Fisheries and Oceans Canada | Pêches et Océans Canada
Ecosystems and Oceans Science | Sciences des écosystèmes et des océans

Pacific Region

Canadian Science Advisory Secretariat
Science Advisory Report 2020/023

RECOVERY POTENTIAL ASSESSMENT FOR 11 DESIGNATABLE UNITS OF FRASER RIVER CHINOOK SALMON, *ONCORHYNCHUS TSHAWYTCHA*, PART 1: ELEMENTS 1 TO 11

Chinook Salmon adult spawning phase. Image credit: Fisheries and Oceans Canada

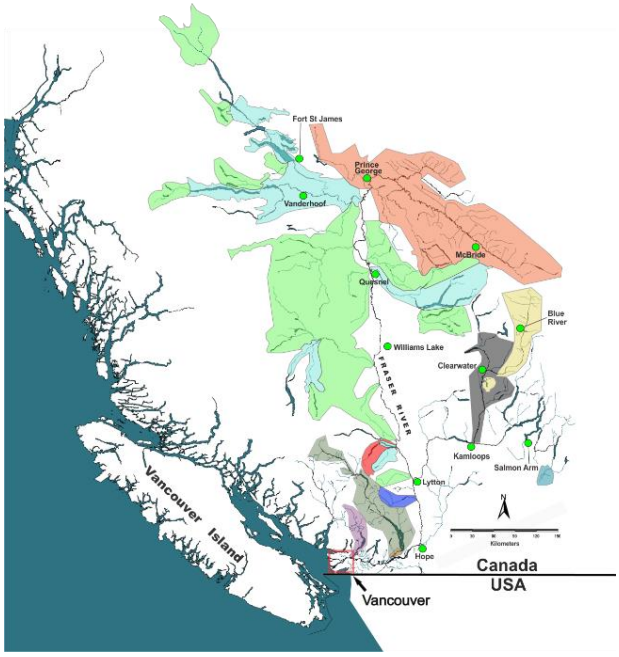

Figure 1. Map of the Fraser River watershed from the Fraser River mouth to the Upper Fraser River near Tête Jaune Cache, British Columbia.

Context:

Eleven populations of southern BC Chinook Salmon that spawn in the Fraser River drainage were designated as either Threatened or Endangered in November 2018 by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). DFO Science was asked to complete a Recovery Potential Assessment (RPA) to provide science advice to inform the potential addition of these Fraser populations to Schedule 1 of the Species at Risk Act (SARA). The advice in the RPA will be used to inform both scientific and socio-economic aspects of the listing process, development of a recovery strategy and action plan, support decision making with regards to the issuance of permits or agreements, and the formulation of exemptions and related conditions. The advice generated via this process will update and/or consolidate any existing advice regarding these populations of southern BC Chinook Salmon.

This Science Advisory Report is from the December 10-12, 2019 regional peer review on the Recovery Potential Assessment – Fraser River Chinook Salmon (Oncorhynchus tshawytscha) – Eleven Designatable Units (Elements 1 to 11). Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

May 2020

Canada

SUMMARY

- This is the first of two parts of a Recovery Potential Assessment (RPA) for 11 Designatable Units (DUs) of southern BC Chinook Salmon that spawn in the Fraser River watershed. The primary focus of this portion of the RPA was to assess threats that may be limiting the survival and recovery of these DUs.
- DUs were assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in November 2018, and four of which were designated as *Threatened* and seven were designated as *Endangered*. Declining trends in abundance have continued for these DUs since the COSEWIC assessment. The assessed DUs are:
    - Lower Fraser River Ocean Fall (DU2)
    - Lower Fraser River Stream Summer - Upper Pitt (DU4)
    - Lower Fraser River Stream Summer (DU5)
    - Middle Fraser River Stream Spring - Nahatlatch (DU7)
    - Middle Fraser River Stream Fall - Portage (DU8)
    - Middle Fraser River Stream Spring (DU9)
    - Middle Fraser River Stream Summer (DU10)
    - Upper Fraser River Stream Spring (DU11)
    - South Thompson Stream Summer - Bessette (DU14)
    - North Thompson Stream Spring (DU16)
    - North Thompson Stream Summer (DU17)
- Redds, the spawning nests constructed by Pacific salmon and other fish species, meet the definition of a “residence” under the *Species at Risk Act* (SARA).
- For each DU the COSEWIC threats calculator was used to assess 33 ongoing and future threats on population trends over the next three generations. The highest ranked anthropogenic threats to all assessed DUs were climate change, modification to ecosystems, pollution, and fishing.
- The overall threat ranking for all DUs was either Extreme or Extreme–High based on the number and severity of the threats.
- Climate change is anticipated to negatively impact all DUs through changes to physical and biological processes in both marine and freshwater environments and through interactions with other threats.
- There was a wide range in the threat risk posed by fishing-related mortality on population trends due to uncertainty about future fishing-related mortality, implementation uncertainty, and effects of other threats on productivity. In Part 2 of the RPA, quantitative modelling will be used to assess the impacts of fishing and other threats on population trends.
- For all DUs, and in particular for the Middle Fraser River Stream Spring and South Thompson Stream Summer (Bessette) DUs, threats posed by ecosystem modifications to both catchment surfaces and streamflow due to water withdrawals, fire, logging, and agricultural and urban development are expected to adversely affect population trends.
- Pollution from many diverse sources was assessed to be a pervasive threat for all DUs, but

the cumulative effect on population trends was identified as a knowledge gap.

- The 2018 Big Bar landslide in the mainstem Fraser River poses an additional threat to three DUs (Middle Fraser River Stream Spring, Middle Fraser River Stream Summer, Upper Fraser River Stream Spring) that spawn upstream of the slide. These DUs are unlikely to persist if this barrier is not removed.
- Information gaps identified during the threats assessment were the main cause of difficulty in assessing the magnitude of impact of many threats.

INTRODUCTION

Rationale for Recovery Potential Assessment

After the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses an aquatic species as *Threatened, Endangered* or *Extirpated*, Fisheries and Oceans Canada (DFO), as the responsible jurisdiction for aquatic species under the *Species at Risk Act* (SARA), undertakes several actions to support implementation of the Act. Many of these actions require scientific information on the current status of the species, threats to its survival and recovery, and the species' potential for recovery. Formulation of this scientific advice has typically been developed through a Recovery Potential Assessment (RPA) following the COSEWIC assessment. This timing allows for the consideration of peer-reviewed scientific analyses into SARA processes, including the decision whether or not to list a species on Schedule 1, and during recovery planning if the species is listed.

In November 2018, COSEWIC (2018) assessed the status of 16 of 28 Chinook Salmon DUs in southern BC that were considered to have received no or little artificial supplementation over the past three generations, or were previously considered by DFO to have insufficient data for assessment. This assessment led to the status assignment of 8 DUs as *Endangered*, 4 as *Threatened*, 1 as *of Special Concern,* and 1 as *Not at Risk*. Two DUs were deemed to have insufficient data for assessment. This RPA covers 11 of the DUs assessed by COSEWIC that spawn in the Fraser River drainage (hereby referred to as FRC), all of which were designated as being either *Threatened* or *Endangered* (Table 1). All 11 DUs covered in this RPA correspond to a single Wild Salmon Policy Conservation Unit (CU), therefore there are no COSEWIC-recognized sub-populations at this time. These 11 DUs are widely distributed throughout the Lower (DUs 2,4, 5), Middle (DUs 7, 8, 9, and 10), and Upper Fraser rivers (DU11), as well as the North (DUs 16 and 17) and South Thompson rivers (DU14). Three of the DUs (DUs 2, 7 and 8) have single spawning sites, while the others have spawning in multiple river systems.

