2020 Summary of Abundance Data for Chinook Salmon (*Oncorhynchus tshawytscha*) in Southern British Columbia, Canada.

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2020

Canadian Technical Report of
Fisheries and Aquatic Sciences 3401

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Canadian Technical Report of Fisheries and Aquatic Sciences

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2020 SUMMARY OF ABUNDANCE DATA FOR CHINOOK SALMON (*ONCORHYNCHUS TSHAWYTSCHA*) IN SOUTHERN BRITISH COLUMBIA, CANADA.

by

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Cat. No. Fs97-6/3401E-PDF ISBN 978-0-660-35945-8 ISSN 1488-5379

Correct citation for this publication:

Brown G.S., Thiess M.E., Wor C., Holt C.A., Patten B. , Bailey R.E., Parken C.K., Baillie S.J., Candy J.R., Willis D.M., Hertz E., Connors B., and Pestal G.P. 2020. 2020 Summary of Abundance Data for Chinook Salmon (*Oncorhynchus tshawytscha*) in Southern British Columbia, Canada.. Can. Tech. Rep. Fish. Aquat. Sci. 3401: xiii + 214 p.

CONTENTS

ABSTRACT

Brown G.S., Thiess M.E., Wor C., Holt C.A., Patten B. , Bailey R.E., Parken C.K., Baillie S.J., Candy J.R., Willis D.M., Hertz E., Connors B., and Pestal G.P. 2020. 2020 Summary of Abundance Data for Chinook Salmon (*Oncorhynchus tshawytscha*) in Southern British Columbia, Canada.. Can. Tech. Rep. Fish. Aquat. Sci. 3401: xiii + 214 p.

This report includes currently available quality-controlled time series of spawner abundance for 38 conservation units of Chinook Salmon (*Oncorhynchus tshawytscha*) in Southern British Columbia, Canada. Annual estimates for individual survey sites were filtered based on data quality, infilled for missing years, and summed to produce time series for wild sites, enhanced sites, and all sites. An expert working group reviewed the time series and assessed which types of analysis each series is suitable for. This report also includes commentary on data quality and interpretation from earlier unpublished manuscripts. Exploitation rate time series from coded-wire tag indicator stocks are shown for context where available, either as direct estimates or using a nearby indicator as a proxy.

RÉSUMÉ

Brown G.S., Thiess M.E., Wor C., Holt C.A., Patten B. , Bailey R.E., Parken C.K., Baillie S.J., Candy J.R., Willis D.M., Hertz E., Connors B., and Pestal G.P. 2020. 2020 Summary of Abundance Data for Chinook Salmon (*Oncorhynchus tshawytscha*) in Southern British Columbia, Canada.. Can. Tech. Rep. Fish. Aquat. Sci. 3401: xiii + 214 p.

Ce rapport comprend des séries chronologiques de qualité contrôlée actuellement disponibles de l'abondance des géniteurs pour 38 unités de conservation du saumon quinnat (*Oncorhynchus tshawytscha*) dans le sud de la Colombie-Britannique, Canada. Les estimations annuelles pour chaque site d'enquête ont été filtrées en fonction de la qualité des données, remplies pour les années manquantes et additionnées pour produire des séries chronologiques pour les sites sauvages, les sites améliorés et tous les sites. Un groupe de travail d'experts a examiné les séries chronologiques et évalué les types d'analyses auxquels chaque série convient. Ce rapport comprend également des commentaires sur la qualité des données et l'interprétation de manuscrits antérieurs non publiés. Les séries chronologiques des taux d'exploitation des stocks indicateurs de micromarques magnétisées codées sont présentées afin de fournir le contexte lorsqu'ils sont disponibles, soit sous forme d'estimations directes ou en utilisant un indicateur proche comme indicateur indirect.

1 Preface

1.1 Sources

Reliable, timely and accessible information on abundance and harvest is the foundation of sustainable salmon fisheries management. However, this information can often be a challenge to compile and disseminate due to disparate data of varying or unknown quality and competing priorities. Nonetheless, there is an urgent need for the synthesis of the best available information on salmon in order to deliver on the evidence-based salmon management and transparent accountability called for under Canada's Policy for Conservation of Wild Pacific Salmon (WSP).

This technical report summarizes information on Southern BC Chinook Salmon from two multi-year status assessment processes. One process was led by DFO and assessed the integrated biological status (Red/Amber/Green) of *Conservation Units* (CU) under the WSP. The other, which is ongoing, is being led by COSEWIC with support from DFO and is assessing the conservation risk (Threatened, Endangered, Not at risk etc.) of *Designatable Units* (DU) under the *Species at Risk Act*. See Section 3.3 for summaries of the two processes.

We specifically synthesized data and associated information from:

- *Published reports*: The two multi-year status assessment processes mentioned above have generated technical reports published either through DFO or through COSEWIC, including results of the WSP status assessment peer-review process (DFO 2016a, 2016b), results of pre-COSEWIC data reviews (DFO 2015a, 2015b), COSEWIC status reports (COSEWIC 2006, 2017, 2018), and recovery potential assessments (Davis et al. 2019; DFO 2019a, 2019b, 2020a), and a recent technical review of Fraser stream-type Chinook management (DFO 2019c).
- *Unpublished Manuscripts*: Our descriptions of data treatment steps and the data notes in the appendices were adapted from two unpublished working papers used in the peer-review processes described in DFO (2016b) and DFO (2015b). These working papers were accepted, but Reseach Documents have not been published. Text from these two working papers was essentially carried over verbatim, except for some light editing to improve flow and eliminate repetitions. For example, the data notes on spawner estimates in the appendices merge text from both working papers into a single summary. However, the data notes on exploitation rate estimates are taken verbatim from the working paper that was used in DFO (2015b).
- *Existing data set*: An updated data set was developed by DFO for submission to COSEWIC in 2019. This includes quality-controlled time series of spawner abundance by site and by CU, site-to-CU matches, database corrections, and site classifications. This report includes summaries of the submitted data, and updated summary figures.

We completed an expert review of data usability for those CUs where explicit statements on data usability were not available from the above sources. Note that we sought consistency with the previous approach in terms of considerations used to categorize usability, but our results were developed through an informal process, whereas the previous assessments of usability were generated through formal peer-review processes (DFO 2015b, 2016b).

1.2 Acronyms

Some acronyms used in this report are highly specific to the data treatment steps and status assessment approach for Southern BC Chinook salmon, and are summarized here. The *Methods* section has more details about the categories of data quality by survey site (Section 4.2.3) and the CU-level assessments of data usability (Section 4.5).

Table 1. Acronyms

Category	Entry	Definition
CU	Abs_Abd	*Absolute Abundance* : If the sites categorized as *persistent* likely account for most of a CU's abundance in most years, and the records had an average quality rating of 2 or lower, then the CU time series was categorized as *absolute abundance*.
CU	Rel_Idx	*Relative Index*: If one or both of the criteria for a *Absolute Abundance* classification are not met.
General	CWT	Coded Wire Tag
General	ER	Exploitation Rate
Site	AGG	*Aggregated* survey sites have records covering multiple other sites, such as a mainstem estimate that would double count fish from the tributary estimates.
Site	DD	*Data Deficient* survey sites have occasional surveys, with insufficient or inconsistent quality.
Site	DEL	*Deleted* survey sites have been identified as likely errors (e.g. wrong time or area for a Chinook observation)
Site	EX	*Extirpated* survey sites have no records, no surveys, or records of "none observed" for a number of years.
Site	P	*Persistent* survey sites have consistent records of good or moderate quality.

2 Project Overview

2.1 Purpose

This report was prepared as part of a broader collaboration between *Fisheries and Oceans Canada* (DFO) and the *Pacific Salmon Foundation* (PSF) to compile and publish salmon data for British Columbia.

DFO regularly publishes the raw data of all salmon spawner surveys (DFO 2019d). DFO also publishes analyses based on these raw data through technical reports and peer-reviewed research documents (e.g. Grant and Pestal 2013; DFO 2016a). Substantial data processing and case-specific interpretation using expert judgment are done before these data can be used in the analyses. However, the current data processing approach has not been previously published in a single document covering all 38 conservation units of Chinook salmon in Southern BC.

The *PSF Salmon Watersheds Program* is undertaking a multi-year initiative to work in collaboration with First Nations, provincial and federal governments, and other non-governmental organizations to bring together existing information on Pacific salmon populations, evaluate the status of salmon populations and their freshwater habitats, and make the data even more accessible to the public. In 2016, PSF launched the Pacific Salmon Explorer (www.salmonexplorer.ca), an online data visualization tool that allows people interested in salmon conservation and management to gain better access to the data that exists for Pacific salmon. Using this platform, the public can explore salmon-related information through interactive maps and figures and print up-to-date status reports for individual salmon populations. This tool provides a centralized platform for exploration and analysis of salmon data in BC.

Evaluating published data sources for Southern BC Chinook salmon was identified as a high-priority focus by PSF's *Population Science Advisory Committee*, a group of BC salmon experts convened by PSF to provide input in the analysis and visualization of data on the Pacific Salmon Explorer. This project was initiated to compile available CU-level and site-level data, together with metadata and supplemental information necessary for interpreting the data.

2.2 Acknowledgements

This project was funded by the PSF as part of the expansion of the *Pacific Salmon Explorer* expansion to cover Southern BC conservation units. The expansion of the Pacific Salmon Explorer to Southern BC was supported through a grant to the PSF from Fisheries and Oceans Canada's Coastal Restoration Fund. Direct funding covered travel costs for the expert working group as well as Gottfried Pestal's work on data compilation, process facilitation, and report preparation. The project was also supported by extensive in-kind contributions from DFO (data, staff time) and the PSF (staff time).

In addition to the named authors, the following experts participated in the data usability reviews and contributed to this report: Diana Dobson (DFO), Kendra Holt (DFO), Wilf Luedke (DFO), Bryan Rusch (DFO), Christine Stevenson (PSF), Lauren Weir (DFO), and Charlotte Whitney (PSF).

2.3 Data Sharing

Data presented in this report are publicly available through two online data sharing portals:

- The PSF hosts the *Pacific Salmon Explorer*, which visualizes abundance trends and habitat information, and the *Salmon Data Library* which makes the underlying data sets easily accessible. Both portals are available at https://www.salmonexplorer.ca.
- DFO has started sharing the source code for research documents and technical reports when those documents are developed and hosted through github repositories, using the *csasdown* package available at https://github.com/pbs-assess/csasdown. Code and data for a selection of salmon-related analyses and reports are hosted at https://github.com/Pacific-salmon-assess.

3 Background

3.1 Population Structure

Chinook salmon spawn throughout Southern BC, with populations ranging from the West Coast of Vancouver Island to the BC Interior. Under Canada's *Wild Salmon Policy* (DFO 2005), spawning populations are grouped into *Conservation Units* (CU), defined as *"A group of wild salmon sufficiently isolated from other groups that, if extirpated, is very unlikely to re-establish naturally within an acceptable time frame, such as a human lifetime or a specified number of salmon generations"*

CU delineations were originally developed coastwide for all 5 species of Pacific salmon by Holtby and Ciruna (2007) based on a combination of criteria including genetic similarities, life history traits, and spawning locations. CU definitions were then updated for specific species and areas during integrated status assessments, such as Grant and Pestal (2013).

For Southern BC Chinook, the rationale for updated CU delineations and site assignments was documented in DFO (2013) and the resulting CUs were used in DFO (2016a). There are currently 18 CUs identified in the Fraser watershed, 12 CUs on the Inner South Coast, 3 CUs on the West Coast of Vancouver Island, and 1 in the Okanagan, which is in the Columbia River watershed. In addition there are 4 transplanted populations, which are considered separately. Table 2 lists the current CUs for Southern BC Chinook.

Southern BC Chinook CUs are grouped into the 3 geographic areas (Fraser, Inner South Coast, West Coast of Vancouver Island). *Management Units* (MU) correspond to the areas for WCVI and Inner South Coast, but the Fraser area is further split based on run timing and life history into 5 MU: Spring 4_2, Spring 5_2, Summer 4_1, Summer 5_2, and Fall (DFO 2018). Okanagan Chinook are in a separate management unit, because the Okanagan River drains into Columbia River Basin, so that Okanagan Chinook enter the ocean about 500km south of the Canada/US border.

Chinook status assessments (Section 3.3) maintained a distinction between wild and enhanced fish, and used the following terminology:

- *Total Unit*: All salmon spawning within the CU boundary, regardless of whether they meet the WSP definition of wild salmon
- *Conservation Unit*: Salmon spawning at sites classified as low or unknown enhancement
- *Enhanced Unit*: salmon spawning at sites classified as moderate or high enhancement

The CU profiles in the appendices of this report use the same approach, showing time series for the sum across persistent wild sites (low or unknown enhancement) and across all persistent sites (total). Section 4.4 describes the site classifications and data processing steps.

Table 2. Southern BC Chinook Conservation Units

Area	MU	CU_ID	Name	Label
Columbia	NA	CK-01	Okanagan_1.x	OK
Fraser	FrFa41	CK-03	Lwr Fraser River_FA_0.3	LFR-fall
Fraser	FrSp42	CK-16	Sth Thomp-Bessette Creek_SU_1.2	STh-BESS
Fraser	FrSp42	CK-17	Lower Thompson_SP_1.2	LTh
Fraser	FrSp52	CK-04	Lwr Fraser River_SP_1.3	LFR-spring
Fraser	FrSp52	CK-05	Lwr Fraser River-Upper Pitt_SU_1.3	LFR-UPITT
Fraser	FrSp52	CK-08	Md Fraser-Fraser Canyon_SP_1.3	FRCanyon
Fraser	FrSp52	CK-10	Md Fraser River_SP_1.3	MFR-spring
Fraser	FrSp52	CK-12	Upper Fraser River_SP_1.3	UFR-spring
Fraser	FrSp52	CK-18	North Thompson_SP_1.3	NTh-spr
Fraser	FrSu41	CK-07	Maria Slough_SU_0.3	Maria
Fraser	FrSu41	CK-13	South Thompson_SU_0.3	STh-0.3
Fraser	FrSu52	CK-06	Lwr Fraser River_SU_1.3	LFR-summer
Fraser	FrSu52	CK-09	Md Fraser River-Portage_FA_1.3	Portage
Fraser	FrSu52	CK-11	Md Fraser River_SU_1.3	MFR-summer
Fraser	FrSu52	CK-14	South Thompson_SU_1.3	STh-1.3
Fraser	FrSu52	CK-15	Shuswap River_SU_0.3	STh-SHUR
Fraser	FrSu52	CK-19	North Thompson_SU_1.3	NTh-sum
Fraser	TBD	CK-82	Upper Adams River_SU_x.x	UADAMS
Inner SC	Inner SC	CK-02	Boundary Bay_FA_0.3	BB
Inner SC	Inner SC	CK-20	Sth Mainland-Georgia Strait_FA_0.x	SMn-GStr
Inner SC	Inner SC	CK-21	East Vanc. Isl. - Goldstream_FA_0.x	Goldstr
Inner SC	Inner SC	CK-22	East Vanc. Isl. - Cowichan & Koksilah_FA_0.x	CWCH-KOK
Inner SC	Inner SC	CK-23	East Vanc. Isl. -Nanaimo_SP_1.x	EVI-Nan-spr
Inner SC	Inner SC	CK-25	East Vanc. Isl. -Nanaimo & Chemainus_FA_0.x	EVI-fall
Inner SC	Inner SC	CK-27	East Vanc. Isl. -Qualicum & Puntledge_FA_0.x	QP-fall
Inner SC	Inner SC	CK-28	Southern Mainland-Southern Fjords_FA_0.x	SMn-SFj
Inner SC	Inner SC	CK-29	East Vancouver Island-North_FA_0.x	NEVI
Inner SC	Inner SC	CK-34	Homathko_SU_x.x	Hom
Inner SC	Inner SC	CK-35	Klinaklini_SU_1.3	Klina
Inner SC	Inner SC	CK-83	East Vancouver Island-Georgia Strait_SU_0.3	EVIGStr-sum
Other	FrFa41	CK-9008	Fraser-Harrison fall transplant_FA_0.3	Chil_transp_FA
Other	TBD	CK-9005	Southern BC-miscellaneous	SBCMisc
Other	TBD	CK-9006	Fraser-Cross-CU Suppl. Exclusion	FraserCross
Other	TBD	CK-9007	Southern BC-Cross-CU Suppl. Exclusion	SBCCross
WCVI	WCVI	CK-31	West Vanc. Isl.-South_FA_0.x	SWVI
WCVI	WCVI	CK-32	West Vanc. Isl.-Nootka & Kyuquot_FA_0.x	NoKy
WCVI	WCVI	CK-33	West Vanc. Isl.-North_FA_0.x	NWVI

3.2 Stock Assessment Approach

Stock assessment and fisheries management of Chinook salmon on the Pacific Coast of North America are coordinated internationally through the *Pacific Salmon Commission* (PSC), and the two components have co-evolved over time. The stock assessment program is built around 2 key components for estimating fishery impacts and abundance trends (e.g. DFO 2014): (1) a coastwide network of coded-wire-tag indicator stocks (Table 3), and (2) spawning surveys at key sites (4.4). Using this information, Chinook fisheries are managed using a combination of approaches. The Chinook Chapter of the most recent Pacific Salmon Treaty Agreement (Pacific Salmon Commission 2020) describes the management and assessment frameworks based on two fishery regimes: Aggregate Abundance-Based Management (AABM) and Individual Stock-Based Management (ISBM).

Table 3. CWT Indicators for Southern BC Chinook

CWT Area	Label	Name	CU	Proxy	Active
Fraser-Lower	HAR	Harrison	LFR-fall	None	Yes
Fraser-Lower	CHI	Chilliwack	Chil_transp_FA	None	Yes
Fraser-Thompson	SHU	Shuswap	STh-SHUR	Maria, STh-0.3	Yes
Fraser-Thompson	NIC	Nicola	Lth	STh-BESS	Yes
Fraser-Upper	DOM	Dome Creek	UFR-spring	11 CUs	No
Northeast VI	QUI	Quinsam	NEVI	None	Yes
Strait of Georgia	COW	Cowichan	CWCH-KOK	Goldstr	Yes
Strait of Georgia	NAN	Nanaimo	EVI-fall	None	No
Strait of Georgia	BQR	Big Qualicum River	QP-fall	SMn-GStr	Yes
Strait of Georgia	PHI	Phillips River	SMn-SFj	None	Yes
Strait of Georgia	PPS	Puntledge	EVIGStr-sum	None	Yes
West Coast VI	RBT	Robertson	SWVI	NWVI, NoKy	Yes
US Upper Columbia	SMK	Similkameen	Part of same population as OK, but south of the border, so not part of the CU.	OK	Yes
US North Puget Sound	SAM	Samish-Nooksack Fall Fingerling	None in BC	BB	Yes

AABM fisheries are mixed-stock ocean fisheries that intercept and catch migratory Chinook from many Canada- and U.S.-origin populations. In Southern BC, these include the WCVI Troll and outside recreational fisheries. These fisheries are managed to an annual total allowable catch based on a forecast abundance index (AI) of the aggregate of stocks that contribute to the fishery. The AI is calculated for large aggregates (e.g. Northern BC, WCVI). The AI for the two Canadian AABM fisheries is calculated based on the sum of stock- and age-specific cohort abundance estimates vulnerable to the component fisheries divided by the average abundance in the 1979-82 base period.

ISBM fisheries include all Chinook salmon fisheries subject to the PST that are not AABM fisheries or fisheries managed under the Transboundary part of the PST Agreement. ISBM

fisheries in southern BC include First Nations fisheries in both marine and fresh waters, recreational fisheries, WCVI seine and gill net, and Fraser River gill net. ISBM fisheries within Canada, and separately within the southern US, are managed to stock-specific average total fishing exploitation rate limits for a list of stocks specified for each country. Total exploitation rates, including mortality incidental to fishing activity, are calculated using coded-wire tag (CWT) recoveries estimated in fishery catches and escapements from a CWT indicator stock representing each stock with an ISBM obligation in either Canadian or southern US fisheries.

Note that all the Southern BC Chinook CWT indicators stocks rely on data from hatchery salmon, which means that if the wild stocks have a different ocean distribution, maturation rate, smolt age-2 (or age-3) survival, or are more at risk due to lower productivity, this will not be detected accurately by the indicator stocks. The CWT program also includes releases and recoveries from non-indicator stocks. The CU profiles in the appendices include an overview of CWT recoveries. Wild indicator stocks currently occur in Columbia River and in the northern transboundary area, and some of the Fraser indicator stocks are based on wild Chinook tagging in the 1970s and 1980s.

Within the AABM and ISBM management frameworks, specific fisheries within Canada are also managed to further constrain impacts on Canadian stocks of concern when the PST framework is not sufficiently precautionary (e.g. through time and area closures). Fishery details are published through the *Integrated Fisheries Management Plans*, such as DFO (2019e).

The overall management approach is based on annual data from total fishery catches and estimates of returning adult spawners and is best served by having annual high quality estimates of total adult spawners from many locations and from all CUs. Obtaining such data is extremely challenging, and often impossible, due to the size and remoteness of many rivers where Chinook spawn and the high cost of the escapement programs.

Given this management approach, as well as the difficulty, danger and cost involved in working in many Chinook salmon spawning locations, stock-specific estimates of brood year recruitment are not routinely calculated and are not currently available for many Southern BC Chinook CUs. Three published spawner-recruit analyses are available for Southern BC Chinook: DFO (2019b) for Okanagan Chinook, Tompkins et al. (2005) for Cowichan Chinook, and Dorner et al. (2018) for Harrison Chinook. In addition, a stock-recruit time series was produced in 2001, though not published, for Harrison River fall Chinook (CK-03) and used to calculate an escapement goal for Canadian and PST management objectives. The stock-recruit time series has recently been updated with data to 2018 and the escapement goal is being assessed with new models and methods.

3.3 Published Status Assessments

The status of Southern BC Chinook CUs has been assessed under two related, but independent, processes (Table 4).

Canada's *Wild Salmon Policy* (DFO 2005) identified standardized monitoring of wild salmon status as a key component of long-term sustainability, and established a framework for status assessment. A suite of status metrics capturing abundance and trends was developed (Holt 2009; Holt et al. 2009), and applied with species-specific adaptations to Fraser River sockeye (Grant and Pestal 2013), Interior Fraser Coho (DFO 2015c) and Southern BC Chinook (DFO 2016a). In these integrated CU status assessments, each CU was assigned to 1 of 7 categories (Red, Red/Amber, Amber, Amber/Green, Green, Data Deficient, To be Determined), based on the quantitative metrics in combination with qualitative information (e.g. habitat condition, harvest patterns). For Southern BC Chinook (Table 4), 2 of the 38 CUs were assessed as *Green* status (one provisionally), 1 CU as *Amber* Status, 1 CU as *Amber/Red* status, 11 CUs as *Red* status, and 9 CUs as *Data Deficient*. A further 14 CUs with moderate to high levels of enhanced contribution were set aside pending development of an adapted assessment framework that could account for these enhanced contributions. These are identified as *To Be Determined* in Table 4.

The *Committee on the Status of Endangered Wildlife in Canada* (COSEWIC) is an independent advisory panel to the Minister of Environment and Climate Change Canada tasked with identifying species for protection under the *Species at Risk Act* (SARA). COSEWIC identifies *Designatable Units* (DU), which are significant and irreplaceable units of biodiversity, and then assesses DUs based on a standard set of criteria as *Not at Risk*, *Special Concern*, *Threatened*, or *Endangered*. For Southern BC Chinook salmon, the DUs mostly match the CUs identified under the WSP (Table 4), except for 2 cases where the DU includes multiple CUs (DU12 contains 2 CUs, DU21 contains 4 CUs). Okanagan Chinook (CK-01) have been assessed twice by COSEWIC (COSEWIC 2006, 2017), and many of the remaining Southern BC Chinook CUs were assessed in 2017 (COSEWIC 2018). 2 CUs, combined in DU12, were assessed as *Not at Risk*, 1 CU as *Special Concern*, 4 CUs as *Threatened*, 9 CUs as *Endangered*, and 2 CUs as *Data Deficient*. A further 20 CUs with high levels of enhanced contribution were set aside pending a follow-up review planned for 2020. These are identified as *To Be Determined* in Table 4.

The WSP and COSEWIC assessments are generally consistent for CUs where both have been completed, or complementary when only one assessment has been done . However, there is one notable discrepancy: Lower Fraser Fall (CK-03, DU2) was assessed as provisionally *Green* status under WSP in 2014, but assessed as *Threatened* by COSEWIC in 2018. This discrepancy is likely due to the additional years of data considered in the COSEWIC assessment that were not part of the earlier WSP assessment.

Table 4. Published Status Assessments

Area	CU_ID	Label	WSP	DU_ID	COSEWIC
Columbia	CK-01	OK	RED	DU_Ok	ENDANGERED
Fraser	CK-82	UADAMS	DD	DU_NA	TBD
Fraser	CK-11	MFR-summer	AMBER	DU10	THREATENED
Fraser	CK-12	UFR-spring	RED	DU11	ENDANGERED
Fraser	CK-13	STh-0.3	GREEN	DU12	NOT AT RISK
Fraser	CK-15	STh-SHUR	TBD	DU12	NOT AT RISK
Fraser	CK-14	STh-1.3	RED/AMBER	DU13	TBD
Fraser	CK-16	STh-BESS	RED	DU14	ENDANGERED
Fraser	CK-17	LTh	RED	DU15	TBD
Fraser	CK-18	NTh-spr	RED	DU16	ENDANGERED
Fraser	CK-19	NTh-sum	RED	DU17	ENDANGERED
Fraser	CK-03	LFR-fall	GREEN(p)	DU2	THREATENED
Fraser	CK-04	LFR-spring	TBD	DU3	SPECIAL CONCERN
Fraser	CK-05	LFR-UPITT	DD	DU4	ENDANGERED
Fraser	CK-06	LFR-summer	DD	DU5	THREATENED
Fraser	CK-07	Maria	TBD	DU6	TBD
Fraser	CK-08	FRCanyon	DD	DU7	ENDANGERED
Fraser	CK-09	Portage	RED	DU8	ENDANGERED
Fraser	CK-10	MFR-spring	RED	DU9	THREATENED
Inner SC	CK-02	BB	TBD	DU1	TBD
Inner SC	CK-20	SMn-GStr	DD	DU18	TBD
Inner SC	CK-23	EVI-Nan-spr	DD	DU19	ENDANGERED
Inner SC	CK-83	EVIGStr-sum	TBD	DU20	TBD
Inner SC	CK-21	Goldstr	TBD	DU21	TBD
Inner SC	CK-22	CWCH-KOK	TBD	DU21	TBD
Inner SC	CK-25	EVI-fall	TBD	DU21	TBD
Inner SC	CK-27	QP-fall	TBD	DU21	TBD
Inner SC	CK-28	SMn-SFj	DD	DU22	TBD
Inner SC	CK-29	NEVI	RED	DU23	TBD
Inner SC	CK-34	Hom	DD	DU27	DATA DEFICIENT
Inner SC	CK-35	Klina	DD	DU28	DATA DEFICIENT
Other	CK-9005	SBCMisc	TBD	DU_NA	TBD
Other	CK-9006	FraserCross	TBD	DU_NA	TBD
Other	CK-9007	SBCCross	TBD	DU_NA	TBD
Other	CK-9008	Chil_transp_FA	TBD	DU_TBD6	TBD
WCVI	CK-31	SWVI	RED	DU24	TBD
WCVI	CK-32	NoKy	RED	DU25	TBD
WCVI	CK-33	NWVI	TBD	DU26	TBD

4 Methods

Abundance time series for Southern BC Chinook CUs and accompanying notes were developed based on two sources of information: regional databases of spawner surveys and expert knowledge previously compiled for the WSP and COSEWIC status assessments (Section 3.3). The raw data were processed by cross-checking across databases, quality filtering, and infilling before generating CU-level abundance estimates. The final step was a review of data usability in the spring of 2020, using expert judgement to evaluate which types of status metrics are suitable for each CU's time series of spawner abundance estimates.

4.1 Data Sources

4.1.1 Regional Databases

Detailed records of spawner estimates are stored in two regional databases maintained by DFO.

The *New Salmon Escapement Database System* (nuSEDS) stores individual spawner survey data records, spawner abundance estimates and the linkages between the two. nuSEDS records cover almost 10,000 sites across 5 species of Pacific Salmon, with historical records for some sites going back to the 1920s, and large-scale records reviewed back to 1995 as part of the WSP status assessment (DFO 2016a). The complete set of raw records is published regularly through Canada's *Open Data* initiative (DFO 2019d).

The *Enhancement Planning and Assessment Database* (EPAD) includes records of hatchery broodstock removed from the natural river and spawner surveys conducted by hatchery crews. EPAD covers 159 return sites coastwide, including 103 for Southern BC Chinook. EPAD is a DFO-internal operational database, but annual summaries of database components are published through the *Integrated Fisheries Management Plans*, such as DFO (2019e).

4.1.2 Expert Knowledge

Records from these regional databases were combined with expert knowledge compiled for the status assessment processes documented in DFO (2016b) and DFO (2015b). This included a list of verified sites for Southern BC Chinook, site-to-CU matches, database corrections (described in Section 4.4.2), and site classifications (described in Sections 4.2 and 4.3). In addition, there were extensive notes on CU characteristics and data interpretation in unpublished working papers from these assessment processes. The data treatment description in this chapter and the CU notes in the appendices of this report were adapted from these sources with light editing for flow and some minor updates.

4.2 Data Quality Classifications

The data quality of each annual record by survey site was categorized as part of the WSP status assessment (DFO 2016a, 2016b) before the data was used to develop CU-level time series. Three distinct aspects of data quality were evaluated : survey quality by record, Start Year for consistent records, and series quality by site.

Some of the data quality classifications have been updated or corrected in the years since the original classifications were developed, but most have been confirmed repeatedly through subsequent expert reviews (e.g. during preparation of the data set for the COSEWIC assessment in 2017).

4.2.1 Survey Quality By Record

The nuSEDS database includes an *Estimate Classification* that assigns each record to 1 of 7 data quality types:

- *Type 1 - True Abundance*: high resolution, total, seasonal counts through fence or fishway; virtually no bypass
- *Type 2 - True Abundance*: medium resolution, high effort (>5 trips), standard methods (e.g. mark-recapture, serial counts for area under curve, etc.)
- *Type 3 - Relative Abundance*: high resolution high effort (>5 trips), standard methods (e.g. equal effort surveys executed by walk, swim, overflight, etc.)
- *Type 4 - Relative Abundance*: medium resolution low to moderate effort (1-4 trips), known survey method
- *Type 5 - Relative Abundance*: low resolution low effort (e.g. 1 trip), use of vaguely defined, inconsistent or poorly executed methods
- *Type 6 - Presence or Absence*: based on any of the above
- *Unknown*: no quality rating

There are some other data quality categories in nuSEDS in addition to the 7 main categories listed above (e.g. *Relative: varying multi-year methods*). These records were excluded because estimate quality can't be reliably inferred.

Records supplemented with data from other sources (See Section 4.4.2) were assigned an estimate classification of *Other*, because no quality ratings were available.

Records with estimate classifications 1-4 or *Other* are retained for analysis. Records with classifications 5-6 or *Unknown* are filtered out in the second step of the data processing sequence (Section 4.4.3), and infilled where possible (Section 4.4.4)

Site summaries in the appendices further group the quality categories into High = Types 1 and 2, Moderate = Types 3 and 4, and Dropped = types 5-6 and Unknown.

4.2.2 Start Year for Consistent Records

Initially, a default Start Year of 1995 was assigned to all survey sites (the cut-off year for detailed review described in Section 4.4.2), which was adjusted depending on the quality of estimates available. Specifically, the Start Year was adjusted to be the earliest year with a high quality spawner abundance estimate for the survey site (i.e. estimate classification equal to Type-1 through Type-4).

Records before the CU-level aggregate Start Year were retained in the data processing sequence, but clearly identified in the final data sets and summary plots. The assumption is that these records can provide some relevant context even if they have not been verified to the same extent as records after the Start Year.

4.2.3 Series Quality By Site

Based on the consistency and quality of their available escapement time series, Southern BC Chinook spawning sites were classified through an expert review process (DFO 2016a, 2016b) which was completed in conjunction with the Start Year assessment. In fact, several iterations were required to settle on the appropriate assignment of a Start Year and site categorization for all sites within a CU.

The following categories were used:

- *persistent* (P): consistent records of good or moderate quality. Specifically, in the 2012 WSP status assessment, these were defined as sites having more than 50% high quality observations (Type-1 to Type-4) during the period Start Year to 2012, with no more than one generation of years missing in sequence. For CUs with a Start Year of 1995, this translated to at least 10 years of high quality data from the period that was part of the in-depth data review, and no more than 3, 4 or 5 years in a row missing (depending on the average generation time for the CU) for each persistent survey site in the CU. Sites with marginal numbers of high quality observations during the Start Year-2012 period were also classified as *persistent* if the criterion could be met with some infilling (i.e. not a full generation missing).
- *extirpated* (EX): no records, no surveys, or records of “none observed” for a number of years
- *data deficient* (DD): occasional surveys, insufficient or inconsistent quality. Specifically, in the 2012 WSP status assessment, these were defined as sites with no high quality records, or with insufficient high-quality records to meet the infill criteria. The DD categorization essentially recognized that annual estimates found in nuSEDS for a site could not be used in a quantitative sense for status assessments due to poor and unreliable quality.
- *aggregated* (AGG): covering multiple other sites, such as a mainstem estimate that would double count fish from the tributary estimates. Specifically, this identifies sites (often tributaries of larger rivers) that were enumerated differently at different points over their time series. In some years, a single estimate was provided at the watershed level, while for

others, independent estimates were made for individual tributaries comprising the larger watershed. Following the detailed data review, time series were verified as aggregates or disaggregates, and survey sites that were found to have been combined within larger aggregates were given a site categorization of “AGG” so that their estimates were not double-counted when the time series were summed at the CU level

- *delete* (DEL): likely errors (e.g. wrong time or area for a Chinook observation)

Records from sites categorized as *persistent* or *extirpated* are retained for analysis. Records from sites categorized as *data deficient*, *aggregate*, or *delete* are filtered out in the second step of the data processing sequence (Section 4.4.3).

4.3 Classification of Enhancement Level By Site

Enhancement classifications were also developed through a multi-step process as part of the work on the WSP status assessment (DFO 2016a, 2016b), based on the intensity of recent enhancement activity occurring within them. Enhancement classifications for a few sites have been updated or corrected in the years since the original classifications were developed, but most of them have been confirmed repeatedly through subsequent expert reviews (e.g. during preparation of the data set for the COSEWIC assessment in 2017).

For the purposes of this paper, we have opted to retain the site-based classifications of enhancement level used in the WSP status assessment (DFO 2016a), as described in this section, rather than use the estimates of percent natural influence (PNI) recommended by Withler et al. (2018), which are preliminary at this point and have not been peer-reviewed.

Enhancement-related data originated from EPAD for years from 2000 to 2011 (which approximates at least three generations for most southern BC Chinook Salmon CUs) and were cross-referenced to the enumeration sites (POP_IDs) found in NuSEDS. Note: All forms of enhancement activity found in EPAD were used in this categorization with the exception of small-scale enhancement activities such as classroom projects. Releases of small juveniles such as unfed fry were also excluded due to characteristically low survival rates and low probability of producing spawners. Evidence of enhancement activity related to the presence of hatchery spawners originating from another spawning site (i.e., hatchery-origin ‘strays’) did not contribute to the enhancement categorization procedure.

The enhancement classifications were based on 3 criteria: (1) CWT-based estimates of enhanced contribution, (2) records of releases from enhancement activities, and (3) records of broodstock collection for enhancement.

Any sites where these criteria don’t meet the thresholds for moderate or high enhancement (as described below) were categorized as low enhancement. Any sites without records of either releases or broodstock collection were classified as unknown enhancement.

CWT-based estimates of enhanced contribution were the highest priority data source. In spawning locations where the occurrence of Chinook with coded-wire tags is expected and recovered through a sampling program, estimates of the contribution of first generation hatchery-origin fish to the total spawning population can be made if spawning population estimates are

available. The CWT recoveries provide a direct, statistically-based estimate of the proportional composition of hatchery-origin fish in the total spawning population in a given spawning year. The percentage contribution estimates of hatchery-origin Chinook to the escapement were based on adult-sized (age 3 or older fish) because sampling and enumeration programs often under-represent the smaller (two-year old) fish in the spawning escapement. If the average estimated enhanced contribution < 25.0%, enhancement is MODERATE. If the average estimated enhanced contribution > 25.0%, enhancement is HIGH.

Releases from enhancement activities were a lower priority criterion. This criterion summarizes the reported records of total annual releases of juvenile Chinook from enhancement-related activities. All stages of juvenile releases, from fed fry to one-year old smolts, were summed for each brood year (releases of unfed fry and eggs were excluded). Most release estimates are for free-swimming juveniles and the age of release is often determined by the juvenile life history type. Populations with an ocean-type life history are most often released sometime during the year following the parental spawning year (i.e., the brood year). For the stream-type life history, release often occurs in the second year following the parental spawning year. In EPAD, data records of this type are more complete than some other categories of enhancement data (e.g., more complete than hatchery removals of returning salmon or reported numbers of salmon artificially spawned for enhancement objectives). This is because greater priority has been placed by SEP on complete documentation of releases. In addition, enhancement activity data from the time period of 2000-2011 was extensively reviewed by SEP to ensure accuracy and completeness to support the COSEWIC and WSP status assessment processes for southern BC Chinook Salmon. If the percent of years (2000-2011) with releases is < 25.0%, enhancement is MODERATE. If the percent of years (2000-2011) with releases is > 25.0%, enhancement is HIGH.

Broodstock removals for enhancement were another lower priority criterion. This criterion summarizes the reported records of total adult-sized Chinook Salmon artificially spawned for enhancement objectives. Counts of Chinook Salmon used for brood stock in enhancement programs may not be complete in EPAD because it is a lower priority to report these data relative to the estimates of brood releases, especially for community hatcheries and DFO projects that are not indicator stocks. There may be cases where there is no matching record of brood removal data to pair with a record of juvenile release data but cases of a record of brood removal unpaired with a record of juvenile release are highly unlikely. The numbers of small, jack-sized fish were excluded as these data were less complete. If the percent of years (2000-2011) with brood removals is < 25.0%, enhancement is MODERATE. If the percent of years (2000-2011) with brood removals is > 25.0%, enhancement is HIGH.

The overall assessment combined the 3 criteria as follows:

- If CWT-based estimates are available, then that value becomes the overall enhancement rank for the escapement site. Otherwise, the highest rank available from either juvenile releases or brood removals is used as the overall enhancement rank for the escapement site.
- If there are no data from any of these sources in the period 2000-2011, but one or more data records from any of the three data types exists prior to 2000, then an enhancement rank of low is assigned.

- Any spawning population without any evidence of enhancement activity of any kind in any year (i.e., is not present in the EPAD database) is assigned an overall enhancement rank of UNKNOWN.

Note that no records of enhancement were found for the following Conservation Units: CK-01, CK-08, CK-09, CK-13, CK-16, CK-23 and CK-34. The CK-9000s were automatically assumed to have a HIGH overall enhancement rank. Records for CK-9005, CK-9006 and CK-9007 include cross-CU transfers and these CUs have been assigned the special enhancement category of HIGH-CROSS_CU.

4.4 Data Treatment

The data treatment approach described in this section was originally developed for the WSP status assessment (DFO 2016a), then updated for the 2018 COSWIC assessement (COSEWIC 2018), and streamlined in 2019. It now includes 4 steps from raw data to CU-level time series. Note that the first 3 steps happen at the site level (i.e. by *PopID*).

The streamlined 4-step process uses all the same components as the earlier approaches, but data treatment steps have been sequentially organized to facilitate automation: merge, then quality filter, then infill, then cut the data off at a CU-specific Start Year. Previously, alternative possible variations were produced (filter and infill, filter only, infill only, all of this with or without Start Year). These variations were considered a sensitivity test, and then the most appropriate version for each CU was selected for the main assessments during the WSP and COSEWIC processes. The single streamlined data treatment sequence developed in 2019 removes the need for this data selection step at the end.

4.4.1 Stage 0: Raw nuSEDS Data

Of the almost 10,000 survey sites in nuSEDS, 408 have been verified and matched to Southern BC Chinook CUs. For these sites, nuSEDS included 5,089 numeric records of adult spawner abundance from 1934 to 2018, plus 1,260 records of adult broodstock removed from the river (all but 67 of these for year/site combinations with an adult spawner estimate), and 10,880 *NA* records (e.g. Presence/absence).

Note that sites in the nuSEDS database can correspond to biologically meaningful populations within the CU (e.g. record based on multiple stream walks of a known spawning area), but can also capture a larger group of populations (e.g. record based on a mainstem counting fence), or a sub-component of a biological population (e.g. record reflects one part of a larger lake-spawning population). Therefore, the number of sites has been used as a rough proxy for biological diversity within a CU for coastwide comparisons *within a species* (DFO 2016a), but needs to be carefully reviewed before interpretation for an individual CU.

4.4.2 Stage 1: Combine all data sources

The first step in the data processing sequence is to compile the most complete series possible for each survey site.

As part of the WSP status assessment (DFO 2016a), an extensive data review was conducted to cross-validate the nuSEDS spawner abundance data against other available sources of information to the greatest extent possible. This included references to paper BC16s, EPAD and CTC files. Discrepancies between data sources were referred to local experts for adjudication. In many instances, estimates could be recreated by including or excluding certain components of the run, such as broodstock or jacks. Efforts were also made to resolve cases of missing or inconsistent data by contacting local authorities, such as community hatcheries. In particular, CUs with multiple survey sites were scrutinized to ensure that individual survey sites within a given CU were aggregated (or disaggregated) consistently for the length of the time series. This was required to prepare for the final step, which is a simple summation of the independent time series to obtain an estimate of the total spawner abundance across all contributing survey sites (i.e. to provide a CU-level total). Despite these efforts, numerous survey sites remained with incomplete data series. It was beyond the scope of the WSP assessment process to conduct additional work to verify historic spawner abundance records (prior to 1995) or to attempt to standardize estimates across different survey methodologies. It should be noted,though, that the southern BC Chinook spawner abundance data could be much improved with additional efforts in both these areas. Most of the resulting updates were incorporated into the regional databases, but the *2012 verified record set* is still being used as a cross-check in the current data processing.

Merging the records across data sources has been automated with a sequence of decision rules:

- For each site and year, check through nuSEDS, EPAD, and the 2012 verified record set.
- If only 1 of these sources has a record, use it
- If there is more than 1 value, then
  - use nuSEDS over EPAD for spawner estimates
  - use EPAD over nuSEDS for broodstock estimates
  - use the 2012 verified record over the other sources unless the nuSEDS record is date stamped after 2012

The merged data set included 5,718 records for 311 sites, compared to the 5,089 numeric records in the raw nuSEDS data.

4.4.3 Stage 2: Filter out low quality data

The second step in the data processing sequence is to filter out sites with inconsistent records and records of poor quality, using the classification described in Section 4.2. Specifically, the quality filtering step currently drops all sites not classified as *persistent* (P) or *extirpated* (EX),

and drops records with low quality (i.e. estimate types 5,6 or unknown). Note that quality ratings for individual records come from nuSEDS. Records supplemented with data from other sources (See Section 4.4.2) were assigned an estimate classification of *Other*, and are not filtered out in this step.

After filtering for record quality, the data set contained 4,301 records from 271 sites. Filtering for site category (*P* or *Ex* only), retained 3,307 records from 131 sites, compared to 5,718 records for 311 sites in the merged data set. About 40% of the numeric records and about 60% of the sites were excluded in the quality filtering step.

4.4.4 Stage 3: Fill in missing records

Where data from multiple sites were available for a CU, assumed covariance in abundance trends among sites was used to infill missing years (i.e. calculate average contribution of a site for years with data, and then assume the same relative contribution in years with missing data). Infilling used the algorithm and code developed by English et al. (2006), hereafter called the 'English method', with adaptations in terms of data preparation for Southern BC Chinook.

The English method calculates the average proportion each survey site contributes to the total, and uses that average proportion to infill years with no spawner abundance data. A key assumption of this method is that relative contributions from component survey sites remain constant over time. More specifically, this assumes that different sites demonstrate a high degree of correlation with respect to their spawner abundance trends over time, enhancement levels do not vary within a site over the duration of the time series, and natural mortality events like landslides do not reduce migration success relative to the sites within the CU that do not have the identical experience.

To assess correlation among sites within CUs, an average correlation for each CU was obtained by averaging all possible pairwise Pearson correlations among sites within the CU. Within pairs of sites, the Pearson correlation calculation excluded any years with a missing value for either of the sites being considered.

Candidate sites for infilling and the years within those sites eligible for infilling were determined via three criteria: 1. The survey site had to be categorized as persistent (P); 2. There had to be at least two persistent survey sites in the CU (i.e. not a single survey site CU or a CU with only 1 persistent survey site; and, 3. Infilling was only done for years after the Start Year (Section 4.2).

For CUs with a single persistent survey site, missing observations were not infilled and no extrapolation was conducted. The Start Year for these CUs was determined using the first year with a high quality spawner abundance estimate (which could precede 1995, if high quality data was available).

For CUs with multiple persistent survey sites, missing estimates and low quality estimates (Type-5, Type-6 or Unknown Estimate Classifications) filtered out in the previous step were infilled for years since the CU-level Start Year.

It was also important to assess survey sites with dwindling spawner abundance trends (possible extirpations) appropriately (i.e. to avoid infilling time series that have shown legitimate declines

in spawner abundance to the point of functional extirpation that cannot be attributed to survey error). Unfortunately, throughout the history of Chinook Salmon assessment, limited resources often led to decreasing survey effort with decreasing spawner abundances, with the end result being that well-documented ("true") extirpations are rare. For the purposes of this analysis, spawner abundance estimates of "0" with Estimate Classifications ranging from Type-1 to Type-4 were retained as "true" zeros. Spawner abundance estimates of "0" associated with low quality Estimate Classifications (Type-5, Type-6 or Unknown) were treated as "qualitative" zeros (observation effort was likely not sufficient to provide a reasonable spawner abundance estimate) and were infilled, if possible. Although a number of cases exist where survey sites appear to have experienced considerable reduction in spawner abundance numbers, only a few survey sites appear to exhibit functional extirpation (categorized as 'EX') during the Start Year-2012 time period.

199 records for 62 sites across 18 CUs were infilled. A further 572 records that were filtered out based on data quality could not be infilled based on the above criteria.

4.4.5 Stage 4: Generate CU-Level time series

The final step in the data processing sequence is to sum the annual estimates across sites to get a CU-level estimate.

Chinook status assessments under the WSP (DFO 2016a, 2016b) maintained a distinction between wild and enhanced fish, and used the following terminology, based on the site quality and enhancement classifications described in Sections 4.2 and 4.3:

- *Conservation Unit*: Naturally spawning salmon descended from naturally spawning parents, assessed using data from persistent sites with low or unknown enhancement.
- *Enhanced Unit*: hatchery brood stock and naturally spawning salmon descended from hatchery releases, assessed using data from persistent sites with moderate or high enhancement.
- *Total Unit*: All salmon spawning within the CU boundary, assessed using data from all persistent sites.

The CU profiles in the appendices of this report use the same approach, showing time series for the sum across persistent wild sites (low or unknown enhancement) and across all persistent sites (total).

Of the 131 persistently surveyed sites, 43 were categorized as high enhancement, 5 as moderate enhancement, 27 as low enhancement, and 56 as unknown enhancement. Sites with unknown enhancement were considered likely to have little or no hatchery contribution.

Note that a CU had to have at least one persistent site in order to be considered for analysis. If a CU had no persistent sites, it was deemed to be a data deficient CU.

For each CU, a CU-level Start Year for the verified time series was calculated as the latest Start

Year across the component sites. For example, if a CU has 8 *persistent* sites with verified time series starting between 1988 and 2002, then the CU Start Year is 2002.

4.5 Review of Spawner Data Usability

To summarize data usability we first reviewed material on data usability compiled for *WSP* status (DFO 2016a, 2016b) and COSEWIC assessments (COSEWIC 2017). An informal working group of experts on Southern BC Chinook (Section 2.2) was then convened to review previous information on data quality and status metrics. An up-to date inventory of information on data usability by CU was then developed. This included information on data usability for those *CUs* where explicit statements on data usability were not available from the published reports or unpublished manuscripts sources. Note that we sought consistency with the previous approach in terms of considerations used to categorize usability, but that our results were developed through a relatively brief and informal process, whereas the previous assessments of usability were generated through formal peer-review processes (DFO 2015b, 2016b).

Four aspects of data usability were assessed: type of data series, absolute abundance metric, trend metric, and percentile benchmark.

4.5.1 Type

CU time series were classified as either a relative index of abundance (*Rel_Idx*) or an estimate of total abundance (*Abs_Abd*).

The assessment was based on two considerations. First, the average quality rating of records for persistent sites, using the 1-6 quality scores described in Section 4.2. Second, expert judgement regarding the contribution of persistent sites to the total. If the sites categorized as *persistent* likely account for most of a CU's abundance in most years, and the records had an average quality rating of 2 or lower, then the CU time series was categorized as *absolute abundance*. If one or both of these criteria was not met, then the CU time series was categorized as *relative index*.

4.5.2 WSP Absolute Abundance Metric

This assessment shows whether the time series can be used for calculating the absolute abundance WSP metric (i.e. comparing the recent generational average to upper and lower abundance benchmark, such as S_{gen} or 85% S_{MSY}).

A CU time series had to be categorized as *Type = Absolute Abundance* as per above in order to be used for the absolute abundance metric.

Note that the WSP and COSEWIC metrics only apply to the CU (i.e. time series from wild sites). Any CUs without data for wild sites are currently categorized as *DD* for the usability of all these metrics. There is on-going work to identify the percent natural origin spawners at enhanced sites,

and construct a time series for WSP assessment based on the corresponding proportion of the total estimate, but this has not been peer-reviewed and was therefore not included in this report.

4.5.3 WSP Trend Metric

This assessment shows whether the time series can be used for calculating the WSP trend metric (i.e. the percent change based on the slope of the log-transformed abundance series over 3 generations).

CU time series categorized as either *absolute abundance* or *relative index* could potentially be used for assessing trend, as long as escapement surveys had consistent coverage for the last 3 generations, exploitation rates stayed fairly constant over the same time period, and other human interventations were unlikely to substantially affect observed spawner abundances (e.g. changes in broodstock take or hatchery production)

CU time series were assessed as *TrendMetric = Yes* if the available data and commentary indicated that these requirements were met, or if participating experts considered it likely that they are met.

4.5.4 Percentile Benchmark

This assessment shows whether the time series can be used to calculate meaningful percentile-based proxies for the WSP benchmarks, such as 25th and 50th percentiles.

Considerations include observed patterns in exploitation rate and productivity. For example, Clark et al. (2014) recommend that average exploitation rate over the time series should be less than 40%. Based on a simulation evaluation on Chum Salmon, Holt et al. (2018) support the application of percentile-based benchmarks for data-limited CUs when productivity is moderate to high (more than 2.5 recruits/spawner) and harvest rates are low to moderate (less than 40%).

None of the 38 Southern BC Chinook CUs currently meet the criteria for percentile-based benchmarks, because exploitation rates have varied substantially over time, ranging from 60-80% in the 1980s for some indicator stocks to 10-30% in recent years.

4.6 Small Population Threshold (COSEWIC Criterion D)

One of the considerations in the COSEWIC status assessments is whether the current abundance is clearly above a threshold for small population sizes (e.g., 1,000 for Threatened status; Criterion D).

For those CUs where *Type = Absolute Abundance* as per above, the COSEWIC criterion D can be clearly evaluated.

For those CUs where *Type = Relative Index*, COSEWIC D criterion could be applied if current estimates of abundances are clearly above COSEWIC thresholds or if the current absolute

abundances would be above that threshold, if given expert-derived expansion factors are applied to the relative index estimates.

For this report, we did not specifically assess whether COSEWIC criterion D is met. We did, however, generate a summary table showing recent generational average of the available time series for the CU (wild sites only), and compile expert opinion on whether the expanded estimates would be likely above 1,000.

5 Results

5.1 Available Data

CU level time series of spawner abundance were generated for 32 of the 38 CUs of Southern BC Chinook. Table 5 and Figure 1 summarize the available data.

