

## Observed and Estimated Bycatch of Salmon in U.S. West Coast Fisheries, 2002–2020

Kate Richerson, Kayleigh A. Somers, Jason E. Jannot, Vanessa Tuttle, Neil B. Riley, and Jon McVeigh

Fishery Resource Analysis and Monitoring Division  
Northwest Fisheries Science Center  
2725 Montlake Boulevard East  
Seattle, Washington 98112

### 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. The WCGOP and A-SHOP are managed by NOAA Fisheries' Northwest Fisheries Science Center Fisheries Observation Science Program. 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 the previous salmon report (Somers et al. 2015) and the most recent groundfish mortality report (Somers et al. 2021).

The A-SHOP observes vessels that catch and process Pacific hake at sea. The WCGOP observes a number of fleets that deliver catch shoreside for processing, including sectors that target and incidentally catch groundfish. Both programs place trained scientists on board commercial fishing vessels to observe and sample catch; the WCGOP specifically focuses on sampling at-sea discards. Once landed shoreside, 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 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 (January to April and November to December) or summer (May to October); for the at-sea processed fisheries, seasons are defined as spring (May 15, when the season opens, to June 30) or fall (July 1 to December 31). Latitudinal divisions are defined as Cape Falcon (45.77°N), Cape Blanco (42.83°N), and Cape Mendocino (40.5°N). For the catch share bottom trawl fishery and catch shares EM fisheries, depth strata have been updated to reflect depth bins more relevant to salmon management (0-100 fm, 100-150 fm, 150-250 fm, and 250+ fm). This update applies to estimates disseminated since 2019. This may result in slightly different estimates of total bycatch

relative to earlier reports. In addition, we include an estimate of bycatch rates for A-SHOP and catch shares fisheries (total salmon bycatch divided by total landed target weight in a strata). 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, 0 values represent cases where catch or salmon was present, but the numeric value was less than the digits shown. In cases where fewer than 3 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 less than 3 vessels and so could not be estimated. This represented less than 0.25 percent of fishing effort in regards to yearly 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, we also include a bycatch summary table as well as summaries of the biological data collected by the WCGOP, A-SHOP, and CM Program.

From April 16 to 30, 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 shares 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 an 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 2002-2020

We focus on Chinook and coho salmon bycatch trends because observed fisheries 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 upon them.

We present data from 2002 to 2020. Chinook bycatch in the hake fishery<sup>1</sup> as a whole has been volatile, with a high in 2014. In 2020, total bycatch in this fishery was lower than in all previous years except 2009. Non-catch shares<sup>2</sup> (NCS) bycatch has been minimal across all years. After extremely high bycatch in 2002 and 2003, mostly in the limited entry bottom trawl fishery, Chinook bycatch has remained relatively low in the shoreside non-hake fishery. In 2014, Chinook bycatch by the shoreside non-hake fishery<sup>3</sup> was the highest since 2005 (mostly attributed to the catch shares bottom trawl fishery), but bycatch was relatively low from 2016-2020.

---

<sup>1</sup> Includes shoreside and at-sea hake sectors.

<sup>2</sup> Includes non-catch shares exempted fishing permits, sablefish primary, nearshore, open access (OA) California halibut, pink shrimp, and OA hook & line sectors.

<sup>3</sup> Includes shoreside limited entry (LE) and catch shares (CS) bottom trawl, CS fixed gear, CS midwater rockfish, and LE California halibut.

Over the time period examined, coho bycatch was generally an order of magnitude lower than Chinook bycatch, with considerable amounts of inter-annual variability. Bycatch in the hake fishery was elevated in 2002, 2005, 2007, 2011, 2014, and 2019 compared to other years. Bycatch in the NCS and shoreside non-hake catch shares fisheries has remained at low or moderate levels across all years, though NCS bycatch of coho salmon in 2018 and 2019 was higher than the preceding several years. In 2020, coho bycatch in these sectors was low.

Figure 1 summarizes Chinook and coho salmon bycatch from 2002-2020 in the combined hake, shoreside non-hake, and non-catch shares 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 the A-SHOP, WCGOP, and 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.