Table 1. Fraser River Chinook Salmon Designatable Units (DU) covered in this RPA, and their relation to Wild Salmon Policy Conservation Units (CU) and fisheries Management Units (MU).

MU	CU	DU	DU Name	COSEWIC Status
Spring 5_2	CK-08	DU7	Middle Fraser River Stream Spring (MFR-Nahatlatch)	Endangered
	CK-10	DU9	Middle Fraser River Stream Spring (MFR-Spring)	Threatened
	CK-12	DU11	Upper Fraser River Stream Spring (UFR-Spring)	Endangered
	CK-18	DU16	North Thompson Stream Spring (NTh-Spring)	Endangered
Summer 5_2	CK-05	DU4	Lower Fraser River Stream Summer (LFR-Upper Pitt)	Endangered

MU	CU	DU	DU Name	COSEWIC Status
	CK-06	DU5	Lower Fraser River Stream Summer (LFR-Summer)	Threatened
	CK-09	DU8	Middle Fraser River Stream Fall (MFR-Portage)	Endangered
	CK-11	DU10	Middle Fraser River Stream Summer (MFR-Summer)	Threatened
	CK-19	DU17	North Thompson Stream Summer (NTh-Summer)	Endangered
Spring 4_2	CK-16	DU14	South Thompson Stream Summer (STh-Bessette)	Endangered
Fall 4_1	CK-03	DU2	Lower Fraser River Ocean Fall (LFR-Harrison)	Threatened

This RPA is the first of two parts for the 11 FRC DUs considered in the COSEWIC (2018) assessment. The primary focus for this portion of the RPA was to assess threats that may be limiting the survival and recovery of these populations, and covers Elements 1 to 11 as outlined by DFO in the Terms of Reference (TOR) for completing RPAs on aquatic species at risk (DFO 2014a[1]). This includes: a summary of FRC biology, abundance, distribution, and recent life history parameters, a summary of FRC habitat and residence requirements, and an assessment of threats and limiting factors to the survival and recovery of these populations. The second part of the RPA will cover Elements 12 to 22 in the TOR and will include: recovery targets and forward projections (data permitting), discussion of scenarios for mitigation of threats and potential alternatives to current activities, and an assessment of allowable harm.

Biology, Abundance, Distribution and Life History Parameters

Chinook Salmon are the largest Pacific salmon species and have an anadromous life cycle that uses both freshwater and ocean habitats. Chinook Salmon spawn in the fall, yet their return to freshwater may precede spawning by days to several months dependent on migration distances and hydrological conditions required to access terminal spawning areas. FRC populations are designated as spring, summer, or fall return populations depending on the time in which more than 50% of spawners pass through the lower Fraser River during their return migration. All return timing groups are represented by DUs assessed in this RPA (Table 2). DU8 (MFR-Portage) is unusual in that, while it has a stream-type life history, its return timing is the latest observed among the stream-type Chinook Salmon populations in the Fraser and more typical of the timing of some of the coastal ocean-type fall Chinook Salmon around the Georgia Basin.

Table 2. Run timing designation, migration timing, and mean generation time for FRC DUs covered in RPA.

Run Timing Designation	Migration Timing	Fraser Chinook DU	Mean Generation Time (years)
Spring	≥ 50% of the spawners pass through the Lower Fraser River by July 15	DU7 – MFR-Nahatlatch	4.5
		DU9 – MFR-Spring	4.5
		DU11 – UFR-Spring	4.5

[1] DFO. 2014a. Guidance for the Completion of Recovery Potential Assessments (RPA) for Aquatic Species at Risk. 30 pp.

Run Timing Designation	Migration Timing	Fraser Chinook DU	Mean Generation Time (years)
		DU16 – NTh-Spring	4.5
Summer	≥ 50% of the spawners pass through the Lower Fraser River between July 15 and August 31	DU4 – LFR-Upper Pitt	4.5
		DU5 – LFR-Summer	4.5
		DU10– MFR-Summer	4.5
		DU14 – STh-Bessette	4.0
		DU17 – NTh-Summer	4.5
Fall	≥ 50% of the spawners pass through the Lower Fraser River after August 31	DU2 – LFR-Harrison	3.8
		DU8 – MFR-Portage	4.5

Over a period of one to several days, female Chinook Salmon construct several redds in succession upstream, depositing a group of eggs in each that are fertilized by one or more males. All adults die after spawning. The length of time required for egg incubation is highly dependent on water temperature, and under ideal conditions, eggs incubate for roughly 1 to 4 months before hatching. After hatching and emergence from spawning beds, juvenile freshwater behaviour falls along a spectrum that can be categorized into two different “types”. In general, Chinook fry emerge from spawning gravels in the spring and either migrate to the ocean within the first five months (designated as ocean-type Chinook Salmon), or rear in freshwater for one or more years before migrating to the ocean (designated as stream-type Chinook Salmon). DU2 (LFR-Harrison) is the only ocean-type population discussed in this RPA, and it should be noted this population is unique within the Fraser River drainage in that the fry migrate immediately to the Fraser River estuary following emergence.

The majority of FRC DUs considered in this RPA are from the Spring and Summer 5_2 Management Units (MUs), which have mean generation times of 4.5 years. The exceptions to this are DU14 (STh-Bessette) and DU2 (LFR-Harrison), which have mean generation times of 4 years and 3.8 years respectively (Table 2).

It is difficult to estimate the annual number of spawners (known as “escapement”) for many FRC DUs due to the large geographic range, remote spawning locations, and limited resources for surveys. As a result, there is currently no comprehensive source of distributional data for FRC. Ten of 11 DUs assessed in this report rely on relative escapement data from visual surveys, whereas DU2 (LFR-Harrison) has absolute abundance data from a long-standing mark-recapture program. An update from the COSEWIC (2018) population trend assessment using additional data from 2016 to 2018 illustrates escapement trends have continued to decline for all DUs. DU4 (LFR-Upper Pitt) is the only DU that has a more gradual declining trend over the whole time series than the COSEWIC report; however, relative escapement remains less than 200 fish. Trends in spawner abundances were calculated over two different ranges: (1) the rate of change over the last three generations based only on the last three generations of data; and (2) the rate of change over the last three generations based on the trend over the whole time series (Figure 2a & 2b).