Table 5 includes the following information:

- *Sites*: shows the maximum number of sites with a spawner estimate *in one year*, and in brackets the maximum number of wild sites (low or unknown enhancement as per Section 4.3).
- *StYr*: is the CU-level Start Year of verified records across component sites, as per Section 4.2.
- *NumObs*: lists the number of observations in the CU time series and the time period covered.
- *CWT*: identifies coded-wire tag indicator stocks for each CU. If a CU has no direct CWT indicator (shown as *x*), then a potential proxy indicator is listed in brackets. Note, however, the CU-specific commentary on exploitation rate estimates in the appendices.
- *ER_BY*: lists the number of observations and year range for brood-year exploitation rate estimates.

Figure 1 shows the specific years with available estimates within the range of years listed in the *NumObs* column of Table 5. Light grey points mark estimates before the CU-specific Start Year listed in the *StYr* column of the table. Solid blue points mark estimates used in the assessment of integrated status under the WSP (DFO 2016a, 2016b).

Table 5. Overview of Available Data

Area	CU_ID	CU_Name	Sites	StYr	NumObs	CWT	ER_BY
CR	CK-01	OK	1 (1)	2001	2 (1997-1998)	x (SMK)	0
SC	CK-02	BB	1 (0)	1995	38 (1980-2018)	x (SAM)	23 (1988-2012)
FR	CK-03	LFR-fall	1 (1)	1984	44 (1975-2018)	HAR	32 (1981-2013)
FR	CK-04	LFR-spring	1 (1)	1995	41 (1977-2018)	x (DOM)	0
FR	CK-05	LFR-UPITT	1 (1)	2002	14 (2002-2018)	x (DOM)	0
FR	CK-06	LFR-summer	2 (2)	2005	32 (1986-2018)	x (DOM)	0
FR	CK-07	Maria	1 (0)	1996	22 (1996-2017)	x (SHU)	0
FR	CK-08	FRCanyon	1 (1)	1996	17 (1997-2018)	x (DOM)	0
FR	CK-09	Portage	1 (1)	2000	19 (2000-2018)	x (DOM)	0
FR	CK-10	MFR-spring	12 (12)	1995	29 (1986-2018)	x (DOM)	0
FR	CK-11	MFR-summer	7 (7)	1999	44 (1975-2018)	x (DOM)	0
FR	CK-12	UFR-spring	28 (28)	1995	41 (1975-2018)	DOM	16 (1986-2002)
FR	CK-13	STh-0.3	4 (4)	1997	30 (1981-2018)	x (SHU)	0
FR	CK-14	STh-1.3	3 (2)	1999	32 (1986-2018)	x (DOM)	0
FR	CK-15	STh-SHUR	2 (1)	1995	44 (1975-2018)	SHU	30 (1984-2013)
FR	CK-16	STh-BESS	3 (3)	1995	24 (1995-2018)	x (NIC)	0
FR	CK-17	LTh	6 (2)	1995	44 (1975-2018)	NIC	28 (1985-2012)
FR	CK-18	NTh-spr	2 (2)	1999	25 (1986-2018)	x (DOM)	0
FR	CK-19	NTh-sum	6 (6)	1997	28 (1986-2018)	x (DOM)	0
SC	CK-20	SMn-GStr	2 (0)	2005	36 (1983-2018)	x (BQR)	0
SC	CK-21	Goldstr	1 (0)	2000	23 (1992-2018)	x (COW)	0
SC	CK-22	CWCH-KOK	1 (0)	1995	44 (1965-2018)	COW	27 (1985-2013)
SC	CK-23	NanR-spr	0 (0)	1995	0	x (PPS)	0
SC	CK-25	EVI-fall	2 (0)	1995	38 (1981-2018)	NAN	19 (1979-2004)
SC	CK-27	QP-fall	4 (0)	1995	46 (1973-2018)	BQR	41 (1973-2013)
SC	CK-28	SMn-SFj	1 (0)	2002	25 (1992-2018)	PHI	0
SC	CK-29	NEVI	5 (1)	1999	44 (1975-2018)	QUI	39 (1974-2012)
WCVI	CK-31	SWVI	14 (3)	1995	39 (1972-2018)	RBT	41 (1973-2013)
WCVI	CK-32	NoKy	9 (3)	1995	37 (1982-2018)	x (RBT)	0
WCVI	CK-33	NWVI	1 (0)	1996	29 (1985-2018)	x (RBT)	0
SC	CK-34	HOMATH	0 (0)	1995	0	x (ATN)	0
SC	CK-35	KLINA	0 (0)	1997	0	x (ATN)	0
FR	CK-82	UADAMS	1 (1)	1999	14 (1999-2018)	x (DOM)	0
SC	CK-83	EVIGStr-sum	2 (0)	1995	46 (1973-2018)	PPS	38 (1975-2013)
SC	CK-9005	sBC-misc	0 (0)	1995	0	x ()	0
FR	CK-9006	FR-XCU	0 (0)	2002	0	x ()	0
SC	CK-9007	sBC-XCU	0 (0)	1995	0	x ()	0
FR	CK-9008	Chil_transp_FA	1 (0)	1986	35 (1984-2018)	CHI	33 (1981-2013)

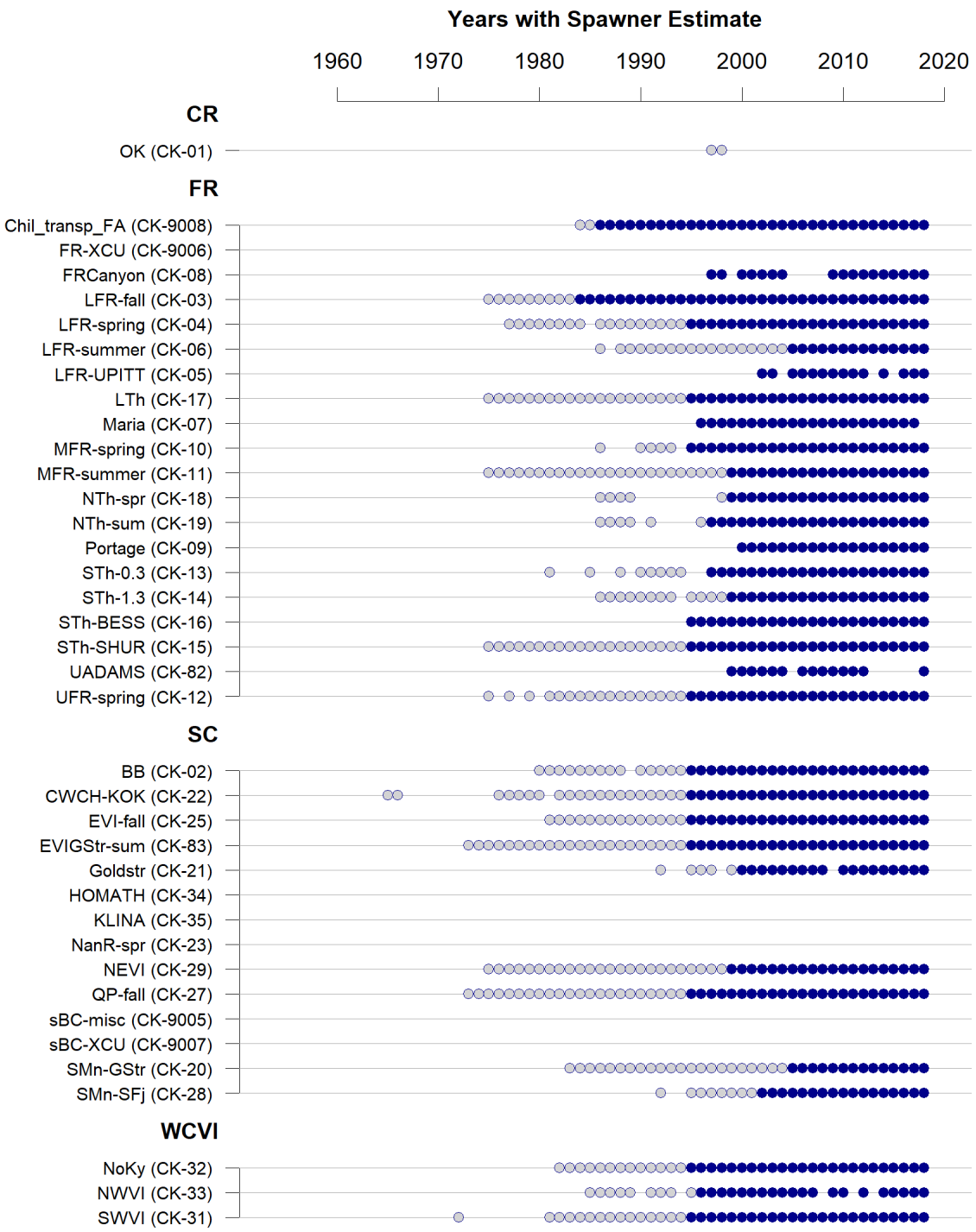

Figure 1. : Availability of Annual Estimates

5.2 Usability of Spawner Data

The quality and interpretation of spawner time series for Southern BC Chinook Conservation Units (CU) differs greatly, due to local differences in life history, habitat characteristics, enhancement history, and survey approach. Tables 6 to 9 summarize data usability by CU, using the criteria desribed in Section 4.5.

Source identifies the source of the usability assessment. *Publ* identifies classifications previously published in DFO (2015b). *Unpubl* identifies classifications based on commentary in the unpublished working papers from the WSP and COSEWIC assessment processes (See *Preface*). *New* identifies classifications developed as per the process described in Section 4.5.

Note that usability classifications are based on the current data set and quality categorizations.

Table 6. Overview of Spawner Data Usability - Fraser River CUs

CU_ID	Label	Type	AbdMetric	TrendMetric	PercBM	Source
CK-03	LFR-fall	Abs_Abd	YES	YES	NO	Publ
CK-04	LFR-spring	Rel_Idx	NO	YES	NO	Publ
CK-05	LFR-UPITT	Rel_Idx	NO	NO	NO	Publ
CK-06	LFR-summer	Rel_Idx	NO	NO	NO	Publ
CK-07	Maria	Rel_Idx	DD	DD	DD	New
CK-08	FRCanyon	Rel_Idx	NO	NO	NO	Unpubl
CK-09	Portage	Rel_Idx	NO	YES	NO	New
CK-10	MFR-spring	Rel_Idx	NO	YES	NO	New
CK-11	MFR-summer	Rel_Idx	NO	NO	NO	Unpubl
CK-12	UFR-spring	Rel_Idx	NO	YES	NO	Unpubl
CK-13	STh-0.3	Rel_Idx	NO	YES	NO	Unpubl
CK-14	STh-1.3	Rel_Idx	NO	YES	NO	Unpubl
CK-15	STh-SHUR	Abs_Abd	YES	YES	NO	Unpubl
CK-16	STh-BESS	Rel_Idx	NO	NO	NO	New
CK-17	LTh	Rel_Idx	NO	YES	NO	New
CK-18	NTh-spr	Rel_Idx	NO	NO	NO	Unpubl
CK-19	NTh-sum	Rel_Idx	NO	YES	NO	Unpubl
CK-82	UADAMS	Rel_Idx	NO	NO	NO	Unpubl

Table 7. Overview of Spawner Data Usability - Inner South Coast

CU_ID	Label	Type	AbdMetric	TrendMetric	PercBM	Source
CK-02	BB	Rel_Idx	NO	YES	NO	Publ
CK-20	SMn-GStr	Rel_Idx	NO	NO	NO	Unpubl
CK-21	Goldstr	Abs_Abd	DD	DD	DD	New
CK-22	CWCH-KOK	Abs_Abd	YES	YES	NO	Publ
CK-23	EVI-Nan-spr	Rel_Idx	DD	DD	DD	New
CK-25	EVI-fall	Rel_Idx	NO	NO	NO	Unpubl
CK-27	QP-fall	Rel_Idx	NO	NO	NO	Unpubl
CK-28	SMn-SFj	Rel_Idx	NO	NO	NO	Unpubl
CK-29	NEVI	Rel_Idx	NO	YES	NO	New
CK-34	Hom	Rel_Idx	DD	DD	DD	New
CK-35	Klina	Rel_Idx	DD	DD	DD	New
CK-83	EVIGStr-sum	Rel_Idx	DD	DD	DD	New

Table 8. Overview of Spawner Data Usability - WCVI

CU_ID	Label	Type	AbdMetric	TrendMetric	PercBM	Source
CK-31	SWVI	Rel_Idx	NO	YES	NO	Publ
CK-32	NoKy	Rel_Idx	NO	YES	NO	New
CK-33	NWVI	Rel_Idx	DD	DD	DD	New

Table 9. Overview of Spawner Data Usability - Other CUs

CU_ID	Label	Type	AbdMetric	TrendMetric	PercBM	Source
CK-01	OK	Rel_Idx	NO	NO	NO	New
CK-9005	SBCMisc	Rel_Idx	DD	DD	DD	New
CK-9006	FraserCross	Rel_Idx	DD	DD	DD	New
CK-9007	SBCCross	Rel_Idx	DD	DD	DD	New
CK-9008	Chil_transp_FA	Rel_Idx	DD	DD	DD	New

5.3 Small Population Threshold

Data from wild sites (i.e. low or unknown level of enhancement, see Section 4.3) can be used to assess CUs relative to the COSEWIC threshold for a small population (Criterion D). Table 10 summarizes the relevant information, showing the most recent available generational average (*GenAvgWild*) for the quality-controlled time series, and expert judgement whether the average for the whole CU represented by the time series is above 1,000 spawners, based on survey coverageand available estimates (*Above1kWild*). For CUs which were assessed as data deficient (DD) under the WSP (Table 4), the numerical estimate of the latest generational average (*GenAvgWild*) is flagged with an asterisk ($*$). *NA* for *GenAvgWild* identifies CUs which do not have any data from wild sites, or have missing observations in the last generation of the time series for the sum of spawners in wild sites. Any CU with NA for *GenAvgWild* was automatically assigned *NA* for *Above1kWild*. For details, refer to each CU's data notes in the Appendices.

Table 10. Information Relevant to Small Population Threshold

Area	CU_ID	CU_Name	Type	GenAvgWild	Above1kWild	BasedOn
CR	CK-01	OK	Rel_Idx	NA	NA	NA
SC	CK-02	BB	Rel_Idx	NA	NA	NA
FR	CK-03	LFR-fall	Abs_Abd	49,250	Clearly	Estimate
FR	CK-04	LFR-spring	Rel_Idx	287	Maybe	Data Notes
FR	CK-05	LFR-UPITT	Rel_Idx	83*	Maybe	Data Notes
FR	CK-06	LFR-summer	Rel_Idx	828*	Likely	Data Notes
FR	CK-07	Maria	Rel_Idx	NA	NA	NA
FR	CK-08	FRCanyon	Rel_Idx	7*	Possible	Data Notes
FR	CK-09	Portage	Rel_Idx	35	Unlikely	Data Notes
FR	CK-10	MFR-spring	Rel_Idx	3,577	Clearly	Estimate
FR	CK-11	MFR-summer	Rel_Idx	9,949	Clearly	Estimate
FR	CK-12	UFR-spring	Rel_Idx	11,974	Clearly	Estimate
FR	CK-13	STh-0.3	Rel_Idx	82,170	Clearly	Estimate
FR	CK-14	STh-1.3	Rel_Idx	684	Likely	Data Notes
FR	CK-15	STh-SHUR	Abs_Abd	16,018	Clearly	Estimate
FR	CK-16	STh-BESS	Rel_Idx	15	Unlikely	Data Notes
FR	CK-17	LTh	Rel_Idx	3,245	Clearly	Estimate
FR	CK-18	NTh-spr	Rel_Idx	82	Possible	Data Notes
FR	CK-19	NTh-sum	Rel_Idx	2,494	Clearly	Estimate
SC	CK-20	SMn-GStr	Rel_Idx	NA	NA	NA
SC	CK-21	Goldstr	Abs_Abd	NA	NA	NA
SC	CK-22	CWCH-KOK	Abs_Abd	NA	NA	NA
SC	CK-23	NanR-spr	Rel_Idx	NA	NA	NA
SC	CK-25	EVI-fall	Rel_Idx	NA	NA	NA
SC	CK-27	QP-fall	Rel_Idx	NA	NA	NA
SC	CK-28	SMn-SFj	Rel_Idx	NA	NA	NA
SC	CK-29	NEVI	Rel_Idx	152	Unlikely	Data Notes
WCVI	CK-31	SWVI	Rel_Idx	348	Possible	Data Notes
WCVI	CK-32	NoKy	Rel_Idx	1,849	Clearly	Estimate
WCVI	CK-33	NWVI	Rel_Idx	NA	NA	NA
SC	CK-34	HOMATH	Rel_Idx	NA	NA	NA
SC	CK-35	KLINA	Rel_Idx	NA	NA	NA
FR	CK-82	UADAMS	Rel_Idx	101*	Unlikely	Data Notes
SC	CK-83	EVIGStr-sum	Rel_Idx	NA	NA	NA
SC	CK-9005	sBC-misc	TBD	NA	NA	NA
FR	CK-9006	FR-XCU	TBD	NA	NA	NA
SC	CK-9007	sBC-XCU	TBD	NA	NA	NA
FR	CK-9008	Chil_transp_FA	Rel_Idx	NA	NA	NA

6 Discussion

6.1 Key Assumptions

The CU-level time series of spawner abundance presented in the appendices are based on 3 key assumptions: (1) source records are complete, (2) data treatment is appropriate, and (3) the context presented in the summaries and data notes is sufficient for properly interpretating the numbers.

6.1.1 Completeness of Source Data

The data sets assembled for each CU are assumed to be complete, because the CU-level data set for Southern BC Chinook has gone through several extensive reviews in the last decade as part of the WSP and COSEWIC assessment processes, especially the 2012 data review and database cross-check outlined in Section 4.4.2. Any major data omissions or errors would most likely have been caught in the three CSAS peer-review processes (DFO 2015a, 2015b, 2016b) or the COSEWIC assessment (COSEWIC 2018).

6.1.2 Data Treatment

Data treatment steps include quality filtering, infilling, and summing across sites in a CU (Sections 4.4.3 to 4.4.5). The current approach has been extensively debated and evolved accordingly over time since the initial work on for the pre-COSEWIC peer-review described in DFO (2015a).

The primary objective of the data treatment approach has been to generate internally consistent time series, and therefore the criteria end up rejecting over 60% of the raw records (Section 4.4.3). The final CU-level time series then exludes a lot of records, but each annual sum includes the same number of sites and only high/moderate quality estimates. Alternative approaches were explored (e.g. year-specific expansion factors), but expert consensus in the peer- review processes (DFO 2015a, 2015b, 2016b) was that this is the best we can do with the available data.

6.1.3 Context

A recurring point raised by participating experts during the peer-review processes (DFO 2015a, 2015b, 2016b) was that no single time series can capture the whole picture of a CU, and that context is important for interpretation. This document attempts to provide such context.

One important piece of context for the spawner time series is corresponding patterns of exploitation rates. Where possible, these have have been included as the second panel in the CU overview plots in the appendices. For some CUs, direct ER indicators are available, and for

others proxy ER indicators can be used (based on similar life history and ocean distribution), as listed in Table 3.

Another key consideration is the level and pattern of enhanced contribution. This is captured in the summary plots by showing 2 time series (wild sites only vs. total across all sites).

Finally, there are CU-specific qualitative considerations that affect how the time series can be interpreted. Available information from previously published and unpublished documentation is included in the *Data Notes* section of each CU profile in the appendices.

For example, *East Vancouver Island - Nanaimo and Chemainus Fall 0.x* (CK-25) shows a gradual increase in total spawner abundance since the 1980s, which could be interpreted as indicating a healthy population (Figure B.3). However, exploitation rate has decreased over the same time period from over 80% to around 30%. In addition, there are no data for any wild sites, and the estimates reflect mostly hatchery production. Together, these two pieces of information point to a potential long-running decline in productivity from the total unit (enhanced and wild), and unknown status of the CU (wild sites only). Accordingly, both the WSP and COSEWIC processes assessed the CU status as *To Be Determined*, pending development of methods and criteria for enhanced populations.

6.2 Limitations

The Working Group for this project (Section 2.2) identified the following key limitations of the spawner abundance data set for Southern BC Chinook salmon:

- Quantitative expansions of the quality-filtered time series, to account for sites that were not surveyed or were excluded due to low quality data, are not feasible for most CUs. Therefore, only 4 of the 38 CUs have time series categorized as *absolute abundance* estimates. The other CUs have either *relative indices* of abundance, or are *data deficient*.
- Habitat-based abundance benchmarks, based on methods developed by Parken et al. (2006), have been calculated for most of the CUs, but are not included in this report. They have not been previously published, and cannot be compared to available spawner data for most CUs, because only relative indices of abundance are available. Of those 4 cases with total abundance estimates, 2 have substantial hatchery supplementation and no data for wild sites, so that habitat-based benchmarks don't apply there either (CK-21: Goldstream, CK-22: Cowichan-Koksilah). That leaves 2 out of 38 CUs where habitat-based benchmark could be used for status assessment (CK-03: Lower Fraser Fall, CK-15: South-Thompson / Shuswap River).
- Trend metrics only applicable for CU time series with consistent assessment approach and coverage (i.e. after quality filtering and infilling). Fifteen out of 38 CUs have time series suitable for assessing trends.
- Percentile-based benchmarks have been used as status proxies for salmon populations without recruitment estimates (e.g. Volk et al. 2009; English et al. 2014), but Clark et al. (2014) recommend using the percentile method only for stocks with low to moderate harvest levels (average ER < 40%). Based on a simulation evaluation on Chum Salmon,

Holt et al. (2018) support the application of percentile-based benchmarks for data-limited CUs when productivity is moderate to high (more than 2.5 recruits/spawner) and harvest rates are low to moderate (less than 40%). None of the 38 Southern BC Chinook CUs currently meet the criteria for percentile-based benchmarks, because exploitation rates have varied substantially over time, ranging from 60-80% in the 1980s for some indicator stocks to 10-30% in recent years.

6.3 Priorities for Future Work

Several on-going initiatives are tackling the challenges of consolidating BC salmon data and making it accessible.

- DFO's *State of the Salmon* program is compiling a regional data set of abundance, productivity, and environmental covariates (Sue Grant, DFO, pers.comm).
- DFO's *Data Management Unit* is developing an updated regional framework for documenting metadata for salmon (Shelee Hamilton, DFO, pers. comm.)
- Future integrated status assessments under the WSP will generate quality-controlled time series, like the ones presented here, for other species and areas.
- The *Pacific Salmon Explorer*, hosted by the PSF, continues to expand the species and areas that are covered. It makes a lot of data on salmon abundance and habitat pressures easily accessible.

While these initiatives differ in scope and timeline, the overarching goals of transparency and efficiency are the same. Ideally, these initiatives could coordinate data management activities in the short term, and generate data sets that are publicly accessible through a single centralized portal in the long-term.

APPENDIX A CU Profiles - Southern Mainland

A.1 Boundary Bay Fall 0.3 (CK-02)

A.1.1 Data Overview

Table A.1 summarizes the available data, and Figure A.1 shows the patterns over time. Section 4 describes the data classifications and usability assessments.

Table A.1. Data Overview for Boundary Bay Fall 0.3 (CK-02)

CU_ID	CK-02
CU_Name	BB
SpnCategory	Rel_Idx
NumObs	38 (1980-2018)
StartYear	1995
NumSites	1 (0)
Gen	4 (3.77)
GenAvgWild	NA
Area	SC
Area2	GS+OK
CWT	x (SAM)
ER_BY	23 (1988-2012)
Area	Inner SC
MU	Inner SC
AbsAbdMetric	NO
TrendMetric	YES
PercBM	NO
Source	Publ
Above1kWild	NA
BasedOn	NA

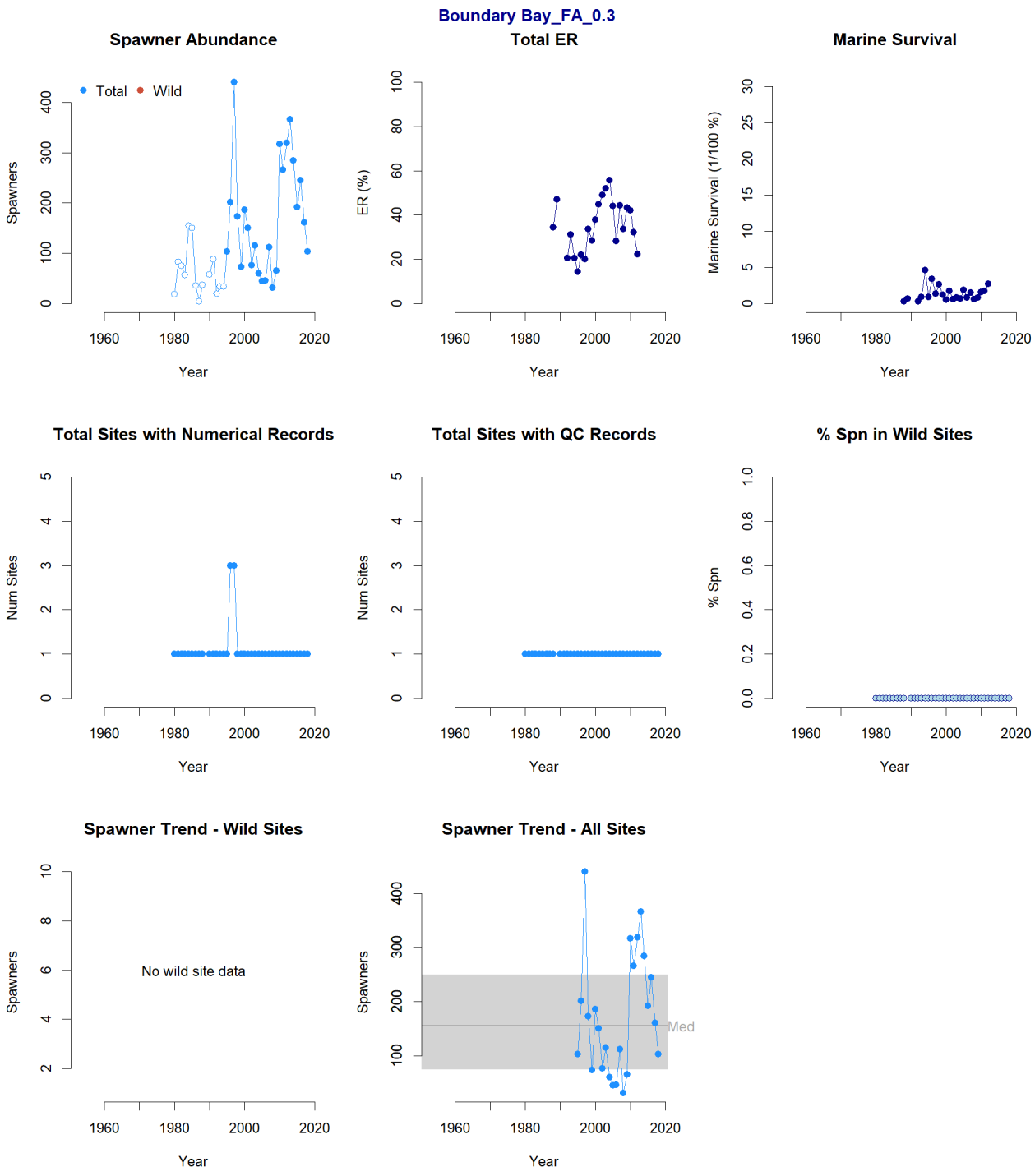

Figure A.1. : Available Data for Boundary Bay Fall 0.3 (CK-02)

A.1.2 Data Notes

Spawner Estimates

The information about the extent of enhancement is unusually poor due to sparse electronic records and insufficient time to enter hard copy enhancement data. All sites in this CU are likely highly enhanced. This CU has the highest human population density among all others in southern BC, and there is broad recognition that the current freshwater environment is unlike what existed 200 years ago. Each spawner abundance enumeration site has at least one stewardship group yet very little information is available about its biology or status. There are no habitat-based estimates of abundance benchmarks for this Total Unit (TU). There is no data stream for any wild sites in the CU. The single site with a data stream in this Enhanced Unit (EU) has notable contributions from hatchery-origin spawners outside the EU.

DFO (2015b) includes the following summary: *No wild sites in this CU but there are wild fish. Suitable for trends analysis, but not absolute abundance metric because missing some component of escapement (i.e., 2/3 sites not surveyed and may be fish below the counting fence).*

Exploitation Rate Estimates

There is no direct measurement of exploitation for this CU. Nearby exploitation rate indicator stocks located in the Nooksack and Cowichan Rivers experience high exploitation relative to other Chinook stocks entering the Salish Sea.

The Cowichan CWT indicator has not been used previously to represent this CU. The rationale for this is that the Cowichan fall stock has a highly atypical (for Chinook generally) maturation schedule and the Boundary Bay CU was thought more likely to be similar to other Chinook stocks, such as those in the nearby Samish and Nooksack rivers. In addition, the frequently reported presence of clipped but untagged Chinook in the return of the Little Campbell River in the Boundary Bay CU, thought likely to be originating from the geographically close Nooksack River with mass marked fall Chinook releases, increases the chance that the fish are probably better represented by the Samish/Nooksack (SAM) CWT indicator.

Based on its poorly known biological attributes, the CU likely has a local distribution in the Salish Sea and along the outer west coast Vancouver Island (WCVI) and Washington Coast.

A.1.3 CWT Recoveries Overview

The *Mark Recovery Program Information System* (DFO 2020b) covers coded wire tag releases and recoveries for indicator and non-indicator systems. Table A.2 summarizes all tag recoveries for release sites matched to this CU, based on a database extract from July 2020. Recoveries are identified by region (e.g. BCYK = British Columbia and Yukon), then by marine (M) or freshwater (F), then by geography where applicable (N = North, S = South), and finally by sector or gear type.

Table A.2. Estimated CWT Recoveries - Boundary Bay Fall 0.3 (CK-02)

RecoveredIn	n	Years
None	0	None

A.1.4 Site Overview

Table A.6 lists all the sites matched to this CU, and summarizes the available information. Enhancement level (*Enh*) and site category (*Cat*) are used for aggregating the site data (see sections 4.2.3 and 4.3 for definitions) . Only persistent (*P*) and extirpated (*EX*) sites are used in the aggregated time series. For the CU-level series, only sites with low or unknown enhancement level are included. For the Total Unit time series, all P and EX sites are combined. Some sites are used as indicators for escapement (*Esc*) or coded-wire tags (*CWT*). The table also shows the highest value (*Max*) and the year of the last available observation (*Last*) for the quality-filtered time series. The remaining columns list the number of observations in different quality categories, with definitions as per Section 4.2.1.

Table A.3. Site Overview for Boundary Bay Fall 0.3 (CK-02)

Name	Enh	Cat	StYr	Esc	CWT	Max	Last	High	Mod	Other	Infill	Dropped
CAMPBELL RIVER	HIGH	P	1979	No	No	440	2018	0	0	38	0	0
NICOMEKL RIVER	LOW	DD	NA	No	No	NA	NA	0	0	2	0	2
SERPENTINE RIVER	UNK	DD	NA	No	No	NA	NA	0	0	5	0	2

A.2 Southern Mainland - Georgia Strait Fall 0.x (CK-20)

A.2.1 Data Overview

Table A.4 summarizes the available data, and Figure A.2 shows the patterns over time. Section 4 describes the data classifications and usability assessments.

Table A.4. Data Overview for Southern Mainland - Georgia Strait Fall 0.x (CK-20)

CU_ID	CK-20
CU_Name	SMn-GStr
SpnCategory	Rel_Idx
NumObs	36 (1983-2018)
StartYear	2005
NumSites	2 (0)
Gen	4 (3.6)
GenAvgWild	NA
Area	SC
Area2	GS+OK
CWT	x (BQR)
ER_BY	0
Area	Inner SC
MU	Inner SC
AbsAbdMetric	NO
TrendMetric	NO
PercBM	NO
Source	Unpubl
Above1kWild	NA
BasedOn	NA

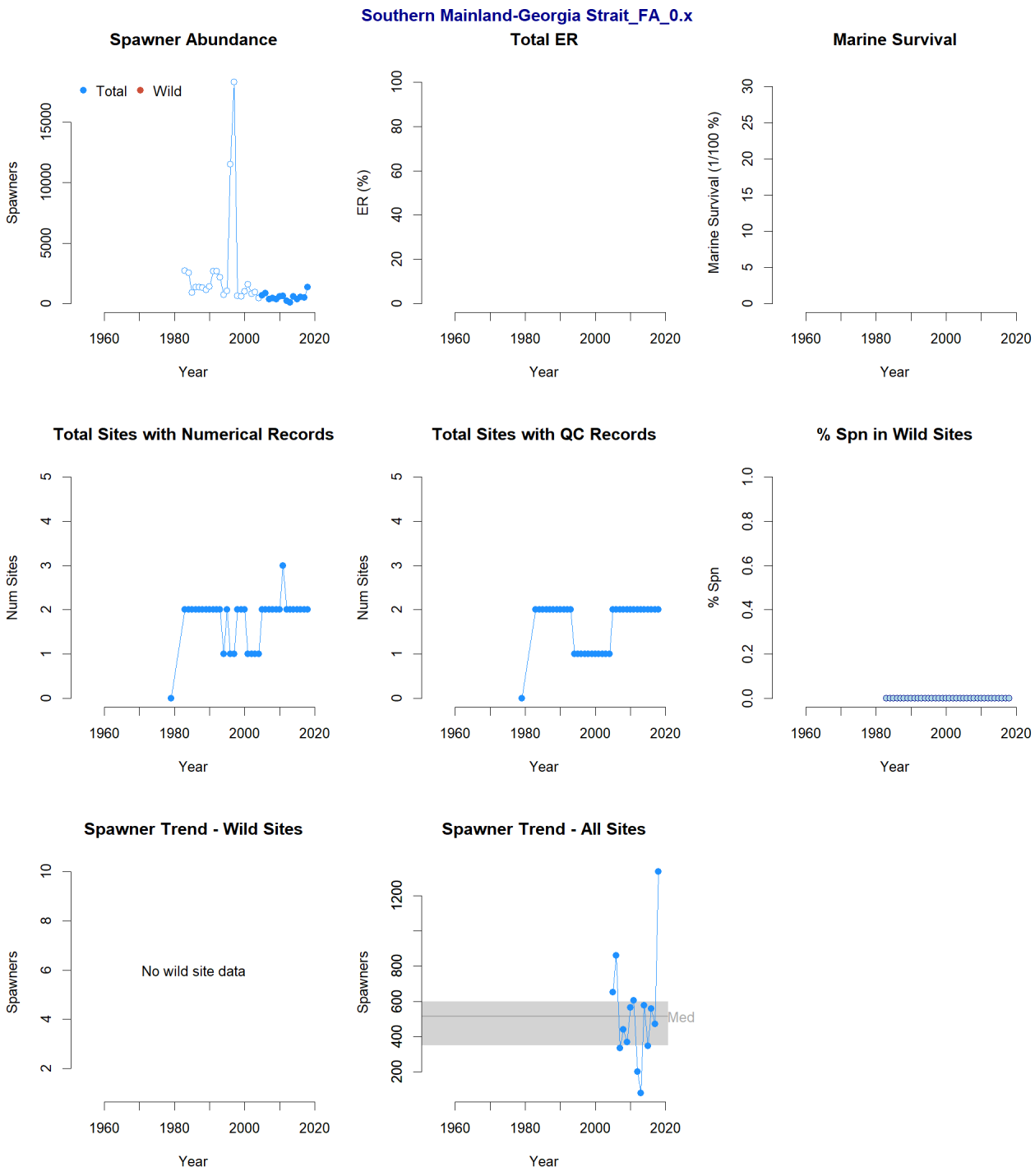

Figure A.2. : Available Data for Southern Mainland - Georgia Strait Fall 0.x (CK-20)

A.2.2 Data Notes

Spawner Estimates

There are a large number of wild sites (20) and enhanced sites (6) in this CU. Spawner abundance estimates are very sporadic for the wild sites. Of the few Type 1-4 estimates that exist for wild sites, most indicate low numbers of fish. Lower quality estimates for one wild site indicates moderate numbers of fish in that system (>3000). A long time series of historical spawner abundance estimates of unknown quality for one enhanced system indicates a fairly large spawner abundance (>10,000). Enhancement activity in this CU has included substantial historical releases of juveniles from outside the CU into a number of systems within the CU.

The escapement data are generally of poor quality for many of the sites in this CU. No attempt has been made to standardize data. The escapement estimates for the Squamish River is an example of very poor quality information being maintained in nuSEDS. Users need to carefully consider other sources of information. Considerable efforts were made by DFO to use mark recapture methods to estimate the escapements during the late 1980s and early 1990s (Schubert 1993). However, the tagging location was in the ocean and after repeating the study over several years, it was found that there were stocks from outside the Squamish River being tagged. This lead to uncorrectable biases in the escapement estimates. Also, the Squamish River is a very large river that has low visibility due to water clarity issues, making it very difficult to apply visual survey methods with any degree of reliability. The basis of the estimates that range up to 40,000 is highly suspicious and their accuracy is unknown (even doubtful). Given the size of the river and drainage network, the Squamish River system should be capable of producing large numbers of Chinook Salmon, however it is unclear if the escapement time series provided here is meaningful. On August 5, 2005, a train derailment resulted in sodium hydroxide spilling into the Cheakamus River which created toxic conditions for many adult and juvenile Chinook Salmon. Subsequently, efforts were made to supplement and rebuild that brood year. Numerous adult Chinook carcasses were recovered by concerned citizens and stewardship groups. The timing of this event and observed Chinook deaths provided evidence that a summer run persists in the Squamish. The CU is more likely to be predominantly summer run, though it has been labeled a fall run based on other information.

DFO (2015b): Data deficient. All available information is presented, but there is no dashboard because there is no escapement data. *[Note: This statement applies to natural spawners. There is some data from enhanced sites. See other comments.]*

Exploitation Rate Estimates

There is no exploitation rate indicator stock for this CU. Several sites have been coded wire tagged and recoveries occurred throughout southern and northern British Columbia. Chinook from other conservation units have been transferred to this CU, and previous studies expressed concerns about the influence of these activities on the biological characteristics of the CU (Schubert 1993).

A.2.3 CWT Recoveries Overview

The *Mark Recovery Program Information System* (DFO 2020b) covers coded wire tag releases and recoveries for indicator and non-indicator systems. Table A.5 summarizes all tag recoveries for release sites matched to this CU, based on a database extract from July 2020. Recoveries are identified by region (e.g. BCYK = British Columbia and Yukon), then by marine (M) or freshwater (F), then by geography where applicable (N = North, S = South), and finally by sector or gear type.

Table A.5. Estimated CWT Recoveries - Georgia Strait Fall 0.x (CK-20)

RecoveredIn	n	Years
AK_M_N_Sport	122 (0-25)	15 (1982-2019)
AK_M_S_Sport	67 (0-18)	11 (1981-2002)
AK_Aboriginal	15 (1-6)	6 (1990-1998)
AK_Net and Seine	66 (0-20)	18 (1981-2019)
AK_Troll	460 (1-104)	24 (1980-2019)
BCYK_F_Sport	43 (6-15)	5 (1980-2018)
BCYK_F_S_Net and Seine	43 (8-13)	4 (1990-2002)
BCYK_M_N_Net and Seine	1,265 (3-291)	17 (1980-2001)
BCYK_M_N_Sport	797 (2-175)	21 (1980-2019)
BCYK_M_N_Troll	287 (2-53)	16 (1981-2010)
BCYK_M_S_Net and Seine	167 (1-35)	12 (1980-2019)
BCYK_M_S_Sport	3,840 (3-777)	28 (1980-2019)
BCYK_M_S_Troll	294 (0-82)	14 (1980-2010)
WA_M_N_Net and Seine	38 (2-25)	3 (1991-2011)
WA_M_N_Sport	3 (3-3)	1 (1997-1997)
WA_M_S_Net and Seine	7 (3-4)	2 (1982-1993)
WA_M_S_Sport	18 (2-5)	5 (1992-2018)
WA_M_S_Troll	2 (2-2)	1 (2010-2010)

A.2.4 Site Overview

Table A.6 lists all the sites matched to this CU, and summarizes the available information. Enhancement level (*Enh*) and site category (*Cat*) are used for aggregating the site data (see sections 4.2.3 and 4.3 for definitions) . Only persistent (*P*) and extirpated (*EX*) sites are used in the aggregated time series. For the CU-level series, only sites with low or unknown enhancement level are included. For the Total Unit time series, all P and EX sites are combined. Some sites are used as indicators for escapement (*Esc*) or coded-wire tags (*CWT*). The table also shows the highest value (*Max*) and the year of the last available observation (*Last*) for the quality-filtered time series. The remaining columns list the number of observations in different quality categories, with definitions as per Section 4.2.1.

Table A.6. Site Overview for Southern Mainland - Georgia Strait Fall 0.x (CK-20)

Name	Enh	Cat	StYr	Esc	CWT	Max	Last	High	Mod	Other	Infill	Dropped
CHEAKAMUS RIVER	MOD	P	2005	No	No	1170	2018	0	0	25	0	0
SQUAMISH RIVER	HIGH	P	2005	Yes	No	18300	2018	0	0	31	5	0
BREM RIVER	UNK	DD	NA	No	No	NA	NA	NA	NA	NA	NA	NA
BROTHERS CREEK	UNK	DD	NA	No	No	NA	NA	NA	NA	NA	NA	NA
INDIAN RIVER	UNK	DD	NA	No	No	NA	NA	0	0	1	0	0
LYNN CREEK	UNK	DD	NA	No	No	NA	NA	0	0	1	0	0
QUATAM RIVER	UNK	DD	NA	No	No	NA	NA	0	0	5	0	0
RICHARDS CREEK	UNK	DD	NA	No	No	NA	NA	0	0	2	0	0
SEYMOUR RIVER	MOD	DD	NA	No	No	NA	NA	0	0	11	0	0
SKWAWKA RIVER	UNK	DD	NA	No	No	NA	NA	0	0	4	0	0
THEODOSIA RIVER	MOD	DD	NA	No	No	NA	NA	0	6	3	0	0
TOBA RIVER	UNK	DD	NA	No	No	NA	NA	NA	NA	NA	NA	NA
TZOONIE RIVER	UNK	DD	NA	No	No	NA	NA	NA	NA	NA	NA	NA
ASHLU CREEK	MOD	AGG	NA	No	No	NA	NA	0	0	16	0	0
BRANCH 100 CREEK	UNK	AGG	NA	No	No	NA	NA	NA	NA	NA	NA	NA
BREM RIVER TRIBUTARY	UNK	AGG	NA	No	No	NA	NA	NA	NA	NA	NA	NA
CHUK-CHUK CREEK	UNK	AGG	NA	No	No	NA	NA	NA	NA	NA	NA	NA
JULY CREEK	UNK	AGG	NA	No	No	NA	NA	NA	NA	NA	NA	NA
KLITE RIVER	UNK	AGG	NA	No	No	NA	NA	0	1	0	0	1
LITTLE TOBA RIVER	UNK	AGG	NA	No	No	NA	NA	NA	NA	NA	NA	NA
MAMQUAM RIVER	UNK	AGG	NA	No	No	NA	NA	0	0	9	0	0
MAMQUAM SPAWNING CHANNEL	UNK	AGG	NA	No	No	NA	NA	NA	NA	NA	NA	NA
MASHITER CREEK	UNK	AGG	NA	No	No	NA	NA	NA	NA	NA	NA	NA
SHOVELNOSE CREEK	UNK	AGG	NA	No	No	NA	NA	0	0	5	0	0

Name	Enh	Cat	StYr	Esc	CWT	Max	Last	High	Mod	Other	Infill	Dropped
SPRING CREEK	UNK	AGG	NA	No	No	NA	NA	NA	NA	NA	NA	NA
TENDERFOOT CREEK	MOD	AGG	NA	No	No	NA	NA	0	0	3	0	0
ANGUS CREEK	UNK	DEL	NA	No	No	NA	NA	0	0	1	0	0
BRITTAIN RIVER	UNK	DEL	NA	No	No	NA	NA	NA	NA	NA	NA	NA
CARLSON CREEK	UNK	DEL	NA	No	No	NA	NA	NA	NA	NA	NA	NA
HASTINGS CREEK	UNK	DEL	NA	No	No	NA	NA	NA	NA	NA	NA	NA
MCNAB CREEK	UNK	DEL	NA	No	No	NA	NA	NA	NA	NA	NA	NA
NOONS CREEK	UNK	DEL	NA	No	No	NA	NA	NA	NA	NA	NA	NA
PENDER HARBOUR CREEK	UNK	DEL	NA	No	No	NA	NA	0	0	0	0	1
ROBERTS CREEK	UNK	DEL	NA	No	No	NA	NA	0	0	0	0	1
SHANNON CREEK	UNK	DEL	NA	No	No	NA	NA	NA	NA	NA	NA	NA
STAWAMUS RIVER	UNK	DEL	NA	No	No	NA	NA	NA	NA	NA	NA	NA
TAHUMMING RIVER	UNK	DEL	NA	No	No	NA	NA	NA	NA	NA	NA	NA
VANCOUVER RIVER	UNK	DEL	NA	No	No	NA	NA	0	0	0	0	1
WILSON CREEK	UNK	DEL	NA	No	No	NA	NA	0	0	0	0	1

A.3 Southern Mainland - Southern Fjords Fall 0.x (CK-28)

A.3.1 Data Overview

25 years of spawner estimates are available for this CU, based on 1 site (Phillips River) with persistent monitoring. Phillips River estimates since 2002 have been verified, but current level of assessment started in 2012. Coverage of other systems has been sporadic and may have been focused on other salmon species.

The Phillips River is a highly enhanced site that serves as a CWT indicator and generates direct estimates of exploitation rate. Table A.7 summarizes the available data, and Figure A.3 shows the patterns over time. Section 4 describes the data classifications and usability assessments.

Table A.7. Data Overview for Southern Mainland - Southern Fjords Fall 0.x (CK-28)

CU_ID	CK-28
CU_Name	SMn-SFj
SpnCategory	Rel_Idx
NumObs	25 (1992-2018)
StartYear	2002
NumSites	1 (0)
Gen	4 (3.6)
GenAvgWild	NA
Area	SC
Area2	WCVI/NEVI/USC
CWT	PHI
ER_BY	0
Area	Inner SC
MU	Inner SC
AbsAbdMetric	NO
TrendMetric	NO
PercBM	NO
Source	Unpubl
Above1kWild	NA
BasedOn	NA

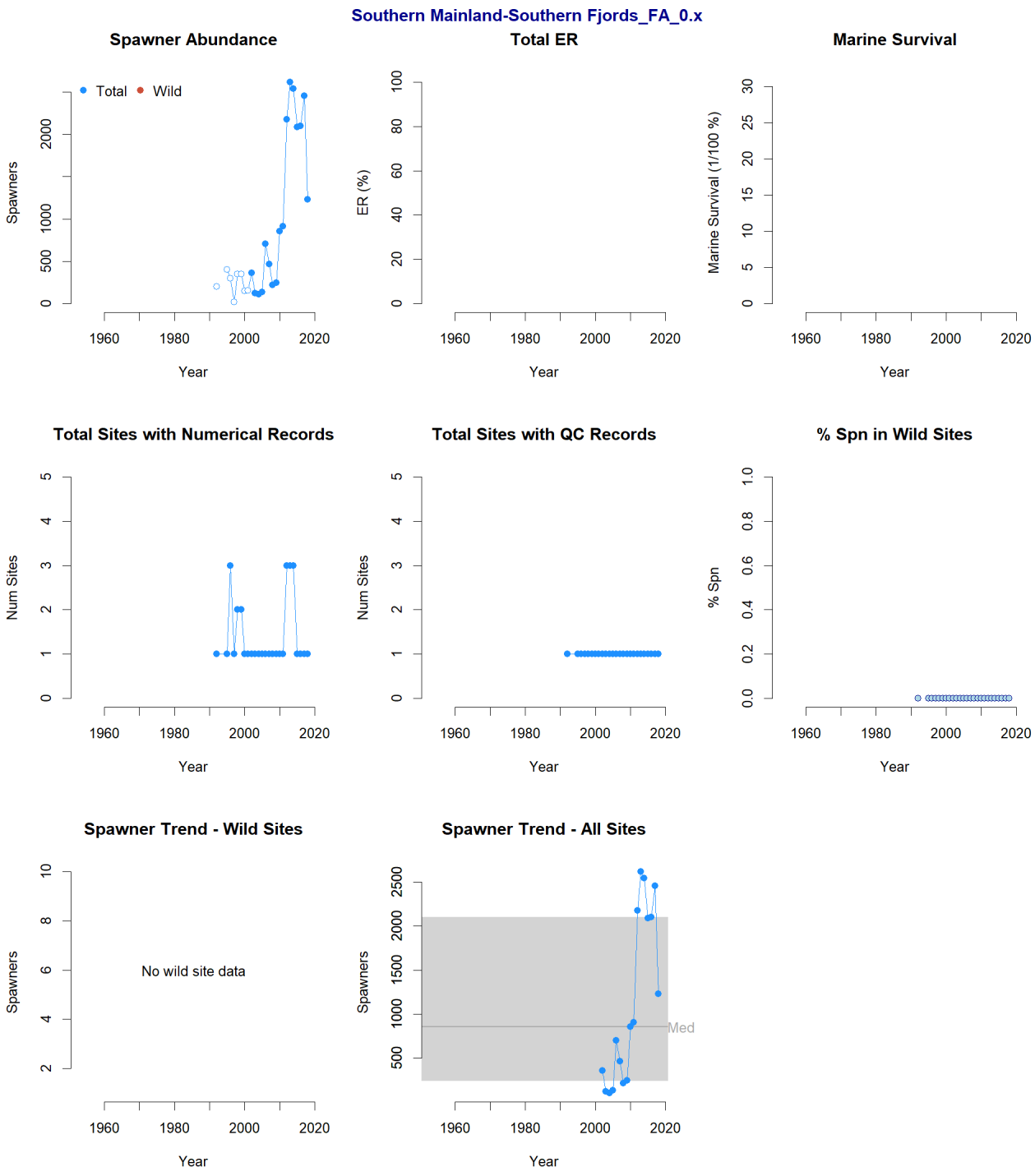

Figure A.3. Available Data for Southern Mainland - Southern Fjords Fall 0.x (CK-28)

A.3.2 Data Notes

Spawner Estimates

In past years, Kakweikan, Wakeman and Kingcome Rivers in this CU have been used as some of the CTC escapement indicator stocks for the Upper Georgia Strait Management Unit. However, starting in 2019 the Phillips River will be used as an indicator stock. The quality of spawner abundance estimates for the Phillips River has improved over time as high quality results from mark recapture methods have been utilized since 2012 (the time series also includes fish removed for enhancement purposes). The increase in the Phillips River escapement in 2012 relative to earlier years of the time series may largely be due to differences in survey methodologies, and cannot be re-calibrated with previous visual survey estimates as they are not readily comparable. For other systems throughout this CU, escapement data quality are generally quite poor; estimates for most sites are based on Chinook counts outside of the peak Chinook spawning period or outside of the Chinook distribution area: data is collected opportunistically during enumeration programs for other Salmon species.

Habitat-based estimates of abundance benchmarks have been previously developed for this CU, but have not been published. They are not included in this report because updating the estimates falls outside the scope of the current project.

The main life history of Chinook Salmon varies among sites within this CU. At lower elevations and areas located outside of the fjords, the most common life history is ocean-type, whereas fish that spawn in the rivers at the head of the fjords and at higher elevations are mainly stream-type. There is also a mix of summer (Kingcome R and Wakeman R) and fall (Phillips R) run types in this CU, varying by location. Future CU reviews may look at reallocating the summer runs to CK-34 or CK-35, if supported by data. For example, Chinook are observed in Ahnuhati (clear system), Kingcome and Wakeman (both large glacial streams with poor visibility) during Pink salmon aerial surveys in July and August, which may justify grouping these populations with other summer-timed spawners in large glacial fjord systems like the Klinaklini (CK-35).

Exploitation Rate Estimates

CWT releases have occurred from Phillips since the 1990s and these indicate a far north ocean distribution pattern, with many recoveries in Alaska troll fisheries and northern BC troll and sport fisheries, similar to Quinsam (CK-29).

