

Observed and Estimated Bycatch of Salmon in U.S. West Coast Fisheries, 2002–2023

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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. The WCGOP and A-SHOP are managed by NOAA Fisheries' Northwest Fisheries Science Center Fisheries Observation Science Program (FOS). The West Coast Electronic Monitoring program transitioned from management under Exempted Fishing Permits (2015-2023) to Federal regulations in 2024. 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. 2024a). 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.

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. In the Trawl Catch Share Program, landings are 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 required to be landed and sampled dockside; this report includes estimates of salmon bycatch in the small amount of unsampled at-sea discards that occur due for operational and/or safety reasons. 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 previous years, and the most recent data processing procedures. Data processing updates are described in the annual groundfish mortality report (Somers et al. 2024a), which is available in draft form annually in the Pacific Fishery Management Council's (PFMC) September Briefing Book and later in the year in final form as a NOAA Technical Memorandum.

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In this report, we have updated the salmon bycatch tables to improve accessibility and ease of analysis for readers by presenting estimated bycatch at only the year and sector level. Methods for estimating unsampled bycatch do not differ from previous reports (i.e., bycatch estimates are generated at the same strata as previous reports, and combined here as appropriate for presentation). Coverage data for these strata are presented in Somers et al. (2024b). New figures illustrate bycatch by latitude, season, and/or depth. The accompanying spreadsheet contains bycatch estimates for all observed/monitored sectors with recorded salmon bycatch, as well as a summary table and information on biological data collected. All weight units are in metric tons (mt), except for individual fish in biological data tables, which are in kilograms (kg).

Trends 2002-2023

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 ecosystems of which they are an essential component.

We present data from 2002 to 2023. Chinook bycatch in the hake fishery¹ as a whole has been volatile, with a high in 2014 (Figures 1, 3, 4). In 2023, total bycatch in this fishery was slightly higher than the median value from 2002-2023. In the shoreside (SS) groundfish trawl sectors², most Chinook bycatch was attributed to the LE, and later CS, bottom trawl fishery (Figures 1, 2). Bycatch was high in 2002 and 2003, but has remained low since 2005 other than 2014 and 2015; however, bycatch has been slowly increasing since 2016. In non-catch shares (NCS)³ sectors, Chinook bycatch has been low across all years (Figure 5).

Over the time period examined, coho bycatch was generally an order of magnitude lower than Chinook bycatch, with considerable amounts of inter-annual variability (Figure 1). Bycatch in the hake fishery in 2023 was slightly lower than the long-term median value (Figures 1, 3, 4). Bycatch in the NCS and SS non-hake catch shares fisheries has remained at low or moderate levels across all years, and was close to the long-term median in 2023 (Figure 2, 3, 5).

A-SHOP, WCGOP, and the CM Program collect biological data on salmon, including length, weight, sex, tissue samples, and other information. Figures 6-8 summarize the number of biological samples collected over time.

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

² Includes shoreside limited entry (LE) and catch shares (CS) bottom trawl, CS fixed gear, CS midwater rockfish, and LE California halibut.

³ Includes non-catch shares exempted fishing permits, sablefish primary, nearshore, open access (OA) California halibut, pink shrimp, and OA hook & line sectors.

Figures 9-20 summarize potential latitudinal, depth, and seasonal patterns in bycatch, relative to overall effort in the catch shares bottom trawl, midwater rockfish, midwater hake, and at-sea hake fisheries. These boxplots show the quartiles of all haul latitudes, depths, and days of year, as well as those of hauls that encountered Chinook and coho, excluding outliers. In the catch shares bottom trawl fishery and at sea hake fishery, hauls with Chinook appeared to occur at more southern latitudes than overall effort in recent years, while the opposite appeared in the midwater hake fishery in recent years (Figures 9, 11, 12). This pattern was not evident in the midwater rockfish fishery (Figure 10). In earlier years in the catch shares bottom trawl fishery, hauls with Chinook typically appeared to be shallower than overall effort, while in recent years, the opposite pattern appears (except in 2023; Figure 13). In the midwater rockfish, midwater hake, and at-sea hake fisheries, hauls with Chinook often appeared to be shallower than overall effort (Figure 14-16). In the catch shares bottom trawl fishery, hauls with Chinook often appeared to occur earlier in the season (Figure 17). In the midwater hake fishery, hauls with Chinook often appeared later in the season (Figure 19). In the midwater rockfish and at-sea hake fishery, seasonal patterns were less obvious (figures 18, 20). Overall, patterns in coho bycatch were more difficult to discern due to smaller and less frequent observations.

Figures

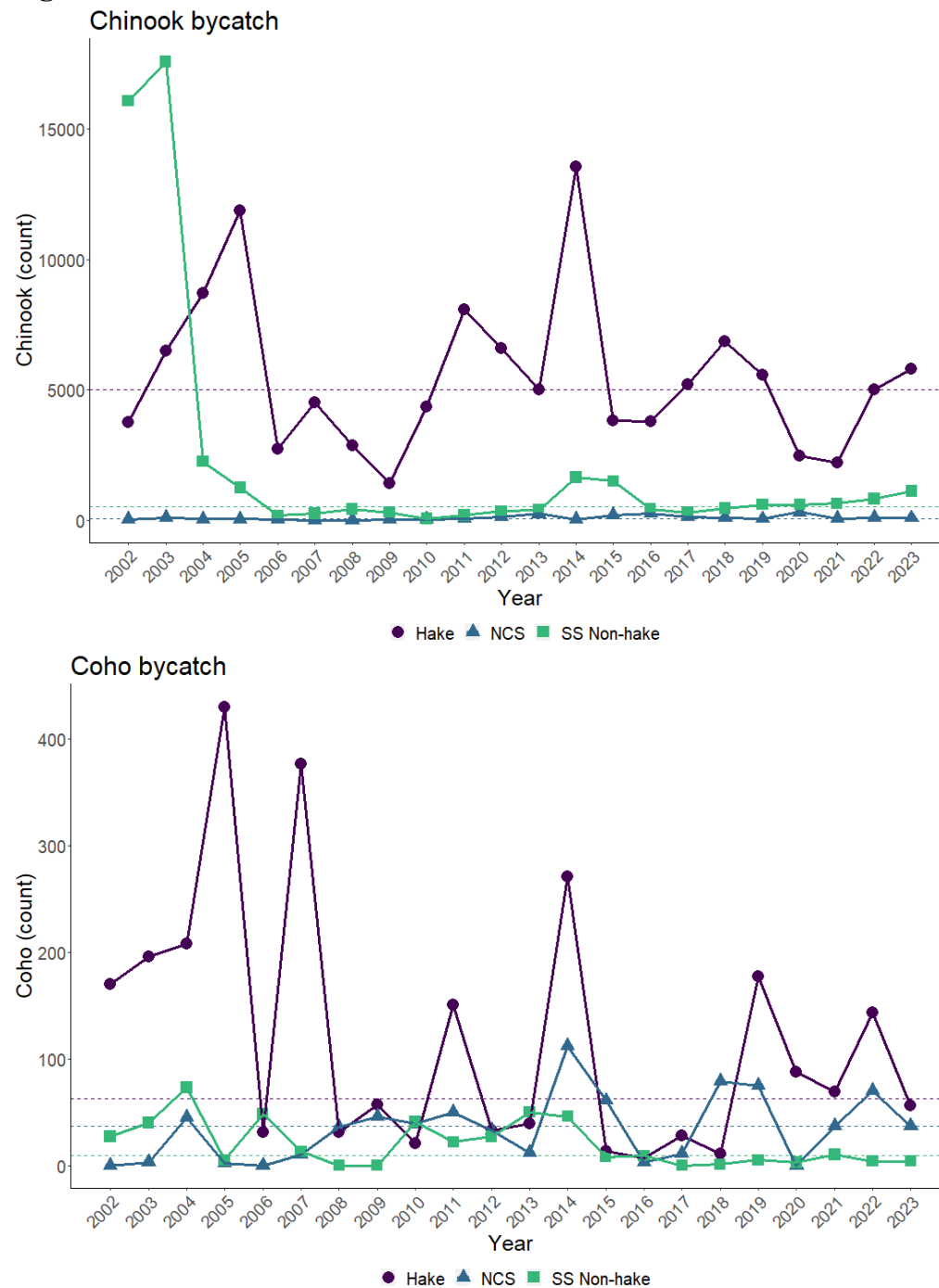


Figure 1. Chinook (upper panel) and coho (lower panel) salmon bycatch in fisheries monitored by the A-SHOP, CM, EM, and WCGOP, 2002-2023. Hake includes at-sea catcher processors, at-sea mothership catcher-vessels, and non-tribal shoreside. Non-catch shares (NCS) includes non-catch shares exempted fishing 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. Horizontal dashed lines show long-term medians.

