

Alaskan Harvest of BC Salmon: State of Knowledge

Part 4: Coho Salmon

Version 1

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January 2022

Preface

This report is part of a series of reports on the ‘State of Knowledge’ of Alaskan interception of BC salmon. This report series is a summary of existing information that was compiled from a number of sources. We also provide information on 2021 catch in Southern Southeast Alaska. The intent of this report series is to promote discussion, identify knowledge gaps, attempt to collect, and make available, all relevant data, and provide recommendations to improve our understanding of Alaskan interceptions of Canadian salmon. To that end, we encourage feedback and discussion on the content, and welcome additional information that we may have missed. As such, it should be considered a ‘living document’. Future versions will include clarifications, edits, and likely additional content. Changes will be tracked and recorded for transparency and collaborative purposes. Please reach out to either of the authors for further information or to provide feedback or additional content.

To complete this ‘State of Knowledge’ report series, we procured, compiled, and surveyed data from numerous sources (e.g., Pacific Salmon Commission website and reports, Fisheries and Oceans Canada, Alaska Department of Fish and Game, Pacific Salmon Foundation, LGL Limited). Estimates of Alaskan capture of BC salmon were from multiple sources and required an extensive effort to compile, including numerous discussions with staff from DFO (NC, WCVI, ECVI, ISC and Fraser regions), LGL Limited, the Pacific Salmon Commission, the Pacific Salmon Foundation, and Alaska Department of Fish and Game.

The objectives of the reports in this series were to:

1. Identify and compile data sources on Southeast Alaska (SEAK) catch of BC salmon, with a focus on South Southeast Alaska (SSEAK);
2. Summarize information on recent and historical SSEAK catch at the regional, stock aggregate, DFO Statistical Area and Conservation Unit (CU) level where possible, including proportions of SEAK catch;
3. Provide details on information specific to District 104 fisheries (Noyes and Dall Island), where possible;
4. Provide context and/or estimates for SSEAK catch of BC salmon in the 2021 fishing season;
5. Identify gaps in knowledge and provide high-level recommendations to stimulate discussion.

While we limited our review and summary to SSEAK salmon fisheries, we do include other areas and fisheries where information was available.

The following points should be considered for context when reading this report series:

- Many of the populations of Canadian salmon that are caught in SSEAK are at depressed or extremely depressed levels of abundance (e.g., North and Central Coast BC chum, some Fraser sockeye Conservation Units (CUs) and have had few, or severely curtailed, Canadian fisheries in recent years.
- There are numerous assumptions and uncertainties in much of the information presented here that simply could not be detailed fully; however, we have tried to identify reference materials and resources that may provide further details should the reader be interested.
- Some of the information presented is based on studies that were completed 35+ years ago.
- There have been recent shifts in terminal run-timing that may influence where and when salmon are present in SSEAK fisheries.

- Climate change and associated marine conditions (e.g., sea surface temperatures, marine heat waves) may be influencing migration routes and migration timing relative to the tagging studies completed in the early 1980's that are used to underpin many of the migration and run-timing assumptions currently employed.
- The effects of climate change in freshwater and marine environments are compounded by natural and human-caused landscape change. These marine and freshwater ecosystem changes are impacting Pacific salmon at every stage of their life-cycle. The changing conditions already observed likely will continue, and possibly accelerate, warranting expanded efforts to understand and address uncertainties in exploitation in both SSEAK and BC.

The Report Series includes:

- Summary
- Part 1: Southeast Alaska Harvest and Pink Salmon Escapement
- Part 2: Southeast Alaskan Harvest of BC Sockeye Salmon
- Part 3: Southeast Alaskan Harvest of BC Chinook Salmon
- Part 4: Southeast Alaskan Harvest of BC Coho Salmon
- Part 5: Southeast Alaskan Harvest of BC Chum Salmon
- Part 6: Southeast Alaskan Harvest of BC Pink Salmon
- Part 7: Southeast Alaskan Harvest of BC Steelhead Trout

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Glossary

ADFG: Alaska Department of Fish and Game.

Bycatch: Catch of a species that is not targeted.

CC: Central Coast (DFO Statistical Management Areas 7-10).

Conservation Unit: A CU is a group of wild salmon sufficiently isolated from other groups that, if extirpated is very unlikely to recolonize naturally within an acceptable timeframe, such as a human lifetime or a specified number of salmon generations.

CWT: Coded Wire Tag. Passive tags implanted in juvenile salmon that are used to identify where and when fish were either released (hatcheries) or tagged (wild systems).

DFO: Department of Fisheries and Oceans.

District: Refers to Alaskan fisheries management areas.

ECVI: East Coast Vancouver Island (Vancouver Island sections of DFO Statistical Management Areas 11-19, 28)

Encounters: All the fish (kept/retained + released) that are encountered in a fishery. Estimates of encounters may include estimates of drop-off (fish that are on/in gear but escape before they are brought on board).

Escapement: Escapement refers to the number of spawners that return to a stream/area/system (fish that have escaped being captured in fisheries). Inter-changeable in this report with spawners or spawner abundance.

Exploitation Rate: Exploitation rate is the amount of catch as a proportion of the total run. We try to present all data in this report as exploitation rates.

FSC: First Nations Section 35(1) Food, Social, and Ceremonial use harvest.

Fraser: Fraser River (DFO Statistical Management Area 29).

FRIM (Fisheries Related Incidental Mortality): FRIM accounts for mortality that occurs prior to capture (e.g., depredation and drop-out mortality), during handling (i.e., on-board mortality), and after release (i.e., post-release mortality). It is added to kept/retained catch/mortalities to estimate total fishing-related mortalities.

Harvest Rate: Harvest rate refers to the proportion of fish caught versus those available to be caught. E.g., for Skeena sockeye, the harvest rate in the marine commercial fishery is the catch divided by the Total Return to Canada, not the Total Run.

ISC: Inner South Coast Areas (Mainland BC sections of DFO Statistical Areas 11-18, 28)

Kept: Fish that are kept in fisheries. Also retained catch.

NC: North Coast (DFO Statistical Management Areas 1-6).

Released: Fish that are caught and then released (live or dead) from a fishery.

Retained: Fish that are kept in fisheries. Also kept catch.

Statistical Area: Refers to DFO Pacific Fisheries Management Areas, or Statistical Area. Haida Gwaii is areas 1 and 2, Nass is area 3, Skeena is area 4, Central Coast is areas 6-10, Johnstone Strait and Strait of Georgia is areas 11-18, Juan de Fuca is areas 19-20, West Coast Vancouver Island is areas 21-27, Howe Sound is area 28, and the Fraser River is area 29.

Total Mortalities: Total mortality includes all natural and fishing-related causes. The latter is composed of retained catch, plus any incidental mortalities associated with fishing activities.

Total Run: Total run (or total abundance) refers to the total return of fish in a given year (total catch + escapement).

WCVI: West Coast Vancouver Island (DFO Statistical Management Areas 20-27).

1 Introduction and Methods

Information on Southeast Alaska (SEAK) catch of BC coho salmon was compiled from a number of sources including the Pacific Salmon Foundation Salmon Explorer, LGL Limited, PSC Coho Technical Committee FRAM modeling, and Coded Wire Tag (CWT) recovery information. We drew predominantly on the Pacific Salmon Explorer for coast wide Conservation Unit level data (PSF 2021) and LGL's North and Central Coast Run Reconstruction website for north coast Statistical Area level data (LGL 2021a). Information on Zolzap coho specifically was provided by and in a draft report (Noble et al. 2020, LGL 2021b). Information for Interior Fraser River coho from 2012-2019 were provided by DFO Stock Assessment (O'Brian and Sawada, 2021) and background information on the FRAM model and SEAK ERs on south coast MUs is given in the 1986-2009 periodic report (PSC JCTC 2013).

Background on the methodology for estimating SEAK catch of north and central coast coho salmon by Statistical Area and Conservation Unit is provided in English et al. (2018: Table 5 and Appendix C).

We provide some background information on SEAK and southern Southeast Alaska (SSEAK) harvest of coho salmon historically and in 2021, as well as information on catch information and timing of catch in District 104. SEAK exploitation rates and proportion of total catch are summarised for north and central coast BC Statistical Areas and Conservation Units. We also present information on SEAK catch of south coast coho MUs.

We do not currently have information on specific fisheries or Districts that contribute to exploitation rate estimates via CWT recoveries for coho, so we have used SEAK throughout this report where appropriate, but recognize that is likely that the vast majority of recoveries in SEAK are likely in SSEAK fisheries.

Table 1 provides a summary of the types of data used, the data source and the years the data covers. Figure 1 and Figure 2 provide maps of SEAK fishing Districts and North Coast BC DFO Statistical Areas respectively.

All figures and statistical analyses were completed using R statistical software (R core team 2020).

Table 1: Types of data, sources, and year range used in this report for coho salmon by region.

<i>Species</i>	<i>Region/Area</i>	<i>Type of Data</i>	<i>Data Source</i>	<i>Year</i>
<i>Coho salmon</i>	BC NC/CC Areas 1-10, by Statistical Area	Escapement, harvest and exploitation rates from run reconstructions	LGL 2021 (North and Central Coast Run Reconstructions)	Various
	BC NC/CC Areas 1-10, by Conservation Unit	Escapement, harvest and exploitation rates from run reconstructions	PSF 2021 (Pacific Salmon Explorer)	Various
	WCVI	Marine distribution patterns	Weitkamp and Neely 2011	Various
	Fraser and Strait of Georgia	FRAM model outputs, total US and CDN ERs, SEAK ERs	PSC JCTC 2013. PSC JCTC 2019. O'Brien and Sawada 2021.	ERs provided for SC MUs for 1986-1997, 2004 to 2009. ERs for IFR coho for 2012-2019.

2 SEAK Harvest Of Coho Salmon

Summary information on coho salmon harvest in SEAK and SSEAK (historically and for 2021) is provided in this report for context. SEAK catch and value (1979-2020) were downloaded from the ADFG website (ADFG 2021a). “Blue Sheet” commercial data from 1980-2020 were provided by ADFG (ADFG 2021b). Preliminary coho salmon harvest information for commercial SEAK harvest in 2021 by fishery type (“Blue Sheet Data”) was downloaded from the ADFG website (ADFG 2021c). District and gear level catch data from 1985-2020 and weekly District 104 catch by gear were also provided by ADFG (2021d and 2021e respectively).