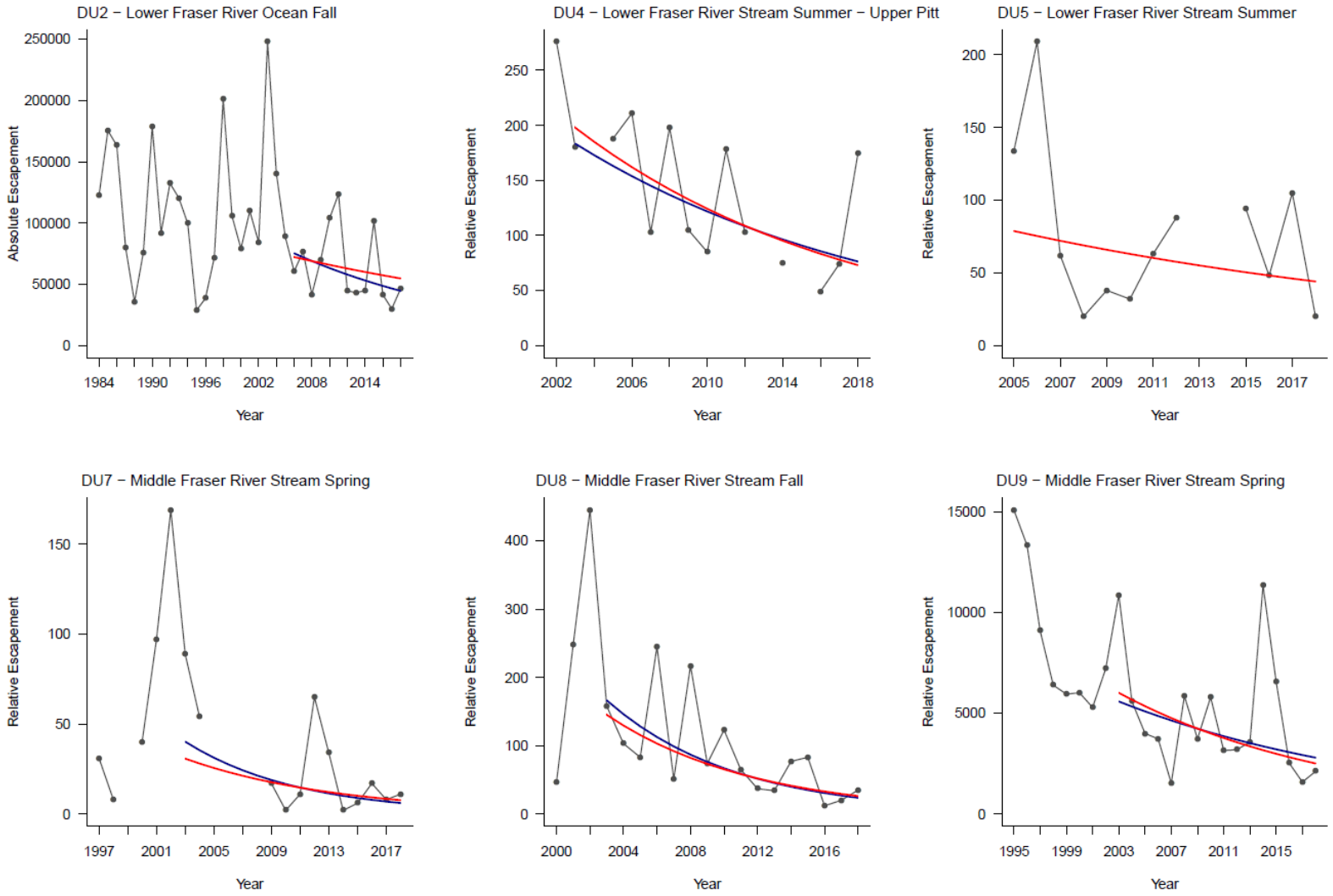

Figure 2a. Time series in absolute (DU2 only) and relative escapement estimates with two estimates of the rate of change in log-escapement through time: (blue) rate of change over the last three generations based only on the last three generations of data, and (red) rate of change over the last three generations based on all available data.

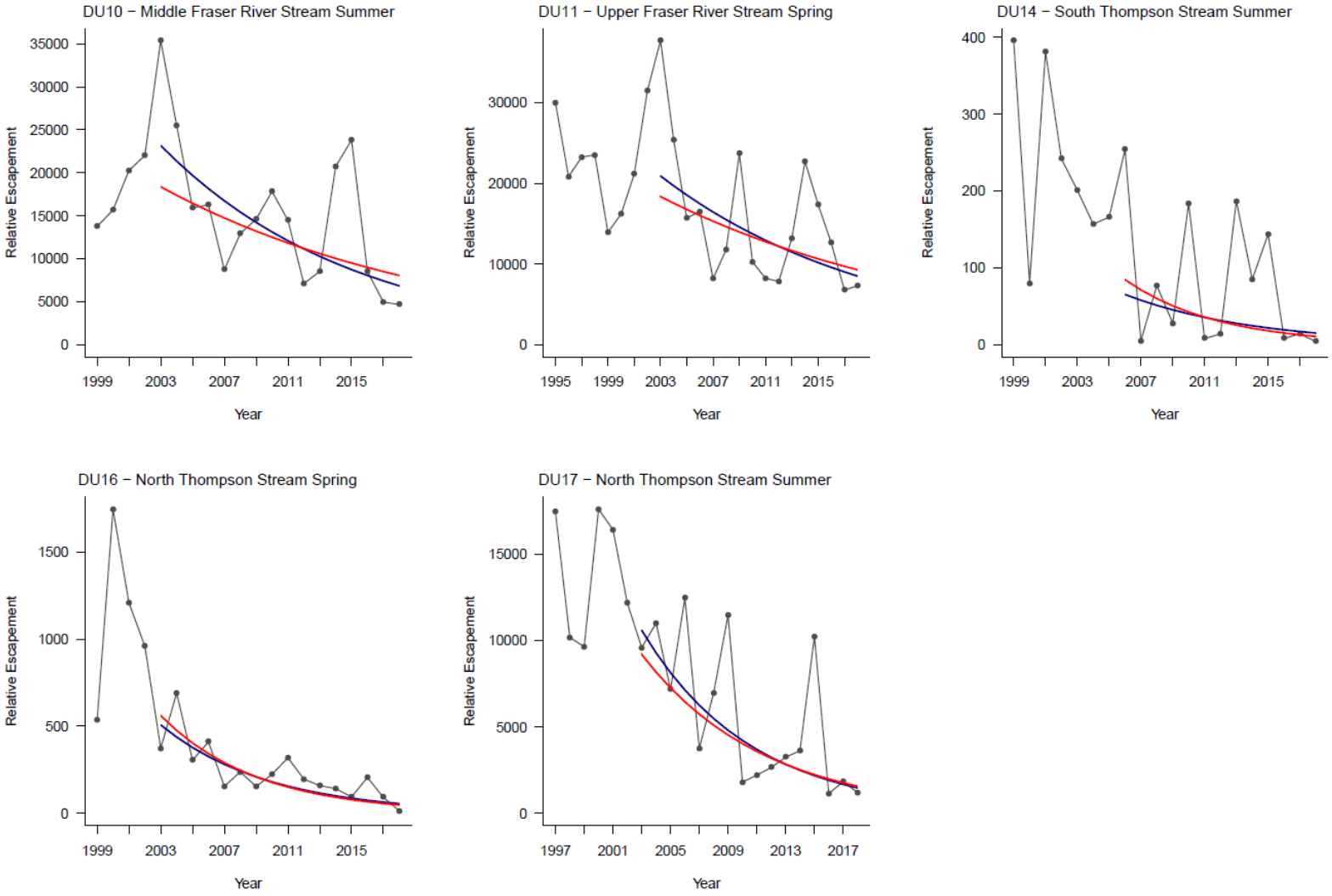

Figure 2b. Time series of relative escapement estimates with two estimates of the rate of change in log-escapement through time: (blue) rate of change over the last three generations based only on the last three generations of data, and (red) rate of change over the last three generations based on all available data.

In some locations hatchery-origin juvenile Chinook Salmon are marked with a small coded-wire tag (CWT), and these tags are recovered from adult fish caught in and sampled from fisheries or from spawning grounds to estimate fishing mortality rates and survival during the smolt to age-2 (or age-3) stage. DU2 (LFR-Harrison) is the only population in this RPA that has recent CWT data.

Prior to 2003, hatchery releases from Dome Creek served as an indicator for DU11 and as a proxy indicator for 8 of 11 DUs covered in this report. The Dome CWT indicator smolt-age-3 survival data are from brood years 1998 to 2002, and thus are unlikely to accurately represent recent survival due to changes in freshwater and ocean productivity, and ecosystem dynamics and trends observed for other Chinook Salmon DUs. The Chilko River population is under development as a CWT indicator for DU10, and it may be able to serve as a proxy indicator for DUs 4, 5, 8, and 17 in the future.