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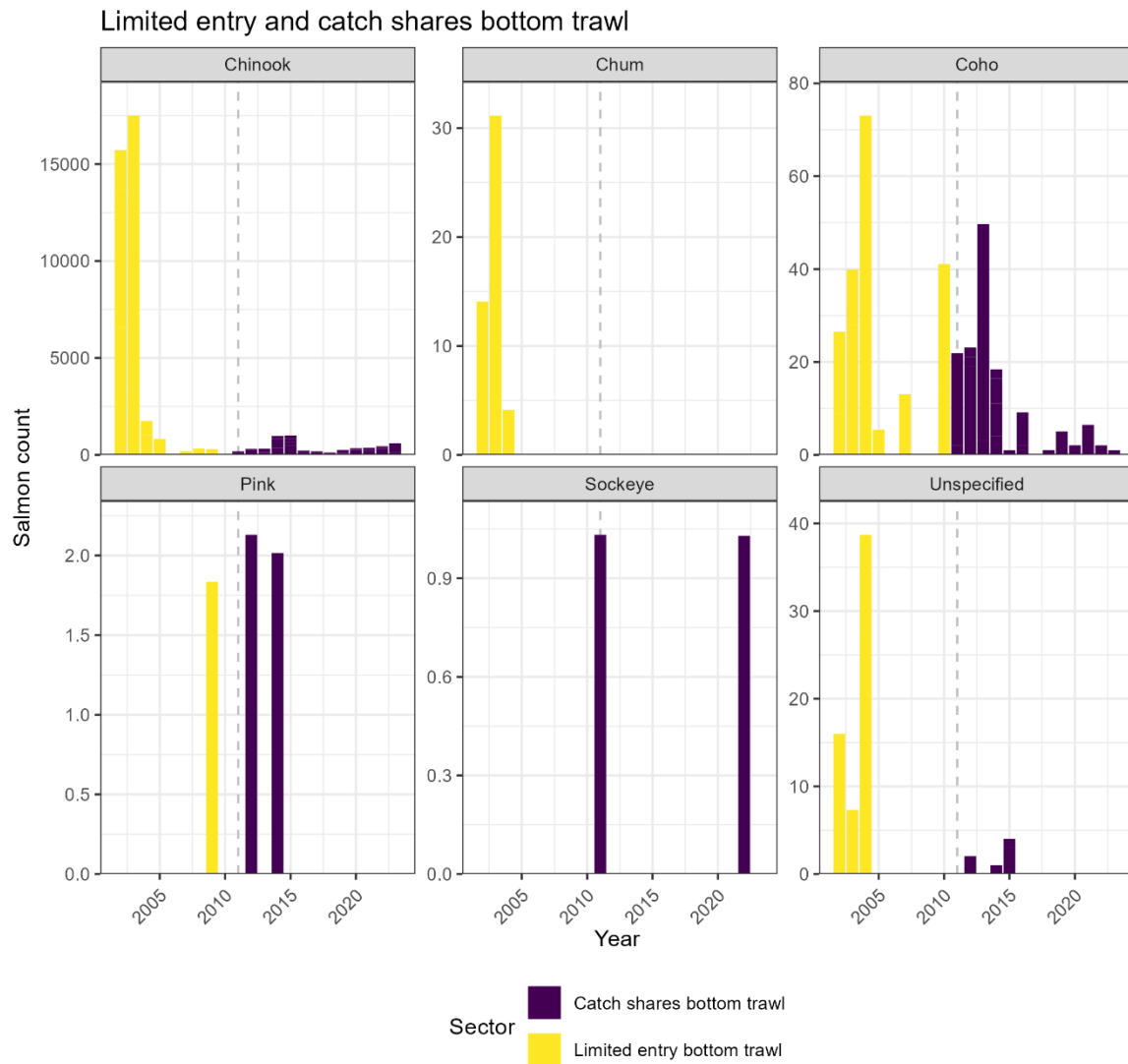


Figure 2. Salmon bycatch in the limited entry (2002-2010) and catch shares (2011-2023) bottom trawl fishery, including EM vessels. Note that the limited entry bottom trawl fishery counts represent estimates based on partial observer coverage, while the catch shares bottom trawl fishery has full observer or electronic monitoring coverage including dockside monitoring. For confidentiality reasons, non-hake midwater trawl in 2011 and LE California halibut in 2011-2013 are combined with catch shares bottom trawl.

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Midwater rockfish, midwater hake, and shoreside hake

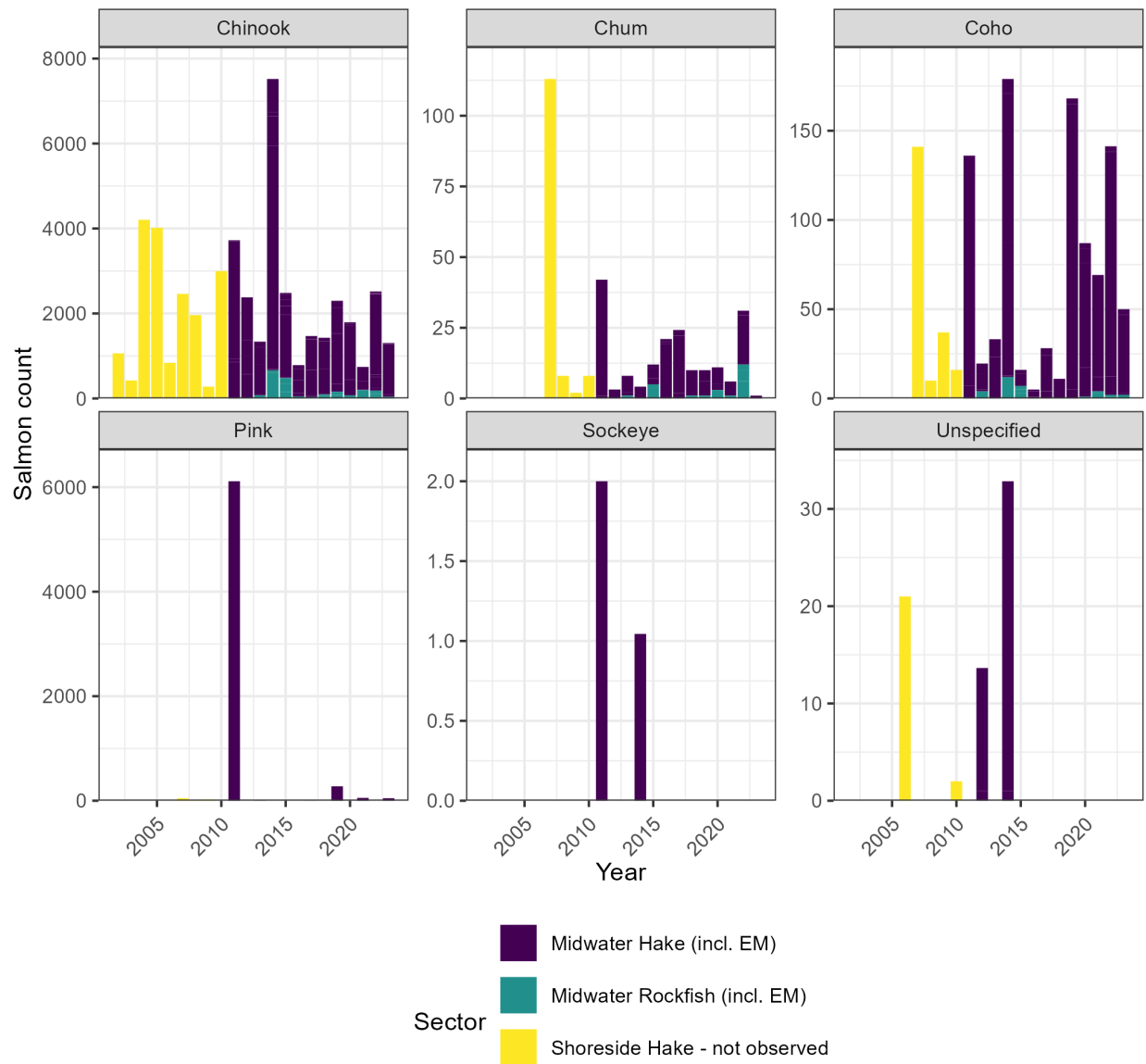


Figure 3. Salmon bycatch in shoreside midwater trawl sectors, including EM vessels, for 2002-2023. Shoreside midwater hake was not observed prior to 2011, and the counts presented here come from shoreside monitoring data housed in PacFin. From 2011 on, these sectors have full observer or electronic monitoring 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.

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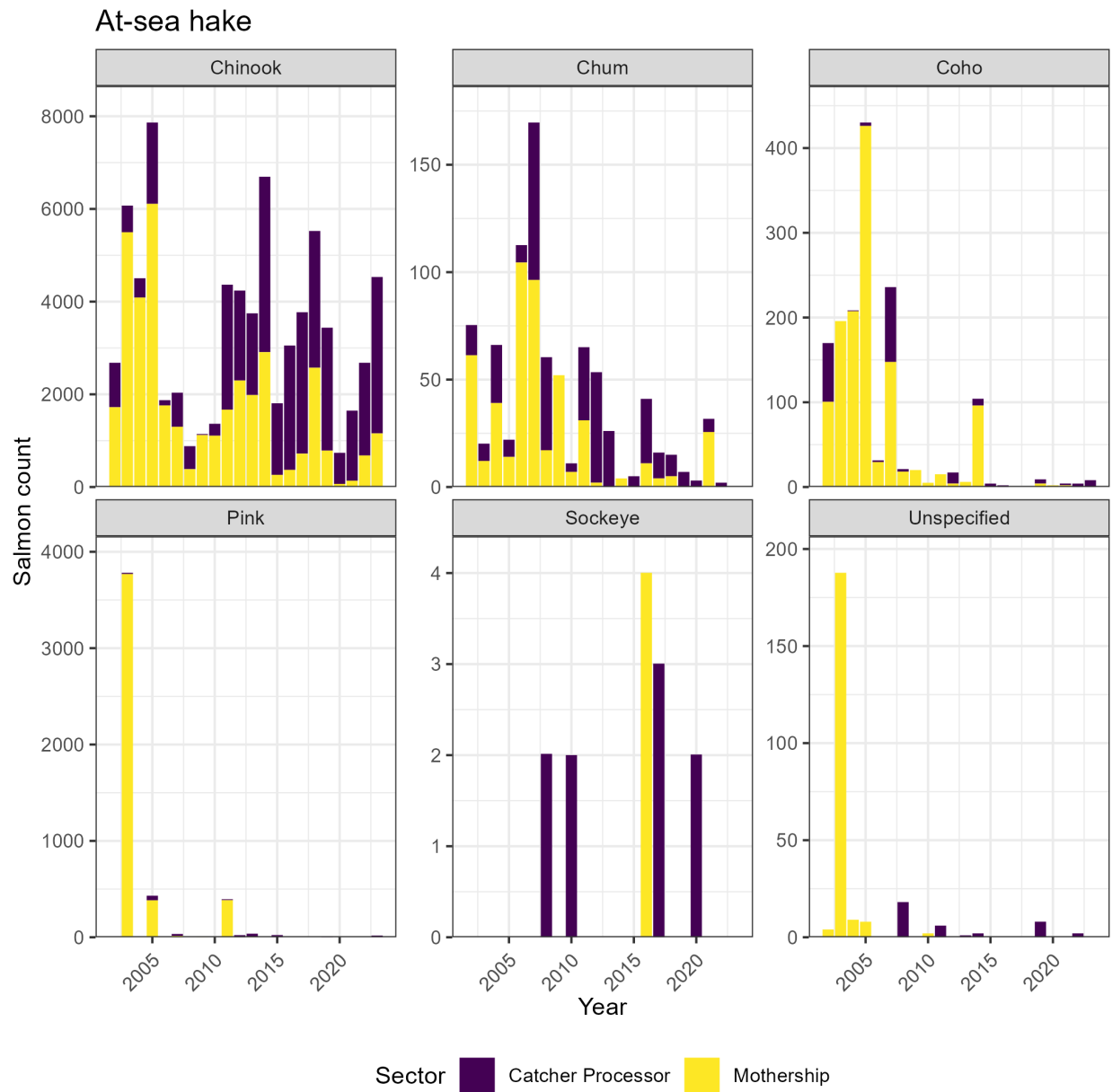


Figure 4. Salmon bycatch in the at-sea hake fishery 2002-2023. This sector has full observer coverage. Data from the tribal mothership sector (active prior to 2013) are included here, excepting 2012 for confidentiality reasons.