- Total coho salmon catch in SEAK peaked in the 90s, declined and has remained relatively constant since, averaging around 2.5 million (Figure 3). Since 2010, catches have averaged just under ~ 2.4 million coho per year. Total SEAK catch of coho in 2021 was over 1.5 million, well below the recent and long-term averages.
- Coho salmon catch in SEAK is historically dominated by power troll fisheries, followed by the southern purse seine fishery, hatchery cost recovery programs, Yakutat, set gillnets, the Prince of Wales and northern purse seine fisheries (Figure 4). Most coho salmon (~ 50%) are caught in the power troll fisheries, with around 10% in southern purse seine fisheries. Median catch from 1979-2021 in the southern purse seine fisheries is just over 241,000, but in some years can be as high as 500,000.
- Median total catch (all gears) of coho salmon in SSEAK Districts 101-106 shows that the net catch of coho catch is highest in District 104, followed by Districts 101, 103 and 106. District 104 contributes about 25% over the entire time series, with Districts 101, 103, and 106 each contributing smaller catches on average (~ 20%) (Figure 5).

- Total catches (all gears) in District 104 is highly variable but has declined slightly since around 2000 (Figure 6). The last few years have seen relatively low catches at less than 100,000. Districts 101 and 106 have also been low in recent years. Catches in both Districts were higher in 2021.
- The proportion of total District 101-106 catch of coho salmon for each district over time is shown in Figure 7. The proportion of coho salmon caught in District 104 has declined over time, and now represents between 15 and 25% in most years. District 103 proportion has increased, and the other Districts have remained relatively constant.
- In 2021, total SEAK catch of coho salmon (including Yakutat at ~ 75,000) was over 1.5 million. SSEAK Districts 101-106 accounted for only about 514,000 of that. As in most years, most catch was taken in the summer troll fishery (~ 55% or ~ 820,000) with about 250,000 caught in southern seine fisheries (Figure 8).
- District 104 only catch of coho salmon in 2021 was ~132,000, split between power troll (~36,000) and seine (~97,000) fisheries. Note that this is distribution of catch is not the same as in other areas or in SEAK overall, where troll catches dominate other fisheries. Weekly catch in purse seine fisheries was highest in Week 31 and 32, with a significant catch later on in Week 36 (Figure 9). 2021 data is preliminary.

3 SEAK Catch of BC Origin Coho Salmon

This section of the report provides a summary of information on SEAK exploitation rates on BC coho salmon, as well as proportions of SEAK exploitation by Statistical Area and Conservation Unit for north and central coast BC (Areas 1-10). We did not, at the time of writing, extract data or provide figures for south coast BC coho Management Units, as FRAM model outputs and base period ER analysis provide considerable evidence that SEAK catch of the coho is very minimal. This is discussed in further detail in Section 3.2 below.

3.1 North Coast and Central Coast BC

Beyond our summary, the PSC has requested a report on north and central coast BC coho status. This report was prepared by north coast DFO Stock Assessment staff, is in review, and will be released shortly. We will review the final report, and provide any updates in future versions of this report.

3.1.1 Statistical Areas

Estimates of SEAK exploitation rates on north and central coast coho salmon from 1954 to 2017 are derived using various methods as detailed in Appendix C of English et al. (2018). It is beyond the scope of this report to provide all the details for each statistical area, but they are largely derived from CWT information from Zolzap Creek coho (Area 3-Nass) and Toboggan Creek coho (Area 4-Middle Skeena), as well as Deena coho (Area 2E and 2W-Haida Gwaii). SEAK ERs on other north and central coast Areas are derived from Area 4 ERs at various levels (e.g. Area 6 =100% Area 4 ER, Area 6-8 and Area 8 are 60% Area 4 ER, Area 4-9 is 40% Area 4 and Areas 9-10 are 20% Area 4).

- Canadian exploitation rates for north and central coast BC coho are shown in Figure 10. In Areas 5-10, Canadian exploitation rates have dropped dramatically in the late 90s following decreased marine survival and the coho crisis which severely curtailed most fisheries. For Areas 2E, 2W, and 3, Canadian ERs dropped in the late 90s, but appear to be close to historical levels in some recent years (~20%). Area 4 ERs were historically the highest, averaging around ~40-50%, dropped in the late 90s and in recent years have averaged between 10 and 20%.
- Figure 10 also shows SEAK exploitation rates on north and central coast coho by Statistical Unit. SEAK ERs are estimated to be highest for Area 3 coho production (averaging around 30-40% with some years over 50%), slightly lower in Area 4 and Area 6 (same ER as Area 4), and much

lower for the rest of the areas. SEAK ERs on Haida Gwaii (Areas 2E and 2W) are very low, averaging around 2-4%)

- The proportion of exploitation attributed to SEAK fisheries for north and central coast coho salmon is shown in Figure 11. Canadian exploitation rates include both Section 35(1) FSC catches and any sport catches, whereas SEAK exploitation rates are based on commercial fisheries only.¹ SEAK percent of exploitation ranges widely between Areas, with SEAK proportion around 75% in most years since 1996 in Area 3, 50-75% in Area 4-8, and much lower in Areas 2E and 2W.

3.1.2 Conservation Units

Interpolation of Statistical Area SEAK ER estimates to coho CUs are detailed in Table 5 of English et al. (2018). The lack of central coast and southern north coast indicator streams requires estimating SEAK ERs from Skeena stocks in this approach, however while this is highly uncertain, it may be the best information we have until more coho indicator stocks are started, or genetic stock compositions are sampled for in non-terminal SEAK coho fisheries.

Since SEAK ERs in CUs are derived from the related Statistical Areas, the basic patterns described above for Statistical Areas hold true for CUs.

- Distribution of SEAK exploitation rates on coho salmon by CU are shown in Figure 12. The Nass and Skeena Estuary CUs have similar median and range of exploitation rates, with median rates at 35-40%, but as low as 20% and more than 50% in some years. Lower Skeena, Middle Skeena, Upper Skeena, Babine, and Douglas Gardner CUs follow with median SEAK ERs of just over 20%. There is some variation as some CUs are missing some years that others are not. Median SEAK ERs decreases in more southern CUs. This follows with information on south coast coho Management Units which have very low ERs in SEAK.
- Figure 13 shows SEAK ERs over time by CU for north and central coast CUs. There is some variation in trends between CUs, but CUs show stable, slightly increasing, or slightly decreasing SEAK ERs in recent years.
- SEAK ERs for north and central coast CUs follow the same patterns as their respective indicator estimates, therefore the proportion of catch attributed to SEAK fisheries is high for Skeena and Nass CUs, and moderate for central coast CUs. This means that these estimates suggest that SEAK catch has been higher in recent years than Canadian catch, and some times by 3-fold (Nass).

3.1.3 Zolzap Creek

Information on Canadian and SEAK catch specifically of Zolzap Creek coho for 1992-2005 and 2010-2018 was provided by LGL (2021b) and in a draft report (Noble et al. 2020). This is similar to the Area 3 data as the Zolzap system is the indicator system for the Area 3 (Nass). This was the only system level data we were able to procure before the writing of this report. SEAK ERs range from over 60% to less than 20%, but average around 40% over the time series, much higher than Canadian ERs (Figure 14). The proportion of total ER attributed to SEAK ranges from ~ 60% in 2018 to 100% in 1997, but averages around 75%.

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- ¹ This may lead to some bias, however the proportion of SEAK exploitation commercial only catch would be higher if CDN FSC and sport were not included. Unfortunately, separate estimates of CDN FSC and sport exploitation rates were not available at the time of report writing, but will be investigated further.

We are in the process of looking for other system specific data (e.g., for Toboggan Creek), and will update this report as we receive it.

3.2 South Coast

Information on SEAK exploitation rates are provided in PSC JCTC reports, for some south coast management units (Lower Fraser, Interior Fraser (including Thompson), Strait of Georgia Mainland and Strait of Georgia Vancouver Island) (PSC JCTC 2013, 2019). Exploitation rates are estimated using the FRAM model. For more details on FRAM modeling and some of the assumptions and concerns around applying base period (1986-1992) information in recent years, given changes in harvest rates, survivals, marine distributions, and implementation of mark selective fisheries, see PSC JCTC (2013). However, both the 2013 report and the 2019 post-season analysis suggest that SEAK ERs on the southern coho MUs are extremely low, and less than 1%. ERs from both Canada and US have been severely diminished since 1997 in response to the coho crisis. Total US exploitation rates on SC coho MUs from 2004-2009 were generally less than 15%, with SEAK ER in most years < 1%. Periodic Report Comparisons from 2010-2018 confirm that in all years SEAK ERs on south coast MUs were extremely low (PSC JCTC 2010-2018).

When we accessed the Pacific Salmon Explorer in October, 2021, there were unfortunately no coho CUs in the south coast, Vancouver Island, or Fraser areas with exploitation rate information.

Other than a paper on marine distribution patterns (discussed below), we were not able to locate any information specific to SEAK catch of south coast coho on the West Coast of Vancouver Island. Further exploration is needed.

Weitkamp and Neely (2011) provide an excellent analysis of ocean migration patterns from CWT recoveries of hatchery and wild coho from Alaska to California. Figure 15 (Figure 2 from Weitkamp and Neely 2011), provides an overview of the recovery patterns for tagged coho. Key findings of this analysis, which are likely still relevant today, are that north BC coast CWT coho are recovered in approximately equal numbers in north and south SEAK fisheries and north BC coast and Haida Gwaii fisheries. There are no central coast hatcheries. Haida Gwaii origin fish are mostly recovered in north BC and Haida Gwaii, and there are very few recoveries of WCVI, ECVI, south mainland, lower or upper Fraser coho in SEAK. This provides support for both the high SEAK ERs in north coast coho, and the low SEAK ERs for southern stocks. Weitkamp and Neely (2011) also determine that CWT'd tagged wild coho follow relatively similar patterns of marine distribution as their specific regional hatchery indicators, suggesting that SEAK ERs would be similar for wild coho as hatchery indicators.

There are also some wild coho indicators in the south coast Vancouver Island area which may provide additional information (e.g., Black Creek coho), and some central coast coho indicators are in development (e.g., Quaye). There may also be additional information from other systems such as the Zymachord Creek and Kitwanga River programs for Lower and mid-Skeena coho. We are in the process of procuring this data to add to the report.

