



NOAA Data Report NMFS-NWFSC-DR-2024-01

<https://doi.org/10.25923/s867-fr13>

Observed and Estimated Bycatch of Salmon in U.S. West Coast Fisheries, 2002–22

January 2024

U.S. DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northwest Fisheries Science Center

NOAA Data Report Series NMFS-NWFSC-DR

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Recommended citation:

(Richerson et al. 2024)¹

¹ Richerson, K. E., K. A. Somers, V. J. Tuttle, N. B. Riley, and J. T. McVeigh. 2024. Observed and Estimated Bycatch of Salmon in U.S. West Coast Fisheries, 2002–22. U.S. Department of Commerce, NOAA Data Report NMFS-NWFSC-DR-2024-01.

<https://doi.org/10.25923/s867-fr13>



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FISHERIES**

Observed and Estimated Bycatch of Salmon in U.S. West Coast Fisheries, 2002–22

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<https://doi.org/10.25923/s867-fr13>

January 2024

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Background

This report summarizes the observed and estimated bycatch of all salmon species observed in fisheries monitored by the West Coast Groundfish Observer Program (WCGOP), the At-Sea Hake Observer Program (A-SHOP), the Electronic Monitoring (EM) program, and the Catch Monitor (CM) program. WCGOP and A-SHOP are managed by NOAA Fisheries' Northwest Fisheries Science Center's Fisheries Observation Science Program (FOS). The EM and CM programs are managed by the Pacific States Marine Fisheries Commission. We present salmon bycatch in terms of both weight and numbers of individuals, by species. Methods used in this report are similar to the methods presented in an earlier version of this report (Somers et al. 2015) and the most recent groundfish mortality report (Somers et al. 2023). This report does not include data from recreational or tribal fisheries, except for the tribal at-sea mothership sector, which is combined with the non-tribal mothership sector for reporting.

A-SHOP observes vessels that catch and process Pacific hake at sea. WCGOP observes a number of fleets that deliver catch shoreside for processing, including sectors that target and incidentally catch groundfish. Once landed shoreside, individual fishing quota catch is sampled by the CM program; for vessels fishing under maximized or optimized retention, this sampling quantifies the majority of their bycatch. All salmon encountered by EM fisheries are either observed at sea or retained and sampled dockside. This report also includes fish ticket landings data from the Pacific Fishery Information Network (PacFIN). Every year this report is updated to include the newest year of data, the most current data from the FOS and PacFIN for previous years, and the most recent data processing procedures. Data processing updates are described in the annual groundfish mortality report, which is available in draft form annually in the Pacific Fishery Management Council's September Briefing Book, and later in the year in final form as a NOAA Technical Memorandum.

In this report, for each fishing sector in which salmon bycatch occurred, we provide two tables: one showing observer or sampling coverage for all strata with observed or electronically monitored effort, and a second showing bycatch data for only those strata with salmon bycatch. Tables include seasonal, latitudinal, and/or depth strata when appropriate, while preserving confidentiality. For the shoreside-processed fisheries, seasons are defined as winter (1 January to 30 April and 1 November to 31 December) or summer (1 May to 31 October); for the at-sea processed fisheries, seasons are defined as spring (15 May, when the season opens, to 30 June) or fall (1 July to 31 December). Latitudinal divisions are defined as Cape Falcon, Oregon (lat 45.77°N), Cape Blanco, Oregon (lat 42.83°N), and Cape Mendocino, California (lat 40.50°N). For the catch share bottom trawl fishery, depth strata are 0–100 fathoms (fm), 100–150 fm, 150–250 fm, and 250+ fm.

We include an estimate of bycatch rates for A-SHOP and catch share fisheries (total salmon bycatch divided by total landed target weight in a stratum). All weight units are in metric tons (mt), except for individual fish in biological data tables, which are in kilograms (kg). All count values were rounded to an integer value using standard rounding rules in each table for presentation purposes; for that reason, a sum of the rounded values over rows within sector-level tables may not be equivalent to the value in the final summary tables. Similarly, zero values represent cases where catch or salmon was present, but the numeric value

was less than the digits shown. In cases where fewer than three vessels were active, data cannot be shown in order to maintain confidentiality; these strata are reported as asterisks (*). Additionally, the at symbol (@) represents strata for which the potential bootstrapping pool had fewer than three vessels and so could not be estimated. This represented less than 0.25% of annual landings. Finally, the hash symbol (#) represents cases where only a single haul with salmon was observed, so the standard error calculation is not informative.

In addition to sector-specific coverage and bycatch information (Tables 1–28), we also include a bycatch summary table (Table 29), as well as summaries of the biological data collected by WCGOP, A-SHOP, and the CM program (Tables 30–32).

From 16–30 April 2020, observer and catch monitor coverage requirements were waived in order to implement mitigation measures to minimize potential COVID-19 transmission. For catch share fisheries, we estimated bycatch during this period using vessel- and gear- specific bycatch ratios from the previous year. This resulted in an estimated 15 Chinook salmon and <1 coho salmon being caught by the catch share bottom trawl fishery, and <1 Chinook salmon and <1 chum salmon being caught by the midwater rockfish sector during the period. Because these estimates could not be assigned to effort strata, they are only included in the summary table (Table 29) and in the figures. For non-catch share fisheries, we included the waiver period effort with all other unobserved effort and used the usual ratio expansion methods.

Trends, 2002–22

We focus on Chinook and coho salmon bycatch trends because the fisheries we observe catch these species in the greatest amounts and at the highest rates. Additionally, these species are targeted by ocean troll fisheries, and both species include multiple populations that are listed under the Endangered Species Act. Accounting for salmon bycatch in groundfish fisheries is important in balancing the needs of different stakeholders in the groundfish and salmon fisheries, as well as conserving salmon and the species that depend on them.

We present data from 2002 to 2022. In the hake fishery,¹ Chinook salmon bycatch as a whole has been volatile, with a high in 2014. In 2022, total bycatch in this fishery was approximately equal to the median value from 2002–22. In the non-hake fishery, non-catch share (NCS)² Chinook salmon bycatch has been minimal across all years. In contrast, in the shoreside (SS) sectors,³ relatively high Chinook salmon bycatch was observed in 2002 and 2003 (mostly attributed to the LE bottom trawl fishery), but has remained relatively low since. In 2014, Chinook salmon bycatch by these sectors was the highest since 2005 (mostly attributed to the catch share bottom trawl fishery), but bycatch was relatively low from 2016–22.

Over the time period examined, coho salmon bycatch was generally an order of magnitude lower than Chinook salmon bycatch, with considerable amounts of inter-annual variability. Bycatch in the hake fishery in 2022 was somewhat higher than the long-term median value. Bycatch in the NCS and SS non-hake catch share fisheries has remained at low or moderate levels across all years.