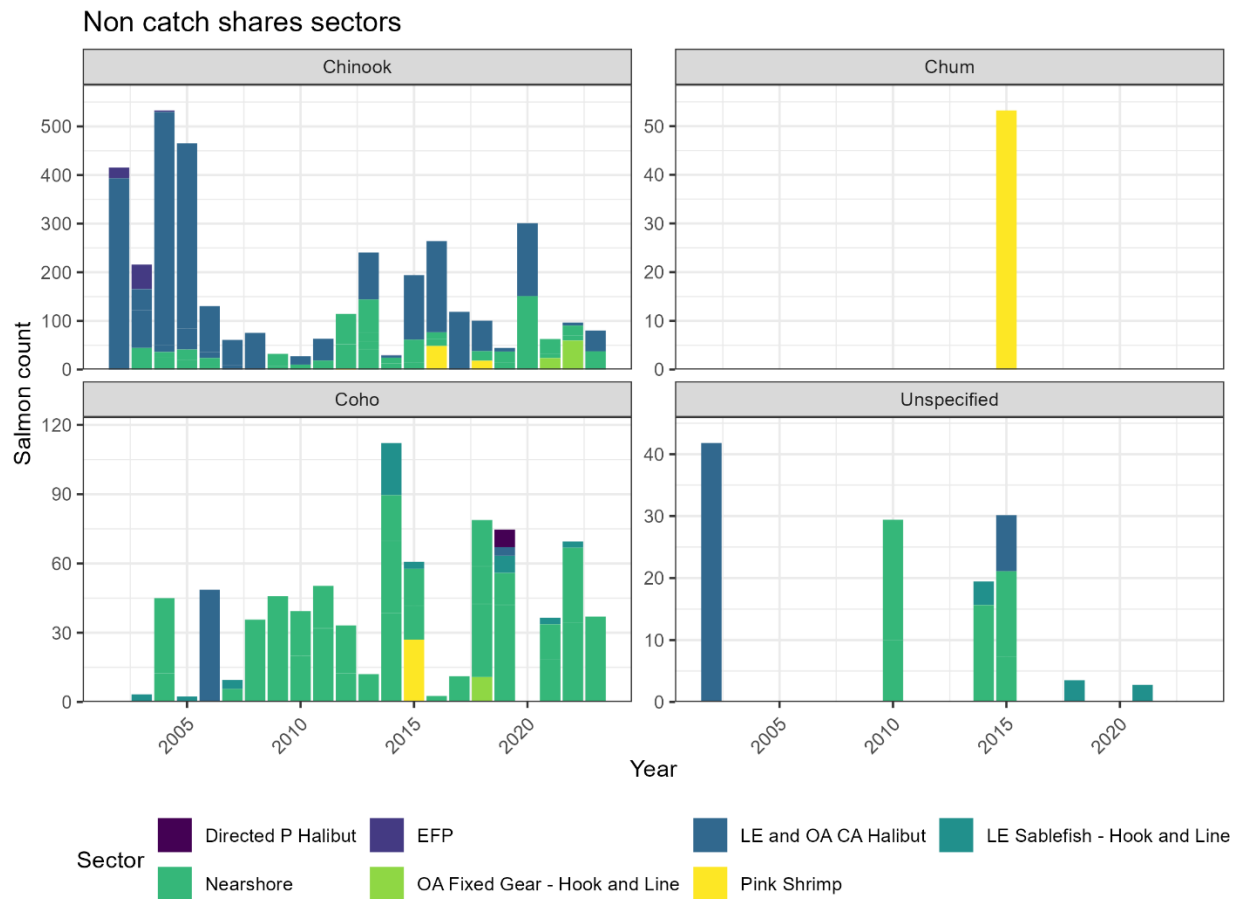


Figure 5. Estimated salmon bycatch in observed non catch shares sectors (excluding limited entry trawl), 2002-2023.

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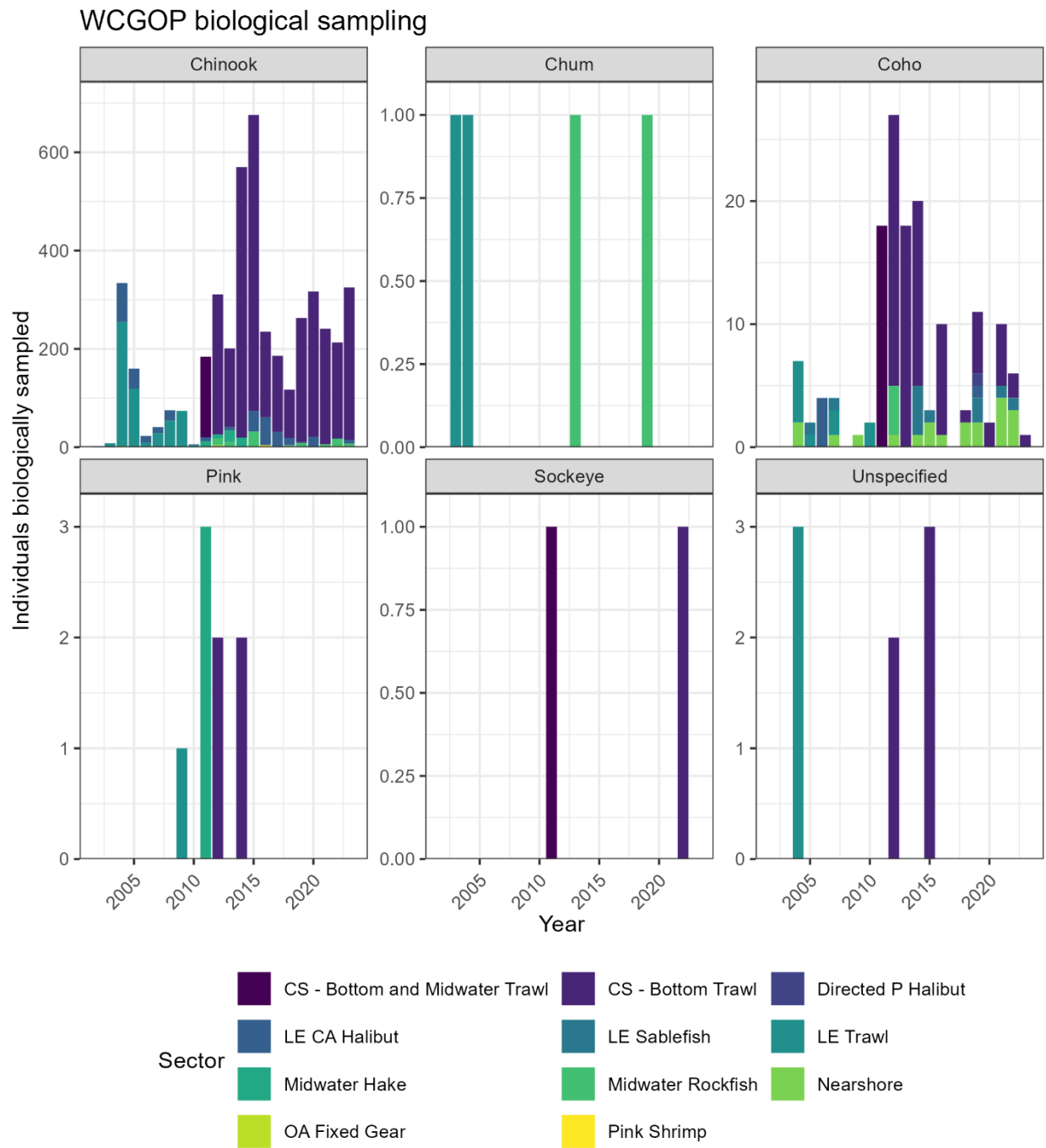


Figure 6. Number of salmon biologically sampled by WCGOP observers 2002-2023.

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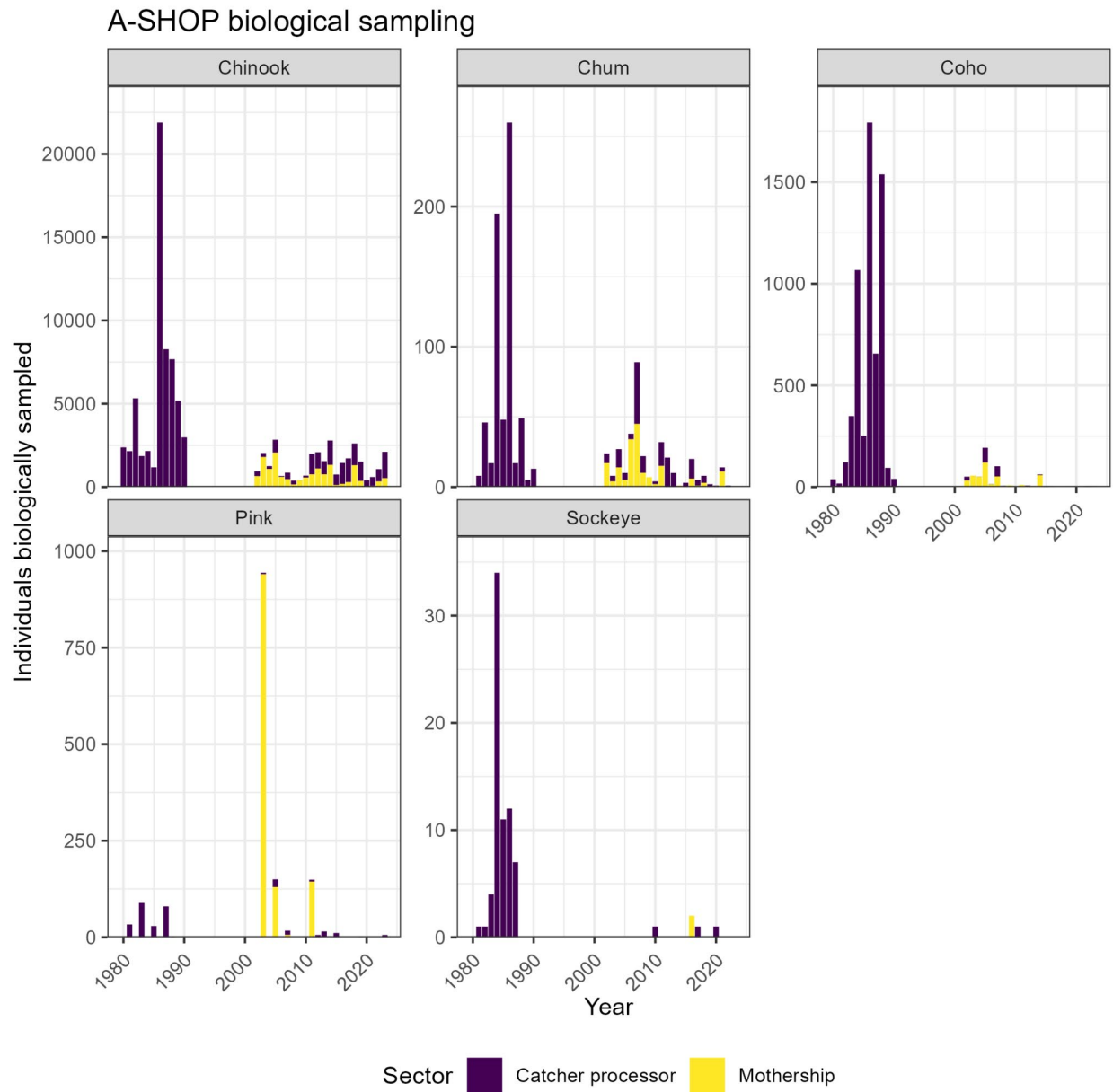


Figure 7. Number of salmon biologically sampled by A-SHOP observers, 1980-2023. Note that while fewer salmon have been sampled in recent years, more samples are taken per individual fish, so the total number of samples is larger than the number of individuals sampled.