3.3 2021 Estimates

2021 estimates of SEAK ERs for coho salmon will not be available in the immediate future. Based on recent trends and catches in SEAK in 2021, it would be expected that estimates of SEAK ERs on north and central coast BC would follow recent trends with high ERs on Nass coho, moderate ERs on Skeena and Area 6 coho, and lower ERs on central coast coho. ERs on southern Management Units would be expected to be very low.

4 Information Gaps

- 1) We were unable to find any direct information on SEAK catch or exploitation rates specifically for WCVI and central coast coho. SEAK ERs for central coast coho are estimated as described above, however there is likely considerable uncertainty in this approach. Apart from Weitkamp and Neely (2011), we did not find any direct information on WCVI coho. We have heard that there are efforts underway for central coast coho indicator stocks, which would confirm or refine current estimates.
- 2) We were unable to locate any references to stock composition studies based on genetic stock ID in Alaskan fisheries (other than a few from Upper Cook Inlet), and we could not find any specific information for SSEAK. We will be following up with DFO and ADFG to see if District level recovery information is available. With the improvement in genetic baselines for central and north coast BC, genetic sampling of coho caught in outside mixed-stock fisheries (e.g., the District 104 purse seine and troll fisheries) may add valuable information to the CWT recovery programs.

5 References

- ADFG (Alaska Department of Fish and Game). 2021a. Southeast Alaska Gross Earnings by Area. Available online at: https://www.adfg.alaska.gov/index.cfm?adfg=commercialbyfisherysalmon.salmon_grossearnings_byarea. Accessed November 2021.
- ADFG. 2021b. SEAK commercial “Blue Sheet” data 1980-2020. Provided by Sabrina Larsen, ADFG, December 2021.
- ADFG. 2021c. Commercial “Blue Sheet” data 2021. No longer accessible online. Accessed November 2021.
- ADFG. 2021d. Southeast Salmon Landings by District by gear type and year 1985-present. Provided by Sabrina Larsen, ADFG, December 2021.
- ADFG. 2021e. Southeast Salmon Landings: District 104 by Stat Week, Gear and Species 1985-present. Provided by Sabrina Larsen, ADFG, December 2021.
- English, K.K., D. Peacock, W. Challenger, C. Noble, I. Beveridge, D. Robichaud, K. Beach, E. Hertz and K. Connors. 2018. North and Central Coast Salmon Escapement, Catch, Run Size and Exploitation Rate Estimates for each Salmon Conservation Unit for 1954-2017. Prepared for the Pacific Salmon Foundation.
- Grant, S.C.H., B.L. MacDonald, and M.L. Winston. 2019. State of Canadian Pacific Salmon: Responses to Changing Climate and Habitats. Can. Tech. Rep. Fish. Aquat. Sci. 3332. ix + 50 p.
- LGL Limited (LGL). 2021a. North and Central Coast Salmon Run Reconstruction Data. Accessed October 2021. Available online at: <http://shiny.lglsidney.com/ncc-salmon/>.
- LGL. 2021b. Zolzap Creek coho data files. Provided by R. Alexander, October 2021.
- Noble, C.A.J., S. Kingshott, N. Morven, C. McCulloch, R. Whitmore, R.F. Alexander, N. Percival, and R.C. Bocking. 2020. Adult and Juvenile Coho Salmon (*Oncorhynchus kisutch*) Enumeration and Coded-Wire Tag Recovery Analysis for Ksi Ts'oohl Ts'ap (Zolzap Creek), B.C. 2011 to 2019. Canadian Manuscript Report of Fisheries and Aquatic Sciences. DRAFT. 71pp.
- O'Brien, M. and J. Sawada. 2021. Exploitation rates for southern coho MUs. Provided November 2021.

PSC JTCT. 2010-2018. Periodic Report Comparisons for 2011-2018. Provided by C. Parken, DFO Stock Assessment, Fraser Region, October 2021.

PSC JCTC. 2013. 1986-2009 Periodic Report. Revised. Report TCCOHO (13)-1. Accessed online October 2021.

PSC JCTC. 2019. 2019 PST Post-Season Coho Assessment. Provided by C. Parken, DFO Stock Assessment, Fraser Region, October 2021.

PSF (Pacific Salmon Foundation). 2021. Pacific Salmon Explorer database. Accessed online October 2021, data provided by Eric Hertz, PSF, 2021.

R Core Team (2020). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL <https://www.R-project.org/>

Weitkamp, L. and K. Neely. 2011. Coho salmon (*Oncorhynchus kisutch*) ocean migration patterns: insight from marine coded-wire tag recoveries. *Canadian Journal of Fisheries and Aquatic Sciences*. 59:1100-1125.

6 Figures

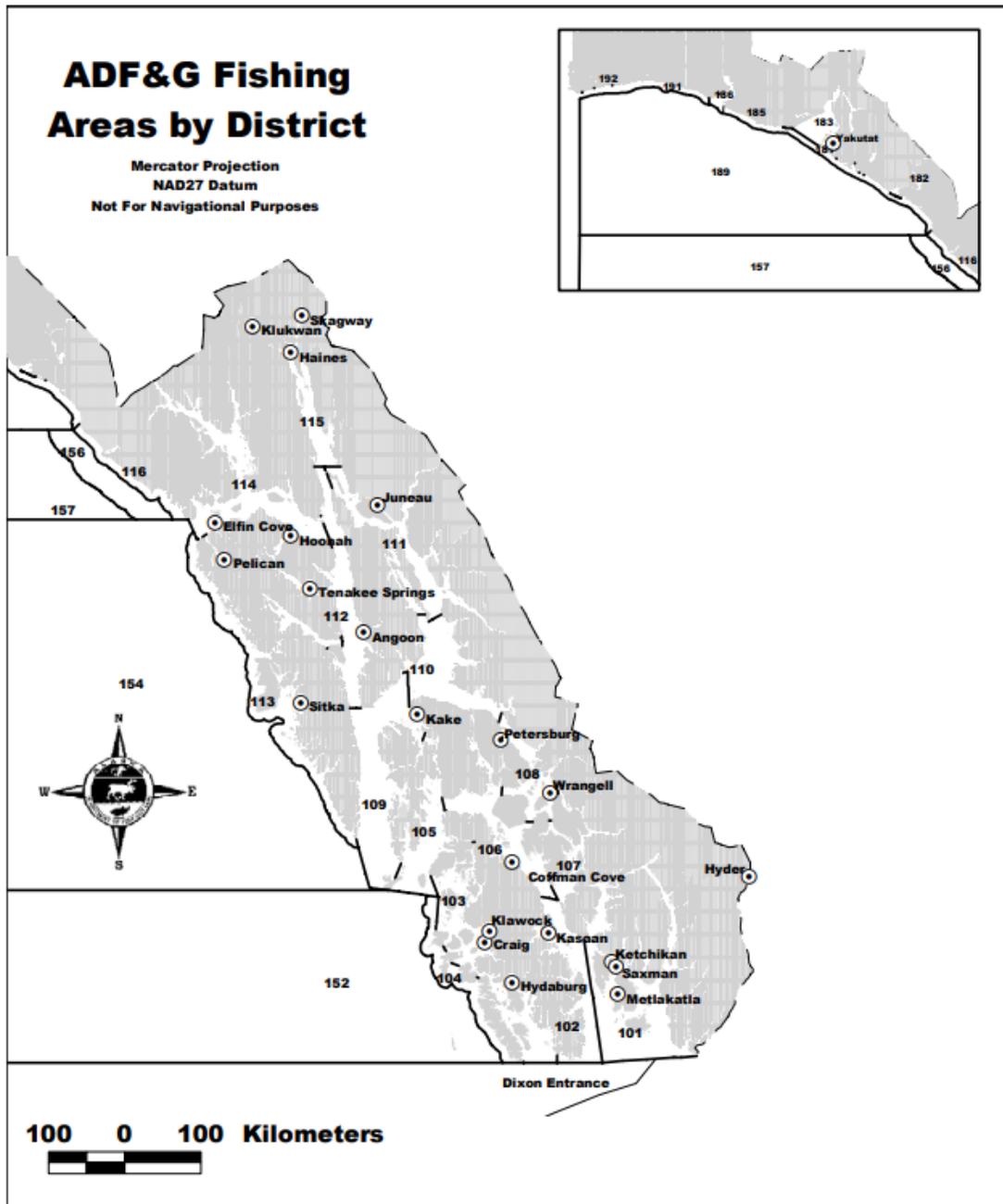


Figure 1: Map of Southeast Alaska Fishing Areas by District.