## Figures

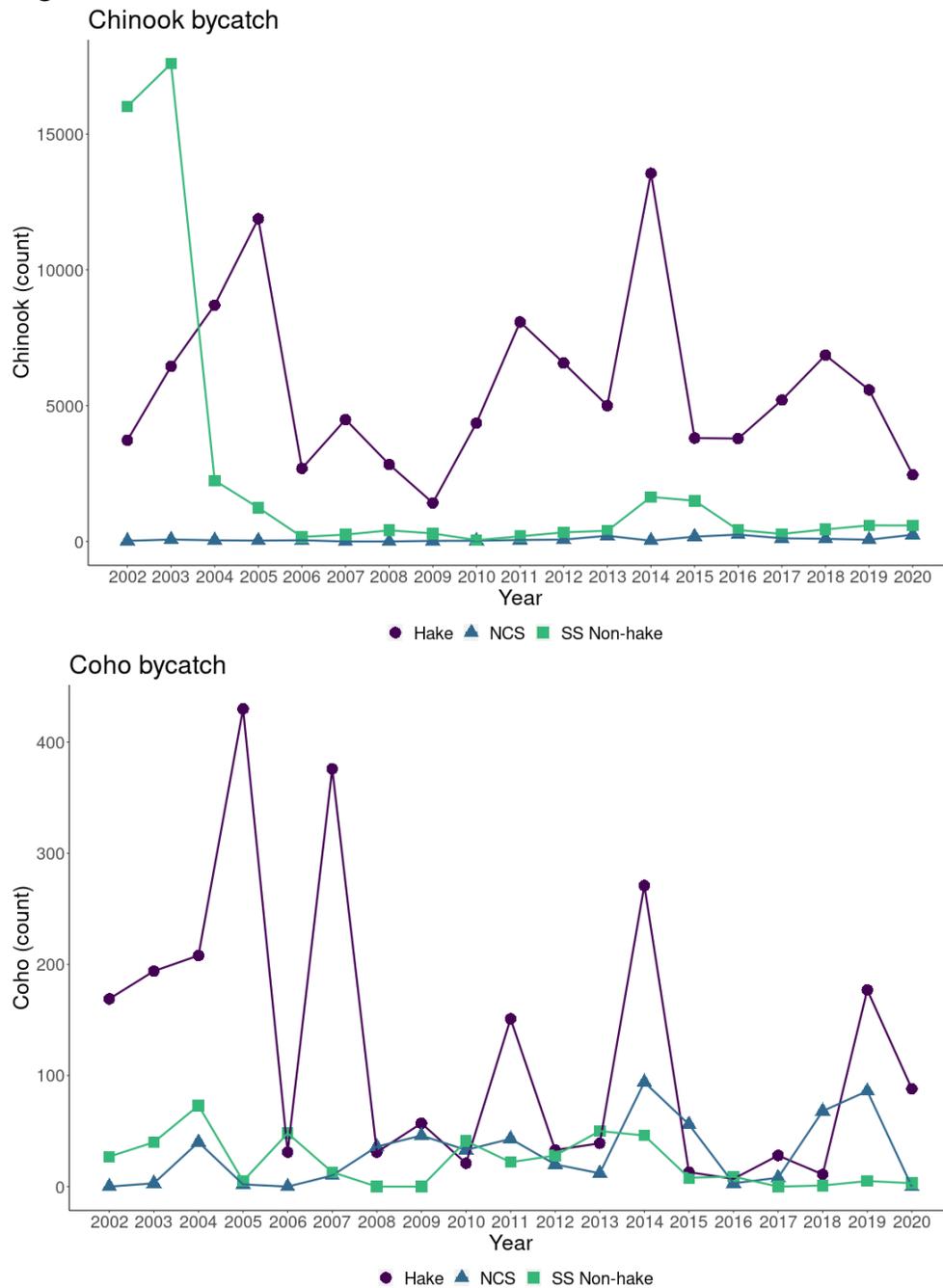


Figure 1. Chinook (upper panel) and coho (lower panel) salmon bycatch in fisheries monitored by the A-SHOP, CM, EM, and WCGOP, 2002-2020. Hake includes at-sea catcher processors, at-sea mothership catcher-vessels, and shoreside processors. Non-catch shares (NCS) includes non-catch shares exempted fishing permits, sablefish primary, nearshore, open access (OA) California halibut, pink shrimp, and OA hook & line. Shoreside (SS) non-hake includes shoreside limited entry (LE) and catch shares (CS) bottom trawl, CS fixed gear, CS midwater rockfish, and LE California halibut.

