Fishing Effort in the 2002-2019 U.S. Pacific Coast Groundfish Fisheries. 2021.

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EXECUTIVE SUMMARY

This report analyzes trends in fishing effort of U.S. west coast groundfish fisheries during the period 2002-2019, including the amount, timing, location, and depth of fishing effort and retained catch. The National Marine Fisheries Science (NMFS) Biological Opinion (BiOp) on Continuing Operation of the Pacific Coast Groundfish Fishery (NMFS 2012) requires that reports are issued every two years and align with harvest specification periods as feasible. We focus on changes that have occurred since the 2011 implementation of an individual fishing quota (IFQ) program and specifically on developments in 2017-2018 and 2019. This analysis contextualizes the other reports required by this BiOp, and this executive summary highlights significant changes in the most recent three years of data.

Groundfish landings in the bottom trawl sector, in both 2018 and 2019, were the lowest since 2002. Total fleetwide towing hours and median duration of tows in the bottom trawl sector also declined. Spatial and depth distribution patterns of landings and effort were similar from 2011 to 2019 and showed a continued concentration to the north and into deeper waters. Seasonal patterns were also similar from 2011 to 2019, although Nov/Dec of 2018 was the highest on record for that bimonthly period.

Groundfish landings in the midwater rockfish trawl sector increased from 2011 to 2019, although landings decreased slightly in 2019, for the first time since 2016. The median tow duration remained between 1.2 and 1.8 hours (Table 2, Figure 3). The spatial distribution of landings were similar across all years, although landings near Bellingham, WA, at 48° N. latitude, were lower in 2017-2019 compared to 2011-2016. Effort in this fishery has expanded to reach from the U.S./Canada border to northern California. A greater proportion of landings were made earlier in the year in 2017-2019, reflecting an exempted fishing permit that allowed some vessels to fish prior to mid-May. The depth distribution of effort was similar across all time periods.

Whiting landings in the shoreside and at-sea hake sectors increased from 2011 to 2017 but plateaued decreased in 2018 and 2019. Total towing hours by the shoreside fleet reached an almost historic high of 6,600 hours in 2019, while total hours of towing by the at-sea processing fleet was lower in 2017-2019 compared to historic highs in 2016. Compared to 2011-2016, the shoreside fleet in 2017 to 2019 landed a lower proportion of hake near Newport, OR and a greater proportion in Astoria, OR. The shoreside fleet landed a larger proportion of annual catch in May/June in 2017 to 2019 compared to 2011 to 2016, reflecting a regulatory change in season start date. The majority of annual landings by the shoreside fleet occurred in 50 to 150 fathoms in 2017-2019, shallower than in 2011-2016. Fishing effort in the at-sea midwater hake trawl fishery was mainly concentrated off Oregon across all time periods. In 2017 to 2019, catcher-processor (CP) effort continued to decrease around 45° N. latitude and was highly variable around 44° N. latitude. Mothership catcher vessel (MS) effort in 2017 to 2019 was more concentrated around 47° N. latitude and 43° N. latitude than in previous years. The proportion of CP landings processed in the May/June and Nov/Dec periods increased from 2017 to 2019, and the MS landings processed in May/Jun increased from 43 to 97 percent over the same time period. From 2006 to the present, more than 80% of CP and MS landings came from hauls in 100 to 250 fms; from 2017 to 2019, this increased to almost 90%.

Annual groundfish landings in the non-catch shares (NCS) pot/trap fleet remained around 600 mt from 2015 to 2019, while the catch shares (CS) pot fleet showed a slight but generally increasing trend from 2013 to 2019 and peaked at more than 850 mt in 2019. Both sectors increased the amount of pot gear deployed from 2013 to 2017 before a decrease in 2018 and slight rebound in 2019. From 2011 to 2019, the majority of landings by the NCS pot fleet occurred between Astoria, OR and Fort Bragg, CA. From 2017 to 2019, landings in Astoria, OR and Newport, OR together accounted for more than half of annual CS pot catch. CS pot effort south of 40° 10' N. latitude continued to decrease in 2017-2018 and 2019, although two areas of concentrated effort persisted off of San Francisco and Fort Bragg, CA. The proportion of NCS pot landings in Sep/Oct increased from 2017 to 2019 and reached a historic high of 46%. The proportion of CS pot landings in Sep/Oct in 2017-2019 was around 25%, half of the median for 2011-2016. From 2017 to 2019, CS pot effort became increasingly more concentrated in shallower depths from 150 to 400 fm.

Groundfish landings by the NCS hook-and-line fleet have ranged from 2,000 to 2,400 mt from 2012 to 2019 and decreased between 2017 and 2019. The median number of hooks per set in the NCS fleet remained around ~2,500 hooks per set from 2014 to 2019. CS hook-and-line landings have been lower and less variable than NCS, ranging between 115 and 200 mt of groundfish from 2013 to 2019. CS hook-and-line effort has generally decreased from 2011 to 2019, and hooks per set in the CS hook-and-line fleet generally increased from 2013 to 2019 and have remained around 3,200 since 2015. From 2017 to 2019, the proportion of NCS hook-and-line landings occurring in the 48° N., 39° N., and 34° N. latitudinal bins increased slightly. Landings in the CS hook-and-line fleet were much more concentrated, with more than half occurring in the 48° N. latitudinal bin in both 2017 and 2019. No landings in the CS hook-and-line fleet occurred south of 43° N. after 2016. Seasonal and depth distributions were similar for both NCS and CS hook-and-line fleets across all time periods.

INTRODUCTION

The Pacific Fishery Management Council (PFMC) designs and adapts the groundfish Fishery Management Plan (FMP; PFMC 2020) with the goals of achieving maximum sustainable yield (MSY) and promoting year-round fishing opportunities to support domestic consumer markets and the economies of coastal communities. In 2011, the PFMC implemented a major management shift by introducing a catch shares program to the federal trawl fleets. This report assesses changes in fishing effort in the Pacific Coast groundfish fisheries, with an emphasis on differences before and after catch shares implementation and is mandated by the NMFS BiOp on Continuing Operation of the Pacific Coast Groundfish Fishery (NMFS 2012). We provide data for the available time series (2002-2019), but focus the main analyses on trends in fishing effort that have occurred since the previous report. We are cautious in definitively attributing differences to IFQ implementation, because many factors outside the scope of this report, including variations in weather, market price, stock size, quota leasing, and catch limits, impact fishing effort over this 18-year period. Management shifts and changes that occurred prior to IFQ implementation are described briefly to provide important background and context in understanding and analyzing fleet dynamics.

SHORE-BASED TRAWL FLEET

1990'S TO 2000: LIMITING PARTICIPANTS

In the shoreside bottom trawl fleet, the number of commercial vessels participating was first limited in 1994, with the implementation of a federal licensing program. At that point, the fishery was considered overcapitalized and, rather than shortening trawl fishing seasons, 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. Catch allocations for rebuilding species were reduced by more than 90% from levels of the 1990s, resulting in new management approaches to ensure fishing opportunities for healthy stocks throughout the year.

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 of stocks by 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 the National Marine Fisheries Service (NMFS), the trawl industry developed a proposal to reduce fleet capacity, which was subsequently enacted by the United States Congress. This plan resulted in a buyback program, initiated in late 2003, which 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 repaid by the fleet through landings fees.

2000 TO 2010: DEVELOPING DATA COLLECTION AND MANAGEMENT TOOLS

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

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

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

2011 to Present: Catch Shares

In 2011, the prior management regime of landing limits for trawl vessels was replaced by a catch share program, which allocates fishing privileges as individual fishing quotas (IFQ) for catch by species or species

complex to individual fishers. The goal of the catch shares program, as defined in Amendment 20 of the FMP (PFMC 2020), is to:

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

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

IFQ management has altered three major aspects of the shoreside trawl fishery. First, accountability for discards has been shifted from the fleet as a whole to individual operations, which has resulted in a rapid and substantial reduction in discards of most species. Second, with the new explicit accounting of all discard, landings limits no longer needed to be set artificially low in an attempt to implicitly account for this mortality. These new opportunities allowed individual operations to better target healthy stocks. The IFQ program creates incentives for individuals to avoid catching species that are overfished or rebuilding and ensures that the fleet remains under species or species complex catch limits. Third, the regulations that implemented the IFQ program allowed for gear switching, which occurs when permit holders with Quota Pounds and a trawl endorsement can use multiple gear types (although not within the same trip), including trawl (bottom and midwater) and fixed gear (pot and hook-and-line). These management changes could impact fishing effort in bottom trawl and shoreside midwater sectors, as well as alter fixed gear fishing effort by providing a new opportunity for fixed gear fishing activity and potential competition between IFQ and other fixed gear sectors. Throughout this report, we aggregate the limited entry (LE) sablefish primary, open access (OA), and daily trip limit sectors into a single non-catch shares (NCS) fixed gear fleet. Fishing areas, tactics, and methods in the NCS fleets are similar to the areas and methods used in the catch shares fixed gear fishery and thus could be impacted by catch shares implementation. We include them here as a comparison to the IFQ fixed gear fleet and for a broader understanding of catch shares impacts to the entire groundfish fleet.

At-Sea Midwater Trawl Fishery

Unlike the shore-based fleet, which delivers catch to processors on land, the at-sea hake midwater trawl fleet processes catch onboard while at sea. The at-sea midwater trawl fishery was observed by the North Pacific Groundfish Observer Program from 1975 until 2001, when the At-Sea Hake Observer Program (A-SHOP) began to manage observer coverage. Under both organizations, observer coverage on board the MS and CPs has been at or near 100% of fishing days prior to IFQ implementation. Coverage to detect discards by catch vessels before the point of delivery to an MS began with catch shares management. Before catch shares

implementation, the CP fleet had formed a fishing cooperative in response to other PFMC management goals. In response to the implementation of catch shares management, the MSs formed a separate fishing cooperative. The shift to catch shares had ramifications on quota management and bycatch accountability, but only minor changes in overall fishery management and so very little effect on fishing. The cooperative system somewhat relieved the race to fish, but the primary driver for change in amount of fishing effort for the at-sea hake fishery has been highly variable Pacific hake total allowable catch over the last 18 years.

Fishing Effort Trends

With this background in mind, we present trends in fishing effort in selected U.S. Pacific coast groundfish fishery sectors from 2002 to 2019. The primary objective of this report is to evaluate changes in fishing effort over time by gear type since implementation of the IFQ management program in the U.S. west coast groundfish fishery. This report updates the previous release (2002-2017) and analyzes two additional years of data, 2018 and 2019. We analyze fishing effort in the following sectors of U.S. west coast groundfish fisheries:

- Bottom and midwater trawl targeting groundfish, excluding Pacific hake
    - **LE Bottom Trawl:** Limited entry bottom trawl (2002-2010)
    - **CS Bottom Trawl:** IFQ non-hake bottom trawl (2011-2019)
    - **CS Midwater Rockfish Trawl:** IFQ shoreside midwater trawl targeting rockfish (2011-2019)
- Midwater trawl targeting Pacific hake
    - **CS SS Midwater Hake Trawl:** IFQ shoreside midwater trawl targeting hake (2011-2019)
    - **CS AS CP:** At-sea midwater trawl targeting hake, utilizing CPs (2002-2019)
    - **CS AS MS:** At-sea midwater trawl targeting hake, utilizing motherships (2002-2019)
- Fixed gear
    - **NCS Pot:** Pot gear fished in NCS, aggregating sablefish LE fixed gear primary (tier endorsed), OA fixed gear, and LE fixed gear daily trip or quota limits (2002-2019)
    - **CS Pot:** IFQ pot (2011-2019)
    - **NCS Hook-and-Line:** Hook-and-line gear fished in NCS, aggregating the same sectors as NCS pot above
    - **CS Hook-and-Line:** IFQ hook-and-line (2011-2019)

This report describes changes in the magnitude of fishing catch and effort coastwide, as well as subtler changes in timing, spatial location, and depth. We analyze total groundfish and hake landings and total and median tow duration or number of hooks or pots coast-wide, as appropriate for the gear. We also present maps showing fishing effort across different sectors, gears, and time periods to compare and contrast fisheries and management regimes. To further explore changes in fishing effort, we present the proportion of shoreside landings (or catch, in the case of the at-sea midwater fleets) in bimonthly periods and latitudinal and depth bins. Together, this information helps to identify changes in the intensity and distribution of effort and catch over the past 18 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 (EM) data from the Pacific States Marine Fisheries Commission (PSMFC).

OBSERVER DATA

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

The goal of the WCGOP is to improve total catch estimates by collecting information on at-sea discards of west coast groundfish. The A-SHOP accounts for total catch and documents bycatch by sampling all catch on at-sea processors. For more details about observer program goals, vessel selection, and data collection, see the FOS website. Observer coverage for each fishery sector can be found in Somers et al. (2020). WCGOP, A-SHOP, and fish ticket data quality assurance, quality control, and processing methods are described in detail in Somers et al. 2021.

LOGBOOK DATA

Vessel logbook recordkeeping is a state-mandated requirement for the LE and CS groundfish bottom trawl sectors 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 2002-2019 were retrieved from the PacFIN database in November 2020. These data were assigned into groundfish fishery sectors following procedures described in Somers et al. 2021. Logbook and observer data sometimes have slight discrepancies, so summaries of fleet-wide vessels, trips, and hauls may be inconsistent with other reports.

LANDINGS DATA

Fleet-wide landing receipts are the cornerstone of landed catch information for shoreside sectors. 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. Fish buyers are required to record catch by market category (single species or a mix of species). Each state conducts species-composition sampling by market category and submit fish ticket and species-composition data to the PacFIN database. PacFIN applies the percentage of weight of each species within market categories obtained from species composition sampling to the fish ticket data. In doing so, landed weights from sampled market categories are distributed to individual species whenever possible. PacFIN data for fish ticket landings with state species composition sampling applied was queried in April 2020. As with logbook data, estimates of total vessels and trips in a fleet may differ between fish tickets and observer data, so discrepancies may exist between this and other reports.

DATA USAGE

We selected the data source for each analysis that ensures both high data quality and consistency for comparisons across sectors and time periods. These sources are summarized in Table 1 and further described below.

In shoreside sectors, we report total landings as recorded on fish tickets of targeted species for each sector: FMP managed groundfish (excluding Pacific hake) for non-hake targeting sectors and only Pacific hake landings for hake targeting sectors. The LE bottom trawl fishery did not and the NCS fixed gear sectors do not have 100% observer coverage, so fish tickets are the primary data source available for fishing effort comparisons. We approximated spatial location of catch using the latitude of the port of landing, although effort occurs at varying distances from landing locations. We also used fish ticket data to describe the proportional landings in bimonthly periods and in latitudinal bins in the shoreside sectors.

To describe haul duration and proportion of hauls in depth bins for bottom trawl sectors, we use logbook data to account for all fishing effort. In fixed gear and shoreside midwater sectors, we use WCGOP data to explore trends in gear usage and in depth on observed hauls. Although not all trips of the non-catch shares portion of the fixed gear sector are observed, this is the only data source available. For 2015-2019, logbook data for the EM portions of the CS pot and midwater fleets were incorporated. In NCS fixed gear sectors, we extrapolated the fleet-wide number of hooks and pots based on observer data; see the Methods section for further details. The use of observer data in sectors with less than 100% observer coverage produced more uncertainty in reported trends of total gear usage, gear use per haul, and depth compared to sectors with logbook or observer data for all trips.

All data used to assess fishing effort in the at-sea hake fishery come from A-SHOP. Haul-level information on location and retained catch 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 as consistent as possible across analyses of different metrics, while maintaining the data

confidentiality. These time periods are summarized in Table 1 and further described here. 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 2006 data were included in all other summaries. The shoreside IFQ fishery was grouped, by gear, into 2011-2016 and annually for the most recent three years of data, except in maps when data was grouped into 2017-2018 and 2019 to balance the necessary masking of confidential data with relevant time periods. To address changes around the implementation of IFQ management, we grouped the non-IFQ fixed gear sector into the pre-IFQ period (2002-2010), the initial IFQ period (2011-2016), and the most recent data (2017, 2018, and 2019 separately except in maps and as needed to mask confidential data). 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 2011-2016, and the most recent three years' data separately except in maps as described above.

LANDINGS

Total targeted 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 and fixed gear sectors and total hake landings to estimate effort by hake-targeting midwater trawl fisheries.

GEAR USAGE

We calculated total hours of fleet-wide towing, total fixed-gear units deployed, towing duration per haul, and number of hooks or pots. These metrics provide estimates of effort that, unlike total catch, are not impacted by fishing efficiency, stock density, and other factors. Expansions were performed in NCS fixed gear sectors to estimate the total number of hooks or pots. NCS fixed gear estimates were generated for each effort index by year, sector, and gear based on the following equation and then summed across all strata:

$$\hat{E} = \frac{\sum_h b}{\sum_h r} \times C$$

where:

$\hat{E}$: estimated effort
b: observed number of gear units
r: observed retained weight (mt) of groundfish species
h: hauls in observer data
C: weight (mt) of retained groundfish species recorded on all fish tickets

We also calculated the number of sets or hauls where lost gear was observed and where gear was recovered in each sector, gear, and year. Recovered gear could consist of crab pots, other fixed gear, or trawl nets retrieved in the codend, but does not include hauls where trawl gear was lost and immediately recovered in the same haul. We report only observed occurrences of lost or recovered gear and do not expand observed events to

create fleet-wide estimates. We report lost or recovered gear summaries at finer sector-level scales than other analyses in this report to better describe these patterns. As part of our quality control procedures, we developed rules to identify cases of lost or recovered gear which ensured consistent reporting and comparisons among years. Recovered gear is reported for all years in all fisheries, except for 2002 in the fixed gear fisheries. In the catch share fixed gear fisheries, gear lost is reported for all years, while those data were only available from 2010 to 2019 in the non-catch share fixed gear fisheries. This report summarizes the most recent data and should be considered the best source of data for this information.

Location of Effort

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

Geospatial Analysis

In addition to describing broad trends in the location of landings and catch and the depth of fishing effort, we also assessed 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 or sets that intersected land or occurred outside the U.S. EEZ for all sectors and, for bottom trawl, also removed hauls deeper than 2,000 m or towing greater than five knots (straight line distance divided by tow duration). From these line features, we created an effort density layer that depicts the relative intensity of fishing effort within relevant gear types and time periods. The following description of methods closely matches those used for development of fishing intensity layers created for the PFMC's review of groundfish EFH (GEFHRC 2012).

Fishing intensity was calculated as the total length of all lines intersecting a standardized area. To calculate this metric, we used a line density algorithm in ArcGIS™ v. 10.7.1 geographical information system software (Environmental Systems Research Institute, Incorporated, Redlands, California). The line density algorithm calculates density within a circular search area centered at a grid cell of specified size (see https://desktop.arcgis.com/en/arcmap/10.7/tools/spatial-analyst-toolbox/how-line-density-works.htm). Effort values were standardized for each time period by dividing per-cell density values by the total number of years in each period. The value (units: km/km^2/yr) for each grid cell is the quotient of total line portions intersecting the circular area per grid cell area per year. Because density outputs are highly sensitive to the specified radius and cell size, relative values are more informative than absolute values. Relative density identifies areas where fishing effort is concentrated, while still ensuring confidentiality of individual fishing locations and is thus superior to depicting confidential tow lines. The initial density output was more spatially extensive than those shown in the map figures, because it included confidential cells where density values were calculated from tows or sets made by less than three vessels. Confidential cells, representing less than three vessels, were removed from the maps presented in this report. Density parameters were chosen to minimize data exclusion but maintain confidentiality while still providing a high spatial resolution (500 m cell

size). A larger search radius (5,000 m) was used to develop shoreside processing midwater trawl and fixed gear density outputs as compared to trawl densities (3,000 m), because effort in those sectors was generally patchier compared to the bottom and at-sea processing midwater trawl sectors. Because the density outputs cannot fully capture the entire footprint of fishing, we summarized length of all lines intersecting 10x10-minute cells. Cumulative lengths were divided by the total length of all lines for each gear sector and time period, and reported as relative coastwide effort (%).

Seasonal Timing of Effort

To assess trends in the timing of fishing effort, we calculated the proportion of annual targeted landings in the shoreside fishery or catch in the at-sea fishery by each fleet and gear occurring in bimonthly periods over each year. We then calculated the median and first and third quartiles of that proportion across years in each time period. To maintain confidentiality, we combine data for 2017 and 2018 for the catch shares pot fleet and do not report data for 2017, 2018, or 2019 for the catch shares hook-and-line fleet because fewer than three vessels fished in each bimonthly 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.

Results

Trawl Sectors

Bottom Trawl

The bottom trawl sector retained ~15,000 mt of FMP groundfish species in both 2018 and 2019, the lowest annual catch by the bottom trawl fleet since 2002 (Table 2, Figure 1). Fleet-wide bottom trawl effort continued to decrease from the high of the catch shares period in 2013 and was almost half that level in 2019 (Table 2, Figure 2). Median haul duration has generally decreased since 2011 to around 3 hours in 2018 and 2019 (Table 2, Figure 3).

The spatial distributions of landings in 2017, 2018, and 2019 were similar (Table A-1, Figure 4). The greatest proportions of landings were made near Astoria, OR (46° N. latitude) but were lower in all three years than in 2011-2016 (Table A-1, Figure 4). Landings near the ports of Newport, OR (44° N. latitude) and Fort Bragg, CA (40° N. latitude) comprised approximately 20% of coastwide landings each. The proportions of landings north of 46° N. latitude and south of 39° N. latitude for the most recent three years remained low and similar to past landings in those areas.

Maps of average annual fishing intensity illustrated these patterns in more detail and revealed the similarity of spatial distribution and intensity patterns from 2011 to 2019 (Figure 5). The more recent time periods

illustrate the continued concentration of effort in the northern part of the coast and in deeper, further offshore waters. Effort in the southern parts of the coast is relatively low and patchy in the few places that bottom trawl fishing occurs, and almost no effort occurred south of 36° N. latitude in 2019.

Seasonal patterns of landings in 2017, 2018, and 2019 largely fell within the patterns observed in previous time periods, although the proportion of catch landed in Nov/Dec of 2018 was the highest on record for that bimonthly period. The proportion of landings in all three years were lowest in Jan/Feb and highest in Mar/Apr and Nov/Dec (Table A-2, Figure 6).

The proportion of hauls in the 0-50 fm depth bin continued to decrease, while activity in the 50-100 fm waters increased slightly (Table A-3, Figure 7). Across other depth bins, the distribution of effort was similar across all time periods.

Midwater Trawl Targeting Rockfish

In 2015, the annual catch limit (ACL) for yellowtail rockfish increased 1.5-times over the 2014 ACL, from approximately 4,400 to 6,600 mt. More dramatically, from 2016 to 2017, the widow rockfish ACL increased more than six-fold from 2,000 mt to more than 13,000 mt. With increased targeting opportunities, the CS midwater trawl rockfish fleet has re-emerged. Groundfish landings and effort in this sector have generally increased from 2011 to 2019, although groundfish retained decreased slightly in 2019 for the first time since 2016 (Table 2, Figures 1 and 2). Variation in tow duration per haul in the midwater rockfish trawl fleet has been similar from 2011 to 2019, and the median has remained between 1.2 and 1.8 hours (Table 2, Figure 3).

From 2011 to 2016, landings of midwater rockfish trawl fishery occurred from central WA to central OR; in 2017 to 2019, a small amount of landings also occurred in southern Oregon and, as part of an exempted fishing permit (EFP), in northern California (Table A-1, Figure 8). More than half of the landings across all years occurred along the OR/WA border at 46° N. Around 25% of landings in 2017, 2018, and 2019 occurred near Newport, OR in the 44° N. latitudinal bin, similar to the median value for 2011 to 2016. Landings near Bellingham, WA at 48° N. latitude were much lower in 2017, 2018, and 2019 compared to 2011-2016. Mapping the fishing effort shows that, even as effort continues to concentrate off of Astoria, OR, the range of this fishery has expanded to reach from the U.S./Canada border to northern California (Figure 9).