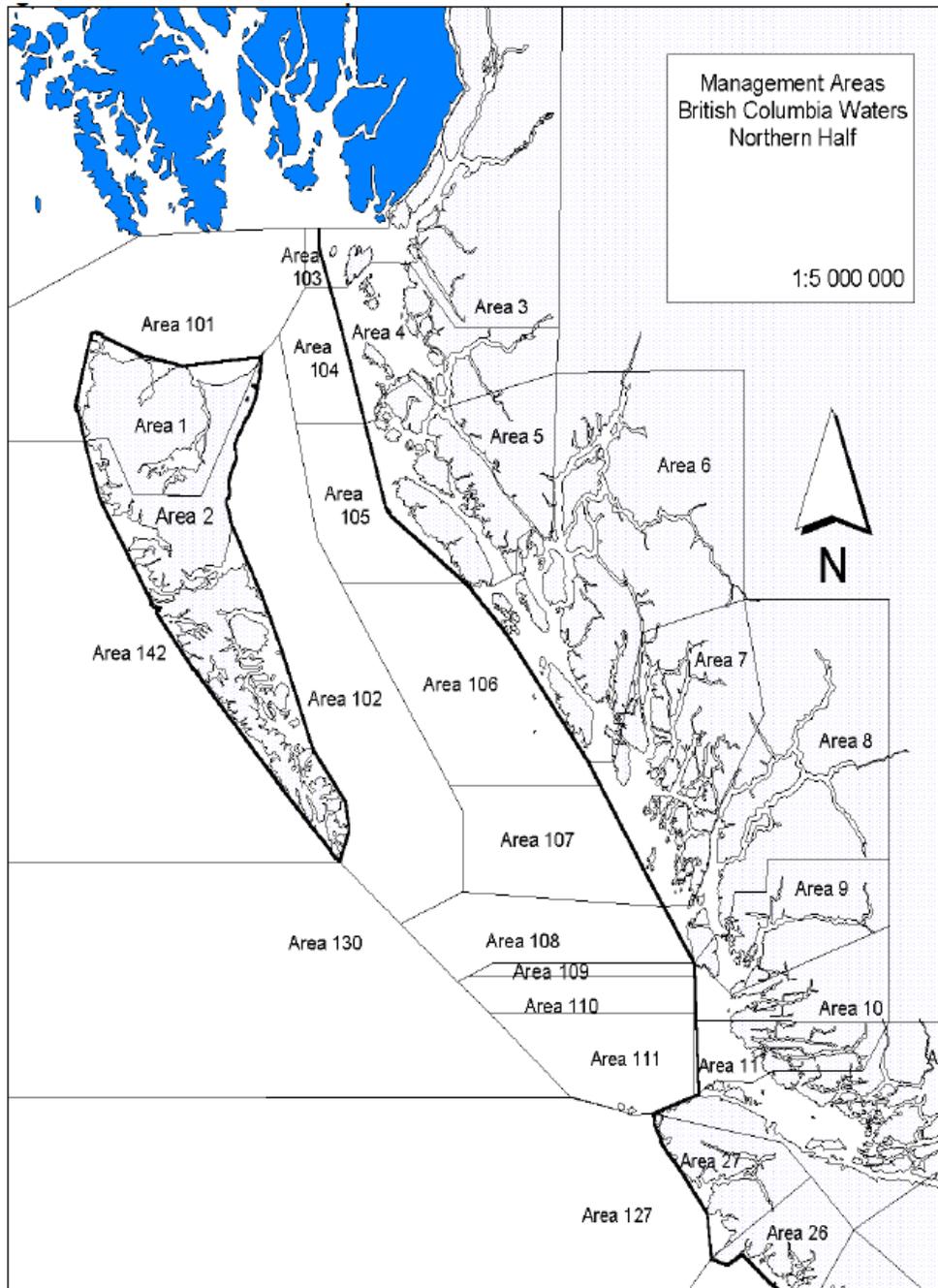


Figure 2. Map of DFO Statistical Areas in the North and Central Coast Areas.

SEAK Harvest: Coho Salmon (1979-2021)

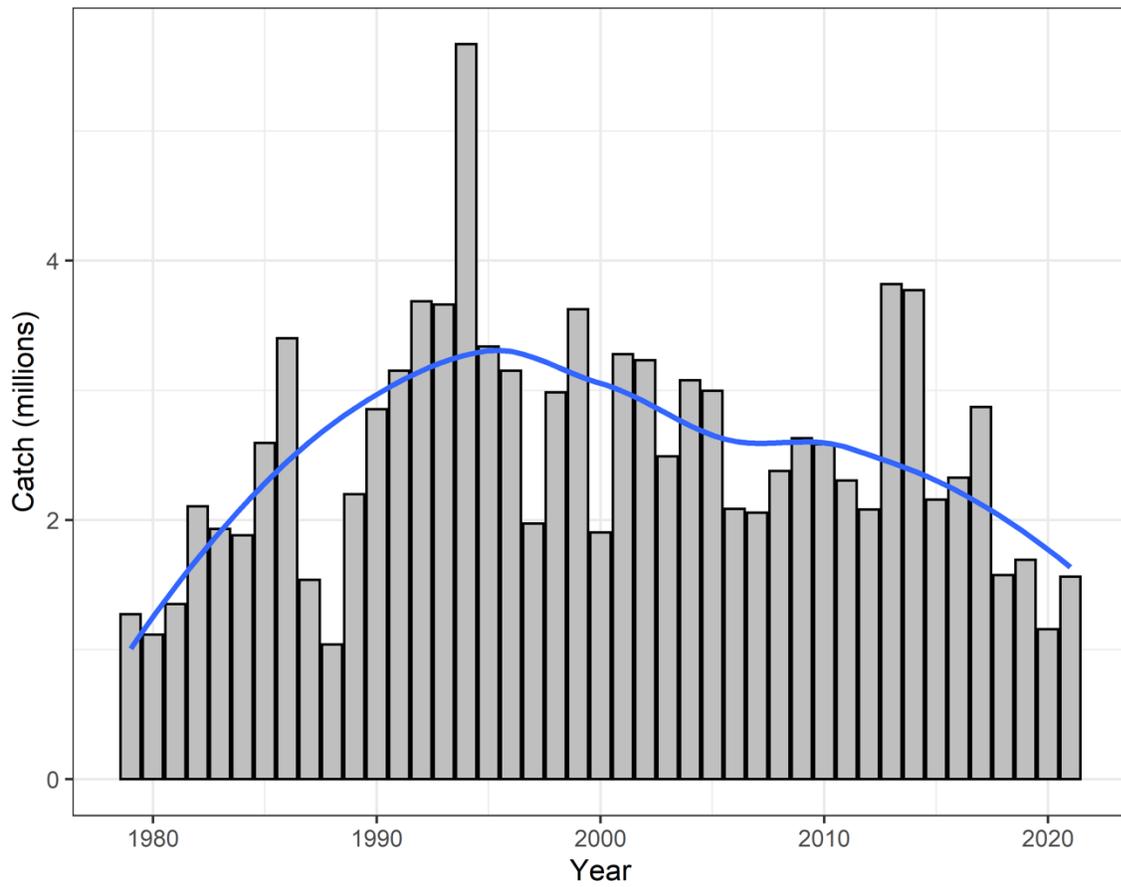


Figure 3: Total SEAK harvest (millions of fish) of coho salmon from 1979-2021. Blue line is fit using LOESS.
Source: ADFG 2021a (1979-2020), ADFG 2021b (2021).

SEAK Catch of Coho Salmon by Fishery Blue Sheet Fisheries (1980-2020)

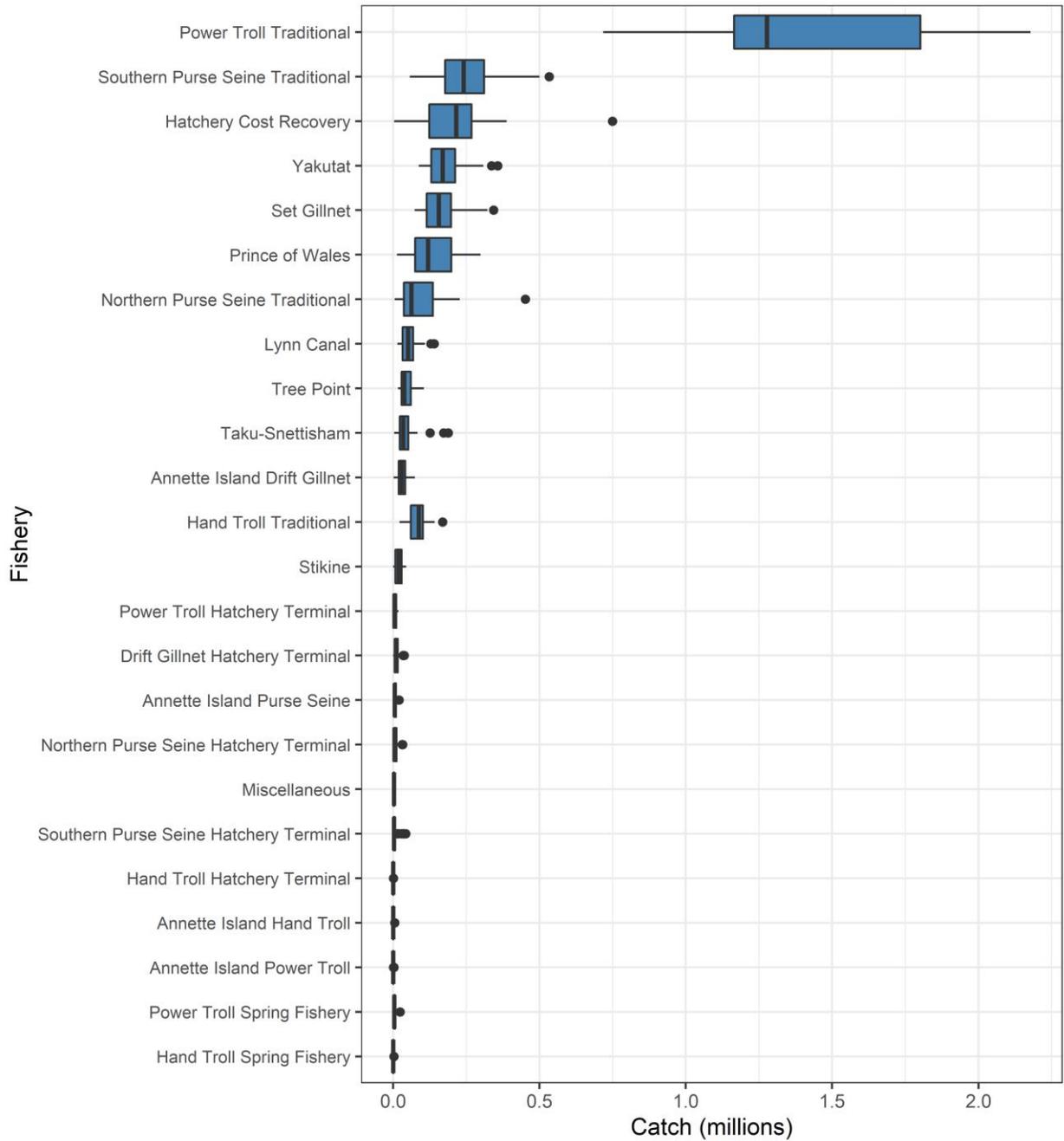


Figure 4: Distribution of total coho salmon commercial catch in SEAK “Blue Sheet” fisheries 1980-2021. Fisheries are ordered from highest catch to lowest catch. The thick black line is the median value, the box in indicates the interquartile range (25th to 75th percentiles – or middle 50% of the data), whiskers are 1.5x the interquartile range and dots are outliers (< 5th or > 95th percentile). Source: ADFG 2021c.