### Limited entry and catch shares bottom trawl

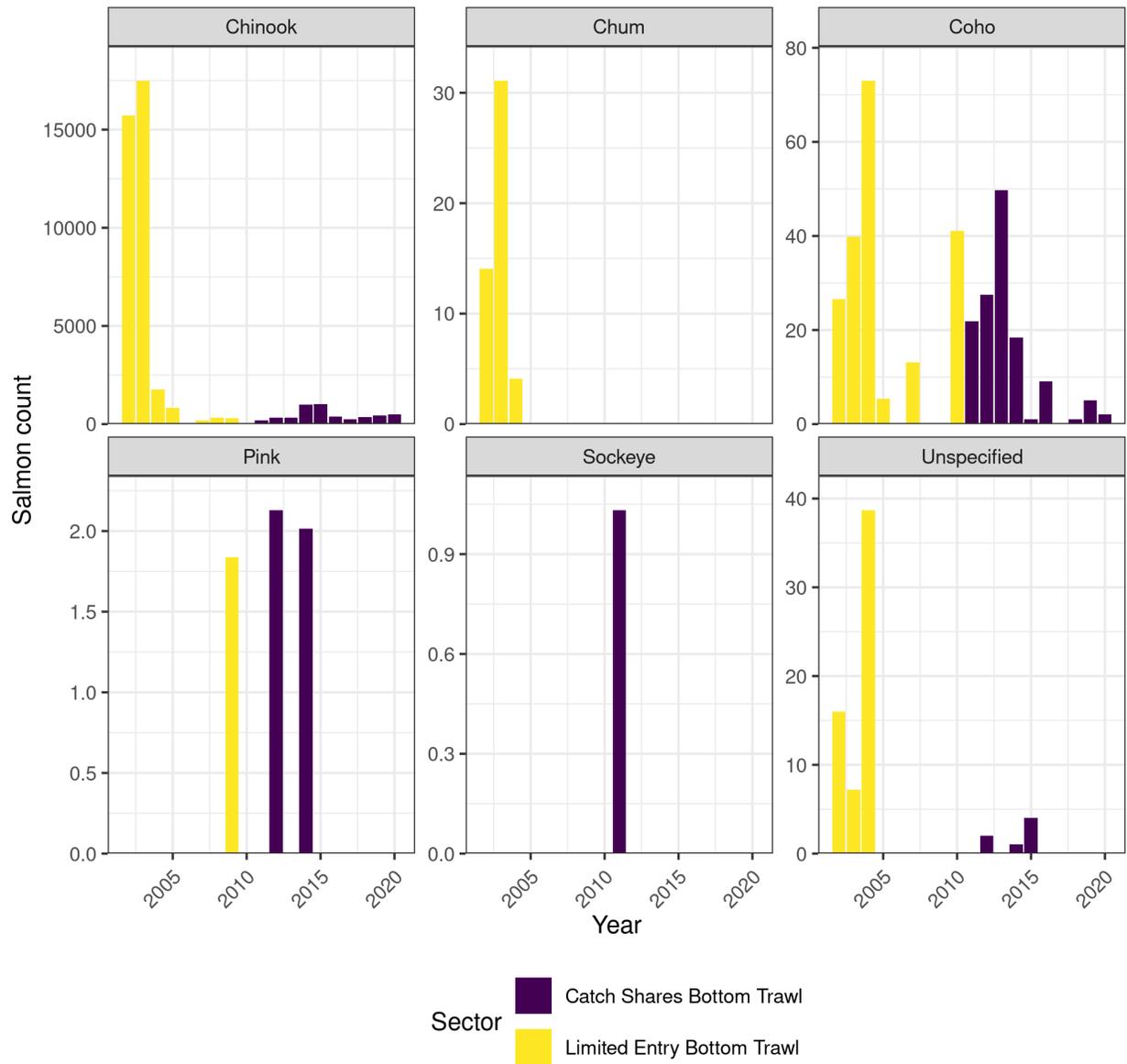


Figure 2. Salmon bycatch in the limited entry (2002-2010) and catch shares (2011-2020) bottom trawl fishery. Note that the limited entry bottom trawl fishery counts represent estimates based on partial observer coverage, while the catch shares bottom trawl fishery has full observer or electronic monitoring coverage. For confidentiality reasons, non-hake midwater trawl in 2011 and LE California halibut in 2011-2013 are combined with catch shares bottom trawl here. Data from electronically-monitored bottom trawl vessels are included here.

