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Fishing Effort in the 2002-2015 Pacific Coast Fisheries

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EXECUTIVE SUMMARY

This report analyzes trends in fishing effort in the U.S. Pacific coast groundfish fisheries for the period 2002-2015. 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.

The IFQ bottom trawl sector landed ~16,000 mt of groundfish in both 2014 and 2015, the lowest recorded in years analyzed. However, the annual catch was within the historic range when accounting for additional gears landing groundfish via IFQ bottom trawl quota (Table 1, Figure 1). Median fleet-wide trawl duration in the IFQ bottom trawl sector decreased from 2011 to 2015, but overlapping quartiles indicate a lack of overall trend (Table 1, Figures 2 and 3). Spatial patterns in bottom trawl landings were consistent across three time periods analyzed (Table 2, Figure 4). Maps of fishing intensity based on haul locations revealed similar patterns, with hot spots off Astoria, OR (Figure 5). Under IFQ management, the proportion of landings made in March/April has increased compared to 2002-2006 and 2006-2010 (Table 3, Figure 6). Depth distribution of hauls has been uniform across the three time periods (Table 4, Figure 7).

Fleet-wide landings and tow duration by the shoreside midwater rockfish trawl fishery have increased from 2011 to 2015 (Table 1, Figures 1 and 8). Median tow duration per haul was ~1 hour in all years (Table 1, Figure 10). All landings occurred in OR and WA, with more than 75% occurring within the 46° N. latitudinal bin (Table 2, Figure 11). The spatial distribution of shoreside landings reflected hotspots of fishing effort in the same area of coast (Figure 13). More than half of the landings made by the midwater rockfish trawl fleet occurred in September/October, and the fleet made 80% of hauls in water 50 to 100 fm deep (Tables 3 and 4, Figures 15 and 17).

From 2011 to 2015, the shoreside midwater hake trawl fishery did not show a clear pattern in terms of either fleet-wide landings or tow duration (Table 1, Figures 8 and 9). Median tow duration ranged from ~2 to 4 hours per haul (Table 1, Figure 10). Although haul locations were fairly evenly distributed along the northern portion of the coast, shoreside landing locations were more condensed, with more than 60% of landings around 46° N. and almost 40% occurring around 44° N. (Table 5, Figures 12and 14). The shoreside midwater hake fleet landed more than half of its catch in July/August, and more than 90% of hauls occurred in 50 to 250 fm (Tables 4 and 6, Figure 16 and 18).

The catcher-processors (CPs) and mothership catcher vessels (MSCVs) showed a similar variable pattern for landed catch, which coincided with fluctuations in the quota from year to year. (Table 1, Figure 9). Landings have generally increased from the previous year in most cases, although large decreases occurred in 2009, when quota was low, and 2015, when fishing was generally poor. Fleetwide tow duration showed a pattern similar to the landings. In 2015, the greatest fleetwide tow duration was recorded since 2002 (Table 1, Figure 8). Median tow duration generally increased from ~1 to ~2 to 3 hours per haul from 2003 to 2007 and has since stabilized (Table 1, Figure 19). Fishing effort across all years focused between 48° N. to 42° N. latitude,

but in 2011-2015 shifted to the southern portion of the range. (Table 5, Figures 20 and 21). CPs shifted from evenly fishing May through October in 2002-2005 to catching more than 80% of hake in May/June and September/October in the 2011-2015 period (Table 6, Figure 23). CPs fished nearly all hauls in waters 50 to 350 fm deep and in 2011-2015 focused more than half of hauls in the 150 to 200 fm depth bin (Table 4, Figure 24).

MSCV trends were often similar to CPs. Overall, hake landings increased from 2002 to 2015, but showed dampened extremes compared to CPs in both low and high catch years (Table 1, Figure 9). Fleet-wide tow duration by MSCVs increased slightly from 2009 to 2014, but decreased in 2015 (Table 1, Figure 8). Median tow duration per haul by MSCVs were slightly lower than those by CPs in most years (Table 1, Figure 19). Fishing effort was focused off of central Oregon, with large proportions of catch occurring in the 47° N. and 43° N. bins across 2 of the 3 time periods (Table 5, Figure 20). Maps of fishing intensity showed multiple hot spots in this portion of the coast in recent years and highlighted a move off-shore in more southern waters (Figure 22). From 2002 to 2010, nearly all hake catch occurred in May/June, but from 2011 to 2015, almost half of catch occurred in September/October (Table 6, Figure 23). Similar to CPs, nearly all hauls occurred in 50 to 250 fm depths, with more than 80% between 100 and 200 fm (Table 4, Figure 24).

Fleet-wide landings by non-catch shares (NCS) pot vessels in 2014 and 2015 were greater than in 2013, but much lower than in other prior years (Table 7, Figure 25). The median number of pots per set was variable, but the quartiles largely overlapped; from 2011 to 2015, the median became more stable at ~35 (except in 2013) (Table 7, Figure 27). The distribution of sablefish landings along the coast did not differ greatly before and after IFQ implementation, as ~80% of landings were made between 39° N. and 46° N. latitude in the latter two time periods (Table 9, Figures 28, 29). After IFQ implementation, landings shifted even more toward the September/October period than the already high proportion in this period during the pre-CS years (Table 10, Figure 30). Hauls in the NCS pot fleet focused on waters either 0 to 250 fm or 500 to 600 fm deep both before and after IFQ implementation, but the proportion in deeper waters was greater in 2011-2015 (Table 11, Figure 31).

Landings by the CS pot fleet were higher than landings in the NCS pot fleet from 2011 to 2015, but the difference was much lower from 2013 to 2015 than in 2011 or 2012 (Table 7, Figure 25). After declining sablefish catch from 2011 to 2013, landings increased in both 2014 and 2015, following the same pattern seen in the NCS pot fleet. The number of fleet-wide CS pots fluctuated, but showed an increasing trend from 2013 to 2015 (Table 7, Figure 26). A large range in the number of pots per set was observed in most years, but the median was ~30 from 2011 to 2015 (Table 7, Figure 27). CS pot landings were distributed in a few hot spots along the coast; for example, almost 36% of landings occurred within the 35° N. bin (Table 9, Figure 28). Fishing effort by the CS pot fleet largely overlapped fishing grounds by the NCS fleet in the northern portion of the coast, but CS pot fishing in the southern portion of the coast occurred in areas never previously observed to be targeted by pot gear (Figure 29). More than half of sablefish landings by the CS pot fleet occurred in September/October (Table 10, Figure 30). Hauls made by the CS pot fleet were evenly distributed in waters 0 to 650 fm deep, with peaks in effort around 0 to 250 and 500 to 600 fm (Table 11, Figure 31).

After nearly historically low sablefish catch in the NCS hook-and-line fleet in 2014, landings increased in 2015 for the first time in 5 years (Table 7, Figure 25). The number of fleet-wide hooks decreased from 2009 to 2015, but remained greater than previously observed lows (Table 8, Figure 32). The median number of hooks per set increased to ~2,500 from 2012 to 2015 after a decade of ~2,000 hooks per set (Table 8, Figure 33). Shoreside landings occurred from 32° N. to 48° N. latitude and were more uniform along the coast after IFQ implementation, although spatial patterns of the haul locations are very similar across the time periods (Table 9, Figure 34). The proportion of landings by the NCS hook-and-line fleet continued to peak in September/October, but this has dampened slightly after IFQ implementation (Table 10, Figure 36). In 2011-2015, NCS hook-and-line hauls occurred more often in deeper waters, with increased percentages of hauls in 400 to 600 fm (Table 11, Figure 37).

Sablefish landings by the CS hook-and-line fleet remained much lower than those in the NCS fleet and have decreased almost every year from 2011 to 2015 (Table 7, Figure 25). The fleet-wide hooks used by the fleet decreased from 2011 to 2013 but have since remained constant at ~60,000 hooks (Table 8, Figure 32). The median number of hooks per set has been variable, but the quartiles have consistently overlapped (Table 8, Figure 33). More than 70% of sablefish catch from the CS hook-and-line fleet was landed around 46° N., and an additional ~20% was landed within the 44° N. bin; the spatial range of fishing effort was mostly a constricted portion of the NCS fishing grounds (Table 9, Figures 34 and 35). The proportion of landings made in bimonthly periods varied, but typically peak catch occurred in September/October (Table 10, Figure 36). Depths of hauls by the CS hook-and-line fleet were shallower than those of the NCS hook-and-line fleet and focused at 50 to 100 fm and 200 to 250 fm depths (Table 11, Figure 37).

INTRODUCTION

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. Pacific coast groundfish fishery. This report is mandated by the National Marine Fisheries Science (NMFS) Biological Opinion on Continuing Operation of the Pacific Coast Groundfish Fishery (NMFS 2012). In this update, we include two sectors previously omitted: shoreside and midwater at-sea sectors. Specifically, we describe fishing effort in the following sectors of U.S. Pacific coast groundfish fisheries for the years 2002-2015, as applicable:

- Limited entry (LE) bottom trawl (2002-10)
- IFQ non-hake, bottom trawl (2011-2015)
- IFQ shoreside, midwater trawl targeting hake and rockfish (2011-2015)
- At-sea midwater trawl targeting hake, utilizing catcher-processors (CP) and mothership catcher-vessels (MSCV) (2002-2015)
- Non-catch shares (NCS) fixed gear (aggregating sablefish LE fixed gear primary (tier endorsed), open access fixed gear, and LE fixed gear daily trip or quota limits) (2002-2015)

Since 2001, the West Coast Groundfish Observer Program (WCGOP) has placed trained scientists aboard fishing vessels operating in sectors that target and incidentally catch groundfish off the U.S. Pacific coast. In 2011, new regulations governing the LE bottom trawl fishery led to the induction of IFQs. Primary goals of IFQ management included decreased bycatch and increased catch accountability, profitability, and efficiency. With this change, each vessel is now required to carry a federal observer on all fishing trips, resulting in 100% observer coverage. In 2015, a number of vessels began using electronic monitoring in lieu of observers for compliance and quota management with supplemental, scientific observer coverage on a subset of trips.

The at-sea hake midwater trawl fishery was 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. The new IFQ regulations introduced in 2011 also applied to the at-sea hake fishery, resulting in a cooperative management structure. In this report, we focus on changes in the fishery since 2002.

Both the A-SHOP and the WCGOP are administered by the NWFSC Fishery Resource Analysis and Monitoring (FRAM) Division, Fishery Observation Science (FOS) Program in Seattle, WA.

In the shoreside bottom trawl fishery, permit holders with IFQ and a trawl endorsement can use multiple gear types (although not within the same trip), including bottom trawl, midwater trawl, hook-and-line gear, and pot gear. 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 the non-catch shares (NCS),

non-nearshore sector to describe overall changes across the fisheries. The introduction of IFQs to the at-sea hake fishery was unlikely to have impacts on fishing effort, but analyzing overall patterns can inform management.

This report describes trends over time in fishing effort, with a particular focus on changes related to the implementation of IFQ management. However, many other factors, including variations in weather, market price, stock size, quota leasing, and catch limits, are at play in the 15-year data set. We cannot definitively attribute changes in effort to the shift to IFQs. We discuss other management shifts and their effects on fishing effort for context when appropriate.

In every iteration of the groundfish Fishery Management Plan (FMP), the Pacific Fishery Management Council (PFMC) has focused on achieving maximum sustainable yield (MSY) and promoting year-round fishing opportunities to support domestic consumer markets and the economies of coastal communities.

The at-sea hake fishery developed cooperatives to achieve these goals: the CPs did so before the implementation of IFQs, and the MSCVs did so in response to IFQ implementation. The shift to IFQ had ramifications on quota management and bycatch accountability, but potentially very little effect on fishing effort. 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—essentially, the vessels fish for hake when they are not fishing for pollock in Alaska. The primary driver for change in fishing effort for the at-sea hake fishery has been highly variable quotas over the last 15 years. A steep decline in the quota has twice dampened effort, as well as more recent seasons of poor fishing conditions.

Management of the shoreside bottom trawl fishery and response by participants has followed a different trajectory than that of the at-sea midwater 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, to evaluate the effects of management alternatives. Around the same time, the NWFSC implemented a comprehensive observer program, with some level of at-sea observation of all groundfish fleets. Random coverage of the bottom trawl fleet was 20-30% of landings, and the data from this program provided critical information to support reliable fishery modeling and estimation of fishing mortality, especially for rebuilding species.

Early in the 2000s, it became clear 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—lines approximating the 100- and 150-fm contours—with the ability to extend the closed area, in shoreward or seaward directions, by 25-fm increments. 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 (initially) 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 based on the identification of essential fishing habitat (EFH) that could be significantly impacted by trawl gear.

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, which allowed fishing to occur in very rocky substrate. Concurrently with the implementation of the RCA, trawl gear use shoreward of the RCA was restricted to using footropes no larger than 20.32 cm in diameter, with added restrictions on 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 exploited the behavior of many rockfish to swim upwards in response to encountering the footrope, allowing them to escape.

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, in which shares of overall trawl sector allocations of numerous species were 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. Estimates of total catch are based on a combination of landing receipts and at-sea observation and monitoring of at-sea discard on all trawl trips. 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.

IFQ management has altered two 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 that result in less bycatch. Over time, the markets for shares should provide another means of addressing remaining excess capacity in this fishery.

Given this background, we present trends in fishing effort in selected U.S. Pacific coast groundfish fishery sectors from 2002 to 2015. This report aims to show changes in fishing catch and effort overall, as well as subtler changes in timing, spatial location, and depth. We provide total groundfish, sablefish, and hake landings and total and median tow duration or number of hooks or pots coast-wide. 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 fleet) in bimonthly periods and latitudinal and depth bins. Together, this information helps to identify changes and trends in fishing effort over the past 15 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) electronic monitoring 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, parts of the NWFSC FRAM 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. For a list of groundfish sectors not observed by FOS, see the description of observer coverage provided in the most recent groundfish mortality report (Somers et al. 2016). A list of fisheries, in order of coverage priority, and detailed information on data collection methods employed in each observed sector can also be found in the WCGOP manual (NWFSC 2017).

The goal of the WCGOP is to improve total bycatch estimates by collecting information on west coast groundfish species that are discarded at sea. 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 http://www.nwfsc.noaa.gov/research/divisions/fram/observer/. The website also provides estimates of observer coverage, observed catch, and a summary of observed fishing depths for each sector.

WCGOP, A-SHOP, and fish ticket data QA/QC methods are described in detail in Somers et al. 2016 and on the FOS website:
http://www.nwfsc.noaa.gov/research/divisions/fram/observation/data_processing.cfm .

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 2002-2015 were retrieved from the PacFIN database in September 2016. These data were divided into groundfish fishery sectors (Somers et al. 2016). Logbook data sometimes differs slightly from observer data, so summaries of fleet-wide vessels, trips, and hauls may differ slightly from 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. Fish ticket and species-composition data are submitted by state agencies 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 were distributed to individual species whenever possible. PacFIN data for fish ticket landings with state species composition sampling applied was queried in April 2016. As with logbook data, on occasion, estimates of total vessel numbers in a fleet based on fish ticket landings data differ from those recorded in observer data, so slight discrepancies may exist between this report and other coverage estimates.

DATA USAGE

We have selected the data source for each analysis that will ensure 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. 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 state-required 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. In 2015, logbook data for the EM portions of the CS pot and midwater fleets were incorporated into summaries. In fixed gear sectors with less than 100% observer coverage, 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 comes 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 a single time period of 2011-2015. 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. However, due to the low coverage rates in NCS sectors

and the focus of this report on changes around the implementation of IFQ management, we grouped the non-IFQ fixed gear sector into only two periods: pre-IFQ (2002-2010) and IFQ (2011-2015). 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.

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. As described above, expansions were performed in sectors with less than 100% observer coverage 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 illustrated changes at the fleet level by calculating total effort per year and described variability within a year by calculating the median observed effort per haul.

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. This 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

report both lost and recovered derelict gear. Hauls with recovered derelict gear are reported from 2002 to 2015 in the trawl fishery, and fixed gears that recovered derelict gear lost on previous trips are reported from 2015. Hauls with lost gear are reported for trawl gear from 2010 to 2015 and for fixed gear from 2013 to 2015. 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 fishery 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.

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 latitudinal bin. 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 Council'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. 10.3 geographical information system software (Environmental System Research Institute, Incorporated, Redlands, California). The line density algorithm calculates density within a circular search area centered at a grid cell of specified size. The value (units: km/km^2) for each grid cell is the quotient of total line portions intersecting the circular area per grid cell area

(Figure A-1). 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 3 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 fixed gear density outputs as compared to trawl densities (3,000 m), because fixed gear effort was generally patchier compared to the bottom and midwater trawl sectors.

RESULTS

TRAWL SECTORS

BOTTOM TRAWL

In both 2014 and 2015, the bottom trawl sector retained ~16,000 mt of groundfish, the lowest retained across all years analyzed (Table 1, Figure 1). However, when accounting for groundfish retained by other gears fishing bottom trawl quota, annual targeted catch during IFQ management was within the 2002 to 2010 range and greater than any annual catch from 2002 to 2006. Fleet-wide bottom trawl duration has decreased from 2011 to 2015, with the total hours in 2014 and 2015 lower than any previous years analyzed (Table 1, Figure 2). Median haul duration decreased from 2011 to 2015, remaining both highly variable and well within the historic range (Table 1, Figure 3).

Over the three time periods summarized, we saw an increased proportion of landings at 46° N. latitude, near Astoria, OR (Table 2, Figure 4). The proportions of landings north of 46° N. and south of 39° N. decreased, while the proportions of landings between 45° N. and 39° N. (Newport, OR to Fort Bragg, CA) were consistent.

Maps of fishing intensity illustrated these patterns in more detail, showing an overall decrease in effort and movement into deeper waters further from the coast (Figure 5). Following implementation of Amendment 19 regulatory measures, most notably the closure of 51 areas to bottom trawling, bottom trawl effort shifted to deeper waters off WA and OR and off San Francisco, CA (Figure 5). Since the implementation of IFQs, there has been an almost ubiquitous decline in bottom trawl effort, with the exception of discrete areas of increase off central WA, the Columbia River on the north side of Astoria Canyon, and a few small areas off central CA and Santa Barbara, CA. In areas south of 40°10' N., trawl effort has nearly disappeared, with effort south of 38° N. extremely low in the few areas it continues to occur. Due to low and patchy distribution of effort in many of these southern areas, large percentages of effort were excluded to maintain confidentiality; 100% of effort in the 34° N. and 35° N. latitudes are not shown in the most recent time period (Figure A-2).

Prior to IFQ management, the proportion of landings in bimonthly periods was nearly equal from January to October, reflecting bimonthly quota periods (Table 3, Figure 6). From 2011 to 2015, variability in the proportion of landings has increased in January/February and decreased in November/December; the proportion of landings in March/April was much higher under IFQ management than in previous time periods.

The proportion of hauls in the 0-50 fm depth bin decreased over the three time periods and remained stable in the 50-100 fm depth bin (Table 4, Figure 7). Across other depth bins, the distribution of effort was similar across all three time periods.

Shoreside Midwater Trawl

The shoreside midwater trawl rockfish fleet continues to develop, as quota for two of their most targeted species (yellowtail and widow rockfish) increase. Groundfish landings and tow duration have steadily increased from 2011 to 2015, and the fishery is anticipated to continue to grow in catch and effort over the coming years (Table 1, Figures 1 and 8). Hake landings and total 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). Median tow duration per haul in the rockfish fleet was typically lower and less variable, with a median around 1.5 hours, than the same metrics for shoreside midwater trawls targeting hake, which ranged from 1.5 to 4 hours (Table 1, Figure 10).

Midwater rockfish and hake trawl catch was landed in WA and OR, with more than 75% of midwater rockfish occurring near Astoria, OR at 46° N. latitude (Table 2, Figure 11). About a quarter of midwater rockfish trawl catch was landed near Bellingham, WA at 48° N. latitude and about a fifth was landed near Newport, OR at 44° N. Due to the developing nature of the fishery, a small but increasing number of vessels have attempted to fish in multiple areas along the coast; this dispersion has resulted in large percentages of effort being excluded from maps (Figure A-3). Maps of non-confidential fishing intensity reveal two hotspots: one between 47 and 48° N., and one around 46° N. (Figure 12). More than 60% of midwater hake landings occurred in the 46° N. latitudinal bin, with the remainder landed south of Astoria, OR, in the 44° N. latitudinal bin (Table 5, Figure 13). 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. (Figure A-4). Despite nearly all landings occurring in two latitudinal bins shoreside, fishing effort based on haul location was evenly distributed along the northern portion of the coast (Figure 14). A hotspot of effort around 44° N. revealed the likely source of landings made to Newport, OR, but also highlighted that the large amount of effort occurring north of 46° N may have been landed far from the source of the catch.

The shoreside midwater season starts in mid-May, so landings are restricted from May to December. The rockfish fleet typically landed more than half of its groundfish catch in September/October, with the majority of the rest landed in July/August and November/December (Table 3, Figure 15). The midwater hake fleet landed more than half of its catch earlier in the year, in July/August, and most of the rest in September/October (Table 6, Figure 16).

Midwater rockfish trawl effort focused on shallow water, with more than 80% of hauls occurring in the 50-100 fm depth bin (Table 4, Figure 17). The depths of midwater hake hauls were more variable, ranging from 0 to 650 fm, but with more than 90% occurring between 50 and 250 fm (Table 4, Figure 18).

At-Sea Midwater Trawl

Hake landings by both the CP and MSCV portions of the at-sea fleet have been variable from 2002 to 2015, reflecting annual variations in quota (Table 1, Figure 9). Landings by the CP portion broadly increased from 2002 to 2009 and from 2009 to 2014, with large decreases in 2009 and 2015. MSCVs followed the same pattern, but with lower inter-annual variability. The MSCV portion receives less hake quota than CPs, resulting in consistently lower catch by MSCVs. Similar to trends in catch, fleet-wide tow duration by CPs rose steadily from 2002 to 2008, with a large decrease in 2009 (Table 1, Figure 8). However, since 2009, tow duration mostly increased, with 2015 having the highest fleetwide duration since 2002, despite relatively low hake landings compared to other years. 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 the previous years. The median and quartiles of duration per haul were similar for CPs and MSCVs in most years, although median CP tow duration was greater in most years (Table 1, Figure 19). Overall, tow duration in both sectors 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 focused on the northern part of the coast, off central Oregon (Table 5, Figure 20). From 2006 to 2010, the proportion of catch by the CPs was evenly distributed in that area, but from 2011 to 2015, catch mostly occurred in the southern portion of the range, from 44° N. to 42° N. However, variability in the location of catch also increased, especially in the 47° N., 43° N., and 42° N. latitudinal bins. MSCVs in 2002-2005 focused the majority of effort in the 44° N. and 43° N. bins, but have shown more variability in more recent time periods. In 2011-2015, the largest median proportion of catch occurred in the 43° N. bin.

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 2015 (Figure 21). Around 42° N., effort has increased, including fishing further seaward than observed in prior periods. A hot spot of effort around 43° N. has steadily intensified over the three periods. In the north, a hot spot of effort around 48° N. was present to varying degrees across all time periods. Little of the at-sea CP hake effort data were excluded, especially in the two most recent periods (Figure A-5). The larger proportion of excluded effort in the first period is likely explained by the inclusion of one fewer year of data.

A greater amount of data were excluded when mapping the MSCV portion of the at-sea fleet (Figure A-6), primarily in 2002-2005 (around 45° N. and 46° N.) and 2011-2015 (around 48° N.). However, the non-confidential data again illustrated the movement of the fleet away from the northern and into the southern portion of the range (Figure 22). Small hot spots were present around 43° N. and 42° N. in the first and second periods, respectively, but a much larger hotspot ranging from 44° N. to 43° N. was clear in the third period. In 2011-2015, the MSCV fleet also moved into deeper waters south of 46° N. and around 42° N.

The midwater at-sea fleet's season began on June 15 until 2015, when the opening data shifted a month earlier and now coincides with the shoreside fleet. In 2011-2015, 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). This pattern differed from the two earlier time periods for both sectors. In the CP portion, from 2002 to 2005, the fleet processed nearly all catch evenly from May to October, and, from 2006 to 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, nearly all catch was processed in May/June from 2002 to 2010.

Nearly all midwater at-sea hauls occurred at 50 to 250 fms (Table 4, Figure 24). Over the three time periods summarized, both the CP and MSCV portions of the midwater fleet have increased the proportion of hauls in deeper waters. In 2011-2015, more than half of CP's hauls occurred at 150 to 200 fm depth, and almost 80% of hauls by the MSCV sector occurred between 100 and 200 fm.

Fixed Gear Sectors

Pot

After declining from 2011 to 2013, sablefish landings by both the CS and NCS pot fleet have increased in 2014 and 2015 (Table 7, Figure 25). CS pot vessels continued to land more sablefish than NCS, but the difference in landings was small in 2014 and 2015. The fleet-wide estimate of pots calculated using observer data has been extremely variable, but the NCS fleet has shown a decreasing trend from 2009 to 2015 (Tables 7 and 8, Figure 26). The number of pots in the CS fleet has shown a slight increasing trend from 2013 to 2015 and became much more consistent. Nearly the equivalent number of pots were estimated in the CS and NCS fleets in 2014, and in all years but 2014, a greater number of pots were fished by the CS than the NCS fleet. In most years, and in both the CS and NCS pot fleets, the median estimated number of pots per set has fluctuated annually between ~19 and ~50 (Tables 7 and 8, Figure 27). In the CS pot fleet, all years showed a median ~30 pots per set, but quartiles showed a large range around that average. In the NCS pot fleet, the median pots per set from 2011 to 2015 was ~35 in all years except 2013, when a historic low of ~20 pots per set was observed.