The Phillips River CWT indicator has ben in use since 2012 and cohort analysis results are available for a number of consecutive broods to represent this CU. However, the 2019 Phillips Chinook brood was the final enhanced group for this stock and no further CWTs will be released after this brood.

It is unclear which marine distribution trend the other stocks in this CU follow, especially stocks with a stream-type life history.

ER estimates based on the Phillips River indicator (PHI) are under development, and have not been included in Figure A.3

A.3.3 CWT Recoveries Overview

The *Mark Recovery Program Information System* (DFO 2020b) covers coded wire tag releases and recoveries for indicator and non-indicator systems. Table A.8 summarizes all tag recoveries for release sites matched to this CU, based on a database extract from July 2020. Recoveries are identified by region (e.g. BCYK = British Columbia and Yukon), then by marine (M) or freshwater (F), then by geography where applicable (N = North, S = South), and finally by sector or gear type.

Table A.8. Estimated CWT Recoveries - Southern Fjords Fall 0.x (CK-28)

RecoveredIn	n	Years
AK_M_N_Sport	83 (1-19)	9 (2009-2019)
AK_M_S_Sport	66 (0-19)	9 (2005-2018)
AK_Aboriginal	9 (2-5)	3 (2017-2019)
AK_Net and Seine	213 (0-80)	14 (2003-2019)
AK_Troll	1,066 (2-250)	16 (2004-2019)
BCYK_M_N_Net and Seine	6 (1-3)	3 (2008-2017)
BCYK_M_N_Sport	1,252 (5-297)	15 (2005-2019)
BCYK_M_N_Troll	68 (2-30)	7 (2004-2018)
BCYK_M_S_Net and Seine	6 (6-6)	1 (2018-2018)
BCYK_M_S_Sport	164 (2-53)	11 (2005-2019)
BCYK_M_S_Test Fisheries	1 (1-1)	1 (2019-2019)
BCYK_M_S_Troll	4 (4-4)	1 (2014-2014)

A.3.4 Site Overview

Table A.9 lists all the sites matched to this CU, and summarizes the available information. Enhancement level (*Enh*) and site category (*Cat*) are used for aggregating the site data (see sections 4.2.3 and 4.3 for definitions) . Only persistent (*P*) and extirpated (*EX*) sites are used in the aggregated time series. For the CU-level series, only sites with low or unknown enhancement level are included. For the Total Unit time series, all P and EX sites are combined. Some sites are used as indicators for escapement (*Esc*) or coded-wire tags (*CWT*). The table also shows the highest value (*Max*) and the year of the last available observation (*Last*) for the quality-filtered time series. The remaining columns list the number of observations in different quality categories, with definitions as per Section 4.2.1.

Table A.9. Site Overview for Southern Mainland - Southern Fjords Fall 0.x (CK-28)

Name	Enh	Cat	StYr	Esc	CWT	Max	Last	High	Mod	Other	Infill	Dropped
PHILLIPS RIVER	HIGH	P	2002	Yes	Yes	2616	2018	0	0	25	0	0
AHNUHATI RIVER	UNK	EX	NA	No	No	NA	NA	0	1	9	0	0
APPLE RIVER	UNK	DD	NA	No	No	NA	NA	0	0	11	0	0
FRANKLIN RIVER	UNK	DD	NA	No	No	NA	NA	NA	NA	NA	NA	NA
FULMORE RIVER	UNK	DD	NA	No	No	NA	NA	NA	NA	NA	NA	NA
HEYDON CREEK	UNK	DD	NA	No	No	NA	NA	0	0	6	0	0
KAKWEIKEN RIVER	UNK	DD	NA	No	No	NA	NA	0	0	7	0	0
KINGCOME RIVER	UNK	DD	2002	No	No	NA	NA	0	0	17	0	3
KWALATE CREEK	UNK	DD	NA	No	No	NA	NA	0	0	1	0	0
ORFORD RIVER	MOD	DD	NA	No	No	NA	NA	0	0	3	0	0
SIM RIVER	UNK	DD	NA	No	No	NA	NA	NA	NA	NA	NA	NA
SOUTHGATE RIVER	UNK	DD	NA	No	No	NA	NA	0	0	1	0	0
STAFFORD RIVER	UNK	DD	NA	No	No	NA	NA	0	0	5	0	0
TEAQUAHAN RIVER	UNK	DD	NA	No	No	NA	NA	NA	NA	NA	NA	NA
WAKEMAN RIVER	UNK	DD	2002	No	No	NA	NA	0	0	16	0	3
WARNER BAY CREEK	UNK	DD	NA	No	No	NA	NA	0	0	1	0	0
AHTA RIVER	UNK	DEL	NA	No	No	NA	NA	0	1	0	0	2
FANNY BAY CREEK	UNK	DEL	NA	No	No	NA	NA	0	0	0	0	1
FRAZER CREEK	UNK	DEL	NA	No	No	NA	NA	NA	NA	NA	NA	NA
GLENDALE CREEK	UNK	DEL	NA	No	No	NA	NA	0	0	0	0	1
ROBBERS KNOB CREEK	UNK	DEL	NA	No	No	NA	NA	NA	NA	NA	NA	NA
SEYMOUR RIVER	UNK	DEL	NA	No	No	NA	NA	NA	NA	NA	NA	NA
SHOAL CREEK	UNK	DEL	NA	No	No	NA	NA	NA	NA	NA	NA	NA
TUNA RIVER	UNK	DEL	NA	No	No	NA	NA	NA	NA	NA	NA	NA
WAUMP CREEK	UNK	DEL	NA	No	No	NA	NA	NA	NA	NA	NA	NA

A.4 Homathko Summer x.x (CK-34)

A.4.1 Data Overview

This CU consists of two wild sites with escapement data that do not pass the data quality and completeness criteria required for use in calculation of metrics for status assessment. There is no exploitation information for this CU.

A.4.2 Data Notes

Spawner Estimates

At present, this CU consists of two wild sites. There is a long time series of historical spawner abundance estimates of unknown quality that cannot be used for analysis. The escapement data available for the two survey sites do not pass the data quality and completeness criteria required for use in calculation of metrics for status assessment. Only one higher quality (Type-4) escapement estimate exists: 267 fish were enumerated in 2011. This is a large, glacially turbid system where accurate visual estimates are difficult. In 1998, the HRSEP program funded a fishwheel program which caught 36 Chinook and reported an escapement estimate of 1,200 Chinook based on a 3% capture efficiency. This estimate does not appear to have been entered into the nuSEDS. Bengeyfield et al. (1984) counted Chinook Salmon in the Homathko River (including tributaries) in 1982 and 1983, and counted 704 and 1,167 Chinook (nuSEDS reports a lower escapement estimate for 1983 than 1982). The linkage between these counts and the estimates in nuSEDS is unclear. Bengeyfield et al. (1984) also describe the poor water clarity conditions in the mainstem of the river. The accuracy of the estimates is unknown.

Exploitation Rate Estimates

There is no exploitation information for this CU.

A.4.3 CWT Recoveries Overview

The *Mark Recovery Program Information System* (DFO 2020b) covers coded wire tag releases and recoveries for indicator and non-indicator systems. Table A.10 summarizes all tag recoveries for release sites matched to this CU, based on a database extract from July 2020. Recoveries are identified by region (e.g. BCYK = British Columbia and Yukon), then by marine (M) or freshwater (F), then by geography where applicable (N = North, S = South), and finally by sector or gear type.

Table A.10. Estimated CWT Recoveries - Homathko Summer x.x (CK-34)

RecoveredIn	n	Years
None	0	None

A.4.4 Site Overview

Table A.11 lists all the sites matched to this CU, and summarizes the available information. Enhancement level (*Enh*) and site category (*Cat*) are used for aggregating the site data (see sections 4.2.3 and 4.3 for definitions) . Only persistent (*P*) and extirpated (*EX*) sites are used in the aggregated time series. For the CU-level series, only sites with low or unknown enhancement level are included. For the Total Unit time series, all P and EX sites are combined. Some sites are used as indicators for escapement (*Esc*) or coded-wire tags (*CWT*). The table also shows the highest value (*Max*) and the year of the last available observation (*Last*) for the quality-filtered time series. The remaining columns list the number of observations in different quality categories, with definitions as per Section 4.2.1.

Table A.11. Site Overview for Homathko Summer x.x (CK-34)

Name	Enh	Cat	StYr	Esc	CWT	Max	Last	High	Mod	Other	Infill	Dropped
HOMATHKO RIVER	UNK	DD	NA	Yes	No	NA	NA	0	0	4	0	0
CUMSACK CREEK	UNK	AGG	NA	No	No	NA	NA	NA	NA	NA	NA	NA

A.5 Klinaklini Summer 1.3 (CK-35)

A.5.1 Data Overview

This CU has wild sites only. However, the CU did have enhancement on Devereux Creek back in the 1980s and was a component of CWT releases at the time. A long time series of historical spawner abundance estimates with unknown data quality is available. There is no exploitation rate indicator stock for this CU.

A.5.2 Data Notes

Spawner Estimates

This CU has wild sites only. It is comprised primarily of one glacially turbid system, and is not currently part of any regular survey program. There is a long time series of historical spawner abundance estimates (prior to 1997), but they are of unknown quality, so cannot be used for analysis at this time. The escapement data available for the two survey sites in this CU do not pass the data quality and completeness criteria required for use in calculation of metrics for status assessment. There are also higher quality (Type 2 and 3) escapement estimates from 1997-2003 (with greater than 10,000 spawners enumerated in some years), but the escapement program was ended after 2003.

With the introduction of a new version of the CTC's Chinook Coast Wide Model in 2020, the Klinaklini River was removed as a contributing stock to the updated set of baseline spawner abundance data. Although data from this river system and others in the region had formerly been included in the data set representing the Upper Georgia Strait Model stock until 2019, the Klinaklini and some other river systems were excluded due to either extremely poor or missing escapement estimates since the early 2000s, which had to be provided through infilling for the period from 2004-2019 in the previous version of the model.

No CU spawning info is available in FISS for this CU. CU spawning length was estimated as 10% of the length of the main Chinook spawning tributary, which is likely biased given the size of the watershed and radio telemetry studies found Chinook spawning in tributaries as well as the mainstem. Updating this information through GIS is recommended. nuSEDS data has not been standardized for this CU. In some years only one or a few tributaries were surveyed, whereas in other years a large scale fishwheel tagging mark recapture program was conducted that showed escapement ranged from 8,000-15,000 Chinook. The time series has been standardized for other objectives but those data have not been recorded in nuSEDS and are not used here. The time series as reported here is not suitable for inferring temporal trends or absolute abundance patterns.

Exploitation Rate Estimates

There is no exploitation rate indicator stock for this CU. Select CWT releases from the 1980s and 1990s suggest a far north migration pattern (with most recoveries in troll, net and sport fisheries in Alaska and northern BC).

A.5.3 CWT Recoveries Overview

The *Mark Recovery Program Information System* (DFO 2020b) covers coded wire tag releases and recoveries for indicator and non-indicator systems. Table A.12 summarizes all tag recoveries for release sites matched to this CU, based on a database extract from July 2020. Recoveries are identified by region (e.g. BCYK = British Columbia and Yukon), then by marine (M) or freshwater (F), then by geography where applicable (N = North, S = South), and finally by sector or gear type.

Table A.12. Estimated CWT Recoveries - Klinaklini Summer 1.3 (CK-35)

RecoveredIn	n	Years
None	0	None

A.5.4 Site Overview

Table A.13 lists all the sites matched to this CU, and summarizes the available information. Enhancement level (*Enh*) and site category (*Cat*) are used for aggregating the site data (see sections 4.2.3 and 4.3 for definitions) . Only persistent (*P*) and extirpated (*EX*) sites are used in the aggregated time series. For the CU-level series, only sites with low or unknown enhancement level are included. For the Total Unit time series, all P and EX sites are combined. Some sites are used as indicators for escapement (*Esc*) or coded-wire tags (*CWT*). The table also shows the highest value (*Max*) and the year of the last available observation (*Last*) for the quality-filtered time series. The remaining columns list the number of observations in different quality categories, with definitions as per Section 4.2.1.

Table A.13. Site Overview for Klinaklini Summer 1.3 (CK-35)

Name	Enh	Cat	StYr	Esc	CWT	Max	Last	High	Mod	Other	Infill	Dropped
KLINAKLINI RIVER	LOW	DD	1997	Yes	No	NA	NA	0	0	9	0	0

APPENDIX B CU Profiles - East Vancouver Island

B.1 East Vancouver Island - Goldstream Fall 0.x (CK-21)

B.1.1 Data Overview

Table B.1 summarizes the available data, and Figure B.1 shows the patterns over time. Section 4 describes the data classifications and usability assessments.

Table B.1. Data Overview for East Vancouver Island - Goldstream Fall 0.x (CK-21)

CU_ID	CK-21
CU_Name	Goldstr
SpnCategory	Abs_Abd
NumObs	23 (1992-2018)
StartYear	2000
NumSites	1 (0)
Gen	3 (3.28)
GenAvgWild	NA
Area	SC
Area2	GS+OK
CWT	x (COW)
ER_BY	0
Area	Inner SC
MU	Inner SC
AbsAbdMetric	DD
TrendMetric	DD
PercBM	DD
Source	New
Above1kWild	NA
BasedOn	NA

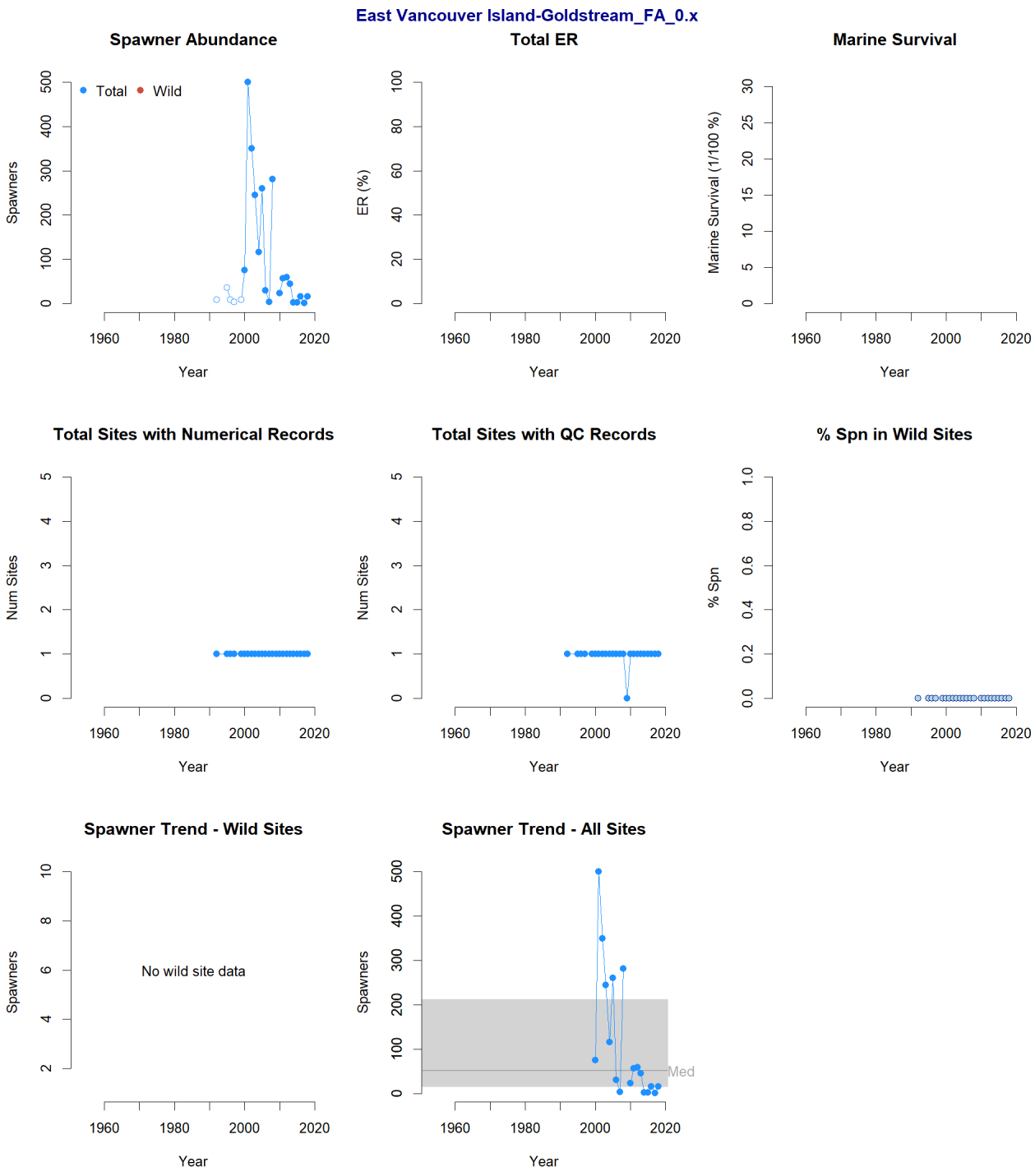

Figure B.1. : Available Data for East Vancouver Island - Goldstream Fall 0.x (CK-21)

B.1.2 Data Notes

Spawner Estimates

Goldstream River lies in a provincial park and the river flows beside a provincial highway. Historically, the Chinook population of EVI-Goldstream was never very high, usually less than 100 individuals. There is no data stream for wild sites in the CU and it is suspected that there would be a high proportion of hatchery-origin spawners found in the TU. Chinook here are enhanced occasionally rather than systematically every year. This run has been monitored through an in-stream fence since 2003 and by frequent foot surveys starting in 2000. This time series is considered to be complete and reliable since 2000. There are no habitat-based estimates of abundance benchmarks for this EU.

In mid-April 2011, a fuel truck crashed on the highway and the fuel drained into the river, killing thousands of juvenile salmon. The stream has a strong stewardship community and efforts continue to improve stream habitat and enhance the fish population.

DFO (2015b): Genetics information is unknown. Considered absolute abundance (although highly enhanced). *[Clarification added: The origin of fish in this CU is uncertain and may have been through transfers from another Vancouver Island CU.]*

Exploitation Rate Estimates

There is no exploitation information for this CU.

B.1.3 CWT Recoveries Overview

The *Mark Recovery Program Information System* (DFO 2020b) covers coded wire tag releases and recoveries for indicator and non-indicator systems. Table B.2 summarizes all Canadian tag recoveries for release sites matched to this CU, based on a database extract from February 2020. Recoveries are identified by region (e.g. BCYK = British Columbia and Yukon), then by marine (M) or freshwater (F), then by geography where applicable (N = North, S = South), and finally by sector or gear type.

Table B.2. Estimated CWT Recoveries - East Vancouver Island - Goldstream Fall 0.x (CK-21)

RecoveredIn	n	Years
None	0	None

B.1.4 Site Overview

Table B.3 lists all the sites matched to this CU, and summarizes the available information. Enhancement level (*Enh*) and site category (*Cat*) are used for aggregating the site data (see sections 4.2.3 and 4.3 for definitions) . Only persistent (*P*) and extirpated (*EX*) sites are used in the aggregated time series. For the CU-level series, only sites with low or unknown enhancement level are included. For the Total Unit time series, all P and EX sites are combined. Some sites are used as indicators for escapement (*Esc*) or coded-wire tags (*CWT*). The table also shows the highest value (*Max*) and the year of the last available observation (*Last*) for the quality-filtered time series. The remaining columns list the number of observations in different quality categories, with definitions as per Section 4.2.1.

Table B.3. Site Overview for East Vancouver Island - Goldstream Fall 0.x (CK-21)

Name	Enh	Cat	StYr	Esc	CWT	Max	Last	High	Mod	Other	Infill	Dropped
GOLDSTREAM RIVER	HIGH	P	2000	No	No	500	2018	3	0	20	0	1
TOD CREEK	UNK	DD	NA	No	No	NA	NA	NA	NA	NA	NA	NA

B.2 East Vancouver Island-Cowichan and Koksilah Fall 0.x (CK-22)

B.2.1 Data Overview

Table B.4 summarizes the available data, and Figure B.2 shows the patterns over time. Section 4 describes the data classifications and usability assessments.

Table B.4. Data Overview for East Vancouver Island-Cowichan and Koksilah Fall 0.x (CK-22)

CU_ID	CK-22
CU_Name	CWCH-KOK
SpnCategory	Abs_Abd
NumObs	44 (1965-2018)
StartYear	1995
NumSites	1 (0)
Gen	3 (3.28)
GenAvgWild	NA
Area	SC
Area2	GS+OK
CWT	COW
ER_BY	27 (1985-2013)
Area	Inner SC
MU	Inner SC
AbsAbdMetric	YES
TrendMetric	YES
PercBM	NO
Source	Publ
Above1kWild	NA
BasedOn	NA

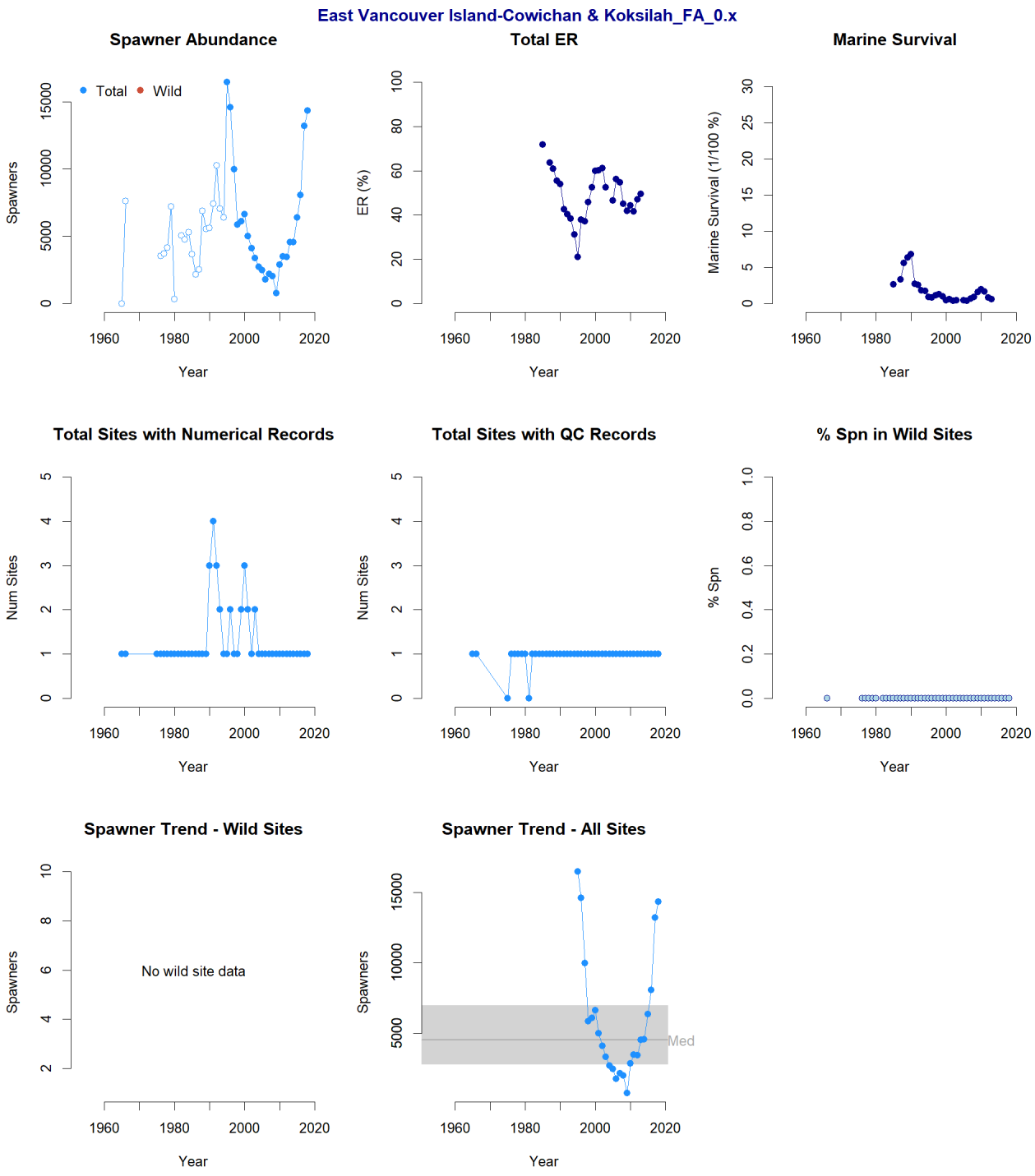

Figure B.2. : Available Data for East Vancouver Island-Cowichan and Koksilah Fall 0.x (CK-22)

B.2.2 Data Notes

Spawner Estimates

Spawning estimates using high quality methods (i.e. fence counts) for Cowichan River Chinook started in 1988. All fall run Chinook are enumerated through a counting fence and any Chinook reported in upstream tributaries have already been included and should not be added to the fence estimate. The EU has very high data quality, representing absolute abundance in spawner abundance. However, the counting fence was typically breached by high water at some point during the return during which counting stopped. High water each year also typically required removal of the fence before the spawning migration was over, and a proportional adjustment for the remainder of the run was applied based on expert judgment.

There is no data stream for wild sites in the CU. This CU includes a CWT indicator site with a full suite of information available.

DFO (2015b): Confident in use for trends and absolute abundance metrics. *(Note: DFO 2015b also includes some commentary on rebuilding efforts, sport fishery closures, and questions regarding genetic delineation of this CU)*

Exploitation Rate Estimates

The Cowichan River Fall Chinook population is the indicator stock for the Lower Georgia Strait Management Unit and it is one of the most intensively studied CUs in southern BC. It exhibits a local ocean distribution pattern and is intercepted primarily in Strait of Georgia sport fisheries. Historically, it was also a large component of troll and net fisheries in the Strait of Georgia. Total Canadian exploitation rates between 1999-2011 were estimated at roughly 45%.

B.2.3 CWT Recoveries Overview

The *Mark Recovery Program Information System* (DFO 2020b) covers coded wire tag releases and recoveries for indicator and non-indicator systems. Table B.5 summarizes all Canadian tag recoveries for release sites matched to this CU, based on a database extract from February 2020. Recoveries are identified by region (e.g. BCYK = British Columbia and Yukon), then by marine (M) or freshwater (F), then by geography where applicable (N = North, S = South), and finally by sector or gear type.

Table B.5. Estimated CWT Recoveries - East Vancouver Island-Cowichan and Koksilah Fall 0.x (CK-22)

RecoveredIn	n	Years
AK_M_N_Sport	2 (0-1)	4 (1984-2019)
AK_M_S_Sport	9 (2-4)	3 (2012-2017)
AK_Net and Seine	21 (0-4)	15 (1982-2019)
AK_Troll	168 (2-20)	23 (1982-2019)
BCYK_F_Sport	25 (3-8)	5 (1985-2012)
BCYK_F_S_Aboriginal	498 (0-372)	8 (2011-2019)
BCYK_F_S_Net and Seine	15 (3-9)	3 (1990-1992)
BCYK_M_N_Net and Seine	263 (1-73)	15 (1981-2018)
BCYK_M_N_Sport	546 (1-66)	27 (1981-2019)
BCYK_M_N_Troll	282 (2-67)	19 (1982-2019)
BCYK_M_S_Net and Seine	1,276 (0-202)	19 (1981-2018)
BCYK_M_S_Sport	15,391 (9-2014)	37 (1980-2019)
BCYK_M_S_Troll	3,924 (1-1006)	33 (1981-2019)
WA_M_Sport	7 (7-7)	1 (2016-2016)
WA_M_N_Net and Seine	302 (1-81)	24 (1982-2018)
WA_M_N_Sport	16 (2-6)	4 (1992-2012)
WA_M_N_Test Fisheries	1 (1-1)	1 (1995-1995)
WA_M_N_Troll	65 (1-24)	6 (1988-1993)
WA_M_S_Net and Seine	1,074 (0-185)	30 (1984-2018)
WA_M_S_Sport	857 (2-175)	24 (1983-2019)
WA_M_S_Troll	312 (1-78)	18 (1989-2019)

B.2.4 Site Overview

Table B.6 lists all the sites matched to this CU, and summarizes the available information. Enhancement level (*Enh*) and site category (*Cat*) are used for aggregating the site data (see sections 4.2.3 and 4.3 for definitions) . Only persistent (*P*) and extirpated (*EX*) sites are used in the aggregated time series. For the CU-level series, only sites with low or unknown enhancement level are included. For the Total Unit time series, all P and EX sites are combined. Some sites are used as indicators for escapement (*Esc*) or coded-wire tags (*CWT*). The table also shows the highest value (*Max*) and the year of the last available observation (*Last*) for the quality-filtered time series. The remaining columns list the number of observations in different quality categories, with definitions as per Section 4.2.1.

Table B.6. Site Overview for East Vancouver Island-Cowichan and Koksilah Fall 0.x (CK-22)

Name	Enh	Cat	StYr	Esc	CWT	Max	Last	High	Mod	Other	Infill	Dropped
COWICHAN RIVER	HIGH	P	1988	Yes	Yes	16449	2018	0	0	44	0	2
KOKSILAH RIVER	UNK	DD	NA	No	No	NA	NA	0	1	0	0	0
MESACHIE CREEK	UNK	AGG	NA	No	No	NA	NA	1	0	0	0	0
PATRICIA CREEK	UNK	AGG	NA	No	No	NA	NA	0	0	0	0	4
ROBERTSON RIVER	UNK	AGG	NA	No	No	NA	NA	0	0	0	0	3
SHAW CREEK	UNK	AGG	NA	No	No	NA	NA	1	1	0	0	7

B.3 East Vancouver Island - Nanaimo Spring 1.x (CK-23)

B.3.1 Data Overview

This CU consists of one wild site with limited escapement data. There is no exploitation information for this CU.

B.3.2 Data Notes

Spawner Estimates

No enhancement. This population represents one of the few stream-type populations that arose secondarily from the Columbia-Cascadia origin group. At present, this CU consists of a single wild site. It is a unique and very small population (one of the few stream-type populations in the lower south coast area). They have a clearly separated spawning area from the two other timed groups in this river.

Genetically this population is grouped with CK-83 and CK-25 but the run timing is spring, and the population has changed to an ocean-type freshwater residency as a local adaptation. Local Ecological Knowledge (LEK) describes a similar population that existed in the Cowichan River, however this population may no longer exist. Cowichan Elders also report that white springs are caught in the Cowichan River in the first few weeks of December. They say this is the winter run.

Exploitation Rate Estimates

There is no exploitation information for this CU. This stock has an unusual stream-type life history for this region so other indicators would be unlikely candidates to represent this population.

B.3.3 CWT Recoveries Overview

The *Mark Recovery Program Information System* (DFO 2020b) covers coded wire tag releases and recoveries for indicator and non-indicator systems. Table B.7 summarizes all tag recoveries for release sites matched to this CU, based on a database extract from July 2020. Recoveries are identified by region (e.g. BCYK = British Columbia and Yukon), then by marine (M) or freshwater (F), then by geography where applicable (N = North, S = South), and finally by sector or gear type.

Table B.7. Estimated CWT Recoveries - East Vancouver Island - Nanaimo Spring 1.x (CK-23)

RecoveredIn	n	Years
None	0	None

B.3.4 Site Overview

Table B.8 lists all the sites matched to this CU, and summarizes the available information. Enhancement level (*Enh*) and site category (*Cat*) are used for aggregating the site data (see sections 4.2.3 and 4.3 for definitions) . Only persistent (*P*) and extirpated (*EX*) sites are used in the aggregated time series. For the CU-level series, only sites with low or unknown enhancement level are included. For the Total Unit time series, all P and EX sites are combined. Some sites are used as indicators for escapement (*Esc*) or coded-wire tags (*CWT*). The table also shows the highest value (*Max*) and the year of the last available observation (*Last*) for the quality-filtered time series. The remaining columns list the number of observations in different quality categories, with definitions as per Section 4.2.1.

Table B.8. Site Overview for East Vancouver Island - Nanaimo Spring 1.x (CK-23)

Name	Enh	Cat	StYr	Esc	CWT	Max	Last	High	Mod	Other	Infill	Dropped
NANAIMO RIVER-UPPER	UNK	DD	NA	No	No	NA	NA	0	1	0	0	23

B.4 East Vancouver Island - Nanaimo and Chemainus Fall 0.x (CK-25)

B.4.1 Data Overview

Table B.9 summarizes the available data, and Figure B.3 shows the patterns over time. Section 4 describes the data classifications and usability assessments.

Table B.9. Data Overview for East Vancouver Island - Nanaimo and Chemainus Fall 0.x (CK-25)

CU_ID	CK-25
CU_Name	EVI-fall
SpnCategory	Rel_Idx
NumObs	38 (1981-2018)
StartYear	1995
NumSites	2 (0)
Gen	3 (3.22)
GenAvgWild	NA
Area	SC
Area2	GS+OK
CWT	NAN
ER_BY	19 (1979-2004)
Area	Inner SC
MU	Inner SC
AbsAbdMetric	NO
TrendMetric	NO
PercBM	NO
Source	Unpubl
Above1kWild	NA
BasedOn	NA

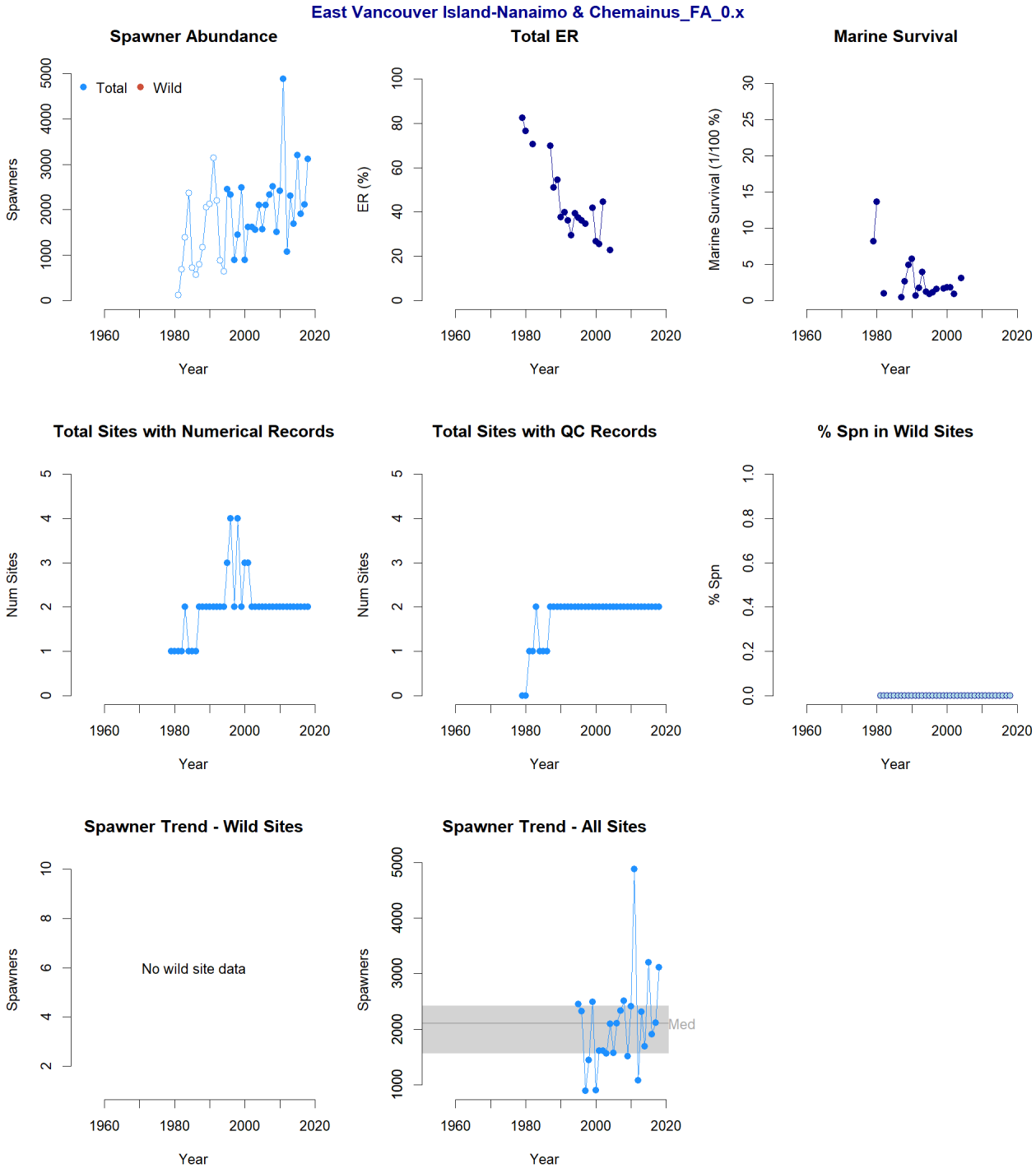

Figure B.3. : Available Data for East Vancouver Island - Nanaimo and Chemainus Fall 0.x (CK-25)

B.4.2 Data Notes

Spawner Estimates

There is no data for any wild sites in the CU. nuSEDS data indicates a summer and fall run existed in the Chemainus River; however, after review, there was no evidence that two separate populations existed. All escapement records were re-assigned to the fall run timing. Traditional Ecological Knowledge (TEK) should be sought to investigate historic run timings. A variety of escapement methods have been used, however the series has not been standardized or calibrated. This includes a CWT indicator site.

Exploitation Rate Estimates

The Nanaimo River was an exploitation rate indicator stock, but it has not been coded wire tagged since brood year 2004. Based on CWT recoveries in fisheries prior to this time, most recoveries occur in Strait of Georgia fisheries although recoveries do occur regularly in fisheries along the central and northern coast regions of BC and into southeast Alaska. Fewer recoveries occur in fisheries along west coast Vancouver Island compared to Cowichan River fall Chinook. Total Canadian exploitation rates between 1999-2011 were estimated at roughly 30%.

B.4.3 CWT Recoveries Overview

The *Mark Recovery Program Information System* (DFO 2020b) covers coded wire tag releases and recoveries for indicator and non-indicator systems. Table B.10 summarizes all tag recoveries for release sites matched to this CU, based on a database extract from July 2020. Recoveries are identified by region (e.g. BCYK = British Columbia and Yukon), then by marine (M) or freshwater (F), then by geography where applicable (N = North, S = South), and finally by sector or gear type.

Table B.10. Estimated CWT Recoveries - East Vancouver Island - Nanaimo and Chemainus Fall 0.x (CK-25)

RecoveredIn	n	Years
AK_M_S_Sport	6 (3-3)	2 (2005-2011)
AK_Net and Seine	41 (0-10)	12 (1982-2003)
AK_Troll	167 (2-37)	21 (1976-2012)
BCYK_F_Sport	53 (3-10)	10 (1983-2003)
BCYK_F_S_Net and Seine	26 (3-9)	4 (1990-1995)
BCYK_M_N_Net and Seine	754 (1-180)	20 (1976-1998)
BCYK_M_N_Sport	727 (3-67)	29 (1977-2012)
BCYK_M_N_Troll	1,307 (2-524)	22 (1976-2008)
BCYK_M_S_Net and Seine	4,189 (0-1162)	25 (1975-2003)
BCYK_M_S_Sport	27,100 (2-3513)	36 (1975-2013)
BCYK_M_S_Troll	7,043 (1-2209)	32 (1975-2013)
OR_M_S_Troll	9 (1-5)	3 (1985-2008)
OR_Net and Seine	4 (4-4)	1 (1986-1986)
WA_M_Sport	7 (2-5)	2 (1990-2004)
WA_M_N_Net and Seine	545 (1-126)	24 (1977-2007)
WA_M_N_Sport	31 (1-18)	4 (1985-2006)
WA_M_N_Test Fisheries	1 (1-1)	1 (1992-1992)
WA_M_N_Troll	102 (2-34)	9 (1987-2009)
WA_M_S_Net and Seine	518 (2-47)	31 (1981-2013)
WA_M_S_Sport	617 (2-71)	28 (1981-2013)
WA_M_S_Troll	118 (1-27)	16 (1982-2013)
WA_Troll	2 (2-2)	1 (1983-1983)

B.4.4 Site Overview

Table B.11 lists all the sites matched to this CU, and summarizes the available information. Enhancement level (*Enh*) and site category (*Cat*) are used for aggregating the site data (see sections 4.2.3 and 4.3 for definitions) . Only persistent (*P*) and extirpated (*EX*) sites are used in the aggregated time series. For the CU-level series, only sites with low or unknown enhancement level are included. For the Total Unit time series, all P and EX sites are combined. Some sites are used as indicators for escapement (*Esc*) or coded-wire tags (*CWT*). The table also shows the highest value (*Max*) and the year of the last available observation (*Last*) for the quality-filtered time series. The remaining columns list the number of observations in different quality categories, with definitions as per Section 4.2.1.

Table B.11. Site Overview for East Vancouver Island - Nanaimo and Chemainus Fall 0.x (CK-25)

Name	Enh	Cat	StYr	Esc	CWT	Max	Last	High	Mod	Other	Infill	Dropped
CHEMAINUS RIVER	HIGH	P	NA	No	No	2210	2018	0	0	31	2	0
NANAIMO RIVER	HIGH	P	1995	Yes	Yes	3577	2018	0	1	37	0	2
HASLAM CREEK	UNK	AGG	NA	No	No	NA	NA	0	2	0	0	4
NAPOLEON CREEK	UNK	AGG	NA	No	No	NA	NA	2	0	0	0	3

B.5 East Vancouver Island - Qualicum and Puntledge Fall 0.x (CK-27)

B.5.1 Data Overview

Table B.12 summarizes the available data, and Figure B.4 shows the patterns over time. Section 4 describes the data classifications and usability assessments.

Table B.12. Data Overview for East Vancouver Island - Qualicum and Puntledge Fall 0.x (CK-27)

CU_ID	CK-27
CU_Name	QP-fall
SpnCategory	Rel_Idx
NumObs	46 (1973-2018)
StartYear	1995
NumSites	4 (0)
Gen	4 (3.6)
GenAvgWild	NA
Area	SC
Area2	GS+OK
CWT	BQR
ER_BY	41 (1973-2013)
Area	Inner SC
MU	Inner SC
AbsAbdMetric	NO
TrendMetric	NO
PercBM	NO
Source	Unpubl
Above1kWild	NA
BasedOn	NA

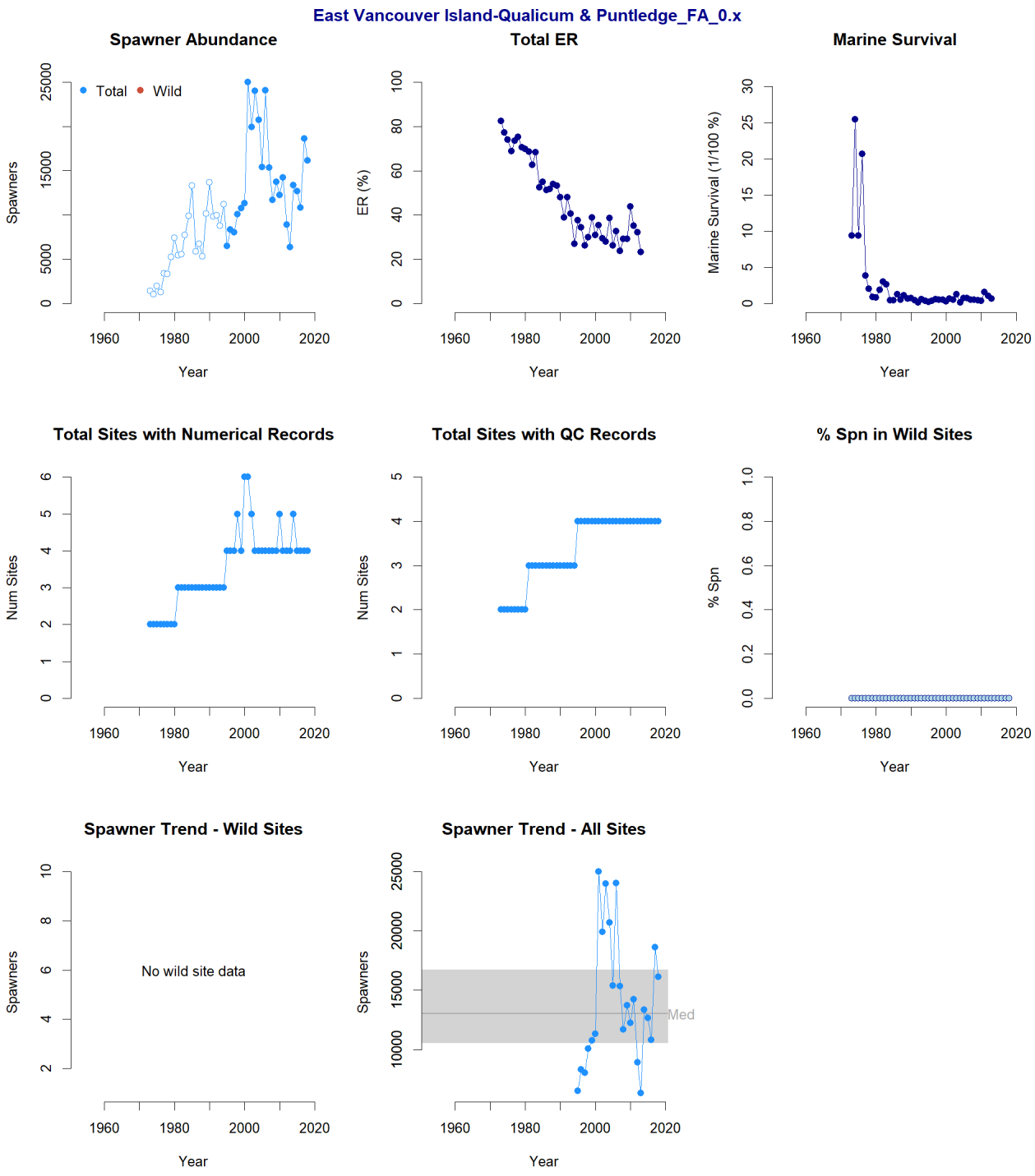

Figure B.4. : Available Data for East Vancouver Island - Qualicum and Puntledge Fall 0.x (CK-27)

B.5.2 Data Notes

Spawner Estimates

Most rivers in this CU have had varying levels of enhancement and there is no data for any wild sites in the CU. Qualicum River Chinook have been used as a source population for transplants throughout this conservation unit as well as in CK-20. Puntledge, Big Qualicum, and Little Qualicum subpopulations are closely monitored and can be a reliable estimate of abundance. Englishman subpopulation has been monitored using a variety of methods and should be considered to be lower quality. This includes a CWT indicator site.

Exploitation Rate Estimates

Big Qualicum is the coded wire tag exploitation rate indicator for this CU. It exhibits a far north ocean distribution pattern, with most recoveries occurring in Strait of Georgia and northern BC troll, net and sport fisheries. Fish from this CU also contribute annually to fisheries in Alaska. Total Canadian exploitation rates between 1999-2011 were estimated at roughly 20%.

B.5.3 CWT Recoveries Overview

The *Mark Recovery Program Information System* (DFO 2020b) covers coded wire tag releases and recoveries for indicator and non-indicator systems. Table B.13 summarizes all tag recoveries for release sites matched to this CU, based on a database extract from July 2020. Recoveries are identified by region (e.g. BCYK = British Columbia and Yukon), then by marine (M) or freshwater (F), then by geography where applicable (N = North, S = South), and finally by sector or gear type.

Table B.13. Estimated CWT Recoveries - East Vancouver Island - Qualicum and Puntledge Fall 0.x (CK-27)

RecoveredIn	n	Years
AK_M_N_Sport	153 (0-41)	25 (1977-2017)
AK_M_S_Sport	133 (0-13)	27 (1976-2018)
AK_Aboriginal	7 (0-3)	7 (1989-2018)
AK_Net and Seine	671 (0-59)	42 (1977-2019)
AK_Sport	1 (0-1)	8 (1984-2014)
AK_Test Fisheries	3 (0-3)	8 (1986-2006)
AK_Troll	3,963 (20-258)	44 (1976-2019)
BCYK_F_Sport	97 (3-21)	13 (1984-2014)
BCYK_F_N_Aboriginal	1 (1-1)	1 (2011-2011)
BCYK_F_S_Net and Seine	24 (3-12)	4 (1990-1996)
BCYK_M_N_Net and Seine	4,868 (1-1311)	29 (1975-2017)
BCYK_M_N_Sport	2,854 (8-224)	45 (1975-2019)
BCYK_M_N_Troll	7,011 (0-906)	43 (1975-2019)
BCYK_M_S_Net and Seine	7,143 (1-1239)	28 (1975-2017)
BCYK_M_S_Sport	28,455 (67-4157)	45 (1975-2019)
BCYK_M_S_Troll	9,275 (2-1564)	42 (1975-2019)
WA_M_Sport	3 (1-2)	2 (1980-2014)
WA_M_N_Net and Seine	153 (1-18)	22 (1977-2018)
WA_M_N_Sport	7 (3-4)	2 (1978-1996)
WA_M_N_Troll	11 (1-6)	4 (1987-1991)
WA_M_S_Net and Seine	172 (1-16)	30 (1975-2017)
WA_M_S_Sport	231 (3-21)	28 (1975-2017)
WA_M_S_Troll	77 (0-25)	16 (1975-2017)
WA_Net and Seine	3 (3-3)	1 (1976-1976)

B.5.4 Site Overview

Table B.14 lists all the sites matched to this CU, and summarizes the available information. Enhancement level (*Enh*) and site category (*Cat*) are used for aggregating the site data (see sections 4.2.3 and 4.3 for definitions) . Only persistent (*P*) and extirpated (*EX*) sites are used in the aggregated time series. For the CU-level series, only sites with low or unknown enhancement level are included. For the Total Unit time series, all P and EX sites are combined. Some sites are used as indicators for escapement (*Esc*) or coded-wire tags (*CWT*). The table also shows the highest value (*Max*) and the year of the last available observation (*Last*) for the quality-filtered time series. The remaining columns list the number of observations in different quality categories, with definitions as per Section 4.2.1.

Table B.14. Site Overview for East Vancouver Island - Qualicum and Puntledge Fall 0.x (CK-27)

Name	Enh	Cat	StYr	Esc	CWT	Max	Last	High	Mod	Other	Infill	Dropped
ENGLISHMAN RIVER	HIGH	P	1995	Yes	No	2900	2018	0	8	13	3	0
LITTLE QUALICUM RIVER	HIGH	P	1995	Yes	No	6128	2018	0	0	38	0	0
PUNTLEDGE RIVER	HIGH	P	1995	Yes	No	15531	2018	0	0	46	0	0
QUALICUM RIVER	HIGH	P	1995	Yes	Yes	6743	2018	0	0	46	0	0
OYSTER RIVER	HIGH	DD	NA	Yes	No	NA	NA	0	1	16	0	0
SIMMS CREEK	UNK	DD	NA	No	No	NA	NA	0	0	9	0	0
TSABLE RIVER	MOD	DD	NA	No	No	NA	NA	0	0	1	0	0
WILLOW CREEK	UNK	DD	NA	No	No	NA	NA	0	0	2	0	2
MORRISON CREEK	UNK	AGG	NA	No	No	NA	NA	0	0	0	0	3
TSOLUM RIVER	UNK	AGG	NA	No	No	NA	NA	NA	NA	NA	NA	NA
BLACK CREEK	UNK	DEL	NA	No	No	NA	NA	1	0	0	0	0
BONELL CREEK	UNK	DEL	NA	No	No	NA	NA	NA	NA	NA	NA	NA
NANOOSE CREEK	UNK	DEL	NA	No	No	NA	NA	0	0	0	0	1
NILE CREEK	UNK	DEL	NA	No	No	NA	NA	NA	NA	NA	NA	NA
ROSEWALL CREEK	UNK	DEL	NA	No	No	NA	NA	0	0	0	0	1
TRENT RIVER	UNK	DEL	NA	No	No	NA	NA	NA	NA	NA	NA	NA
WOODS CREEK	UNK	DEL	NA	No	No	NA	NA	0	0	0	0	1

B.6 East Vancouver Island - North Fall 0.x (CK-29)

B.6.1 Data Overview

Table B.15 summarizes the available data, and Figure B.5 shows the patterns over time. Section 4 describes the data classifications and usability assessments.