### Midwater rockfish, midwater hake, and shoreside hake

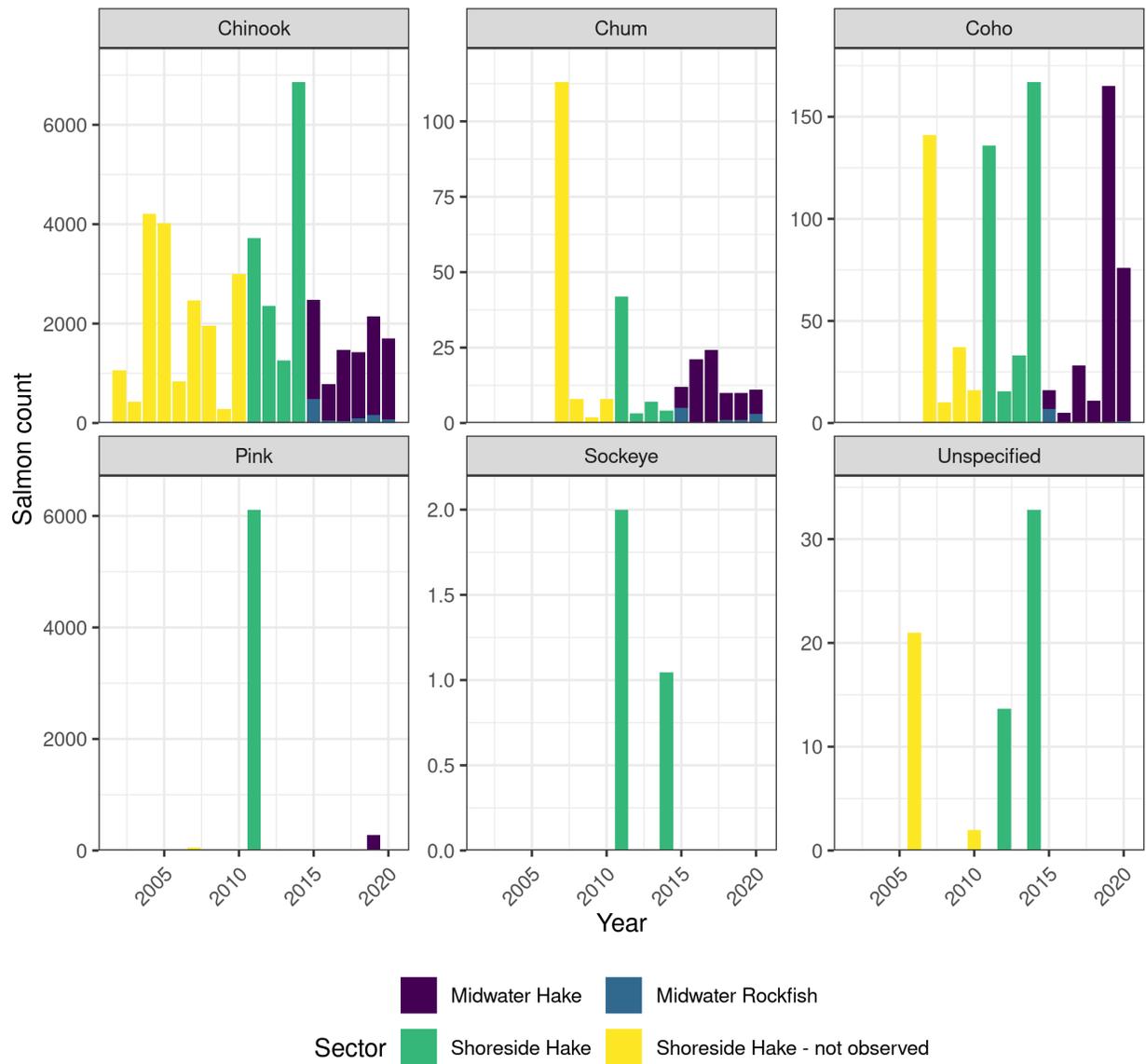


Figure 3. Salmon bycatch in shoreside midwater trawl sectors. Note that in 2015 the definition for shoreside midwater hake changed from the captain's stated target to the proportion hake landed; thus the shore-based hake fishery was called "shoreside hake" prior to 2015 and "midwater hake" thereafter. 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 shares midwater trawl in 2011 is shown combined with catch shares bottom trawl in Figure 2. Data from electronically-monitored midwater trawl vessels are included here.

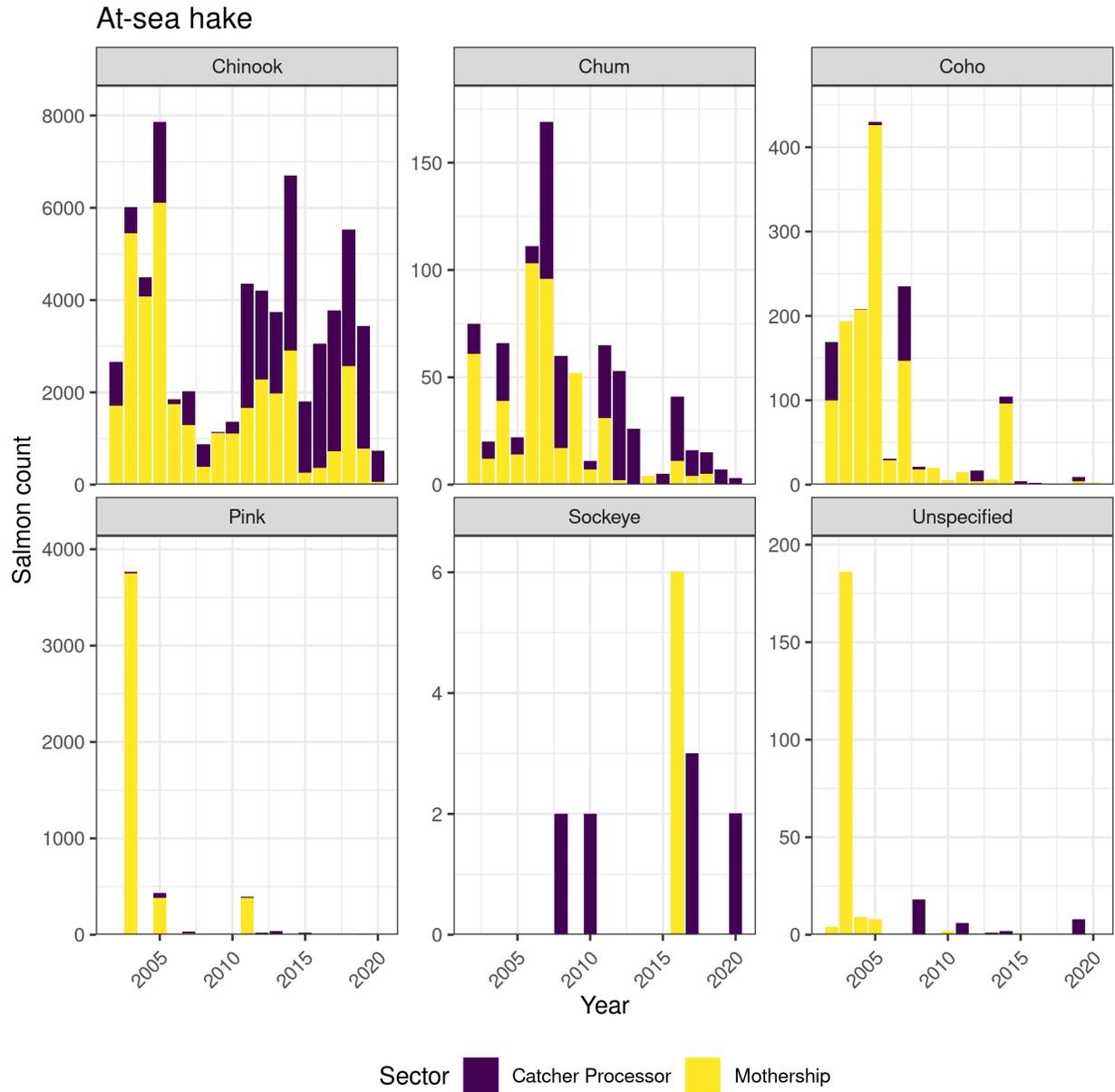


Figure 4. Salmon bycatch in the at-sea hake fishery. This sector has full observer coverage. Data from the tribal mothership sector (active prior to 2013) are included here, excepting 2012 for confidentiality reasons.