The proportional distribution of sablefish landings coastwide by the NCS pot fleet was consistent before and after IFQ implementation (Table 9, Figure 28). In both time periods, ~80% of landings were made between 46° N. and 39° N. latitude, with the greatest proportions in the 46° N., 44° N., 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° N. and 35° N. after IFQ implementation. The high dispersion of fishing effort by different vessels made it difficult to accurately display fishing intensity while maintaining confidentiality (Figure A-7). In many latitudinal bins, we were unable to display any fishing effort even at a large spatial scale due to low vessel participation. However, comparing the primary areas where fishing by three or more vessels occurred consistently across periods revealed similar spatial distribution of the bulk of NCS pot effort before and after IFQ implementation (Figure 29). Shoreside, CS pot landings were less uniform than NCS, with almost 30% of landings occurring in the 35° N. bin (Figure 29). In the northern portion of the coast, most landings occurred in the 46° N., 44° N., and 42° N. latitudinal bins. Due to low coverage in the NCS fishery and differing number of years in time periods, direct comparisons of magnitude

of effort between the NCS and CS maps were inappropriate. As with NCS pot, we excluded all or most effort in many latitudinal bins where only small amounts of fishing by less than 3 vessels occurred (Figure A-7). However, effort clearly focused on an area between 46° N. and 44° N. and in smaller, but more intense, hot spots located around 41° N. and 39° N. CS pot effort was distributed similarly to NCS pot throughout the northern portion of the coast, but CS pot fishing also expanded around 42° N. and between 36° N. and 32° N., where little or no pot fishing previously occurred.

In recent years, NCS hook-and-line fishers between Point Lopez, CA and Point Conception, CA have raised concerns about this increased CS pot fishing in new areas, due to spatial competition and possible local depletion of sablefish (L. Pfeiffer, personal communication). Somers used WCGOP data from 2002 to 2015 to explore the spatial range of NCS hook-and-line effort in the area. The location of 72% of observed hooks in the NCS fleet directly overlapped in space (though not necessarily in time) with observed CS pot effort in this area; almost 100% of observed hooks in the NCS fleet were within 2.5 km of CS pot sets. This analysis highlighted the potential for conflict, but did not attempt to assess the extent of actual conflict or economic impacts. Full results and analysis will be published in the forthcoming Five Year Catch Shares Review report to the PFMC.

Landings by the NCS pot fleet peaked in May/June, with high proportions of catch from May to October prior to IFQ implementation (Table 10, Figure 30). In 2011-2015, this peak shifted to September/October and was much more pronounced. The CS pot fleet also peaked in September/October, with half of landings occurring in that single bimonthly period. The proportion of landings made by the CS pot fleet in November/December were also greater than those by the NCS fleet.

Fishing effort in the NCS and CS pot fleets occurred primarily in 0 to 650 fm depth (Table 11, Figure 31). Both NCS and CS showed bimodal peaks, likely reflecting the depths of shelf and slope fishing. In the 2011-2015 period, the proportion of hauls by the NCS pot fleet in waters 0 to 250 fm decreased, and the proportion in 500 to 600 fm increased. Effort in the CS pot fleet was more evenly distributed, but the proportion of hauls showed small peaks around 0 to 250 and 500 to 600 fm.

HOOK-AND-LINE

Sablefish landings by the NCS hook-and-line fleet were at a nearly historic low in 2014, but increased in 2015, for the first time in 5 years, to the middle of the historic range (Table 7, Figure 25). Landings by the CS hook-and-line fleet remained low compared both to previous years and to the NCS landings, despite a small increase in 2014. The estimated number of NCS fleet-wide hooks continued to decline from 2009 to 2015, but remained above previous low levels of 2002 and 2005 (Table 8). The total number of hooks fished by the CS hook-and-line fleet decreased from 2011 to 2013, but has since been constant (Tables 7 and 8, Figure 32). The median number of hooks per set in the NCS fleet was stable, at ~2,000 hooks, from 2002 to 2011; this rate increased in 2012 and has been closer to ~2,500 hook per set through 2015 (Tables 7 and 8, Figure 33). Variability was similar across years. In the CS fleet, hooks per set decreased from 2011 to 2013 and then increased in 2015. The variability in hooks per set was much greater in 2013 and 2014 than in other years or by the NCS fleet.

Hook-and-line sablefish landings ranged from 48° N. to 32° N. latitude. Landings by the NCS hook-and-line fleet were more uniform along the coast in the 2011-2015 period than in 2002-2010 (Table 9, Figure 34). After IFQ implementation, landings by the NCS fleet decreased in the 48° N. and 46° N. latitudinal bins and increased south of 36° N. latitude, around Monterey Bay, CA. Spatial patterns in fishing intensity between 2002-2010 and 2011-2015 were similar to those seen in shoreside landings, despite the difference in years and observed hauls across time periods (Figure 35). Much of the variation in the spatial analysis could be due to the amount of effort excluded in latitudinal bins (Figure A-8). However, non-confidential data in the maps showed that fishing along the northern borders of American waters have decreased, while fishing in deeper waters along the southern border increased. The CS hook-and-line fleet lands nearly all catch in two bins: more than 70% of catch near Astoria, OR in the 46° N. latitudinal bin and ~20% in the 44° N. bin. Due to the high amount of excluded data, it is difficult to assess the full distribution of fishing, especially in the southern portion of the coast (Figure A-8). Non-confidential data shows 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, and a few areas of focused effort around 36° N. were only accessed by the CS fleet (Figure 35).

Landings by the NCS hook-and-line fleet peaked in September/October both before and after IFQ implementation, but this became less prominent in the 2011-2015 period, as landings in March to August increased (Table 10, Figure 36). 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.

Both NCS and CS hook-and-line fish in waters ranging from 0 to 700 fm (Table 11, Figure 37). NCS hook-and-line hauls were more commonly in deeper waters in the 2011-2015 time period than in the earlier time period, due to a large decrease in 100-150 fm hauls and increases in 400-600 fm hauls. The CS hook-and-line effort focused on shallower waters, especially 50 to 100 fm and 200 to 250 fm. There was much less effort in waters deeper than 300 fm by the CS fleet than by the NCS fleet.

Lost Gear and Recovered Derelict Gear

Hauls where gear was lost or that recovered derelict gear were rare in all fishery sectors. Less than 0.2% of annual observed hauls across shoreside trawl sectors lost gear; no observed hauls in the shoreside midwater trawl sector were lost (Table 12). The proportion of annual observed hauls with lost gear in the NCS fixed gear fishery ranged from 0.3 to 6% for the years 2013 to 2015; a similar range of 0.5 to 5.6% was observed in the CS fixed gear fleet. Gear loss in the at-sea hake fishery occurred even less often, with a total of 4 and 3 hauls with lost gear in the CP and MSCV sectors, respectively, from 2002 to 2015. At most, lost gear was observed in only one haul in a given year across both sectors combined.

Hauls with recovered gear are those where derelict gear was retrieved, rather than gear lost and immediately retrieved within the same haul. The bottom trawl fishery recovered derelict gear in 2 to 9% of annual observed hauls from 2002 to 2015, while less than 1% of shoreside midwater trawl hauls recovered gear

annually (Table 12). The LE California halibut fishery had a higher proportion of hauls recovering derelict gear, ranging from 6 to 32% from 2003 to 2008. No gear was recovered in any hauls in the at-sea hake midwater fishery from 2002 to 2015.

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FIGURES

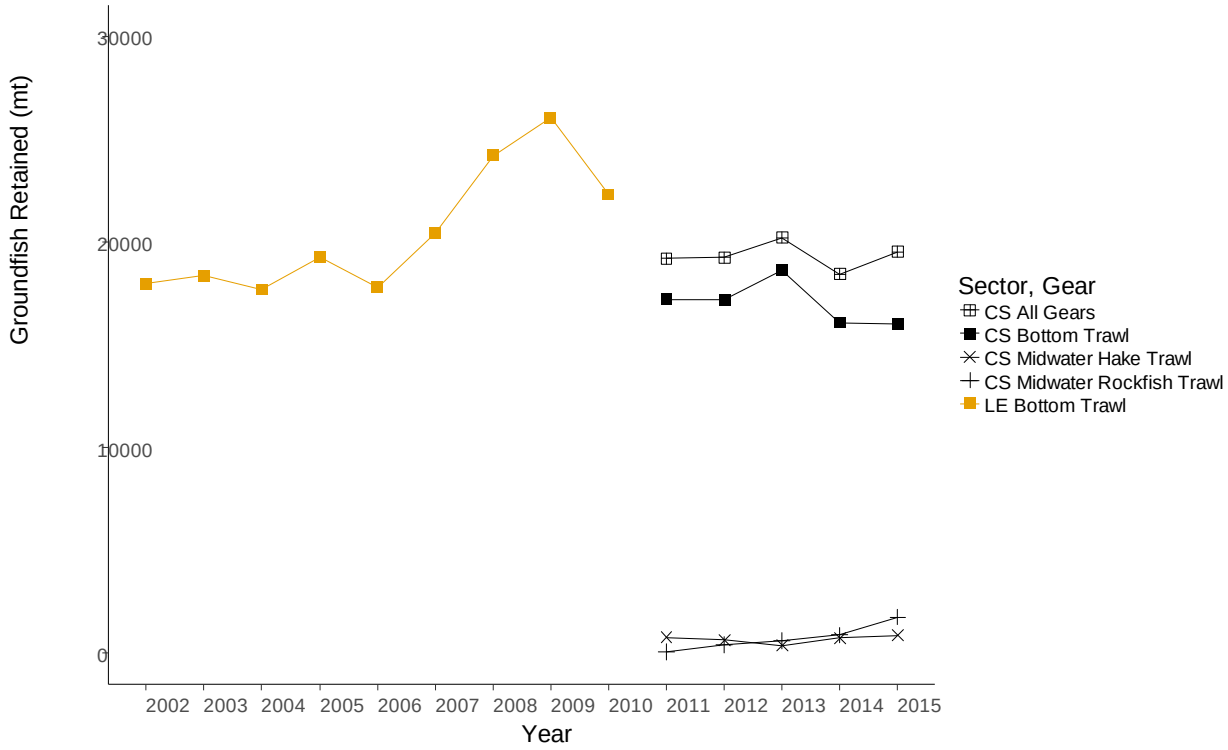

FIGURE 1. Annual total fleet-wide FMP-groundfish landings (mt) in shoreside trawl sectors.

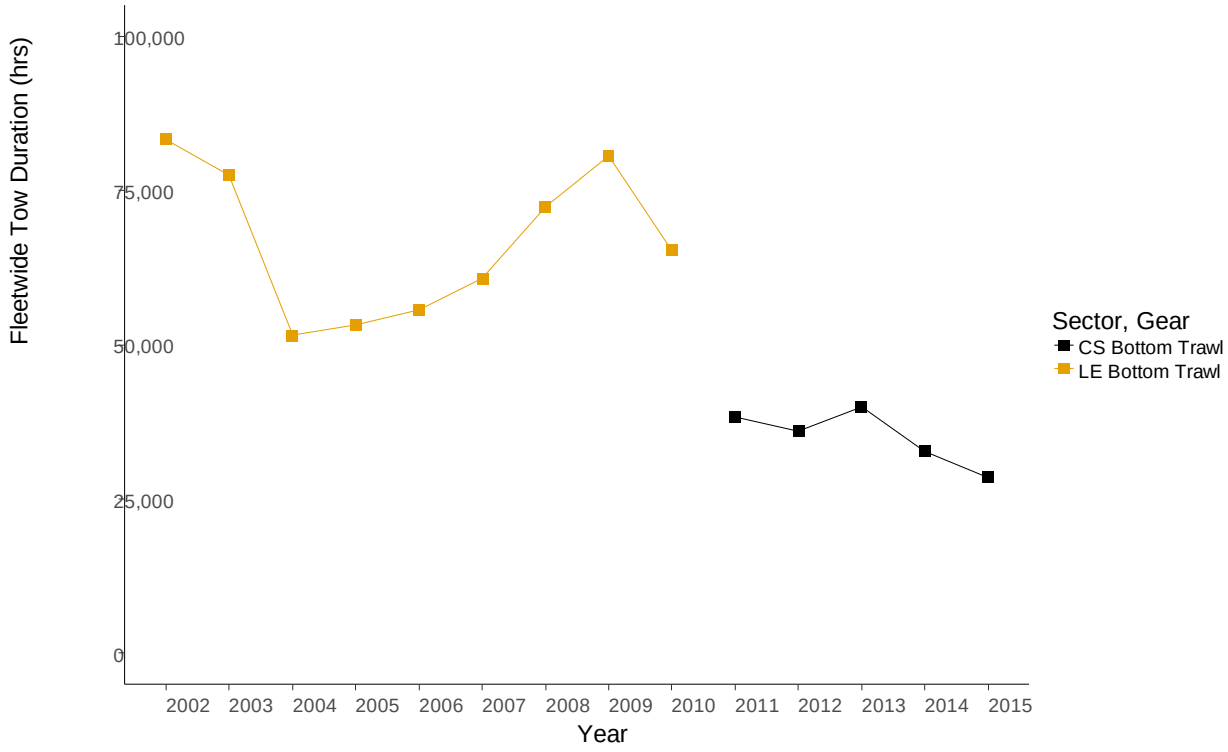

FIGURE 2. Annual total fleet-wide tow duration (hours) in shoreside bottom trawl sectors.

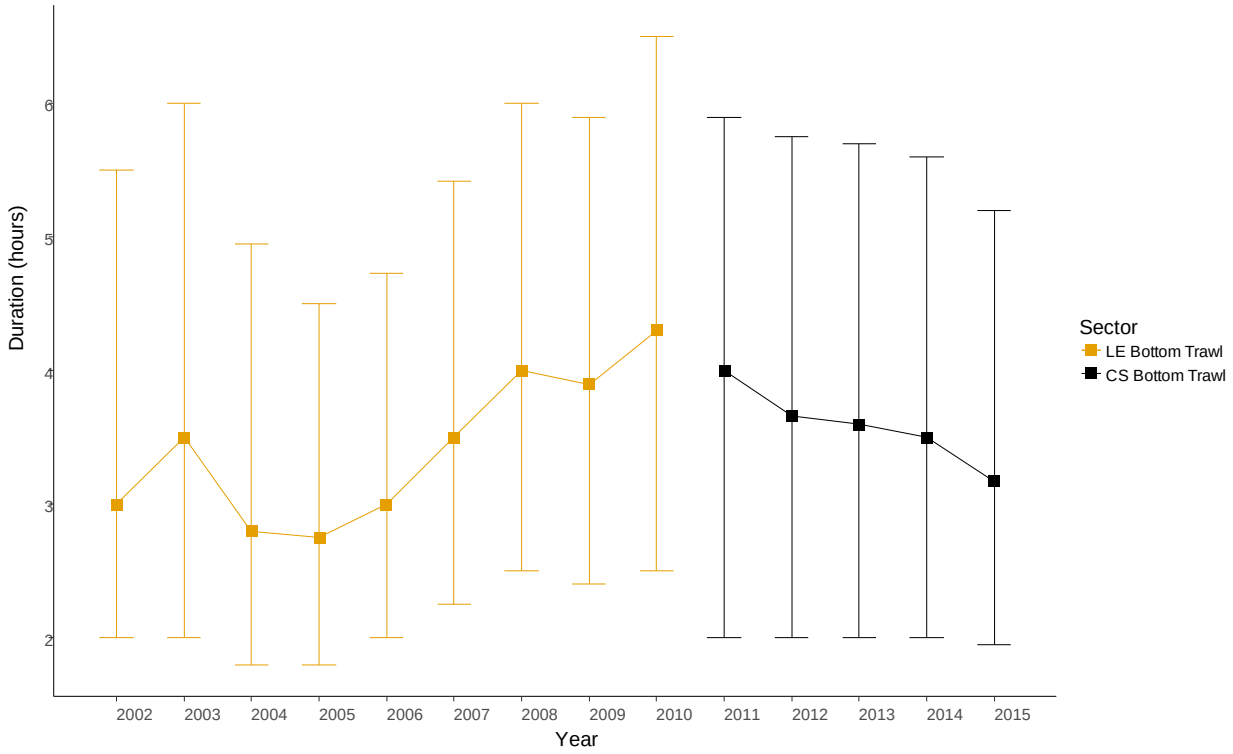

FIGURE 3. Tow duration (hours) per haul in shoreside bottom trawl sectors. Medians and first and third quartiles for each year are shown.

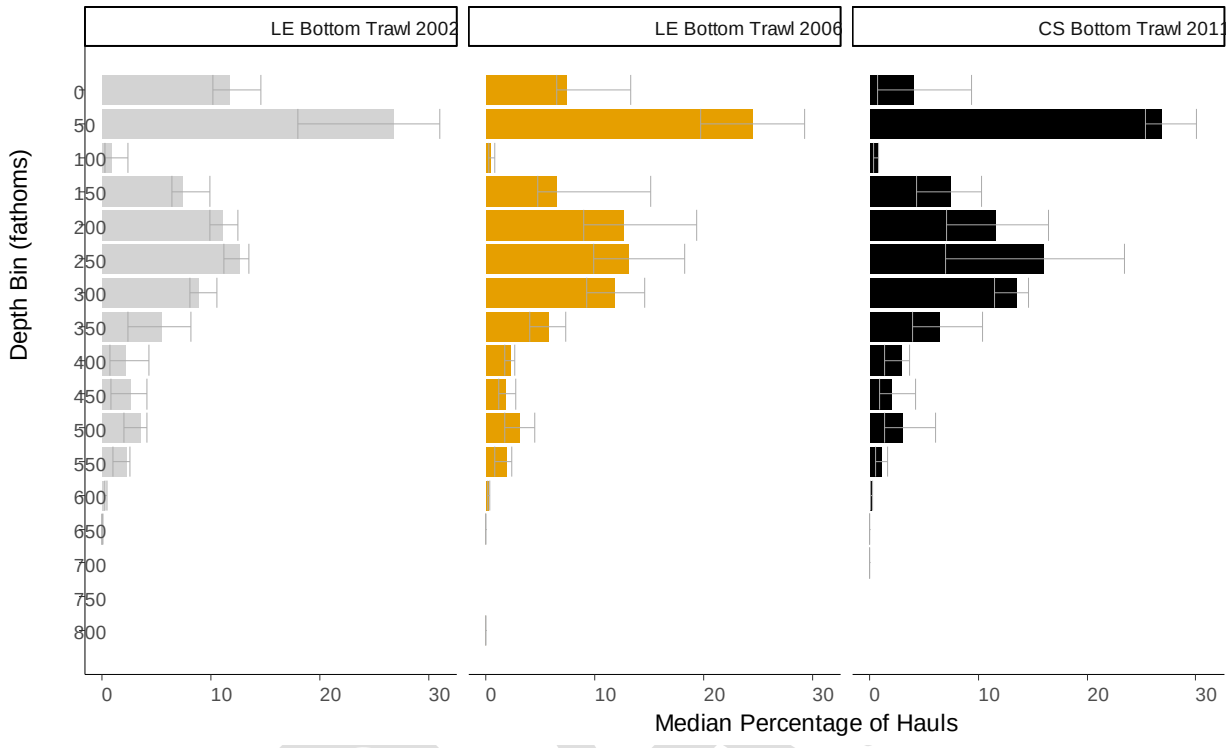

FIGURE 4. Percentage of retained groundfish landed in latitudinal bins by bottom trawl sectors targeting groundfish. Medians and first and third quartiles for each time period are shown.

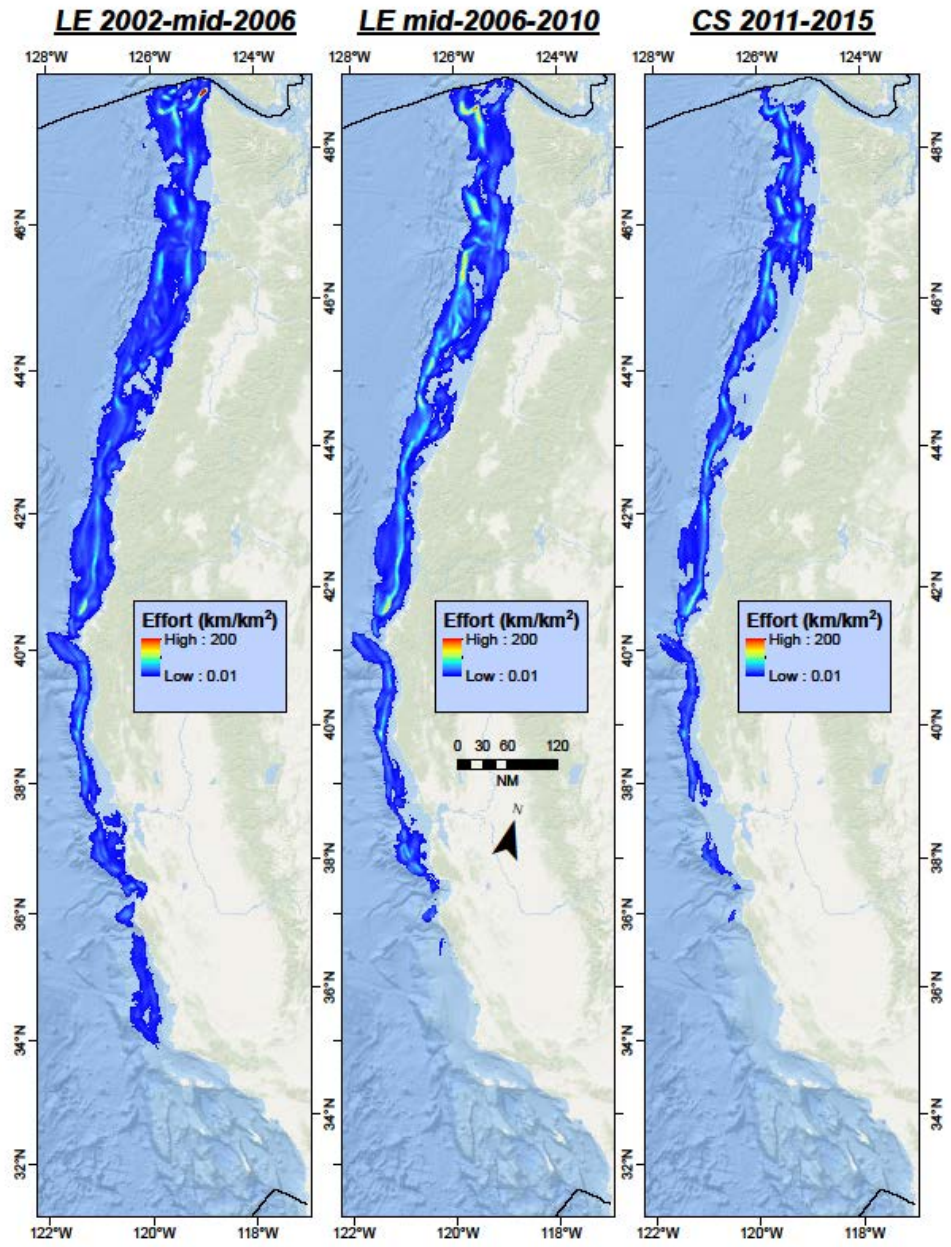

FIGURE 5. Spatial distribution and intensity of bottom trawl fishing effort within 3 relevant time periods, as described in the text. The density values for the color ramps for each map panel are equal, so pixel-by-pixel comparisons can be made. The highest (red) and lowest (blue) values are set arbitrarily so that areas of relatively high and low fishing intensity can be compared across time periods.

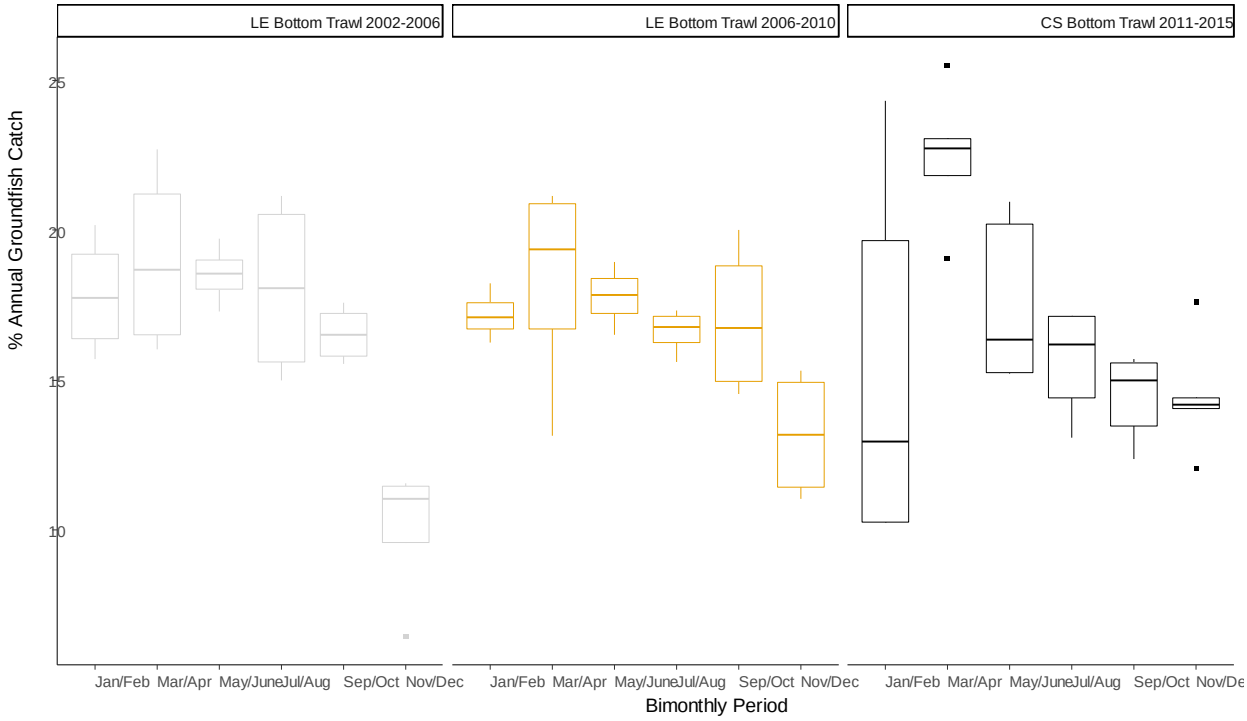

FIGURE 6. Percentage of retained groundfish landed in bimonthly bins by bottom trawl sectors targeting groundfish. Medians and first and third quartiles for each time period are shown.

