

Alaskan Interceptions of BC Salmon: State of Knowledge

Report Series Summary

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Preface

This report is part of a series of reports on the ‘State of Knowledge’ of Alaskan interception of south migrating 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

Abstract

Alaskan fisheries intercept and catch salmon of all species from British Columbia (BC) in Southeast Alaska (SEAK). There is growing concern that as Canadian salmon abundance declines, and Canada closes or restricts its fisheries, Alaskan catch continues to have an impact on Canadian salmon and steelhead populations. Information gaps regarding the assessment of stock and species composition, and catch reporting in Alaskan fisheries, are increasing the risk to Canadian salmon caught in these fisheries. Fisheries located in southern Southeast Alaska (SSEAK, Alaskan Fishing Districts 101-106) are where most BC salmon (excluding Transboundary Rivers) are caught. While fisheries intercepting BC salmon populations occur throughout SEAK, this report focuses mostly on southern Southeast Alaska (SSEAK) and District 104.

In 2021, SSEAK net fisheries from Districts 101-106 caught over 50,000 Chinook (net only), over 1.2 million chum, ~540,000 coho, 34 million pink, and ~800,000 sockeye. The District 104 fishery - located on the outside of the Alaskan panhandle - is where the largest proportion of Canadian salmon and steelhead are caught. The total salmon catch in District 104 during 2021 was ~20,000 Chinook (power troll and seine combined), over 212,000 chum, ~130,000 coho, ~10.7 million pink, and ~495,000 sockeye. The proportion of Canadian salmon in the catch, and the certainty of the estimates, varies by species.

We provide a 'State of Knowledge' on SSEAK catch of BC salmon and steelhead that compiles and summarizes historical and recent information. Information on SSEAK catch (either information or data) were obtained through discussions with staff from Department of Oceans and Fisheries (DFO), Alaska Department of Fisheries and Game (ADF&G), and LGL Limited, and other agencies, and many additional resources were found online through the Pacific Salmon Commission Technical Committee websites, the Pacific Salmon Foundation Pacific Salmon Explorer, LGL Limited, and published literature and reports. Products of this work include the following technical summary, 100+ page data report, and R-code for figures and data summaries.

This report provides information that indicates significant Alaskan exploitation on many BC stocks, such as Area 3 (Nass), 4 (Skeena), and 5 (coastal streams south of the Skeena), coho, chum and pink salmon, other North and Central Coast Chinook and coho, Fraser River sockeye, and Chinook from Vancouver Island, Strait of Georgia, and some Fraser River populations. Importantly, these impacts continue despite declines in abundance of many species in BC. Additionally, catch of Canadian-bound salmon in most recent years is highest in Alaska. Data quality and quantity vary between species and regions. While several models provide estimates of catch based on previous tagging studies, historical effort/catch relationships, stock composition (known or inferred), and migration timing, these models are based on assumptions that generate considerable uncertainties.

While the inclusion of details for all data sources, expansions, and models is beyond our scope, we provide citations for many reports where further details are included. Rather than thoroughly review specific methodology, we collate and present available information, and highlight important considerations for further discussion.

Given the current depressed status of many wild populations across BC, and in the context of changing marine and freshwater environments due to various threats such as land use, forestry practices, and climate change, further examination of SSEAK impacts on BC salmon appears warranted.

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).

Summary

Alaskan fisheries intercept and catch salmon of all species from British Columbia (BC) in Southeast Alaska (SEAK). There is growing concern that as Canadian salmon abundance declines and Canada further restricts its fisheries, the relative impact of Alaskan catch of Canadian salmon and steelhead populations may be increasing. There are further concerns that information gaps are increasing the risk to many BC populations given their depressed state.

While fisheries intercepting BC salmon populations occur throughout SEAK and other areas of Alaska, this report focuses mostly on salmon directed fisheries in southern Southeast Alaska (SSEAK). The objective of our report is to provide a 'State of Knowledge' on SSEAK catch of BC salmon and steelhead trout, including historical and recent estimates of catch and exploitation for populations where information exists. Furthermore, we provide more detailed information in some 'data-rich' areas on the location and timing of these fisheries. Background information on Alaskan catch and pink salmon abundance is included for additional context. Concerns regarding assumptions and information gaps in current assessment methods are identified, with recommendations to guide further discussion.