The shoreside midwater season starts in mid-May, except for participants in an EFP that began in 2017 and removed seasonal restrictions for this gear. Subsequently, approximately 10% of landings in 2018 and 2019 were made in Jan/Feb, and the percent of landings in Mar/Apr increased from 7% in 2017 to more than 25% in 2019 (Table A-2, Figure 10). The high variability in percent of landings made in Jul/Aug for 2011 to 2016 reflect the re-emergence of the targeting strategy during this period.

The depth distribution of midwater rockfish trawl effort in 2017 to 2019 was similar to that of 2011-2016, with more than 75% of effort occurring in the 50 to 100 fm depth bin in most years (Table A-3, Figure 11). The proportion of effort in the 100-150 fm depth bin increased from 2017 to 2019 but remained below the maximum of 27% during 2011-2016.

Midwater Trawl Targeting Pacific Hake

Landings by all three sectors of the hake-targeting midwater fleet increased from 2015 to 2016 (Table 2, Figure 12), and the shoreside and CP fleets' annual hake landings continued to increase in 2017. The two fleets decreased in 2018 and 2019, despite nearly constant allocations from 2017 to 2019. The MS fleet remained constant from 2016 to 2018 and then decreased substantially in 2019.

Effort, measured by total number of hours towing, increased in the shoreside fleet from 2016 to an almost historical high of 6,600 hours in 2019 (Table 2, Figure 13). Both at-sea processing fleets were more variable in recent years but were lower in 2017-2019 compared to historic highs in 2016. Towing hours per haul was highly variable, ranging from 1 to 4 hours between 2017 and 2019. However, on average, the duration of shoreside and MS hauls was around 2 to 2.5 hours, while hauls by the CP fleet were slightly higher (2.5 to 3.3 hours) (Table 2, Figure 14).

Shoreside Pacific Hake Fleet

Compared to 2011-2016, the shoreside fleet in 2017 to 2019 landed a lower proportion of hake near Newport, OR (44° N. latitudinal bin) and a greater proportion near Astoria, OR (46° N. latitudinal bin) (Table A-4, Figure 15). Fishing effort occurred from the U.S./Canada border to the Oregon/California border across all three time periods, with a small amount of effort occurring off of northern California between 2011 and 2016 (Figure 16). Across all three time periods, fishing effort was concentrated off of Newport, OR, with additional hot spots further north in 2017-2018 and 2019.

In 2015, the shoreside fleet's opening date shifted from June 15 to May 15 to coincide with the at-sea sector. Reflecting this change, the fleet landed a greater proportion of annual catch in May/June in 2017 to 2019 compared to 2011 to 2016. The proportion of landings in all other bimonthly periods in 2017 to 2019 were on the low end of the range observed in 2011-2016 (Table A-5, Figure 17). The majority of landings continued to occur in Jul/Aug in most years.

The majority of annual landings by the shoreside fleet occurred in 50 to 150 fathoms in 2017 to 2019, shallower waters than in 2011-2016 (Table A-6, Figure 18). The shoreside midwater fleet landed a greater proportion of their catch in 50 to 100 fathoms in 2017 to 2019 and in 100 to 150 fathoms in 2017 and 2018, compared to earlier years. The proportion of catch made in 150 to 250 fathom depths was lower in 2017 to 2019 compared to 2011-2016.

At-sea Pacific Hake Fleet

Fishing effort in the at-sea midwater hake trawl fishery concentrated off Oregon across all time periods (Table A-4, Figure 19). The distribution of CP effort was fairly evenly distributed from 48° to 42° N. latitude across all time periods. In 2017 to 2019, effort continued to decrease around 45° N. latitude and was highly variable around 44° N. latitude. Maps of CP fishing effort for 2017-2018 show a hot spot off of Newport, OR, while effort in 2019 was more concentrated between 48° and 47° N. latitude and around 43° N. latitude (Figure 20).

The spatial distribution of MS effort in 2017 to 2019 was also similar to that of earlier time periods, with greater proportions of landings generally occurring around 47°N. latitude and 43° N. latitude (Table A-4, Figure 19). Mapping this effort further emphasizes the similarity of spatial distribution from 2011 to 2019, including an area of concentrated fishing around 44° to 43° N. latitude present in all three time periods (Figure 21).

The midwater at-sea fleet's season begins on May 15. The proportion of CP landings processed in the May/June and Nov/Dec periods increased from 2017 to 2019, while the proportion remained near zero in Jul/Aug and decreased in Sep/Oct (Table A-5, Figure 22). The majority of MS landings were processed in May/Jun in most years, and increased from 43 to 97 percent from 2017 to 2019. Landings processed in Sep/Oct decreased from 53 to 5 percent over the same time period, and less than 8 percent of landings were processed in Jul/Aug or Nov/Dec from 2017 to 2019.

From 2006 to the present, more than 80% of CP and MS landings came from hauls in 100 to 250 fms; from 2017 to 2019 this pattern intensified to almost 90% or more in each year (Table A-6, Figure 23).

Fixed Gear Sectors

Pot

Annual groundfish landings using pot gear were fairly stable from 2015 to 2019 in the NCS fleet at about 600 mt, while the CS fleet showed a slight but generally increasing trend from 2013 to 2019, with a high of more than 850 mt (Table 3, Figure 24). Based on landings and observer data in the NCS fleet and census monitoring in the CS fleet, both sectors increased the total number of pots deployed from 2013 to 2017 before a decrease in 2018 and slight rebound in 2019 (Tables 3 and 4, Figure 25). Since 2011, the median number of pots per set in both the CS and NCS pot fleet has ranged between ~15 and ~40 (Table 3, Figure 26). The median number of pots per set has been greater in the NCS than the CS fleet in all years except 2013 and 2018.

From 2002 to 2019, the majority of landings by the NCS pot fleet occurred between Astoria, OR (48° N. latitude) and Fort Bragg, CA (39° N. latitude) (Table A-6, Figure 27). From 2017 to 2019, landings in the 44° N. latitudinal bin increased from 19 to 36% of annual catch, while landings in the 39° N. latitudinal bin decreased from 29 to 23%. Landings in Astoria, OR (48° N. latitude) and Newport, OR (44° N. latitude) together accounted for more than half of annual CS pot landings from 2017 to 2019 and were at the high end or above the 2011-2016 range (Table A-6, Figure 27). Landings in other parts of the coast largely showed the opposite pattern, including that 2017-2019 landings in the 35° N. latitudinal bin were below the 2011-2016 minimum.

The high dispersion of fishing effort by different vessels made it difficult to accurately display fishing intensity while maintaining confidentiality (Figure 28). However, comparing the primary fishing areas (excluding confidential data) across time periods revealed similarly distributed effort along the entire west coast from 2011 to 2019 (Figure 28). Due to lower observer coverage in the NCS fishery, direct comparisons of magnitude of effort between the NCS and CS maps are inappropriate. CS pot effort was greatest and

increasingly concentrated off of Washington and Oregon (Figure 29). Fishing in the southern part of the coast continued to decrease in 2017-2018 and 2019, although two concentrated effort areas persist off of San Francisco and Fort Bragg, CA. This new area of fixed gear fishing may represent initiatives introduced with catch shares implementation that supported a shift from trawl to fixed gear fishing near Morro Bay, CA.

From 2002 to 2016, the majority of landings by the NCS pot fleet occurred between May and October (Table A-8, Figure 30). Landings typically peaked in May/June and Jul/Aug prior to IFQ implementation in 2011, when this peak shifted to September/October. The proportion of landings occurring in both Jul/Aug and Sep/Oct increased from 2017 to 2019 and reached a historic high of 46% of landings in Sep/Oct of 2019. Landings in May/Jun decreased from 2017 to 2019, with a historic low of 8% in 2019. To mask confidential data, seasonal catch data for the CS pot fleet from January to April across all years and from 2017 and 2018 across all periods are summarized together. Landings in 2017 to 2019 from January to June were within the range of 2011-2016, but were near or above the maximum in Jul/Aug and Nov/Dec. In 2017-2019, around 25% of catch was landed in Sep/Oct compared to a median of 50% in 2011-2016.

From 2002 to 2019, fishing effort in the NCS pot fleet occurred primarily in depths between 100 and 300 fathoms (Table A-9, Figure 31). The depth distribution of landings from 2017 to 2019 were generally within those of 2002-2010 and 2011-2016. The majority of CS pot fleet effort in 2011-2016 occurred in depths from 150 fm to 600 fm. From 2017 to 2019, this effort became increasingly more concentrated in shallower depths from 150 fm to 400 fm.

Hook-and-Line

Groundfish landings by the NCS hook-and-line fleet ranged from 2,000 mt to 2,400 mt from 2012 to 2019 and recently decreased between 2017 and 2019 (Table 3, Figure 24). Estimated fleetwide hooks, calculated from total landings and observed hooks per set (see Table 4) showed a similar pattern and on average remained around 11 million hooks per year (Table 3, Figure 32). The median number of hooks per set in the NCS fleet was stable from 2002 to 2010 at ~2,000 hooks; this rate increased in 2012 and has been closer to ~2,500 hooks per set through 2019 (Table 3, Figure 33).

CS landings have been lower and less variable than NCS, ranging between 115 and 200 mt of groundfish from 2013 to 2019. CS effort has generally decreased from 2011 to 2019 and remained around a half-million hook in all years from 2013 to 2019 other than 2016 (Table 3, Figures 32). Hooks per set in the CS fleet generally increased from 2013 to 2019 and have remained around 3,200 since 2015.

Hook-and-line groundfish landings occurred from 48° to 32° N. latitude (Table A-7, Figure 34). Generally, landings by the NCS hook-and-line fleet were fairly evenly distributed along the coast. From 2017 to 2019, the proportion of landings occurring in the 48° N., 39° N., and 34° N. latitudinal bins increased slightly. Landings in the CS fleet were much more concentrated, with more than half occurring in the 48° N. latitudinal bin in both 2017 and 2019. Landings also increased in the 46° N. latitudinal bin from 2017 to 2019 but remained at the lower range of 2011-2016. No landings in the CS fleet occurred south of 43° N. after 2016.

Observed effort in the NCS hook-and-line fleet occurred along the entire west coast and was similar across the three analyzed time periods, although a hotspot near the U.S./Canada border was present in both 2017-2018 and 2019 (Figure 35). Due to a small number of vessels participating in the CS hook-and-line fleet, all years were summarized together and show an area of concentrated effort in the north off of Washington and Oregon and in the south off of southern California (Figure 36).

Landings by the NCS hook-and-line fleet increased throughout the calendar year before peaking in Sep/Oct across all time periods and years (Table A-8, Figure 37). To protect confidential data, the seasonal distribution of CS hook-and-line landings in 2017, 2018, and 2019 could not be shown. In 2011-2016, around half of landings occurred in Sep/Oct and landings in Jul/Aug and Nov/Dec were highly variable.

Both the NCS and CS hook-and-line fleets fish in depths ranging from 0 to 750 fm (Table A-9, Figure 38). The depth distribution of observed NCS hook-and-line hauls were similar across time periods and years, with the majority of landings coming from hauls in the 150-200 fm depth bin. The majority of CS hook-and-line effort occurred in the 200-250 fm depth bin across time periods and years, while effort in other depth bins was highly variable.

Lost Gear and Recovered Gear

Observed gear loss was least common in trawl fisheries. In shoreside bottom trawl fleets, gear loss occurred on ~0.1% of observed hauls annually and was never observed in shoreside midwater trawl fleets (Table 5). On average, in at-sea midwater fleets, 0.02% of hauls lost gear annually, with a maximum of less than 0.2% (Table 6). Gear loss was observed more often in fixed gear fisheries than in the trawl fleet. Lost gear was observed in the non-catch shares hook-and-line fisheries on about 2% of hauls, representing 0.3% of observed hooks. In the catch shares hook-and-line fleet, approximately 1% of hauls lost approximately 0.4% of hooks. In the catch shares pot fleet, around 4% of hauls lost approximately 0.4% of pots; in the non-catch shares pot fleet, around 3% of hauls lost approximately 0.1% of pots.

The percentage of hauls recovering gear was typically greater than those losing gear, likely reflecting gear loss in unobserved fisheries. Gear recovery was observed most frequently in fisheries using bottom trawl gear, when ~3.7% of hauls recovered gear. Midwater gears rarely contact the ocean floor, so gear recovery is exceedingly rare. Less than 0.6% of observed shoreside midwater hauls recovered gear, and no recovered gear has been observed in the at-sea midwater fleet. Fixed gears are less likely than bottom trawl to recover gear due to differences in deployment and the gear itself. Hook-and-line fleets recovered gear on less than 0.3% of observed hauls, with no incidents in most years. Approximately 0.1% of observed pot hauls recovered gear.

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The authors are grateful to the many A-SHOP and WCGOP observers who work hard under sometimes extreme conditions to collect these valuable data. The authors would also like to thank members of the Groundfish Endangered Species Work Group for helpful feedback and suggestions. Additionally, the authors are very appreciative of an extensive review from Lewis Barnett (Alaska Fisheries Science Center), whose comments greatly improved this report.

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FIGURES

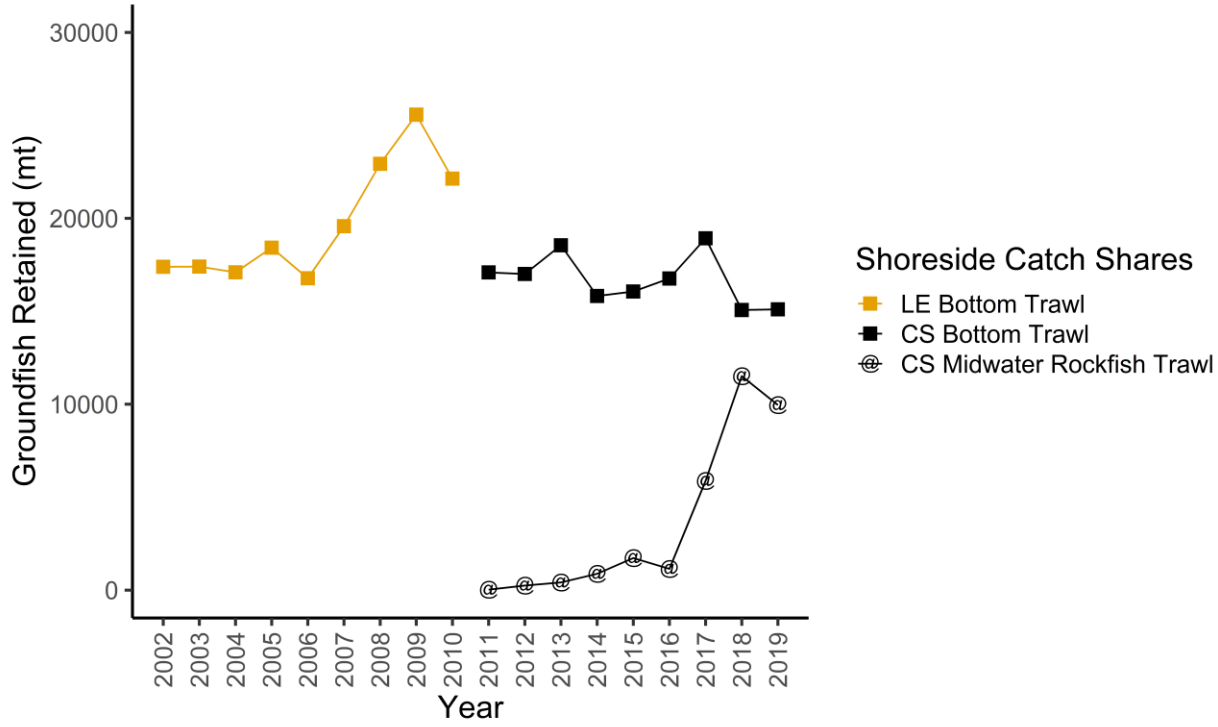

FIGURE 1. Annual total fleet-wide FMP groundfish (not including hake) landings (mt) in bottom trawl and midwater rockfish trawl sectors.

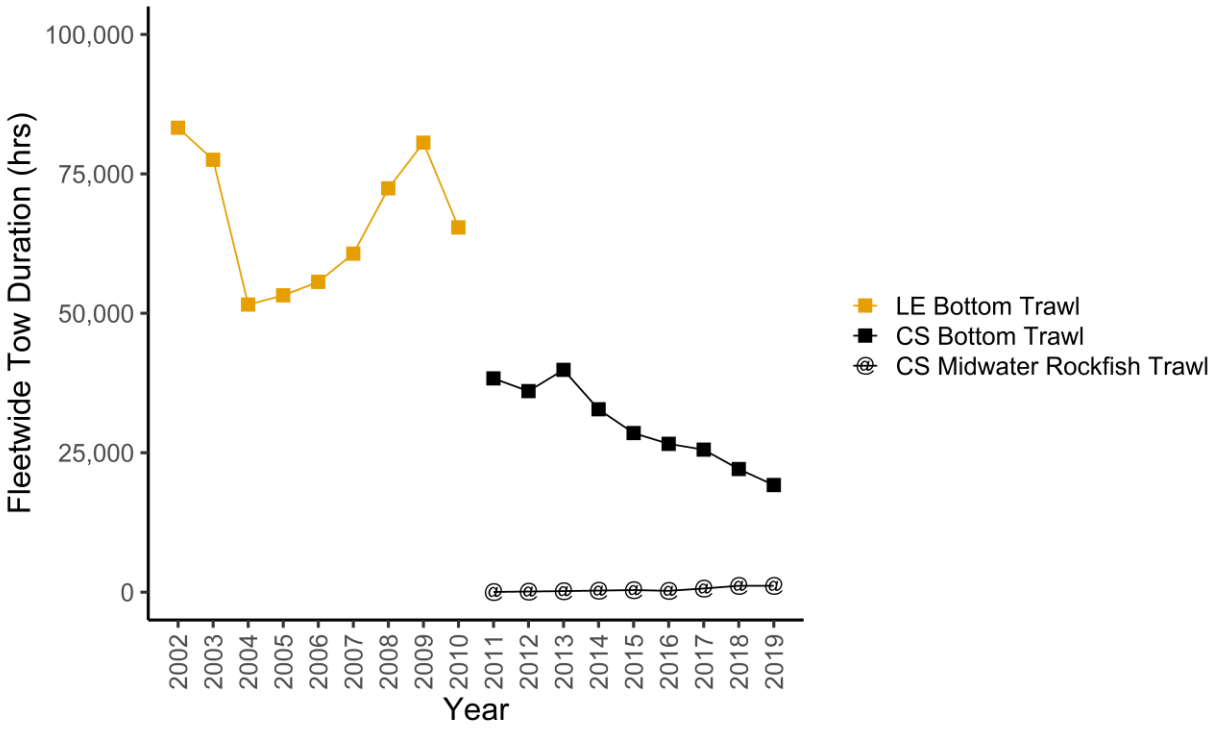

FIGURE 2. Annual fleet-wide total towing hours in the bottom trawl and midwater rockfish trawl sectors.

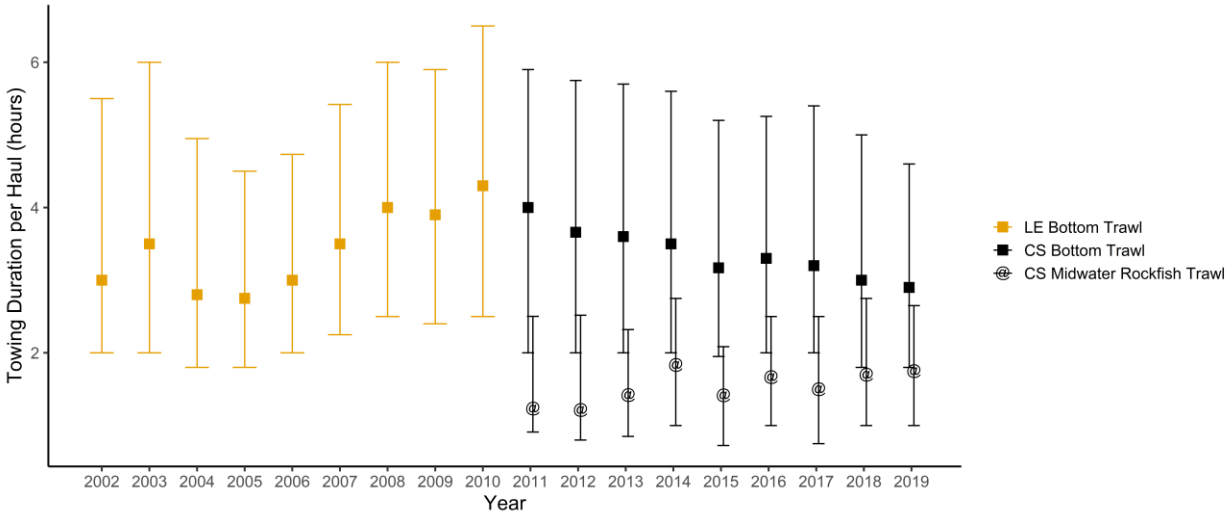

FIGURE 3. Tow duration per haul (hours) in the bottom trawl and midwater rockfish trawl sectors. Medians and first and third quartiles for each year are shown.

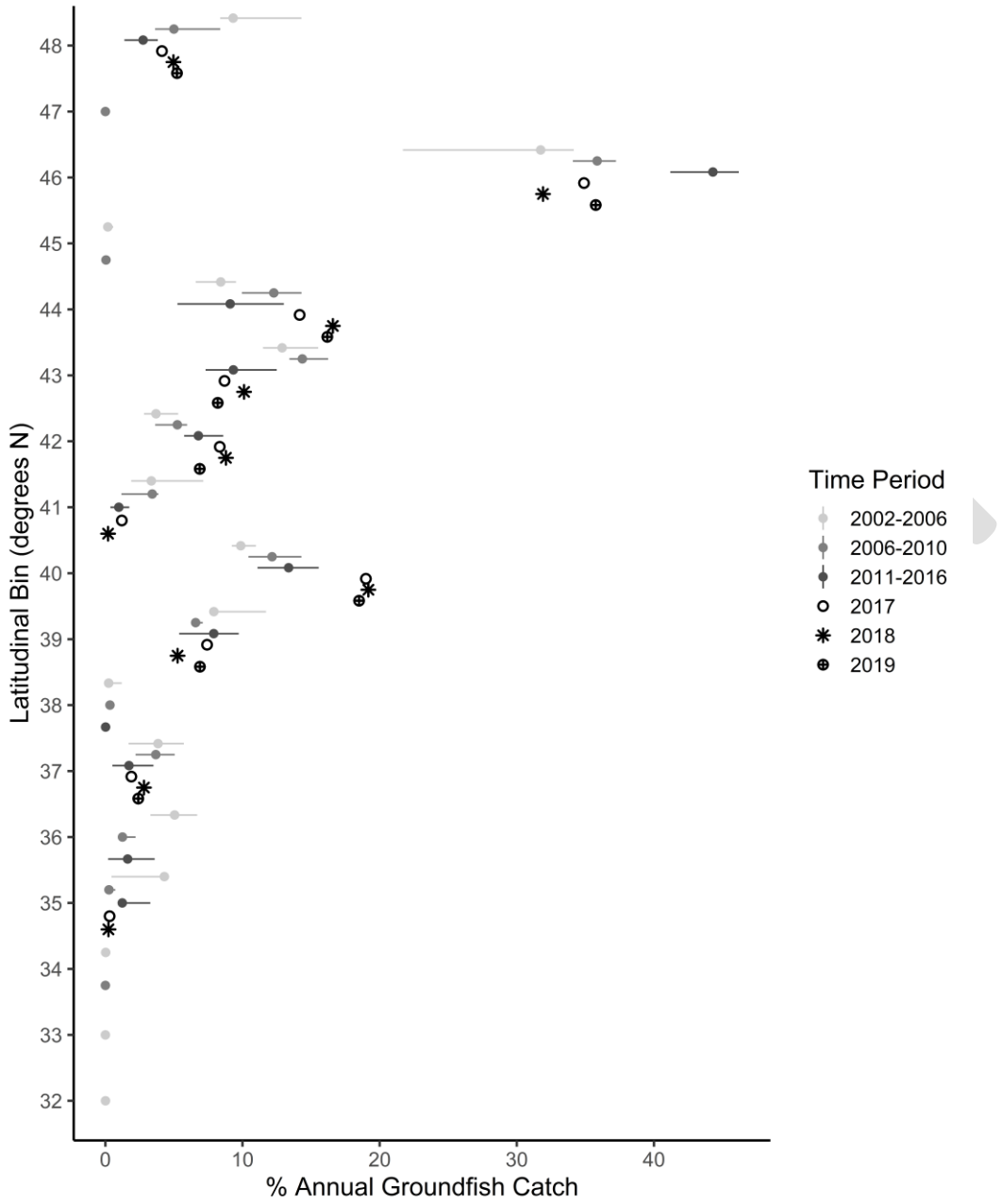

FIGURE 4. Percentage of retained FMP groundfish landed in latitudinal bins by the bottom trawl sector; patterns in actual fishing activity are shown in Figure 5. Minimum, median, and maximum are shown for each time period; annual estimates are shown for the most recent three years of data.