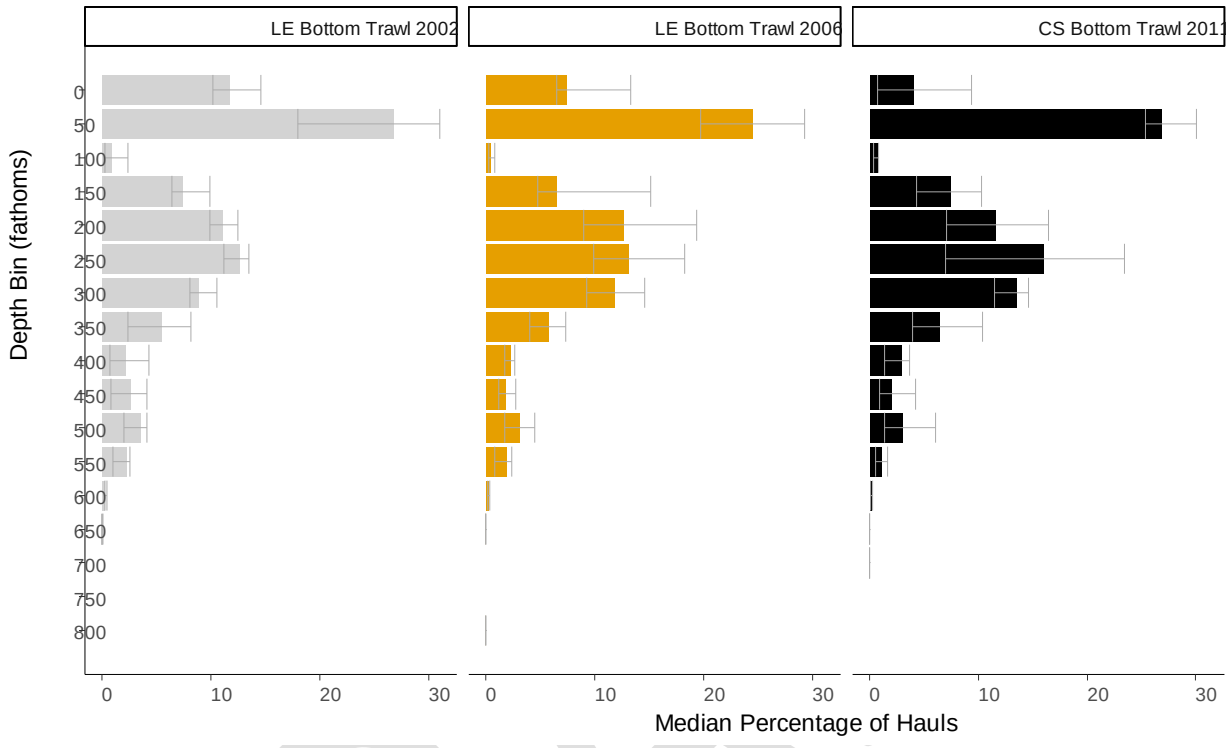

FIGURE 7. Percentage of hauls in 50-fathom depth bins by bottom trawl sectors targeting groundfish. Medians and first and third quartiles for each time period are shown.

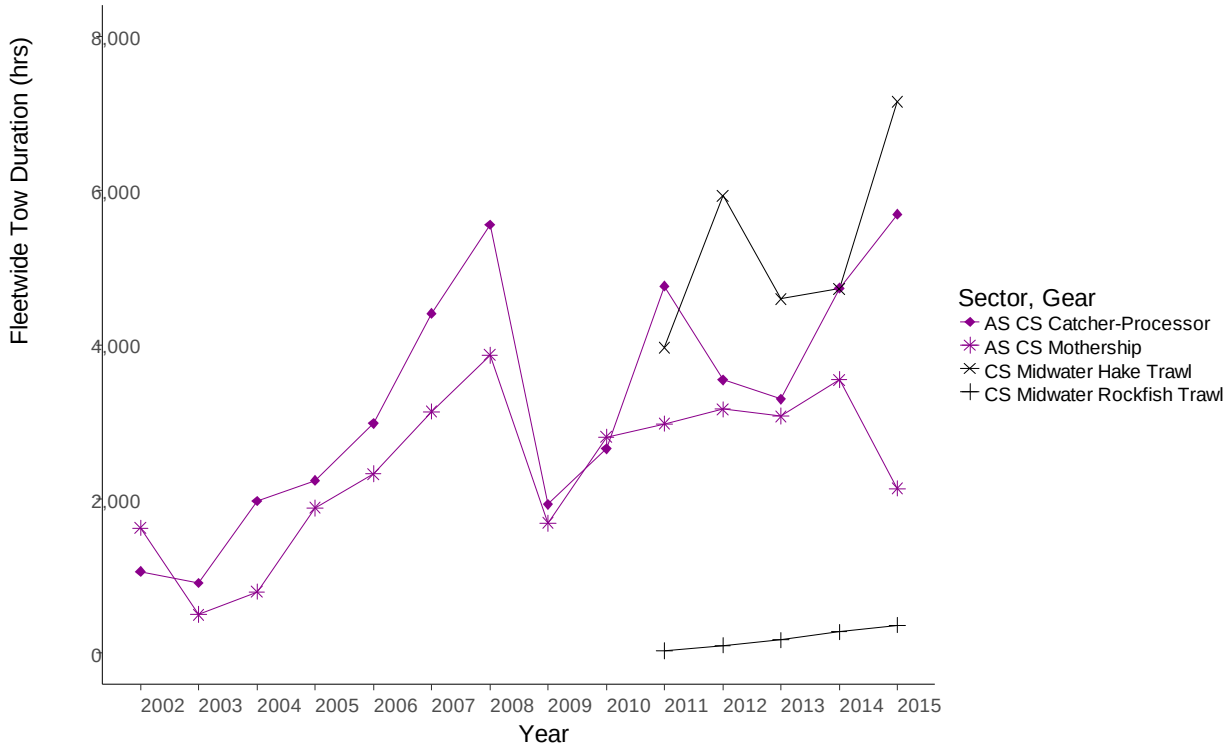

FIGURE 8. Annual total fleet-wide tow duration (hours) in shoreside and at-sea midwater trawl sectors.

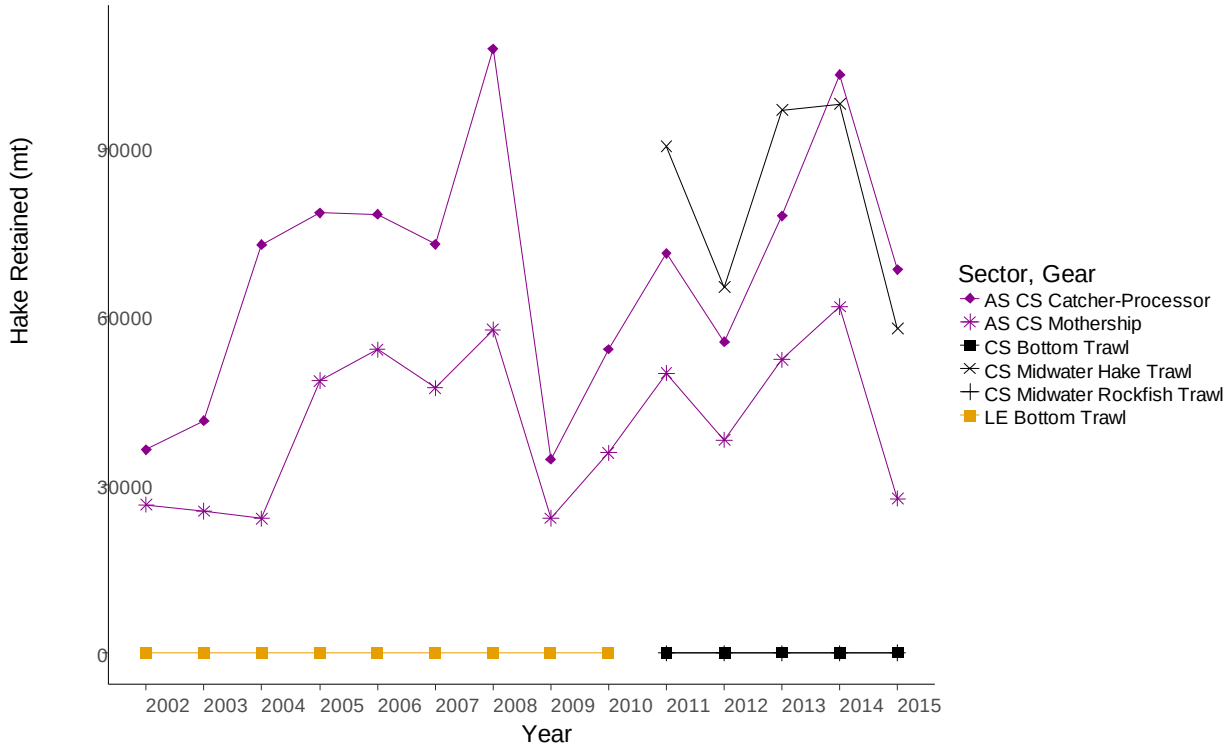

FIGURE 9. Annual total fleet-wide hake landings (mt) in shoreside bottom and midwater and at-sea midwater trawl sectors.

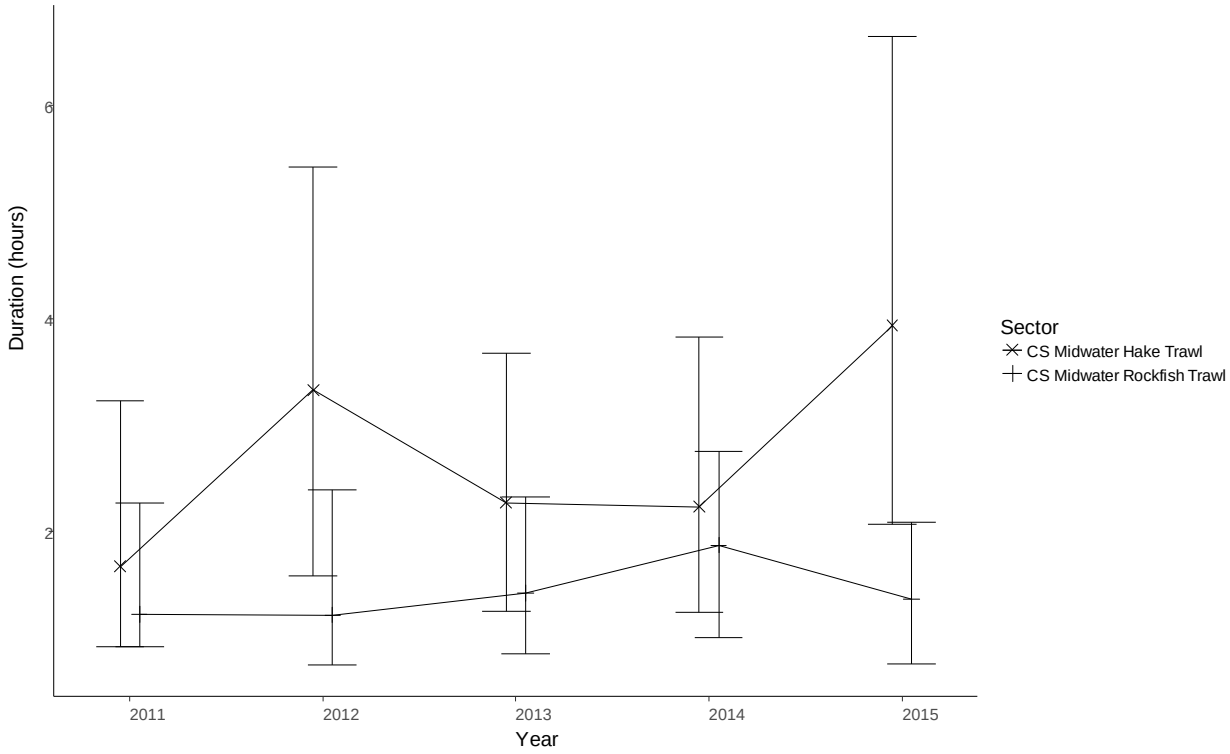

FIGURE 10. Tow duration (hours) per haul in shoreside midwater trawl sectors. Medians and first and third quartiles for each year are shown.

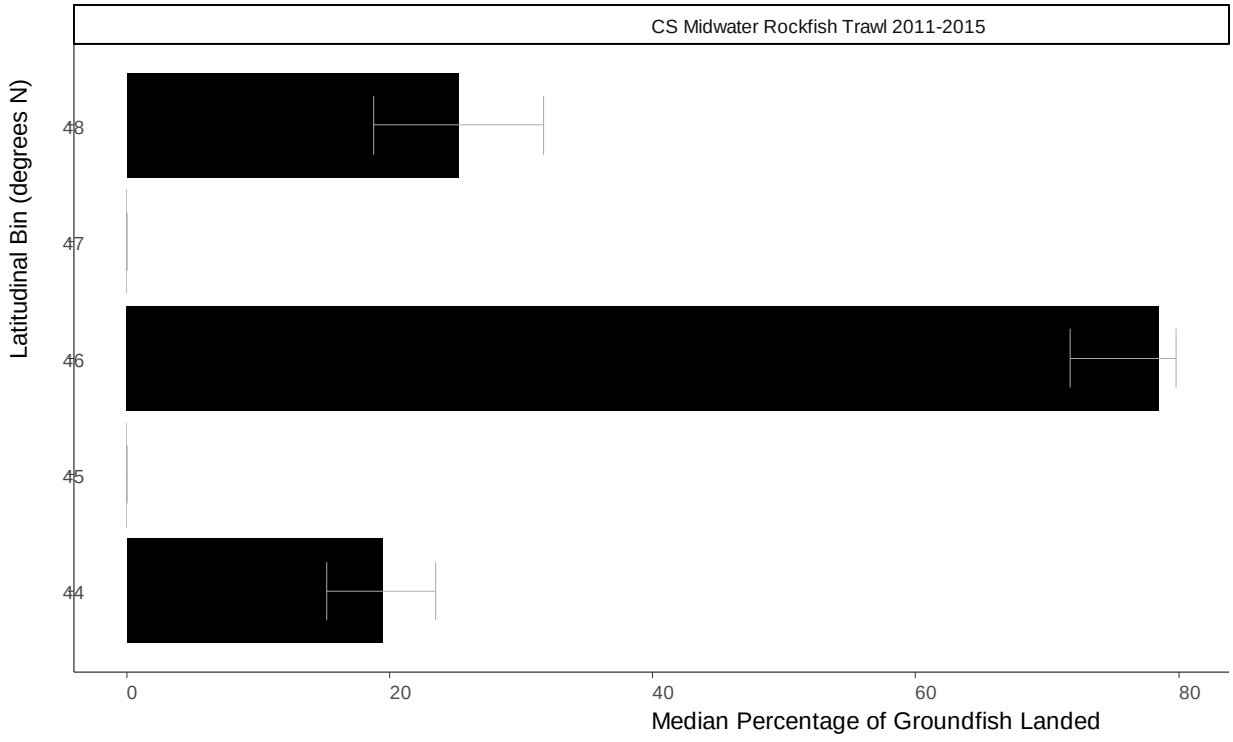

FIGURE 11. Percentage of retained groundfish landed in latitudinal bins by shoreside midwater trawl targeting rockfish. Medians and first and third quartiles are shown.

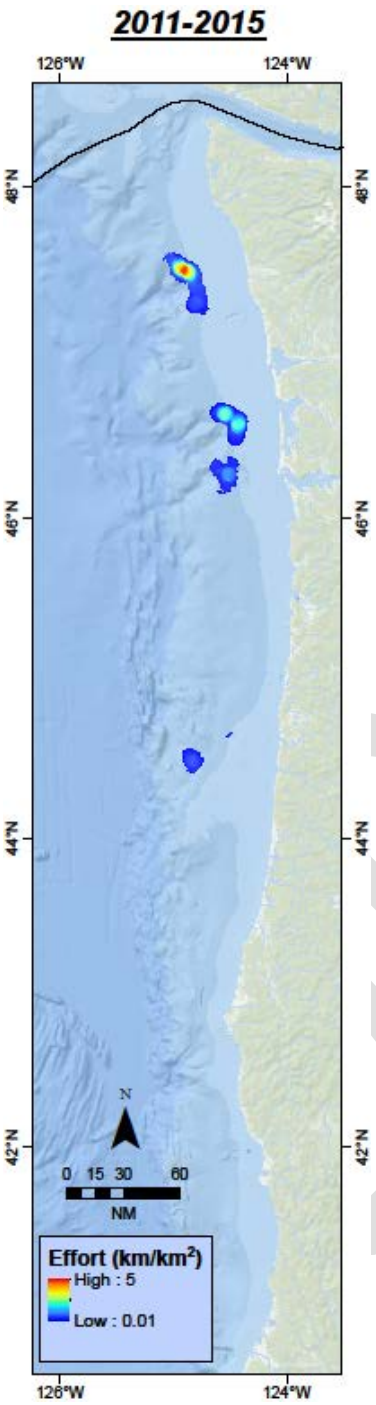

FIGURE 12. Spatial distribution and intensity of fishing effort by shoreside midwater trawl targeting rockfish.

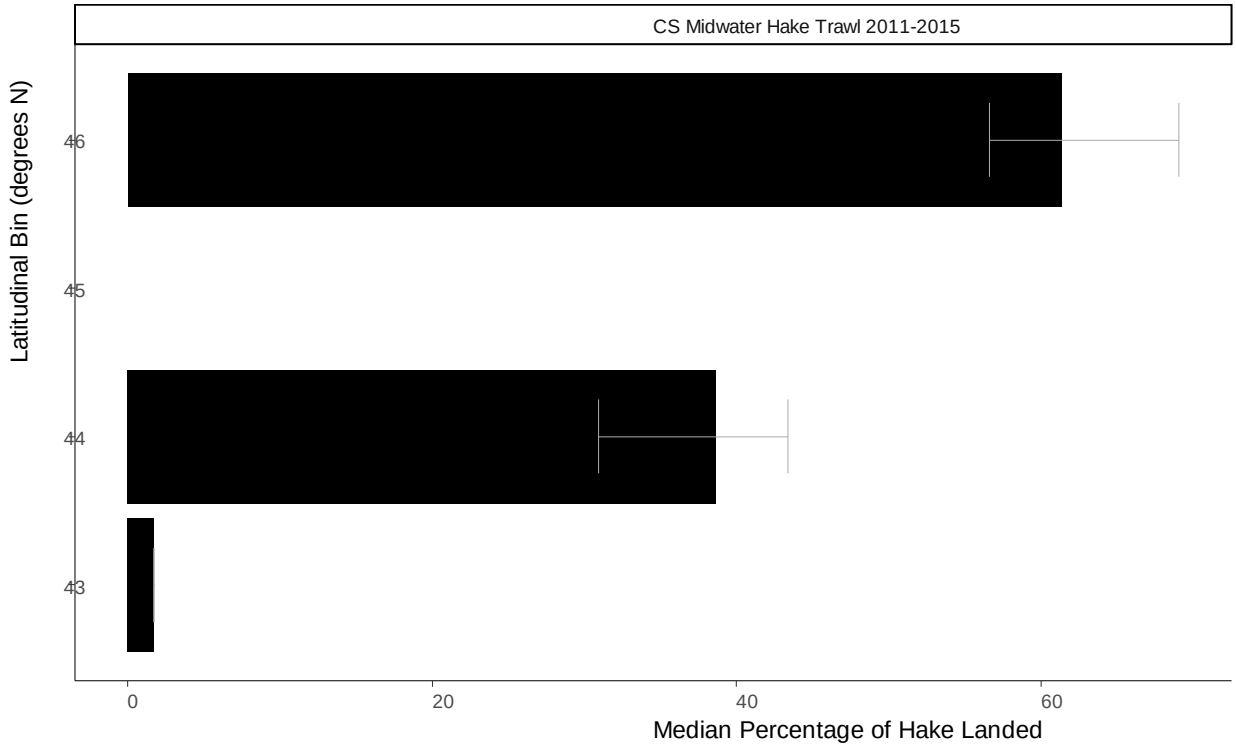

FIGURE 13. Percentage of retained hake landed in latitudinal bins by shoreside midwater trawl targeting hake. Medians and first and third quartiles are shown.

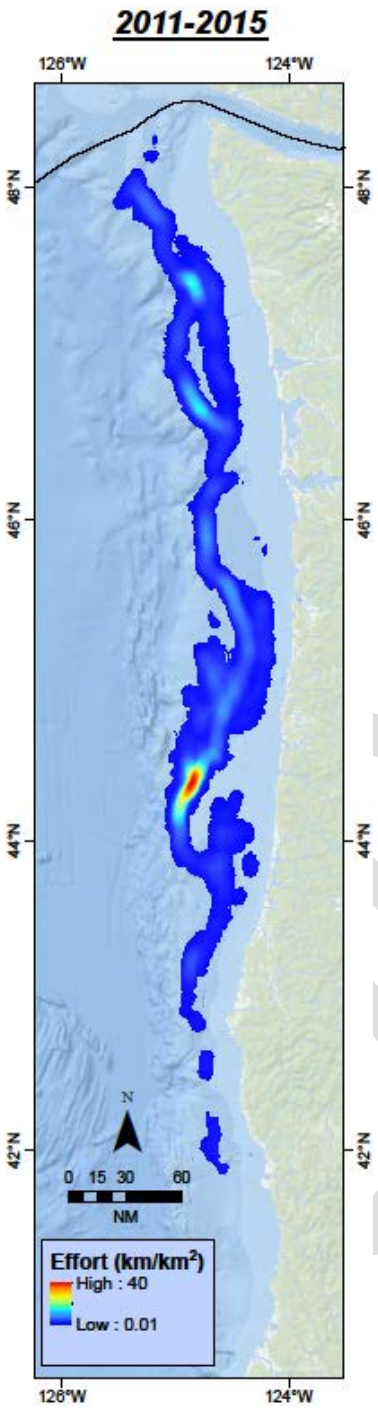

FIGURE 14. Spatial distribution and intensity of fishing effort by shoreside midwater trawl targeting hake.

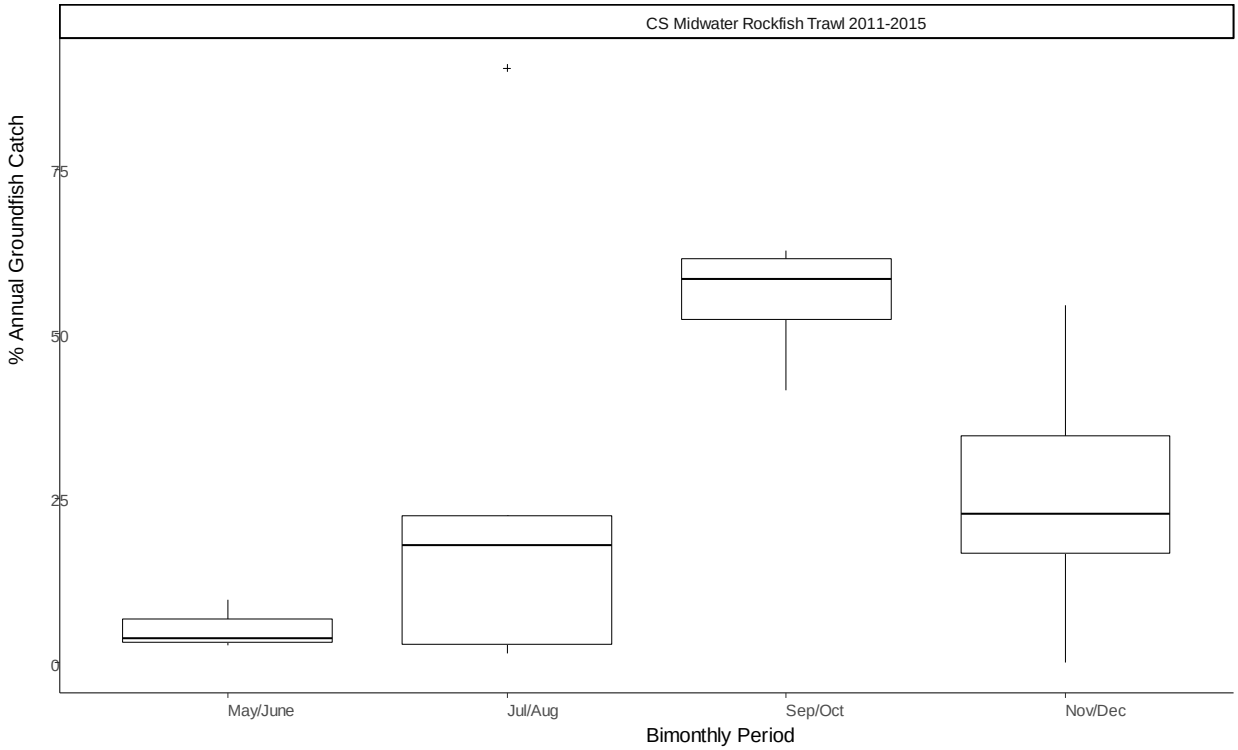

FIGURE 15. Percentage of retained groundfish landed in bimonthly bins by shoreside midwater trawl targeting rockfish. Medians and first and third quartiles for each time period are shown.