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) to complete this 'State of Knowledge', and reviewed current assessment methodologies (e.g., Northern Boundary Sockeye Run Reconstruction Model). Some analyses were completed to explore potential exploitation of steelhead in Alaskan fisheries using information from sockeye, and the potential mortalities of BC Chinook in District 104 seine fisheries.

Estimates of Alaskan catch of BC salmon were quantified from multiple sources, and required an extensive effort to compile, including numerous discussions with staff from DFO Stock Assessment (North and Central Coast, West Coast Vancouver Island Strait of Georgia, and Fraser regions), LGL Limited, the Pacific Salmon Commission, the Pacific Salmon Foundation, and Alaska Department of Fish and Game. Much information was found online through the Pacific Salmon Commission Technical Committee website and reports, as well as other publications from various agencies, and in the primary literature. To aid in future discussions, we will be compiling all available information into a data package, including a code package to re-produce figures from this report.

First, we outline several contextual comments for the reader to better understand the scope and nature of our report:

1. This is a preliminary summary of information, with some basic analysis, which is not meant serve as a complete and definitive report. Rather, we hope that it will serve to continue and expand discussions so that a complete set of reports can be developed to hold all available information on US (beyond just SSEAK) interceptions of BC salmon in a publicly available and accessible manner. We invite feedback and welcome additional information that may have been missed.
2. While the scope of our report is limited to SSEAK catch of BC salmon, we aim to expand to transboundary and other fisheries that catch BC salmon (e.g., Alaskan trawl, Fraser sockeye, chum and pink, etc.).
3. Many of the stocks/populations of salmon that are caught in SSEAK are at depressed or highly depressed levels of abundance (e.g., North and Central Coast BC chum, some Skeena and Fraser sockeye populations).

4. Canadian fisheries (subsistence, recreational, and commercial) have been severely reduced in recent years due to low abundance for some population in some years; SSEAK often has the largest commercial catch of BC salmon.
5. There are numerous assumptions and uncertainties in the information presented here that simply could not be detailed in full (e.g., expansions of Coded-Wire Tag information, etc.); however, we try to identify reference materials (e.g., PSC Chinook Technical Committee reports, etc.) that may provide further details for the reader.
6. Some of the information presented is based on studies that were completed 35+ years ago.
7. There have been recent shifts in terminal run-timing that suggest there could be changes in where and when salmon are present in SEAK fisheries.
8. 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.
9. 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 (Grant et al., 2019)¹.
10. Commitments by the Canadian government to protect, recover, and sustainably manage BC salmon and steelhead in the recently announced Pacific Salmon Strategy Initiative (PSSI) warrant expanded efforts to understand and address uncertainties in exploitation in both SEAK and BC fisheries.

Key findings

SSEAK Harvest

- Southern Southeast Alaskan catch of salmon is significant, typically in the tens of millions, and dominated numerically by pink salmon.
- Chinook and coho are caught predominantly in troll fisheries, with some catch in seine fisheries, and limited catch in gillnet fisheries.
- Most pink salmon are caught in seine fisheries, and most chum are caught in seine fisheries and terminal-hatchery fisheries.
- Most sockeye are caught in southern purse seine fisheries, with some caught in gillnet fisheries.
- In 2021, SSEAK (Districts 101-106) commercial fisheries caught over 50,000 Chinook, over 1.2 million chum, ~540,000 coho, 34 million pink, and ~800,000 sockeye.
- In 2021, the District 104 fishery alone (power troll and seine combined) caught ~20,000 Chinook (see comments on seine fisheries below), over 200,000 chum, over 130,000 coho, over 10 million pink, and ~500,000 sockeye salmon.

¹ Grant, S.C.H., MacDonald, B.L., and Winston, M.L. 2019. State of Canadian Pacific Salmon: Responses to Changing Climate and Habitats. Can. Tech. Rep. Fish. Aquat. Sci. 3332. ix + 50 p.

SSEAK Pink and Chum Production

- SSEAK pink salmon production is predominantly ‘wild’ and returns to inside SSEAK systems. There are no index systems and little production from the District 104 area located on the outside of the Alaskan panhandle.
- The situation is similar for SSEAK wild chum salmon production, there are no index streams and little production in the District 104 area.
- We could find little information on the proportion of wild and enhanced chum in common property seine fisheries by District.

