Fisheries and Oceans Canada | Pêches et Océans Canada
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Pacific Region

Canadian Science Advisory Secretariat
Science Advisory Report 2026/054

STOCK ASSESSMENT OF FRASER SUMMER 5_2 (1.3) CHINOOK SALMON (*ONCORHYNCHUS TSHAWYTSCHA*) IN 2024

CONTEXT

The Fisheries Management sector of Fisheries and Oceans Canada (DFO) has requested that reference points consistent with the DFO Precautionary Approach (DFO 2006) be developed for Fraser Summer 5_2 (1.3) Chinook salmon (*Oncorhynchus tshawytscha*). This request includes a review of possible fishing scenarios and rebuilding actions for Fraser Summer 5_2 (1.3) Chinook salmon that could contribute to stock rebuilding, and that the stock status be assessed relative to the reference points.

This Fisheries Science Advisory Report is from the regional peer review meeting of March 3-5, 2026 on Fraser Spring 5-2 and Summer 5-2 Chinook Salmon (*Oncorhynchus tshawytscha*) Stock Assessment in 2024. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

SCIENCE ADVICE

Status

- The Fraser Summer 5_2 (1.3) Chinook salmon Stock Management Unit (SMU) consists of six Conservation Units (CUs) – Lower Fraser – Upper Pitt SU 1.3, Lower Fraser River SU 1.3, Middle Fraser River – Portage FA 1.3, Middle Fraser SU 1.3, South Thompson SU 1.3 and North Thompson SU 1.3.
- This SMU is below the CU-status based Limit Reference Point (LRP), based on the Wild Salmon Policy (WSP) Rapid Status Approach because two of the six CUs in the Summer 5_2 (1.3) SMU are assessed as *Red* status. The WSP defines *Red* status CUs as being in poor status with a high risk of extinction.
- Lower Fraser – Upper Pitt SU 1.3 CU is *Red* since it falls below the long-term trend metric lower threshold. Middle Fraser River - Portage FA 1.3 CU is *Red* since it falls below the absolute abundance metric lower threshold. Respectively, these CUs were approximately 0.2% and 0.7% of the surveyed abundance of the SMU over the most recent generational average (2020-2024).

Trends

- In 2024, an estimated 11,800 spawners returned to the surveyed proportion of the Fraser Summer 5_2 (1.3) SMU, which is 60% of the 1975-2024 average. The estimated number of returning spawners in the Fraser Summer 5_2 (1.3) SMU ranged from ~18,000 – 30,000 in the 1980s to mid-1990s, with substantial variation over the last decade (~6,500 – 28,000).
- Hatchery production has been relatively limited for this SMU. Releases were highest in the 1980s and 1990s (averaging ~1,900,000 annually) and have decreased since then.

Production since 2020 has averaged approximate 700,000 releases per year, for multiple enhancement objectives.

- Following declines in abundance, management measures have been implemented to progressively reduce fisheries impact. The Fishery Mortality Index (FMI) between 2019 and 2024 has been between 10 and 16% in Canada for the Fraser Summer 5_2 (1.3) SMU. Preliminary total calendar year exploitation rate (CYER) estimates range between 3 and 21% for both Canada and the United States. These estimates are likely below the estimated removal reference credible range.

Ecosystem and Climate Change Considerations

- The consequences of habitat and climate change impacts were qualitatively taken into account in the WSP Rapid Status Assessment approach. We expect with climate change and ongoing land-use activities that upstream migratory, spawning, and rearing conditions will continue to degrade.
- Current freshwater habitat conditions are poor due to elevated stream temperatures and low flows in the summer period. These are expected to increase pre-spawn mortality and reduce fry production due to decreased summer rearing habitat.
- Major disturbances, such as recent landslides in the Fraser River mainstem (Big Bar 2019) and Chilcotin River (July 2024) that limited Fraser Summer 5_2 (1.3) adult access to spawning grounds are expected to increase in frequency.
- Effects of climate change were indirectly considered in model simulations of future Chinook abundance by testing a broad range of possible future stock productivities.

Stock Advice

- A simulation analysis was developed to determine the SMU level impacts of different exploitation rates. In simulation, no combinations of Canadian exploitation rate and productivity produced enough spawners for all CUs to have an *Amber* or better status with high probability. Thus, an exploitation rate-based fisheries reference point lower (FRP-L) could not be identified. This result was driven by four CUs (Lower Fraser Upper Pitt SU 1.3, Middle Fraser River – Portage FA 1.3, Lower Fraser SU 1.3, South Thompson SU 1.3) with very small accessible watershed areas, which had a low or very low probability of exceeding the 1,500 spawner threshold.
- In simulation, despite little variation in future outcomes with respect to the CU status-based LRP, various combinations of Canadian exploitation rate and productivity resulted in different outcomes for individual CUs in achieving certain WSP statuses, and surpassing 20% S_{max} thresholds.
- The relationship between the FMI and the Canadian CYER was investigated, and they were weakly correlated with high uncertainty. Given this, the FMI-based data provided on catch, recruitment, and fisheries impact should be interpreted cautiously.
- Comprehensive stock advice and a complete suite of reference points requires a stock-recruit time series for salmon. Currently, absolute spawner abundance estimates are not available for this SMU. Exploitation rate by age is available only for a short time series. To address these data gaps, improved monitoring of escapement and continuation of the indicator stock program for the Chilko River Summer Chinook population are recommended.

BASIS FOR ASSESSMENT

Assessment Details

The methods used to assess the status of Pacific Salmon CUs in this paper were identified and approved in 2009 (Holt et al. 2009; Grant 2013; Pestal et al. 2023; DFO 2024) and the Pacific Salmon SMU LRP methods were approved in 2022/2023 (Holt et al. 2023).

Year Assessment Approach was Approved

2022

Assessment Type

Full Assessment

Most Recent Assessment Date

1. Last Full Assessment: 2022 (Weir et al 2022, Doutaz et al 2021)
2. Last Interim-Year Update: 2018 (COSEWIC 2018)

Stock Assessment Approach

1. Broad category: Multiple Approaches: Index-based, Wild Salmon Policy Rapid Status Approach, adaptation of closed loop simulation models.
2. Specific category: Stock-recruitment Relationship, Virtual population analysis, Relationship between Fisheries Mortality Index (FMI) and the Canadian portion of Calendar Year Exploitation Rate (CYER).

This Fraser Summer 5_2 (1.3) Chinook assessment used a mix of previously-established peer-reviewed methods and new methods because Chinook data time series for Fraser Summer 5_2 (1.3) Chinook stocks are short (i.e., exploitation rate and escapement/recruitment by age timeseries spans return years 2019-2024) and uncertain (dominated by escapement data type classifications 3 & 4)[1]. For status assessment, the WSP Rapid Status Approach was used. For the remaining elements of this assessment, new methods were developed:

1. to estimate stock recruitment parameters;
2. to describe the relationship between two different measures of fishery impacts (Fisheries Mortality Index vs Canadian Calendar Year Exploitation Rate); and
3. to simulate future CU-level abundance for the Fraser Summer 5_2 (1.3) Chinook SMUs across a range of potential harvest rates and productivity scenarios.

The Wild Salmon Policy Rapid Status Approach was used to assign a ‘Red’ (poor), ‘Amber’ (intermediate), or ‘Green’ (good) status with ‘Low’, ‘Medium’, or ‘High’ confidence rating to WSP conservation units (CU) with applicable data. SMU status (above or below the LRP) was determined using the CU status-based method where all CUs must achieve an Amber or better status for the SMU to exceed its LRP. CU statuses are generated by applying available CU data

[1] Bailey, C.J., Borea, I., Freshwater, C., Greenberg, D., Wor, C., Parken C., and Strait, A. In prep. Stock Status, Exploitation Rate Conversion, and Simulation Analysis of Future Stock Status under Varying Productivity and Exploitation Rate Scenarios for Fraser River Spring and Summer 1.3 (5_2) Chinook Salmon (*Oncorhynchus tshawytscha*). DFO Can. Sci. Advis. Sec. Res. Doc.

to a computer-coded WSP rapid status decision tree. Methods and best practices are described in greater detail in (Grant et al. 2026; Pestal et al. 2023; DFO 2024).

Fraser Summer 5_2 (1.3) Chinook stock recruitment parameters were estimated at the SMU-level for Ricker α and at the CU-level for Ricker β. The Ricker α parameter was estimated by using stock-recruit data from the most closely-related Fraser Chinook stock (Fraser Spring 4_2 (1.2) Chinook) and adjusting the parameter based on proportional differences in fecundity between the stocks. Information on differences in fecundity are not available at the CU-level for all CUs, so a single Ricker α value was estimated for the entire SMU. The Ricker β parameter for each CU was estimated using the Parken Habitat Model (Parken et al. 2006 - details available in the code repository (Bailey et al. 2026) and the accompanying research document[1]).

