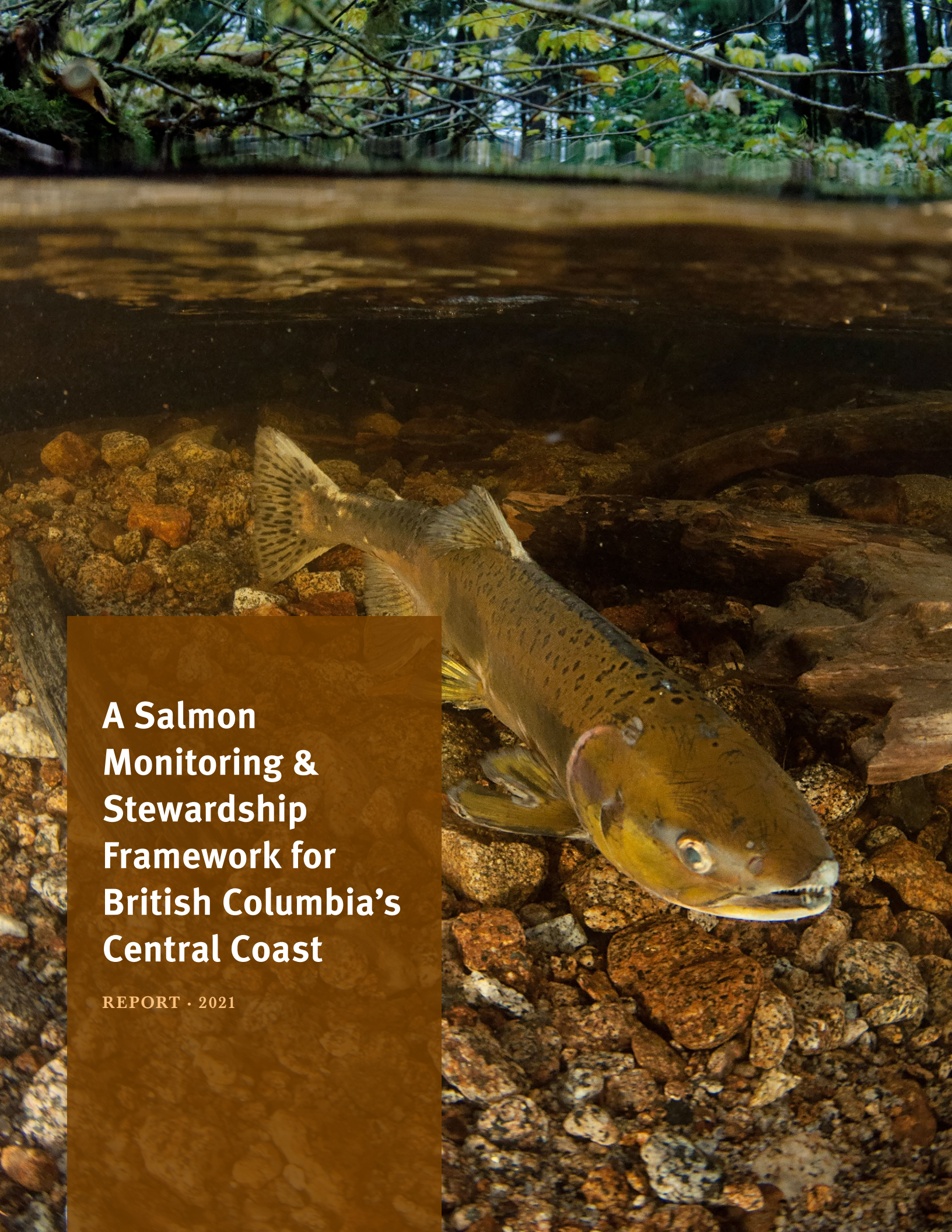

A Salmon Monitoring & Stewardship Framework for British Columbia's Central Coast

REPORT · 2021

CITATION

Atlas, W. I., K. Connors, L. Honka, J. Moody, C. N. Service, V. Brown, M .Reid,
J. Slade, K. McGivney, R. Nelson, S. Hutchings, L. Greba, I. Douglas, R. Chapple,
C. Whitney, H. Hammer, C. Willis, and S. Davies. (2021).
A Salmon Monitoring & Stewardship Framework for British Columbia's Central Coast.
Vancouver, BC, Canada: Pacific Salmon Foundation.

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PUBLISHED BY
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Vancouver, BC, V6J 4S6, Canada
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PACIFIC SALMON FOUNDATION

SALMON WATERSHEDS PROGRAM

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Acknowledgements

We thank everyone who has been a part of this collaborative effort to develop a salmon monitoring and stewardship framework for the Central Coast of British Columbia. This includes the Central Coast Indigenous Resource Alliance, technical staff and community members from the Kitasoo/Xai'xais, Nuxalk, Heiltsuk, and Wuikinuxv First Nations, Charter Patrolmen, and staff from Fisheries and Oceans Canada. In particular, we would like to thank the following individuals for providing valuable advice and feedback: Bernie Elkin, Peter-Siwallace, Megan Moody, Doug Neasloss, Diana Chan, William Housty, Jennifer Walkus, Andra Forney, Ted Walkus, Madeleine Mcgreer, Brendan Connors, Charmaine Carr-Harris, Katie Beach, Bradley Koroluk, Lana Miller, Melanie Anthony, Sandie MacLaurin, Russ Hilland, and Brian Riddell. Our sincere thanks to everyone for sharing your time and expert knowledge, and for welcoming us into your communities.

Support for this project was provided by the Pacific Salmon Foundation through a grant from the Pew Charitable Trusts.

Front cover photograph and photograph on pages 4–5 are by Conor McCracken (CDM Images).

Back cover photograph by Bryant DeRoy.

The graphic design is by Rocketday Arts (www.rocketday.studio).

CCIRA

KITASOO/XAI'XAIS First Nation

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PACIFIC SALMON FOUNDATION

SALMON WATERSHEDS PROGRAM

Executive Summary

Pacific salmon are central to the culture and economies of communities on the Central Coast of British Columbia, Canada.

Despite their importance for people and ecosystems, fisheries management is challenged by major gaps in information on spawner abundance, exploitation rates, and catch composition for many Central Coast salmon populations. Over the past decade, investments in salmon monitoring have declined significantly, limiting the availability of baseline salmon data. Current monitoring and management efforts rely on a mix of community-led initiatives, Fisheries and Oceans Canada-led monitoring programs, and research projects of varying duration and scope. While these efforts collectively provide important information for salmon management, there is an urgent need to work towards greater coordination and investment in salmon monitoring and stewardship to ensure that the information that underpins decision-making is being collected.

This project represents a collaborative effort between the Pacific Salmon Foundation, the Kitasoo/Xai'xais, Nuxalk, Heiltsuk, and Wuikinuxv First Nations, the Central Coast Indigenous Resource Alliance, Fisheries and Oceans Canada , and Charter Patrolmen to develop a regional *Salmon Monitoring and Stewardship Framework* for British Columbia's Central Coast. Using a structured decision-making process, a Working Group (many of whom are co-authors on this report) identified *goals*, *objectives*, *strategies*, and on-the-ground *actions* for salmon monitoring and stewardship in the region. The resulting *Monitoring Framework* reflects a suite of priority monitoring, coordination, and community engagement *actions* needed to monitor and assess salmon in order to meet shared salmon conservation and management *goals*. Ultimately, our intent is that this framework can support and inform emerging collaborative monitoring and management efforts for salmon in the region including through emerging opportunities under the Fisheries Resources Reconciliation Agreement.

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1 Introduction

On the coast of British Columbia (BC), Canada, the well-being of Pacific salmon and people are inextricably linked. This is certainly true for First Nations communities located on the Central Coast of BC who have stewarded, fished, and managed salmon for more than 7,000 years.[1,2] With hundreds of locally adapted Chinook, chum, coho, pink, and sockeye salmon populations, the Central Coast remains a stronghold for salmon. Yet in recent years, many salmon populations in the region have experienced declining trends in abundance [3,4] raising concerns about the future of salmon in the region and their ability to provide social-ecological benefits.[5] These downward trends have been attributed to a variety of factors including anthropogenic climate change, habitat destruction, competition with hatchery-origin fish in the high seas, overfishing, and mixed-stock fisheries.[4,5,6,7,8,9,10]

Effective decision-making to support the long-term persistence of salmon on the Central Coast requires information on the status, trends, and productivity of local salmon populations. However, recent efforts to assess the status of salmon in the region highlighted major spatial and temporal gaps in baseline data. This includes missing or incomplete information on escapement, catch, freshwater, and marine survival, as well as age- and life-history diversity for many salmon populations.[4] Over the past decade, government-funded investments in salmon monitoring have declined significantly, further limiting the availability of baseline salmon data. A recent assessment of escapement monitoring on BC's North and Central Coast found that the number of routinely monitored spawning streams has declined by 50% since 2006.[11]

There is an urgent need for a more coordinated and strategic approach to salmon monitoring and stewardship on the Central Coast. Currently, data are collected through a mix of First Nations-led initiatives, ongoing programs led by Fisheries and Oceans Canada (DFO), and a variety of academic research projects of varying duration and scope. While these efforts collectively provide important information for fisheries management, there is a critical need to evaluate opportunities for greater coordination, standardization, and investments in salmon monitoring. A lack of adequate baseline information, and processes for sharing this information transparently, limit the ability of First Nations and DFO to develop collaborative fisheries management plans and make scientifically informed decisions for salmon conservation on the Central Coast.[12]

These shortfalls with salmon data are set against a backdrop of changes in governance being negotiated under the Fisheries Resources Reconciliation Agreement between eight coastal First Nations — including the Kitasoo/Xai'xais, Nuxalk, Heiltsuk, and Wuikinuxv — and the Government of Canada.[13] This agreement will advance economic opportunities and support collaborative governance of fisheries resources and expand First Nations access to commercial fishing licenses and opportunities. Changes in management arrangements include increased First Nations leadership of monitoring, collaborative development of Integrated Fishery Management Plans, and license buybacks that will transition some commercial salmon licenses to First Nations communities. These changes in governance create an urgent need to develop a coordinated and strategic approach to salmon monitoring

Photo by Grant Callegari.

