

Review of Salmon Bycatch in the Pacific Region 2022/23 Groundfish Trawl Fishery and Preliminary Results of an Enhanced Monitoring Program

Cory R. Lagasse, Kathryn A. Fraser, Rob Houtman, Erik Grundmann,
Nicholas Komick, Michael O'Brien, Emily Braithwaite, A. Maria Cornthwaite

Fisheries and Oceans Canada
Pacific Biological Station
3190 Hammond Bay Rd
Nanaimo, BC V9T 6N7

2024

**Canadian Manuscript Report of
Fisheries and Aquatic Sciences 3273**



Fisheries and Oceans
Canada

Pêches et Océans
Canada

Canada

Canadian Manuscript Report of Fisheries and Aquatic Sciences

Manuscript reports contain scientific and technical information that contributes to existing knowledge but which deals with national or regional problems. Distribution is restricted to institutions or individuals located in particular regions of Canada. However, no restriction is placed on subject matter, and the series reflects the broad interests and policies of Fisheries and Oceans Canada, namely, fisheries and aquatic sciences.

Manuscript reports may be cited as full publications. The correct citation appears above the abstract of each report. Each report is abstracted in the data base *Aquatic Sciences and Fisheries Abstracts*.

Manuscript reports are produced regionally but are numbered nationally. Requests for individual reports will be filled by the issuing establishment listed on the front cover and title page.

Numbers 1-900 in this series were issued as Manuscript Reports (Biological Series) of the Biological Board of Canada, and subsequent to 1937 when the name of the Board was changed by Act of Parliament, as Manuscript Reports (Biological Series) of the Fisheries Research Board of Canada. Numbers 1426 - 1550 were issued as Department of Fisheries and Environment, Fisheries and Marine Service Manuscript Reports. The current series name was changed with report number 1551.

Rapport manuscrit canadien des sciences halieutiques et aquatiques

Les rapports manuscrits contiennent des renseignements scientifiques et techniques qui constituent une contribution aux connaissances actuelles, mais qui traitent de problèmes nationaux ou régionaux. La distribution en est limitée aux organismes et aux personnes de régions particulières du Canada. Il n'y a aucune restriction quant au sujet; de fait, la série reflète la vaste gamme des intérêts et des politiques de Pêches et Océans Canada, c'est-à-dire les sciences halieutiques et aquatiques.

Les rapports manuscrits peuvent être cités comme des publications à part entière. Le titre exact figure au-dessus du résumé de chaque rapport. Les rapports manuscrits sont résumés dans la base de données *Résumés des sciences aquatiques et halieutiques*.

Les rapports manuscrits sont produits à l'échelon régional, mais numérotés à l'échelon national. Les demandes de rapports seront satisfaites par l'établissement auteur dont le nom figure sur la couverture et la page du titre.

Les numéros 1 à 900 de cette série ont été publiés à titre de Manuscrits (série biologique) de l'Office de biologie du Canada, et après le changement de la désignation de cet organisme par décret du Parlement, en 1937, ont été classés comme Manuscrits (série biologique) de l'Office des recherches sur les pêcheries du Canada. Les numéros 901 à 1425 ont été publiés à titre de Rapports manuscrits de l'Office des recherches sur les pêcheries du Canada. Les numéros 1426 à 1550 sont parus à titre de Rapports manuscrits du Service des pêches et de la mer, ministère des Pêches et de l'Environnement. Le nom actuel de la série a été établi lors de la parution du numéro 1551.

Canadian Manuscript Report of
Fisheries and Aquatic Sciences 3273

2024

Review of Salmon Bycatch in the Pacific Region 2022/23 Groundfish Trawl Fishery and
Preliminary Results of an Enhanced Monitoring Program

Cory R. Lagasse, Kathryn A. Fraser, Rob Houtman, Erik Grundmann, Nicholas Komick,
Michael O'Brien, Emily Braithwaite, A. Maria Cornthwaite

Fisheries and Oceans Canada
Pacific Biological Station
3190 Hammond Bay Rd
Nanaimo, BC
V9T 6N7

© His Majesty the King in Right of Canada, as represented by the Minister of the
Department of Fisheries and Oceans, 2024.
Cat. No. Fs97-4/3273E-PDF ISBN 978-0-660-69095-7 ISSN 1488-5387

Correct Citation for this publication:

Lagasse, C.R., Fraser, K.A., Houtman, R., Grundmann, E., Komick, N., O'Brien, M., Braithwaite, E., Cornthwaite, A. M. 2024. Review of Salmon Bycatch in the Pacific Region 2022/23 Groundfish Trawl Fishery and Preliminary Results of an Enhanced Monitoring Program. Can. Manuscr. Rep. Fish. Aquat. Sci. 3273: v + 35 p.

TABLE OF CONTENTS

Introduction	1
Methods.....	1
Salmon Bycatch Monitoring and Sampling.....	1
Catch Data Analysis.....	3
Coded Wire Tag and Stock Composition Analysis.....	4
CWT Analysis.....	5
Stock Composition Analysis	5
Results.....	6
Salmon Catch	6
Coded Wire Tag and Stock Composition Results	7
Discussion.....	9
Acknowledgements.....	11
References	12
Tables	13
Appendix A - 2022/23 Option A Groundfish Trawl Fleet Enhanced Salmon Monitoring, Bycatch Reporting & Biological Sampling Program Requirements	23
Appendix B - DFO Option A Trawl Salmon Head Sampling Instructions for Vessels Landing Catch Frozen25	
Appendix C - Table and map of Regions for defining catch strata.....	27
Appendix D - CWT Exploitation Rate Indicator Stocks used in Exploitation Rate Analysis.....	29
Appendix E - SMU-CU-Reporting Units Tables.....	32
Appendix F - Salmon catch by Pacific Fishery Management Area for 2022	35

ABSTRACT

Lagasse, C.R., Fraser, K.A., Houtman, R., Grundmann, E., Komick, N., O'Brien, M., Braithwaite, E., Cornthwaite, A. M. 2024. Review of Salmon Bycatch in the Pacific Region 2022/23 Groundfish Trawl Fishery and Preliminary Results of an Enhanced Monitoring Program. Can. Manuscr. Rep. Fish. Aquat. Sci. 3273: v + 35 p.

The Pacific Region groundfish trawl fishery is one of the largest fisheries in British Columbia by catch volume and value, operating throughout the year with all fishing trips subject to at-sea electronic monitoring and independent validation of landings via a dockside monitoring program. An enhanced monitoring and sampling program for salmon bycatch was initiated for all Option A trawl licence holders on September 26, 2022 to improve the accuracy of estimates of salmon catch by species and collect coded wire tag (CWT) and stock composition information to assess potential impacts on Chinook salmon (*Oncorhynchus tshawytscha*) stocks of concern. This report summarizes estimates of Pacific salmon bycatch in the groundfish trawl fishery since 2008, with a focus on the 2022/23 fishery. Catch of Pacific salmon in the 2022/23 fishery was the highest recorded since 2008 with a total catch of 28,117 Pacific salmon, including 26,273 Chinook salmon. Most of this catch occurred during the enhanced monitoring period from September 26, 2022 to February 20, 2023, with 15,234 Chinook salmon sampled during this period for CWT analysis and estimation of stock composition. The enhanced monitoring program will continue to be implemented through the 2023/24 fishery with additional results described in future reports.

RÉSUMÉ

Lagasse, C.R., Fraser, K.A., Houtman, R., Grundmann, E., Komick, N., O'Brien, M., Braithwaite, E., Cornthwaite, A. M. 2024. Review of Salmon Bycatch in the Pacific Region 2022/23 Groundfish Trawl Fishery and Preliminary Results of an Enhanced Monitoring Program. Can. Manuscr. Rep. Fish. Aquat. Sci. 3273: v + 35 p.

Les pêches au chalut des poissons de fond dans la Région du Pacifique est l'une des plus importantes pêcheries de la Colombie-Britannique en termes de volume et de valeur des prises, opérant tout au long de l'année avec toutes les sorties de pêche étant soumises à une surveillance électronique en mer et à une validation indépendante des débarquements via un programme de surveillance à quai. Pour améliorer l'exactitude des estimations des prises de saumon par espèce et recueillir des données sur la composition des stocks afin d'évaluer les impacts potentiels sur les stocks préoccupants de saumon quinnat (*Oncorhynchus tshawytscha*), un programme amélioré de surveillance et d'échantillonnage des prises de saumon a été lancé pour tous les titulaires de permis de chalutage de l'option A le 26 septembre 2022. Ce rapport résume les estimations des prises de saumon du Pacifique dans la pêche au chalut du poisson de fond depuis 2008, en mettant l'accent sur la pêche de 2022-23. Les prises de saumon du Pacifique dans la pêche de 2022-2023 ont été les plus élevées enregistrées depuis 2008 avec une capture totale de 28 117 saumons du Pacifique, dont 26 273 saumons quinnat. La plupart de ces prises ont eu lieu pendant la période de surveillance accrue du 26 septembre 2022 au 20 février 2023, avec 15 234 saumons quinnat échantillonnés au cours de cette période pour l'analyse étiquette de fil codée (CWT) et l'estimation de la composition du stock. Le programme de surveillance améliorée continuera d'être mis en œuvre tout au long de la pêche de 2023-2024 et une période de données plus longue sera décrite dans les prochains rapports.

INTRODUCTION

The Pacific Region groundfish trawl fishery is one of the largest fisheries in British Columbia by catch volume and value, operating year-round using either mid-water or bottom trawl gear to target various flatfish, rockfish, and other groundfish species. The fishery consists of approximately 45 active vessels that are managed under an individual transferable quota / individual vessel quota system with each vessel individually accountable for their catch (Fisheries and Oceans Canada 2023a). Management of the fishery is informed by a comprehensive catch monitoring program with all fishing trips requiring logbook records and independent validation via at-sea electronic monitoring (EM) and a dockside monitoring program (DMP).

