Fishing Effort in the 2002-2021 U.S. Pacific Coast Groundfish Fisheries. 2023.

K.A. Somers[1], C.E. Whitmire[2], K. Richerson[1], and V.J. Tuttle[1].

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

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

Table of Contents

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

This report analyzes trends in fishing effort of U.S. West Coast groundfish fisheries during the period 2002–21, 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 2019–20 and 2021. 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.

Landings and effort (tow hours) in the catch shares (CS) bottom trawl fleet continued to decrease in 2020 and 2021. The spatial and seasonal distribution of landings was similar to previous years. Effort in the 0-50fth depth bin decreased compared to earlier years, while activity in the 50-100fth depth bin increased slightly.

Landings in the midwater rockfish trawl fleet were similar from 2017 to 2021. Effort in tow hours remained around 1100 from 2018 to 2021, other than a decrease to 900 hours in 2020. The median tow duration per haul increased slightly from 1.5 hours in 2017 to 2 hours in 2021. The spatial distribution of landings from 2019 to 2021 were similar to previous years, although the proportion of landings near Newport increased to 32% in 2021 and landings near Bellingham decreased to 0% in 2021. Seasonally, 2019 to 2021 landings were higher in March-April and lower in September-October compared to previous years. The depth distribution was similar, although less effort occurred in the 50-100 fth depth bin and more effort occurred in the 100-150 fth depth bin.

Landings in the shoreside hake, at-sea motherships (MSs), and at-sea catcher processors (CPs) mostly decreased from 2019 to 2021. In the shoreside fleet, effort in tow hours decreased for the first time in 2021 since 2016. In both at-sea fleets, tow hours have mostly decreased from 2019 to 2021. Landings by the shoreside fleet were lower near Newport and higher near Astoria compared to 2011 to 2018. The seasonal and depth distributions of shoreside hake landings were similar to previous years. The at-sea CP fleet processed the majority of catch in September-October, resulting in the highest catch processed in that bimonthly period across the years compared. The proportion of catch processed in July-August continued to decrease, with no catch processed in 2021. The majority of MS landings were processed in May–June and September-October in 2019 to 2021. More than 90% of CP and MS landings come from hauls in depths of 100–250 fth.

Non-catch shares (NCS) pot landings remained around 600 mt from 2015 to 2020 and increased to 670 mt in 2021, while the CS fleet has decreased from 2019 to 2021 to 680 mt. Effort in number of pots has decreased in both sectors from 2019 to 2021. The median

number of pots per set in the CS fleet reached an all-time high of ~50 pots in 2020 and 2021. In the NCS fleet, 2019 to 2021 landings in Newport were higher than in previous years, while landings near Astoria and Fort Bragg were lower. In the CS pot fleet, landings in Newport accounted for 40 to 50 percent of annual landings, higher than in previous years; landings in Astoria decreased while landings in Bellingham increased. CS pot landings also continued to occur further south than NCS pot landings, specifically in the 35 to 37°N latitudinal bins. Seasonally, the NCS pot fleet landed more catch later in the year in 2019 to 2021, reflecting season extensions in 2020 and 2021. Landings in May–June from 2019 to 2021 were lower than in previous years, around 7%. In the CS pot fleet, landings have been concentrated in September-October with the remaining effort fairly evenly distributed throughout the rest of the year. In 2019 to 2020, the proportion of landings were higher in November-December than in previous years. Fishing effort in the NCS pot fleet continued to occur primarily in depths from 100–300 fth, while the majority of CS pot fleet effort occurred slightly deeper in 150–350 fth.

Groundfish landings by the NCS hook-and-line fleet decreased from 2,400 mt in 2017 to 1,600 mt in 2021, and estimated annual fleetwide hooks reached an historic low of 6 million hooks in 2021. The median number of hooks per set in the NCS fleet has increased to ~2,500 hooks per set from 2010 to 2021 (Table 3, Figure 33). CS hook-and-line landings have been lower, and no effort occurred in 2020 or 2021. Generally, landings by the NCS hook-and-line fleet were fairly evenly distributed along the coast, while more than half of CS landings occurred in the 48°N latitudinal bin in 2019. Seasonal and depth distributions in the NCS and CS fleets were similar in 2019 to 2021 compared to previous years.

Lost and recovered gear patterns in 2019 to 2021 were similar to those of previous years.

ACKNOWLEDGMENTS

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.

INTRODUCTION

The Pacific Fishery Management Council (PFMC) designs and adapts the groundfish fishery management plan (FMP; PFMC 2022), 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, 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 U.S. Pacific Coast groundfish fisheries, with an emphasis on differences before and after catch shares implementation, and is mandated by the NMFS Biological Opinion (BiOp) on Continuing Operation of the Pacific Coast Groundfish Fishery (NMFS 2012). We provide data for the available time series (2002–21), 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—have impacted fishing effort over this 20-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

1990S 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 subcommittee of 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 two-to-four times the amount needed to harvest the available resource. With the help of 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. West Coast. 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 coastwide 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-fathom [fth] 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 12 June 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):

1. Flatfish were targeted 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).

2. Rockfish, or a mix of rockfish and flatfish, were targeted 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 underside 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 and north of lat 40°10′N. This design featured a headrope that was longer than the footrope, which increased selectivity 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 share program, as defined in Amendment 20 of the FMP (PFMC 2022), 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 and discard mortality and minimize ecological impacts. To accomplish these goals, shares of overall trawl sector allocations of numerous species are distributed to trawl permit owners based on catch history. Each year, share percentages are converted to poundage amounts that limit catch of those species. Transfers of quota pounds and quota shares themselves are allowed, but are subject to accumulation restrictions to discourage consolidation. To provide full accounting of catch, including at-sea discards, against these quotas, 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 altered three major aspects of the shoreside trawl fishery. First, accountability for discards shifted from the fleet as a whole to individual operations,

resulting in a rapid and substantial reduction in discards of most species. Second, with the new explicit accounting of all discards, 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 impacted fishing effort in bottom trawl and shoreside midwater sectors, and altered 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 share (NCS) fixed gear fleet. Fishing areas, tactics, and methods in the NCS fleets are similar to the areas and methods used in the catch share fixed gear fishery, and thus could be impacted by catch share implementation. We include them here as a comparison to the IFQ fixed gear fleet, and for a broader understanding of catch share impacts to the entire groundfish fleet.

At-Sea Hake Midwater Trawl Fishery

The at-sea hake midwater trawl fleet processes catch onboard while at sea, and 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 mothership catcher vessels (MS) and catcher–processors (CP) was at or near 100% of fishing days prior to IFQ implementation. Coverage to detect discards by catcher vessels before the point of delivery to an MS began with catch share management. Before catch share implementation, the CP fleet had formed a fishing cooperative in response to other PFMC management goals. In response to the implementation of catch share management, the MS fleet 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 therefore 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 total allowable catch of hake over the last 20 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 2021. 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 (2002–19) and analyzes two additional years of data, 2020 and 2021. We analyze fishing effort in the following sectors of U.S. West Coast groundfish fisheries:

1. Bottom and midwater trawl targeting groundfish, excluding hake:
   - LE Bottom Trawl: Limited entry bottom trawl (2002–10).
   - CS Bottom Trawl: IFQ non-hake bottom trawl (2011–21).
   - CS Midwater Rockfish Trawl: IFQ shoreside midwater trawl targeting rockfish (2011–21).
2. Midwater trawl targeting hake:
   - CS SS Midwater Hake Trawl: IFQ shoreside midwater trawl targeting hake (2011–21).
   - CS AS CP: At-sea midwater trawl targeting hake, utilizing CPs (2002–21).
   - CS AS MS: At-sea midwater trawl targeting hake, utilizing MSs (2002–21).
3. 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 (2002–21).
   - CS Pot: IFQ pot (2011–21).
   - NCS Hook-and-Line: Hook-and-line gear fished in NCS, aggregating the same sectors as NCS Pot.
   - CS Hook-and-Line: IFQ hook-and-line (2011–21).

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 coastwide, 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 20 years.

Data Sources

Data sources for this report include: 1) observers aboard commercial fishing vessels landing catch shoreside (recorded and maintained by WCGOP), 2) observers aboard commercial fishing vessels processing catch at sea (recorded and maintained by A-SHOP), 3) state logbooks from the 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 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. WCGOP observes several federally managed sectors of the groundfish fishery, including the LE bottom trawl, LE and OA fixed gear, and shoreside midwater trawl. 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.

WCGOP's goal is to improve total catch estimates by collecting information on at-sea discards of groundfish on the U.S. West Coast. A-SHOP accounts for total catch and documents bycatch by sampling all hauls on at-sea processors. For more details about observer program goals, vessel selection, and data collection, see the FOS web page.[1] Observer coverage for each fishery sector can be found in Somers et al. (2022).[2] WCGOP, A-SHOP, and fish ticket data quality assurance, quality control, and processing methods are described in detail in Somers et al. (2022).

Logbook Data

Vessel logbook recordkeeping is a state-mandated requirement for the LE and CS groundfish bottom trawl sectors in Washington, Oregon, and California. 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 PSMFC.

Bottom trawl logbook data for 2002–21 were retrieved from the PacFIN database in December 2022. These data were assigned into groundfish fishery sectors following procedures described in Somers et al. (2022). Logbook and observer data sometimes have slight discrepancies, so summaries of fleetwide vessels, trips, and hauls may be inconsistent with other reports.

[1] https://www.fisheries.noaa.gov/west-coast/science-data/fisheries-observation-science-west-coast

[2] Somers, K. A., K. Richerson, V. Tuttle, and J. T. McVeigh. 2022. Fisheries Observation Science Program Coverage Rates, 2002-21. U.S. Department of Commerce, NOAA Data Report DR-2022-02.

Landings Data

Fleetwide 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 agencies in each state (WA, OR, or CA) and must be returned to the agencies 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 submits 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 were queried in July 2022. 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 are 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 hake) for non-hake-targeting sectors, and hake landings only 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 depth on observed hauls or sets. Although not all trips of the non-catch share portion of the fixed gear sector are observed, this is the only data source available. For 2015–21, logbook data for the EM portions of the CS pot and midwater fleets were incorporated. In NCS fixed gear sectors, we extrapolated the fleetwide numbers of hooks and pots based on observer data; see Methods for 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 or set, and depth than it did in 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 12 June 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 2011–18 and annually for the most recent three years of data, except in maps, where data were grouped into 2019–20 and 2021 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 (2002–10), the initial IFQ period (2011–18), and the most recent data (2019, 2020, and 2021 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: 2002–05, 2006–10, 2011–18, 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 fleetwide towing, total fixed-gear units deployed, towing duration per haul or set, 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 (in mt) of groundfish species,
h = number of hauls or sets in observer data, and
C = weight (mt) of retained groundfish species recorded on all fish tickets.

We also calculated the number of hauls or sets where lost gear was observed and where gear was recovered, by 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 fleetwide 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, lost gear 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 landings patterns in the shoreside fishery and catch in the at-sea fishery by one-degree latitudinal bins. Similar to the methods used for timing, described 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. exclusive economic zone (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 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 Pro 2.9.0 (Environmental Systems Research Institute, Inc., Redlands, California). The line density algorithm calculates density within a circular search area centered at a grid cell of specified size (see How Line Density works).[3] 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 what is 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 than for trawl densities (3,000 m), because effort in those sectors was generally patchier compared to the bottom and at-sea processing midwater trawl sectors. Because the density outputs cannot fully capture the entire footprint of fishing, we summarized length of all lines intersecting 10 × 10-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 and 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. We do not

[3] https://pro.arcgis.com/en/pro-app/2.9/tool-reference/spatial-analyst/how-line-density-works.htm

report data for 2019, 2020, or 2021 for the catch share 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 or sets in 50-fth 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 ~12,300 mt of FMP groundfish species in 2020 and ~12,800 mt in 2021; the two lowest annual catch amounts by the bottom trawl fleet since at least 2002 (Table 2, Figure 1). Fleetwide bottom trawl effort continued to decrease from the high of the catch share period in 2013 and was almost a third that level in 2020 and 2021 (Table 2, Figure 2). Median haul duration has generally decreased since 2011 to around two hours and forty minutes in 2020 and 2021 (Table 2, Figure 3).

The spatial distributions of landings were similar from 2019 to 2021 (Table A-1, Figure 4). The greatest proportions of landings were made near Astoria, Oregon (lat 46°N), but were lower in all three years than in 2011–18 (Table A-1, Figure 4). Landings near the ports of Newport, Oregon (lat 44°N), and Fort Bragg, California (lat 40°N), each comprised approximately 20% of coastwide landings. The proportions of landings north of lat 46°N and south of lat 39°N 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 2021 (Figure 5). The more recent time periods illustrate the continued concentration of effort in the northern part of the coast and in deeper, farther-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 lat 36°N after 2018.

Seasonal patterns of landings in 2019 to 2020 largely fell within the patterns observed in previous time periods, although the proportion of catch landed in November–December was the highest on record for that bimonthly period. Landings in 2019 to 2020 were lowest in January-February and highest in March-April; around 15% of landings occurred in all other bimonthly periods. Landings in 2021 were less uniform: landings in 2021 peaked in

March-April and then decreased to around 15% September-December. Additionally, across all time periods, the highest proportion of May-June landings and the lowest proportion of September-October landings both occurred in 2021 (Table A-2, Figure 6).

The proportion of hauls in the 0–50-fth depth bin continued to decrease, while activity in 50–100-fth waters increased slightly (Table A-3, Figure 7). This shift may reflect the recent opening of the trawl rockfish conservation area to effort by this fleet via Amendment 28 (84 FR 63966). 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 sixfold, 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 in this sector generally increased from 2011 to 2018, although groundfish retained decreased slightly in 2019 and 2020 before returning to 2018 levels in 2021 (Table 2, Figure 1 and Figure 2). After doubling compared to the previous year in 2018, fleetwide tow hours remained around 1100 in 2019 and 2021, but decreased to around 900 in 2020. The median tow duration per haul in the midwater rockfish trawl fleet has increased slightly from 1.5 hours in 2017 to 2 hours in 2021; variability in tow duration was higher in 2020 and 2021 compared to previous years (Table 2, Figure 3).

From 2011 to 2018, landings of midwater rockfish occurred from central Washington to central Oregon; in 2019 to 2020, landings also occurred in southern Oregon and in 2019 to 2021, as part of an exempted fishing permit (EFP), in northern California (Table A-1, Figure 8). Between two-thirds and three-quarters of the landings in each time period occurred along the Oregon–Washington border at lat 46°N. Around 22% of landings in 2019 to 2020 and around 32% of landings in 2021 occurred near Newport in the 44°N latitudinal bin. Landings near Bellingham, Washington (lat 48°N) were much lower in 2019 to 2020 than in 2011 to 2018, and no landings occurred in this latitudinal bin in 2021. Mapping the fishing effort shows that effort continues to concentrate off of Astoria and Newport (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. From 2011 to 2018 and in 2021, approximately 12% of landings were made in January-February; only 8% of 2019 to 2020 landings were made in this bimonthly period. A greater proportion of landings occurred from 2019 to 2021 in March-April compared to 2011 to 2018; landings were lower in these more recent years in September-October compared to the median in 2011 to

2018 (Table A-2, Figure 10). The high variability in percent of landings made in July–August for 2011 to 2018 reflects the re-emergence of the targeting strategy during this period.

The depth distribution of midwater rockfish trawl effort in 2019 to 2021 was similar to that of 2011 to 2018, although less effort occurred in the 50-100 fth depth bin and more effort occurred in the 100-150 fth depth bin (Table A-3, Figure 11). No effort occurred deeper than 250 fth after 2018.

Midwater trawl targeting hake

Landings by all three sectors of the hake-targeting midwater fleet increased from 2015 to 2016 (Table 2, Figure 12), and annual hake landings in the shoreside and CP fleets continued to increase in 2017. These two fleets decreased from 2017 to 2021, except a slight rebound in 2019. The MS fleet remained constant from 2016 to 2018, then decreased from 2018 to 2021.

Effort, measured by total number of hours towing, increased in the shoreside fleet from 2016 to an historical high of 8,600 hours in 2020 and then decreased to 6,000 hours in 2021 (Table 2, Figure 13). Trends in both at-sea processing fleets were more variable in recent years, but have mostly decreased following historic highs in 2016. Towing hours per haul were highly variable between 2019 and 2021; the shoreside fleet ranged from 1.3 to 4.3 hours with an average around 2.5 hours, and the at-sea CP fleet similarly ranged from 1.7 to 4.4 hours with a slightly higher average of 3 hours. The MS fleet showed greater variability, ranging from 0.9 to 5.2 hours and an average of 2.4 hours (Table 2, Figure 14).

Shoreside hake fleet

Compared to 2011–18, the shoreside fleet in 2019 to 2021 landed a greater proportion near Astoria (lat 46°N) and a lower proportion of hake near Newport (lat 44°N; 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 occurring off of northern California in all time periods (Figure 16). Across all three time periods, fishing effort was concentrated off of Newport, with additional hotspots farther north in 2019-20 and 2021.

The seasonal distribution of landings by the shoreside fleet were similar in 2019 to 2021 compared to previous years, with the majority of landings continued to occur in July and August in most years (Table A-5, Figure 17). The proportion of landings in May-June in 2019 to 2021 were on the higher end of the 2011 to 2018 range, while the opposite was true of November-December.

The depth distribution of landings in 2019 to 2021 was similar to that of 2011 to 2018, with the majority of annual landings by the shoreside fleet coming from water depths of 50–150 fth (Table A-6, Figure 18). Landings from deeper than 250 fth continued to be low,

with no landings greater than 250 fth in 2019 to 2020 and no landings from waters deeper than 400 fth in 2021.

At-sea hake fleet

Fishing effort in the at-sea midwater hake trawl fishery was concentrated off Oregon across all time periods (Table A-4, Figure 19). In 2019 to 2020, effort primarily occurred in the 47°N, 43°N, and 42°N latitudinal bins, while 2021 effort was concentrated in the 44N° to 42°N latitudinal bins. Maps of CP fishing effort for 2019-2020 and 2021 show hotspots off of Newport as well as between lat 48 to 47°N and around lat 43°N (Figure 20).

The spatial distribution of MS effort in 2019 to 2020 was concentrated in the 47°N, 43°N, and 42°N latitudinal bins and 2021 effort focused in the 47°N, 42°N, and 41°N latitudinal bins (Table A-4, Figure 19). Mapping this effort further emphasizes the similarity of spatial distribution from 2011 to 2021, including continued concentrated fishing around lat 44–43°N present in all three time periods (Figure 21).

The midwater at-sea fleet's season begins on 15 May. The proportion of CP landings processed in the May–June period was on the higher range of previous years in 2019 to 2020, but on the lower end in 2021 (Table A-5, Figure 22). The majority of catch processed in 2021 occurred in September-October, resulting in the highest catch processed in that bimonthly period across the years compared. The proportion of catch processed in July-August continued to decrease, with no catch processed in 2021. The majority of MS landings were processed in May–June in most years. In 2019 to 2020, small proportions of catch were also processed from July to December. In 2021, more than a quarter of catch was also processed in September-October, but no catch was processed in any other bimonthly period.

Since 2006, more than 80% of CP and MS landings have come from hauls in 100–250 fth; from 2019 to 2021, this pattern increased to 90% or more in each year (Table A-6, Figure 23).

Fixed Gear Sectors

Pot

Annual NCS groundfish landings using pot gear were fairly stable from 2015 to 2020 at about 600 mt, with an increase to 670 mt in 2021 (Table 3, Figure 24). The CS fleet showed a slight but generally increasing trend from 2013–19, with a high of more than 850 mt, and has since decreased to 680 mt in 2021. 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 followed by a continued decease in 2020 and 2021 (Tables 3 and 4, Figure 25). Since 2011,

the median number of pots per set in both the CS and NCS pot fleets has ranged between ~15 and ~50 (Table 3, Figure 26). The median number of pots per set in the CS fleet in 2020 and 2021 reached an all-time high of ~50 pots in 2020 and 2021, two of the only years when the median number of pots per set was greater in the CS than in the NCS fleet.

From 2002 to 2021, the majority of landings by the NCS pot fleet occurred between Astoria (lat 46°N) and Fort Bragg (lat 39°N; Table A-6, Figure 27). From 2019 to 2021, landings in Newport (lat 44°N) bin were higher than in previous years, while landings near Astoria and Fort Bragg were lower. In the CS pot fleet, landings in Newport accounted for 40 to 50 percent of annual landings from 2019 to 2021, above the 2011 to 2018 range (Table A-6, Figure 27). The percentage of landings made in Astoria decreased from 38 in 2019 to 8 in 2021; the percentage of landings in Bellingham (lat 48°N) increased from less than 1% in 2011 to 2018 to 10% in 2021. Catch shares pot landings also continued to occur further south than NCS pot landings, specifically in the 35 to 37°N latitudinal bins.

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 effort continuing to decrease off of central and southern California from 2019 to 2021 (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 be low in 2019-2020 and 2021, although two concentrated effort areas persist off of Morro Bay, San Francisco, and Fort Bragg. Some of this effort may represent initiatives introduced with catch share implementation that supported a shift from trawl to fixed gear fishing near Morro Bay.

From 2002–18, 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 July–August prior to IFQ implementation in 2011, when this peak shifted to September–October. The proportion of landings occurring in both July–August and September–October increased from 2019 to 2021 and reached historic highs of almost half of landings made in September–October. Landings in November-December were also higher, reflecting season extensions in 2020 and 2021. Landings in May–June from 2019 to 2021 were lower than in previous years, around 7%. The 2019 to 2021 seasonal landings of the CS pot fleet have been more variable than the NCS fleet. To maintain confidentiality, 2021 landings are reported with March-June combined. Generally, landings have been concentrated in September-October with the remaining effort fairly evenly distributed throughout the rest of the year. In 2019 to 2020, the proportion of landings were higher in November-December than in previous years.