Due to limited direct information, many of the parameters used for the forward projections for Elements 12-22 will have to be estimated using proxy stocks or indirect information. Producing representative life history parameters is ongoing for the second part of this RPA. Consequently, there was limited data available to estimate current marine survival, productivity (adult returns per parent spawner), and the threat posed by fishing mortality in this part of the RPA (except for DU2, LFR-Harrison).

ASSESSMENT

Habitat and Residence Requirements

Chinook Salmon use a diverse range of habitats throughout their life cycle, and habitat use in both freshwater and marine environments can vary among populations depending on the hydrology of native spawning streams and the nearby stream network. Coastal streams and rivers with rain-dominated hydrology tend to produce Chinook Salmon that migrate to the ocean in their first year of life (ocean-type), whereas interior watersheds with snow-dominated hydrology tend to have Chinook Salmon populations that overwinter for one year or more in freshwater (stream-type). Mixed rain and snow-dominated headwaters of some coastal streams also may support stream-types, as occurs in DU4 (LFR-Upper Pitt) and DU5 (LFR-Summer).

Spawning and egg incubation habitat: FRC spawn over a wide variety of habitats from small streams to the mainstems of large rivers. Spawning sites are typically selected in areas upstream of riffles, pool tail-outs (especially below log jams), and on the upstream side of large gravel dunes in large rivers. The habitat attributes of FRC redds have been shown to be highly variable and are dependent on spawning location and fish size. Hydrological conditions within redds change between the time adults arrive on the spawning grounds and when fry emerge from the gravel. Interior Fraser streams generally experience declining discharges during the autumn and winter as temperatures drop below freezing. In many interior Fraser systems, ground and hyporheic water have important roles in mediating the effects of seasonal environmental conditions. Features that may affect the hydrology of these water sources may therefore also indirectly influence important habitat properties for FRC, particularly for spring-run stream-type Chinook Salmon, as they spawn in smaller streams that are not buffered from environmental variations in discharge and stream temperature as are summer- and fall-run Chinook Salmon populations that spawn in larger rivers.

Fry and juvenile rearing habitat: Ocean-type Chinook Salmon typically migrate to the ocean in the first few months following emergence from spawning gravels; however, as previously noted, fish from DU2 (LFR-Harrison) are unique in that they migrate to the Fraser estuary immediately following emergence. Harrison River Chinook Salmon rear in the Fraser estuary from March

until June, where the mid-intertidal (e.g. eelgrass meadows) and emergent vegetation (e.g. sedges, rushes, and riparian trees and shrubs) habitats are vital components providing detritus and habitat for Chinook Salmon prey. For stream-type FRC, freshwater rearing occurs throughout the Fraser watershed from headwater tributaries downstream to the lower Fraser River, and the distribution of fry and parr varies with and among populations. Three commonly observed strategies for stream-type juvenile FRC from the Interior Fraser and Thompson watersheds are:

1. juveniles rear in their natal stream from emergence until smolting;
2. juveniles rear in their natal stream from emergence to late summer and then migrate into a larger mainstem river such as the Thompson or Fraser Rivers where they overwinter and before smolting the following spring; or
3. juveniles immediately leave their natal stream after emergence and disperse downstream to mainstem, side channel, and small tributary habitats throughout the Fraser River and the estuary.

For the latter group, these tributaries include non-natal streams that are not used by Chinook Salmon for spawning, but provide transient rearing habitat for juvenile Chinook Salmon that are migrating downstream.

An additional critical component of fry and juvenile rearing is access to ephemeral habitats, which play an important role for both ocean and stream-type Chinook Salmon. Access to these habitats is tied to the timing and intensity of the freshet, and when accessible, these habitats provide juvenile Chinook Salmon important opportunities for access to resources (e.g. prey and protection from predators). Degradation of these habitats, or features and conditions that limit access to these habitats, may therefore indirectly influence important habitat properties for FRC.

Outmigration and ocean rearing habitat: Ocean-type FRC from the lower Fraser and South Thompson rivers encounter snowmelt-induced flooding in May, June, and July and may use seasonal flood cycles as a queue to begin downstream emigration. After one year in freshwater, juvenile stream-type Chinook Salmon from the interior and lower Fraser systems migrate downstream in the spring and early summer and enter the Strait of Georgia. Tagging studies indicate that it takes hatchery Chinook smolts from the Nicola watershed (not considered in this RPA) between 3.4 and 19.2 days (median) to travel from interior release sites to the mouth of the Fraser River. Similar data are not available for wild smolts, nor smolts from other interior DUs.

Chinook Salmon require productive nearshore marine habitats. Nearly all FRC spend the first few months in the Salish Sea and tend to remain within 200 to 400 km of the Fraser River for the first year at sea, irrespective of life history type. During this period, Chinook Salmon generally rear in sheltered, near-shore environments for varying periods depending on factors such as food availability, competition, predation, and environmental conditions. Ocean-type FRC rear in coastal waters for most of their life at sea and typically do not disperse more than 1,000 km from the Fraser River. Stream-type FRC tend to have the broadest marine distribution and are generally found more northerly and westerly than ocean-type variants, and catches have been reported as far north as the Bering Sea.

Adult freshwater migratory habitat: FRC migrate variable distances to reach natal spawning streams, and some DUs experience significantly different thermal and flow conditions depending on the location and timing of their adult return to freshwater. During the adult migrations FRC require water of sufficient velocity and depth to access spawning grounds, and hydrological conditions can limit or impede migration and affect survival.

Freshwater habitat distribution: FRC spawn throughout the Fraser River drainage, and are present in the Fraser River mainstem and all its major accessible tributaries (Figure 1). FRC distribution throughout the drainage is based on surveys of adult spawners and juveniles. For rearing juvenile FRC, distributional surveys are largely limited to inventories conducted to plan forestry activities or other industrial activities, and additional surveys based on a structured survey study design is considered to be a major knowledge gap.

Marine distribution: The marine distribution of FRC can differ between populations with different life history strategies; however, the full extent of their marine distribution is not well understood due to insufficient sampling to adequately characterize all their rearing locations in the North Pacific. In general, stream-type Chinook Salmon spend their first summer in the marine environment in the Salish Sea, before migrating off the coastal shelf or northward along the continental shelf to Alaska and other parts of the North Pacific to feed and mature prior to migrating back to freshwater. There is some evidence that the Lower Fraser stream type fish are far-north migrants and rear on the continental shelf, while interior stream-type FRC perform extensive offshore migrations as far north as the Bering Sea. DU2, the only ocean-type DU in the RPA, are considered to be coastal shelf residents and seldom disperse more than 1,000 km from the mouth of the Fraser.

Spatial configuration constraints: FRC as a whole have not been heavily affected by hydroelectric development due to an absence of dams on the mainstem of the Fraser and Thompson rivers; however, the Bridge-Seton hydroelectric complex in the middle Fraser River, and possibly the Kenney Dam in the Nechako watershed have impacted historical interior FRC distribution. The Seton dam has been a concern for Chinook Salmon passage from Seton River into Seton Lake on their way to their spawning grounds at Portage Creek, which connects Seton and Anderson Lakes.