SSEAK interceptions of BC Salmon

There is significant catch of all species of BC salmon in SSEAK fisheries; however, exploitation, information quantity and quality, and certainty in estimates vary substantially between species and Districts. Estimates of BC salmon caught in SSEAK in 2021 are limited, with preliminary information available for some species and areas, but not most. The following provides a summary of key findings by species.

Sockeye Salmon

- In 2021, SSEAK fisheries caught a total of ~800,000 sockeye salmon, mostly in seine fisheries. Sockeye (~21,000) also were caught in the Tree Point gillnet fishery.
- SSEAK catch of Skeena, Nass, and Area 5 sockeye has been significant in recent years. The Alaskan commercial marine catch has exceeded the Canadian commercial marine catch in 7 of the last 10 years (Skeena) and 5 of the last 6 years (Nass), based on Northern Boundary Sockeye Run Reconstruction (NBSRR) model outputs.
- BC sockeye from areas other than the Fraser, Skeena and Nass Rivers are present in these fisheries in most years.
- SSEAK exploitation of some depressed Skeena sockeye Conservation Units has been high (e.g., Babine Late-Wild and Kitwanga), relative to the Skeena aggregate.
- The District 104 seine fishery captures 50% to 75% of all Skeena sockeye caught in SSEAK, and between ~10% and 50% of all Nass sockeye.
- Fraser sockeye are also caught in SSEAK fisheries, and can constitute more than 50% of the total sockeye catch in District 104 in the latter part of August.
- SSEAK catch of Fraser sockeye exceeded Canadian catch in 2019, and likely will do so again in 2021.
- Although formal estimates of SSEAK catch of BC sockeye are not yet available for 2021, preliminary information suggests significant catch of both Nass (~101,000) and Skeena (~280,000) sockeye in SSEAK fisheries (predominantly in District 104). There was no Canadian commercial catch of sockeye in the Skeena and Nass in 2021. This represents an SSEAK exploitation rate for both stocks of ~ 20%.
- The 2021 commercial catch of sockeye salmon in north and central BC was limited, with little marine commercial catch, and only limited treaty catch in Area 3 (~40,000).
- There is evidence of a shift to later run-timing for Skeena and Nass sockeye which may mean that provisions in the Pacific Salmon Treaty that limit the number and duration of D104 seine fisheries prior to Week 31 (end of July) may be less effective than intended.

Chinook Salmon

- In 2021, SSEAK fisheries caught ~51,000 Chinook, mostly (66%) in the summer troll fishery. Chinook non-retention was required for most 2021 SSEAK seine fisheries.
- Unlike Canadian seine fisheries, Alaskan fishers are not required to sort their catch, release non-target species with the least possible harm, record bycatch in logbooks, or have independent monitoring of their fisheries.
- Historical and current estimates of SEAK exploitation of BC Chinook are largely derived from Coded Wire Tag (CWT) information from indicator stocks. However, Genetic Stock ID (GSI) methods have also been used more recently to estimate stock composition in SEAK troll and sport fisheries.
- Information from the PSC Chinook Technical Committee (mortality distribution tables) from CTC indicator populations indicate that BC Chinook are caught predominantly in SSEAK troll fisheries, where exploitation rates are typically 10-20% for many stocks (and higher in some years). North migrating stocks with high exploitation rates include West Coast Vancouver Island (Robertson), East Vancouver Island (Big Qualicum, Puntledge, Quinsam, and Phillips), north and central coast (Atnarko and Kitsumkalum), and some Fraser River populations (Middle and Lower Shuswap).
- Estimates of SEAK exploitation on Cowichan, Nicola, Harrison, Chilliwack, and Dome (limited to 1990-2007) and Nanaimo (1990-2007) are very low (< 1%).
- Terminal SEAK fisheries catch very few north and south coast BC Chinook; however, Transboundary Alek, Taku, and Stikine stocks are harvested in SEAK in directed abundance-based SEAK fisheries (including gillnet), as well as incidentally in terminal sockeye gillnet, sport, and personal-use fisheries. Stikine Chinook also are harvested in SEAK non-terminal sport and troll fisheries.
- Of the stocks where SEAK exploitation rates are greater than ~5% in most years, almost all show trends towards lower SEAK exploitation rates in recent years (with the exception of Puntledge).
- Coded Wire Tags (CWT) are analyzed by removing the tags from salmon heads recovered from troll, net, and recreational fisheries. A higher proportion of heads, and therefore tags, is recovered in Alaskan fisheries head recoveries from than from BC fisheries (mainly FSC and recreational), leading ADF&G to suggest that CWT analyses may be biased.
- While Chinook are targeted in troll fisheries, they are considered bycatch in seine fisheries. SSEAK seine fisheries do not permit the retention of chinook for sale for most of the season. Estimates of legal and sub-legal encounters and incidental mortalities are provided in Pacific Salmon Commission Chinook Technical Committee (CTC) reports by gear (e.g., purse seine); however, information on individual fisheries/areas are not provided, nor are methodologies for how estimates of Chinook total mortalities are derived.
- In 2021, approximately 5,800 Chinook were retained in District 104 seine fisheries during one period of retention (~2 days). We do not have estimates of encounters or incidental mortality for 2021; however, there were significant numbers of legal releases as well as sub-legal releases in 2020 and 2019, and corresponding incidental mortality.
- We were not able to determine if releases were sampled for either CWT or GSI to derive stock composition estimates, or if releases were available at a District or even fishery level. Moreover, regulations allow fishers to retain, but not report, certain sizes of Chinook, further complicating the issue.