From 2002 to 2021, fishing effort in the NCS pot fleet occurred primarily in depths from 100–300 fth (Table A-9, Figure 31). The depth distribution of landings from 2019 to 2021 were generally within the range of previous years. The majority of CS pot fleet effort in 2011 to 2018 occurred in depths from 150–600 fth. From 2019 to 2021, this effort became more concentrated in shallower depths, from 150–350 fth.

HOOK-AND-LINE

Groundfish landings by the NCS hook-and-line fleet decreased from 2,400 mt in 2017 to 1,600 mt in 2021 (Table 3, Figure 24). Estimated fleetwide hooks, calculated from total landings and observed hooks per set (see Table 4), showed a similar pattern and reached an historic low of 6 million hooks per year in 2021 (Table 3, Figure 32). The median number of hooks per set in the NCS fleet was fairly 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 2021 (Table 3, Figure 33).

CS landings have been lower and less variable than NCS landings, ranging between 115–200 mt of groundfish from 2013 to 2019, with no effort in 2020 or 2021 (Table 3, Figure 32) (reference figure/table). CS effort has generally decreased from 2011 to 2021, and remained around a half-million hooks in all years from 2013 to 2019 except 2016, 2020, and 2021(Table 3, Figure 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 lat 48–32°N (Table A-7, Figure 34). Generally, landings by the NCS hook-and-line fleet were fairly evenly distributed along the coast. Landings in the CS fleet were patchier, with concentrations near lats 48, 46, and 45°N. No landings in the CS fleet occurred south of lat 43°N after 2016.

Observed effort in the NCS hook-and-line fleet occurred along the entire U.S. West Coast and was similar across the three analyzed time periods, although effort of southern California has decreased in recent years (Figure 35). Due to the small number of vessels participating in the CS hook-and-line fleet, all years were summarized together and show areas of concentrated effort—in the north, off of Astoria and Newport 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 September–October across all time periods and years (Table A-8, Figure 37). In the CS fleet, the seasonal distribution of landings was fairly stable from January to June in most years and peaked in September-October, with typically half or more landings occurring in that bimonthly period.

Both the NCS and CS hook-and-line fleets fish in depths ranging from 0–750 fth (Table A-9, Figure 38). The depth distribution of observed NCS hook-and-line sets was similar across time periods and years, with the majority of landings coming from sets in the 150–200-fth depth bin. The majority of CS hook-and-line effort occurred in the 200–250-fth depth bin from 2011 to 2018, 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 share hook-and-line fisheries on about 2% of sets, representing 0.5% of observed hooks. In the catch share hook-and-line fleet, approximately 1% of sets lost approximately 0.3% of hooks. In the catch share pot fleet, around 4% of sets lost approximately 0.4% of pots; in the non-catch share pot fleet, around 3% of sets lost approximately 0.4% 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 ~4% of hauls recovered gear. Midwater gears rarely contact the ocean floor, so gear recovery is exceedingly rare. Less than 0.7% 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 sets, with no incidents in most years. Approximately 0.1% of observed pot sets recovered gear.

REFERENCES

GEFHRC (Groundfish Essential Fish Habitat Review Committee). 2012. Pacific Coast Groundfish 5-Year Review of Essential Fish Habitat Report to the Pacific Fishery Management Council Phase 1: New Information. Pacific Fishery Management Council, Portland, Oregon. Available: www.pcouncil.org/documents/2012/09/h-groundfish-management-september-2012.pdf/ (July 2021).

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

PFMC (Pacific Fishery Management Council). 2000. Status of the Pacific Coast Groundfish Fishery Through 2000 and Recommended Biological Catches for 2001: Stock Assessment and Fishery Evaluation. Pacific Fishery Management Council, Portland, Oregon.

PFMC (Pacific Fishery Management Council). 2022. Pacific Groundfish Fishery Management Plan for the California, Oregon, and Washington Groundfish Fishery. Pacific Fishery Management Council, Portland, OR.

Rogers, J. B., and E. K. Pikitch. 1992. Numerical definition of groundfish assemblages caught off the coasts of Oregon and Washington using commercial fishing strategies. Canadian Journal of Fisheries and Aquatic Sciences 49:2648–2656.

Somers, K. A., J. Jannot, K. Richerson, V. Tuttle, N. B. Riley, and J. T. McVeigh. 2022. Estimated Discard and Catch of Groundfish Species in the 2020 U.S. West Coast Fisheries. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-175.

FIGURES

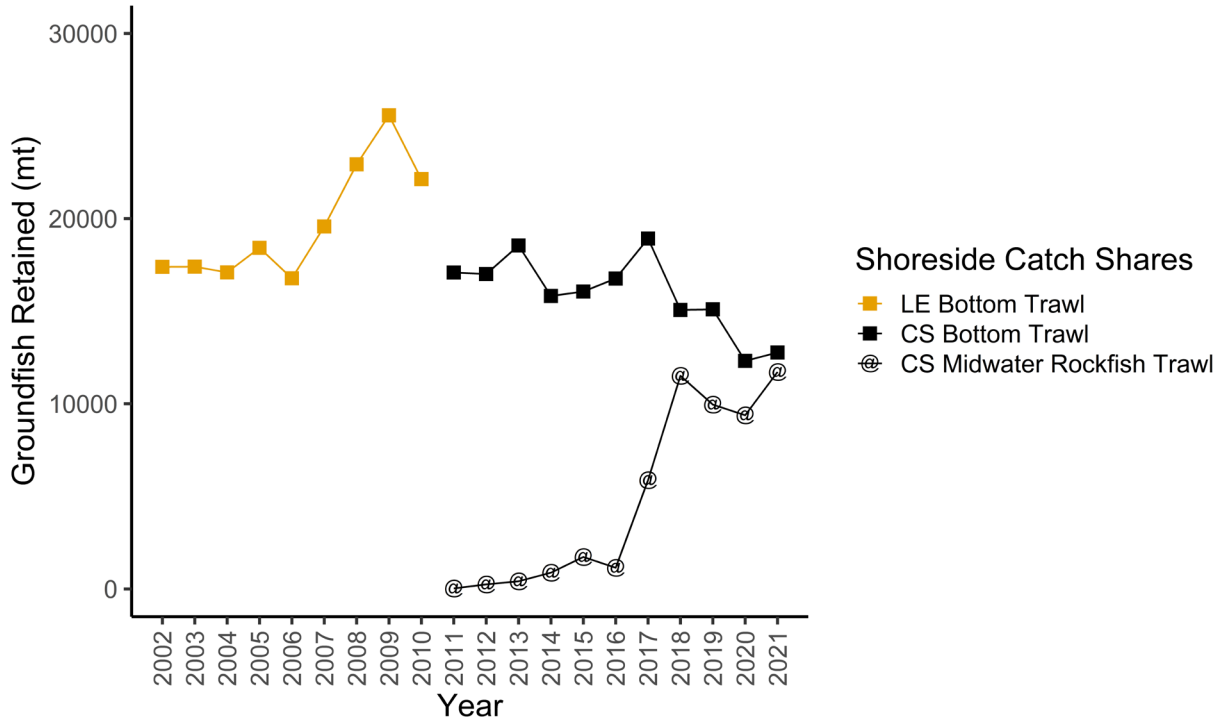

FIGURE 1. Annual total fleet-wide FMP groundfish (not including hake) landings (mt) in bottom trawl and midwater rockfish trawl sectors.

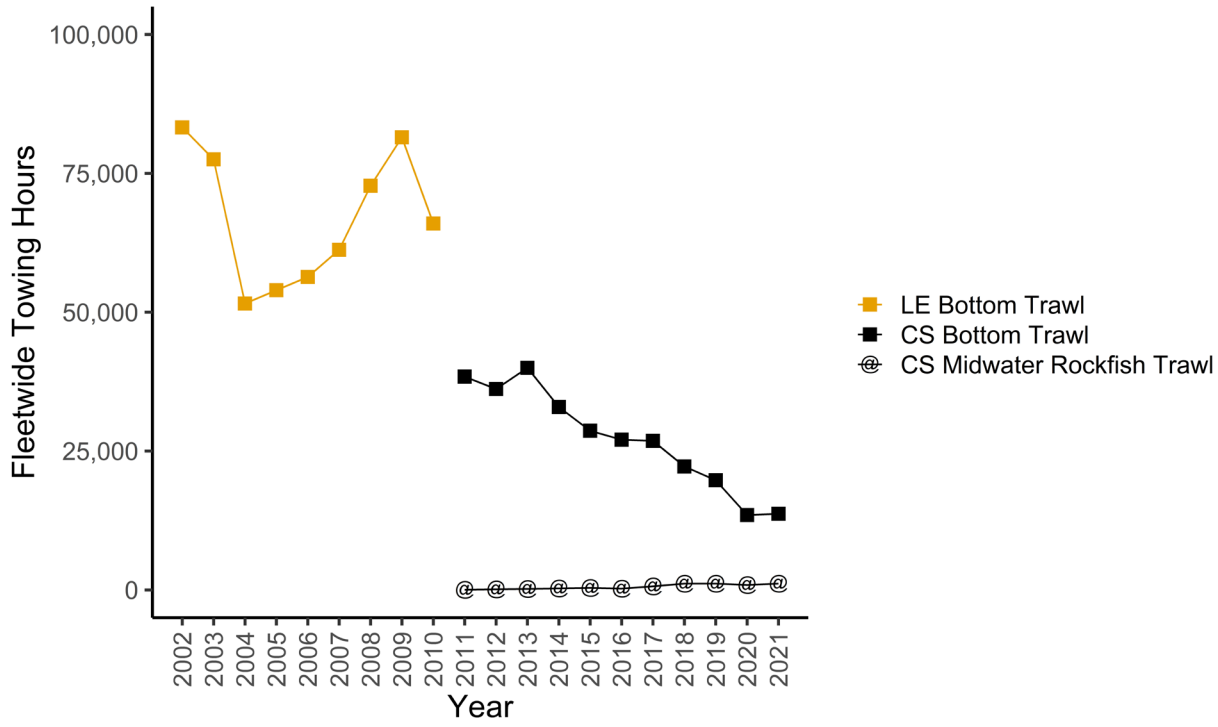

FIGURE 2. Annual fleet-wide total towing hours in the bottom trawl and midwater rockfish trawl sectors.

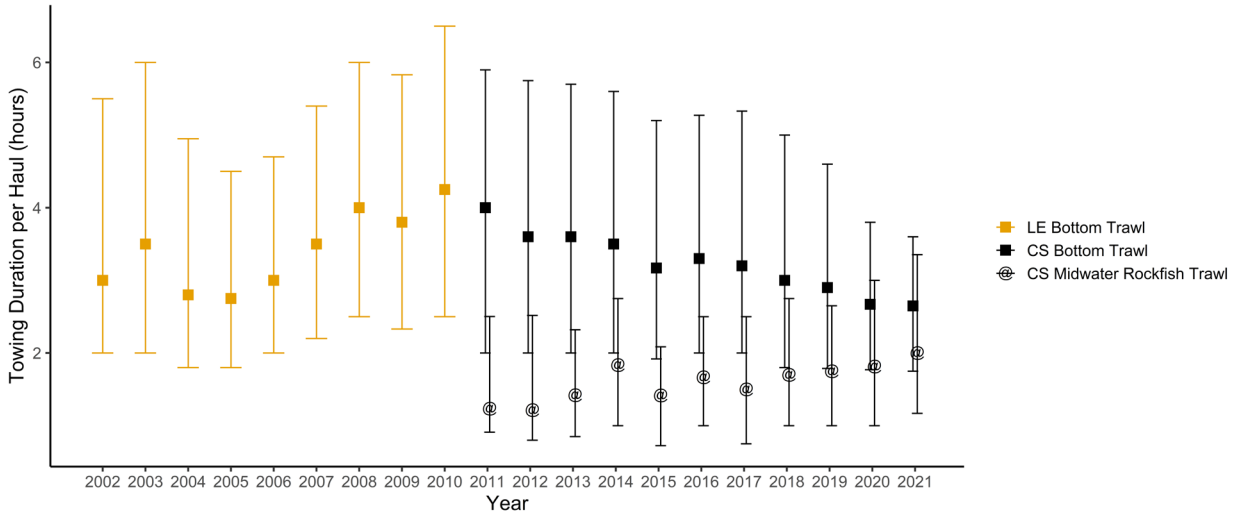

FIGURE 3. Tow duration per haul (hours) in the bottom trawl and midwater rockfish trawl sectors. Medians and first and third quartiles for each year are shown.

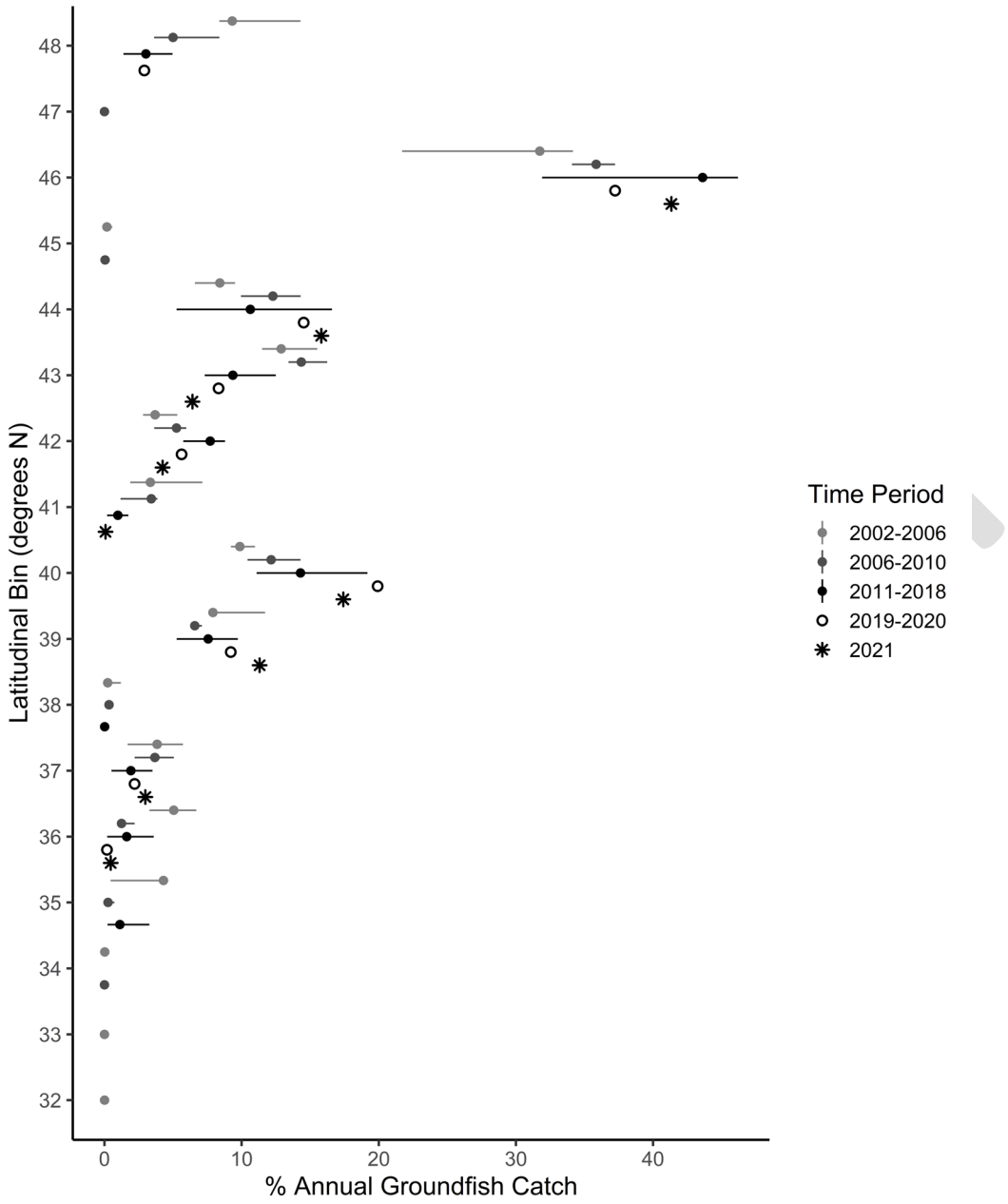

FIGURE 4. Percentage of retained FMP groundfish landed in latitudinal bins by the bottom trawl sector; patterns in actual fishing activity are shown in Figure 5. Minimum, median, and maximum are shown for each time period.

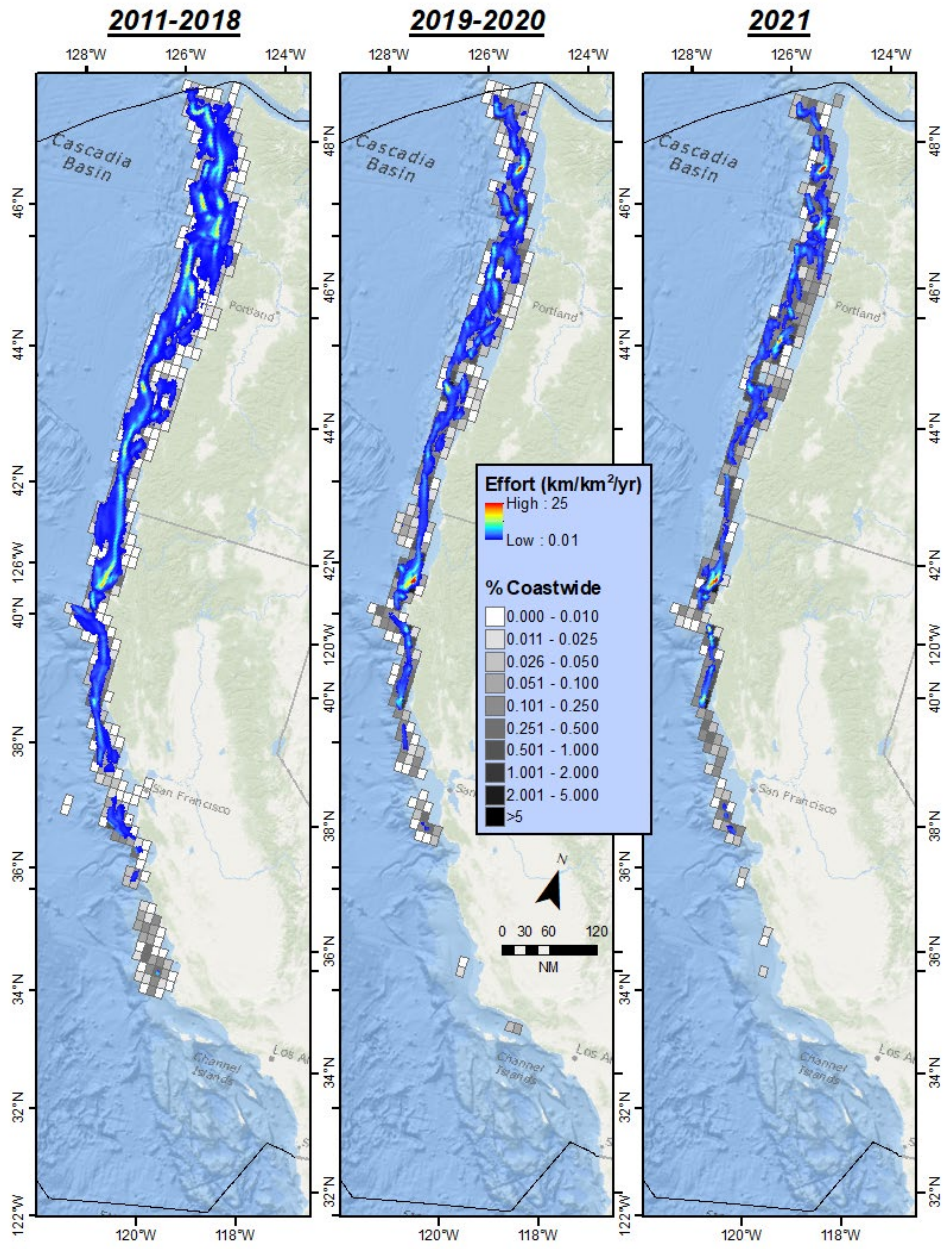

FIGURE 5. Spatial distribution and intensity of bottom trawl fishing effort. Intensity (units: km/km²/yr) is depicted by a color ramp of cool (low) to warm (high) colors. The overall footprint of fishing for each time period is depicted in grayscale, with darker (black) tones depicting a higher relative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

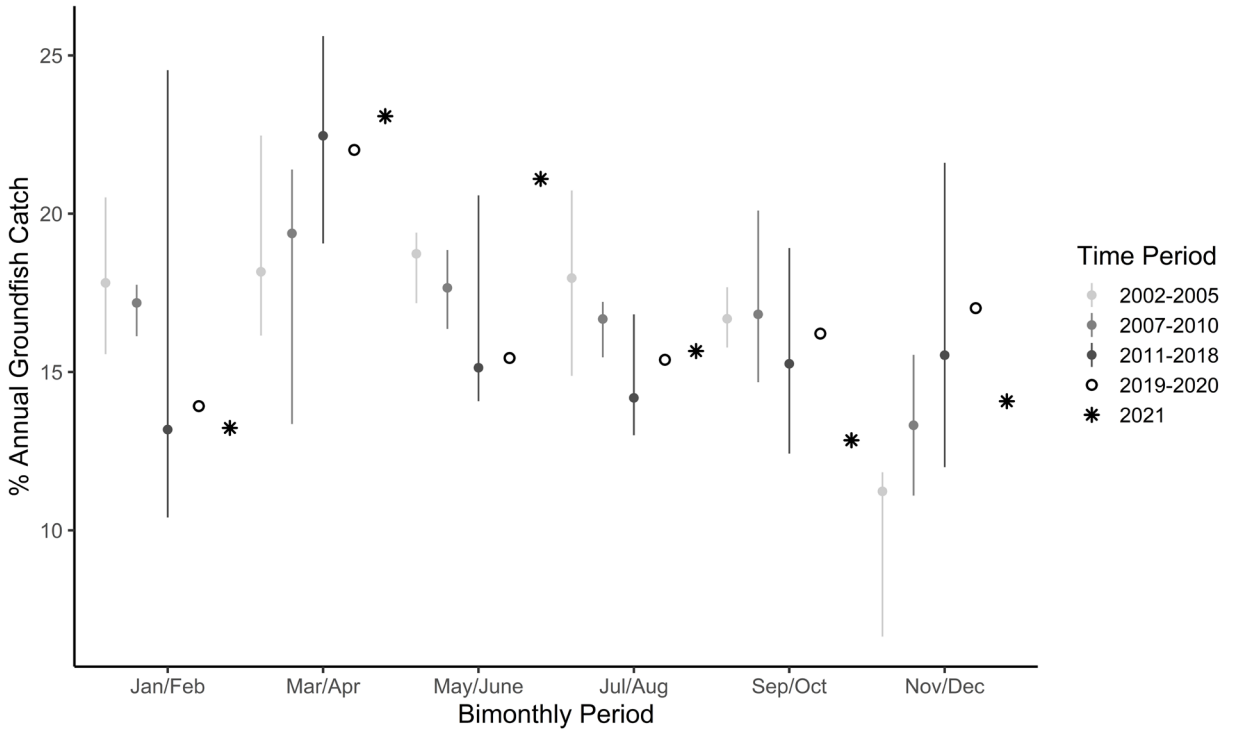

FIGURE 6. Percentage of retained FMP groundfish landed in bimonthly bins by the bottom trawl sector. Minimum, median, and maximum are shown for each time period.