Both the CYER and FMI provide imperfect estimates of fishing impacts. The former is a multidecadal time series and has received extensive validation given its role in Pacific Salmon Treaty processes (Pacific Salmon Commission 2023). Conversely, year-specific estimates of FMI only began to track year-to-year changes in fishery impacts since 2019 and the methods used to estimate FMI continue to be revised, suggesting it may have greater uncertainty (DFO 2025b). Since the contemporary CYER time series for the Fraser Summer 5_2 (1.3) Chinook SMU is relatively short, fisheries management objectives have recently been evaluated using the FMI. The relationship between FMI and CYER was quantified using a measurement error model to better understand how managing fisheries using FMI may result in deviations between target and realized exploitation rates (i.e., implementation error)[1].

Previously used closed-loop simulation methods (Holt et al. 2023; DFO in press) were adapted to evaluate the performance of fixed Canadian ER scenarios for the Fraser Summer 5_2 (1.3) SMU. Specifically, simulations were used to assess the probability that each CU would exceed either 1,500 spawners or their respective lower benchmarks (whichever value was larger; this is an approximation of a WSP Rapid Status Assessment), that each CU would exceed their lower biological benchmarks (20% S_{max}, regardless of whether the value exceeds 1,500 spawners or not), and that each SMU would exceed its CU status-based LRP. The simulations were parameterized with:

1. Ricker stock-recruit parameters estimated using non-traditional methods described above;
2. correlations among the natural-origin spawner escapement time series for each CU;
3. estimates of the mean and variance in spawner proportions-at-age; and
4. ER implementation error[1].

Additional detail on the methods described above are available both in a code repository (Bailey et al. 2026) and in the accompanying research document[1] for this FSAR.

Stock Structure Assumption

The Fraser Summer 5_2 (1.3) Chinook Salmon SMU consists of six Conservation Units (CUs; Table 1). The CUs are based on ecology, life history, genetics and ecological characterizations (Holtby and Ciruna 2007). The extent of spawning in this SMU covers a large geographical area within the Lower Fraser and Middle Fraser River watershed, South Thompson River and tributaries, and the North Thompson River and several of its tributaries (Figure 1). There are limited age-structure data available for this SMU, however, available data suggest that the dominant age class of adults returning to freshwater to spawn is 5-year-olds with observations of 3, 4 and 6-year olds. Chinook Salmon in this SMU exhibit a stream-type life history, spending at least one year rearing as juveniles in freshwater prior to migrating to the ocean, and return to

freshwater as adults several weeks before spawning. Greater than 50% of spawners pass through the Lower Fraser River between July 15th and August 31st (Weir et al. 2022 ; Dionne et al. 2023). The Middle Fraser River-Portage FA 1.3 CU is an exception, with peak migration through the Lower Fraser River around September 28th (Potapova et al. 2026). All six Fraser Summer 5_2 (1.3) CUs were historically enhanced by several hatchery facilities. Moderate enhancement continues in three of the CUs (Lower Fraser River, Middle Fraser River, South Thompson) across three major hatchery facilities.

Table 1. List of Conservation Units (CUs) within the Fraser Summer 5_2 (1.3) Stock Management Unit with corresponding Designatable Units (DUs), Committee on the Status of Endangered Wildlife in Canada (COSEWIC) status, and Wild Salmon Policy (WSP) Rapid Statuses.

Stock Management Unit	Conservation Unit ID	Conservation Unit name	Designatable Unit ID	Designatable Unit	COSEWIC Status (2018, 2020)	WSP Rapid Status (2024)
Fraser River Summer 5_2 (1.3) Chinook Salmon	CK-05	Lower Fraser-Upper Pitt SU 1.3	DU4	Lower Fraser River Stream Summer (Upper Pitt)	Endangered	Red, medium confidence
	CK-06	Lower Fraser River SU 1.3	DU5	Lower Fraser River Stream Summer	Threatened	Data Deficient
	CK-09	Middle Fraser River – Portage FA 1.3	DU8	Middle Fraser River Stream Fall (Portage)	Endangered	Red, high confidence
	CK-11	Middle Fraser SU 1.3	DU10	Middle Fraser River Stream Summer	Threatened	Amber, low confidence
	CK-14	South Thompson SU 1.3	DU13	South Thompson Stream Summer	Endangered	Amber, low confidence
	CK- 19	North Thompson SU 1.3	DU17	North Thompson Stream Summer	Endangered	Amber, low confidence

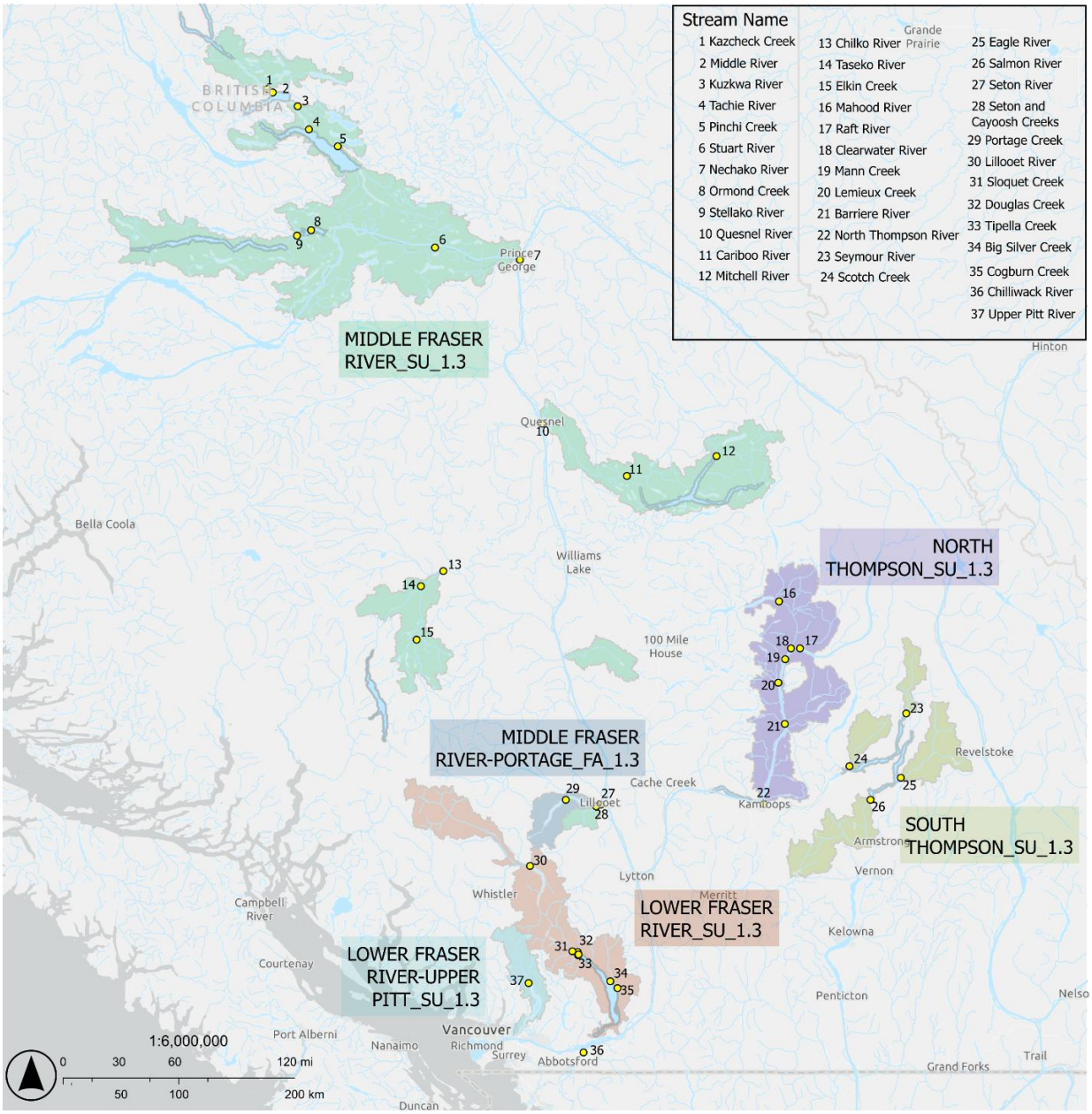


Figure 1. Fraser Summer 5_2 (1.3) Chinook Salmon Conservation Units and surveyed spawning populations. Adapted from Fisheries and Oceans Canada (2026). Salmon Space. Government of Canada

Reference Points

Reference points for the Fraser Summer 5_2 (1.3) Chinook Salmon SMU were developed based on Ricker stock-recruit parameter estimates described in the accompanying research document[1]. The status of the Fraser Summer 5_2 (1.3) Chinook salmon SMU was determined using a CU status-based limit reference point (LRP), where an SMU is below its LRP if there is at least one CU in the red status zone, and above its LRP if all CUs are WSP Amber or better status. Reference points were developed using natural-origin recruit and spawner data from a proxy population (Nicola River, Fraser Spring 4_2 (1.2) Chinook salmon SMU) and fecundity data from the proxy and Fraser Summer 5_2 (1.3) Chinook sampled during the Big Bar landslide

response, and pertain only to the natural-origin component of the SMU. While Fraser Spring 4_2 (1.2) Chinook salmon present the most suitable Fraser River proxy to Fraser Summer 5_2 (1.3) Chinook salmon from a life-history perspective, it is important to note that the latter mature later and that the Nicola River Chinook population experience extreme environmental conditions that are not representative of the average spawning conditions for Fraser Summer 5_2 (1.3) Chinook. Besides the LRP, only rate-based references points were developed or attempted to be developed because the SMU spawner abundances are primarily relative index abundance data (i.e., not valid for comparing against absolute abundance-based reference points). These include U_{MSY} (maximum sustainable exploitation rate; also known as the Removal Reference) and the Lower Fisheries Reference Point (FRP-L). U_{MSY} was estimated from a non-traditional estimate of the SMU-level Ricker α for Fraser Summer 5_2 (1.3) Chinook (methods described in detail in accompanying research document)[1]. Estimating a Lower fishery reference point (FRP-L) was attempted, but there were no simulation scenarios that produced greater than a 4% probability of the SMU exceeding its CU status-based LRP (Table 2).