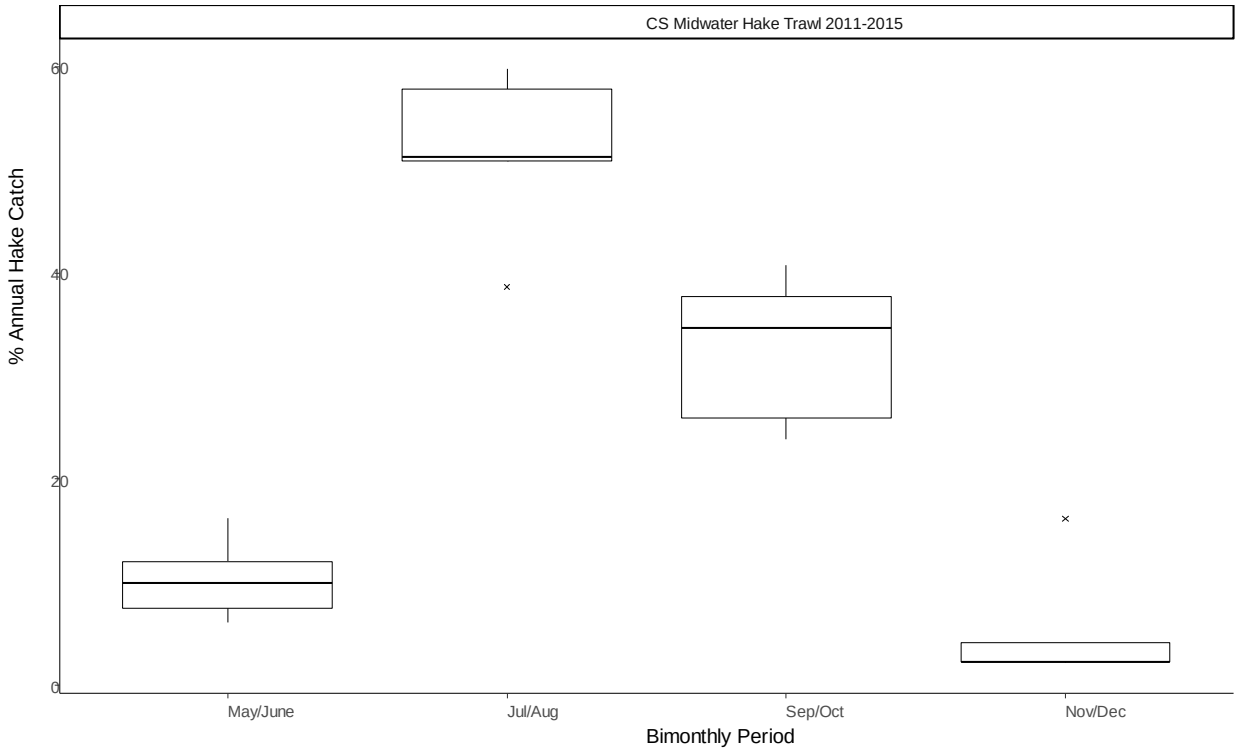

FIGURE 16. Percentage of retained hake landed in bimonthly bins by shoreside midwater trawl targeting hake. Medians and first and third quartiles for each time period are shown.

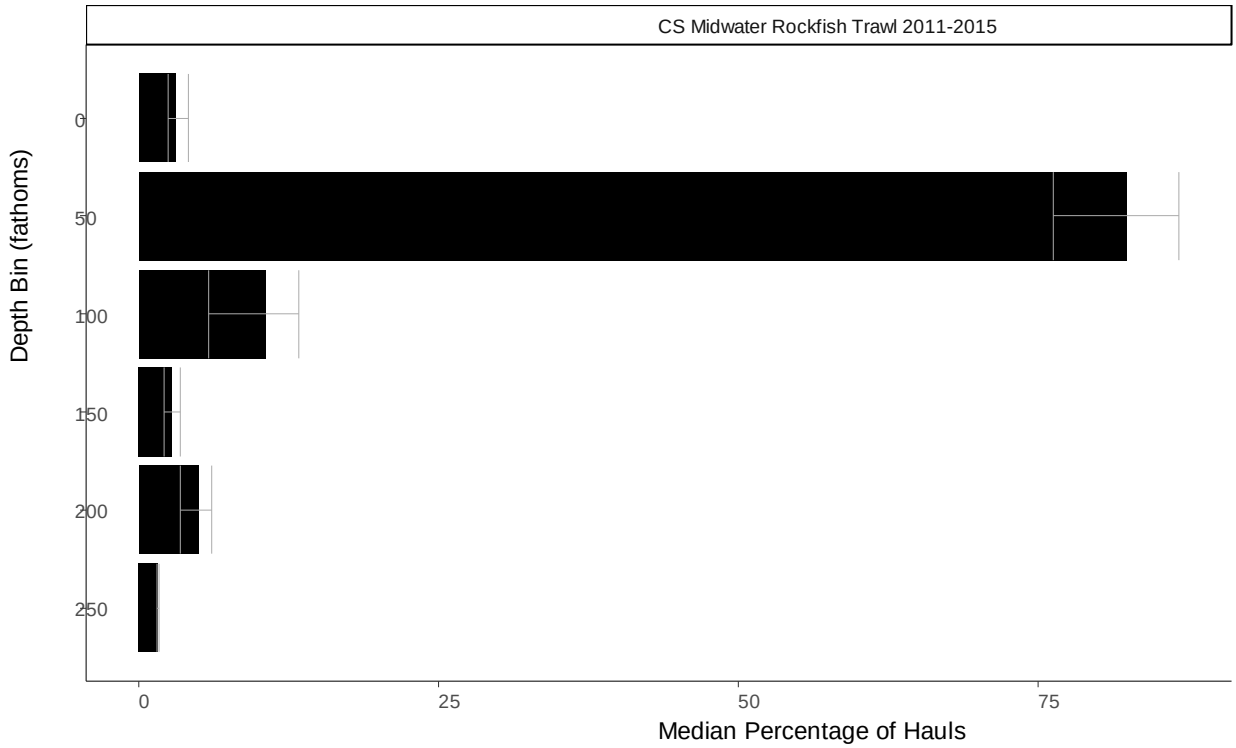

FIGURE 17. Percentage of hauls in 50-fathom depth bins by shoreside midwater trawl targeting rockfish. Medians and first and third quartiles for each time period are shown.

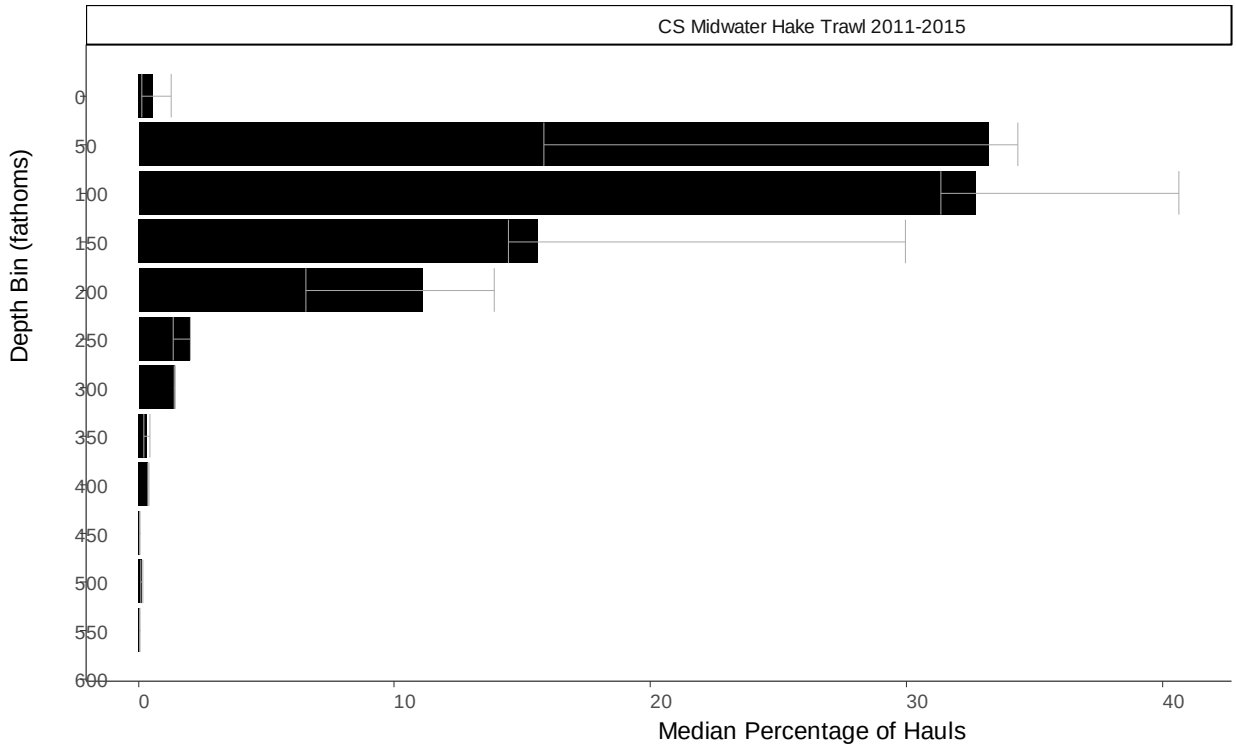

FIGURE 18. Percentage of hauls in 50-fathom depth bins by shoreside midwater trawl targeting hake. Medians and first and third quartiles for each time period are shown.

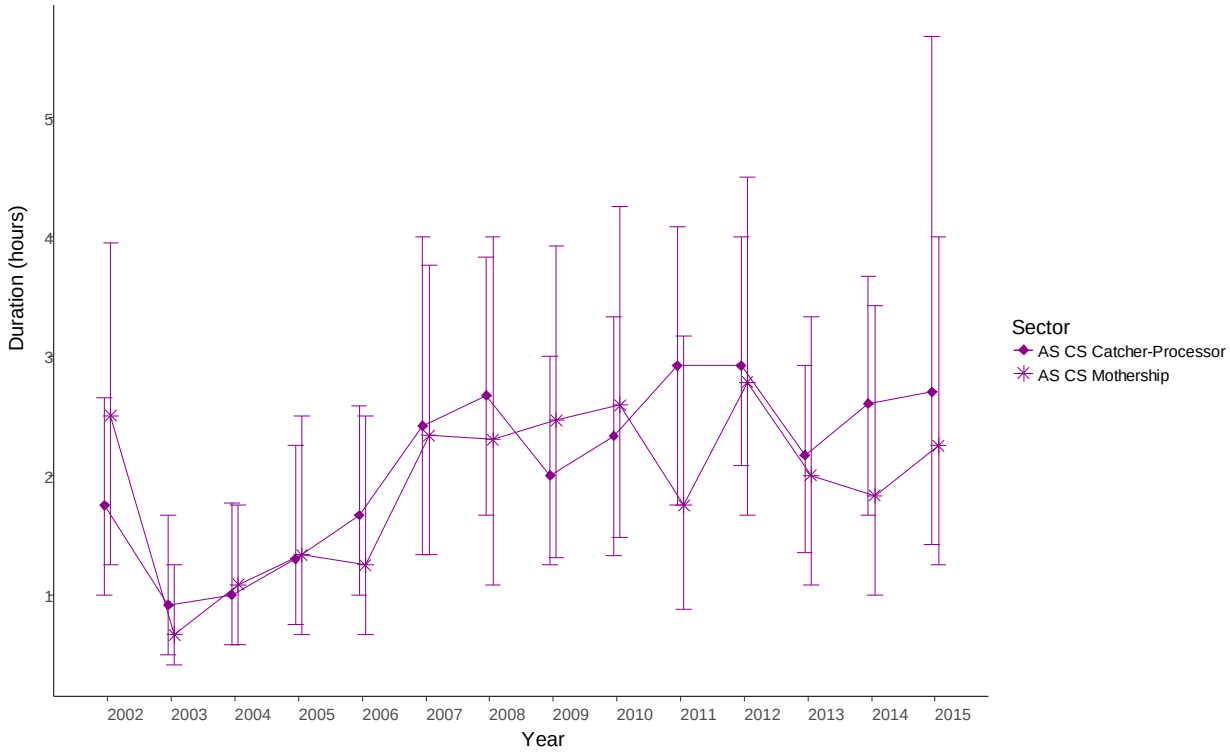

FIGURE 19. Tow duration (hours) per haul in at-sea midwater trawl sectors. Medians and first and third quartiles for each year are shown.

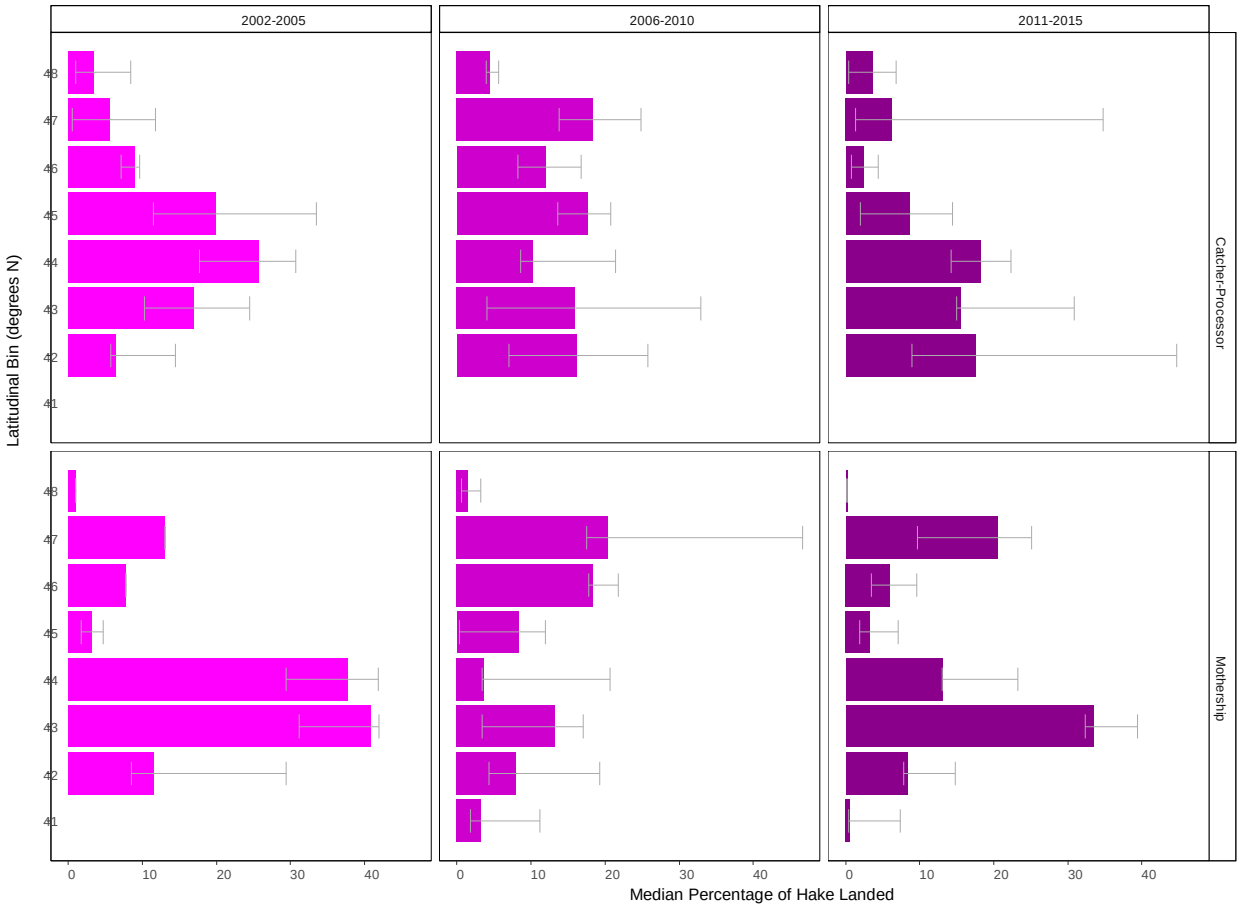

FIGURE 20. Percentage of retained hake caught in latitudinal bins by at-sea midwater trawl sectors. Medians and first and third quartiles are shown.

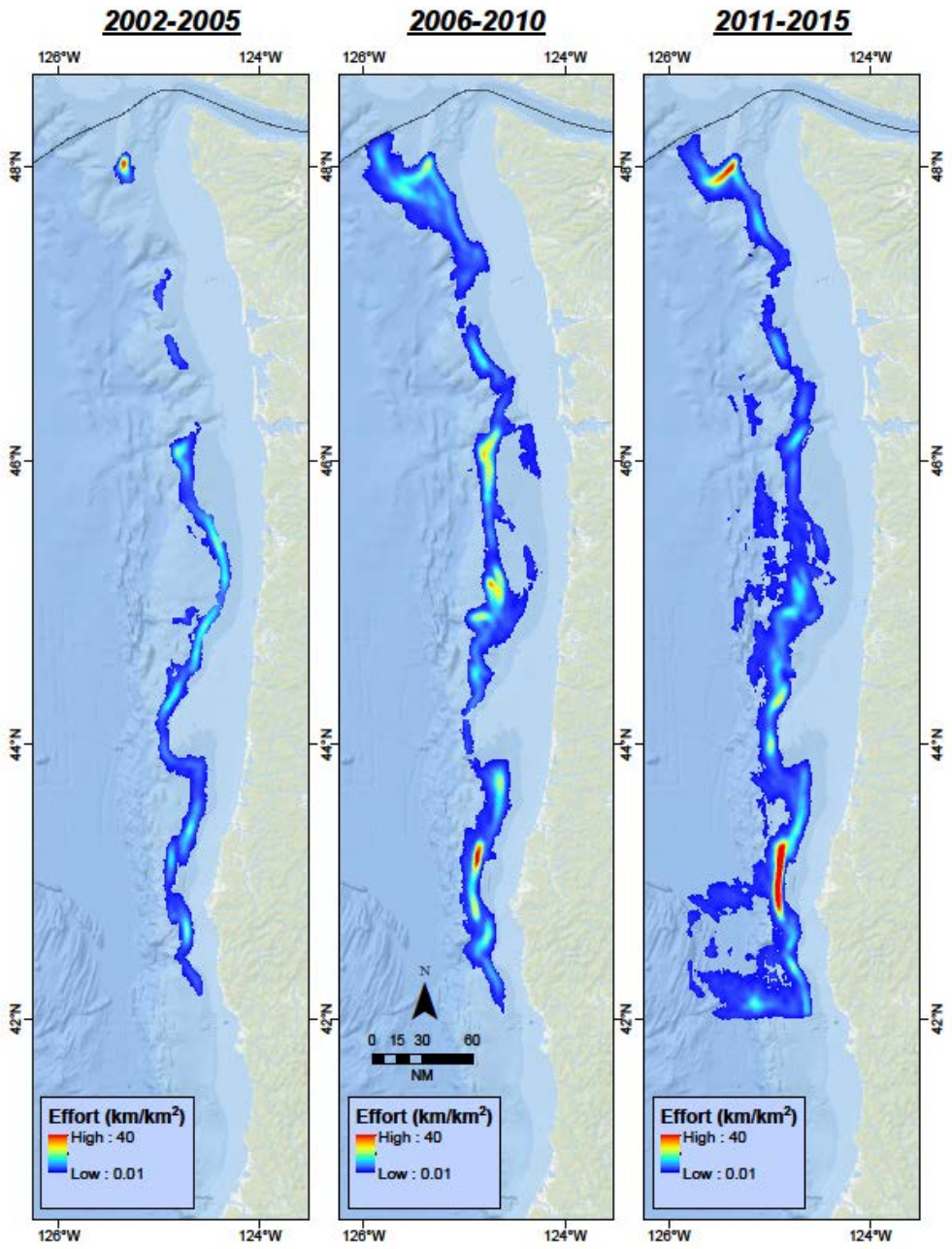

FIGURE 21. Spatial distribution and intensity of fishing effort by at-sea midwater trawl catcher-processors in 3 time periods, as described by text. The density values for the color ramps for each map panel are equal, so pixel-by-pixel comparisons can be made. The highest (red) and lowest (blue) values are set arbitrarily so that areas of relatively high and low fishing intensity can be compared across time periods.

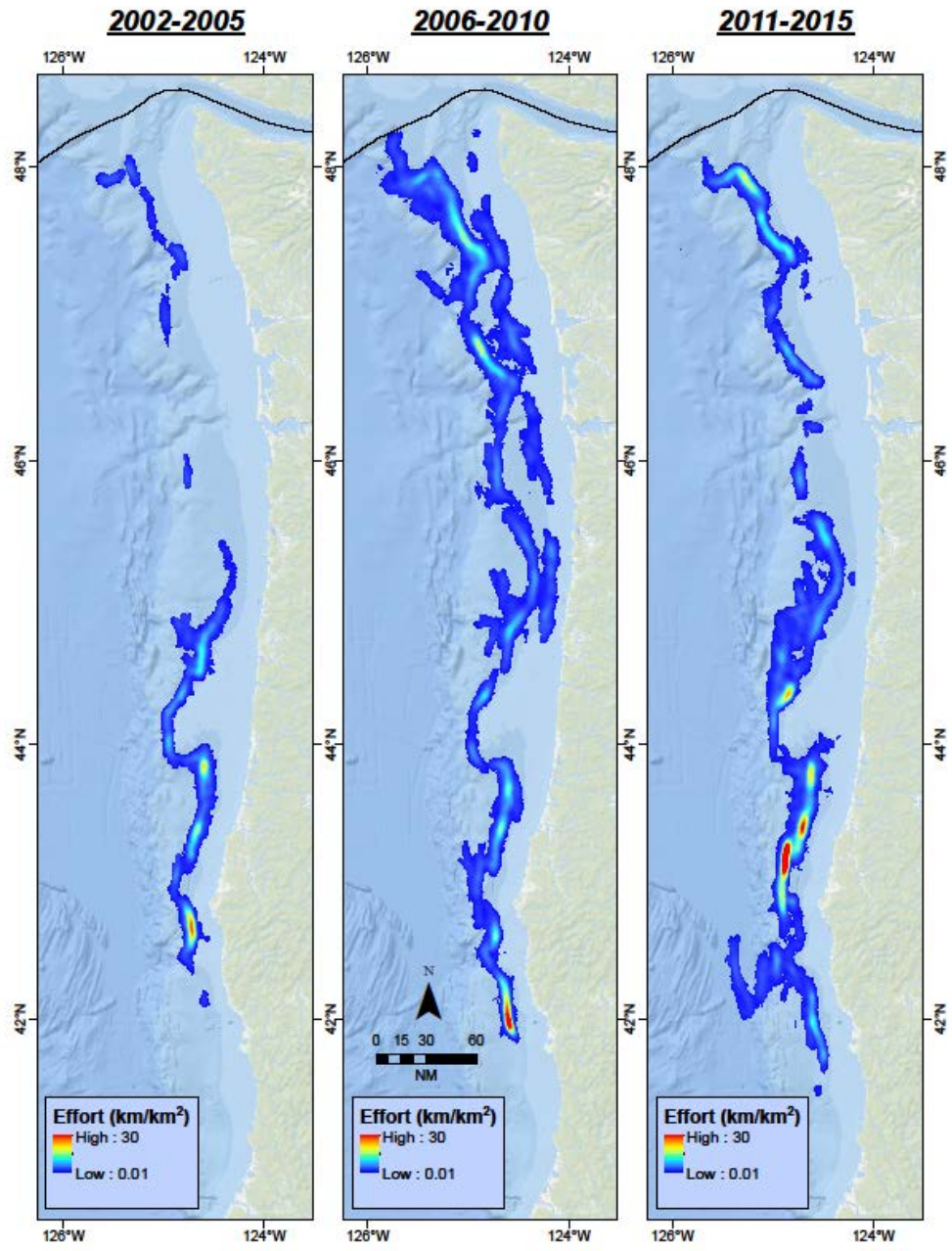

FIGURE 22. Spatial distribution and intensity of fishing effort by at-sea midwater trawl mothership catcher-vessels in 3 time periods, as described by text. The density values for the color ramps for each map panel are equal, so pixel-by-pixel comparisons can be made. The highest (red) and lowest (blue) values are set arbitrarily so that areas of relatively high and low fishing intensity can be compared across time periods.