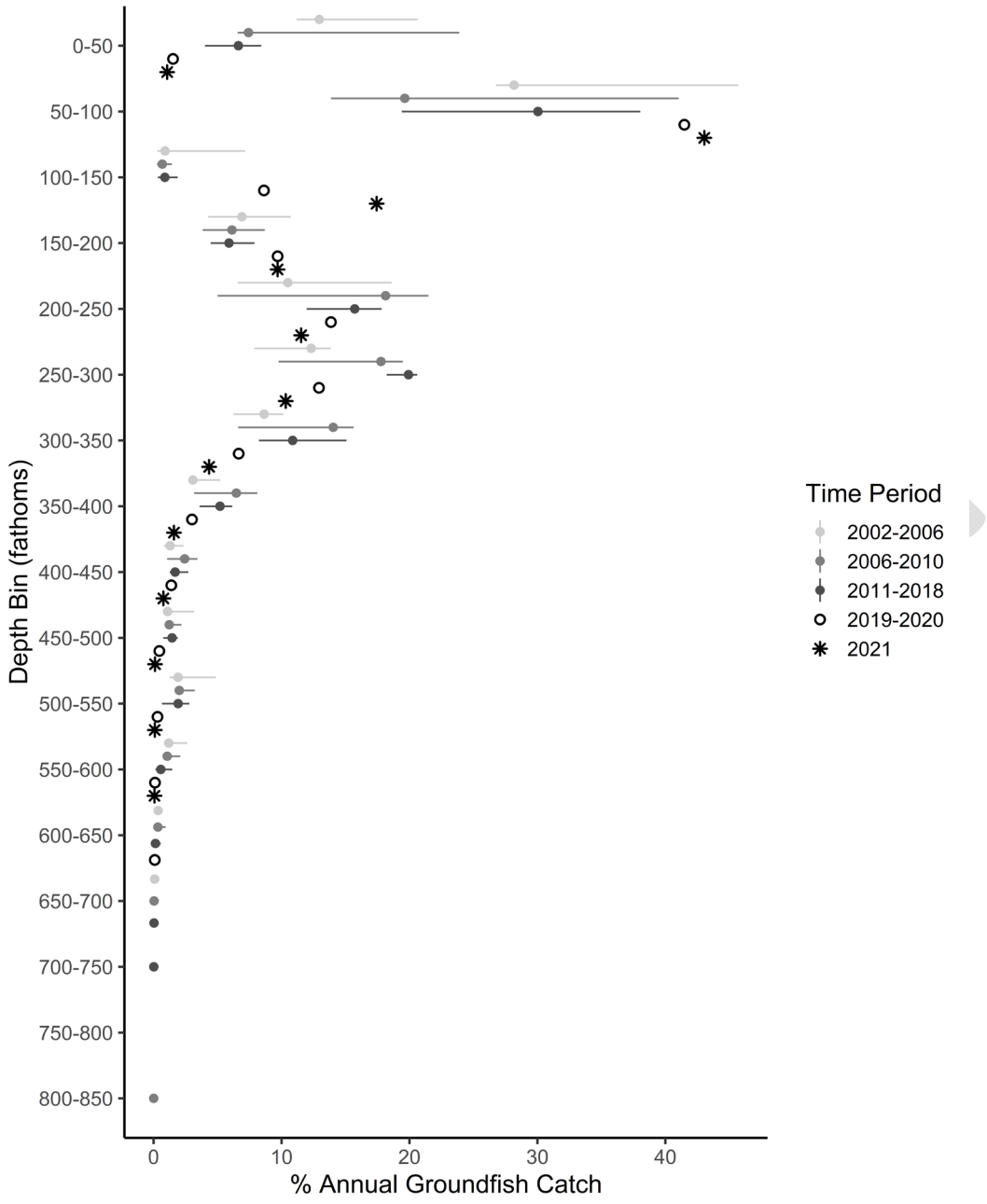

FIGURE 7. Percentage of bottom trawl hauls in 50-fathom depth bins. Minimum, median, and maximum are shown for each time period.

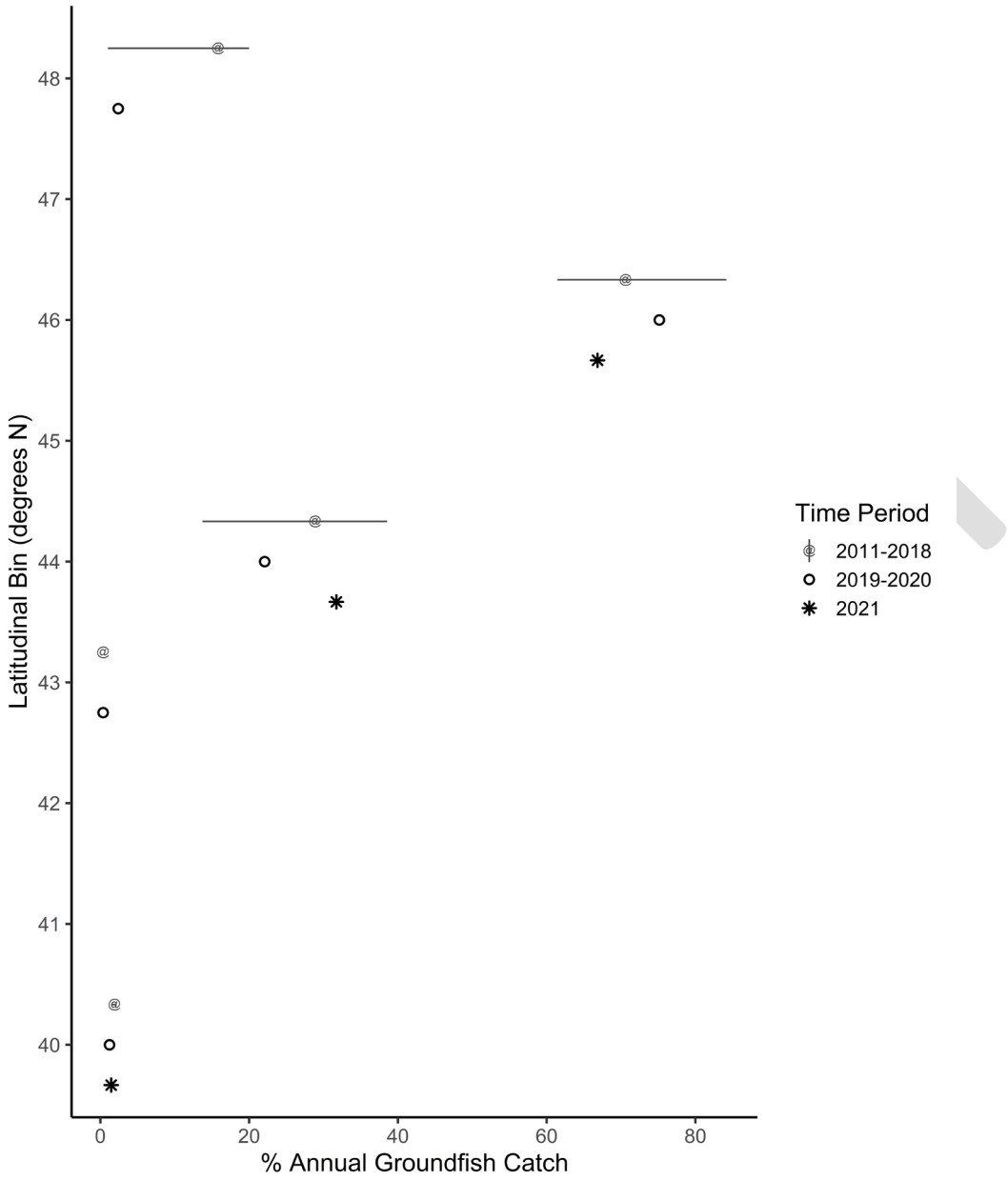

FIGURE 8. Percentage of retained FMP groundfish landed in latitudinal bins by the midwater rockfish trawl sector; patterns in actual fishing activity are shown in Figure 9. Minimum, median, and maximum are shown for each time period.

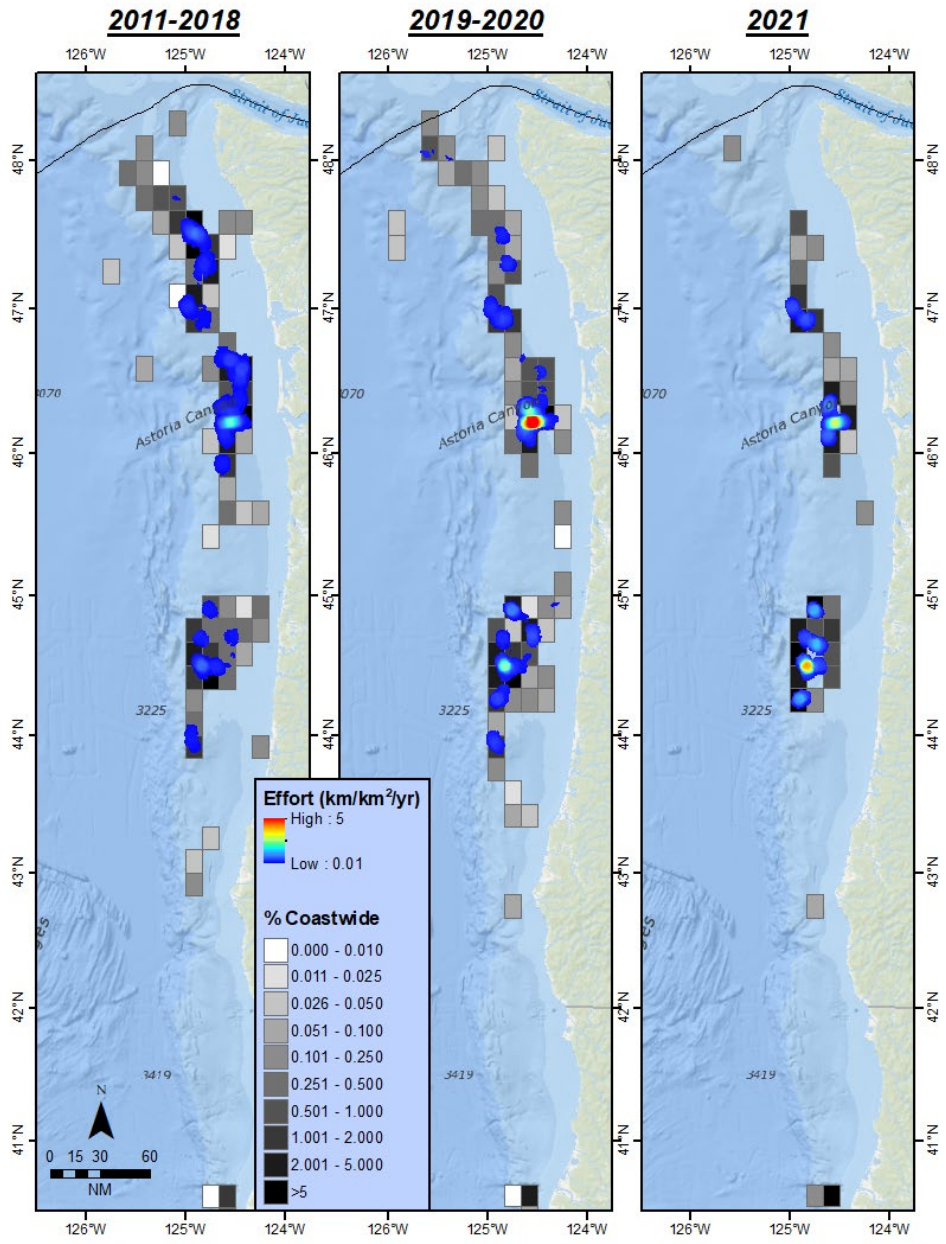

FIGURE 9. Spatial distribution and intensity of midwater rockfish trawl fishing effort. Intensity (units: km/km^2/yr) is depicted by a color ramp of cool (low) to warm (high) colors. The overall footprint of fishing for each time period is depicted in grayscale, with darker (black) tones depicting a higher relative contribution to coastwide effort within 10x10 min cells.

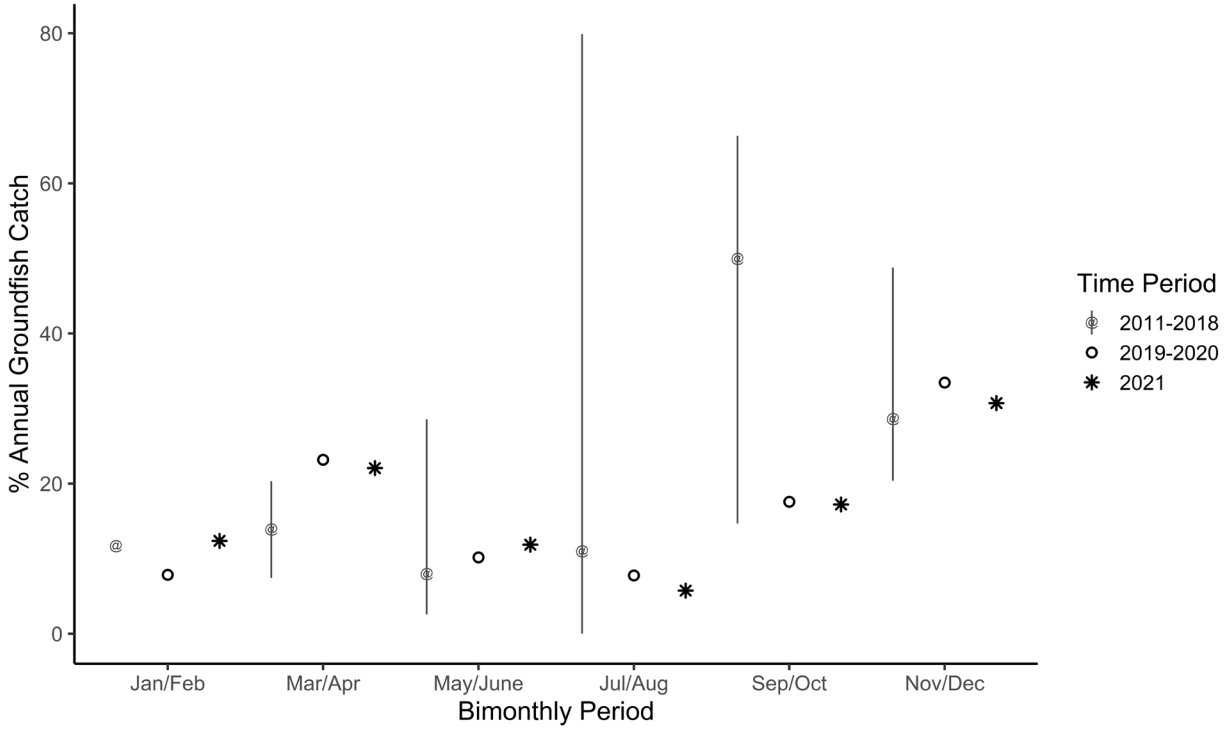

FIGURE 10. Percentage of retained FMP groundfish landed in bimonthly bins by the midwater rockfish trawl sector. Minimum, median, and maximum are shown for each time period.

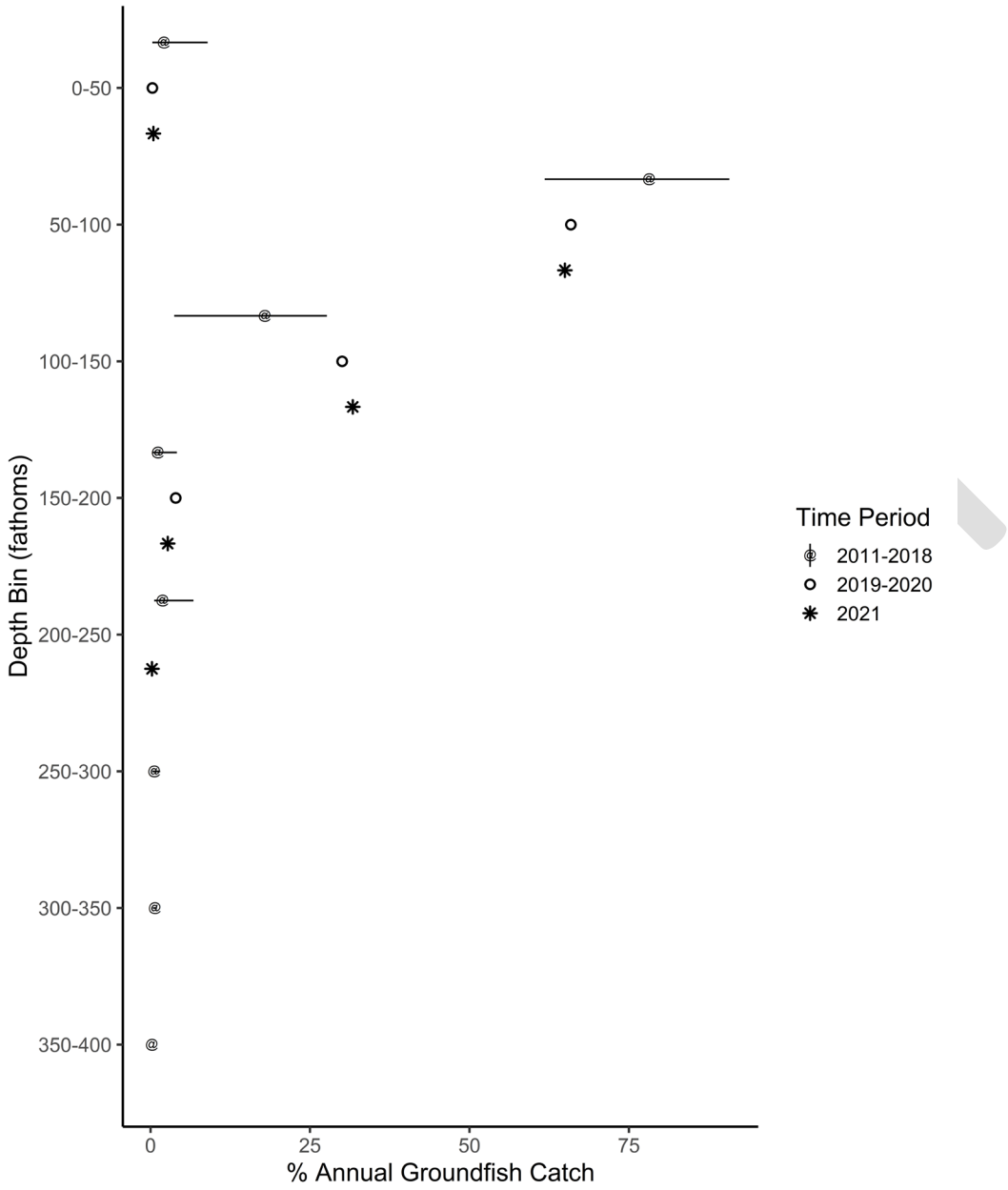

FIGURE 11. Percentage of midwater rockfish trawl hauls in 50-fathom depth bins. Minimum, median, and maximum are shown for each time period.