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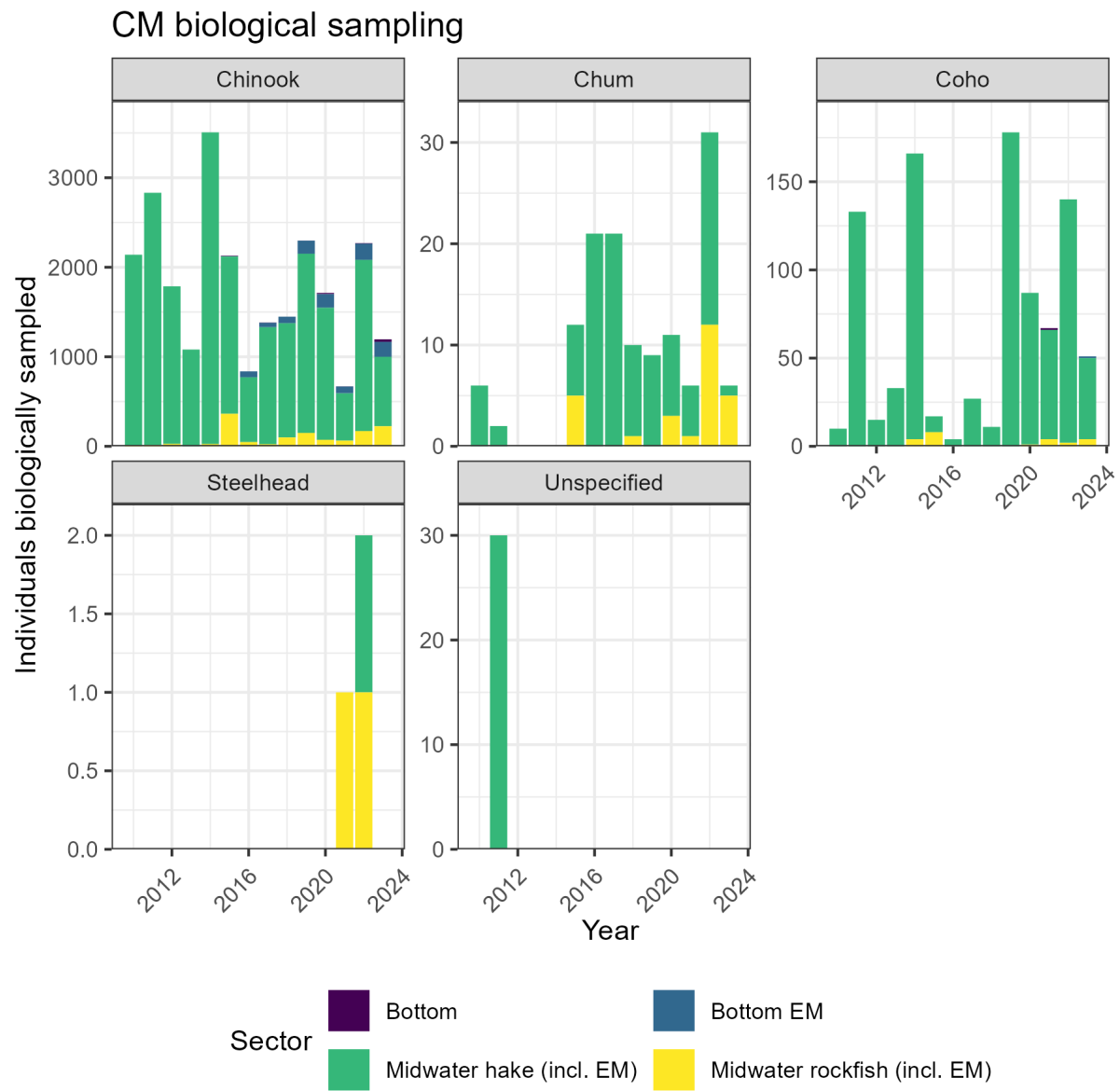


Figure 8. Number of salmon biologically sampled by the CM program, 2010-2023.

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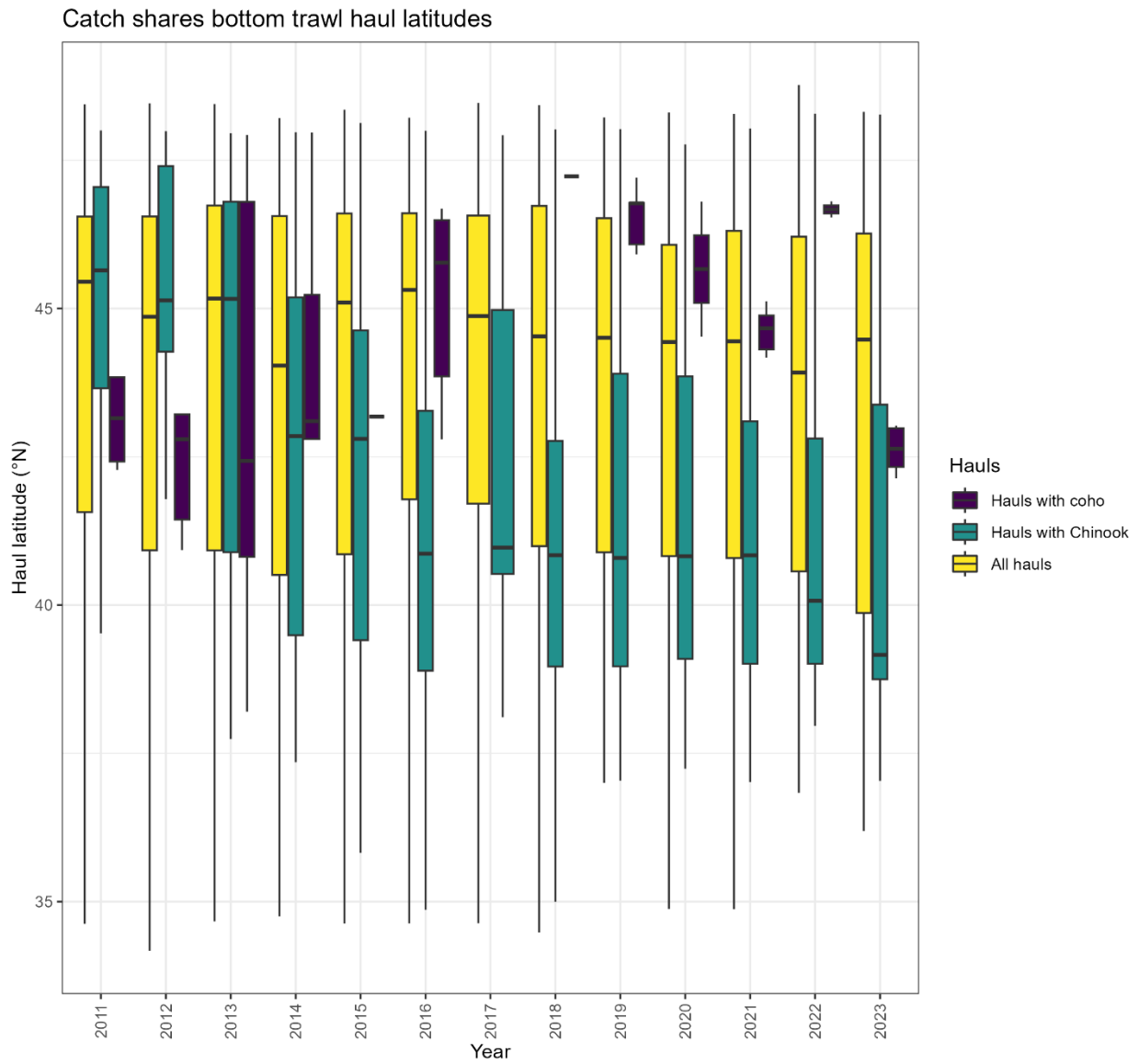


Figure 9. Boxplot of haul latitudes in the catch share bottom trawl fishery. Outliers are not shown.