Recent estimates from catch monitoring data in the groundfish trawl fishery indicated that thousands of Pacific salmon (*Oncorhynchus spp.*) were being caught on an annual basis, with most bycatch occurring using mid-water trawl gear and Chinook salmon (*Oncorhynchus tshawytscha*) the main species of salmon being caught. While existing monitoring programs in the trawl fishery provide comprehensive estimates of catch weights of groundfish species, they were not targeted towards accurate estimation of salmon piece counts by species or assessment of potential impacts on stocks of concern. Over the past decades, there have been widespread declines for many stocks of Chinook salmon, and a growing number of populations are now 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 (Fisheries and Oceans Canada 2023b). In salmon-directed fisheries, monitoring programs require the collection of samples for genetic analysis and coded wire tag (CWT) recovery to estimate stock composition and impacts on stocks of concern. This information supports the assessment of fisheries management objectives for stocks of concern, including for Fraser Chinook stocks (Dobson et al. 2020).

Beginning in 2021, DFO engaged with industry representatives and monitoring service providers to review monitoring procedures and develop an enhanced monitoring and sampling program for salmon bycatch. The program was initiated on September 26, 2022, and is ongoing during the 2023/24 fishery. This report summarizes estimates of bycatch of Pacific salmon in the groundfish trawl fishery since 2008, with a focus on the 2022/23 groundfish fishing year, which began on February 21, 2022, and ended on February 20, 2023. Preliminary results from the enhanced monitoring program are also provided including CWT and stock composition analysis.

METHODS

Salmon Bycatch Monitoring and Sampling

Monitoring requirements for the groundfish trawl fishery are detailed in Appendix 8 of the Groundfish Integrated Fisheries Management Plan (Fisheries and Oceans Canada 2023a). This section provides a brief overview of monitoring requirements with a focus on changes to catch monitoring and sampling of Pacific salmon that occurred during the 2022/23 groundfish trawl fishery for Option A licence holders (see Table 1). Groundfish trawl license holders may choose one of two license options at the beginning of each fishing year that determines allowable fishing locations and gear type: Option B vessels must fish exclusively within PFMA 12 to 20 and 29 using bottom trawl gear, while Option A vessels may fish in all other areas and inside PFMA 12 to 20 and 29 using mid-water trawls only. Option A licences represents approximately 40 of the 45 active commercial groundfish trawl licences and the only licence type permitted to use mid-

water trawl gear, and thus this licence type was the focus for changes to monitoring and sampling of Pacific salmon.

Commercial groundfish trawl catch is monitored and reported using a combination of fisher logbooks, independent at-sea EM auditing, and DMP validation of landed catch. While at sea, all vessels must keep accurate records of fishing activities in an electronic fishing logbook 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 logbooks via audits of a random subset of tows from each trip. If fisher reported information does not meet accuracy requirements, logbook data may be replaced by EM results and additional audits conducted. Prior to March 2020, independent at-sea monitoring requirements for Option A trips were fulfilled by the at-sea observer program (ASOP), with the exception of trips targeting Pacific hake using midwater trawl gear and landing fresh product; however, the ASOP has been suspended since the Covid pandemic. At the end of each fishing trip, landed catch must be independently validated by the DMP during offload to ensure accurate catch weights for each species.

Prior to implementation of the enhanced monitoring program, there were no requirements for monitoring Pacific salmon in the groundfish trawl fishery, other than the requirements that apply to all species encountered in the fishery. As a prohibited species, Pacific salmon were not allowed to be targeted and were required to be released at-sea if caught. Therefore, available estimates of Pacific salmon catch were based on fisher logbook information, with DMP validation only when Pacific salmon were landed incidentally. Before March 2020, the ASOP provided independent monitoring of retained and released catch of Pacific salmon as described above. In addition, opportunistic at-sea or shoreside biological sampling, including the retention of heads from adipose clipped Chinook and Coho and the recording of lengths and weights, occurred as a lower priority to other groundfish catch monitoring duties.

A review of monitoring procedures beginning in 2021 led to the development of an enhanced monitoring program for salmon bycatch that revised retention and monitoring requirements in order to provide more accurate estimates of bycatch counts by species and collect CWT and genetic samples. The enhanced monitoring program was developed collaboratively with representatives from DFO Pacific Region Science and Fisheries Management, the groundfish trawl industry, the David Suzuki Foundation, and monitoring service providers from Archipelago Marine Research Ltd. and J.O. Thomas and Associates Ltd. In consideration of information needs for assessment and management, the following four objectives were used to guide development of the program:

1. Accurately estimate fishery catch counts (pieces) of fish of each Pacific salmon species;
2. Ensure sufficiently precise and representative CWT sampling to quantify the fishery mortality for Chinook CWT exploitation rate indicator stocks;
3. Use genetic stock identification to identify the stock composition of Chinook catch, including for populations that do not have CWT exploitation rate indicator stocks; and
4. Estimate the spatial and temporal distribution of Chinook catch to determine when and where mortality on stocks of concern may be occurring.

Objectives 2 to 4 were focused on Chinook salmon as these were the most prevalent salmon bycatch species, and where potential impacts on stocks of concern were considered most likely. Coho salmon were also sampled for CWTs and DNA, but represented a much smaller portion of salmon catch. The program was targeted towards all Option A trawl vessels, but did not include trawl vessels fishing under Option B,

which represent a smaller component of the fishery and do not capture significant amounts of salmon bycatch because they are not permitted to fish using mid-water trawl gear.

The changes to retention and sampling requirements were implemented via scientific licences under Section 52 of the Fisheries (General) Regulations (1993). Scientific licences were issued to all Option A Groundfish trawl vessels authorizing the retention of salmon to enable independent validation of catch numbers by species and collection of DNA and CWTs. Changing to mandatory retention was not expected to significantly increase mortality from trawl bycatch; although there are no established mortality rates for salmon released at-sea caught with trawl gear, all species entering a receiving tank vessel (those landing catch frozen) have a 100% mortality rate applied and it was assumed that most salmon do not survive being caught in a trawl net regardless of retention status. The sale, trade, or personal use of any retained salmon remained prohibited in the licence requirements.

Most Option A trawl vessels land catch fresh and whole, while a few vessels are fitted to process and freeze landed catch at sea. Different catch retention requirements and sampling procedures were developed for vessels landing catch fresh versus frozen to achieve monitoring objectives (see Appendix A for a detailed description of requirements). For vessels landing fresh catch, all Pacific salmon were required to be retained and landed whole, where they would be subject to DMP validation of catch numbers and weight by species on all trips. 25% of trips were also targeted for collection of Chinook and Coho salmon heads by the dockside observer, with sampling of trips randomly selected 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, plus a 5% buffer for potential implementation error.

For vessels landing frozen catch, which consisted of six active licence holders in the 2022/23 groundfish Option A trawl fishery, scientific licences required the retention of heads only in recognition of the limited freezer space available for storage of non-marketable fish. Vessels were responsible for retaining heads, including gills and collars, and bagging and labelling them on all trips according to instructions provided by DFO (Appendix B). The requirements specified that salmon heads from each tow should be bagged and labelled separately so that samples could be matched to tow information such as location and date. At the end of each trip, heads were to be packaged in larger trip bags and received by the DMP. The 100% sampling rate was chosen to ensure representative sampling of the small number of vessels that were able to 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 specialized electronic detection equipment. CWTs were recovered from all heads that scanned positive. DNA tissue samples were initially collected from the operculum and then later changed to cheek tissue to improve success rates of DNA amplification for genetic analysis.

Catch Data Analysis

Summaries of salmon catch information presented in this report are based on commercial groundfish trawl catch monitoring data, with adjustment of salmon catch using information from the enhanced monitoring program beginning on September 26, 2022. Commercial groundfish fisher log, ASOP, and DMP data are housed in the Fishery Operations Systems (FOS) 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 for Groundfish scientists.

During the standard monitoring period, prior to September 26, 2022, estimates of salmon bycatch were compiled from the GFFOS Official Catch table, which summarizes the best available data for each fishing event (i.e. trawl tow) using fisher logbook, ASOP, and DMP sources. Landed catch for each tow is calculated by prorating the DMP landed catch at trip offload over the retained catch from logbook and ASOP sources, such that landed catch for a species added across all tows for a trip will equal the DMP landed catch for that trip. If there are DMP records for a species that is not recorded in ASOP or fisher logbook data for a trip, it will be associated with the trip but not assigned to a specific tow, and therefore catch location and other data may be unavailable. Since 2020, ASOP data has been based on fisher reported information that is corrected using EM data where the audit reveals consistent differences between EM and fisher reported catches.

For the enhanced monitoring period, from September 26, 2022 onward, different methods for determining best estimates of salmon catch by species were applied for landed fresh catch versus frozen catch corresponding with the different collection methods and sampling requirements. For vessels landing catch fresh, salmon catch was compiled from the GFFOS Official Catch table and based upon DMP validation of landed catch. DMP validation occurred on all retained fresh salmon catch due to new retention requirements, whereas during the standard monitoring period only salmon retained incidentally would have been validated by the DMP. For the subset of trips where DMP collected Chinook and Coho salmon heads, the DMP counts of catch by species at offload were compared to counts of salmon heads by species conducted by J.O. Thomas to confirm accuracy.

For vessels landing catch frozen during the enhanced monitoring period, salmon catch estimates were derived from lab counts of salmon heads identified to species and matched to trips and tows. If salmon heads were unable to be matched to tows using label information, salmon catch was estimated from lab counts over the entire trip and not associated at the tow level, analogous to the method for applying DMP validation of landed catch. Salmon catch from logbooks in GFFOS were not used to estimate salmon catch by species, however, they provided information on tows where salmon catch occurred for trips with missing label information.