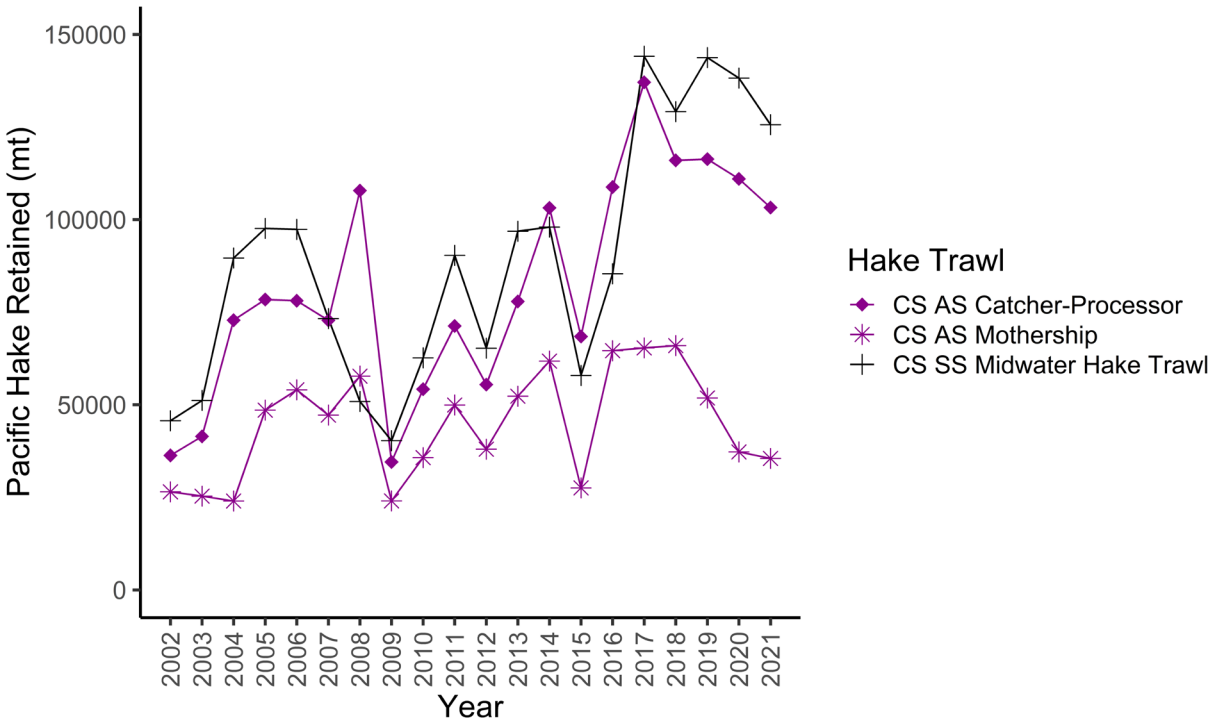

FIGURE 12. Annual total fleet-wide Pacific hake landings (mt) in midwater hake trawl sectors.

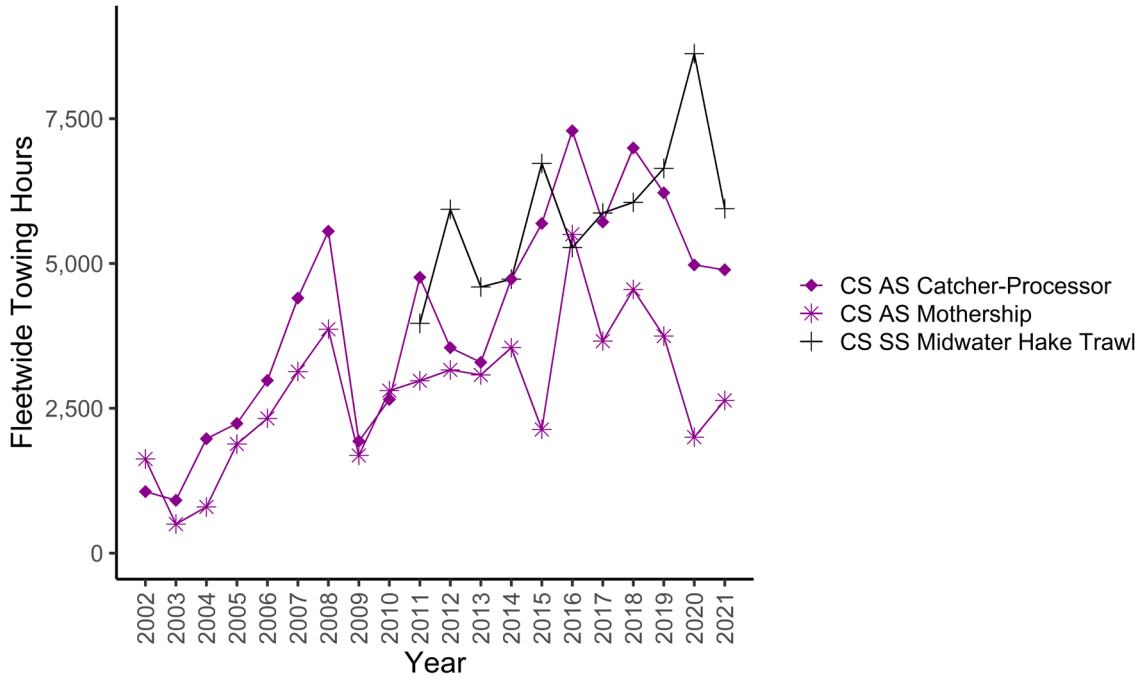

FIGURE 13. Annual fleet-wide total towing hours in midwater hake trawl sectors.

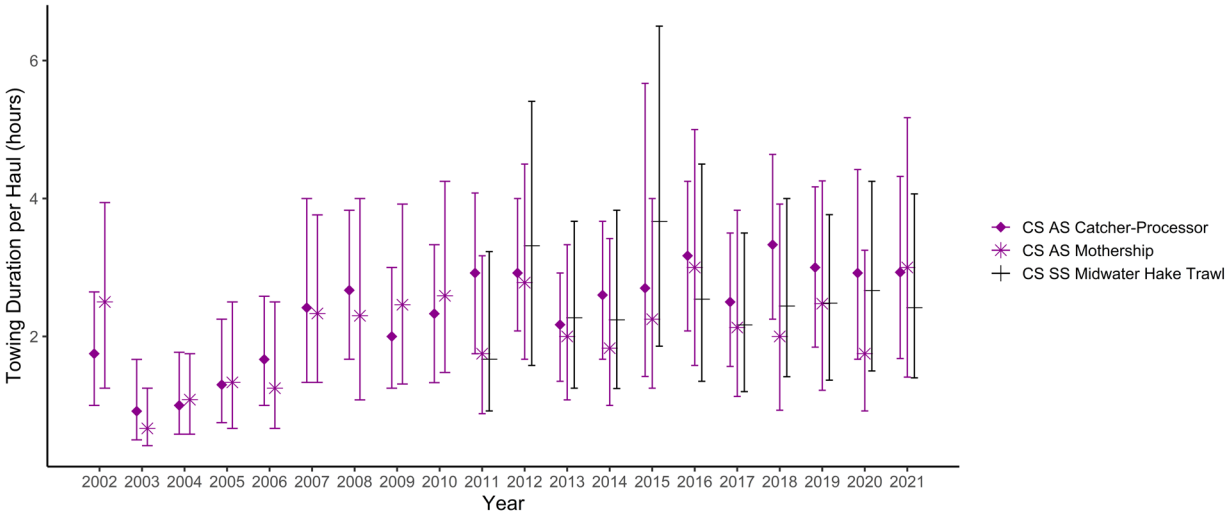

FIGURE 14. Tow duration per haul (hours) in midwater hake trawl sectors. Medians and first and third quartiles for each year are shown.

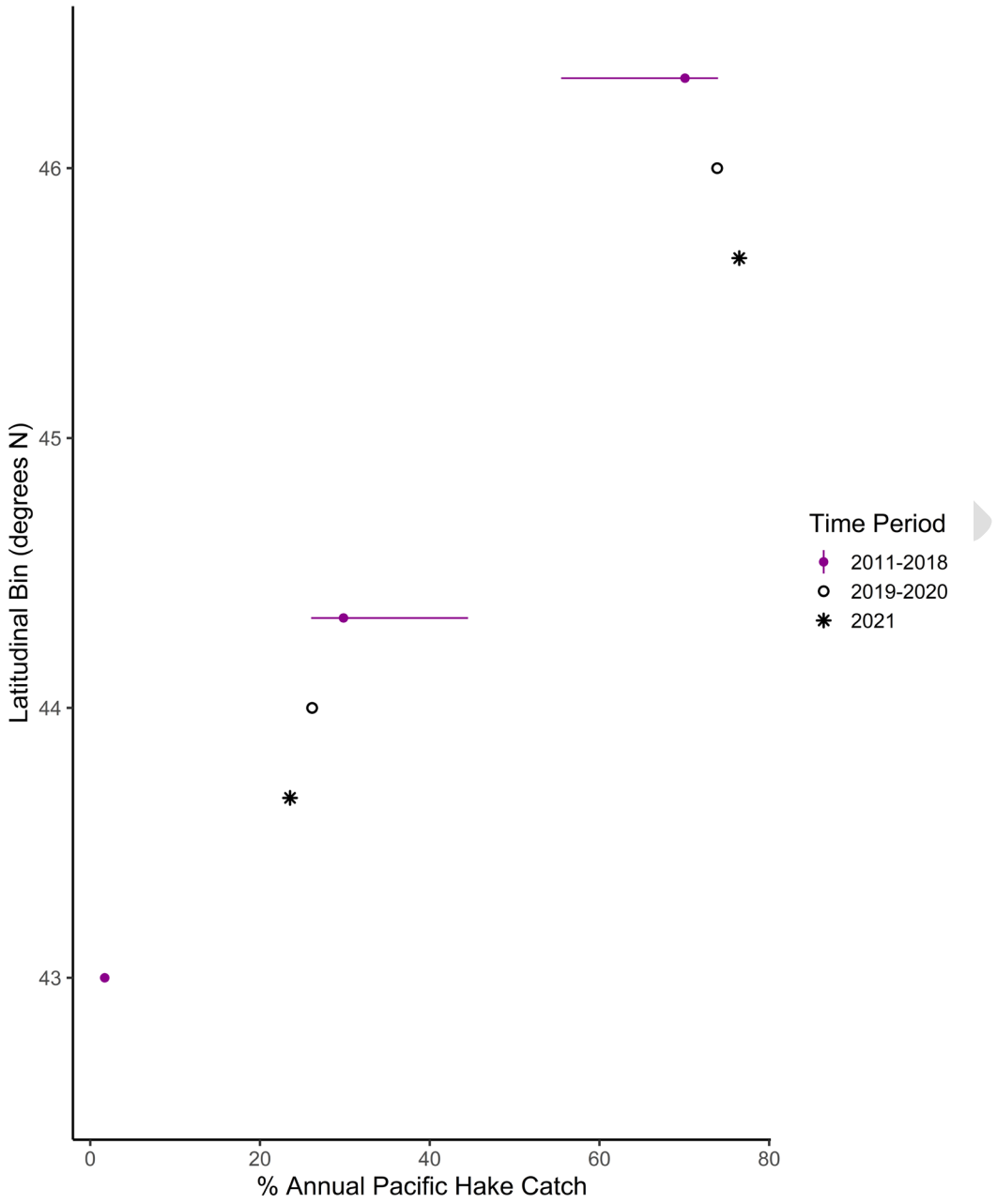

FIGURE 15. Percentage of retained Pacific hake landed in latitudinal bins by shoreside midwater hake trawl; patterns in actual fishing activity are shown in Figure 16. Minimum, median, and maximum are shown for each time period.

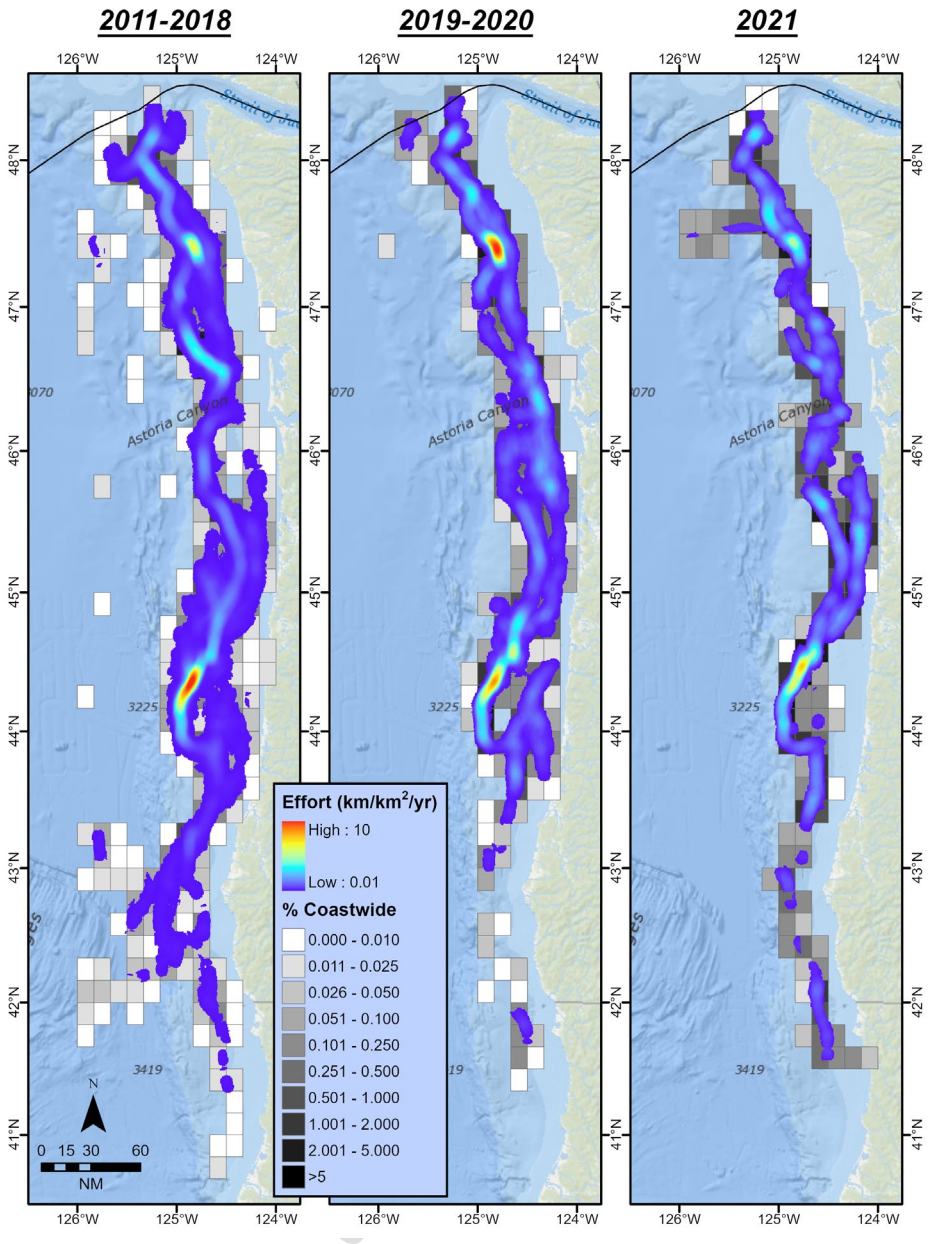

FIGURE 16. Spatial distribution and intensity of fishing effort by shoreside midwater hake trawl. Intensity (units: km/km^2/yr) is depicted by a color ramp of cool (low) to warm (high) colors. The overall footprint of fishing for each time period is depicted in grayscale, with darker (black) tones depicting a higher relative contribution to coastwide effort within 10x10 min cells.

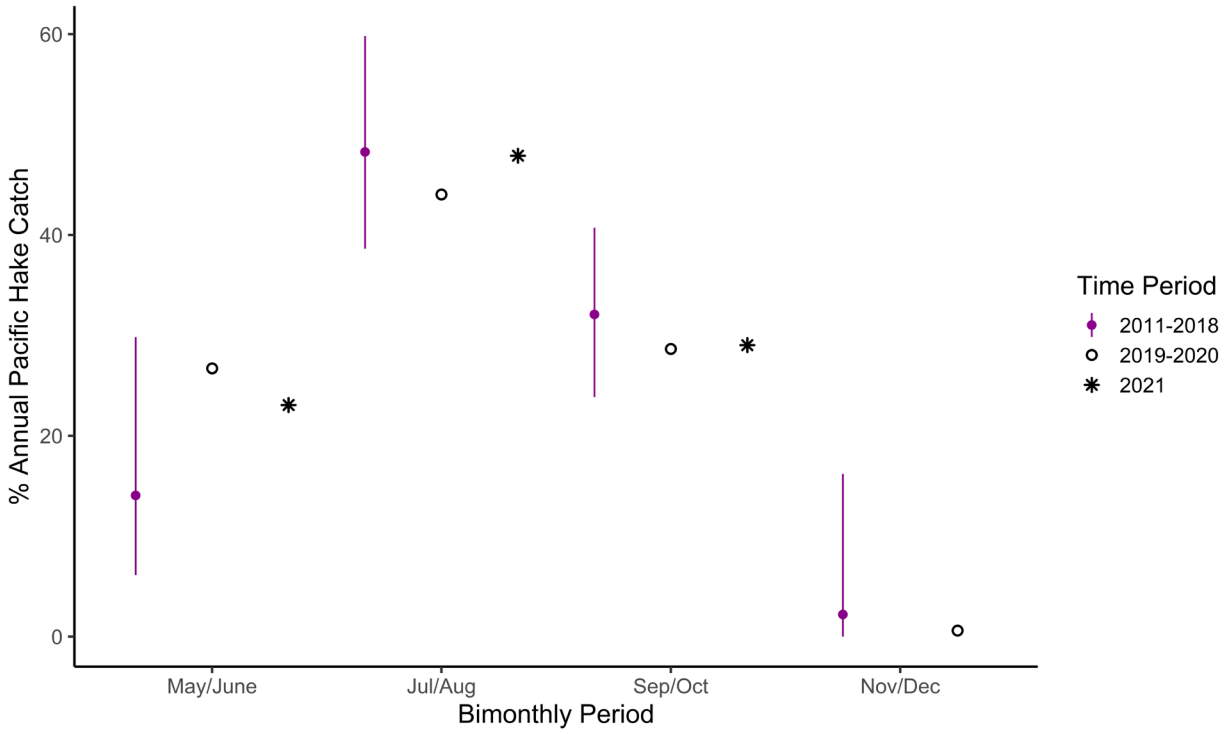

FIGURE 17. Percentage of retained hake landed in bimonthly bins by shoreside midwater trawl targeting hake. Minimum, median, and maximum are shown for each time period.

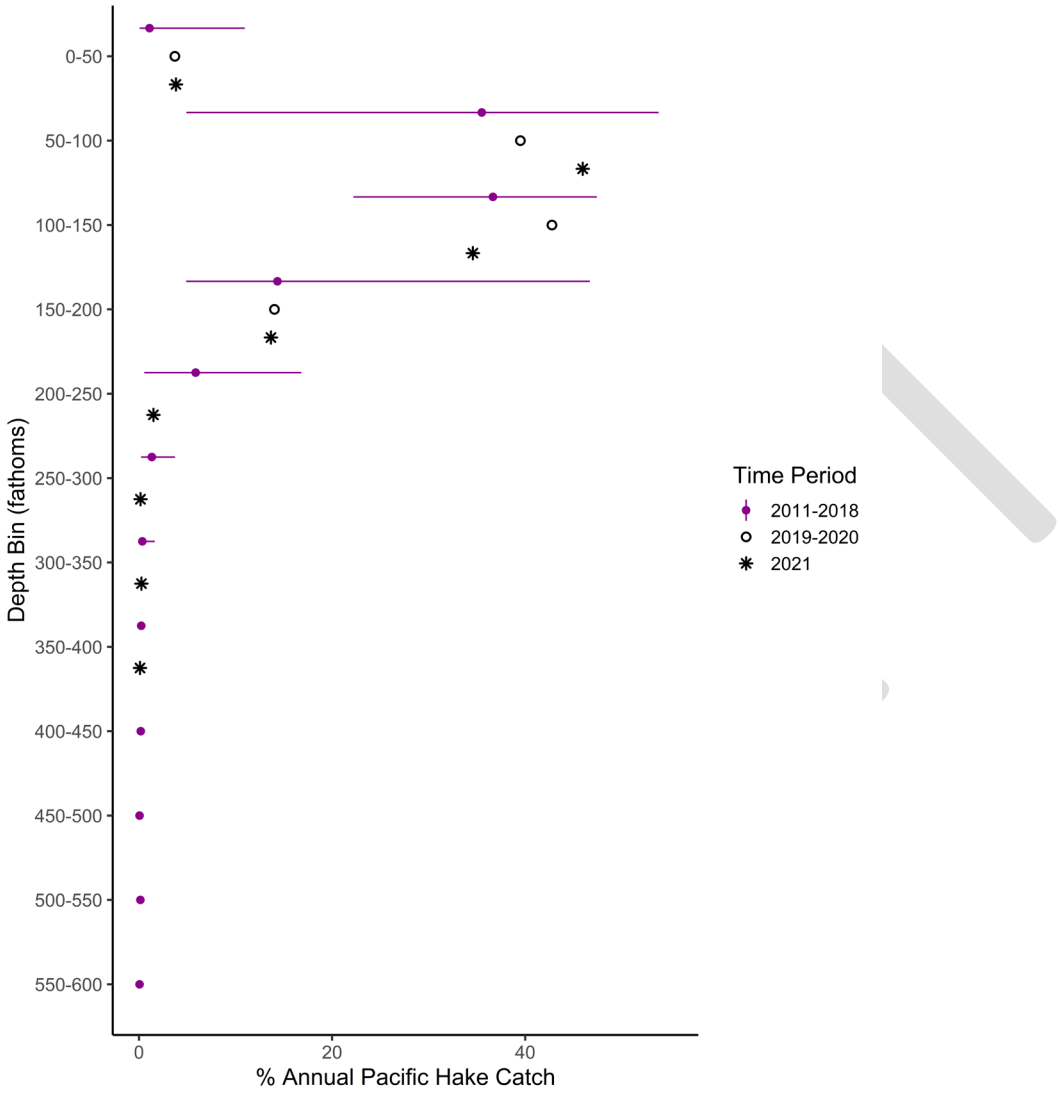

FIGURE 18. Percentage of shoreside midwater hake trawl hauls in 50-fathom depth bins. Minimum, median, and maximum are shown for each time period.