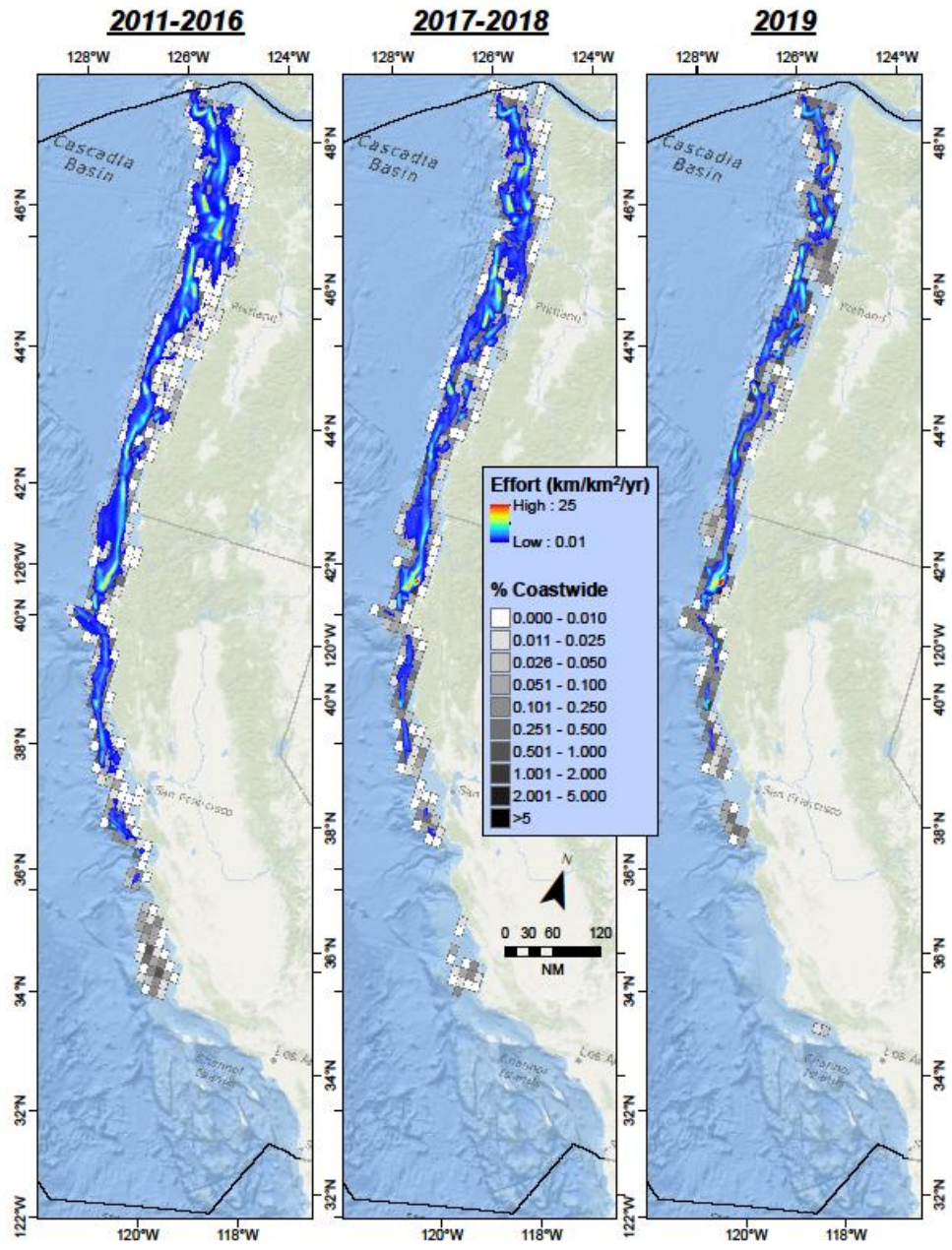

FIGURE 5. Spatial distribution and intensity of bottom trawl fishing effort. Intensity (units: km/km^2/yr) is depicted by a color ramp of cool (low) to warm (high) colors. The LE bottom trawl sector time periods account EFH closures that began mid-2006 on June 12. The overall footprint of fishing for each time period is depicted in grayscale, with darker (black) tones depicting a higher relative contribution to coastwide effort within 10x10 min cells.

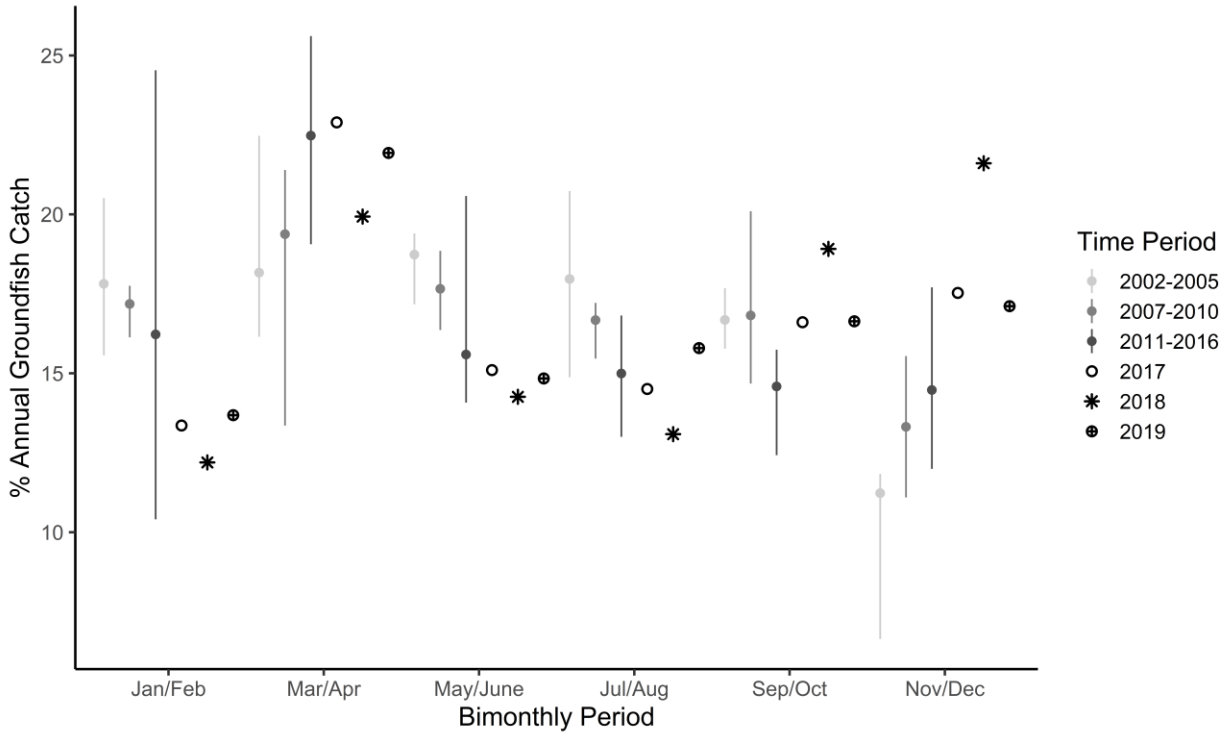

FIGURE 6. Percentage of retained FMP groundfish landed in bimonthly bins by the bottom trawl sector. Minimum, median, and maximum are shown for each time period; annual estimates are shown for the most recent three years of data.

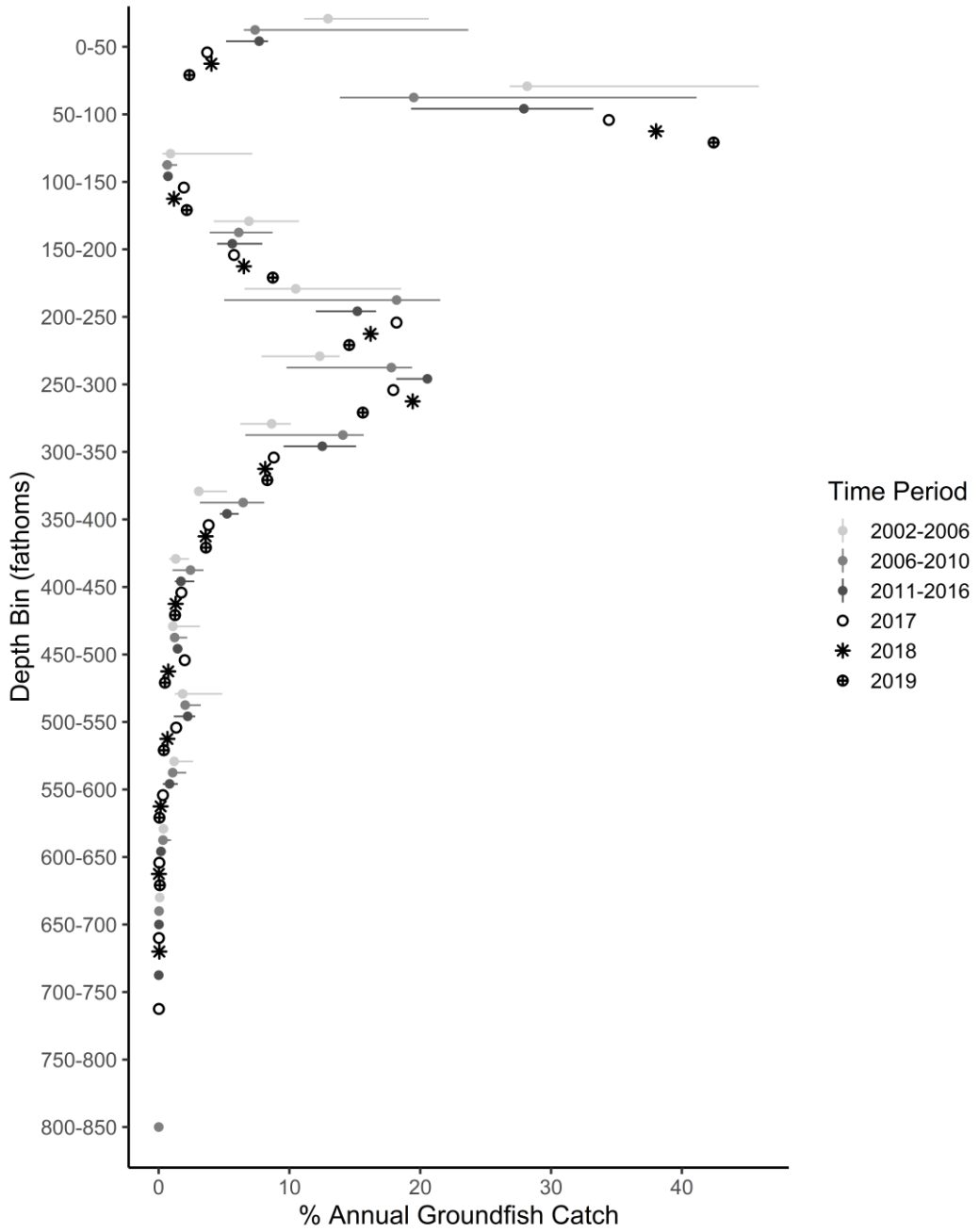

FIGURE 7. Percentage of bottom trawl hauls in 50-fathom depth bins. Minimum, median, and maximum are shown for each time period; annual estimates are shown for the most recent three years of data.

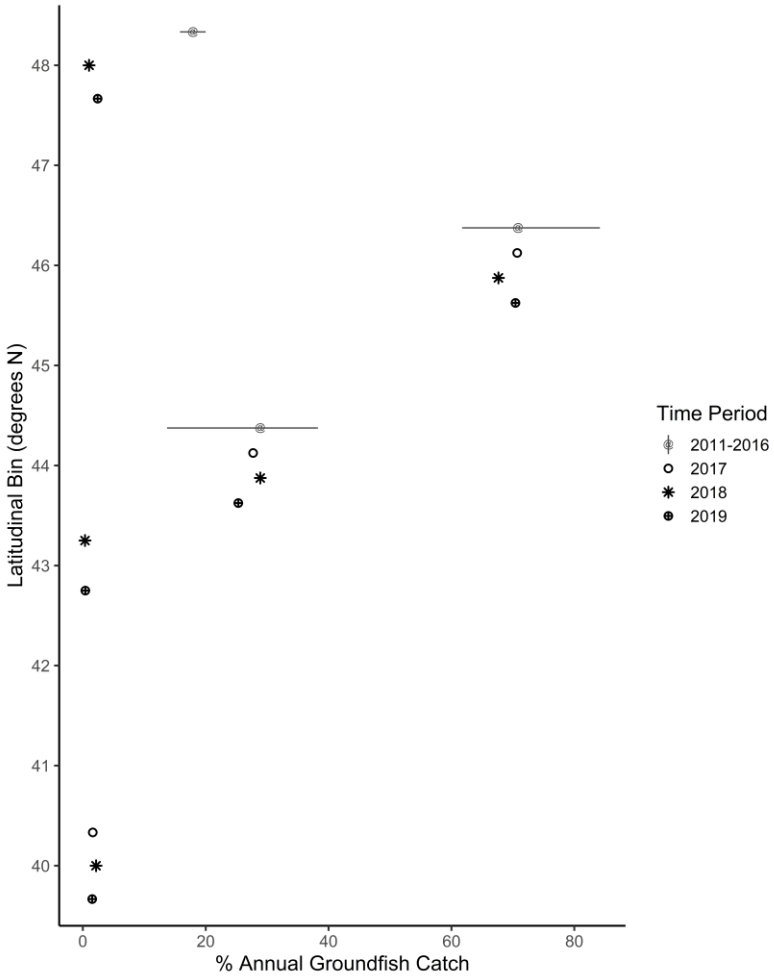

FIGURE 8. Percentage of retained FMP groundfish landed in latitudinal bins by the midwater rockfish trawl sector; patterns in actual fishing activity are shown in Figure 9. Minimum, median, and maximum are shown for each time period; annual estimates are shown for the most recent three years of data.

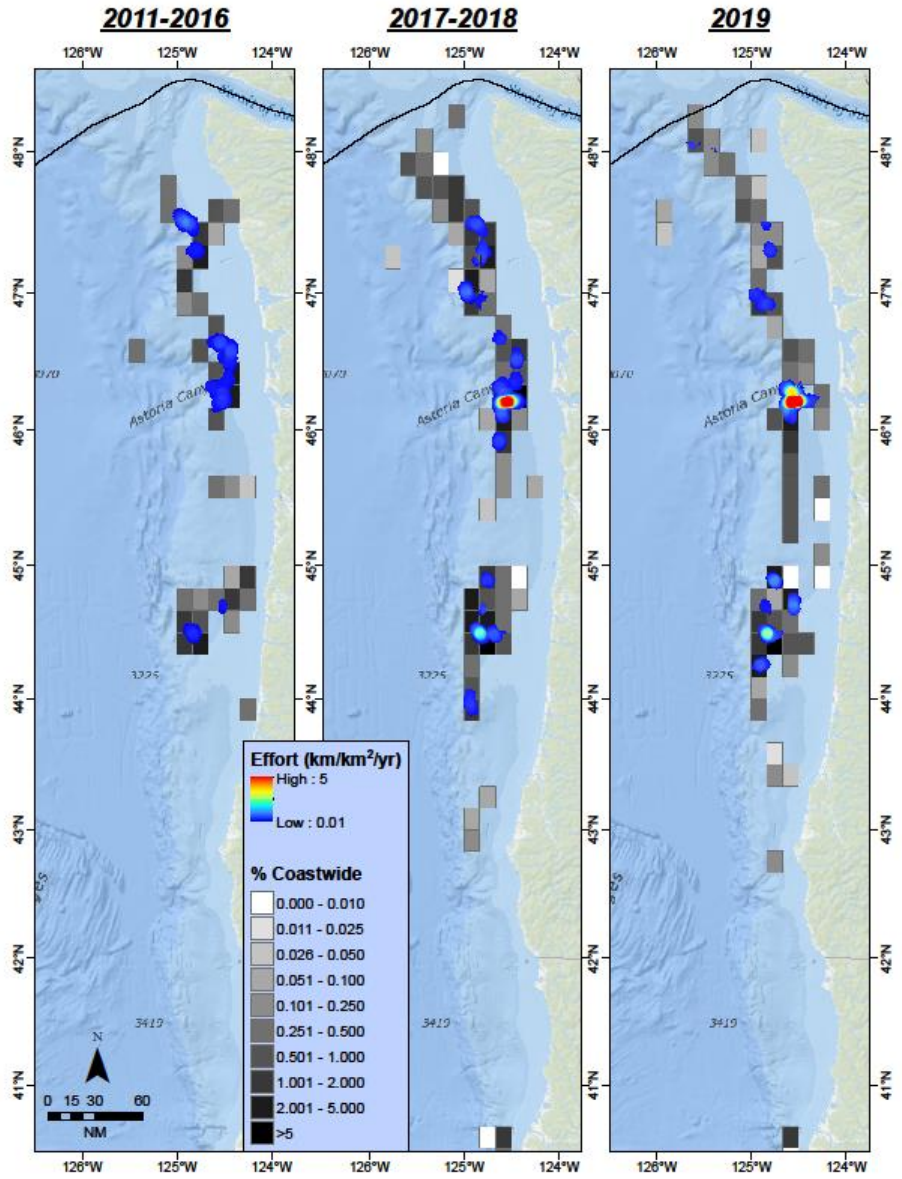

FIGURE 9. Spatial distribution and intensity of midwater rockfish trawl fishing effort. Intensity (units: km/km²/yr) is depicted by a color ramp of cool (low) to warm (high) colors. The overall footprint of fishing for each time period is depicted in grayscale, with darker (black) tones depicting a higher relative contribution to coastwide effort within 10x10 min cells.

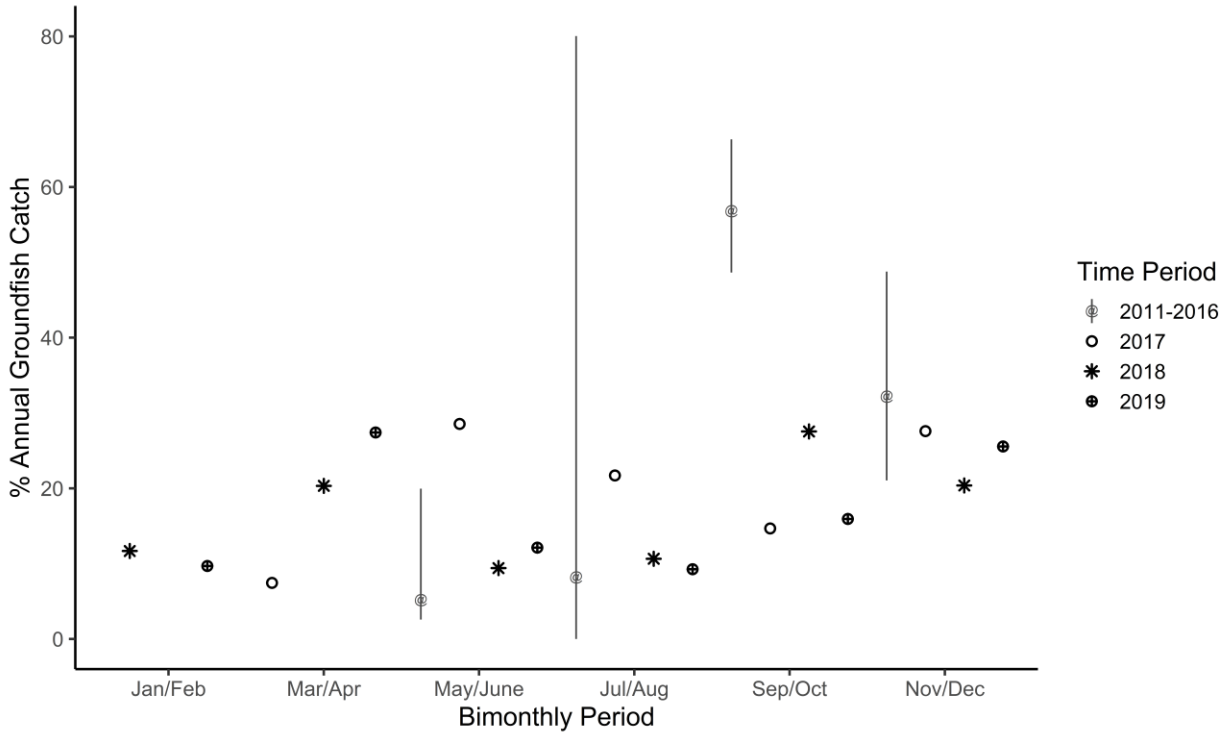

FIGURE 10. Percentage of retained FMP groundfish landed in bimonthly bins by the midwater rockfish trawl sector. Minimum, median, and maximum are shown for each time period; annual estimates are shown for the most recent three years of data.

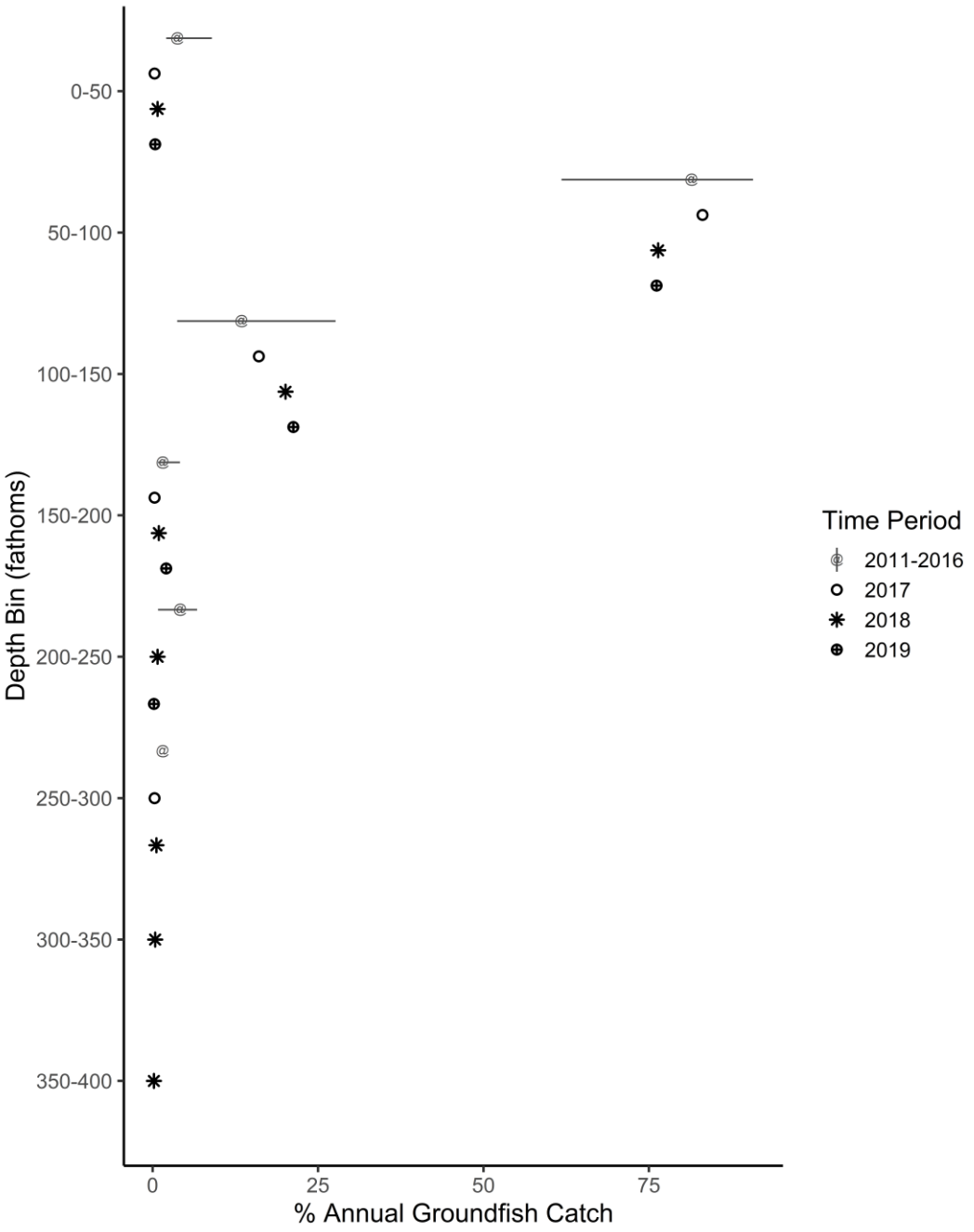

FIGURE 11. Percentage of midwater rockfish trawl hauls in 50-fathom depth bins. Minimum, median, and maximum are shown for each time period; annual estimates are shown for the most recent three years of data.