Total SSEAK Catch All Gear by District (101-106) Coho Salmon (1985-2021)

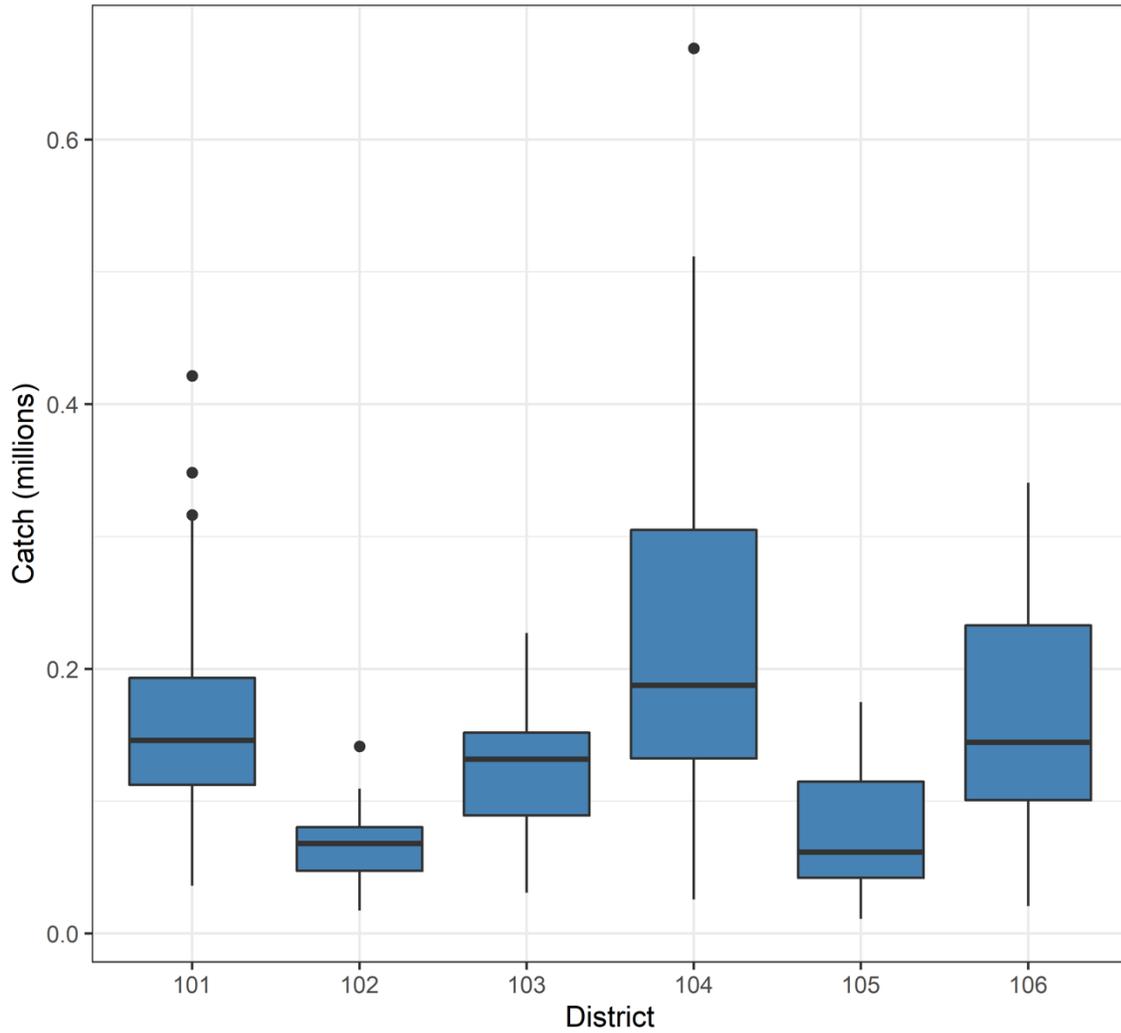


Figure 5: Median catch of coho salmon from all gears in SSEAK fisheries by district (districts 101-106) from 1985-2021. The thick black line is the median value, the box in indicates the interquartile range (25th to 75th percentiles – or middle 50% of the data), whiskers are 1.5x the interquartile range and dots are outliers (< 5th or > 95th percentile). Source: ADFG 2021d.

SSEAK Catch All Gear by District (101-106)
Coho Salmon (1985-2021)

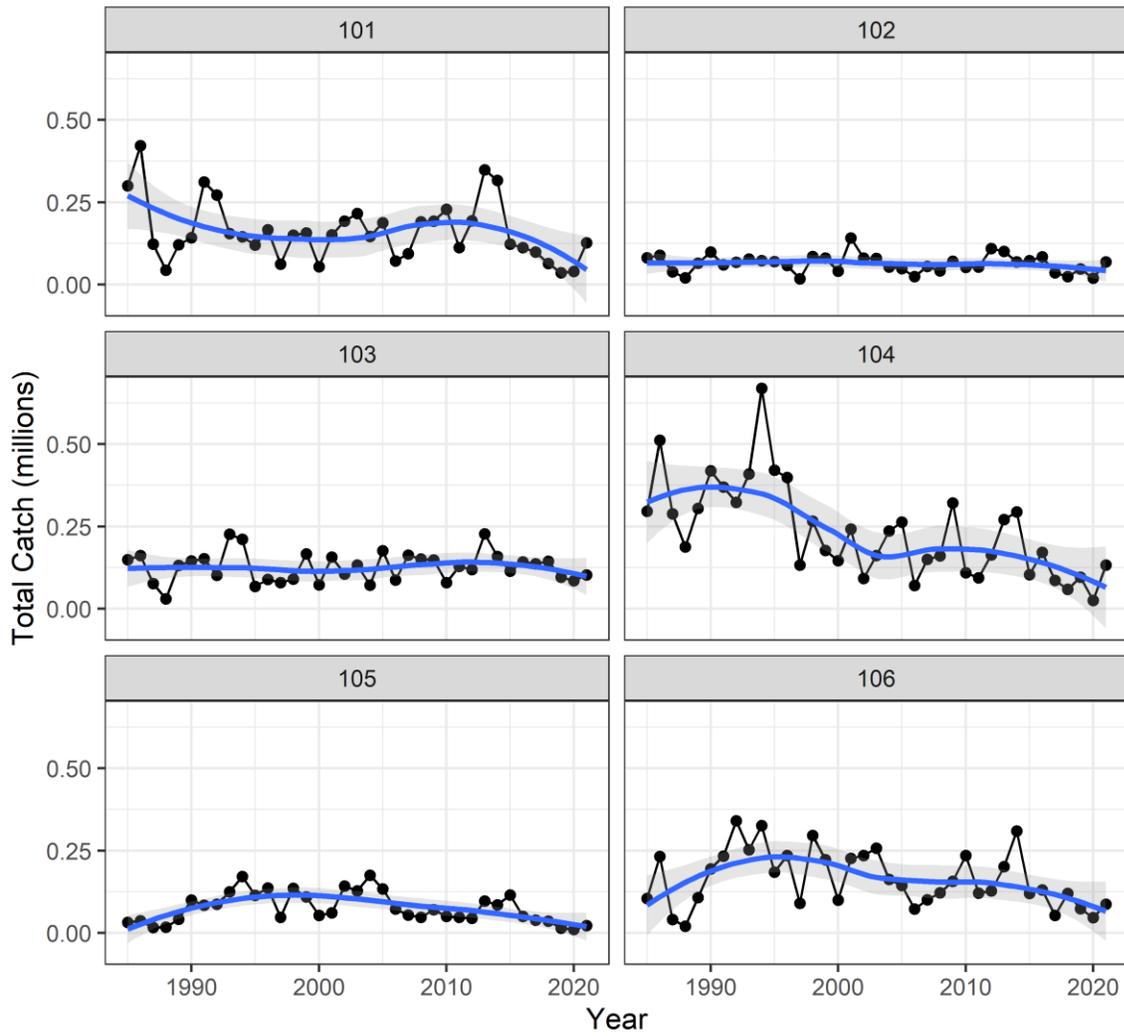


Figure 6: Total catch of coho salmon by year for SSEAK Districts 101-106 (1985-2021). Smoothed lines are derived by LOESS with standard errors shown in grey. Source: ADFG 2021d.

Proportion of Total D101-106 Catch
Coho Salmon (1985-2021)

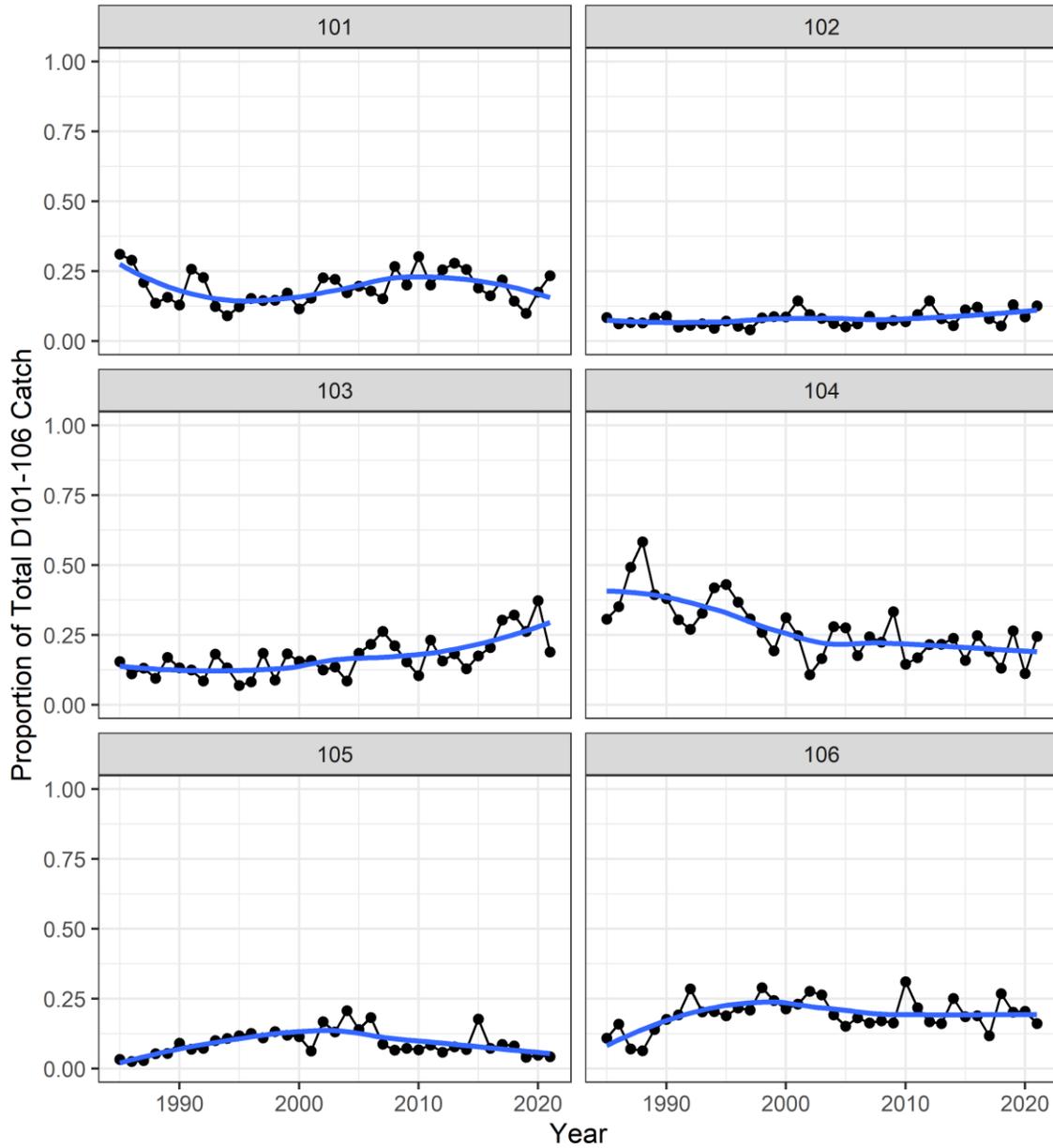


Figure 7: Proportion of total SSEAK District 101-106 coho salmon catch (all gears) by year for 1985-2021. Blue lines are estimated by LOESS fits. Source: ADFG 2021d.