The location of salmon catch was determined for individual tows or across a trip using logbook information. Salmon heads that could be matched to specific tows were assigned to PFMA from the GFFOS Official Catch table based on tow start and end locations. For salmon heads that could not be matched to a specific tow, including most catch landed fresh and unlabeled catch landed frozen, catch locations were inferred for broader regions based on the locations of all tows within a trip. Regions consisted of geographic groupings of PFMA (e.g. West Coast Vancouver Island South) and were identified based upon fishing patterns by catch type and areas of salmon encounters (see Appendix C for correspondence between Regions, PFMA, and groundfish management areas). Where logbook records of species catch by tow occurred within the same Region throughout a trip, all salmon catch from that trip was assigned to the Region. Using this method, almost all salmon catch during the 2022/23 groundfish trawl fishery could be assigned to a Region, with only a small proportion of catch remaining in an “unassigned” category.

Coded Wire Tag and Stock Composition Analysis

A key component of the enhanced monitoring program was the collection of CWTs and DNA tissue from Chinook salmon to estimate recoveries of CWT exploitation rate indicator stocks and estimate stock composition. To develop these estimates, salmon bycatch in the trawl fishery was divided into catch strata that represented different fishing areas, catch type, and time periods. More specifically, each catch

stratum consisted of a combination of Region, whether catch was landed fresh or frozen, and whether catch occurred from September 26 to December 31, 2022, or from January 1 to February 20, 2023. CWT Analysis relied on CWT recoveries from all head samples, while stock composition analysis used CWT recoveries and DNA.

CWT Analysis

CWTs are tiny lengths of metal wire inscribed with a numeric code that are implanted in the snout of groups of Chinook and Coho salmon juveniles before their ocean migration. When recovered, read with a microscope and associated with CWT release data, CWTs accurately identify the stock of origin, brood year, and other associated rearing information of the CWT release group. The Chinook Technical Committee (CTC) of the Pacific Salmon Commission uses CWTs to perform an annual exploitation rate analysis (CTC 1988), and currently monitors 45 Chinook CWT exploitation rate indicator stocks within Canada and the US (see Appendix D for geographic locations, stock acronyms, and full stock names). Recovery of CWT indicator stocks in salmon-directed fisheries and escapement is used to assess survival, maturation rates, exploitation, and fishery mortality rates in Canada and United States fisheries, as required under Chapter 3 of the Pacific Salmon Treaty and reported on annually (e.g. CTC 2023).

To estimate total CWT recoveries for Canadian Chinook CWT exploitation rate indicator stocks, the CWTs recovered were expanded by the inverse of the sample rate within each catch stratum. Sample rates corresponded to the number of Chinook salmon heads collected and scanned for CWTs, divided by the total Chinook salmon catch in each catch stratum. Total CWT recoveries are reported separately by 2022 and 2023 calendar years for consistency with CWT recovery estimates developed by the CTC for Canadian salmon-directed fisheries.

CWT analytical methods and stock information presented in this report were created from the Mark Recovery Program Information System (MRPIS). MRPIS is maintained by Salmon Stock Assessment and is DFO's centralized repository for salmon coded wire tag data in the Pacific Region.

Stock Composition Analysis

Stock composition of Chinook salmon catch 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 E for SMU assignment tables). CWT recoveries can determine the stock of origin to high accuracy and resolution; however, they cannot be used to determine stock composition for hatchery or wild fish that do not have CWTs. Therefore, for fish that did not contain a CWT, DNA tissue samples were analyzed to determine stock of origin using parentage-based tagging (PBT) and genetic stock identification (GSI) assignment methods.

GSI assignment matches genetic markers to baselines collected from spawning grounds to identify the population of origin for wild or hatchery fish, while PBT assignment matches hatchery produced fish back to their parents, allowing determination of the hatchery of origin and age of sampled fish (Beacham et al. 2018). PBT analysis can only be conducted for populations in which all hatchery brood stock is genotyped, and therefore can only be applied to fish produced in Canadian hatcheries that have PBT programs in place. PBT results provide better accuracy than GSI and were used instead of GSI to determine stock of origin where available, with the combined application of both methods denoted by PBT-GSI.

To determine stock composition of Chinook salmon catch, each stratum was partitioned into fish containing CWTs and fish that did not contain CWTs, and separate stock proportions for each partition were calculated using CWT and genetic (PBT-GSI) stock assignments respectively. The overall stock

composition estimate for each catch stratum was calculated by weighting each set of stock proportions according to their respective catch. The CWT partition represented the proportion of catch estimated to have CWTs and was equal to the number of CWTs recovered divided by the number of heads scanned for CWTs within each catch stratum. The PBT-GSI partition consisted of all Chinook salmon estimated to not have CWTs within the catch strata, and was calculated as the remaining proportion of catch after subtracting the CWT partition. The sample rate for the PBT-GSI partition was the number of PBT-GSI samples successfully analyzed divided by the estimated catch without CWTs within each catch stratum, while the sample rate for the CWT partition was equal to the number of heads scanned for CWTs divided by the total catch.

In addition to stock identification, results from the PBT analysis provided information on brood year composition, which can be used to calculate salmon age by subtracting the year a fish was caught from the brood year. Chinook salmon from the 2020 brood year would represent age 2 fish if caught in 2022 and age 3 fish if caught in 2023. While CWTs can also provide brood year information, most Canadian CWT indicator stocks from the 2019 brood year were not tagged due to the Covid pandemic. Therefore, brood year compositions based upon CWTs are not reported due to expected bias.

RESULTS

Salmon Catch

Catch of Pacific salmon was estimated from the standard monitoring program beginning in 2008, the first full year where data are stored in the Fishery Operations System (FOS) database, up until September 25, 2022, while catch between September 26, 2022 to February 20, 2023 was estimated from the enhanced monitoring program procedures. Annual totals of salmon bycatch by species, numbers of fishing trips, tows using mid-water gear type, and total landed catch weights are summarized by groundfish fishing year from 2008/09 to 2022/23 in Table 2. Annual salmon bycatch by calendar year from 2008 to 2022 are summarized in Table 3. Monthly catch of salmon by species for the 2022/23 fishery is provided in Table 4. Table 5 provides salmon catch by species for the 2022/23 fishery within each Region, catch type, and time period strata (for catch by PFMA in the 2022 calendar year see Appendix F). Key catch results are summarized below:

- Estimated bycatch of Pacific salmon in the groundfish trawl fishery for the 2022/23 groundfish fishing year was the highest recorded among recent years with a total catch of 28,117 salmon (Table 2). The second highest fishing year was 2020/21 with a total catch of 12,354 salmon.
- Chinook salmon was the primary salmon species caught in the 2022/23 groundfish fishing year with an estimated catch of 26,273, representing 93% of total salmon catch. Chinook salmon represent greater than 80% of Pacific salmon bycatch in most groundfish fishing years from 2008/09 to 2022/23.
- Estimated catch of other salmon species caught in the 2022/23 groundfish fishing year was 625 Coho salmon, 1097 Chum salmon, 18 Pink Salmon, and 42 Sockeye salmon. There were 123 salmon that were reported as Pacific salmon and trout that could not be identified to species either by fisher or independent monitoring programs.
- Most salmon bycatch in the 2022/23 groundfish fishing year occurred during the enhanced monitoring period, with 18,867 salmon caught between September 26, 2022 and February 20,

2023. The highest monthly catch occurred in October and February, with 8,268 and 3,272 salmon caught in these months respectively (Table 4).

- The Regions with the highest salmon catch in 2022/23 were Queen Charlotte and Johnstone Strait with 12,176 salmon caught, followed by WCVI South with 10,428 salmon, and Strait of Georgia with 3,264 salmon (Table 5). There were only 540 salmon caught in the North Coast Region, while 1,065 salmon were caught in the WCVI North Region. 644 salmon were unassigned and could not be associated to a specific Region.
- There were 6 active licences for vessels landing frozen catch in 2022/23 that caught 74% of salmon in the trawl fishery, corresponding to 20,745 salmon pieces including 19,026 Chinook salmon. All of the 12,176 salmon caught in the Queen Charlotte and Johnstone Strait Region were landed frozen catch, while the remaining landed frozen catch of salmon mostly occurred in the WCVI South Region where 7,135 salmon were caught by these vessels.
- For vessels landing fresh catch, 3,293 pieces or 45% of this salmon catch in 2022/23 occurred in the southern West Coast Vancouver Island Region, while 3,264 pieces or 44% of salmon catch occurred in the Strait of Georgia.
- 96% of salmon were caught using midwater trawl gear during the 2022/23 fishery. 26,907 salmon were caught in tows with midwater trawl gear as the reported gear type, while 807 salmon were caught with bottom trawl gear. 403 salmon were caught with an unspecified or unavailable gear type.
- There were 847 unique trawl fishing trips and 3,424 tows with mid-water trawl gear that occurred in the 2022/23 groundfish fishing year (Table 2). This was lower than the annual average from 2008/09 to 2022/23 of 1,316 trips and 3,699 mid-water tows. Total landed catch of Pacific Hake (*Merluccius productus*) in 2022/23 was among the lowest in the time series at 38,560,000 kg compared to the average of 66,402,000 kg; however, landed catch of Walleye Pollock (*Gadus chalcogrammus*) was the highest in the time series at 9,412,000 kg compared to the average of 4,945,000 kg.
- Salmon catch was concentrated within a small proportion of trawl fishing trips and tows. Out of the 847 trips in the 2022/23 groundfish fishery, the 10 trips with the highest salmon catch caught 15,145 salmon, or 54% of the total salmon catch. Out of the 3,424 tows using mid-water trawl gear in 2022/23, 42 tows caught more than 100 salmon, while no salmon catch was recorded in 2,616 or 76% of tows.