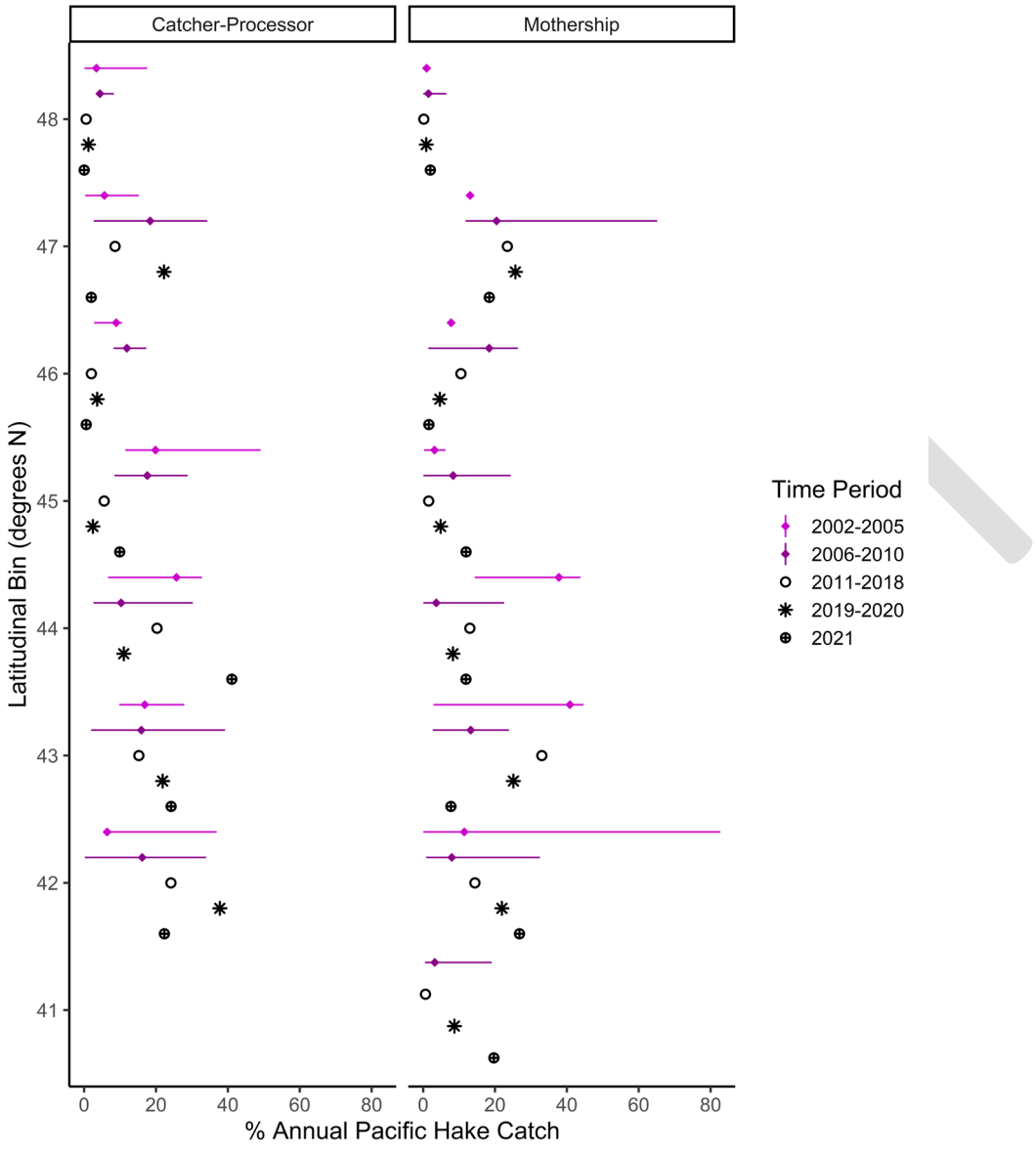

FIGURE 19. Percentage of retained hake caught in latitudinal bins by at-sea midwater trawl sectors. Minimum, median, and maximum are shown for each time period.

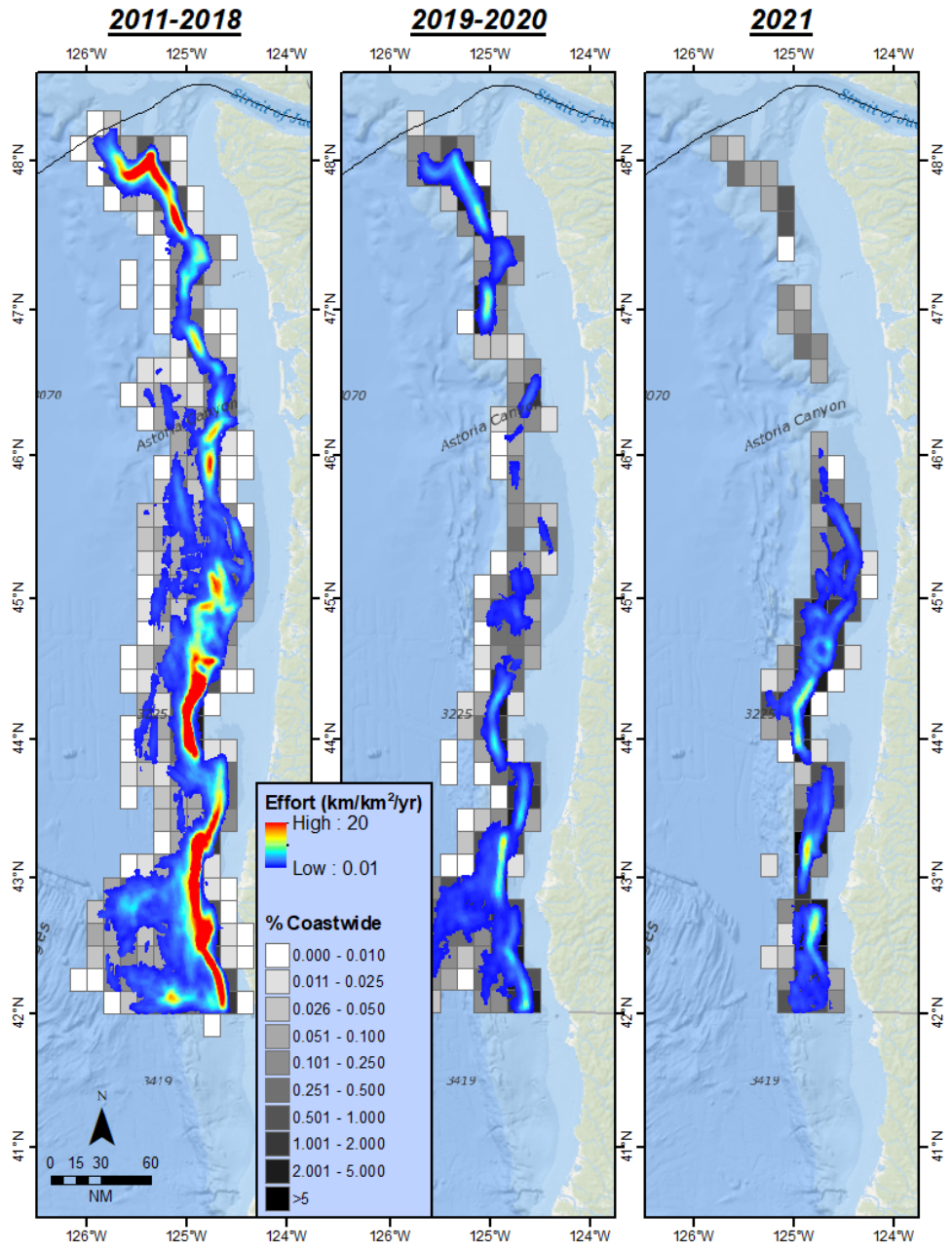

FIGURE 20. Spatial distribution and intensity of fishing effort by at-sea midwater trawl catcher-processors. Intensity (units: km/km²/yr) is depicted by a color ramp of cool (low) to warm (high) colors. The overall footprint of fishing for each time period is depicted in grayscale, with darker (black)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

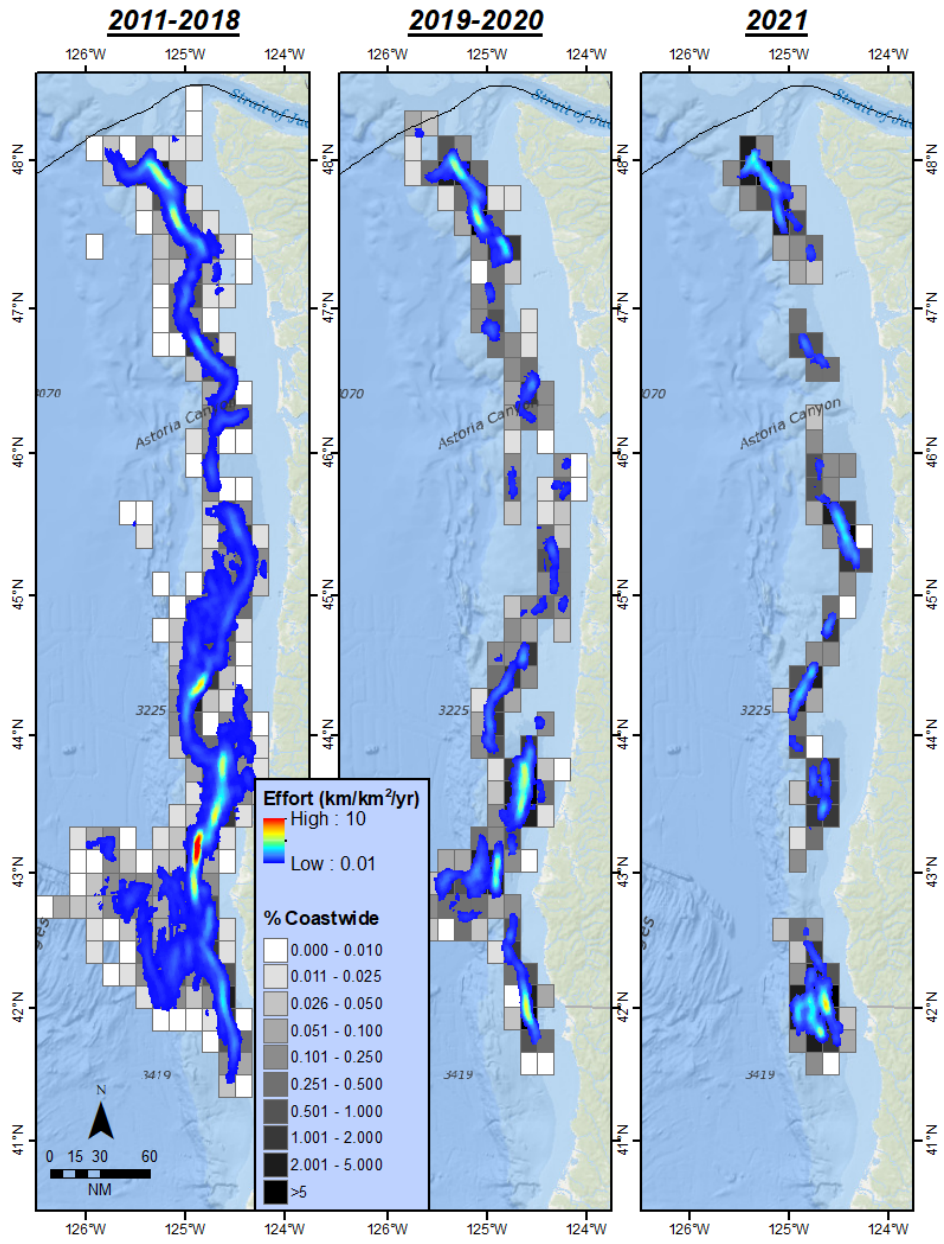

FIGURE 21. Spatial distribution and intensity of fishing effort by at-sea midwater trawl mothership catcher-vessels. Intensity (units: km/km²/yr) is depicted by a color ramp of cool (low) to warm (high) colors. The overall footprint of fishing for each time period is depicted in grayscale, with darker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

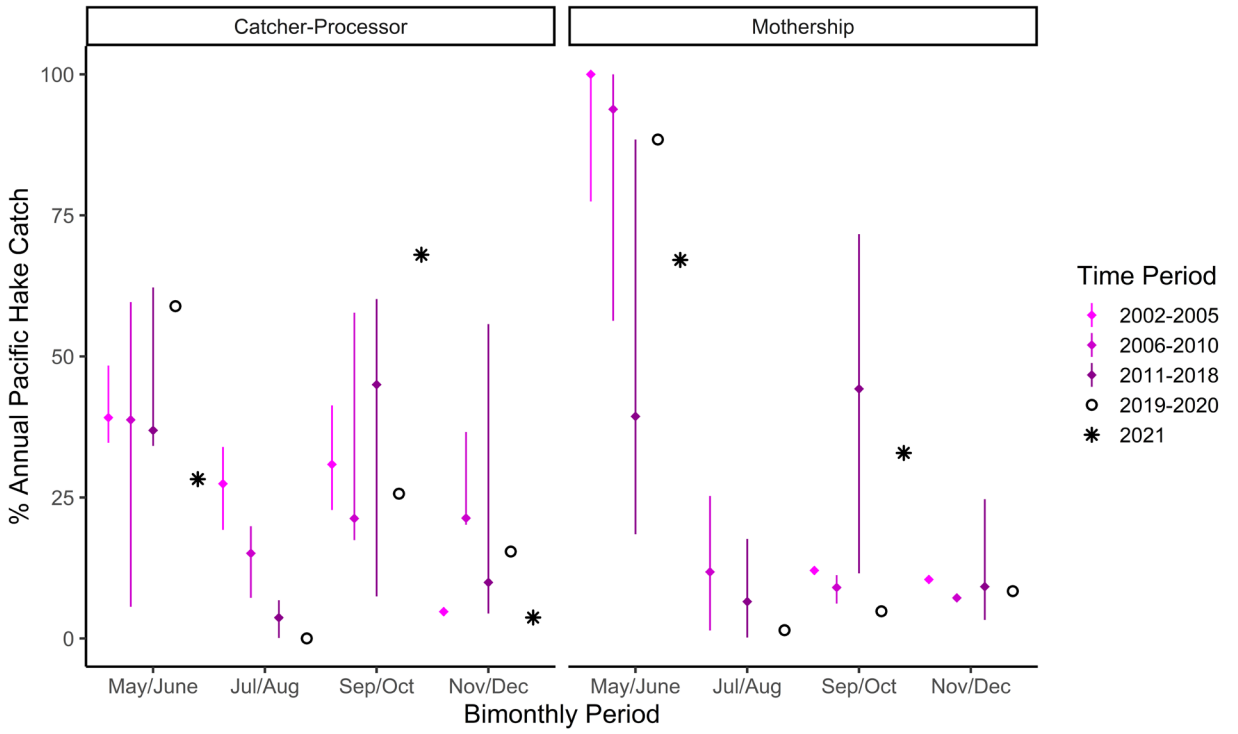

FIGURE 22. Percentage of retained hake caught in bimonthly bins by at-sea midwater trawl sectors. Minimum, median, and maximum are shown for each time period.

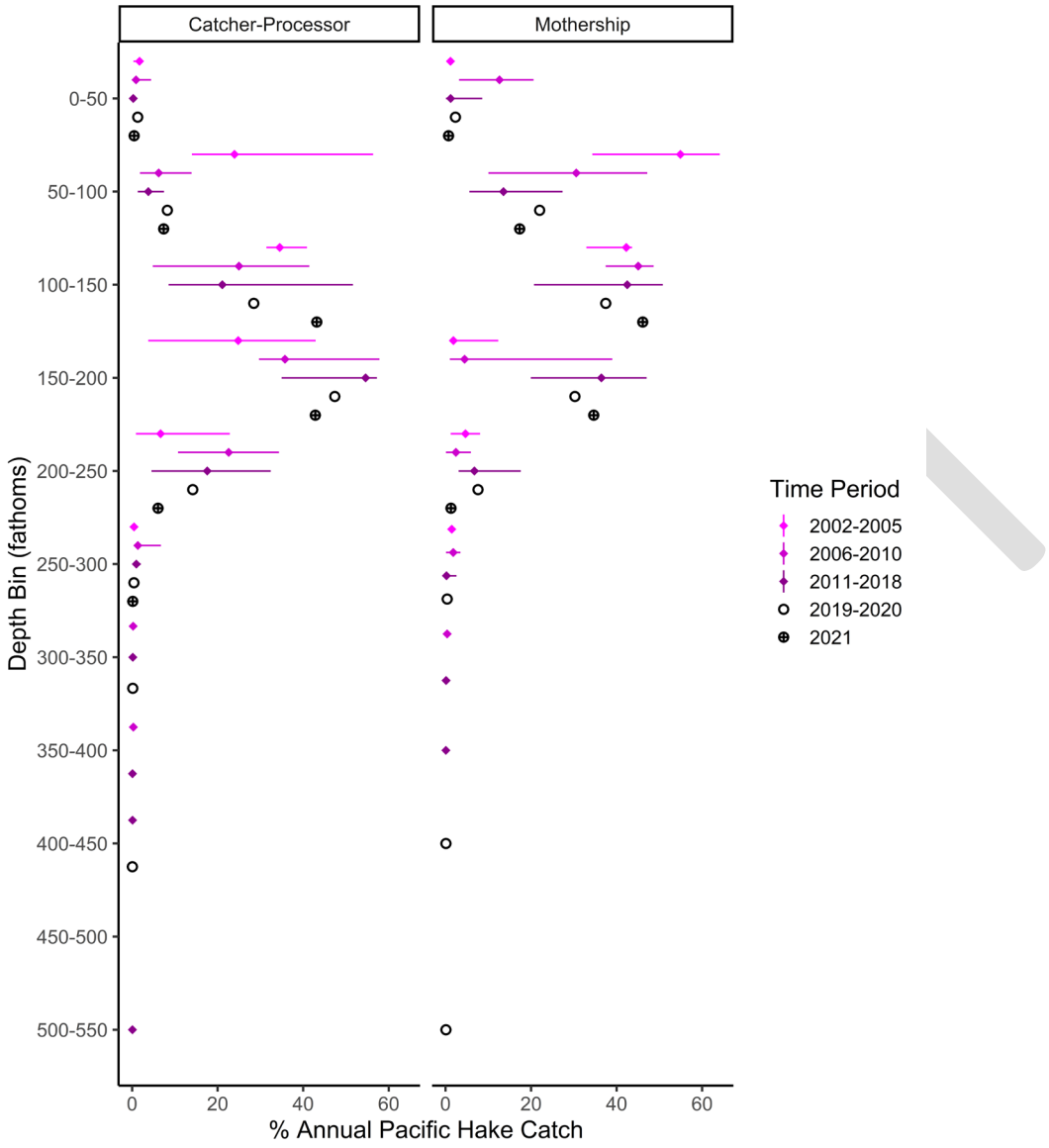

FIGURE 23. Percentage of at-sea midwater trawl hauls in 50-fathom depth bins. Minimum, median, and maximum are shown for each time period.

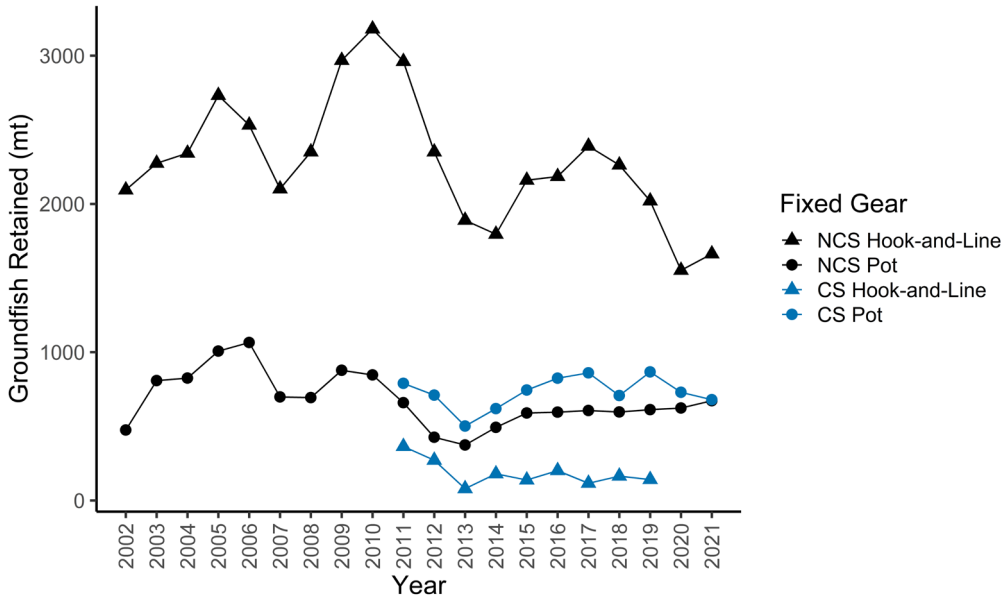

FIGURE 24. Annual total fleet-wide groundfish landings (mt) in fixed gear sectors.