Figure 1 summarizes Chinook and coho salmon bycatch from 2002–22 in the combined hake, SS non-hake, and NCS sectors. Figures 2–8 show salmon bycatch for selected sectors in more detail, including bycatch of Chinook, chum, coho, pink, sockeye, and unspecified salmon. Figures 9–11 summarize the number of biological samples collected by A-SHOP, WCGOP, and the CM program. The accompanying spreadsheet contains coverage and bycatch estimates for all observed/monitored sectors with recorded salmon bycatch, as well as a summary table and information on biological data collected.

¹Includes at-sea and non-tribal shoreside hake sectors.

²Includes non-catch share exempted fishing permits, sablefish primary, nearshore, open access (OA) California halibut, pink shrimp, and OA hook-and-line sectors.

³Includes shoreside limited entry (LE) and catch share (CS) bottom trawl, CS fixed gear, CS midwater rockfish, and LE California halibut.

Figures

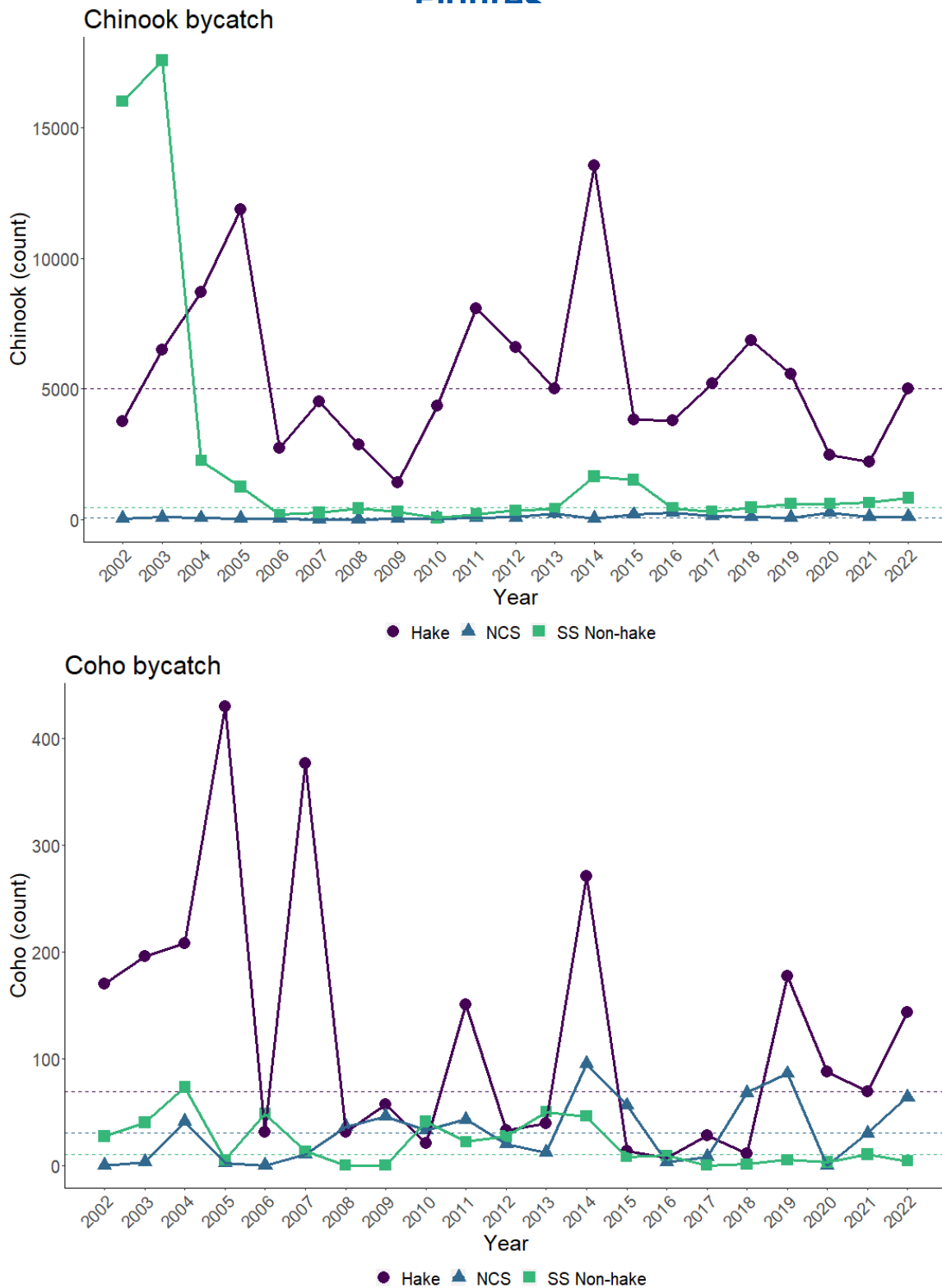


Figure 1. Chinook (upper panel) and coho (lower panel) salmon bycatch in fisheries monitored by A-SHOP, WCGOP, and the CM and EM programs, 2002–22. Hake includes at-sea catcher-processors, at-sea mothership catcher vessels, and non-tribal shoreside processors. Non-catch share (NCS) includes non-catch share exempted fishing permits, sablefish primary, nearshore, open access (OA) California halibut, pink shrimp, and OA hook-and-line. Shoreside (SS) non-hake includes shoreside limited entry (LE) and catch share (CS) bottom trawl, CS fixed gear, CS midwater rockfish, and LE California halibut. Horizontal dashed lines show long-term medians.