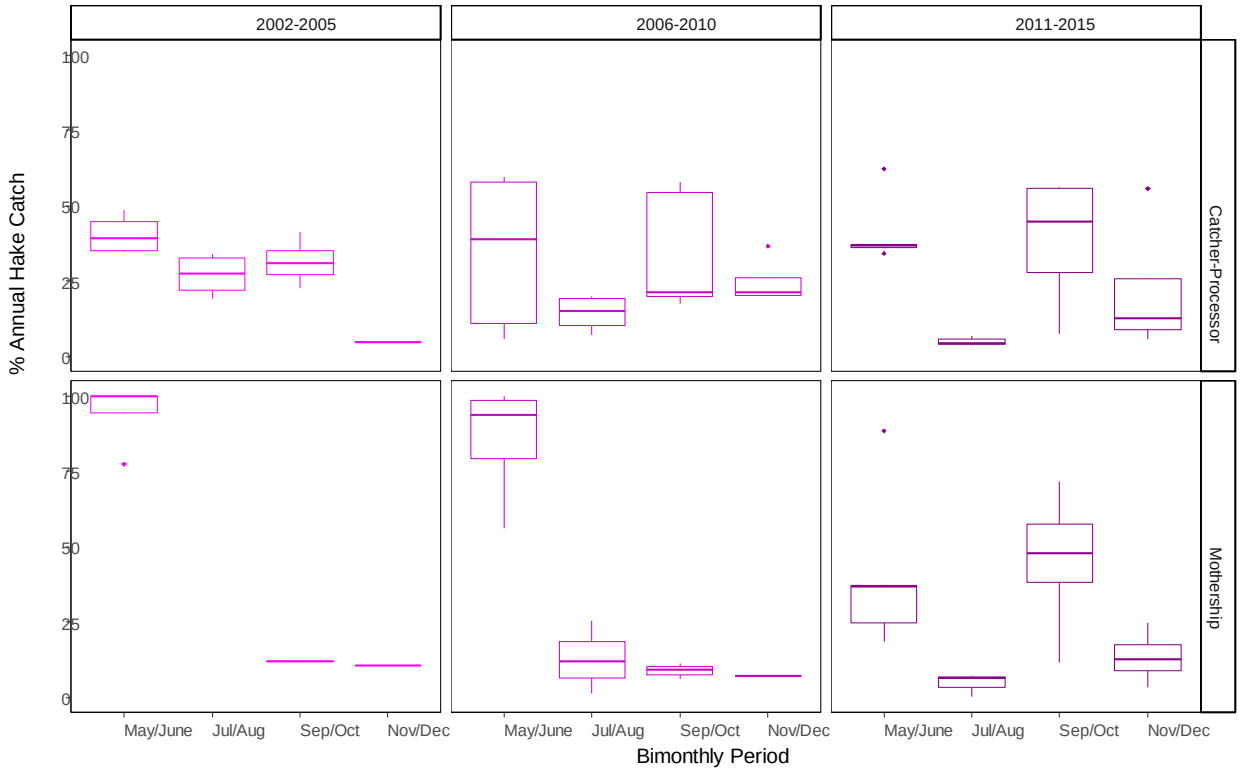

FIGURE 23. Percentage of retained hake caught in bimonthly bins by at-sea midwater trawl sectors. Medians and first and third quartiles for each time period are shown.

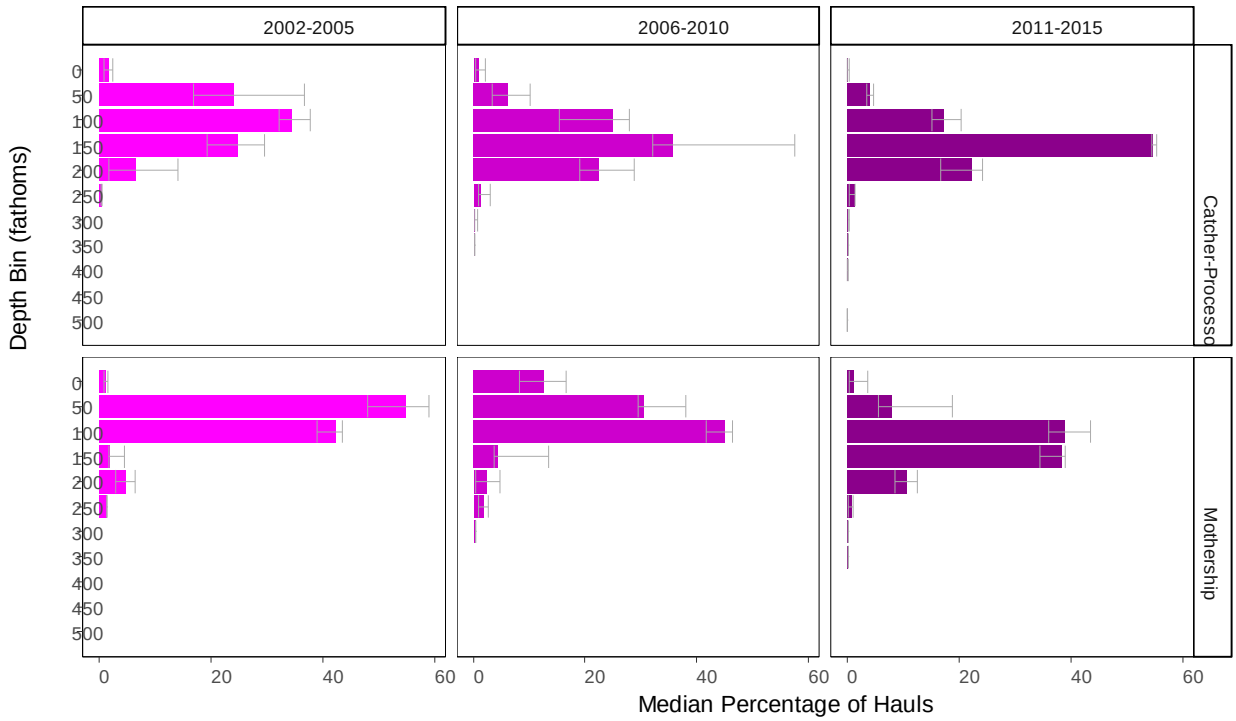

FIGURE 24. Percentage of hauls in 50-fathom depth bins by at-sea midwater trawl sectors. Medians and first and third quartiles for each time period are shown.

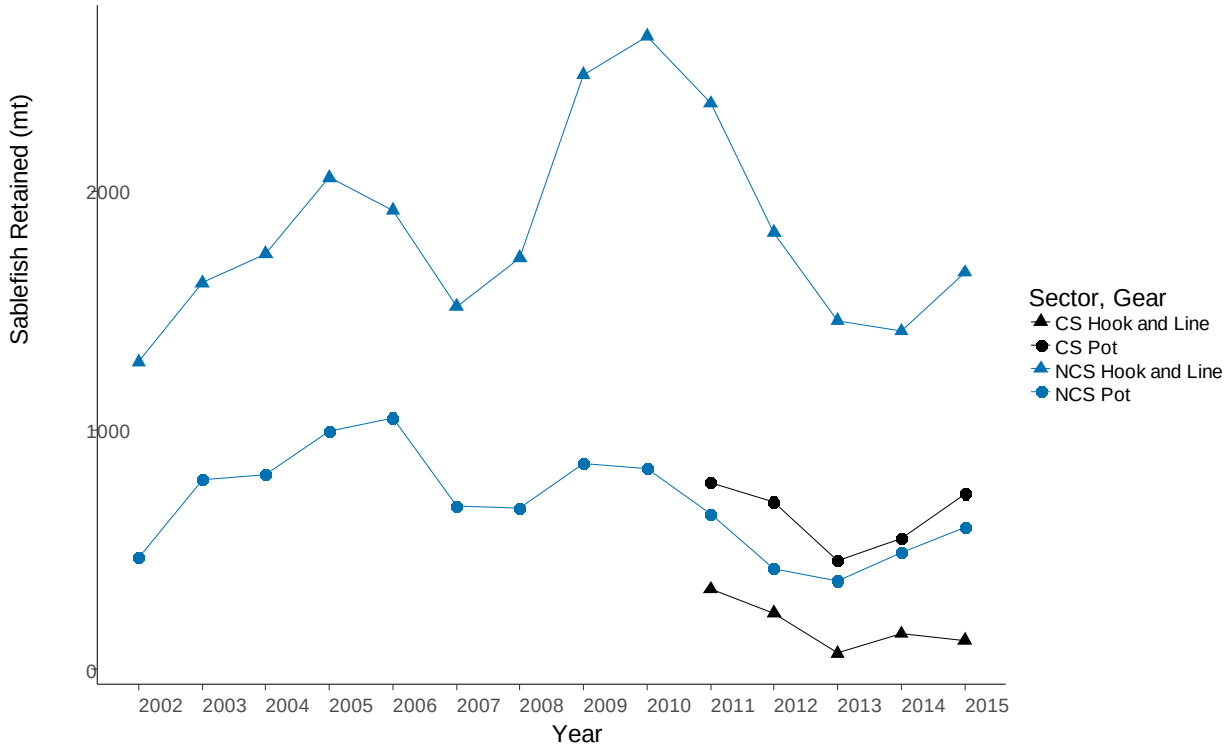

FIGURE 25. Annual total fleet-wide sablefish landings (mt) in fixed gear sectors.

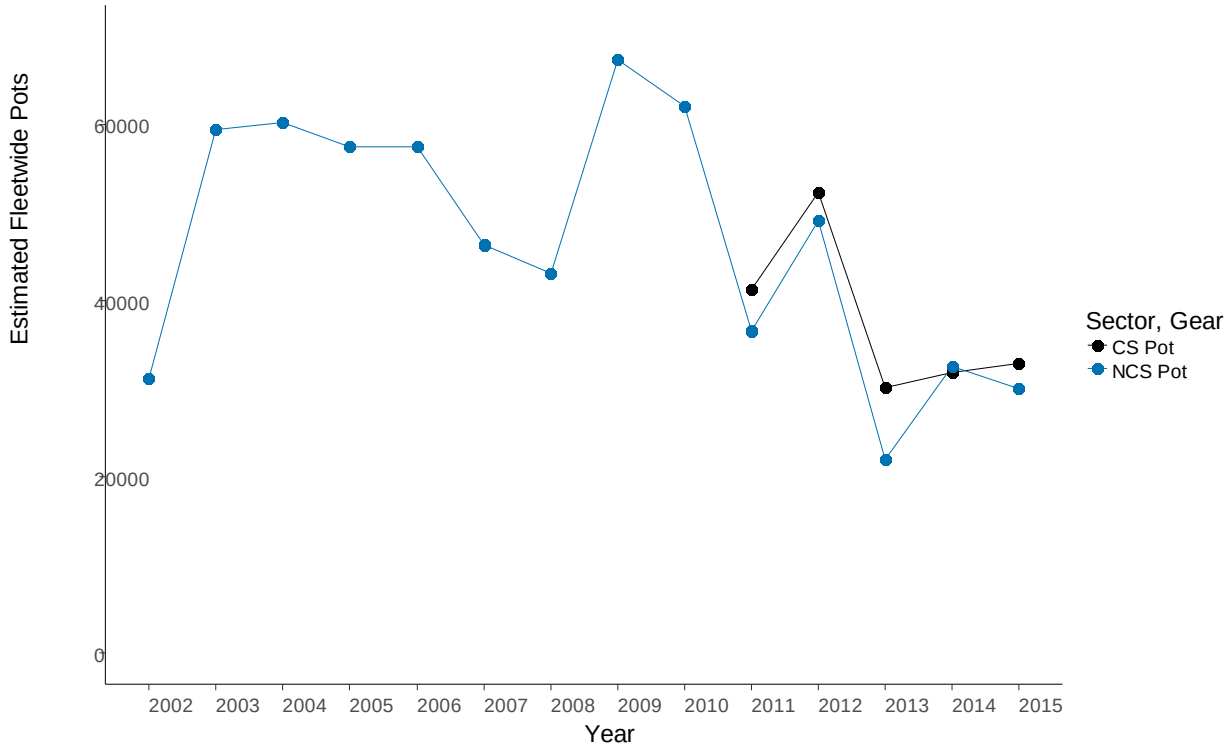

FIGURE 26. Annual total fleet-wide gear units in pot sectors.

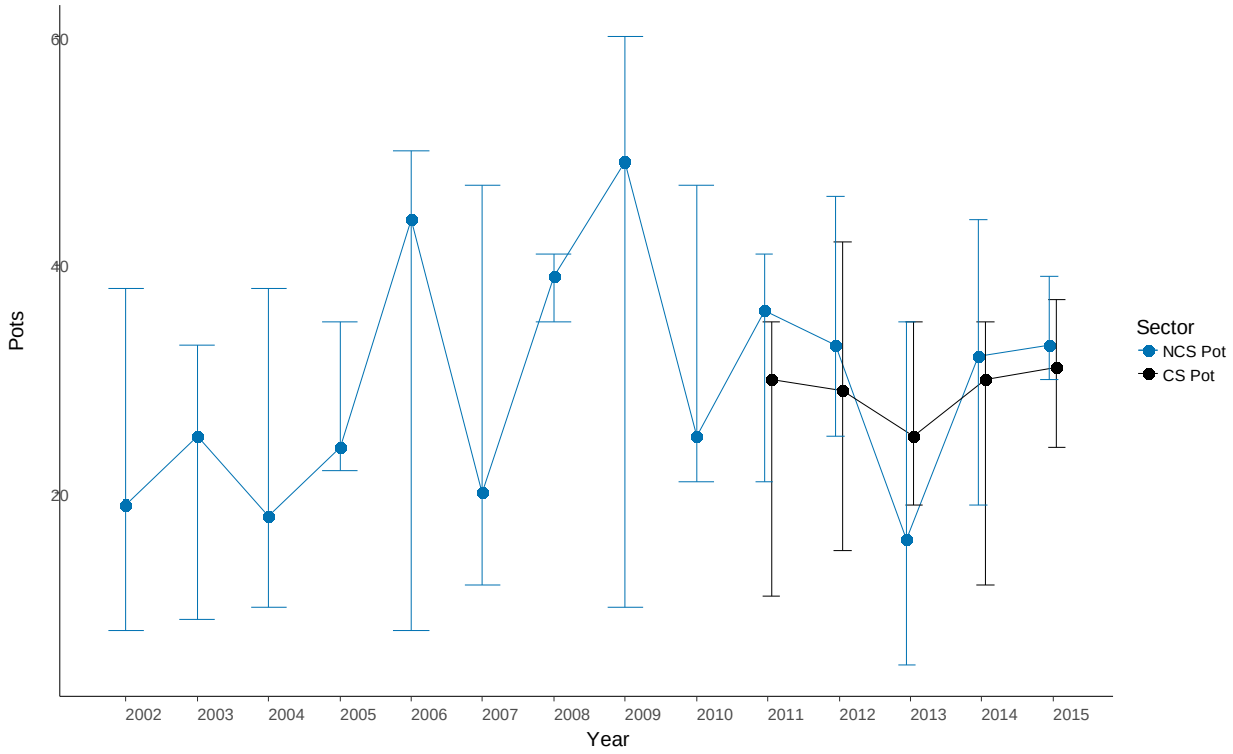

FIGURE 27. Gear units per haul in pot sectors. Medians and first and third quartiles for each year are shown.

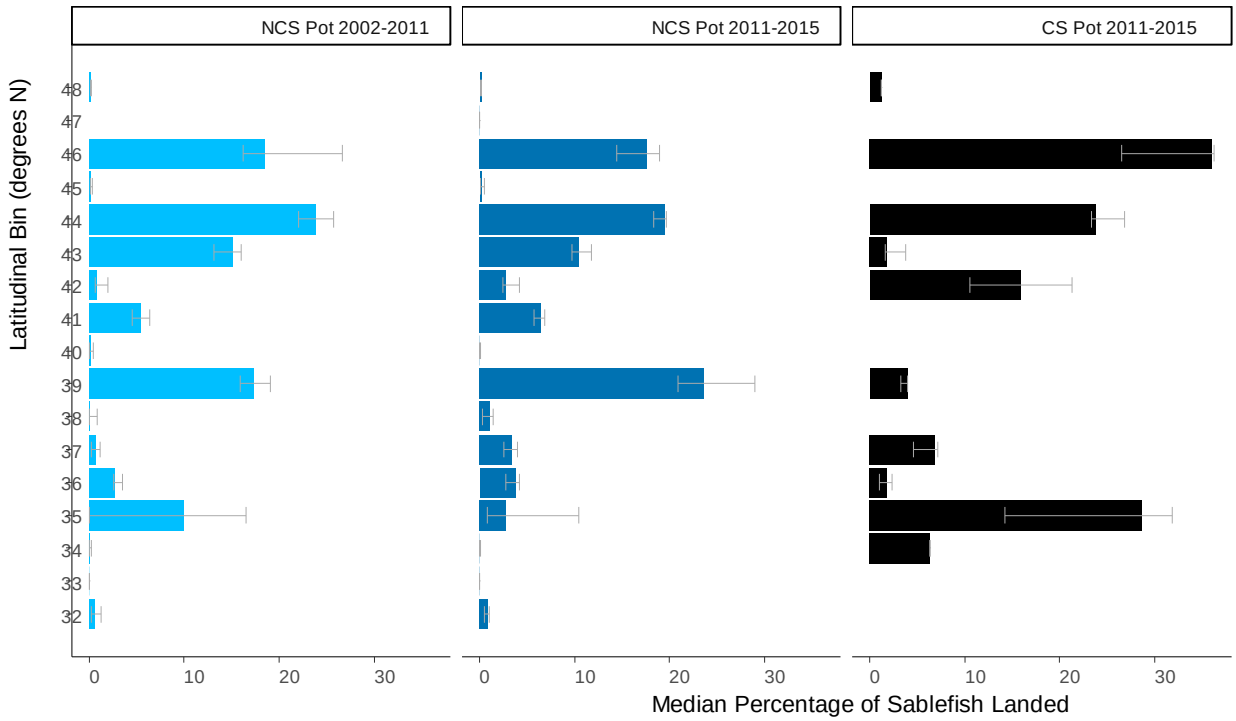

FIGURE 28. Percentage of retained sablefish landed in latitudinal bins by pot sectors. Medians and first and third quartiles are shown.

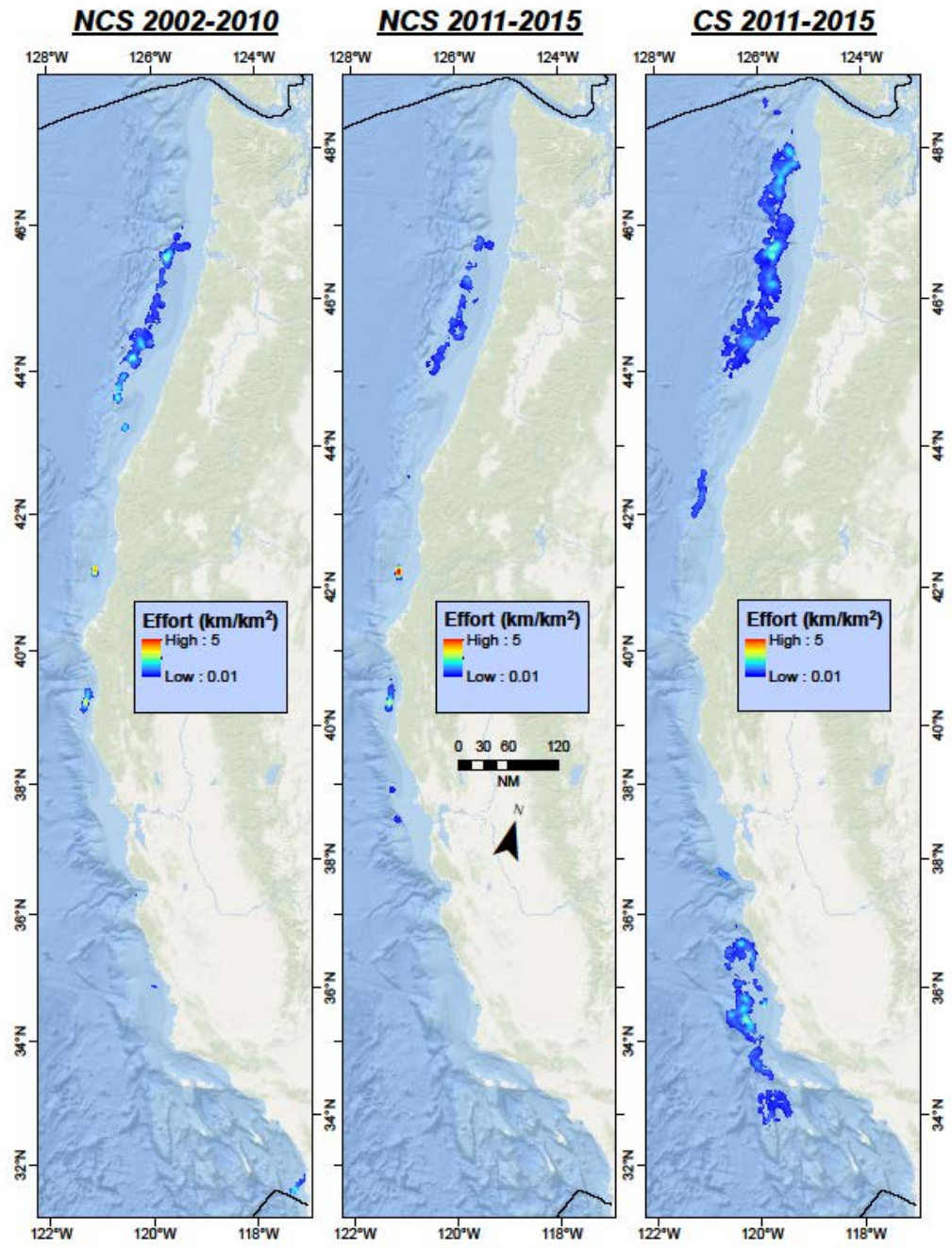

FIGURE 29. Spatial distribution and intensity of fishing effort by pot sectors. The density values for the color ramps for each map panel are equal, so pixel-by-pixel comparisons can be made. The highest (red) and lowest (blue) values are set arbitrarily so that areas of relatively high and low fishing intensity can be compared across time periods.

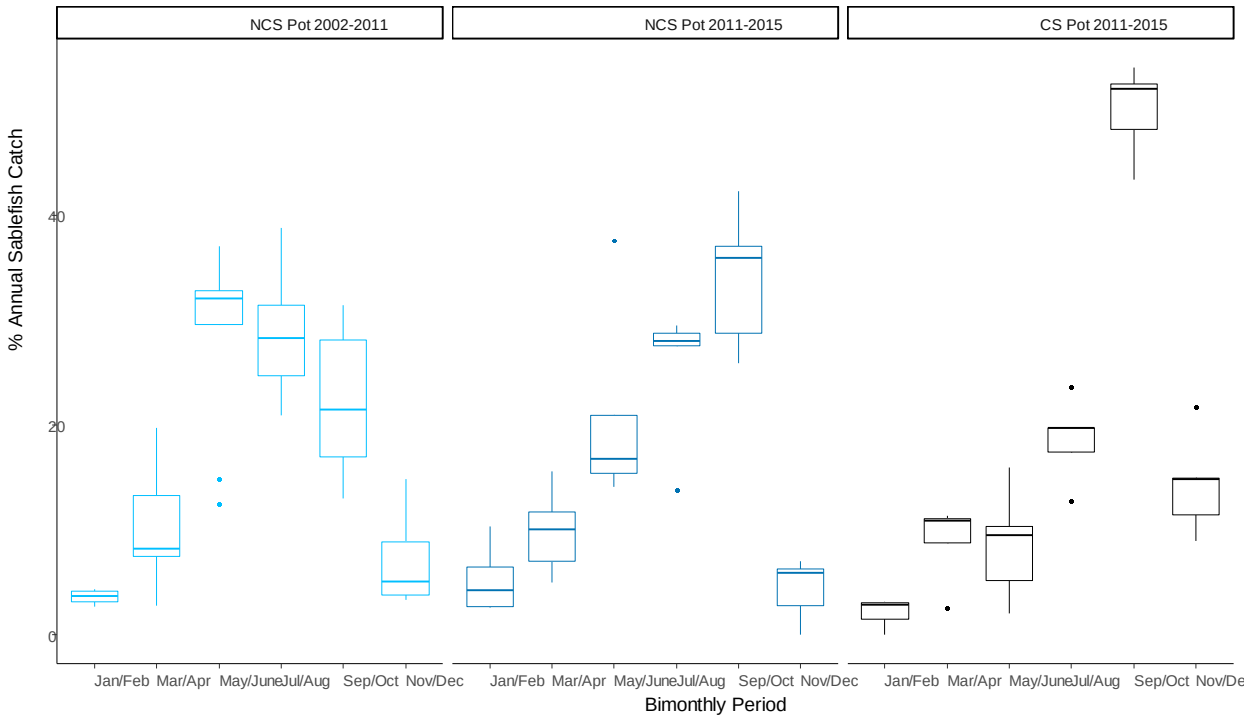

FIGURE 30. Percentage of retained sablefish landed in bimonthly bins by pot sectors. Medians and first and third quartiles for each time period are shown.