### Limited entry and open access California halibut

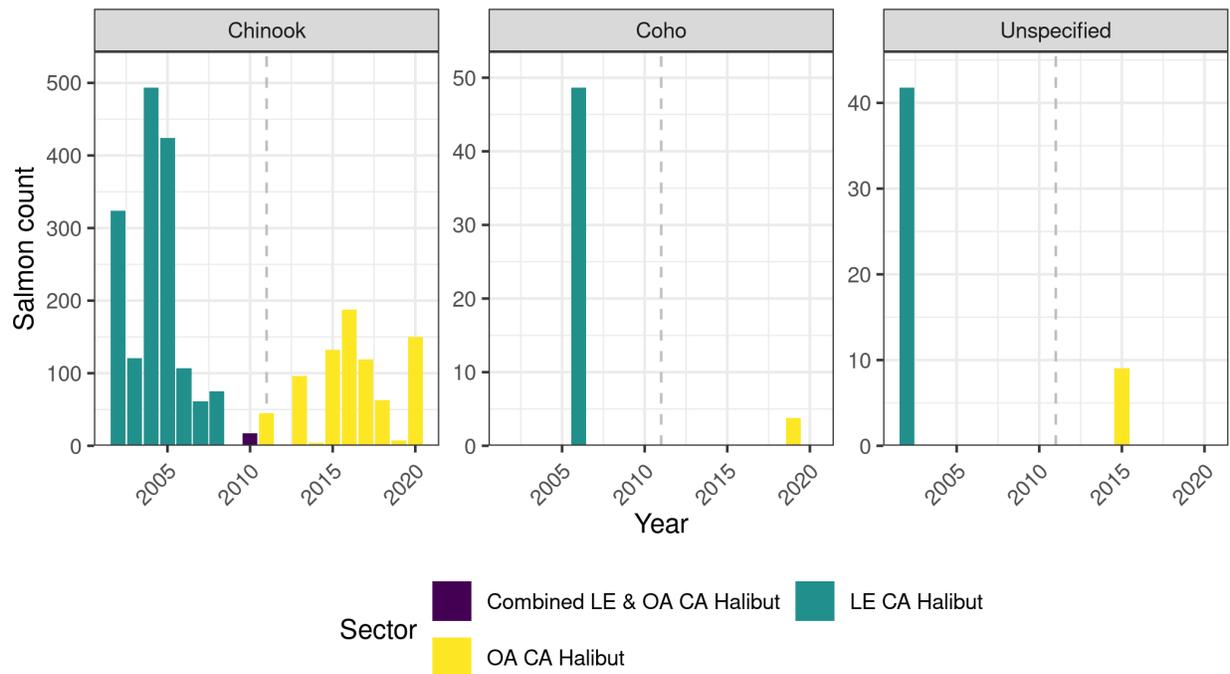


Figure 5. Estimated salmon bycatch in the limited entry and open access California halibut fishery. Note that starting in 2011, LE California halibut is combined with CS bottom trawl for confidentiality reasons, but there has been no activity in this sector since 2013.

### Limited entry sablefish - hook and line

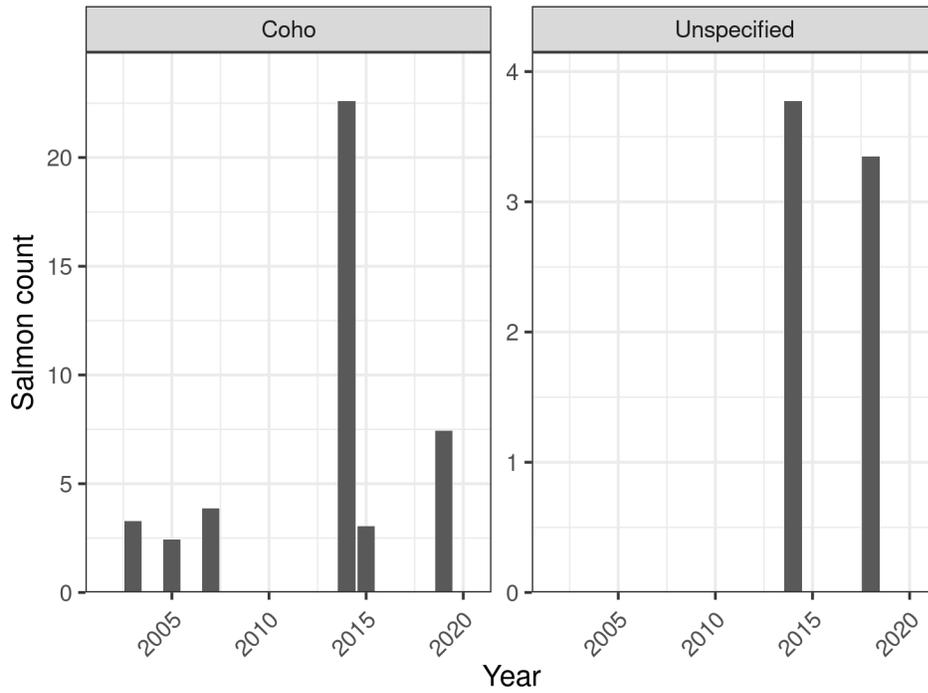


Figure 6. Estimated salmon bycatch in the limited entry sablefish hook and line fishery.