Limited entry and catch shares bottom trawl

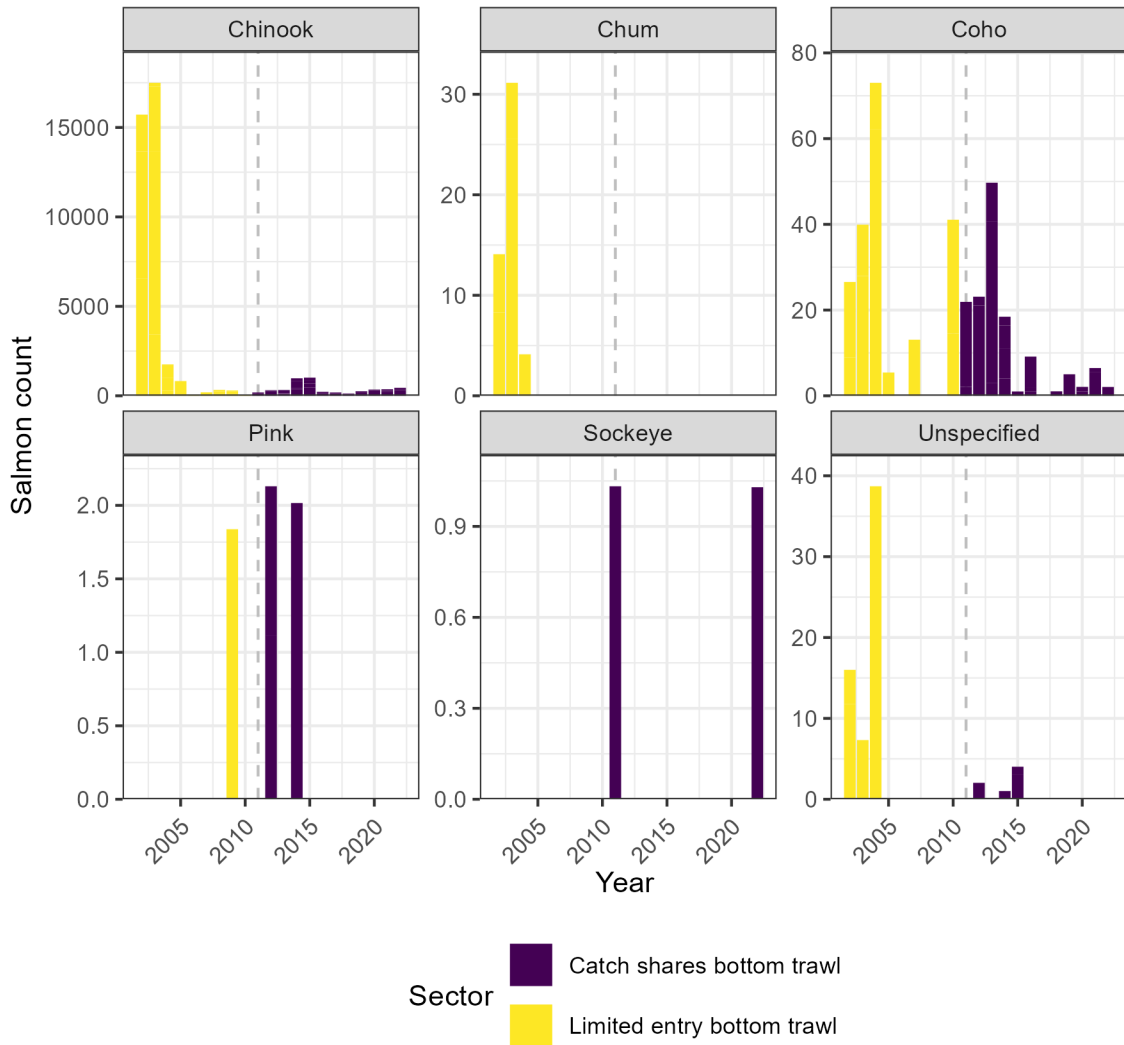


Figure 2. Salmon bycatch in the limited entry (2002–10) and catch share (2011–22) bottom trawl fishery. Note that the limited entry bottom trawl fishery counts represent estimates based on partial observer coverage, while the catch share bottom trawl fishery has full observer or electronic monitoring coverage. For confidentiality reasons, non-hake midwater trawl in 2011 and LE California halibut in 2011–13 are combined with catch share bottom trawl here. Data from electronically monitored bottom trawl vessels are included here.

Midwater rockfish, midwater hake, and shoreside hake

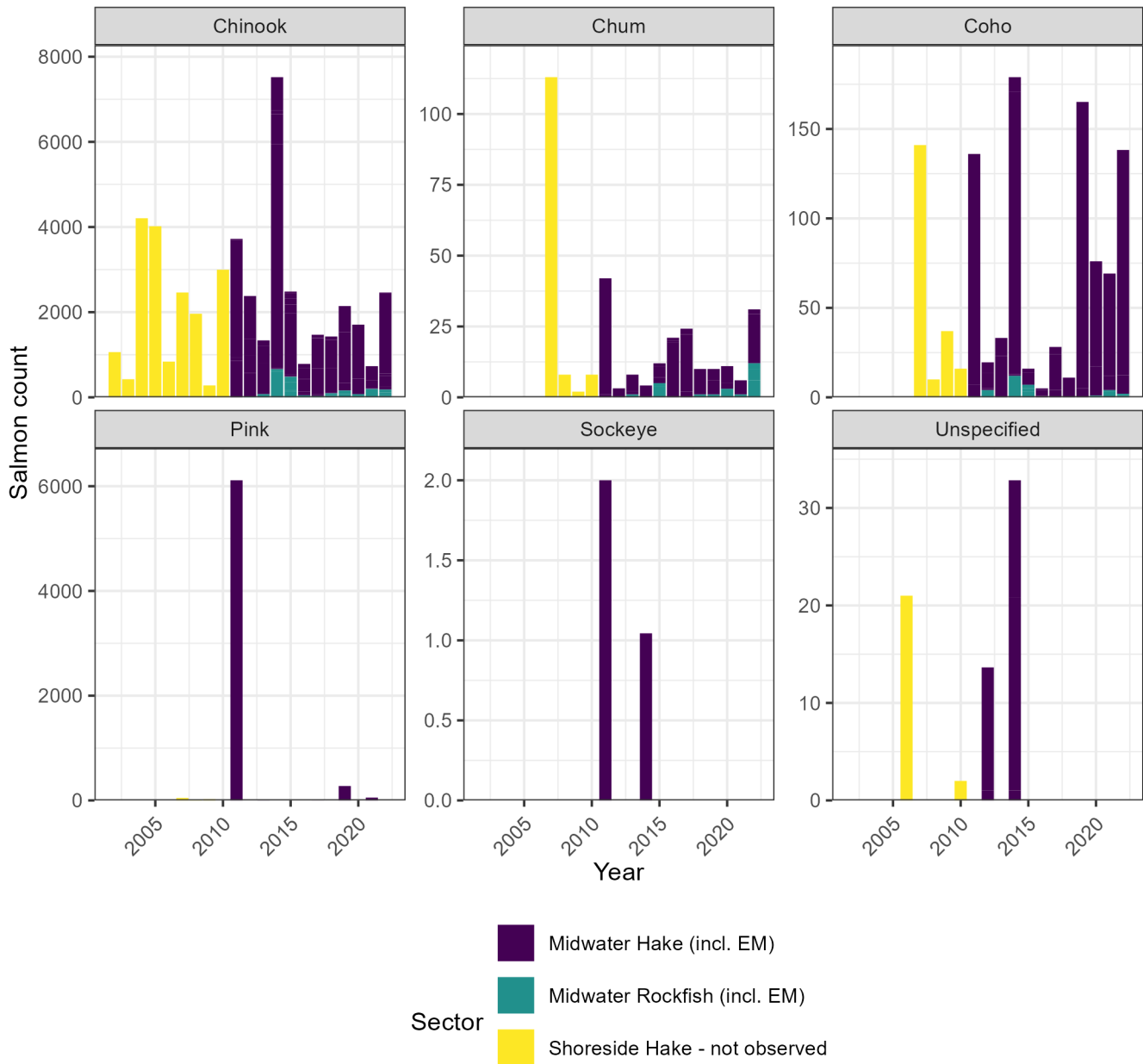


Figure 3. Salmon bycatch in shoreside midwater trawl sectors, 2002–22. Shoreside midwater hake was not observed prior to 2011, and the counts presented here come from shoreside monitoring data housed in PacFin. From 2011 on, these sectors have full observer or electronic monitoring coverage. Note that for confidentiality reasons, non-hake catch share midwater trawl in 2011 is shown combined with catch share bottom trawl in Figure 2. Data from electronically monitored midwater trawl vessels are included here.

