Salmon Bycatch Monitoring and Sampling Results for the Pacific Region 2023/24 Groundfish Trawl Fishery

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ABSTRACT

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The Pacific Region Groundfish Trawl Fishery is one of the largest fisheries in British Columbia by catch volume and value. Beginning fall 2022, new monitoring and retention requirements for salmon bycatch were introduced in the fishery to improve the accuracy of catch estimates and collect information on Chinook salmon stock composition and coded wire tags (CWT). This report describes results for the 2023/24 groundfish fishery, the first full year of the enhanced monitoring program. There was an estimated total of 28,145 salmon caught in the 2023/24 groundfish fishery including 21,696 Chinook salmon. CWT and genetic stock composition estimates indicate that most bycatch of Canadian origin Chinook salmon was from the Fraser Fall 4(1) stock management unit, which includes CWT exploitation rate indicator stocks from the Chilliwack and Harrison River. A new salmon bycatch management plan has been implemented for the 2024/25 fishery, including a fleet-wide bycatch cap of 9,500 Chinook salmon, therefore, future catches will be reduced compared to information reported here for 2023/24.

RÉSUMÉ

Lagasse, C.R., Fraser, K.A., Braithwaite, E., Komick, N. 2025. Salmon Bycatch Monitoring and Sampling Results for the Pacific Region 2023/24 Groundfish Trawl Fishery. Can. Manuscr. Rep. Fish. Aquat. Sci. 3298: vi + 41 p. https://doi.org/10.60825/d0e4-pp46

La pêche au chalut du poisson de fond dans la région du Pacifique est l'une des plus importantes pêcheries de la Colombie-Britannique en volume et en valeur des prises. À compter de l'automne 2022, de nouvelles exigences de surveillance et de rétention des prises accessoires de saumon ont été introduites dans la pêche pour améliorer l'exactitude des estimations des prises et recueillir des renseignements sur la composition des stocks de saumon quinnat et les étiquettes codées en fil métallique (CWT). Ce rapport décrit les résultats de la pêche du poisson de fond en 2023-2024, la première année complète du programme de surveillance améliorée. Un total estimé de 28 145 saumons ont été capturés dans la pêche du poisson de fond en 2023-2024, dont 21 696 saumons quinnat. Les estimations des CWT et de la composition génétique des stocks indiquent que la plupart des prises accessoires de saumon quinnat d'origine canadienne provenaient de l'unité de gestion des stocks de l'automne 4(1) du Fraser, qui comprend les stocks indicateurs de taux d'exploitation des CWT des rivières Chilliwack et Harrison. Un nouveau plan de gestion des prises accessoires de saumon a été mis en œuvre pour la pêche de 2024-2025, y compris un plafond de prises accessoires à l'échelle de la flottille de 9 500 saumons quinnat. Par conséquent, les prises futures seront réduites par rapport aux informations rapportées ici pour 2023-24.

INTRODUCTION

Fisheries catch monitoring provides a basis for informed assessment and fisheries management decisions. Catch monitoring programs are often designed to meet multiple objectives including accurate and timely estimation of harvest mortality for target or bycatch species, ensuring compliance with fisheries regulations, and collecting biological samples or environmental information. In the Pacific Region groundfish trawl fishery, the combination of mandatory at-sea and dockside monitoring have been integral components of the fishery management system since 1996, with procedures updated over time to address changing management objectives, conservation needs, and technology.

A recent focus for monitoring in the groundfish trawl fishery has been the collection of accurate and timely catch data and biological samples from bycatch of Pacific salmon, particularly Chinook salmon (*Oncorhynchus tshawytscha*) which are the primary salmon bycatch species. While trawl fisheries in British Columbia have been intercepting salmon as bycatch for decades (Riddell 1981), concerns around Chinook salmon bycatch levels have increased due to the potential for impacts on stocks of conservation concern. Chinook salmon are economically and culturally important, yet many populations in southern British Columbia are assessed as at risk by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2018, 2020), and designated as stocks of concern by DFO (DFO 2023). Over the past decade, new regulations and closures have been implemented in salmon-directed fisheries to reduce mortality of Chinook salmon stocks of concern, informed by exploitation rates analysis based on coded-wire tags (CWTs) and genetic stock identification (GSI). In trawl fisheries, salmon are a prohibited species that cannot be targeted or sold. Until recently all vessels were required to release all salmon bycatch at sea and monitoring requirements for salmon bycatch were no different than those applicable to all catch species.

Beginning in September 2022, an enhanced salmon bycatch monitoring program, including mandatory salmon bycatch retention, was initiated in the groundfish trawl fishery to provide accurate estimates of Pacific salmon bycatch by species and to assess the stock composition and CWT recoveries of Chinook salmon bycatch. Preliminary results from the enhanced monitoring program were described in Lagasse et al. 2024 focusing on the 2022/23 groundfish fishery. This report describes salmon bycatch monitoring and sampling results for the 2023/24 groundfish fishery and the 2023 calendar year. This marks the first full year of mandatory retention requirements and sampling to estimate impacts of the fishery on Chinook salmon. We provide updated information on salmon bycatch in the groundfish trawl fishery, and expand on reporting of CWT, stock composition, and age composition.

METHODS

Groundfish Trawl Catch Monitoring

The Pacific region groundfish trawl fishery is one of the largest fisheries in British Columbia by catch volume and value. The multi-species fishery is one of seven commercial groundfish harvesting sectors in the Pacific region managed under the Groundfish Integrated Fisheries Management Plan (DFO 2024). All commercial groundfish fisheries use an individual transferable quota (ITQ) system with individual vessel accountability for catch and 100% at-sea and dockside monitoring. The fishery year and quota allocations begin on February 21 annually and, with the exception of the halibut fishery, vessels may fish their available quota throughout the year.

Each year, licensed commercial groundfish trawl vessels must choose to fish under one of two licence options. The majority of the fleet, approximately 40 active vessels, fish under an Option A licence allowing the use of bottom and mid-water trawl gear within all groundfish management areas except for area 4B (east side of Vancouver Island), where only mid-water trawl gear may be used (see Figure 1 for a map of groundfish management areas). A smaller number of trawl vessels (approximately 8 of much smaller size and horsepower) fish under an Option B licence, allowing bottom trawl gear only within groundfish management area 4B.

Commercial groundfish trawl catch is monitored and reported using a combination of fisher logs, independent at-sea electronic monitoring (EM) auditing, and dockside monitoring program (DMP) validation of landed catch. While hailed out, all vessels must keep accurate records of fishing activities in an electronic fishing log while ensuring that the at-sea EM systems are fully operational. EM system requirements are specified by DFO and include video cameras, global positioning systems (GPS), and hydraulic sensors. EM information is used to verify the accuracy of information recorded in fisher logs via audits of all GPS data and total catch per tow, and detailed audits of a random subset of tows from each trip. If fisher reported information does not meet accuracy requirements, log data may be replaced by EM results and additional tow audits conducted. Prior to March 2020, independent at-sea monitoring requirements for Option A trips were fulfilled by the at-sea observer program, with the exception of trips targeting Pacific hake using midwater trawl gear and landing fresh product; however, the at-sea observer program has been suspended since the Covid-19 pandemic and replaced with a more comprehensive EM program. At the end of each fishing trip, all landed catch must be independently validated by the DMP during offload to ensure accurate catch weights for each species. Further details on monitoring requirements for the groundfish trawl fishery are detailed in Appendix 8 of the Groundfish Integrated Fisheries Management Plan (DFO 2024).

Pacific salmon are designated as a prohibited species in groundfish fisheries, and the Option A trawl fishery has been subject to new monitoring and retention requirements since September 2022 as part of an enhanced salmon bycatch monitoring program. Prior to 2022, the catch monitoring requirements for Pacific salmon were the same as those that applied to other prohibited species. Conditions of licence required that Pacific salmon be released at-sea if caught and available estimates of salmon bycatch were based on fisher logs, observer logbook (prior to March of 2020), or EM audit review (from March 2020 to September 2022) information with DMP validation only when Pacific salmon were landed incidentally. Under the enhanced monitoring program, scientific licences are issued to all Option A trawl vessels requiring the retention of all salmon. This enables independent validation of catch by species and collection of biological samples. Option B trawl vessels make up a much smaller portion of total landings for the fishery and available monitoring data indicated they intercept virtually zero salmon, therefore, monitoring and retention requirements were unchanged for this licence type.

In addition to the enhanced monitoring requirements for salmon bycatch, a spatial closure to mid-water trawl fishing was implemented from November 15, 2023 to February 20, 2024 in portions of Pacific Fishery Management Area (PFMA) 12. This closure was enacted as an interim measure to reduce Chinook salmon bycatch while new management measures were in development for the 2024/25 groundfish fishery.

Sampling of Pacific Salmon Catch

Retention and sampling requirements for Pacific salmon bycatch in the groundfish trawl fishery were designed to enable:

1. Accurate estimation of the number of salmon caught by species;

2. Sufficiently precise and representative CWT sampling to quantify the fishery mortality for Chinook CWT exploitation rate indicator stocks; and
3. Sufficiently precise and representative genetic tissue sampling to identify the stock composition of Chinook catch.

To provide this information, different retention and sampling requirements were developed for vessels landing catch fresh on ice versus vessels that head, gut, and freeze catch at-sea.

For vessels landing fresh catch, which consist of most Option A trawl licence holders, all Pacific salmon were required to be retained and landed whole for DMP validation of catch numbers and weights by species. 25% of trips were randomly selected for collection of Chinook and Coho salmon heads by dockside observers, with the random selection occurring after vessel hail-in. A target of 25% was chosen to correspond with the 20% standard sampling rate to recover CWT indicator stocks in salmon-directed fisheries (PSC CWT Workgroup 2008), plus a 5% buffer for potential implementation error. Samples were not collected from catch landed fresh from April to May 2023 due to delays in implementation of the enhanced monitoring program.

For vessels landing frozen catch headed and gutted at sea, also known as receiving tank vessels, scientific licences required the retention of salmon heads only in recognition of the limited freezer space available for storage of non-marketable fish. Receiving tank vessels were responsible for retaining, bagging, and labelling heads on all trips according to instructions provided by DFO (Appendix A). This vessel type consisted of six active licence holders in the 2023/24 groundfish fishery that were generally larger in size and each caught a greater amount of fish compared to vessels landing fresh catch. A 100% sampling rate for frozen catch was chosen to ensure representative sampling of the small number of vessels that fish over long periods and wide areas.

After landing, salmon head bags were collected and labelled by dockside observers to allow the bags to be traced back to the trip, placed in cold storage, and shipped to the sampling service provider, J.O. Thomas and Associates Ltd. Every head was identified to species, counted, and checked for the presence of a CWT using electronic detection equipment. CWTs were recovered from all heads that scanned positive, while DNA cheek tissue samples were collected from heads that did not have CWTs.

Catch and Effort Estimation

We report on bycatch of Pacific salmon for the 2023/24 groundfish trawl fishery using at-sea records from fisher logs, landed catch from the DMP, and biological samples of heads. With the exception of salmon biological samples, this data is housed in the Fishery Operations Systems database, DFO's centralized repository for commercial fishery data in the Pacific Region. DFO Pacific Science maintains a 'Groundfish views of FOS' (GFFOS) database that restructures the data for convenient access and was used for querying information in this report.

Procedures for estimating the numbers of salmon caught by species and location are described in Lagasse et al. 2024. To summarize, for vessels landing fresh catch, salmon bycatch was compiled from the GFFOS Official Catch table using DMP validated data of catch offloads. For vessels landing frozen catch, salmon bycatch was determined from lab enumeration of salmon heads collected and bagged by fishers. Samples were matched to trips and tows using information from bag labels. For salmon heads that could not be matched to a specific tow due to unlabeled samples or catch not reported in fisher logs, catch locations were inferred across broader geographic regions based on the locations of all tows within a trip. Reporting

by regions for stock composition and CWT analysis reduced the amount of bycatch with an unassigned location compared to groundfish management areas and Pacific Fishery Management Areas (PFMAs).

Groundfish quota systems and integrated fisheries management plans are administered by groundfish year beginning on February 21 until February 20 of the subsequent year. By contrast, catch in salmon-directed fisheries are generally reported by calendar year. In recognition of the different reporting periods for groundfish and salmon fisheries, we report on annual bycatch of salmon by species using both calendar year and groundfish fishery periods; however, we focus on the calendar year for the analysis and reporting of results for CWTs and stock composition.

To provide information on rates of Chinook salmon bycatch during 2023, we estimated catch per unit effort (CPUE) by tow or trip. For catch landed frozen, CPUE was calculated as the Chinook salmon catch for each tow event divided by the tow duration. For catch landed fresh, we calculated CPUE by trip to obtain a more accurate representation of CPUE across all vessels. These vessels may not sort through all catch before depositing it in the hold and were not responsible for collecting and labelling salmon heads at sea, therefore, fisher log data included gaps in reporting salmon bycatch by tow. Only tows using midwater trawl gear were included in CPUE estimates by tow or trip because they represent the vast majority of Chinook salmon bycatch.

For both methods of estimating CPUE, we associated CPUE to target species by classifying the primary landed species where a single catch species represented greater than 50% of landed catch by tow or trip. While GFFOS includes up to 5 target species entered into fisher logs, these target species may not correspond with landed catch. Therefore, we used primary landed species to represent the species most frequently associated with Chinook salmon bycatch in midwater trawls. The primary species categories consisted of Pacific Hake (*Merluccius productus)*, Walleye Pollock (*Gadus chalcogrammus*), Yellowtail Rockfish (*Sebastes flavidus*), Widow Rockfish (*Sebastes entomelas)*, and Other, which generally represented catch of multiple groundfish species.