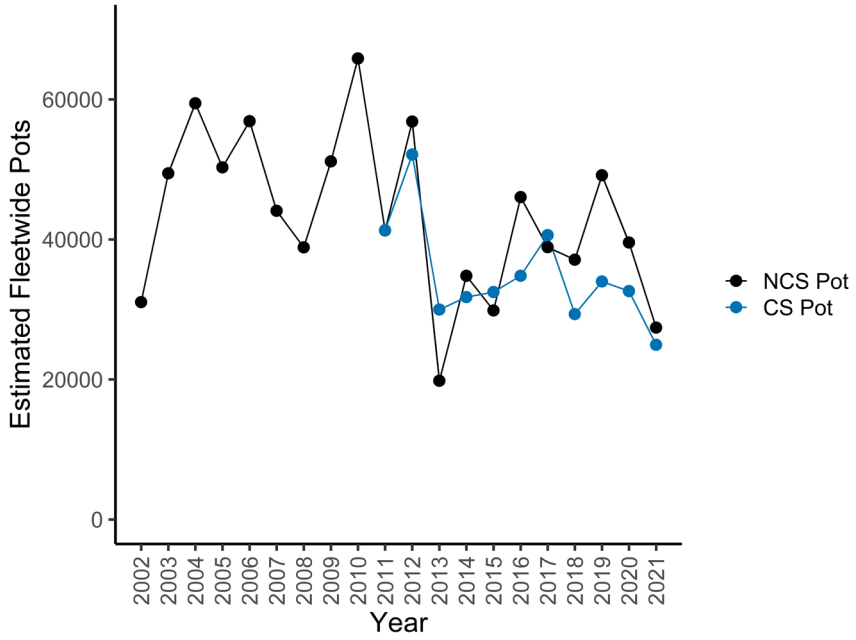

FIGURE 25. Annual total fleet-wide number of pots in the pot sectors.

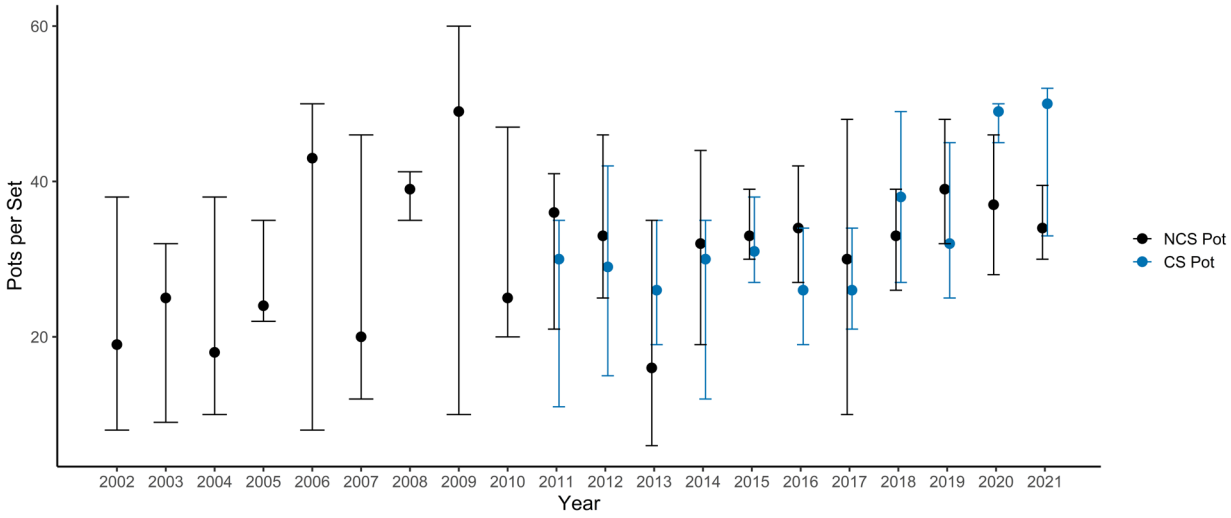

FIGURE 26. Number of pots per set in pot sectors, summarized as median, first, and third quartiles in each year.

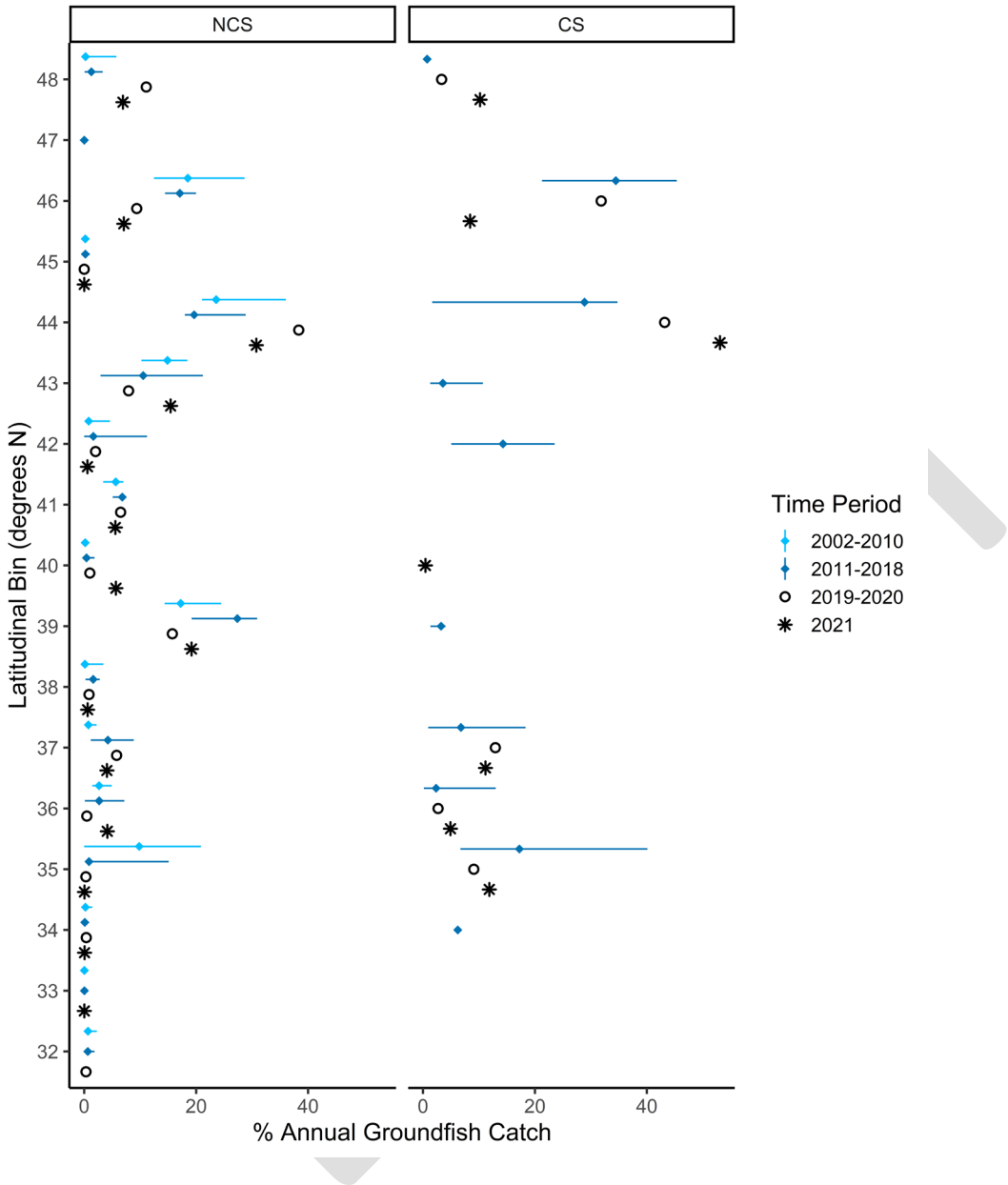

FIGURE 27. Percentage of retained groundfish landed in latitudinal bins by pot sectors patterns in actual fishing activity are shown in Figures 28 and 29. Minimum, median, and maximum are shown for each time period.

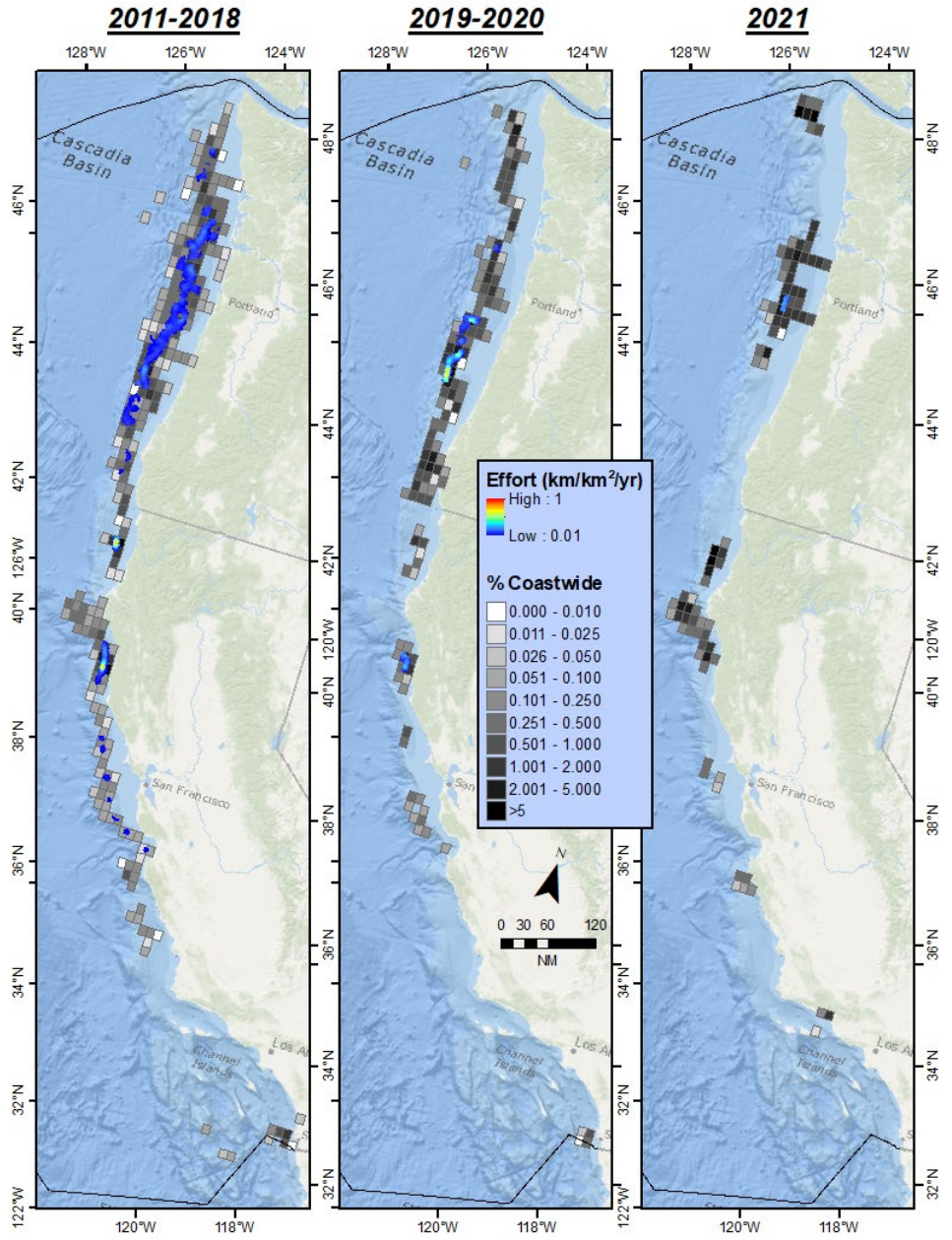

FIGURE 28. Spatial distribution and intensity of fishing effort by the non-catch shares pot sector. Intensity (units: km/km²/yr) is depicted by a color ramp of cool (low) to warm (high) colors. The overall footprint of fishing for each time period is depicted in grayscale, with darker (black) tones depicting a higher relative contribution to coastwide effort within 10x10 min cells.

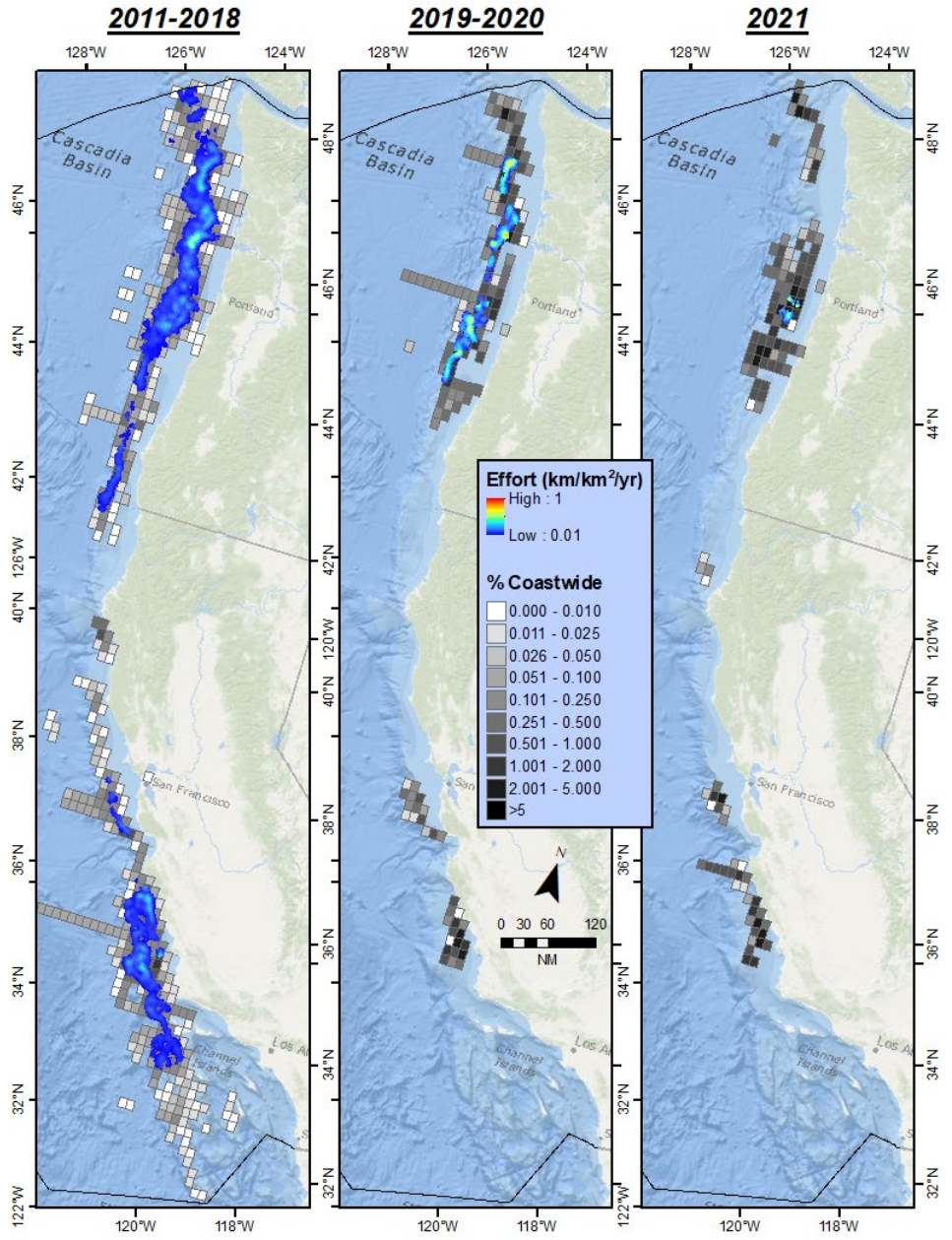

FIGURE 29. Spatial distribution and intensity of fishing effort by the catch shares pot sector. Intensity (units: km/km²/yr) is depicted by a color ramp of cool (low) to warm (high) colors. The overall footprint of fishing for each time period is depicted in grayscale, with darker (black) tones depicting a higher relative contribution to coastwide effort within 10x10 min cells.

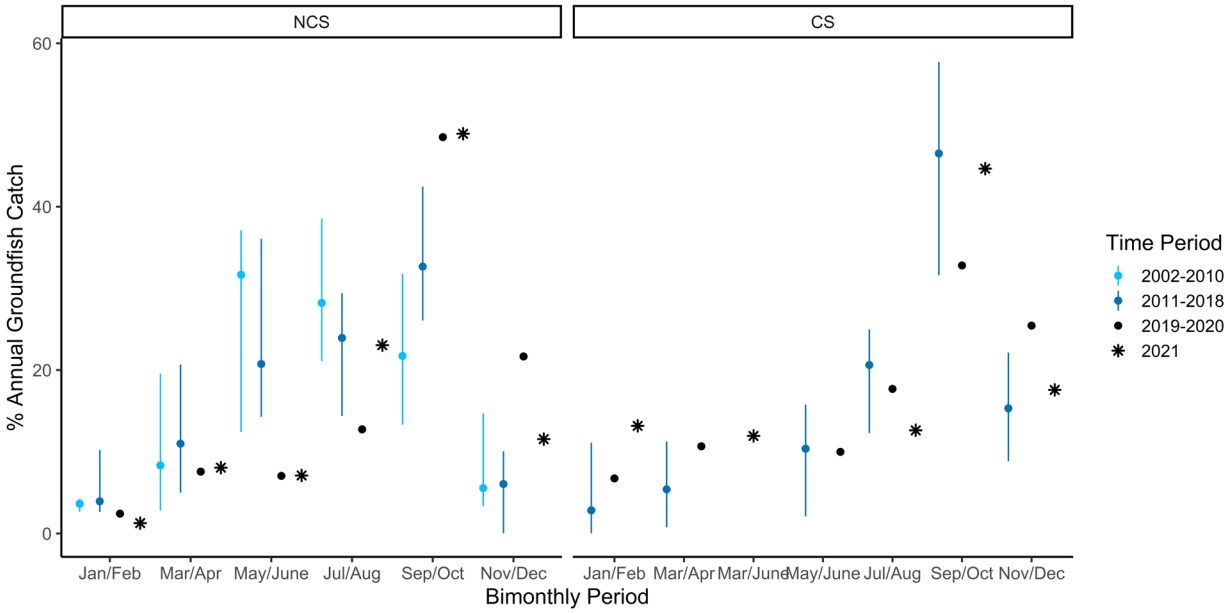

FIGURE 30. Percentage of retained groundfish landed in bimonthly bins by pot sectors. Minimum, median, and maximum are shown for each time period. To maintain confidentiality, the catch shares fleet data are summarized for March through June for 2021.

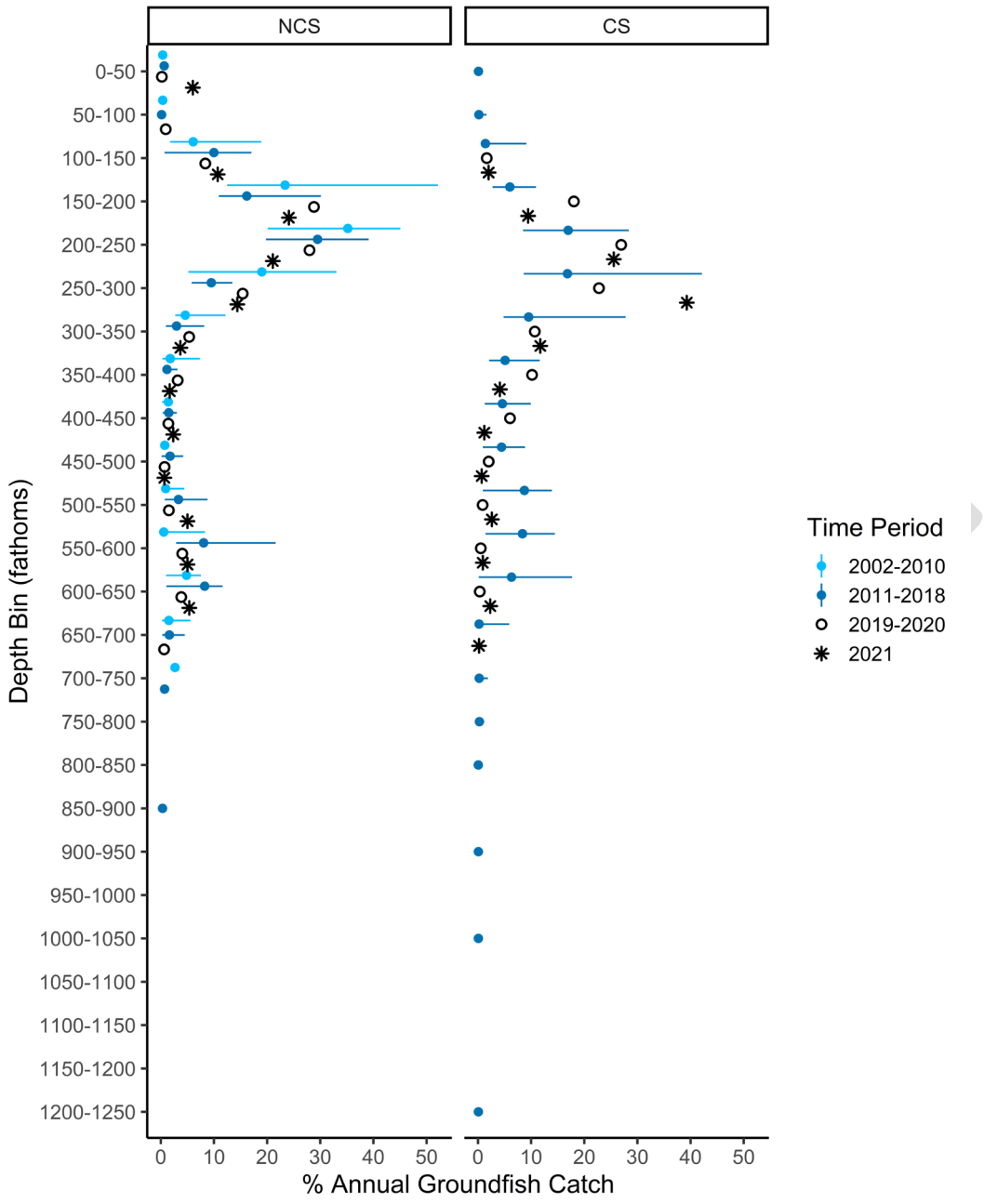

FIGURE 31. Percentage of observed pot sets in 50-fathom depth bins. Minimum, median, and maximum are shown for each time period.