At-sea hake

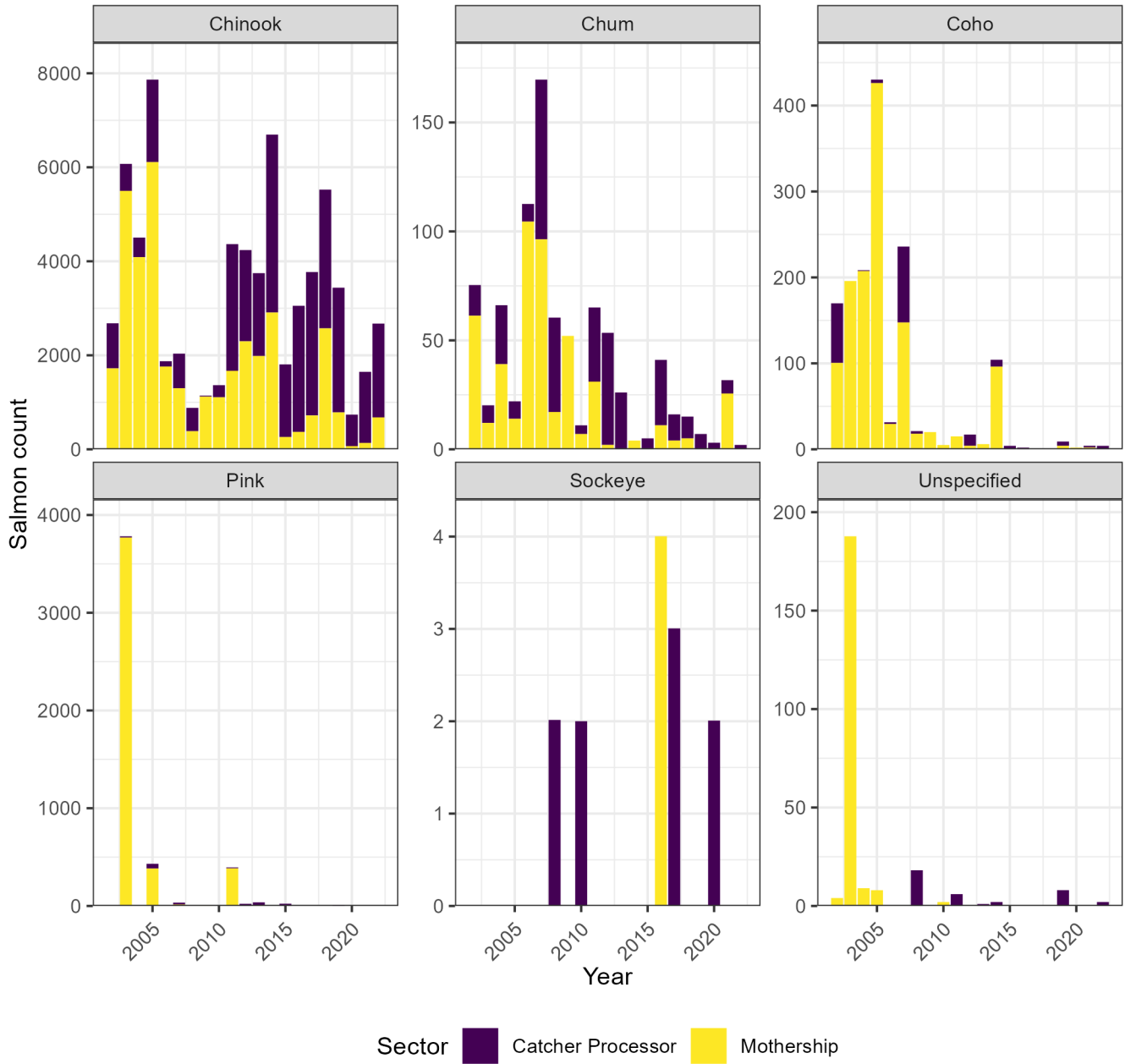


Figure 4. Salmon bycatch in the at-sea hake fishery, 2002–22. This sector has full observer coverage. Data from the tribal mothership sector (active prior to 2013) are included here, excepting 2012 for confidentiality reasons.

Limited entry and open access California halibut

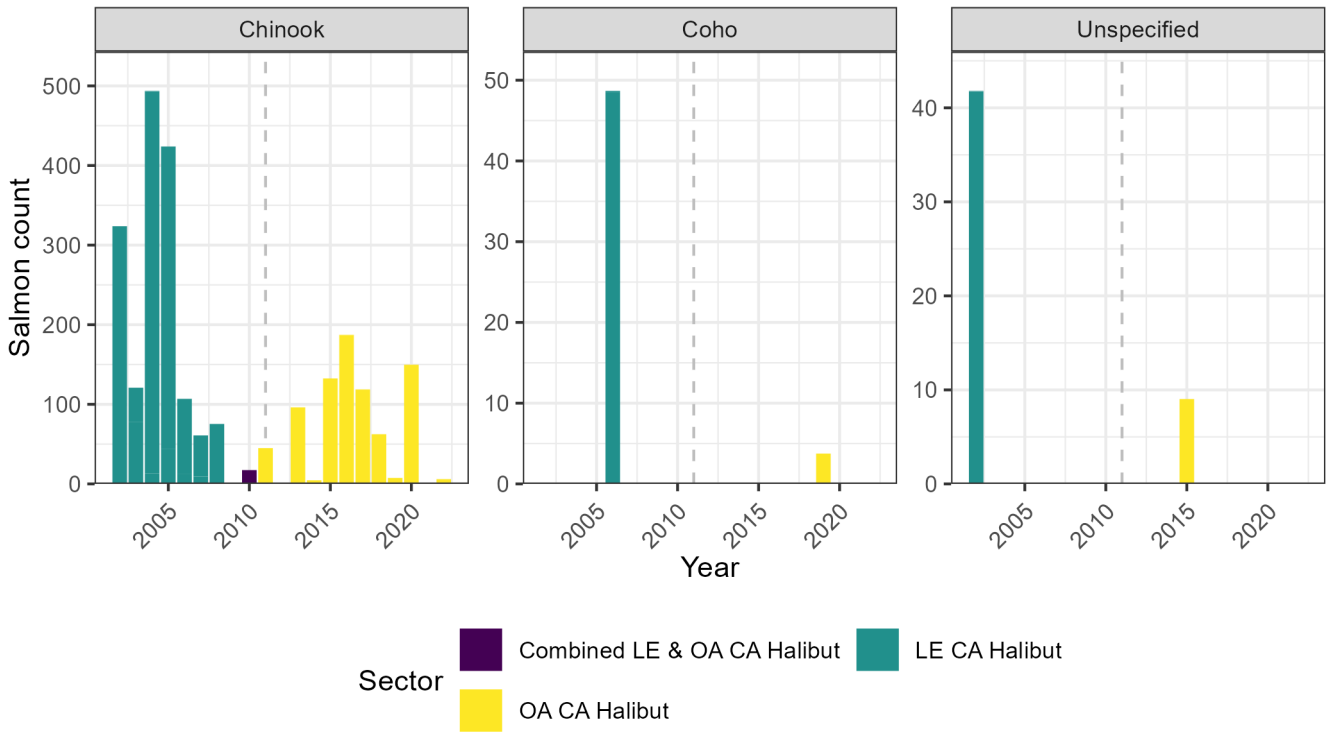


Figure 5. Estimated salmon bycatch in the limited entry and open access California halibut fishery, 2002–22. Note that starting in 2011, LE California halibut is combined with CS bottom trawl for confidentiality reasons, but there has been no activity in this sector since 2013.