### Nearshore

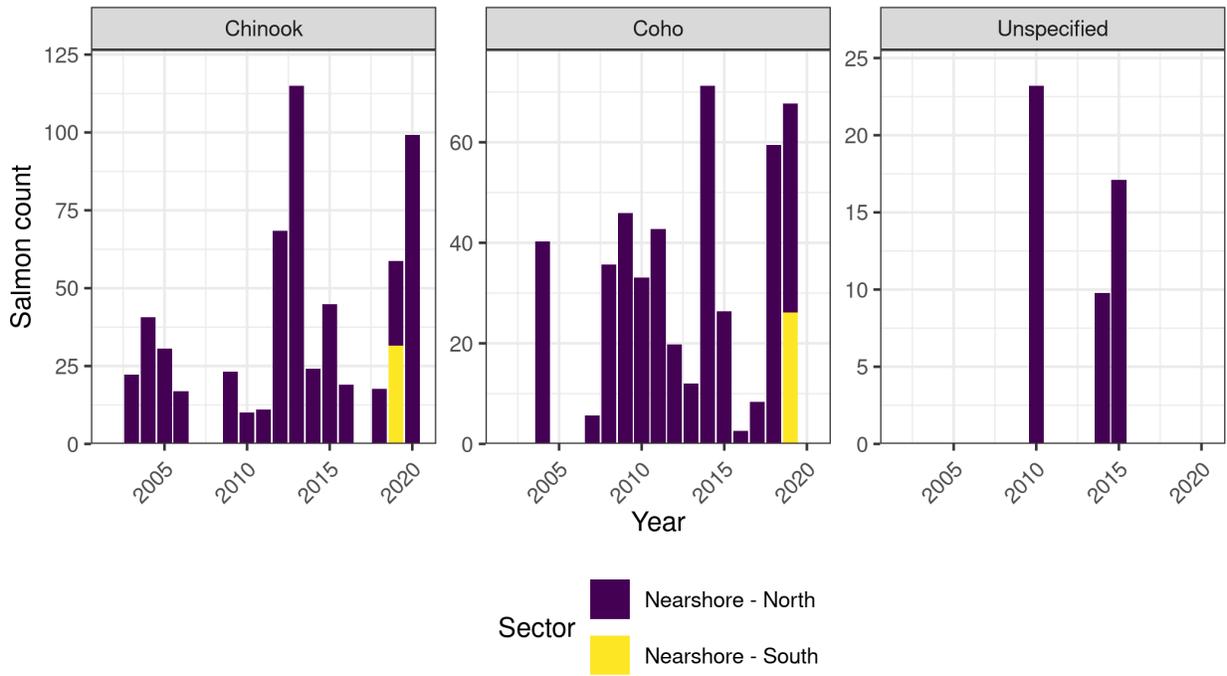


Figure 7. Estimated salmon bycatch in the nearshore fisheries north and south of 40°10' N.

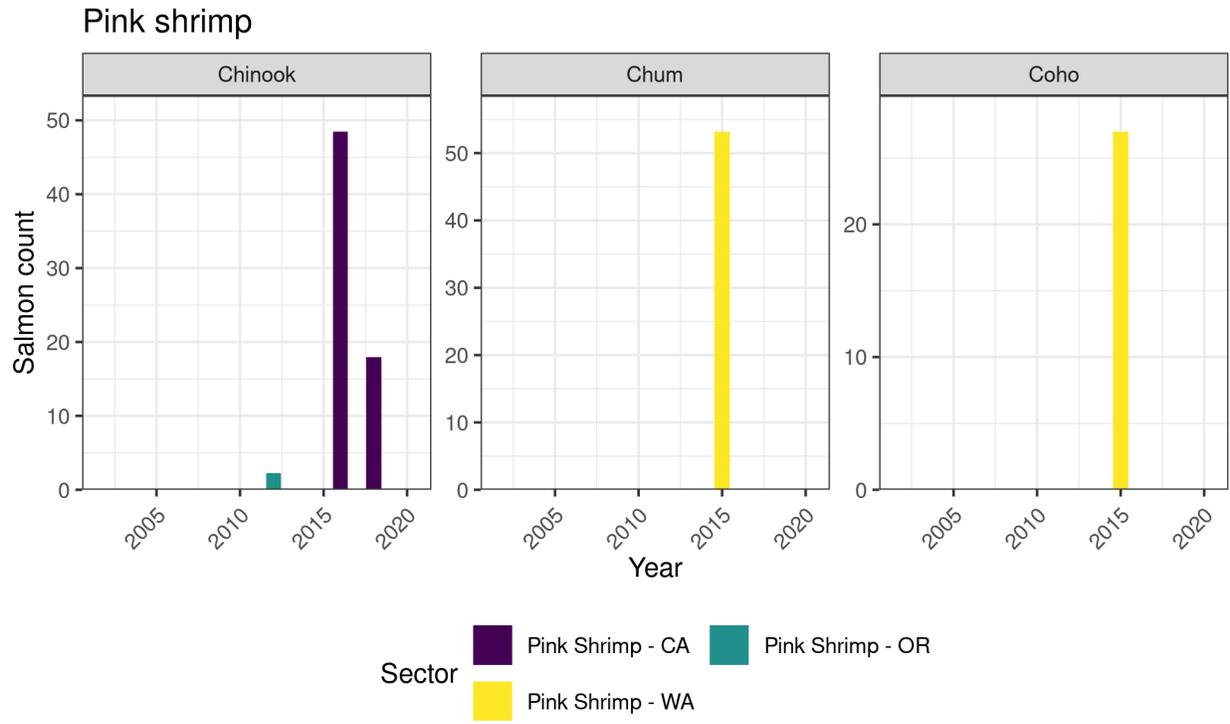


Figure 8. Estimated salmon bycatch in the pink shrimp fishery.