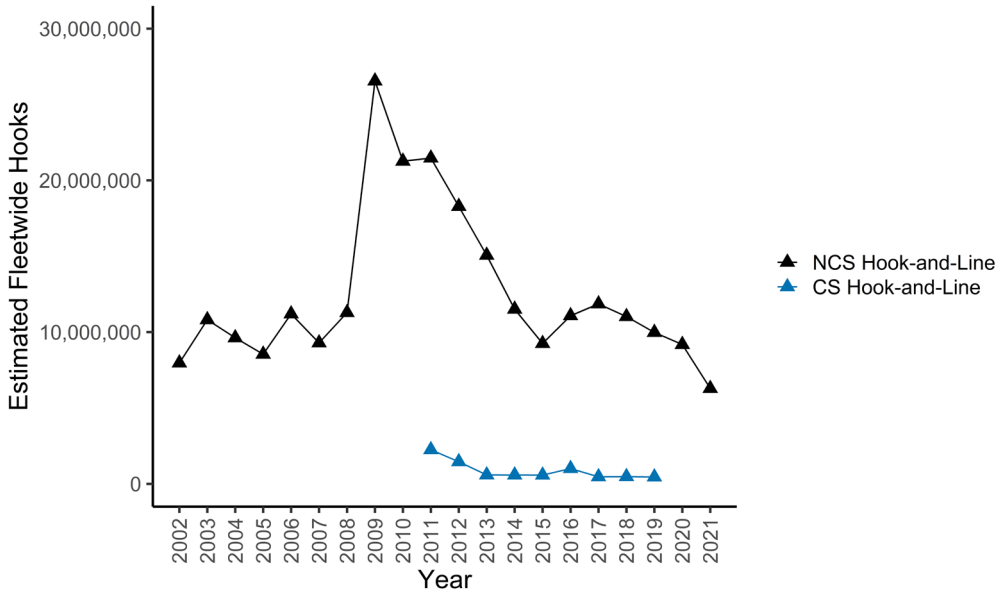

FIGURE 32. Annual total fleetwide number of hooks deployed in hook-and-line sectors.

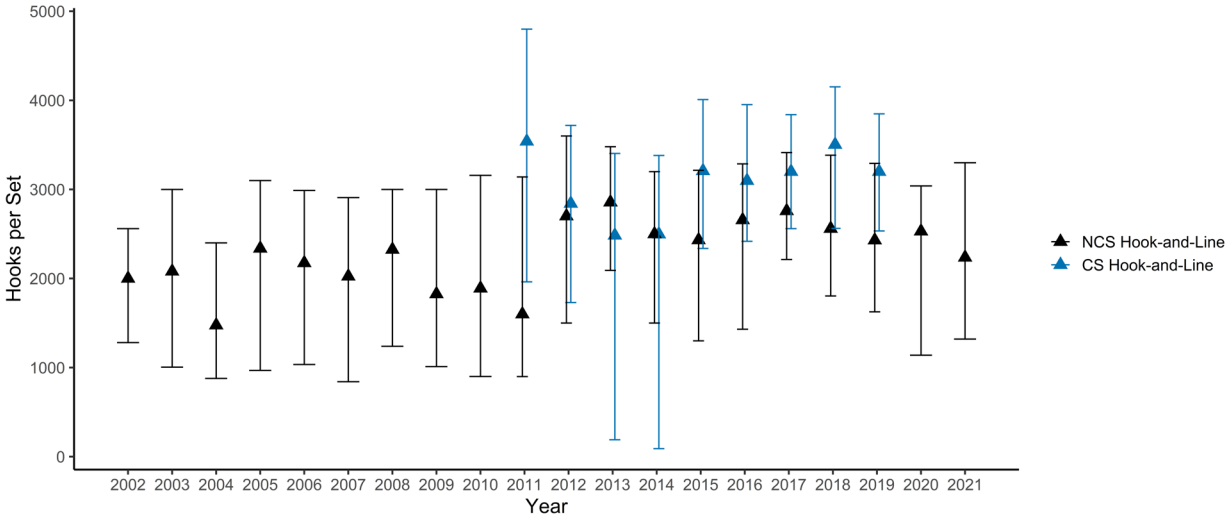

FIGURE 33. Number of hooks per set in hook-and-line sectors, summarized as median, first, and third quartiles in each year.

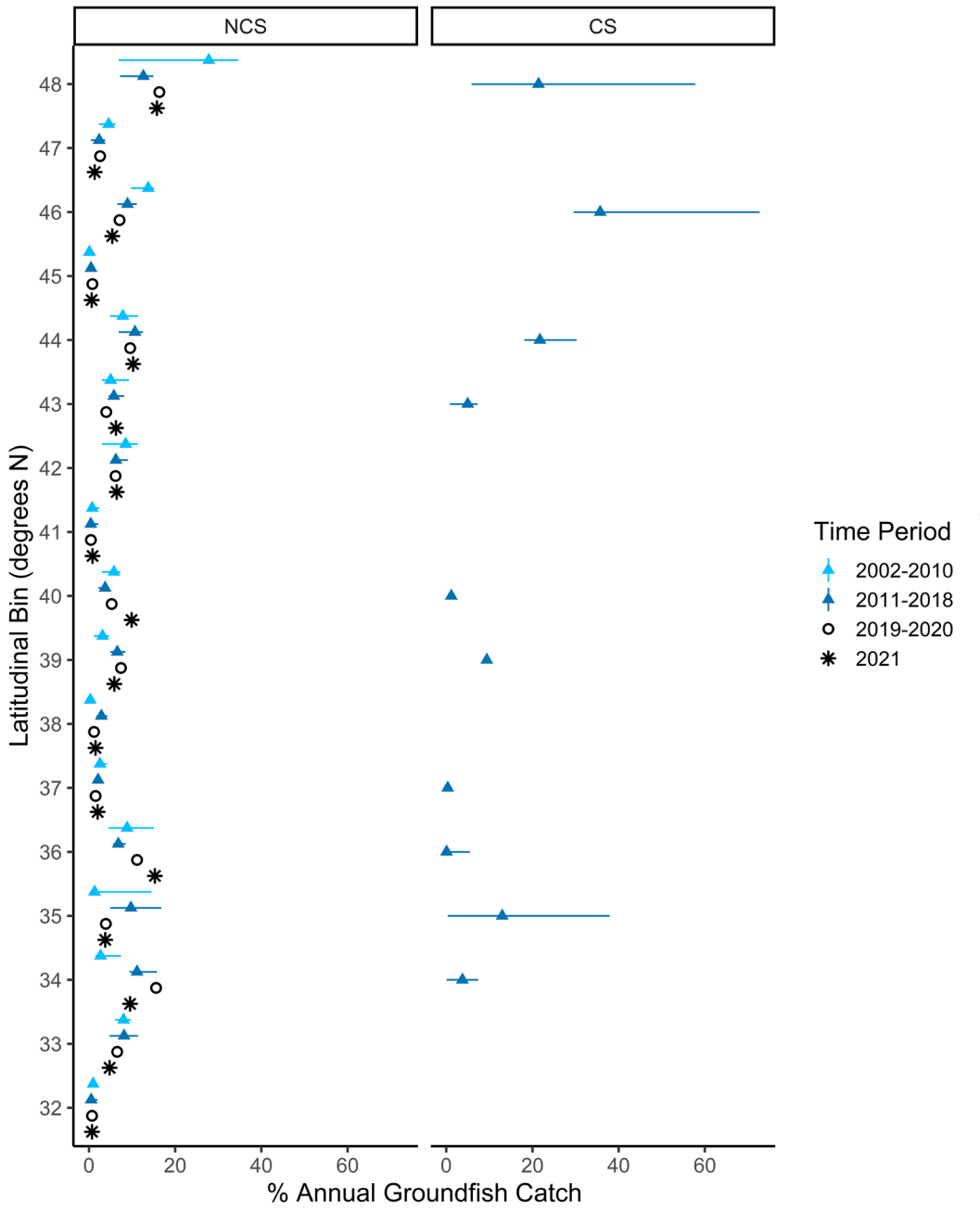

FIGURE 34. Percentage of retained groundfish landed in latitudinal bins by hook-and-line sectors patterns in actual fishing activity are shown in Figures 36 and 37. Minimum, median, and maximum are shown for each time period.

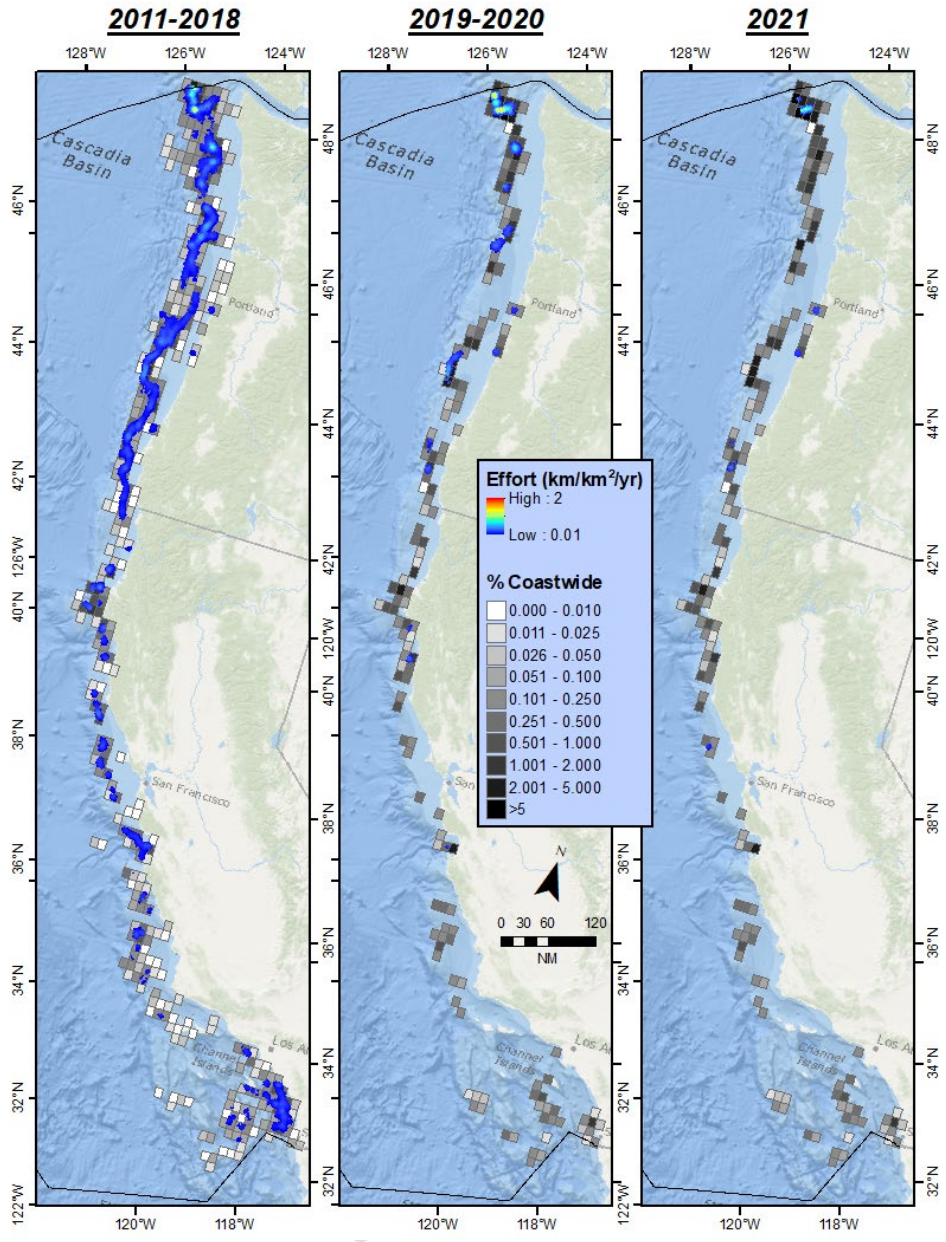

FIGURE 35. Spatial distribution and intensity of fishing effort by the non-catch shares hook-and-line sector. Intensity (units: km/km²/yr) is depicted by a color ramp of cool (low) to warm (high) colors. The overall footprint of fishing for each time period is depicted in grayscale, with darker (black) tones depicting a higher relative contribution to coastwide effort within 10x10 min cells.

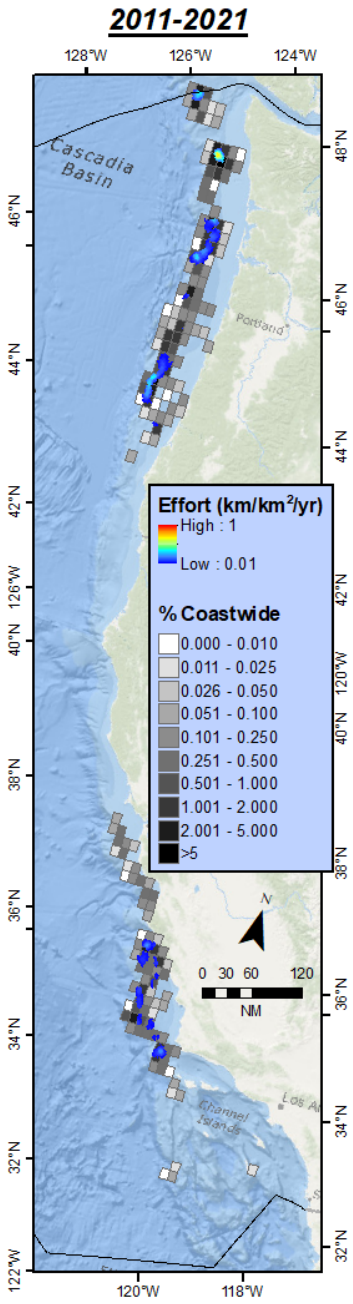

FIGURE 36. Spatial distribution of fishing effort by the catch shares hook-and-line sector. The overall footprint of fishing for each time period is depicted in grayscale, with darker (black) tones depicting a higher relative contribution to coastwide effort within 10x10 min cells.

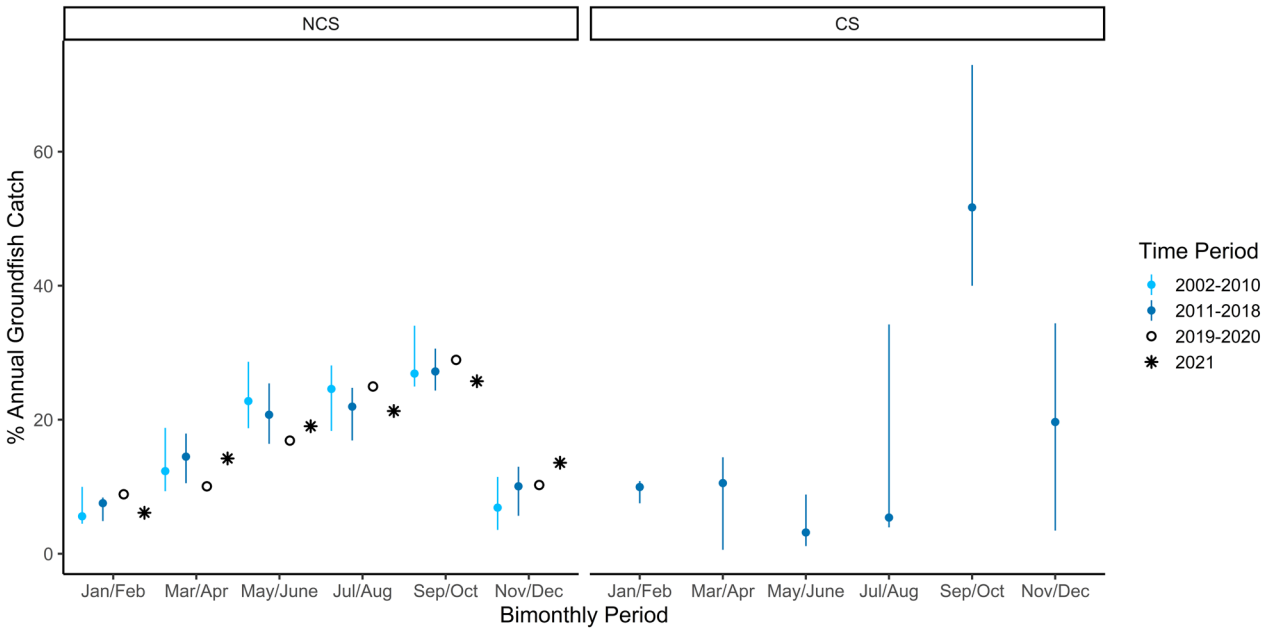

FIGURE 37. Percentage of retained groundfish landed in bimonthly bins by hook-and-line sectors. Minimum, median, and maximum are shown for each time period. Catch shares data beyond 2018 are not shown to maintain confidentiality, because less than 3 vessels were active in some of the seasonal strata.

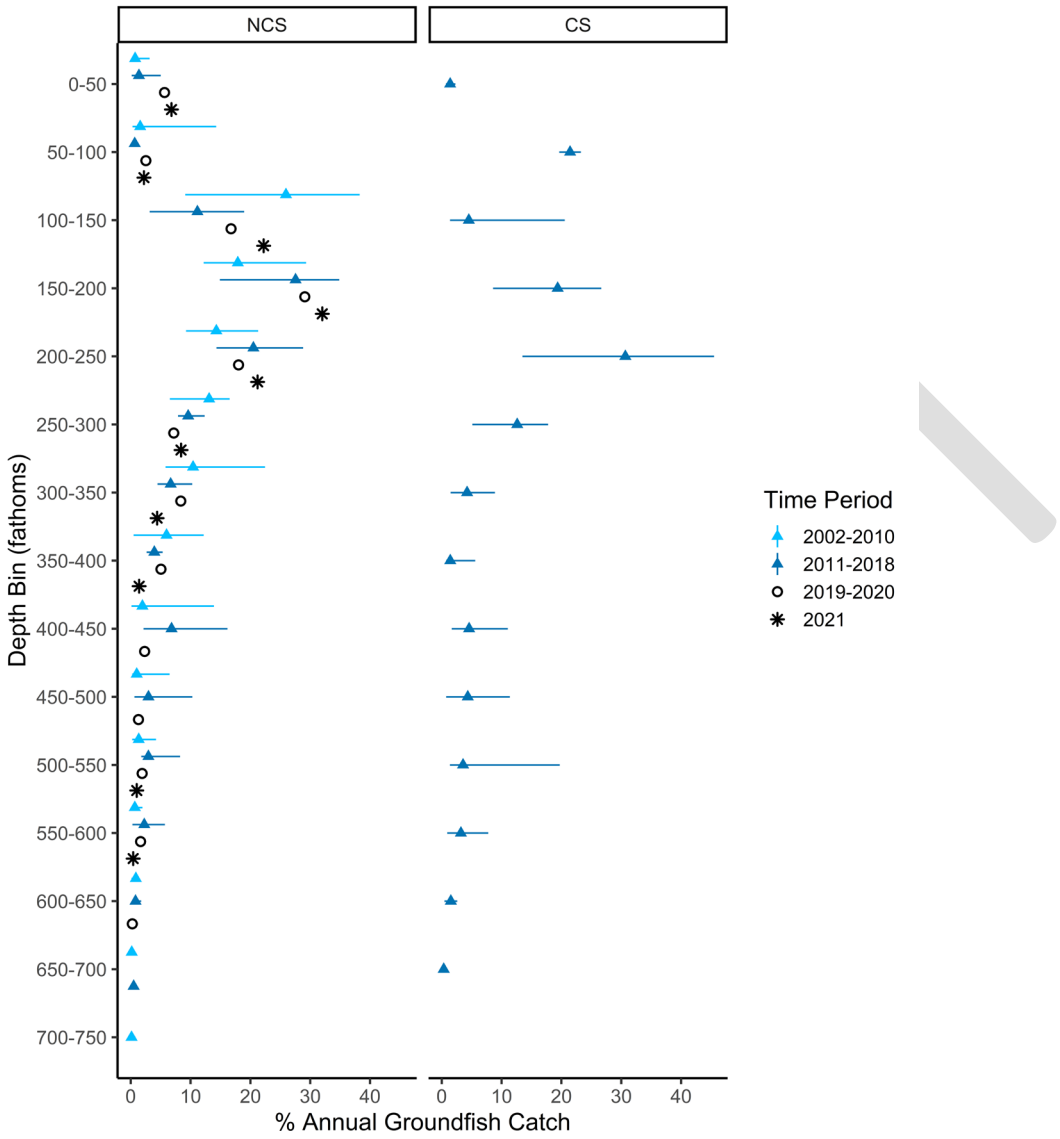

FIGURE 38. Percentage of observed hook-and-line sets in 50-fathom depth bins. Minimum, median, and maximum are shown for each time period.

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 2019 and 2020 are grouped for analysis whereas 2021 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 2018; 2019; 2020; 2021.
CS Midwater Rockfish Trawl	Fish tickets	WCGOP, Logbook	Fish tickets	WCGOP, Logbook	Fish tickets	WCGOP, Logbook	2011 to 2018; 2019; 2020; 2021.
CS SS Midwater Hake Trawl	Fish tickets	WCGOP, Logbook	Fish tickets	WCGOP, Logbook	Fish tickets	WCGOP, Logbook	2011 to 2018; 2019; 2020; 2021.
CS At-Sea CP	A-SHOP	A-SHOP	A-SHOP	A-SHOP	A-SHOP	A-SHOP	2002 to 2006; 2006 to 2010; 2011 to 2018; 2019; 2020; 2021.
CS At-Sea MSCV	A-SHOP	A-SHOP	A-SHOP	A-SHOP	A-SHOP	A-SHOP	2002 to 2006; 2006 to 2010; 2011 to 2018; 2019; 2020; 2021.
NCS Pot	Fish tickets	WCGOP, Fish Tickets	Fish tickets	WCGOP	Fish tickets	WCGOP	2002 to 2010; 2011 to 2018; 2019; 2020; 2021. Latitudinal and depth: 2011 to 2018; 2019 to 2020; 2021.
CS Pot	Fish tickets	WCGOP, Logbook	Fish tickets	WCGOP, Logbook	Fish tickets	WCGOP, Logbook	2011 to 2018; 2019; 2020; 2021. Depth: 2011 to 2018; 2019 to 2020; 2021.
NCS Hook-and-Line	Fish tickets	WCGOP, Fish Tickets	Fish tickets	WCGOP	Fish tickets	WCGOP	2002 to 2010; 2011 to 2018; 2019 to 2020; 2021.
CS Hook-and-Line	Fish tickets	WCGOP, Logbook	Fish tickets	WCGOP, Logbook	Fish tickets	WCGOP, Logbook	2011 to 2018 only.