Hells Gate in the Fraser River canyon and Little Hells Gate in the North Thompson River are obstructions that can be barriers to upstream migrating Chinook Salmon at certain flows, although fishways installed at Hells Gate alleviate most passage issues. The Big Bar rock slide encountered by adult FRC migration in 2019 has become a near complete migration barrier during the majority of the migration period for DU9 (MFR-Spring), DU10 (MFR-Summer), and DU11 (UFR-Spring) that spawn upstream of the slide. Observations of Chinook Salmon passage in 2019 over the Big Bar slide via radio telemetry and sonar suggest that passage is unlikely when river discharge exceeds 2100 m^3s^{-1}. Discharge exceeded this value from June to the middle of August in 2019; however, it was a lower flow year compared to the average summer flow of ~4000 m^3s^{-1}. Thus the period of obstruction could be longer than was observed in 2019, unless the slide is remediated.

Flood control and agricultural development, particularly in the lower Fraser River, have led to a loss of off-channel and stream habitat. The loss of floodplain connectivity has likely reduced the freshwater carrying capacity for those DUs with life histories that rely on these areas for rearing. Large-scale development within the floodplain of the lower Fraser River for agricultural and residential development, as well as dike construction, has caused wetlands to be drained, riparian zones to be degraded, and the aquatic systems to be polluted.

Concept of residence: SARA defines “residence” as “a dwelling-place, such as a den, nest or other similar area or place, that is occupied or habitually occupied by one or more individuals during all or part of their life cycles, including breeding, rearing, staging, wintering, feeding or hibernating”. Redds, the spawning nests constructed by Pacific salmon and other fish species, are considered residences under this definition in the event of listing as *Threatened, Endangered or Extirpated* under SARA.

Threats and Limiting Factors to Survival and Recovery

This RPA follows the definition of threats found in the "Guidance on Assessing Threats, Ecological Risk and Ecological Impacts for Species at Risk" Science Advisory Report (DFO 2014b). This definition states: a threat is "any human activity or process that has caused, is causing, or may cause harm, death, or behavioural changes to a wildlife species at risk, or the destruction, degradation, and/or impairment of its habitat, to the extent that population-level effects occur". For the purpose of this report, FRC are considered to be the "wildlife species at risk".

The threat categories used for the assessment are based on the unified classification system used by COSEWIC when assessing status of wildlife species (COSEWIC 2012[2]). This threat classification system was used to define broad categories of threats, and the final threat assessment follows DFO (2014a[1]) guidance to the extent possible in the context of limited data and information on threats to FRC within Canadian waters. For FRC, a working group assessed threats using a COSEWIC threats calculator tool prior to the Regional Peer Review. The information and rankings from the initial COSEWIC-style assessment by the working group were then used to convert the assessment into the DFO (2014a[1]) standardized assessment method.

Anthropogenic Threats

Climate change, ecosystem modifications, pollution, and fishing were identified as the leading anthropogenic threats to all FRC DUs.

Climate Change

Climate change is expected to negatively impact all FRC DUs through shifting habitat conditions in both marine and freshwater environments. In addition, the occurrence of extreme weather events such as droughts, heat waves, storms and floods are also projected to increase in frequency with the changing climate, all of which have significant negative implications for FRC.

North Pacific Ocean surface temperatures have been steadily increasing and are projected to continue increasing, threatening FRC through shifts in zooplankton distribution, ocean productivity and nutrient availability, metabolic requirements, and intensification of predation by other species. Compounding the threat from changing ocean conditions is the increasing frequency of marine heatwaves such as "The Blob" between 2013-2016 which caused unprecedented shifts in marine ecosystems along the Pacific coast of North America, and the more recent "Northeast Pacific Marine Heatwave of 2019" which has the potential to be as strong as the former event. Climate change-induced impacts within freshwater include changes in snowpack accumulation, groundwater availability and discharge regimes that affect the quantity, quality, availability, and temperature of freshwater rearing habitat for FRC. The earlier onset of spring freshet and reduced flows in late summer could create challenges for rearing juveniles and may result in conditions less suitable for successful spawning in the early fall. This is particularly true for stream-type Chinook Salmon, which make up 10 of the 11 DUs discussed in this RPA.

Ecosystems Modifications

Ecosystems modifications that alter catchment surfaces or increase impervious surfaces can have significant effects on stream temperatures and flow regimes. These activities include water extraction, forestry, wildfires, and development from agricultural, industrial, and residential

[2] COSEWIC. 2012. Guidance for completing the Threats Classification and Assessment Calculator and Determining the number of 'Locations'. Committee on the Status of Endangered Wildlife in Canada. April 2012. Version 1.1, Ottawa, Ontario. iii + 10 pp.

sectors. Impacts of wildfires are similar to forestry as they alter flow and temperature regimes, however, subsequent salvage logging operations can further destabilize watersheds. Changes to flow regimes may lead to timing mismatches with the availability of seasonally inundated habitats that are critical to FRC growth and survival.

Linear development includes straightening and channelization of streams, often modifying natural landscapes with riprap, dikes, culverts, bridges, and floodgates, which are associated with the protection of agricultural, industrial, and urban development. These modifications can render habitat less suitable for juvenile Chinook Salmon. Additionally, there is often an associated reduction in the overall amount of habitat after channelization due to a reduction in stream length and isolation from rearing habitats (e.g. side channels, off-channel habitat, ponds, and wetlands).

Pollution

Pollution within the Fraser River drainage was considered to be a significant threat risk to all FRC. Many contaminant sources exist within both the freshwater and marine habitat of FRC. Pacific salmon are, in general, particularly susceptible to the effects of environmental contamination as extensive migrations, physiological transformations, and rapid growth rates lead to high rates of exposure and accumulation of contaminants. This exposure can lead to impairment of salmonid olfactory function, migratory behaviour, and immune system function, which may reduce individual survival, but can also reduce reproductive success and productivity of a population. There are, however, challenges in understanding the effects of individual contaminants on FRC as many are persistent in the environment, may travel long distances, and have a tendency to accumulate in sediments and food chains from multiple sources. All pollution threat categories were anticipated to pose up to a medium risk to all FRC DUs with the exception of garbage and solid waste, as our current understanding of how FRC will be impacted is limited. It is anticipated that the threat from garbage and solid waste, which includes micro-plastics and lost or abandoned fishing gear, has some impact on FRC and that the overall impacts are negative. Participants of the threats workshop identified that the combined threat from all pollution categories may constitute a more significant threat to FRC than reported here, but there is currently insufficient information, specifically from the Fraser River estuary, to substantiate this. Chinook Salmon rearing in estuarine and marine habitats of Puget Sound have been shown to be impacted by pollution; these are waters where Chinook Salmon from DU2 are known to inhabit.

Fishing & Harvesting Aquatic Resources

Fisheries operating in both Canada and the United States intercept FRC Salmon along their migration corridor. In Canada, these fisheries include: First Nations food, social, and ceremonial fisheries; recreational fisheries; commercial fisheries (including First Nations economic opportunity); and test fisheries. The impact of these fisheries on FRC is not well known for most DUs, especially where Chinook Salmon are not retained as catch. This is due to the lack of indicator programs for nearly all DUs. The exception is DU2 (LFR-Harrison), which has the only high quality time series of escapement and harvest rate data. At the MU level there are some estimates of Fraser River harvest rates, yet these estimates have considerable uncertainty. There was a lack of consensus during the CSAS meeting surrounding the threat risk posed to FRC by fishing. As such, the threat from fishing was ranked low to high for all FRC DUs, acknowledging that it might not be in the high range for DU2, and may not be in the low range for the remaining DUs.

DU-Specific Impacts

Additional DU-specific threats were identified, the most noteworthy of which were aquaculture, water extraction and landslides.