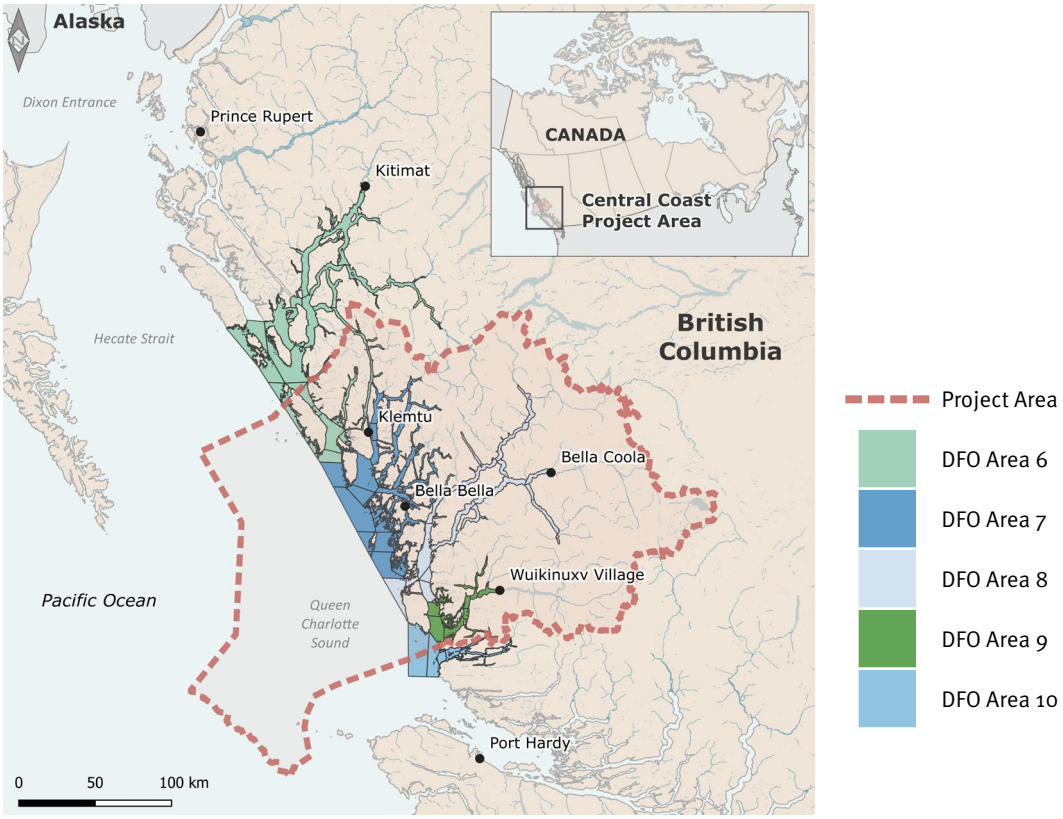


FIGURE 1. The Central Coast project area encompassing the traditional territories of the Kitasoo/Xai'xais (Klemtu), Nuxalk (Bella Coola), Heiltsuk (Bella Bella), and Wuikinuxv (Wuikinuxv Village) First Nations in BC, Canada. The project area overlaps with DFO Pacific Fishery Management Areas 6–10.

that can support collaborative management and co-governance of salmon across the Central Coast in the context of the Fisheries Resources Reconciliation Agreement.

In order to address the challenges highlighted above, the Pacific Salmon Foundation (PSF), the Central Coast Indigenous Resource Alliance (CCIRA), the Kitasoo/Xai'xais, Nuxalk, Heiltsuk, and Wuikinuxv First Nations, DFO, and regional salmon experts (e.g. Charter Patrolmen*) came together to collaboratively develop a regional *Salmon Monitoring and Stewardship Framework* (hereafter referred to as the *Monitoring Framework*) for the Central Coast. We focused our efforts within the combined traditional territories of the four Central Coast Nations, which overlap with DFO Pacific Fishery Management Areas 6–10 (see Figure 1 — the "project area"). This report details our efforts to work through a structured decision-making approach to identify a suite of *objectives*, *strategies*, and on-the-ground *actions* to meet shared salmon monitoring and stewardship *goals* for the region. Recognizing the realities of limited resources and competing priorities for salmon conservation and management in the region, each potential *action* was evaluated against a set of criteria that helped to provide a transparent assessment of community benefits, costs, management relevance, and capacity building. The result is a *Monitoring Framework*, detailed in Section 4 of this report. The *Monitoring Framework* is intended to strengthen the scientific foundations for sustainable fisheries, identify shared priorities and capacity needs across the four Central Coast Nations, and build collaboration towards management and recovery of wild salmon across the region.

* Charter patrolmen are contractors hired annually by DFO to conduct fishery and population monitoring for salmon and other species

Box 1. Building off past work on the Central Coast of BC

In 2016–2018, PSF worked with CCIRA, the Kitasoo/Xai'xais, Nuxalk, Heiltsuk, Wuikinuxv, Gitxaala and Haisla First Nations, DFO, and other salmon experts to improve our collective understanding of the status of Pacific salmon and their habitats on BC's Central Coast. The outputs of this work include a report — *BC Central Coast: A Snapshot of Salmon Populations and their Habitats*[14] — which provides a snapshot of the status and trends of salmon in the region and identifies critical gaps in baseline data. This project found that the biological status of over 50% of salmon on the Central Coast could not be assessed due to a lack of baseline salmon stock assessment data. All of the data that was compiled and analyzed through this project is publicly available on the Pacific Salmon Explorer (*www.salmonexplorer.ca*)[15] a web-based visualization tool for salmon data throughout BC, including the Central Coast.

A separate study[16] led by PSF examined how missing or incomplete baseline data may impact evaluations of biological status for salmon. The study found that status assessments were most impacted by high uncertainty in exploitation rates of different salmon populations, which could lead to misclassifications of status and increase conservation risks for salmon.[17] This finding highlights the need to improve estimates of catch in fisheries and our ability to allocate this catch among different salmon populations through improved monitoring and enhanced collection of baseline stock assessment data.

Additionally, the baseline salmon data that has been compiled and analyzed to-date for the Central Coast has been recently used to inform a strategic planning exercise[18] for salmon in the region, undertaken in collaboration with CCIRA, the Kitasoo/Xai'xais, Nuxalk, Heiltsuk, Wuikinuxv, DFO, and regional salmon experts. Using a decision-support tool — the Priority Threat Management framework — the strategic planning process identified and evaluated the cost-effectiveness of various conservation strategies for promoting the recovery and long-term persistence of wild salmon in the region.[19] Monitoring was identified as a key strategy for enabling the long-term protection and recovery for wild salmon populations, and the *Monitoring Framework* emerged on the basis of these recommendations.

2 Central Coast Salmon Social-Ecological System

Across the traditional territories of the four Central Coast First Nations involved in this project — Kitasoo/Xai'xais, Nuxalk, Heiltsuk, and Wuikinuxv — most people now live within the communities of Bella Coola, Klemtu, Bella Bella, and Wuikinuxv Village (Figure 1). The combined population across these communities is more than 4,000 people. Additionally, many members of each Nation live off-reserve in communities outside of the Central Coast. Combined, their territories include terrestrial and marine ecosystems encompassing more than 55,000 km, including some of BC's most intact and productive salmon habitats.

These Central Coast First Nations share a commitment to the stewardship of the lands, waters, and natural resources within their territories, as evidenced by strong ongoing Indigenous governance.[20,21] This governance includes traditional knowledge and customary management practices, as well as scientific data collection and empowering their leadership in resource management, land use, and conservation actions.[22,23,24] CCIRA was established by the Heiltsuk, Kitasoo/Xai'xais, Nuxalk, and Wuikinuxv First Nations to uphold Indigenous laws and ensure sustainable use and stewardship of natural resources, protecting resource health for future generations.

The abundance of wild salmon on the Central Coast, and effective place-based management of salmon fisheries, has been essential to the prosperity of First Nations in the region for millennia. Ongoing harvest and stewardship of salmon in Food, Social, Ceremonial (FSC) fisheries are inextricably linked and grounded in a reciprocity-based worldview and long-term place-based management.[1,2,25]

Photo by Leah Honka. Big House in Klemtu, BC.

2.1 Central Coast First Nations Communities

Kitasoo/Xai'xais Nation

With a traditional territory ranging from inner fjords to outer coastal waters in the northern portions of the Central Coast (overlapping with DFO Pacific Fishery Management Areas 6 and 7 — see Figure 1), the population of the Kitasoo/Xai'xais First Nation is currently based in and around the town of Klemtu. As a remote community only accessible by air or ferry, harvest of traditional foods including salmon, and particularly sockeye salmon, supports community food security in very tangible ways. Kitasoo/Xai'xais fisheries are monitored and managed by the community food fish committee, a group of leaders comprised of hereditary leaders and individuals with extensive knowledge of salmon runs in Kitasoo/Xai'xais territory.