- Reports completed in 1987 and 1988 surveyed fishers on numbers of Chinook released, retained for personal use, or retained for sale. The reports estimated that total mortalities of Chinook were many times higher than what was reported on sales slips. We could not find similar reports for recent years.
- Formal estimates of SEAK exploitation on BC Chinook salmon in 2021 will be produced by the PSC Chinook Technical Committee, and will not be available until late 2022/early 2023. However, it is reasonable to assume that there was similar exploitation of north-migrating Chinook populations as in recent years.
- In 2021 BC fisheries caught ~ 64,000 chinook were caught in Area 1-10 (north and central coast) mixed-stock troll fisheries (predominantly south coast stocks), with another 36,000 caught in sport fisheries in Areas 1, 2W, and 3/4. In southern BC, there were terminal seine and gillnet fisheries on WCVI Chinook targeting Somass Chinook, and large recreational fisheries both on the WCVI and ECVI. Final catch numbers are not available, and will be reviewed by the PSC CTC over the next year.
- In addition, because most BC fisheries – other than terminal ones – employ non-retention, final estimates of total mortalities can be much higher than catch estimates.

Coho Salmon

- In 2021, SSEAK fisheries caught over 540,000 coho.
- In 2021, ~130,000 coho were caught in District 104, with 73% (~97,000) caught in the purse seine fishery.
- Estimates of SEAK exploitation of BC coho are largely derived from CWT information from indicator populations and modelling.
- Information from north coast (Skeena and Nass) coho indicators indicates that SSEAK exploitation is typically 2.5- to 5-fold higher than Canadian exploitation (Nass), with SSEAK exploitation on Nass coho ranging from ~20% to 60%, and ~30% to 50% on Skeena coho. Much like Chinook indicator stocks, this information is stock specific, but is used as an indicator for surrounding populations.
- SSEAK catch represents ~75% of the total catch in most years for both Skeena and Nass coho.
- There are no CWT exploitation rate indicator stocks on the central coast, so estimates of SSEAK catch and exploitation are derived from Area 3 and 4.
- A soon to be released report from the Pacific Salmon Commission on north and central coast coho may contain updated estimates of SEAK exploitation of coho salmon, and our report will be updated upon review of the PSC report.
- SSEAK exploitation of South coast coho is likely very low (~1%), based on Coded Wire CWT recoveries and modelling (FRAM model) completed by the PSC Coho Technical Committee.
- Estimates of SSEAK exploitation of BC coho are not yet available for 2021, however recent information suggests that SEAK coho exploitation will likely remain high on north coast (Skeena and Nass ~20-40%) and very low on the south coast.
- In 2021, ~200,000 coho were caught in north and central BC, primarily in mixed stock troll and Area 1 and 3/4 sport fisheries.

Pink Salmon

- In 2021, SSEAK fisheries caught over 34 million pink salmon.
- In 2021, approximately 10.7 million pink salmon were caught in the District 104 purse seine fishery.