Limited entry sablefish - hook and line

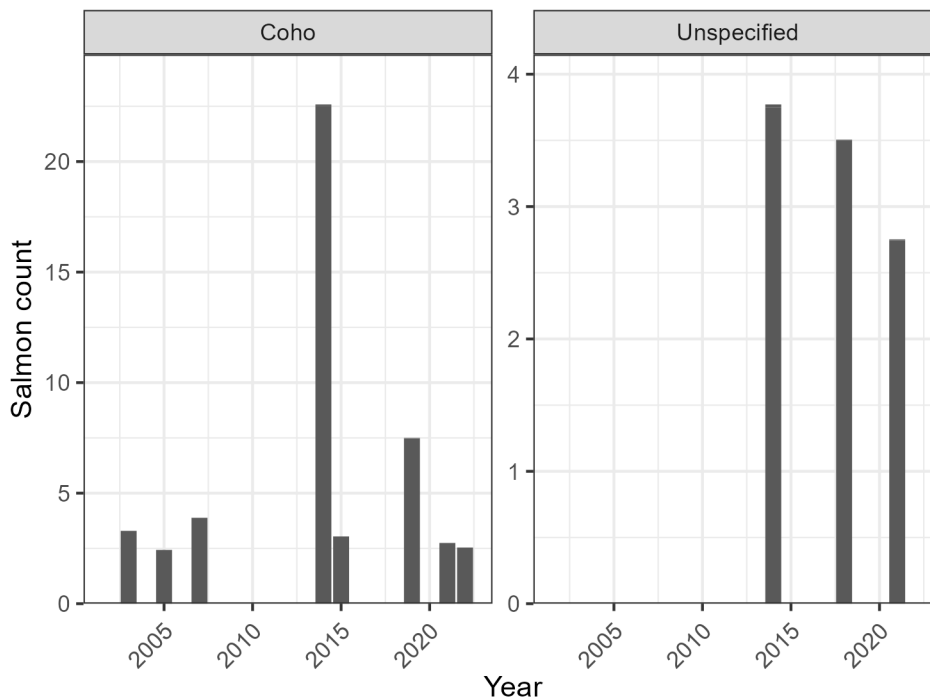


Figure 6. Estimated salmon bycatch in the limited entry sablefish hook-and-line fishery, 2002–22.

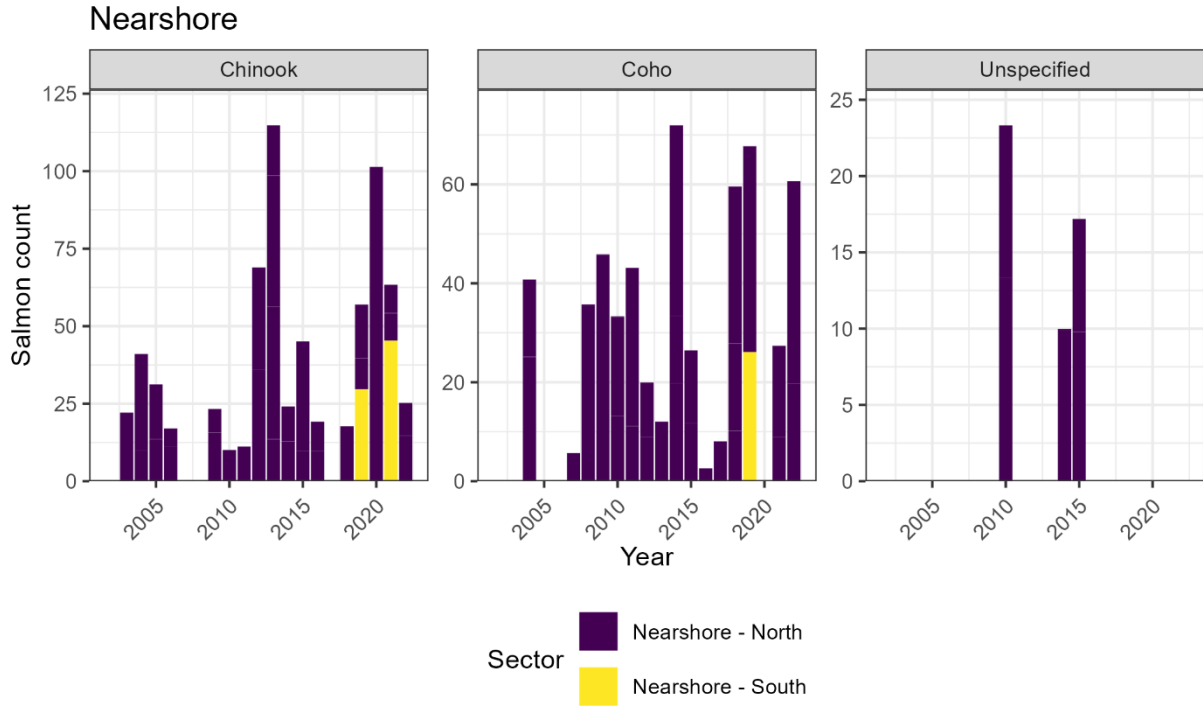


Figure 7. Estimated salmon bycatch in the nearshore fisheries north and south of lat 40.17°N, 2002–22.