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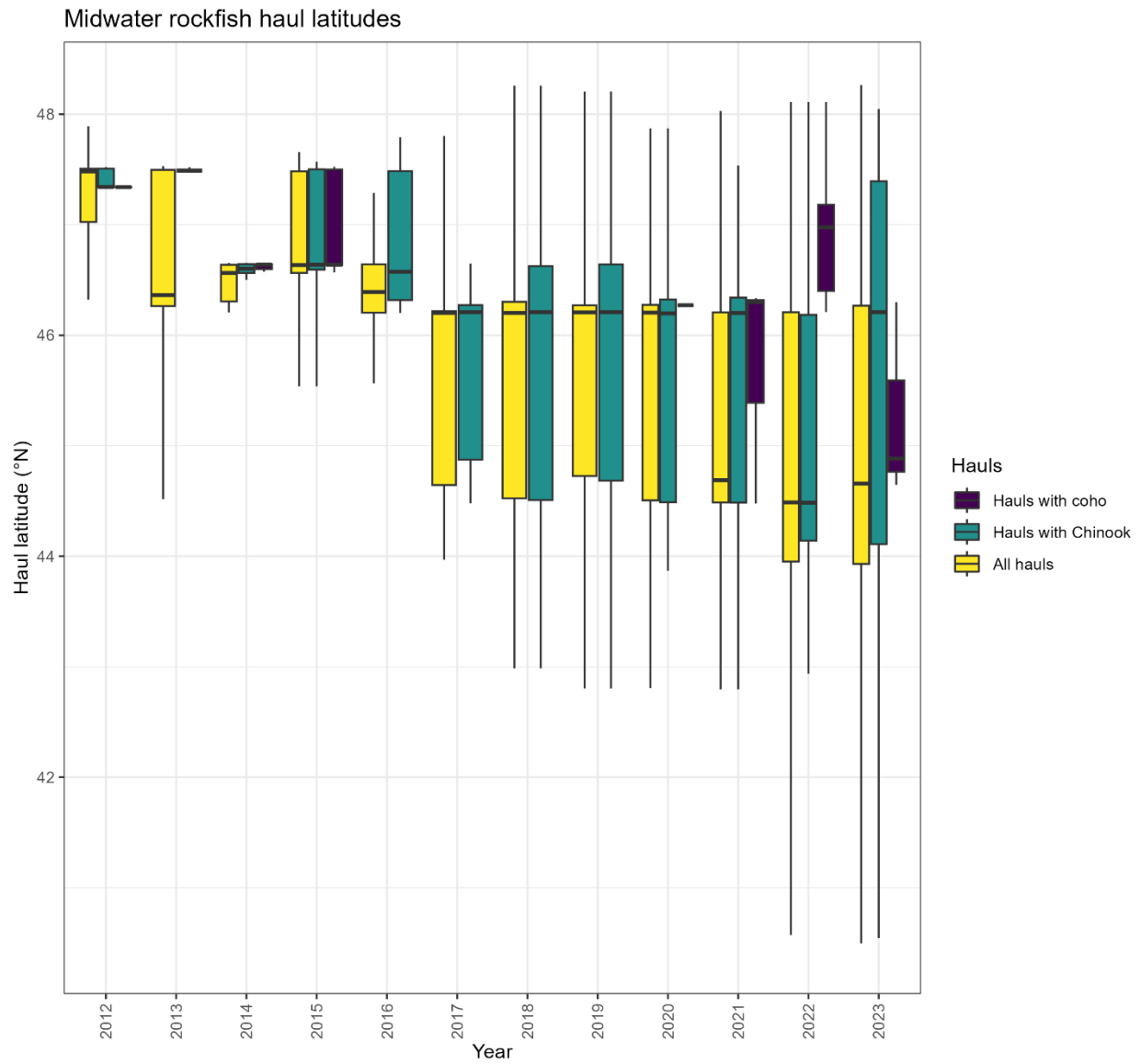


Figure 10. Boxplot of haul latitudes in the midwater rockfish trawl fishery. Outliers are not shown.

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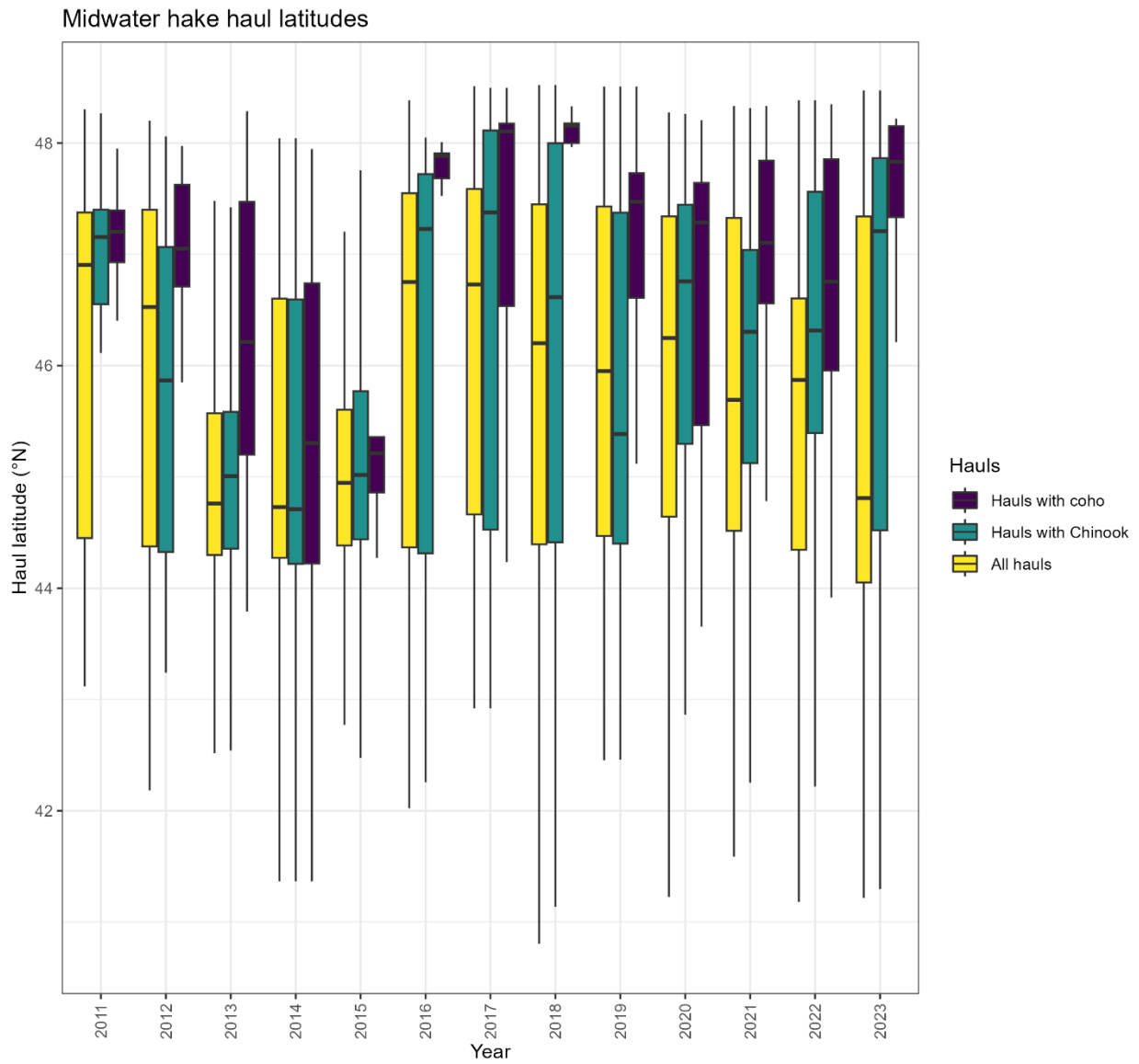


Figure 11. Boxplot of haul latitudes in the midwater hake trawl fishery. Outliers are not shown.

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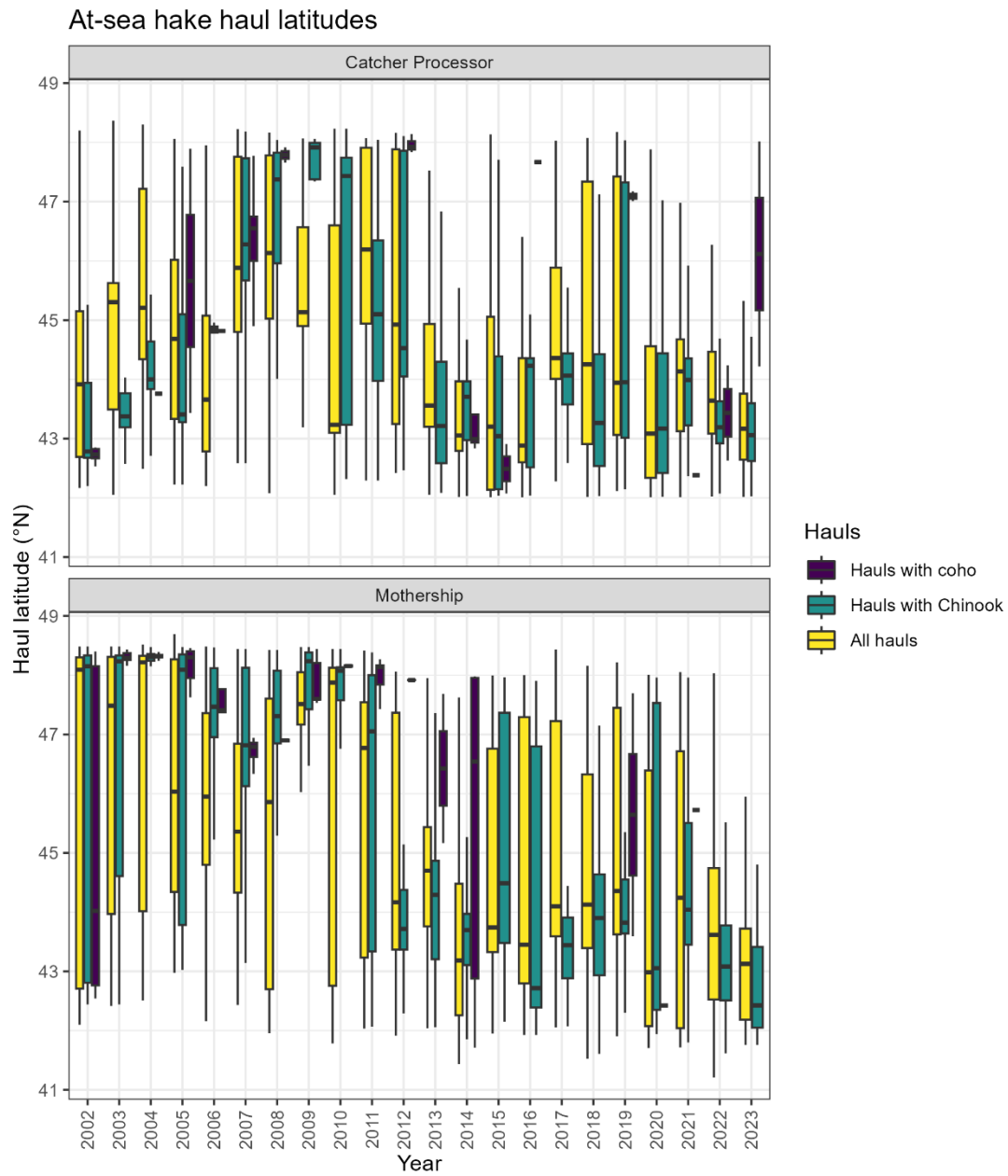


Figure 12. Boxplot of haul latitudes in the at-sea hake fishery. Outliers are not shown.