Table B.15. Data Overview for East Vancouver Island - North Fall 0.x (CK-29)

CU_ID	CK-29
CU_Name	NEVI
SpnCategory	Rel_Idx
NumObs	44 (1975-2018)
StartYear	1999
NumSites	5 (1)
Gen	4 (4.41)
GenAvgWild	152
Area	SC
Area2	WCVI/NEVI/USC
CWT	QUI
ER_BY	39 (1974-2012)
Area	Inner SC
MU	Inner SC
AbsAbdMetric	NO
TrendMetric	YES
PercBM	NO
Source	New
Above1kWild	Unlikely
BasedOn	Data Notes

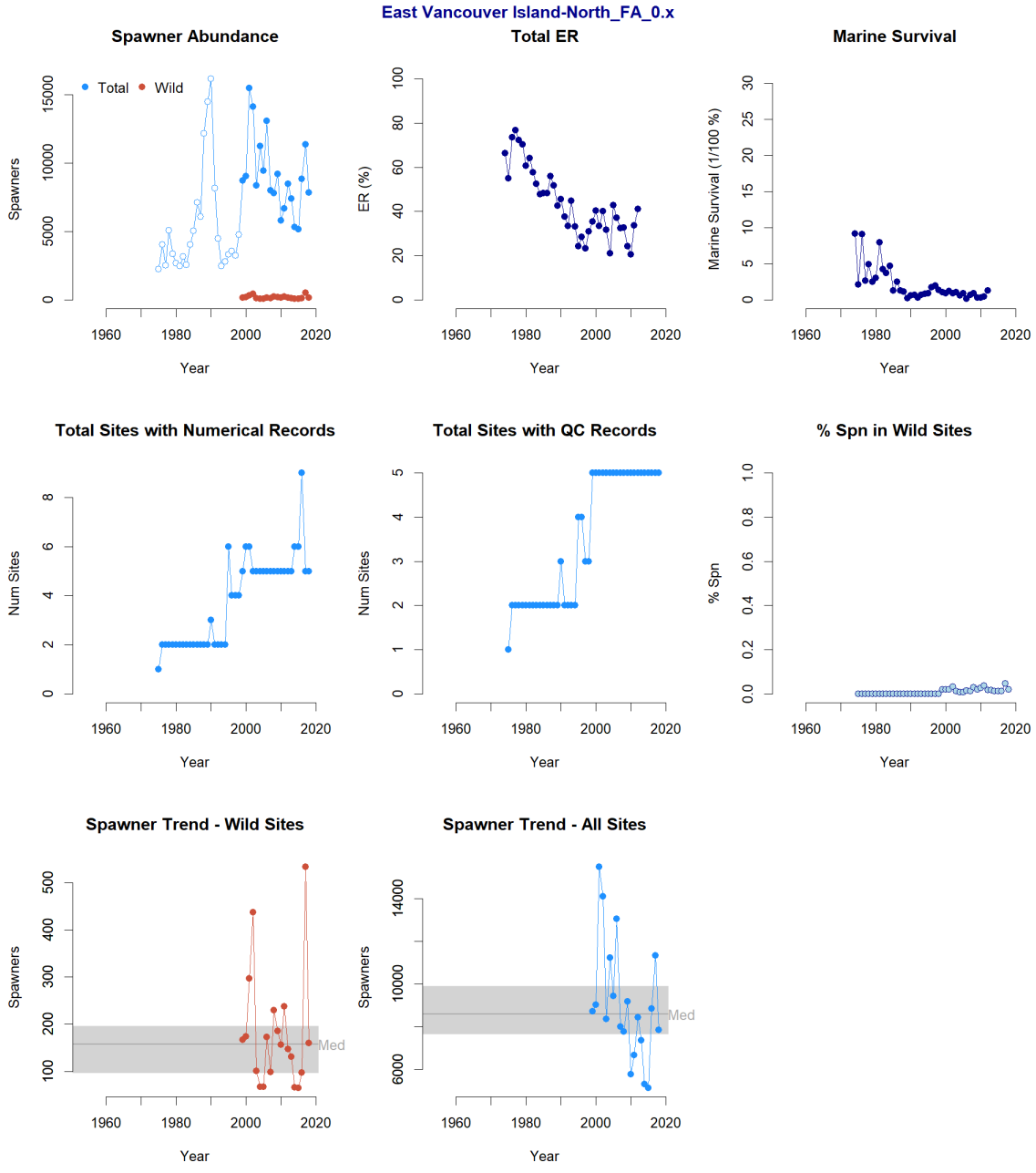

Figure B.5. Available Data for East Vancouver Island - North Fall 0.x (CK-29)

B.6.2 Data Notes

Spawner Estimates

Previously, the Nimpkish River has been included as one of the CTC escapement indicator stocks for the Upper Georgia Strait Management Unit. The Nimpkish River has an enhanced component and was historically a large Chinook Salmon producing system. The amount of accessible fish habitat was increased significantly when Karmutsen Falls was modified, however total Chinook escapement is unclear now as only part of the entire spawning distribution is assessed. Surveys have been standardized since 2002.

High precision escapement estimates for Campbell and Quinsam Chinook are based on a long running mark recapture program (since 1984); estimates also include broodstock removals and hatchery enumeration. Other consistently monitored systems in this CU are the Salmon River, also enhanced, and the Adam/Eve River.

Data quality is high for the Campbell and Quinsam since 1984, moderate for the Nimpkish, Salmon and Adam/Eve systems and generally poor elsewhere in the CU. DFO is in the process of evaluating some of the NEVI systems to see which would be a good candidate system to develop into an escapement indicator for this CU.

Exploitation Rate Estimates

Quinsam River Chinook demonstrate a far north ocean distribution pattern and are often recovered in Alaska and northern BC troll, net and sport fisheries. Total Canadian exploitation rates between 1999-2011 were estimated at roughly 20%. There is limited tag recovery data representing the distribution of Nimpkish Chinook, however they do not seem to be as far north migrating and exhibit more local distribution when compared to Quinsam (based on CWT and DNA information). It is unclear which trend other stocks in this CU follow.

B.6.3 CWT Recoveries Overview

The *Mark Recovery Program Information System* (DFO 2020b) covers coded wire tag releases and recoveries for indicator and non-indicator systems. Table B.16 summarizes all tag recoveries for release sites matched to this CU, based on a database extract from July 2020. Recoveries are identified by region (e.g. BCYK = British Columbia and Yukon), then by marine (M) or freshwater (F), then by geography where applicable (N = North, S = South), and finally by sector or gear type.

Table B.16. Estimated CWT Recoveries - East Vancouver Island - North Fall 0.x (CK-29)

RecoveredIn	n	Years
AK_M_N_Sport	632 (0-120)	33 (1980-2019)
AK_M_S_Sport	372 (0-60)	35 (1980-2019)
AK_Aboriginal	26 (0-8)	6 (1990-2019)
AK_Miscellaneous	1 (0-1)	13 (1977-2015)
AK_Net and Seine	2,013 (0-237)	43 (1977-2019)
AK_Sport	2 (0-2)	7 (1985-2017)
AK_Test Fisheries	10 (0-10)	10 (1986-2006)
AK_Troll	8,002 (2-1326)	44 (1976-2019)
BCYK_F_Sport	4 (4-4)	1 (1985-1985)
BCYK_M_N_Net and Seine	6,070 (2-750)	29 (1975-2018)
BCYK_M_N_Sport	5,034 (4-705)	42 (1978-2019)
BCYK_M_N_Troll	4,805 (0-652)	41 (1975-2019)
BCYK_M_S_Net and Seine	2,321 (1-343)	27 (1975-2019)
BCYK_M_S_Sport	2,924 (2-254)	45 (1975-2019)
BCYK_M_S_Troll	381 (2-57)	20 (1977-2019)
WA_M_N_Net and Seine	4 (2-2)	2 (1989-1998)
WA_M_N_Sport	4 (4-4)	1 (1988-1988)
WA_M_N_Troll	5 (5-5)	1 (1985-1985)
WA_M_S_Sport	8 (4-4)	2 (1984-1986)
WA_M_S_Troll	1 (1-1)	1 (2019-2019)

B.6.4 Site Overview

Table B.17 lists all the sites matched to this CU, and summarizes the available information. Enhancement level (*Enh*) and site category (*Cat*) are used for aggregating the site data (see sections 4.2.3 and 4.3 for definitions) . Only persistent (*P*) and extirpated (*EX*) sites are used in the aggregated time series. For the CU-level series, only sites with low or unknown enhancement level are included. For the Total Unit time series, all P and EX sites are combined. Some sites are used as indicators for escapement (*Esc*) or coded-wire tags (*CWT*). The table also shows the highest value (*Max*) and the year of the last available observation (*Last*) for the quality-filtered time series. The remaining columns list the number of observations in different quality categories, with definitions as per Section 4.2.1.

Table B.17. Site Overview for East Vancouver Island - North Fall 0.x (CK-29)

Name	Enh	Cat	StYr	Esc	CWT	Max	Last	High	Mod	Other	Infill	Dropped
ADAM RIVER	UNK	P	1999	No	No	533	2018	0	8	9	3	0
CAMPBELL RIVER	HIGH	P	1999	Yes	Yes	5000	2018	32	0	12	0	0
NIMPKISH RIVER	HIGH	P	NA	Yes	No	2570	2018	0	0	24	0	0
QUINSAM RIVER	HIGH	P	1999	Yes	Yes	13150	2018	0	0	43	0	0
SALMON RIVER	HIGH	P	1999	Yes	No	2900	2018	0	5	17	1	0
AMOR DE COSMOS CREEK	UNK	DD	NA	No	No	NA	NA	0	4	6	0	1
CLUXEWE RIVER	UNK	DD	NA	No	No	NA	NA	0	0	3	0	0
KOKISH RIVER	MOD	DD	NA	No	No	NA	NA	0	3	6	0	2
MENZIES CREEK	UNK	DD	NA	No	No	NA	NA	0	5	9	0	2
MOHUN CREEK	UNK	DD	NA	No	No	NA	NA	0	0	3	0	0
QUATSE RIVER	MOD	DD	NA	No	No	NA	NA	0	0	12	0	0
TSITIKA RIVER	UNK	DD	NA	No	No	NA	NA	0	0	1	0	1
EVE RIVER	UNK	AGG	NA	No	No	NA	NA	0	0	0	0	1
WHITE RIVER	UNK	AGG	NA	No	No	NA	NA	0	0	1	0	0
DREW CREEK	UNK	DEL	NA	No	No	NA	NA	0	0	0	0	2
GRANITE BAY CREEK	UNK	DEL	NA	No	No	NA	NA	0	0	0	0	1
KEOGH RIVER	UNK	DEL	NA	No	No	NA	NA	NA	NA	NA	NA	NA
MCKERCHER CREEK	UNK	DEL	NA	No	No	NA	NA	0	0	0	0	1
NAHWITTI RIVER	UNK	DEL	NA	No	No	NA	NA	0	0	0	0	1

B.7 East Vancouver Island - Georgia Strait Summer 0.3 (CK-83)

B.7.1 Data Overview

Table B.18 summarizes the available data, and Figure B.6 shows the patterns over time. Section 4 describes the data classifications and usability assessments.

Table B.18. Data Overview for East Vancouver Island - Georgia Strait Summer 0.3 (CK-83)

CU_ID	CK-83
CU_Name	EVIGStr-sum
SpnCategory	Rel_Idx
NumObs	46 (1973-2018)
StartYear	1995
NumSites	2 (0)
Gen	4 (3.51)
GenAvgWild	NA
Area	SC
Area2	GS+OK
CWT	PPS
ER_BY	38 (1975-2013)
Area	Inner SC
MU	Inner SC
AbsAbdMetric	DD
TrendMetric	DD
PercBM	DD
Source	New
Above1kWild	NA
BasedOn	NA

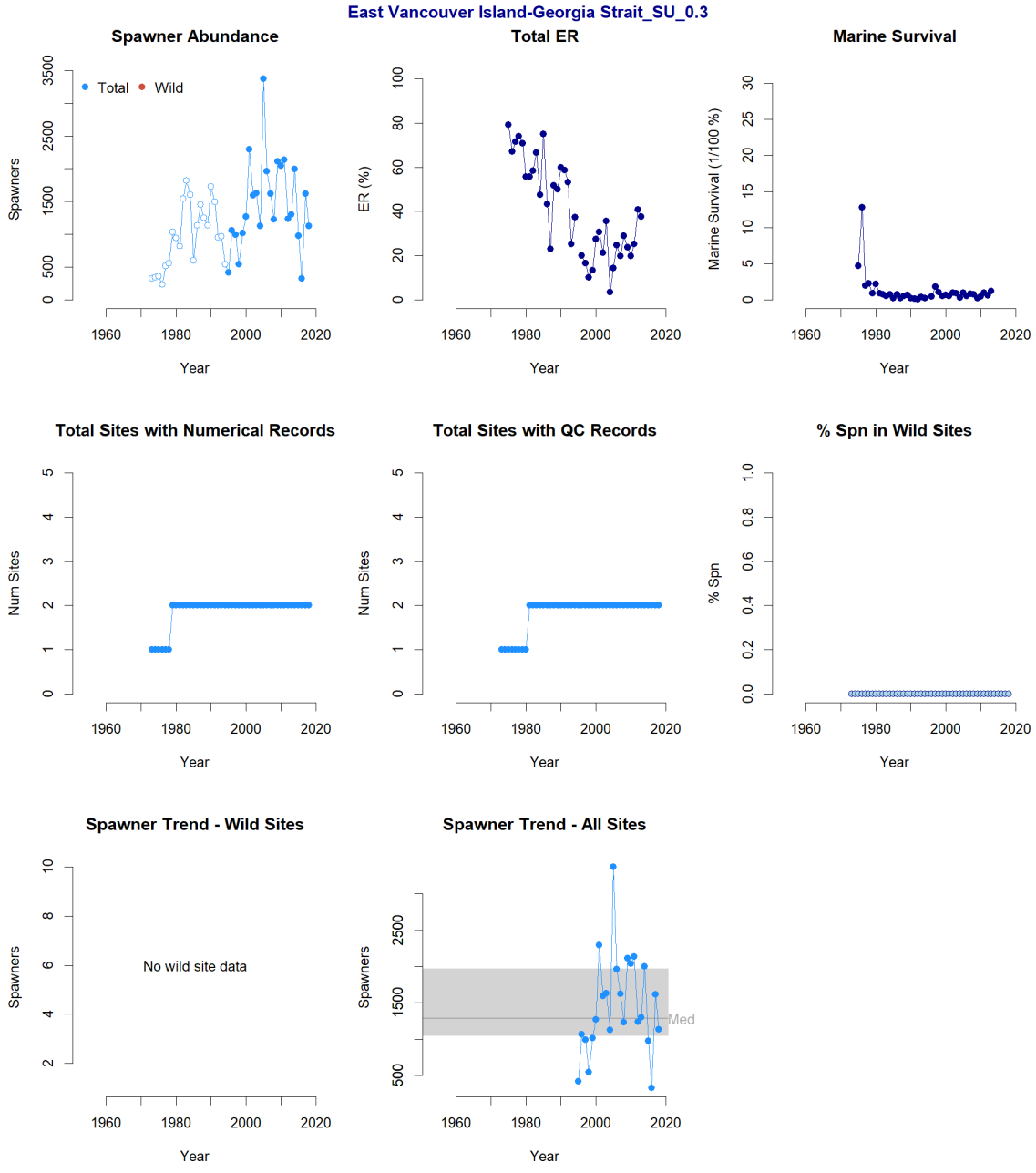

Figure B.6. Available Data for East Vancouver Island - Georgia Strait Summer 0.3 (CK-83)

B.7.2 Data Notes

Spawner Estimates

Of the Chinook spawning locations in this CU, the Puntledge River is the only location from which there is reliable historical information and a time series of annual spawner estimates.

Summer run Chinook in the Cowichan and Nanaimo Rivers can experience high pre-spawn mortalities in summers when air and stream temperatures are high. (Note that at present, neither run is monitored and no escapement, spawner enumeration or catch data is collected.) Therefore, these events are only discovered through occasional reports from concerned public. One can speculate that warmer stream temperatures in the summer, caused by climate change, will produce adverse mortality conditions and reduce the productivity of this CU. Escapement monitoring plans are designed to survey spawners in the fall and these programs do not quantify mortality that occurs when the fish may be holding in very warm waters during late July and early August. In addition to high water temperatures, Cowichan summers also face additional migration challenges due to low water levels and accretion of sediments in the lower river. Puntledge summer run Chinook have been heavily supported by enhancement, including a captive breeding program in the 2000s. There is also specific seal predation on this population associated with artificial lighting along the Comox River, for which mitigation measures have been developed. CK-24 and CK-26 were merged into CK-26 based on similar genetics, run timing and life history and renamed CK-83 (DFO 2013). This includes a CWT indicator site.

Exploitation Rate Estimates

The Puntledge River is an exploitation rate indicator stock and the Nanaimo summer run has been coded wire tagged in the past. Recoveries of these CWTs indicate a far north ocean distribution with most showing up in northern and southern BC sport fisheries and a few recoveries in Alaska troll fisheries. Total Canadian exploitation rates between 1999-2011 were estimated at roughly 20%.

B.7.3 CWT Recoveries Overview

The *Mark Recovery Program Information System* (DFO 2020b) covers coded wire tag releases and recoveries for indicator and non-indicator systems. Table B.19 summarizes all tag recoveries for release sites matched to this CU, based on a database extract from July 2020. Recoveries are identified by region (e.g. BCYK = British Columbia and Yukon), then by marine (M) or freshwater (F), then by geography where applicable (N = North, S = South), and finally by sector or gear type.

Table B.19. Estimated CWT Recoveries - East Vancouver Island - Georgia Strait Summer 0.3 (CK-83)

RecoveredIn	n	Years
AK_M_N_Sport	73 (0-27)	15 (1977-2017)
AK_M_S_Sport	88 (0-13)	21 (1982-2018)
AK_Aboriginal	4 (1-3)	2 (1990-2001)
AK_Net and Seine	298 (0-47)	37 (1977-2019)
AK_Troll	2,047 (1-177)	44 (1976-2019)
BCYK_F_Sport	7 (7-7)	1 (1989-1989)
BCYK_F_N_Aboriginal	1 (1-1)	1 (2011-2011)
BCYK_F_S_Net and Seine	3 (3-3)	1 (1995-1995)
BCYK_M_N_Net and Seine	1,188 (1-125)	26 (1975-2017)
BCYK_M_N_Sport	1,271 (3-153)	40 (1977-2019)
BCYK_M_N_Troll	2,161 (0-336)	38 (1975-2018)
BCYK_M_S_Net and Seine	1,221 (1-115)	22 (1975-2014)
BCYK_M_S_Sport	5,559 (11-693)	45 (1975-2019)
BCYK_M_S_Troll	911 (0-146)	32 (1975-2018)
WA_M_N_Net and Seine	17 (2-7)	5 (1977-1990)
WA_M_S_Net and Seine	28 (1-8)	9 (1983-2017)
WA_M_S_Sport	53 (3-12)	8 (1975-2017)
WA_M_S_Troll	2 (0-2)	2 (1992-2001)

B.7.4 Site Overview

Table B.20 lists all the sites matched to this CU, and summarizes the available information. Enhancement level (*Enh*) and site category (*Cat*) are used for aggregating the site data (see sections 4.2.3 and 4.3 for definitions) . Only persistent (*P*) and extirpated (*EX*) sites are used in the aggregated time series. For the CU-level series, only sites with low or unknown enhancement level are included. For the Total Unit time series, all P and EX sites are combined. Some sites are used as indicators for escapement (*Esc*) or coded-wire tags (*CWT*). The table also shows the highest value (*Max*) and the year of the last available observation (*Last*) for the quality-filtered time series. The remaining columns list the number of observations in different quality categories, with definitions as per Section 4.2.1.

Table B.20. Site Overview for East Vancouver Island - Georgia Strait Summer 0.3 (CK-83)

Name	Enh	Cat	StYr	Esc	CWT	Max	Last	High	Mod	Other	Infill	Dropped
NANAIMO RIVER	HIGH	P	NA	Yes	No	1043	2018	0	0	37	1	2
PUNTLEDGE RIVER	HIGH	P	1990	Yes	Yes	3048	2018	0	0	46	0	0

APPENDIX C CU Profiles - Fraser - Lower

C.1 Lower Fraser Fall 0.3 (CK-03)

C.1.1 Data Overview

Table C.1 summarizes the available data, and Figure C.1 shows the patterns over time. Section 4 describes the data classifications and usability assessments.

Table C.1. Data Overview for Lower Fraser Fall 0.3 (CK-03)

CU_ID	CK-03
CU_Name	LFR-fall
SpnCategory	Abs_Abd
NumObs	44 (1975-2018)
StartYear	1984
NumSites	1 (1)
Gen	4 (3.8)
GenAvgWild	49,250
Area	FR
Area2	Fraser-Lower
CWT	HAR
ER_BY	32 (1981-2013)
Area	Fraser
MU	FrFa41
AbsAbdMetric	YES
TrendMetric	YES
PercBM	NO
Source	Publ
Above1kWild	Clearly
BasedOn	Estimate

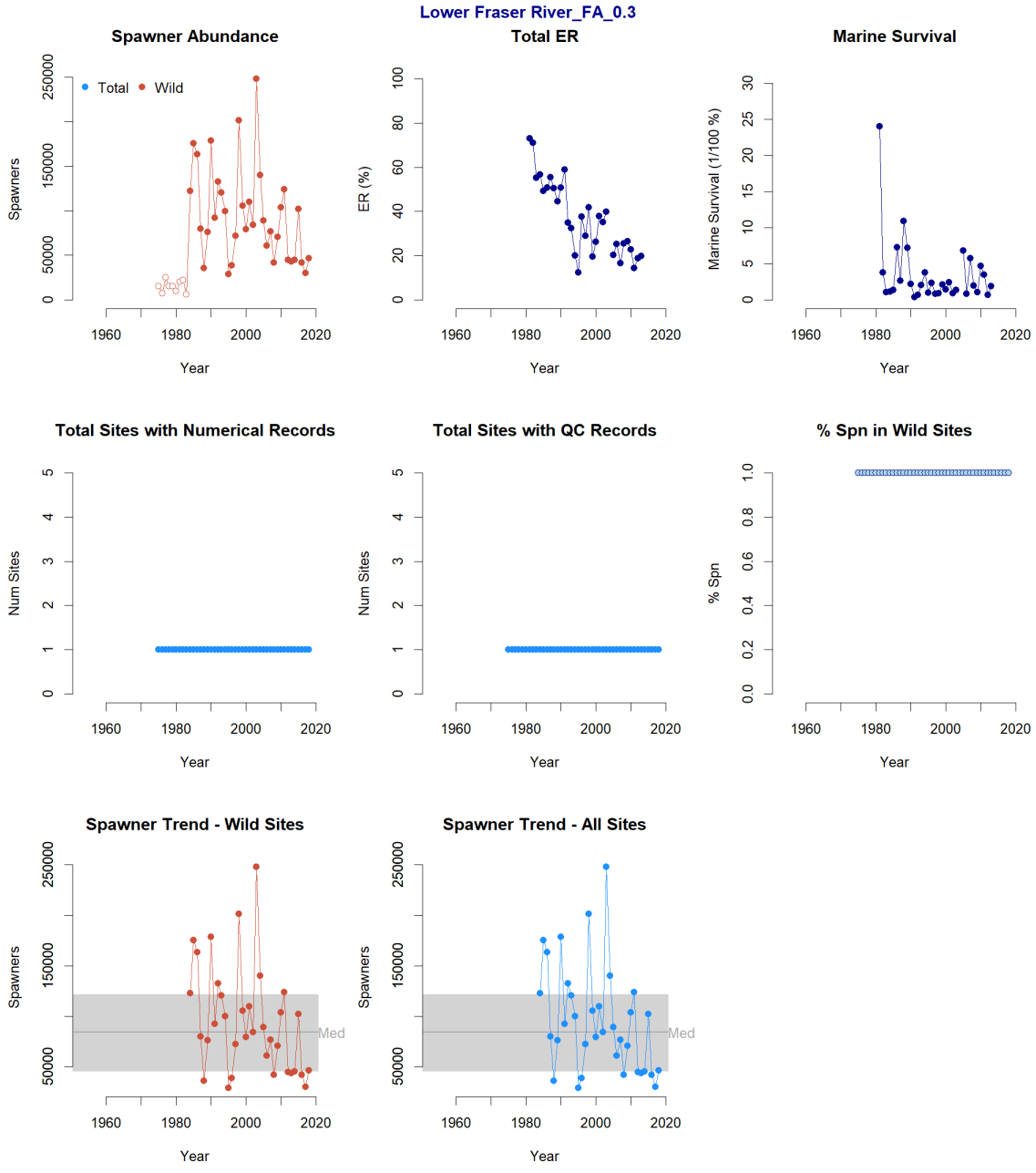

Figure C.1. : Available Data for Lower Fraser Fall 0.3 (CK-03)

C.1.2 Data Notes

Spawner Estimates

This CU has the largest naturally occurring Chinook population in Canada and it makes large contributions to fisheries in southern BC. It is one of the most intensively studied Chinook CUs in BC. Spawner abundance in the Harrison River for large males and females has been estimated using mark recapture methods since 1984, and small males have been estimated using mark recapture methods since 1995 (e.g. Farwell et al. 2000). Previously, the escapement was estimated by visual surveys from a helicopter with an expansion made for the part of the spawning population that was not counted. However, there is no source or detail for the expansion factor. There were attempts to cross-calibrate the visual survey method with the mark-recapture method from 1984-1988, however the expansion factors were highly variable and ranged from 1.58 to 17.26, and the mean factor had a CV of 96%. The study demonstrated it was unlikely that much, if any, information about relative spawner abundance could be generated from the estimates based on the visual survey method before 1984 in the Harrison River. Also, the study poorly represented the variations in abundance of chum, pink and sockeye salmon in the Harrison River that likely influence the accuracy of visual counts of Chinook Salmon spawners, holders, and carcasses. The escapement data prior to the initiation of the mark-recapture program in 1984 are highly uncertain and there is no evidence those data are associated with spawner abundance. In short, those data are uninformative and should not be used for quantitative purposes. This includes a CWT indicator site with a full suite of information available.

DFO (2015b): Good example of the effect of data quality filters because there are many past years with low abundances excluded from analysis.

Exploitation Rate Estimates

Exploitation rates are monitored at the Harrison River using coded wire tags. This CU has a local distribution mainly in the Salish Sea, WCVI and coastal Washington. However, some individuals have been caught as far south as California and as far north as Alaska. Recent exploitation rates have been 20-30%.

C.1.3 CWT Recoveries Overview

The *Mark Recovery Program Information System* (DFO 2020b) covers coded wire tag releases and recoveries for indicator and non-indicator systems. Table C.2 summarizes all tag recoveries for release sites matched to this CU, based on a database extract from July 2020. Recoveries are identified by region (e.g. BCYK = British Columbia and Yukon), then by marine (M) or freshwater (F), then by geography where applicable (N = North, S = South), and finally by sector or gear type.

Table C.2. Estimated CWT Recoveries - Lower Fraser Fall 0.3 (CK-03)

RecoveredIn	n	Years
AK_M_N_Sport	3 (3-3)	1 (2014-2014)
AK_M_S_Sport	2 (2-2)	1 (2013-2013)
AK_Net and Seine	13 (0-5)	7 (2008-2019)
AK_Troll	51 (1-10)	12 (1984-2019)
BCYK_F_Sport	85 (4-33)	8 (1983-2019)
BCYK_F_S_Aboriginal	163 (37-44)	4 (2011-2019)
BCYK_F_S_Net and Seine	59 (4-33)	3 (2008-2010)
BCYK_M_N_Net and Seine	22 (1-16)	3 (1983-1985)
BCYK_M_N_Sport	94 (2-23)	8 (2010-2019)
BCYK_M_N_Troll	205 (2-127)	13 (1975-2019)
BCYK_M_S_Net and Seine	400 (2-188)	14 (1975-2019)
BCYK_M_S_Sport	4,199 (28-665)	16 (1975-2019)
BCYK_M_S_Test Fisheries	7 (7-7)	1 (2019-2019)
BCYK_M_S_Troll	2,181 (16-1143)	16 (1975-2019)
OR_M_S_Sport	3 (1-2)	2 (2008-2011)
OR_M_S_Troll	90 (2-26)	11 (1984-2018)
WA_M_Sport	2 (2-2)	1 (2013-2013)
WA_M_N_Net and Seine	236 (1-93)	14 (1975-2018)
WA_M_N_Sport	40 (2-21)	3 (1983-2012)
WA_M_N_Troll	9 (1-5)	3 (1985-2014)
WA_M_S_Net and Seine	68 (2-22)	10 (1983-2018)
WA_M_S_Sport	659 (2-112)	17 (1983-2019)
WA_M_S_Troll	1,097 (1-224)	15 (1975-2019)
WA_Net and Seine	2 (2-2)	1 (1976-1976)
WA_Troll	7 (7-7)	1 (1983-1983)

C.1.4 Site Overview

Table C.3 lists all the sites matched to this CU, and summarizes the available information. Enhancement level (*Enh*) and site category (*Cat*) are used for aggregating the site data (see sections 4.2.3 and 4.3 for definitions) . Only persistent (*P*) and extirpated (*EX*) sites are used in the aggregated time series. For the CU-level series, only sites with low or unknown enhancement level are included. For the Total Unit time series, all P and EX sites are combined. Some sites are used as indicators for escapement (*Esc*) or coded-wire tags (*CWT*). The table also shows the highest value (*Max*) and the year of the last available observation (*Last*) for the quality-filtered time series. The remaining columns list the number of observations in different quality categories, with definitions as per Section 4.2.1.

Table C.3. Site Overview for Lower Fraser Fall 0.3 (CK-03)

Name	Enh	Cat	StYr	Esc	CWT	Max	Last	High	Mod	Other	Infill	Dropped
HARRISON RIVER	LOW	P	1984	Yes	Yes	247916	2018	0	9	35	0	0

C.2 Lower Fraser Spring 1.3 (CK-04)

C.2.1 Data Overview

Table C.4 summarizes the available data, and Figure C.2 shows the patterns over time. Section 4 describes the data classifications and usability assessments.

Table C.4. Data Overview for Lower Fraser Spring 1.3 (CK-04)

CU_ID	CK-04
CU_Name	LFR-spring
SpnCategory	Rel_Idx
NumObs	41 (1977-2018)
StartYear	1995
NumSites	1 (1)
Gen	5 (4.52)
GenAvgWild	287
Area	FR
Area2	Fraser-Lower
CWT	x (DOM)
ER_BY	0
Area	Fraser
MU	FrSp52
AbsAbdMetric	NO
TrendMetric	YES
PercBM	NO
Source	Publ
Above1kWild	Maybe
BasedOn	Data Notes

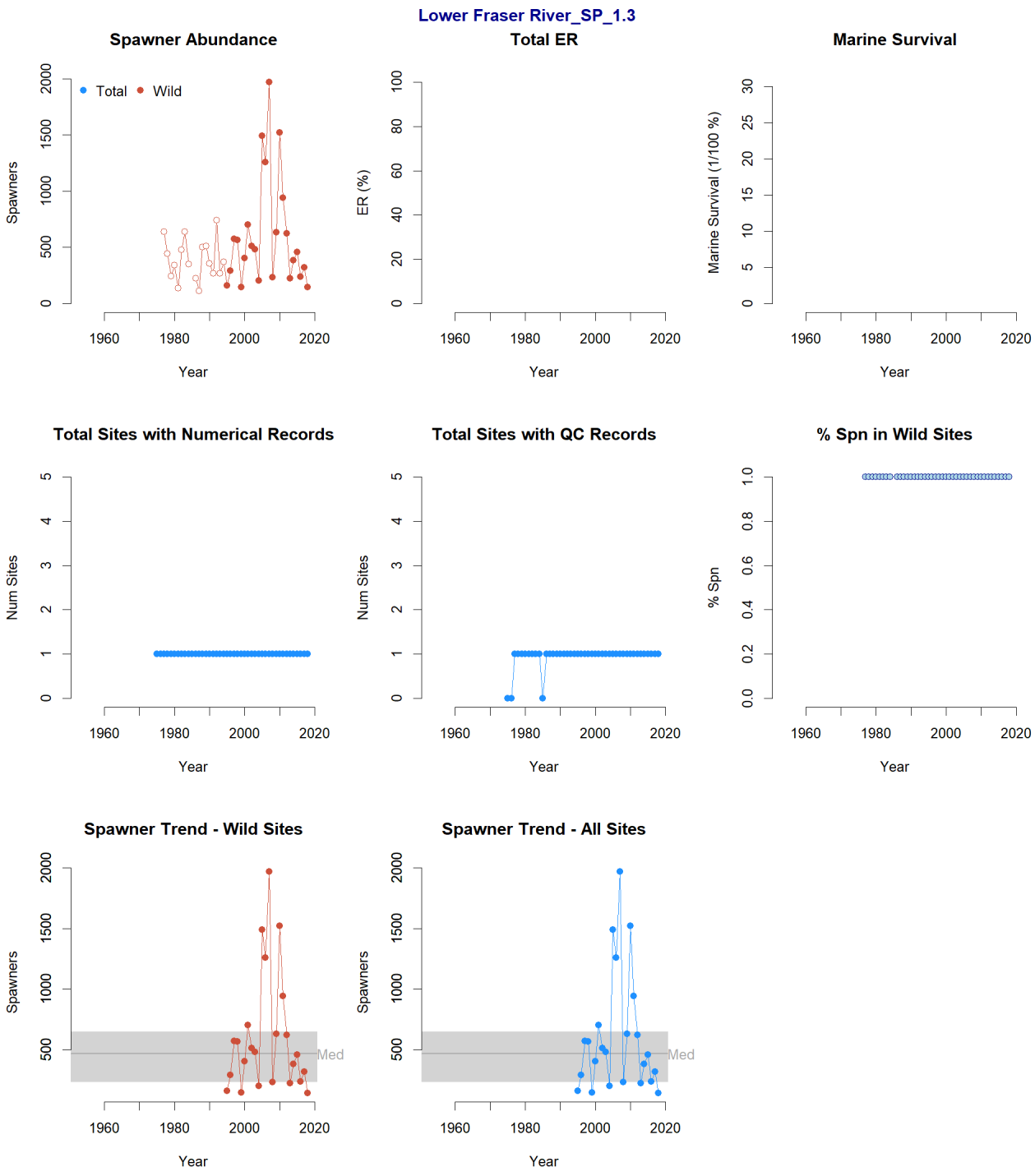

Figure C.2. : Available Data for Lower Fraser Spring 1.3 (CK-04)

C.2.2 Data Notes

Spawner Estimates

This stock has an unusual extreme northern ocean distribution and also unusual migration timing, entering the Fraser River from February to May, with a peak in April. These fish do not spawn until early September, so some fish reside as adults in freshwater for up to 6 months, which increases their risk from freshwater fisheries, freshwater environmental conditions, and habitat disturbances. Schubert et al. (2007) reviewed the Birkenhead River escapement data comprehensively and developed a standardized series of escapement estimates for the purposes of developing inferences about stock status. The extent that these data have been included in the time series is unclear as some of the estimates from Schubert et al. (2007) are the same as those in the table above and some are not the same (e.g. data prior to 1988). The review developed standardized procedures to monitor escapements on the Birkenhead River and the quality of data likely improved thereafter. There is virtually no information to assess how well the escapements measured at Birkenhead represent the abundance of the entire CU, due to extremely little information from the other survey sites. Birkenhead was likely chosen opportunistically as a survey system because of its easy access, favourable river conditions for counting Chinook, and because of the local community's knowledge about Chinook Salmon spawning and hatchery activities.

DFO (2015b): Five census sites and only one site met the appropriate criteria to be included in analysis. Likely fish in other sites, but do not have means to survey there. Minimum estimate, not suitable for absolute abundance metric. Trend analysis is suitable, because escapement from the one site is probably a large component of total escapement to the CU. *[Note: That site is Birkenhead]*

Exploitation Rate Estimates

The only site with exploitation information is the Birkenhead River. Schubert et al. (2007) comprehensively reviewed exploitation and other data for the Birkenhead location, and made several assumptions to characterize its exploitation and fishery distribution. The Birkenhead River has a CWT distribution that is unlike any other that has been monitored in southern BC. The stock was harvested in ocean troll fisheries in Alaska and others along the migration corridor as fish returned to the natal stream (particularly freshwater net fisheries and sport fisheries in the Salish Sea). This indicates it has a far north ocean distribution but is also likely timed to be intercepted in local fisheries upon their return as adults.

C.2.3 CWT Recoveries Overview

The *Mark Recovery Program Information System* (DFO 2020b) covers coded wire tag releases and recoveries for indicator and non-indicator systems. Table C.5 summarizes all tag recoveries for release sites matched to this CU, based on a database extract from July 2020. Recoveries are identified by region (e.g. BCYK = British Columbia and Yukon), then by marine (M) or freshwater (F), then by geography where applicable (N = North, S = South), and finally by sector or gear type.

Table C.5. Estimated CWT Recoveries - Lower Fraser Spring 1.3 (CK-04)

RecoveredIn	n	Years
AK_M_N_Sport	17 (5-12)	2 (1983-1999)
AK_Net and Seine	4 (0-2)	4 (1982-1999)
AK_Test Fisheries	1 (1-1)	1 (1986-1986)
AK_Troll	238 (2-72)	16 (1981-2000)
BCYK_F_S_Net and Seine	78 (4-31)	4 (1991-1995)
BCYK_M_N_Net and Seine	8 (8-8)	1 (1986-1986)
BCYK_M_N_Troll	21 (2-7)	5 (1980-2000)
BCYK_M_S_Net and Seine	13 (1-6)	3 (1979-1988)
BCYK_M_S_Sport	104 (3-26)	12 (1979-1994)
BCYK_M_S_Troll	11 (2-6)	3 (1980-1988)
WA_M_S_Sport	10 (3-4)	3 (1985-1993)

C.2.4 Site Overview

Table C.6 lists all the sites matched to this CU, and summarizes the available information. Enhancement level (*Enh*) and site category (*Cat*) are used for aggregating the site data (see sections 4.2.3 and 4.3 for definitions) . Only persistent (*P*) and extirpated (*EX*) sites are used in the aggregated time series. For the CU-level series, only sites with low or unknown enhancement level are included. For the Total Unit time series, all P and EX sites are combined. Some sites are used as indicators for escapement (*Esc*) or coded-wire tags (*CWT*). The table also shows the highest value (*Max*) and the year of the last available observation (*Last*) for the quality-filtered time series. The remaining columns list the number of observations in different quality categories, with definitions as per Section 4.2.1.

Table C.6. Site Overview for Lower Fraser Spring 1.3 (CK-04)

Name	Enh	Cat	StYr	Esc	CWT	Max	Last	High	Mod	Other	Infill	Dropped
BIRKENHEAD RIVER	LOW	P	1975	No	No	1968	2018	0	15	26	0	3
GREEN RIVER	UNK	DD	NA	No	No	NA	NA	0	2	0	0	0

C.3 Lower Fraser River-Upper Pitt_SU_1.3 (CK-05)

C.3.1 Data Overview

Table C.7 summarizes the available data, and Figure C.3 shows the patterns over time. Section 4 describes the data classifications and usability assessments.

Table C.7. Data Overview for Lower Fraser Upper Pitt Summer 1.3 (CK-05)

CU_ID	CK-05
CU_Name	LFR-UPITT
SpnCategory	Rel_Idx
NumObs	14 (2002-2018)
StartYear	2002
NumSites	1 (1)
Gen	5 (4.52)
GenAvgWild	NA
Area	FR
Area2	Fraser-Lower
CWT	x (DOM)
ER_BY	0
Area	Fraser
MU	FrSp52
AbsAbdMetric	NO
TrendMetric	NO
PercBM	NO
Source	Publ
Above1kWild	Maybe
BasedOn	Data Notes

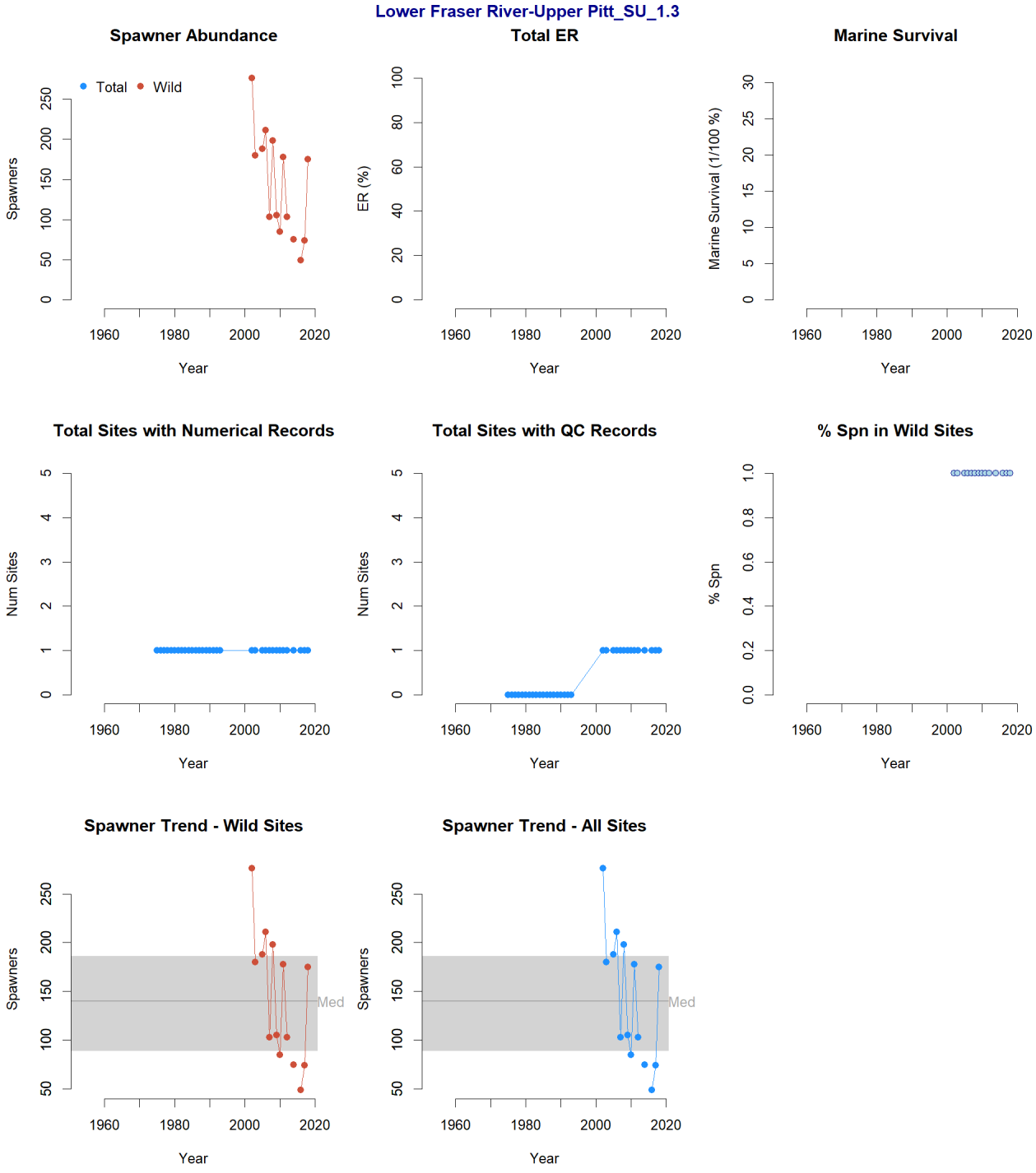

Figure C.3. : Available Data for Lower Fraser Upper Pitt Summer 1.3 (CK-05)

C.3.2 Data Notes

Spawner Estimates

This CU has low spawner abundance, based on a relative index from a single surveyed site. Much of the escapement time series is based on surveys of spawners in Blue Creek. Chinook also spawn in the mainstem of the Pitt River and its tributaries, but the water is too turbid to see fish with any reliability when Chinook are present. Also, the fraction of the CU that spawns in Blue Creek is unknown, thus the total CU spawner abundance is likely much greater than the number reported for Blue Creek. This creates a problematic situation when comparing the Blue Creek escapement estimate to abundance-based benchmarks for the entire CU. Furthermore, it is debatable whether Blue Creek represents a consistent percentage of the escapement to the CU, thus its utility as an index for time series trend analysis is unknown. Within the Pitt River watershed, there are numerous braided channels and paleochannels that are used for spawning and the relative component of the CU using these habitats could vary among years due to water flow and habitat availability. There is no direct measurement of the run timing for this stock, and designation as a summer run is based on the timing when spawning occurs. Some individuals are present in the upper Pitt River during April and May based on incidental catches by recreational anglers targeting steelhead and other species.

DFO (2015b): One survey site for a multi-branching system, therefore not really true abundance of whole system. Recorded in nuSEDS as Pitt River Upper (however know from other sources that it is Blue Creek), which is a larger issue in terms of nuSEDS data entry/management. Data only a reliable estimate of Blue Creek abundance, not Upper Pitt aggregate abundance. The site was likely selected for convenience as opposed to its representativeness. Not known whether fish would use other sites in different flow or abundance scenarios.

Exploitation Rate Estimates

There are no measurements of exploitation for this CU, and nearby CUs vary greatly in their ocean distribution and exploitation patterns, so it is not informative to speculate about the intensity of fisheries. The stock could be harvested in fisheries from as far south as California to as far north as Alaska.

Associated CWT recoveries from the 1980s indicate that they are caught in Alaskan and northern BC troll fisheries as well as sport and net fisheries in the Salish Sea

C.3.3 CWT Recoveries Overview

The *Mark Recovery Program Information System* (DFO 2020b) covers coded wire tag releases and recoveries for indicator and non-indicator systems. Table C.8 summarizes all tag recoveries for release sites matched to this CU, based on a database extract from July 2020. Recoveries are identified by region (e.g. BCYK = British Columbia and Yukon), then by marine (M) or freshwater (F), then by geography where applicable (N = North, S = South), and finally by sector or gear type.

Table C.8. Estimated CWT Recoveries - Lower Fraser Upper Pitt Summer 1.3 (CK-05)

RecoveredIn	n	Years
None	0	None

C.3.4 Site Overview

Table C.9 lists all the sites matched to this CU, and summarizes the available information. Enhancement level (*Enh*) and site category (*Cat*) are used for aggregating the site data (see sections 4.2.3 and 4.3 for definitions) . Only persistent (*P*) and extirpated (*EX*) sites are used in the aggregated time series. For the CU-level series, only sites with low or unknown enhancement level are included. For the Total Unit time series, all P and EX sites are combined. Some sites are used as indicators for escapement (*Esc*) or coded-wire tags (*CWT*). The table also shows the highest value (*Max*) and the year of the last available observation (*Last*) for the quality-filtered time series. The remaining columns list the number of observations in different quality categories, with definitions as per Section 4.2.1.

Table C.9. Site Overview for Lower Fraser Upper Pitt Summer 1.3 (CK-05)

Name	Enh	Cat	StYr	Esc	CWT	Max	Last	High	Mod	Other	Infill	Dropped
PITT RIVER-UPPER	LOW	P	2002	Yes	No	276	2018	0	14	0	0	19

C.4 Lower Fraser River Summer 1.3 (CK-06)

C.4.1 Data Overview

Table C.10 summarizes the available data, and Figure C.4 shows the patterns over time. Section 4 describes the data classifications and usability assessments.

Table C.10. Data Overview for Lower Fraser Summer 1.3 (CK-06)

CU_ID	CK-06
CU_Name	LFR-summer
SpnCategory	Rel_Idx
NumObs	32 (1986-2018)
StartYear	2005
NumSites	2 (2)
Gen	5 (4.52)
GenAvgWild	828
Area	FR
Area2	Fraser-Lower
CWT	x (DOM)
ER_BY	0
Area	Fraser
MU	FrSu52
AbsAbdMetric	NO
TrendMetric	NO
PercBM	NO
Source	Publ
Above1kWild	Likely
BasedOn	Data Notes

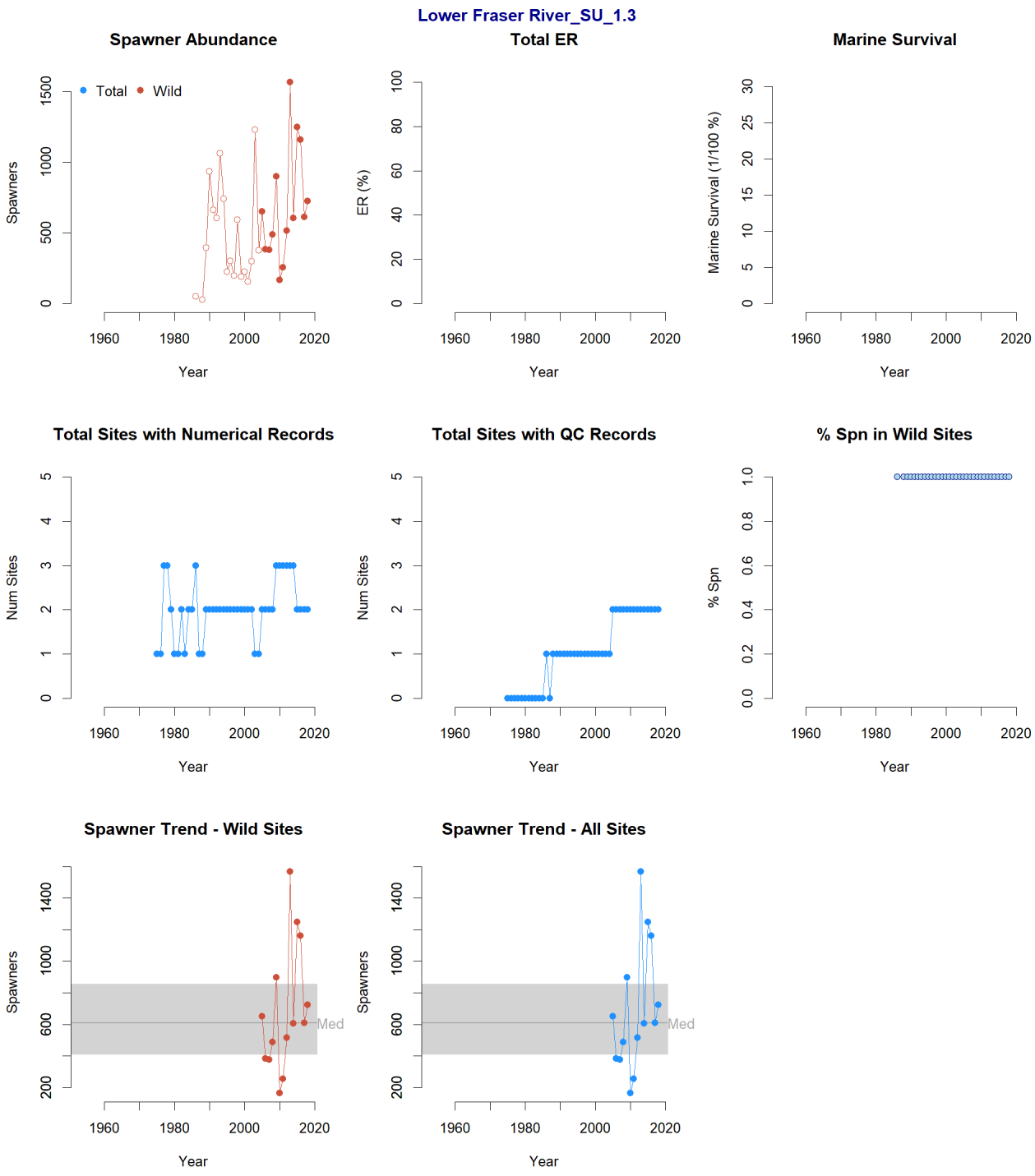

Figure C.4. : Available Data for Lower Fraser Summer 1.3 (CK-06)

C.4.2 Data Notes

Spawner Estimates

The quality of the escapement data is extremely poor, with the exception of Big Silver Creek which has been surveyed regularly over the last 10 years or so. A large amount of the mainstem Lillooet River upstream of Lillooet Lake was channelized and dyked for flood control. The Lillooet River is extremely glacial, with visibility less than 1cm during the spawning period. Accordingly, none of the river is surveyed for spawning Chinook Salmon. It is unknown how representative Big Silver Creek is of the abundance or trend in abundance for the entire CU.