Stock Composition and CWT Analysis

The collection of CWT and DNA samples allowed estimation of stock composition and catch by stock from Chinook salmon bycatch, and also provided information on bycatch age composition. To representatively sample heads for stock identification, all Chinook salmon heads were first scanned for CWTs using electronic detection equipment and CWTs were recovered from all heads that scanned positive. Any heads that did not scan positive had a DNA sample collected from cheek tissue. A sub-sample of DNA was selected for genetic stock identification (GSI) analysis, targeting a minimum sample size of 150 within each catch strata and scaling up the sample sizes in strata with higher catches.

The catch strata for estimation of stock composition and CWT recoveries consisted of combinations of regions (West Coast Vancouver Island, Strait of Georgia, Queen Charlotte & Johnstone Strait, North Coast, or unassigned), catch type (fresh or frozen), and time periods (January – June or July – December, 2023). These factors combined to form 16 catch strata that contained Chinook salmon bycatch during the 2023 calendar year (see Appendix B for all strata). Out of these catch strata, 13 included CWT and DNA samples for estimation of stock composition. Stock composition was not estimated in the three unsampled catch strata that represented a small proportion of total bycatch.

Stock Composition Analysis

Stock composition of Chinook salmon bycatch in each stratum was estimated using both CWT and genetic methods to identify fish to population or conservation unit of origin, which were rolled up to the stock

management unit (SMU) level for reporting (see Appendix C for correspondence between SMU, CUs and genetic reporting units). CWT recoveries can determine the stock of origin to high accuracy and resolution for populations that have been tagged. For fish that did not contain a CWT, a sub-sample of DNA tissue samples were analyzed by DFO's Molecular Genetics Lab to determine stock of origin using parentage-based tagging (PBT) and GSI assignment methods from a panel of at least 150 single nucleotide polymorphisms (SNPs) (Beacham et al 2018).

GSI assignment matches genetic markers (SNPs in this case) from samples to baselines collected from spawning grounds to identify the population of origin for wild or hatchery fish, while PBT assignment matches sampled fish with their parents from hatchery broodstock, allowing determination of the hatchery of origin and age of sampled fish (Beacham et al. 2018). PBT results were used when available due to their higher accuracy and resolution, with the combined application of both methods denoted by PBT-GSI.

To determine stock proportions and catch by stock in each catch strata, separate stock proportions were estimated for samples assigned to stock using CWT versus GSI-PBT methods, and then a combined stock proportion was calculated by weighting these proportions according to their respective partition of the catch. For rare cases where a fish was identified using both CWT and GSI-PBT methods, the CWT assignment was used due to its higher resolution and accuracy. The CWT partition of the catch was calculated as the number of CWTs detected divided by the number of heads observed (i.e. scanned using detection equipment), while the GSI-PBT partition was the remaining proportion of the catch. This partitioning prevented bias in stock composition estimates associated with the higher sample rate for CWTs versus GSI-PBT, ensuring that stocks without CWT indicator programs would be equally represented when estimating stock proportions.

We assumed 100% accuracy from stock assignments using CWT and PBT methods, and characterized uncertainty in GSI stock proportions by bootstrapping assignment probabilities. For each Chinook salmon identified using GSI, we simulated 1,000 samples from a probability distribution equal to the assignment probabilities for each stock. We then estimated stock proportions from GSI-PBT samples in each strata by calculating the mean proportions of samples assigned to each stock across all simulations. Uncertainty in GSI stock assignment was summarized using 95% confidence intervals (±1.96 SD) of the stock proportions across all simulations. Finally, the mean weighted stock proportions from CWT and GSI-PBT stock assignments with confidence intervals were multiplied by catch in each strata to obtain estimates of catch by stock including uncertainty in GSI assignment.

CWT Analysis

A CWT is an internal fish tag that consists of a microscopic length of magnetized stainless-steel wire inscribed with a numeric code denoting a specific batch. CWTs are injected into the snouts of groups of Chinook and Coho salmon juveniles so they can be recovered as stocks migrate to the ocean and are caught in fisheries or return to their spawning grounds or hatcheries. When tags are recovered and associated with release data, CWTs accurately identify the stock of origin, brood year, and other associated information of the release group. As a massive mark-recapture program, both Canada and the U.S. tag Chinook and Coho indicator stocks, conduct intensive fishery and spawning grounds/hatchery returns sampling programs, and share standardized CWT data.

The Chinook Technical Committee (CTC) of the Pacific Salmon Commission uses CWTs to perform an annual exploitation rate analysis (CTC 2023), and currently monitors 45 Chinook CWT exploitation rate indicator stocks, including 16 within Canada (see Appendix D for geographic locations, stock acronyms,

and full stock names). For Chinook salmon bycatch in the trawl fishery, we estimate total CWT recoveries to provide information on mortality of exploitation rate indicator stocks in Canada. Notably, this includes Harrison and Chilliwack River indicator stocks, which are both within the Fraser Fall 4(1) SMU and cannot be reliably distinguished using genetic methods. The CTC uses CWT recoveries to estimate exploitation rates in fisheries, however, this analysis is developed for salmon-directed fisheries only.

To estimate total CWT recoveries for Canadian Chinook indicator stocks within each catch stratum, we expand the raw CWT observations by dividing the number of CWTs observed for each stock by the CWT sampling rate in each stratum. The CWT sample rate was the number of Chinook salmon heads observed (i.e. that passed through electronic tag detection equipment) divided by the total Chinook salmon catch in each stratum.

CWT estimation methods and stock information presented in this report are consistent with the Mark Recovery Program Information System (MRPIS) for commercial fisheries. MRPIS is maintained by Salmon Stock Assessment and is DFO's centralized repository for salmon coded wire tag data in the Pacific Region.

Age Composition

We provide a summary of Chinook salmon bycatch age composition data using brood year assignments from PBT analysis. Representation of this age composition information is limited to stocks with PBT programs. CWT age information was also available but is not reported because most Canadian CWT indicator stocks from the 2019 brood year were not tagged during the Covid pandemic, therefore age proportions from CWTs do not represent age 4 fish and were considered biased. We report on age composition by SMU for trawl bycatch in all regions, as well as age composition by region where PBT sample sizes were four or greater.

RESULTS

Salmon Bycatch

There was an estimated total of 28,145 salmon caught in the 2023/24 groundfish fishery, which was similar to the previous year's catch of 28,183 (Table 1, also reported by calendar year in Table 2). Most of this bycatch was Chinook salmon, which represented 21,696 salmon or 77% of the total. The majority of Chinook salmon bycatch occurred using mid-water trawl gear, with 94% or 20,470 Chinook salmon caught using mid-water trawl gear compared to a catch of 1,004 Chinook salmon using bottom trawl gear (Table 3). Pink salmon were the second most abundant salmon species caught with a catch of 3,894. This was much higher than the previous year's catch of 18 pink salmon, reflecting the higher abundance of odd-year runs in coastal waters of British Columbia.

The location and timing of Chinook salmon bycatch reflected seasonal changes in the distribution of effort and catch for the groundfish trawl fishery. Most Chinook salmon bycatch in the 2023/24 fishery occurred in the West Coast Vancouver Island (WCVI) region between May and October (Figure 2), where vessels targeted a mixture of species using mid-water trawl gear. Pacific Hake was the primary landed species by weight in this region and time, followed by Walleye Pollock and Yellowtail Rockfish representing the next largest portions of mid-water trawl catch by weight. Over the 2023/24 fishery, Chinook salmon bycatch in the WCVI Region was 14,689, representing 67% of total Chinook salmon bycatch (Table 4, see Appendix E for salmon bycatch by groundfish management area and Appendix F for bycatch by PFMA).

During the fall of 2023 and winter of 2024, Chinook salmon bycatch occurred primarily in the Strait of Georgia where a small number of vessels were targeting a resident stock of Pacific Hake. Total Chinook

salmon bycatch in this region was 2,798 during the 2023/24 fishery. Total bycatch in the Queen Charlotte Strait and Johnstone Strait region was significantly reduced compared to the previous year (Figure 2) following closure of portions of PFMA 12 to mid-water trawling beginning on November 15, 2023. A total of 2,607 Chinook salmon were caught in this region during the 2023/24 fishery from vessels freezing and processing catch at sea that were targeting Walleye Pollock.

Rates of Chinook salmon bycatch, as estimated using Chinook salmon CPUE by tow and trip, were variable among regions and primary catch species. For catch landed frozen, where CPUE was estimated by tow, highest bycatch rates were observed when Walleye Pollock was the primary catch species with an average CPUE of 20.4 Chinook salmon/hour across 219 tows using mid-water trawl gear. By comparison, average CPUE for vessels landing frozen catch was 3.0 and 2.8 Chinook salmon/hour when Pacific Hake and Yellowtail Rockfish were the primary catch species, respectively (Figure 3).

For catch landed fresh, where CPUE from midwater trawling was estimated at the trip level, higher CPUEs were associated with trips landing Pacific Hake with an average CPUE of 6.1 salmon/hour across 96 trips (Figure 4). These trips mostly occurred in the Strait of Georgia during the fall. Many trips landing fresh catch were not associated with a primary landed species (i.e. they had mixed catch) and had lower CPUE for salmon, with 164 trips having an average CPUE of 1.3 salmon/hour.

Stock Composition and CWT

Over the 2023 calendar year, 6,233 samples from individual Chinook salmon were collected and successfully analyzed to determine stock of origin, representing 24% of estimated Chinook salmon bycatch. Of these samples, 3,466 were assigned to stock of origin using GSI and 508 could be matched to parental origin using PBT. There were 2,259 CWTs successfully analyzed and matched to a release group by tag code. Analyzed samples covered all regions and time periods where Chinook salmon bycatch was observed (Figure 5).

Sampling rates for Chinook salmon bycatch were variable using CWT and PBT-GSI, however, most regions and time periods were represented with PBT-GSI sample sizes above 150 and CWT sample rates close to or above the target of 20% used in salmon-directed fisheries (Table 5). The CWT sampling rate exceeded the target of 20% in most strata during the 2023 calendar year, with the exception of bycatch landed fresh from the WCVI region and bycatch from July to December in the Strait of Georgia hake fishery. Sample rates in these strata were lower than the target due to the delayed implementation of sampling in WCVI and one large bycatch event in the Strait of Georgia that was not randomly selected for sampling.

Sample rates for PBT-GSI partitions when estimating stock composition varied between 6-50%, though generally exceeded 10% (Table 5). In most strata, PBT-GSI sample sizes were 150 or greater. While necessary sample sizes to achieve desired statistical power depend on a number of factors, a minimum sample size target of 150 GSI-PBT samples is commonly used to assess stock composition in strata for salmon-directed fisheries.

Stock Composition

Chinook salmon stock composition was variable among regions and time periods with the proportion of Canadian origin stocks in trawl salmon bycatch ranging from 14 - 83% across strata during the 2023 calendar year (Figure 6, Table 6). The proportion of Canadian origin stocks was highest in the Strait of Georgia region where it was 80 - 84% throughout the year. The mean estimated bycatch of all Canadian origin stocks was 10,817 across all strata, representing 41% of Chinook salmon for the 2023 calendar year (Table 7).

Among Canadian origin stocks, the Fraser Fall 4(1) SMU was the largest proportion of bycatch across all regions and time periods. Fraser Fall 4(1)s represented 6 - 53% of the total among strata and more than half of the Canadian proportion in every region except for the North Coast. The mean estimated bycatch of Fraser Fall 4(1) was 7,652 salmon, representing 71% of Canadian origin stocks. Uncertainty in estimates of Fraser Fall 4(1) catch from GSI assignment was minor among regions (Figure 7) with a 95% confidence interval of 7,634 – 7,669 for total catch.

The Lower Georgia Strait, Middle Georgia Strait, and Fraser Summer 4(1) SMUs were present at proportions greater than 10% in some strata, with mean estimated bycatch for these stocks of 907, 959, and 681 respectively. Other Canadian Chinook salmon SMUs that were detected included WCVI, Fraser Summer 5(2), Fraser Spring 5(2), Fraser Spring 4(2), Boundary Bay Fall 4(1), Mainland Inlet, Central Coast, Nass, and Skeena SMUs. Stock proportions and estimated catch for these SMUs were much smaller, with proportions of each SMU less than 3% in each strata and estimated bycatch less than 200.

CWT Indicator Stocks

Most CWT recoveries were from stocks of US origin, with 1,863 out of the 2,259 CWTs observed in 2023 belonging to stocks from the US West Coast. Of the remaining 396 CWTs observed, 355 belonged to the Fraser Fall 4(1) SMU, which includes the Chilliwack and Harrison CWT indicator stocks. After expanding for sample rates, the total estimated CWT recoveries for Chilliwack and Harrison exploitation rate indicator stocks were 139.8 and 171.9, respectively (Table 8). CWTs from these stocks were caught in all regions but most recoveries occurred in the Queen Charlotte Strait & Johnstone Strait and WCVI regions.

Other Canadian CWT indicator stocks had much lower total estimated recoveries. Cowichan River, Big Qualicum River, and Nicola River had total estimated recoveries of 13.7, 5, and 5.2 CWTs respectively. There were 8.3 total CWT recoveries of the Similkameen River stock, which originates from the US just downstream of the Canadian Okanagan River. Recoveries from this stock are reported as a proxy for the Canadian Okanagan Chinook stock that returns at much lower abundances.