Coded Wire Tag and Stock Composition Results

Estimates of the catch of Canadian exploitation rate indicator stocks and stock composition for Chinook salmon cover the enhanced monitoring period from September 26, 2022 to February 20, 2023. Although this period represents less than 5 months of sample collection, it coincided with the period of highest salmon bycatch in recent years within the groundfish trawl fishery, with a total of 15,642 Chinook salmon heads collected.

Every Chinook salmon head collected was scanned for CWTs, yielding 2,051 CWTs from Canadian and US tagging projects, and 298 CWTs from Canadian exploitation rate indicator stocks. More than 35% of catch

was sampled from all catch strata, except in the WCVI North, WCVI South, and North Coast Regions where smaller catches occurred. There were 1,913 DNA samples that were successfully analyzed for PBT-GSI among sampled Chinook salmon without CWTs, out of which 362 were identified to stock of origin by PBT and 1,555 were identified by GSI. PBT-GSI sample sizes and sample rates varied considerably and not all catch strata were sufficiently represented to accurately estimate stock composition, particularly those catch strata occurring in the WCVI North and WCVI South Regions where sample rates were 2% or less.

The number of Chinook salmon sampled, numbers and proportions of CWTs, and sample rates for CWT and PBT-GSI are summarized by catch strata in Table 6. Estimates of total CWT recoveries of Canadian exploitation rate indicator stocks are provided in Table 7, including a comparison to 2022 estimates of CWT indicator stock recoveries in Canadian marine salmon-directed fisheries. Stock composition estimates using combined CWT and PBT-GSI stock assignments are provided for southern BC Chinook salmon SMUs in Table 8 and for northern BC SMUs in Table 9. The brood year composition of PBT samples is summarized by catch strata in Table 10.

Key observations from CWT and genetic analysis are as follows:

- The highest estimated CWT recoveries for Canadian exploitation rate indicator stocks were from Chilliwack, Harrison, and Cowichan stocks, with estimates of 76.1, 40.5, and 37.6 respectively during the 2022 calendar year (Table 7). By comparison, total estimated CWT recoveries for the 2022 calendar year from Canadian salmon-directed fisheries in marine areas was 178.1, 87.8, and 276.6 for Chilliwack, Harrison, and Cowichan stocks respectively. Comparisons between estimated CWT recoveries in fisheries are based on CWT sampling over the entire year in salmon-directed fisheries, while trawl CWT sampling occurred from September 26 to December 31, 2022 and has not been expanded to represent catch prior to the enhanced monitoring period.
- Other Canadian exploitation rate indicator stocks in trawl samples included Big Qualicum River, Nicola River, Robertson Creek, Puntledge River, and Quinsam River. Estimated CWT recoveries of the US Samish River indicator stock, included as a proxy for Boundary Bay Chinook, was 63.1 in 2022. There were no CWT recoveries of the Similkameen River stock, which is used as a proxy for Canadian Okanagan Chinook. Proxies were used to provide an indication of potential fisheries catch for Boundary Bay and Canadian Okanagan Chinook because there is no Canadian indicator stock for these populations (Dionne et al. 2023, Matylewich et al. 2019).
- The stock composition of Chinook salmon represented by Canadian-origin stocks, as estimated based upon combined CWT and PBT-GSI information, varied from 21% to 83% among catch strata. The highest proportions of Canadian-origin stocks were estimated in the Strait of Georgia Region, with estimates of 82% to 83%. In the Queen Charlotte & Johnstone Strait Region, where the largest amount of Chinook salmon catch occurred, the Canadian proportion was estimated at 37% for bycatch occurring between September 26 to December 31, 2022, and 60% for bycatch occurring between January 1 to February 20, 2023.
- Most of the Canadian-origin Chinook salmon catch originated from the Fraser Fall 4(1), Lower Georgia Strait, and Middle Georgia Strait SMUs according to stock composition estimates (Table 8). Fraser Fall 4(1), which includes Chilliwack and Harrison Chinook CUs, was the highest proportion of catch among Canadian SMUs, representing 21% to 51% of Chinook catch within the Queen Charlotte & Johnstone Strait and Strait of Georgia Regions. Stocks of concern that

were represented by smaller proportions in some catch strata included Fraser Spring 4(2), Fraser Spring 5(2), Fraser Summer 5(2), and WCVI Chinook. Central Coast, Skeena, and Nass were the only northern BC SMUs detected and represented a much smaller proportion of the catch than southern BC SMUs (Table 9).

- Most Canadian-origin Chinook salmon that could be assigned to brood year using PBT belonged to the 2020 brood year, which represented 69% of the 141 PBT observations from catch occurring between September 26 and December 31, 2022 and 91% of the 226 PBT observations from catch occurring between January 1 and February 20, 2023 (Table 10).

DISCUSSION

This report summarizes estimates of salmon bycatch in the groundfish trawl fishery since 2008, with a focus on estimates for the 2022/23 fishery and results from an enhanced monitoring program that was implemented beginning on September 26, 2022. As this is a new monitoring program, the results may be subject to change and further revisions. There are also several sources of uncertainty and limitations that should be considered when interpreting results.

Known sources of uncertainty and limitations in the results include:

- Catch counts (pieces) for salmon may be incomplete or lower accuracy prior to the enhanced monitoring program. Catch weight by species is the primary metric for quota management and catch reporting used in the groundfish trawl fishery, however, piece counts of fish are used throughout this report as they are the metric used to manage salmon-directed fisheries. Salmon piece counts of released catch were not subject to DMP, auditing, or verification of species, except by the ASOP prior to March 2020.
- Estimates of CWT recoveries of Canadian Chinook indicator stocks (Table 7) do not include fish from the 2019 brood year for most stocks because they were not tagged with CWTs due to the Covid pandemic. Estimates may therefore be lower than would otherwise have occurred if CWT tagging had included the 2019 brood year. For exploitation rate analysis, the Chinook Technical Committee has developed infilling methods to compensate for this missing information using the long time series of CWT data (CTC 2023); however, this was not possible for the trawl fishery.
- Estimates of CWT recoveries of Chinook indicators are provided irrespective of age and have not been adjusted into adult equivalent mortalities according to models developed and applied by the CTC when reporting on CWT-based exploitation rates in salmon-directed fisheries (see CTC 2019, page 9). By adjusting fishery catches into adult equivalent mortality based on age and stock, CTC models are intended to more accurately 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. Available information from PBT brood year assignments (Table 10), while limited in its representation of the fishery, suggests that most Chinook salmon caught in the trawl fishery during the enhanced monitoring period were from the 2020 brood year or 2-3 year olds. This is younger than most Chinook salmon catch in salmon-directed fisheries and therefore catch numbers in trawl and salmon fisheries may not be directly comparable in terms of adult equivalent mortality.

- Estimates of CWT recoveries of Chinook indicators and stock composition only represent the enhanced monitoring period occurring in the final 5 months of the 2022/23 groundfish fishery year. Fishing activity in the trawl fishery changes throughout the season and across years in response to various factors, therefore, the results should not be considered representative of the entire fishery or other years. Stock and age composition may also vary considerably between years and during the year as a result of changing distributions and abundances of Chinook salmon populations.
- Stock proportions of Chinook salmon SMUs (Table 8 and 9) are derived from PBT-GSI results that have low sample rates for some catch strata, particularly for bycatch occurring in October and November 2022 and in WCVI Regions.
- During the first few months of the enhanced monitoring program, PBT-GSI analysis had low success rates because DNA tissue collected from the operculum was inadequate quality. As a result, sampling rates were lower for PBT-GSI stock assignments at the beginning of the enhanced monitoring program. DNA sampling protocols were revised to collect samples from cheek tissue for the remainder of the program, resulting in improved rates for successful PBT-GSI analysis.

Despite potential sources of uncertainty, monitoring data shows that bycatch of Pacific salmon in the groundfish trawl fishery were the highest on record during the 2022/23 fishery, as estimated using a combination of standard and enhanced monitoring procedures. Most bycatch occurred around the southern West Coast Vancouver Island and the Queen Charlotte & Johnstone Strait Regions during a small number of fishing trips, primarily from vessels landing frozen catch. Most salmon were caught using mid-water trawl gear, with less than 4% of salmon caught when using bottom trawl gear. Many of these mid-water trawl tows with salmon bycatch targeted Pacific Hake and Walleye Pollock, though detailed information on target species associated with salmon bycatch was not examined.

There are many factors that may influence the prevalence and distribution of salmon bycatch in the trawl fishery. An analysis of these factors and the spatiotemporal dynamics of salmon encounters was not included in this report; however, information on total landed catch of groundfish species and the number of fishing trips and mid-water tows suggest that overall fishing activity in the 2022/23 groundfish fishing year did not increase compared to previous years, with the exception of landed catch of Walleye Pollock. Further analyses could explore the use of spatiotemporal models as a forecasting tool to predict Chinook salmon bycatch associations with target species, locations, depths, times, and other fishing characteristics (e.g. Shirk et al. 2023).

Stock composition estimates and recoveries of CWT indicators during the enhanced monitoring period indicate that the Fraser Fall 4(1) SMU is the largest proportion of catch among Canadian-origin stocks, followed by Lower Georgia Strait and Middle Georgia Strait SMUs. Due to sampling gaps and the limited time series represented by these results, stock composition estimates were not applied to Chinook salmon catch to calculate catches by SMU or determine exploitation rate indices, as has been applied to salmon-directed fisheries to assess achievement of fisheries management objectives for Fraser Chinook stocks of concern (Dobson et al. 2020); however, estimates of total CWT recoveries are provided for Canadian exploitation rate indicator stocks to compare with marine salmon-directed fisheries, albeit with some limitations and differences. These comparisons show that estimates of CWT indicators in the groundfish

trawl fishery for Chilliwack and Harrison River Chinook between September 26 to December 31, 2022 were more than 40% of CWT recoveries from salmon-directed fisheries in Canadian marine waters in 2022. Relative proportions between groundfish trawl catch and marine salmon-directed fisheries were variable for other indicator stocks, and these comparisons do not include estimates of CWT recoveries that occur in freshwater or terminal fisheries.