The upper Lillooet River lies in a geologically active part of BC. There is enormous bed load movement due to landslides and debris flows off the Mount Meager volcano, with the most recent slide occurring in 2010. The channel is extremely braided and the main channel wanders across the valley, except in the areas where it has been channelized.

The Lillooet/Harrison drainage has the highest water yield of any large drainage in the Fraser River watershed and its headwaters arise from large glaciers in the Coast Range mountains. This watershed hosts multiple stocks that range from the earliest to the latest run timing among all those in the Fraser River watershed. The summer run spawns in the Lillooet River downstream of Lillooet Lake and historically, the main spawning area was likely the channel between Lilllooet and Little (Tenas) Lillooet Lake. The lake outlet was dredged to lower the elevation of Lillooet Lake several decades ago in order to reduce the frequency of flooding in Pemberton and its surrounding agricultural areas. The dredging took place in the area where Chinook spawning was likely most productive, based on observed Chinook spawner distribution in other Fraser River survey sites. The lowering of the lake elevation likely removed the highest quality spawning habitat in this system, and it is unclear if what remains is still being used for spawning. The data series used for trend and abundance analysis should be reviewed and chosen carefully since the accuracy of the data varies considerably among the sites, but there is no information readily available to correct for known or expected biases.

Note: The time series for Chilliwack (popID = 46985) combines EPAD broodstock from all years with nuSEDS spawner numbers (some years) and EPAD spawner estimates (a few recent years), according to the standarized data treatment method used for all the time series in this report. However, for the recent assessment of recovery potential (DFO 2020a), the EPAD data were excluded.

DFO (2015b): Same situation as Lower Fraser River-Upper Pitt_SU_1.3 (CK-05), where one small river is counted in a bigger river system. There are probably a lot more fish in the CU than the Big Silver number indicates but we cannot see in the water to count them (due to water clarity issues). Not convinced that trend in Big Silver is indicative of trend in CU. Not suitable for absolute abundance or trend metrics.

Exploitation Rate Estimates

Associated CWT recoveries from the 1990s indicate that Chinook from CK-06 are caught primarily in freshwater and Salish Sea sport and net fisheries (Figure 58). Smaller numbers are found in troll fisheries from WCVI to Alaska. This indicates a predominantly local ocean distribution where most interceptions occur during the adult return to freshwater.

C.4.3 CWT Recoveries Overview

The *Mark Recovery Program Information System* (DFO 2020b) covers coded wire tag releases and recoveries for indicator and non-indicator systems. Table C.11 summarizes all tag recoveries for release sites matched to this CU, based on a database extract from July 2020. Recoveries are identified by region (e.g. BCYK = British Columbia and Yukon), then by marine (M) or freshwater (F), then by geography where applicable (N = North, S = South), and finally by sector or gear type.

Table C.11. Estimated CWT Recoveries - Lower Fraser Summer 1.3 (CK-06)

RecoveredIn	n	Years
AK_M_N_Sport	2 (0-2)	2 (1990-2019)
AK_M_S_Sport	18 (0-11)	3 (1985-1991)
AK_Net and Seine	17 (0-4)	10 (1984-2019)
AK_Test Fisheries	1 (1-1)	1 (1986-1986)
AK_Troll	394 (1-90)	29 (1984-2019)
BCYK_F_Sport	7,501 (21-796)	37 (1983-2019)
BCYK_F_S_Aboriginal	608 (16-207)	6 (2011-2019)
BCYK_F_S_Net and Seine	1,226 (6-138)	20 (1990-2010)
BCYK_M_N_Net and Seine	295 (3-46)	17 (1983-2013)
BCYK_M_N_Sport	224 (1-26)	25 (1983-2019)
BCYK_M_N_Troll	699 (0-254)	30 (1983-2019)
BCYK_M_S_Net and Seine	1,912 (1-463)	27 (1983-2019)
BCYK_M_S_Sport	15,462 (55-1236)	37 (1983-2019)
BCYK_M_S_Test Fisheries	8 (8-8)	1 (2019-2019)
BCYK_M_S_Troll	14,063 (19-2001)	36 (1983-2019)
OR_M_S_ Shoreside comp. (OR/WA)	1 (0-1)	4 (2010-2015)
OR_M_S_Sport	22 (2-6)	6 (1984-2012)
OR_M_S_Troll	490 (2-67)	28 (1984-2018)
OR_Net and Seine	2 (2-2)	1 (2007-2007)
OR_Sport	5 (5-5)	1 (2012-2012)
WA_M_Sport	25 (1-11)	5 (1983-2012)
WA_M_N_Net and Seine	1,701 (0-239)	34 (1983-2018)
WA_M_N_Sport	273 (2-45)	24 (1983-2018)
WA_M_N_Test Fisheries	4 (1-1)	4 (1994-2016)
WA_M_N_Troll	618 (2-170)	17 (1984-2015)
WA_M_S_Net and Seine	674 (2-80)	31 (1983-2018)
WA_M_S_Sport	3,836 (15-434)	37 (1983-2019)
WA_M_S_Troll	7,849 (2-902)	36 (1984-2019)
WA_Troll	3 (3-3)	1 (1983-1983)

C.4.4 Site Overview

Table C.12 lists all the sites matched to this CU, and summarizes the available information. Enhancement level (*Enh*) and site category (*Cat*) are used for aggregating the site data (see sections 4.2.3 and 4.3 for definitions) . Only persistent (*P*) and extirpated (*EX*) sites are used in the aggregated time series. For the CU-level series, only sites with low or unknown enhancement level are included. For the Total Unit time series, all P and EX sites are combined. Some sites are used as indicators for escapement (*Esc*) or coded-wire tags (*CWT*). The table also shows the highest value (*Max*) and the year of the last available observation (*Last*) for the quality-filtered time series. The remaining columns list the number of observations in different quality categories, with definitions as per Section 4.2.1.

See note above regarding inclusion of EPAD estimates for the Chilliwack site.

Table C.12. Site Overview for Lower Fraser Summer 1.3 (CK-06)

Name	Enh	Cat	StYr	Esc	CWT	Max	Last	High	Mod	Other	Infill	Dropped
BIG SILVER CREEK	UNK	P	2005	No	No	150	2018	0	4	0	10	12
CHILLIWACK	LOW	P	NA	No	No	1416	2018	0	0	32	0	0
COGBURN CREEK	UNK	DD	NA	No	No	NA	NA	0	3	0	0	3
DOUGLAS CREEK	UNK	DD	NA	No	No	NA	NA	NA	NA	NA	NA	NA
LILLOOET RIVER	UNK	DD	NA	No	No	NA	NA	NA	NA	NA	NA	NA
SLOQUET CREEK	UNK	DD	NA	No	No	NA	NA	0	3	0	0	27
TIPELLA CREEK	UNK	DD	NA	No	No	NA	NA	0	8	0	0	0
WEAVER CREEK	UNK	DEL	NA	No	No	NA	NA	NA	NA	NA	NA	NA

C.5 Maria Slough_SU_0.3 (CK-07)

C.5.1 Data Overview

Table C.13 summarizes the available data, and Figure C.5 shows the patterns over time. Section 4 describes the data classifications and usability assessments.

Table C.13. Data Overview for Maria Slough SU 0.3 (CK-07)

CU_ID	CK-07
CU_Name	Maria
SpnCategory	Rel_Idx
NumObs	22 (1996-2017)
StartYear	1996
NumSites	1 (0)
Gen	4 (3.83)
GenAvgWild	NA
Area	FR
Area2	Fraser-Lower
CWT	x (SHU)
ER_BY	0
Area	Fraser
MU	FrSu41
AbsAbdMetric	DD
TrendMetric	DD
PercBM	DD
Source	New
Above1kWild	NA
BasedOn	NA

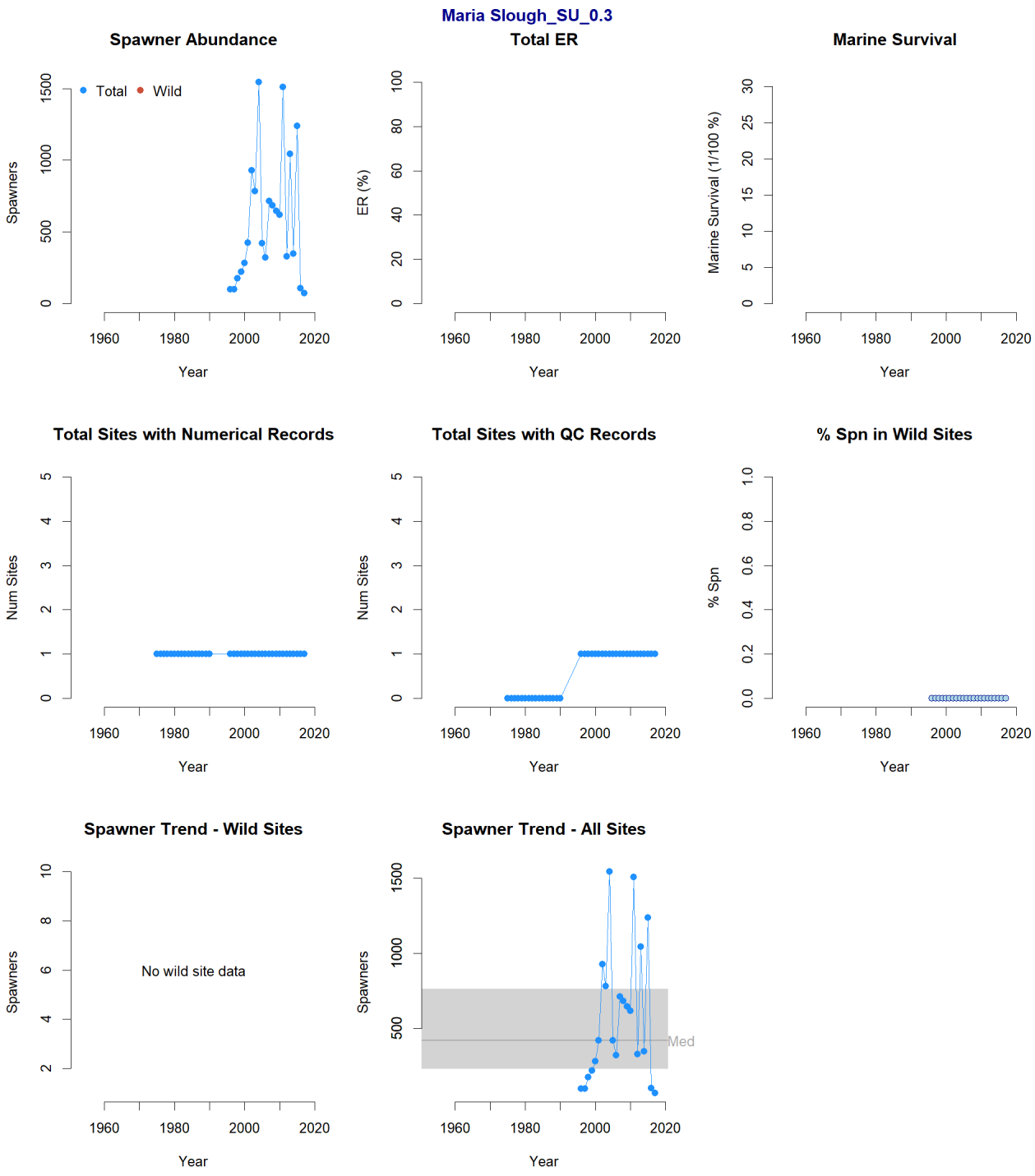

Figure C.5. : Available Data for Maria Slough Summer 0.3 (CK-07)

C.5.2 Data Notes

Spawner Estimates

The CU has received an enormous amount of stewardship and watershed restoration activity. Much of the slough flows through agricultural areas and the head of the slough was historically connected to the Fraser River during high flow periods. However, the head of the slough is now cut off by dykes and other flood control measures. The spawner abundance in Maria Slough has been estimated using a variety of methods and no attempts have been made to cross-calibrate or standardize the estimates to facilitate interannual comparisons. In some years prior to 1995, the Salmon Enhancement Program used a fence to count the escapement and collect brood stock. In other years, the escapement was estimated by observers walking the stream bank on one or more survey dates. In years with few surveys, the peak count of spawners, holders, and carcasses was likely expanded to account for fish that were not visible on the survey date (due to observer efficiency and the proportion of the population that was present in the survey area), which has been the situation for the past 7 or 8 years. In years with more frequent surveys, area-under-the-curve methods were used, however specific descriptions of the method used to generate the curve were not readily available (i.e. survey life and observer efficiency estimates). It is likely that maximum likelihood methods were used in some years and the trapezoidal method was used for others. There are some years when no surveys were conducted and escapement was not estimated. Some years had very low spawning escapements in the tens of fish, and even single digits, and the large increase in abundance over the last decade is presumed to have resulted from the creation of spawning channels and supplementation. There is much more information about the characteristics of this CU from unpublished sources that could be synthesized to develop better quality inferences. Parts of the slough have upwelling from the hyperheic zone, and salmon will spawn in these patches even though the surface flow rate is near 0 m/s. These conditions are now rare in the lower Fraser River valley, but they may have been more common prior to flood control and agricultural activities over the last century.

DFO (2015b): Was highly enhanced, but still has natural production. Enhancement stopped 6 or 7 years ago, so all natural returns as of last year. Exploitation data is not available, because although CWTs were applied, we are missing escapement data. Habitat in this CU was rebuilt. [*Notes: missing escapement data is for the main age-at-return of the single cohort that was tagged. Habitat was rebuilt and enhanced*.]

Exploitation Rate Estimates

Maria Slough has been highly enhanced for some brood years and coded wire tagged, however escapements have not been estimated or adequately sampled in all years using methods that are suitable for exploitation rate analysis. There are reasonable coded wire tag data available to estimate fishery distribution and it is possible that exploitation rates can be estimated after reviewing the escapement data and addressing any issues. The stock has been caught in fisheries throughout the BC coast and its peak migration into the Fraser is during August, which coincides with intensive terminal fisheries. It is also found in Alaskan and northern BC troll fisheries, indicating a far north ocean distribution

C.5.3 CWT Recoveries Overview

The *Mark Recovery Program Information System* (DFO 2020b) covers coded wire tag releases and recoveries for indicator and non-indicator systems. Table C.14 summarizes all tag recoveries for release sites matched to this CU, based on a database extract from July 2020. Recoveries are identified by region (e.g. BCYK = British Columbia and Yukon), then by marine (M) or freshwater (F), then by geography where applicable (N = North, S = South), and finally by sector or gear type.

Table C.14. Estimated CWT Recoveries - Maria Slough SU 0.3 (CK-07)

RecoveredIn	n	Years
AK_M_N_Sport	3 (3-3)	1 (2004-2004)
AK_M_S_Sport	5 (2-3)	2 (2002-2004)
AK_Troll	178 (2-61)	6 (2001-2006)
BCYK_F_Sport	16 (2-10)	3 (2002-2005)
BCYK_F_S_Net and Seine	102 (0-27)	6 (2000-2006)
BCYK_M_N_Sport	43 (6-11)	5 (2001-2005)
BCYK_M_N_Troll	139 (0-52)	6 (2002-2007)
BCYK_M_S_Net and Seine	3 (3-3)	1 (2002-2002)
BCYK_M_S_Sport	40 (2-21)	5 (2001-2005)
BCYK_M_S_Troll	4 (4-4)	1 (2006-2006)
WA_M_N_Net and Seine	30 (2-15)	4 (2002-2006)
WA_M_S_Net and Seine	5 (2-3)	2 (2003-2005)
WA_M_S_Sport	8 (8-8)	1 (2004-2004)

C.5.4 Site Overview

Table C.15 lists all the sites matched to this CU, and summarizes the available information. Enhancement level (*Enh*) and site category (*Cat*) are used for aggregating the site data (see sections 4.2.3 and 4.3 for definitions) . Only persistent (*P*) and extirpated (*EX*) sites are used in the aggregated time series. For the CU-level series, only sites with low or unknown enhancement level are included. For the Total Unit time series, all P and EX sites are combined. Some sites are used as indicators for escapement (*Esc*) or coded-wire tags (*CWT*). The table also shows the highest value (*Max*) and the year of the last available observation (*Last*) for the quality-filtered time series. The remaining columns list the number of observations in different quality categories, with definitions as per Section 4.2.1.

Table C.15. Site Overview for Maria Slough SU 0.3 (CK-07)

Name	Enh	Cat	StYr	Esc	CWT	Max	Last	High	Mod	Other	Infill	Dropped
MARIA SLOUGH	HIGH	P	1996	Yes	No	1543	2017	0	10	12	0	16

APPENDIX D CU Profiles - Fraser - Middle and Upper

D.1 Middle Fraser-Fraser Canyon Spring 1.3 (CK-08)

D.1.1 Data Overview

Table D.1 summarizes the available data, and Figure D.1 shows the patterns over time. Section 4 describes the data classifications and usability assessments.

Table D.1. Data Overview for Middle Fraser-Fraser Canyon Spring 1.3 (CK-08)

CU_ID	CK-08
CU_Name	FRCanyon
SpnCategory	Rel_Idx
NumObs	17 (1997-2018)
StartYear	1996
NumSites	1 (1)
Gen	5 (4.52)
GenAvgWild	7
Area	FR
Area2	Fraser-UpperUPF
CWT	x (DOM)
ER_BY	0
Area	Fraser
MU	FrSp52
AbsAbdMetric	NO
TrendMetric	NO
PercBM	NO
Source	Unpubl
Above1kWild	Possible
BasedOn	Data Notes

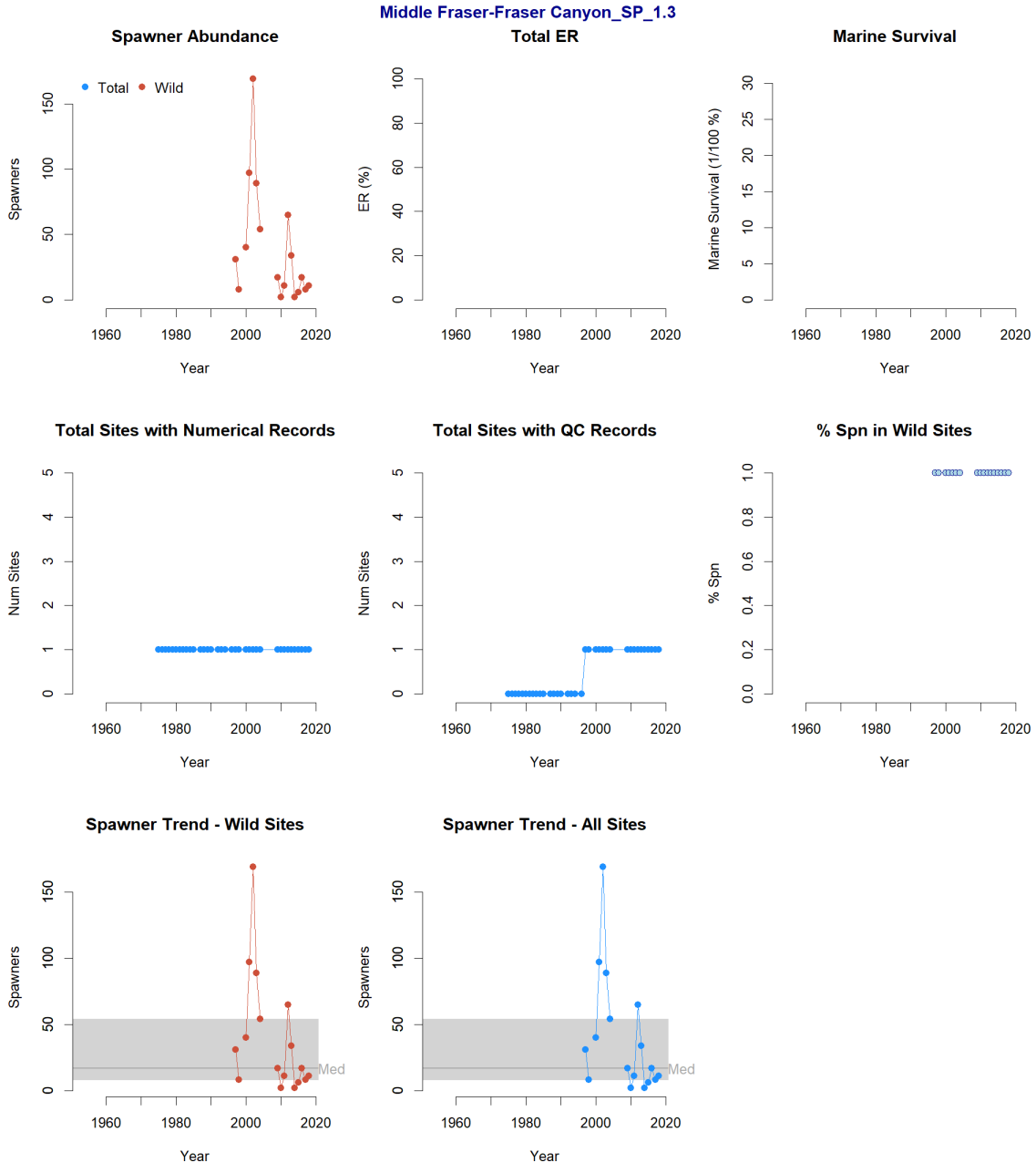

Figure D.1. : Available Data for Middle Fraser-Fraser Canyon Spring 1.3 (CK-08)

D.1.2 Data Notes

Spawner Estimates

The escapement data available for the two survey sites in this CU do not pass the data quality and completeness criteria required for use in calculation of metrics for WSP status assessment. The data are reported to support qualitative observations concerning risks to the CU. Escapements are not surveyed regularly for this CU. Overall, the spawner indices are likely underestimates because of the timing of surveys and water clarity during the survey period. During the spawning period, the Nahatlatch River is moderately turbid and visibility is generally less than 2m. Only spawning fish in shallow water can be counted, and those spawning in deep water cannot. Spawning occurs during mid to late August. However, much of the escapement information was collected during surveys in late August that are timed to coincide with the sockeye spawning period. This CU is spatially isolated from others. Within the Nahatlatch River, Chinook spawn in the mainstem of the river upstream of a series of 5 lakes. Downstream of the lakes, the river has high gradient and the substrate is boulder-dominated. The nearest spawning stream in the downstream direction is Maria Slough (near Agassiz), and in the upstream direction is Stein River (near Lytton). In general, there is little information about this CU compared to others in southern BC. The spawner abundance has been estimated by visual counts from helicopter and boat surveys. Spawning occurs in the mainstem of the Nahatlatch River upstream of the lake. When the Chinook are spawning in late August, it can be difficult to see fish in more than 1 m of water due to glacial flour in the river. These visual conditions may vary among years depending on the weather, and periods of cool weather could reduce the melting of the glaciers and produce conditions with excellent visibility. However the frequency of these conditions is unknown and not apparent with the escapement data. The method used to generate the escapement is presumed to be a peak count expansion where the survey date with the highest count of spawners, holders, and carcasses has the total count multiplied by 1.54. It is unclear if any other factors were applied to adjust for the water clarity and other conditions that influence the proportion of the population counted (e.g. count from boat vs. helicopter). Carcasses can be difficult to count in this system because they can settle in water deeper than 1 m and not be visible and the carcasses that settle along the shore appear to be removed by scavengers quickly (more so than other Fraser River tributaries). There are some years when the escapement was not surveyed.

DFO (2015b): CU is data deficient.

Exploitation Rate Estimates

There are no measurements of exploitation for this CU, and nearby CUs vary greatly in their ocean distribution and exploitation patterns, so it is not informative to speculate about the intensity of fisheries.

D.1.3 CWT Recoveries Overview

The *Mark Recovery Program Information System* (DFO 2020b) covers coded wire tag releases and recoveries for indicator and non-indicator systems. Table D.2 summarizes all tag recoveries for release sites matched to this CU, based on a database extract from July 2020. Recoveries are identified by region (e.g. BCYK = British Columbia and Yukon), then by marine (M) or freshwater (F), then by geography where applicable (N = North, S = South), and finally by sector or gear type.

Table D.2. Estimated CWT Recoveries - Middle Fraser-Fraser Canyon Spring 1.3 (CK-08)

RecoveredIn	n	Years
None	0	None

D.1.4 Site Overview

Table D.3 lists all the sites matched to this CU, and summarizes the available information. Enhancement level (*Enh*) and site category (*Cat*) are used for aggregating the site data (see sections 4.2.3 and 4.3 for definitions) . Only persistent (*P*) and extirpated (*EX*) sites are used in the aggregated time series. For the CU-level series, only sites with low or unknown enhancement level are included. For the Total Unit time series, all P and EX sites are combined. Some sites are used as indicators for escapement (*Esc*) or coded-wire tags (*CWT*). The table also shows the highest value (*Max*) and the year of the last available observation (*Last*) for the quality-filtered time series. The remaining columns list the number of observations in different quality categories, with definitions as per Section 4.2.1.

Table D.3. Site Overview for Middle Fraser-Fraser Canyon Spring 1.3 (CK-08)

Name	Enh	Cat	StYr	Esc	CWT	Max	Last	High	Mod	Other	Infill	Dropped
NAHATLATCH RIVER	UNK	P	1996	No	No	169	2018	0	17	0	0	19

D.2 Middle Fraser River-Portage Fall 1.3 (CK-09)

D.2.1 Data Overview

Table D.4 summarizes the available data, and Figure D.2 shows the patterns over time. Section 4 describes the data classifications and usability assessments.

Table D.4. Data Overview for Middle Fraser River-Portage Fall 1.3 (CK-09)

CU_ID	CK-09
CU_Name	Portage
SpnCategory	Rel_Idx
NumObs	19 (2000-2018)
StartYear	2000
NumSites	1 (1)
Gen	5 (4.52)
GenAvgWild	35
Area	FR
Area2	Fraser-UpperUPF
CWT	x (DOM)
ER_BY	0
Area	Fraser
MU	FrSu52
AbsAbdMetric	NO
TrendMetric	YES
PercBM	NO
Source	New
Above1kWild	Unlikely
BasedOn	Data Notes

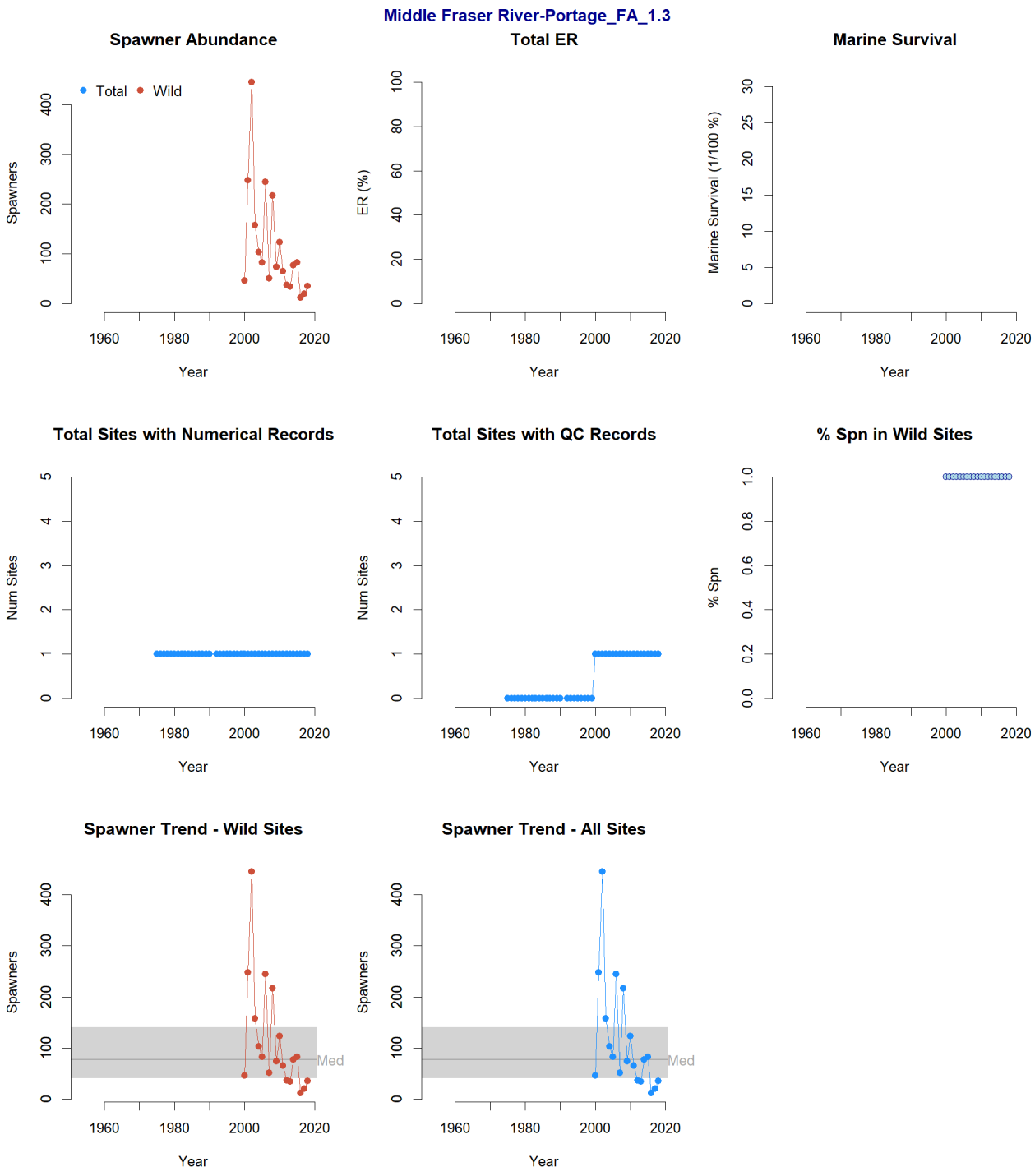

Figure D.2. : Available Data for Middle Fraser River-Portage Fall 1.3 (CK-09)

D.2.2 Data Notes

Spawner Estimates

This CU has low spawner abundance, based on a relative index. The quality of escapement data for this CU is likely better than average for the Fraser system. Spawning occurs mainly at the outlet of Anderson Lake in late October and early November, and viewing conditions are generally exceptional for stream surveys.

Historically there was likely a large group of spawning Chinook at the outlet of Seton Lake, however that area was inundated following construction of the Seton Dam. Very small numbers of Chinook Salmon are observed downstream of the dam and it is unclear whether these are Fall Chinook heading to Portage (Ck-09) that were unable to find the fish ladder or to ascend it, or Summer Chinook from populations spawning in Seton River or Seton Creek (Ck-11).

Exploitation Rate Estimates

There are no measurements of exploitation for this CU, and nearby CUs vary greatly in their ocean distribution and exploitation patterns, so it's not informative to speculate about the intensity of fisheries. This is the only fall-run CU in the Fraser River upstream of the Harrison, with peak migration timing during mid-September.

D.2.3 CWT Recoveries Overview

The *Mark Recovery Program Information System* (DFO 2020b) covers coded wire tag releases and recoveries for indicator and non-indicator systems. Table D.5 summarizes all tag recoveries for release sites matched to this CU, based on a database extract from July 2020. Recoveries are identified by region (e.g. BCYK = British Columbia and Yukon), then by marine (M) or freshwater (F), then by geography where applicable (N = North, S = South), and finally by sector or gear type.

Table D.5. Estimated CWT Recoveries - Middle Fraser River-Portage Fall 1.3 (CK-09)

RecoveredIn	n	Years
None	0	None

D.2.4 Site Overview

Table D.6 lists all the sites matched to this CU, and summarizes the available information. Enhancement level (*Enh*) and site category (*Cat*) are used for aggregating the site data (see sections 4.2.3 and 4.3 for definitions) . Only persistent (*P*) and extirpated (*EX*) sites are used in the aggregated time series. For the CU-level series, only sites with low or unknown enhancement level are included. For the Total Unit time series, all P and EX sites are combined. Some sites are used as indicators for escapement (*Esc*) or coded-wire tags (*CWT*). The table also shows the highest value (*Max*) and the year of the last available observation (*Last*) for the quality-filtered time series. The remaining columns list the number of observations in different quality categories, with definitions as per Section 4.2.1.

Table D.6. Site Overview for Middle Fraser River-Portage Fall 1.3 (CK-09)

Name	Enh	Cat	StYr	Esc	CWT	Max	Last	High	Mod	Other	Infill	Dropped
PORTAGE CREEK	UNK	P	2000	Yes	No	445	2018	0	19	0	0	24

D.3 Middle Fraser River Spring 1.3 (CK-10)

D.3.1 Data Overview

Table D.7 summarizes the available data, and Figure D.3 shows the patterns over time. Section 4 describes the data classifications and usability assessments.

Note that the first 3 records in the wild time series (top left panel of D.3) are much lower, but are based on fewer surveyed sites (middle panel) and the resulting infilled early values may not reflect the actual pattern in abundance.

Table D.7. Data Overview for Middle Fraser River Spring 1.3 (CK-10)

CU_ID	CK-10
CU_Name	MFR-spring
SpnCategory	Rel_Idx
NumObs	29 (1986-2018)
StartYear	1995
NumSites	12 (12)
Gen	5 (4.52)
GenAvgWild	3,577
Area	FR
Area2	Fraser-UpperUPF
CWT	x (DOM)
ER_BY	0
Area	Fraser
MU	FrSp52
AbsAbdMetric	NO
TrendMetric	YES
PercBM	NO
Source	New
Above1kWild	Clearly
BasedOn	Estimate

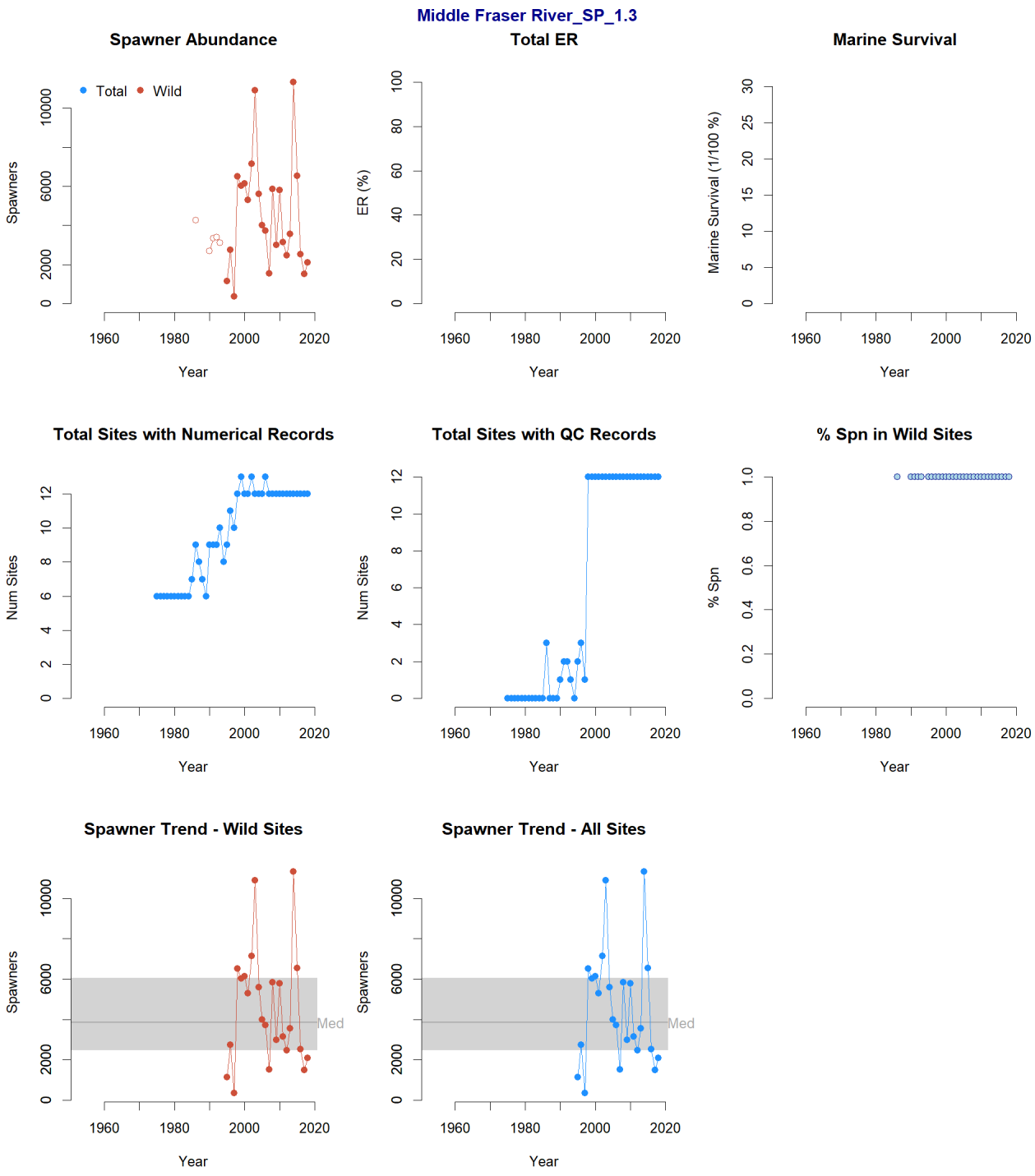

Figure D.3. : Available Data for Middle Fraser River Spring 1.3 (CK-10)

D.3.2 Data Notes

Spawner Estimates

Chilcotin River Chinook has two runs. The Upper Chilcotin group migrates prior to the Fraser River Spring freshet and is important for local First Nations. This group is not an indicator for the CTC. The second group, Lower Chilcotin migrates during and after the freshet and is monitored as a CTC indicator stock. Some of the sites in this CU have had their stream habitats modified significantly. The Bridge River system was the site of a gold rush during the mid to late 1800s and placer mining continued up until very recently (2000s). Also, a major diversion dam was constructed on the Bridge that redirected flows into Seton Lake. Subsequently, the flow and thermal regimes of the Bridge were altered substantially. Another gold rush occurred in the Cottonwood during the mid-1800s and placer mining continued through to the 2000s. The amount of sediment input and stream bed disturbance from placer gold activities is significant. The escapement of Chinook through the Westroad system appears very low based on the size of the system and the number of moss-covered spawning dunes that remain in the river and span its width. These spawning dunes are created by Chinook Salmon when they build their redds and mound-up the gravel at the downstream end, which creates additional hydraulic head and stream flow through the interstices among the gravel. Spawning dunes are common at other locations where large abundances of Chinook spawn, and their presence in the Westroad system identifies that much greater numbers of Chinook Salmon likely spawned here historically.

The visual counting conditions vary among streams within the CU, and even within a stream the light conditions can vary among surveys, which can greatly affect the accuracy of the escapement estimates. Some of the rivers, like the Lower Chilcotin, have dark substrates which provide little contrast between the fish and the bottom, further reducing the accuracy of the counts compared to other systems where the substrates are lighter. Since the data series have used the same expansion factor regardless of substrate, there are is more uncertainty in the absolute abundance than for other CUs where there is less variability in the fish counting conditions. Also, the number of surveys conducted annually has varied for some of the sites, and no adjustments were made to standardize the estimates among years. One expects that accuracy will be lower when there are 1 or 2 surveys per year compared to years when there are 3 or more surveys performed. Assumptions must be made about the extent to which the relative index represents true abundance prior to interpreting WSP abundance benchmarks.

Exploitation Rate Estimates

Coded wire tags were used in the 1980s and 1990s to provide some information about ocean distribution. Most Chinook were caught in freshwater fisheries, with a smaller number also found troll fisheries from the southern US to Alaska.

D.3.3 CWT Recoveries Overview

The *Mark Recovery Program Information System* (DFO 2020b) covers coded wire tag releases and recoveries for indicator and non-indicator systems. Table D.8 summarizes all tag recoveries for release sites matched to this CU, based on a database extract from July 2020. Recoveries are identified by region (e.g. BCYK = British Columbia and Yukon), then by marine (M) or freshwater (F), then by geography where applicable (N = North, S = South), and finally by sector or gear type.

Table D.8. Estimated CWT Recoveries - Middle Fraser River Spring 1.3 (CK-10)

RecoveredIn	n	Years
AK_Troll	22 (2-7)	5 (1981-1996)
BCYK_F_Sport	65 (3-33)	5 (1991-1996)
BCYK_F_S_Net and Seine	470 (31-197)	7 (1990-1996)
BCYK_M_N_Sport	9 (4-5)	2 (1993-1995)
BCYK_M_N_Troll	24 (4-7)	4 (1990-1994)
BCYK_M_S_Net and Seine	55 (3-13)	7 (1978-1994)
BCYK_M_S_Sport	133 (2-31)	11 (1979-1996)
BCYK_M_S_Troll	130 (4-57)	10 (1978-1995)
OR_M_S_Troll	4 (4-4)	1 (1988-1988)
WA_M_N_Net and Seine	31 (3-12)	5 (1981-1995)
WA_M_N_Troll	4 (2-2)	2 (1987-1995)
WA_M_S_Sport	46 (2-32)	5 (1989-1995)
WA_M_S_Troll	36 (2-13)	7 (1987-1994)

D.3.4 Site Overview

Table D.9 lists all the sites matched to this CU, and summarizes the available information. Enhancement level (*Enh*) and site category (*Cat*) are used for aggregating the site data (see sections 4.2.3 and 4.3 for definitions) . Only persistent (*P*) and extirpated (*EX*) sites are used in the aggregated time series. For the CU-level series, only sites with low or unknown enhancement level are included. For the Total Unit time series, all P and EX sites are combined. Some sites are used as indicators for escapement (*Esc*) or coded-wire tags (*CWT*). The table also shows the highest value (*Max*) and the year of the last available observation (*Last*) for the quality-filtered time series. The remaining columns list the number of observations in different quality categories, with definitions as per Section 4.2.1.

Table D.9. Site Overview for Middle Fraser River Spring 1.3 (CK-10)

Name	Enh	Cat	StYr	Esc	CWT	Max	Last	High	Mod	Other	Infill	Dropped
AHBAU CREEK	UNK	P	NA	No	No	150	2018	0	14	0	8	0
BAEZAEKO RIVER	LOW	P	1995	No	No	1320	2018	0	18	1	3	0
BRIDGE RIVER	UNK	P	1995	Yes	No	1866	2018	2	15	6	2	19
CHILAKO RIVER	UNK	P	1995	Yes	No	417	2018	0	15	0	6	23
CHILCOTIN RIVER-LOWER	UNK	P	1995	No	No	5774	2018	0	21	0	0	23
CHILCOTIN RIVER-UPPER	UNK	P	1995	Yes	No	3140	2018	0	21	7	0	0
ENDAKO RIVER	UNK	P	1995	Yes	No	340	2018	1	18	0	2	23
HORSEFLY RIVER	LOW	P	1995	Yes	No	509	2018	0	21	0	0	23
LIGHTNING CREEK	UNK	P	NA	No	No	251	2018	0	21	0	0	0
NAZKO RIVER	LOW	P	1995	No	No	415	2018	0	19	1	2	0
SWIFT RIVER	UNK	P	NA	Yes	No	1727	2018	0	21	0	0	0
WEST ROAD (BLACKWATER) RIVER	UNK	P	1995	Yes	No	3657	2018	0	20	1	1	22
BAKER CREEK	UNK	DD	1995	No	No	NA	NA	0	9	0	0	8
CARIBOO RIVER-UPPER	UNK	DD	NA	No	No	NA	NA	0	12	5	0	3
CHURN CREEK	UNK	DD	NA	No	No	NA	NA	NA	NA	NA	NA	NA
DRIFTWOOD RIVER	UNK	DD	NA	No	No	NA	NA	NA	NA	NA	NA	NA
NARCOSLI CREEK	UNK	DD	1995	No	No	NA	NA	0	5	3	0	3
NAVER CREEK	UNK	DD	1995	No	No	NA	NA	0	8	0	0	11
STEIN RIVER	UNK	DD	NA	No	No	NA	NA	NA	NA	NA	NA	NA
TASEKO LAKE	UNK	DD	NA	No	No	NA	NA	NA	NA	NA	NA	NA
MCKINLEY CREEK	UNK	AGG	NA	No	No	NA	NA	1	14	1	0	0
SHOVEL CREEK	UNK	AGG	NA	No	No	NA	NA	0	0	0	0	2
YALAKOM RIVER	UNK	AGG	NA	No	No	NA	NA	NA	NA	NA	NA	NA

D.4 Middle Fraser River Summer 1.3 (CK-11)

D.4.1 Data Overview

Table D.10 summarizes the available data, and Figure D.4 shows the patterns over time. Section 4 describes the data classifications and usability assessments.

Table D.10. Data Overview for Middle Fraser River Summer 1.3 (CK-11)

CU_ID	CK-11
CU_Name	MFR-summer
SpnCategory	Rel_Idx
NumObs	44 (1975-2018)
StartYear	1999
NumSites	7 (7)
Gen	5 (4.52)
GenAvgWild	9,949
Area	FR
Area2	Fraser-UpperUPF
CWT	x (DOM)
ER_BY	0
Area	Fraser
MU	FrSu52
AbsAbdMetric	NO
TrendMetric	NO
PercBM	NO
Source	Unpubl
Above1kWild	Clearly
BasedOn	Estimate

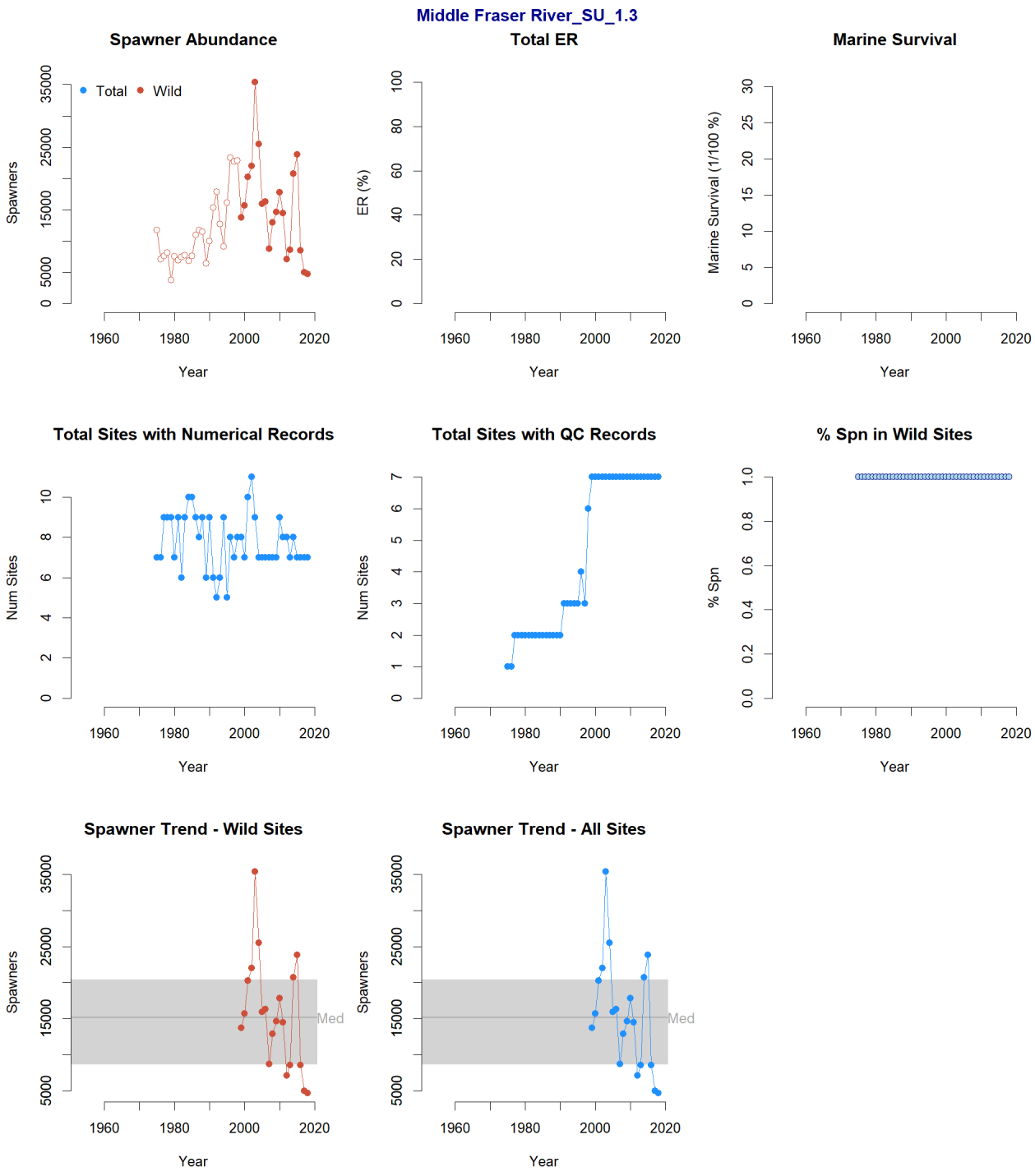

Figure D.4. : Available Data for Middle Fraser River Summer 1.3 (CK-11)

D.4.2 Data Notes

Spawner Estimates

The quality of the escapement data varies from good to poor in this CU. Some sites have good conditions for visual surveys (e.g. Nechako and Chilko Rivers) whereas others have variable conditions (e.g. Stuart River) or unsuitable conditions (Taseko River). The Stuart River has a large number of fish, up to 15,000 in some years; however, the percentage of the fish that are counted is unknown and varies annually depending on the water clarity. Winds on Stuart Lake disturb the shoreline sediments and can lead to visibility of less than 1m in some years, whereas in others, visibility can be up to 4m. In the mid-2000s, the noise in the time series was believed to exceed any signal and the surveys were dropped from the monitoring program.

At Taseko River, the visibility is < 1cm during the spawning period and the spawner estimates based on visual surveys are guesses that provide qualitative information only.

Very small numbers of Chinook Salmon are observed downstream of the Seton dam and it is unclear whether these are Fall Chinook heading to Portage (Ck-09) that were unable to find the fish ladder or to ascend it, or Summer Chinook from populations spawning in Seton River or Seton Creek (Ck-11).

Exploitation Rate Estimates

Several of the sites have been coded wire tagged. Recoveries occur from southern British Columbia through to Alaska.

D.4.3 CWT Recoveries Overview

The *Mark Recovery Program Information System* (DFO 2020b) covers coded wire tag releases and recoveries for indicator and non-indicator systems. Table D.11 summarizes all tag recoveries for release sites matched to this CU, based on a database extract from July 2020. Recoveries are identified by region (e.g. BCYK = British Columbia and Yukon), then by marine (M) or freshwater (F), then by geography where applicable (N = North, S = South), and finally by sector or gear type.

Table D.11. Estimated CWT Recoveries - Middle Fraser River Summer 1.3 (CK-11)

RecoveredIn	n	Years
AK_M_S_Sport	10 (0-6)	4 (1991-1996)
AK_Troll	209 (1-29)	18 (1982-2019)
BCYK_F_Sport	94 (5-42)	7 (1981-1993)
BCYK_F_S_Aboriginal	44 (44-44)	1 (2018-2018)
BCYK_F_S_Net and Seine	771 (18-165)	10 (1990-1999)
BCYK_M_N_Net and Seine	9 (1-3)	5 (1989-1995)
BCYK_M_N_Sport	61 (2-40)	6 (1990-1998)
BCYK_M_N_Troll	504 (3-98)	17 (1979-1999)
BCYK_M_S_Net and Seine	278 (1-65)	16 (1980-2019)
BCYK_M_S_Sport	156 (1-24)	17 (1980-2018)
BCYK_M_S_Troll	619 (11-142)	14 (1981-1997)
WA_M_N_Net and Seine	99 (3-17)	13 (1981-1998)
WA_M_S_Net and Seine	17 (2-6)	4 (1990-1998)
WA_M_S_Sport	111 (3-23)	12 (1980-2019)
WA_M_S_Troll	28 (2-17)	6 (1990-1999)

D.4.4 Site Overview

Table D.12 lists all the sites matched to this CU, and summarizes the available information. Enhancement level (*Enh*) and site category (*Cat*) are used for aggregating the site data (see sections 4.2.3 and 4.3 for definitions) . Only persistent (*P*) and extirpated (*EX*) sites are used in the aggregated time series. For the CU-level series, only sites with low or unknown enhancement level are included. For the Total Unit time series, all P and EX sites are combined. Some sites are used as indicators for escapement (*Esc*) or coded-wire tags (*CWT*). The table also shows the highest value (*Max*) and the year of the last available observation (*Last*) for the quality-filtered time series. The remaining columns list the number of observations in different quality categories, with definitions as per Section 4.2.1.