Historically, and in recent times, the Kitasoo/Xai'xais people have exercised governance authority rooted in their traditional law to manage fisheries and other marine resources.[20] Since the 1990s, the Nation has taken an active role in salmon monitoring, stewardship, and enhancement primarily through Kitasoo Fisheries. Kitasoo Fisheries has conducted hatchery enhancement for chum and coho salmon in Kitasoo Creek since 1982 and raises sockeye that are released into Mary Cove Lake. Kitasoo Fisheries also conducts annual spawning ground surveys in DFO Pacific Fishery Management Area 7 and oversees the co-management of fisheries in Kitasoo/Xai'xais territory. In recent years, the Kitasoo/Xai'xais Stewardship Authority (KXSA) has been established to oversee land and marine use planning, manage the Guardian Watchmen and youth programs, conduct scientific research, and manage activities related to Indigenous Rights and Title. The KXSA's salmon monitoring efforts have also increased in recent years largely due to the cessation of funding for the regional Charter Patrolman who had been responsible for salmon enumeration in Area 6 for the past 39 years. For example, when DFO funding for the Charter Patrolman ended in 2016, KXSA stepped in to ensure that escapement monitoring continued in these areas of Kitasoo/Xai'xais territory.

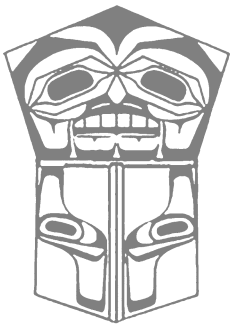
Nuxalk Nation

The Nuxalk First Nation is centered in the Bella Coola Valley, with a traditional territory that radiates out from the inner waters of North Bentinck and South Bentinck Arms, the Dean and Burke Channels and surrounding inlets. *Nuxalkmc* (Nuxalk people) have been and continue to be active stewards of their lands

and waters. Salmon fisheries are vital to Nuxalk culture and food security, and *Nuxalkmc* practice ongoing stewardship of salmon through a range of monitoring, restoration, enhancement and fisheries management activities. Historically, weirs were a primary mode of fishing for *Nuxalkmc* and there were as many as a dozen weirs on the Bella Coola River alone.[26] Today, salmon are caught in in-river and tidal gillnet fisheries, however *Nuxalkmc* also employ a variety of methods to capture salmon for FSC purposes.

The Bella Coola River remains one of the most important salmon producing rivers on the Central Coast, supporting the largest Chinook and chum salmon populations in the region, as well as major runs of coho and pink salmon. Historically, the Atnarko River — a tributary of the Bella Coola River in its upper reaches — has supported major fisheries for sockeye salmon with historic run sizes (1970s–1990s) regularly exceeding 60,000 fish. Atnarko sockeye salmon collapsed in the early 2000s and have remained depressed since; this has created major hardship for the Nuxalk and has been the focus of recovery planning and analysis initiated by the Nuxalk Nation.[5,12]

The Nuxalk Fisheries office conducts numerous monitoring and stewardship activities within Nuxalk traditional territory. These include ongoing assessment activities for salmon populations, bio-sampling of salmon populations, and salmon enhancement activities. Since 1997, Nuxalk Fisheries has collected data on FSC catch and more recently sampled catches for DNA and scale aging. In addition, since 2005 Nuxalk Fisheries has led a sockeye salmon recovery project, with support from Snootli Creek Hatchery, involving annual enhancement of sockeye salmon in the lower Atnarko and Lonesome Lake systems.



Heiltsuk Nation

Today, the population of the Heiltsuk First Nation is concentrated in Bella Bella on Campbell Island, but their traditional territory spans an area that stretches from the southern tip of Calvert Island in the south, to Mathieson and Finlayson channels in the north, Roscoe Inlet to the northeast, and the Goose Island Group to the west. Salmon are vital to the Heiltsuk, and their knowledge and stewardship practices have promoted the sustained abundance of salmon for millennia.[27,28,29] Heiltsuk leadership of salmon monitoring, management, and enhancement continues to the present day. Like other Central Coast communities, sockeye salmon are particularly prized by the Heiltsuk; however, Heiltsuk FSC fishers also catch other species especially Chinook and coho salmon.[30]

In 2010, the Nation established the Heiltsuk Integrated Resource Management Department (HIRMD) to manage stewardship activities within Heiltsuk territory. Today HIRMD is responsible for fisheries, lands, marine use, and a range of other stewardship focused activities. In particular, HIRMD conducts salmon-focused population monitoring, hatchery-based enhancement activities, and catch monitoring. HIRMD also works collaboratively with community organizations and research partners to ensure that Heiltsuk traditional knowledge and the best available science guides resource management within their territory.

Wuikinuxv Nation

Today, about half of the members of the Wuikinuxv First Nation reside in Wuikinuxv Village (also known as Katit) near the outlet of Owikeno Lake in Rivers Inlet. With a traditional territory that extends from the headwaters of Owikeno Lake to the outer coastal waters of Calvert Island, Wuikinuxv people maintain an active and dynamic connection to wild salmon that reflects their longstanding relationship with the lands, waters, and natural resources that have sustained them.

Across their territory, the Wuikinuxv Stewardship office and Wuikinuxv Fisheries Program conduct numerous stewardship activities focused on salmon and their habitats. In recent years, the Wuikinuxv Fisheries Program has worked with LGL Limited to develop a sonar monitoring and in-river test fishery program for Owikeno Lake sockeye salmon and Wannock River Chinook salmon.[31] In addition to monitoring, the Wuikinuxv Nation runs the Percy Walkus Hatchery and conducts annual enhancement and coded-wire tagging for Chinook salmon in the Wannock, Kilbella, and Chuckwalla rivers. Salmon enhancement and monitoring through the Percy Walkus Hatchery is a collaborative effort between the Wuikinuxv and recreational lodge operators (Duncanby and Good Hope) with support from PSF and DFO. Wuikinuxv Stewardship staff also conduct creek walks and contribute to the Owikeno Lake Clear Streams Index escapement monitoring program for sockeye salmon. Together, these programs and the range of other land use and resource monitoring initiatives led by the Wuikinuxv Stewardship office provide vital information for management and recovery of salmon in Wuikinuxv territory.

2.2 Salmon Populations on the Central Coast

The Central Coast project area supports hundreds of locally adapted populations of Pacific salmon comprising 79 genetically, ecologically, and spatially distinct groups of populations — known as Conservation Units (CUs).[32] These CUs include Chinook (*Oncorhynchus tshawytscha*), chum (*Oncorhynchus keta*), coho (*Oncorhynchus kisutch*), pink (*Oncorhynchus gorbushca*), and sockeye (*Oncorhynchus nerka*) salmon (see Figures A1 to A7 in Appendix 1).

Within each of these CUs, salmon spawn in a number of different streams that have been identified as "indicator" and "non-indicator" streams as part of a Core Stock Assessment Program established in 2006.[11,33] Indicator streams are those streams that are more intensively surveyed, using higher-quality methods, and thus provide more accurate estimates of annual spawner abundance. Non-indicator streams have less-consistent survey coverage due to environmental or geographic factors, such as water clarity or remoteness, that make them more difficult to survey. Within the 79 CUs included in this project, we identified 995 streams with historically documented salmon spawning (based on data in the Pacific Salmon Explorer[15] and local knowledge), of which 270 are identified as indicator streams.

Chinook Salmon

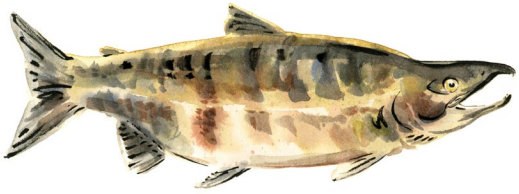
On the Central Coast, Chinook salmon exhibit both "stream-type" and "ocean-type" life history strategies. Chinook with a stream-type life history are more commonly found in headwater streams of large river systems, have a longer residency in freshwater, and undergo extensive offshore migration in the central North Pacific. Ocean-type Chinook are typically found in coastal streams, have a shorter residency in freshwater, and migrate to the ocean within the first three months of life. Most Chinook populations on the Central Coast are stream-type with the exception of Wannock River Chinook that exhibit a predominantly ocean-type life history.[34]

Chinook salmon are targeted in recreational fisheries throughout the Central Coast and also provide important FSC fishing opportunities for all Central Coast First Nations. While Chinook are primarily caught in mixed-stock fisheries in the ocean, they are also routinely captured in riverine gillnet fisheries by Nuxalk and Wuikinuxv fishers, near Bella Coola and Wuikinuxv Village, respectively. The only targeted commercial fishery for Chinook salmon on the Central Coast is conducted from May to June in the Bella Coola Gillnet Area (within DFO Pacific Fishery Management Area 8), and targets Chinook returning to the Bella Coola and Atnarko rivers.

There are six Chinook salmon CUs on the Central Coast (Figure A1, Appendix 1), comprised of 51 streams with historically documented spawning within the project area; however local knowledge suggests that there are about 25 sustained spawning populations. Of these streams, 10 are listed as indicators.[15] The majority of wild Chinook salmon currently spawn in the Bella Coola River, the Dean River, and the Wannock River — indicator streams for the Bella Coola-Bentinck, Dean River, and Wannock CUs, respectively. Chinook salmon are the least abundant salmon species in the project area. Data from the Pacific Salmon Explorer[15] shows that recent annual escapements for indicator streams are below their long-term average.

All of the major Chinook salmon spawning streams on the Central Coast have some level of hatchery enhancement, with the exception of the Dean River. The Atnarko River — part of the Bella Coola-Bentick CU — supports the largest enhanced Chinook salmon population on the Central Coast. From 2013–2017, hatchery-origin Chinook comprised 30–50% of all spawners in the Atnarko River.[35] The Wannock River — the only stream in the Wannock CU — supports the second largest enhanced Chinook population on the Central Coast. The Percy Walkus Hatchery, near Wuikinuxv Village, rears Chinook salmon from the Wannock River as well as the Kilbella and Chuckwalla rivers — part of the Rivers Inlet Chinook CU — with a goal of releasing an average of 300,000 fed fry back into the Wannock River and 100,000 fry into Kilbella Bay every spring.[36] Based on standardized methods developed by PSF,[37] the Bella Coola-Bentick CU is characterized as having a "High" enhancement level, the Wannock CU is "Moderate", and the Rivers Inlet CU is "Low". In the Bella Coola watershed, the Snootli Creek Hatchery collects Chinook broodstock in the Atnarko, the Salloomt, and the Nusatsum rivers. Data from the Pacific Salmon Explorer[15] shows that annual production of age-0 hatchery-reared juveniles has exceeded two million for the Atnarko River, and 50,000 for Chinook reared from broodstock collected in the Nusatsum and Salloomt rivers.