PBT Age Composition

Observed PBTs among Chinook salmon in 2023 belonged primarily to the Fraser Fall 4(1) and Middle Georgia Strait SMUs, which respectively represented 362 and 121 out of the total of 520 PBT samples (Table 9). Most PBT samples represented fish from the 2020 brood year; age 3 fish represented 69% of PBT samples across all stocks. Although there were differences in PBT age composition by stock and region (Table 10), age 2 fish were generally the next most abundant age class and represented 20% of PBT samples across all stocks, while age 4 fish were 10% of all PBT samples.

DISCUSSION

This report provides results from the first full year of the enhanced salmon bycatch monitoring program for the Pacific Region groundfish trawl fishery, building upon preliminary results provided in Lagasse et al 2024. Total bycatch of Pacific salmon, estimated from independent fisheries monitoring programs, remained higher than historical levels during the 2023/24 trawl fishery with a total catch of 28,145, consisting mostly of Chinook salmon. The majority of Chinook salmon catch consisted of US origin stocks, with Canadian origin Chinook salmon bycatch mostly belonging to the Fraser Fall 4(1) SMU.

Enhancements to reporting and monitoring of salmon bycatch are intended to inform management of the trawl fishery and provide a more thorough understanding of mortality sources from fisheries for Chinook salmon stocks of concern. Evaluating the impacts of bycatch in the trawl fishery in the context of

management and conservation objectives for Chinook salmon is complex, particularly given the multiple management agreements, plans, and policies that set out objectives related to Pacific salmon and their fisheries. In Canada and the US, salmon fisheries targeting Chinook salmon are managed according to the Pacific Salmon Treaty, which sets escapement targets for indicator stocks and determines allowable catch levels for certain fisheries intercepting stocks from both countries. Canadian fisheries are also managed to meet numerous domestic objectives, such as allocation among fisheries according to the salmon allocation policy, fisheries management objectives for stocks of concern, and supporting recovery of Southern Resident Killer Whales under the Species at Risk Act (DFO 2024b). Fisheries planning and decision making is increasingly shifting to co-management groups and collaborative governance structures with Indigenous groups, such as the Fraser Salmon Management Board. Therefore, catch estimates in this report may be considered from different perspectives when evaluating risk and impacts.

The simplest metric for evaluating the impact of trawl bycatch on Chinook salmon would be to compare total catch in terms of numbers of fish, which was estimated at 26,091 Chinook salmon for the groundfish trawl fishery during the 2023 calendar year (as opposed to the trawl fishery year). By comparison, the preliminary estimate of total mortality from Canadian salmon fisheries by the CTC was 631,425, including incidental mortality (CTC 2024). However, this coarse comparison does not include area or stock-specific considerations that are often important for management of salmon fisheries and motivated the development of the enhanced salmon bycatch monitoring program to collect stock composition and CWT information.

The 2023 calendar year was the first year in which representative stock composition and CWT recoveries could be estimated for Chinook salmon bycatch in the groundfish trawl fishery. Results clearly indicate that most bycatch of Chinook salmon originating from Canada belonged to the Fraser Fall 4(1) SMU, which includes the Harrison River and Chilliwack River indicator stocks. The Chilliwack River is an artificially established population transplanted from the Harrison River that does not have conservation objectives because it is not of natural origin. The Harrison River indicator stock represents the Lower Fraser River Ocean Fall designatable unit that was assessed as threatened by the Committee for the Status of Endangered Wildlife in Canada (COSEWIC) in 2018 and science advice recommends minimizing harm to the extent possible (DFO 2021). This indicator stock has an escapement objective of 75,100 under the Pacific Salmon Treaty, which was not met from 2019 to 2021 but was exceeded in 2022 and 2023 (CTC 2024). Due to the common ancestry of Chilliwack and Harrison River Chinook, GSI cannot accurately distinguish between them and catch estimates derived from stock composition are reported at the SMU level. Both populations have a CWT indicator stock, however, observed CWT recoveries are not directly scalable to total catch due to potential differences in tagging rates and proportions of wild versus enhanced fish.

Estimated bycatch of other Canadian stocks was much lower than Fraser Fall 4(1)s, but included stocks of conservation concern. Interior Fraser Chinook were detected including the Fraser Spring 4(2), Fraser Spring 5(2), and Fraser Summer 5(2) SMUs. These SMUs include designatable units that have been assessed as threatened and endangered by COSEWIC (COSEWIC 2018, 2020). Fisheries management objectives for these SMUs are to manage Canadian fisheries in a precautionary manner to allow as many fish to escape to spawn as possible (DFO 2024b). The bycatch of WCVI Chinook was estimated at just over 100 fish, while total abundance in 2023 exceeded 400,000 (Brown et al *in review*). The fisheries management objective for WCVI Chinook is to maintain Canadian fisheries within a 10% exploitation rate (DFO 2024b).

Stock composition and stock-specific catch information represent estimates with potential error related to sampling, stock identification, and analysis of stock composition. The sampling procedures developed for the enhanced monitoring program targeted 100% coverage of catch from vessels landing frozen catch and 25% coverage of catch from vessels landing catch fresh. By requiring mandatory retention of all catch and sub-sampling at the trip level any bias associated with selectivity of individual fish should be minimized. However, error may be introduced when aggregating fishing events into catch strata for estimation of stock composition. We grouped Chinook salmon bycatch into two catch types, four geographic regions, and two six-month time periods for analysis based on the resolution of fisheries catch information and availability of samples. We obtained adequate representation from GSI-PBT and CWT samples from most strata relative to our target sample rates, however, some strata were sampled below the target CWT sample rate of 20% and had patchy representation of fishing events because samples originated from just a few trips within a strata. For example, vessels landing fresh catch in the WCVI region were not sampled from April - May 2023, so stock composition in this stratum may be skewed towards catch from later in the sampling period. Chinook salmon stock composition can vary significantly across weeks and months, particularly during summer periods when stocks migrate through marine areas towards their natal streams at different times (Freshwater et al 2021). Thus, our aggregation of catch into half-year periods for estimating stock composition may not capture this variability.

Stock identification of individual fish was accomplished using CWT and GSI-PBT methods. The application of GSI has been demonstrated to be accurate for southern BC Chinook conservation units (Beacham et al. 2021), and we aggregated stock assignments by SMUs. Bootstrapping of GSI assignment probabilities suggests relatively small differences in catch estimates by stock due to uncertainty in GSI identification. For estimates of CWT indicator stock recoveries, bycatch does not represent Chinook salmon from the 2019 brood year because most stocks were not tagged during the Covid pandemic. Therefore, CWT information from catches in 2023 does not include age 4 fish. This may bias CWT recovery and stock composition estimates, although the effect on stock composition is expected to be minor because stock composition in each strata was more heavily weighted towards PBT-GSI samples which represent both wild and hatchery origin fish.

We reported on catches by stock without adjustments for adult equivalent mortality. In Chinook salmon fisheries, age composition is incorporated into exploitation rate analysis to more accurately represent the effect of harvest on productivity and spawner abundance. The CTC models adult equivalent mortalities when reporting on CWT-based exploitation rates to represent the numbers of fish of a given age that would, in the absence of fishing, leave the ocean and return to terminal areas to spawn (CTC 2019). Alaskan trawl fisheries have also estimated age equivalent mortalities using length frequency data and size-at-age models to more precisely evaluate stock-specific impacts (Ianelli and Stram 2015). The enhanced monitoring program's representation of age composition information is limited to stocks with CWT or PBT programs, which does not include all conservation units of Chinook salmon in southern British Columbia. Estimation of adult equivalent mortalities would also require modelling natural survival and maturation rates that may be difficult to accurately represent for trawl bycatch.

While we did not estimate adult equivalent mortality, available information from PBT samples suggests that 3 year olds represented the largest proportion of bycatch of Canadian origin Chinook salmon (Table 9), but that age was variable among stocks and regions (Table 10). Most SMUs were represented by sample sizes smaller than 10, therefore, our ability to draw inference on the age composition of trawl bycatch is mostly limited to the Fraser Fall 4(1) and Middle Georgia Strait SMUs that constituted the majority of PBT samples. Within these stocks, higher proportions of age 3 fish were observed in PBT

samples from the Queen Charlotte and Johnstone Strait and WCVI regions while a larger proportion of age 2 fish were observed in the Strait of Georgia, primarily during the fall and winter. This variability is undoubtedly influenced by seasonal shifts in stock composition and differences in marine life histories of Chinook salmon in southern BC (Weitkamp 2010; Freshwater et al. 2021), and suggests that caution should be used in extrapolating stock and age composition results among regions or years.

Although the total amount of Chinook salmon bycatch in the 2023/24 groundfish trawl fishery was similar to 2022/2023 and above historical averages, a new salmon bycatch management plan aimed at creating greater individual vessel incentives for salmon bycatch avoidance has been implemented for the 2024/25 groundfish trawl fishery. This plan includes a fleetwide total bycatch cap of 9,500 Chinook salmon for the groundfish trawl fleet, individual vessel bycatch caps (IVBCs), a transfer mechanism for IVBCs, and daily reporting of Chinook salmon bycatch to DFO and authorized fleet representatives (DFO 2024, p.290). The IVBC is initially capped at 10% of the fleet cap with higher allowances possible later in the season based on total Chinook bycatch and the available Chinook bycatch cap. Vessels that have caught Chinook salmon in excess of their IVBC will be prevented from hailing out until the vessel's overages have been reconciled. All individual vessel catches will count towards the fleet cap of 9,500 Chinook salmon. Therefore, the results in this report should be interpreted in the context of a changing management regime with the expectation that fleet behaviour and future catches will change in response. Enhancements to bycatch monitoring have only been implemented very recently, with this report focusing on just one year of catch monitoring that should not be considered representative of other time periods.

With the introduction of an annual Chinook salmon bycatch cap, total bycatch of Chinook salmon is expected to decline compared to amounts in this report for 2023/24. The enhanced salmon bycatch monitoring program will continue during the 2024/25 groundfish fishery to inform ongoing management of the trawl fishery.

ACKNOWLEDGEMENTS

This work is dedicated in memory of Brian Mose, whose advice and contributions were instrumental in the development and implementation of the enhanced salmon bycatch monitoring program.

The enhanced monitoring program was developed collaboratively by the trawl salmon bycatch working group that included representatives from DFO Fisheries Management, DFO Science, the groundfish trawl fishery, the Canadian Groundfish Research and Conservation Society, Archipelago Marine Research, and JO Thomas and Associates. We are thankful in particular for advice and contributions during the past year from Maureen Finn, Lindsay Richardson-Deranger, Rachel Rickaby, Mike Hawkshaw, Scott Buchanan, Sylvia Chow, Bruce Turris, Trevor Ruelle, and John Driscoll. Thanks to Malcolm Wyeth, Norm Olsen and Jonathan Faris for their work developing and maintaining the GFFOS database, and to Maria Cornthwaite for assisting with use of GFFOS data.

As with any fisheries monitoring and sampling program, collection of data relies upon the work and dedication of fishers, technicians, and field staff. We are grateful to trawl fishers, dockside monitors from Archipelago Marine Research, and lab technicians from JO Thomas and Associates for their work to count, collect, and analyze salmon bycatch.

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FIGURES

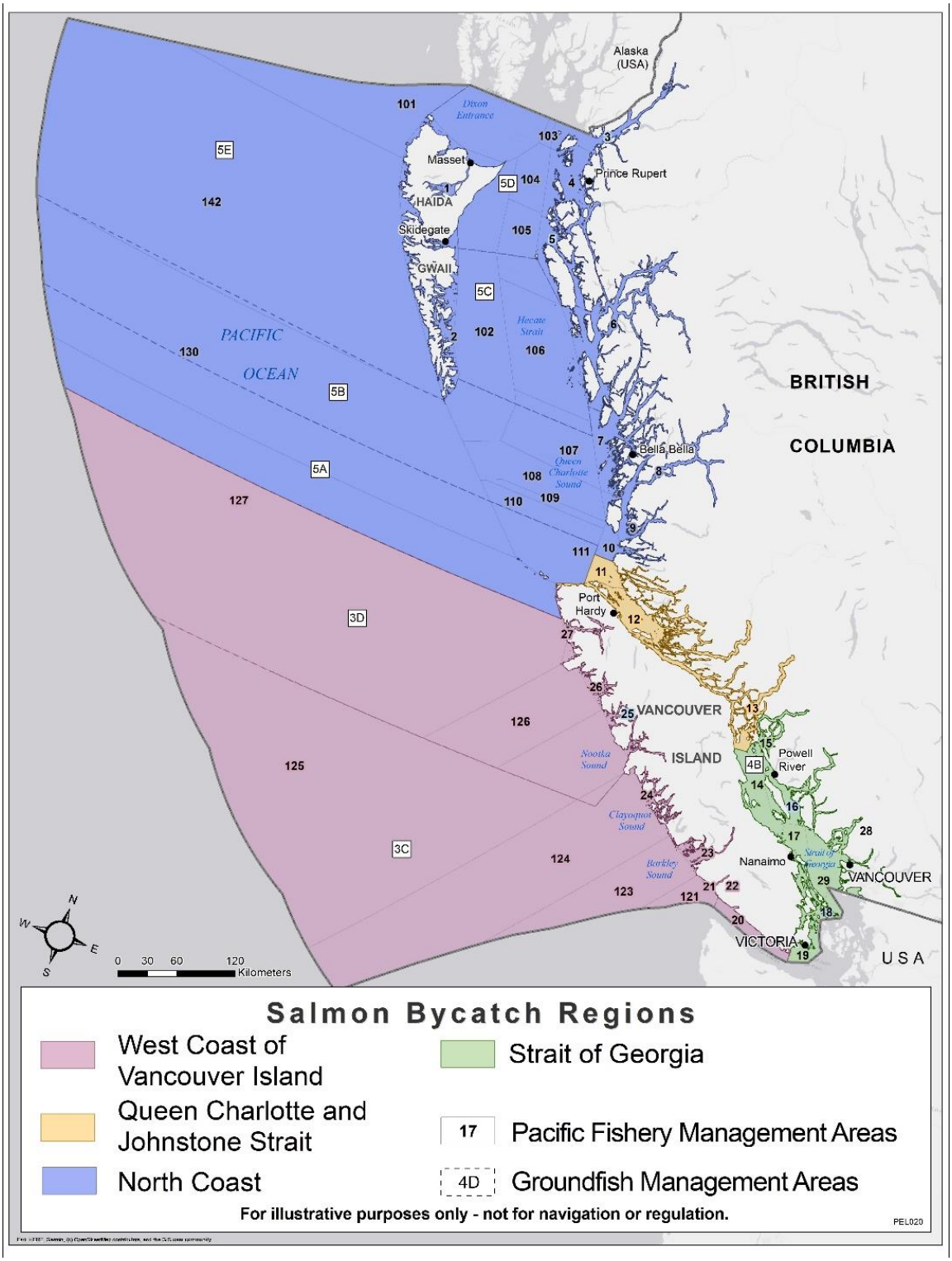

Figure 1 – Map of the British Columbia coast with regions used for stratifying salmon bycatch overlaid on groundfish management areas (dashed lines) and Pacific fishery management areas (PFMAs, solid lines).