Table D.12. Site Overview for Middle Fraser River Summer 1.3 (CK-11)

Name	Enh	Cat	StYr	Esc	CWT	Max	Last	High	Mod	Other	Infill	Dropped
CARIBOO RIVER	LOW	P	1999	Yes	No	2198	2018	0	21	0	0	17
CHILKO RIVER	LOW	P	1999	Yes	No	22379	2018	4	33	7	0	0
KUZKWA RIVER	UNK	P	1999	No	No	639	2018	0	17	0	3	17
NECHAKO RIVER	LOW	P	1999	Yes	No	8291	2018	0	39	0	0	5
PINCHI CREEK	UNK	P	1999	No	No	60	2018	0	23	0	1	7
QUESNEL RIVER	LOW	P	1999	Yes	No	5514	2018	0	14	14	0	16
STELLAKO RIVER	UNK	P	NA	Yes	No	231	2018	3	15	0	4	15
ELKIN CREEK	UNK	DD	NA	No	No	NA	NA	0	6	0	0	26
KAZCHEK CREEK	UNK	DD	NA	No	No	NA	NA	0	9	0	0	16
MITCHELL RIVER	UNK	DD	NA	No	No	NA	NA	0	4	3	0	1
ORMOND CREEK	UNK	DD	NA	Yes	No	NA	NA	NA	NA	NA	NA	NA
SETON AND CAYOOSH CREEKS	UNK	DD	NA	No	No	NA	NA	0	1	0	0	2
SETON RIVER	UNK	DD	NA	Yes	No	NA	NA	0	8	0	0	20
STUART RIVER	LOW	DD	NA	Yes	No	NA	NA	0	0	12	0	2
TASEKO RIVER	UNK	DD	NA	No	No	NA	NA	0	9	2	0	0
MIDDLE RIVER	UNK	AGG	NA	No	No	NA	NA	NA	NA	NA	NA	NA
TACHIE RIVER	UNK	AGG	NA	No	No	NA	NA	NA	NA	NA	NA	NA
GATES RIVER	UNK	DEL	NA	No	No	NA	NA	NA	NA	NA	NA	NA

D.5 Upper Fraser River Spring 1.3 (CK-12)

D.5.1 Data Overview

Table D.13 summarizes the available data, and Figure D.5 shows the patterns over time. Section 4 describes the data classifications and usability assessments.

Table D.13. Data Overview for Upper Fraser River Spring 1.3 (CK-12)

CU_ID	CK-12
CU_Name	UFR-spring
SpnCategory	Rel_Idx
NumObs	41 (1975-2018)
StartYear	1995
NumSites	28 (28)
Gen	5 (4.52)
GenAvgWild	11,974
Area	FR
Area2	Fraser-UpperUPF
CWT	DOM
ER_BY	16 (1986-2002)
Area	Fraser
MU	FrSp52
AbsAbdMetric	NO
TrendMetric	YES
PercBM	NO
Source	Unpubl
Above1kWild	Clearly
BasedOn	Estimate

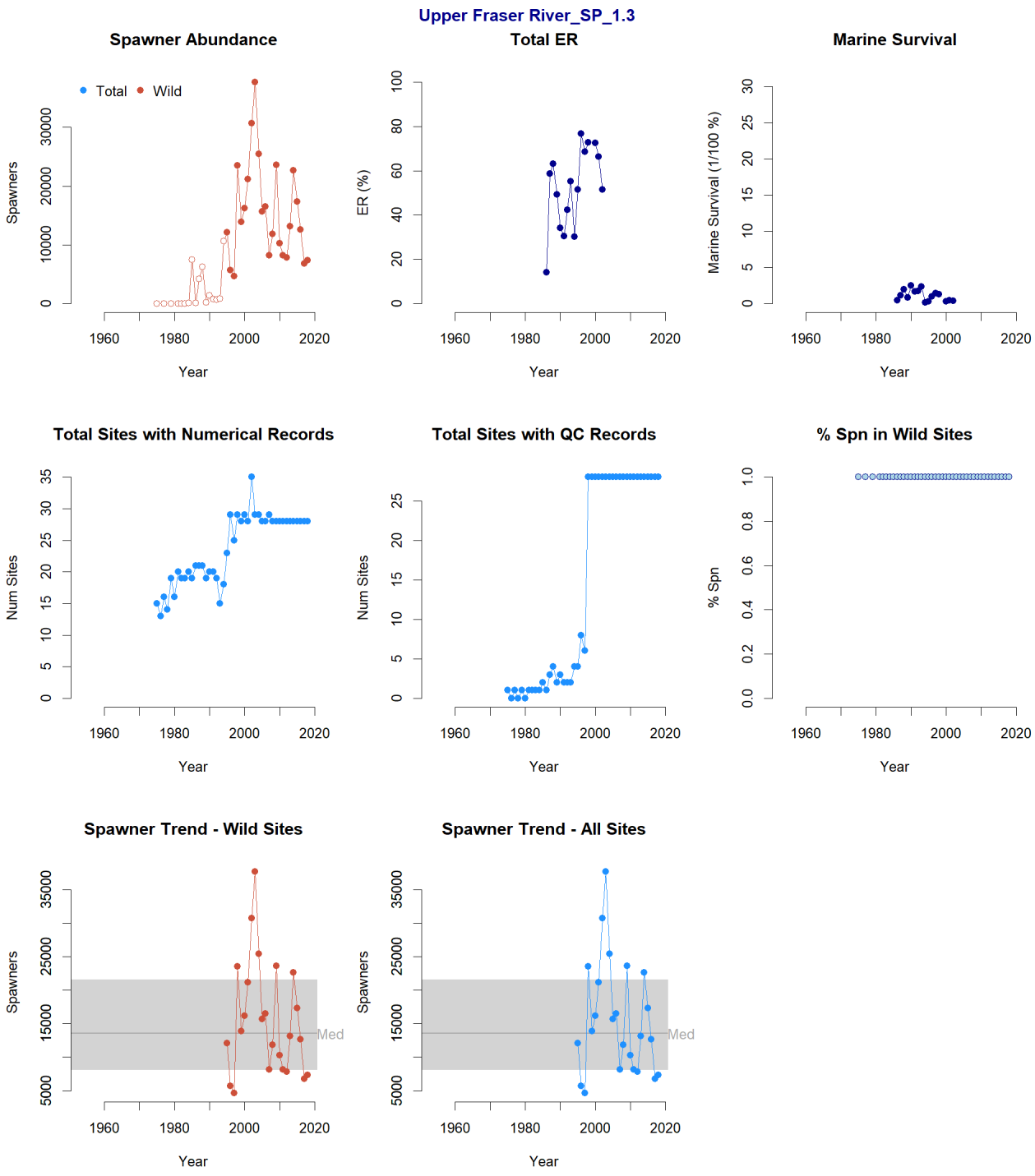

Figure D.5. : Available Data for Upper Fraser River Spring 1.3 (CK-12)

D.5.2 Data Notes

Spawner Estimates

The quality and accuracy of the escapement data vary among sites because the visual survey conditions vary among sites in this CU. Some sites with large numbers of Chinook have poor counting conditions, such as the mainstem of the Fraser River downstream of the Robson River, whereas other systems have good visibility. Chinook appear to spawn opportunistically among many small creeks and rivers when environmental conditions allow them access. In many of these areas, Chinook appear to use some very small systems in years when the creek levels are high but not in years when the levels are low.

This includes a CWT indicator site, although the CWT monitoring ended with the 2003 brood year. This Total Unit (TU) is dominated by the wild CU and should be reviewed once the enhancement level is re-evaluated (the EU may disappear altogether).

Exploitation Rate Estimates

Several of the sites have been coded wire tagged and recoveries occurred from southern BC to Alaska. Total Canadian exploitation rates between 1999-2008 were estimated at roughly 20%.

D.5.3 CWT Recoveries Overview

The *Mark Recovery Program Information System* (DFO 2020b) covers coded wire tag releases and recoveries for indicator and non-indicator systems. Table D.14 summarizes all tag recoveries for release sites matched to this CU, based on a database extract from July 2020. Recoveries are identified by region (e.g. BCYK = British Columbia and Yukon), then by marine (M) or freshwater (F), then by geography where applicable (N = North, S = South), and finally by sector or gear type.

Table D.14. Estimated CWT Recoveries - Upper Fraser River Spring 1.3 (CK-12)

RecoveredIn	n	Years
AK_Troll	9 (0-3)	6 (1986-2008)
BCYK_F_Sport	122 (1-21)	10 (1991-2005)
BCYK_F_S_Net and Seine	1,376 (26-179)	14 (1990-2008)
BCYK_M_N_Net and Seine	2 (2-2)	1 (1983-1983)
BCYK_M_N_Sport	22 (2-8)	5 (1991-2001)
BCYK_M_N_Troll	61 (3-16)	7 (1982-2005)
BCYK_M_S_Net and Seine	49 (4-24)	4 (1985-1989)
BCYK_M_S_Sport	356 (3-41)	21 (1985-2009)
BCYK_M_S_Troll	87 (0-16)	13 (1985-2006)
OR_M_S_Sport	1 (1-1)	1 (1992-1992)
WA_M_N_Net and Seine	8 (2-4)	3 (1988-1997)
WA_M_N_Troll	2 (2-2)	1 (1995-1995)
WA_M_S_Sport	57 (4-26)	6 (1988-2007)
WA_M_S_Troll	28 (1-5)	10 (1991-2007)

D.5.4 Site Overview

Table D.15 lists all the sites matched to this CU, and summarizes the available information. Enhancement level (*Enh*) and site category (*Cat*) are used for aggregating the site data (see sections 4.2.3 and 4.3 for definitions) . Only persistent (*P*) and extirpated (*EX*) sites are used in the aggregated time series. For the CU-level series, only sites with low or unknown enhancement level are included. For the Total Unit time series, all P and EX sites are combined. Some sites are used as indicators for escapement (*Esc*) or coded-wire tags (*CWT*). The table also shows the highest value (*Max*) and the year of the last available observation (*Last*) for the quality-filtered time series. The remaining columns list the number of observations in different quality categories, with definitions as per Section 4.2.1.

Table D.15. Site Overview for Upper Fraser River Spring 1.3 (CK-12)

Name	Enh	Cat	StYr	Esc	CWT	Max	Last	High	Mod	Other	Infill	Dropped
ANTLER CREEK	UNK	P	1995	No	No	410	2018	0	23	0	0	1
BAD RIVER (JAMES CREEK)	LOW	P	1995	No	No	966	2018	0	22	0	0	15
BOWRON RIVER	LOW	P	1995	Yes	No	9104	2018	1	21	1	0	21
CAPTAIN CREEK	UNK	P	1995	No	No	324	2018	0	23	0	0	1
DOME CREEK	LOW	P	1995	Yes	Yes	728	2018	3	0	19	10	6
FONTONIKO CREEK	UNK	P	1995	Yes	No	1338	2018	0	19	1	3	16
FORGETMENOT CREEK	UNK	P	NA	No	No	218	2018	0	13	0	8	0
FRASER RIVER-ABOVE TETE JAUNE	UNK	P	1995	Yes	No	5862	2018	0	22	0	0	22
GOAT RIVER	UNK	P	1995	Yes	No	820	2018	0	21	0	0	23
HAGGEN CREEK	UNK	P	1995	No	No	854	2018	0	21	0	0	3
HOLLIDAY CREEK	UNK	P	1995	No	No	126	2018	0	20	0	1	3
HOLMES RIVER	UNK	P	1995	Yes	No	4110	2018	0	21	0	0	23
HORSEY CREEK	UNK	P	1995	Yes	No	308	2018	0	20	0	1	22
ICE CREEK	UNK	P	1995	No	No	157	2018	0	17	0	4	0
INDIANPOINT CREEK	LOW	P	1995	No	No	900	2018	0	23	1	0	2
MCKALE RIVER	UNK	P	1995	Yes	No	122	2018	0	20	0	1	17
MORKILL RIVER	UNK	P	1995	No	No	1788	2018	0	16	0	5	19
NEVIN CREEK	UNK	P	1995	Yes	No	385	2018	0	21	0	0	23
SALMON RIVER	UNK	P	1995	Yes	No	2448	2018	2	18	1	3	20
SEEBACH CREEK	LOW	P	1995	Yes	No	2261	2018	0	20	0	1	18
SLIM CREEK	LOW	P	1995	Yes	No	5066	2018	0	24	2	0	18
SMALL CREEK	UNK	P	1995	No	No	212	2018	0	19	0	2	3
SWIFT CREEK	UNK	P	1995	No	No	1098	2018	0	20	0	1	23
TORPY RIVER	UNK	P	1995	Yes	No	4457	2018	0	21	0	0	23
TWIN CREEKS (COMBINED)	UNK	P	1995	No	No	196	2018	0	0	38	1	0
WALKER CREEK	UNK	P	1995	Yes	No	543	2018	0	21	0	0	23
WANSA CREEK	UNK	P	1995	No	No	300	2018	0	20	0	1	2
WILLOW RIVER	LOW	P	1995	Yes	No	1679	2018	0	21	0	0	23
KENNETH CREEK	UNK	DD	NA	No	No	NA	NA	0	0	6	0	1

Name	Enh	Cat	StYr	Esc	CWT	Max	Last	High	Mod	Other	Infill	Dropped
MCGREGOR RIVER	UNK	DD	NA	No	No	NA	NA	0	0	0	0	3
PTARMIGAN CREEK	UNK	DD	NA	No	No	NA	NA	0	0	9	0	1
ROBSON RIVER	UNK	DD	NA	No	No	NA	NA	0	0	2	0	0
SNOWSHOE CREEK	UNK	DD	NA	No	No	NA	NA	0	0	2	0	2
HERRICK CREEK	UNK	AGG	NA	Yes	No	NA	NA	0	0	2	0	0
HUMBUG CREEK	UNK	AGG	NA	No	No	NA	NA	0	0	3	0	0
OTTER CREEK	UNK	AGG	NA	No	No	NA	NA	0	0	2	0	0
SPAKWANIKO CREEK	UNK	AGG	NA	No	No	NA	NA	0	0	5	0	1
SUS CREEK	UNK	AGG	NA	No	No	NA	NA	0	0	0	0	1
DRISCOLL CREEK	UNK	DEL	NA	No	No	NA	NA	0	0	0	0	1
EAST TWIN CREEK	UNK	DEL	NA	No	No	NA	NA	0	19	0	0	19
WEST TWIN CREEK	UNK	DEL	NA	No	No	NA	NA	0	17	0	0	4

APPENDIX E CU Profiles - Fraser - Thompson

E.1 South Thompson Summer 0.3 (CK-13)

E.1.1 Data Overview

Table E.1 summarizes the available data, and Figure E.1 shows the patterns over time. Section 4 describes the data classifications and usability assessments.

Table E.1. Data Overview for South Thompson Summer 0.3 (CK-13)

CU_ID	CK-13
CU_Name	STh-0.3
SpnCategory	Rel_Idx
NumObs	30 (1981-2018)
StartYear	1997
NumSites	4 (4)
Gen	4 (3.83)
GenAvgWild	82,170
Area	FR
Area2	Fraser-THOM
CWT	x (SHU)
ER_BY	0
Area	Fraser
MU	FrSu41
AbsAbdMetric	NO
TrendMetric	YES
PercBM	NO
Source	Unpubl
Above1kWild	Clearly
BasedOn	Estimate

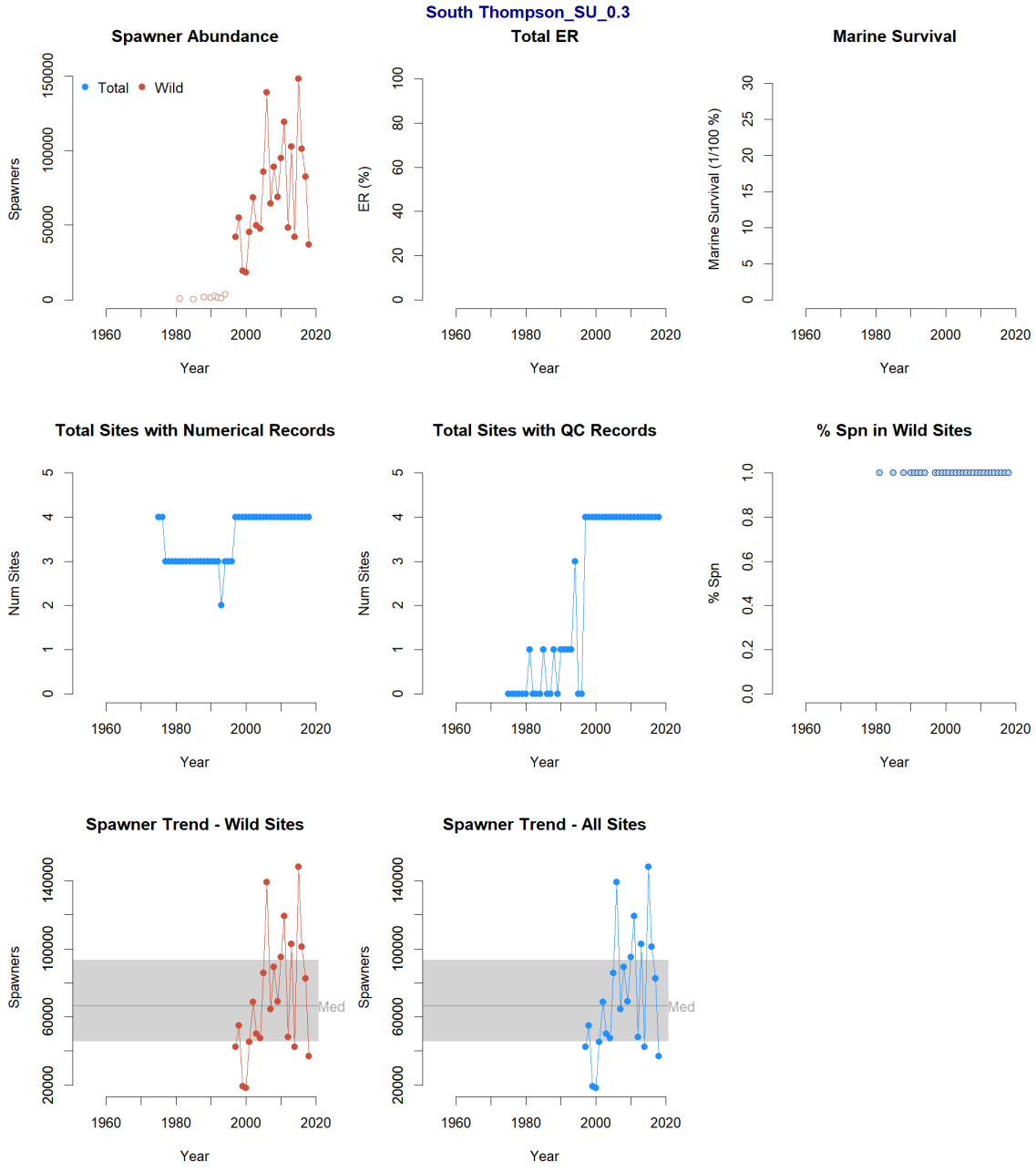

Figure E.1. : Available Data for South Thompson Summer 0.3 (CK-13)

E.1.2 Data Notes

Spawner Estimates

This CU includes the largest spawning systems in BC which have some of the most difficult conditions for visual surveys even though the water is very clear. However, the current visual survey methods are thought to under-estimate spawner numbers because of poor counting conditions experienced during helicopter surveys in the South and Lower Thompson Rivers (R. Bailey, DFO Kamloops, BC, pers. comm.). This is due to a combination of factors including but not exclusive to the large abundances of returning fish, varying depths of the systems as well as natural wind-riffling and helicopter rotor wash of surface waters limiting visibility during surveys in the South and Lower Thompson Rivers. The South Thompson River is so large that one cannot see both sides of the river when the helicopter is at an elevation suitable for counting fish and this makes it difficult to count fish in visual polygons while flying along the river. The Lower Thompson River is even larger, and it is too deep to count individual fish, however redds can be counted in most places. There are numerous locations where even the redds are too deep to be counted though. Efforts have been made to account for undercounting bias based on results from the Lower and Middle Shuswap escapement survey calibration programs, where visual surveys underestimated escapement by 20% - 65% (Chamberlain and Parken 2013), however those data were not used or reported in this analysis. These sites are downstream of large lakes that moderate river flows and the thermal regime. These are likely some of the highest quality spawning habitats for Chinook Salmon in Canada.

Exploitation Rate Estimates

The stock has a far north ocean distribution and is harvested mainly in Alaska and northern BC, and then through fisheries located along the return migration corridors through the northern and southern entrances to the Salish Sea.

E.1.3 CWT Recoveries Overview

The *Mark Recovery Program Information System* (DFO 2020b) covers coded wire tag releases and recoveries for indicator and non-indicator systems. Table E.2 summarizes all tag recoveries for release sites matched to this CU, based on a database extract from July 2020. Recoveries are identified by region (e.g. BCYK = British Columbia and Yukon), then by marine (M) or freshwater (F), then by geography where applicable (N = North, S = South), and finally by sector or gear type.

Table E.2. Estimated CWT Recoveries - South Thompson Summer 0.3 (CK-13)

RecoveredIn	n	Years
None	0	None

E.1.4 Site Overview

Table E.3 lists all the sites matched to this CU, and summarizes the available information. Enhancement level (*Enh*) and site category (*Cat*) are used for aggregating the site data (see sections 4.2.3 and 4.3 for definitions) . Only persistent (*P*) and extirpated (*EX*) sites are used in the aggregated time series. For the CU-level series, only sites with low or unknown enhancement level are included. For the Total Unit time series, all P and EX sites are combined. Some sites are used as indicators for escapement (*Esc*) or coded-wire tags (*CWT*). The table also shows the highest value (*Max*) and the year of the last available observation (*Last*) for the quality-filtered time series. The remaining columns list the number of observations in different quality categories, with definitions as per Section 4.2.1.

Table E.3. Site Overview for South Thompson Summer 0.3 (CK-13)

Name	Enh	Cat	StYr	Esc	CWT	Max	Last	High	Mod	Other	Infill	Dropped
ADAMS RIVER	UNK	P	1997	Yes	No	12753	2018	0	29	0	0	15
LITTLE RIVER	UNK	P	1997	Yes	No	25296	2018	0	23	0	1	19
SOUTH THOMPSON RIVER	UNK	P	1997	Yes	No	100384	2018	0	23	0	0	21
THOMPSON RIVER	UNK	P	1997	No	No	23646	2018	0	13	0	9	2

E.2 South Thompson Summer 1.3 (CK-14)

E.2.1 Data Overview

Table E.4 summarizes the available data, and Figure E.2 shows the patterns over time. Section 4 describes the data classifications and usability assessments.

Table E.4. Data Overview for South Thompson Summer 1.3 (CK-14)

CU_ID	CK-14
CU_Name	STh-1.3
SpnCategory	Rel_Idx
NumObs	32 (1986-2018)
StartYear	1999
NumSites	3 (2)
Gen	5 (4.52)
GenAvgWild	684
Area	FR
Area2	Fraser-THOM
CWT	x (DOM)
ER_BY	0
Area	Fraser
MU	FrSu52
AbsAbdMetric	NO
TrendMetric	YES
PercBM	NO
Source	Unpubl
Above1kWild	Likely
BasedOn	Data Notes

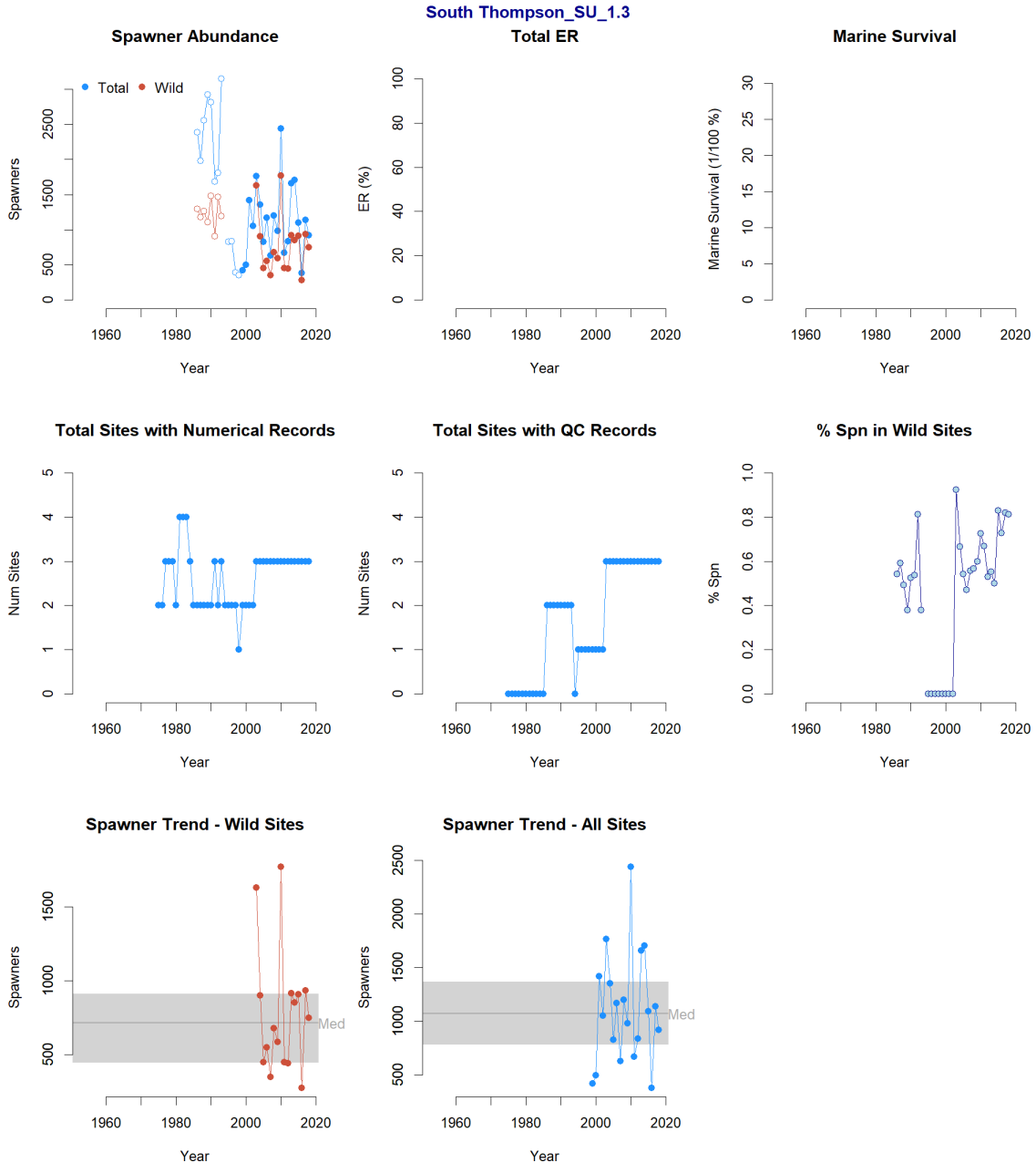

Figure E.2. : Available Data for South Thompson Summer 1.3 (CK-14)

E.2.2 Data Notes

Spawner Estimates

These sites are located around Shuswap Lake. Rivers on the north and east parts of Shuswap Lake (windward side) experience more precipitation and have more stable flows than rivers on the leeward side. In some years, surface flows of the Salmon River are catastrophically low and fish cannot naturally enter the system without human intervention. Under these conditions, Salmon River fish are likely to stray to nearby systems and some coded wire tagged fish have been found to stray to the Lower Shuswap River. Accordingly, the Salmon River is a site with considerable stewardship and enhancement activities. Spawner abundance is roughly balanced between wild and enhanced components.

The biology of this CU is complex and the accuracy of the age data is questionable, even by experts at the DFO schlerochronology lab. Some fish have a clear stream-type pattern with slow growth during the first year, which may be associated with fish that rear for the entire year in the natal streams. Other individuals show patterns of rapid growth in the first year and a well-defined freshwater annulus, which may be associated with fish that emigrate to Shuswap Lake and rear for up to one year. Other individuals appear to have rapid freshwater growth and a pattern that may indicate estuarine residency or perhaps rearing in a non-natal freshwater site. The range of scale patterns and opportunities for diverse freshwater life histories makes it difficult to generalize the freshwater life history of these fish. Another complicating factor is the amount of interannual variation in the freshwater rearing environments among wet and dry years, and the variation in the ecosystem dynamics in Shuswap Lake, including the cyclic abundance of spawning and rearing sockeye. The degree to which the Eagle River represents the escapement abundance and trends in the unmonitored sites is unknown. However, one expects that the Salmon River escapement information does not represent the patterns that occur for the unmonitored populations because it has a high level of enhancement, human intervention, and significant habitat issues that do not occur, or to the same extent, at the other sites. The visual counting conditions in the Eagle River are strongly influenced by the low water clarity of the Perry River, since it carries glacial flour and has low visibility. This likely reduces the accuracy of counts in the areas downstream of the Perry River confluence compared to the accuracy of the counts in the clear areas upstream of the confluence. The same peak count expansion factor was applied to the counts upstream and downstream of the Perry River confluence, thus the escapements are likely underestimated.

Exploitation Rate Estimates

Several of the sites have been coded wire tagged. Recoveries occurred from Alaska through to southern British Columbia.

E.2.3 CWT Recoveries Overview

The *Mark Recovery Program Information System* (DFO 2020b) covers coded wire tag releases and recoveries for indicator and non-indicator systems. Table E.5 summarizes all tag recoveries for release sites matched to this CU, based on a database extract from July 2020. Recoveries are identified by region (e.g. BCYK = British Columbia and Yukon), then by marine (M) or freshwater (F), then by geography where applicable (N = North, S = South), and finally by sector or gear type.

Table E.5. Estimated CWT Recoveries - South Thompson Summer 1.3 (CK-14)

RecoveredIn	n	Years
AK_M_N_Sport	5 (0-5)	2 (1994-1995)
AK_M_S_Sport	4 (0-2)	4 (1987-2012)
AK_Troll	278 (2-61)	13 (1987-2004)
BCYK_F_Sport	127 (1-33)	15 (1986-2006)
BCYK_F_S_Aboriginal	1 (1-1)	1 (2012-2012)
BCYK_F_S_Net and Seine	509 (0-135)	10 (1990-2010)
BCYK_M_N_Net and Seine	19 (1-4)	7 (1987-1994)
BCYK_M_N_Sport	279 (2-53)	18 (1987-2012)
BCYK_M_N_Troll	559 (2-91)	15 (1987-2010)
BCYK_M_S_Net and Seine	151 (2-72)	7 (1987-2011)
BCYK_M_S_Sport	433 (2-78)	17 (1987-2012)
BCYK_M_S_Troll	261 (3-66)	13 (1987-2012)
WA_M_N_Net and Seine	11 (2-5)	3 (1988-2012)
WA_M_N_Sport	2 (2-2)	1 (1989-1989)
WA_M_N_Troll	1 (1-1)	1 (1989-1989)
WA_M_S_Net and Seine	2 (2-2)	1 (1990-1990)
WA_M_S_Sport	68 (3-37)	7 (1987-1993)
WA_M_S_Troll	20 (1-6)	6 (1990-2001)

E.2.4 Site Overview

Table E.6 lists all the sites matched to this CU, and summarizes the available information. Enhancement level (*Enh*) and site category (*Cat*) are used for aggregating the site data (see sections 4.2.3 and 4.3 for definitions) . Only persistent (*P*) and extirpated (*EX*) sites are used in the aggregated time series. For the CU-level series, only sites with low or unknown enhancement level are included. For the Total Unit time series, all P and EX sites are combined. Some sites are used as indicators for escapement (*Esc*) or coded-wire tags (*CWT*). The table also shows the highest value (*Max*) and the year of the last available observation (*Last*) for the quality-filtered time series. The remaining columns list the number of observations in different quality categories, with definitions as per Section 4.2.1.

Table E.6. Site Overview for South Thompson Summer 1.3 (CK-14)

Name	Enh	Cat	StYr	Esc	CWT	Max	Last	High	Mod	Other	Infill	Dropped
EAGLE RIVER	UNK	P	1999	Yes	No	1711	2018	0	16	8	0	19
SALMON RIVER	HIGH	P	1999	Yes	No	1956	2018	0	0	32	0	12
SEYMOUR RIVER	UNK	P	NA	No	No	62	2018	0	11	0	5	9
SCOTCH CREEK	UNK	DD	NA	No	No	NA	NA	1	8	0	0	3

E.3 Shuswap River Summer 0.3 (CK-15)

E.3.1 CU Overview

Over 40 years of spawner estimates are available for this CU, based on three sites. Data since 1995 are considered consistent across sites. The Lower Shuswap River is a CWT indicator that can be used to derive exploitation rate for this CU. Table E.7 summarizes the available data, and Figure E.3 shows the patterns over time.

Table E.7. Data Overview for Shuswap River Summer 0.3 (CK-15)

CU_ID	CK-15
CU_Name	STh-SHUR
SpnCategory	Abs_Abd
NumObs	44 (1975-2018)
StartYear	1995
NumSites	2 (1)
Gen	4 (3.83)
GenAvgWild	16,018
Area	FR
Area2	Fraser-THOM
CWT	SHU
ER_BY	30 (1984-2013)
Area	Fraser
MU	FrSu52
AbsAbdMetric	YES
TrendMetric	YES
PercBM	NO
Source	Unpubl
Above1kWild	Clearly
BasedOn	Estimate

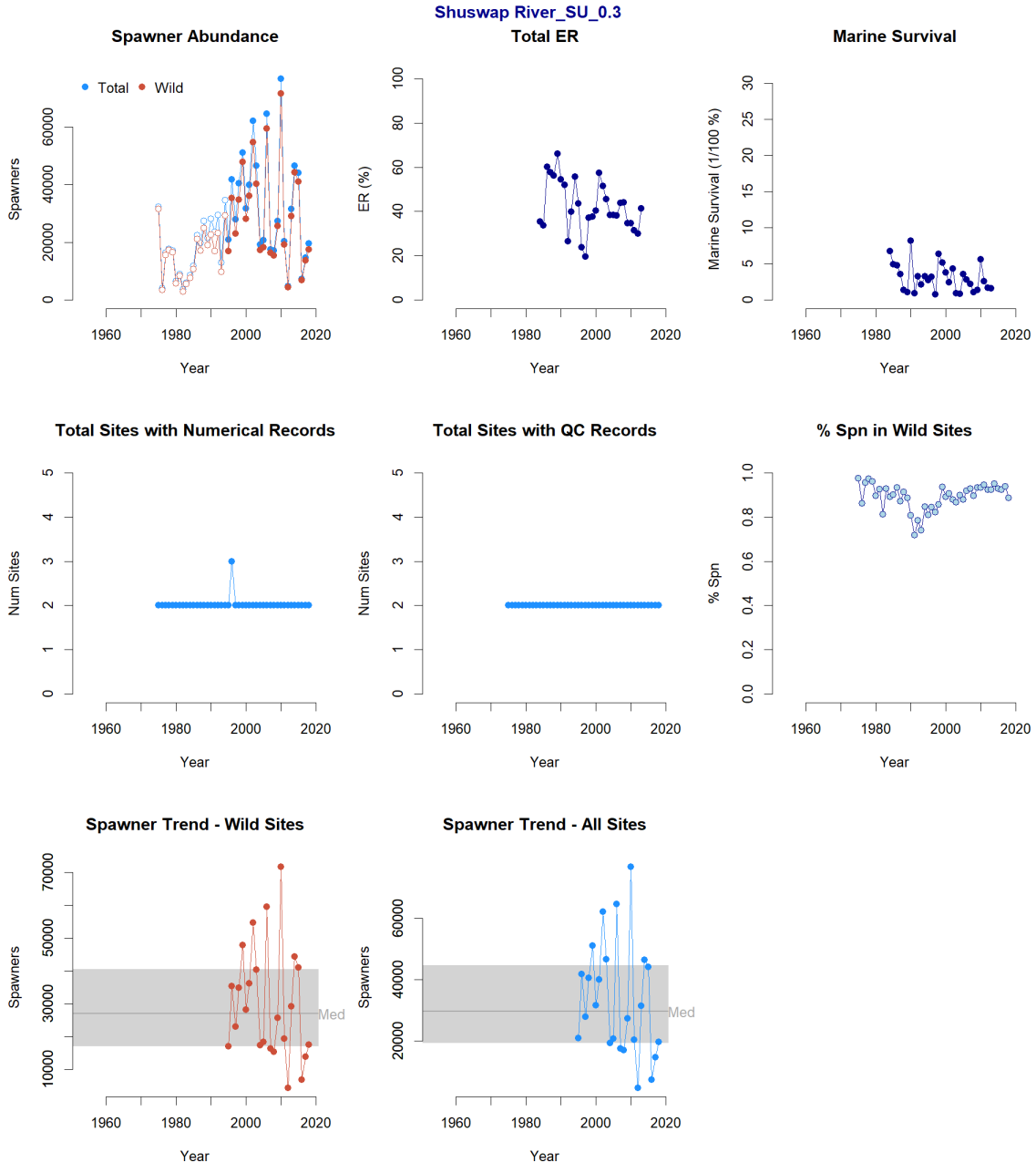

Figure E.3. : Available Data for Shuswap River Summer 0.3 (CK-15)

E.3.2 Data Notes

Spawner Estimates

Escapements to the Lower and Middle Shuswap rivers have been estimated using visual surveys from helicopters and mark-recapture methods. The peak count expansion method was used for aerial survey counts of spawners, holders and carcasses using an expansion factor of 1.54. The escapement data have been very high quality during the 2000s and escapement data based on visual surveys have been calibrated to estimates of total escapement back to 1975. Concurrent mark-recapture and visual surveys occurred on the Lower Shuswap during the early 1980s and since 2000, and at the Middle Shuswap since 2003. These studies provided information to calibrate the visual surveys, since the paired studies showed that visual surveys often under-estimated the escapement. A technical report is in preparation that describes the field programs and escapement methods, the methods used to calibrate the surveys, and the standardized time series (Susan Lemke, pers. comm.). Recently, escapements have been estimated using mark-recapture methods which produce very high precision estimates at Lower Shuswap (CV<5%) and modest precision (CV~20%) at Middle Shuswap, while the visual survey method was continued. For each river, linear regression models were developed for years with escapement estimates from both methods, and these calibration relationships were used to standardize the time series to the mark recapture method. The concurrent studies provided the information necessary to develop relationships between the escapements from both methods, and these relationships were used to calibrate the time series back in time. Escapement estimates prior to 1975 were not calibrated and they are biased lower.

The Middle Shuswap River fish spawn in areas below Wilsley Dam which is located at Shuswap Falls. It is inconclusive whether Chinook Salmon ascended the falls prior to construction of the dam. Downstream of the dam, the channel has been actively eroding the stream banks and the has course varied over time. Several riparian habitat restoration projects have occurred along the river. Natural production of Chinook Salmon from the Middle Shuswap River appears to be unusually poor compared to the Lower Shuswap River. The mechanisms causing poor production are unclear, but some speculate that predation from whitefish during egg deposition and fry emergence is a significant mortality source. The river has been highly enhanced for several generations without signs of recovery to levels that the system should be able to support based on the size of the system and knowledge of fishing mortality.

Exploitation Rate Estimates

The Lower Shuswap River is an exploitation rate indicator stock that has recently been used in PSC analyses (2012). Recently, the Middle Shuswap site has also been coded wire tagged, but those data have not yet been analysed for exploitation patterns and rates. Based on information for the Lower Shuswap, the stock has a far north migration distribution with most tag recoveries occurring in northern BC and Alaska, and in fisheries located along the migration corridor as fish migrate through the northern and southern entrances to the Salish Sea. Although most recoveries are from northern fisheries, some tags are also recovered each year from fisheries located along coastal Oregon and Washington. Total Canadian exploitation rates (1999-2011) were estimated at about 25%.

E.3.3 CWT Recoveries Overview

The *Mark Recovery Program Information System* (DFO 2020b) covers coded wire tag releases and recoveries for indicator and non-indicator systems. Table E.8 summarizes all tag recoveries for release sites matched to this CU, based on a database extract from July 2020. Recoveries are identified by region (e.g. BCYK = British Columbia and Yukon), then by marine (M) or freshwater (F), then by geography where applicable (N = North, S = South), and finally by sector or gear type.

Table E.8. Estimated CWT Recoveries - Shuswap River Summer 0.3 (CK-15)

RecoveredIn	n	Years
AK_M_N_Sport	200 (0-29)	22 (1990-2019)
AK_M_S_Sport	476 (0-57)	29 (1989-2019)
AK_Net and Seine	126 (0-28)	22 (1982-2019)
AK_Sport	12 (0-5)	7 (1998-2019)
AK_Troll	5,786 (8-524)	37 (1981-2019)
BCYK_F_Sport	2,300 (13-213)	33 (1987-2019)
BCYK_F_S_Aboriginal	1,873 (7-532)	10 (2009-2019)
BCYK_F_S_Net and Seine	2,091 (26-268)	20 (1990-2010)
BCYK_M_N_Net and Seine	143 (1-30)	16 (1981-1997)
BCYK_M_N_Sport	3,812 (5-437)	33 (1987-2019)
BCYK_M_N_Troll	5,625 (1-574)	36 (1980-2019)
BCYK_M_S_Net and Seine	1,032 (1-234)	28 (1980-2019)
BCYK_M_S_Sport	5,054 (8-898)	36 (1980-2019)
BCYK_M_S_Test Fisheries	3 (3-3)	1 (2019-2019)
BCYK_M_S_Troll	1,203 (0-179)	28 (1981-2019)
OR_M_S_Troll	14 (2-5)	5 (2003-2017)
WA_M_N_Net and Seine	498 (1-49)	27 (1981-2018)
WA_M_N_Sport	2 (2-2)	1 (1989-1989)
WA_M_S_Net and Seine	52 (2-8)	11 (1982-2017)
WA_M_S_Sport	380 (2-80)	24 (1988-2019)
WA_M_S_Troll	353 (1-129)	20 (1993-2019)

E.3.4 Site Overview

Table E.9 lists all the sites matched to this CU, and summarizes the available information. Enhancement level (*Enh*) and site category (*Cat*) are used for aggregating the site data (see sections 4.2.3 and 4.3 for definitions) . Only persistent (*P*) and extirpated (*EX*) sites are used in the aggregated time series. For the CU-level series, only sites with low or unknown enhancement level are included. For the Total Unit time series, all P and EX sites are combined. Some sites are used as indicators for escapement (*Esc*) or coded-wire tags (*CWT*). The table also shows the highest value (*Max*) and the year of the last available observation (*Last*) for the quality-filtered time series. The remaining columns list the number of observations in different quality categories, with definitions as per Section 4.2.1.

Table E.9. Site Overview for Shuswap River Summer 0.3 (CK-15)

Name	Enh	Cat	StYr	Esc	CWT	Max	Last	High	Mod	Other	Infill	Dropped
SHUSWAP RIVER-LOWER	LOW	P	1983	Yes	No	71593	2018	3	8	33	0	0
SHUSWAP RIVER-MIDDLE	HIGH	P	1983	Yes	Yes	7441	2018	0	11	33	0	0
WAP CREEK	UNK	DD	NA	Yes	No	NA	NA	0	15	0	0	1

E.4 South Thompson - Bessette Creek Summer 1.2 (CK-16)

E.4.1 Data Overview

Table E.10 summarizes the available data, and Figure E.4 shows the patterns over time. Section 4 describes the data classifications and usability assessments.

Note that the first 3 records in the wild time series (top left panel of E.4) are much lower, but are based on fewer surveyed sites (middle panel) and the resulting infilled early values may not reflect the actual pattern in abundance.

Table E.10. Data Overview for South Thompson - Bessette Creek Summer 1.2 (CK-16)

CU_ID	CK-16
CU_Name	STh-BESS
SpnCategory	Rel_Idx
NumObs	24 (1995-2018)
StartYear	1995
NumSites	3 (3)
Gen	4 (4.06)
GenAvgWild	15
Area	FR
Area2	Fraser-THOM
CWT	x (NIC)
ER_BY	0
Area	Fraser
MU	FrSp42
AbsAbdMetric	NO
TrendMetric	NO
PercBM	NO
Source	New
Above1kWild	Unlikely
BasedOn	Data Notes

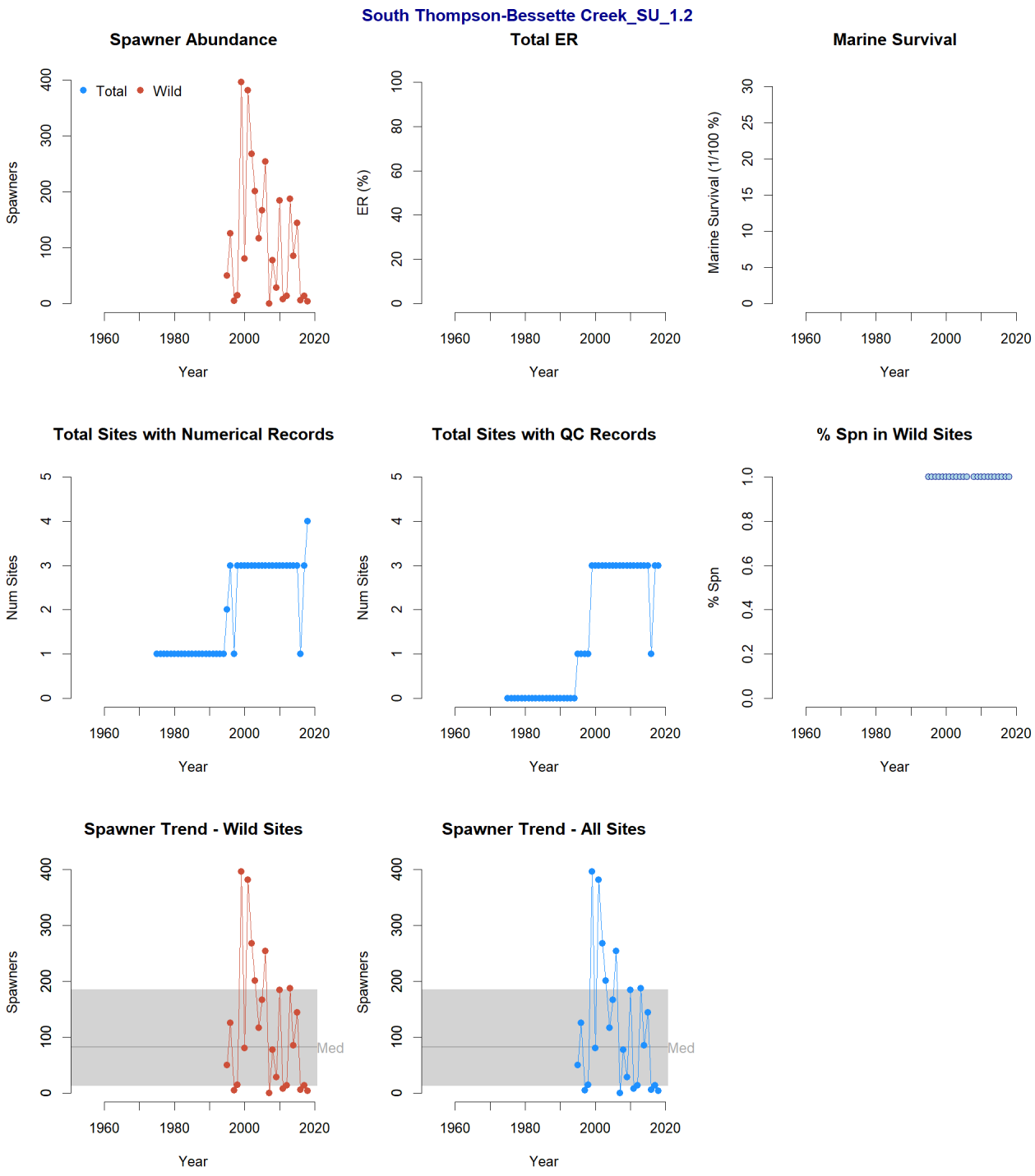

Figure E.4. : Available Data for South Thompson - Bessette Creek Summer 1.2 (CK-16)

E.4.2 Data Notes

Spawner Estimates

The escapement information is collected during foot surveys, and the survey frequency has varied during the time series. In some years, escapements have been extremely low and it is unclear what contributed to these situations. Stream discharge can be so low that some Chinook either cannot enter at all, or only enter the system for a short distance. In high discharge years, Chinook Salmon are able to migrate upstream to tributaries such as Harris and Duteau. The spawner abundance in Bessette Creek has been estimated using a variety of methods and no attempts have been made to cross-calibrate or standardize the estimates to facilitate interannual comparisons. The escapement was estimated by observers walking the stream bank on one or more survey dates. In years with few surveys the peak count of spawners, holders, and carcasses was likely expanded to account for fish that were not visible on the survey date (due to observer efficiency and the proportion of the population that was present in the survey area). In years with more frequent surveys, the area-under-the-curve method was used however specific descriptions of the method used to generate the curve were not readily available. It is likely that the trapezoidal method was used mainly. The sources of the survey life and observer efficiency estimates were not readily available. There are some years when no surveys were conducted and escapement was not estimated. Bessette Creek lies in the north Okanagan and it represents the farthest upstream locations that Chinook spawn in the South Thompson drainage. The watershed is adjacent to the Okanagan watershed, which drains into the Columbia River. Much of the Bessette drainage has been developed for agriculture, forestry and a significant volume of water is used for other anthropogenic purposes. The water use and water quality of this system have been well studied.

This may no longer be a distinct CU due to small population size, straying from Middle Shuswap and hatchery practices.

Exploitation Rate Estimates

There are no measurements of exploitation for this CU, and nearby CUs vary in their ocean distribution and exploitation patterns, so it's not informative to speculate about the intensity of fisheries.

E.4.3 CWT Recoveries Overview

The *Mark Recovery Program Information System* (DFO 2020b) covers coded wire tag releases and recoveries for indicator and non-indicator systems. Table E.11 summarizes all tag recoveries for release sites matched to this CU, based on a database extract from July 2020. Recoveries are identified by region (e.g. BCYK = British Columbia and Yukon), then by marine (M) or freshwater (F), then by geography where applicable (N = North, S = South), and finally by sector or gear type.

Table E.11. Estimated CWT Recoveries - South Thompson - Bessette Creek Summer 1.2 (CK-16)

RecoveredIn	n	Years
None	0	None

E.4.4 Site Overview

Table E.12 lists all the sites matched to this CU, and summarizes the available information. Enhancement level (*Enh*) and site category (*Cat*) are used for aggregating the site data (see sections 4.2.3 and 4.3 for definitions) . Only persistent (*P*) and extirpated (*EX*) sites are used in the aggregated time series. For the CU-level series, only sites with low or unknown enhancement level are included. For the Total Unit time series, all P and EX sites are combined. Some sites are used as indicators for escapement (*Esc*) or coded-wire tags (*CWT*). The table also shows the highest value (*Max*) and the year of the last available observation (*Last*) for the quality-filtered time series. The remaining columns list the number of observations in different quality categories, with definitions as per Section 4.2.1.

Table E.12. Site Overview for South Thompson - Bessette Creek Summer 1.2 (CK-16)

Name	Enh	Cat	StYr	Esc	CWT	Max	Last	High	Mod	Other	Infill	Dropped
BESSETTE CREEK	UNK	P	1995	Yes	No	258	2018	0	17	0	3	23
CREIGHTON CREEK	UNK	P	NA	No	No	8	2018	0	18	0	1	2
DUTEAU CREEK	UNK	P	1995	No	No	136	2018	0	21	1	1	0
HARRIS CREEK	UNK	DD	NA	No	No	NA	NA	0	21	0	0	1

E.5 Lower Thompson Spring 1.2 (CK-17)

E.5.1 Data Overview

Table E.13 summarizes the available data, and Figure E.5 shows the patterns over time. Section 4 describes the data classifications and usability assessments.