### WCGOP biological sampling

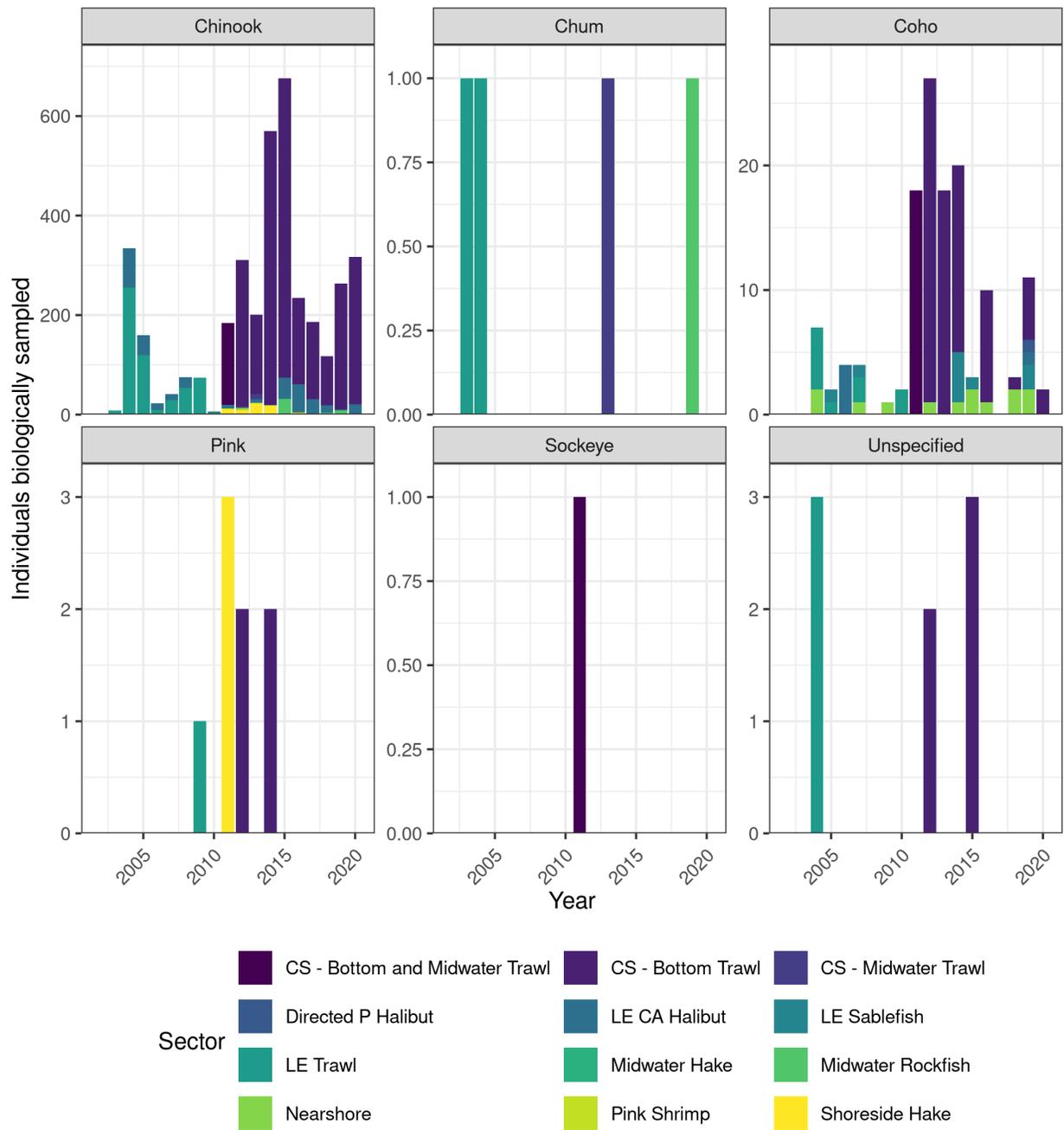


Figure 9. Number of salmon biologically sampled by WCGOP observers 2002-2020.