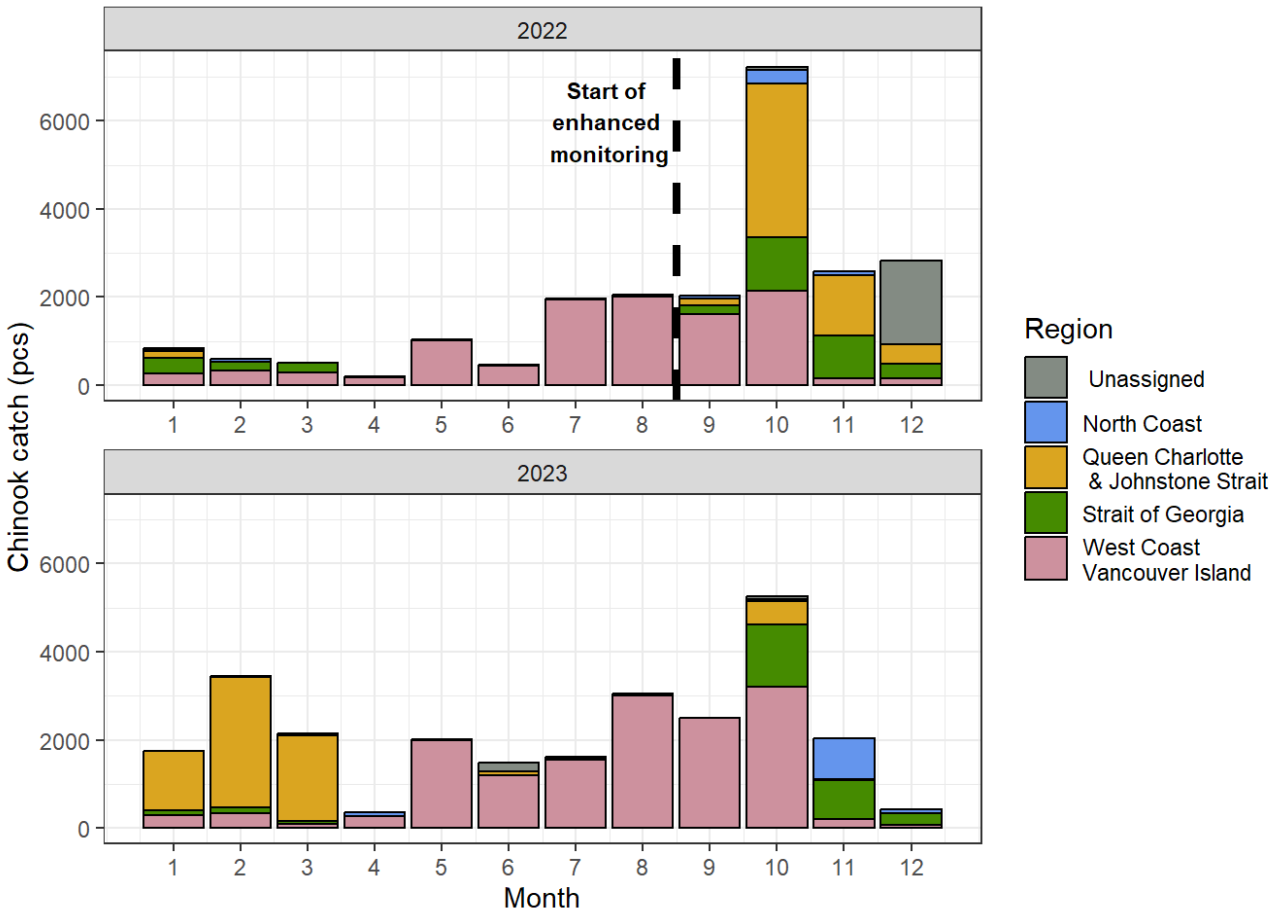

Figure 2 – Chinook salmon bycatch by month and region in the groundfish trawl fishery from 2022 to 2023. The enhanced monitoring program and changes to retention requirements began on September 22, 2022.

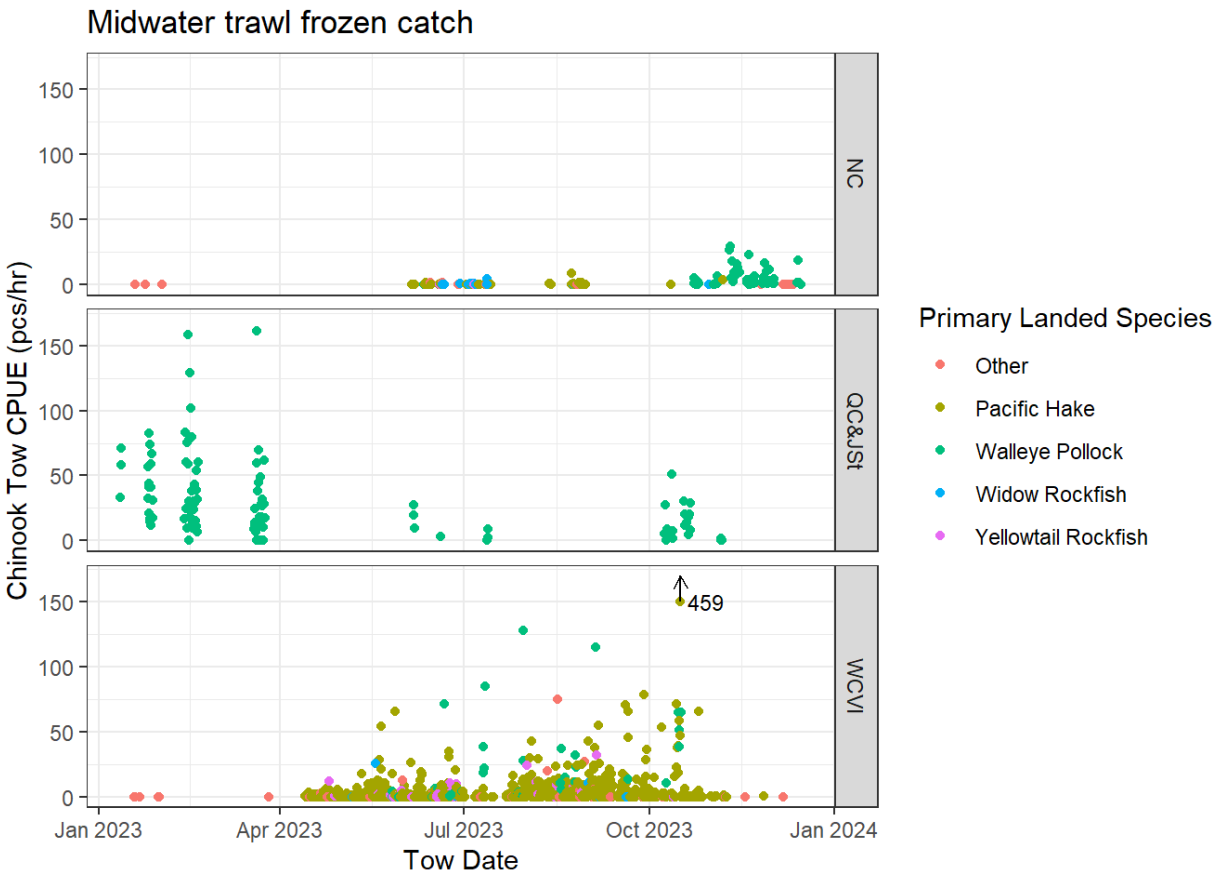

Figure 3 – Catch per unit effort (CPUE, pcs/hr) of Chinook salmon by tow from vessels freezing and processing catch at-sea for the 2023 calendar year. Only tows using midwater trawl gear are included. The primary landed species (colour) is determined based upon the species that constituted >50% of catch weight in a tow, with the Other category typically representing mixed catch. A CPUE value of 459 is labelled in the WCVI panel but not represented to scale on the y-axis.

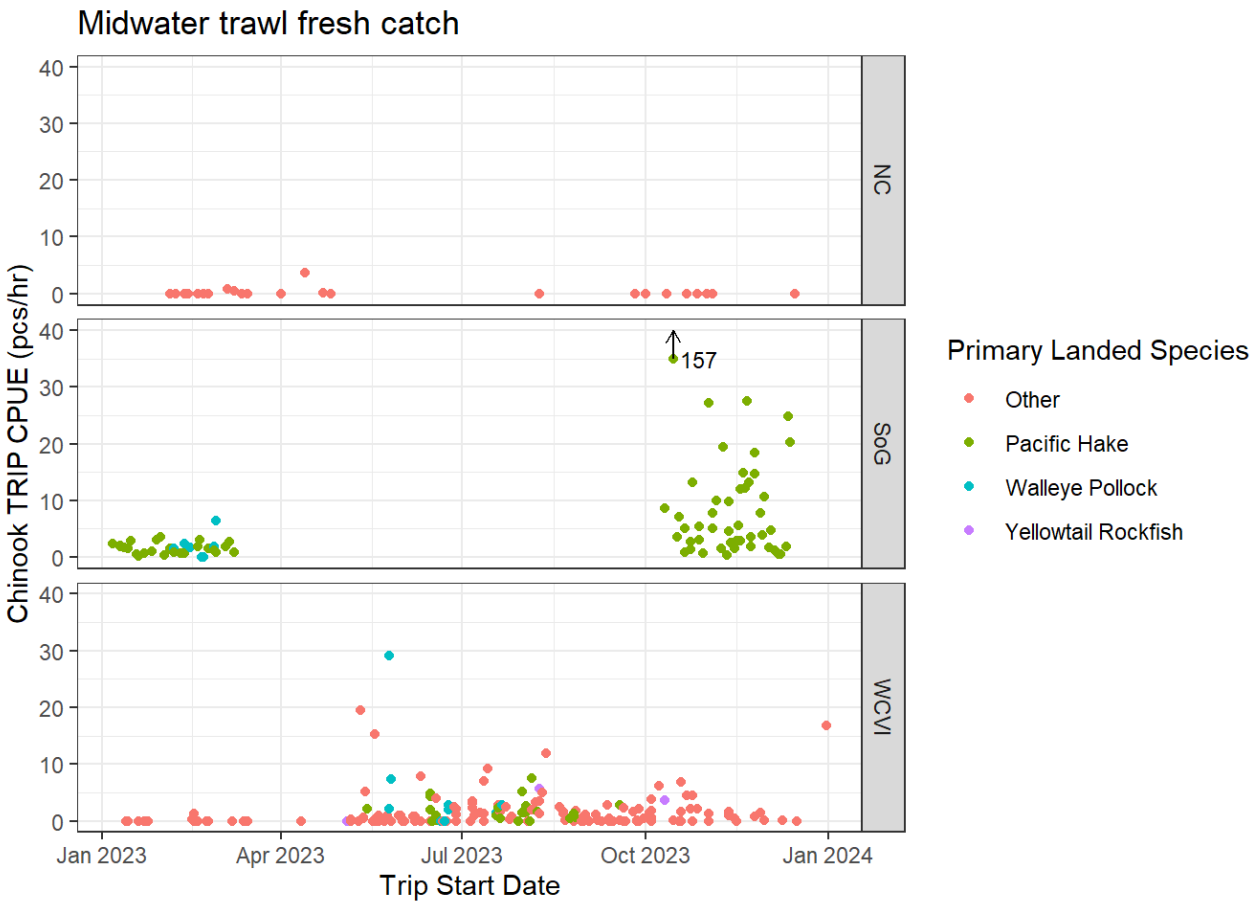

Figure 4 - Catch per unit effort (CPUE, pcs/hr) of Chinook salmon by trip from vessels landing catch fresh and unprocessed for the 2023 calendar year. Only tows using midwater trawl gear were included when estimating effort and catch by trip. The primary landed species (colour) is determined based upon the species that constituted >50% of catch weight in trip landings, with the Other category typically representing mixed catch. A CPUE value of 157 is labelled in the SoG panel but not represented to scale on the y-axis.