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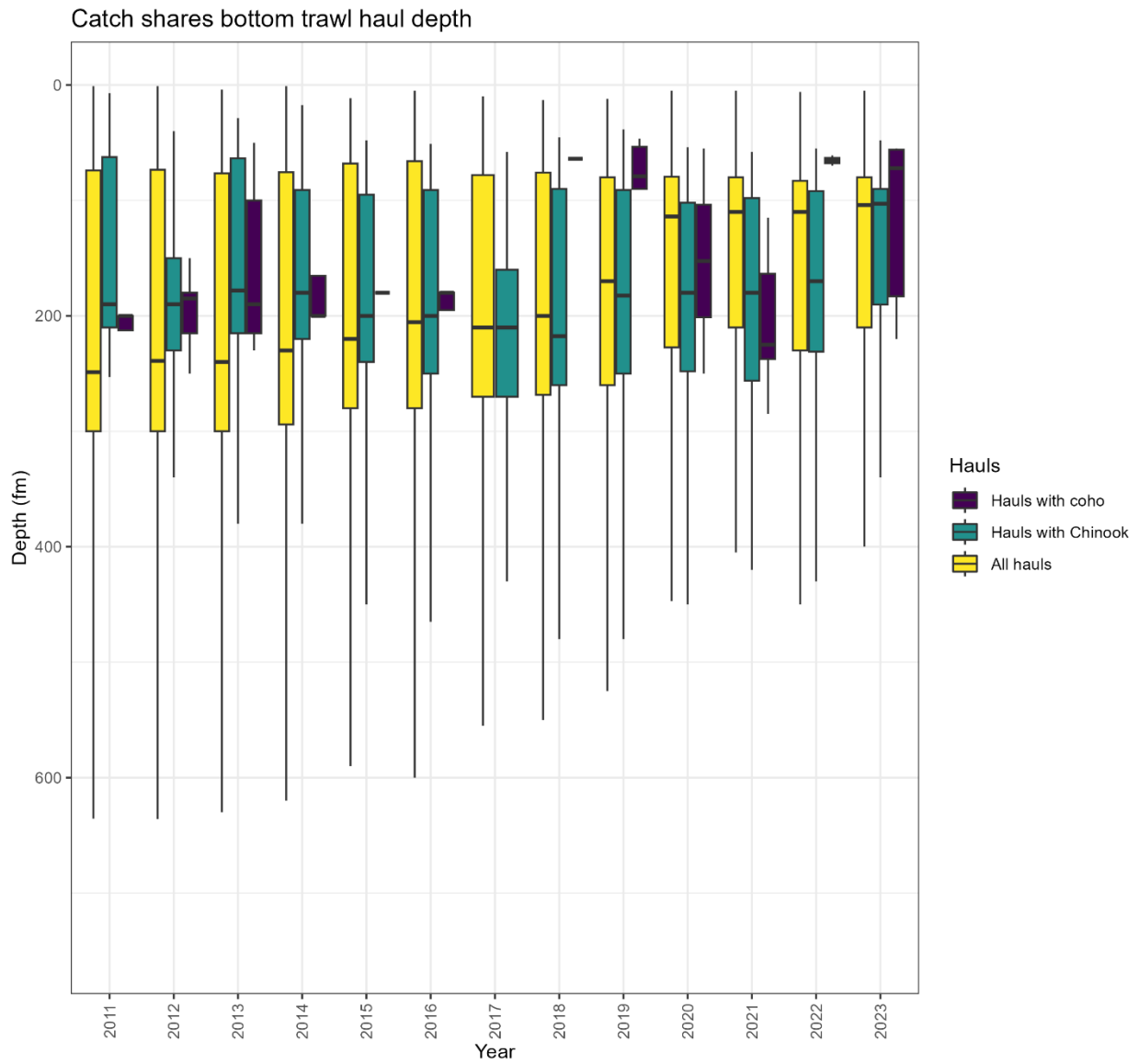


Figure 13. Boxplot of haul bottom depths in the catch share bottom trawl fishery. Outliers are not shown.

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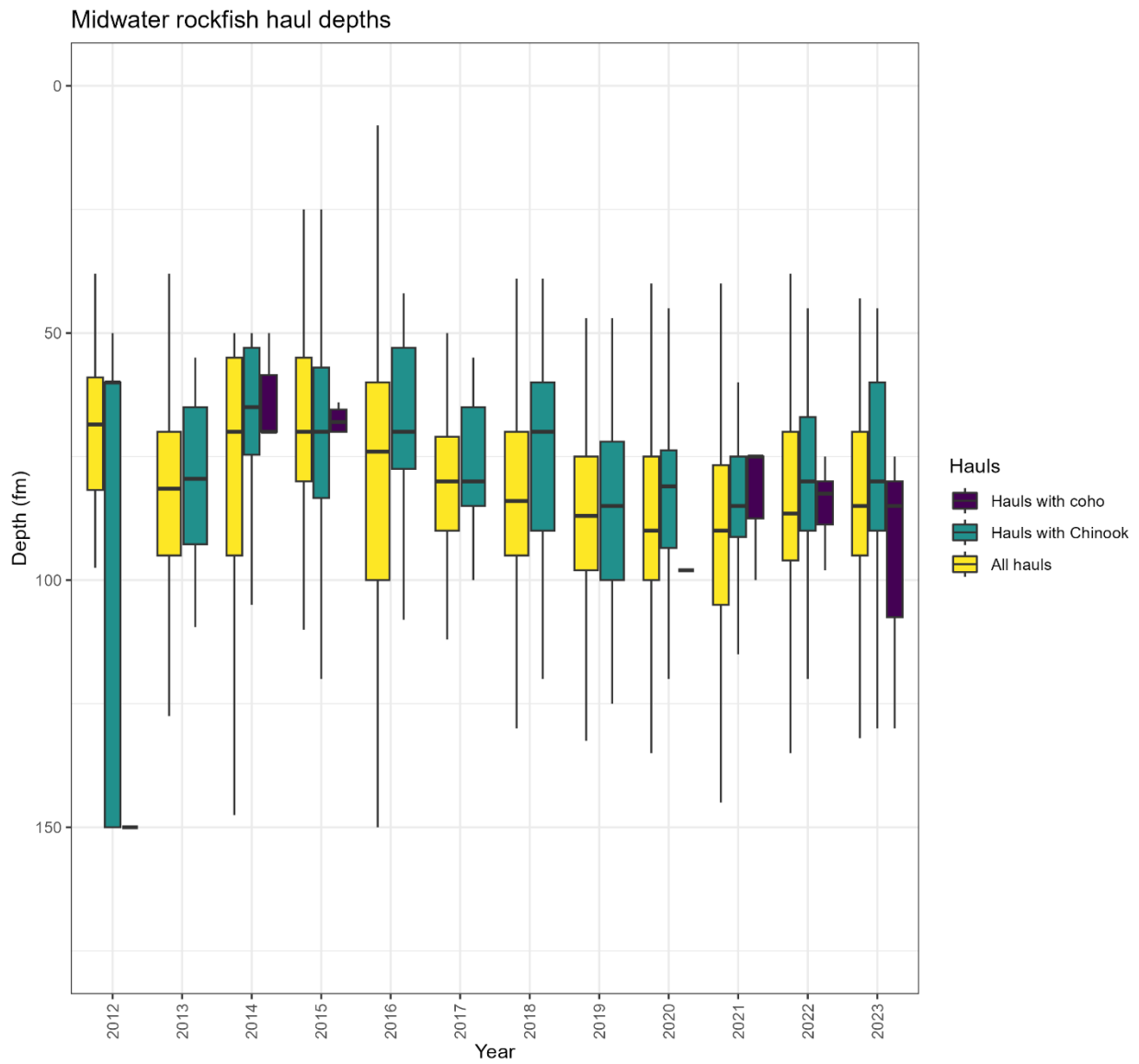


Figure 14. Boxplot of haul depths in the midwater hake trawl fishery. Outliers are not shown.

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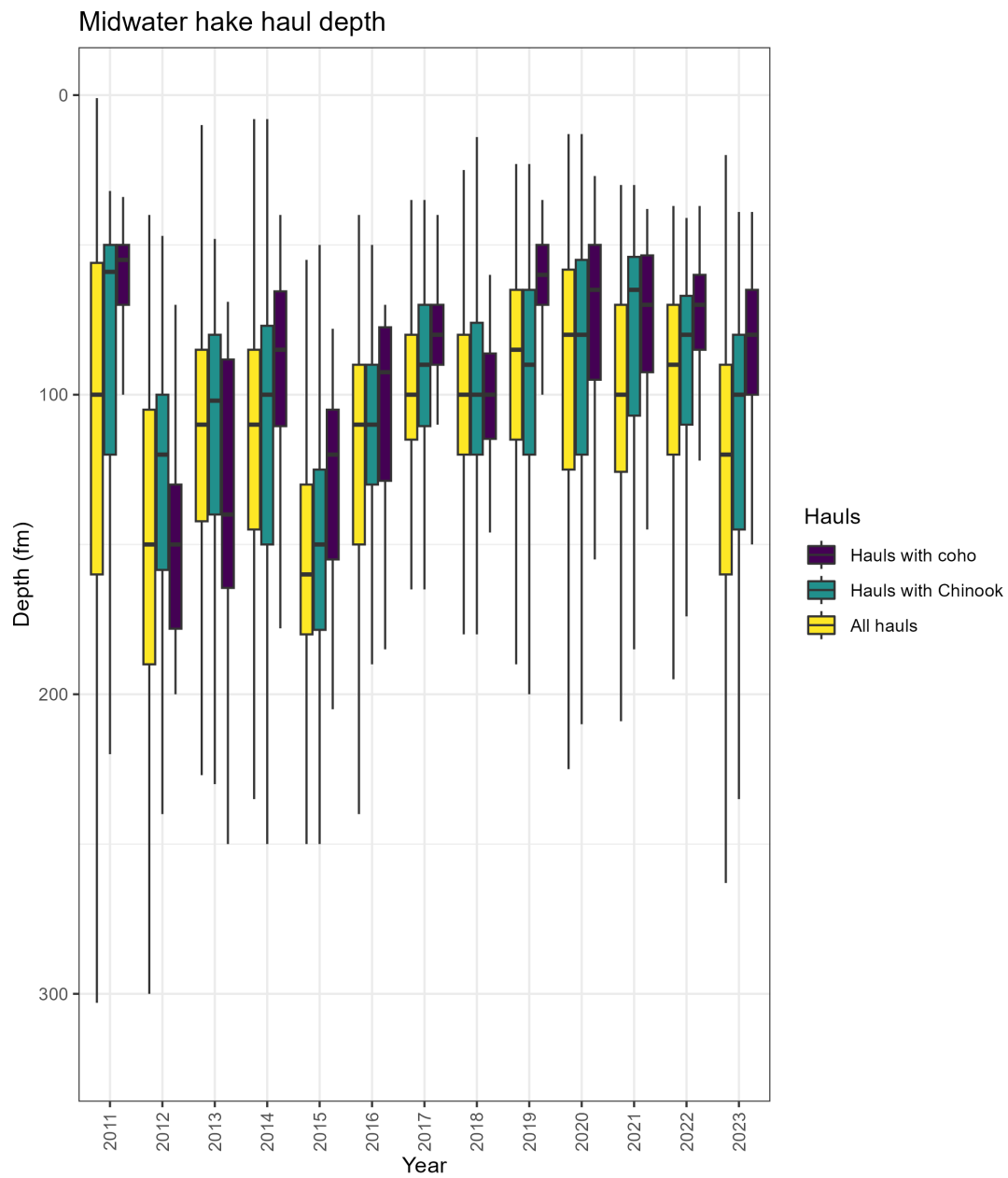


Figure 15. Boxplot of haul depths in the midwater hake trawl fishery. Outliers are not shown.