Chinook salmon have historically spawned in several other locations on the Central Coast; however, the current escapement and status of these smaller populations is largely unknown. A modest number of Chinook historically spawned in the Khutze and Aaltanash rivers, the Noeick and Taleomey rivers (tributaries of South Bentick Arm), and Owikeno Lake. Similarly, historic records of Chinook salmon spawning exist for the Kwatna and Kimsquit rivers, however the current abundance of these populations is unknown. Overflight surveys at the outlet of Kimsquit Lake in 2019 confirmed the presence of spawning Chinook, although they were not enumerated at the time and current population sizes remain unknown.[38]



Chum Salmon

Like chum salmon elsewhere in BC, juvenile chum on the Central Coast spend very little time in freshwater, beginning their downstream migration to the ocean almost immediately after emerging from the gravel as fry. Chum undertake lengthy ocean migrations and return to their natal stream to spawn between three- and five-years of age. The timing of returning adults to Central Coast streams and rivers varies by population, but typically occurs between August and October.

Chum salmon returning to the Central Coast have historically been among the most important species for First Nations FSC fisheries, since their relatively low-fat content is conducive for drying and long-term preservation.[28] Since the early 1900s, chum salmon have supported fisher livelihoods in many of the First nations communities. Indeed, chum are the target species in one of the largest remaining commercial fisheries in BC. Chum that originate from a mix of enhanced populations in the Bella Coola area, and wild populations in dozens of other rivers around the Central Coast, are targeted by gillnet and seine fishers in DFO Pacific Fishery Management Areas 7 and 8. In recent years, fisheries have primarily been in Area 8, with most activity in the vicinity of Fitz Hugh Sound and the Bella Coola Gillnet Area.

There are nine chum salmon CUs on the Central Coast (Figure A2, Appendix 1), comprised of 214 streams with historically documented spawning within the project area. Of these streams, 87 are listed as indicator streams, many of which have been consistently monitored in recent years.[15] Indicator streams with the greatest abundance of spawning chum include Airport Side Channel and Snootli Creek, both tributaries of the Bella Coola River, as well as Roscoe and Neekas creeks north of Bella Bella. Chum salmon were historically very abundant on the Central Coast, however data from the Pacific Salmon Explorer[15] shows that in recent years, escapements in indicator streams have often fallen below their long-term average. Observational evidence from Wuikinuxv Nation members indicates that chum population in the Wannock River have collapsed, however this population is currently unmonitored. Likewise, local observations suggest that chum salmon populations in Kitasoo/Xai'xais, Nuxalk, and Heiltsuk territories have collapsed in recent years, possibly due to changing oceanographic conditions and warming temperatures in the North Pacific and competition with hatchery-reared salmon in the high seas.[8,39]

Chum salmon populations on the Central Coast are primarily wild, however some populations are the subject of major hatchery enhancement efforts. Snootli Creek Hatchery in Bella Coola is the largest chum enhancement operation in the region, with an annual production goal of 7.2 million chum eggs.[40] In 2019, about 1.6 million fed fry were released into Snootli Creek, 1.6 million fed fry to Thorsen Creek, and 800 thousand fed fry into the Salloomt River.[15] Smaller, community-run hatcheries in Bella Bella (McLoughlin) and Klemtu (Kitasoo Creek) have annual production goals of around two million and 1.3 million fry respectively, although in recent years low returns have limited the ability of hatchery managers to meet these broodstock collection targets.

Coho Salmon

Across the Central Coast, hundreds of coho salmon populations spawn in watersheds ranging from small headwater tributaries and coastal creeks, to major river systems that drain from the interior of the Chilcotin Plateau through the Coastal Mountain range. Coho salmon typically rear in freshwater including riverine, lacustrine, and floodplain habitats, although recent evidence suggests that some brackish estuaries also serve as important nursery habitats for juvenile coho.[41,42] Depending on the temperature and feeding conditions in their rearing environment, coho typically migrate to the

ocean after one to two years in freshwater and return to their natal streams to spawn at the age of three or four.

Coho salmon contribute significantly to FSC, recreational, and commercial fisheries in BC. On the Central Coast, coho are typically captured in marine fisheries, primarily using trolling methods. In many years, coho provide more than half of the annual catch in recreational and FSC fisheries.[30]

There are six coho salmon CUs on the Central Coast (Figure A3, Appendix 1), comprised of 197 streams with historically documented spawning within the project area. Of these streams, 27 are identified as indicators.[15] Despite their importance for fisheries, very few coho populations have been monitored consistently over time. While limited escapement data for coho CUs indicates relatively stable trends in escapement, local knowledge suggests that many populations have declined dramatically. Uncertainty in escapement as well as fisheries catches hinders reliable assessments of status and trends for coho CUs.

Currently, enhancement of coho salmon on the Central Coast is limited to the McLoughlin and Kitasoo Creek community hatcheries, near Bella Bella and Klemtu respectively. With relatively modest production goals of about 60,000 juveniles annually, the two community hatcheries make important contributions to local fisheries, but likely represent a tiny fraction of total Central Coast coho escapement. Historically, Snootli Creek Hatchery produced juvenile coho and collected broodstock from a number of locations within the Bella Coola valley including Thorsen Creek, Snootli Creek, Salloomt River, and the Atnarko River; however coho enhancement is no longer ongoing in the Bella Coola River and its tributaries.[43]

Pink Salmon

By far the most abundant species on the Central Coast, pink salmon migrate to the ocean as newly emerged fry and spend two summers in saltwater before returning to freshwater to spawn in the millions during years of high survival.[4] Because their age-at-return is fixed, pink salmon populations that return to spawn in even- and odd-years represent distinct evolutionary lineages, with odd- and even-years comprising separate CUs.

Pink salmon are captured in gillnet and seine fisheries in DFO Pacific Fishery Management Area 8, but are minimally important for local FSC and recreational fisheries. Pink salmon do however play an important role in the health of aquatic and riparian ecosystems. Large annual returns of pink salmon subsidize stream, estuary, and riparian food webs, fueling the productivity of coastal habitats and driving the abundance and life history of stream rearing salmonids like coho and steelhead.[44,45,46] Protecting the abundance and productivity of pink salmon populations is therefore critical to the health of salmon watersheds on the Central Coast.

There are five pink salmon CUs in the region, with both even- and odd-year spawners represented (Figures A4 and A5, Appendix 1). For pink (even-year) salmon, there are 197 historically documented spawning streams, with 67 of these identified as indicators within the project area.[15] For pink (odd-year) salmon, there are 199 documented spawning streams, of which 57 are listed as indicators. In

recent years, the abundance of pink salmon has fluctuated dramatically, with large returns to many river systems in the middle of the past decade followed by a collapse in more recent years. For instance, the Bella Coola River supported over three million spawning pink (even-year) salmon in 1992, however data in the Pacific Salmon Explorer[15] shows that this number declined to approximately 100,000 fish in the past decade. This decline is likely related to the marine heatwave, referred to as the 'blob', which emerged in 2014 and persisted through 2016.[39] Pink salmon populations have not experienced the same levels of enhancement as other salmon species on the Central Coast.

Sockeye Salmon

Sockeye salmon CUs on the Central Coast are primarily lake-type sockeye, made up of single spawning populations, which spend one- to two-years rearing in nursery lakes prior to entering saltwater. Three CUs — Northern Coastal Streams, Northern Coastal Fjords, and Rivers-Smith Inlets — are comprised entirely of river-type sockeye, which rear in off-channel riverine habitats or migrate to the ocean as newly emerged fry. Sockeye from Central Coast CUs typically spend two- or-three winters in saltwater before returning to freshwater to spawn.

Sockeye salmon are among the most prized species of salmon on the Central Coast for both FSC and commercial fisheries. Populations range in abundance from a few hundred spawners to hundreds of thousands of spawners. Sockeye formerly supported large commercial and subsistence catches, however commercial fisheries targeting sockeye were discontinued on the Central Coast in the 1990s following the collapse of the Rivers Inlet and Atnarko sockeye populations. Historically, Owikeno Lake sockeye supported one of the largest commercial fisheries in BC with total run sizes often exceeding 1 million fish. The population collapsed in the 1990s and subsequently failed to recover.[3] Likewise, the Atnarko River formerly supported the second-most abundant sockeye population in the region, but has failed to recover since collapsing in 2005, despite major reductions in FSC and commercial fishing effort.[12] While these examples of sockeye population declines are well known, most, if not all, sockeye CUs in the project area have experienced declines in abundance and productivity.[3,5,47] These declines are believed to be driven primarily by low juvenile-to-adult survival,[3,5] but are also associated with habitat degradation that has contributed to low and variable rates of freshwater survival among juvenile sockeye in Owikeno Lake.[48]

Within the project area, there are 50 lake-type sockeye salmon CUs (Figure A6, Appendix 1) and three river-type sockeye CUs (Figure A7, Appendix 1). The status of many sockeye CUs is unknown since recent escapement data are not available. Using the best available data to 2017,[15] the biological status of 39 sockeye CUs was assessed as data deficient using PSF's standardized methods. The logistical and financial challenge of monitoring annual escapement across dozens of small, remote populations on the Central Coast has contributed to the dearth of information on sockeye salmon status.