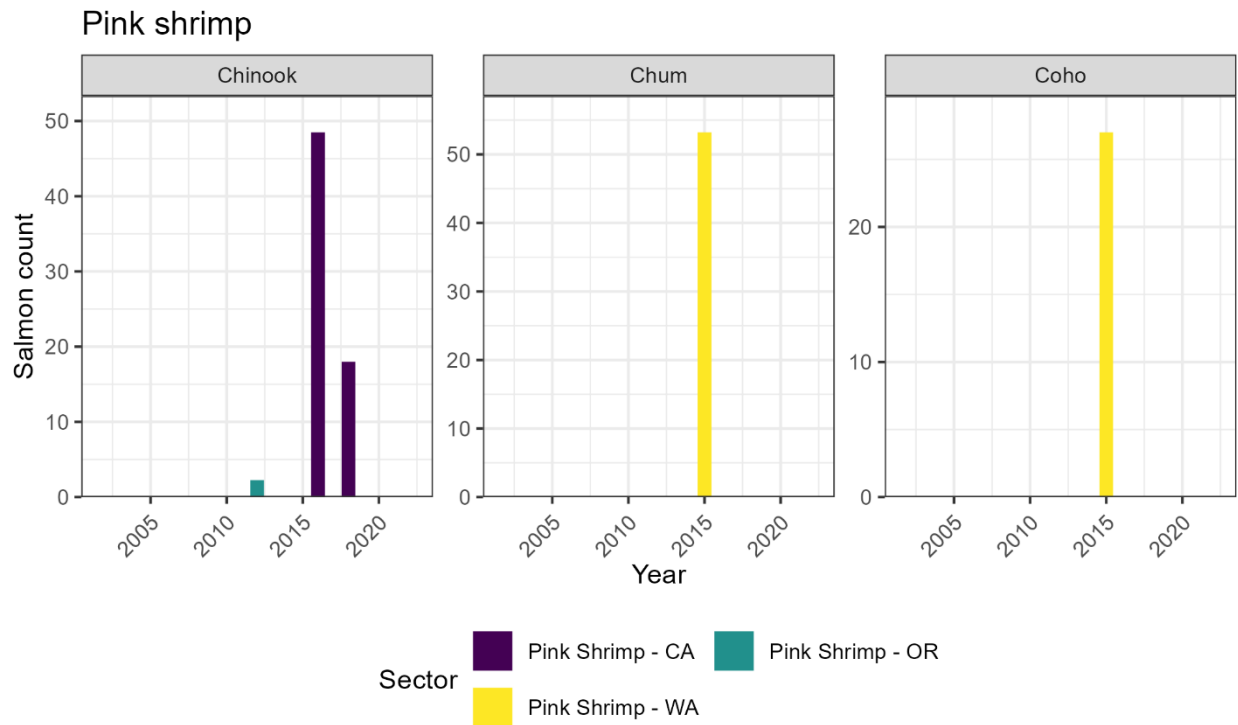


Figure 8. Estimated salmon bycatch in the pink shrimp fishery, 2002–22.

WCGOP biological sampling

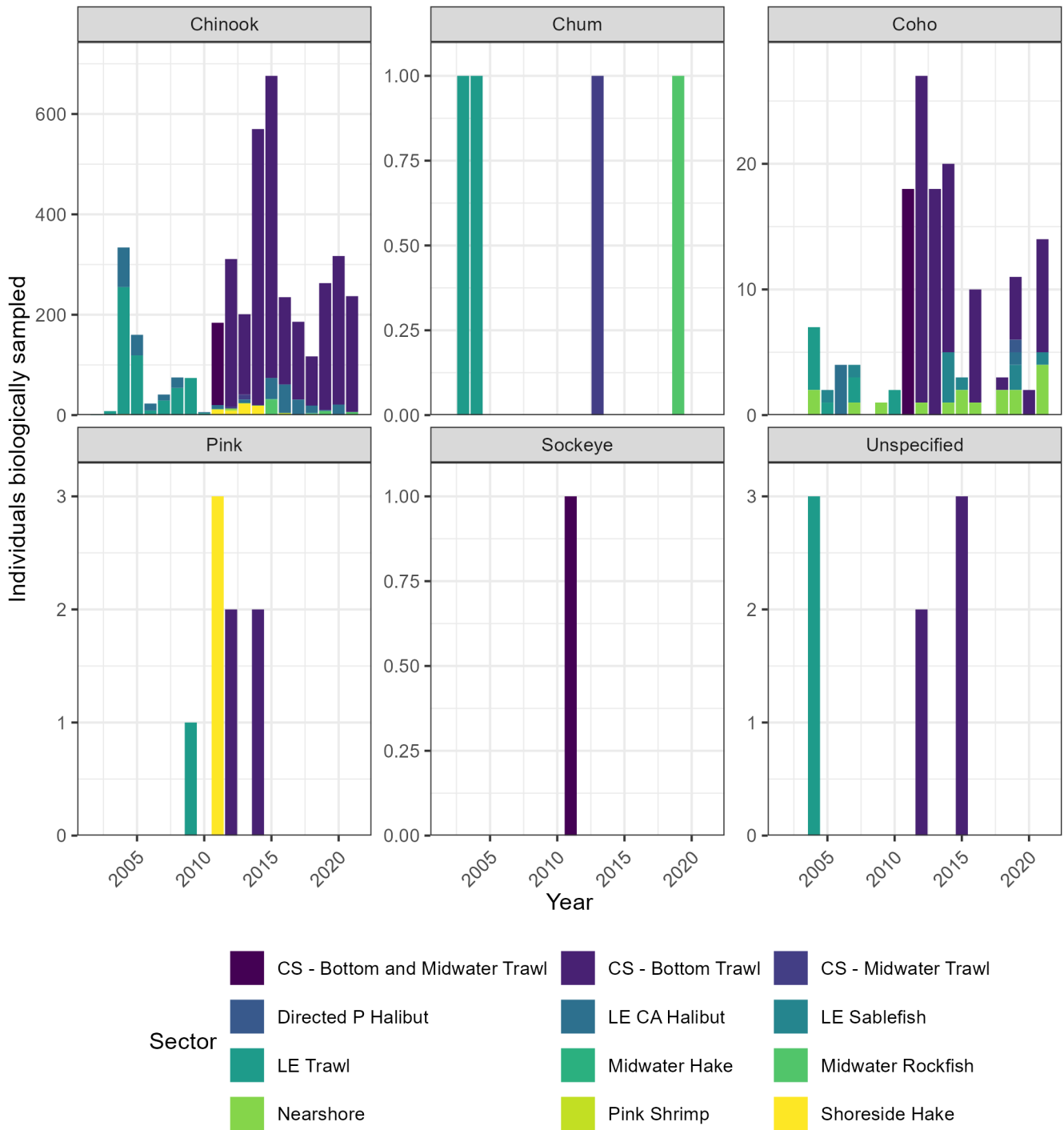


Figure 9. Number of salmon biologically sampled by WCGOP observers, 2002–22.