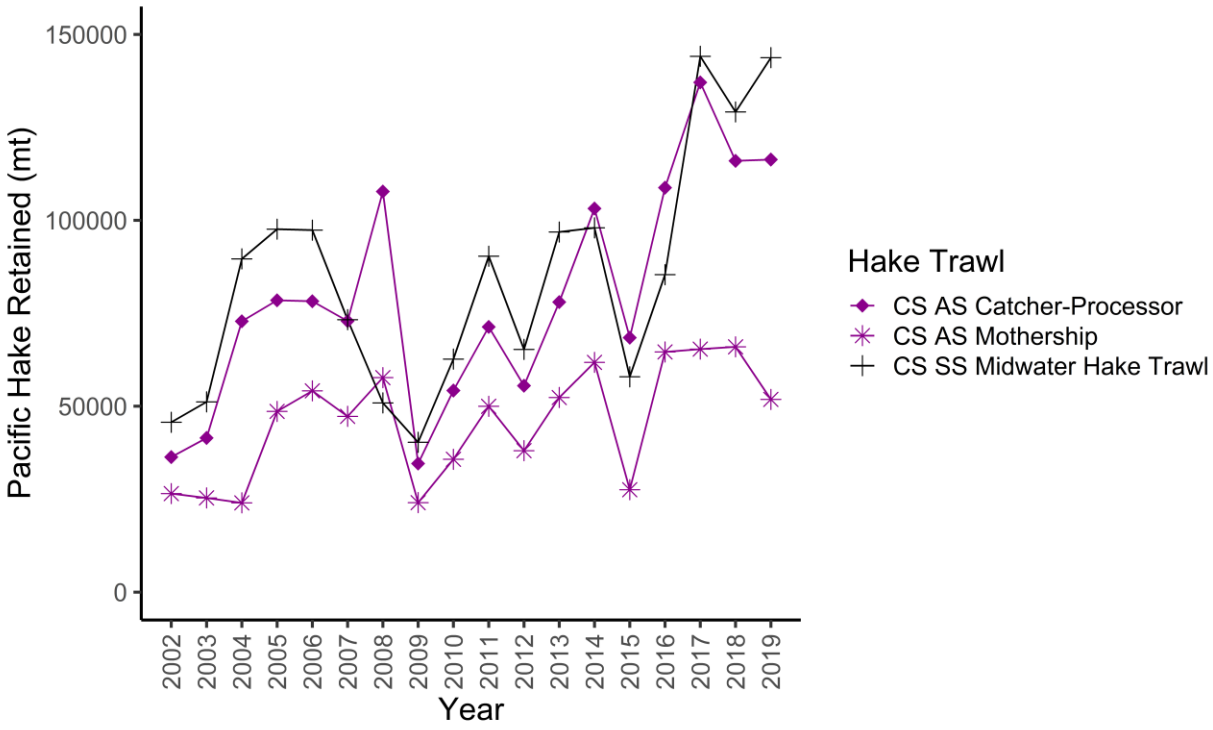

FIGURE 12. Annual total fleet-wide Pacific hake landings (mt) in midwater hake trawl sectors.

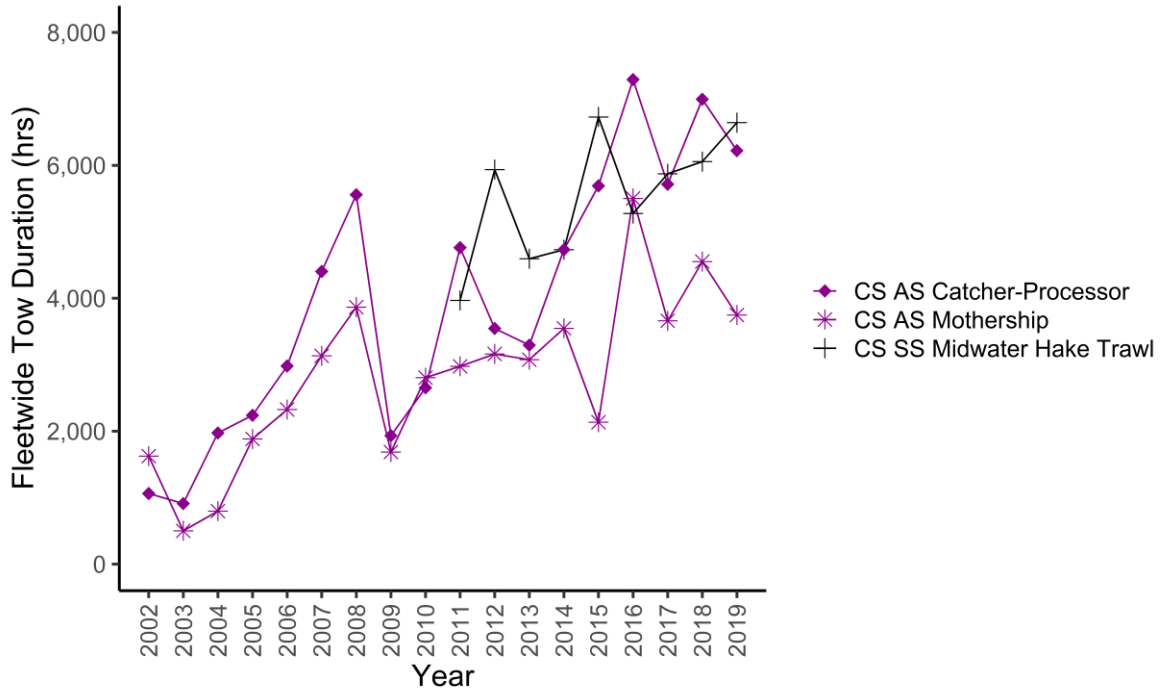

FIGURE 13. Annual fleet-wide total towing hours in midwater hake trawl sectors.

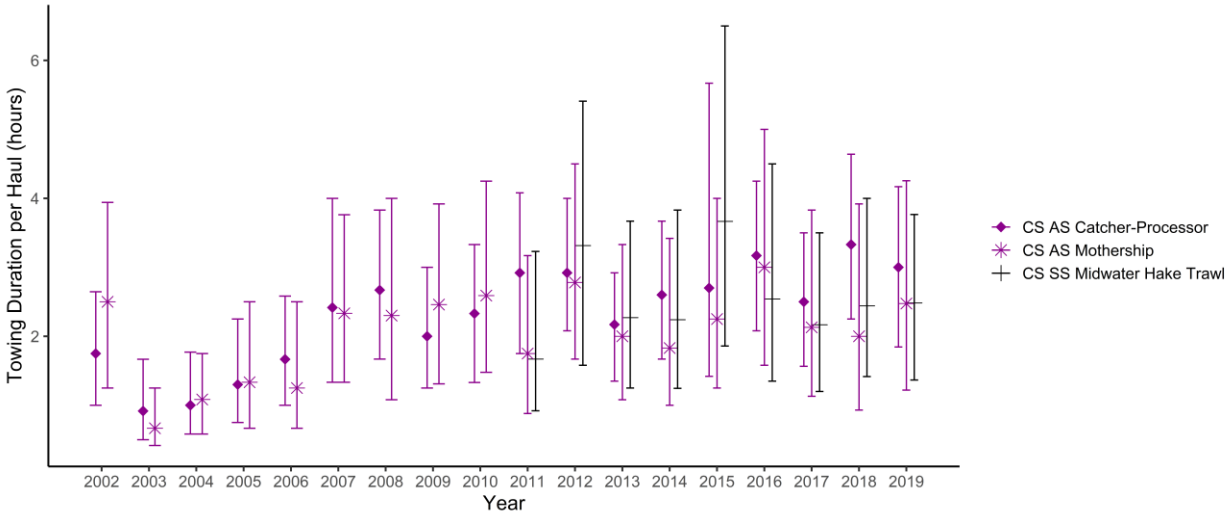

FIGURE 14. Tow duration per haul (hours) in midwater hake trawl sectors. Medians and first and third quartiles for each year are shown.

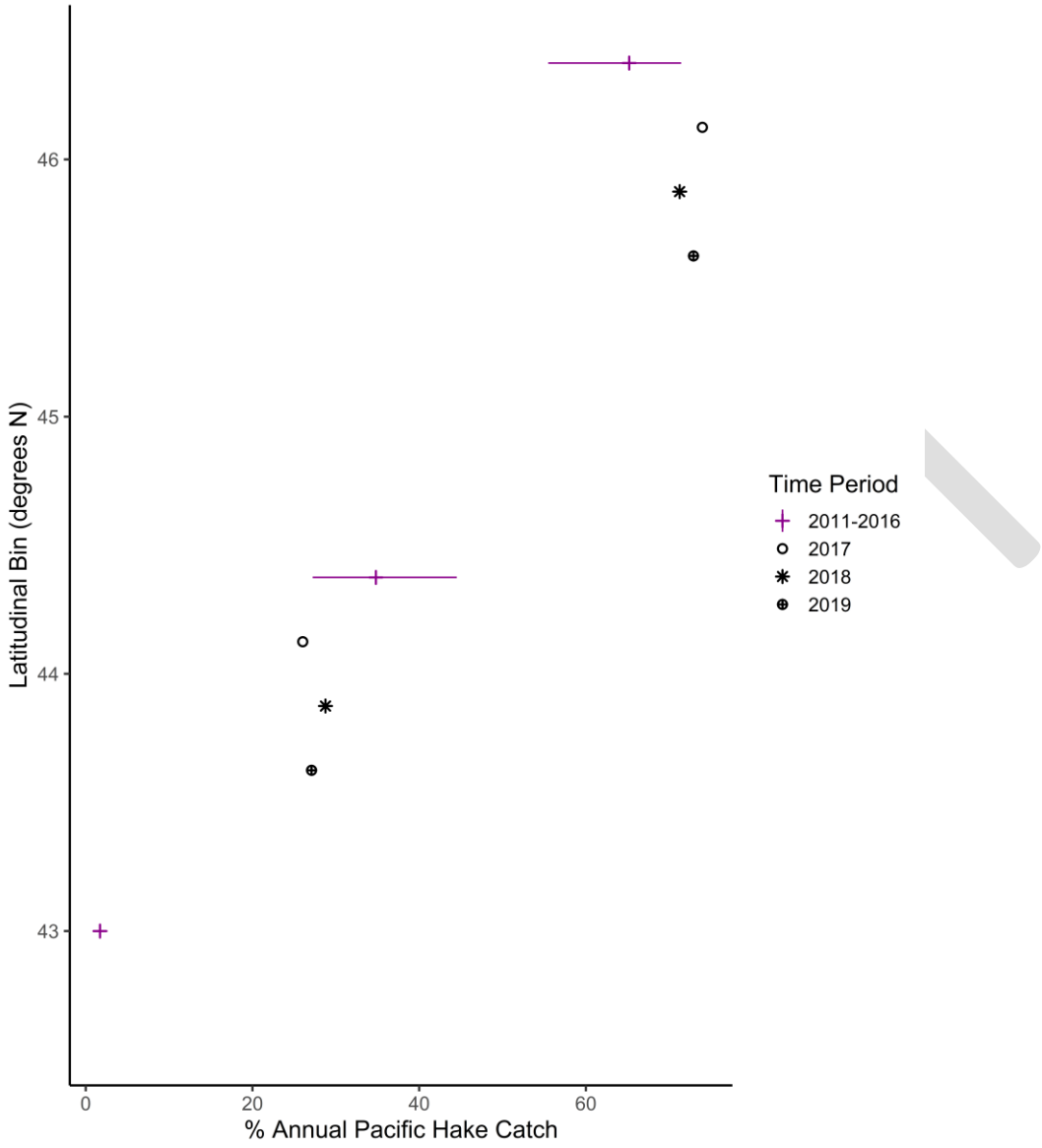

FIGURE 15. Percentage of retained Pacific hake landed in latitudinal bins by shoreside midwater hake trawl; patterns in actual fishing activity are shown in Figure 16. Minimum, median, and maximum are shown for each time period; annual estimates are shown for the most recent three years of data.

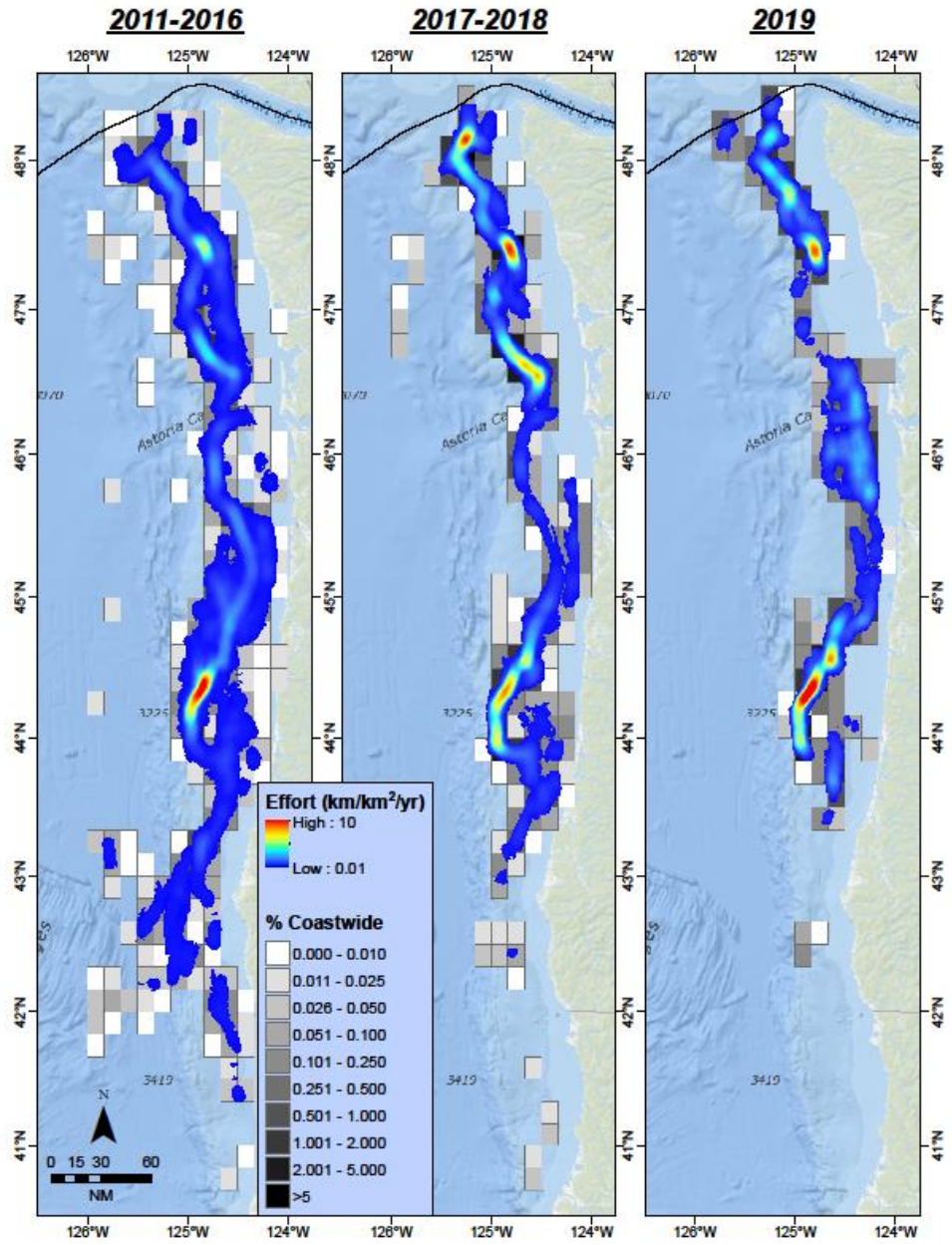

FIGURE 16. Spatial distribution and intensity of fishing effort by shoreside midwater hake trawl. Intensity (units: km/km²/yr) is depicted by a color ramp of cool (low) to warm (high) colors. The overall footprint of fishing for each time period is depicted in grayscale, with darker (black) tones depicting a higher relative contribution to coastwide effort within 10x10 min cells.

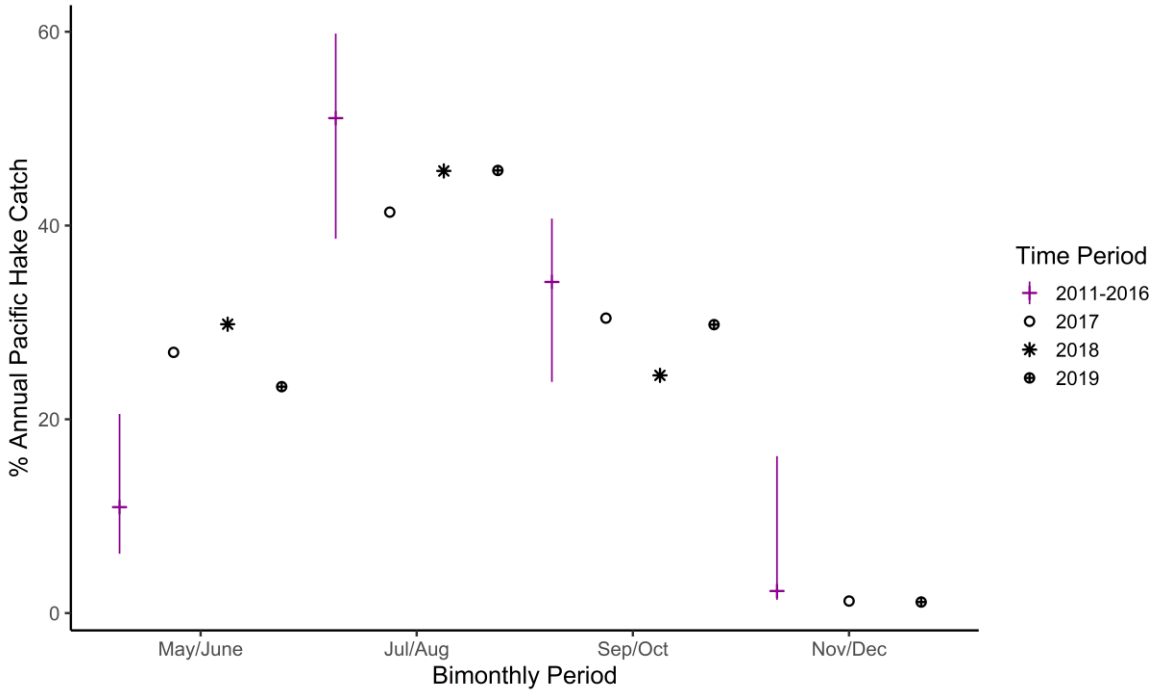

FIGURE 17. Percentage of retained hake landed in bimonthly bins by shoreside midwater trawl targeting hake. Minimum, median, and maximum are shown for each time period; annual estimates are shown for the most recent three years of data.

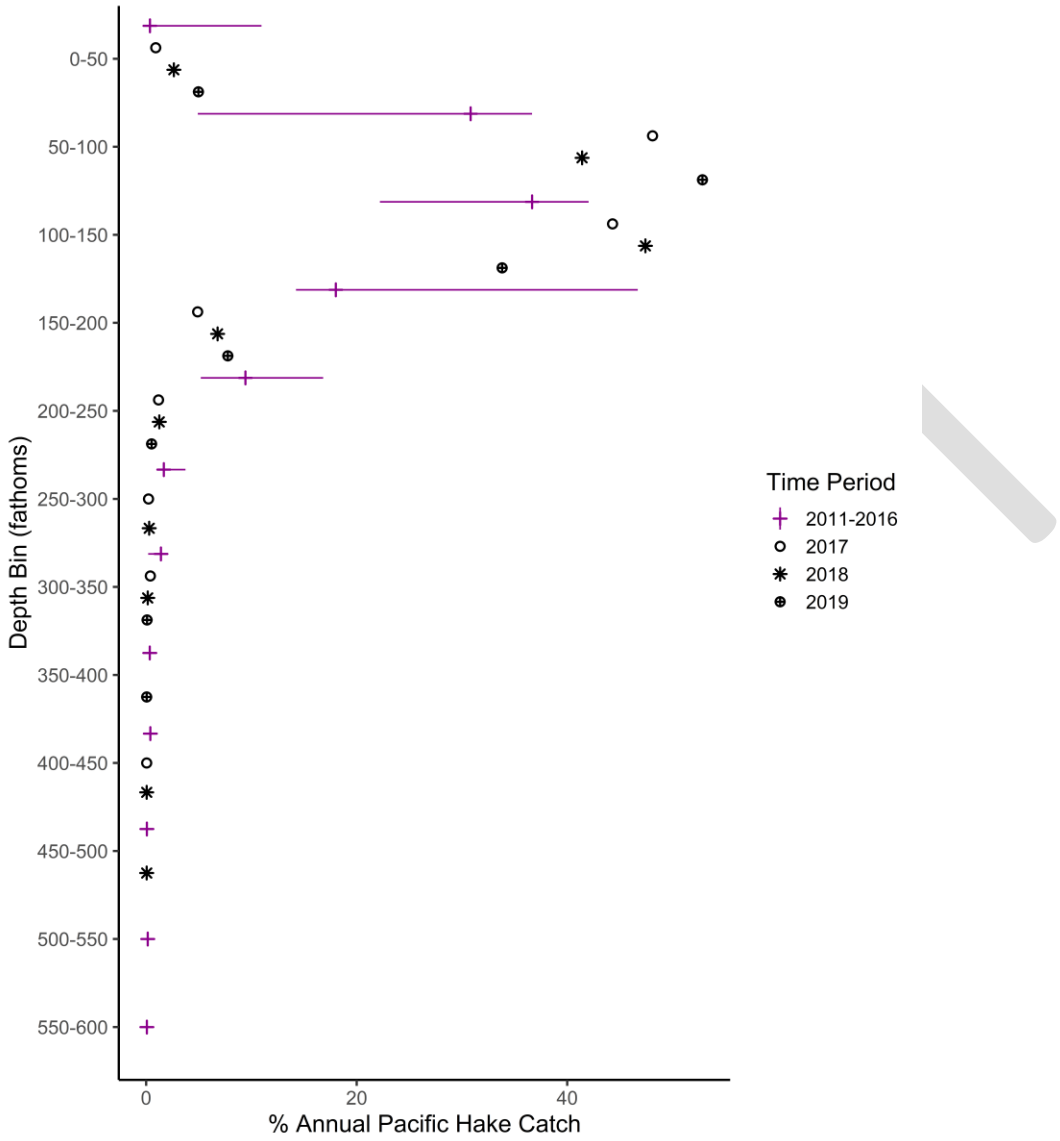

FIGURE 18. Percentage of shoreside midwater hake trawl hauls in 50-fathom depth bins. Minimum, median, and maximum are shown for each time period; annual estimates are shown for the most recent three years of data.