WINDRIVER

3 Project Approach & Findings

The overarching aim of this project was to develop a salmon monitoring and stewardship framework for the Central Coast that reflects the priorities of local First Nations and DFO. This project was guided by a Working Group comprised of stewardship coordinators, resource managers, and biologists from the Kitasoo/Xai'xais, Nuxalk, Heiltsuk, and Wuikinuxv Nations, Charter Patrolmen, CCIRA staff, regional biologists and stock assessment staff from DFO, and two retired DFO employees with extensive experience in the Central Coast as well as ongoing involvement in local salmon stewardship. The Working Group played a critical role in developing the *Monitoring Framework* by sharing their extensive local knowledge and on-the-ground experience related to salmon escapement, catch, genetic monitoring, and fisheries management.

In order to build the *Monitoring Framework* in a collaborative and transparent manner, we took a structured decision-making (SDM) approach.[49] SDM is a powerful tool for making transparent decisions in group settings as it allows individuals with diverse backgrounds, perspectives, and needs to make value-based choices based on clearly defined *goals*. Fundamental to SDM is the collaborative process that is used to define the values, consequences, and alternatives that go into any decision.

Photo by Grant Callegari.

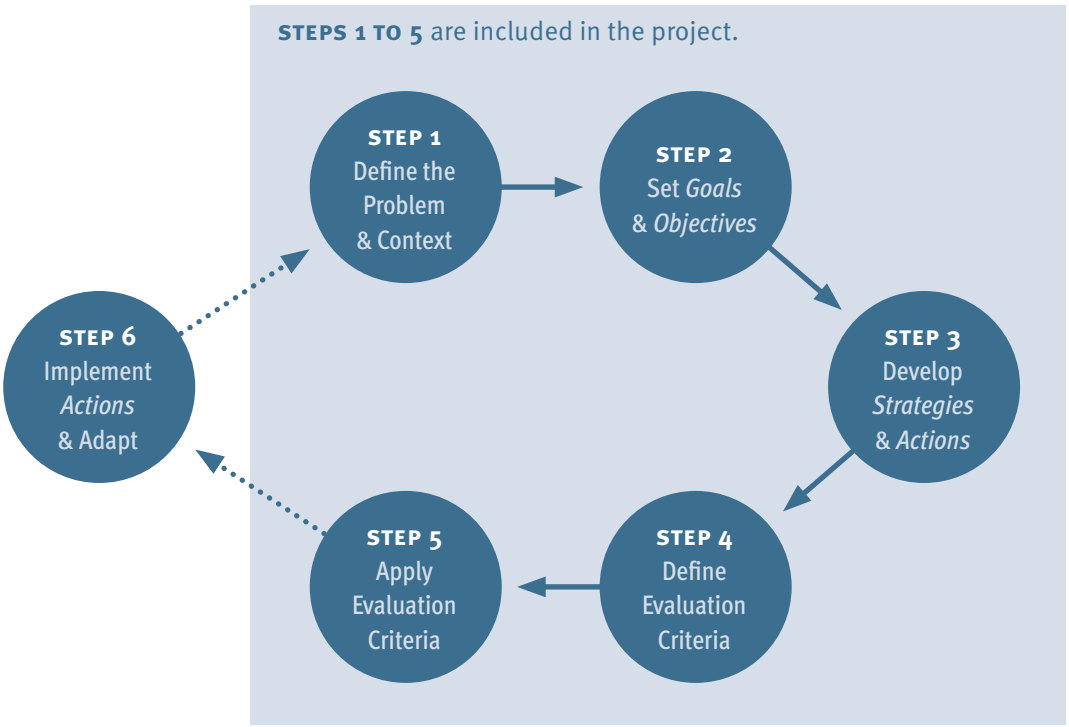


FIGURE 2. Adapted six-step structured decision-making approach (modified from Gregory et al., 2012).

Box 2. Defining Goals, Objectives, Strategies & Actions

In the context of this project, we defined our *goals* as "the aspirational management, recovery, or stewardship outcomes we hope to achieve through salmon monitoring and stewardship," *objectives* as "specific and measurable steps that address key data gaps or capacity needs, and pave the way to attaining the identified *goals*," *strategies* as "high-level sets of *actions* designed to meet the *objective*," and *actions* as "specific investments in monitoring or capacity building, which when taken together fill a core uncertainty or capacity need."

We established a collaborative process with the Working Group working over a one-year period (October 2019 – October 2020). During this time, we worked through a five-step SDM process (Figure 2) to develop the *Monitoring Framework*. This involved working as a group to: (1) define the problem and decision context, (2) define *goals* and *objectives*, (3) develop *strategies* and *actions* to address the stated *objectives*, (4) define evaluation criteria for evaluating *strategies* and *actions*, and (5) evaluate group preferences for *strategies* and *actions*. Typically, there is a final step in SDM processes that involves implementing *strategies* and *actions* and monitoring the outcomes. This final step in the SDM process (**STEP 6** in Figure 2) was not part of this project. This project only set out to develop the initial framework; a separate ongoing effort exists to support the implementation of specific aspects of the *Monitoring Framework*.

The following sections describe the five-steps of our SDM process in further detail.

3.1 STEP 1 – Defining the Context for Salmon Monitoring & Management

For **STEP 1** in our SDM approach, PSF staff conducted (i) a comprehensive review of salmon monitoring activities on the Central Coast and (ii) interviews with key technical salmon experts (both First Nations and DFO) and community members. **STEP 1** took place from November 2019 to January 2020 and allowed us to identify critical gaps in baseline data collection, identify priorities of the Central Coast Nations and DFO related to salmon monitoring, and understand the social context for monitoring and co-management of salmon fisheries in the region. Together, this information helped to lay the groundwork for the development of the *Monitoring Framework*.

3.1.1 Review of Salmon Monitoring Activities

To better understand the state of salmon monitoring in the region, we undertook a comprehensive review of historical and ongoing efforts to monitor salmon in the 79 salmon CUs and hundreds of spawning populations that inhabit the project area. Our review focused on the following monitoring activities:

- Escapement monitoring,
- Catch monitoring,
- Juvenile salmon monitoring,
- Genetic baseline collections, and
- Regional climate monitoring.

These five types of salmon monitoring are described in further detail below. We relied on information in the Pacific Salmon Explorer,[15] technical reports, and existing databases such as DFO's New Salmon Escapement Database, and the North and Central Coast database.[50]

Escapement Monitoring: Method

Information on salmon escapement (i.e. the number of fish that 'escape' fisheries and return to freshwater to spawn) is one of the most fundamental elements of salmon stock assessment. Annual escapement data derived from monitoring programs is used generate estimates of spawner abundance for CUs. These estimates are necessary to develop spawner-recruit relationships and forecast the production of the next generation. In addition, escapement and catch data are combined to produce estimates of total run size, which are important for tracking status and trends for CUs.

Escapement can be estimated using a suite of methods and can vary considerably by stream, CU, and species. Commonly used methods on the Central Coast include estimates based on counting fences (or weirs), mark-recapture studies, overflight surveys, visual surveys and corresponding estimates derived from area-under-the-curve models, test fisheries, and hydro-acoustic counters.

In many cases where escapement monitoring is not regularly carried out (e.g. non-indicator streams), estimates of CU-level spawner abundance are based on a run reconstruction that attempts to account for missing data and imperfect observations of spawner abundance. On the Central Coast, the reconstruction is based on (1) trends in escapement from indicator streams to infer trends for non-indicator streams within a CU, (2) a correction for missing estimates within indicator streams, (3) an expansion to account for all streams of a CU, and (4) a final expansion for observer efficiency, to account for the extent to which the methodology used to estimate spawner abundance may underestimate true abundance.[51]

Escapement Monitoring: Findings

Our review of historic escapement monitoring within the project area indicates that 995 salmon streams have been monitored across the Central Coast since 1950; however, not every stream has been monitored each year. Despite ongoing efforts to monitor escapement, the overall number of populations that are monitored within streams, and the number of times individual streams are counted during a given season, has declined over the past three decades. In 2016, LGL Ltd. was commissioned by PSF to conduct a review of escapement monitoring on the North and Central Coast of BC. This review found that since 2006 — when a Core Stock Assessment Program was established for the region — the number of monitored streams had declined by 50%.[11,33]

Based on conversations with First Nations fisheries and DFO staff, we catalogued 170 streams that had been monitored in 2019 (Appendix 2, Table A1). Among these, chum and pink salmon are monitored more consistently. The remaining species, Chinook, coho, and sockeye, comprise a much smaller proportion of the total escapement monitoring annually. For example, while 10 spawning streams have been designated as indicators for Chinook salmon within the project area, recent Chinook escapement data is only available for the Atnarko River as well as the Wannock River.[15] Escapement monitoring for Chinook salmon in the Dean River was discontinued in 2011 due to high costs and concerns about data quality. Likewise, annual escapement monitoring ceased for Chinook salmon in the Chuckwalla River in 2011, and the Kilbella River in 2013. Limited efforts to monitor escapement for these species is due, in part, to the remote nature of their freshwater spawning habitats, coupled with their assumed lower abundance and protracted spawning periods. Many remote streams require helicopter or floatplane access for stream walks. Given the high cost of hiring a helicopter or floatplane, there have been limited opportunities to monitor many of these remote populations in recent years.

Historically, a large portion of escapement monitoring on the Central Coast was carried out by Charter Patrolmen, including Stan Hutchings and Ralph Nelson. Throughout much of the region the same Charter Patrolmen have been counting spawning salmon in the same streams for the past 30–35 years, generating valuable long-term escapement datasets.[51] Historically, more than a dozen Charter Patrolmen monitored salmon spawning streams and fisheries on the Central Coast. However, DFO funding has diminished in recent years and only four Charter Patrolmen are currently active in the region, only working seasonally or on a part-time basis as funding allows. Today, spawning salmon are enumerated by the Central Coast First Nations, four Charter Patrolmen, as well as academic, and NGO scientists.