A-SHOP biological sampling

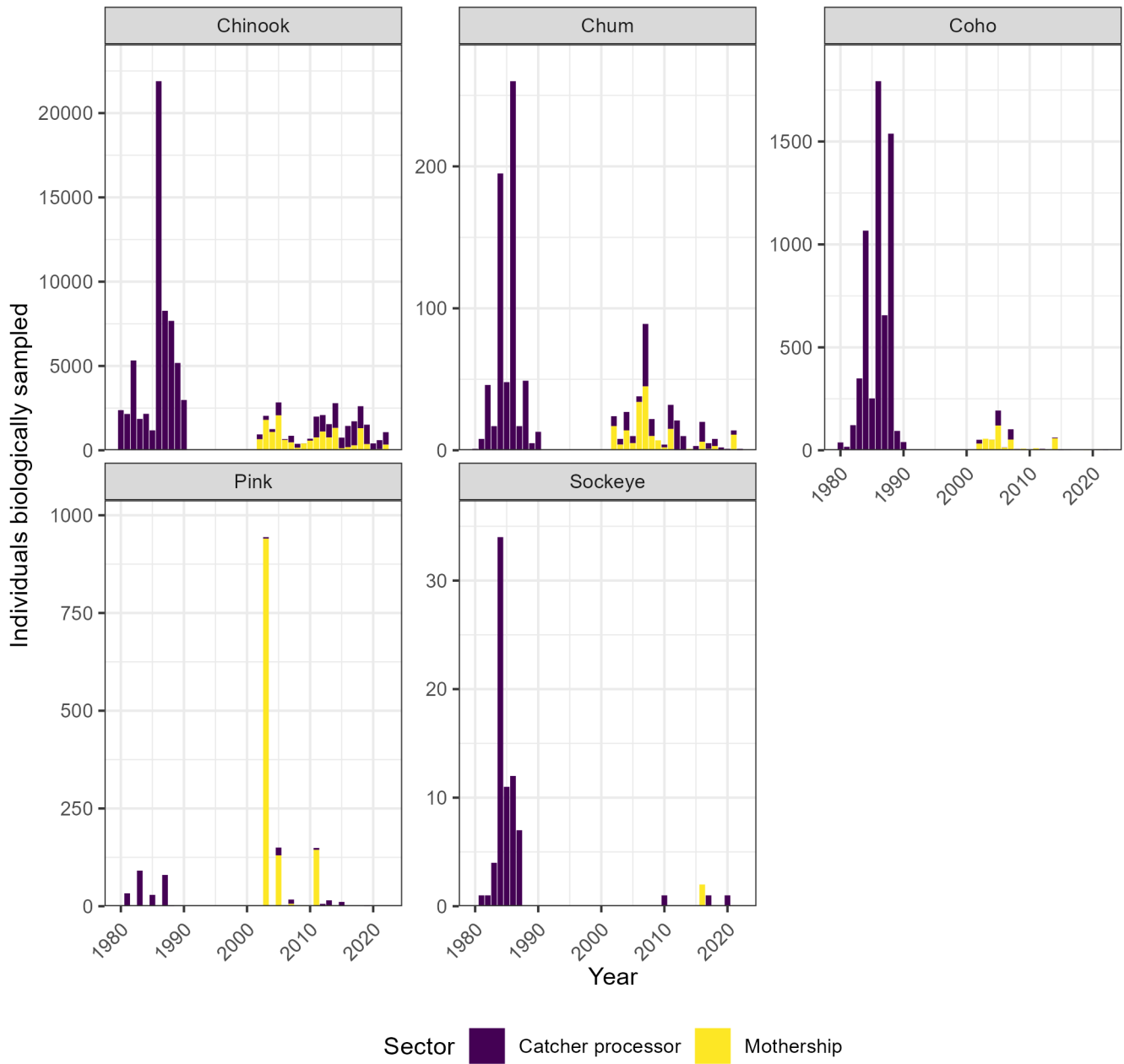


Figure 10. Number of salmon biologically sampled by A-SHOP observers, 1980–2022.

CM biological sampling

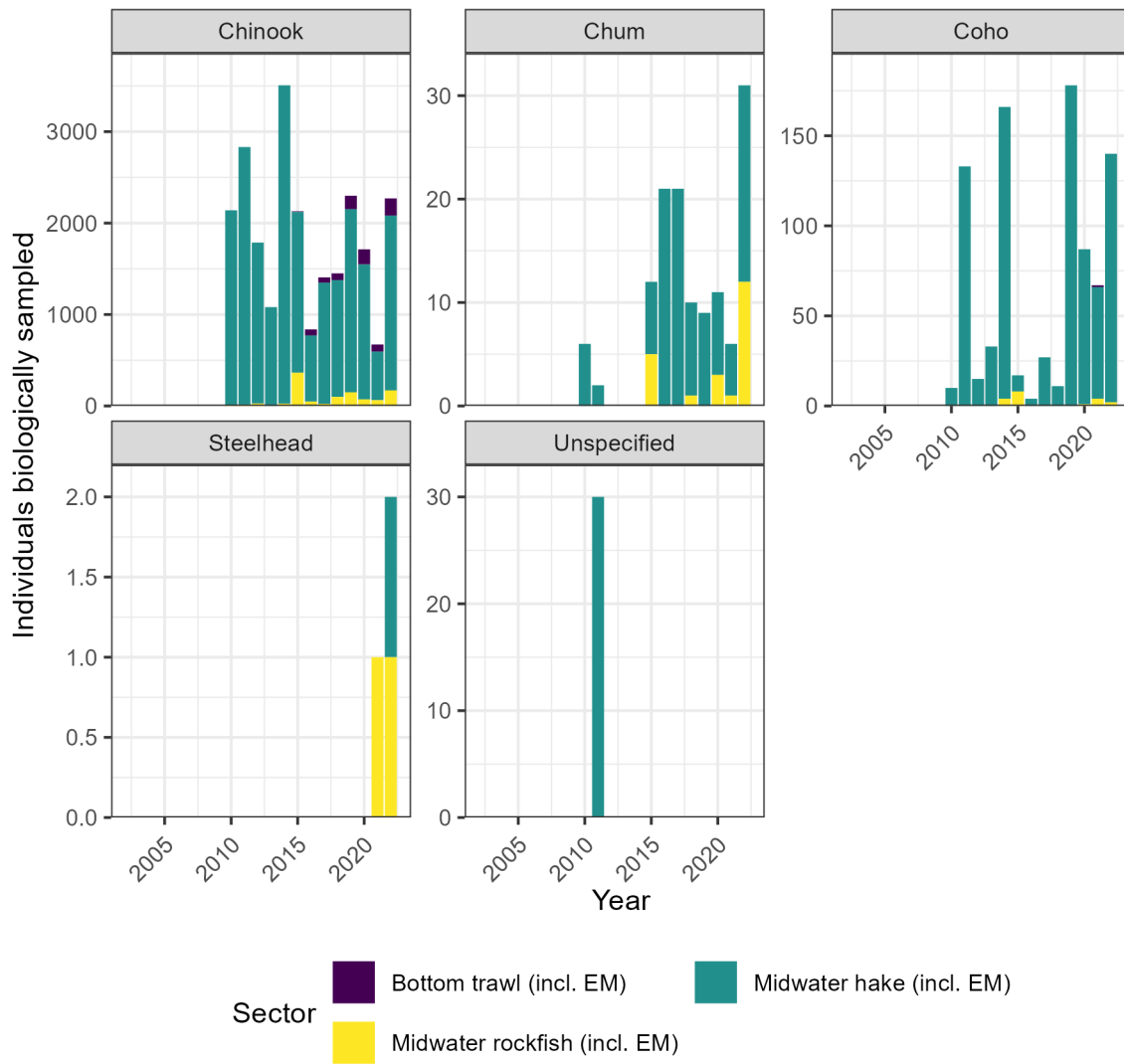


Figure 11. Number of salmon biologically sampled by the CM program, 2010–22.