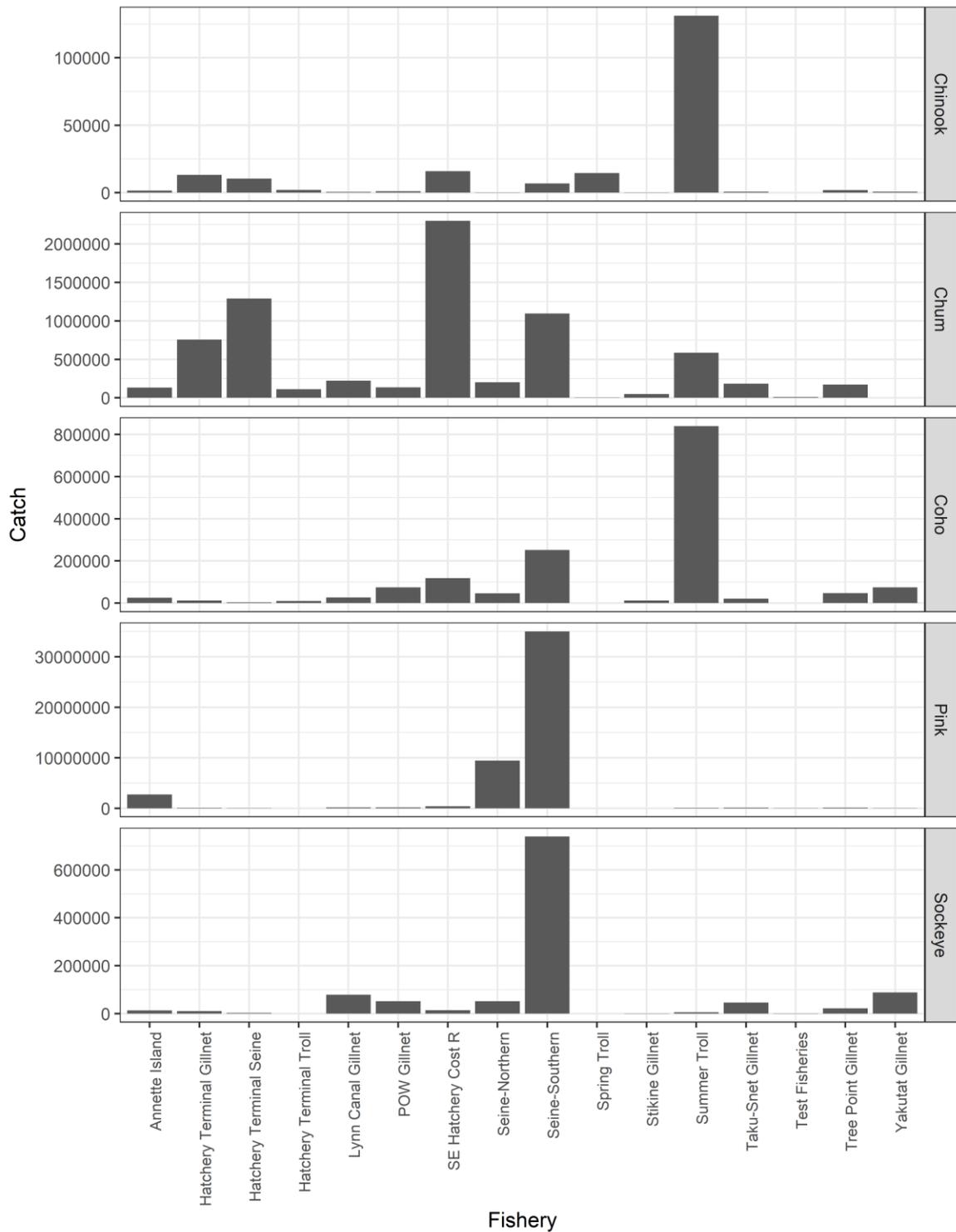


Figure 8: Harvest of all salmon species in SEAK “Blue Sheet” commercial fisheries in 2021. Source: ADFG 2021b.

Weekly Harvest of Coho Salmon by Gear Type District 104: 2021

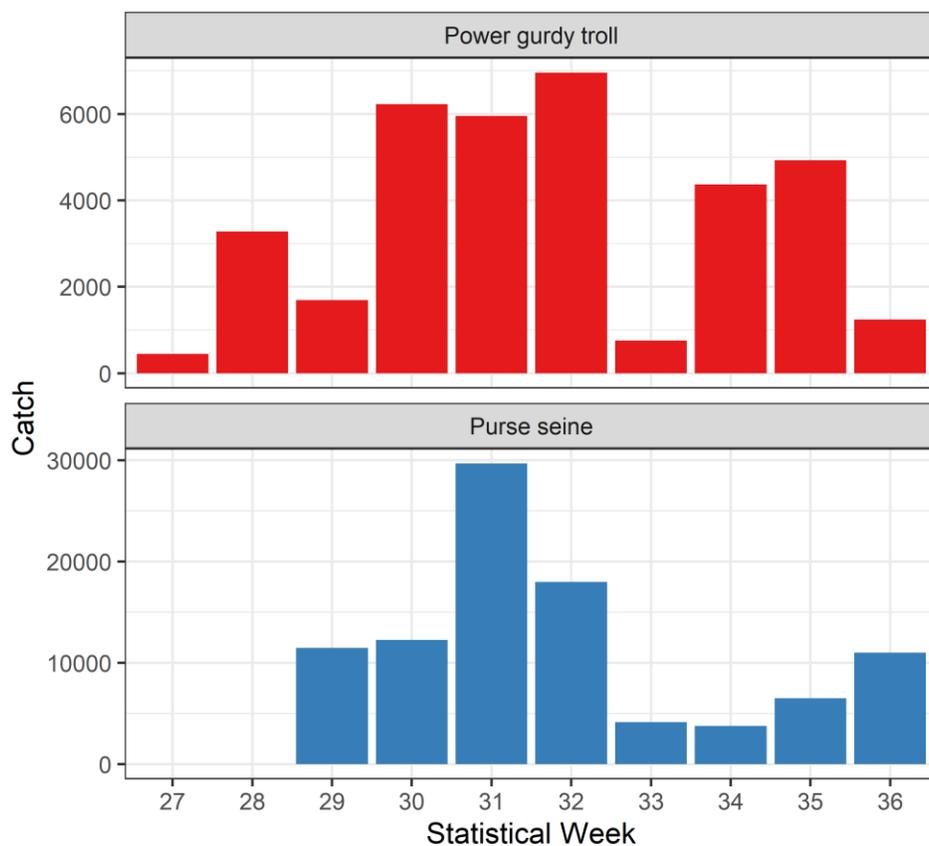


Figure 9: Weekly catch of coho salmon in District 104 fisheries by gear type for 2021. Note y-axis scales are not the same between panels. Source: ADFG 2021e.

SEAK and CDN Exploitation Rates Coho (1954-2017)