Table 2. Fraser River Summer 5_2 (1.3) Chinook Stock Management Unit (SMU) proposed reference points. Uncertainty in these values is large, thus the 95% CIs are presented first as a hypothetical range of plausible values, followed by the median in brackets.

SMU scale Reference Point	Description	Value
Lower fishery reference point (FRP-L)	Greatest Exploitation Rate (ER) that allows all CUs to exceed WSP *Amber* status	NA[1]
U_{MSY}	Discrete fishing mortality (U) that will produce Maximum Sustainable Yield (MSY) under equilibrium conditions	0.12 – 0.72 (0.38)[1]

Data

Enumeration Methods

The number of adult Chinook Salmon that return to the spawning grounds has been estimated using a variety of survey methods from 1975-2024 across the six CUs. Since 1995, approximately 50-90% of observed spawners have been surveyed using visual methods (stream walks, float counts, aerial surveys) and a peak count expansion factor of 1.54 is applied to generate the final escapement estimate (Parken et al. 2003). These estimates are considered an index of escapement rather than an absolute count, and are only appropriate for describing trends in abundance through time. In 2010, a mark-recapture program was implemented to estimate escapement in the Chilko River (Middle Fraser CU). The Salmon River in the South Thompson CU has been surveyed using a fixed-site counting fence since the 1980s. The Chilko River population is the established ERIS for the Fraser Summer 5_2 (1.3) SMU. Historical low-precision visual-based escapement estimates prior to 2010 for the Chilko River have been calibrated to the contemporary high-precision mark recapture estimates following the methods established in Farwell et al. (2001). In the calibrated time series, all visual-based survey estimates were replaced with predicted spawner abundances from a simple linear model fit to 14 years (2010 – 2024) of paired visual-based and mark-recapture-based estimates.

Data Quality Filtering

Spawner escapement time series included in this assessment only include sites where the number of natural-origin spawners could be estimated or are expected to make up greater than 97% of the population. Key steps in processing escapement data for the purposes of the Rapid Status Assessment and model simulations are described in the accompanying research document[1]. Briefly, data quality is assessed based on the number and completeness of surveys, coverage of the spawning period, visibility and reliability of records, and level of hatchery enhancement. There are 39 sites across the six Fraser Summer 5_2 (1.3) CUs, 21 of which are included as sites with acceptable survey data quality. Three sites are excluded due to enhancement and the remaining are considered data deficient. The average spawner data quality is considered moderate throughout the time series for all CUs (classified as data Types 3-4)[1], with occasional high-quality data where SONAR or resistivity counters have been implemented (classified as data Types 1-2)[1]. For the Lower Fraser SU 1.3 (5_2) CU, most sites were considered data deficient, resulting in a limited time series with acceptable data. Similarly, the Lower Fraser – Upper Pitt SU 1.3 (5_2) CU had a limited time series with sufficient data quality.

Exploitation Rate

Under the 2019 PST Agreement (Pacific Salmon Commission 2023), the Chilko population is considered both a developing escapement indicator stock and Coded Wire Tag (CWT) Exploitation Rate Indicator Stock (ERIS) with the introduction of the CWT program. As such, the population will be subject to Calendar Year Exploitation Rate (CYER) limits for Individual Stock Based Management (ISBM) fisheries in Canada and the U.S. Due to lack of historical estimates, a CYER limit has not been set for this ERIS. There are enough CWT recovery data from the 2020 brood year onwards to calculate the CYER, however, the results have not yet been included as part of the official CTC annual Exploitation Rate Analysis (ERA) to meet PST obligations (Pacific Salmon Commission 2023; Chinook Technical Committee 2023). The CYER estimates used for this analysis are preliminary.

Smolt-to-age 3 Survival

Smolt survival (SS) is the proportion of out-migrating smolts that survive to recruit to the fishery (age-3 for stream-type populations). SS is calculated using CWT recoveries and a backwards cohort analysis to estimate the pre-fishery cohort abundance, which is then divided by the total number of CWT-marked smolts released for the cohort (Chinook Technical Committee 2025a). SS is determined as part of the annual ERA developed by the CTC for ERISs. For the Chilko ERIS, 2020 is the first brood year with sufficient CWT recovery data to estimate SS.

ASSESSMENT

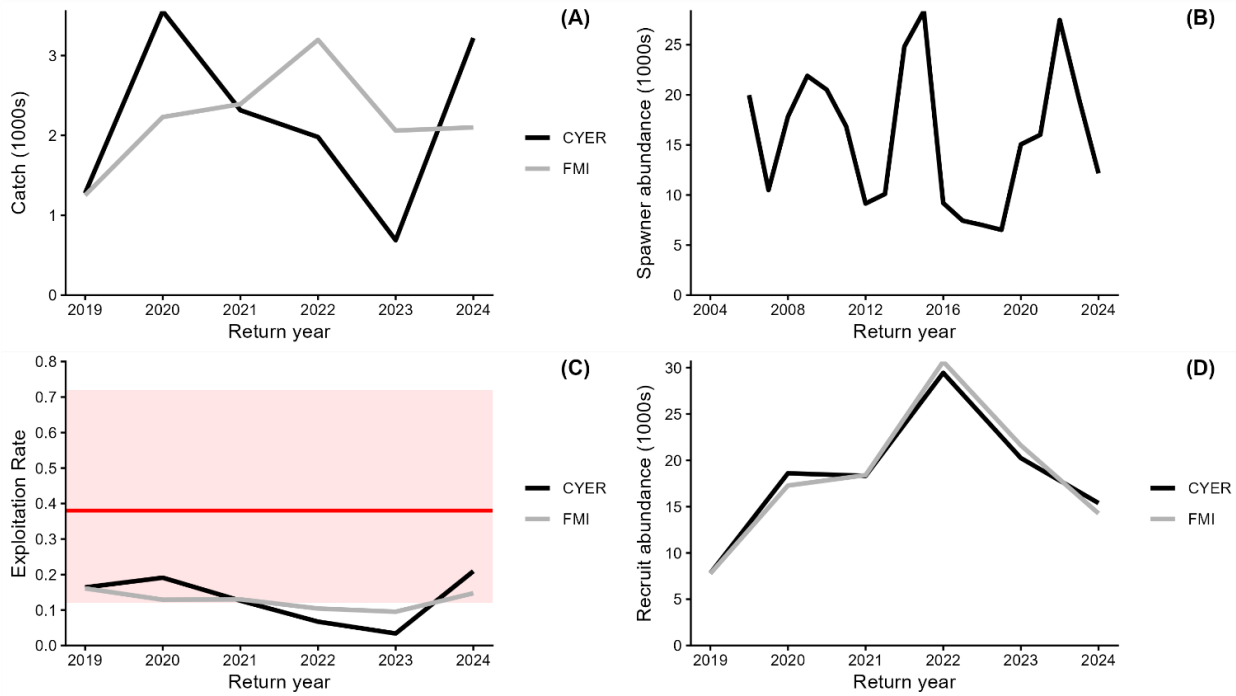


Figure 2. Fraser Summer 5_2 (1.3) Chinook (A) aggregate catch derived from Canadian Calendar Year Exploitation Rate (CYER - represented by the black solid line) and Fishing Mortality Index (FMI – represented by the grey solid line), (B) aggregate index spawner abundance for all spawning populations included in the WSP Rapid Status Assessment, (C) Canadian exploitation rate (CYER – represented by the black solid line and FMI - represented by the grey solid line) in relation to fishing mortality that results in maximum sustainable yield (U_{msy} - represented by the solid red horizontal line, with upper and lower 95% Credible Intervals represented by the red shaded area), (D) recruit abundance derived from CYER (represented by the black solid line) and FMI (represented by the grey solid line). Note the different x-axis limits for (B) as catch, exploitation rate and recruit abundance data are derived from FMI and CWT recovery data that are only available from 2019-2024.