Implementation of the enhanced monitoring program will continue through the 2023/24 Option A groundfish trawl fishery and mandatory retention requirements to collect head samples have been ongoing since the program was initiated. Results from the enhanced monitoring program that include 2023/24 will be described in future reports. Additional monitoring information will support more comprehensive assessments of groundfish trawl fishery bycatch of Chinook salmon stocks of concern compared to the limited time series represented in this report.

ACKNOWLEDGEMENTS

Development and implementation of the groundfish trawl salmon bycatch enhanced monitoring program has been a collaborative initiative that benefited greatly from the expertise and contributions of Brian Mose from the Groundfish Trawl Industry, Bruce Turriss from the Canadian Groundfish Research and Conservation Society, Doug Tallman and Sylvia Chow from JO Thomas and Associates Ltd, Scott Buchanan from Archipelago Marine Research Ltd, and Deirdre Finn, Rob Tadey, Lindsay Richardson-Deranger, Trevor Ruelle, Mike Hawkshaw, Chuck Parken, and Rachel Rickaby from DFO. Thanks to Malcolm Wyeth, Norm Olsen and Jonathan Faris for their work developing and maintaining the GFFOS database. We would also like to acknowledge the work accomplished by those that collected data and samples for the enhanced monitoring program, including dockside observers with Archipelago Marine Research, fisheries and lab technicians with JO Thomas and Associates Ltd, and fishers in the groundfish trawl industry. Funding for the enhanced monitoring program was provided by DFO via the Harvest Transformation Pillar of the Pacific Salmon Strategy Initiative. The David Suzuki Foundation also provided funding to support a pilot program to test sampling procedures prior to fleetwide program implementation.

REFERENCES

- Beacham, T.D., Wallace, C., Macconnachie, C., Jonsen, K., McIntosh, B., Candy, J.R., and Withler, R.E. 2018. Population and individual identification of Chinook salmon in British Columbia through parentage-based tagging and genetic stock identification with single nucleotide polymorphisms. *Can. J. Fish. Aquat. Sci.* **75**(7): 1096–1105. doi:10.1139/cjfas-2017-0168.
- COSEWIC. 2018. COSEWIC assessment and status report on the Chinook Salmon *Oncorhynchus tshawytscha*, Designatable Units in Southern British Columbia (Part One - Designatable Units with no or low levels of artificial releases in the last 12 years), in Canada. *In* Committee on the Status of Endangered Wildlife in Canada, Ottawa. Available from <https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html>.
- COSEWIC. 2020. COSEWIC assessment and status report on the Chinook Salmon *Oncorhynchus tshawytscha*, Designatable Units in Southern British Columbia (Part Two – Designatable Units with High Levels of Artificial Releases in the Last 12 Years), in Canada. *In* Committee on the Status of Endangered Wildlife in Canada. Ottawa. Available from <https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html>.
- CTC (Chinook Technical Committee). 1988. 1987 Annual Report. Pacific Salmon Commission Joint Chinook Technical Committee Report TCCHINOOK (88)-2. Vancouver, BC.
- CTC (Chinook Technical Committee). 2019. 2018 Exploitation Rate Analysis and Model Calibration, Volume One. Pacific Salmon Commission Joint Chinook Technical Committee Report TCCHINOOK (19)-02. Vancouver, BC.
- CTC (Chinook Technical Committee). 2023. 2022 Exploitation Rate Analysis. Pacific Salmon Commission Joint Chinook Technical Committee Report TCCHINOOK (23)-01. Vancouver, BC.
- Dionne, K., Rachinski, T., Parken, C., Weir, L., Doutaz, D., Ritchie, L., Bailey, R., Jenewein, B., Miller-Saunders, K., Labelle, M., Manson, M., Welch, P., Trouton, N., Mozin, P., and Walsh, M. 2023. Recovery Potential Assessment for Southern British Columbian Chinook Populations, Fraser and Southern Mainland Chinook Designatable Units (1, 6, 13 and 15). DFO Can. Sci. Advis. Sec. Res. Doc. 2023/042. xvii + 291 p.
- Dobson, D., Holt, K., and Davis, B. 2020. A Technical Review of the Management Approach for Stream-Type Fraser River Chinook. DFO Can. Sci. Advis. Sec. Res. Doc: x +281 pp.
- Fisheries and Oceans Canada. 2023a. Groundfish Integrated Fisheries Management Plan 2023/24.
- Fisheries and Oceans Canada. 2023b. Southern Salmon Integrated Fisheries Management Plan 2023/24.
- Fishery (General) Regulations*, SOR/93-53.
- Matylewich, M., M. Oatman, C. Parken, B. Riddell, B. Tweit, H. Wright, C. Baldwin, T. Garrison, R. Lothrop, and E. McGrath. 2019. A Summary of Okanagan Chinook Information Requested by the Pacific Salmon Commission. Pacific Salmon Comm. Tech. Rep. No. 42: 89 p.
- Shirk, P.L., Richerson, K., Banks, M., and Tuttle, V. 2023. Predicting bycatch of Chinook salmon in the Pacific hake fishery using spatiotemporal models. *ICES J. Mar. Sci.* **80**(1): 133–144. Oxford Academic. doi:10.1093/ICESJMS/FSAC219.

TABLES

Table 1 – Summary of salmon bycatch monitoring and sampling requirements in the Option A groundfish trawl fishery for the standard and enhanced monitoring periods.

		Standard Monitoring Period	Enhanced Monitoring Period
Time period		<ul style="list-style-type: none"> All catch monitoring results prior to September 26, 2022 	<ul style="list-style-type: none"> September 26, 2022 to February 20, 2023, ongoing as of report publication
Retention requirements by catch type	Vessels landing fresh catch	<ul style="list-style-type: none"> Retention of salmon prohibited 	<ul style="list-style-type: none"> 100% retention of entire salmon to enable accurate enumeration and sampling
	Vessels landing frozen catch	<ul style="list-style-type: none"> Retention of salmon prohibited 	<ul style="list-style-type: none"> 100% retention of salmon heads only, vessels responsible for cutting and bagging heads
Species identification and counts	Vessels landing fresh catch	<ul style="list-style-type: none"> Fisher logbook reporting of at-sea released salmon catch ASOP catch monitoring up until March 2020 DMP counts of any landed salmon by species 	<ul style="list-style-type: none"> Fisher logbook reporting of counts and weights of retained salmon catch. DMP counts and weights of all landed salmon catch by species 25% of trips randomly selected for collection of Chinook and Coho salmon heads by DMP Lab: Counts and speciation of all salmon heads
	Vessels landing frozen catch	<ul style="list-style-type: none"> Fisher logbook reporting of at-sea released salmon catch ASOP catch monitoring up until March 2020 DMP counts of any landed salmon by species 	<ul style="list-style-type: none"> Fisher logbook reporting of counts and weights of at-sea retained salmon catch with EM auditing 100% of trips targeted for collection of salmon heads (all species) Lab: Counts and speciation of all salmon heads
Coded wire tag sampling	Vessels landing fresh catch	<ul style="list-style-type: none"> No random/representative requirement for sampling of CWTs ASOP opportunistic sampling of CWTs 	<ul style="list-style-type: none"> 25% of trips randomly selected for collection of Chinook and Coho salmon heads at offload Lab: All heads sampled for CWTs
	Vessels landing frozen catch	<ul style="list-style-type: none"> No random/representative requirement for sampling of CWTs ASOP opportunistic sampling of CWTs 	<ul style="list-style-type: none"> 100% of trips targeted for collection of salmon heads, bagged and labelled by tow Lab: All heads sampled for CWTs.
DNA sampling	Vessels landing fresh catch	<ul style="list-style-type: none"> No requirements for DNA sampling 	<ul style="list-style-type: none"> Lab: All heads sampled for DNA; Sub-sample of Chinook salmon heads selected for genetic analysis
	Vessels landing frozen catch	<ul style="list-style-type: none"> No requirements for DNA sampling 	<ul style="list-style-type: none"> Lab: All heads sampled for DNA; Sub-sample of Chinook salmon heads selected for genetic analysis

Table 2 – Summary of annual coastwide salmon catch (numbers of fish retained and released) by species, number of fishing trips, tows with mid-water gear type, 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.