Aquaculture

Aquaculture occurs in the Fraser River Basin and nearshore rearing habitats, and it is anticipated that all FRC will encounter aquaculture in the form of hatchery fish or open net pens at some point in their life cycle. The threat risk from direct interactions of FRC with open net pen footprints is expected to be negligible for all DUs; however, intraspecific competition for finite and limited ecological resources between hatchery-origin and wild salmon in the Fraser River and nearby coastal waters is anticipated to constitute a threat for FRC. This is particularly true for DU2 (LFR-Harrison), as there is potential for direct competition with lower Fraser River fall Chinook Salmon hatchery releases from the Chilliwack and other lower Fraser River hatcheries. The announcement of an increase in hatchery production by 1,000,000 fall Chinook Salmon smolts at the Chilliwack hatchery, paired with the future increase of hatchery production in Puget Sound by 30 million smolts could increase the risk of competition. The remaining DUs considered in this RPA are stream-type life history variants, for which there is considerably less hatchery supplementation as ocean-type variants make up most releases in the Fraser River drainage. These DUs were considered to be at a low level of risk from hatchery competition.

Water Extraction

Water extraction for irrigation and livestock can impact FRC through reduced flows in streams, limiting the wetted area of streams, and potentially increasing water temperatures. Groundwater extraction is of particular concern to stream-type Chinook Salmon as these populations are highly dependent on hyporheic and groundwater inputs for much of their freshwater residence. Hyporheic and groundwater upwelling protects redds from anchor-ice formation, maintains suitable temperatures for late-summer rearing habitats, moderates temperatures and water levels for returning adults, and creates thermal refugia. Despite the critical dependence of stream-resident salmonids on hyporheic and groundwater, in the past, groundwater extraction has not been actively managed. Surface water resources are also fully subscribed in many rivers, particularly in the arid southern interior. Water extraction is of particular concern for DU14 (STh-Bessette), which spawn in a drought-sensitive system in an area of extensive water extraction. Agricultural water use creates low summer flows and high stream temperatures to the point where fish kills have been recorded. The town of Lumby is a large contributor to groundwater extraction for the surrounding area, and water demands are expected to increase in the future. Due to the deficit of water caused by anthropogenic activities this threat was deemed to have a high to extreme level of impact on this population. Watersheds of DU9 (MFR-Spring) have also experienced significant water extraction and impacts from groundwater extraction are likely to be higher in this DU than the others because of its reliance on streams fed by groundwater and runoff.

Landslides

Landslides can block migration of both adult and juvenile fish, destroy habitat, and alter habitat conditions by introducing unnaturally high concentrations of sediment. Landslides can occur naturally or from human-driven cumulative impacts, and are expected to increase in frequency in North America due to extended freeze-thaw periods resulting from a changing climate. The Big Bar rock slide encountered by adult Chinook Salmon migrating upstream in 2019 has become a significant barrier for a large portion of the migration period for populations that spawn upstream of the slide. Based on data from telemetry and sonar in 2019, adult Chinook Salmon are unlikely to be able to migrate past the slide at river discharge levels that are

common from May to September. The effect of the slide on outmigrating juveniles is currently unknown. FRC DUs affected by the Big Bar slide are DUs 9 (MFR-Spring), 10 (MFR-Summer), and 11 (UFR-Spring), all of which are considered to be at an extreme level of threat risk. DU8 (MFR-Portage) was considered to be at a high level of risk because there are ongoing sediment issues in Portage Creek from the November 2016 landslide at Whitecap Creek (which included the deposition of sediment in spawning habitat); there are no alternate spawning grounds for this DU. Currently, returns in DU8 are so low that there are insufficient spawners to effectively dislodge fine sediments from the gravels, a natural process that can improve the quality of salmon spawning habitats when they are extensively used.

Natural Limiting Factors

Natural limiting factors are defined as “non-anthropogenic factors that, within a range of natural variation, limit the abundance and distribution of a wildlife species or a population” (DFO 2014). Natural limiting factors or processes may be exacerbated by anthropogenic activities and can then become a threat. By default, a natural limiting factor would be scored as having a “Low” Threat Risk in the calculator unless there are other factors that are exacerbating natural levels of variation or impacts to a population. As almost all of the natural limiting factors are affected by anthropogenic-induced climate change or landscape-level human activities. Natural limiting factors are intertwined with existing threats and impacts. Natural limiting factors to FRC include: the biological and physiological limits of Chinook Salmon; predation of Chinook Salmon at all life stages; and inter/intra-specific competition in both marine and freshwater environments.

Table 3. Overall threat ranking for FRC DUs assessed.

COSEWIC Major Threat Category	DU2	DU4	DU5	DU7	DU8	DU9	DU10	DU11	DU14	DU16	DU17
Residential and commercial development	Low	Low	Low	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
Agriculture & aquaculture (Hatchery competition)	High-Medium	Low	Low	Low	Low	Low	Low	Low	Medium-Low	Low	Low
Energy production & mining	Medium-Low	N/A	Low	Low	Low	Medium	Low	Low	Low	Low	Low
Transportation & service corridors	Unknown	Unknown	Unknown	Unknown	Unknown	Negligible	Negligible	Negligible	Unknown	Low	Low
Biological resource use (Fishing)	High-Low	High-Low	High-Low	High-Low	High-Low	High-Low	High-Low	High-Low	High-Low	High-Low	High-Low
Human intrusions & disturbance	Negligible	Medium-Low	Negligible	Negligible	Negligible	Low	Negligible	Low	Low	Low	Low
Natural systems modifications (Water management, ecosystems modifications)	Medium-Low	Medium-Low	Medium-Low	Medium-Low	Medium	High-Medium	Medium-Low	Medium-Low	Extreme - High	Medium-Low	Medium-Low
Invasive & other problematic species & genes	Medium-Low	Medium-Low	Medium-Low	Low	Low	Low	Low	Low	Medium-Low	Low	Low
Pollution (From all sources and threats)	Medium	Medium-Low	Medium-Low	Medium-Low	Medium-Low	Medium	Medium-Low	Medium-Low	Medium	Medium	Medium
Geological events (Landslides)	Unknown	Unknown	Unknown	Unknown	High	Extreme	Extreme	Extreme	Unknown	Medium-Low	Medium-Low
Climate change & severe weather (Shifting habitats)	High-Low	High-Medium	High-Medium	High-Medium	High-Medium	High-Medium	High-Medium	High-Medium	High-Medium	High-Medium	High-Medium
OVERALL THREAT RANKING	Extreme-High	Extreme-High	Extreme-High	Extreme-High	Extreme	Extreme	Extreme	Extreme	Extreme	Extreme-High	Extreme-High

Sources of Uncertainty

- There are significant knowledge gaps surrounding the freshwater and marine habitat distribution of FRC, particularly for DUs within the Spring and Summer 5_2 MUs, which make up the majority of DUs assessed in this RPA. FRC freshwater distribution spans a large geographical area within the Fraser Basin and much of this habitat has not been thoroughly studied. Furthermore, the marine distribution of FRC is poorly known due to a lack of indicator programs for these DUs, and as a result, some of the distribution information reported in this RPA is inferred from limited data
- Although we have a basic understanding of the freshwater and marine biology of FRC, for most DUs we lack specific information such as egg-to-fry survival, detailed freshwater habitat use, productivity, stock-recruit data, and freshwater and marine survival information.
- There is no current smolt to age-3 survival data or harvest rate information for 10 of 11 DUs due to a lack of appropriate assessment information. For DUs 4 (LFR-Upper Pitt) and 5 (LFR-Summer), there is only moderate to high quality relative abundance data from one tributary in each DU, which may not represent changes at the DU level. For DUs 4, 5, 7 (MFR-Nahatlatch), 8 (MFR-Portage) and 14 (Sth-Bessette), there have been no recent CWT releases and subsequent marine recoveries, thus all distributional information for those DUs is inferred.
- The impacts of fisheries (both targeted and non-targeted at Chinook) is currently limited or unknown for the majority of DUs. DU2 is the only population with a long-standing time series of CWT data; therefore, much of the information surrounding fisheries is inferred for the remaining DUs using the assessment of DU2 as a point of reference.
- There are significant gaps in our knowledge of current invasive species distributions, and their potential effects on FRC in both marine and freshwater environments. One species of particular concern is the European Green Crab, which is currently present in several locations within the Salish Sea, and is anticipated to continue to expand its range in BC.
- There are a multitude of sources for pollution in the Fraser River drainage, yet there is currently limited available information surrounding the effects of these contaminants on FRC, and how they affect FRC survival in both marine and freshwater environments.
- It is currently unknown what effects future large-scale increases in hatchery production will have on FRC, and whether these increases will lead to increased competition for finite and limited ecological resources between hatchery-origin and wild salmon from the Fraser River.