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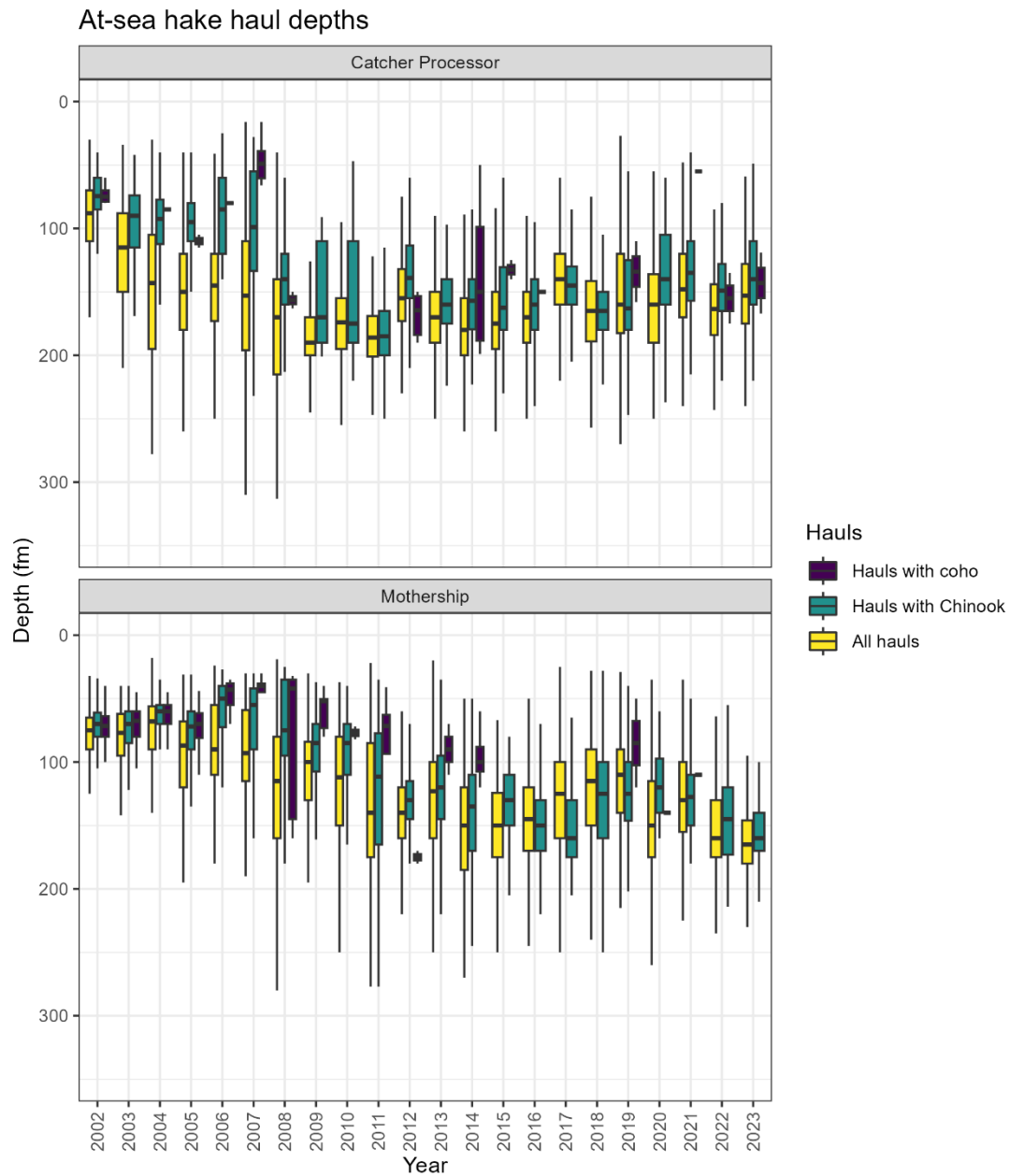


Figure 16. Boxplot of haul depths in the at-sea hake fishery. Outliers are not shown.

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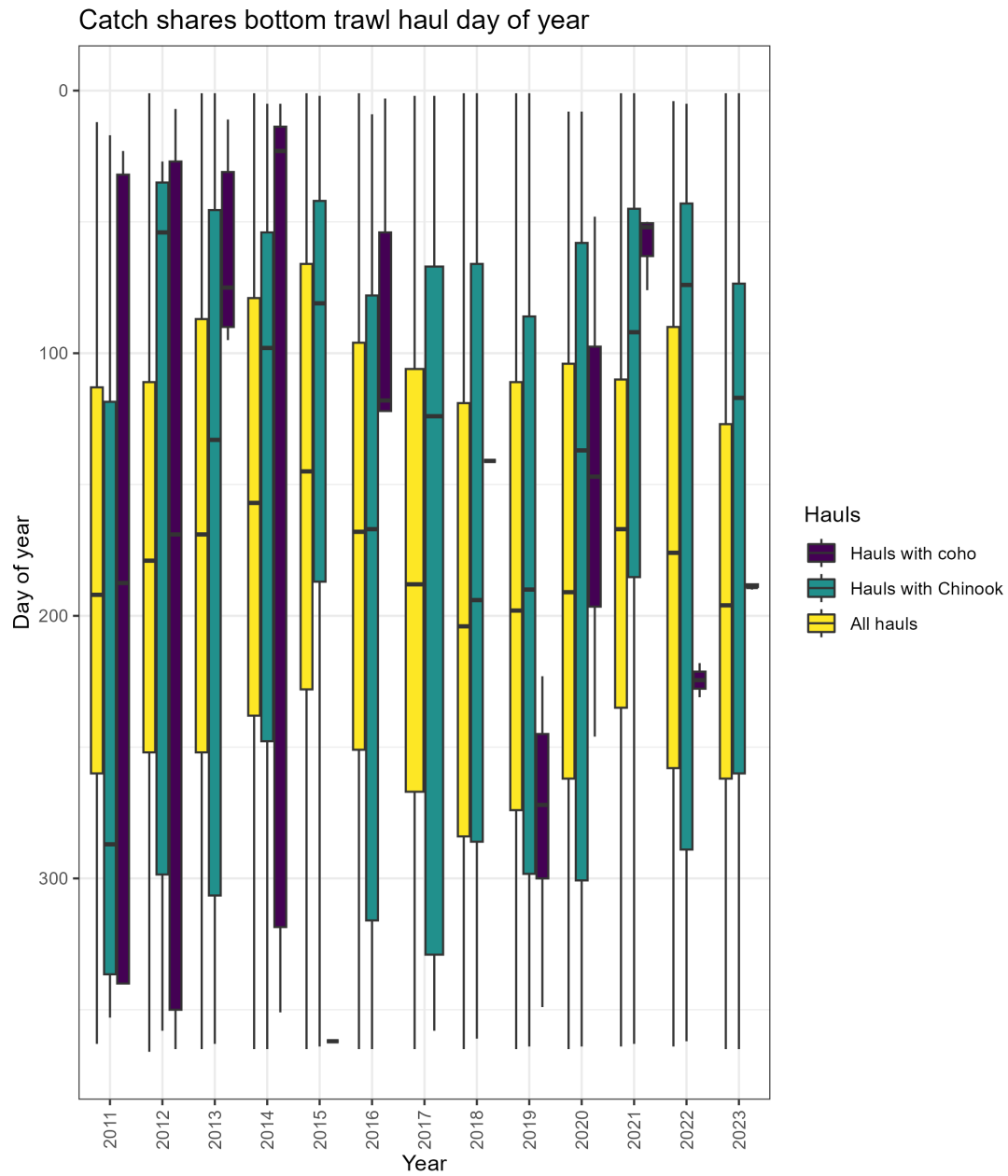


Figure 17. Boxplot of haul day of year in the catch share bottom trawl fishery. Outliers are not shown.