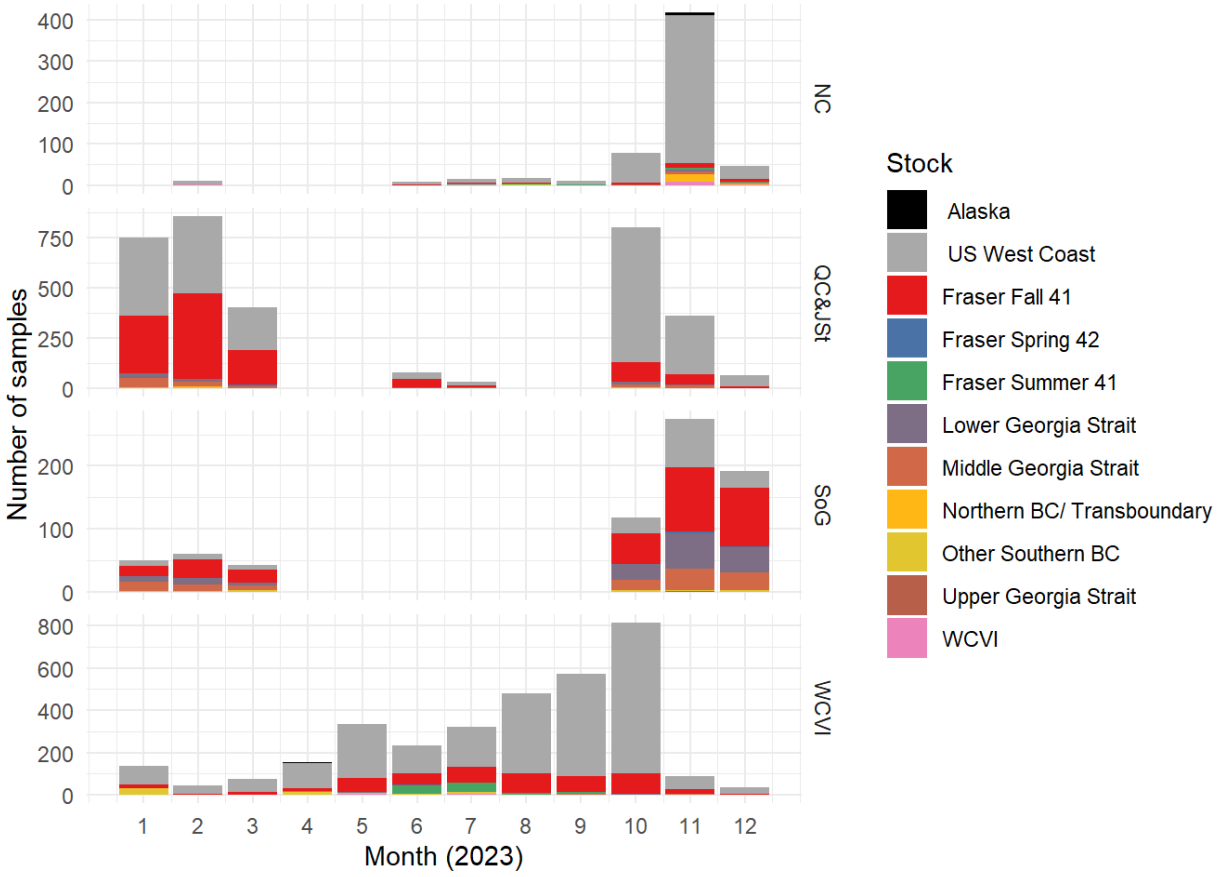

Figure 5 – Stock assignments of Chinook salmon bycatch samples from the trawl fishery in 2023 by catch region and month. Stock assignment from samples used either CWT, GSI, or PBT methods. The stock with the highest assignment probability from GSI analysis is shown in cases where there are multiple potential stocks of origin. The Other Southern BC group includes including Fraser Spring 5(2), Fraser Summer 5(2), Boundary Bay Fall 4(1), and Mainland Inlet SMUs, and the Northern BC/ Transboundary includes Nass, Skeena, Central Coast, Alsek, and Unuk SMUs.. Note the different y-axis scales between panels.

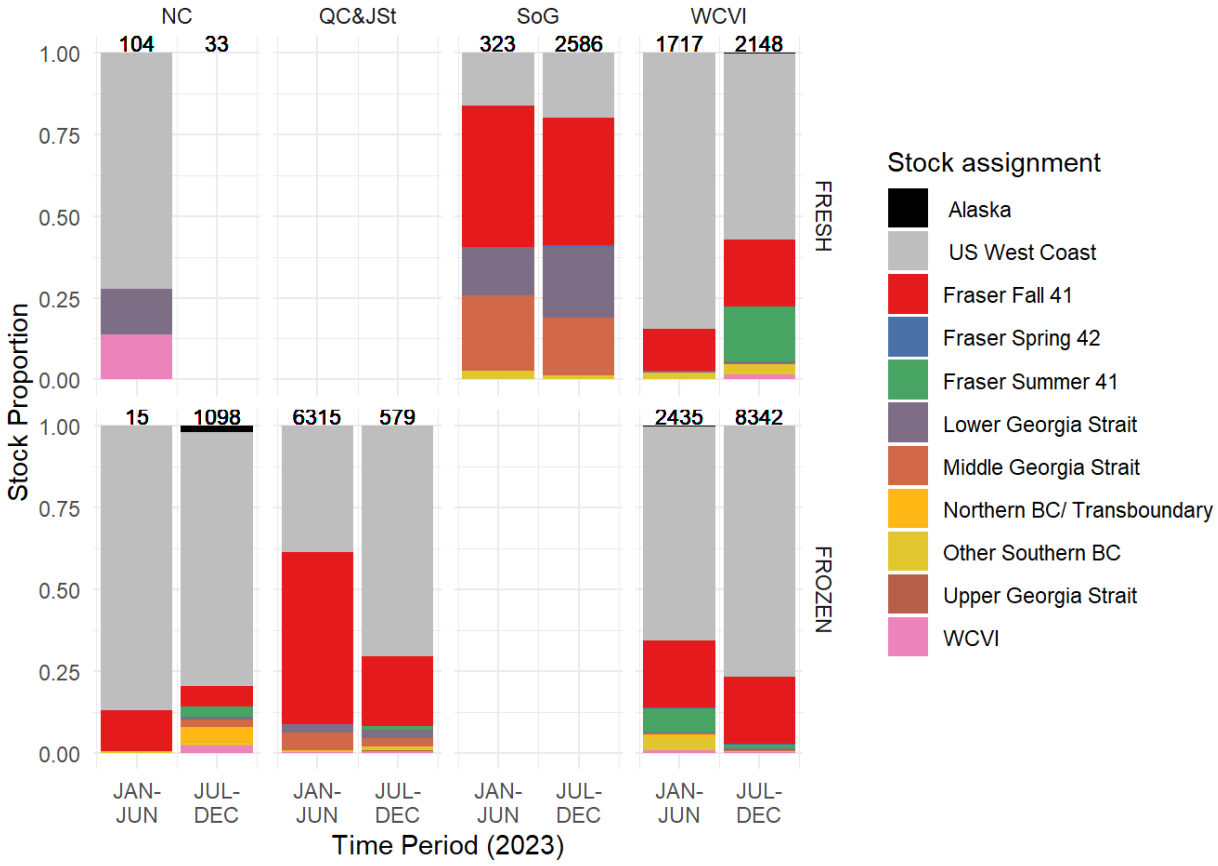

Figure 6 - Stock composition of Chinook salmon trawl bycatch by region, catch type (fresh or frozen), and time period (January-June or July-December 2023). Numbers above each bar represent the total catch of Chinook salmon in the stratum. The Other Southern BC group includes including Fraser Spring 5(2), Fraser Summer 5(2), Boundary Bay Fall 4(1), and Mainland Inlet SMUs, and the Northern BC/ Transboundary includes Nass, Skeena, Central Coast, Alsek, and Unuk SMUs.

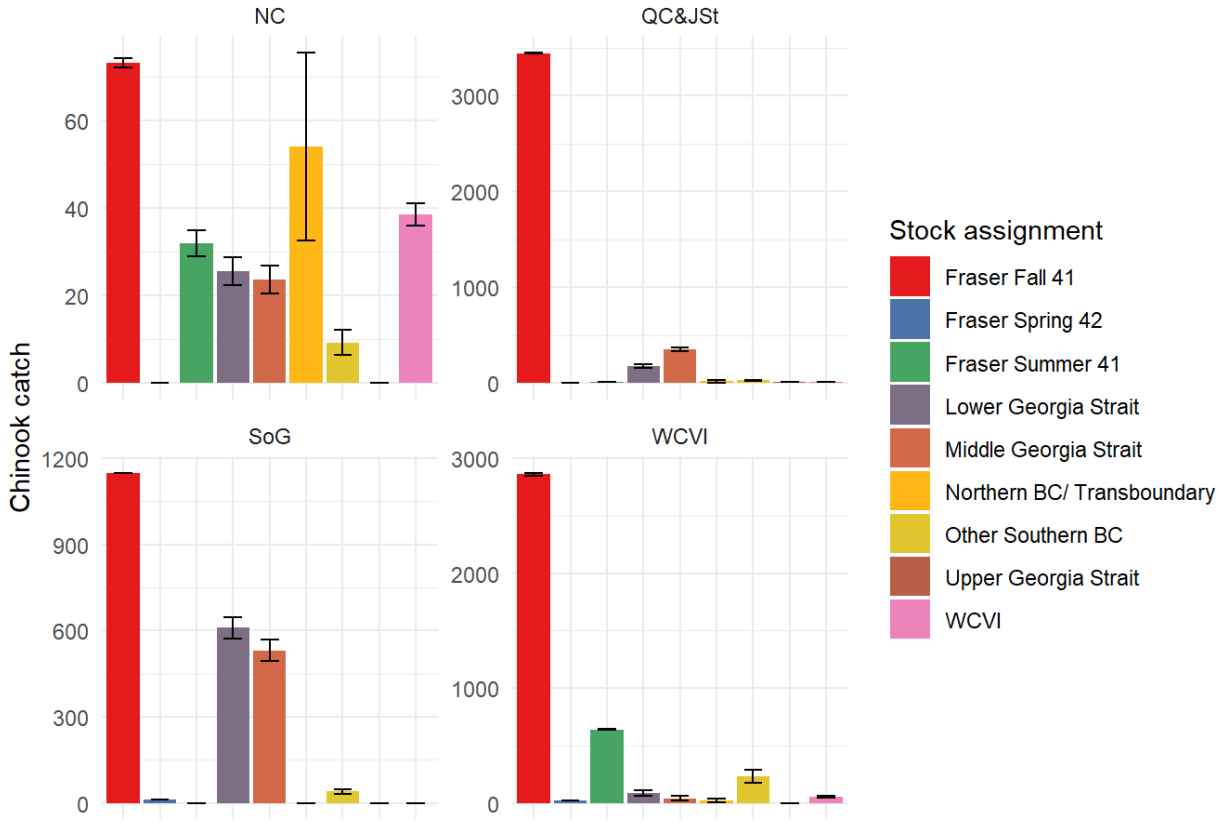

Figure 7 – Estimated Chinook salmon bycatch for Canadian SMUs by region including error bars representing 95% confidence intervals from GSI assignments. The Other Southern BC group includes Fraser Spring 5(2), Fraser Summer 5(2), Boundary Bay Fall 4(1), and Mainland Inlet SMUs, and the Northern BC/ Transboundary includes Nass, Skeena, Central Coast, Alsek, and Unuk SMUs. Note the different y-axis scales between panels.

TABLES

Table 1 – Summary of annual coastwide salmon catch (numbers of fish retained and released) by species, and landed catches (kg) in the groundfish trawl fishery reported by groundfish fishing year (February 21 of the starting year to February 20 of the subsequent year). Unidentified salmon catch was reported as Pacific salmon and trout and represents salmonids that could not be identified to species either by fisher or independent monitoring programs. Total landed catch is the landed weight of all species in the groundfish trawl fishery.

Groundfish Fishery	Total salmon (# of fish)	Chinook (# of fish)	Coho (# of fish)	Chum (# of fish)	Pink (# of fish)	Sockeye (# of fish)	Steelhead (# of fish)	Unidentified salmon (# of fish)	Total landed catch (kg)
2008/09	3,470	3,121	56	195	19	0	0	79	103,600,000
2009/10	9,611	8,628	95	191	566	32	0	99	85,280,000
2010/11	7,364	6,973	62	185	44	21	0	79	85,760,000
2011/12	11,193	9,808	242	457	328	22	0	336	90,780,000
2012/13	8,062	7,119	418	253	25	18	0	229	81,190,000
2013/14	4,813	3,034	292	218	700	16	7	553	90,790,000
2014/15	7,668	6,641	234	240	125	23	1	405	79,640,000
2015/16	7,645	6,319	193	794	122	80	4	137	80,470,000
2016/17	3,510	2,469	403	296	21	28	3	293	109,800,000
2017/18	8,265	7,320	113	394	157	39	1	242	124,300,000
2018/19	8,886	8,290	123	284	46	16	0	127	133,200,000
2019/20	7,680	6,776	199	294	80	59	10	272	132,200,000
2020/21	12,354	11,848	27	197	30	2	0	250	127,300,000
2021/22	11,627	9,635	695	708	572	17	0	0	98,350,000
2022/23	28,183	26,273	628	1,099	18	42	0	123	74,710,000
2023/24	28,145	21,696	501	1,952	3,894	30	0	72	61,590,000

Table 2 – Estimated annual coastwide salmon catch (numbers of fish retained and released) by species in the groundfish trawl fishery reported by calendar year.