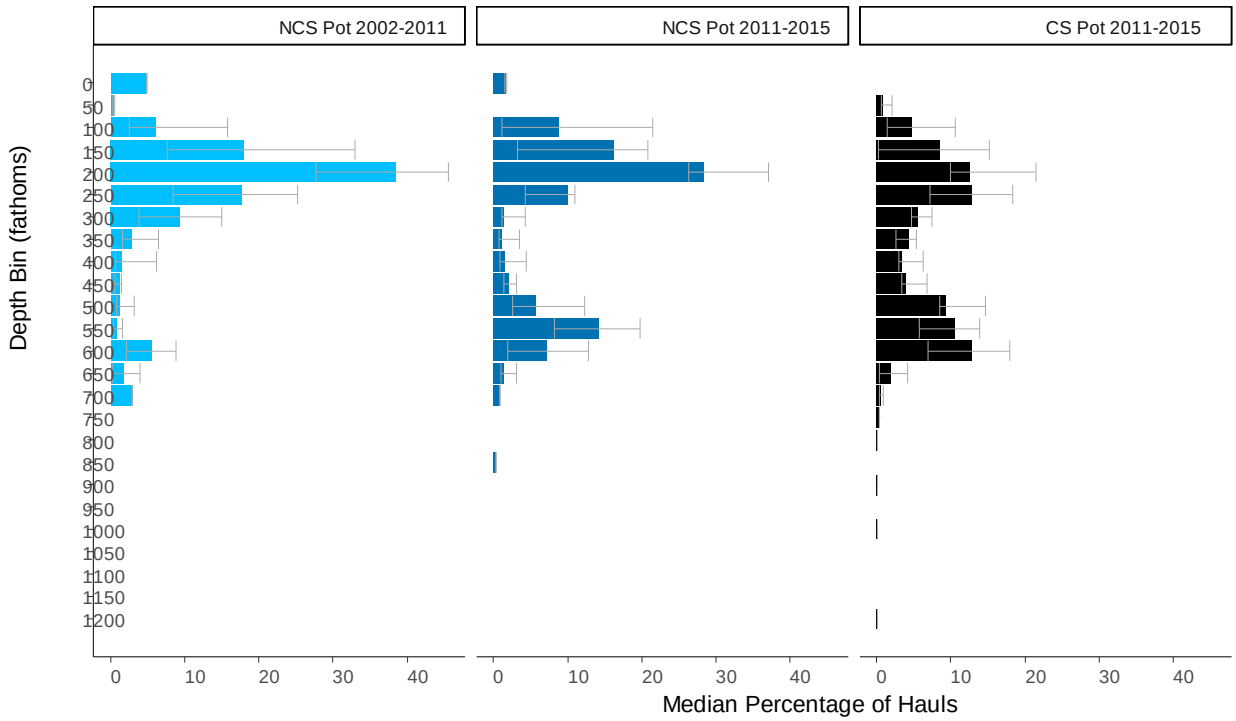

FIGURE 31. Percentage of observed hauls in 50-fathom depth bins by pot sectors. Medians and first and third quartiles for each time period are shown.

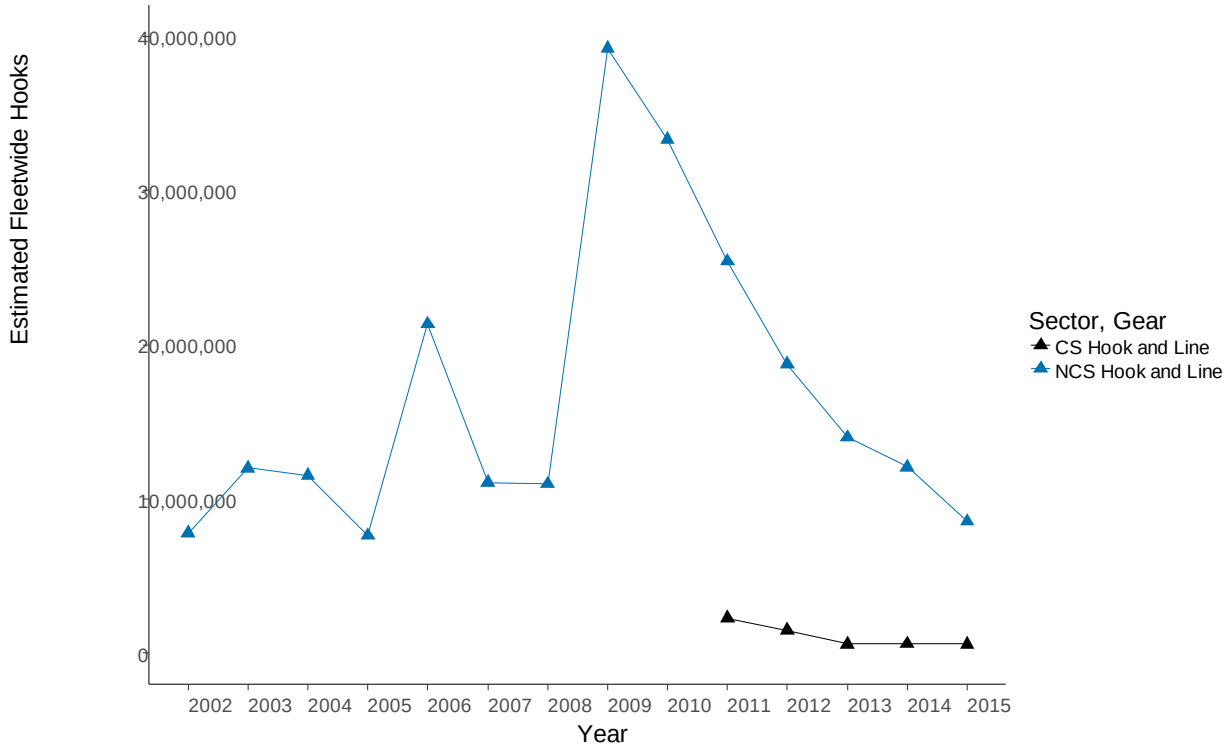

FIGURE 32. Annual total fleet-wide gear units in hook-and-line sectors.

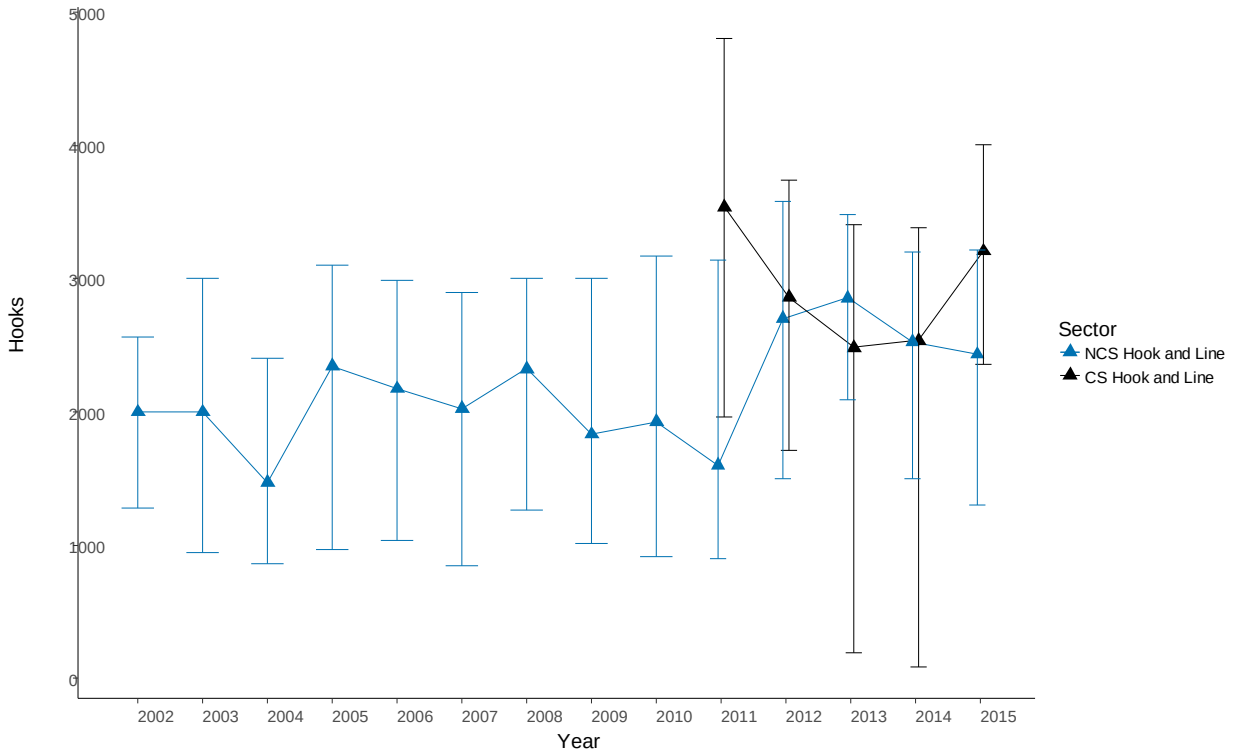

FIGURE 33. Gear units per haul in hook-and-line sectors. Medians and first and third quartiles for each year are shown.

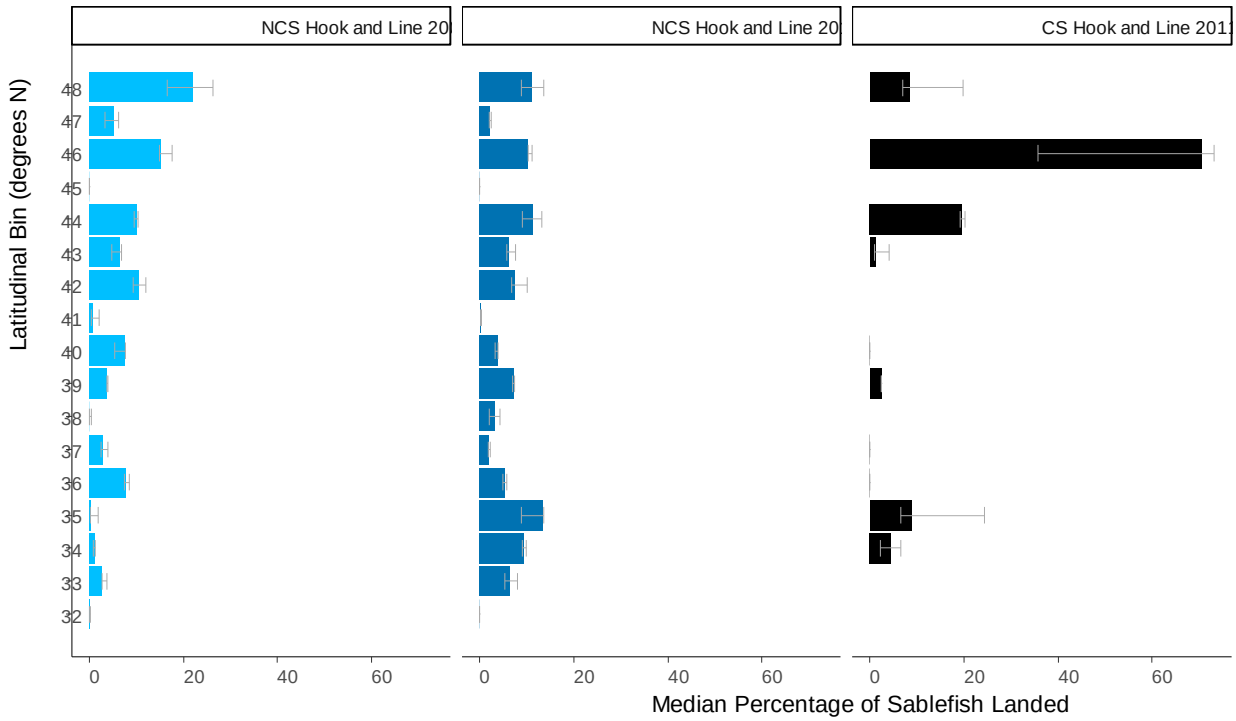

FIGURE 34. Percentage of retained sablefish landed in latitudinal bins by hook-and-line sectors. Medians and first and third quartiles are shown.

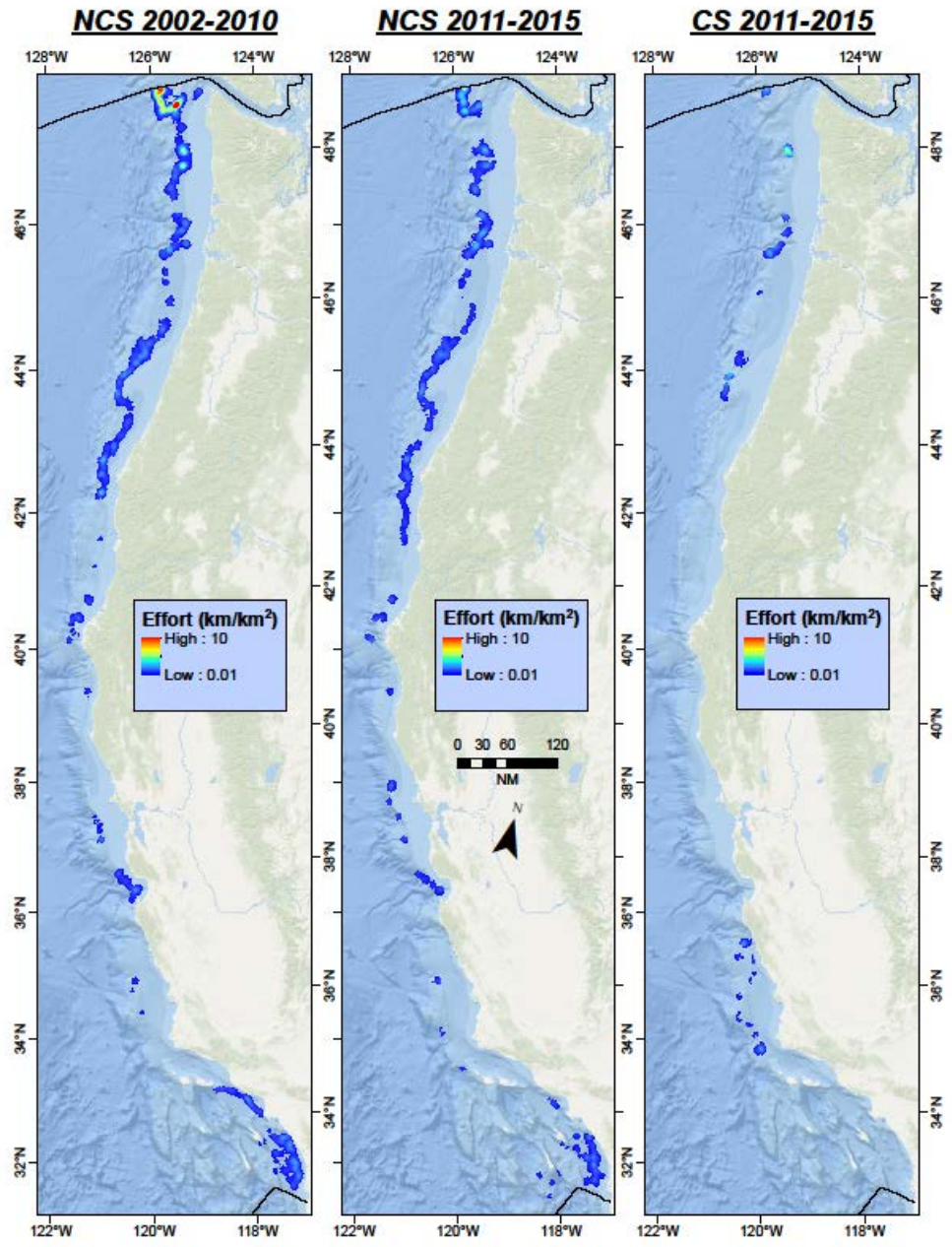

FIGURE 35. Spatial distribution and intensity of fishing effort by hook-and-line sectors. The density values for the color ramps for each map panel are equal, so pixel-by-pixel comparisons can be made. The highest (red) and lowest (blue) values are set arbitrarily so that areas of relatively high and low fishing intensity can be compared across time periods.

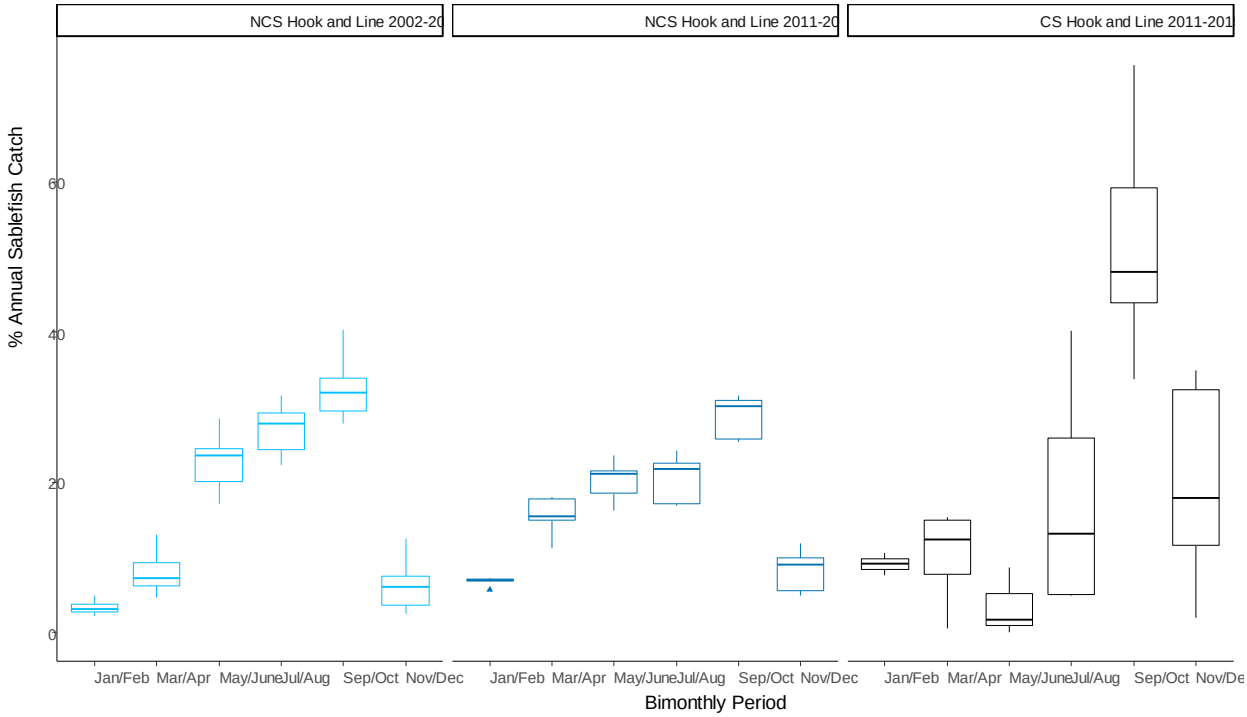

FIGURE 36. Percentage of retained sablefish landed in bimonthly bins by hook-and-line sectors. Medians and first and third quartiles for each time period are shown.

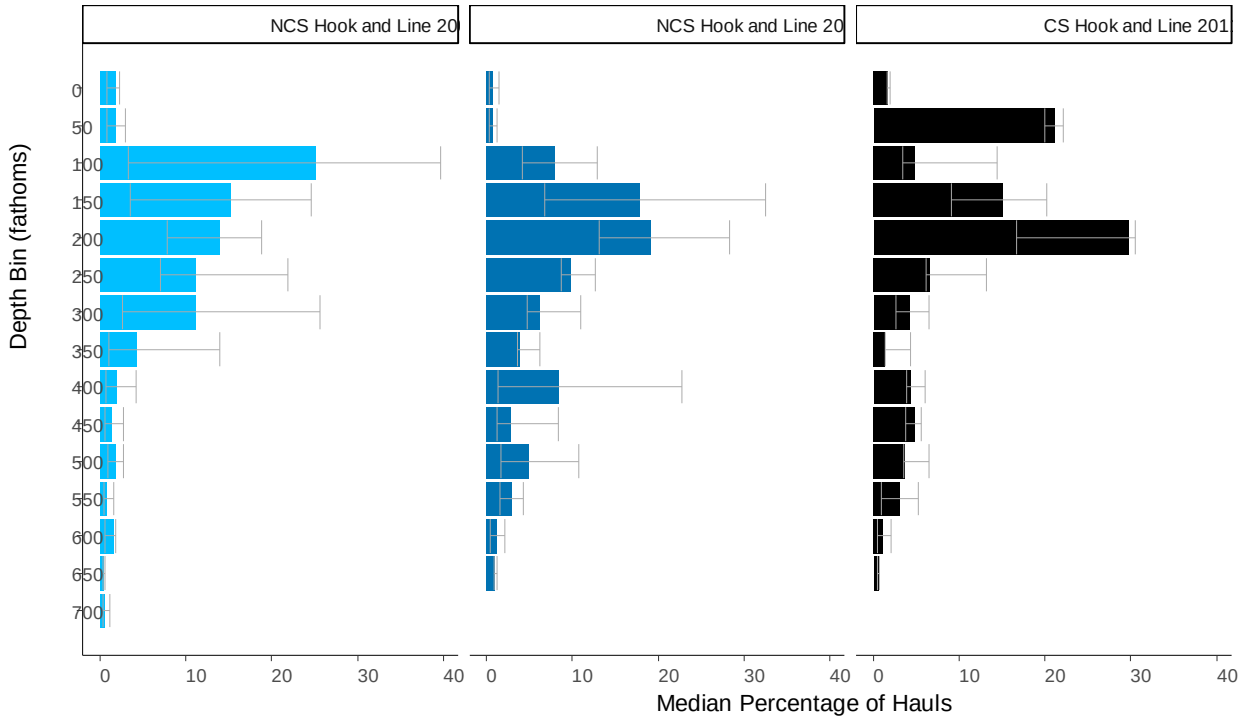

FIGURE 37. Percentage of observed hauls in 50-fathom depth bins by hook-and-line sectors. Medians and first and third quartiles for each time period are shown.