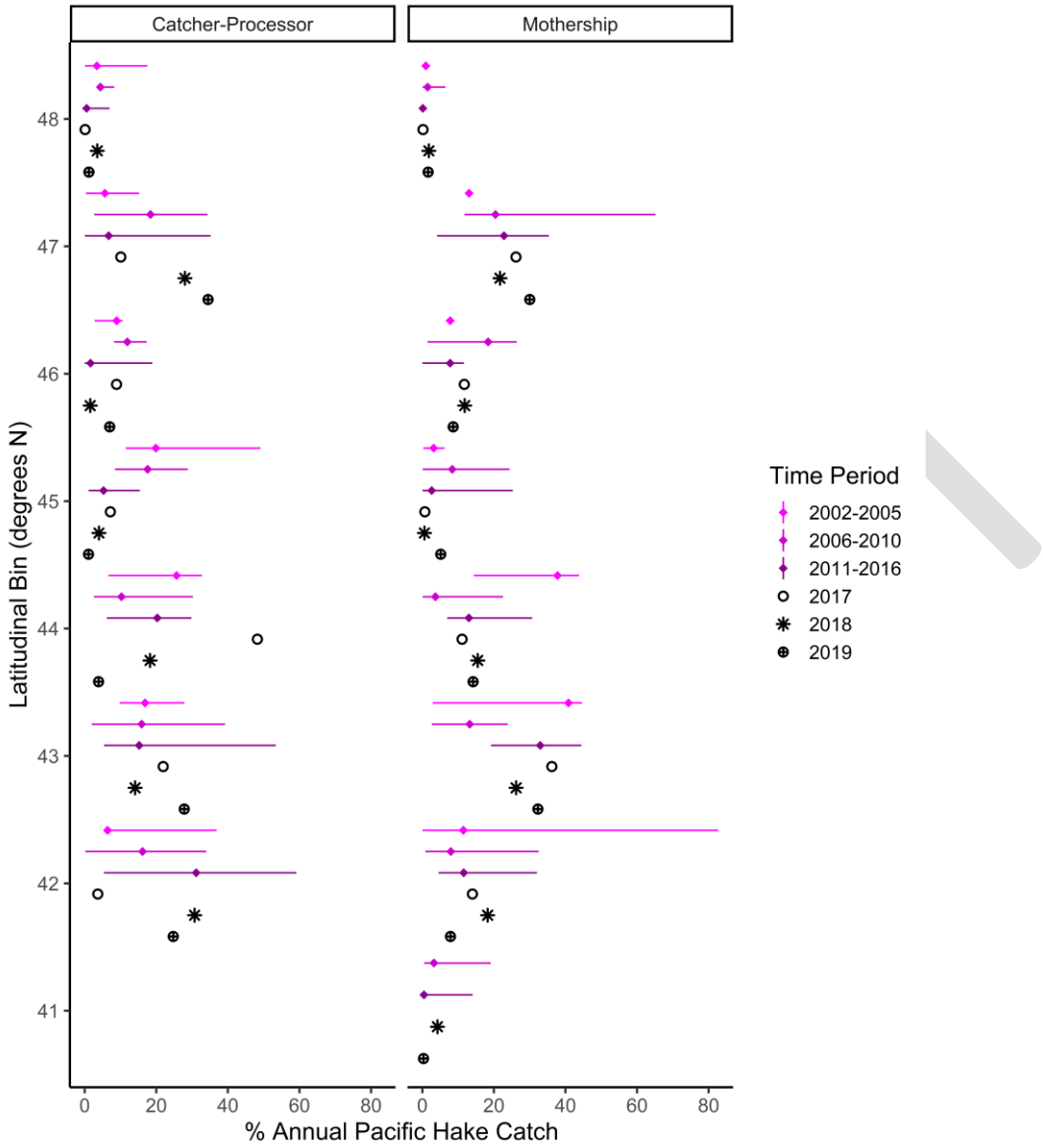

FIGURE 19. Percentage of retained hake caught in latitudinal bins by at-sea midwater trawl sectors. Minimum, median, and maximum are shown for each time period; annual estimates are shown for the most recent three years of data.

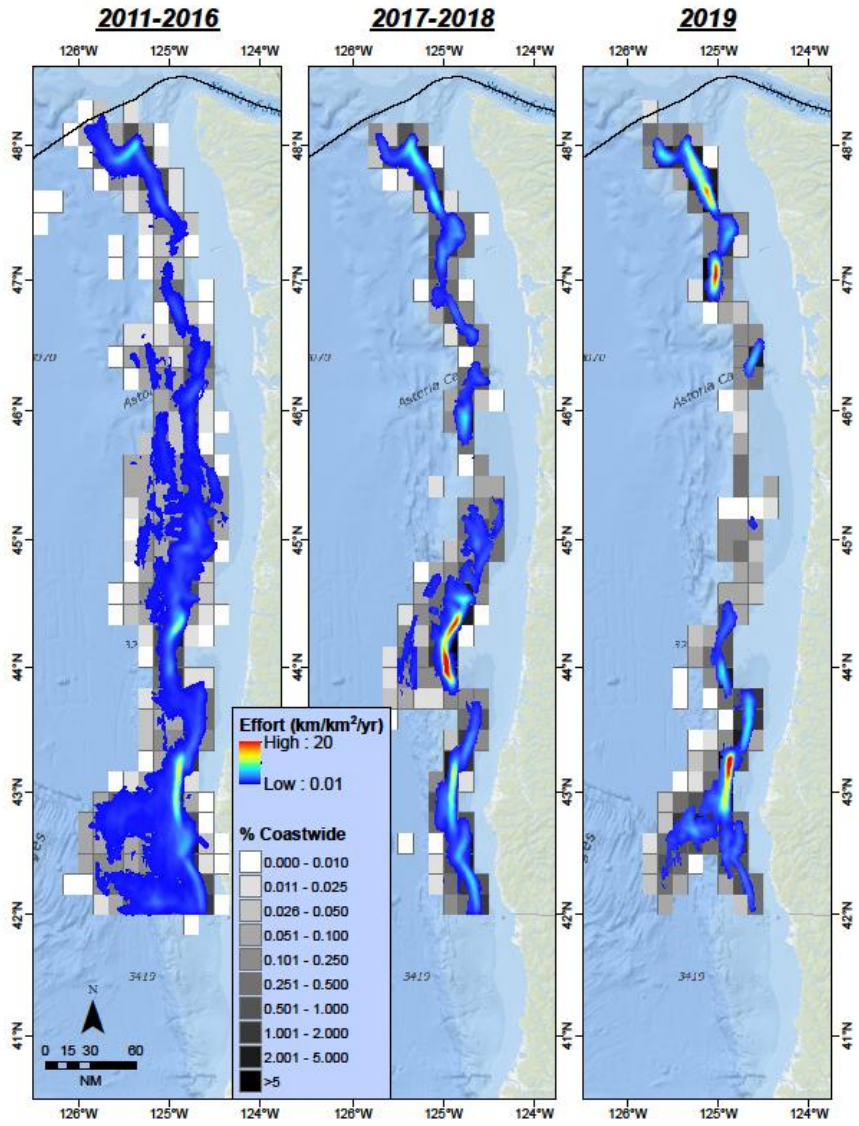

FIGURE 20. Spatial distribution and intensity of fishing effort by at-sea midwater trawl catcher-processors. Intensity (units: km/km²/yr) is depicted by a color ramp of cool (low) to warm (high) colors. The overall footprint of fishing for each time period is depicted in grayscale, with darker (black) tones depicting a higher relative contribution to coastwide effort within 10x10 min cells.

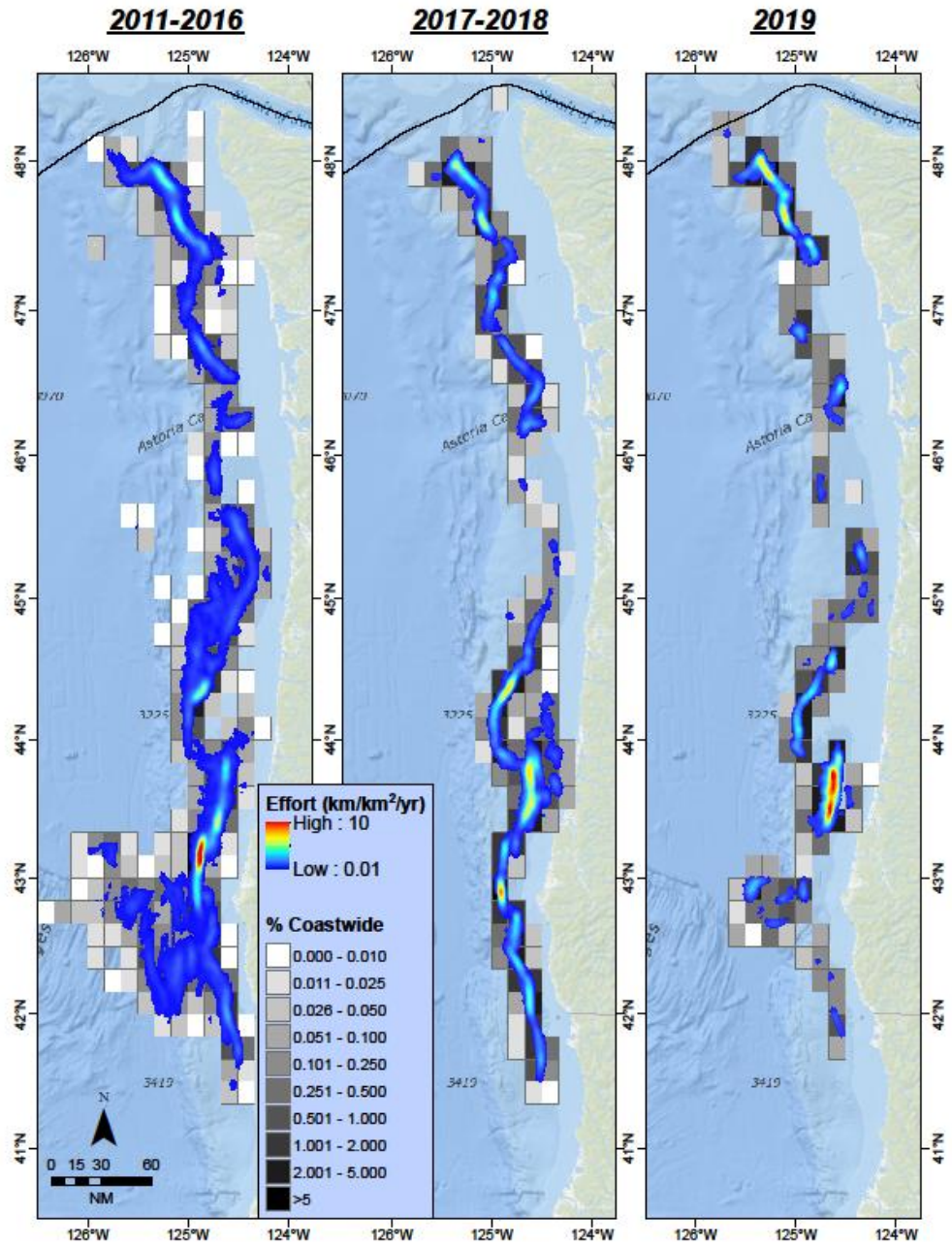

FIGURE 21. Spatial distribution and intensity of fishing effort by at-sea midwater trawl mothership catcher-vessels. Intensity (units: km/km²/yr) is depicted by a color ramp of cool (low) to warm (high) colors. The overall footprint of fishing for each time period is depicted in grayscale, with darker (black) tones depicting a higher relative contribution to coastwide effort within 10x10 min cells.

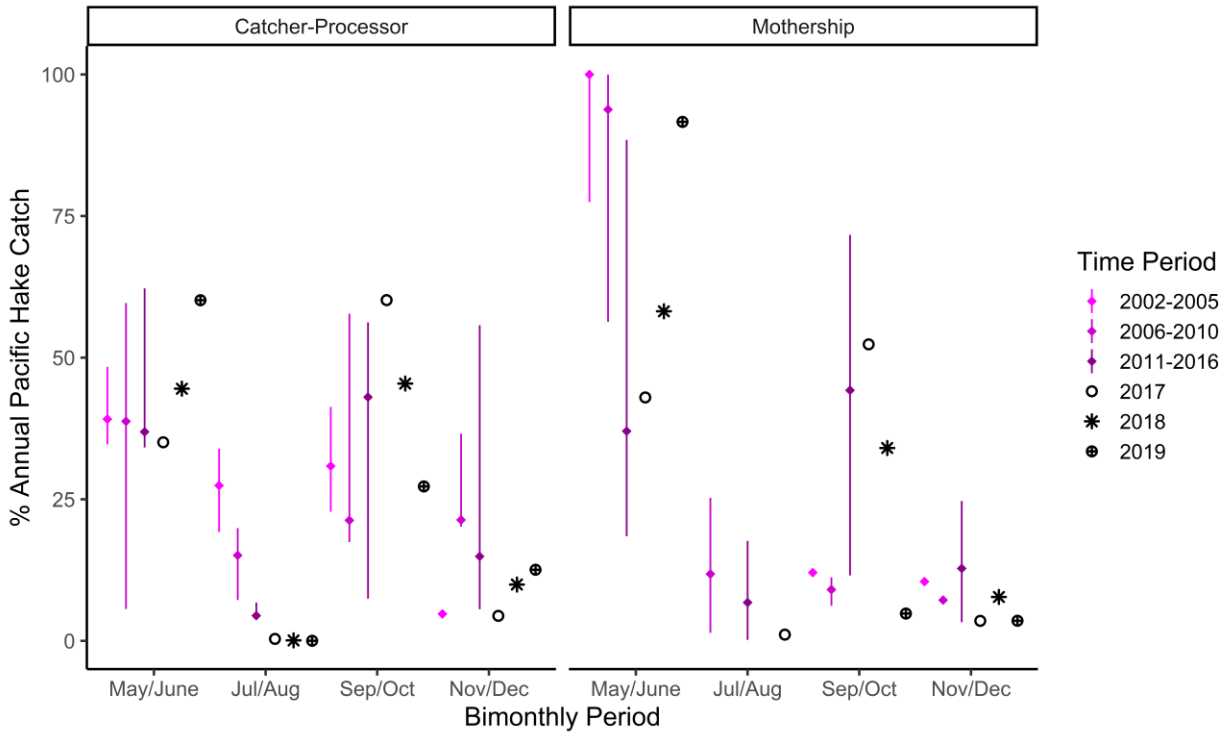

FIGURE 22. Percentage of retained hake caught in bimonthly bins by at-sea midwater trawl sectors. Minimum, median, and maximum are shown for each time period; annual estimates are shown for the most recent three years of data.

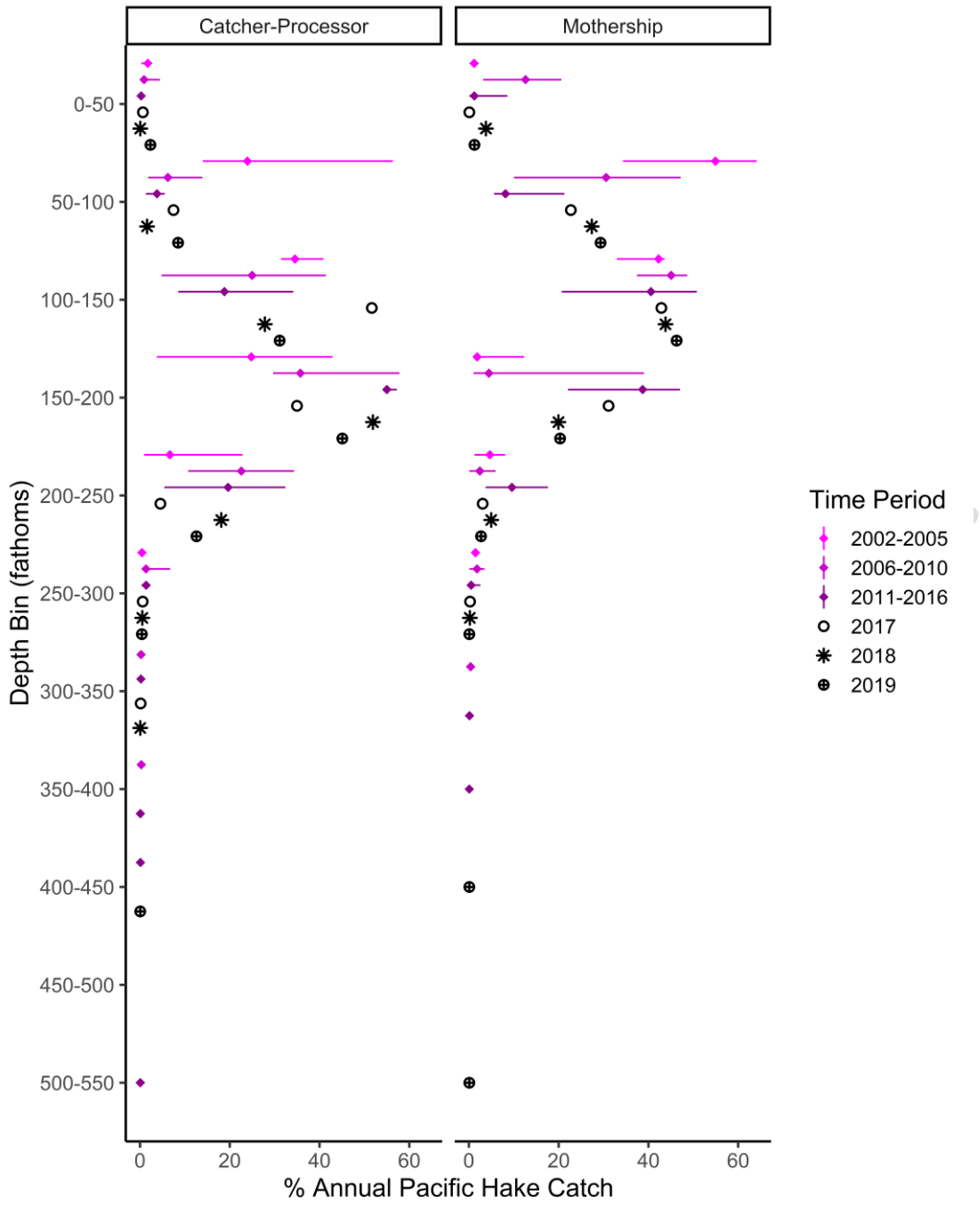

FIGURE 23. Percentage of at-sea midwater trawl hauls in 50-fathom depth bins. Minimum, median, and maximum are shown for each time period; annual estimates are shown for the most recent three years of data.

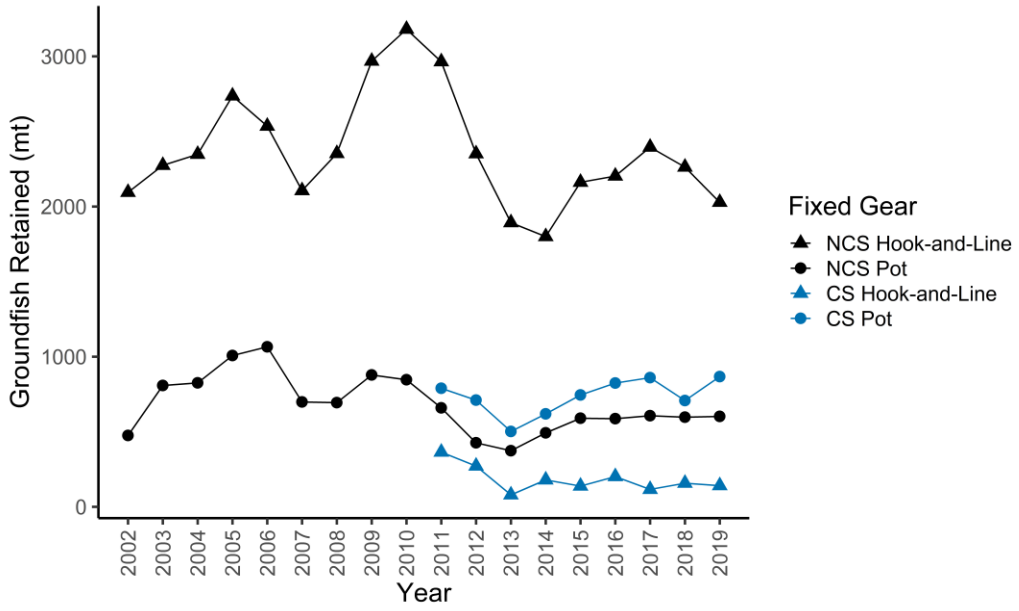

FIGURE 24. Annual total fleet-wide groundfish landings (mt) in fixed gear sectors.

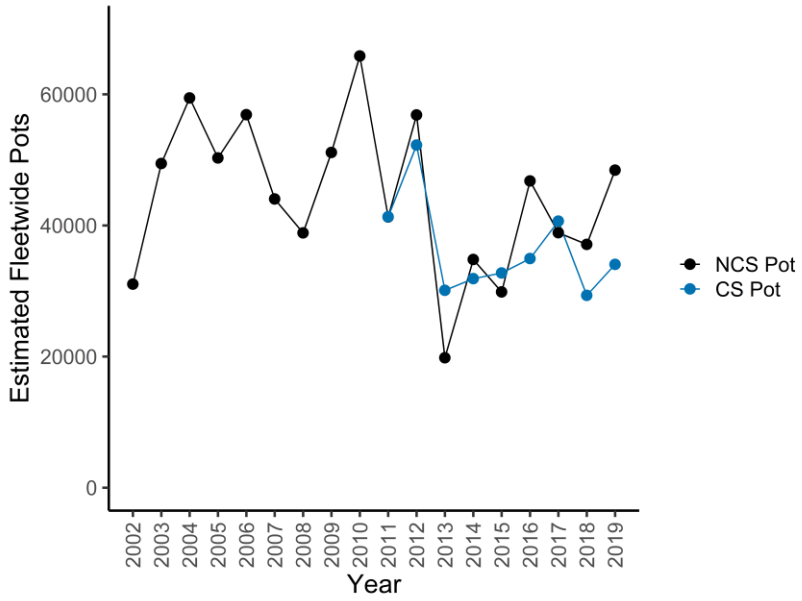

FIGURE 25. Annual total fleet-wide number of pots in the pot sectors.

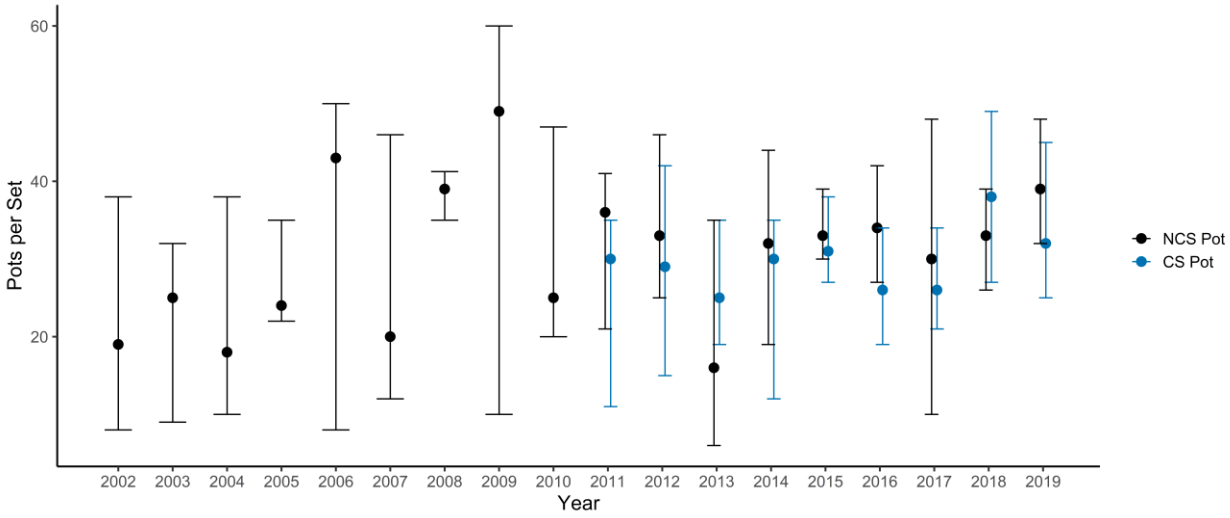

FIGURE 26. Number of pots per set in pot sectors, summarized as median, first, and third quartiles in each year.