Stock Status and Trends

Current Status

Two of six CUs in the Fraser Summer 5_2 (1.3) Chinook salmon SMU are assessed as in the WSP Red Status Zone (Figure 3), therefore the Fraser Summer 5_2 (1.3) SMU is below its CU-status based LRP. Statuses for most CUs within this SMU are determined using trend-based metrics under the WSP Rapid Status Approach because the data quality is too poor to assess against abundance-based benchmarks.

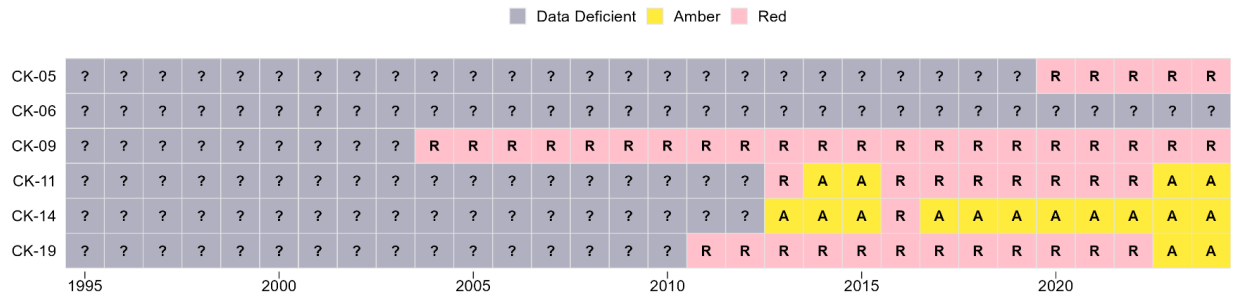


Figure 3. Fraser Summer 5_2 (1.3) Chinook (CK-05 Lower Fraser-Upper Pitt; CK-06 Lower Fraser River; CK-09 Middle Fraser River-Portage; CK-11 Middle Fraser River; CK-14 South Thompson; CK-19 North Thompson) Wild Salmon Policy Rapid Status time series for years with applicable data. Each row summarizes the statuses available for each Conservation Unit.

Escapement

Spawner estimates of Fraser Summer 5_2 (1.3) Chinook have varied substantially over the last decade. For historical context, the Chinook Technical Committee (CTC) 2024 Fraser River Summer 5_2 (1.3) escapement estimate was 11,800 spawners – 60% of the CTC 1975-2024 average escapement of 19,800 spawners (Chinook Technical Committee 2024). Return years 2018 and 2019 had the lowest estimates (relative to CTC data) observed since 1995 (Figure 2B). In this paper, we report only natural-origin (as opposed to total) spawner abundances using WSP data filtering and updated escapements, thus the shorter timeseries (2006-2024) with escapements ranging from ~6,500 – 28,300 adults, and a 2024 estimate of 12,160 adults. Escapement estimates remain below average for 2024 due to the 5-year-old adults returning from the brood year that were severely impacted by the 2019 Big Bar landslide in the Fraser River mainstem. Both small population CUs (Lower Fraser – Upper Pitt and Lower Fraser River) spawn in tributaries that meet the Fraser River mainstem downstream of Big Bar.

Smolt-to-age 3 Survival

For years where sufficient CWT recovery data are available to estimate SS for the Chilko CWT ERIS, the smolt-to-age 3 survival index is variable. Survival was below 1.0% prior to 2017, peaked in 2019 at 2.4%, and then declined to 1.4% in 2020 (Figure 4; note that the age 5 component of the 2020 brood year is not included and biasing the survival estimate low). However, the initial run of the Chilko exploitation rate analysis (ERA) included CWTs from both smolt and fry releases, thus survival estimates are likely biased low relative to smolt-to-age 3 survival for the dominant freshwater life history type.

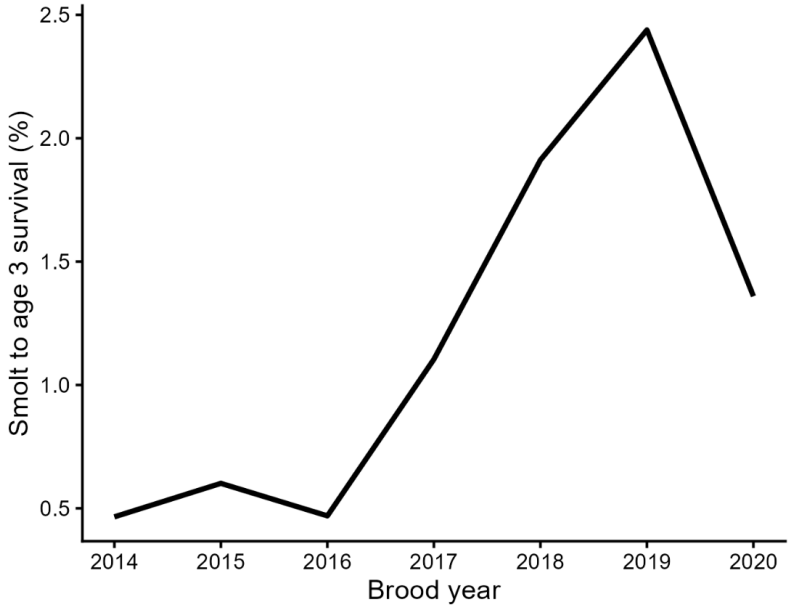


Figure 4. Smolt-to-age 3 survival values based on the Exploitation Rate Analysis (ERA) for the Chilko Coded Wire Tag (CWT) Exploitation Rate Indicator Stock (ERIS). Note that this run of the ERA included CWTs from juveniles released as fry, thus survival rates are likely underestimated.

Exploitation Rate

Estimated fisheries impacts using the FMI (2019 – 2024) has ranged between 10 and 16% (Figure 2C). In contrast, the CYER from the Chilko River ERIS has ranged from 3 – 21 % (Figure 2C, with U.S. fishing contributing on average 4% total mortality). Canadian-only CYER has ranged from 2 – 19%. However, given the uncertainty in the FMI metric, that it estimates Canadian fisheries impact with a subset of Canadian fisheries, and the relatively weak correlation between FMI and Canadian CYER[1] (Figure 5), the FMI-based time series of fisheries impact (and thus catch (Figure 2A) and recruit abundance (Figure 2D)) should be interpreted cautiously. The results of the measurement error model (Figure 5) warrant using caution when interpreting the FMI - even assuming conservative observation error in both indices (CV = 0.1), the relationship between the indices is positive but weak and highly uncertain. At low levels of the FMI (< 0.12), Canadian CYER is overestimated, and at higher levels of the FMI (> 0.12) CYER is underestimated. Note that this relationship is built off of paired CYER and FMI estimates from Fraser Chinook indicator populations including other SMUs, and thus describes the average relationship and uncertainty among these fisheries impact measures rather than the specific relationship for the Fraser Summer 5_2 (1.3) Chinook SMU.

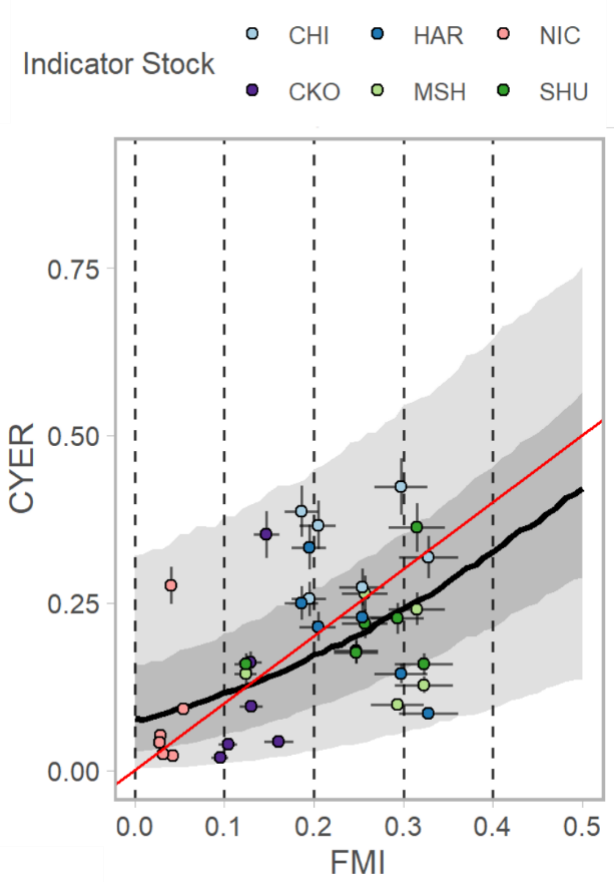


Figure 5. Posterior predictions, in proportional space, of a Generalized Linear Model estimating the relationship between the Fisheries Mortality Index (FMI) and Calendar Year Exploitation Rate (CYER). The model assumes equal error (CV = 0.1) for observations of both CYER and FMI. The black line represents the median, dark and light ribbons represent the 50th and 90th percentile intervals, respectively. The Red line shows the one-to-one line representing a perfect correlation between indices. Points represent individual Fraser River Chinook salmon Exploitation Rate Indicator Stocks (ERIS) and year observations. Whiskers represent the assumed CVs described above. Vertical dashed black lines align with the horizontal coloured lines in the kernel density plots in column a) of the simulation results figures shown below (Figures 8-10). ERISes are: Chilliwack (CHI; Fall 4_1 (0.3) SMU), Harrison (HAR; Fall 4_1 (0.3) SMU), Nicola (NIC; Spring 4_2 (1.2) SMU), Chilko (CKO; Summer 5_2 (1.3) SMU), Middle Shuswap (MSH; Summer 4_1 (0.3) SMU), and Shuswap (SHU, Summer 4_1 (0.3) SMU).