TABLES

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

Sector	Gear	Year	Fleetwide Vessels	Trips	Hauls	Retained (mt) Groundfish	Sablefish	Hake	Tow Duration (hrs)	Trawl Hours per Haul Lower Quartile	Median	Upper Quartile
Shoreside	LE Bottom Trawl	2002	198	4126	19518	17967	1382	29	83263	2.00	3.00	5.50
		2003	197	3527	17488	18360	2086	35	77526	2.00	3.50	6.00
		2004	121	2432	14124	17689	2183	21	51559	1.80	2.80	4.95
		2005	123	2563	15354	19285	2312	3	53213	1.80	2.75	4.50
		2006	119	2379	15202	17795	2459	1	55628	2.00	3.00	4.73
		2007	121	2359	14901	20443	2418	2	60692	2.25	3.50	5.42
		2008	118	2387	16191	24203	2864	0	72396	2.50	4.00	6.00
		2009	117	2675	18410	26056	2999	0	80594	2.40	3.90	5.90
		2010	104	1947	13665	22318	2506	10	65393	2.50	4.30	6.50
	CS Bottom Trawl	2011	72	1152	8991	17219	1678	27	38323	2.00	4.00	5.90
		2012	66	1116	8769	17190	1441	19	36037	2.00	3.66	5.75
		2013	68	1214	9716	18637	1399	60	39852	2.00	3.60	5.70
		2014	63	1009	8087	16064	1273	36	32773	2.00	3.50	5.60
		2015	59	914	7394	16001	1457	56	28517	1.95	3.17	5.20
	Midwater Hake Trawl	2011	26	901	1715	778	30	90354	3966	0.92	1.67	3.23
		2012	24	702	1580	653	47	65279	5934	1.58	3.33	5.42
		2013	24	916	1715	381	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	1485	870	7	57901	7157	2.06	3.93	6.64
	Midwater Rockfish Trawl	2011	4	5	17	58	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	228	1763	0	54	363	0.75	1.36	2.08
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
	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	22	--	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

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			2011-2015		
(deg. N)	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ
48	9.31	9.53	11.21	4.63	5.16	5.65	2.38	2.83	2.95	18.81	25.25	31.69
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
46	24.04	31.22	32.05	35.26	36.29	36.73	43.68	44.07	46.42	71.75	78.51	79.81
45	0.16	0.19	0.30	0.04	0.05	0.11	0.00	0.00	0.00	0.00	0.00	0.00
44	8.89	9.55	9.69	10.99	12.20	12.96	6.12	8.93	9.10	15.21	19.51	23.50
43	12.50	13.48	13.68	14.34	14.61	15.04	8.62	10.08	12.17	0.00	0.00	0.00
42	3.20	3.56	4.88	4.60	5.14	5.28	6.23	6.52	7.05	0.00	0.00	0.00
41	2.74	3.23	4.71	3.11	3.30	3.42	0.57	0.80	1.16	0.00	0.00	0.00
40	9.59	9.76	10.70	10.94	11.94	12.07	12.32	12.44	13.55	0.00	0.00	0.00
39	7.41	7.51	7.95	6.29	6.42	6.50	7.73	8.09	8.90	0.00	0.00	0.00
38	0.15	0.24	1.03	0.19	0.33	0.41	0.02	0.02	0.02	0.00	0.00	0.00
37	2.65	3.65	4.50	2.48	3.49	3.54	1.48	1.97	2.07	0.00	0.00	0.00
36	3.40	4.61	5.80	1.13	1.18	1.52	1.25	2.06	2.66	0.00	0.00	0.00
35	2.17	4.14	4.40	0.12	0.26	0.46	1.17	1.26	1.56	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
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
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

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

Bimonthly Period	Bottom Trawl									Midwater Rockfish Trawl		
	2002 - mid-2006			Mid-2006 - 2010			2011-2015			2011-2015		
	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ
Jan/Feb	17.74	16.37	19.21	17.10	16.69	17.59	12.96	10.27	19.66	0.00	0.00	0.00
Mar/Apr	18.70	16.50	21.23	19.35	16.71	20.90	22.74	21.83	23.06	0.00	0.00	0.00
May/June	18.55	18.05	19.02	17.83	17.21	18.40	16.35	15.25	20.21	3.74	3.18	6.68
Jul/Aug	18.06	15.60	20.52	16.76	16.25	17.12	16.20	14.40	17.14	17.95	2.83	22.39
Sep/Oct	16.50	15.79	17.24	16.75	14.95	18.82	14.97	13.47	15.58	58.31	52.14	61.37
Nov/Dec	11.02	9.56	11.47	13.17	11.42	14.91	14.18	14.06	14.40	22.62	16.68	34.46

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

	Shoreside															At-Sea														
	Bottom Trawl									Midwater Rockfish Trawl			Midwater Hake Trawl			Midwater Hake Trawl Catcher-Processor									Midwater Hake Trawl Mothership Catcher Vessel					
	2002 - mid-2006			Mid-2006 - 2010			2011-2015			2011-2015			2011-2015			2002-2005			2006-2010			2011-2015			2002-2005			2006-2010			2011-2015		
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	LQ	Median	UQ
0	10.18	11.78	14.57	6.57	7.42	13.30	0.77	4.06	9.38	2.51	3.11	4.15	0.13	0.58	1.28	0.92	1.73	2.36	0.38	0.90	2.11	0.07	0.17	0.36	0.77	1.16	1.54	8.19	12.60	16.65	0.25	1.19	3.70
50	18.01	26.84	31.03	19.77	24.51	29.25	25.39	26.85	30.07	76.29	82.35	86.73	15.82	33.20	34.34	16.84	23.93	36.65	3.46	6.20	10.15	3.54	4.04	4.74	47.99	54.91	58.98	29.50	30.55	38.10	5.63	7.95	18.75
100	0.26	0.93	2.37	0.25	0.45	0.82	0.41	0.80	0.85	5.88	10.62	13.40	31.33	32.67	40.63	32.14	34.53	37.73	15.36	24.97	27.90	15.21	17.25	20.36	39.02	42.25	43.50	41.67	45.05	46.48	36.09	38.99	43.47
150	6.43	7.45	9.94	4.81	6.57	15.14	4.31	7.46	10.33	2.14	2.80	3.46	14.46	15.61	29.94	19.30	24.80	29.57	32.13	35.74	57.49	54.56	54.64	55.37	1.73	1.83	4.52	3.74	4.45	13.42	34.56	38.30	39.09
200	9.90	11.08	12.50	9.02	12.71	19.35	7.07	11.56	16.45	3.54	5.00	6.08	6.56	11.08	13.90	1.79	6.65	14.13	19.01	22.57	28.79	16.79	22.25	24.12	2.93	4.65	6.36	0.35	2.42	4.79	8.52	10.63	12.50
250	11.22	12.64	13.48	9.97	13.15	18.32	6.99	16.02	23.41	1.56	1.63	1.71	1.37	1.98	2.04	0.30	0.44	0.59	0.92	1.33	3.09	0.36	1.36	1.37	1.44	1.44	1.44	0.95	1.80	2.64	0.16	0.84	1.12
300	8.08	8.92	10.57	9.26	11.85	14.61	11.54	13.55	14.65	0.00	0.00	0.00	1.39	1.40	1.46	0.00	0.00	0.00	0.19	0.23	0.84	0.16	0.18	0.29	0.00	0.00	0.00	0.37	0.37	0.37	0.10	0.12	0.14
350	2.34	5.50	8.16	4.04	5.77	7.32	3.94	6.47	10.40	0.00	0.00	0.00	0.23	0.34	0.46	0.00	0.00	0.00	0.28	0.28	0.28	0.12	0.12	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.08	0.08
400	0.73	2.19	4.32	1.76	2.34	2.65	1.37	2.95	3.72	0.00	0.00	0.00	0.35	0.39	0.43	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
450	0.84	2.69	4.09	1.18	1.84	2.81	0.96	2.05	4.23	0.00	0.00	0.00	0.06	0.06	0.07	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	1.98	3.56	4.16	1.72	3.17	4.51	1.40	3.06	6.09	0.00	0.00	0.00	0.10	0.15	0.19	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
550	1.00	2.31	2.55	0.88	1.90	2.39	0.55	1.13	1.67	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	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	0.00	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	0.03	0.06	0.10	0.03	0.04	0.05	0.02	0.03	0.04	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	0.01	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	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	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	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.

	Shoreside Midwater Hake Trawl			At-Sea Midwater Hake Catcher-Processor									At-Sea Midwater Hake Mothership Catcher Vessel								
	2011-2015			2002-2005			2006-2010			2011-2015			2002-2005			2006-2010			2011-2015		
Latitude (deg. N)	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	1.03	3.39	8.45	3.96	4.38	5.64	0.42	3.62	6.77	0.96	0.96	0.96	0.63	1.46	3.18	0.17	0.20	0.23
47	0.00	0.00	0.00	0.55	5.64	11.78	13.80	18.37	24.80	1.36	6.27	34.71	13.06	13.06	13.06	17.46	20.42	46.69	9.65	20.49	25.13
46	56.61	61.33	69.06	7.11	8.92	9.62	8.22	11.90	16.78	0.79	2.44	4.43	7.77	7.77	7.77	17.75	18.37	21.75	3.43	5.96	9.57
45	0.00	0.00	0.00	11.49	19.86	33.45	13.61	17.57	20.76	1.95	8.56	14.38	1.71	3.15	4.69	0.35	8.34	11.98	1.94	3.28	7.09
44	30.94	38.67	43.39	17.71	25.67	30.67	8.62	10.28	21.37	14.28	18.25	22.30	29.39	37.77	41.81	3.35	3.65	20.67	13.00	13.00	23.25
43	1.70	1.70	1.70	10.24	16.86	24.47	4.09	15.91	32.91	14.95	15.49	30.85	31.19	40.83	41.93	3.38	13.24	17.08	32.39	33.50	39.37
42	0.00	0.00	0.00	5.69	6.39	14.47	7.02	16.15	25.74	8.97	17.56	44.72	8.51	11.46	29.37	4.36	7.95	19.23	7.85	8.34	14.79
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	1.86	3.22	11.16	0.42	0.64	7.35

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			2002-2005			2006-2010			2011-2015			2002-2005			2006-2010			2011-2015		
	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
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
May/June	7.48	9.92	11.96	34.94	39.15	44.55	10.87	38.76	57.82	36.13	36.81	36.99	94.37	100.00	100.00	79.15	93.82	98.59	24.72	36.95	37.11
Jul/Aug	50.90	51.29	57.83	21.97	27.43	32.48	10.15	15.11	19.28	4.08	4.46	5.62	0.00	0.00	0.00	6.61	11.80	18.53	3.36	6.54	6.79
Sep/Oct	25.93	34.64	37.69	27.26	30.87	35.06	19.72	21.28	54.31	27.98	44.61	55.81	12.07	12.07	12.07	7.62	9.05	10.14	38.36	47.77	57.61
Nov/Dec	2.26	2.30	4.15	4.76	4.76	4.76	20.23	21.35	25.99	8.74	12.68	25.61	10.47	10.47	10.47	7.21	7.21	7.21	8.80	12.79	17.38

TABLE 7. Effort by fixed gear sectors. Dashes indicate data summaries not applicable to or unknown for the given sector. 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	Fleetwide		Retained (mt)		Estimated Total Gear Units	Observed Gear Units per Set		
			Vessels	Trips	Groundfish	Sablefish		Lower Quartile	Median	Upper Quartile
Pot	Non-Catch Shares	2002	106	1071	473	467	31139	8	19	38
		2003	129	1295	804	794	59380	9	25	33
		2004	99	1097	825	815	60236	10	18	38
		2005	139	1348	1008	996	57474	22	24	35
		2006	232	1923	1065	1051	57510	8	44	50
		2007	170	1422	698	684	46350	12	20	47
		2008	152	1439	686	674	43063	35	39	41
		2009	167	1468	877	861	67365	10	49	60
		2010	144	1259	846	837	62087	21	25	47
		2011	156	1052	659	650	36545	21	36	41
		2012	126	695	427	419	49051	25	33	46
		2013	72	530	374	370	22019	5	16	35
		2014	97	514	492	487	32595	19	32	44
		2015	140	854	613	594	30071	30	33	39
	Catch Shares	2011	19	221	790	779	41307	11	30	35
		2012	22	251	711	699	52248	15	29	42
		2013	11	93	502	452	30097	19	25	35
		2014	14	100	552	545	31876	12	30	35
		2015	13	115	745	732	18808	24	31	37
Hook-and-Line	Non-Catch Shares	2002	453	4389	2104	1287	7782158	1280	2000	2560
		2003	500	4664	2252	1617	12003434	948	2000	3000
		2004	472	4011	2335	1739	11527231	862	1473	2400
		2005	499	4376	2694	2058	7635580	967	2345	3100
		2006	529	4088	2521	1920	21352171	1034	2175	2988
		2007	506	3955	2093	1518	11063042	845	2025	2900
		2008	464	4578	2373	1722	10981021	1264	2325	3000
		2009	484	5413	3002	2488	39231008	1014	1833	3000
		2010	464	5986	3191	2648	33319985	914	1927	3173
		2011	506	5484	2961	2368	25423054	900	1600	3140
		2012	476	4605	2351	1826	18761597	1500	2700	3584
		2013	473	3996	1894	1459	13942413	2091	2856	3480
		2014	511	3986	1796	1415	12078267	1500	2527	3200
		2015	656	4502	2110	1660	8556420	1300	2432	3215
	Catch Shares	2011	14	108	362	335	2265264	1965	3540	4800
		2012	9	36	271	235	1472865	1711	2863	3740
		2013	10	29	80	66	587238	190	2484	3404
		2014	11	40	180	148	601654	90	2537	3382
		2015	5	16	138	121	592919	2357	3208	4009

TABLE 8. Observed effort in NCS and CS EM fixed gear sectors. Compare to Table 7 for fleet-wide values. 100% of observed CS sector trips are covered, so observed and fleet-wide values are equivalent and not shown here.

Sector and Gear		Year	Observed						Fleetwide		Percentage of
						Retained (mt)			Retained (mt)		Sablefish Landings
			Vessels	Trips	Hauls	Groundfish	Sablefish	Gear Units	Groundfish	Sablefish	Observed
NCS	Pot	2002	6	23	249	83	82	5496	473	467	17.65
		2003	13	51	420	153	151	9602	804	794	19.05
		2004	20	109	325	102	100	7358	825	815	12.22
		2005	21	82	545	294	292	14734	1008	996	29.29
		2006	22	77	330	213	208	11471	1065	1051	19.81
		2007	25	77	233	102	99	6670	698	684	14.43
		2008	26	79	405	258	255	14512	686	674	37.89
		2009	21	57	112	76	75	4423	877	861	8.70
		2010	33	83	387	167	150	12010	846	837	17.92
		2011	32	83	313	157	156	9901	659	650	24.06
		2012	24	54	425	111	110	14947	427	419	26.31
		2013	20	40	97	48	47	2528	374	370	12.67
		2014	25	57	258	117	116	8260	492	487	23.72
		2015	26	84	363	236	233	11933	613	594	39.29
	Hook-and-Line	2002	29	79	417	218	192	834213	2104	1287	14.96
		2003	45	219	633	289	244	1373477	2252	1617	15.10
		2004	45	149	515	219	190	903560	2335	1739	10.94
		2005	47	170	778	550	490	1719291	2694	2058	23.84
		2006	47	198	691	343	306	1521018	2521	1920	15.92
		2007	83	284	896	414	325	1828654	2093	1518	21.39
		2008	82	257	832	400	352	1957875	2373	1722	20.45
		2009	75	252	667	162	127	1447050	3002	2488	5.12
		2010	92	439	1368	452	396	3151866	3191	2648	14.97
		2011	96	369	1204	377	311	2733071	2961	2368	13.14
		2012	66	250	840	292	253	2375293	2351	1826	13.84
		2013	53	205	631	227	188	1805223	1894	1459	12.90
		2014	55	190	689	282	229	1769175	1796	1415	16.22
		2015	62	200	830	487	435	2115187	2110	1660	26.20
CS EM	Pot	2015	7	18	184	102	101	4272	339	333	30.28

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

	Pot									Hook-and-Line								
	Non-Catch Shares						Catch Shares			Non-Catch Shares						Catch Shares		
Latitude	2002-2010			2011-2015			2011-2015			2002-2010			2011-2015			2011-2015		
(deg. N)	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	1.26	1.26	1.26	16.62	21.90	26.33	8.89	11.22	13.58	7.04	8.40	19.76
47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.37	5.29	6.19	2.02	2.31	2.51	0.00	0.00	0.00
46	16.20	18.42	26.64	14.46	17.65	18.99	26.54	36.06	36.25	14.99	15.23	17.52	10.34	10.42	11.16	35.79	70.42	73.12
45	0.16	0.19	0.32	0.09	0.23	0.52	0.00	0.00	0.00	0.00	0.01	0.02	0.00	0.00	0.02	0.00	0.00	0.00
44	22.00	23.89	25.70	18.36	19.53	19.69	23.32	23.76	26.87	9.63	10.06	10.40	9.05	11.39	13.17	19.11	19.71	20.31
43	13.08	15.13	15.98	9.78	10.41	11.81	1.59	1.86	3.77	4.72	6.48	6.91	5.85	6.13	7.57	1.07	1.27	4.04
42	0.67	0.79	1.92	2.45	2.81	4.20	10.53	15.91	21.29	9.23	10.56	12.00	6.78	7.53	10.18	0.00	0.00	0.00
41	4.48	5.49	6.33	5.70	6.51	6.87	0.00	0.00	0.00	0.54	0.81	2.02	0.25	0.30	0.35	0.00	0.00	0.00
40	0.03	0.17	0.42	0.05	0.05	0.12	0.00	0.00	0.00	5.39	7.49	7.77	3.23	3.88	3.91	0.00	0.00	0.00
39	15.92	17.32	19.11	20.90	23.66	29.02	3.28	3.97	4.00	3.78	3.83	4.03	7.06	7.25	7.46	2.37	2.37	2.37
38	0.06	0.13	0.85	0.36	1.12	1.44	0.00	0.00	0.00	0.02	0.09	0.37	2.16	3.38	4.27	0.00	0.00	0.00
37	0.25	0.74	1.16	2.55	3.38	4.04	4.63	6.81	7.12	2.50	2.91	4.04	1.94	2.08	2.34	0.00	0.00	0.00
36	2.58	2.68	3.48	2.73	3.76	4.18	1.00	1.84	2.34	7.56	7.79	8.42	4.92	5.44	5.82	0.00	0.00	0.00
35	0.04	9.95	16.46	0.78	2.72	10.48	14.20	28.69	31.91	0.13	0.47	1.95	8.80	13.45	13.64	6.55	8.95	22.23
34	0.04	0.13	0.25	0.00	0.00	0.10	6.30	6.30	6.30	0.86	1.18	1.34	9.11	9.55	9.95	2.26	4.46	6.66
33	0.01	0.02	0.05	0.01	0.01	0.02	0.00	0.00	0.00	2.62	2.80	3.72	5.38	6.35	7.97	0.00	0.00	0.00
32	0.20	0.62	1.25	0.49	0.96	1.01	0.00	0.00	0.00	0.12	0.28	0.30	0.03	0.04	0.05	0.00	0.00	0.00

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

	Pot									Hook-and-Line								
Bimonthly	Non-Catch Shares						Catch Shares			Non-Catch Shares						Catch Shares		
Period	2002-2010			2011-2015			2011-2015			2002-2010			2011-2015			2011-2015		
	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ	LQ	Median	UQ
Jan/Feb	3.13	3.68	4.16	2.69	4.22	6.45	1.48	2.91	3.02	2.72	3.08	3.74	6.86	6.99	7.05	8.13	8.64	9.15
Mar/Apr	7.46	8.19	13.30	7.03	10.09	11.68	8.78	10.89	11.07	6.21	7.20	9.29	15.08	15.46	17.83	7.03	12.00	14.94
May/June	29.59	32.02	32.76	15.40	16.80	20.93	5.17	9.49	10.30	20.07	23.58	24.49	18.64	21.17	21.45	0.80	1.60	5.12
Jul/Aug	24.66	28.26	31.42	27.54	27.99	28.77	17.42	19.71	19.74	24.37	27.86	29.22	17.08	21.79	22.57	5.07	13.16	25.95
Sep/Oct	16.95	21.51	28.13	28.71	35.93	37.02	48.21	51.99	52.51	29.50	31.87	33.89	25.78	30.19	30.61	43.95	47.98	59.24
Nov/Dec	3.77	5.06	8.86	2.74	5.92	6.30	11.40	14.80	14.89	3.70	6.11	7.51	5.60	9.07	9.98	11.64	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			2011-2015			2002-2010			2011-2015			2011-2015		
Depth Bin (fm)	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	0.00	0.00	0.00	0.86	1.90	2.34	0.35	0.77	1.47	1.60	1.80	2.00
50	0.33	0.49	0.65	0.00	0.00	0.00	0.61	0.89	2.04	0.79	1.86	2.95	0.32	0.75	1.27	20.02	21.10	22.18
100	2.52	6.04	15.73	1.20	8.70	21.49	1.45	4.72	10.57	3.32	25.07	39.70	4.14	7.95	12.95	3.50	4.86	14.42
150	7.69	18.00	32.96	3.28	16.20	20.77	0.23	8.56	15.18	3.55	15.20	24.65	6.81	17.91	32.55	9.06	15.14	20.26
200	27.71	38.51	45.51	26.34	28.32	37.12	9.97	12.55	21.55	7.90	13.95	18.79	13.18	19.18	28.29	16.74	29.73	30.52
250	8.44	17.66	25.23	4.26	10.00	10.96	7.14	12.84	18.34	7.10	11.17	21.85	8.70	9.85	12.70	6.20	6.61	13.24
300	3.88	9.37	15.04	1.12	1.43	4.24	4.69	5.68	7.50	2.64	11.09	25.58	4.80	6.27	10.92	2.64	4.29	6.52
350	1.60	2.82	6.48	0.78	1.11	3.56	2.61	4.29	5.35	1.05	4.39	13.92	3.59	3.88	6.21	1.40	1.43	4.32
400	0.70	1.52	6.23	0.84	1.50	4.41	3.00	3.36	6.26	0.66	1.90	4.18	1.32	8.48	22.73	3.95	4.41	6.04
450	0.60	1.21	1.56	1.35	1.99	3.13	3.42	3.95	6.76	0.64	1.41	2.71	1.27	2.80	8.41	3.78	4.94	5.58
500	0.81	1.19	3.23	2.62	5.71	12.33	8.46	9.29	14.69	0.95	1.81	2.77	1.67	5.00	10.71	3.56	3.72	6.49
550	0.40	0.81	1.61	8.22	14.17	19.79	5.73	10.62	13.84	0.48	0.86	1.60	1.53	2.94	4.31	0.93	3.16	5.25
600	2.22	5.61	8.79	1.96	7.12	12.82	6.94	12.81	17.96	0.58	1.67	1.88	0.48	1.18	2.09	0.52	1.22	2.07
650	0.30	1.74	3.94	0.96	1.39	3.17	0.45	1.95	4.14	0.41	0.49	0.60	0.93	1.02	1.18	0.56	0.63	0.71
700	2.97	2.97	2.97	0.85	0.85	0.85	0.39	0.60	0.88	0.36	0.60	1.16	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	0.38	0.39	0.42	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	0.12	0.13	0.14	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
900	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
1000	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
1200	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

TABLE 12. Observed hauls with lost and recovered gear in shoreside federal groundfish fisheries. Lost gear was recorded consistently in trawl fisheries beginning in 2010 and in fixed gear fisheries in 2013. Hauls with recovering gear represent hauls recovering derelict gear, not gear lost and then recovered in the same haul; this data has been recorded from 2002 to 2015 in trawl fisheries. In the catch shares fixed gear fisheries, hauls recovering gear lost on previous trips has been recorded since 2015. Dashes represents no available data.

			Observed				Fleetwide				Hauls	% Observed
Sector	Gear	Year	Trips	Hauls	Vessels	Retained Target Species (mt)	Targeted Species or Groups Retained	% Landings Observed	Hauls with Lost Gear	% Observed Hauls with Lost Gear	Recovering Other Derelict Gear	Hauls Recovering Other Derelict Gear
Limited Entry California Halibut	Bottom Trawl	2003	73	207	12	19.1	105.5	18%	N/A	N/A	18	8.70%
		2004	46	171	8	31.5	136.3	23%	N/A	N/A	27	15.79%
		2005	74	235	10	30.5	188.9	16%	N/A	N/A	14	5.96%
		2006	78	224	9	14.3	119.5	12%	N/A	N/A	18	8.04%
		2007	40	81	5	5.4	39.2	14%	N/A	N/A	6	7.41%
		2008	40	118	6	9.6	36.4	26%	N/A	N/A	38	32.20%
Limited Entry Trawl	Bottom Trawl	2002	578	3223	133	2680.0	17967.0	15%	N/A	N/A	64	1.99%
		2003	466	2318	125	2590.4	18359.9	14%	N/A	N/A	73	3.15%
		2004	617	3501	103	4309.8	17688.7	24%	N/A	N/A	102	2.91%
		2005	525	3527	105	4241.6	19285.3	22%	N/A	N/A	169	4.79%
		2006	477	3039	87	3443.3	17794.9	19%	N/A	N/A	250	8.23%
		2007	374	2550	88	3442.3	20442.5	17%	N/A	N/A	138	5.41%
		2008	438	3226	100	4905.2	24203.2	20%	N/A	N/A	162	5.02%
		2009	590	4457	101	6053.5	26055.6	23%	N/A	N/A	239	5.36%
		2010	348	2640	83	4019.5	22318.3	18%	3	0.11%	87	3.30%
Catch Shares	Bottom and Midwater Trawl	2011	1135	9197	72	17258.6	17355.3	99%	12	0.13%	404	4.39%
	Bottom Trawl	2012	1089	8967	67	17164.7	17271.1	99%	4	0.04%	363	4.05%
		2013	1193	10016	68	18615.0	18665.9	100%	6	0.06%	301	3.01%
		2014	1033	8321	64	16018.4	16109.1	99%	2	0.02%	262	3.15%
		2015	904	7479	60	15541.3	15593.7	100%	3	0.04%	281	3.76%
Catch Shares EM	Bottom and Midwater Trawl	2015	9	57	4	134.8	404.5	33%	0	0.00%	0	0.00%
Catch Shares	Midwater Trawl	2012	10	35	5	197.6	197.6	100%	0	0.00%	0	0.00%
		2013	26	78	8	404.7	404.7	100%	0	0.00%	0	0.00%
		2014	34	133	9	873.7	873.7	100%	0	0.00%	1	0.75%
Shoreside Hake	Midwater Trawl	2011	929	1717	27	90248.8	90248.8	100%	0	0.00%	17	0.99%
		2012	744	1601	24	65288.0	65288.0	100%	0	0.00%	1	0.06%
		2013	960	1734	24	96867.8	96867.8	100%	0	0.00%	8	0.46%
		2014	996	1725	25	97925.2	97982.7	100%	0	0.00%	9	0.52%
Midwater Hake	Midwater Trawl	2015	129	289	5	11461.4	11461.4	100%	0	0.00%	0	0.00%
Midwater Rockfish	Midwater Trawl	2015	43	147	7	968.5	968.5	100%	0	0.00%	1	0.68%
Catch Shares	Hook and Line	2011	94	629	11	335.6	335.6	100%	--	--	--	--
		2012	32	506	8	241.3	241.3	100%	--	--	--	--
		2013	29	215	8	86.6	86.6	100%	4	1.86%	--	--
		2014	31	227	8	88.7	98.5	90%	5	2.20%	--	--
		2015	16	185	5	137.8	137.8	100%	1	0.54%	0	0.00%
	Pot	2011	234	1550	17	816.8	817.2	100%	--	--	--	--
		2012	278	1708	19	740.7	740.7	100%	--	--	--	--
		2013	100	1085	10	470.8	470.8	100%	36	3.32%	--	--
		2014	118	1287	14	685.4	685.4	100%	56	4.35%	--	--
		2015	62	583	8	405.3	405.3	100%	33	5.66%	4	0.69%
Catch Shares EM	Pot	2015	18	184	7	102.4	339.4	30%	8	4.35%	--	--
Limited Entry Sablefish	Hook and Line	2010	143	788	21	343.1	1304.2	26%	--	--	--	--
		2011	98	675	23	240.7	1153.4	21%	--	--	--	--
		2012	88	535	17	227.2	1075.0	21%	--	--	--	--
		2013	58	353	18	166.4	750.4	22%	6	1.70%	--	--
		2014	85	496	17	203.0	746.1	27%	8	1.61%	--	--
		2015	97	632	26	392.0	911.9	43%	2	0.32%	--	--
	Pot	2010	43	316	7	139.4	503.5	28%	--	--	--	--
		2011	22	228	3	137.4	371.9	37%	--	--	--	--
		2012	19	355	5	101.1	286.0	35%	--	--	--	--
		2013	15	49	3	40.5	283.1	14%	3	6.12%	--	--
		2014	16	195	4	104.0	337.3	31%	7	3.59%	--	--
		2015	35	299	9	218.8	358.1	61%	9	3.01%	--	--
LE Fixed Gear DTL	Fixed Gear	2010	226	474	38	33.8	336.2	10%	--	--	--	--
		2011	201	427	38	52.5	534.0	10%	--	--	--	--
		2012	128	252	26	15.8	348.3	5%	--	--	--	--
		2013	124	248	22	17.7	326.5	5%	2	0.81%	--	--
		2014	77	154	18	15.7	325.6	5%	1	0.65%	--	--
		2015	65	144	21	29.2	369.1	8%	4	2.78%	--	--
OA Fixed Gear	Fixed Gear	2010	106	177	60	30.0	967.1	3%	--	--	--	--
		2011	124	187	65	37.0	579.7	6%	--	--	--	--
		2012	69	123	42	18.9	323.2	6%	--	--	--	--
		2013	47	78	30	10.4	195.4	5%	1	1.28%	--	--
		2014	64	102	37	22.3	279.4	8%	1	0.98%	--	--
		2015	85	118	36	28.2	459.8	6%	4	3.39%	--	--

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
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

APPENDIX A: SUPPLEMENTAL FIGURES

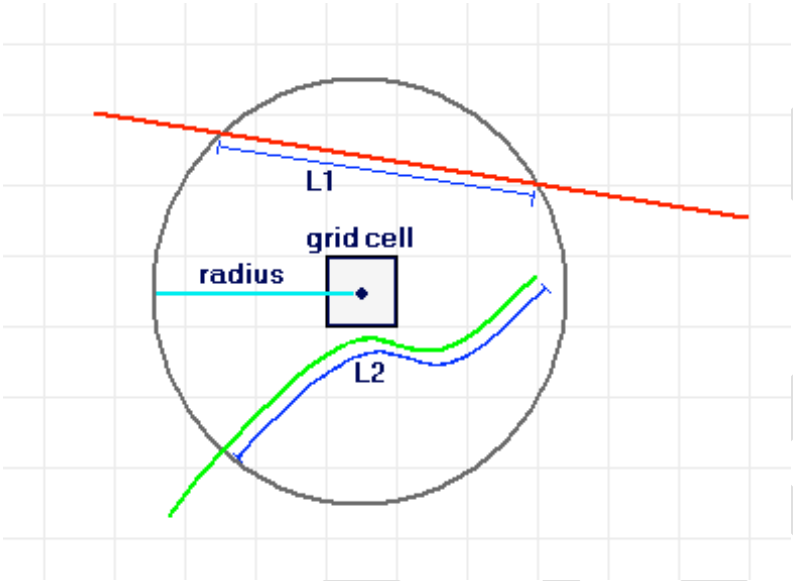

FIGURE A-1. Conceptual drawing of how the ArcGIS™ line density algorithm works, showing application of the user specified parameter values: search radius and grid cell size. "L1" and "L2" represent hypothetical line inputs to the density algorithm. Image source: Environmental Systems Research Institute, Inc.