- Recent estimates of SSEAK exploitation of north coast pink salmon are based on an Effort-Harvest Rate model (Area 3, 4, 5 Pink and Chum Exploitation Rate Model produced for the Pacific Salmon Foundation by LGL Limited). The model is based on tagging studies completed in the 1980s and historical effort-catch relationships from the late 1980s/early 1990s when BC's seine fleet was many times larger than today and fished under much less restrictive regulations.
- The only areas in BC for which SSEAK exploitation of BC pink salmon is estimated is on the north coast: Areas 3, 4 and 5.
- Results from pink salmon tagging studies in the early 80s were confounded by incomplete surveys in fisheries and escapements in central coast and southern areas. In some years tagged pink salmon were recovered in central coast areas and as far south as WCVI and Johnstone Strait. Considering Canadian stock compositions by week in D104 (in excess of 10% in some periods) from tagging studies relative to the 10 million pink salmon pink salmon caught in D104 in 2021, the catch of Canadian origin pink salmon may have been significant depending on numbers available to the fishery and their vulnerability.
- We were unable to find any information on Alaskan catch of southern BC pink salmon other than described in the NOAA report summarising the 80s tagging studies.
- Estimated exploitation rates in SSEAK on pink salmon from Areas 3, 4, and 5 range from 10-30% in most years, with very little difference between odd and even years.
- There is little information on SSEAK exploitation rates of pink salmon from other north and central coast Areas, including many places in the Great Bear Rainforest and other areas of BC's central coast, although the results of the tagging studies in 1984 and 1985 indicate that central and southern B.C. pinks are caught in SSEAK pink fisheries
- Since 1980, both Canadian and SSEAK pink salmon exploitation rates have been declining, however, Canadian exploitation rates have declined much more than SEAK exploitation rates.
- Formal estimates of exploitation rates on BC pink salmon using the current Effort-Harvest model are not available yet for 2021; however, if exploitation rates remain similar to the most recent years, then exploitation rates of approximately 10% would be expected. There were no pink salmon fisheries during the summer in Areas 3 -10 in BC in 2021. However, there was a fishery in Area 1 on Haida Gwaii in late August that caught 270,000 pink salmon.
- Over the long term, SSEAK exploitation has comprised ~50% of the total SSEAK and Canadian exploitation (CDN includes all catch: commercial, Food, Social, and Ceremonial, and sport); however, that proportion has increased in recent years (since the early 2000s), likely due to declines in abundance of BC pink salmon.
- SSEAK pink salmon production is much larger than Canadian pink production, so even modest catch in Alaska that targets Alaskan pink salmon could have significant impacts on Canadian pink salmon.
- Alaska does not assess pink salmon stock composition in District 104 fisheries. The abundance of Alaskan relative to Canadian pink salmon in District 104, and limitations in fine scale genetic resolution for pink salmon, may make the use of GSI techniques too challenging and expensive.

Chum Salmon

- In 2021, SSEAK fisheries caught over 1.2 million chum salmon.
- In 2021, just over 200,000 chum salmon were caught in the District 104 purse seine fishery.
- There are no direct estimates of SEAK exploitation of north coast chum salmon. Current estimates are based on pink salmon SEAK exploitation rates derived by the Effort-Harvest rate model described above.

- Very few chums were tagged in the tagging studies completed in the early 1980's.
- The only areas where SSEAK exploitation of BC chum salmon is estimated on the north coast is Areas 3, 4, and 5.
- As for pink salmon, there is little information on SSEAK exploitation on chum salmon returning to Haida Gwaii, areas of the Great Bear Rainforest other than Areas 3, 4, and 5, and BC's central coast.
- We were unable to find any information on Alaskan interceptions of southern BC chum salmon, including WCVI, ECVI, ISC, and Fraser areas. The later run-timing of southern BC chum salmon suggests interceptions would be minimal.
- Estimated exploitation rates in SSEAK on chum salmon from Areas 3, 4, and 5 are typically less than 20%, though some years are 30%. There is no difference in odd versus even year catch rates. These are likely near, or possibly above, the total allowable exploitation rates for unproductive or depressed chum populations.
- Since 1980, both Canadian and SSEAK exploitation rates on BC Areas 3, 4, and 5 chum salmon have been declining; however, Canadian exploitation rates have declined much more than SSEAK exploitation rates, with Canadian exploitation rates near zero in most years since 2010 in Areas 4 and 5, and Area 3 below 10% since ~2000.
- Historically, SEAK exploitation has accounted for ~50% of total exploitation (Canadian includes all catch: commercial, FSC, and sport); however, in recent years (since the early 2000s), that proportion has increased dramatically concurrently with the decline in Canadian catch, and in recent years has accounted for nearly all catch.
- Formal estimates of exploitation on BC chum salmon are not yet available for 2021; however, exploitation rates of approximately 10% would be expected if exploitation remains similar to recent years.
- There were extremely low catches of chum salmon in Areas 1-10 in BC in 2021, with most areas closed and only limited opportunities for Food, Social, and Ceremonial fisheries. Because Canada has not developed benchmarks or reference points for its north/central coast chum stocks, it is not possible to comment on current exploitation rates relative to stock status.