History of Management

History of Management Objective and Outcomes

The Pacific Salmon Treaty framework for Chinook Salmon consists of two fisheries management regimes: Aggregate Abundance-Based Management (AABM) and Individual Stock-Based Management (ISBM) (Pacific Salmon Commission 2023). AABM fisheries are managed to an annual total allowable catch under a variable harvest rate strategy. ISBM fisheries are managed domestically under a fixed exploitation rate strategy for multiple indicator stocks, where the limit is defined by the CYER (Pacific Salmon Commission 2023).

In response to low abundance, directed commercial and recreational fisheries for stream-type Fraser Chinook Salmon have been restricted and First Nations Food, Social and Ceremonial (FSC) fisheries have also been significantly limited (DFO 2025a). Between 2000-2008,

management measures implemented to mitigate exploitation impacts from the Northern BC and West Coast of Vancouver Island commercial troll fisheries led to closures that also reduced impacts on co-migrating stream-type Fraser Chinook stocks, including the Summer 5_2 (1.3) SMU. These troll fisheries are regulated through Aggregate Abundance Based Management (AABM) under stipulation of Chapter 3 of the Pacific Salmon Treaty (Doutaz et al. 2021; Pacific Salmon Commission 2023). Similarly, FSC fisheries management measures including area closures, limited catch and effort, and included gear restrictions to reduce impacts on early-timed Fraser Chinook. The temporal restrictions were extended through June-July to protect the Fraser Spring and Summer 5_2 aggregate (Dobson et al. 2020).

Fraser River Chinook stocks are impacted by marine recreational fisheries in Juan de Fuca Strait and Strait of Georgia (Doutaz et al. 2021). To reduce impacts on early-timed Fraser Chinook wild retention limits, additional size limits (Dobson et al. 2020) were implemented in 2008. An additional maximum size limit of 80 cm was introduced in 2019 for many areas. In 2018 area closures and Chinook non-retention were introduced in the southern area of the Strait (Dobson et al. 2020). In 2008, time and area closures (including non-retention and full salmon closures), additional size limits on retained catch, and reduced bag limits were also implemented for the Fraser River recreational fishery to reduce impacts on early-timed Chinook, and in 2012 were extended to protect the Fraser Spring and Summer 5_2 (1.3) aggregate (Dobson et al. 2020). As of 2019, with few exceptions for terminal areas, there is generally no fishing for salmon or non-retention of Chinook in the Fraser River recreational fishery year-round. Since 2012, the Albion gill-net test fishery was delayed to late-April to reduce impacts on stream-type Fraser Chinook (Dobson et al. 2020).

There have also been changes to test fisheries that operate along the migration corridor of Fraser River Chinook. Since 2012, the Albion gill net test fishery was delayed to late-April to reduce impacts on stream-type Fraser Chinook (Dobson et al. 2020).

There is currently no quantitative escapement goal for Fraser Summer 5_2 (1.3) Chinook at the SMU level (Chinook Technical Committee 2025b); however, the objective of Summer 5_2 (1.3) Chinook management outlined in the 2025 Southern BC Salmon Integrated Fisheries Management Plan was to manage Canadian fisheries in a highly precautionary manner to allow as many fish to pass through the spawning grounds as possible (DFO 2025a). This approach was also implemented in 2019-2024 and reduced fisheries-related mortalities of Summer 5_2 (1.3) Chinook from 24.7% (2014-2018 average) to 12.2% (2019-2024 average; DFO 2025b).

History of Hatchery and Supplementation

Hatchery enhancement of Fraser Summer 5_2 (1.3) Chinook was more prolific during the mid-1980s to early 1990s (Figure 6). Historically there are 3 main release strategies for hatchery-produced Fraser Spring 5_2 (1.3) Chinook: fed-fry, sub-yearling smolts, and yearling smolts. Fed-fry are released 1 week to 1 month after hatching and are fed before release. Sub-yearling smolts are released the same year they hatched, and are grown at an accelerated rate for a few months after hatching and then released (an ocean-type release strategy applied to stream-type Chinook in this case). Yearling smolts are hatched and grown in the hatchery through their first winter post-hatching and released in the following spring (matching the natural stream-type life history). The Lower Fraser Upper-Pitt SU 1.3 CU (CK-05) had annual sub-yearling smolt releases up to ~ 150,000 historically, but has not been enhanced since the 1990s. Chilliwack River, in the Lower Fraser SU 1.3 CU (CK-06), has been consistently enhanced since the late 1980s, with annual releases of ~500,000 sub-yearling smolts. Middle Fraser River – Portage SU 1.3 (CK-09) began enhancement in 2021, with ~160,000 yearling smolts released between 2021-2024. In the Middle Fraser River SU 1.3 CU (CK-11), five major systems were enhanced

historically, with Quesnel River having the most recent release in 2001 of ~250,000 yearling smolts. Enhancement continues in the Nechako River with annual releases of ~200,000 fed fry between 2015 and 2024. Significant enhancement of Eagle River and Salmon River in the South Thompson SU 1.3 CU (CK-14) occurred historically (peaking at 650,000 fry and 500,000 sub-yearling smolts in 1991, and 125,000 yearling smolts in 1990), with Salmon River having more recent yearling smolt releases ranging between ~50,000 to ~100,000 smolts from 1994-2010. Fry continue to be released annually in Salmon River, averaging ~65,000 releases between 2010-2023. At the peak, over 1 million sub-yearling smolts were released annually in the late 1980s and early 1990s in the North Thompson SU 1.3 CU (CK-19), but there have been no releases in the major systems of this CU since 1994. The North Thompson SU 1.3 CU (CK-19) was significantly enhanced historically, but there have been no releases in the major systems from 1994 onward.