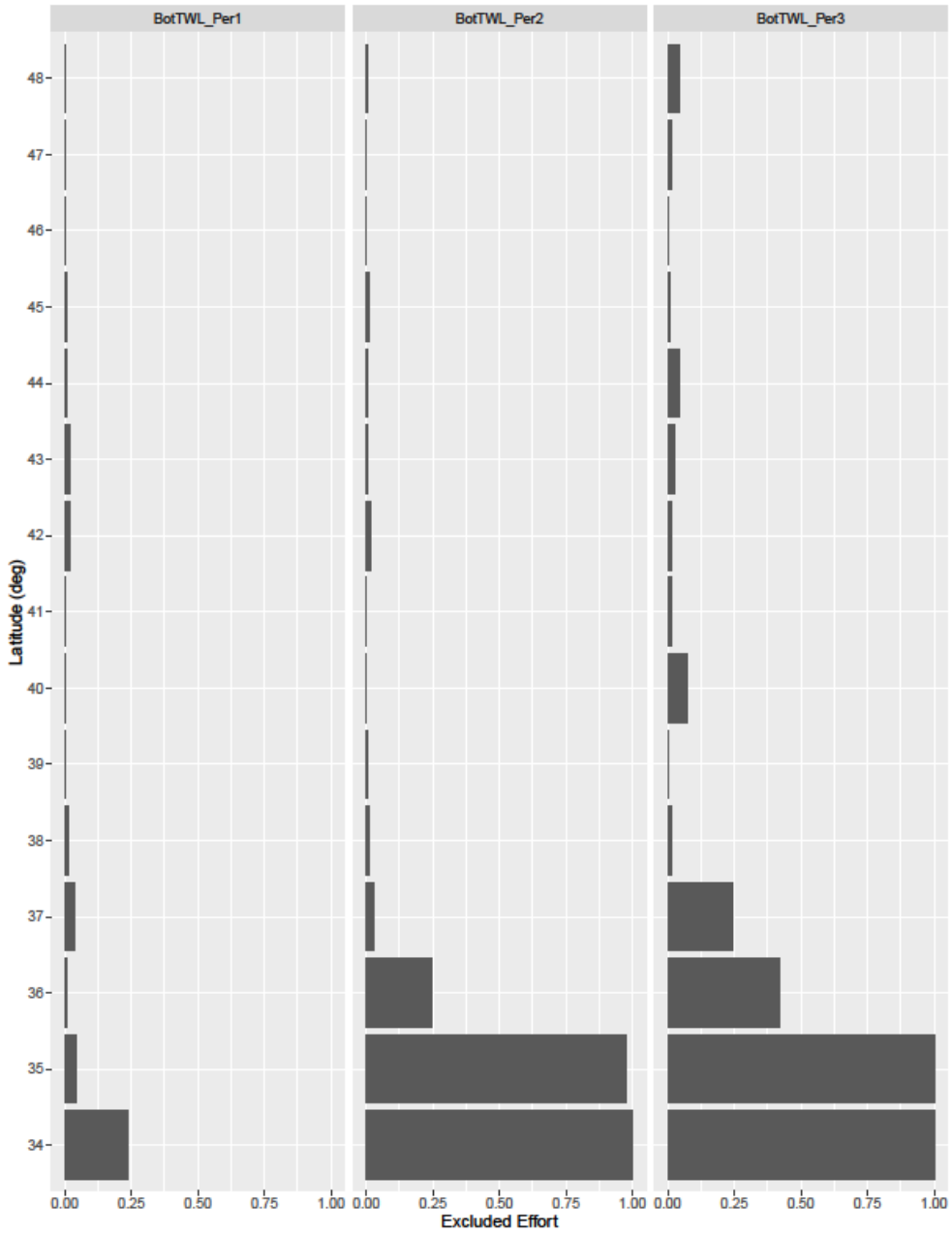

FIGURE A-2. Relative proportion of fishing effort (km) by bottom trawl by degree of latitude excluded from map figures due to confidentiality requirements. Time periods are defined in the text and represent major eras in regulatory regimes.

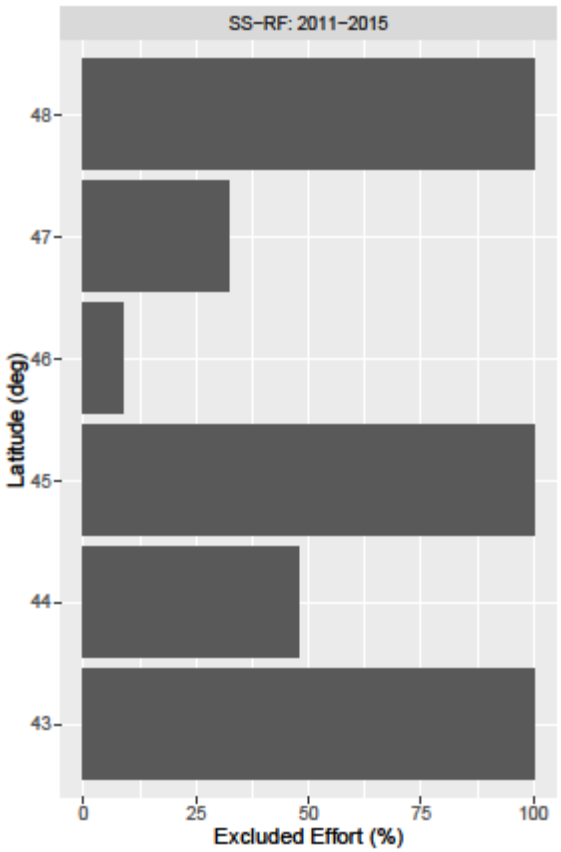

FIGURE A-3. Relative proportion of fishing effort (km) by shoreside midwater trawl targeting rockfish by degree of latitude excluded from map figures due to confidentiality requirements. Time periods are defined in the text and represent major eras in regulatory regimes.

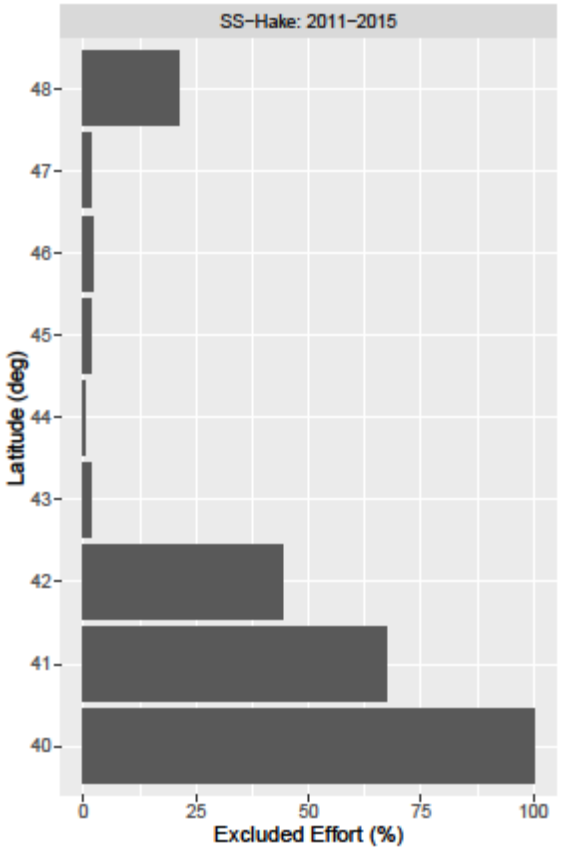

FIGURE A-4. Relative proportion of fishing effort (km) by shoreside midwater trawl targeting hake by degree of latitude excluded from map figures due to confidentiality requirements. Time periods are defined in the text and represent major eras in regulatory regimes.

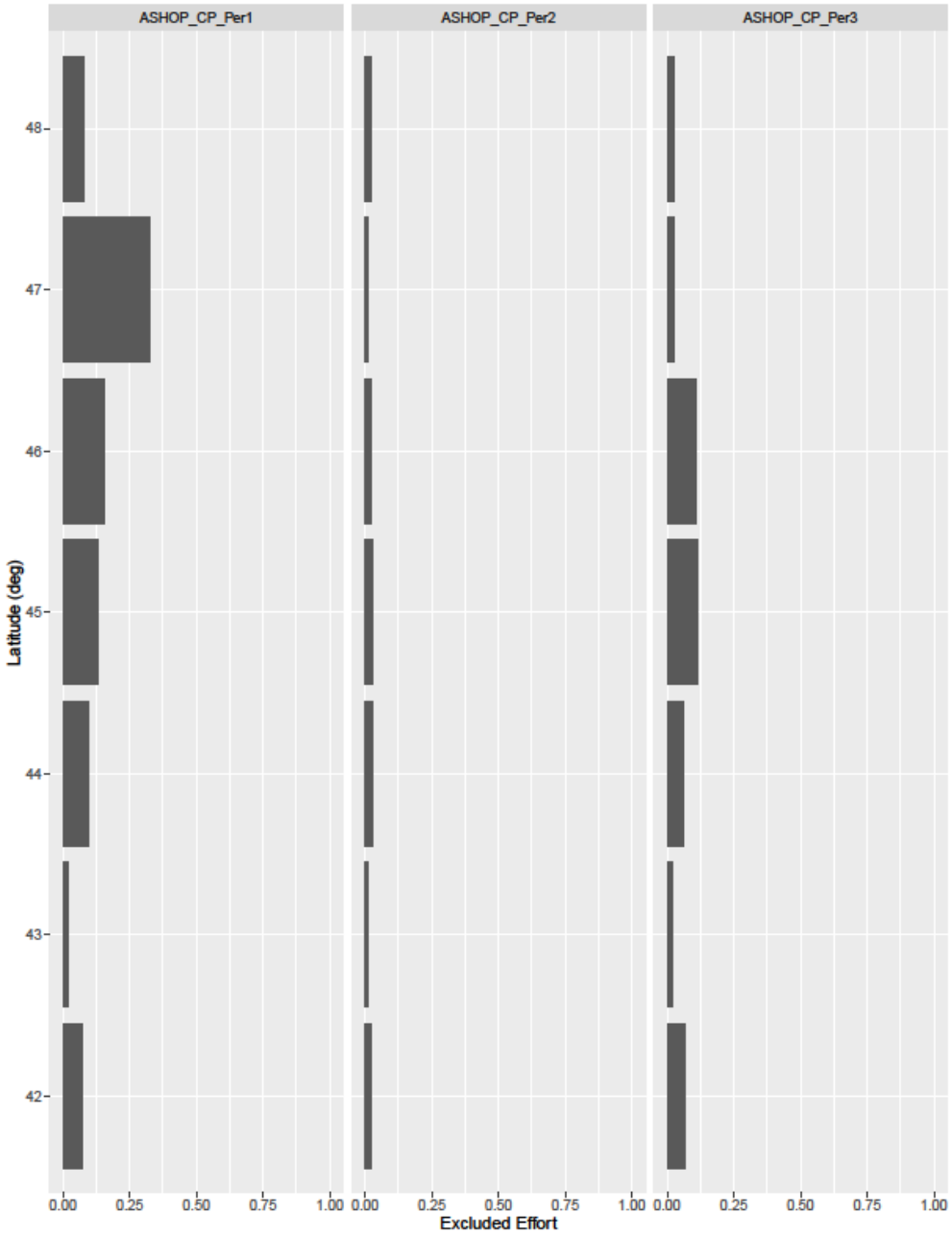

FIGURE A-5. Relative proportion of fishing effort (km) by at-sea midwater trawl targeting hake using catcher-processors by degree of latitude excluded from map figures due to confidentiality requirements. Time periods are defined in the text and represent major eras in regulatory regimes.

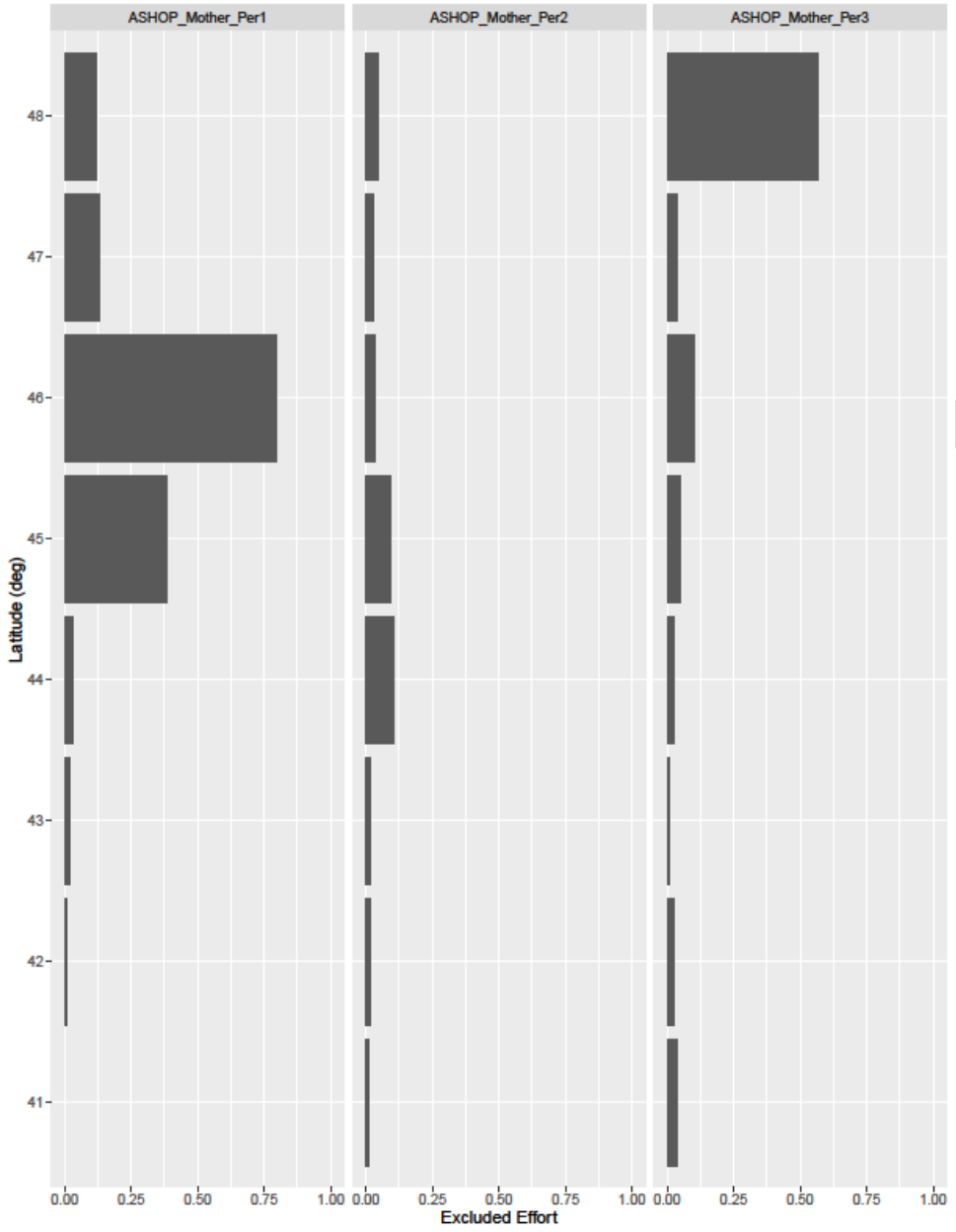

FIGURE A-6. Relative proportion of fishing effort (km) by at-sea midwater trawl targeting hake using mothership catcher-vessels by degree of latitude excluded from map figures due to confidentiality requirements. Time periods are defined in the text and represent major eras in regulatory regimes.

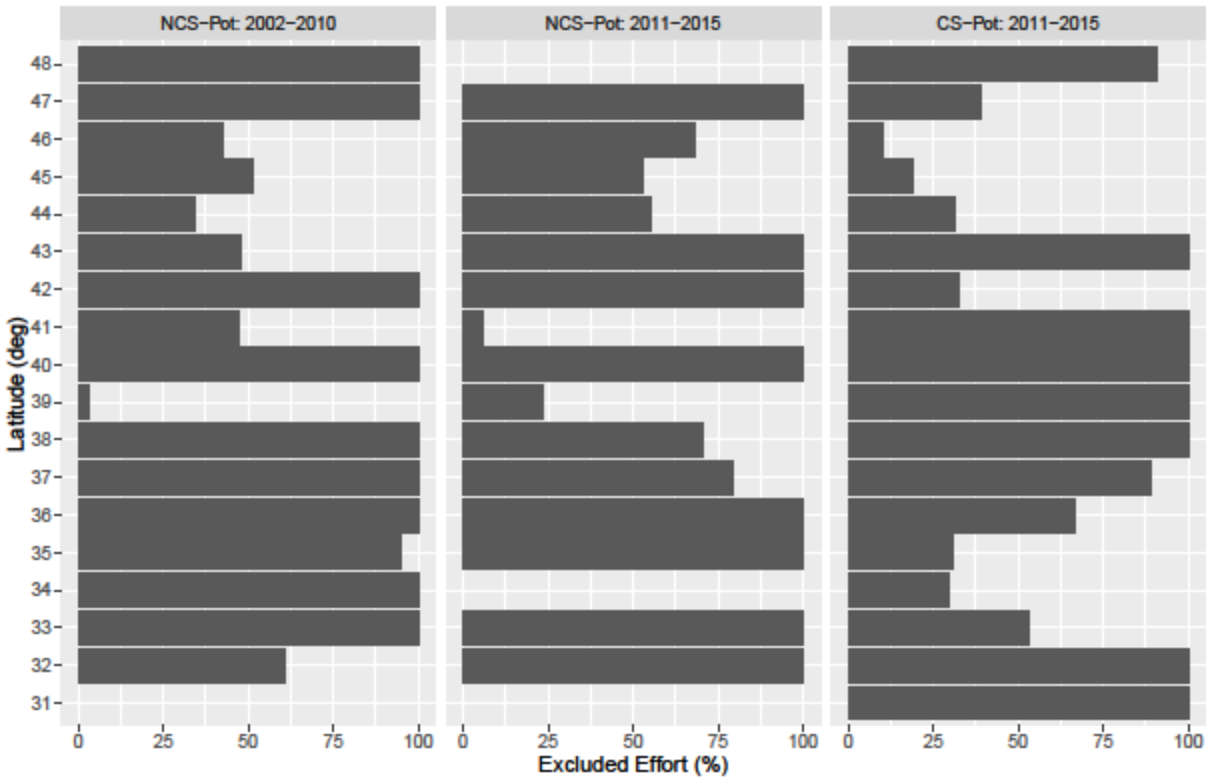

FIGURE A-7. Relative proportion of fishing effort (km) by pot by degree of latitude excluded from map figures due to confidentiality requirements.

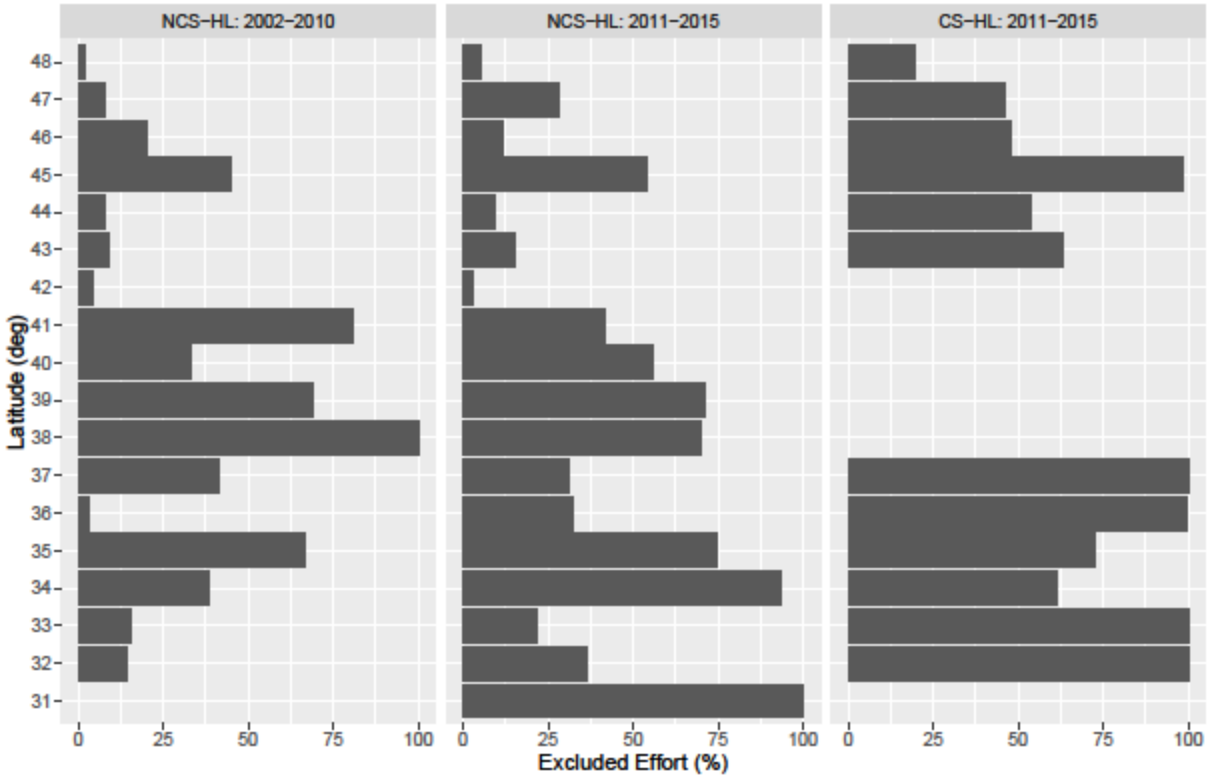

FIGURE A-8. Relative proportion of fishing effort (km) by longline by degree of latitude excluded from map figures due to confidentiality requirements.