Calendar year	Total salmon catch	Chinook catch	Coho catch	Chum catch	Pink catch	Sockeye catch	Steelhead catch	Unidentified salmon catch
2008	3,209	2,871	26	191	19	0	0	102
2009	9,646	8,666	121	178	566	32	0	83
2010	7,582	7,097	65	205	44	20	0	151
2011	11,081	9,753	242	456	325	23	0	282
2012	8,299	7,404	378	254	28	18	0	217
2013	4,681	2,898	289	212	701	14	1	567
2014	7,299	6,303	247	244	121	24	7	360
2015	8,171	6,731	211	795	119	81	4	234
2016	3,157	2,211	400	290	28	28	3	200
2017	6,839	5,944	129	394	93	39	1	240
2018	9,218	8,514	119	288	85	16	0	196
2019	7,828	6,945	146	292	96	55	9	294
2020	10,002	9,442	83	178	39	6	1	254
2021	14,270	12,255	697	729	572	17	0	0
2022	24,227	22,333	613	1,101	16	42	0	122
2023	31,941	26,091	511	1,344	3,892	30	0	73

Table 3 – Number of tows and salmon catch (numbers of fish retained and released) by species, region, and gear subtype for the 2023/24 groundfish fishery year (February 21, 2023 to February 20, 2024). Catch with unspecified gear subtype represent a small proportion of tow events and are summarized across all regions only. Regions are abbreviated as follows: NC = North Coast, QC&JST = Queen Charlotte & Johnstone Strait, SoG = Strait of Georgia, WCVI = West Coast Vancouver Island. Catch with Region UNK could not be associated to a single geographic Region.

Gear subtype	Region	Number of tows	Total salmon catch	Chinook catch	Coho catch	Chum catch	Pink catch	Sockeye catch	Unidentified salmon catch
Bottom Trawl	TOTAL	5,411	1,067	1,004	3	26	29	1	4
	NC	2,913	71	36	3	17	14	1	0
	QC&JSt	14	0	0	0	0	0	0	0
	SoG	777	0	0	0	0	0	0	0
	UNK	117	4	4	0	0	0	0	0
	WCVI	1,590	992	964	0	9	15	0	4
Midwater Trawl	TOTAL	3,012	26,795	20,470	489	1,879	3,865	29	63
	NC	357	1,310	1,199	2	69	26	0	14
	QC&JSt	60	2,620	2,607	0	10	2	0	1
	SoG	264	2,840	2,786	54	0	0	0	0
	UNK	27	282	274	3	3	2	0	0
	WCVI	2,304	19,743	13,604	430	1,797	3,835	29	48
Unspecified	TOTAL	118	283	222	9	47	0	0	5

Table 4 – Total salmon catch (numbers of fish retained and released) by species, region, and catch type for the 2023/24 groundfish fishery year (February 21, 2023 to February 20, 2024). Regions are abbreviated as follows: NC = North Coast, QC&JST = Queen Charlotte & Johnstone Strait, SoG = Strait of Georgia, WCVI = West Coast Vancouver Island. Catch with Region UNK could not be associated to a single geographic Region.

Region	Catch type	Total salmon catch	Chinook catch	Coho catch	Chum catch	Pink catch	Sockeye catch	Unidentified salmon catch
NC	FRESH	296	142	5	120	14	1	14
	FROZEN	1,152	1,111	2	13	26	0	0
QC&JSt	FRESH	0	0	0	0	0	0	0
	FROZEN	2,620	2,607	0	10	2	0	1
SoG	FRESH	2,852	2,798	54	0	0	0	0
	FROZEN	0	0	0	0	0	0	0
UNK	FRESH	97	92	2	3	0	0	0
	FROZEN	262	257	3	0	2	0	0
WCVI	FRESH	4,152	3,874	49	141	22	13	53
	FROZEN	16,714	10,815	386	1,665	3,828	16	4
TOTAL	FRESH	7,397	6,906	110	264	36	14	67
	FROZEN	20,748	14,790	391	1,688	3,858	16	5

Table 5 – Summary of Chinook catch (numbers of fish), sample sizes of CWTs and PBT-GSI, and sample rates for CWT and stock composition analysis during the 2023 calendar year. Catch was stratified by region, catch type, and bi-annual time periods for estimation of sample rates. The CWT sample rate is equal to the proportion of Chinook catch that had heads collected and scanned for CWTs, while the PBT-GSI sample rate is the number of successfully analyzed PBT-GSI samples within the PBT-GSI proportion of catch.

					CWT Analysis			Stock Composition Analysis			
Region	Catch Type	Time Period	Chinook catch	Chinook sampled (# heads collected)	CWT Sample Rate	# CWTs observed	# Canadian CWTs	CWT Proportion	PBT-GSI Proportion	# PBT-GSI analyzed	PBT-GSI Sample Rate
NC	FRESH	JAN-JUN	104	24	23%	4	0	17%	83%	6	6%
		JUL-DEC	33	0	0%	0	0			0	0%
	FROZEN	JAN-JUN	15	11	73%	1	0	9%	91%	7	50%
		JUL-DEC	1,098	1,090	99%	159	6	15%	85%	306	33%
QC&JSt	FROZEN	JAN-JUN	6,315	6,315	100%	763	181	12%	88%	1282	23%
		JUL-DEC	579	579	100%	103	9	18%	82%	232	49%
SoG	FRESH	JAN-JUN	323	176	55%	9	6	5%	95%	149	48%
		JUL-DEC	2,586	345	13%	0	0	0%	100%	259	10%
UNK	FRESH	JAN-JUN	13	0	0%	0	0			0	0%
		JUL-DEC	86	0	0%	0	0			0	0%
	FROZEN	JAN-JUN	264	264	100%	23	5	9%	91%	42	17%
		JUL-DEC	30	30	100%	6	0	20%	80%	0	0%
WCVI	FRESH	JAN-JUN	1,720	258	15%	37	3	14%	86%	151	9%
		JUL-DEC	2,148	309	14%	3	0	1%	99%	254	12%
	FROZEN	JAN-JUN	2,435	2,264	93%	218	23	10%	90%	496	22%
		JUL-DEC	8,342	8,167	98%	933	82	11%	89%	816	11%

Table 6 – Stock composition of Chinook salmon stock management units during the 2023 calendar year across region, catch type, and half-year time strata. Stock proportions are estimated using weighted proportions from CWT and PBT-GSI samples and values shown represent mean estimates from bootstrapping GSI assignment probabilities.

Catch region	Catch type	Time period	Chinook catch	% Cana-dian	Fraser Fall 4(1)	Lower Georgia Strait	Middle Georgia Strait	Upper Georgia Strait	WCVI	Fraser Summer 4(1)	Fraser Summer 5(2)	Fraser Spring 5(2)	Fraser Spring 4(2)	Boundary Bay Fall 4(1)	Mainland Inlet	North Coast[a]	Trans-boundary[b]
NC	FRESH	JAN-JUN	104	28%	0.0%	13.9%	0.0%	0.0%	13.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
		JUL-DEC	33	0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	FROZEN	JAN-JUN	15	13%	12.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	0.0%	0.0%	0.0%
		JUL-DEC	1098	27%	6.5%	1.0%	2.1%	0.0%	2.2%	2.9%	0.8%	0.0%	0.0%	0.0%	0.0%	3.1%	2.3%
QC&JSt	FROZEN	JAN-JUN	6315	62%	52.6%	2.5%	5.3%	0.1%	0.2%	0.1%	0.1%	0.0%	0.0%	0.0%	0.2%	0.2%	0.0%
		JUL-DEC	579	30%	21.4%	2.7%	2.6%	0.4%	0.4%	1.1%	0.7%	0.0%	0.0%	0.0%	0.4%	0.0%	0.0%
SoG	FRESH	JAN-JUN	323	84%	43.4%	14.8%	22.9%	0.0%	0.0%	0.0%	0.7%	0.7%	0.0%	0.0%	0.0%	0.0%	0.0%
		JUL-DEC	2586	80%	39.0%	21.7%	17.7%	0.0%	0.0%	0.0%	1.2%	0.0%	0.4%	0.0%	0.0%	0.0%	0.0%
UNK	FRESH	JAN-JUN	13														
		JUL-DEC	86														
	FROZEN	JAN-JUN	264	51%	44.7%	4.2%	2.2%	0.0%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
		JUL-DEC	30		3.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
WCVI	FRESH	JAN-JUN	1720	16%	12.8%	0.5%	0.2%	0.0%	0.0%	0.0%	0.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
		JUL-DEC	2148	45%	20.4%	0.6%	0.4%	0.0%	1.6%	16.7%	2.1%	0.1%	0.0%	0.3%	0.0%	0.0%	0.0%
	FROZEN	JAN-JUN	2435	35%	20.3%	0.4%	0.3%	0.0%	0.7%	7.4%	1.8%	1.3%	0.3%	0.0%	0.0%	0.5%	0.4%
		JUL-DEC	8342	23%	20.5%	0.7%	0.2%	0.0%	0.0%	1.2%	0.0%	0.0%	0.1%	0.2%	0.0%	0.0%	0.0%

[a] Includes Central Coast, Skeena, and Nass SMUs

[b] Includes Alsek, Unuk, Taku, and Stikine SMUs

Table 7 – Estimates of Chinook salmon stock management unit bycatch by region and catch type in the groundfish trawl fishery during the 2023 calendar year. Lower and upper 95% confidence intervals are included for total catches by stock using results from bootstrapping GSI assignment probabilities.

Region	Catch Type	Chinook catch	Canadian stocks catch	Fraser Fall 4(1)	Lower Georgia Strait	Middle Georgia Strait	Upper Georgia Strait	WCVI	Fraser Summer 4(1)	Fraser Summer 5(2)	Fraser Spring 5(2)	Fraser Spring 4(2)	Boundary Bay Fall 4(1)	Mainland Inlet	North Coast[a]	Trans-boundary[b]
NC	FRESH	137	29	0	14	0	0	14	0	0	0	0	0	0	0	0
	FROZEN	1,113	227	73	11	24	0	24	32	9	0	0	0	0	34	20
QC&JSt	FRESH	0	0												0	0
	FROZEN	6,894	4,047	3,446	174	351	9	12	10	8	0	2	0	18	17	0
SoG	FRESH	2,909	2,339	1,149	610	531	0	0	0	32	2	10	1	0	0	0
	FROZEN	0	0												0	0
UNK	FRESH	99	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	FROZEN	294	137	119	11	6	0	1	0	0	0	0	0	0	0	0
WCVI	FRESH	3,868	1,183	658	21	12	0	33	358	56	1	0	7	0	0	0
	FROZEN	10,777	2,760	2,206	63	27	0	18	280	46	33	17	14	0	13	4
	Lower 95%		10,407	7633	822	869	9	94	674	135	20	29	0	12	33	11
	Total (mean)	**26,091**	**10,723**	**7,651**	**905**	**950**	**9**	**103**	**681**	**152**	**36**	**29**	**22**	**18**	**65**	**24**
	Upper 95%		11,048	7670	987	1032	9	112	687	168	53	29	47	23	99	41

[a] Includes Central Coast, Skeena, and Nass SMUs

[b] Includes Alsek, Unuk, Taku, and Stikine SMUs

Table 8 – Estimates of CWT recoveries of Canadian exploitation rate indicator stocks in the Groundfish Trawl Fishery during the 2023 calendar year by region and catch type. CWT estimates are calculated by multiplying the observed number of CWTs by the inverse of the sample rate, with sample rates calculated for each combination of region, catch type, and half-year period.

Canadian CWT stock codes are as follows: CHI = Chilliwack River; HAR = Harrison River; BQR = Big Qualicum River; COW = Cowichan River; NIC = Nicola River; RBT = Robertson Creek; PPS = Puntledge River; QUI = Quinsam River. The Similkameen River (SMK) US CWT stock is included as a proxy for Okanagan Chinook.

						Estimated CWT Recoveries By Indicator Stock								
Region	**Catch Type**	**Chinook catch**	**Chinook sampled**	**# CWTs observed**	**CWT Sample Rate**	**CHI**	**HAR**	**BQR**	**COW**	**NIC**	**RBT**	**PPS**	**QUI**	**SMK**
NC	FRESH	137	24	4	0.18	0	0	0	0	0	0	0	0	4.3
	FROZEN	1,113	1,101	160	0.99	1	3	0	0	0	2	0	0	0
QC&JSt	FRESH	0	0	0		0	0	0	0	0	0	0	0	0
	FROZEN	6,894	6,894	866	1.00	68	102	5	10	2	0	1	2	2
SoG	FRESH	2,909	521	9	0.18	1.8	5.5	0	3.7	0	0	0	0	0
	FROZEN	0	0	0										
UNK	FRESH	99	0	0	0	0	0	0	0	0	0	0	0	0
	FROZEN	294	294	29	1.00	3	2	0	0	0	0	0	0	0
WCVI	FRESH	3,868	567	40	0.15	13.3	6.7	0	0	0	0	0	0	0
	FROZEN	10,777	10,431	1,151	0.97	52.7	52.7	0	0	3.2	0	0	0	2
TOTAL		26,091	19,832	2,259		139.8	171.9	5	13.7	5.2	2	1	2	8.3

Table 9 – Age composition of Canadian stock management units from PBT samples from the 2023 calendar year. Salmon age is calculated by subtracting the year a fish was caught from the brood year. The number of CWTs observed is shown but CWT age composition is not provided due to expected bias because age 4 fish are not represented.