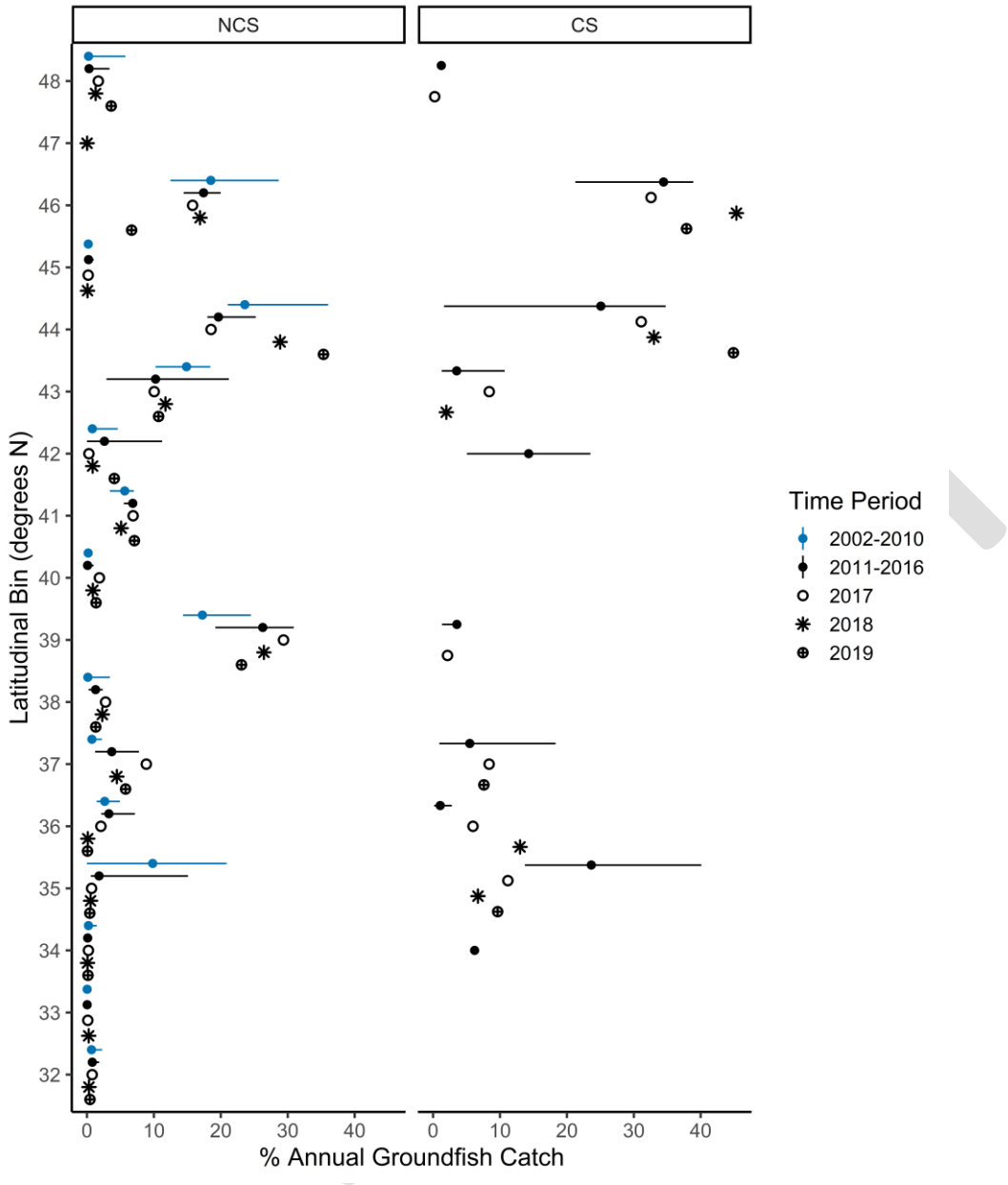

FIGURE 27. Percentage of retained groundfish landed in latitudinal bins by pot sectors patterns in actual fishing activity are shown in Figures 28 and 29. Minimum, median, and maximum are shown for each time period; annual estimates are shown for the most recent three years of data.

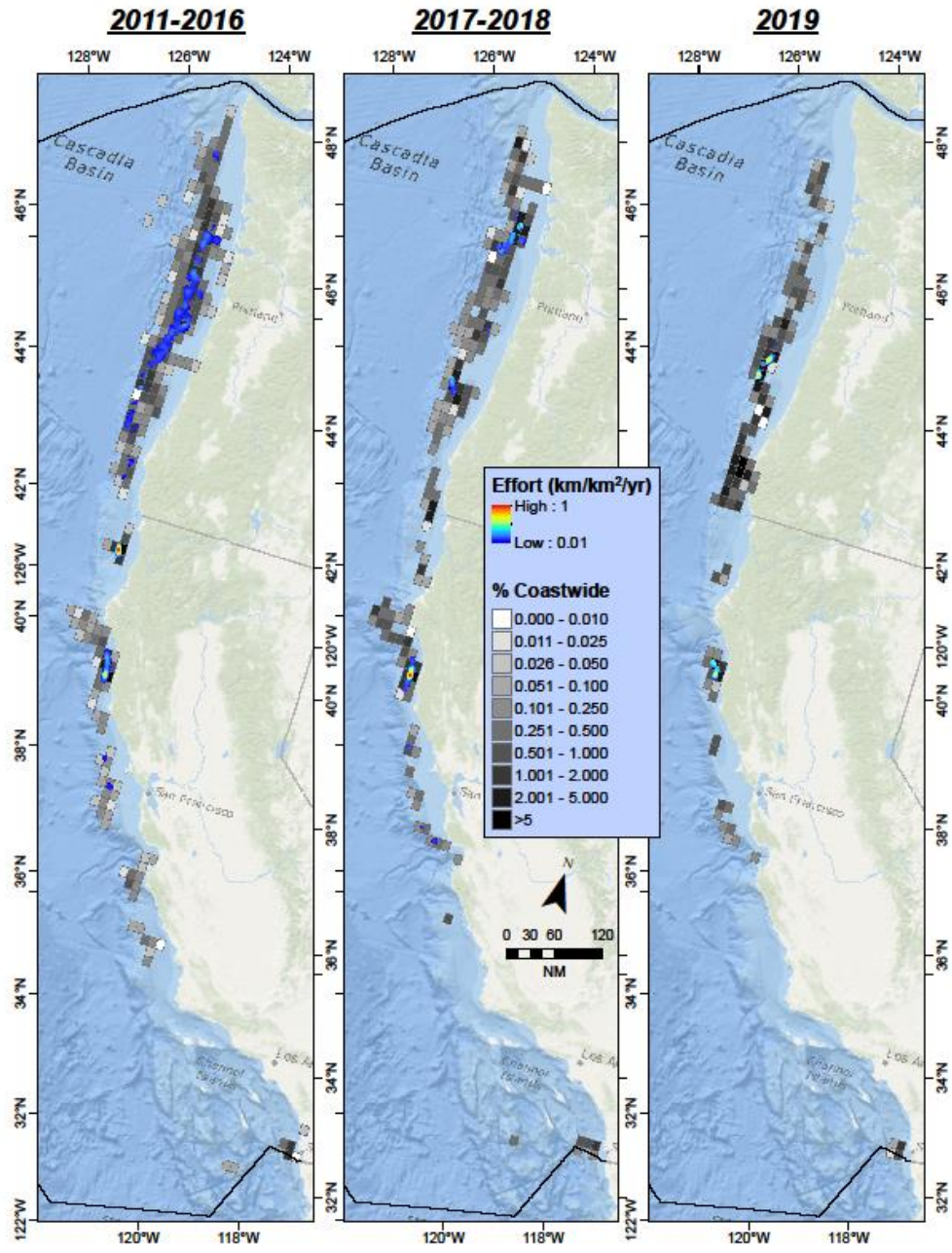

FIGURE 28. Spatial distribution and intensity of fishing effort by the non-catch shares pot sector. Intensity (units: km/km^2/yr) is depicted by a color ramp of cool (low) to warm (high) colors. The overall footprint of fishing for each time period is depicted in grayscale, with darker (black) tones depicting a higher relative contribution to coastwide effort within 10x10 min cells.

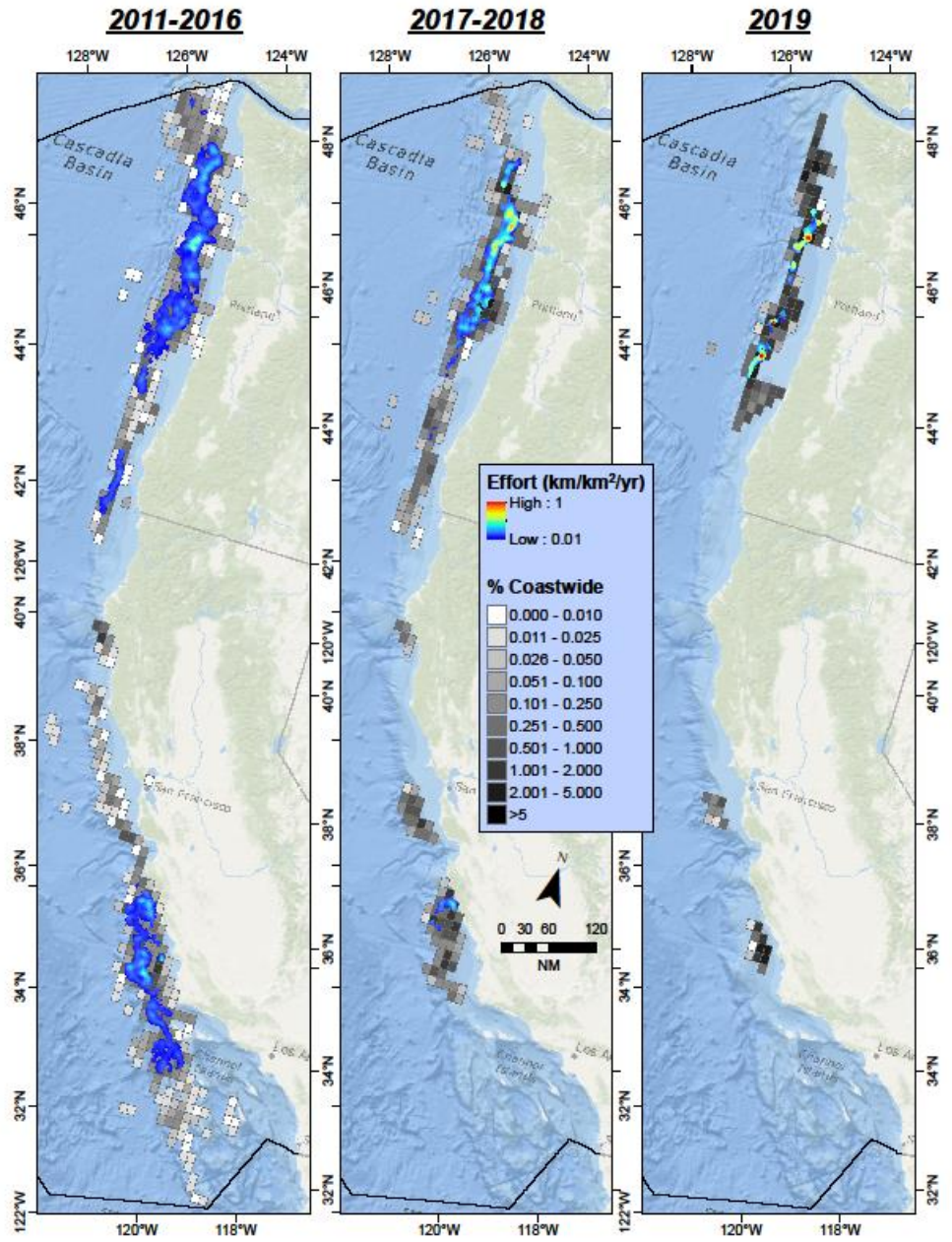

FIGURE 29. Spatial distribution and intensity of fishing effort by the catch shares pot sector. Intensity (units: km/km^2/yr) is depicted by a color ramp of cool (low) to warm (high) colors. The overall footprint of fishing for each time period is depicted in grayscale, with darker (black) tones depicting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

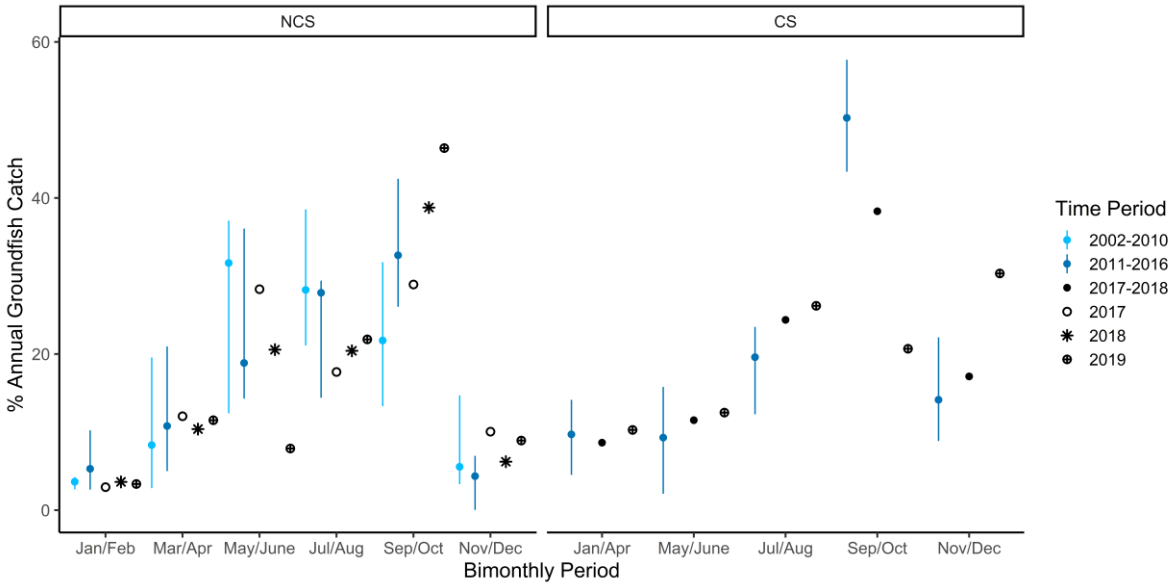

FIGURE 30. Percentage of retained groundfish landed in bimonthly bins by pot sectors. Minimum, median, and maximum are shown for each time period; annual estimates are shown for the most recent three years of data. To maintain confidentiality, the catch shares fleet data are summarized for January through April and for 2017 and 2018.

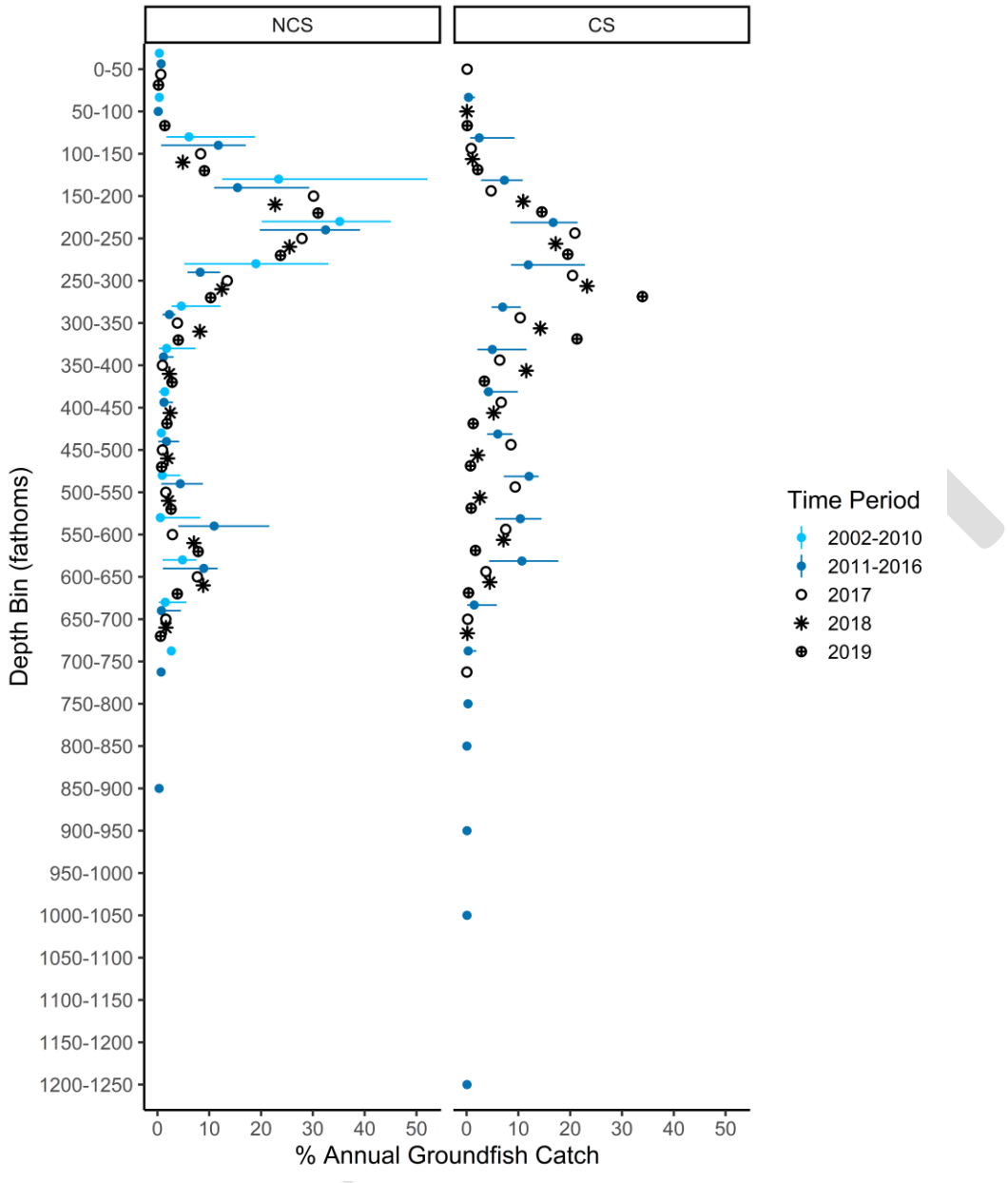

FIGURE 31. Percentage of observed pot hauls in 50-fathom depth bins. Minimum, median, and maximum are shown for each time period; annual estimates are shown for the most recent three years of data.

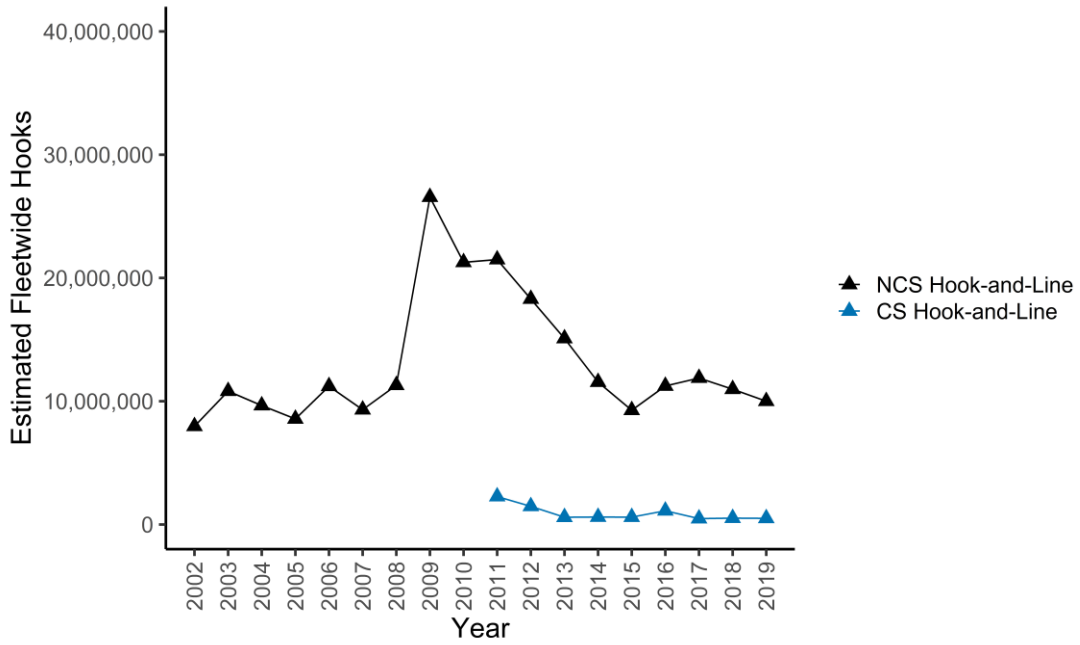

FIGURE 32. Annual total fleetwide number of hooks deployed in hook-and-line sectors.

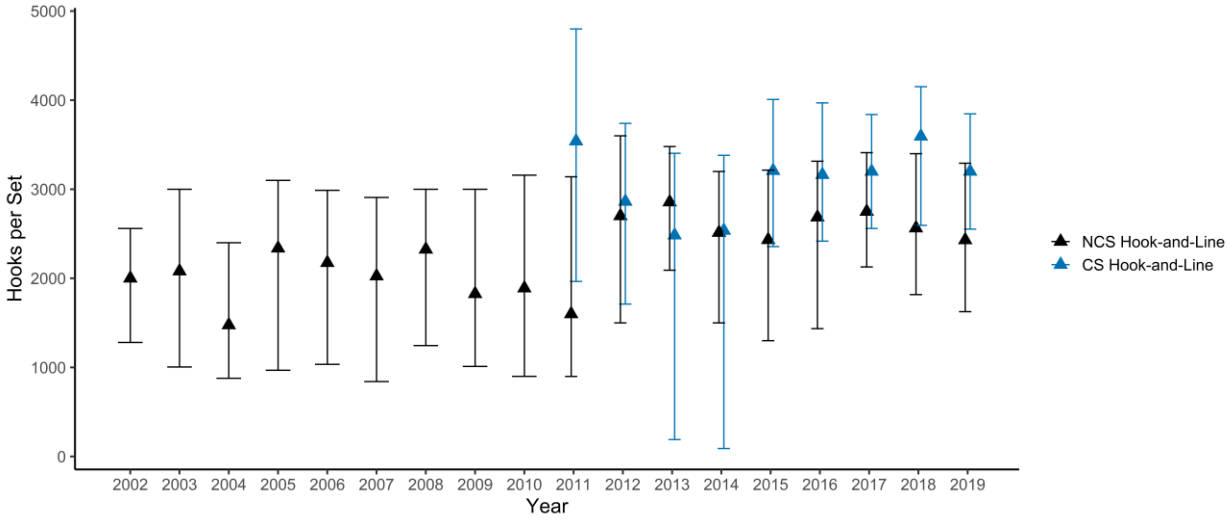

FIGURE 33. Number of hooks per set in hook-and-line sectors, summarized as median, first, and third quartiles in each year.