TABLE 2. Effort by trawl gears. 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. Dashes indicate data summaries not applicable to the given sector. Asterisks indicate confidential data.

Sector and Gear		Year	Vessels	Trips	Hauls	Targeted Retained (mt)	Tow Duration (hrs)	Trawl Hours per Haul		
								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	15607	18421	53954	1.80	2.75	4.50
		2006	119	2379	15461	16774	56348	2.00	3.00	4.70
		2007	121	2395	15086	19575	61227	2.20	3.50	5.40
		2008	119	2391	16327	22930	72760	2.50	4.00	6.00
		2009	117	2675	18736	25576	81481	2.33	3.80	5.83
		2010	104	1947	13863	22134	65966	2.50	4.25	6.50
	CS Bottom Trawl	2011	72	1156	9042	17091	38400	2.00	4.00	5.90
		2012	66	1119	8821	17006	36163	2.00	3.60	5.75
		2013	68	1218	9763	18549	39983	2.00	3.60	5.70
		2014	63	1012	8158	15820	32932	2.00	3.50	5.60
		2015	59	913	7452	16062	28656	1.92	3.17	5.20
		2016	57	890	6895	16762	27047	2.00	3.30	5.27
		2017	62	972	6849	18925	26834	2.00	3.20	5.33
		2018	58	868	6208	15067	22223	1.80	3.00	5.00
		2019	54	829	5854	15100	19739	1.79	2.90	4.60
		2020	50	699	4459	12314	13483	1.77	2.67	3.80
		2021	48	729	4728	12768	13698	1.75	2.65	3.60
	Midwater Rockfish Trawl	2011	*	*	*	*	*	*	*	*
		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
		2020	28	210	384	9382	882	1.00	1.82	3.00
		2021	27	267	448	11722	1133	1.17	2.00	3.35
	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
		2020	28	1239	2763	138224	8623	1.50	2.67	4.25
		2021	25	1014	2013	125633	5947	1.40	2.42	4.07
At-Sea	Midwater Hake Catcher-Processor	2002	5	--	559	36314	1061	1.00	1.75	2.65
		2003	6	--	768	41452	911	0.50	0.92	1.67
		2004	6	--	1501	72839	1973	0.58	1.00	1.77
		2005	6	--	1337	78421	2239	0.75	1.30	2.25
		2006	9	--	1497	78096	2981	1.00	1.67	2.58
		2007	9	--	1577	72800	4404	1.33	2.42	4.00
		2008	8	--	1886	107846	5558	1.67	2.67	3.83
		2009	5	--	868	34542	1932	1.25	2.00	3.00
		2010	6	--	1068	54210	2653	1.33	2.33	3.33
		2011	9	--	1549	71282	4762	1.75	2.92	4.08
		2012	9	--	1107	55457	3546	2.08	2.92	4.00
		2013	9	--	1459	77906	3294	1.35	2.17	2.92
		2014	9	--	1696	103172	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
		2020	10	--	1505	111015	4975	1.67	2.92	4.42
		2021	10	--	1522	103261	4891	1.68	2.93	4.32
	Midwater Hake Mothership Catcher Vessel	2002	11	--	574	26489	1625	1.25	2.50	3.94
		2003	12	--	536	25323	501	0.42	0.67	1.25
		2004	10	--	571	24004	797	0.58	1.08	1.75
		2005	18	--	1040	48553	1883	0.67	1.33	2.50
		2006	20	--	1283	54034	2326	0.67	1.25	2.50
		2007	20	--	1147	47213	3134	1.33	2.33	3.76
		2008	19	--	1349	57736	3866	1.08	2.30	4.00
		2009	19	--	600	24032	1686	1.31	2.46	3.92
		2010	21	--	908	35722	2805	1.48	2.59	4.25
		2011	18	--	1248	49932	2976	0.88	1.75	3.17
		2012	16	--	949	37997	3162	1.67	2.78	4.50
		2013	18	--	1256	52305	3076	1.08	2.00	3.33
		2014	19	--	1308	61794	3547	1.00	1.83	3.42
		2015	14	--	640	27549	2135	1.25	2.25	4.00
		2016	17	--	1565	64598	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
		2020	15	--	769	37261	2002	0.92	1.75	3.25
		2021	17	--	716	35507	2636	1.41	3.00	5.17

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		
							Gear Units per Set		
			Vessels	Trips	Groundfish Retained (mt)	Estimated Total Gear Units	Lower Quartile	Median	Upper 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	44074	12	20	46
		2008	153	1441	693	38850	35	39	41
		2009	167	1468	878	51130	10	49	60
		2010	144	1260	846	65840	20	25	47
		2011	155	1051	659	41280	21	36	41
		2012	124	697	426	56838	25	33	46
		2013	72	530	374	19803	6	16	35
		2014	98	515	493	34797	19	32	44
		2015	138	854	590	29848	30	33	39
		2016	159	938	596	46037	27	34	42
		2017	152	950	607	38886	10	30	48
		2018	144	704	597	37105	26	33	39
		2019	105	599	612	49153	32	39	48
		2020	86	363	623	39545	28	37	46
		2021	75	412	673	27400	30	34	40
	Catch Shares	2011	18	218	789	41310	11	30	35
		2012	19	247	710	52116	15	29	42
		2013	11	93	502	29982	19	26	35
		2014	13	103	619	31754	12	30	35
		2015	13	115	745	32482	27	31	38
		2016	14	128	824	34793	19	26	34
		2017	14	124	860	40615	21	26	34
		2018	12	91	707	29329	27	38	49
		2019	13	130	867	33979	25	32	45
		2020	10	119	729	32614	45	49	50
		2021	8	87	679	24935	33	50	52
Hook-and-Line	Non-Catch Shares	2002	455	4395	2094	7966946	1280	2000	2560
		2003	498	4655	2274	10817806	1005	2080	3000
		2004	486	4035	2342	9624423	878	1476	2400
		2005	505	4406	2732	8546003	968	2338	3100
		2006	533	4148	2532	11195417	1035	2175	2988
		2007	508	3991	2101	9290013	842	2025	2908
		2008	472	4613	2350	11286289	1239	2325	3000
		2009	494	5474	2968	26552037	1011	1826	3000
		2010	474	6058	3180	21263056	900	1890	3158
		2011	518	5554	2961	21469414	899	1600	3140
		2012	483	4685	2351	18284681	1500	2700	3600
		2013	485	4085	1890	15065733	2091	2856	3480
		2014	516	4072	1796	11510664	1500	2500	3200
		2015	674	4682	2160	9252980	1300	2432	3215
		2016	618	4365	2185	11078120	1431	2657	3287
		2017	610	4680	2389	11860064	2213	2759	3414
		2018	610	4366	2262	11022083	1805	2560	3384
		2019	507	3870	2020	9980575	1626	2430	3293
		2020	452	3487	1552	9180567	1139	2530	3040
		2021	419	3204	1663	6284939	1320	2237	3300
	Catch Shares	2011	13	107	364	2247803	1963	3540	4800
		2012	9	37	271	1457954	1730	2842	3719
		2013	9	29	80	587238	190	2484	3404
		2014	12	43	179	579183	90	2497	3382
		2015	5	16	138	577070	2338	3208	4009
		2016	7	33	201	1005900	2418	3099	3953
		2017	3	12	116	464557	2560	3200	3840
		2018	4	11	164	473437	2563	3503	4152
		2019	3	10	141	452294	2534	3200	3849
		2020	*	*	*	*	*	*	*
		2021	*	*	*	*	*	*	*

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	6447	698	15%
		2008	26	79	404	258	14471	693	37%
		2009	21	57	112	76	4424	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	283	21906	596	48%
		2017	47	99	312	142	9101	607	23%
		2018	40	93	612	311	19316	597	52%
		2019	31	70	495	225	18088	612	37%
		2020	16	45	483	259	16449	623	42%
		2021	13	33	299	228	9292	673	34%
	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	2342	9%
		2005	47	170	775	547	1712636	2732	20%
		2006	47	198	682	340	1503077	2532	13%
		2007	83	284	888	410	1813650	2101	20%
		2008	82	257	829	406	1950815	2350	17%
		2009	75	252	664	161	1437920	2968	5%
		2010	92	439	1339	452	3024816	3180	14%
		2011	95	368	1200	375	2722104	2961	13%
		2012	66	250	837	305	2369109	2351	13%
		2013	53	205	631	226	1805223	1890	12%
		2014	55	190	679	271	1739445	1796	15%
		2015	62	200	826	492	2109489	2160	23%
		2016	65	190	809	408	2069693	2185	19%
		2017	77	204	844	478	2374657	2389	20%
		2018	81	232	1019	554	2697800	2262	24%
		2019	63	183	840	430	2125334	2020	21%
		2020	30	92	254	108	637403	1552	7%
		2021	50	148	500	305	1152957	1663	18%

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

Sector	Gear	Year	Observed					Fleetwide Targeted Species or Groups Retained (mt)	% Landings Observed	Observed Hauls or Sets with Lost Gear	% Observed Hauls or Sets with Lost Gear	Observed Fixed Gear Lost	% Observed Fixed Gear Lost	Observed Hauls or Sets Recovering Derelict Gear	% Observed Hauls or Sets Recovering Derelict Gear
			Vessel	Trips	Hauls or Sets	Effort (hours or hooks/pots)	Retained Target Species (mt)								
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	9180	40120.12	16964.3	17086.1	99%	11	0.12%	--	--	403	4.39%
	Bottom Trawl	2012	67	1089	8944	37961.1	16902.2	17050.3	99%	4	0.04%	--	--	362	4.05%
		2013	68	1193	9995	42000.31	18484.2	18571.2	100%	5	0.05%	--	--	301	3.01%
		2014	64	1032	8314	34154.95	15731.2	15838.7	99%	2	0.02%	--	--	264	3.18%
		2015	60	904	7467	28816.8	15590.3	15658.2	100%	2	0.03%	--	--	281	3.76%
		2016	53	802	6598	24951.63	14900.9	15002.8	99%	4	0.06%	--	--	192	2.91%
		2017	54	839	6388	25112.3	16096.9	16125.4	100%	4	0.06%	--	--	195	3.05%
		2018	48	695	5364	19434.93	12689.4	12780.0	99%	1	0.02%	--	--	136	2.54%
		2019	45	647	5014	16805.39	12668.5	12741.3	99%	4	0.08%	--	--	177	3.53%
		2020	42	519	3597	10769.24	9513.0	10500.7	91%	0	0.00%	--	--	203	5.64%
		2021	38	565	3874	11655.17	10871.4	11241.6	97%	3	0.08%	--	--	219	5.65%
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	51	278	1000.96	582.8	2343.8	25%	2	0.72%	--	--	7	2.52%
		2020	5	13	66	210.94	160.0	2065.3	8%	0	0.00%	--	--	3	4.55%
		2021	6	23	108	284.61	163.6	1512.5	11%	0	0.00%	--	--	4	3.70%
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	624	2247803	334.0	335.9	99%	6	0.96%	4286	0.19%	2	0.32%
		2012	8	32	501	1457954	239.0	241.3	99%	7	1.40%	12057	0.83%	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	219	579183	85.2	98.4	87%	5	2.28%	79	0.01%	0	0.00%
		2015	5	16	180	577070	133.4	137.8	97%	1	0.56%	382	0.07%	0	0.00%
		2016	5	30	322	1005900	177.2	192.7	92%	3	0.93%	6172	0.61%	1	0.31%
		2017	4	13	145	464557	112.9	116.4	97%	0	0.00%	0	0.00%	1	0.69%
		2018	4	10	135	473437	152.3	164.0	93%	1	0.74%	513	0.11%	0	0.00%

TABLE 5, CONTINUED.

Sector	Gear	Year	Observed					Fleetwide Targeted Species or Groups Retained (mt)	% Landings Observed	Observed Hauls or Sets with Lost Gear	% Observed Hauls or Sets with Lost Gear	Observed Fixed Gear Lost	% Observed Fixed Gear Lost	Observed Hauls or Sets Recovering Derelict Gear	% Observed Hauls or Sets Recovering Derelict Gear
			Vessel	Trips	Hauls or Sets	Effort (hours or hooks/pots)	Retained Target Species (mt)								
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	1704	52116	739.0	740.7	100%	87	5.11%	322	0.62%	1	0.06%
		2013	10	100	1080	29982	467.5	470.8	99%	35	3.24%	100	0.33%	0	0.00%
		2014	14	118	1284	31754	678.0	681.1	100%	56	4.36%	203	0.64%	0	0.00%
		2015	8	62	575	18556	401.8	405.3	99%	33	5.74%	126	0.68%	4	0.70%
		2016	8	61	580	15632	384.9	387.1	99%	34	5.86%	90	0.58%	2	0.34%
		2017	6	44	572	16258	365.4	366.0	100%	12	2.10%	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	488	16667	367.8	376.0	98%	18	3.69%	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	318	6740	164.2	414.8	40%	9	2.83%	11	0.16%	2	0.63%
		2019	6	30	194	5563	125.6	491.1	26%	4	2.06%	14	0.25%	0	0.00%
Limited Entry Sablefish	Hook and Line	2003	15	48	351	733602	222.8	1051.6	21%	3	0.85%	0	0.00%	0	0.00%
		2004	17	45	326	492009	180.0	1319.0	14%	6	1.84%	0	0.00%	0	0.00%
		2005	26	101	678	1456102	481.5	1350.2	36%	9	1.33%	0	0.00%	2	0.29%
		2006	19	68	470	939951	295.9	1401.2	21%	2	0.43%	0	0.00%	0	0.00%
		2007	22	75	517	1034046	298.5	1106.6	27%	3	0.58%	0	0.00%	0	0.00%
		2008	18	77	540	1245241	338.1	1111.1	30%	8	1.48%	0	0.00%	1	0.19%
		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	1162.8	21%	5	0.74%	4205	0.30%	1	0.15%
		2012	17	88	532	1580075	239.3	1093.8	22%	6	1.13%	2104	0.13%	0	0.00%
		2013	18	58	353	1047526	166.4	754.3	22%	6	1.70%	5312	0.51%	0	0.00%
		2014	17	85	486	1174141	199.7	767.2	26%	8	1.65%	10862	0.93%	7	1.44%
		2015	26	97	628	1531122	396.8	960.9	41%	2	0.32%	1224	0.08%	4	0.64%
		2016	21	94	662	1714034	334.9	1026.1	33%	6	0.91%	3511	0.20%	4	0.60%
		2017	25	109	694	2094856	394.0	1077.2	37%	7	1.01%	6675	0.32%	5	0.72%
		2018	27	122	830	2379757	458.8	1054.6	44%	6	0.72%	7489	0.31%	5	0.60%
		2019	21	98	673	1791897	358.6	940.6	38%	1	0.15%	1982	0.11%	3	0.45%
		2020	12	49	176	478317	85.4	676.9	13%	2	1.14%	2195	0.46%	2	1.14%
		2021	19	93	416	1029800	254.1	814.1	31%	3	0.72%	2880	0.28%	6	1.44%
	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	626.9	13%	6	4.32%	0	0.00%	0	0.00%
		2005	7	39	492	13822	281.2	614.3	46%	14	2.85%	0	0.00%	0	0.00%
		2006	7	39	289	10708	200.5	611.1	33%	25	8.65%	0	0.00%	0	0.00%
		2007	4	30	154	5823	90.0	428.4	21%	12	7.79%	0	0.00%	0	0.00%
		2008	6	24	329	13638	244.9	433.0	57%	3	0.91%	0	0.00%	0	0.00%
		2009	3	27	67	3884	66.5	488.6	14%	5	7.46%	0	0.00%	0	0.00%
		2010	7	43	314	11294	140.4	505.9	28%	9	2.87%	39	0.35%	0	0.00%
		2011	3	22	227	9029	137.4	368.7	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	262.8	367.5	72%	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	406.6	72%	4	0.76%	11	0.06%	0	0.00%
		2019	5	24	425	17451	206.6	439.2	47%	3	0.71%	6	0.03%	1	0.24%
		2020	9	34	461	16339	251.4	536.5	47%	5	1.08%	11	0.07%	0	0.00%
		2021	8	25	274	8990	222.1	571.5	39%	5	1.82%	32	0.36%	2	0.73%

TABLE 5, CONTINUED.

Sector	Gear	Year	Observed					Fleetwide Targeted Species or Groups Retained (mt)	% Landings Observed	Observed Hauls or Sets with Lost Gear	% Observed Hauls or Sets with Lost Gear	Observed Fixed Gear Lost	% Observed Fixed Gear Lost	Observed Hauls or Sets Recovering Derelict Gear	% Observed Hauls or Sets Recovering Derelict Gear
			Vessel	Trips	Hauls or Sets	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%	4	3.08%	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	69	244567	23.4	553.3	4%	2	2.90%	882	0.36%	0	0.00%
		2017	12	34	71	183990	15.7	564.1	3%	7	9.86%	6995	3.80%	1	1.41%
		2018	13	29	85	227071	20.7	555.3	4%	8	9.41%	4282	1.89%	0	0.00%
		2019	14	39	87	271718	17.9	503.6	4%	3	3.45%	1130	0.42%	0	0.00%
		2020	8	21	44	133467	7.7	406.0	2%	6	13.64%	11440	8.57%	0	0.00%
		2021	7	11	21	63925	7.2	323.2	2%	0	0.00%	0	0.00%	1	4.76%
Open Access Fixed Gear	Hook and Line	2003	13	41	49	86518	16.5	563.0	3%	2	4.08%	0	0.00%	0	0.00%
		2004	14	42	52	85895	16.2	481.6	3%	2	3.85%	0	0.00%	0	0.00%
		2005	10	34	37	58384	9.8	623.9	2%	1	2.70%	0	0.00%	0	0.00%
		2007	25	51	67	55215	10.4	263.4	4%	1	1.49%	0	0.00%	0	0.00%
		2009	34	69	104	119849	21.8	645.0	3%	4	3.85%	0	0.00%	0	0.00%
		2010	37	70	105	160570	23.1	756.4	3%	1	0.95%	320	0.20%	2	1.90%
		2011	40	69	101	162419	20.1	434.3	5%	3	2.97%	1766	1.09%	0	0.00%
		2015	20	38	54	124895	17.5	364.0	5%	1	1.85%	150	0.12%	0	0.00%
		2017	43	62	79	95811	14.9	356.6	4%	1	1.27%	1990	2.08%	0	0.00%
		2018	43	83	104	90972	15.9	315.3	5%	2	1.92%	23	0.03%	1	0.96%
		2019	30	50	80	61719	11.8	290.0	4%	1	1.25%	6	0.01%	0	0.00%
		2020	11	24	34	25619	6.6	250.1	3%	0	0.00%	0	0.00%	1	2.94%
		2021	28	47	63	59232	14.8	290.3	5%	2	3.17%	39	0.07%	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%	3	4.00%	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	125.8	7%	2	2.86%	5	0.82%	0	0.00%
		2013	17	25	48	590	6.3	72.2	9%	1	2.08%	1	0.17%	0	0.00%
		2014	21	41	63	686	11.7	147.7	8%	1	1.59%	4	0.58%	0	0.00%
		2015	17	49	64	604	14.6	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%
		2020	7	11	22	110	4.2	64.6	7%	1	4.55%	3	2.73%	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	559	0	0.00%	0	0.00%	0.00
	2003	768	1	0.13%	0	0.00%	0.00
	2004	1501	1	0.07%	0	0.00%	0.00
	2005	1337	0	0.00%	0	0.00%	0.00
	2006	1497	0	0.00%	0	0.00%	0.00
	2007	1577	0	0.00%	0	0.00%	0.00
	2008	1886	0	0.00%	0	0.00%	0.00
	2009	868	0	0.00%	0	0.00%	0.00
	2010	1068	0	0.00%	0	0.00%	0.00
	2011	1549	0	0.00%	0	0.00%	0.00
	2012	1107	0	0.00%	0	0.00%	0.00
	2013	1459	0	0.00%	0	0.00%	0.00
	2014	1696	1	0.06%	0	0.00%	0.00
	2015	1519	1	0.07%	0	0.00%	4.00
	2016	2205	0	0.00%	0	0.00%	0.00
	2017	2159	0	0.00%	0	0.00%	0.00
	2018	1971	0	0.00%	0	0.00%	0.00
	2019	1948	0	0.00%	0	0.00%	0.00
	2020	1505	0	0.00%	0	0.00%	0.00
	2021	1522	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	1040	1	0.10%	0	0.00%	20.00
	2006	1283	0	0.00%	0	0.00%	0.00
	2007	1147	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	1308	0	0.00%	0	0.00%	0.00
	2015	640	0	0.00%	0	0.00%	0.00
	2016	1565	2	0.13%	0	0.00%	63.61
	2017	1309	0	0.00%	0	0.00%	0.00
	2018	1535	0	0.00%	0	0.00%	0.00
	2019	1232	0	0.00%	0	0.00%	0.00
	2020	769	0	0.00%	0	0.00%	0.00
	2021	716	0	0.00%	0	0.00%	0.00