The reduction in monitoring effort has diminished our collective ability to understand changes in spawner abundance at the CU-level, the status of salmon populations and CUs, plan recovery actions, and manage for sustainable fishing opportunities. For example, current CU-level spawner abundance — calculated as the geometric mean of CU spawner abundance over the most recent generation — could only be calculated for 36 of the 79 CUs in the project area using data available on the Pacific Salmon Explorer.[15] A summary of escapement monitoring in the region by CU can be found in Appendix 2, Table A1.

Catch Monitoring: Method

Catch monitoring in commercial, recreational, and FSC fisheries is conducted for a wide variety of reasons. For some species and areas, catch monitoring is the main tool used to assess the abundance of salmon populations during the fishing

season. Estimating the total number of salmon caught in fisheries, and attributing them to specific populations or CUs, is also critical for understanding salmon status and trends.

Catch (the total number of salmon caught in fisheries) and corresponding exploitation rates (the percentage of the total run caught in fisheries) are estimated in different ways depending on the species. In general, these datasets are estimated from some combination of direct counts of total catch or estimates of catch in fisheries by weight, exploitation rate to effort relationships, species- and CU-specific run-timing, and coded wire tag (CWT) recoveries from enhanced populations.

Our review focused on catch monitoring for commercial, recreational, and FSC fisheries operating on the Central Coast. The primary tools for monitoring commercial and recreational catch are creel surveys (dockside interviews), lodge and fishing vessel logbooks, DNA sampling, and CWT recoveries. Hatchery-origin juvenile salmon are often marked with adipose clips and implanted with CWTs denoting their release location. Salmon caught in fisheries are then scanned for CWTs, and tagged fish have their heads removed for subsequent CWT reading. Exploitation rates are estimated from these recovered tags and data are shared between Canada and the United States under the terms of the Pacific Salmon Treaty.[52] FSC catches are typically estimated based on self-reported catches from fishers and interviews conducted by stewardship staff in each First Nations community. Given uncertainty in methods used to estimate FSC catches over time, and a lack of quantitative study designs to quantify total catches, these utility of these data is limited.

Catch Monitoring: Findings

Our review of catch monitoring on the Central Coast shows that there are large gaps in baseline data collection that make it difficult to quantify and attribute catch and exploitation rates to specific salmon CUs in the region. More often than not, when CU-specific catch and exploitation rates are reported, the rates are not derived from actual field-collected CU-specific data. Instead, these rates are estimated using models in combination with local knowledge of the region.

Monitoring of total catch and CU-specific catch composition is limited on the Central Coast and is currently conducted through a mix of DFO and First Nations-led initiatives (see Appendix 2, Table A2). Commercial catch is estimated from vessel logbooks required for each commercial license holders. Likewise, fishing lodges are required to make weekly reports of both total catch by species and hatchery mark-rates. Catch data for lodges and commercial fisheries record total catch by salmon species, however genetic samples for mixed-stock analysis are not routinely collected, limiting understanding of fishery impacts on individual populations and CUs. Independent recreational fisheries are unmonitored on the Central Coast and represent a large and growing share of the recreational fishery. First Nations FSC catch is estimated by each community, however the configuration of these monitoring initiatives varies and has changed over time. In many cases, estimates of FSC catch have come from voluntary reporting by fishers and from data collected by Guardian Watchmen or Fishery Monitoring staff in each community.

Despite limited catch monitoring on the Central Coast, estimates of catch and exploitation rates for 2017 are available for 40 of the 79 CUs in the region.[15] For some Chinook salmon CUs, a small number of exploitation rate estimates are derived from CWT recoveries in fisheries, which enable CU-specific attribution of catch. Currently, within these CUs CWT programs for Chinook are restricted to a small number of populations including the Atnarko, Salloomt, Nusatsum, Wannock, Kilbella, and Chuckwalla. However, with the exception of

the Atnarko and Wannock populations, data on escapement and CWT mark-rate are lacking from these enhanced populations, precluding estimates of exploitation rate or juvenile-to-adult survival. Likewise, coho salmon were formerly CWT-marked at hatcheries on the Central Coast, but these programs were discontinued due to a lack of funding, limited escapement data, and low tag recovery rates. In the absence of CWT marking in Central Coast coho populations, managers have made assumptions about the relationship between catches of Central Coast coho and other North Coast CWT indicator populations. In recent years, estimates of coho salmon catches have been based on extrapolation from Tobbogan Creek, an enhanced coho salmon population on the Skeena River. For chum, pink, and sockeye, the majority of catch and exploitation rate estimates are derived using data on commercial catch and escapement within each DFO Pacific Fishery Management Area. The estimates assume that the exploitation rate is the same for all CUs within a species, rather than from data collected in specific fisheries and knowledge of the composition of CUs within the catch. Across all five species of salmon, programs to mark juvenile salmon with CWT at hatcheries have been spatially and temporally limited, precluding reliable estimates of exploitation rates.

Increasingly, Central Coast First Nations are developing programs to quantify catch across different fisheries in their territories. For example, in Bella Coola, the Nuxalk River Monitor Program run by Nuxalk Fisheries has produced estimates of FSC catches since 2000. In Bella Bella, a pilot program run by the Heiltsuk Nation is providing quantitative, population-specific estimates of Chinook and coho catch in recreational and FSC fisheries in portions of DFO Pacific Fishery Management Areas 7 and 8.

Given the limited success of CWT marking programs for chum, coho, pink, and sockeye salmon, there is a need to evaluate alternative methods for quantifying and attributing catch to salmon CUs on the Central Coast. The emergence of high throughput genetic analysis and rapid genotyping have enabled the development of new parentage-based tagging methods. For parentage-based tagging, DNA is collected from hatchery broodstock and genetic parentage analyses are applied to mixed-stock samples to assign fish back to their hatchery of origin. These methods have recently been proposed as a more reliable and cost-effective method of quantifying population-specific exploitation rates than current CWT marking programs.[53]

Juvenile Salmon Monitoring: Method

Outmigrating juvenile salmon are often enumerated downstream from in-river spawning and rearing areas. By counting juvenile salmon as they migrate to the ocean as fry or smolts, these data capture annual fluctuations in juvenile-to-adult survival that are controlled by density-dependent habitat limitations and climate variability in freshwater. Accordingly, juvenile salmon monitoring often improves our understanding of the productivity of freshwater habitats, knowledge that can support conservation and fisheries management planning.

Commonly used sampling methods to enumerate outmigrating juvenile salmon include mark-recapture studies, fences or weirs, and traps. Mark-recapture is used to determine an estimate of total population size and can be more accurate than other methods since trap efficiency is taken into account. Before outmigration, juveniles are marked, usually by adipose fin-clipping and CWTs. During downstream sampling, the number of marked juveniles is compared to the number that are unmarked, and calculations are used to derive a total population size. Fences are used to funnel outmigrating juveniles through narrow openings so that a population census can be completed. Traps,

such as a fyke trap or an inclined plane trap, block downstream migration of juveniles and funnel them into a live trap where they can be enumerated.

Juvenile Salmon Monitoring: Findings

Our review of juvenile salmon monitoring on the Central Coast showed that efforts to enumerate juvenile salmon across the project area have been limited to only a handful of locations over the years. Juvenile salmon monitoring typically requires daily sampling so these programs can be very labour- and resource-intensive; outmigration typically occurs over the span of several months, beginning in late-winter and continuing into at least the early summer.[54]

Currently, annual juvenile salmon enumeration is ongoing at three locations: 1) Mary's Cove Creek, 2) the Koeye River, and 3) Owikeno Lake (see the Pacific Salmon Explorer[15] for data). At Mary's Cove Creek and the Koeye River, juvenile coho and sockeye salmon are enumerated with downstream trapping. In Owikeno Lake, annual hydroacoustic surveys are used to monitor juvenile sockeye salmon abundance. Estuary and nearshore monitoring of juvenile salmon abundance, growth, and condition is ongoing in portions of DFO Pacific Fishery Management Area 7 within near Klemtu and also in the Koeye River estuary. A summary of juvenile salmon monitoring in the region by CU can be found in Appendix 2, Table A1.

Genetic Baseline Collections: Method

The identification of individual salmon populations and CUs using DNA is critical for effective salmon conservation and management. For example, the ability to quantify the contribution of co-migrating salmon populations in catch from mixed-stock fisheries can help fisheries managers target fishing opportunities for healthy or enhanced populations while reducing impacts on at-risk populations. Genetic information is also used to develop estimates of total run size for specific salmon CUs and track these trends in run size over time.

Our review of genetic baseline collections focused on identifying the populations that have had genetic data collected since 1950. Typically, a minimum of 50 DNA samples from an individual spawning population is required for reliable identification in mixed-stock samples, although 100+ samples yields more accurate results. We also identified the number of populations within a CU that have adequate genetic baselines. To determine the extent of genetic baselines and the number of samples for each population on the Central Coast, we reviewed a summary document provided by Ben Sutherland (DFO Molecular Genetics Lab).

Genetic Baseline Collections: Findings

Our monitoring review revealed that, for some Central Coast salmon, population-specific genetic baselines are established through the collection of DNA tissue samples during annual escapement monitoring or in test fisheries. Population or CU-specific catches are estimated from samples collected in marine fisheries. These mixed-stock samples have occasionally been collected from commercial fisheries landings, and have increasingly been collected by First Nations' catch monitoring programs.[5,30] Samples are sent to the DFO Molecular Genetics Lab at the Pacific Biological Station in Nanaimo, BC, where they are analyzed and assigned to their population of origin. However, despite recent investments in genetic tool development by the DFO Molecular Genetics Lab and the relatively low cost of processing DNA samples for genetic stock identification (GSI), there is poor coverage of genetic baselines across salmon populations on the Central Coast. In addition, minimal progress has been made towards applying GSI tools to mixed-stock fisheries.