Table E.13. Data Overview for Lower Thompson Spring 1.2 (CK-17)

CU_ID	CK-17
CU_Name	LTh
SpnCategory	Rel_Idx
NumObs	44 (1975-2018)
StartYear	1995
NumSites	6 (2)
Gen	4 (4.06)
GenAvgWild	3,245
Area	FR
Area2	Fraser-THOM
CWT	NIC
ER_BY	28 (1985-2012)
Area	Fraser
MU	FrSp42
AbsAbdMetric	NO
TrendMetric	YES
PercBM	NO
Source	New
Above1kWild	Clearly
BasedOn	Estimate

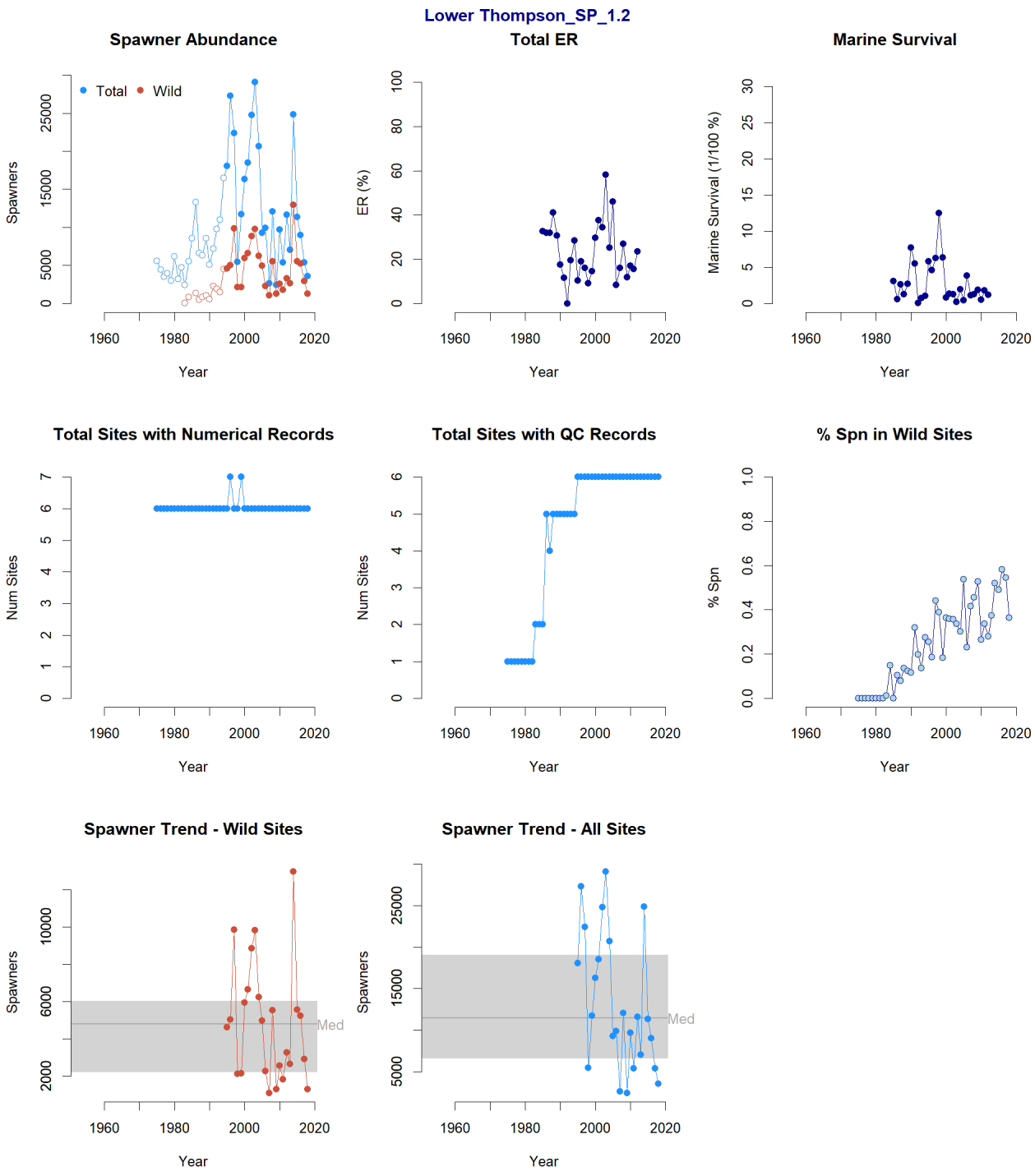

Figure E.5. : Available Data for Lower Thompson Spring 1.2 (CK-17)

E.5.2 Data Notes

Spawner Estimates

This CU has biological characteristics that are unusual among southern BC CUs. The stock is stream-type with a short generation time, and the vast majority of males and females mature at age 4. Their young age is also associated with small body size and many of these mature fish are below minimum size limits for some of the ocean fisheries. High quality escapement data are collected at the Nicola, Bonaparte and Deadman Rivers, but the time series based on visual surveys have not yet been calibrated to the more accurate estimates developed from mark-recapture studies and resistivity counters. At the Bonaparte River, a fishway was constructed around an impassable falls in 1988 to provide access for anadromous fish species. Chinook were enhanced over a 5 year cycle to help establish Chinook in the upstream areas. Historically, there was a small number of Chinook that spawned in the 2.6 km downstream of the falls. Chinook continue to spawn in the areas downstream of the falls, but their numbers are not estimated regularly. The escapement estimates provided here are based on counts of Chinook passing the falls. Recently these counts have been made electronically using a resistivity counter. The Bonaparte estimates have not been adjusted to account for spawning below the fishway, so they have a small underestimation bias (~1.7% of fishway count). At the Deadman River, a resistivity counter has been used recently to estimate escapement. In some years, the counter begins operation after the Chinook migration has started. Previously, the early component of the migration was estimated using the average migration timing distribution measured at the Bonaparte fishway in order to standardize the time series for comparisons among years and to abundance-based reference points (Parken et al. 2006), however the data used for the analysis in this report have not been standardized. Furthermore, there was at least one year in the time series when one of the counting channels was damaged and no counts were recorded for those migrants. At that time, the plan was to calibrate the counts among the counting channels according to discharge and then to apply to the calibration factors to the year with the missing data for one of the channels. It is unclear if the adjustments were made. The Nicola River estimates are based on mark-recapture studies conducted since 1995 and Bailey et al. (2000) describe the methods in detail. Coldwater River and Spius Creek estimates are based on aerial surveys. There is considerable information from the Nicola River that shows the aerial counts are biased low (Parken et al. 2003). The time series in this report have not been bias corrected, although they have been in the past when escapements were compared to abundance-based benchmarks (Parken et al. 2006).

This includes a CWT indicator site. The data stream is a relative index because a known wild site does not contribute to the data stream (due to data quality issues) but is known to make a significant contribution to annual spawner abundances (water clarity issues hamper enumeration efforts).

Exploitation Rate Estimates

The Nicola River is the exploitation rate indicator stock for this group, and several of the other sites have been coded wire tag to provide information such as distribution and timing through fisheries. The stock is harvested mainly in terminal fisheries with some exploitation occurring when adults return via the northern and southern entrances to the Salish Sea. It is considered to have an offshore ocean distribution. Total Canadian exploitation rates between 1999-2011 were

estimated at less than 10%.

E.5.3 CWT Recoveries Overview

The *Mark Recovery Program Information System* (DFO 2020b) covers coded wire tag releases and recoveries for indicator and non-indicator systems. Table E.14 summarizes all tag recoveries for release sites matched to this CU, based on a database extract from July 2020. Recoveries are identified by region (e.g. BCYK = British Columbia and Yukon), then by marine (M) or freshwater (F), then by geography where applicable (N = North, S = South), and finally by sector or gear type.

Table E.14. Estimated CWT Recoveries - Lower Thompson Spring 1.2 (CK-17)

RecoveredIn	n	Years
AK_Net and Seine	3 (0-3)	3 (1989-2014)
AK_Troll	17 (2-6)	6 (1991-2016)
BCYK_F_Aboriginal	20 (20-20)	1 (2019-2019)
BCYK_F_Sport	1,689 (4-223)	26 (1980-2014)
BCYK_F_S_Aboriginal	627 (23-154)	7 (2011-2018)
BCYK_F_S_Net and Seine	2,335 (4-405)	16 (1990-2010)
BCYK_M_N_Net and Seine	33 (2-12)	9 (1979-2002)
BCYK_M_N_Sport	209 (3-27)	18 (1989-2018)
BCYK_M_N_Troll	303 (0-51)	24 (1981-2017)
BCYK_M_S_Net and Seine	305 (2-171)	22 (1979-2019)
BCYK_M_S_Sport	1,617 (4-155)	37 (1979-2019)
BCYK_M_S_Troll	587 (0-101)	29 (1978-2018)
OR_M_Net and Seine	3 (3-3)	1 (2008-2008)
OR_M_S_Sport	10 (2-3)	4 (1991-2008)
OR_M_S_Troll	22 (2-8)	5 (1992-2012)
WA_M_N_Net and Seine	51 (1-16)	9 (1981-2018)
WA_M_N_Sport	3 (3-3)	1 (1989-1989)
WA_M_N_Troll	21 (2-14)	4 (1987-1995)
WA_M_S_Net and Seine	3 (3-3)	1 (1989-1989)
WA_M_S_Sport	321 (2-70)	19 (1987-2019)
WA_M_S_Troll	402 (2-59)	29 (1987-2019)

E.5.4 Site Overview

Table E.15 lists all the sites matched to this CU, and summarizes the available information. Enhancement level (*Enh*) and site category (*Cat*) are used for aggregating the site data (see sections 4.2.3 and 4.3 for definitions) . Only persistent (*P*) and extirpated (*EX*) sites are used in the aggregated time series. For the CU-level series, only sites with low or unknown enhancement level are included. For the Total Unit time series, all P and EX sites are combined. Some sites are used as indicators for escapement (*Esc*) or coded-wire tags (*CWT*). The table also shows the highest value (*Max*) and the year of the last available observation (*Last*) for the quality-filtered time series. The remaining columns list the number of observations in different quality categories, with definitions as per Section 4.2.1.

Table E.15. Site Overview for Lower Thompson Spring 1.2 (CK-17)

Name	Enh	Cat	StYr	Esc	CWT	Max	Last	High	Mod	Other	Infill	Dropped
BONAPARTE RIVER	LOW	P	1995	No	No	12659	2018	26	0	8	1	9
COLDWATER RIVER	HIGH	P	1995	Yes	No	2234	2018	0	0	33	0	11
DEADMAN RIVER	MOD	P	1995	Yes	No	2282	2018	23	0	9	2	10
LOUIS CREEK	UNK	P	1995	Yes	No	611	2018	5	16	0	3	20
NICOLA RIVER	MOD	P	1995	Yes	Yes	17983	2018	0	11	33	0	0
SPIUS CREEK	HIGH	P	1995	Yes	No	1950	2018	0	0	32	0	12
NICOLA RIVER-UPPER	UNK	AGG	NA	No	No	NA	NA	0	1	0	0	2

E.6 North Thompson Spring 1.3 (CK-18)

E.6.1 Data Overview

Table E.16 summarizes the available data, and Figure E.6 shows the patterns over time. Section 4 describes the data classifications and usability assessments.

Table E.16. Data Overview for North Thompson Spring 1.3 (CK-18)

CU_ID	CK-18
CU_Name	NTh-spr
SpnCategory	Rel_Idx
NumObs	25 (1986-2018)
StartYear	1999
NumSites	2 (2)
Gen	5 (4.52)
GenAvgWild	82
Area	FR
Area2	Fraser-THOM
CWT	x (DOM)
ER_BY	0
Area	Fraser
MU	FrSp52
AbsAbdMetric	NO
TrendMetric	NO
PercBM	NO
Source	Unpubl
Above1kWild	Possible
BasedOn	Data Notes

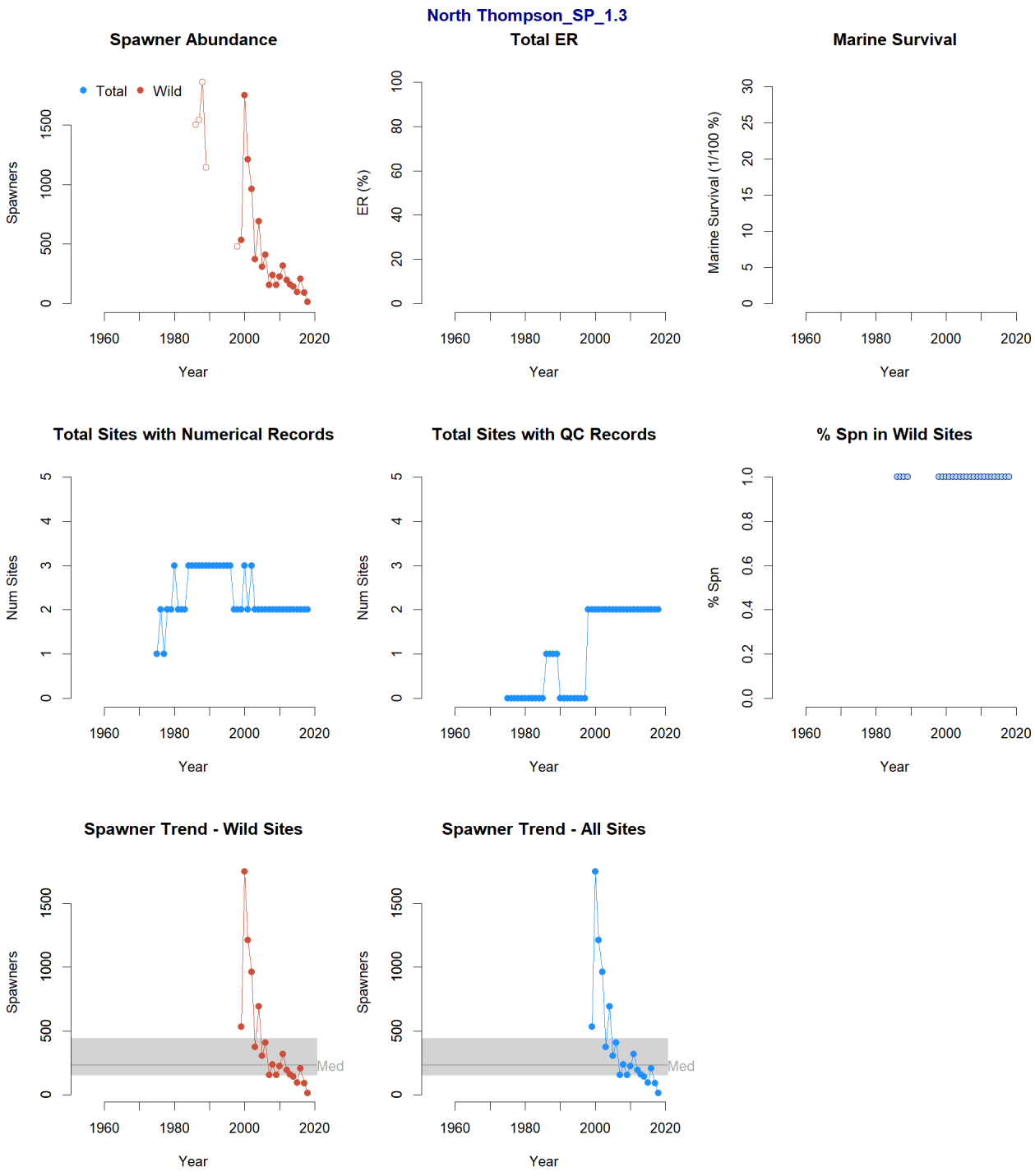

Figure E.6. : Available Data for North Thompson Spring 1.3 (CK-18)

E.6.2 Data Notes

Spawner Estimates

There is little information about the relative abundance, spawning distribution, and biology of this CU compared to others in southern British Columbia. The total abundance of the CU is likely much greater than the abundance for the sum of Blue and Finn Creek, and it is unclear how well these systems represent the escapement pattern for the CU. Escapement information is regularly collected at these two survey sites, but the proportion of the CU abundance that spawns in these sites is unknown. The Finn Creek site includes the creek and areas adjacent to the mainstem of the North Thompson River where the gravel fan extends. Chinook spawn in the mainstem of the North Thompson at the mouth of Finn Creek, but it is difficult to estimate the abundance due to poor visibility in the North Thompson River. This CU also includes spring run Chinook Salmon that spawn in the mainstem of the North Thompson from Avola upstream to a barrier that is upstream of the Stormking Creek confluence. The escapements have not been estimated for this component of the CU due to very poor counting conditions (low water clarity). The escapements that have been reported for the North Thompson River have been for the summer run which spawns mainly downstream of the Clearwater River confluence.

Exploitation Rate Estimates

There is no exploitation rate indicator stock for this CU. Finn Creek has been coded wire tagged and recoveries occurred from Alaska through southern British Columbia.

E.6.3 CWT Recoveries Overview

The *Mark Recovery Program Information System* (DFO 2020b) covers coded wire tag releases and recoveries for indicator and non-indicator systems. Table E.17 summarizes all tag recoveries for release sites matched to this CU, based on a database extract from July 2020. Recoveries are identified by region (e.g. BCYK = British Columbia and Yukon), then by marine (M) or freshwater (F), then by geography where applicable (N = North, S = South), and finally by sector or gear type.

Table E.17. Estimated CWT Recoveries - North Thompson Spring 1.3 (CK-18)

RecoveredIn	n	Years
BCYK_M_N_Sport	7 (7-7)	1 (1989-1989)
BCYK_M_N_Troll	12 (3-9)	2 (1989-1990)
BCYK_M_S_Net and Seine	30 (2-28)	2 (1988-1989)
BCYK_M_S_Sport	28 (6-22)	2 (1989-1990)
BCYK_M_S_Troll	15 (2-7)	3 (1987-1989)
WA_M_N_Net and Seine	2 (2-2)	1 (1989-1989)
WA_M_S_Sport	2 (2-2)	1 (1990-1990)

E.6.4 Site Overview

Table E.18 lists all the sites matched to this CU, and summarizes the available information. Enhancement level (*Enh*) and site category (*Cat*) are used for aggregating the site data (see sections 4.2.3 and 4.3 for definitions) . Only persistent (*P*) and extirpated (*EX*) sites are used in the aggregated time series. For the CU-level series, only sites with low or unknown enhancement level are included. For the Total Unit time series, all P and EX sites are combined. Some sites are used as indicators for escapement (*Esc*) or coded-wire tags (*CWT*). The table also shows the highest value (*Max*) and the year of the last available observation (*Last*) for the quality-filtered time series. The remaining columns list the number of observations in different quality categories, with definitions as per Section 4.2.1.

Table E.18. Site Overview for North Thompson Spring 1.3 (CK-18)

Name	Enh	Cat	StYr	Esc	CWT	Max	Last	High	Mod	Other	Infill	Dropped
BLUE RIVER	UNK	P	1999	No	No	480	2018	0	18	0	3	16
FINN CREEK	LOW	P	1999	Yes	No	1857	2018	0	21	4	0	19
ALBREDA RIVER	UNK	DD	NA	No	No	NA	NA	0	0	1	0	0
LYON CREEK	UNK	DD	NA	No	No	NA	NA	0	8	0	0	21
MAD RIVER	UNK	DD	NA	No	No	NA	NA	NA	NA	NA	NA	NA
DUNN CREEK	UNK	DEL	NA	No	No	NA	NA	NA	NA	NA	NA	NA
MCTAGGART CREEK	UNK	DEL	NA	No	No	NA	NA	NA	NA	NA	NA	NA

E.7 North Thompson Summer 1.3 (CK-19)

E.7.1 Data Overview

Table E.19 summarizes the available data, and Figure E.7 shows the patterns over time. Section 4 describes the data classifications and usability assessments.

Table E.19. Data Overview for North Thompson Summer 1.3 (CK-19)

CU_ID	CK-19
CU_Name	NTh-sum
SpnCategory	Rel_Idx
NumObs	28 (1986-2018)
StartYear	1997
NumSites	6 (6)
Gen	5 (4.52)
GenAvgWild	2,494
Area	FR
Area2	Fraser-THOM
CWT	x (DOM)
ER_BY	0
Area	Fraser
MU	FrSu52
AbsAbdMetric	NO
TrendMetric	YES
PercBM	NO
Source	Unpubl
Above1kWild	Clearly
BasedOn	Estimate

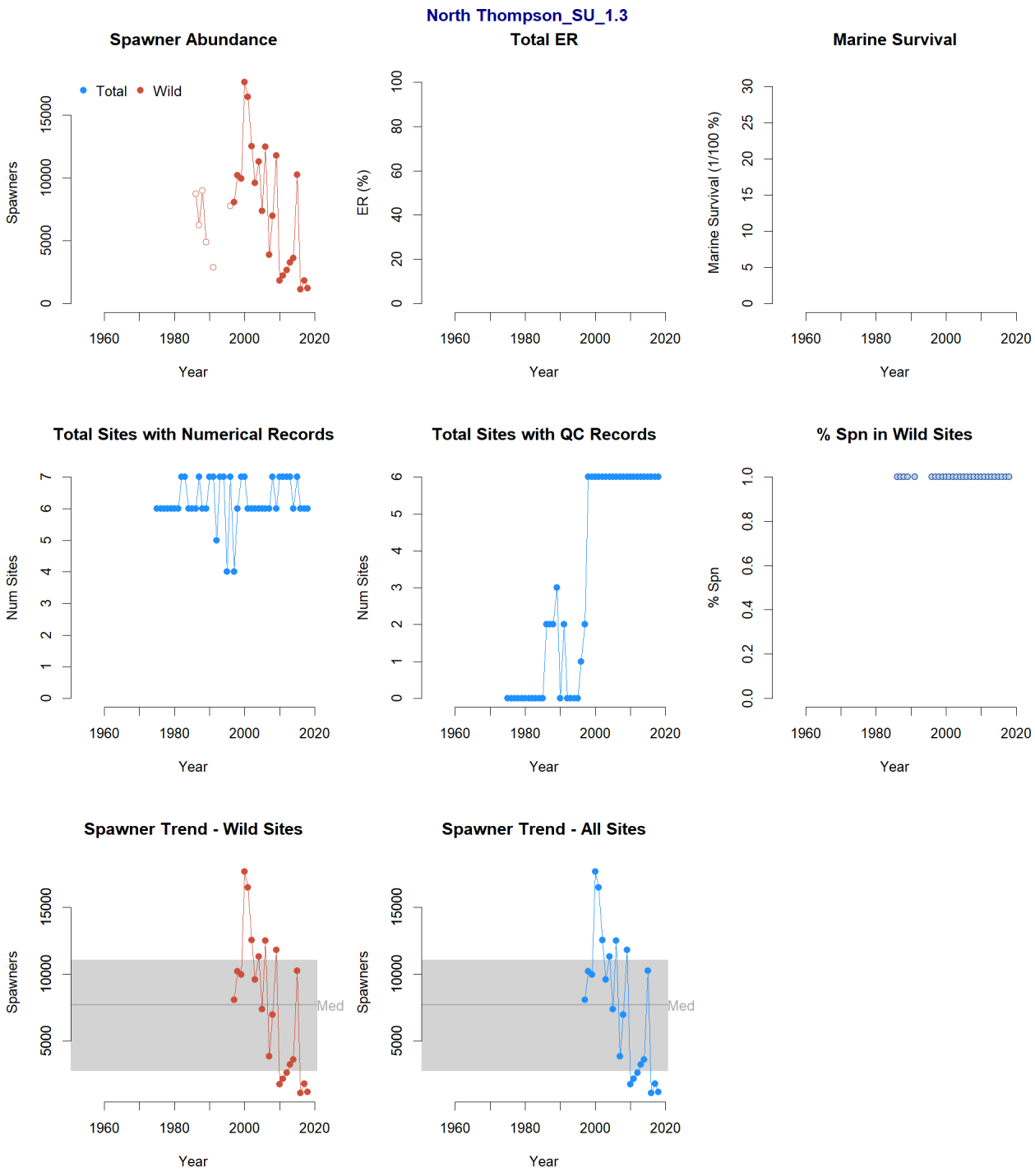

Figure E.7. : Available Data for North Thompson Summer 1.3 (CK-19)

E.7.2 Data Notes

Spawner Estimates

The escapement data for the Clearwater, Mahood, and Raft rivers are moderate quality due to the favourable counting conditions and clear waters. In comparison, the North Thompson has low visibility during the spawning period, and many of the escapement estimates are based on counts of redds after the water clarity improves in late fall. Chinook spawning in the North Thompson summer run component occurs over a long distance from McLure upstream to the Clearwater River confluence, and any mainstem spawners upstream are presumed to be spring run. There is a large number (several thousand) Chinook that spawn in the North Thompson mainstem based on the expanded redd counts, however the accuracy of the estimates is unknown. The systems in this CU that are surveyed are probably sufficient to represent the temporal escapement pattern, however an adjustment would be needed to account for the proportion of the population that is not surveyed to characterize total abundance.

DFO operated a hatchery in Clearwater and the DFO office on the Raft River collected considerable data about the biology of Chinook in this CU. The hatchery stopped producing Chinook Salmon in the 1990s and was sold to the province of British Columbia shortly after.

Exploitation Rate Estimates

There is no exploitation rate indicator stock for this CU. Clearwater and Raft rivers have been coded wire tagged and recoveries occurred from Alaska through southern British Columbia, with many recoveries in WCVI and northern BC troll fisheries.

E.7.3 CWT Recoveries Overview

The *Mark Recovery Program Information System* (DFO 2020b) covers coded wire tag releases and recoveries for indicator and non-indicator systems. Table E.20 summarizes all tag recoveries for release sites matched to this CU, based on a database extract from July 2020. Recoveries are identified by region (e.g. BCYK = British Columbia and Yukon), then by marine (M) or freshwater (F), then by geography where applicable (N = North, S = South), and finally by sector or gear type.

Table E.20. Estimated CWT Recoveries - North Thompson Summer 1.3 (CK-19)

RecoveredIn	n	Years
AK_M_N_Sport	15 (15-15)	1 (1996-1996)
AK_M_S_Sport	1 (0-1)	3 (1989-1995)
AK_Troll	218 (3-50)	10 (1987-1996)
BCYK_F_Sport	145 (4-44)	8 (1988-1995)
BCYK_F_S_Net and Seine	1,039 (50-316)	7 (1990-1996)
BCYK_M_N_Net and Seine	35 (2-10)	6 (1989-1995)
BCYK_M_N_Sport	106 (7-40)	6 (1990-1995)
BCYK_M_N_Troll	918 (8-172)	9 (1987-1995)
BCYK_M_S_Net and Seine	217 (2-105)	10 (1986-1995)
BCYK_M_S_Sport	143 (2-31)	10 (1987-1996)
BCYK_M_S_Troll	987 (20-296)	9 (1987-1995)
OR_M_S_Troll	2 (2-2)	1 (1988-1988)
WA_M_N_Net and Seine	52 (2-25)	5 (1988-1995)
WA_M_S_Net and Seine	6 (1-5)	2 (1992-1995)
WA_M_S_Sport	130 (15-59)	5 (1989-1993)
WA_M_S_Troll	8 (4-4)	2 (1992-1993)

E.7.4 Site Overview

Table E.21 lists all the sites matched to this CU, and summarizes the available information. Enhancement level (*Enh*) and site category (*Cat*) are used for aggregating the site data (see sections 4.2.3 and 4.3 for definitions) . Only persistent (*P*) and extirpated (*EX*) sites are used in the aggregated time series. For the CU-level series, only sites with low or unknown enhancement level are included. For the Total Unit time series, all P and EX sites are combined. Some sites are used as indicators for escapement (*Esc*) or coded-wire tags (*CWT*). The table also shows the highest value (*Max*) and the year of the last available observation (*Last*) for the quality-filtered time series. The remaining columns list the number of observations in different quality categories, with definitions as per Section 4.2.1.

Table E.21. Site Overview for North Thompson Summer 1.3 (CK-19)

Name	Enh	Cat	StYr	Esc	CWT	Max	Last	High	Mod	Other	Infill	Dropped
BARRIERE RIVER	UNK	P	1997	Yes	No	377	2018	0	19	0	2	21
CLEARWATER RIVER	LOW	P	1997	Yes	No	7830	2018	0	23	5	0	16
LEMIEUX CREEK	UNK	P	1997	No	No	198	2018	0	19	0	2	20
MAHOOD RIVER	UNK	P	1997	No	No	929	2018	0	22	0	0	22
NORTH THOMPSON RIVER	LOW	P	NA	Yes	No	11959	2018	0	14	4	7	18
RAFT RIVER	LOW	P	1997	Yes	No	1095	2018	0	21	2	0	21
MANN CREEK	UNK	DD	NA	No	No	NA	NA	0	2	0	0	17

E.8 Upper Adams River Summer x.x (CK-82)

E.8.1 Data Overview

Table E.22 summarizes the available data, and Figure E.8 shows the patterns over time. Section 4 describes the data classifications and usability assessments.

Table E.22. Data Overview for Upper Adams River Summer x.x (CK-82)

CU_ID	CK-82
CU_Name	UADAMS
SpnCategory	Rel_Idx
NumObs	14 (1999-2018)
StartYear	1999
NumSites	1 (1)
Gen	5 (4.52)
GenAvgWild	NA
Area	FR
Area2	Fraser-THOM
CWT	x (DOM)
ER_BY	0
Area	Fraser
MU	TBD
AbsAbdMetric	NO
TrendMetric	NO
PercBM	NO
Source	Unpubl
Above1kWild	Unlikely
BasedOn	Data Notes

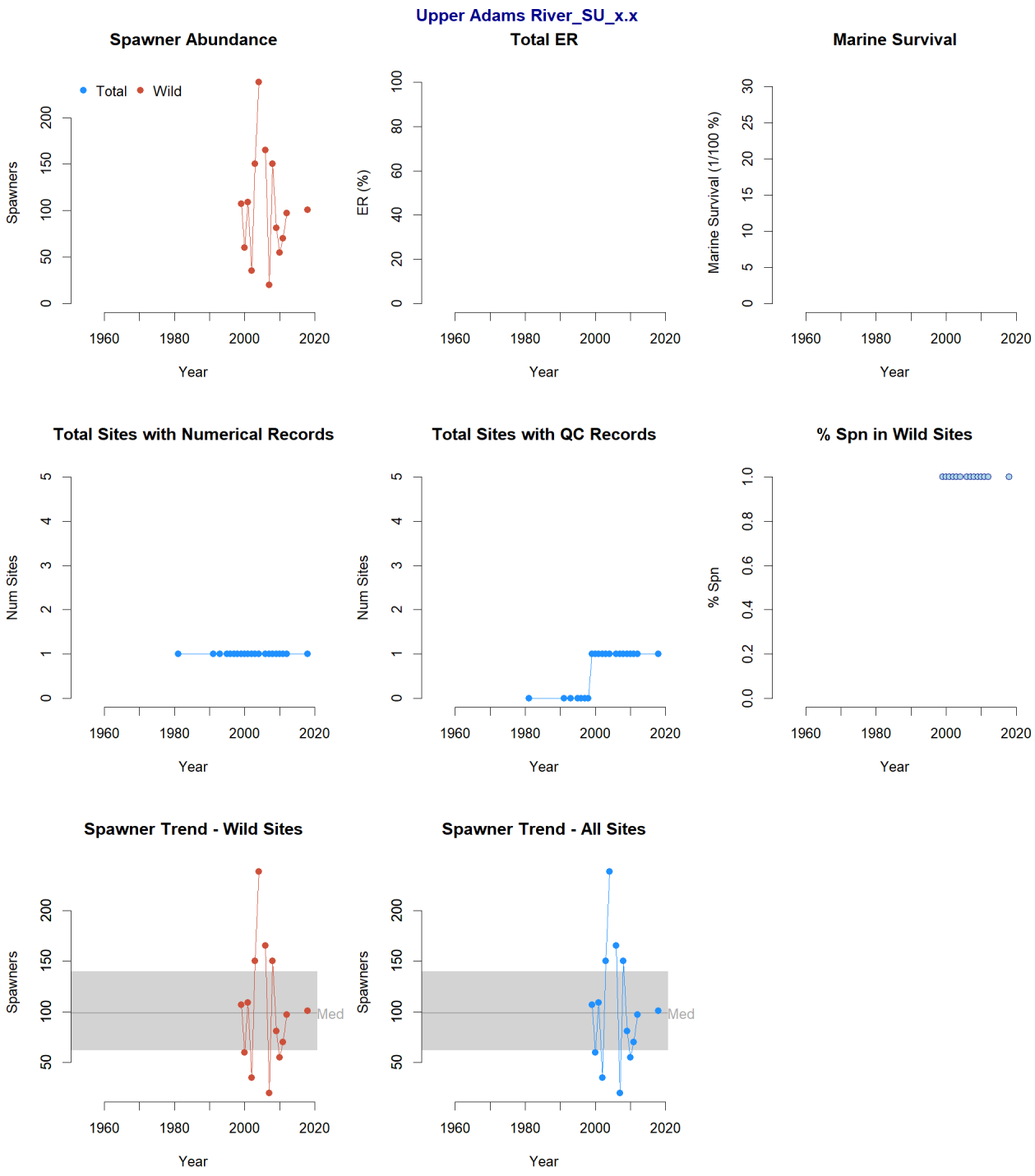

Figure E.8. : Available Data for Upper Adams River Summer x.x (CK-82)

E.8.2 Data Notes

Spawner Estimates

Chinook in the Upper Adams were extirpated because there was an impassable dam built across the outlet of Adams Lake. When the dam was removed, Chinook were introduced from the Lower Shuswap River (ocean-type) and another location, possibly Finn Creek (stream-type). This group of fish (whatever their origin) appears to be self-sustaining. At this time, no information is available to confirm their life history or genetic origins.

This CU presents low spawner abundance estimates and sparse data. The representativeness of the data stream to the entire CU is uncertain.

Transplants originated from two spots: Finn Creek (North Thompson Spring 1.3) and Shuswap (Summer 0.3). Life history of the transplanted CU is unknown, and it would require a fair bit of effort to evaluate whether one or the other, or a blend of the two, or something entirely different was the colonizers that remain. We know that there are only a few spawners that have been observed, and getting biosamples would be challenging. Therefore this CU cannot be assigned to one of the management units of Fraser Chinook. More information is required to determine whether this CU fits within a single management unit or covers multiple management units.

Exploitation Rate Estimates

No information available.

E.8.3 CWT Recoveries Overview

The *Mark Recovery Program Information System* (DFO 2020b) covers coded wire tag releases and recoveries for indicator and non-indicator systems. Table E.23 summarizes all tag recoveries for release sites matched to this CU, based on a database extract from July 2020. Recoveries are identified by region (e.g. BCYK = British Columbia and Yukon), then by marine (M) or freshwater (F), then by geography where applicable (N = North, S = South), and finally by sector or gear type.

Table E.23. Estimated CWT Recoveries - Upper Adams River Summer x.x (CK-82)

RecoveredIn	n	Years
None	0	None

E.8.4 Site Overview

Table E.24 lists all the sites matched to this CU, and summarizes the available information. Enhancement level (*Enh*) and site category (*Cat*) are used for aggregating the site data (see sections 4.2.3 and 4.3 for definitions) . Only persistent (*P*) and extirpated (*EX*) sites are used in the aggregated time series. For the CU-level series, only sites with low or unknown enhancement level are included. For the Total Unit time series, all P and EX sites are combined. Some sites are used as indicators for escapement (*Esc*) or coded-wire tags (*CWT*). The table also shows the highest value (*Max*) and the year of the last available observation (*Last*) for the quality-filtered time series. The remaining columns list the number of observations in different quality categories, with definitions as per Section 4.2.1.

Table E.24. Site Overview for Upper Adams River Summer x.x (CK-82)

Name	Enh	Cat	StYr	Esc	CWT	Max	Last	High	Mod	Other	Infill	Dropped
ADAMS RIVER-UPPER	LOW	P	1999	No	No	238	2018	0	14	0	0	7

APPENDIX F CU Profiles - WCVI

F.1 West Vancouver Island South Fall 0.x (CK-31)

F.1.1 Data Overview

Table F.1 summarizes the available data, and Figure F.1 shows the patterns over time. Section 4 describes the data classifications and usability assessments.

Table F.1. Data Overview for West Vancouver Island South Fall 0.x (CK-31)

CU_ID	CK-31
CU_Name	SWVI
SpnCategory	Rel_Idx
NumObs	39 (1972-2018)
StartYear	1995
NumSites	14 (3)
Gen	4 (4)
GenAvgWild	348
Area	WCVI
Area2	WCVI/NEVI/USC
CWT	RBT
ER_BY	41 (1973-2013)
Area	WCVI
MU	WCVI
AbsAbdMetric	NO
TrendMetric	YES
PercBM	NO
Source	Publ
Above1kWild	Possible
BasedOn	Data Notes

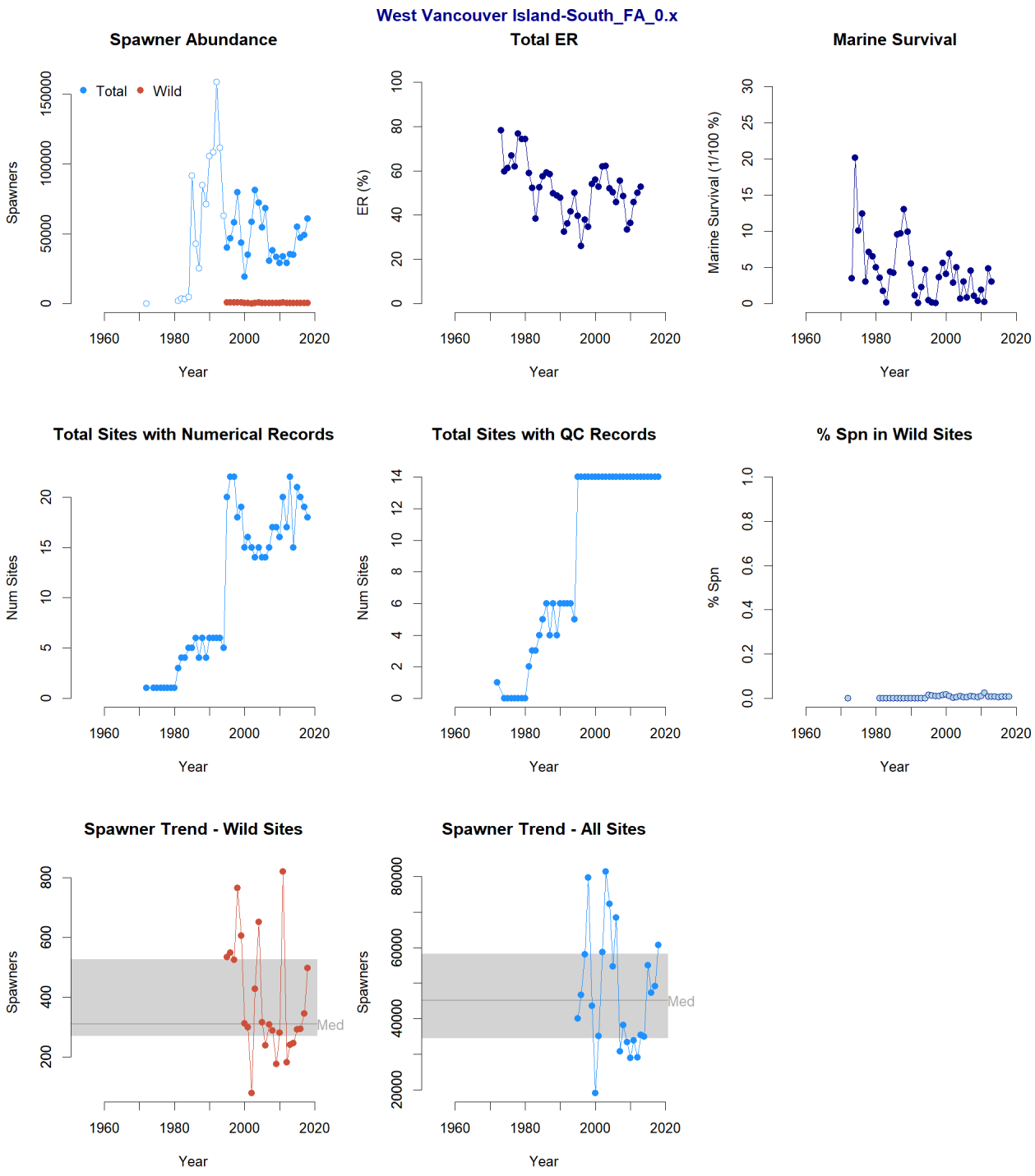

Figure F.1. : Available Data for West Vancouver Island South Fall 0.x (CK-31)

F.1.2 Data Notes

Spawner Estimates

There are many rivers in this CU that have persistent Chinook populations. This includes a CWT indicator site. The CTC uses Nahmint, Sarita, Tranquil and Bedwell Rivers as escapement indicator stocks. There are several rivers that are not represented in NUSEDs, e.g. Sproat River and Sproat Lake tributaries. The Somass System is represented by enumeration at a fixed point site on Stamp Falls. Data quality is variable. There is some evidence of extensive straying of enhanced fish to wild systems and also other enhanced systems (thermal marks and genetic data). CK-30 (Port San Juan) and CK-31 (SWVI) were merged into one CU based on corrected spawn timing information.

Terminal exploitation on the non-CWT indicator populations are bounded by the Total and Marine exploitation rates illustrated in Figure F.3 (but are definitely less than the Total Exploitation rates shown). Note habitat-based estimates of abundance benchmarks have limited applicability to Units that include enhancement.

DFO (2015b): Three persistent wild sites (Megin, Moyeha and Bedwell) can be used for trends. Bedwell is 100% marked for enhancement. Consider data as relative abundance estimates, which are suitable for trend analysis.

Exploitation Rate Estimates

Releases of coded-wire tagged smolts from Robertson Creek Hatchery, located in the Somass River system, is the only CWT exploitation rate indicator stock available to represent fishery impacts for all Chinook stocks along the west coast of Vancouver Island. It is also used to represent CK-32 and CK-33, however, only for the impacts occurring in pre-terminal, ocean fisheries. Directed terminal harvest by specific First Nations, recreational and commercial fisheries occurs inside the surf line of Barkley Sound and within the Somass River system which do not occur to the same magnitude in the terminal areas for stocks comprising CK-32 and CK-33. Thus, CWT-based estimates of terminal harvest rates from the Robertson Creek Hatchery stock are applicable only to the hatchery stock within CK-31. Total Canadian exploitation rates between 1999-2011 were estimated at 10-15%.

F.1.3 CWT Recoveries Overview

The *Mark Recovery Program Information System* (DFO 2020b) covers coded wire tag releases and recoveries for indicator and non-indicator systems. Table F.2 summarizes all tag recoveries for release sites matched to this CU, based on a database extract from July 2020. Recoveries are identified by region (e.g. BCYK = British Columbia and Yukon), then by marine (M) or freshwater (F), then by geography where applicable (N = North, S = South), and finally by sector or gear type.

Table F.2. Estimated CWT Recoveries - West Vancouver Island South Fall 0.x (CK-31)

RecoveredIn	n	Years
AK_M_N_Sport	1,397 (0-150)	38 (1978-2019)
AK_M_S_Sport	3,206 (0-264)	38 (1982-2019)
AK_Aboriginal	26 (0-9)	8 (1989-2018)
AK_Miscellaneous	32 (0-28)	26 (1977-2018)
AK_Net and Seine	4,505 (0-373)	40 (1978-2019)
AK_Sport	23 (0-5)	19 (1986-2019)
AK_Test Fisheries	3 (0-3)	5 (1986-2006)
AK_Troll	30,141 (56-2706)	44 (1976-2019)
BCYK_F_Sport	288 (5-36)	20 (1977-2018)
BCYK_M_N_Net and Seine	2,583 (1-446)	25 (1975-2015)
BCYK_M_N_Sport	8,384 (4-1307)	40 (1978-2019)
BCYK_M_N_Troll	18,041 (1-1724)	43 (1975-2019)
BCYK_M_S_Aboriginal	3,359 (0-584)	17 (1994-2017)
BCYK_M_S_Net and Seine	20,392 (2-4885)	38 (1975-2019)
BCYK_M_S_Sport	27,584 (16-2337)	45 (1975-2019)
BCYK_M_S_Troll	9,152 (3-2258)	35 (1975-2019)
OR_M_S_Sport	3 (0-3)	2 (1991-1993)
OR_M_S_Troll	2 (2-2)	1 (2019-2019)
OR_Net and Seine	5 (2-3)	2 (1980-1991)
OR_Sport	3 (3-3)	1 (2015-2015)
WA_M_Net and Seine	3 (3-3)	1 (2006-2006)
WA_M_Sport	1 (1-1)	1 (2018-2018)
WA_M_N_Net and Seine	165 (1-28)	18 (1975-2011)
WA_M_N_Test Fisheries	1 (1-1)	1 (1993-1993)
WA_M_S_Net and Seine	123 (1-31)	20 (1976-2018)
WA_M_S_Sport	142 (2-21)	22 (1976-2019)
WA_M_S_Troll	28 (1-11)	7 (1978-2019)

F.1.4 Site Overview

Table F.3 lists all the sites matched to this CU, and summarizes the available information. Enhancement level (*Enh*) and site category (*Cat*) are used for aggregating the site data (see sections 4.2.3 and 4.3 for definitions) . Only persistent (*P*) and extirpated (*EX*) sites are used in the aggregated time series. For the CU-level series, only sites with low or unknown enhancement level are included. For the Total Unit time series, all P and EX sites are combined. Some sites are used as indicators for escapement (*Esc*) or coded-wire tags (*CWT*). The table also shows the highest value (*Max*) and the year of the last available observation (*Last*) for the quality-filtered time series. The remaining columns list the number of observations in different quality categories, with definitions as per Section 4.2.1.

Table F.3. Site Overview for West Vancouver Island South Fall 0.x (CK-31)

Name	Enh	Cat	StYr	Esc	CWT	Max	Last	High	Mod	Other	Infill	Dropped
BEDWELL SYSTEM	MOD	P	1995	Yes	No	580	2018	0	0	24	0	0
CLEMENS CREEK	LOW	P	NA	No	No	704	2018	0	8	0	16	0
CYPRE RIVER	HIGH	P	NA	No	No	3674	2018	0	4	19	1	0
MEGIN RIVER	UNK	P	1995	Yes	No	370	2018	0	6	15	3	0
MOYEHA RIVER	UNK	P	1995	Yes	No	362	2018	0	2	16	6	0
NAHMINT RIVER	HIGH	P	1995	Yes	No	1628	2018	0	0	35	1	0
NITINAT RIVER	HIGH	P	1995	No	No	34469	2018	0	0	38	0	0
SAN JUAN RIVER	HIGH	P	1995	Yes	No	4515	2018	0	0	35	2	0
SARITA RIVER	HIGH	P	1995	Yes	No	3705	2018	0	0	30	0	0
SOMASS-SPROAT-GC SYSTEM	HIGH	P	1995	No	Yes	122035	2018	11	0	22	1	11
SOOKE RIVER	HIGH	P	1995	No	No	2402	2018	0	0	20	4	0
THORNTON CREEK	HIGH	P	1995	No	No	3000	2018	0	0	30	3	0
TOQUART RIVER	HIGH	P	1995	No	No	864	2018	0	0	23	4	0
TRANQUIL CREEK	HIGH	P	1995	No	No	2080	2018	0	3	20	1	0
CARNATION CREEK	UNK	DD	NA	No	No	NA	NA	0	0	1	0	1
CAYCUSE RIVER	UNK	DD	NA	No	No	NA	NA	0	0	2	0	0
CHINA CREEK	UNK	DD	NA	No	No	NA	NA	NA	NA	NA	NA	NA
COEUR D'ALENE CREEK	UNK	DD	NA	No	No	NA	NA	0	0	2	0	0
COLEMAN CREEK	UNK	DD	NA	No	No	NA	NA	NA	NA	NA	NA	NA
COUS CREEK	UNK	DD	NA	No	No	NA	NA	0	0	0	0	1
EFFINGHAM RIVER	UNK	DD	NA	No	No	NA	NA	0	0	3	0	0
FRANKLIN RIVER	UNK	DD	NA	No	No	NA	NA	0	0	4	0	1
GORDON RIVER	LOW	DD	NA	No	No	NA	NA	0	0	11	0	2
HENDERSON LAKE CREEK	HIGH	DD	1995	No	No	NA	NA	0	0	1	0	0
ICE RIVER	UNK	DD	NA	No	No	NA	NA	0	0	5	0	1

Name	Enh	Cat	StYr	Esc	CWT	Max	Last	High	Mod	Other	Infill	Dropped
KENNEDY RIVER-LOWER	HIGH	DD	NA	No	No	NA	NA	0	0	18	0	0
KLANAWA RIVER	UNK	DD	NA	No	No	NA	NA	0	0	7	0	1
MACKTUSH CREEK	UNK	DD	NA	No	No	NA	NA	0	0	1	0	2
MERCANTILE CREEK	UNK	DD	NA	No	No	NA	NA	0	0	12	0	1
SMITH CREEK	UNK	DD	NA	No	No	NA	NA	0	0	6	0	0
SYDNEY RIVER	UNK	DD	NA	No	No	NA	NA	0	0	6	0	1
TOFINO CREEK	UNK	DD	NA	No	No	NA	NA	0	0	2	0	2
UCHUCK CREEK	UNK	DD	NA	No	No	NA	NA	NA	NA	NA	NA	NA
WARN BAY CREEK	UNK	DD	NA	No	No	NA	NA	0	0	8	0	5
WATTA CREEK	UNK	DD	NA	No	No	NA	NA	0	0	5	0	0
AYUM CREEK	UNK	AGG	NA	No	No	NA	NA	0	0	0	0	1
CHARTERS RIVER	UNK	AGG	NA	No	No	NA	NA	0	0	0	0	3
CLAYOQUOT RIVER-LOWER	UNK	AGG	NA	No	No	NA	NA	0	0	0	0	2
CLAYOQUOT RIVER-UPPER	UNK	AGG	NA	No	No	NA	NA	1	1	0	0	2
DE MAMIEL CREEK	UNK	AGG	NA	No	No	NA	NA	0	1	0	0	6
DEER CREEK	UNK	AGG	NA	No	No	NA	NA	NA	NA	NA	NA	NA
DRINKWATER CREEK	UNK	AGG	NA	No	No	NA	NA	1	0	0	0	0
HARRIS CREEK	UNK	AGG	NA	No	No	NA	NA	0	2	0	0	12
KENNEDY LAKE BEACHES	UNK	AGG	NA	No	No	NA	NA	NA	NA	NA	NA	NA
KENNEDY LAKE FEEDER STREAMS	UNK	AGG	NA	No	No	NA	NA	NA	NA	NA	NA	NA
KENNEDY RIVER-UPPER	UNK	AGG	NA	No	No	NA	NA	2	5	0	0	7
LENS CREEK	UNK	AGG	NA	No	No	NA	NA	0	0	0	0	7
LITTLE TOQUART CREEK	UNK	AGG	NA	No	No	NA	NA	NA	NA	NA	NA	NA
MURIEL LAKE	UNK	AGG	NA	No	No	NA	NA	NA	NA	NA	NA	NA
RENFREW CREEK	UNK	AGG	NA	No	No	NA	NA	0	1	0	0	10
ROCKY CREEK	UNK	AGG	NA	No	No	NA	NA	0	0	0	0	3
SAND RIVER	UNK	AGG	NA	No	No	NA	NA	1	0	0	0	6
SOMASS RIVER	HIGH	AGG	NA	No	No	NA	NA	0	0	41	0	0
ATLEO RIVER	UNK	DEL	NA	No	No	NA	NA	0	0	0	0	1
CAMPUS CREEK	UNK	DEL	NA	No	No	NA	NA	NA	NA	NA	NA	NA
CANOE PASS CREEK	UNK	DEL	NA	No	No	NA	NA	NA	NA	NA	NA	NA
CATARACT CREEK	UNK	DEL	NA	No	No	NA	NA	NA	NA	NA	NA	NA
CONSINKA CREEK	UNK	DEL	NA	No	No	NA	NA	0	0	0	0	1

Name	Enh	Cat	StYr	Esc	CWT	Max	Last	High	Mod	Other	Infill	Dropped
DOOBAH CREEK	UNK	DEL	NA	No	No	NA	NA	1	0	0	0	0
ITATSOO CREEK	UNK	DEL	NA	No	No	NA	NA	0	0	0	0	1
LUCKY CREEK	UNK	DEL	NA	No	No	NA	NA	NA	NA	NA	NA	NA
MAGGIE RIVER	UNK	DEL	NA	No	No	NA	NA	0	0	0	0	1
PIPESTEM CREEK	UNK	DEL	NA	No	No	NA	NA	0	0	0	0	1
SNUG BASIN CREEK	UNK	DEL	NA	No	No	NA	NA	0	0	0	0	1
SUGSAW CREEK	UNK	DEL	NA	No	No	NA	NA	0	0	0	0	2
SUTTON MILL CREEK	UNK	DEL	NA	No	No	NA	NA	NA	NA	NA	NA	NA
TWIN RIVERS WEST CREEK	UNK	DEL	NA	No	No	NA	NA	NA	NA	NA	NA	NA
WALLACE CREEK	UNK	DEL	NA	No	No	NA	NA	NA	NA	NA	NA	NA

F.2 West Vancouver Island - Nootka & Kyuquot Fall 0.x (CK-32)

F.2.1 Data Overview

Table F.4 summarizes the available data, and Figure F.2 shows the patterns over time. Section 4 describes the data classifications and usability assessments.