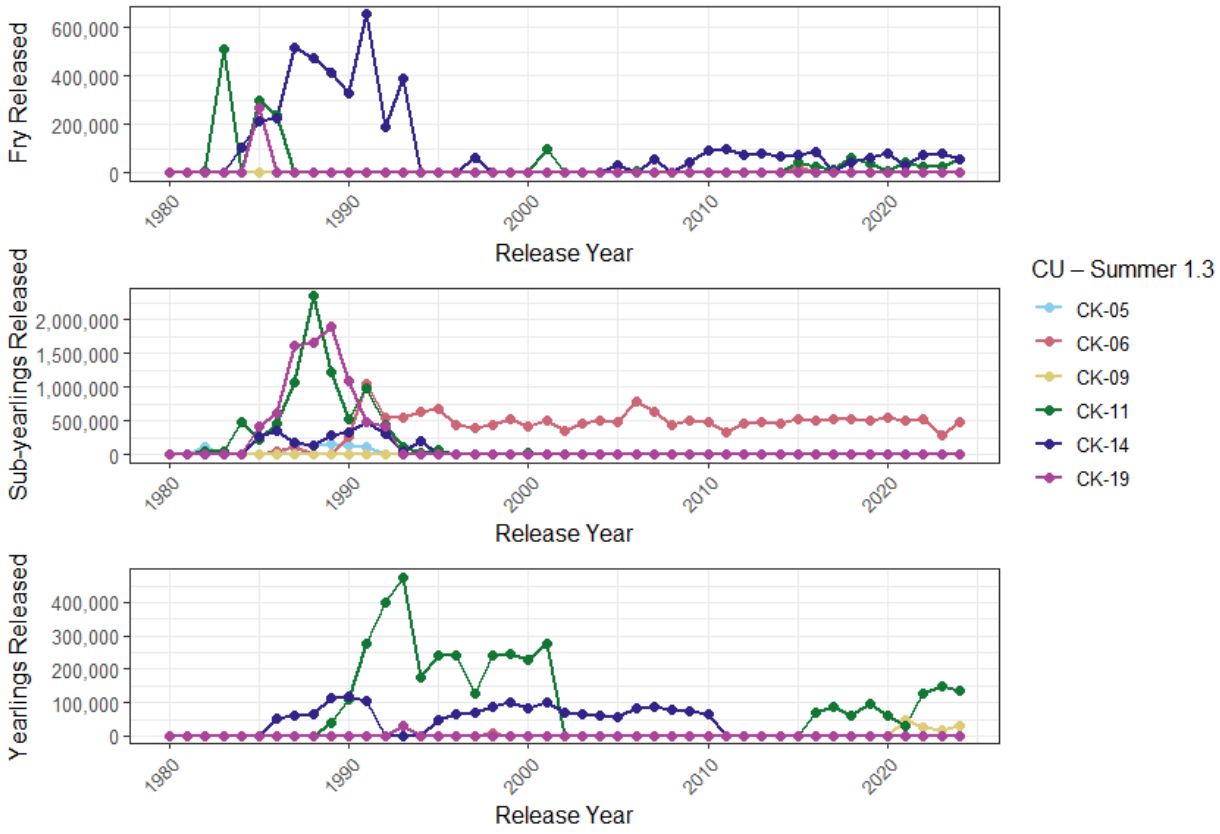


Figure 6. Hatchery releases by life stage (Fry, Sub-yearling Smolts, Yearling Smolts) and Conservation Unit (CK-05 Lower Fraser – Upper Pitt SU 1.3; CK-06 Lower Fraser River SU 1.3; CK-09 Middle Fraser River – Portage FA 1.3; CK-11 Middle Fraser SU 1.3; CK-14 South Thompson SU 1.3; CK-19 North Thompson SU 1.3) for the Fraser Summer 5_2 (1.3) Stock Management Unit.

To contextualize the hatchery release information, the proportion of hatchery-origin spawners (pHOS) was calculated for return years with available CWT recovery data for the Chilko ERIS (Figure 7). CWT recoveries for a given return year correspond to brood year smolt releases from 1-3 years prior. For example, CWTs recovered in the 2019 return year would be associated with smolts released in 2017-2019. The lowest pHOS was in 2020 at 3%, and has since increased to a maximum of 16% in 2024 (Figure 7).

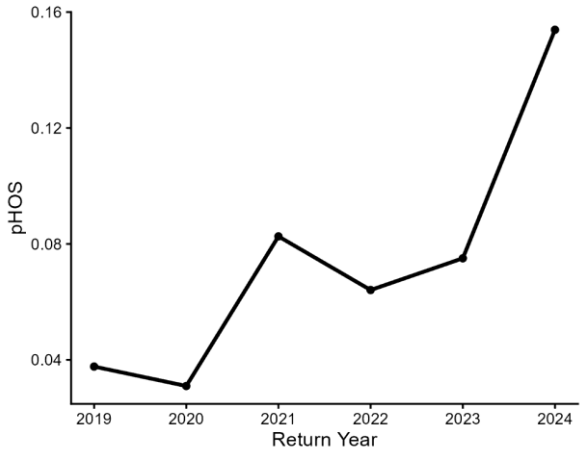


Figure 7. Proportion of hatchery origin spawners (pHOS) by return year for the Chilko ERIS. Chilko pHOS was estimated by dividing mark-recapture-based estimates of Coded Wire Tagged (CWT) spawners by total spawners. Return year CWT recoveries correspond to smolt-releases from 1-3 years prior.

History of Freshwater Habitat Impacts

Fraser Summer 5_2 (1.3) Chinook spend a significant portion of their life cycle in freshwater as a result of their stream-type life history strategy (Doutaz et al. 2021). Juveniles rear in their natal streams as well as in off-channel mainstream habitats and non-natal tributaries of the Thompson and Fraser Rivers, dispersing and rearing downstream of their natal stream as far as the lower Fraser River (Murray and Rosenau 1989; Bradford and Taylor 1997; Bradford and Taylor 2023). Since the beginning of the colonization of British Columbia, the Lower Fraser River and Estuary has been heavily modified for floodplain control and agricultural development, which has drastically altered conditions in off-channel habitat used by Chinook juveniles for rearing. Many systems in this SMU are highly susceptible to extreme weather events such as wildfires, landslides, high water temperatures, and extreme high or low flows. Variability and plasticity in the timing of spawning ground arrival and dispersal of juveniles throughout the Fraser watershed helps buffer impacts on survival during upstream migration and rearing. Substantial adult mortality occurred during the 2019 Big Bar Landslide on the Fraser River mainstem, which restricted migration of 12 out of 32 Summer 5_2 (1.3) populations, including the developing ERIS in the Chilko River (Chinook Technical Committee 2025b). There was no mortality or delay detected with respect to Big Bar passage in 2020-2022 for Summer 5_2 (1.3) stocks returning through the Fraser Canyon (Chinook Technical Committee 2025b; DFO 2025b). In July of 2024, a landslide occurred on the Chilcotin River, blocking fish passage for multiple weeks during the migration period of populations that spawn upstream from the slide, including the Chilko River ERIS. Although SONAR data showed that migration resumed in early September, mortality due to the initial blockage and downstream debris flow has not been quantified, and impacts on productivity of the affected CUs will not be evident until the full cohort has returned (Chinook Technical Committee 2025a). Because none of the Fraser Summer 5_2 (1.3) Chinook streams are actively monitored for habitat changes and juvenile production, we are not able to quantify the impacts of these events.

Ecosystem and Climate Change Considerations

Fraser Summer 5_2 (1.3) Chinook migration routes, spawning and rearing habitat encompasses a large geographic area, therefore they encounter a wide range of ecosystems and climatic conditions during their life-cycle (Doutaz et al. 2021; Weir et al. 2022; Dionne et al. 2023). Table 3 summarizes major ecosystem and climate considerations by life-stage. An in-depth

summary of the major climate threats to specific CUs and recommended management actions to address these threats are outlined in the associated Recovery Potential Assessments (RPAs; Doutaz et al. 2021; Weir et al. 2022; Dionne et al. 2023).

Table 3. Fraser River Summer 5_2 (1.3) Chinook required habitats and the effect of top threats by life stage. Information adapted from Doutaz et al. (2021).

Life stage	Top threats	Mechanisms of threats
Egg/alevin	• Modifications to catchment surfaces • Climate change increasing freshwater environmental variation	• Increased likelihood of dewatering or egg/alevin-scouring flood events.
Fry/parr	• Modifications to catchment surfaces • Climate change increasing freshwater environmental variation	• Alters freshets, affecting the timing and duration of access to off-channel rearing habitat. • Increases variation in stream temperature and the number of metabolically stressful days.
Smolt	• Modifications to catchment surfaces • Climate change increasing freshwater and marine environmental variation	• Alters freshets, timing of smolt migration and ocean entry. • Influences early marine survival through competition and predation.
Immature adult	• Climate change increasing marine environmental variation	• Influences growth rates and survival through competition and predation.
Spawning adult	• Modifications to catchment surfaces • Climate change increasing freshwater environmental variation	• Alters surface and groundwater availability, determining whether salmon can access spawning areas. • Watersheds heavily impacted by wildfires are more susceptible to landslides that can restrict salmon access to spawning areas.

Simulations

Simulations of future Summer 5_2 (1.3) Chinook abundance explored a range of Canadian ERs (0-0.45) and smolt survival/productivity rates (Ricker ln(α) 0.26-2.05) to determine whether any combination of these could result in:

1. Spawner escapement that would exceed the WSP lower biological abundance benchmarks (larger of 20% S_{max} or 1,500 spawners; Figure 8).
2. Spawner escapement that would exceed the WSP lower biological benchmarks (20% S_{max} only; Figure 9).
3. Spawner escapement that would exceed the SMU based LRP (Figure 10).

The simulations resulted in the following insights:

- No combinations of ER and productivity escaped enough spawners to exceed Rapid Status Approach thresholds (greater of 20% S_{max} and 1,500 spawners), thus an FRP-L could not be identified for the SMU.

- The small population CUs (Lower Fraser – Upper Pitt, and Middle Fraser River - Portage) were unlikely to exceed the 1,500 spawner threshold, but moderately to highly likely to exceed the 20% S_{max} threshold.