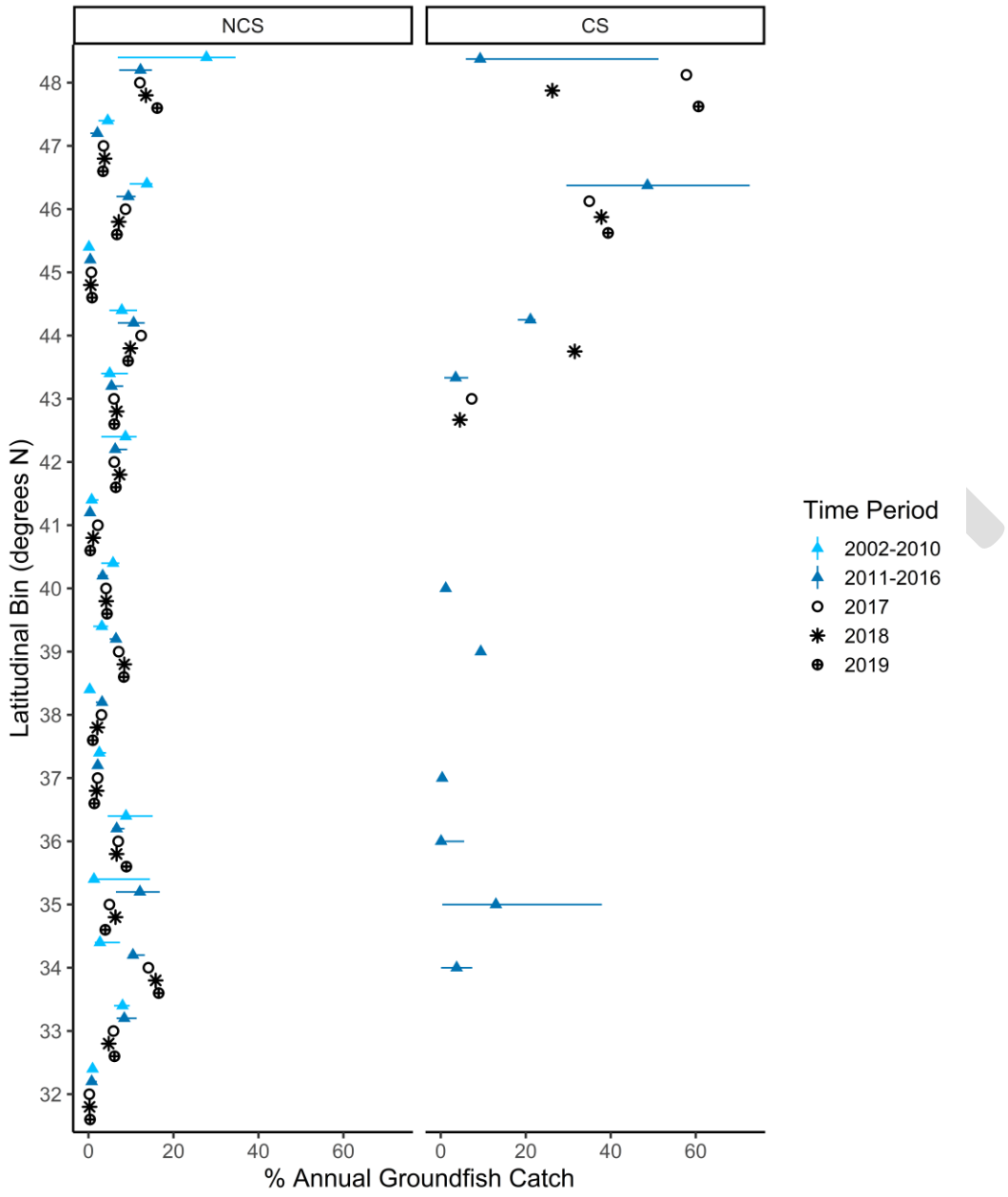

FIGURE 34. Percentage of retained groundfish landed in latitudinal bins by hook-and-line sectors patterns in actual fishing activity are shown in Figures 36 and 37. Minimum, median, and maximum are shown for each time period; annual estimates are shown for the most recent three years of data.

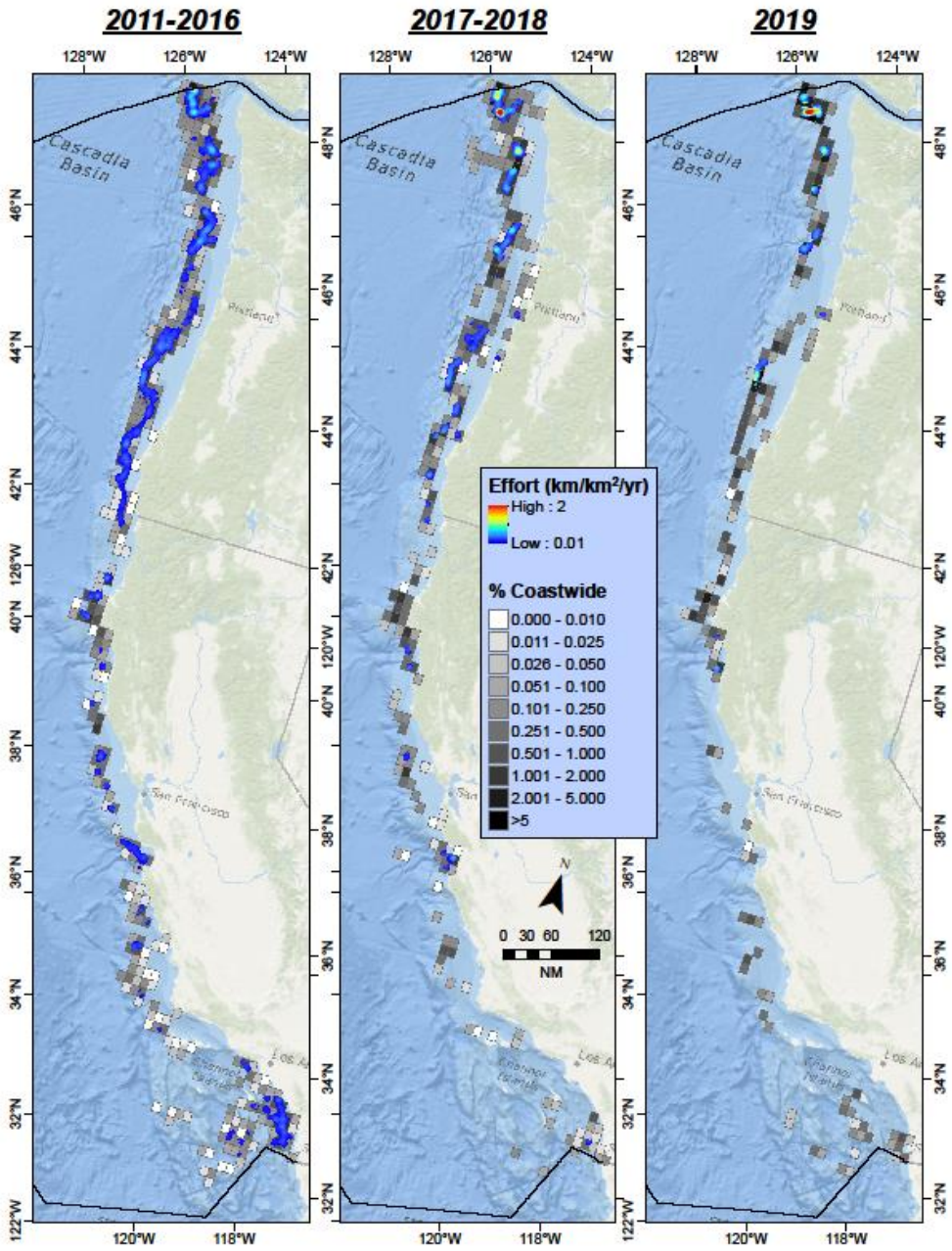

FIGURE 35. Spatial distribution and intensity of fishing effort by the non-catch shares hook-and-line sector. Intensity (units: km/km^2/yr) is depicted by a color ramp of cool (low) to warm (high) colors. The overall footprint of fishing for each time period is depicted in grayscale, with darker (black) tones depicting a higher relative contribution to coastwide effort within 10x10 min cells.

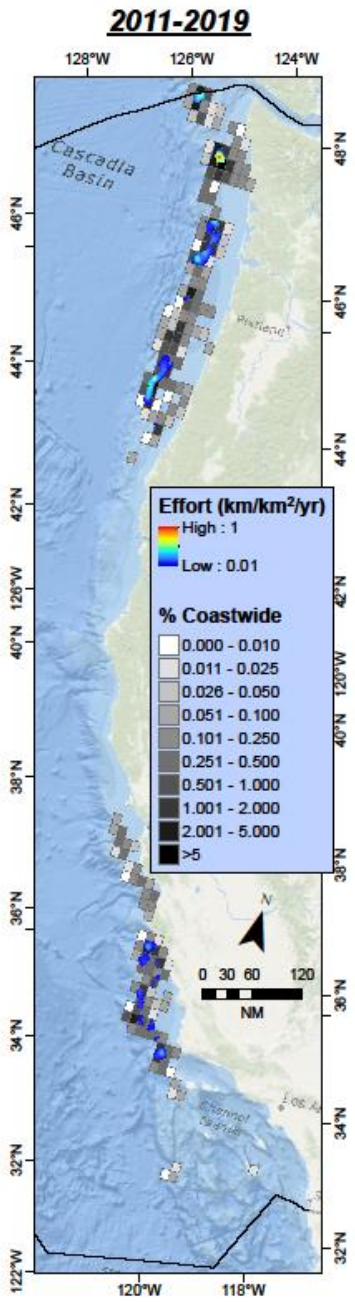

FIGURE 36. Spatial distribution of fishing effort by the catch shares hook-and-line sector. The overall footprint of fishing for each time period is depicted in grayscale, with darker (black) tones depicting a higher relative contribution to coastwide effort within 10x10 min cells.

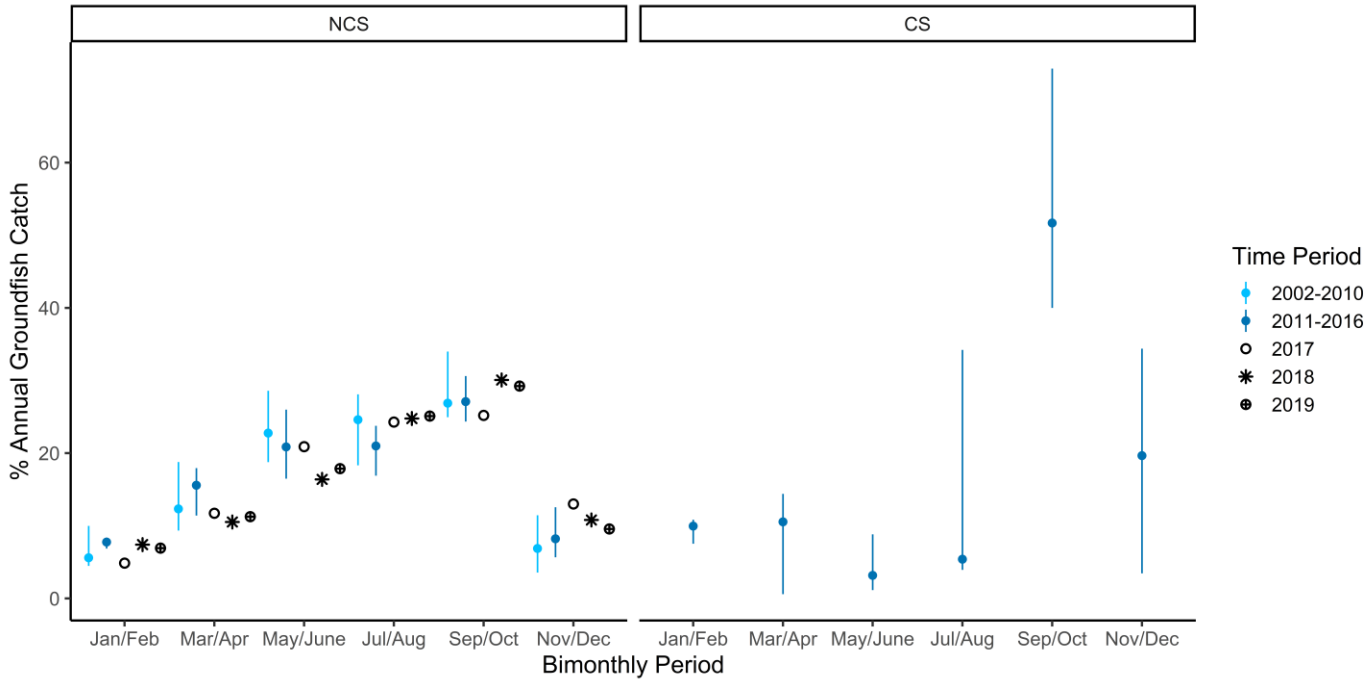

FIGURE 37. Percentage of retained groundfish landed in bimonthly bins by hook-and-line sectors. Minimum, median, and maximum are shown for each time period; annual estimates are shown for the most recent three years of data. Catch shares 2017, 2018, and 2091 data are not shown to maintain confidentiality, because less than 3 vessels were active in some of the seasonal strata.

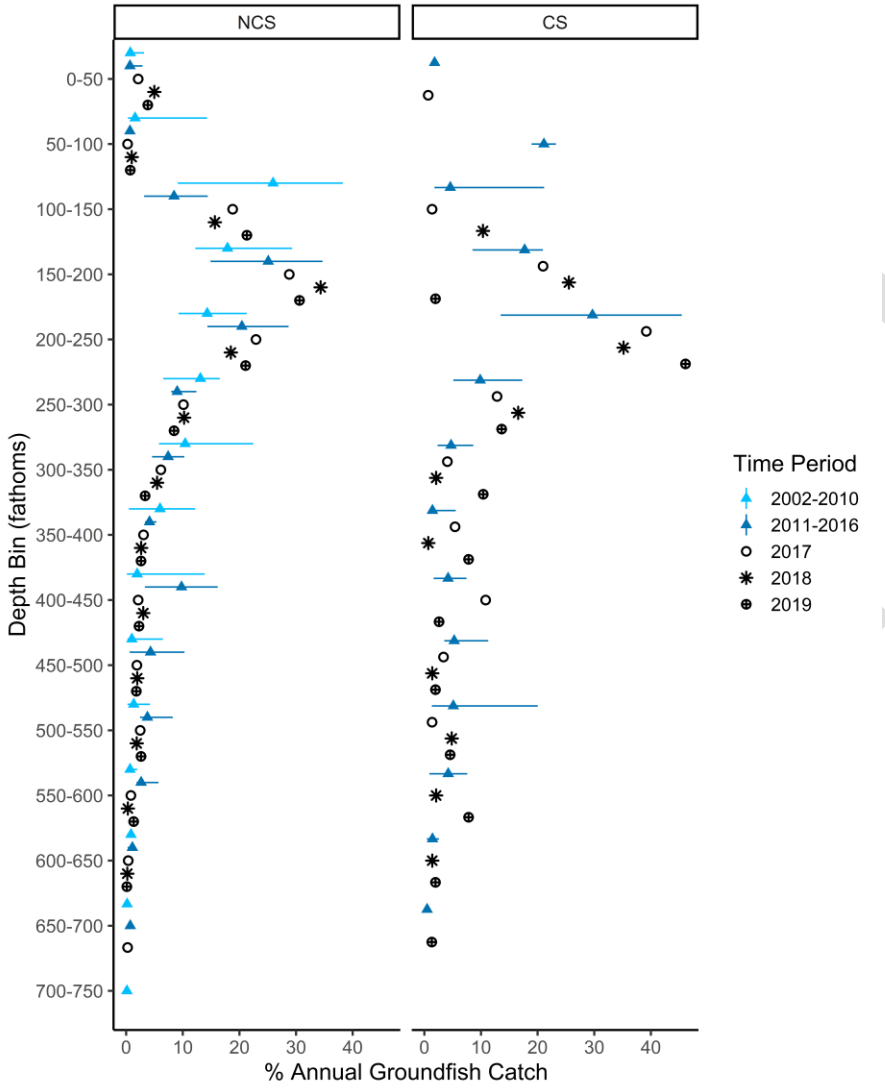

FIGURE 38. Percentage of observed hook-and-line hauls in 50-fathom depth bins. Minimum, median, and maximum are shown for each time period; annual estimates are shown for the most recent three years of data.

TABLES

TABLE 1. Data sources for reported metrics for each sector and gear and time periods analyzed by sector and gear. The time periods used in geospatial analysis differ from those presented in this table because 2017 and 2018 are grouped for analysis whereas 2019 is analyzed as a single year.

Sector and Gear	Landings	Gear Usage	Location of Effort	Geospatial Analysis	Seasonal Timing of Effort	Depth of Effort	Time Periods Analyzed
LE Bottom Trawl	Fish tickets	Logbook	Fish tickets	Logbook	Fish tickets	Logbook	2002 to mid-2006; mid-2006 to 2010. Seasonal: 2002 to 2005; 2007 to 2010.
CS Bottom Trawl	Fish tickets	Logbook	Fish tickets	Logbook	Fish tickets	Logbook	2011 to 2016; 2017; 2018; 2019.
CS Midwater Rockfish Trawl	Fish tickets	WCGOP, Logbook	Fish tickets	WCGOP, Logbook	Fish tickets	WCGOP, Logbook	2011 to 2016; 2017; 2018; 2019.
CS SS Midwater Hake Trawl	Fish tickets	WCGOP, Logbook	Fish tickets	WCGOP, Logbook	Fish tickets	WCGOP, Logbook	2011 to 2016; 2017; 2018; 2019.
CS AS CP	A-SHOP	A-SHOP	A-SHOP	A-SHOP	A-SHOP	A-SHOP	2002 to 2006; 2006 to 2010; 2011 to 2016; 2017; 2018; 2019.
CS AS MSCV	A-SHOP	A-SHOP	A-SHOP	A-SHOP	A-SHOP	A-SHOP	2002 to 2006; 2006 to 2010; 2011 to 2016; 2017; 2018; 2019.
NCS Pot	Fish tickets	WCGOP, Fish Tickets	Fish tickets	WCGOP	Fish tickets	WCGOP	2002 to 2010; 2011 to 2016; 2017; 2018; 2019.
CS Pot	Fish tickets	WCGOP, Logbook	Fish tickets	WCGOP, Logbook	Fish tickets	WCGOP, Logbook	2011 to 2016; 2017; 2018; 2019. Seasonal timing and location: 2011 to 2016; 2017 to 2018; 2019.
NCS Hook-and-Line	Fish tickets	WCGOP, Fish Tickets	Fish tickets	WCGOP	Fish tickets	WCGOP	2002 to 2010; 2011 to 2016; 2017; 2018; 2019.
CS Hook-and-Line	Fish tickets	WCGOP, Logbook	Fish tickets	WCGOP, Logbook	Fish tickets	WCGOP, Logbook	2011 to 2016; 2017; 2018; 2019. Seasonal: 2011 to 2016 only.

TABLE 2. Effort by trawl gears. Dashes indicate data summaries not applicable to the given sector. Targeted retained consists of all FMP-groundfish except Pacific whiting for bottom trawl and midwater rockfish and of only Pacific whiting for all whiting-targeting sectors.

Sector and Gear		Year	Fleetwide					Trawl Hours per Haul		
			Vessels	Trips	Hauls	Targeted Retained (mt)	Tow Duration (hrs)	Lower Quartile	Median	Upper Quartile
Shoreside	LE Bottom Trawl	2002	199	4163	19518	17394	83263	2.00	3.00	5.50
		2003	200	3542	17488	17405	77526	2.00	3.50	6.00
		2004	121	2442	14124	17097	51559	1.80	2.80	4.95
		2005	123	2563	15354	18421	53213	1.80	2.75	4.50
		2006	119	2379	15202	16774	55628	2.00	3.00	4.73
		2007	121	2395	14901	19575	60692	2.25	3.50	5.42
		2008	119	2391	16191	22930	72396	2.50	4.00	6.00
		2009	117	2675	18410	25576	80594	2.40	3.90	5.90
		2010	104	1947	13665	22134	65393	2.50	4.30	6.50
	CS Bottom Trawl	2011	72	1156	8991	17091	38323	2.00	4.00	5.90
		2012	66	1119	8769	17006	36037	2.00	3.66	5.75
		2013	68	1218	9716	18549	39852	2.00	3.60	5.70
		2014	63	1012	8087	15820	32781	2.00	3.50	5.60
		2015	59	913	7394	16062	28517	1.95	3.17	5.20
		2016	57	890	6783	16762	26581	2.00	3.30	5.26
		2017	62	972	6445	18925	25543	2.00	3.20	5.40
		2018	58	868	6154	15067	22067	1.80	3.00	5.00
		2019	54	829	5671	15103	19194	1.80	2.90	4.60
	Midwater Rockfish Trawl	2011	4	7	16	28	30	0.91	1.24	2.50
		2012	6	18	54	242	98	0.80	1.22	2.52
		2013	5	22	97	413	171	0.85	1.42	2.32
		2014	9	35	134	877	271	1.00	1.84	2.75
		2015	14	67	223	1728	358	0.73	1.42	2.09
		2016	9	46	123	1144	239	1.00	1.67	2.50
		2017	17	174	349	5877	642	0.75	1.50	2.50
		2018	24	296	538	11515	1135	1.00	1.70	2.75
		2019	25	283	541	9959	1128	1.00	1.75	2.65
	Midwater Hake Trawl	2011	26	902	1716	90354	3967	0.92	1.67	3.23
		2012	24	703	1582	65279	5936	1.58	3.32	5.41
		2013	24	916	1715	96857	4595	1.25	2.27	3.67
		2014	25	939	1724	97980	4730	1.25	2.24	3.83
		2015	22	580	1467	57920	6728	1.86	3.67	6.50
		2016	23	743	1618	85382	5275	1.35	2.54	4.50
		2017	25	1236	2314	144126	5873	1.20	2.17	3.50
		2018	26	1127	2094	129158	6056	1.42	2.44	4.00
		2019	27	1240	2360	143757	6643	1.37	2.48	3.77
At-Sea	Midwater Hake Catcher-Processor	2002	5	--	559	36333	1061	1.00	1.75	2.65
		2003	6	--	768	41469	911	0.50	0.92	1.67
		2004	6	--	1501	72859	1973	0.58	1.00	1.77
		2005	6	--	1337	78497	2239	0.75	1.30	2.25
		2006	9	--	1497	78246	2981	1.00	1.67	2.58
		2007	9	--	1577	72898	4404	1.33	2.42	4.00
		2008	8	--	1886	107754	5558	1.67	2.67	3.83
		2009	5	--	868	34591	1932	1.25	2.00	3.00
		2010	6	--	1068	54217	2653	1.33	2.33	3.33
		2011	9	--	1549	71337	4762	1.75	2.92	4.08
		2012	9	--	1107	55523	3546	2.08	2.92	4.00
		2013	9	--	1459	78005	3294	1.35	2.17	2.92
		2014	9	--	1696	103171	4731	1.67	2.60	3.67
		2015	9	--	1519	68435	5691	1.42	2.70	5.67
		2016	9	--	2205	108781	7291	2.08	3.17	4.25
		2017	9	--	2159	137104	5716	1.57	2.50	3.50
		2018	9	--	1971	116005	6994	2.25	3.33	4.64
		2019	9	--	1948	116352	6221	1.85	3.00	4.17
	Midwater Hake Mothership Catcher Vessel	2002	11	--	574	26503	1625	1.25	2.50	3.94
		2003	12	--	536	25333	501	0.42	0.67	1.25
		2004	10	--	571	24010	797	0.58	1.08	1.75
		2005	18	--	1040	48601	1883	0.67	1.33	2.50
		2006	20	--	1283	54139	2326	0.67	1.25	2.50
		2007	20	--	1147	47276	3134	1.33	2.33	3.76
		2008	19	--	1349	57687	3866	1.08	2.30	4.00
		2009	19	--	600	24066	1686	1.31	2.46	3.92
		2010	21	--	908	35727	2805	1.48	2.59	4.25
		2011	18	--	1248	49971	2976	0.88	1.75	3.17
		2012	16	--	949	38042	3162	1.67	2.78	4.50
		2013	18	--	1256	52348	3076	1.08	2.00	3.33
		2014	19	--	1308	61794	3547	1.00	1.83	3.42
		2015	14	--	640	27544	2135	1.25	2.25	4.00
		2016	17	--	1565	64597	5502	1.58	3.00	5.00
		2017	15	--	1309	65358	3661	1.13	2.13	3.83
		2018	17	--	1535	65979	4552	0.93	2.00	3.92
		2019	19	--	1232	51829	3748	1.22	2.48	4.26

TABLE 3. Effort by fixed gear sectors. Trips in the non-catch shares sectors are estimated based on landings by a vessel on a unique day. See Table 4 for coverage rates.