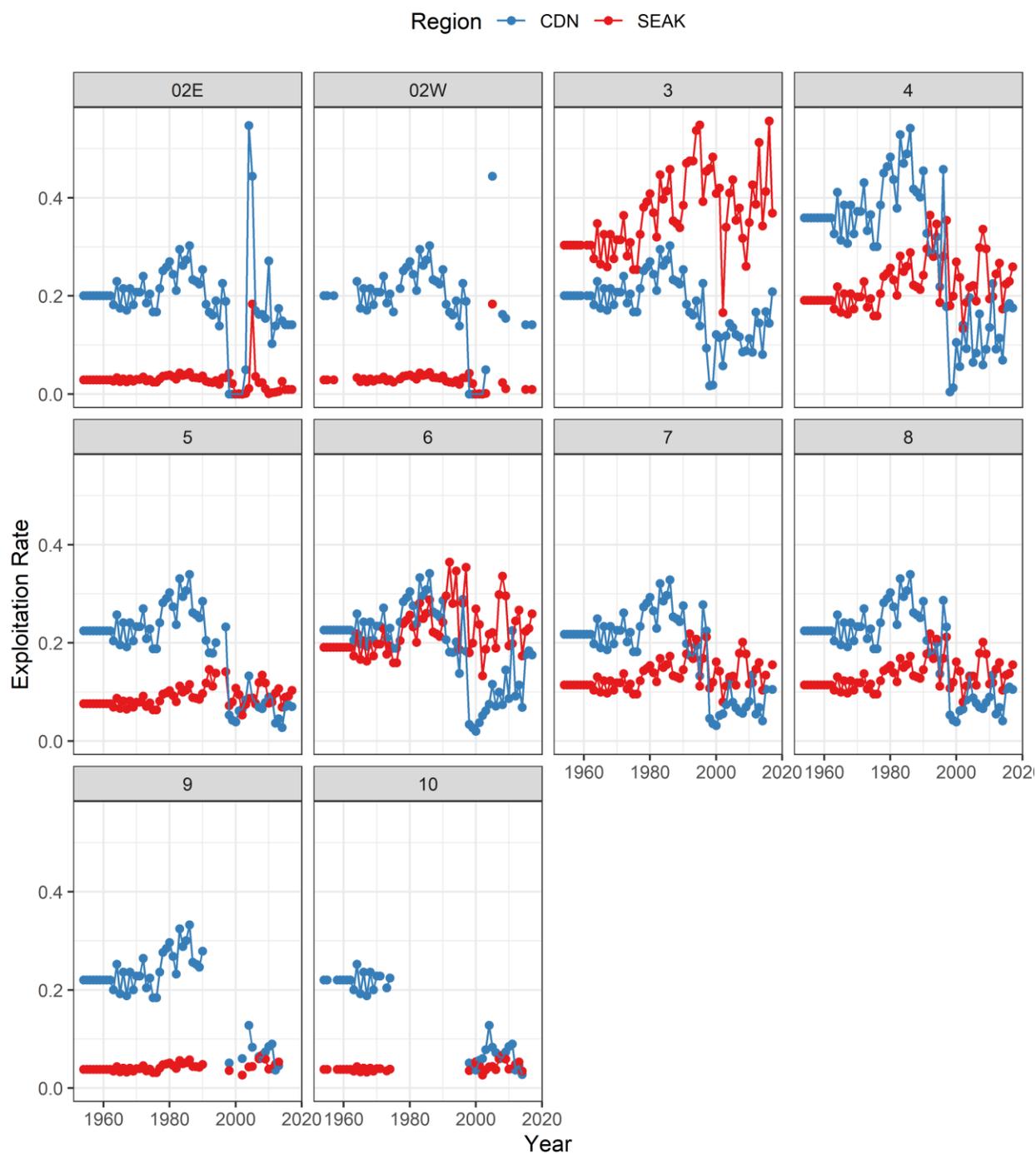


Figure 10: SEAK (red) and Canadian (blue) exploitation rates by year for north and central coast (Statistical Areas 1-10) coho salmon from 1954-2017. Source: LGL 2021a.

SEAK Percent of Total Exploitation Coho Salmon (1954-2017)

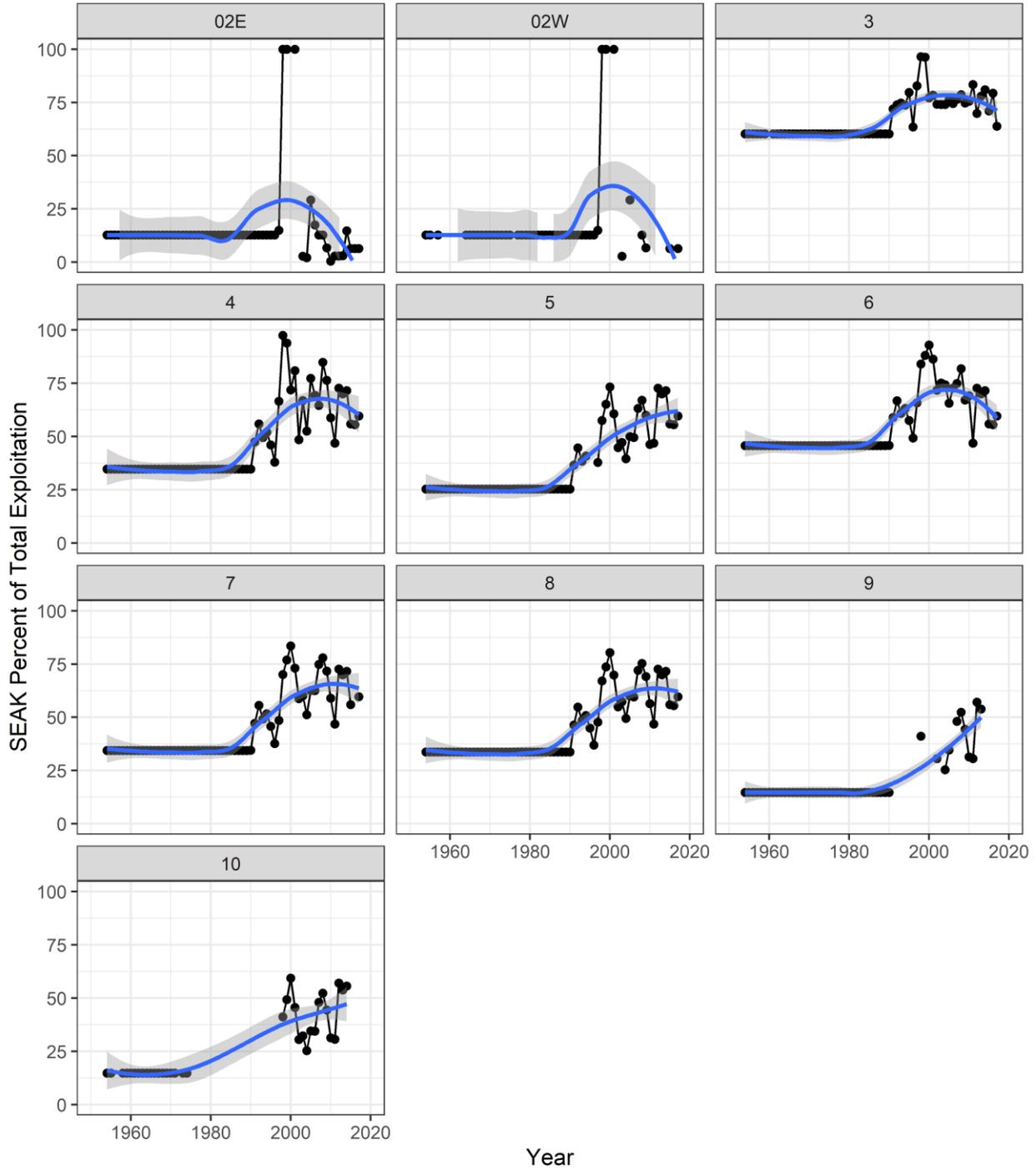


Figure 11: Percent of exploitation attributed to SEAK for coho salmon from north and central coast BC from 1954-2017. Trend lines and SEs were derived using LOESS in R. Source: LGL 2021.

SEAK Exploitation Rate by Conservation Unit Coho Salmon (1954-2017)

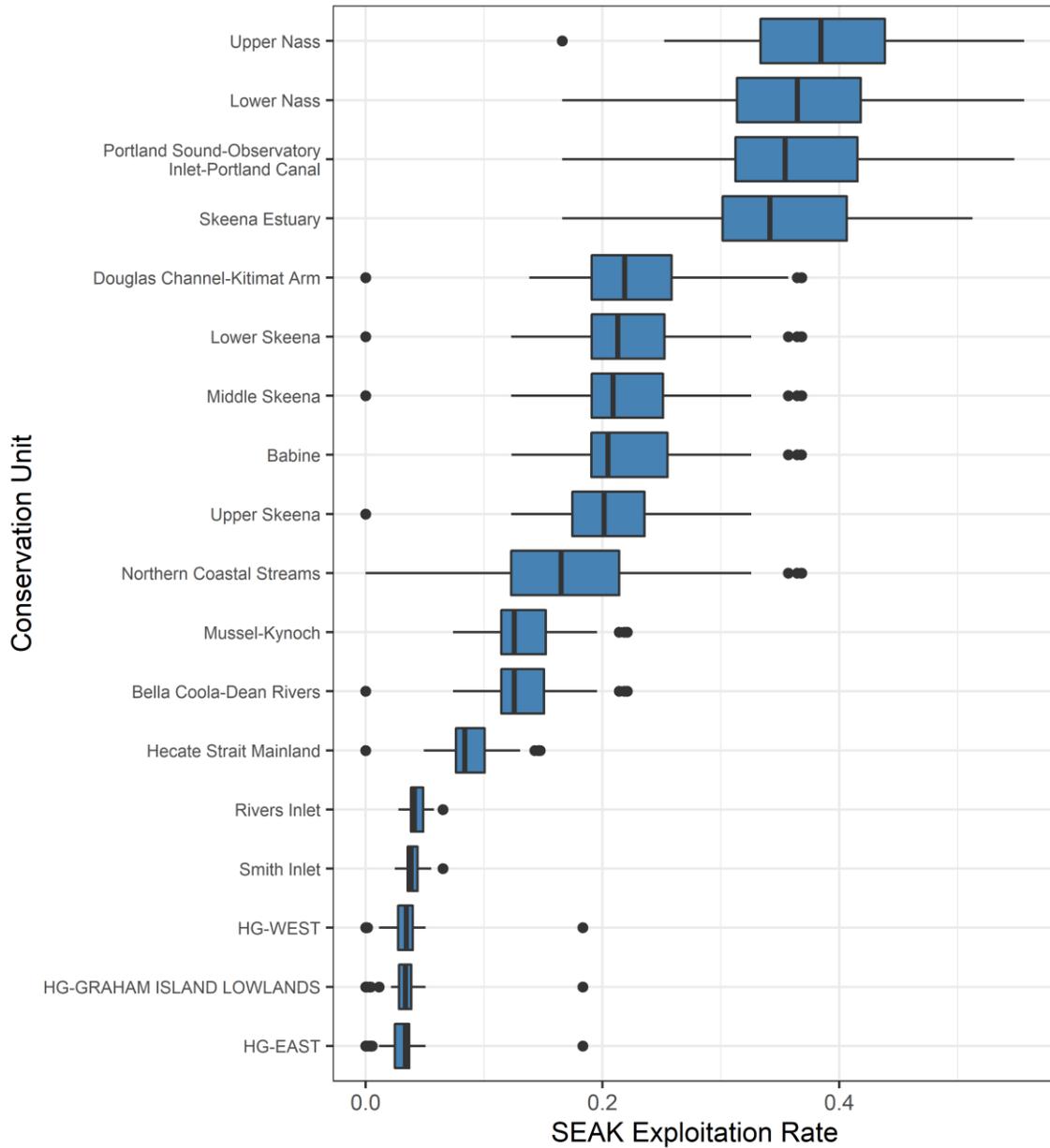


Figure 12: Boxplot of SEAK exploitation rates on coho north and central coast BC Conservation Units for 1954 to 2017. CUs are ordered from highest median exploitation rate to lowest. Source: PSF 2021.