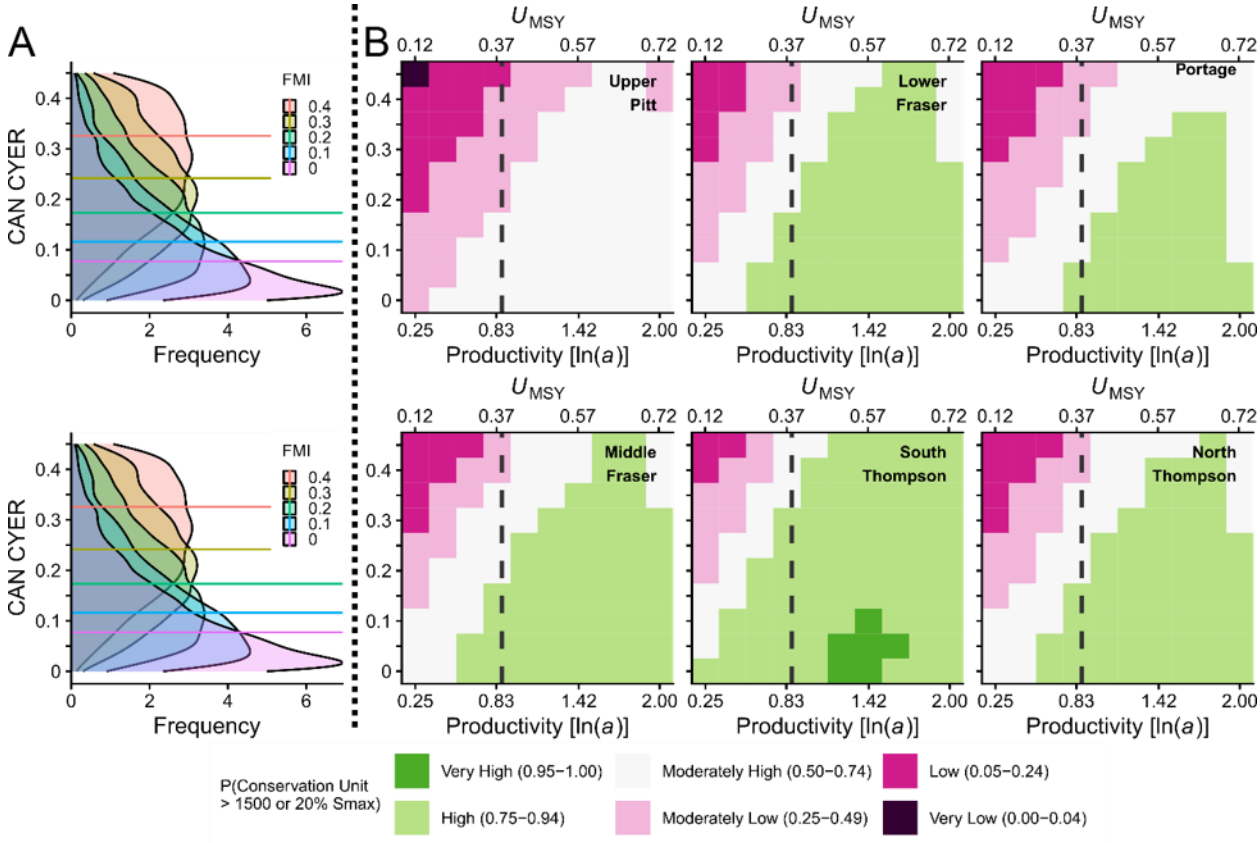


Figure 8. Simulated probability that Conservation Units (CUs) in the Fraser Summer 5_2 (1.3) Chinook Stock Management Unit (SMU) meet or exceed their Wild Salmon Policy (WSP) lower biological benchmarks. Horizontal lines in the A side plots represent median values of Calendar Year Exploitation Rate (CYER) for a given value of Fisheries Mortality Index (FMI), with associated posterior distributions describing the range of possible CYER outcomes for a given target FMI. The A-side plots are derived from a measurement error model of CYER ~ FMI assuming both indices include an observation error with CV = 0.1. B-side ice-cream plot results are based on CYER with implementation error (CV = 0.1) across a range of productivity values covering the 95% CI of estimated productivity (Ricker ln(alpha)). The secondary x-axis shows U_{MSY} values relative to productivity. Squares are colour-coded according to the probability that the geometric mean of the last generation (5 years) of spawner abundance for a given CU meets or exceeds 20% S_{max} or 1,500 spawners, whichever value is greater. The vertical dashed grey lines in the B-side plots indicates the median estimated productivity. Given the expectation that climate change will negatively impact the productivity of this SMU, scenarios to the left of the dashed grey lines are more likely.

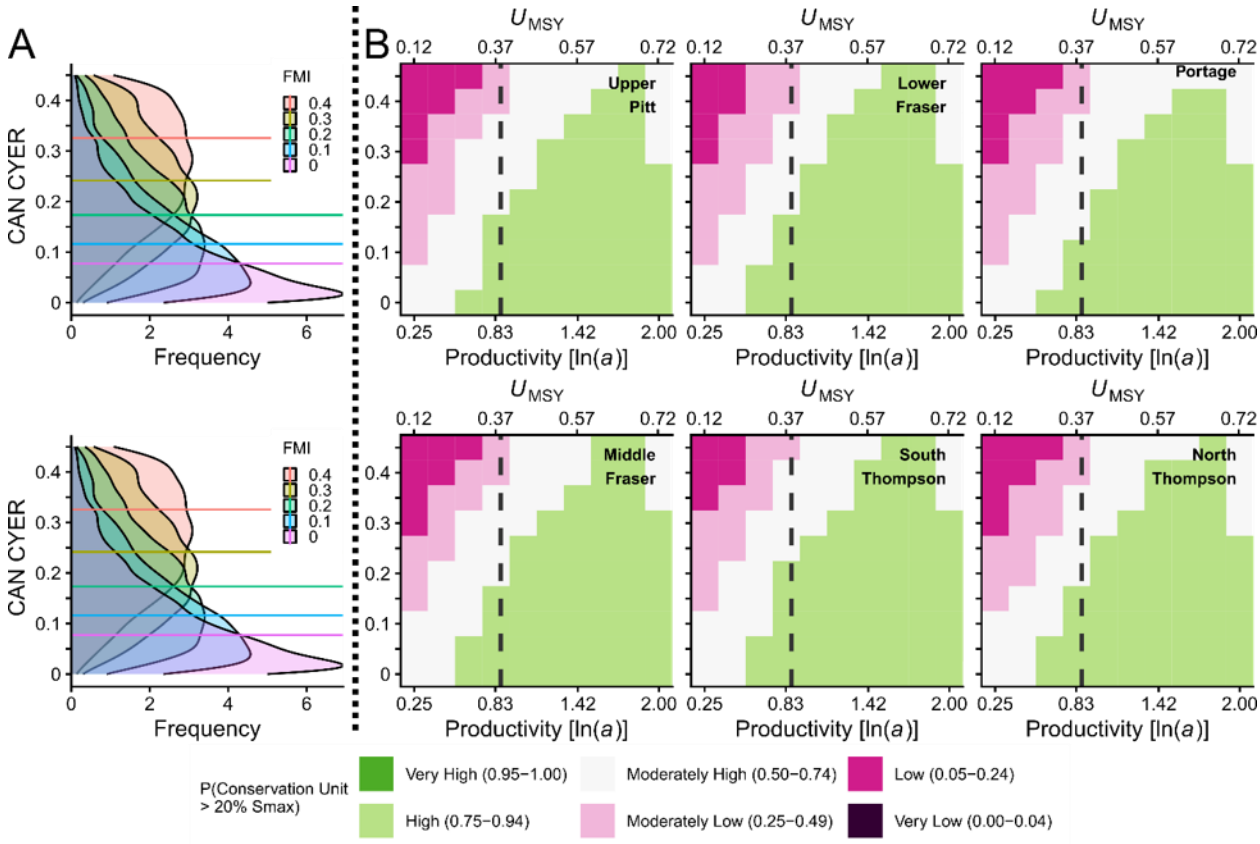


Figure 9. Simulated probability that Conservation Units (CUs) in the Fraser Summer 5_2 (1.3) Chinook Stock Management Unit (SMU) meet or exceed 20% S_{max}. Horizontal lines in the A side plots represent median values of Calendar Year Exploitation Rate (CYER) for a given value of Fisheries Mortality Index (FMI), with associated posterior distributions describing the range of possible CYER outcomes for a given target FMI. The A-side plots are derived from a measurement error model of CYER ~ FMI assuming both indices include an observation error with CV = 0.1. B-side ice-cream plot results are based on CYER with implementation error (CV = 0.1) across a range of productivity values covering the 95% CI of estimated productivity (Ricker ln(alpha)). The secondary x-axis shows U_{MSY} values relative to productivity. Squares are colour-coded according to the probability that the geometric mean of the last generation (5 years) of spawner abundance for a given CU meets or exceeds 20% S_{max}. The vertical dashed grey lines in the B-side plots indicates the median estimated productivity. Given the expectation that climate change will negatively impact the productivity of this SMU, scenarios to the left of the dashed grey lines are more likely.

