17	96	185	1950	17.0	186.0	9%	3	1.62%	--	--	0	0.00%
		2005	14	43	50	835	10.7	379.3	3%	2	4.00%	--	--	0	0.00%
		2006	15	38	39	666	7.9	442.9	2%	2	5.13%	--	--	0	0.00%
		2007	21	46	75	624	8.8	257.9	3%	4	5.33%	--	--	0	0.00%
		2008	20	55	75	833	10.4	240.8	4%	1	1.33%	--	--	0	0.00%
		2010	26	40	71	648	10.7	318.3	3%	1	1.41%	2	0.31%	0	0.00%
		2011	29	61	85	831	18.9	255.8	7%	3	3.53%	6	0.72%	0	0.00%
		2012	19	35	70	610	9.1	125.8	7%	2	2.86%	5	0.82%	0	0.00%
		2013	17	25	48	590	6.3	72.2	9%	1	2.08%	1	0.17%	0	0.00%
		2014	21	41	63	686	11.7	147.7	8%	1	1.59%	4	0.58%	0	0.00%
		2015	17	49	64	604	14.6	234.2	6%	3	4.69%	8	1.32%	0	0.00%
		2016	27	55	73	687	15.3	206.8	7%	5	6.85%	15	2.18%	0	0.00%
		2017	44	87	126	1249	24.9	210.6	12%	2	1.59%	3	0.24%	0	0.00%

TABLE 13. Observed hauls with lost and recovered gear in the 100% observed at-sea midwater fisheries.

Sector	Year	Total Hauls	Hauls with Lost Gear	% Hauls with Lost Gear	Hauls Recovering Gear	% Hauls Recovering Gear	Estimated Lost Catch (mt)
Catcher Processor	2002	559	0	0.00	0	0.00	0.00
	2003	768	1	0.13	0	0.00	0.00
	2004	1501	1	0.07	0	0.00	0.00
	2005	1337	0	0.00	0	0.00	0.00
	2006	1497	0	0.00	0	0.00	0.00
	2007	1577	0	0.00	0	0.00	0.00
	2008	1886	0	0.00	0	0.00	0.00
	2009	868	0	0.00	0	0.00	0.00
	2010	1068	0	0.00	0	0.00	0.00
	2011	1549	0	0.00	0	0.00	0.00
	2012	1107	0	0.00	0	0.00	0.00
	2013	1459	0	0.00	0	0.00	0.00
	2014	1696	1	0.06	0	0.00	0.00
	2015	1519	1	0.07	0	0.00	4.00
	2016	2205	0	0.00	0	0.00	0.00
	2017	2159	0	0.00	0	0.00	0.00
Mothership Catcher Vessel	2002	1207	0	0.00	0	0.00	0.00
	2003	1076	0	0.00	0	0.00	0.00
	2004	1203	0	0.00	0	0.00	0.00
	2005	1673	1	0.06	0	0.00	20.00
	2006	1443	0	0.00	0	0.00	0.00
	2007	1303	0	0.00	0	0.00	0.00
	2008	1731	1	0.06	0	0.00	65.00
	2009	1004	0	0.00	0	0.00	0.00
	2010	1424	0	0.00	0	0.00	0.00
	2011	1476	0	0.00	0	0.00	0.00
	2012	953	0	0.00	0	0.00	0.00
	2013	1256	1	0.08	0	0.00	18.14
	2014	1308	0	0.00	0	0.00	0.00
	2015	640	0	0.00	0	0.00	0.00
	2016	1565	2	0.13	0	0.00	63.61
	2017	1309	0	0.00	0	0.00	0.00