Tables

The tables described below can be downloaded from this report's [NOAA Institutional Repository](#)⁴ record by following the "Supporting Files" link.

Table 1. Observed vessels, trips, hauls, catch, and salmon interactions, as well as total fleet landings, stratified by year, season, salmon management area, and depth interval for the LE trawl fishery.

Table 2. Observed and expanded salmon bycatch in the LE trawl fishery.

Table 3. Observed vessels, trips, hauls, catch, and salmon interactions, as well as total fleet landings, stratified by year and season for the LE CA halibut fishery. To preserve confidentiality: 2010 data are reported in Tables 7 and 8, combined with OA CA halibut; 2011 and 2013 data are reported in Table 16, combined with IFQ Bottom Trawl; 2012 data cannot be reported; no fishing effort in LE CHLB has occurred since 2013.

Table 4. Observed and expanded salmon bycatch in the LE California halibut fishery.

Table 5. Observed vessels, trips, hauls, catch, and salmon interactions, as well as fleet landings, stratified by year for the OA CA halibut fishery. Strata not listed were not observed.

Table 6. Observed and expanded salmon bycatch in the LE California halibut fishery.

Table 7. Observed vessels, trips, hauls, catch, and salmon interactions, as well as fleet landings for the combined LE & OA CA halibut fishery, combined in 2010 to maintain confidentiality.

Table 8. Observed and expanded salmon bycatch in the combined LE & OA CHLB fishery in 2010.

Table 9. Observed vessels, trips, hauls, catch, and salmon interactions, as well as fleet landings, stratified by year and area for the LE sablefish primary fishery, using hook-and-line gear. Strata not listed were not observed.

Table 10. Observed and expanded salmon bycatch in the LE sablefish primary fishery using hook-and-line gear.

Table 11. Observed vessels, trips, hauls, catch, and salmon interactions, as well as fleet landings, stratified by state, year, and area for the pink shrimp fishery. Strata not listed were not observed.

Table 12. Observed and expanded salmon bycatch in the pink shrimp fishery.

Table 13. Observed vessels, trips, hauls, catch, and salmon interactions, as well as fleet landings, stratified by state, year, and area for the nearshore fishery. No salmon interactions south of 40° 10' N lat. occurred prior to 2019 or in 2020, so we only include information for the 2019 and 2021 Nearshore South fishery here for simplicity.

Table 14. Observed and expanded salmon bycatch in the Nearshore fishery.

Table 15. Observed vessels, trips, hauls, catch, and salmon interactions, as well as fleet landings, for the OA hook-and-line fishery. Only 2018, 2021, and 2022 are shown for simplicity (no salmon bycatch in other years).

Table 16. Observed and expanded salmon bycatch in the open access hook and line fishery.

Table 17. Observed vessels, trips, hauls, catch, and salmon interactions, as well as fleet landings, for the directed Pacific halibut fishery. Note that WCGOP began observing this fishery in 2017.

Table 18. Observed and expanded salmon bycatch in the directed Pacific halibut fishery.

Table 19. Observed vessels, trips, hauls, catch, and salmon, as well as fleet landings, stratified by year, season, depth bin, and salmon management area for catch shares non-hake bottom trawl, including non-hake midwater trawl in 2011 and LE California halibut in 2011 and 2013.

⁴<https://repository.library.noaa.gov/>

Table 20. Observed at-sea, estimated unknown, landed, and total salmon bycatch in the catch shares non-hake bottom trawl fishery, including non-hake midwater trawl in 2011 and LE California halibut in 2011 to 2013.

Table 21. Observed vessels, trips, hauls, catch, and salmon interactions, as well as fleet landings for the CS hook-and-line fishery.

Table 22. Observed at-sea, estimated unknown, landed, and total salmon bycatch in the CS hook-and-line fishery.

Table 23. Observed vessels, trips, hauls, catch, and salmon, as well as fleet landings, stratified by year, target strategy, season, and salmon management area for shoreside catch shares non-EM midwater trawl. To maintain confidentiality, data from the 2019-onward midwater hake trawl sector is included in Tables 25 and 26, and data from the non-hake midwater trawl in 2011 is include in Tables 20 and 21. In 2015, the basis of the definition for shoreside midwater changed from the captain's stated target to the proportion hake landed.

Table 24. Observed at-sea, estimated unknown, landed, and total salmon bycatch in the catch shares midwater trawl fishery. To maintain confidentiality, data from the 2019-onward midwater hake trawl sector is included in Tables 25 and 26, and data from the non-hake midwater trawl in 2011 is include in Tables 19 and 20. In 2015, the basis of the definition for shoreside midwater changed from the captain's stated target to the proportion hake landed.

Table 25. Effort in the electronically-monitored (EM) portion of the shoreside catch shares trawl fleet, based on EM, logbook, and fish ticket data. Data for the 2019-2022 non-EM midwater hake sector is combined with EM data here to preserve confidentiality (see Tables 23 and 24 for all other non-EM midwater hake information).

Table 26. Salmon bycatch EM portion of the shoreside catch shares trawl fleet, based on EM, logbook, and fish ticket data. Data for the 2019-2022 non-EM midwater hake sector is combined with EM data here to preserve confidentiality (see Tables 23 and 24 for all other non-EM midwater hake information). All salmon are required to be retained and sampled by shoreside catch monitors.

Table 27. Observed vessels, hauls, and salmon interactions, as well as fleet landings, stratified by sector, year, and season for the at-sea hake fishery. Note that the small amount of effort in the 2012 tribal mothership sector is not included for confidentiality reasons.

Table 28. Observed salmon bycatch in the at-sea hake fishery. Note that the 2012 tribal mothership sector is not included for confidentiality reasons.

Table 29. Summary of salmon bycatch count and weight by species, sector, and year. Bycatch in the shoreside catch shares fisheries include both EM and 100% observed sub-sectors. Weights were not recorded in the shoreside hake EFP sector.

Table 30. Summary of biological data for at-sea salmon catch, separated by sector, collected by WCGOP observers from 2002 to 2022. Not every type of biological data was collected from every individual sampled. Due to 100% coverage in Catch Shares sectors, more biological data is typically collected.

Table 31. Summary of biological data for salmon discarded shoreside, collected by the Catch Monitor (CM) program 2010 to 2022. Not every type of biological data was collected from every individual sampled. 100% coverage of the catch typically leads to greater collection of biological data than in other fishery sectors.

Table 32. Summary of biological data for salmon species, separated by sector, collected by A-SHOP observers from 1980 to 2022. Not every type of biological data was collected from every individual sampled. 100% observer coverage leads to greater collection of biological data than in other fishery sectors.

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