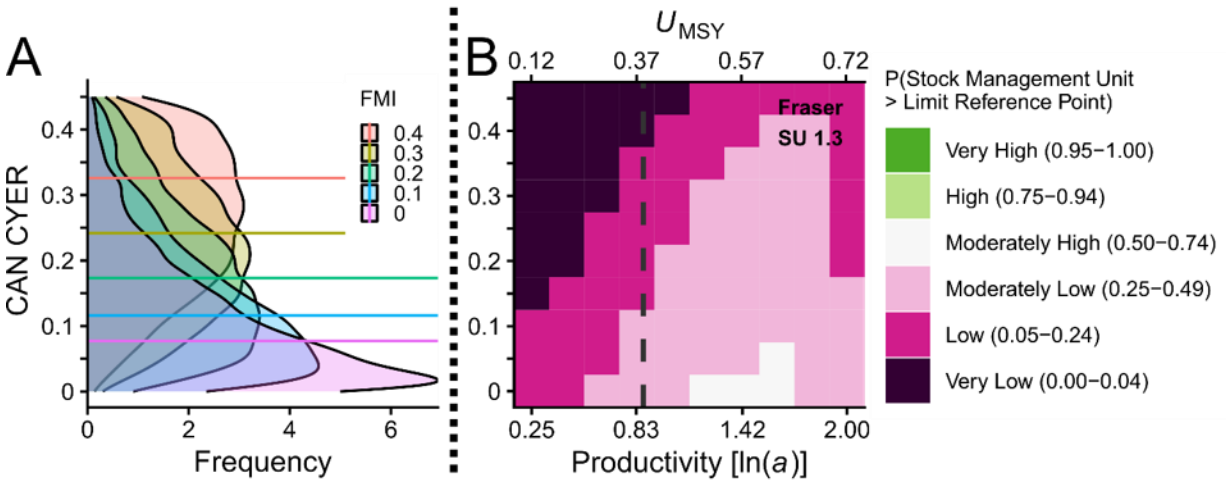


Figure 10. Simulated probability the Fraser Summer 5₂ (1.3) Chinook Stock Management Unit (SMU) meets or exceeds the Conservation Unit (CU) status-based Limit Reference Point (LRP). Horizontal lines in the A-side plots represent median values of Calendar Year Exploitation Rate (CYER) for a given value of Fisheries Mortality Index (FMI), with associated posterior distributions describing the range of possible CYER outcomes for a given target FMI. The-A side plots are derived from a measurement error model of CYER ~ FMI assuming both indices include an observation error with CV = 0.1. B side ice-cream plot results are based on CYER with implementation error (CV = 0.1) across a range of productivity values covering the 95% CI of estimated productivity (Ricker ln(alpha)). The secondary x-axis shows U_{MSY} values relative to productivity. Squares are colour-coded according to the probability that the geometric mean of the last generation (5 years) of spawner abundance for all CUs meets or exceeds CU-specific 20% S_{max} or 1,500 spawners, whichever value is greater. The vertical dashed grey line in the B-side plot indicates the median estimated productivity. Given the expectation that climate change will negatively impact the productivity of this SMU, scenarios to the left of the dashed grey lines are more likely.

Exceptional Circumstances

A re-assessment of the Fraser Summer 5₂ (1.3) SMU is recommended if any of the following occur:

- New information becomes available that results in changes to the historical time-series of spawner abundance and/or catch data used in this research document.
- New information becomes available that results in changes to stock structure (e.g., CU designations) and/or major drivers of stock dynamics.
- New information becomes available regarding the recent landslide impacts on spawner abundance and the susceptibility of CUs to future landslides.
- There is a long enough time series of exploitation rate data to classify Chilko as an established CWT ERIS rather than a developing CWT ERIS.

BYCATCH

Enhanced monitoring of the Pacific region groundfish trawl fishery was initiated in 2022 to provide accurate estimates of Pacific Salmon bycatch by species and assess stock composition (Lagasse et al., 2025). CWT recoveries and/or DNA samples are taken from a random sample of Chinook Salmon bycatch from each fishery region to determine the CU of origin. Fraser Summer 5₂ (1.3) Chinook Salmon represented a very low proportion (less than 3%) of Chinook

bycatch in 2023, totaling approximately 152 fish across all Canadian Fisheries (Lagasse et al. 2025). Note that these impacts are not accounted for in the FMI estimate of fisheries impact.

SOURCES OF UNCERTAINTY

The type and quality of the escapement data contributes substantial uncertainty into the assessment, including reference point estimates and the simulation methods. Most systems within the Summer 5_2 (1.3) SMU are based on visual survey methods, with a standardized expansion factor applied to estimate spawner escapement. This expansion factor is not adjusted for stream-specific factors that affect observer efficiency, such as turbidity, stream size and morphology, and fish density and estimates tend to be biased low[1]. Additionally, the relationship between the FMI and Canadian CYER is positive, but relatively weak. Parameter estimates indicate low values of FMI (e.g., less than 0.1) are associated with estimates of CYER that are slightly higher, while high values of FMI are associated with estimates of CYER that are moderately lower. Importantly, these general patterns become more extreme as observation error in both indices increases[1]. Although there appear to be qualitative differences in the mean relationship between indices among SMUs, there are too few observations for each ERIS to estimate these effects with high precision. While CYER is an imperfect measure of fishing mortality, it has received more validation and includes a greater number of fisheries (including US fisheries) than the FMI, thus we recommend continuing to operate the indicator stock program for the Chilko River Summer Chinook population.

The way in which the Ricker stock-recruit parameters were estimated for this assessment is a large source of uncertainty for both the generation of reference points and the simulation outcomes. A single fecundity-based estimate of productivity was used for the entire SMU. In reality, each CU has its own intrinsic productivity (due to differences in ecosystems and potential genetic variation among CUs). Similarly, the estimate of the CU-specific Ricker β values introduce additional uncertainty as they are not based directly on CU-specific stock-recruit data, but instead assume that the only factor driving differences in capacity (S_{max}) among CUs is accessible watershed area, which again fails to account for differences in ecosystems and potential genetic variation among CUs. Thus, if the resources were available, there would ideally be an ERIS for each CU rather than a single ERIS (Chilko River) to represent the entire SMU.

For the simulation results, there were two more major sources of uncertainty. First, initial spawner abundance could not be based on observed absolute spawner abundance data (many CUs only had relative index data). Simulations were initialized using stochastic projections from assumed Ricker parameters, so starting conditions likely did not reflect current spawner abundances (i.e., the starting abundances of spawners in the simulations were not grounded in current reality). Second, the simulations assumed perfect observation of spawner abundances, comparing simulated true spawner abundance against absolute abundance reference points (20% S_{max}). In reality, Fraser Summer 5_2 (1.3) Chinook CUs are dominated by relative index abundance data for which status assessment occurs with trend-based metrics using the Rapid Status Approach. Thus, the simulation results may not accurately reflect future statuses because trend-based metrics rather than absolute abundance metrics will likely determine future statuses.

LIST OF MEETING PARTICIPANTS

Last Name	First Name	Affiliation
Anderson	Erika	DFO Science
Bailey	Colin	DFO Science
Bailey	Richard	Upper Fraser Fisheries Conservation Alliance
Bannar-Martin	Katherine	DFO Canadian Science Advisory Secretariat
Borea	Isabella	DFO Science
Campbell	Kelsey	Upper Fraser Fisheries Conservation Alliance
Curtis	Shamus	Upper Fraser Fisheries Conservation Alliance; Fraser Salmon Management Council
Davis	Brooke	DFO Science
Dennert	Allison	Raincoast Conservation Foundation
Dobko	Ashley	DFO Fisheries Management
Fisher	Aidan	Lower Fraser Fisheries Alliance; Fraser Salmon Management Council
Frederickson	Nicole	Island Marine Aquatic Working Group; Fraser Salmon Management Council
Freshwater	Cameron	DFO Science
Grant	Sue	DFO Science
Greenberg	Dan	DFO Science
Hamazaki	Toshihide "Hamachan"	Alaska Department of Fish and Game
Hawkshaw	Mike	DFO Fisheries Management
Hertz	Eric	Pacific Salmon Foundation
Holt	Carrie	DFO Science
Jenewein	Brittany	DFO Fisheries Management
Labelle	Marc	FSMC-JTC Mid-Fraser Rep.
Ladell	Jason	DFO
Laliberte	Bernette	Cowichan Tribes
Lewis	Dawn	DFO Science
Lowe	Geoff	DFO Science
Luedke	Wilf	DFO Science Alumni
MacDuffee	Misty	Raincoast Conservation Foundation
Maxwell	Marla	DFO Salmonid Enhancement Program
Maynard	Jeremy	Sport Fishing Advisory Board
Nicklin	Pete	Tŝilhqot'in National Government
Parken	Chuck	DFO Science
Pestal	Gottfried	Solv Consulting
Riley	Rebecca	Lillooet Tribal Council Fisheries Program Manager
Straight	Angus	DFO Salmonid Enhancement Program
Thompson	Patrick	DFO Science
Trouton	Nicole	DFO Science
Valentine	Bill	Esquimalt Nation
Weil	Jacob	DFO Salmonid Enhancement Program
Wor	Catarina	DFO Science

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3190 Hammond Bay Rd
Nanaimo, BC V9T 6N7

E-Mail: DFO.PacificCSA-CASPacifique.MPO@dfo-mpo.gc.ca
Internet address: www.dfo-mpo.gc.ca/csas-sccs/

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