SEAK Exploitation Rate by Conservation Unit Coho Salmon (1954-2017)

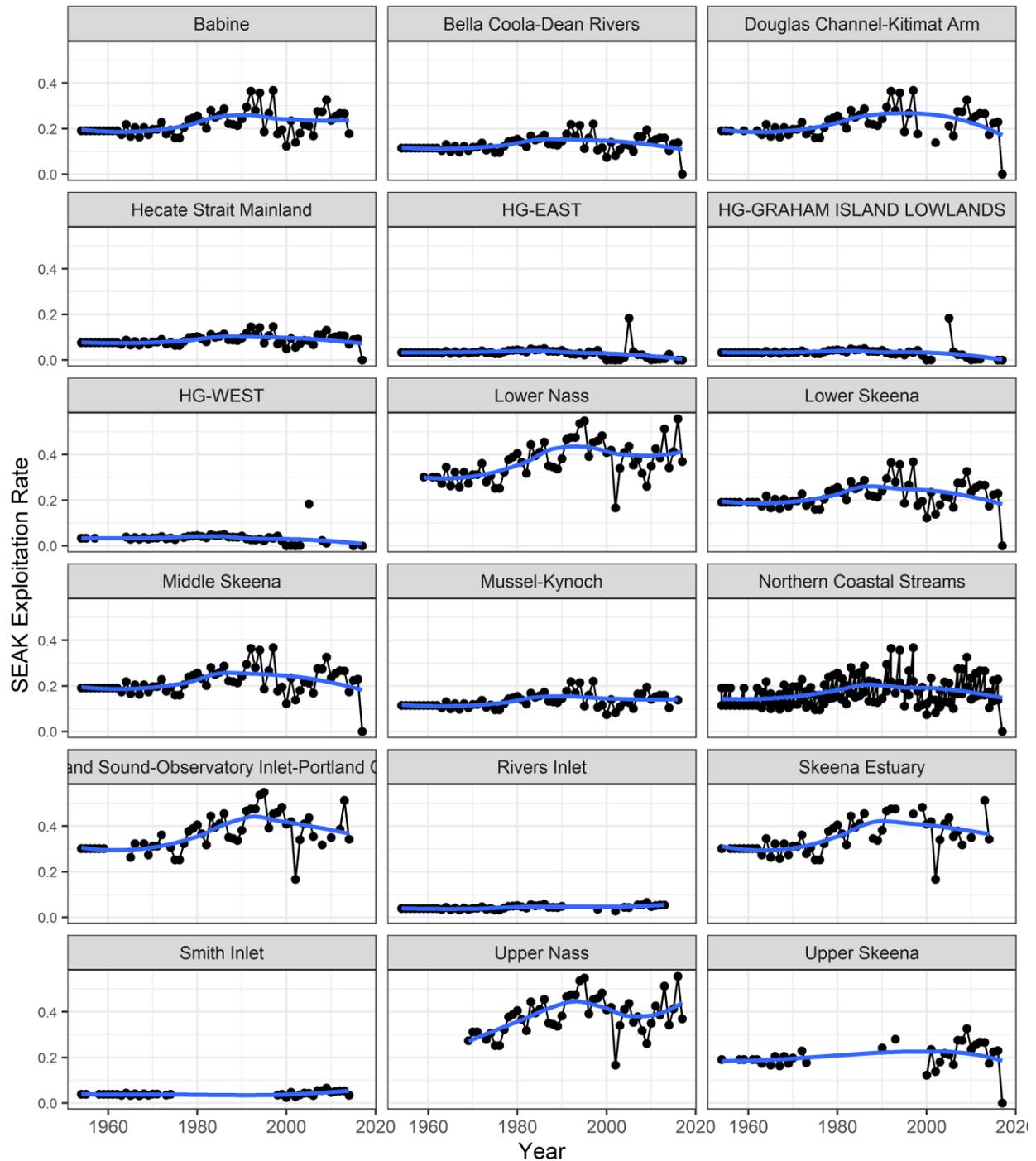


Figure 13: SEAK exploitation rates for coho salmon from north and central coast Conservation Units from 1954-2017. Trend lines derived using LOESS in R. Source: PSF 2021.

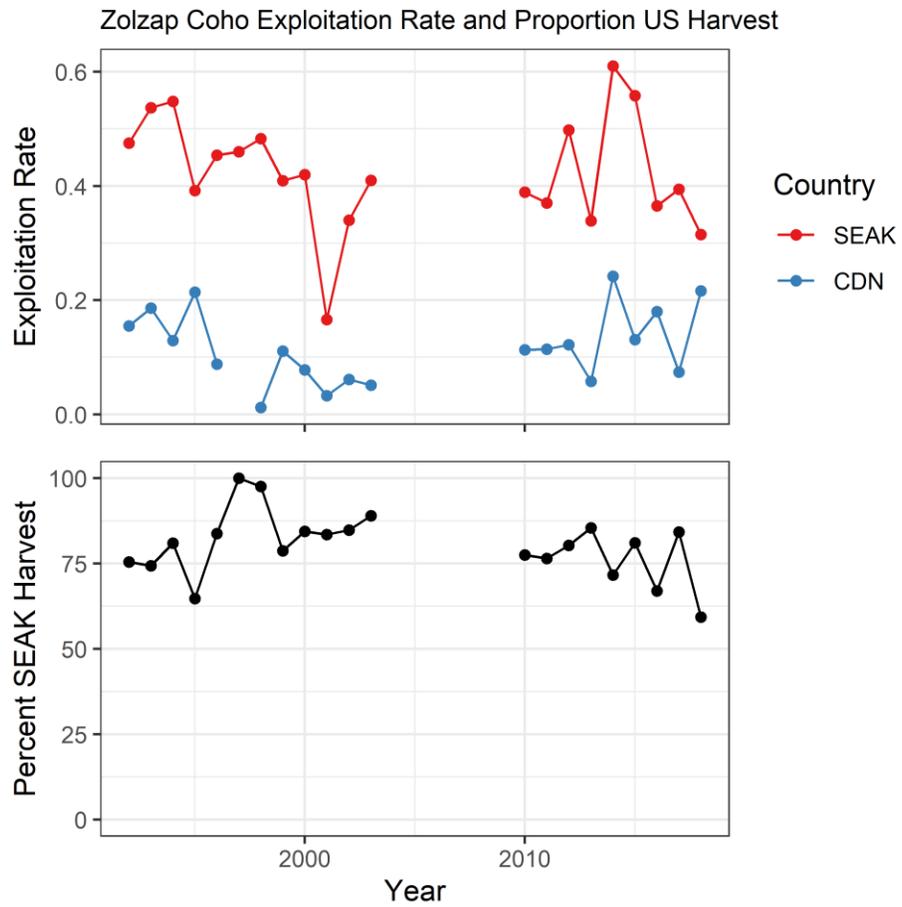


Figure 14: CDN (blue) and SEAK (red) exploitation rates (top) and the percent of SEAK harvest for Zolzap Creek coho. Source: LGL 2021b, Noble et al. 2020.

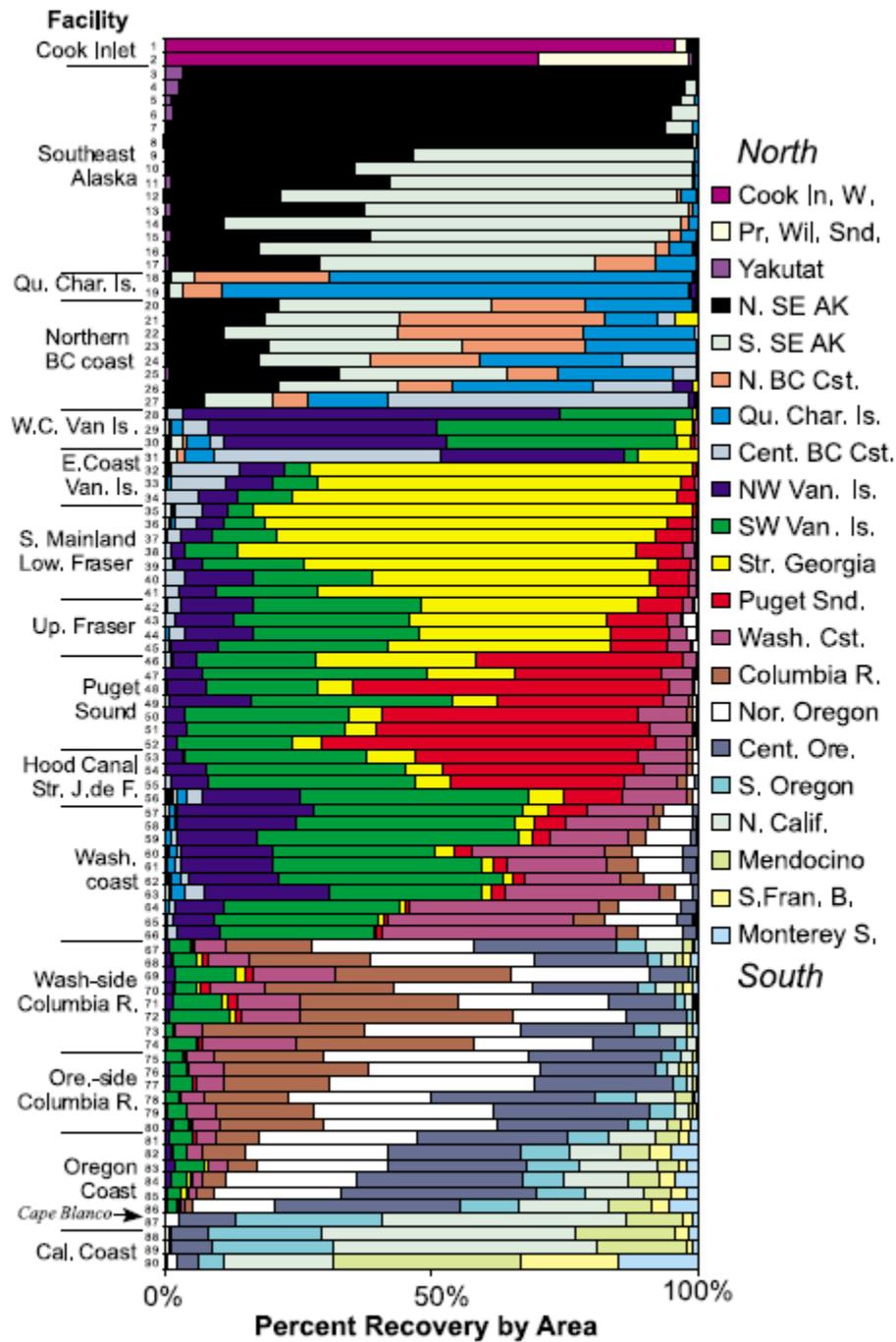


Figure 15: Recovery patterns of coded-wire tagged coho salmon (*Oncorhynchus kisutch*) by hatchery. Each bar provides the percent of recoveries in the 21 recovery areas for a single hatchery. The geographic region of hatcheries is indicated. Source: Weitkamp and Neely (2011).