Research Recommendations

Part 2 of this RPA will provide recovery targets and forward projections, discuss threat mitigation, and assess allowable harm for the 11 FRC DUs discussed in this report. This information, paired with the information presented in Part 1 of the RPA, will be used as the basis for recommending future research to aid in the survival and recovery of FRC.

LIST OF MEETING PARTICIPANTS

Last Name	First Name	Affiliation
Arbeider	Michael	DFO Stock Assessment
Bailey	Richard	DFO Stock Assessment
Benner	Keri	DFO Fish and Fish Habitat Protection Program
Bonney	Giselle	DFO SARA Program
Bradford	Mike	DFO Science
Braun	Doug	DFO Science
Brown	Gayle	DFO Science
Bylenga	John	DFO Stock Assessment
Candy	John	DFO Centre for Science Advice Pacific
Caron	Chantelle	DFO SARA Program
Churchland	Carolyn	DFO Salmonid Enhancement Program
Crowley	Sabrina	Nuu-chah-nulth Tribal Council
Curtis	Shamus	Upper Fraser Fisheries Conservation Alliance
Davidson	Katie	DFO Stock Assessment
Decker	Scott	DFO Stock Assessment
Desy	Travis	DFO Stock Assessment
Dionne	Kaitlyn	Fraser and Interior Area Stock Assessment
Doutaz	Dan	DFO Stock Assessment
Frederickson	Nicole	Island Marine Aquatic Working Group (IMAWG)
Grant	Paul	DFO Science
Grout	Jeff	RM, RHQ
Huang	Ann-Marie	Management Strategy Evaluations, Science
Jenewein	Brittany	DFO Resource Management
Labelle	Marc	Okanagan Nation Alliance
Laliberte	Bernette	Cowichan Tribes
Lofthouse	Doug	DFO Salmonid Enhancement Program
MacConnachie	Sean	DFO Science
MacKay	David	Area F Salmon Troll
Magnan	Al	DFO Centre for Science Advice Pacific
Mahoney	Jason	DFO Salmonid Enhancement Program
Maynard	Jeremy	Sport Fishing Advisory Board
McDuffee	Misty	Raincoast Conservation Foundation/Marine Conservation Caucus
McGreer	Madeleine	Central Coast Indigenous Resource Alliance
Milligan	Laurie	Sport Fishing Advisory Board
Mozin	Paul	Scw’exmx Tribal Council (Nicola)
Parken	Chuck	DFO Stock Assessment
Paulson	Lawrence	Area F Salmon Troll
Potyrala	Mark	DFO Fish and Fish Habitat Protection Program
Rickards	Karen	RM Fraser and Interior Area
Ritchie	Lynda	DFO Stock Assessment

Last Name	First Name	Affiliation
Rosenberger	Andy	Marine Conservation Caucus
Rublee	Bill	Contractor, Triton Environmental
Ryan	Teresa	University of British Columbia
Scroggie	Jamie	DFO Resource Management
Staley	Mike	Fraser Salmon Management Council
Thomson	Madeline	DFO SARA Program
Thorpe	Suzanne	DFO Fish and Fish Habitat Protection Program
Trouton	Nicole	DFO Stock Assessment
Vivian	Tanya	DFO Stock Assessment
Walsh	Michelle	Secwepmec Fisheries Commission
Weir	Lauren	DFO Stock Assessment
Welch	Paul	DFO Salmonid Enhancement Program
Whitehouse	Timber	DFO Stock Assessment
Whitney	Charlotte	Pacific Salmon Foundation
Young	Jeffery	David Suzuki Foundation/Marine Conservation Caucus

SOURCES OF INFORMATION

This Science Advisory Report is from the December 10-12, 2019 regional peer review on the Recovery Potential Assessment – Fraser River Chinook Salmon (*Oncorhynchus tshawytscha*) – Eleven Designatable Units (Elements 1 to 11). Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

COSEWIC 2019. COSEWIC assessment and status report on the Chinook Salmon *Oncorhynchus tshawytscha*, Designatable Units in Southern British Columbia (Part One – Designatable Units with no or low levels of artificial releases in the last 12 years), in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xxxi + 283 pp.

DFO. 2014b. Guidance on Assessing Threats, Ecological Risk and Ecological Impacts for Species at Risk. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep 2014/013. (*Erratum*: June 2016).

APPENDIX

Table 4. The overall threat rating from the COSEWIC threats calculator workshop and summary comments. The workshop was conducted prior to the regional peer review of this RPA.

DU	Overall Threat Risk	Comments from Threats Workshop
DU8 - Middle Fraser Stream Fall	Extreme	*71-100% population level decline expected over the next three generations* DU8 was assigned an overall impact rating of Extreme. In addition to the impacts from the Seton hydroelectric dam, there has been a recent landslide that has significantly impacted the ability of the population to successfully spawn. There is only one spawning site in this DU, so ongoing impacts to the spawning habitat will have profound effects. Additionally, the early fall return of this DU overlaps with the return of more abundant Chinook stocks and other salmon species for which there are directed fisheries, leading to slightly higher concern for the impact of bycatch on this DU compared to the others. *Highest Ranked Threats: Landslides (H), Climate Change (H-M), Dams and Water Management (M), Fishing (M-L), Other Ecosystem Modifications (M-L), Pollution (M-L)*
DU9 - Middle Fraser Stream Spring	Extreme	*71-100% population level decline expected over the next three generations* DU9 was assigned an overall impact rating of Extreme. It was determined at the Threats Workshop that this stock-aggregate was in serious trouble and that if passage issues at the Big Bar Slide are not resolved, the DU would be unlikely to persist. The passage observed past Big Bar in the summer of 2019 will not maintain these populations over multiple generations. In addition, there are other serious threats from natural systems modification due to changes in catchment surfaces from forestry and fires, as well as the additional impact from climate change. Due to the high level of disturbance in the watersheds of this DU, it is particularly sensitive to climate change impacts. *Highest Ranked Threats: Landslides (H), Climate Change (H-M), Other Ecosystem Modifications (H-M), Pollution (M), Dams and Water Management (M-L), Fishing (M-L)*
DU10 - Middle Fraser Stream Summer	Extreme	*71-100% population level decline expected over the next three generations* DU10 was assigned an overall impact rating of Extreme. It was determined at the Threats Workshop that this stock-aggregate was in serious trouble and that if passage issues at the Big Bar Slide are not resolved, the DU would be unlikely to persist. The passage observed past Big Bar in the summer of 2019 will not maintain these populations over multiple generations. The anticipated impacts from climate change along with those of the slide resulted in the Extreme rating. It is in a slightly less dire situation than DU9 because