Sector and Gear		Year	Fleetwide				Observed		
					Groundfish	Estimated	Gear Units per Set		
					Retained	Total Gear	Lower		Upper
			Vessels	Trips	(mt)	Units	Quartile	Median	Quartile
Pot	Non-Catch Shares	2002	105	1086	475	31039	8	19	38
		2003	130	1312	808	49434	9	25	32
		2004	99	1097	825	59433	10	18	38
		2005	139	1349	1007	50289	22	24	35
		2006	233	1926	1065	56879	8	43	50
		2007	170	1423	698	44026	12	20	46
		2008	153	1441	693	38850	35	39	41
		2009	167	1468	878	51118	10	49	60
		2010	144	1260	846	65840	20	25	47
		2011	155	1051	659	41280	21	36	41
		2012	125	698	426	56850	25	33	46
		2013	73	531	374	19804	6	16	35
		2014	98	515	493	34797	19	32	44
		2015	138	854	590	29848	30	33	39
		2016	159	938	587	46782	27	34	42
		2017	152	950	607	38886	10	30	48
		2018	144	704	597	37105	26	33	39
		2019	103	598	602	48422	32	39	48
	Catch Shares	2011	18	218	789	41310	11	30	35
		2012	19	247	710	52248	15	29	42
		2013	11	93	502	30097	19	25	35
		2014	13	103	619	31876	12	30	35
		2015	13	115	745	32734	27	31	38
		2016	14	128	824	34946	19	26	34
		2017	14	124	860	40645	21	26	34
		2018	12	91	707	29329	27	38	49
		2019	13	130	867	34045	25	32	45
Hook-and-Line	Non-Catch Shares	2002	455	4395	2094	7966946	1280	2000	2560
		2003	498	4655	2274	10817806	1005	2080	3000
		2004	486	4078	2348	9646493	878	1476	2400
		2005	505	4454	2737	8561148	968	2338	3100
		2006	533	4186	2535	11211465	1035	2175	2988
		2007	508	4027	2106	9310812	842	2025	2908
		2008	472	4636	2353	11292153	1246	2325	3000
		2009	494	5479	2968	26556870	1011	1826	3000
		2010	474	6071	3180	21268978	900	1890	3158
		2011	518	5596	2964	21494764	899	1600	3140
		2012	484	4700	2351	18290524	1500	2700	3600
		2013	488	4143	1893	15090958	2091	2856	3480
		2014	518	4116	1799	11545985	1500	2514	3200
		2015	675	4712	2162	9265755	1300	2432	3215
		2016	618	4373	2203	11230944	1436	2686	3315
		2017	609	4714	2396	11877531	2128	2750	3412
		2018	611	4367	2262	10972325	1817	2564	3400
		2019	513	3910	2028	9999321	1626	2430	3293
	Catch Shares	2011	13	107	364	2265264	1965	3540	4800
		2012	9	37	271	1472865	1711	2863	3740
		2013	9	29	80	587238	190	2484	3404
		2014	12	43	179	601654	90	2537	3382
		2015	5	16	138	592919	2357	3208	4009
		2016	7	33	201	1110926	2418	3163	3970
		2017	3	12	116	476944	2560	3200	3840
		2018	4	11	157	514093	2595	3594	4152
		2019	3	10	141	495234	2553	3200	3847

TABLE 4. Observed effort in NCS fixed gear sectors.

Sector and Gear		Year	Observed					Fleetwide Groundfish Retained (mt)	Percentage of Groundfish Landings Observed
			Vessels	Trips	Hauls	Retained Groundfish (mt)	Gear Units		
NCS	Pot	2002	6	23	247	83	5438	475	18%
		2003	13	51	412	153	9362	808	19%
		2004	20	109	324	102	7328	825	12%
		2005	21	82	542	294	14657	1007	29%
		2006	22	77	328	213	11374	1065	20%
		2007	25	76	229	102	6440	698	15%
		2008	26	79	404	258	14471	693	37%
		2009	21	57	112	76	4423	878	9%
		2010	33	83	385	154	11942	846	18%
		2011	32	83	312	157	9860	659	24%
		2012	24	54	421	111	14828	426	26%
		2013	20	39	95	48	2524	374	13%
		2014	25	57	258	117	8247	493	24%
		2015	26	84	363	236	11933	590	40%
		2016	34	110	669	275	21906	587	47%
		2017	47	99	312	142	9101	607	23%
		2018	40	93	612	311	19316	597	52%
		2019	31	70	497	226	18155	602	37%
	Hook-and-Line	2002	29	79	413	217	825624	2094	10%
		2003	45	219	619	285	1357937	2274	13%
		2004	45	149	508	218	895952	2348	9%
		2005	47	170	775	547	1712636	2737	20%
		2006	47	198	682	340	1503077	2535	13%
		2007	83	284	888	410	1813650	2106	19%
		2008	82	257	829	406	1949715	2353	17%
		2009	75	252	664	161	1437920	2968	5%
		2010	92	439	1339	452	3024816	3180	14%
		2011	95	368	1200	375	2722104	2964	13%
		2012	66	250	837	305	2369109	2351	13%
		2013	53	205	631	226	1805223	1893	12%
		2014	55	190	688	275	1765919	1799	15%
		2015	62	200	830	493	2115187	2162	23%
		2016	65	190	819	412	2101392	2203	19%
		2017	77	204	851	482	2387457	2396	20%
		2018	81	232	1028	563	2729695	2262	25%
		2019	63	183	840	431	2125334	2028	21%

TABLE 5. Lost and recovered gear on hauls observed in shoreside federal groundfish fisheries. Dashes represent no available data and where data are not applicable.

Sector	Gear	Year	Observed Vessel	Trips	Hauls	Effort (hours or hooks/pots)	Retained Target Species (mt)	Fleetwide Targeted Species or Groups Retained (mt)	% Landings Observed	Observed Hauls with Lost Gear	% Observed Hauls with Lost Gear	Observed Fixed Gear Lost	% Observed Fixed Gear Lost	Observed Hauls Recovering Derelict Gear	% Observed Hauls Recovering Derelict Gear
Limited Entry Trawl	Bottom Trawl	2002	132	570	3185	13606.37	2496.3	17393.7	14%	2	0.06%	--	--	64	2.01%
		2003	125	465	2315	11599.6	2433.6	17405.3	14%	7	0.30%	--	--	72	3.11%
		2004	103	616	3482	13921.86	4176.0	17096.9	24%	2	0.06%	--	--	102	2.93%
		2005	105	524	3504	12715.41	4042.8	18420.8	22%	4	0.11%	--	--	167	4.77%
		2006	87	476	3025	11577.61	3247.0	16773.5	19%	4	0.13%	--	--	250	8.26%
		2007	88	374	2549	11457.89	3311.3	19575.5	17%	8	0.31%	--	--	138	5.41%
		2008	100	438	3224	15129.47	4670.5	22929.6	20%	5	0.16%	--	--	162	5.02%
		2009	101	590	4455	19786.54	5947.3	25576.3	23%	5	0.11%	--	--	239	5.36%
		2010	83	348	2640	13151.99	4042.4	22133.8	18%	3	0.11%	--	--	87	3.30%
Catch Shares	Bottom and Midwater Trawl	2011	72	1134	9196	40206.89	16991.1	17086.1	99%	11	0.12%	--	--	404	4.39%
	Bottom Trawl	2012	67	1089	8967	38036.85	16939.8	17050.3	99%	4	0.04%	--	--	363	4.05%
		2013	68	1193	10016	42066.17	18521.5	18572.0	100%	5	0.05%	--	--	301	3.01%
		2014	64	1033	8322	34201.04	15753.5	15838.7	99%	2	0.02%	--	--	265	3.18%
		2015	60	904	7479	28855.21	15605.7	15658.2	100%	2	0.03%	--	--	281	3.76%
		2016	53	802	6622	25050.62	14960.1	15002.8	100%	4	0.06%	--	--	192	2.90%
		2017	54	839	6397	25142.33	16111.9	16125.4	100%	4	0.06%	--	--	195	3.05%
		2018	48	695	5393	19531.33	12742.6	12780.0	100%	1	0.02%	--	--	136	2.52%
		2019	45	646	5018	16822.79	12679.1	12743.0	99%	4	0.08%	--	--	177	3.53%
Catch Shares EM	Bottom and Midwater Trawl	2016	7	29	182	918.62	487.2	1755.9	28%	0	0.00%	--	--	3	1.65%
		2017	8	25	152	679.21	469.3	2761.1	17%	1	0.66%	--	--	5	3.29%
		2018	9	54	309	1162.37	690.7	2285.3	30%	1	0.32%	--	--	10	3.24%
		2019	8	50	272	981.71	575.6	2345.7	25%	2	0.74%	--	--	7	2.57%
Catch Shares	Midwater Rockfish Trawl	2014	9	34	133	268.46	873.7	873.7	100%	0	0.00%	--	--	1	0.75%
		2015	7	43	147	246.47	968.5	968.5	100%	0	0.00%	--	--	1	0.68%
		2018	13	200	383	836.41	6448.6	6448.6	100%	0	0.00%	--	--	1	0.26%
		2019	13	181	362	776.44	5311.4	5320.0	100%	0	0.00%	--	--	1	0.28%
Catch Shares	Shoreside Hake Trawl	2011	27	929	1717	3974.59	90248.8	90248.8	100%	0	0.00%	--	--	17	0.99%
		2012	24	744	1601	5960.79	65288.0	65288.0	100%	0	0.00%	--	--	1	0.06%
		2013	24	960	1734	4628.08	96867.8	96867.8	100%	0	0.00%	--	--	8	0.46%
		2014	25	996	1725	4732.66	97925.2	97982.7	100%	0	0.00%	--	--	9	0.52%
		2018	5	107	180	608.84	9746.0	9746.0	100%	0	0.00%	--	--	4	2.22%
Catch Shares	Hook and Line	2011	11	94	629	2265264	335.9	335.9	100%	6	0.95%	4286	0.19%	2	0.32%
		2012	8	32	506	1472865	241.3	241.3	100%	7	1.38%	12057	0.82%	0	0.00%
		2013	8	29	215	587238	79.4	79.4	100%	4	1.86%	4810	0.82%	0	0.00%
		2014	8	31	227	601654	88.5	98.4	90%	5	2.20%	79	0.01%	0	0.00%
		2015	5	16	185	592919	137.8	137.8	100%	1	0.54%	382	0.06%	0	0.00%
		2016	5	30	351	1110926	192.7	192.7	100%	3	0.85%	6172	0.56%	1	0.28%
		2017	4	13	148	476944	115.9	116.4	100%	0	0.00%	0	0.00%	1	0.68%
		2018	4	10	145	514093	154.6	157.3	98%	1	0.69%	513	0.10%	0	0.00%

TABLE 5, CONTINUED.

Sector	Gear	Year	Observed					Fleetwide Targeted		Observed	% Observed	Observed	% Observed	Observed Hauls	% Observed Hauls
			Vessel	Trips	Hauls	Effort (hours or hooks/pots)	Retained Target Species (mt)	Species or Groups Retained (mt)	% Landings Observed	Hauls with Lost Gear	Hauls with Lost Gear	Fixed Gear Lost	Fixed Gear Lost	Recovering Derelict Gear	Recovering Derelict Gear
Catch Shares	Pot	2011	17	233	1535	41310	813.8	817.2	100%	51	3.32%	93	0.23%	0	0.00%
		2012	19	278	1708	52248	740.7	740.7	100%	89	5.21%	322	0.62%	1	0.06%
		2013	10	100	1085	30097	470.8	470.8	100%	36	3.32%	101	0.34%	0	0.00%
		2014	14	118	1287	31876	681.1	681.1	100%	56	4.35%	203	0.64%	0	0.00%
		2015	8	62	583	18808	405.3	405.3	100%	33	5.66%	126	0.67%	4	0.69%
		2016	8	61	584	15785	387.1	387.1	100%	34	5.82%	90	0.57%	2	0.34%
		2017	6	44	573	16288	366.0	366.0	100%	12	2.09%	16	0.10%	0	0.00%
		2018	6	24	309	11510	292.6	292.6	100%	7	2.27%	8	0.07%	0	0.00%
		2019	6	35	490	16733	369.2	376.0	98%	18	3.67%	78	0.47%	0	0.00%
Catch Shares EM	Pot	2015	7	18	184	4272	102.4	339.4	30%	8	4.35%	18	0.42%	0	0.00%
		2016	6	19	249	6275	152.0	445.5	34%	15	6.02%	19	0.30%	2	0.80%
		2017	7	22	270	7147	184.1	493.7	37%	10	3.70%	10	0.14%	0	0.00%
		2018	5	24	321	6839	166.4	414.8	40%	9	2.80%	11	0.16%	2	0.62%
		2019	6	30	197	5652	127.3	491.1	26%	4	2.03%	14	0.25%	0	0.00%
Limited Entry Sablefish	Hook and Line	2003	15	48	351	733602	222.8	1051.6	21%	4	1.14%	0	0.00%	0	0.00%
		2004	17	45	326	492009	180.0	1318.1	14%	27	8.28%	0	0.00%	0	0.00%
		2005	26	101	678	1456102	481.5	1341.6	36%	71	10.47%	0	0.00%	2	0.29%
		2006	19	68	470	939951	295.9	1401.2	21%	10	2.13%	0	0.00%	0	0.00%
		2007	22	75	517	1034046	298.5	1103.9	27%	5	0.97%	0	0.00%	0	0.00%
		2008	18	77	540	1244141	338.1	1103.4	31%	11	2.04%	0	0.00%	1	0.19%
		2009	8	45	287	648980	97.8	1441.5	7%	2	0.70%	0	0.00%	0	0.00%
		2010	21	143	762	1761173	345.8	1304.2	27%	8	1.05%	5801	0.33%	1	0.13%
		2011	23	98	673	1405444	240.7	1160.0	21%	5	0.74%	4205	0.30%	1	0.15%
		2012	17	88	532	1580075	239.3	1079.2	22%	7	1.32%	2104	0.13%	0	0.00%
		2013	18	58	353	1047526	166.4	748.0	22%	6	1.70%	5312	0.51%	0	0.00%
		2014	17	85	495	1200615	203.2	747.1	27%	8	1.62%	10862	0.90%	7	1.41%
		2015	26	97	632	1536820	397.8	959.4	41%	2	0.32%	1224	0.08%	4	0.63%
		2016	21	94	671	1743233	338.1	1034.0	33%	6	0.89%	3511	0.20%	4	0.60%
		2017	25	109	701	2107656	396.8	1062.3	37%	7	1.00%	6675	0.32%	5	0.71%
		2018	27	122	839	2411652	467.2	1018.9	46%	6	0.72%	7489	0.31%	5	0.60%
		2019	21	98	673	1791897	359.4	918.2	39%	1	0.15%	1982	0.11%	3	0.45%
	Pot	2003	6	35	362	9017	148.3	604.0	25%	13	3.59%	0	0.00%	0	0.00%
		2004	3	13	139	5378	82.7	619.6	13%	6	4.32%	0	0.00%	0	0.00%
		2005	7	39	492	13822	281.2	615.0	46%	15	3.05%	0	0.00%	0	0.00%
		2006	7	39	289	10708	200.5	581.8	34%	25	8.65%	0	0.00%	0	0.00%
		2007	4	30	154	5816	90.0	428.4	21%	12	7.79%	0	0.00%	0	0.00%
		2008	6	24	329	13638	244.9	433.0	57%	4	1.22%	0	0.00%	0	0.00%
		2009	3	27	67	3883	66.5	489.1	14%	5	7.46%	0	0.00%	0	0.00%
		2010	7	43	314	11294	140.4	503.5	28%	9	2.87%	39	0.35%	0	0.00%
		2011	3	22	227	9029	137.4	371.9	37%	2	0.88%	9	0.10%	0	0.00%
		2012	5	19	351	14218	101.1	286.0	35%	5	1.42%	20	0.14%	0	0.00%
		2013	3	14	47	1934	40.5	283.1	14%	3	6.38%	4	0.21%	0	0.00%
		2014	4	16	195	7561	104.0	338.1	31%	6	3.08%	75	0.99%	0	0.00%
		2015	9	35	299	11329	218.8	358.2	61%	9	3.01%	13	0.11%	1	0.33%
		2016	7	55	596	21219	254.3	359.0	71%	10	1.68%	11	0.05%	2	0.34%
		2017	3	14	186	7852	115.5	374.8	31%	13	6.99%	23	0.29%	0	0.00%
		2018	7	36	523	18424	292.3	408.5	72%	4	0.76%	11	0.06%	0	0.00%
		2019	5	24	427	17518	206.9	410.9	50%	3	0.70%	6	0.03%	1	0.23%

TABLE 5, CONTINUED.

Sector	Gear	Year	Observed					Fleetwide Targeted Species or Groups Retained (mt)	% Landings Observed	Observed Hauls with Lost Gear	% Observed Hauls with Lost Gear	Observed Fixed Gear Lost	% Observed Fixed Gear Lost	Observed Hauls Recovering Derelict Gear	% Observed Hauls Recovering Derelict Gear
			Vessel	Trips	Hauls	Effort (hours or hooks/pots)	Retained Target Species (mt)								
Limited Entry Fixed Gear (DTL)	Hook and Line	2003	17	130	219	537817	32.1	354.7	9%	7	3.20%	0	0.00%	0	0.00%
		2004	14	62	130	318048	15.8	313.0	5%	5	3.85%	0	0.00%	0	0.00%
		2006	21	121	201	533830	23.5	333.2	7%	10	4.98%	0	0.00%	1	0.50%
		2007	36	158	304	724389	37.6	311.8	12%	2	0.66%	0	0.00%	0	0.00%
		2008	32	122	221	631689	31.7	367.3	9%	7	3.17%	0	0.00%	0	0.00%
		2009	34	138	273	669091	30.3	510.8	6%	3	1.10%	0	0.00%	0	0.00%
		2010	38	226	472	1103073	57.8	586.2	10%	7	1.48%	8425	0.76%	0	0.00%
		2011	38	201	426	1154241	84.2	829.5	10%	8	1.88%	13662	1.18%	1	0.23%
		2012	26	128	252	706437	27.9	555.4	5%	2	0.79%	3088	0.44%	0	0.00%
		2013	22	124	248	705827	32.1	485.2	7%	4	1.61%	3950	0.56%	0	0.00%
		2014	18	77	154	493845	23.8	464.4	5%	1	0.65%	650	0.13%	0	0.00%
		2015	21	65	144	453472	38.3	515.0	7%	4	2.78%	4600	1.01%	0	0.00%
		2016	16	41	70	247067	23.8	553.3	4%	2	2.86%	882	0.36%	0	0.00%
		2017	12	34	71	183990	15.7	564.8	3%	7	9.86%	6995	3.80%	1	1.41%
		2018	13	29	85	227071	20.7	554.8	4%	8	9.41%	4282	1.89%	0	0.00%
		2019	14	39	87	271718	17.9	506.0	4%	3	3.45%	1130	0.42%	0	0.00%
Open Access Fixed Gear	Hook and Line	2003	13	41	49	86518	16.5	563.0	3%	6	12.24%	0	0.00%	0	0.00%
		2004	14	42	52	85895	16.2	487.0	3%	7	13.46%	0	0.00%	0	0.00%
		2005	10	34	37	58384	9.8	628.8	2%	3	8.11%	0	0.00%	0	0.00%
		2007	25	51	67	55215	10.4	268.1	4%	1	1.49%	0	0.00%	0	0.00%
		2009	34	69	104	119849	21.8	645.5	3%	4	3.85%	0	0.00%	0	0.00%
		2010	37	70	105	160570	23.1	757.3	3%	1	0.95%	320	0.20%	2	1.90%
		2011	40	69	101	162419	20.1	437.8	5%	3	2.97%	1766	1.09%	0	0.00%
		2015	20	38	54	124895	17.5	366.1	5%	1	1.85%	150	0.12%	0	0.00%
		2017	43	62	79	95811	14.9	360.6	4%	1	1.27%	1990	2.08%	0	0.00%
		2018	43	83	104	90972	15.9	315.5	5%	2	1.92%	23	0.03%	1	0.96%
		2019	30	50	80	61719	11.8	292.9	4%	1	1.25%	6	0.01%	0	0.00%
	Pot	2003	7	16	50	345	2.9	190.6	2%	1	2.00%	0	0.00%	0	0.00%
		2004	17	96	185	1950	17.0	186.0	9%	3	1.62%	0	0.00%	0	0.00%
		2005	14	43	50	835	10.7	379.3	3%	2	4.00%	0	0.00%	0	0.00%
		2006	15	38	39	666	7.9	442.9	2%	2	5.13%	0	0.00%	0	0.00%
		2007	21	46	75	624	8.8	257.9	3%	4	5.33%	0	0.00%	0	0.00%
		2008	20	55	75	833	10.4	248.4	4%	1	1.33%	0	0.00%	0	0.00%
		2010	26	40	71	648	10.7	318.3	3%	1	1.41%	2	0.31%	0	0.00%
		2011	29	61	85	831	18.9	255.8	7%	3	3.53%	6	0.72%	0	0.00%
		2012	19	35	70	610	9.1	125.9	7%	2	2.86%	5	0.82%	0	0.00%
		2013	17	25	48	590	6.3	72.2	9%	1	2.08%	1	0.17%	0	0.00%
		2014	21	41	63	686	11.7	147.7	8%	1	1.59%	4	0.58%	0	0.00%
		2015	17	49	64	604	14.6	222.9	7%	3	4.69%	8	1.32%	0	0.00%
		2016	27	55	73	687	15.3	206.5	7%	5	6.85%	15	2.18%	0	0.00%
		2017	44	87	126	1249	24.9	211.2	12%	2	1.59%	3	0.24%	0	0.00%
		2018	33	58	89	892	17.2	175.7	10%	6	6.74%	18	2.02%	0	0.00%

TABLE 6. Observed hauls with lost and recovered gear in the 100% observed at-sea midwater whiting 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	557	0	0.00%	0	0.00%	0.00
	2003	767	1	0.13%	0	0.00%	0.00
	2004	1496	1	0.07%	0	0.00%	0.00
	2005	1334	0	0.00%	0	0.00%	0.00
	2006	1490	0	0.00%	0	0.00%	0.00
	2007	1570	0	0.00%	0	0.00%	0.00
	2008	1882	0	0.00%	0	0.00%	0.00
	2009	863	0	0.00%	0	0.00%	0.00
	2010	1064	0	0.00%	0	0.00%	0.00
	2011	1534	0	0.00%	0	0.00%	0.00
	2012	1102	0	0.00%	0	0.00%	0.00
	2013	1443	0	0.00%	0	0.00%	0.00
	2014	1684	1	0.06%	0	0.00%	0.00
	2015	1507	1	0.07%	0	0.00%	4.00
	2016	2189	0	0.00%	0	0.00%	0.00
	2017	2145	0	0.00%	0	0.00%	0.00
	2018	1956	0	0.00%	0	0.00%	0.00
	2019	1938	0	0.00%	0	0.00%	0.00
Mothership Catcher Vessel	2002	574	0	0.00%	0	0.00%	0.00
	2003	536	0	0.00%	0	0.00%	0.00
	2004	571	0	0.00%	0	0.00%	0.00
	2005	1039	1	0.10%	0	0.00%	20.00
	2006	1283	0	0.00%	0	0.00%	0.00
	2007	1146	0	0.00%	0	0.00%	0.00
	2008	1349	1	0.07%	0	0.00%	65.00
	2009	600	0	0.00%	0	0.00%	0.00
	2010	908	0	0.00%	0	0.00%	0.00
	2011	1248	0	0.00%	0	0.00%	0.00
	2012	949	0	0.00%	0	0.00%	0.00
	2013	1256	1	0.08%	0	0.00%	18.14
	2014	1306	0	0.00%	0	0.00%	0.00
	2015	631	0	0.00%	0	0.00%	0.00
	2016	1557	2	0.13%	0	0.00%	63.61
	2017	1302	0	0.00%	0	0.00%	0.00
	2018	1514	0	0.00%	0	0.00%	0.00
	2019	1230	0	0.00%	0	0.00%	0.00