Across all species of Central Coast salmon, 137 of 995 populations within the project area have at least 50 DNA samples in existing baselines. Coverage for Chinook salmon populations is adequate (15 populations), and includes most of the larger populations in the region (› 1000 spawners). DNA baselines for sockeye (lake-type) salmon populations is slightly more complete (24 populations), with most of the larger and more important populations for FSC and commercial fisheries have been sampled. By comparison, chum, coho, and pink salmon have very poor DNA baseline coverage, and major investments in baseline collections are needed for reliable GSI of mixed-stock samples.

In recent years, the DFO Molecular Genetics Lab has developed powerful new genetic panels, comprised of hundreds of genetic markers known as single nucleotide polymorphisms (SNPs). SNPs have shown promise for improved reliability in GSI[55] and can often be used to differentiate proximal salmon populations that are indistinguishable using older microsatellite and allozyme markers.[56] Thus far, SNP panels have been developed for Chinook, chum, coho, and sockeye salmon on the Central Coast, and DNA baselines have been rerun against these panels for Chinook, coho, and chum salmon enabling their use for population identification in mixed-stock fisheries. Work is underway to run existing sockeye samples against the newly developed SNP panels. A summary of genetic baseline collections in the region by CU can be found in Appendix 2, Table A1.

Regional Climate Monitoring: Method

Climate change related impacts will affect available freshwater and marine salmon habitats and food sources, reduce reproductive success, and change the timing of salmon spawning and migration. Monitoring the state of freshwater and marine environments is a key aspect of improving our understanding of the status of salmon populations.

We reviewed existing temperature, river hydrology (i.e. flow), and marine climate monitoring programs from a variety of sources including first-hand information from DFO biologists and academic researchers, as well as the government of Canada Hydrometric Data Portal.[57] This work revealed the scope of current monitoring efforts, as well as changes in monitoring programs over the past decade.

Regional Climate Monitoring: Findings

Our review of regional climate monitoring showed that, to date, there has been no coordinated effort to gather regional climate data across freshwater and marine salmon habitats on the Central Coast; rather it has been a patchwork of efforts, often with inconsistent data archiving. Historically, a variety of independent monitoring programs in the Central Coast have collected climate-related data such as stream temperature, stream flow, and other physical and biological conditions in the marine environment. In recent years, Central Coast First Nations, DFO, and a variety of other research groups have increased stream temperature and flow monitoring efforts producing valuable datasets that can start to generate a picture of climate change impacts on freshwater salmon habitats in the region.

Stream temperature data has been the most commonly collected type of climate data within freshwater salmon habitats in the Central Coast, and sufficient data exist to reconstruct historic changes in temperature in a handful of locations. For example, DFO spawner inspection log (SIL) forms — used by Charter Patrolmen to record spawning escapements — also include fields for recording biophysical information such as stream temperature. These data have routinely been collected since the 1950s but, while these forms are publicly available, they have not been compiled and digitized for storage in a centralized database making it difficult to extract and utilize the data for analysis.

Additional stream temperature monitoring has occurred sporadically in watersheds and estuaries around the region. For example, in the early 2000s, temperature data were collected at several locations in Heiltsuk territory in collaboration with the DFO Community Advisor, and also several chum and pink spawning locations by students in the lab of Dr. John Reynolds at Simon Fraser University, but these efforts have since been discontinued.[58] Stream temperature data have also been collected in the Koeye River, Namu Lake, Hook Nose Creek, and Upper and Lower Kadjusdis Lake — all sockeye migration and spawning habitats — since 2013.[59] Other temperature monitoring efforts have occurred in Kitasoo/Xai'xais, Nuxalk, and Wuikinuxv territories. However, no centralized database of stream temperature monitoring data currently exists, and reports are not routinely published from these monitoring initiatives. Future efforts will be required to organize existing data into a centralized database for analysis and interpretation.

Far fewer locations have had continuous hydrologic monitoring of river discharge (i.e. flow). The locations that have been monitored are primarily concentrated in a handful of road-accessible watersheds. For example, Environment Canada has conducted continuous hydrologic monitoring in the Atnarko and Salloomt rivers since 1965.[58] Likewise, the Wannock River at the outlet of Owikeno Lake has had continuous flow monitoring since 1961. Currently, flow on the Bella Coola River is also monitored by Environment Canada. Hydrologic and stream temperature monitoring in watersheds on Calvert and Hecate Islands has been led by the Hakai Institute since 2014.[60] Likewise the Koeye River Salmon Ecosystem study has monitored flow in the Koeye River since 2012.[61] These data provide valuable baselines for understanding hydrologic conditions facing salmon populations in coastal watersheds.

Monitoring of climate-related variables in the marine environment has also been sporadic on the Central Coast. Since 2014, the oceanography program at the Hakai Institute has provided data on physical and biological conditions in the marine environment around Calvert Island, Fitz Hugh Sound, and in Rivers Inlet.[62] More recently, two permanent oceanographic moorings have been installed providing continuous data on temperature, salinity, and other pertinent oceanographic variables. Daily sea surface temperature and salinity measurements have been taken at McInnes Island and Egg Island light stations,[63] and satellite monitoring by the US National Oceanographic and Atmospheric Administration[64] also provides coarse-scale measurements of temperature.

Compiling existing data and developing strategic initiatives to understand ongoing climate-driven changes in freshwater and marine ecosystems is a critical need, since this information can support adaptation and conservation in the future.

Additional details of monitoring initiatives on the Central Coast can be found in the supplemental materials accompanying this report.

3.1.2 Semi-Structured Interviews with Salmon Experts

From November 2019 to January 2020, PSF staff conducted a series of semi-structured interviews with regional salmon experts to elicit local perspectives on critical data gaps that hinder annual salmon population assessment, identify outstanding needs for salmon monitoring and stewardship, and the current context for salmon management and decision-making in the region. We interviewed a total of 31 experts including: (i) Central Coast First Nations stewardship staff and elected leadership, (ii) DFO staff from North Coast Stock Assessment and the Salmonid Enhancement Program, (iii) current and former Charter Patrolmen

who have conducted surveys of spawning salmon in Central Coast watersheds for decades, and (iv) former DFO employees and researchers with expert knowledge of Central Coast salmon populations and monitoring efforts. For each interview, we used a standard set of semi-structured questions as a starting point for discussion (see Appendix 3). However, the interviews were open-ended allowing interviewees to express their own ideas, values, and priorities.

Across interviews, several common themes emerged that subsequently shaped the development of the *Monitoring Framework*. For example, most of the interviewees pointed to climate change and ongoing mixed-stock fisheries as the primary pressures on Central Coast salmon.

In some communities, for example Bella Coola and Wuikinuxv Village, concerns about historic and ongoing loss of freshwater habitats were also highlighted as primary drivers affecting the status of local salmon populations. Several respondents pointed to a need for better escapement and catch monitoring to improve quantitative estimates of exploitation rates in fisheries and track changes in population and CU status. The decline of escapement monitoring programs and recent increase in recreational fisheries targeting Chinook and coho salmon on the Central Coast were identified as driving these concerns. Additionally, First Nations fisheries managers expressed frustration at the difficulties they have faced in accessing management-relevant climate information in a timely fashion. Finally, an overarching priority that emerged from all of the interviews is the need for greater investment in capacity building (e.g. resources and infrastructure), coordination, and collaborative governance between DFO and the Kitasoo/Xai'xais, Nuxalk, Heiltsuk, and Wuikinuxv First Nations related to salmon monitoring and fisheries management. Investments in capacity building can help ensure that limited monitoring resources are used effectively and could help shape fisheries management (e.g. Integrated Fishery Management Plans, and in-season management) under the Fisheries Resources Reconciliation Agreement.

The results of these interviews not only helped us complete the review of salmon monitoring activities (i.e. Section 3.1.1), but also laid the groundwork for the development of the *Monitoring Framework*.

3.2 STEP 2 – Identify Goals and Objectives for Salmon Monitoring

For **STEP 2** of our SDM approach, in January 2020, the Working Group came together for a two-day workshop in Vancouver facilitated by PSF. The aim of the workshop was to generate a broad understanding of existing salmon monitoring programs on the Central Coast and work together to develop high-level *goals* and draft *objectives* for salmon monitoring and stewardship in the region. In total, 15 participants from the Working Group, including First Nations staff, staff from DFO and other regional salmon experts, attended the meeting.

On the first day of the workshop, PSF staff shared results from both the comprehensive review of monitoring activities and the semi-structured interviews, outlined in Section 3.1. The Working Group was then guided through a series of breakout sessions, presentations, and discussions to brainstorm overarching *goals* for salmon monitoring that reflected desired outcomes for salmon conservation and management. Having identified overarching *goals*, PSF staff then facilitated discussions to develop draft *objectives* to help meet these *goals*. *Objectives* were developed by identifying critical uncertainties, capacity needs, or data gaps related to each *goal*. For example, if the *goal* is to "*minimize overfishing risk*," then a relevant *objective* might be to "*Estimate exploitation rates for priority populations in recreational, commercial, and FSC fisheries*."

Four *goals* emerged from the workshop that provided the foundation for developing the *Monitoring Framework*:

- GOAL 1 — Strengthen Central Coast community participation in stewardship and collaborative salmon management.
- GOAL 2 — Strengthen ability to detect and respond to changes in status of Central Coast salmon.
- GOAL 3 — Strengthen catch monitoring of Central Coast salmon.
- GOAL 4 — Strengthen understanding of current and future climate pressures on Central Coast salmon.