DU	Overall Threat Risk	Comments from Threats Workshop
		of the large lakes that provide some buffering from the impacts of modification to catchment surfaces. *Highest Ranked Threats: Landslides (H), Climate Change (H-M), Other Ecosystem Modifications (M-L), Fishing (M-L), Pollution (M-L)*
DU11 - Upper Fraser Stream Spring	Extreme	*71-100% population level decline expected over the next three generations* DU11 was assigned an overall impact rating of Extreme. It was determined at the Threats Workshop that this stock-aggregate was in serious trouble and that if passage issues at the Big Bar Slide are not resolved, the DU would be unlikely to persist. The passage observed past Big Bar in the summer of 2019 will not maintain these populations over multiple generations. This DU is in a less dire situation than DUs 9 and 10 because of the cooler, wetter climate and comparatively less disturbance in the watersheds overall. Without the Big Bar slide this DU would likely have a threat rating of High. However, this DU is at higher risk from continued logging than DUs 9 and 10, and is potentially at higher risk for additional modifications to catchment surfaces. *Highest Ranked Threats: Landslides (H), Climate Change (H-M), Other Ecosystem Modifications (M-L), Fishing (M-L), Pollution (M-L)*
DU14 - South Thompson Stream Spring	Extreme	*71-100% population level decline expected over the next three generations* DU14 was assigned an overall threat rating of Extreme. It was determined at the Threats Workshop that this was a reasonable outcome and that the extirpation of this DU within the next three generations was plausible. This rating is based on water use, changes to catchment surfaces, climate change, agricultural impacts and pollution. This DU inhabits a system that is historically temperature and drought sensitive, and the occurrence of climate change and water extraction have severely impacted this DU. These threats are very unlikely to diminish or be successfully mitigated in the near future. *Highest Ranked Threats: Dams and Water Management (E-H), Ecosystem Modifications (E-H), Climate Change (H-M), Other Pollution (M), Agriculture (M-L), Fishing (M-L), Invasives (M-L)*
DU2 - Lower Fraser Ocean Fall	High - Extreme	*31-100% population level decline expected over the next three generations* DU2 was assigned an overall impact rating of High to Extreme. It was determined at the Threats Workshop that predicting a 100% reduction in population size might not be reasonable, but that the possibility of having a loss of

DU	Overall Threat Risk	Comments from Threats Workshop
		greater than 70% was certainly reasonable. This rating was based on competition with other hatchery fish, climate change, existing harvest rates and trends in marine survival. This DU is particularly sensitive to the loss of wetlands in the estuary, predation by seals and pollution compared to other Fraser DUs. It is also likely that this DU has been over-harvested in some of the last 25 years. *Highest Ranked Threats: Aquaculture (H-M), Climate Change (H-L), Pollution (M), Fishing (M-L), Other Ecosystem Modifications (M-L), Invasives (M-L),Gravel Extraction (M-L)*
DU4 - Lower Fraser Stream Summer	High - Extreme	*31-100% population level decline predicted over the next three generations* DU4 was assigned an overall impact rating of High to Extreme. It was determined at the Threats Workshop that predicting a 100% reduction might not be reasonable, but that the possibility of having a loss of over 70% was certainly reasonable. This rating was based on climate change impacts, logging, the amount of recreational use in the area and on flood events. It is important to note that escapement data are only available for one tributary to the Upper Pitt River and there are likely Chinook Salmon spawning in the mainstem and other tributaries to the Pitt River, but we do not know what is occurring in those areas. The trend that we are observing in Blue Creek may or may not be representative of other parts of the DU. *Highest Ranked Threats: Climate Change (H-M), Other Ecosystem Modifications (M-L), Recreational Activities (M-L), Fishing (M-L), Invasives (M-L), Pollution (M-L)*
DU5 - Lower Fraser Stream Summer	High - Extreme	*31-100% population level decline expected over the next three generations* DU5 was assigned an overall impact rating of High to Extreme. This DU may be buffered a little because some of the rearing habitat is located in areas that are not highly developed. There is a lot of uncertainty associated with this DU, because Big Silver Creek is the only system for which escapement data exist. There are other spawning populations, including one in the Lillooet River; however, we have no information of the status of those other demes. It is highly probable that historic spawning habitats in the Lillooet River have been dredged and also impacted by sediment inputs from the Meager Creek landslide. Climate change was a principal factor influencing the rating. Since there are such low escapements currently being observed, the Threat Workshop participants agreed it was reasonable to predict the possibility of extinction within the next three generations, assuming that the trends in Big Silver Creek represent the remainder of the DU.

DU	Overall Threat Risk	Comments from Threats Workshop
		Highest Ranked Threats: Climate Change (H-M), Other Ecosystem Modifications (M-L), Fishing (M-L), Invasives (M-L), Pollution (M-L)
DU7 - Middle Fraser Stream Spring	High - Extreme	*31-100% population level decline expected over the next three generations* DU7 was assigned an overall impact rating of High to Extreme. It was agreed at the Threats Workshop that 100% reduction over the next three generations might not be reasonable, but that the possibility of having a loss of over 70% was certainly reasonable and has potentially already occurred. This is a single site DU, and fish from this DU do not have alternate habitat available if the current habitat become degraded. Recently, there have been years where less than 10 spawners have been counted in the system. Snow pack failures or early melts could become more common, and would significantly impact this DU. The overall rating was predominantly based on ecosystem modifications, climate change, harvest rates and pollution. *Highest Ranked Threats: Climate Change (H-M), Other Ecosystem Modifications (M-L), Fishing (M-L), Pollution (M-L)*
DU16 - North Thompson Stream Spring	High - Extreme	*31-100% population level decline expected over the next three generations* DU16 was assigned a threat impact of High to Extreme. There was some discussion about ranking this DU as High, instead of High to Extreme, but given the uncertainty of possible oil spill events in the future along with the threat of climate change, modifications to catchment surfaces, and fisheries harvest the workshop participants determined that this was an appropriate ranking. *Highest Ranked Threats: Climate Change (H-M), Pollution (M), Other Ecosystem Modifications (M-L), Fishing (M-L), Landslides (M-L)*
DU17 - North Thompson Stream Summer	High - Extreme	*31-100% population level decline expected over the next three generations* DU17 was assigned a threat impact of High to Extreme. There was some discussion about ranking this DU as High, instead of High to Extreme, but given the uncertainty of possible spill events in the future along with the threat of climate change, modifications to catchment surfaces, and fisheries harvest the workshop participants determined that this was an appropriate ranking. *Highest Ranked Threats: Climate Change (H-M), Pollution (M), Other Ecosystem Modifications (M-L), Fishing (M-L), Landslides (M-L)*

THIS REPORT IS AVAILABLE FROM THE:

Centre for Science Advice
Pacific Region
Fisheries and Oceans Canada
3190 Hammond Bay Road
Nanaimo, BC V9T 6N7

Telephone: (250) 756-7208
E-Mail: csap@dfo-mpo.gc.ca
Internet address: www.dfo-mpo.gc.ca/csas-sccs/

ISSN 1919-5087

Correct Citation for this Publication:

DFO. 2020. Recovery Potential Assessment for 11 Designatable Units of Fraser River Chinook Salmon, *Oncorhynchus tshawytscha*, Part 1: Elements 1 to 11. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2020/023.

Aussi disponible en français :

MPO. 2020. Évaluation du potentiel de rétablissement pour 11 unités désignables de saumon quinnat du fleuve Fraser, Oncorhynchus tshawytcha, partie 1 : Éléments 1 à 11. Secr. can. de consult. sci. du MPO, Avis sci. 2020/023.