Groundfish fishing year	All salmon (# of fish)	Chinook (# of fish)	Coho (# of fish)	Chum (# of fish)	Pink (# of fish)	Sockeye (# of fish)	Unidentified salmon (# of fish)	# of trawl trips	# of mid-water tows	Total landed catch (kg)	Landed catch Pacific Hake (kg)	Landed catch Walleye Pollock (kg)
2008/09	3,470	3,121	56	195	19	0	79	1,882	4,029	103,600,000	73,800,000	1,606,000
2009/10	9,611	8,628	95	191	566	32	99	1,586	2,967	85,280,000	55,780,000	3,570,000
2010/11	7,364	6,973	62	185	44	21	79	1,537	3,333	85,760,000	56,020,000	3,706,000
2011/12	11,193	9,808	242	457	328	22	336	1,534	3,500	90,780,000	55,400,000	3,866,000
2012/13	8,062	7,119	418	253	25	18	229	1,369	3,286	81,190,000	46,910,000	5,807,000
2013/14	4,813	3,034	292	218	700	16	553	1,395	3,415	90,790,000	54,060,000	4,063,000
2014/15	7,668	6,641	234	240	125	23	405	1,151	2,671	79,640,000	37,440,000	7,006,000
2015/16	7,645	6,319	193	794	122	80	137	1,049	2,673	80,470,000	45,420,000	3,984,000
2016/17	3,510	2,469	403	296	21	28	293	1,268	3,454	109,800,000	74,610,000	2,340,000
2017/18	8,265	7,320	113	394	157	39	242	1,374	3,988	124,300,000	90,780,000	3,363,000
2018/19	8,886	8,290	123	284	46	16	127	1,403	4,741	133,200,000	102,400,000	3,275,000
2019/20	7,680	6,776	199	294	80	59	272	1,304	5,063	132,200,000	98,830,000	7,587,000
2020/21	12,354	11,848	27	197	30	2	250	1,141	5,030	127,300,000	102,100,000	6,006,000
2021/22	11,627	9,635	695	708	572	17	0	907	3,912	98,350,000	63,930,000	8,588,000
2022/23	28,117	26,273	625	1,097	18	42	123	847	3,424	74,710,000	38,560,000	9,412,000

Table 3 – 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	Unidentified salmon catch
2008	3,209	2,871	26	191	19	0	102
2009	9,646	8,666	121	178	566	32	83
2010	7,582	7,097	65	205	44	20	151
2011	11,081	9,753	242	456	325	23	282
2012	8,299	7,404	378	254	28	18	217
2013	4,681	2,898	289	212	701	14	567
2014	7,299	6,303	247	244	121	24	360
2015	8,171	6,731	211	795	119	81	234
2016	3,157	2,211	400	290	28	28	200
2017	6,839	5,944	129	394	93	39	240
2018	9,218	8,514	119	288	85	16	196
2019	7,828	6,945	146	292	96	55	294
2020	10,002	9,442	83	178	39	6	254
2021	14,270	12,255	697	729	572	17	0
2022	24,457	22,624	613	1,101	16	42	122

Table 4 – Coastwide monthly catch by salmon species (numbers of fish retained and released) in the groundfish trawl fishery for the 2022/23 Groundfish Fishing Year (February 21, 2022 to February 20, 2023). The number of salmon heads collected represents heads that were counted and identified to species by independent lab verification as part of the enhanced monitoring program, and are included in monthly catches by species.

Month	Total salmon catch	# salmon heads collected	Chinook catch	Coho catch	Chum catch	Pink catch	Sockeye catch	Steelhead catch	Unidentified salmon catch
Feb 21 – Feb 28	67	0	67	0	0	0	0	0	0
Mar	514	0	514	0	0	0	0	0	0
Apr	267	0	189	13	61	1	3	0	0
May	1,117	0	1,044	7	66	0	0	0	0
Jun	495	0	464	2	29	0	0	0	0
Jul	1,978	0	1,963	6	3	4	0	0	2
Aug	2,704	0	2,053	547	90	1	13	0	0
Sep	2,227	1	2,029	33	53	9	25	0	78
Oct	8,268	7,129	7,518	4	767	1	0	0	39
Nov	2,625	2,124	2,594	1	27	0	1	0	2
Dec	2,827	2,556	2,825	0	1	0	0	0	1
Jan	1,756	1,585	1,755	1	0	0	0	0	0
Feb 1- Feb 20	3,272	3,057	3,258	11	0	2	0	0	1

Table 5 – Total salmon catch (numbers of fish retained and released) by species, Region (see Appendix C for included PFMA) and catch type for the 2022/23 groundfish fishery year (February 21, 2022 to February 20, 2023). Catch in the Unassigned Region could not be associated to a single geographic Region.

Region	Catch type	Total salmon catch	Total heads sampled	Chinook catch	Coho catch	Chum catch	Pink catch	Sockeye catch	Unidentified salmon catch
North Coast	FRESH	87	4	44	15	20	5	3	0
	FROZEN	453	346	427	11	8	1	0	6
QC & JSt Strait	FRESH	0	0	0	0	0	0	0	0
	FROZEN	12,176	11,987	11,649	4	513	2	25	3
Strait of Georgia	FRESH	3,264	1,162	3,220	4	40	0	0	0
	FROZEN	0	0	0	0	0	0	0	0
WCVI NORTH	FRESH	360	2	355	1	0	0	0	4
	FROZEN	705	393	383	27	309	0	1	11
WCVI SOUTH	FRESH	3,293	105	3,280	12	1	0	0	0
	FROZEN	7,135	1,965	6,299	550	179	10	13	99
Unassigned	FRESH	368	216	348	1	19	0	0	0
	FROZEN	276	272	268	0	8	0	0	0
TOTAL	FRESH	7,372	1,489	7,247	33	80	5	3	4
	FROZEN	20,745	14,963	19,026	592	1,017	13	39	119
TOTAL		28,117	16,452	26,273	625	1,097	18	42	123

Table 6 – Summary of Chinook catch (numbers of fish), sample sizes of CWTs and PBT-GSI, and sample rates for CWT and stock composition analysis in the Groundfish Trawl Fishery during the enhanced monitoring period (September 26, 2022 to February 20, 2023). The CWT sample rate is equal to the proportion of Chinook catch that had heads collected and scanned for CWTs, while the CWT Partition is the proportion of heads that contained CWTs from those that were scanned. The PBT-GSI partition is the remaining fraction without CWTs where stock composition is estimated from PBT-GSI samples. The PBT-GSI partition sample rate is the proportion of Chinook catch without CWTs that have been analyzed using PBT-GSI, while the CWT partition sample rate is the same as the CWT sample rate.

Time period	Region	Catch type	Chinook catch (# of fish)	Chinook sampled (# heads collected)	CWT Analysis			Stock Composition Analysis			
					CWT Sample Rate	# CWTs recovered	# Indicator CWTs from Canadian Stocks	CWT Partition	PBT-GSI Partition	# PBT-GSI analyzed	PBT-GSI Partition Sample Rate
Sep 26 – Dec 31 2022	North Coast	FRESH	23	2	9%	0	0	0.0%	100.0%	0	0%
		FROZEN	342	339	99%	67	1	19.8%	80.2%	38	14%
	QC & JSt Strait	FROZEN	7212	7212	100%	1088	116	15.1%	84.9%	306	5%
	Strait of Georgia	FRESH	2606	1037	40%	95	17	9.2%	90.8%	315	13%
		FROZEN	178	0	0%	0	0				
	WCVI North	FRESH	178	0	0%	0	0				
		FROZEN	193	190	98%	28	1	14.7%	85.3%	47	29%
WCVI South	FRESH	271	96	35%	5	0	5.2%	94.8%	5	2%	
	FROZEN	1941	1941	100%	203	15	10.5%	89.5%	18	1%	
Jan 1 - Feb 20 2023	North Coast	FRESH	0	0		0	0				
		FROZEN	2	0	0%	0	0			0	
	QC & JSt Strait	FROZEN	4287	4287	100%	558	144	13.0%	87.0%	1068	29%
	Strait of Georgia	FRESH	247	120	49%	6	4	5.0%	95.0%	111	47%
	WCVI North	FRESH	43	2	5%	0	0	0.0%	100.0%	0	0%
		FROZEN	0	0		0	0			0	
	WCVI South	FRESH	332	7	2%	1	0	14.3%	85.7%	5	2%
FROZEN		1	1	100%	0	0			0		

Table 7 – Estimates of CWT recoveries of Canadian exploitation rate indicator stocks in the Groundfish Trawl Fishery during the enhanced monitoring period (September 26, 2022 to February 20, 2023). The CWT sample rate is equal to the proportion of Chinook catch that had heads collected and scanned for CWTs for each combination of Region, catch type and calendar year. Regions without any CWTs recovered from indicator stocks are excluded from the table. Estimates of CWT recoveries of indicator stocks for 2022 salmon-directed fisheries in BC marine waters are provided for comparative purposes. For consistency with trawl estimates, estimates for salmon-directed fisheries do not include incidental mortality, do not represent adult equivalents, and have not been infilled to compensate for missing observations on 2019 brood years due to lack of tagging. These estimates may therefore differ from numbers reported in PSC Chinook Technical Committee reports.

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

Time Period	Region	Catch Type	CWT Sample Rate	CHI	HAR	BQR	COW	NIC	RBT	PPS	QUI	SAM ¹	SMK ²
Sep 26 - Dec 31 2022	North Coast	FROZEN	99%	1	0	0	0	0	0	0	0	3	0
	QC & JSt Strait	FROZEN	100%	57	31	12	14	1	1	0	0	36	0
	Strait of Georgia	FRESH	40%	10.1	2.5	5	22.6	2.5	0	0	0	15.1	0
	WCVI North	FROZEN	98%	1	0	0	0	0	0	0	0	1	0
	WCVI South	FROZEN	100%	7	7	0	1	0	0	0	0	8	0
	TOTAL				76.1	40.5	17	37.6	3.5	1	0	0	63.1
Estimated CWT recoveries in 2022 BC marine salmon-directed fisheries retained catch				178.1	87.8	7.2	276.6	21.5	2609	5.1	275.3	412.8	87.9
Jan 1 – Feb 20 2023	QC & JSt Strait	FROZEN	100%	56	73	5	7	1	0	1	1	10	0
	Strait of Georgia	FRESH	49%	2.1	4.1	0	2.1	0	0	0	0	0	0
	TOTAL				58.1	77.1	5	9.1	1	0	1	1	10

¹ SAM = Samish River is a US stock and has been included as a proxy for Boundary Bay Chinook

² SMK = Similkameen River is a US stock and has been included as a proxy for Okanagan Summer Chinook

Table 8 – Stock composition for Southern BC Canadian stock management units of Chinook salmon during the enhanced monitoring period (September 26, 2022 to February 20, 2023) across Region, catch type, and time period strata. Stock proportions are estimated using weighted proportions from CWT and PBT-GSI samples, with CWT stock proportions applied to fish with CWTs and PBT-GSI proportions applied to the remaining subset of fish without CWTs. Stock composition estimates from strata with less than 5% CWT or PBT-GSI sample rates have not been estimated due to low sample sizes.