Table F.4. Data Overview for West Vancouver Island - Nootka & Kyuquot Fall 0.x (CK-32)

CU_ID	CK-32
CU_Name	NoKy
SpnCategory	Rel_Idx
NumObs	37 (1982-2018)
StartYear	1995
NumSites	9 (3)
Gen	4 (4)
GenAvgWild	1,849
Area	WCVI
Area2	WCVI/NEVI/USC
CWT	x (RBT)
ER_BY	0
Area	WCVI
MU	WCVI
AbsAbdMetric	NO
TrendMetric	YES
PercBM	NO
Source	New
Above1kWild	Clearly
BasedOn	Estimate

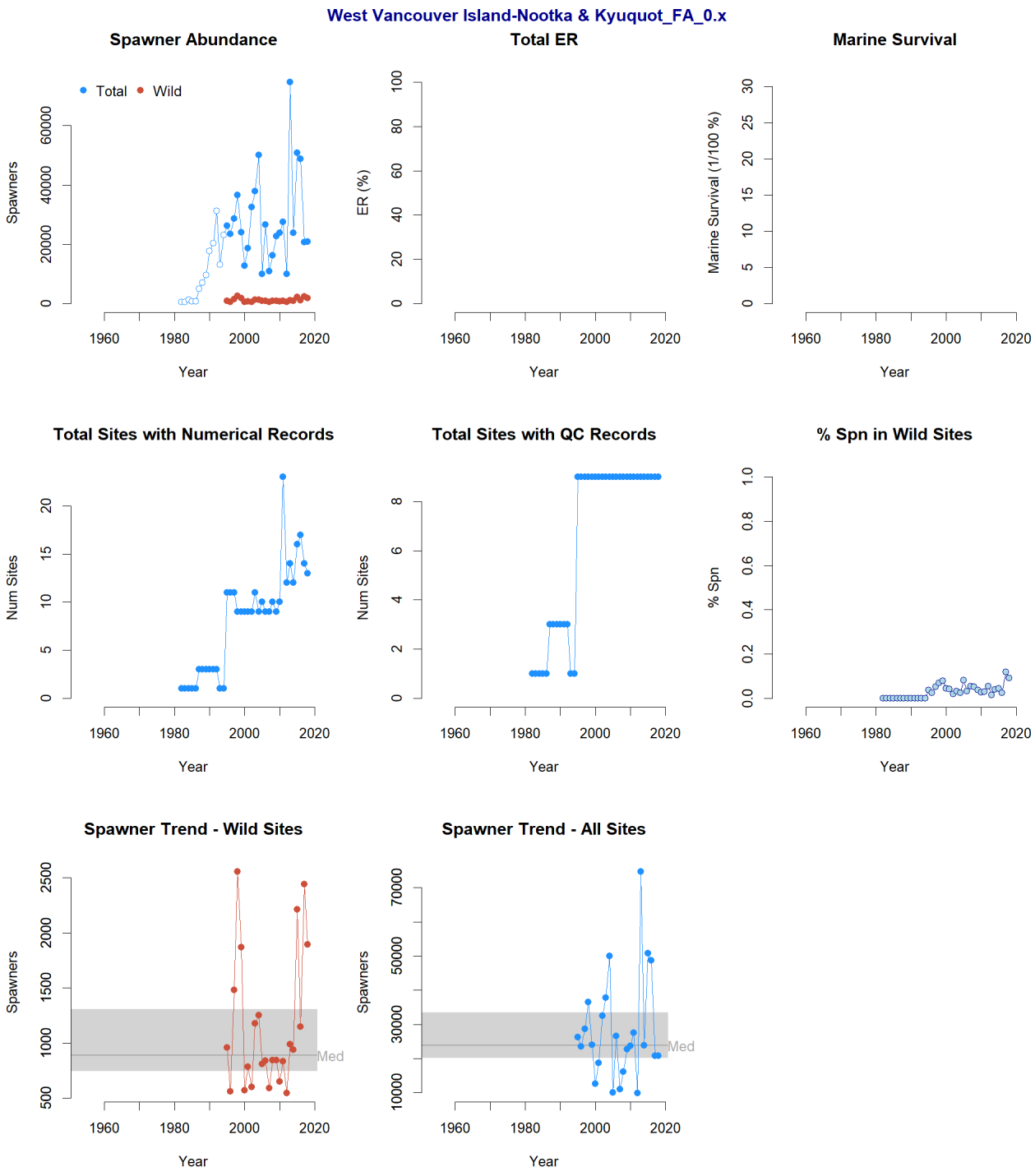

Figure F.2. : Available Data for West Vancouver Island - Nootka and Kyuquot Fall 0.x (CK-32)

F.2.2 Data Notes

Spawner Estimates

There are many rivers in this CU that have persistent Chinook populations. The CTC uses Burman, Tahsis, Leiner, Artlish, Tahsish and Kaouk Rivers as escapement indicator stocks. The spawner abundance for this TU is dominated by the EU. Note habitat-based estimates of abundance benchmarks have limited applicability to EUs. There is evidence of contributions of spawners from outside the CU in some spawning sites

Exploitation Rate Estimates

There is no exploitation rate indicator stock available within this CU. Results of a cohort analysis procedure applied to CWT recoveries of tagged releases from Robertson Creek Hatchery in CK-31 provide estimates of pre-terminal fishery impacts and other statistics such as maturations rates. See additional commentary under the Exploitation section for CK-31. Fisheries recovery rates from select CWT releases indicate an ocean distribution pattern that is similar to CK-31.

F.2.3 CWT Recoveries Overview

The *Mark Recovery Program Information System* (DFO 2020b) covers coded wire tag releases and recoveries for indicator and non-indicator systems. Table F.5 summarizes all tag recoveries for release sites matched to this CU, based on a database extract from July 2020. Recoveries are identified by region (e.g. BCYK = British Columbia and Yukon), then by marine (M) or freshwater (F), then by geography where applicable (N = North, S = South), and finally by sector or gear type.

Table F.5. Estimated CWT Recoveries - West Vancouver Island - Nootka and Kyuquot Fall 0.x (CK-32)

RecoveredIn	n	Years
AK_M_N_Sport	192 (0-54)	17 (1985-2006)
AK_M_S_Sport	303 (0-47)	20 (1984-2007)
AK_Aboriginal	3 (1-1)	3 (1990-1992)
AK_Net and Seine	152 (0-34)	19 (1982-2005)
AK_Sport	4 (0-4)	3 (1998-2003)
AK_Troll	3,951 (2-644)	27 (1982-2008)
BCYK_F_Sport	6 (6-6)	1 (1999-1999)
BCYK_M_N_Net and Seine	282 (2-60)	18 (1981-1999)
BCYK_M_N_Sport	904 (3-184)	20 (1983-2007)
BCYK_M_N_Troll	2,174 (2-429)	22 (1982-2007)
BCYK_M_S_Aboriginal	13 (5-8)	2 (1994-1995)
BCYK_M_S_Net and Seine	462 (2-222)	14 (1982-2006)
BCYK_M_S_Sport	4,859 (13-1259)	26 (1981-2007)
BCYK_M_S_Troll	1,834 (2-565)	16 (1982-2007)
WA_M_S_Troll	5 (1-4)	2 (1994-2006)

F.2.4 Site Overview

Table F.6 lists all the sites matched to this CU, and summarizes the available information. Enhancement level (*Enh*) and site category (*Cat*) are used for aggregating the site data (see sections 4.2.3 and 4.3 for definitions) . Only persistent (*P*) and extirpated (*EX*) sites are used in the aggregated time series. For the CU-level series, only sites with low or unknown enhancement level are included. For the Total Unit time series, all P and EX sites are combined. Some sites are used as indicators for escapement (*Esc*) or coded-wire tags (*CWT*). The table also shows the highest value (*Max*) and the year of the last available observation (*Last*) for the quality-filtered time series. The remaining columns list the number of observations in different quality categories, with definitions as per Section 4.2.1.

Table F.6. Site Overview for West Vancouver Island - Nootka and Kyuquot Fall 0.x (CK-32)

Name	Enh	Cat	StYr	Esc	CWT	Max	Last	High	Mod	Other	Infill	Dropped
ARTLISH RIVER	LOW	P	1995	Yes	No	1113	2018	0	7	16	1	0
BURMAN RIVER	HIGH	P	1995	Yes	No	10730	2018	0	1	29	0	0
CONUMA RIVER	HIGH	P	1995	No	No	62096	2018	0	0	37	0	0
GOLD RIVER	HIGH	P	NA	Yes	No	4492	2018	0	0	25	5	0
KAOUK RIVER	UNK	P	1995	Yes	No	824	2018	0	8	16	0	0
LEINER RIVER	MOD	P	1995	Yes	No	1860	2018	0	3	21	0	0
TAHSIS RIVER	HIGH	P	1995	Yes	No	1606	2018	0	4	20	0	0
TAHSISH RIVER	UNK	P	1995	Yes	No	1561	2018	0	7	16	1	0
ZEBALLOS RIVER	HIGH	P	1995	No	No	862	2018	0	7	14	3	0
DESERTED CREEK	UNK	EX	NA	No	No	NA	NA	0	0	3	0	0
AMAI CREEK	UNK	DD	NA	No	No	NA	NA	0	0	1	0	2
BATTLE BAY RIVER	UNK	DD	NA	No	No	NA	NA	0	0	2	0	0
BRODICK CREEK	UNK	DD	NA	No	No	NA	NA	NA	NA	NA	NA	NA
CANTON CREEK	UNK	DD	1995	No	No	NA	NA	0	3	11	0	2
CHAMISS CREEK	UNK	DD	NA	No	No	NA	NA	0	0	0	0	1
CHUM CREEK	UNK	DD	NA	No	No	NA	NA	0	0	3	0	5
CLANNINICK CREEK	UNK	DD	NA	No	No	NA	NA	NA	NA	NA	NA	NA
EASY CREEK	UNK	DD	NA	No	No	NA	NA	0	1	3	0	2
ELIZA CREEK	UNK	DD	NA	No	No	NA	NA	NA	NA	NA	NA	NA
ESPINOSA CREEK	UNK	DD	NA	No	No	NA	NA	0	0	10	0	5
HOISS CREEK	UNK	DD	NA	No	No	NA	NA	0	0	7	0	1
HOUSTON RIVER	UNK	DD	NA	No	No	NA	NA	NA	NA	NA	NA	NA
JACKLAH RIVER	UNK	DD	NA	No	No	NA	NA	NA	NA	NA	NA	NA
KASHUTL RIVER	UNK	DD	NA	No	No	NA	NA	0	0	2	0	4
KAUWINCH RIVER	UNK	DD	NA	No	No	NA	NA	0	3	5	0	4
KLEEPTEE CREEK	UNK	DD	NA	No	No	NA	NA	0	0	9	0	2
LITTLE ZEBALLOS RIVER	UNK	DD	NA	No	No	NA	NA	0	3	10	0	5

Name	Enh	Cat	StYr	Esc	CWT	Max	Last	High	Mod	Other	Infill	Dropped
MALKSOPE RIVER	UNK	DD	NA	No	No	NA	NA	0	7	5	0	1
MAMAT CREEK	UNK	DD	NA	No	No	NA	NA	NA	NA	NA	NA	NA
MARVINAS BAY CREEK	UNK	DD	NA	No	No	NA	NA	0	0	4	0	1
MCKAY COVE CREEK	UNK	DD	NA	No	No	NA	NA	0	0	1	0	0
MOOYAH RIVER	LOW	DD	NA	No	No	NA	NA	0	0	11	0	2
NARROWGUT CREEK	UNK	DD	NA	No	No	NA	NA	0	0	2	0	2
NASPARTI RIVER	UNK	DD	NA	No	No	NA	NA	0	0	1	0	0
OUOUKINSH RIVER	UNK	DD	NA	No	No	NA	NA	0	0	3	0	1
PARK RIVER	UNK	DD	NA	No	No	NA	NA	0	0	0	0	2
POWER RIVER	UNK	DD	NA	No	No	NA	NA	NA	NA	NA	NA	NA
SILVERADO CREEK	UNK	DD	NA	No	No	NA	NA	NA	NA	NA	NA	NA
SUCWOA RIVER	HIGH	DD	1995	No	No	NA	NA	0	1	23	0	0
TLUPANA RIVER	HIGH	DD	1995	No	No	NA	NA	0	0	29	0	2
TSOWWIN RIVER	UNK	DD	NA	No	No	NA	NA	0	0	11	0	3
MUCHALAT RIVER	HIGH	AGG	NA	No	No	NA	NA	1	0	5	0	0
OKTWANCH RIVER	UNK	AGG	NA	No	No	NA	NA	1	0	0	0	4
SILBURN CREEK	UNK	AGG	NA	No	No	NA	NA	NA	NA	NA	NA	NA
BLACK CREEK	UNK	DEL	NA	No	No	NA	NA	0	0	0	0	1
CACHALOT CREEK	UNK	DEL	NA	No	No	NA	NA	1	0	0	0	1
COUGAR CREEK	UNK	DEL	NA	No	No	NA	NA	NA	NA	NA	NA	NA
ELAINE CREEK	UNK	DEL	NA	No	No	NA	NA	NA	NA	NA	NA	NA
ELIZA EAST RIVER	UNK	DEL	NA	No	No	NA	NA	1	0	0	0	3
INNER BASIN RIVER	UNK	DEL	NA	No	No	NA	NA	0	0	0	0	2
JANSEN LAKE CREEK	UNK	DEL	NA	No	No	NA	NA	NA	NA	NA	NA	NA
KAPOOSE CREEK	UNK	DEL	NA	No	No	NA	NA	0	0	0	0	1
KENDRICK CREEK	UNK	DEL	NA	No	No	NA	NA	NA	NA	NA	NA	NA
MCCURDY CREEK	UNK	DEL	NA	No	No	NA	NA	NA	NA	NA	NA	NA
OWOSSITSA CREEK	UNK	DEL	NA	No	No	NA	NA	NA	NA	NA	NA	NA
PORRITT CREEK	UNK	DEL	NA	No	No	NA	NA	NA	NA	NA	NA	NA
TATCHU CREEK	UNK	DEL	NA	No	No	NA	NA	0	0	0	0	1

F.3 West Vancouver Island North Fall 0.x (CK-33)

F.3.1 Data Overview

Table F.7 summarizes the available data, and Figure F.3 shows the patterns over time. Section 4 describes the data classifications and usability assessments.

Table F.7. Data Overview for West Vancouver Island North Fall 0.x (CK-33)

CU_ID	CK-33
CU_Name	NWVI
SpnCategory	Rel_Idx
NumObs	29 (1985-2018)
StartYear	1996
NumSites	1 (0)
Gen	4 (4)
GenAvgWild	NA
Area	WCVI
Area2	WCVI/NEVI/USC
CWT	x (RBT)
ER_BY	0
Area	WCVI
MU	WCVI
AbsAbdMetric	DD
TrendMetric	DD
PercBM	DD
Source	New
Above1kWild	NA
BasedOn	NA

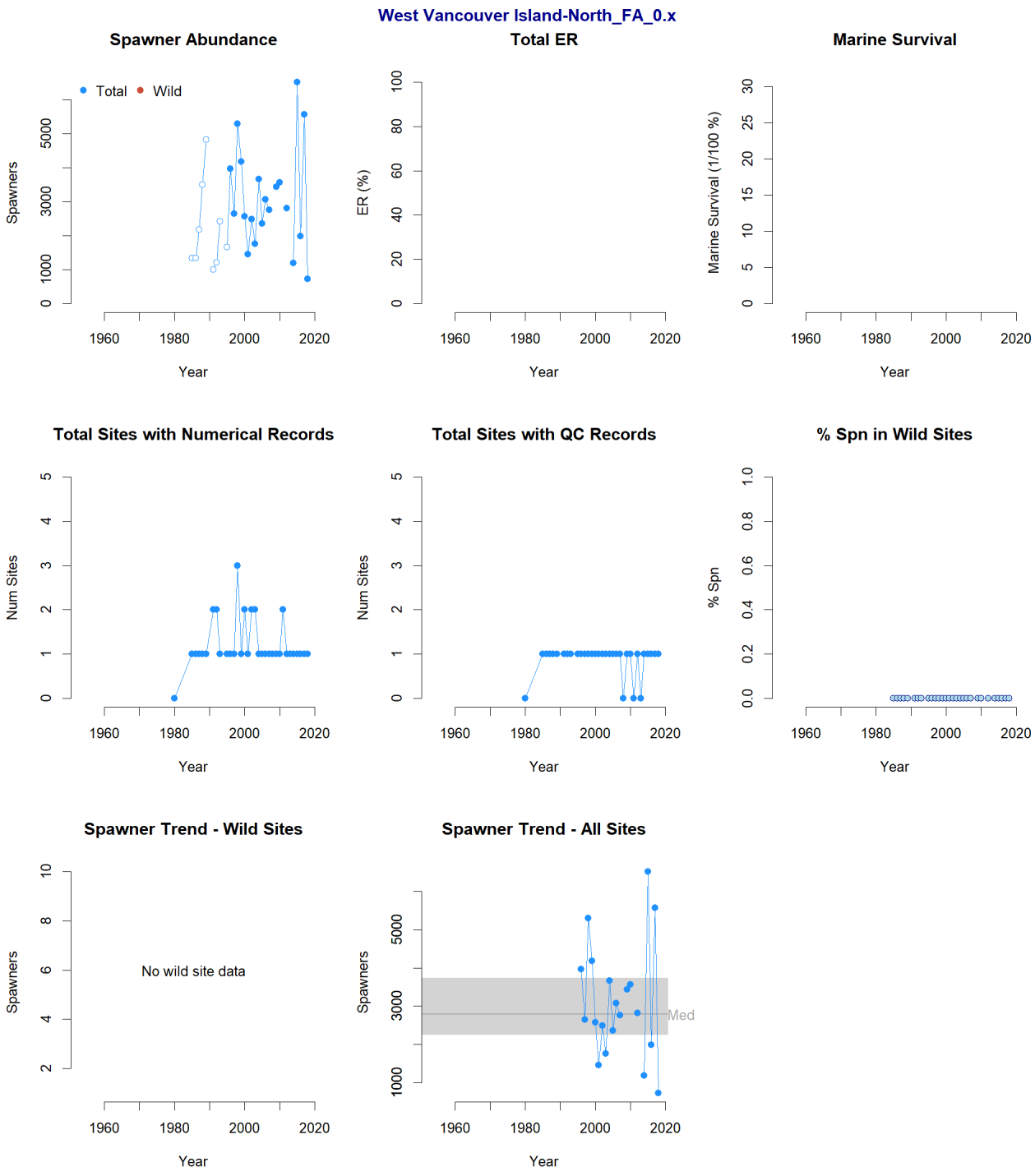

Figure F.3. : Available Data for West Vancouver Island North Fall 0.x (CK-33)

F.3.2 Data Notes

Spawner Estimates

There are many rivers in this TU that have persistent Chinook populations though only one (enhanced) site contributes to the spawner abundance time series. The CTC uses the Marble River as an escapement indicator stock.

The representativeness of the Marble River site for the entire CU is unclear. The majority of Chinook spawn downstream of a lake but spawning is known to occur in some of the tributaries to the lake also, though no estimates are made there.

Exploitation Rate Estimates

There is no exploitation rate indicator stock available within this CU. Results of a cohort analysis procedure applied to CWT recoveries of tagged releases from Robertson Creek Hatchery in CK-31 provide estimates of pre-terminal fishery impacts and other statistics such as maturations rates. See additional commentary under the Exploitation section for CK-31. Fisheries recovery rates from select CWT releases indicate a far north ocean distribution pattern that is similar to CK-31, with most fisheries recoveries occurring in Alaska and northern BC troll fisheries.

F.3.3 CWT Recoveries Overview

The *Mark Recovery Program Information System* (DFO 2020b) covers coded wire tag releases and recoveries for indicator and non-indicator systems. Table F.8 summarizes all tag recoveries for release sites matched to this CU, based on a database extract from July 2020. Recoveries are identified by region (e.g. BCYK = British Columbia and Yukon), then by marine (M) or freshwater (F), then by geography where applicable (N = North, S = South), and finally by sector or gear type.

Table F.8. Estimated CWT Recoveries - West Vancouver Island North Fall 0.x (CK-33)

RecoveredIn	n	Years
AK_M_N_Sport	18 (0-5)	11 (1986-2013)
AK_M_S_Sport	86 (0-39)	9 (1988-2013)
AK_Net and Seine	101 (0-23)	13 (1985-2010)
AK_Troll	1,036 (2-231)	17 (1985-2013)
BCYK_M_N_Net and Seine	133 (0-39)	11 (1984-1996)
BCYK_M_N_Sport	117 (2-28)	11 (1987-2013)
BCYK_M_N_Troll	646 (3-164)	13 (1985-2010)
BCYK_M_S_Net and Seine	17 (2-9)	3 (1987-1993)
BCYK_M_S_Sport	132 (3-26)	9 (1987-2010)
BCYK_M_S_Troll	160 (2-77)	9 (1986-2010)
WA_M_S_Sport	3 (3-3)	1 (1985-1985)

F.3.4 Site Overview

Table F.9 lists all the sites matched to this CU, and summarizes the available information. Enhancement level (*Enh*) and site category (*Cat*) are used for aggregating the site data (see sections 4.2.3 and 4.3 for definitions) . Only persistent (*P*) and extirpated (*EX*) sites are used in the aggregated time series. For the CU-level series, only sites with low or unknown enhancement level are included. For the Total Unit time series, all P and EX sites are combined. Some sites are used as indicators for escapement (*Esc*) or coded-wire tags (*CWT*). The table also shows the highest value (*Max*) and the year of the last available observation (*Last*) for the quality-filtered time series. The remaining columns list the number of observations in different quality categories, with definitions as per Section 4.2.1.

Table F.9. Site Overview for West Vancouver Island North Fall 0.x (CK-33)

Name	Enh	Cat	StYr	Esc	CWT	Max	Last	High	Mod	Other	Infill	Dropped
MARBLE RIVER	HIGH	P	1996	Yes	No	6516	2018	0	3	26	0	3
CAYEGHLE SYSTEM	HIGH	DD	NA	Yes	No	NA	NA	0	0	8	0	0
EAST CREEK	UNK	DD	NA	No	No	NA	NA	0	0	2	0	0
GOODSPEED RIVER	MOD	DD	NA	No	No	NA	NA	0	0	8	0	0
KEITH RIVER	UNK	DD	NA	No	No	NA	NA	0	0	2	0	0
KLASKISH RIVER	UNK	DD	NA	No	No	NA	NA	0	0	4	0	0
MAHATTA CREEK	UNK	DD	NA	No	No	NA	NA	NA	NA	NA	NA	NA
WASHLAWLIS CREEK	UNK	DD	NA	No	No	NA	NA	NA	NA	NA	NA	NA
BENSON RIVER	UNK	AGG	NA	No	No	NA	NA	0	0	0	0	3
UTLUH CREEK	UNK	AGG	NA	No	No	NA	NA	NA	NA	NA	NA	NA
DENAD CREEK	UNK	DEL	NA	No	No	NA	NA	0	0	0	0	1
GALATO CREEK	UNK	DEL	NA	No	No	NA	NA	NA	NA	NA	NA	NA
KLAYINA CREEK	UNK	DEL	NA	No	No	NA	NA	NA	NA	NA	NA	NA
KLOOTCHLIMMIS CREEK	UNK	DEL	NA	No	No	NA	NA	0	0	0	0	3
SAN JOSEF RIVER	UNK	DEL	NA	No	No	NA	NA	NA	NA	NA	NA	NA
STEPHENS CREEK	UNK	DEL	NA	No	No	NA	NA	0	0	0	0	1
WANOKANA CREEK	UNK	DEL	NA	No	No	NA	NA	NA	NA	NA	NA	NA

APPENDIX G CU Profiles - Other

G.1 Okanagan 1.x (CK-01)

CK-01 includes Chinook salmon spawning in the Canadian portion of the Okanagan River, above Osoyoos Lake. They were identified as a *Designatable Unit* (DU) by COSEWIC and as a *Conservation Unit* (CU) under the *Wild Salmon Policy*. Historically they were likely a part of a much larger reproductive unit spanning the Canada/US border, but COSEWIC (2006) identifies them as unique within Canada. They are now the *"last remaining Canadian population using the Columbia River.They they are geographically and reproductively isolated from other Canadian Chinook populations, with the nearest coastal population being 1400 km away."* (COSEWIC 2006).

Observed numbers of Okanagan Chinook have been very small, and very limited stock assessment has been done by DFO. However, there has been extensive stock assessment by local First Nations through the *Okanagan Nation Alliance* (ONA) fisheries program. Using ONA data, two status assessments have been completed by COSEWIC (2006: Threatened, 2017: Endagered) and 2 corresponding recovery potential assessments were peer-reviewed through DFO's CSAS process (COSEWIC 2006, 2017; Davis et al. 2019; DFO 2019a, 2019b). Okanagan Chinook were also assessed as *Red* status under the WSP (DFO 2016a).

This report describes DFO data holdings, summarized as quality-controlled time series. For Okanagan Chinook, this currently includes only 2 records: 5 fish in 1997 and 4 fish in 1998.

ONA assessments have generated a time series starting the early 2000s. DFO (2019b) states that *"Area-under-the-curve escapement estimates for Okanagan Chinook averaged nine non-adipose clipped individuals from 2009 – 2012, then averaged 50 individuals from 2013-2017. In 2018, the escapement estimate was 10 individuals."*

The PSC began an *Ad-hoc Working Group* in 2019 to review available information for Okanagan Chinook (Matylewich et al. 2019). Their Appendix B describes the methods used to estimate ER for Okanagan Yearling Summer Chinook, based on the Similkameen (SMK) indicator stock. Further work is required to determine whether the resulting estimates are equivalent to the ER series for other CUs in this report, and the Okanagan estimates are therfore not included in Figure G.1.

G.1.1 Data Overview

Note: This summary is based on DFO data holdings. For recent estimates developed by ONA, refer to Davis et al. (2019).

Table G.1. Data Overview for Okanagan 1.x (CK-01)

CU_ID	CK-01
CU_Name	OK
SpnCategory	Rel_Idx
NumObs	2 (1997-1998)
StartYear	2001
NumSites	1 (1)
Gen	4 (4.49)
GenAvgWild	NA
Area	CR
Area2	GS+OK
CWT	x (SMK)
ER_BY	0
Area	Columbia
MU	NA
AbsAbdMetric	NO
TrendMetric	NO
PercBM	NO
Source	New
Above1kWild	NA
BasedOn	NA

G.1.2 CWT Recoveries Overview

The *Mark Recovery Program Information System* (DFO 2020b) covers coded wire tag releases and recoveries for indicator and non-indicator systems. Table G.2 summarizes all tag recoveries for release sites matched to this CU, based on a database extract from July 2020. Recoveries are identified by region (e.g. BCYK = British Columbia and Yukon), then by marine (M) or freshwater (F), then by geography where applicable (N = North, S = South), and finally by sector or gear type.

Table G.2. Estimated CWT Recoveries - Okanagan 1.x (CK-01)

RecoveredIn	n	Years
None	0	None

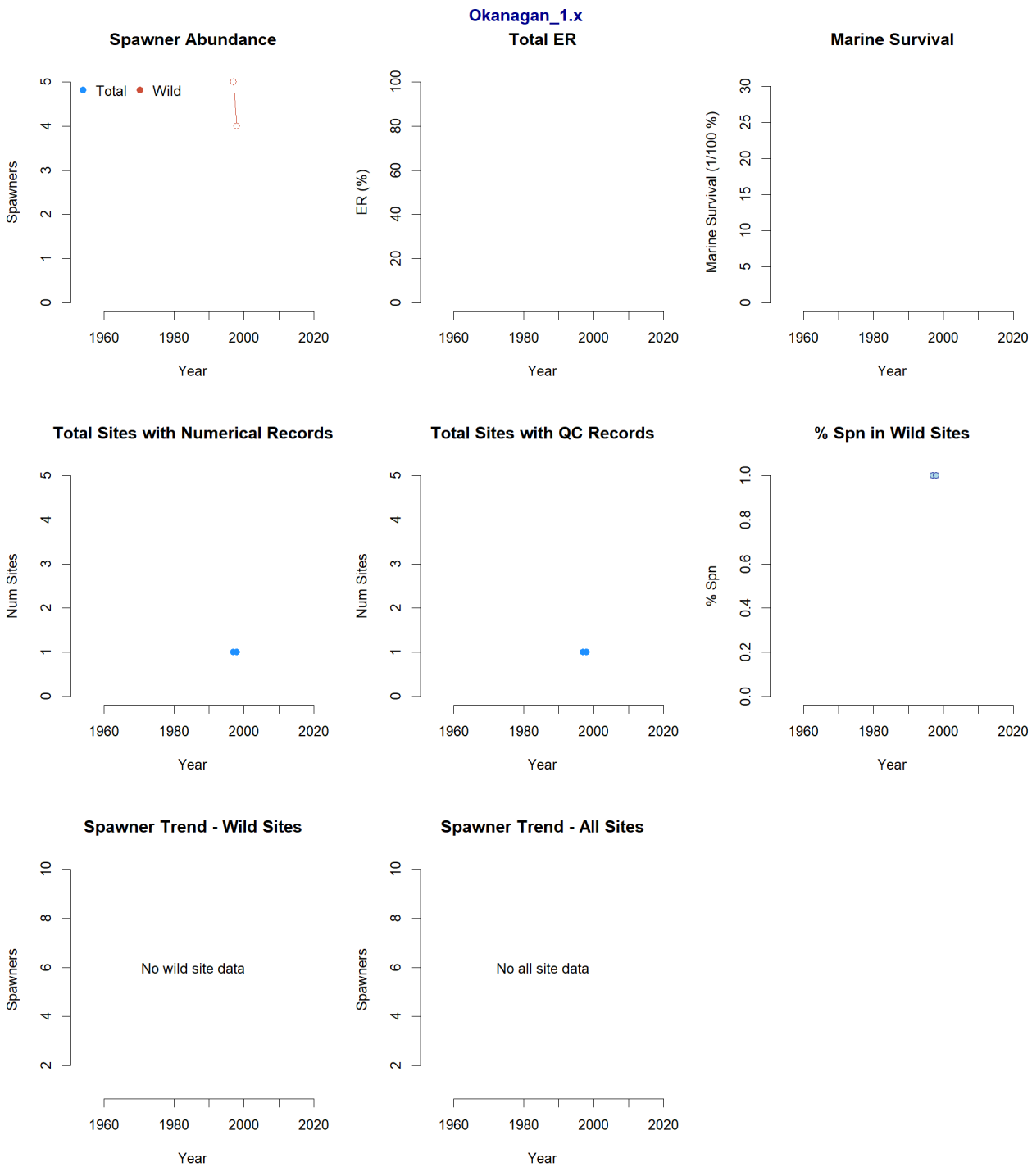

Figure G.1. : Available Data for Okanagan 1.x (CK-01)

G.1.3 Site Overview

Table G.3 list all the sites matched to these four CUs, and summarizes the available information. Enhancement level (*Enh*) and site category (*Cat*) are used for aggregating the site data (see sections 4.2.3 and 4.3 for definitions) . Only persistent (*P*) and extirpated (*EX*) sites are used in the aggregated time series. For the CU-level series, only sites with low or unknown enhancement level are included. For the Total Unit time series, all P and EX sites are combined. Some sites are used as indicators for escapement (*Esc*) or coded-wire tags (*CWT*). The table also shows the highest value (*Max*) and the year of the last available observation (*Last*) for the quality-filtered time series. The remaining columns list the number of observations in different quality categories, with definitions as per Section 4.2.1.

Note: This summary is based on DFO data holdings. For recent estimates developed by ONA, refer to Davis et al. (2019) .

Table G.3. Site Overview for Okanagan 1.x (CK-01)

CU	Name	Enh	Cat	StYr	Esc	CWT	Max	Last	High	Mod	Other	Infill	Dropped
CK-01	OKANAGAN RIVER	UNK	P	2001	No	No	5	1998	0	0	2	0	0

G.2 Hatchery Exclusions, Cross-CU Supplementations, and Transplants (CK-900X)

G.2.1 Purpose of the "9000 Series" CU delineations

Some of the survey sites have a documented history of multiple releases of non-local fish transferred in from other locations (i.e., stocks) and it is unknown whether the native stock has persisted. For these cases, the overall enhancement activity rating is assumed HIGH but is assigned the special category of *HIGH-CROSS_CU*. These cases have been aggregated within CUs CK-9005, CK-9006, CK-9007 and CK-9008 depending on the geographic location of the spawning site where the releases occurred.

These *HIGH-CROSS* CUs were excluded from the WSP or COSEWIC assessments (Sec. 3.3), but do contribute to the aggregate abundance indices used for fisheries management (Sec. 3.2). Formal criteria for assessing enhanced contribution to salmon conservation units have recently been accepted through the CSAS peer-review process (Withler et al. 2018), but implementation details for the applied calculations are still being developed.

For the purposes of this paper, we have opted to retain the site-based classifications of enhancement level used in the WSP status assessment (DFO 2016a), as described in Section 4.3, rather than the estimates of *percent natural influence* (PNI) recommended by Withler et al. (2018), which are preliminary at this point and have not been peer-reviewed. Using the site-based enhancement classifications and the associated definitions of *Total Unit*, *Enhanced Unit*, and *Conservation Unit*, as per Section 4.4.5, there is no data for the CU component of the 9000 series. There is, however, some abundance information for the TU of Fraser-Harrison fall transplant FA 0.3 (CK-9008), which is included in Figure G.2.

Table G.4 summarizes the 9000 series CUs. The rest of this section provides brief commentary on each of these CUs, and includes available information (i.e. site summary, overview of CWT recoveries).

Table G.4. Data Summary for 9000 Series Chinook CUs

	CK-9005	CK-9006	CK-9007	CK-9008
CU_Name	sBC-misc	FR-XCU	sBC-XCU	Chil_transp_FA
SpnCategory	TBD	TBD	TBD	Rel_Idx
NumObs	0	0	0	35 (1984-2018)
StartYear	1995	2002	1995	1986
NumSites	0 (0)	0 (0)	0 (0)	1 (0)
Gen	3 (4)	3 (3.48)	4 (4)	3 (3.48)
Area2				Fraser-Lower
CWT	x ()	x ()	x ()	CHI
ER_BY	0	0	0	33 (1981-2013)
Area	Other	Other	Other	Other
MU	TBD	TBD	TBD	FrFa41
AbsAbdMetric	DD	DD	DD	DD
TrendMetric	DD	DD	DD	DD
PercBM	DD	DD	DD	DD
Source	New	New	New	New
Above1kWild	NA	NA	NA	NA
BasedOn	NA	NA	NA	NA

G.2.2 Southern BC-miscellaneous (CK-9005)

CK-9005 includes one small stream. Chinook returning to the site are the result of historical transfers from outside the CU.

Salmon access to Shawnigan Creek is prevented by a natural barrier at tidewater. Chinook were introduced to this system and now a community enhancement group operates a salmon collection facility there. Some salmon are used for brood stock and others are released upstream of the barrier.

Only four observations of unknown quality exist for the entire time series and these range from only 1-30 spawners. There are no spawner estimates for CK-9005 in the quality-controlled data set, and there are no records of CWT recoveries.

G.2.3 Fraser-Cross-CU Supplementation Exclusion (CK-9006)

This CU is comprised of an amalgamated stock resulting from several transfers of spring and summer Chinook stocks from the middle and upper Fraser River.

The Chehalis River historically supported an indigenous spring Chinook stock (part of CK-04, Lower Fraser Spring), but it must be clearly noted that the transplanted stock is not the same stock. Local knowledge indicates that the indigenous stock can be differentiated by genetics, spawn timing and spawn location (D Willis, DFO SEP, Vancouver, BC, pers. comm.).

The Alouette and Stave sites are primarily from transplants of CK-03 (Harrison River) origin.

There are no spawner estimates for CK-9006 in the quality-controlled data set, but there are records of CWT recoveries. Select CWT releases in the 2000s indicate an offshore ocean distribution with most recoveries in WCVI and southern US troll and sport fisheries. Some recoveries also came from Strait of Georgia sport fisheries. This pattern is similar to that seen in CK-03 and CK-9008.

Some observations of spawners in the Stave River and the Chehalis River exist. These are not presented because either the estimate classification is unknown or low, or the observations occurred after the transfers of non-indigenous Chinook and the identity of the spawners is uncertain.

G.2.4 Southern BC-Cross-CU Supplementation Exclusion (CK-9007)

CK-9007 combines the *High-Cross* sites on the Sunshine Coast (Sliammon, Chapman & Lang), which are transplants from the Big Qualicum River. The Capilano River site was initially stocked with transplants from Big Qualicum as well, but there have been considerable transplants from elsewhere through the 1990s. Currently the Capilano site is comprised exclusively of Chilliwack fall-origin transplants (CK-9008). The stock that was native to each system is believed to have been extirpated.

There are no spawner estimates for CK-9007 in the quality-controlled data set, but there are records of CWT recoveries.

The escapement data are generally of poor quality for most years and sites in CK-9007. For example, Capilano River Hatchery has received and transplanted Chinook stock from many sources, both within and outside of the CU, and of varying life history traits. Annual records of the fish spawned in the hatchery are maintained but observations of spawners in the river have not been made. Historical records are not available to determine the extent to which survey sites in this CU were utilized by Chinook Salmon prior to the enhancement programs.

Fisheries recoveries from select CWT releases indicate a local ocean distribution pattern with most recoveries in Strait of Georgia sport fisheries

G.2.5 Fraser-Harrison fall transplant FA 0.3 (CK-9008)

CK-9008CK-03 (Harrison River) origin. Annual releases from Chilliwack River Hatchery into Chilliwack River are at one million subyearling smolts currently (since 2010), and ranged from 1.2 million to two million since 1993 (except 2001 where there was no brood stock collected). Prior to 1993 (back to 1982), releases ranged from 100,000 to one million.

Although it is considered a transplanted stock (part of the CK-9000 series of southern BC Chinook CUs), this CU consists of one survey site (Chilliwack River) established from successful historical transfers of juveniles from the Harrison River (CK-03, Lower Fraser River_FA_0.3). Prior to these transfers, a fall run of Chinook Salmon is not known to have existed in the

Chilliwack River despite close proximity to the donor site.

Note that Chilliwack has used returns to the river for broodstock for many years, not new transplants from Harrison. However, there is virtually no natural production from these transplants in the Chilliwack, based on habitat characteristics and the frequency of spawn retention in females.

Exploitation rates are monitored at the Chilliwack River using coded wire tags. This CU has a local distribution mainly in the Salish Sea, WCVI and coastal Washington. However, some individuals have been caught as far south as California and as far north as Alaska.

There are spawner estimates for CK-9008 in the quality-controlled data set (Figure G.2), and there are records of CWT recoveries.

G.2.6 Data Plots

A quality-controlled time series is available for one of the four High-Cross Southern BC Chinook CUs (Ck-9008).

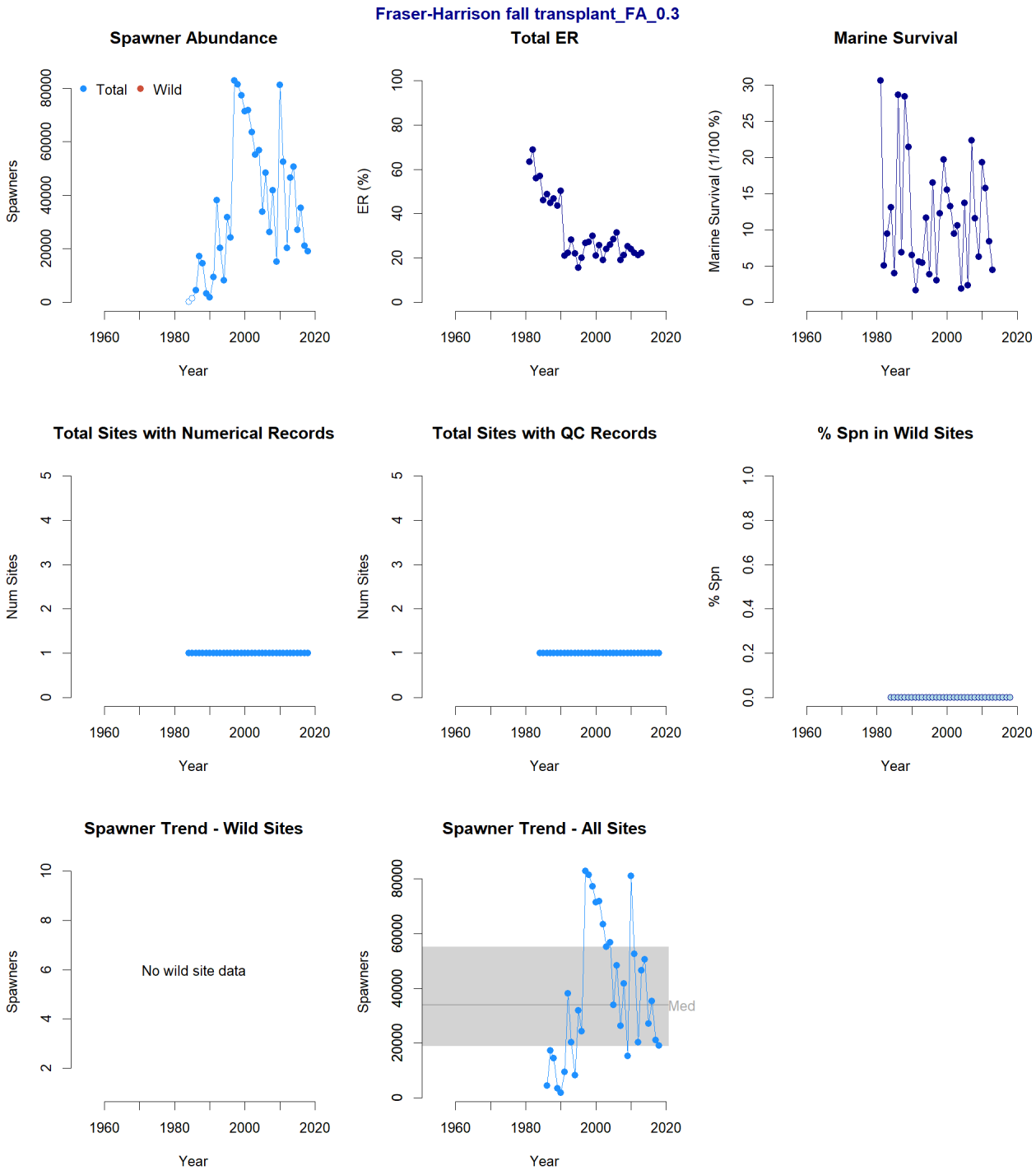

Figure G.2. : Available Data for Fraser-Harrison fall transplant 0.3 (CK-9008)

G.2.7 Site Overview

Table G.5 list all the sites matched to these four CUs, and summarizes the available information. Enhancement level (*Enh*) and site category (*Cat*) are used for aggregating the site data (see sections 4.2.3 and 4.3 for definitions) . Only persistent (*P*) and extirpated (*EX*) sites are used in the aggregated time series. For the CU-level series, only sites with low or unknown enhancement level are included. For the Total Unit time series, all P and EX sites are combined. Some sites are used as indicators for escapement (*Esc*) or coded-wire tags (*CWT*). The table also shows the highest value (*Max*) and the year of the last available observation (*Last*) for the quality-filtered time series. The remaining columns list the number of observations in different quality categories, with definitions as per Section 4.2.1.

Table G.5. Site Overview for 9000 Series Chinook CUs

CU	Name	Enh	Cat	StYr	Esc	CWT	Max	Last	High	Mod	Other	Infill	Dropped
CK9005	SHAWNIGAN CREEK	HIGHCROSS_CU	DD	NA	No	No	NA	NA	NA	NA	NA	NA	NA
CK9006	STAVE RIVER	HIGHCROSS_CU	P	2002	No	No	1588	2015	0	4	12	0	14
CK9006	ALOUETTE RIVER	HIGHCROSS_CU	EX	NA	No	No	NA	NA	NA	NA	NA	NA	NA
CK9006	CHEHALIS RIVER	HIGHCROSS_CU	DD	NA	No	No	NA	NA	0	0	26	0	7
CK9007	CAPILANO RIVER	HIGHCROSS_CU	P	1990	Yes	No	2075	2018	0	0	36	5	3
CK9007	LANG CREEK	HIGHCROSS_CU	P	1990	Yes	No	2323	2018	0	0	28	1	1
CK9007	SLIAMMON CREEK	HIGHCROSS_CU	P	1990	No	No	337	2018	1	1	24	2	0
CK9007	CHAPMAN CREEK	HIGHCROSS_CU	DD	NA	No	No	NA	NA	0	0	7	0	2
CK9008	CHILLIWACK/VEDDER RIVER	HIGH	P	1986	No	Yes	82805	2018	0	2	33	0	0

G.2.8 CWT Recoveries Overview

The *Mark Recovery Program Information System* (DFO 2020b) covers coded wire tag releases and recoveries for indicator and non-indicator systems. The tables in this section summarize all tag recoveries for release sites matched to this CU, based on a database extract from July 2020. Recoveries are identified by region (e.g. BCYK = British Columbia and Yukon), then by marine (M) or freshwater (F), then by geography where applicable (N = North, S = South), and finally by sector or gear type.

Coded-wire tag recoveries are available for three of the four High-Cross Southern BC Chinook CUs (Ck-9006, Ck-9007, Ck-9008).

Table G.6. Estimated CWT Recoveries - Southern BC-miscellaneous (CK-9005)

RecoveredIn	n	Years
None	0	None

Table G.7. Estimated CWT Recoveries - Fraser-Cross-CU Supplementation Exclusion (CK-9006)

RecoveredIn	n	Years
AK_M_N_Sport	5 (5-5)	1 (1988-1988)
AK_Net and Seine	3 (0-2)	4 (1991-2000)
AK_Troll	119 (0-18)	18 (1986-2006)
BCYK_F_Sport	111 (4-14)	15 (1984-2000)
BCYK_F_S_Net and Seine	555 (0-137)	16 (1990-2006)
BCYK_M_N_Net and Seine	191 (2-38)	14 (1984-1997)
BCYK_M_N_Sport	72 (2-21)	9 (1986-2005)
BCYK_M_N_Troll	197 (2-40)	15 (1985-2006)
BCYK_M_S_Net and Seine	680 (1-161)	14 (1984-2002)
BCYK_M_S_Sport	4,395 (5-604)	25 (1984-2008)
BCYK_M_S_Troll	5,296 (0-692)	24 (1984-2008)
OR_M_S_Sport	5 (5-5)	1 (2001-2001)
OR_M_S_Troll	305 (3-61)	18 (1985-2006)
OR_Sport	3 (3-3)	1 (1989-1989)
WA_M_Sport	4 (4-4)	1 (1985-1985)
WA_M_N_Net and Seine	748 (0-182)	21 (1984-2005)
WA_M_N_Sport	167 (4-28)	12 (1985-2004)
WA_M_N_Troll	362 (3-83)	9 (1987-1996)
WA_M_S_Net and Seine	186 (3-37)	15 (1984-2005)
WA_M_S_Sport	1,065 (2-135)	24 (1984-2007)
WA_M_S_Test Fisheries	2 (2-2)	1 (1991-1991)
WA_M_S_Troll	2,023 (5-358)	20 (1988-2007)

Table G.8. Estimated CWT Recoveries - Southern BC-Cross-CU Supplementation Exclusion (CK-9007)

RecoveredIn	n	Years
AK_M_N_Sport	7 (0-7)	2 (1986-1989)
AK_M_S_Sport	2 (2-2)	1 (1987-1987)
AK_Net and Seine	50 (0-18)	12 (1978-2000)
AK_Troll	315 (0-30)	25 (1976-2017)
BCYK_F_Sport	131 (3-37)	12 (1979-2019)
BCYK_F_S_Net and Seine	4 (4-4)	1 (1993-1993)
BCYK_M_N_Net and Seine	2,063 (1-372)	23 (1975-1997)
BCYK_M_N_Sport	270 (1-44)	20 (1975-2017)
BCYK_M_N_Troll	2,551 (2-547)	25 (1975-2018)
BCYK_M_S_Net and Seine	3,904 (1-845)	25 (1975-2017)
BCYK_M_S_Sport	18,446 (35-2334)	32 (1975-2018)
BCYK_M_S_Troll	7,895 (3-1075)	30 (1975-2018)
OR_M_S_Sport	3 (3-3)	1 (2002-2002)
OR_M_S_Troll	73 (1-20)	7 (1996-2003)
OR_Net and Seine	2 (2-2)	1 (1984-1984)
WA_M_N_Net and Seine	459 (1-170)	21 (1975-2002)
WA_M_N_Sport	14 (2-7)	3 (1983-2017)
WA_M_N_Troll	11 (1-4)	4 (1988-1999)
WA_M_S_Net and Seine	55 (2-19)	9 (1976-2000)
WA_M_S_Sport	317 (2-36)	21 (1975-2018)
WA_M_S_Troll	381 (2-84)	15 (1981-2018)
WA_Net and Seine	14 (14-14)	1 (1976-1976)
WA_Troll	4 (4-4)	1 (1983-1983)

Table G.9. Estimated CWT Recoveries - Fraser-Harrison fall transplant 0.3 (CK-9008)

RecoveredIn	n	Years
AK_M_N_Sport	2 (0-2)	2 (1990-2019)
AK_M_S_Sport	18 (0-11)	3 (1985-1991)
AK_Net and Seine	17 (0-4)	10 (1984-2019)
AK_Test Fisheries	1 (1-1)	1 (1986-1986)
AK_Troll	394 (1-90)	29 (1984-2019)
BCYK_F_Sport	7,501 (21-796)	37 (1983-2019)
BCYK_F_S_Aboriginal	608 (16-207)	6 (2011-2019)
BCYK_F_S_Net and Seine	1,226 (6-138)	20 (1990-2010)
BCYK_M_N_Net and Seine	295 (3-46)	17 (1983-2013)
BCYK_M_N_Sport	224 (1-26)	25 (1983-2019)
BCYK_M_N_Troll	699 (0-254)	30 (1983-2019)
BCYK_M_S_Net and Seine	1,912 (1-463)	27 (1983-2019)
BCYK_M_S_Sport	15,462 (55-1236)	37 (1983-2019)
BCYK_M_S_Test Fisheries	8 (8-8)	1 (2019-2019)
BCYK_M_S_Troll	14,063 (19-2001)	36 (1983-2019)
OR_M_S_ Shoreside comp. (OR/WA)	1 (0-1)	4 (2010-2015)
OR_M_S_Sport	22 (2-6)	6 (1984-2012)
OR_M_S_Troll	490 (2-67)	28 (1984-2018)
OR_Net and Seine	2 (2-2)	1 (2007-2007)
OR_Sport	5 (5-5)	1 (2012-2012)
WA_M_Sport	25 (1-11)	5 (1983-2012)
WA_M_N_Net and Seine	1,701 (0-239)	34 (1983-2018)
WA_M_N_Sport	273 (2-45)	24 (1983-2018)
WA_M_N_Test Fisheries	4 (1-1)	4 (1994-2016)
WA_M_N_Troll	618 (2-170)	17 (1984-2015)
WA_M_S_Net and Seine	674 (2-80)	31 (1983-2018)
WA_M_S_Sport	3,836 (15-434)	37 (1983-2019)
WA_M_S_Troll	7,849 (2-902)	36 (1984-2019)
WA_Troll	3 (3-3)	1 (1983-1983)

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