			PBT age composition			
Stock Management Unit	**# CWTs**	**# PBTs**	**Age 2**	**Age 3**	**Age 4**	**Age 5**
Central Coast	2	4	25%	75%	0%	0%
Fall 41 Boundary Bay	1	1	0%	100%	0%	0%
Fraser Fall 41	355	362	16%	73%	11%	0%
Fraser Spring 42	5	0	0%	0%	0%	0%
Fraser Summer 52	2	1	0%	100%	0%	0%
Lower Georgia Strait	12	9	11%	67%	22%	0%
Middle Georgia Strait	10	121	33%	63%	3%	1%
Upper Georgia Strait	3	0				
WCVI	4	12	8%	25%	67%	0%

Table 10 – Age composition of PBT samples from groundfish trawl bycatch for the 2023 calendar year by stock management unit and region. Only region and stock combinations with four or more PBT samples are included.

Stock Management Unit	Conservation Unit	Region	# PBT	Age 2	Age 3	Age 4
Central Coast	NORTH AND CENTRAL COAST-EARLY TIMING	NC	4	0.25	0.75	0
Fraser Fall 41	LOWER FRASER RIVER_FA_0.3	NC	4	0.25	0.5	0.25
		QC&JSt	186	0.04	0.9	0.06
		SoG	55	0.42	0.4	0.18
		WCVI	111	0.23	0.61	0.15
Lower Georgia Strait	EAST VANCOUVER ISLAND-NANAIMO AND CHEMAINUS_FA_0.X	QC&JSt	4	0	1	0
		SoG	4	0.25	0.5	0.25
Middle Georgia Strait	EAST VANCOUVER ISLAND-QUALICUM AND PUNTLEDGE_FA_0.X	NC	5	1	0	0
		QC&JSt	61	0.1	0.89	0
		SoG	50	0.56	0.36	0.08
WCVI	WEST VANCOUVER ISLAND-SOUTH_FA_0.X	WCVI	7	0	0	1

Appendix A - 2023/24 Option A Groundfish Trawl Fleet Enhanced Salmon Monitoring, Bycatch Reporting & Biological Sampling Program Requirements

Introduction

Program requirements were developed in 2021 by DFO in consultation with the Groundfish Trawl Salmon Bycatch Technical Working Group with representatives from the GTAC, and dockside monitoring service providers. The requirements apply to all salmon bycatch, including steelhead.

A pilot program for the groundfish trawl fleet was conducted on the F/V Pacific Legacy No. 1 between September 2021 and February 2022. A second program involving the option A fleet was conducted September 2022 to February 2023. Lessons learned from both programs have informed sampling procedures and further development of the monitoring program.

Vessels Freezing Catch at Sea

Changes starting July 1, 2023 for <u>Receiving Tank Vessels (RTVs) freezing product at sea:</u>

- Head cuts are smaller – they no longer include the collar, but must include the operculum
- Record all salmon heads in the at-sea observer logbook as "retained", with utilization "sampled fish"

<u>Vessel Requirements</u>

1. For each tow,
    a. Remove the heads from all salmon bycatch according to sampling instructions.
    b. Package all heads into bags by tow. Do not mix samples from separate tows.
    c. Using TOW bag labels in sequence, record the vessel name, packing date and time, and tow # using pencil, on a TOW bag label.
    d. Put a completed TOW bag label into each bag and seal with a zip tie.
    e. In the at-sea observer logbook:
        - Record the total retained pieces and round weights of all salmon by species, and record as retained, with utilization "sampled fish"
        - If species cannot be determined, record as "salmonids (106)".
2. Freeze bags until delivery.
3. Record the estimated number of salmon heads retained during the trip in the comments of the hail in the Trawler application for each trip.
4. Transfer all frozen samples in tow bags to the dockside monitor at the end of the offload.

Sampling supplies provided by the dockside monitor:

- Revised Option A Trawl RTV Salmon Head Sampling Instructions
- Bags for samples and zip ties
- TOW bag labels and pencils

Throughout the season, more supplies will be available from the dockside monitor. Please verify sufficient supply as part of your pre-departure checklist.

<u>AMR Dockside Monitor Procedures</u>

For all landings:

1. Receive all tow bags from the vessel.

2. Ask the vessel crew if they need a resupply of any items they are running low on.
3. Fill in the Groundfish Salmon Head DMP form using pencil.
4. Pack all tow bags into larger trip bags to consolidate the samples. If the vessel used large bags for tows there is no need to consolidate the tow bags, but each tow bag will need to be labelled with a TRIP bag label.
5. Record essential information for the landing on TRIP bag labels using pencil.
6. Take a digital photo of the first TRIP bag label used and the last TRIP bag label used to associate the TRIP label series used to the hail number.
7. Close all trip bags and attach a TRIP bag label to each bag using zip ties.
8. Create a record of each bag in the "tagged fish" form of the Trawler dockside monitor application noting the hail number and TRIP bag label number.
9. Coordinate cold storage and direct shipment of trip bags to the CWT lab in Vancouver or to DFO's Pacific Biological Station in Nanaimo.

Vessels Landing Fresh Product

Vessel Requirements

1. Retain all salmon bycatch.
2. In the at-sea observer logbook, record the total estimated retained pieces and weights of all salmon retained by species. If species cannot be determined, record as "salmonids (106)".
3. All salmon retained must be landed at the conclusion of each trip.

AMR Dockside Monitor Procedures

Dockside Monitors will be responsible for the collection of salmon heads from 25% of the landings. The dockside monitoring data management system will be used to randomly select vessels and notify dockside monitors which landings require salmon head sampling.

For all landings:

1. In the trawler platform, record the pieces and weights of all salmon by species.

For landings randomly selected for salmon head sampling:

1. Remove the heads from all Chinook, Coho and unknown species of salmon.
2. Package salmon heads into bags. Do not mix samples from separate landings.
3. Using TRIP bag labels in sequence, record essential information for the landing on TRIP bag labels using pencil.
4. Take a digital photo of the first TRIP bag label used and the last TRIP bag label used to associate the TRIP label series used to the hail number.
5. Close all trip bags and attach a TRIP bag label to each bag of heads using zip ties.
6. Fill in the Groundfish Salmon Head DMP form using pencil.
7. Create a record of each bag of salmon heads in the "tagged fish" form of the Trawler dockside monitor application noting the hail number and TRIP bag label number.
8. Coordinate storage or direct shipment of trip bags to the CWT lab in Vancouver or to DFO's Pacific Biological Station in Nanaimo.
9. Send all salmon bodies to offal after heads have been removed.

For landings not selected for salmon head sampling, send all salmon to offal.

Appendix B - Regions and Catch Strata for Reporting and Analysis

Table B1 – Strata variables for reporting, CWT analysis, and stock composition estimation.

Variable	Region	Catch Type	Period
Definition	Location of catch by tow (where available) or trip	Vessel type and method of sampling	Calendar half-year
Values	WCVI QC&JS SoG NC	Fresh Frozen	Jan-Jun 2023 Jul-Dec 2023

Table B2 – Correspondence between Regions and PFMAs and groundfish management areas. Regions were used to define strata for reporting, CWT analysis, and stock composition estimation.

Region	Abbreviation	Pacific Fishery Management Areas (PFMAs)	Groundfish Management Areas
West Coast Vancouver Island	WCVI	20 to 27, 121 to 126, 127-1 and 127-2	3C and 3D
Strait of Georgia	SoG	14 to 19, 28, 29	Portions of 4B
Queen Charlotte Strait & Johnstone Strait	QC&JSt	11, 12	Portions of 4B and 5A
North Coast	NC	3 to 10, 101 to 11, 127-3 and 127-4, 130, 142	5A, 5B, 5C, 5D, 5E
Unassigned	UN	Unknown or multiple PFMAs	Unknown or multiple areas

Appendix C - SMU-CU-Reporting Units Tables

Table C1 – PBT-GSI reporting units and corresponding CU and SMU assignments used for stock composition estimates in this report.

Reporting Unit	CU #	Conservation Unit (CU) name	Stock Management Unit (SMU)
DOCEE	36	Docee	Central Coast
RI	37	Rivers Inlet	Central Coast
WANN	38	Wannock	Central Coast
BCR-BENT	39	Bella Coola-Bentinck	Central Coast
DEAN	40	Dean River	Central Coast
NCC-lake	41	North and Central Coast-late timing	Central Coast
NCC-stream	42	North and Central Coast-early timing	Central Coast
BB	2	Boundary Bay_FA_0.3	Fall 41 Boundary Bay
LFR-fall	3	Lower Fraser River_FA_0.3	Fraser Fall 41
STh-BESS	16	South Thompson-Bessette Creek_SU_1.2	Fraser Spring 42
LTh	17	Lower Thompson_SP_1.2	Fraser Spring 42
MFR-spring	10	Middle Fraser River_SP_1.3	Fraser Spring 52
UFR-spring	12	Upper Fraser River_SP_1.3	Fraser Spring 52
NTh-spr	18	North Thompson_SP_1.3	Fraser Spring 52
LFR-spring	4	Lower Fraser River_SP_1.3	Fraser Spring 52
LFR-UPITT	5	Lower Fraser River-Upper Pitt_SU_1.3	Fraser Spring 52
FRCanyon	8	Middle Fraser-Fraser Canyon_SP_1.3	Fraser Spring 52
STh-0.3	13	South Thompson_SU_0.3	Fraser Summer 41
STh-SHUR	15	Shuswap River_SU_0.3	Fraser Summer 41
Maria	7	Maria Slough_SU_0.3	Fraser Summer 41
MFR-summer	11	Middle Fraser River_SU_1.3	Fraser Summer 52
STh-1.3	14	South Thompson_SU_1.3	Fraser Summer 52
NTh-sum	19	North Thompson_SU_1.3	Fraser Summer 52
LFR-summer	6	Lower Fraser River_SU_1.3	Fraser Summer 52
Portage	9	Middle Fraser River-Portage_FA_1.3	Fraser Summer 52
LFR-suppl	9006	Fraser-Cross-CU Supplementation Exclusion<<Bin>>	Fraser-Cross
HGN	43	Haida Gwaii-North	Haida Gwaii
CWCH-KOK	22	East Vancouver Island-Cowichan and Koksilah_FA_0.x	Lower Georgia Strait
EVI-fall	25	East Vancouver Island-Nanaimo and Chemainus_FA_0.x	Lower Georgia Strait
SMn-SFj	28	Southern Mainland-Southern Fjords_FA_0.x	Mainland Inlet
HOMATH	34	Homathko_SU_x.x	Mainland Inlet
KLINA	35	Klinaklini_SU_1.3	Mainland Inlet

Reporting Unit	CU #	Conservation Unit (CU) name	Stock Management Unit (SMU)
SMn-GStr	20	Southern Mainland-Georgia Strait_FA_0.x	Middle Georgia Strait
QP-fall	27	East Vancouver Island-Qualicum and Puntledge_FA_0.x	Middle Georgia Strait
EVIGStr-sum	83	East Vancouver Island-Georgia Strait_SU_0.3	Middle Georgia Strait
LNR-P	57	Portland Sound-Observatory Inlet-Lower Nass	Nass
UNR	58	Upper Nass	Nass
SKEst	45	Skeena Estuary	Skeena
ECST	46	Ecstall	Skeena
LSK	48	Lower Skeena	Skeena
KALUM-E	49	Kalum_early timing	Skeena
KALUM-L	50	Kalum_late timing	Skeena
MSK-LGLKS	53	Middle Skeena-large lakes	Skeena
MSK-M_S	54	Middle Skeena-mainstem tributaries	Skeena
MSK-UprBulk	55	Upper Bulkley River	Skeena
USK	56	Upper Skeena	Skeena
ZYM	80	Zymoetz	Skeena
SIC	81	Sicintine	Skeena
NEVI	29	East Vancouver Island-North_FA_0.x	Upper Georgia Strait
SWVI	31	West Vancouver Island-South_FA_0.x	WCVI
NoKy	32	West Vancouver Island-Nootka and Kyuquot_FA_0.x	WCVI
NWVI	33	West Vancouver Island-North_FA_0.x	WCVI

Table C2 – CWT exploitation rate indicator stock codes and corresponding Chinook salmon CUs and SMUs used for stock composition estimates. Canadian CWTs that did not belong to an indicator stock are not included in this table, but were matched to CU and SMU through a table provided by the Enhancement Planning and Assessment Database (EPAD). EPAD is maintained by the Salmonid Enhancement Program and is DFO's centralized repository for enhancement data in the Pacific Region.