Time period	Region	Catch type	Chinook catch (# of fish)	% Canadian origin	Fraser Fall 4(1)	Fraser Sum. 4(1)	Fraser Sum. 5(2)	Fraser Spring 4(2)	Fraser Spring 5(2)	Lower Georgia Strait	Middle Georgia Strait	Upper Georgia Strait	WCVI	SC Mainland Inlet	
Sep 26 - Dec 31 2022	North Coast	FRESH	23												
		FROZEN	342	23.5%	6.6%	2.1%	2.1%	0.0%	0.0%	2.1%	4.2%	0.0%	4.2%	0.0%	
	QC & JSt Strait	FROZEN	7212	36.9%	21.4%	0.0%	0.0%	0.0%	0.6%	4.4%	10.2%	0.3%	0.0%	0.0%	
	Strait of Georgia	FRESH	2606	82.2%	49.5%	0.0%	0.0%	0.4%	0.3%	17.6%	13.5%	0.4%	0.0%	0.3%	
	WCVI North	FRESH	178												
		FROZEN	193	36.8%	27.7%	0.0%	1.8%	0.0%	0.0%	3.6%	3.6%	0.0%	0.0%	0.0%	
	WCVI South	FRESH	271												
		FROZEN	1941												
Jan 1 – Feb 20 2023	QC & JSt Strait	FROZEN	4287	60.2%	51.1%	0.0%	0.0%	0.0%	0.0%	2.6%	5.6%	0.1%	0.2%	0.3%	
	Strait of Georgia	FRESH	247	82.8%	41.4%	0.0%	0.0%	0.0%	0.0%	17.2%	22.5%	0.0%	0.0%	0.0%	
	WCVI North	FRESH	43												
	WCVI South	FRESH	332												

Table 9 - Stock composition for Northern BC Canadian stock management units of Chinook salmon during the enhanced monitoring period (September 26, 2022 to February 20, 2023) across Region, catch type, and time period strata. Stock proportions are estimated using weighted proportions from CWT and PBT-GSI samples, with CWT stock proportions applied to fish with CWTs and PBT-GSI proportions applied to the remaining subset of fish without CWTs. Stock composition estimates from strata with less than 5% CWT or PBT-GSI sample rates have not been estimated due to low sample sizes.

Time period	Region	Catch type	Chinook Catch (# of fish)	% Canadian origin	Central Coast	Skeena	Nass
Sep 26 - Dec 31 2022	North Coast	FRESH	23				
		FROZEN	342	23.5%	0.0%	2.1%	0.0%
	QC & JSt Strait	FROZEN	7212	36.9%	0.0%	0.0%	0.0%
	Strait of Georgia	FRESH	2606	82.2%	0.0%	0.0%	0.0%
	WCVI North	FRESH	178				
		FROZEN	193	36.8%	0.0%	0.0%	0.0%
WCVI South	FRESH	271					
	FROZEN	1941					
Jan 1 – Feb 20 2023	QC & JSt Strait	FROZEN	4287	60.2%	0.1%	0.1%	0.1%
	Strait of Georgia	FRESH	247	82.8%	0.0%	0.0%	0.0%
	WCVI North	FRESH	43				
	WCVI South	FRESH	332				

Table 10 – Brood year composition of Canadian-origin Chinook salmon samples based on parentage-based tags (PBTs) collected during the enhanced monitoring period from September 26, 2022 to February 20, 2023. Regions not shown did not contain any PBT samples. Salmon age may be calculated by subtracting the year a fish was caught from the brood year.

Time period	Region	# PBT	2018 brood year (# of Chinook)	2019 brood year (# of Chinook)	2020 brood year (# of Chinook)	% 2018 brood year	% 2019 brood year	% 2020 brood year
Sep 26 - Dec 31 2022	North Coast	6	0	2	4	0%	33%	67%
	QC & JSt Strait	47	0	3	44	0%	6%	94%
	Strait of Georgia	85	1	37	47	1%	44%	55%
	WCVI North	3	0	1	2	0%	33%	67%
	TOTAL	141	1	43	97	1%	30%	69%
Jan 1 – Feb 20 2023	QC & JSt Strait	192	0	8	184	0%	4%	96%
	Strait of Georgia	29	1	11	17	3%	38%	59%
	TOTAL	221	1	20	200	1%	17%	82%

Appendix A - 2022/23 Option A Groundfish Trawl Fleet Enhanced Salmon Monitoring, Bycatch Reporting & Biological Sampling Program Requirements

Introduction

Aug 30, 2022

Program requirements were developed 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. Lessons learned from the pilot have informed sampling procedures and further development of the monitoring program.

Separate requirements have been developed for Receiving Tank Vessels (RTVs) that freeze product at sea and vessels that land fresh product.

Vessels Freezing Catch at Sea

Vessel Requirements

For all trips:

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

Sampling kits will be provided by the dockside monitor and will contain:

- Detailed sampling instructions, including salmon head cut requirements
- 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.

AMR Dockside Monitor Procedures

For all landings:

1. Receive all tow bags containing heads 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 containing salmon heads 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. Close all trip bags and attach a TRIP bag label **to each bag** using zip ties.
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 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

For all trips:

1. Retain all salmon bycatch.
2. In the at-sea observer logbook, record the total estimated retained pieces and weights of all salmon 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 and Coho salmon.
2. Package salmon heads into bags.
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 - DFO Option A Trawl Salmon Head Sampling Instructions for Vessels Landing Catch Frozen



Fisheries and Oceans Canada / Pêches et Océans Canada



Option A Trawl RTV Salmon Head Sampling Instructions (for Receiving Tank Vessels that freeze their product at sea)

According to the scientific licence conditions, all Option A Trawl Receiving Tank Vessels that freeze their product at sea are required to remove and retain heads from all salmon caught as bycatch prior to landing. The bags and labels provided with these instructions must be used to store these heads.

1. Remove the heads from **all salmon species** with a straight cut running square to the lateral line, at least 1 cm behind the operculum, and include the gills and pectoral fins.



2. Heads must be packed by the tow in which they were caught. Do not mix heads from separate tows.
3. Use as many bags as needed for storing heads from a given tow. Three sizes of bags are provided so that you can choose the appropriate sized bag for the quantity of heads being packed – do not overfill medium and large bags as they may break during handling or transport.

Large Bags	18 x 30 inches	Leave approx. 12 inches (30 cm) of space at top before closing
Medium Bags	14 x 24 inches	Leave approx. 8 inches (20 cm) of space at top before closing
Small Bags	12 x 18 inches	Leave enough space at top to securely zip-tie

4. Every bag must have a completed tow bag label inside. Fill out a tow bag label: record the vessel name, tow number (if known), and packing date and time on the label. Put the label inside the tow bag, then close the bag securely with a zip tie.

SALMON HEAD <u>TOW</u> BAG LABEL			GROUND FISH							
(Instructions on back)										
Vessel Name: _____	Tow#: _____	Unknown: <input type="checkbox"/>	<div style="display: flex; align-items: center; justify-content: center;"> </div> <p style="margin: 0;">1 5 0 9 0 0 1</p> <div style="display: flex; justify-content: space-around; font-size: small;"> P <input type="checkbox"/> H <input type="checkbox"/> C <input type="checkbox"/> </div> <div style="display: flex; justify-content: space-around; font-size: x-small;"> 15 24 NP FM LF LP </div>							
Packing Date & Time:	<table border="1" style="border-collapse: collapse; text-align: center; width: 100%;"> <tr> <td style="width: 25px;">D</td><td style="width: 25px;">D</td><td style="width: 25px;">M</td><td style="width: 25px;">M</td><td style="width: 25px;">2</td><td style="width: 25px;">0</td><td style="width: 25px;"></td><td style="width: 25px;"></td> </tr> </table> :	D		D	M	M	2	0		
D	D	M	M	2	0					

5. Heads in bags must be frozen until delivery to preserve samples.
6. Transfer all bags containing heads to the designated Archipelago Marine Research (AMR) dockside monitor **at the end of the offload.**
7. Let the AMR dockside monitor know if there aren't enough supplies for your next trip and they will resupply you.

For further assistance call the DFO Salmon Head Recovery Program at **1-866-483-9994.**

Appendix C - Table and map of Regions for defining catch strata

Table C1 – Correspondence between Regions and PFMA's and groundfish management areas. Regions were used to define strata for reporting, CWT analysis, and stock composition estimation.