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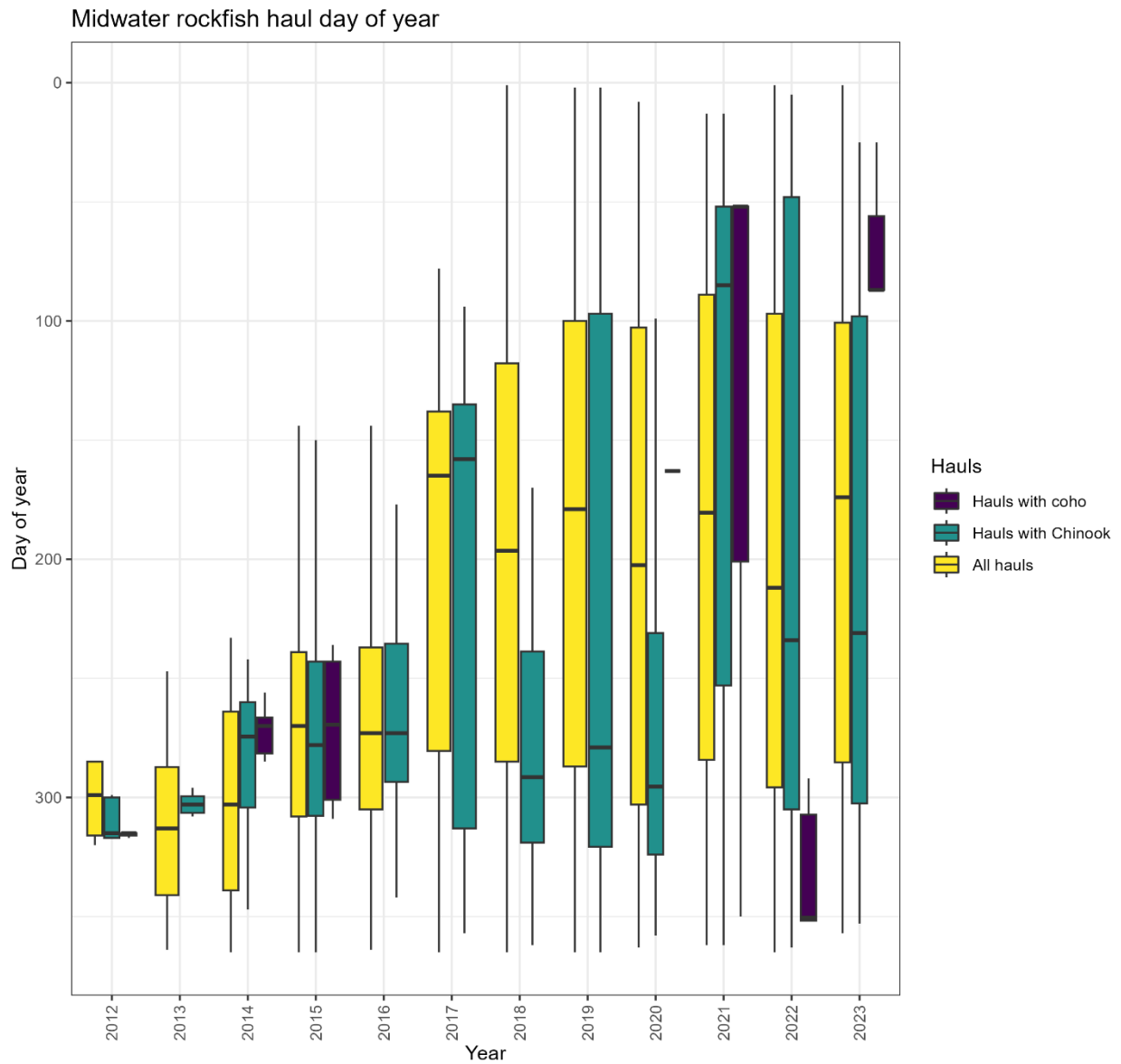


Figure 18. Boxplot of haul day of year in the midwater rockfish trawl fishery. Outliers are not shown.

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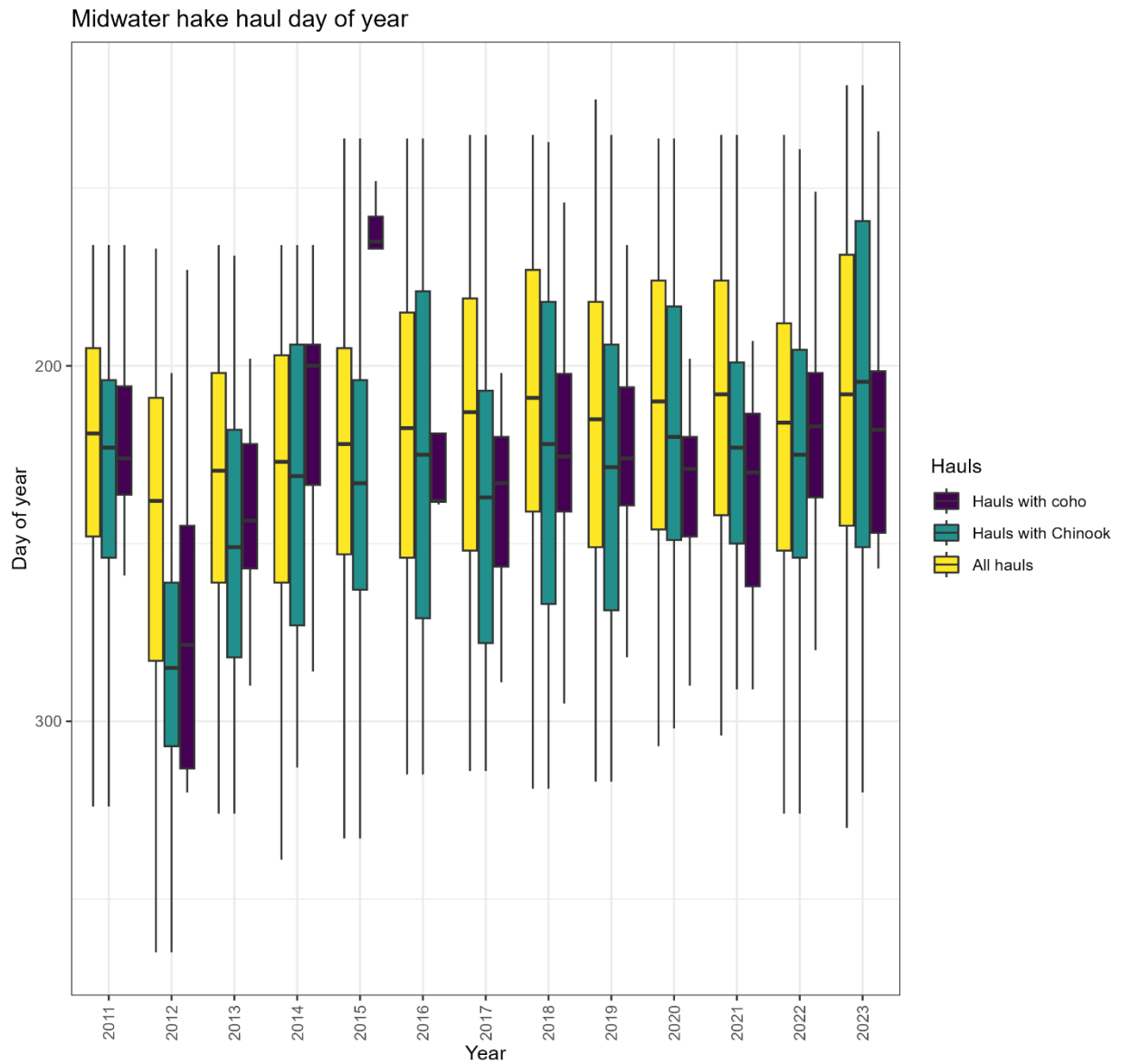


Figure 19. Boxplot of haul day of year in the midwater hake trawl fishery. Outliers are not shown.

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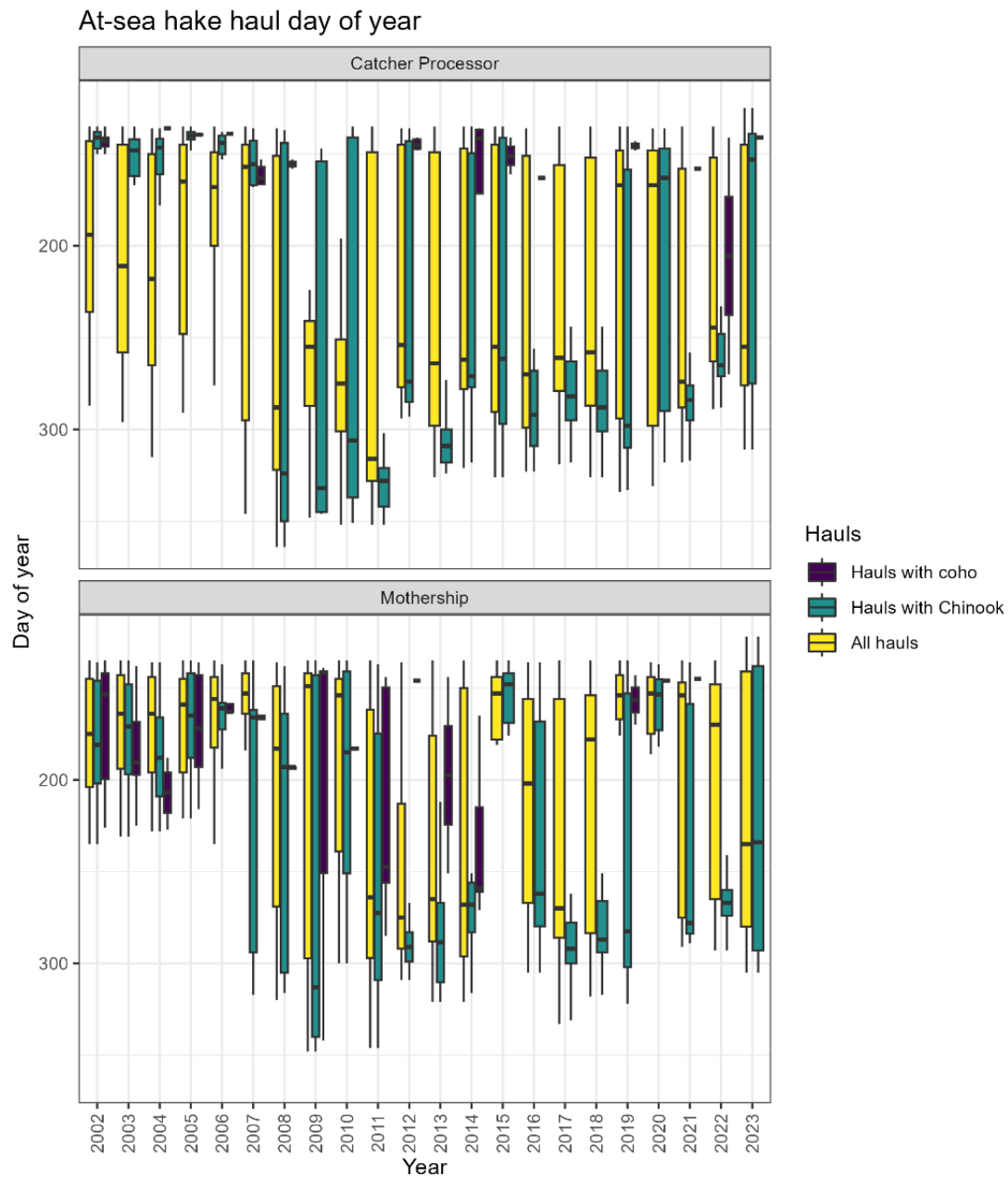


Figure 20. Boxplot of haul day of year in the at-sea hake fishery. Outliers are not shown.

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