Stock code	Stock name	Conservation Unit (CU)	Stock Management Unit (SMU)
SHU	Lower Shuswap	Shuswap River_SU_0.3	Fraser Summer 41
MSH	Middle Shuswap	Shuswap River_SU_0.3	Fraser Summer 41
HAR	Harrison River	Lower Fraser River_FA_0.3	Fraser Fall 41
RBT	Robertson Creek	West Vancouver Island-South_FA_0.x	WCVI
KLM	Kitsumkalum	Kalum_late timing	Skeena
PHI	Phillips River Fall	Southern Mainland-Southern Fjords_FA_0.x	Mainland Inlet
ATN	Atnarko	Bella Coola-Bentinck	Central Coast
BQR	Big Qualicum River	East Vancouver Island-Qualicum and Puntledge_FA_0.x	Middle Georgia Strait
KLY	Kitsumkalum	Kalum_late timing	Skeena
QUI	Quinsam River	East Vancouver Island-North_FA_0.x	Upper Georgia Strait
PPS	Puntledge River	East Vancouver Island-Georgia Strait_SU_0.3	Middle Georgia Strait
NIC	Nicola River	Lower Thompson_SP_1.2	Fraser Spring 42
COW	Cowichan River	East Vancouver Island-Cowichan and Koksilah_FA_0.x	Lower Georgia Strait
CHI	Chilliwack River	Fraser-Harrison Fall Transplant_FA_0.3	Fraser Fall 41

Appendix D - CWT Exploitation Rate Indicator Stocks used in Exploitation Rate Analysis

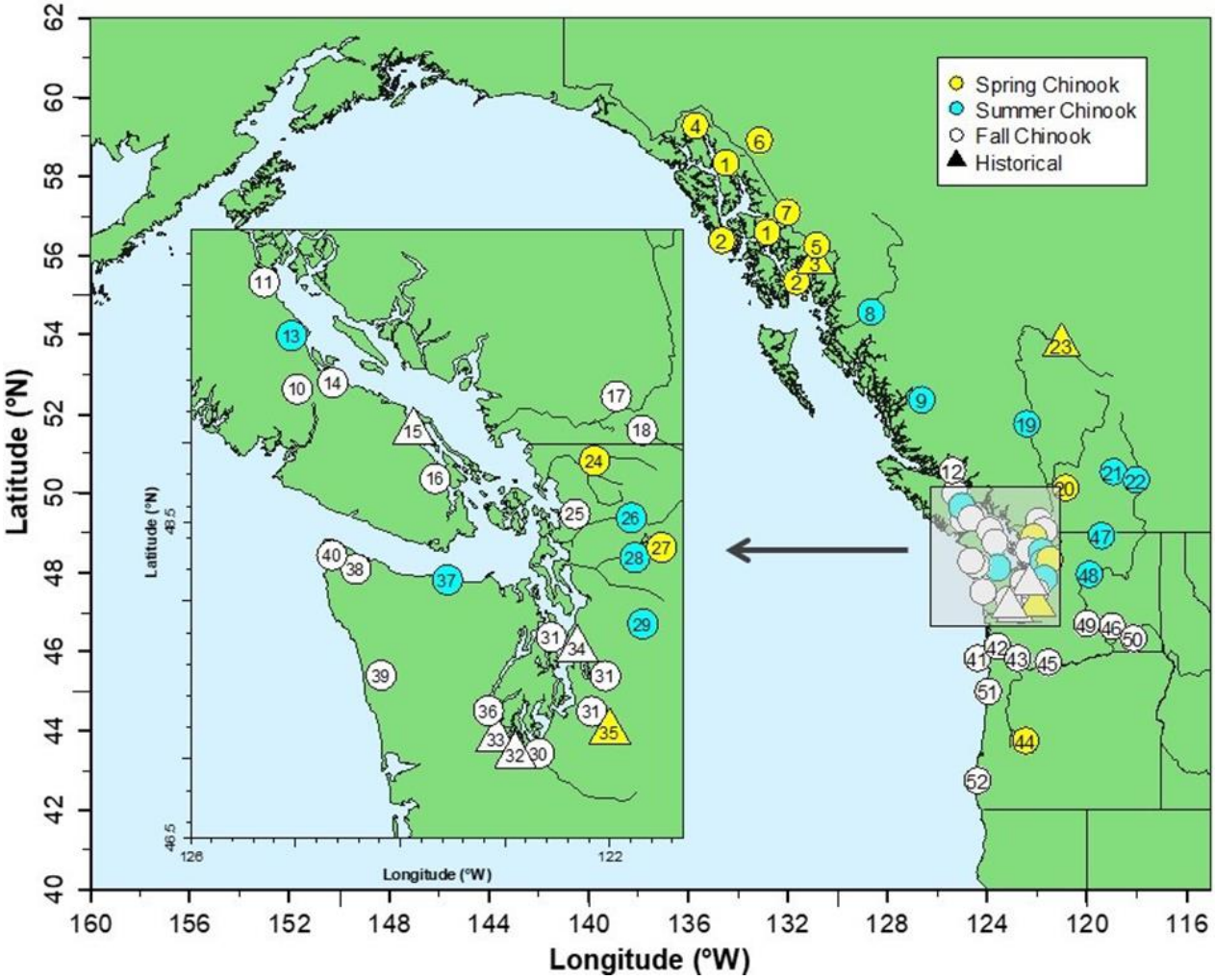

Figure D1—Geographical locations of historic and current Chinook salmon coded wire tag (CWT) exploitation rate indicator stocks. See Table D1 for the full stock names associated with each number. The southern B.C. and Puget Sound area, where concentration of the CWT indicators is greatest, is shown in the expanded view. Adapted from CTC 2023, Page 3

Table D1—Summary of current and historic (last tagged brood year in brackets) coded wire tag (CWT) exploitation rate indicator stocks, location, run type, and smolt age. Adapted from CTC 2023, Pages 4-5.

Stock/Area	Exploitation Rate Indicator Stock	Hatchery	Run Type	Smolt Age	Map No.	Status
Southeast Alaska	Northern Southeast Alaska (NSA)	Crystal Lake (ACI), Macaulay (AMC)	Spring	Age 1	1	Current
	Southern Southeast Alaska (SSA)	Herring Cove (AHC), Little Port Walter (ALP), Deer Mountain (ADM), Neets Bay (ANB)	Spring	Age 1	2	Current
Transboundary Rivers	Chickamin (CHM)	Wild	Spring	Age 1	3	Historical (2005)
	Chilkat (CHK)	Wild	Spring	Age 1	4	Current
	Unuk (UNU)	Wild	Spring	Age 1	5	Current
	Taku (TAK)	Wild	Spring	Age 1	6	Current
	Stikine (STI)	Wild	Spring	Age 1	7	Current
North/Central B.C.	Kitsumkalum (KLM)	Deep Creek	Summer	Age 1	8	Current
	Atnarko (ATN)	Snootli	Summer	Age 0	9	Current
WCVI	Robertson Creek (RBT)	Robertson Creek	Fall	Age 0	10	Current
Strait of Georgia	Quinsam (QUI)	Quinsam	Fall	Age 0	11	Current
	Phillips (PHI)	Gillard Pass	Summer/Fall	Age 0	12	Current
	Puntledge (PPS)	Puntledge	Summer	Age 0	13	Current
	Big Qualicum (BQR)	Big Qualicum	Fall	Age 0	14	Current
	Nanaimo (NAN)	Nanaimo	Fall	Age 0	15	Historical (2004)
	Cowichan (COW)[1]	Cowichan	Fall	Age 0	16	Current
Fraser River	Harrison (HAR)	Chehalis	Fall	Age 0	17	Current
	Chilliwack (CHI)[1]	Chilliwack	Fall	Age 0	18	Current
	Chilko (CKO)	Spius Creek, Chehalis	Summer	Age 1	19	In development
	Nicola (NIC)	Spius Creek	Spring	Age 1	20	Current
	Lower Shuswap (SHU)[1]	Shuswap Falls	Summer	Age 0	21	Current
	Middle Shuswap (MSH)	Shuswap Falls	Summer	Age 0	22	Current
	Dome (DOM)	Penny Creek	Spring	Age 1	23	Historical (2002)
North Puget Sound	Nooksack Spring Fingerling (NSF)	Kendall Creek	Spring	Age 0	24	Current
	Nooksack Spring Yearling (NKS)	Kendall Creek	Spring	Age 1		Historical (1996)
	Samish Fall Fingerling (SAM)[2]	Samish	Summer/Fall	Age 0	25	Current
	Skagit Summer Fingerling (SSF)	Marblemount	Summer	Age 0	26	Current
	Skagit Spring Fingerling (SKF)	Marblemount	Spring	Age 0	27	Current
	Skagit Spring Yearling (SKS)[2]	Marblemount	Spring	Age 1		Historical (2010)

Stock/Area	Exploitation Rate Indicator Stock	Hatchery	Run Type	Smolt Age	Map No.	Status
Central Puget Sound	Stillaguamish Fall Fingerling (STL)[3]	Stillaguamish Tribal	Summer/Fall	Age 0	28	Current
	Skykomish Summer Fingerling (SKY)[2,3]	Wallace	Summer/Fall	Age 0	29	Current
South Puget Sound	Nisqually Fall Fingerling (NIS)[2]	Clear Creek	Summer/Fall	Age 0	30	Current
	South Puget Sound Fall Fingerling (SPS)[2]	Soos/Grovers/Issaquah creeks	Summer/Fall	Age 0	31	Current
	South Puget Sound Fall Yearling (SPY)	Tumwater Falls	Summer/Fall	Age 1	32	Historical (2013)
	Squaxin Net Pens Fall (SQP)	Squaxin Net Pen			33	Historical (1997)
	University of Washington Accelerated (UWA)	University of Washington			34	Historical (1988)
	White River Spring Yearling (WRY)[4]	White River	Spring	Age 1	35	Historical (2015)
Hood Canal	George Adams Fall Fingerling (GAD)[2]	George Adams	Summer/Fall	Age 0	36	Current
Juan de Fuca	Elwha Fall Fingerling (ELW)	Lower Elwha	Summer/Fall	Age 0	37	Current
North Washington Coast	Hoko Fall Fingerling (HOK)	Hoko Makah National Hatchery	Fall	Age 0	38	Current
	Queets Fall Fingerling (QUE)	Wild, Salmon River (WA)	Fall	Age 0	39	Current
	Tsoo-Yess Fall Fingerling (SOO)[5]	Makah National Fish Hatchery	Fall	Age 0	40	Current
Lower Columbia River	Columbia Lower River Hatchery (LRH)[2]	Big Creek	Fall Tule	Age 0	41	Current
	Cowlitz Tule (WA) (CWF)	Cowlitz	Fall Tule	Age 0	42	Current
	Lewis River Wild (LRW)	Wild	Fall Bright	Age 0	43	Current
	Willamette Spring (WSH)[1]	Willamette Hatcheries	Spring	Age 1	44	Current
	Spring Creek Tule (WA) (SPR)[2]	Spring Creek National Hatchery	Fall Tule	Age 0	45	Current
Upper Columbia River	Hanford Wild (HAN)	Wild	Fall Bright	Age 0	46	Current
	Similkameen Summer Yearling (SMK)	Similkameen and Omak Pond	Summer	Age 1	47	Current
	Columbia Summers (WA) (SUM)	Wells	Summer	Age 0/1	48	Current
	Columbia Upriver Brights (URB)[2]	Priest Rapids	Fall Bright	Age 0	49	Current
Snake River	Lyons Ferry Fingerling (LYF)[6]	Lyons Ferry	Fall Bright	Age 0	50	Current
	Lyons Ferry Yearling (LYY)[2]	Lyons Ferry	Fall Bright	Age 1		Current
North Oregon Coast	Salmon (SRH)	Salmon	Fall	Age 0	51	Current
Mid Oregon Coast	Elk River (ELK)	Elk River	Fall	Age 0	52	Current

Appendix E – Salmon bycatch by groundfish management area for the 2023/24 groundfish fishery

Table E1 – **Total salmon catch (numbers of fish retained and released) by species, groundfish management area and catch type for the 2023/24 groundfish fishery year (February 21, 2023 to February 20, 2024). Catch in the UNK category could not be associated to a single geographic Region.**

Groundfish Management Area	Catch Type	Total salmon catch	Chinook catch	Coho catch	Chum catch	Pink catch	Sockeye catch	Unidentified salmon catch
3C	FRESH	2,658	2,463	6	107	16	13	53
	FROZEN	15,251	10,000	360	1,087	3,785	16	3
3D	FRESH	1,094	1,047	41	6	0	0	0
	FROZEN	1,056	470	16	558	11	0	1
4B	FRESH	2,852	2,798	54	0	0	0	0
	FROZEN	2,316	2,303	0	10	2	0	1
5A	FRESH	262	132	2	114	0	0	14
	FROZEN	372	353	1	6	12	0	0
5B	FRESH	8	0	1	7	0	0	0
	FROZEN	23	21	0	2	0	0	0
5C	FRESH	4	4	0	0	0	0	0
	FROZEN	25	23	0	2	0	0	0
5D	FRESH	10	9	1	0	0	0	0
	FROZEN	1,035	1,018	1	2	14	0	0
5E	FRESH	0	0	0	0	0	0	0
	FROZEN	1	0	0	1	0	0	0
UNK	FRESH	509	453	5	30	20	1	0
	FROZEN	669	602	13	20	34	0	0
TOTAL 2023/24		28,145	21,696	501	1,952	3,894	30	72

Appendix F - Salmon bycatch by Pacific fishery management area for the 2023 calendar year

Table F1 – Estimated annual salmon catch (pieces retained and released) by Pacific Fishery Management Area (PFMA) in the groundfish trawl fishery during the 2023 calendar year.

PFMA	Total salmon catch	Chinook	Coho	Chum	Pink	Sockeye	Unidentified salmon
0 (unknown)	2,595	1,908	72	212	386	1	16
3	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0
7	22	20	0	2	0	0	0
11	438	438	0	0	0	0	0
12	6,476	6,456	4	10	4	0	2
14	2,882	2,828	54	0	0	0	0
15	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0
29	34	30	4	0	0	0	0
101	960	944	0	2	14	0	0
102	4	4	0	0	0	0	0
103	1	1	0	0	0	0	0
104	83	82	1	0	0	0	0
105	0	0	0	0	0	0	0
106	0	0	0	0	0	0	0
107	3	2	0	1	0	0	0
108	6	3	0	3	0	0	0
109	0	0	0	0	0	0	0
110	15	11	0	4	0	0	0
111	12	10	0	2	0	0	0
121	7,688	6,601	200	162	700	16	9
123	6,911	3,926	144	68	2,750	0	23
124	1,612	1,315	5	256	15	13	8
125	849	742	0	103	3	0	1
126	666	288	5	372	1	0	0
127	623	428	19	143	19	0	14
130	7	3	3	1	0	0	0
142	2	1	0	1	0	0	0