### A-SHOP biological sampling

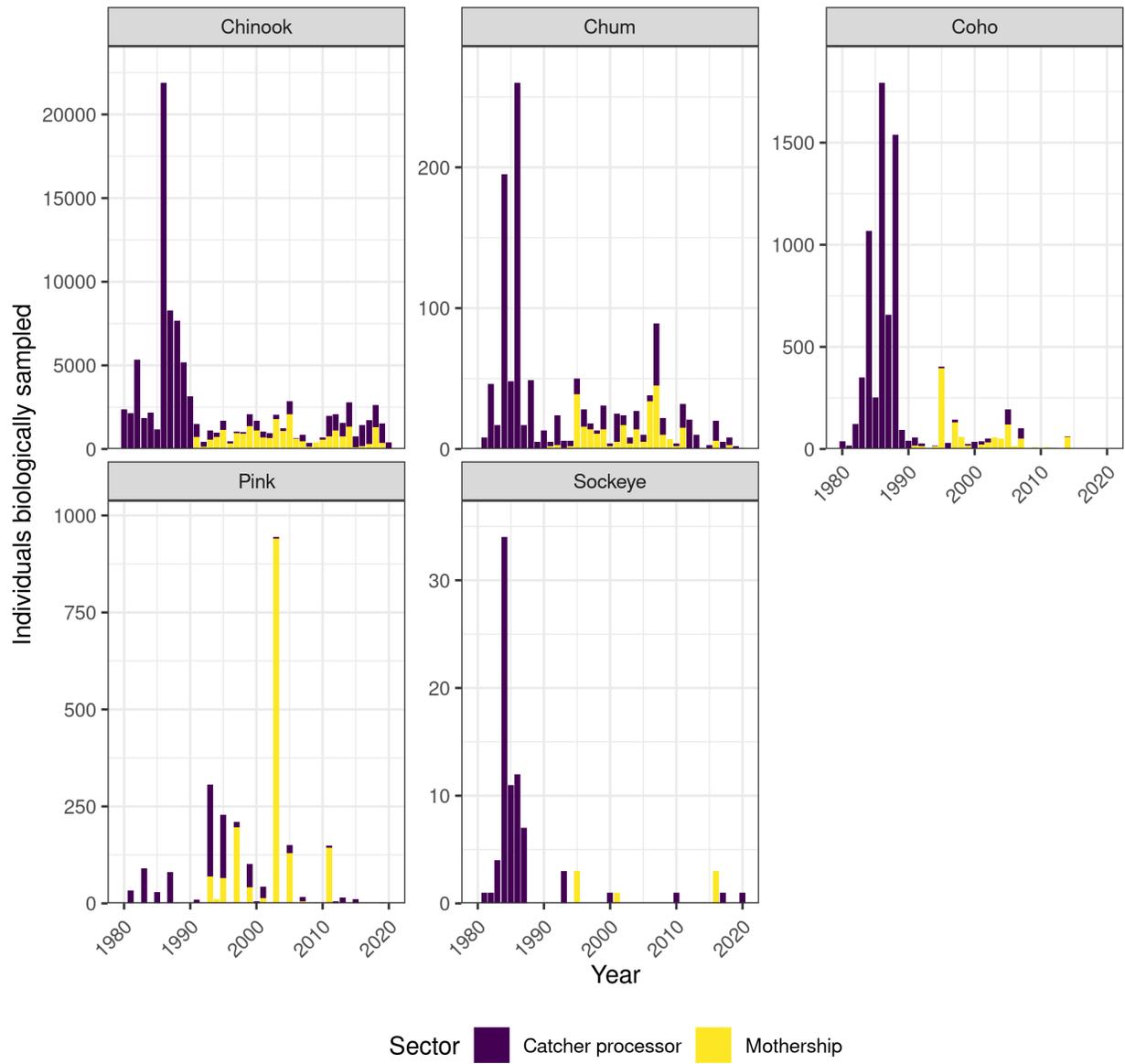


Figure 10. Number of salmon biologically sampled by A-SHOP observers, 1980-2020.

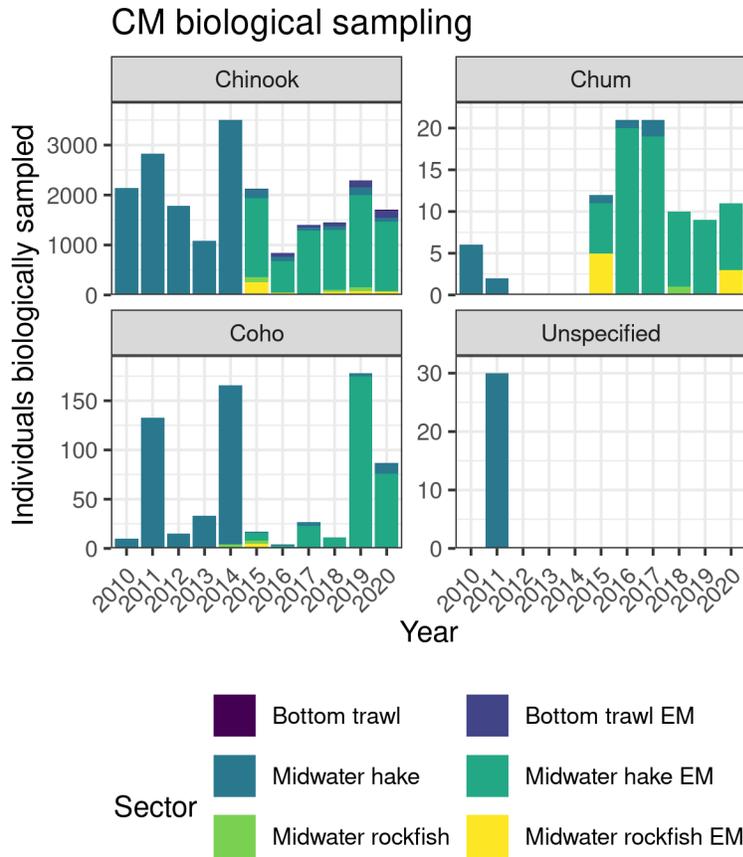


Figure 11. Number of salmon biologically sampled by the CM program, 2010-2020.

### References

Somers, K. A., M.A. Bellman, J.E. Jannot, Y.-W. Lee, J. McVeigh, and V. Tuttle. 2015. Observed and estimated total bycatch of salmon in the 2002-2013 U.S. west coast fisheries. West Coast Groundfish Observer Program. National Marine Fisheries Service, NWFSC, 2725 Montlake Blvd E., Seattle, WA 98112.

Somers, K.A., J.E. Jannot, K.E. Richerson, V.J. Tuttle, N.B. Riley, and J.T. McVeigh. 2021. Estimated discard and catch of groundfish species in the 2021 U.S. west coast fisheries. Available at <https://www.pcouncil.org/documents/2021/08/c-1-b-nmfs-report-1-estimated-discard-and-catch-of-groundfish-species-in-the-2020-u-s-west-coast-fisheries.pdf/>