Region	Abbreviation	Pacific Fishery Management Areas (PFMA's)	Groundfish Management Areas
West Coast Vancouver Island South	WCVI South	20 to 24, 121 to 124	3C, portions of 4B and 3D
West Coast Vancouver Island North	WCVI North	25 to 27, 125 to 127	3D, portions of 5A
Strait of Georgia	SoG	14 to 19, 28, 29	Portions of 4B
Queen Charlotte & Johnstone Strait	QC & JSt Strait	11, 12	Portions of 4B and 5A
North Coast	NC	3 to 10, 101 to 11, 127, 130, 142	5B, 5C, 5D, 5E, portions of 5A
Unassigned	UN	Unknown or multiple PFMA's	

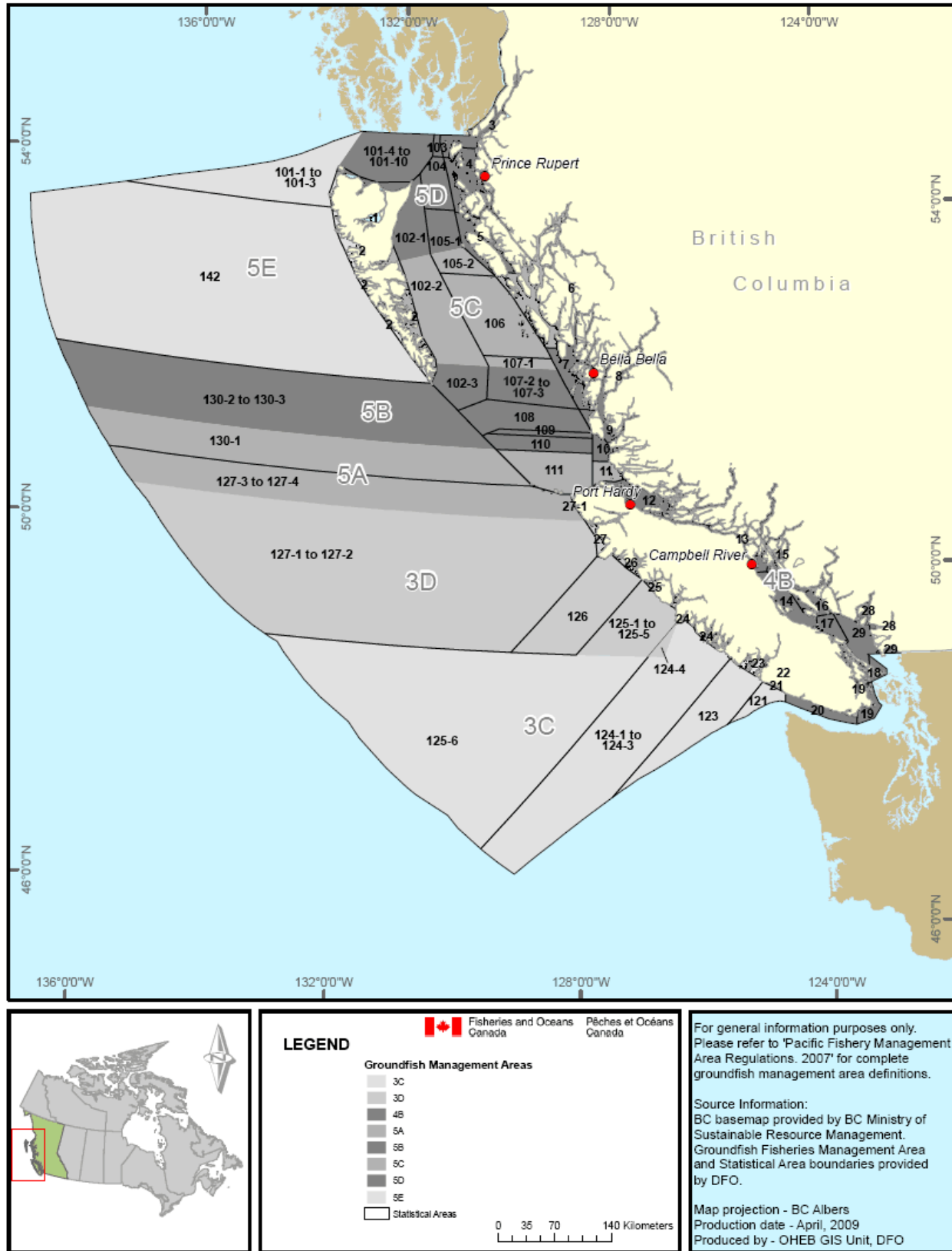


Figure C1 – Map of Groundfish Management Areas and PFMA. Adapted from <https://www.pac.dfo-mpo.gc.ca/fm-gp/maps-cartes/ground-fond/index-eng.html>

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

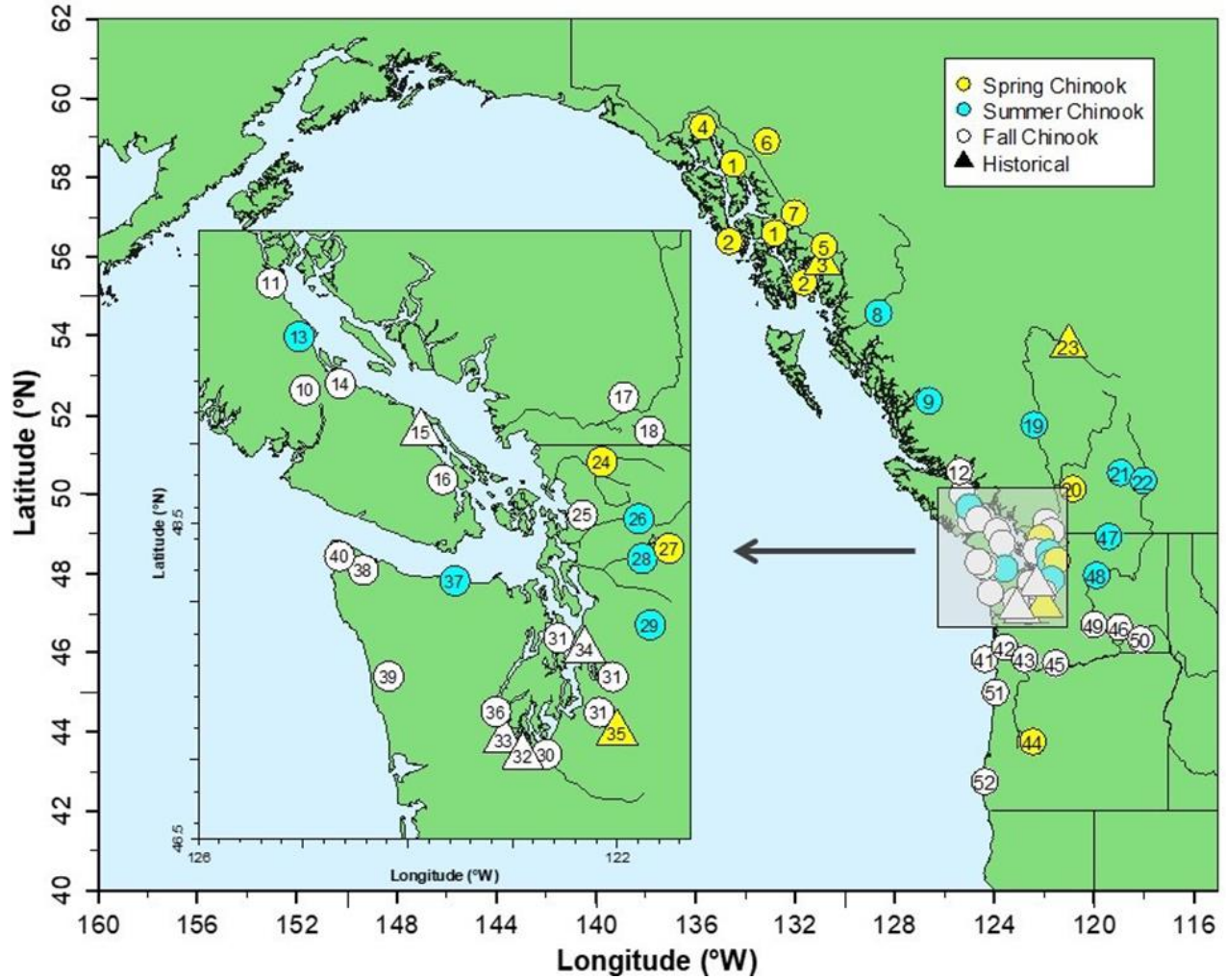


Table D1—Summary of current and historic (last tagged brood year in brackets) coded wire tag (CWT) exploitation rate indicator stocks, location, run type, and smolt age. Adapted from CTC 2023, Pages 4-5.

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
	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
Transboundary Rivers	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)
Central Puget Sound	Stillaguamish Fall Fingerling (STL) ₃	Stillaguamish Tribal	Summer/Fall	Age 0	28	Current

Stock/Area	Exploitation Rate Indicator Stock	Hatchery	Run Type	Smolt Age	Map No.	Status
	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/Is saquah 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 - SMU-CU-Reporting Units Tables

Table E1 – 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
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

Reporting Unit	CU #	Conservation Unit (CU) name	Stock Management Unit (SMU)
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 E2 – 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 F - Salmon catch by Pacific Fishery Management Area for 2022

Table F1 – Estimated annual salmon catch (pieces retained and released) by Pacific Fishery Management Area (PFMA) in the groundfish trawl fishery during the 2022 calendar year. *Catches are confidential when fewer than 3 distinct vessels fished in an area over the time period.

PFMA	All salmon	Chinook	Coho	Chum	Pink	Sockeye	Unidentified salmon
0	4,235	4,191	2	34	0	0	5
3*							
7	228	216	7	1	1	0	3
11	3,819	3,350	0	455	0	13	1
12	2,340	2,291	0	57	0	12	0
14	2,854	2,816	0	38	0	0	0
15	38	38	0	0	0	0	0
17*							
18	123	123	0	0	0	0	0
20	206	145	32	29	0	0	0
21*							
29	49	49	0	0	0	0	0
101	183	173	0	7	2	0	1
104	32	31	1	0	0	0	0
105	1	1	0	0	0	0	0
107	10	1	6	1	0	0	2
108	24	15	4	4	1	0	0
109	12	4	3	3	2	0	0
110	5	2	0	3	0	0	0
111	17	11	2	4	0	0	0
121	4,911	4,337	374	99	9	13	79
123	3,175	3,004	138	33	0	0	18
124	902	860	17	22	1	0	2
125	526	457	4	64	0	1	11
126	54	42	0	12	0	0	0
127	548	306	23	234	0	0	0
130	2	2	0	0	0	0	0
142	3	0	0	0	0	3	0
Total	24,457	22,624	613	1,101	16	42	122