Steelhead Trout

- We were unable to find any information on current SSEAK exploitation of BC north or south coast steelhead trout, either in terms of reported catch in SSEAK fisheries or data on exploitation rates. It is unknown how many steelhead were encountered in the District 104 fisheries.
- Since 1997, steelhead may only be retained for personal use in SEAK fisheries, and are not required to be recorded or reported. The North Pacific Anadromous Fish Commission database does not contain any steelhead catch estimates since 1997 for SEAK.
- In 2021, the Skeena River steelhead return was the lowest on record (~5,400 to September 29), and far below the Extreme Conservation Concern Zone.
- In 2021, an unknown number of BC steelhead were encountered in SSEAK fisheries; however, there likely was a significant impact on Skeena River steelhead in SSEAK fisheries given that terminal run-timing is similar to late-timed Skeena River sockeye stocks, there is similar vulnerability to fisheries, and high release mortality.

Uncertainties and Recommendations:

1. Estimates of SSEAK exploitation of BC chum are inferred from pink salmon exploitation rates using an Effort-Harvest model based on tagging studies from the 1980s, and effort-catch relationships from the late 1980s and early 1990s. Given the current biological status of BC chum, especially on the north and central coast where SSEAK exploitation is likely to be highest, we recommend sampling chum in SEAK non-terminal net and troll fisheries (otolith, then GSI) to estimate stock composition, focussed on Districts 104 and 101.
2. Estimates of SSEAK exploitation of BC pink salmon are made using an Effort-Harvest model (see above) based on tagging studies from the early 1980s and effort /harvest relationships from the late 1980's and early 1990's when BC's seine fleet was many times larger than today and fished under much less restrictive regulations.
3. In that the tagging studies completed in 1984 and 1985 identified that pink salmon caught in SSEAK were recovered as far south as WCVI and Johnstone Straits, and given the current status of BC pink salmon and limited catch in BC in recent years, we recommend sampling (for GSI) pink salmon in SSEAK seine fisheries to provide estimates of the number of BC salmon caught and, where possible, their stock composition. We recognize that given the ratio of abundance (Alaskan pink production is much greater than BC), there could be considerable logistical constraints to this. Preliminary information from recent work on pink Single Nucleotide polymorphism (SNP) baselines in Alaska suggest that there is still low small-scale resolution, and pink salmon only separate out at large regional levels. However, this may be enough information should BC regional groups separate out from Alaskan and Southern US groups.
4. We were unable to find much information on SSEAK interception of BC steelhead. Since 1997, Alaskan regulations prohibit sale of steelhead, and allow retention only for personal use with no reporting requirements. Quantification of steelhead caught and retained for personal use, and quantification of steelhead released from net and troll fisheries - especially in non-terminal south SEAK fisheries - should be discussed. Given the current critical biological status in many steelhead populations in BC, this work would be both timely and a priority in the context of recovering populations.
5. It is difficult to provide an estimate of total Chinook mortalities or stock composition associated with the seine fishery without improved monitoring and assessment of releases and retention for personal use.
6. It may be useful to survey other Alaskan commercial mixed-stock fisheries, similar to the D104 seine fishery, to determine what strategies Alaskan managers employ to decrease risks to salmon stocks or species of conservation concern caught as bycatch to the target species, and ensure management objectives for both the target and bycatch species are achieved.
7. There is limited information that aligns with the scale of Canada's Wild Salmon Policy in terms of Conservation Units. In some instances (e.g., some years, some species), sub-aggregate estimates are made through modelling (e.g., Skeena sockeye) or GSI (Fraser sockeye). We recommend that DFO and ADFG review existing, and design new, assessment programs that can provide opportunities to improve our understanding of exploitation at the sub-aggregate/Conservation Unit level.