In order to meet the stated *goals*, the Working Group developed 13 *objectives*. They are diverse and include everything from working with the Central Coast Nations to build technical capacity for collaborative salmon management (OBJECTIVE 1.1) and developing escapement goals to guide collaborative management (OBJECTIVE 1.4), to quantifying escapement in wild and hatchery salmon populations (OBJECTIVES 2.1 & 2.2), and building comprehensive DNA baselines and First Nations-led catch monitoring initiatives to quantify CU-specific exploitation rates (OBJECTIVES 3.1 & 3.2). Figure 3 summarizes all *goals* and *objectives* developed through **STEP 2** of our SDM approach.

On the second day of the workshop, the Working Group focused on brainstorming potential *strategies* and *actions* for achieving the stated *goal* and *objectives*. Group members also provided feedback on potential criteria to evaluate individual *actions* and what values the criteria should capture (e.g. cost, capacity, and community support). These *strategies*, *actions*, and evaluation criteria provided the backbone of a draft *Monitoring Framework* that we sought further input and feedback on in subsequent steps of our SDM process.

GOAL 1 — Strengthen Central Coast community participation in stewardship and collaborative salmon management.		
	**OBJECTIVE 1.1**	Build technical capacity for collaborative salmon management.
	**OBJECTIVE 1.2**	Increase opportunities for community outreach, engagement, and participation in stewardship and collaborative salmon management.
	**OBJECTIVE 1.3**	Ensure that traditional and local knowledge guide salmon monitoring, planning, and fisheries management.
	**OBJECTIVE 1.4**	Develop escapement goals for priority salmon populations to guide precautionary management of fisheries.
GOAL 2 — Strengthen ability to detect and respond to changes in status of Central Coast salmon.		
	**OBJECTIVE 2.1**	Quantify escapement, spawn timing, and age-at-return for priority populations of salmon.
	**OBJECTIVE 2.2**	Quantify contribution of hatchery-origin fish to estimates of catch and escapement for all Central Coast CUs.
	**OBJECTIVE 2.3**	Quantify juvenile salmon abundance and juvenile-to-adult survival.
	**OBJECTIVE 2.4**	Quantify current impacts and risks associated with pathogens and how these impacts may affect salmon survival.
	**OBJECTIVE 2.5**	Create standardized tools and processes for data collection, sharing, assessment, and reporting.
GOAL 3 — Strengthen catch monitoring of Central Coast salmon.		
	**OBJECTIVE 3.1**	Build a comprehensive genetic stock identification (GSI) baseline.
	**OBJECTIVE 3.2**	Quantify CU-specific recreational, commercial, and food, social, ceremonial (FSC) catch.
	**OBJECTIVE 3.3**	Characterize the vulnerability of individual salmon populations to overfishing to inform understanding of fisheries and conservation trade-offs.
GOAL 4 — Strengthen understanding of current and future climate pressures on Central Coast salmon.		
	**OBJECTIVE 4.1**	Evaluate current climate stressors on estuary, marine and freshwater salmon habitats.

FIGURE 3. Goals and the associated objectives identified by Working Group members.

3.3 STEP 3 – Develop Strategies and Actions

For **STEP 3** of our SDM approach, PSF staff planned to visit Bella Coola, Bella Bella, Klemtu, and Wuikinuxv Village in order to engage directly with First Nations communities on the development of the *Monitoring Framework*. The intent was to gather input on local priorities and monitoring needs and further develop potential monitoring *strategies* and *actions* with local fishers and knowledge holders.

In February 2020, PSF staff travelled to Bella Coola for meetings with Nuxalk Stewardship and Fisheries staff. This meeting was followed by a presentation to about 80 people at the Lobelco Hall for an Annual Marine Use Planning meeting. *Nuxalkmc* identified a number of urgent issues related to salmon and suggested improvements to both salmon escapement and catch monitoring in the region. Community members also expressed concern over a lack of catch monitoring and fisheries enforcement in their territory. Follow up conversations with Nuxalk Fisheries, DFO, and Snootli Creek Hatchery in Bella Coola clarified the extent of current monitoring and the need for new investments. This information was subsequently used to inform monitoring *strategies* and further develop detailed *actions* in Nuxalk territory.

In March 2020, PSF staff travelled to Bella Bella, met with staff from HIRMD, and hosted a community meeting attended by about 15 people at the Bella Bella Elders Building. During the community meeting, those in attendance expressed enthusiasm for the ongoing monitoring work and voiced a number of concerns related to salmon monitoring and management, especially related to the potential impacts of recreational fisheries on local coho salmon populations. Meetings with HIRMD staff further prioritized *strategies* and *actions* to be included in the draft *Monitoring Framework*.

Due to the rapid emergence of COVID-19 as a global pandemic in March 2020, PSF staff were not able to visit Klemtu or Wuikinuxv Village. Consequently, community engagement with the Wuikinuxv and Kitasoo/Xai'xais Nations was conducted by phone and videoconferencing.

In May 2020, PSF hosted a call with the leadership and science staff of the KXSA and Kitasoo Fisheries. The *actions* identified reflect ongoing Kitasoo/Xai'xais monitoring programs and a handful of proposed new initiatives focused on community priorities such as sockeye salmon, youth, and cultural programs. These *actions* are less specific than many identified by other Nations and DFO and will be further refined in the coming years pending community input and ongoing conversations with the KXSA and Kitasoo Fisheries.

Throughout May 2020, PSF staff worked with the Wuikinuxv Stewardship Office to better understand the priorities and salmon monitoring needs of the Wuikinuxv community. A series of phone interviews were conducted to solicit input from members of the Wuikinuxv Stewardship Committee, fisheries program, and hatchery staff. These findings were subsequently presented to the full Wuikinuxv Stewardship Committee by teleconference to review our findings and elicit feedback on the proposed monitoring *strategies* and *actions*.

Further development of *strategies* and *actions* was completed through follow-up discussions with numerous individuals involved in salmon monitoring and stewardship across the Central Coast. These discussions included calls with DFO Salmonid Enhancement Program staff to discuss potential monitoring partnerships with regional hatcheries, follow up conversations with DFO Stock Assessment

and Fish Management staff, and other salmon experts including Brendan Connors (DFO), Brian Riddell (Commissioner, Pacific Salmon Commission and PSF Science Advisor), Coastal First Nations (CFN) staff responsible for the CoastTracker monitoring system, and Karl English (LGL consulting).

As a result, 43 *strategies* were developed by Working Group members and refined through community visits and consultation with First Nations fisheries managers and DFO staff. Like the *objectives*, these 43 *strategies* seek to fill a diverse mix of needs ranging from community engagement that bolsters participation and awareness of ongoing community-led monitoring initiatives, to specific sets of monitoring *actions* that provide the information needed to manage sustainable salmon fisheries. In addition, 285 *actions* for salmon monitoring and stewardship were proposed to fulfill the *strategies*.

3.4 STEP 4 – Review and Finalize Evaluation Criteria

STEP 4 of our SDM approach focused on further engagement with Working Group members to develop a simple framework to qualitatively evaluate all proposed 285 monitoring *actions*. In June 2020, PSF convened the Working Group for a second workshop which was held online rather than in-person due to the COVID-19 pandemic. In total, 30 participants attending the meeting, including most members of the Working Group, as well as additional staff from DFO and other regional salmon experts.

During the workshop, attendees helped to finalize a set of eight overarching criteria (Table 1) that would be used to evaluate all proposed *actions*, plus two additional criteria for each of the four *goals* (i.e. goal-specific criteria) (Table 2) — for a total of 10 criteria to be applied to each *action*.

The **eight overarching evaluation criteria** include:

1. **Community support** — a measure of how much each of the Central Coast Nations supported a given action.
2. **Strengthens connections to salmon** — the degree to which an action would bolster cultural connections to salmon and their watersheds.
3. **DFO support and engagement** — a measure of the amount of DFO support for a given action.
4. **Community participation** — the degree of participation and leadership on the part of the Nations that is expected in implementation of a given action.
5. **Builds or Maintains Capacity** — the level of capacity for salmon monitoring and stewardship that would be created through implementing a specific action.
6. **Costs** — the level of funding required for the project and potential to leverage existing funding or gain new funding.
7. **Realistic and achievable** — a measure of the uncertainty associated with project outcomes and the degree of certainty that the project would succeed.
8. **Reduces biological risks to salmon** — a measure of the potential benefit of a given monitoring action for salmon on the Central Coast.

The **eight goal-specific criteria** include:

GOAL 1 — Strengthen Central Coast community participation in stewardship and collaborative salmon management.

1 **Supports collaborative management** — the degree to which a specific action would contribute to co-governance between First Nations and DFO.

2 **Strengthens participation in management** — the benefits of a given action in ability to support greater inclusion of First Nations community members in fisheries management and stewardship.

GOAL 2 — Strengthen ability to detect and respond to changes in status of Central Coast salmon.

3 **Detecting trends in population status** — the focus of this goal on tracking changes in the status of salmon CUs, and the degree to which a given action supported that goal.

4 **Informs management actions** — the level to which a monitoring action would contribute management-relevant information.

GOAL 3 — Strengthen catch monitoring of Central Coast salmon.

5 **Quantifying catch** — how much a given action would contribute data needed to quantify fisheries impacts.

6 **Informs management actions** — a measure of whether a monitoring action would contribute management-relevant information.

GOAL 4 — Strengthen understanding of current and future climate pressures on Central Coast salmon.

7 **Leverages existing or new data to improve understanding** — how much an action improves our understanding of climate impacts and their effects on salmon. (This criterion was articulated by the Central Coast Nations based on the need for actions that analyzed regional climate data sets.)

8 **Supports adaptive management** — the degree to which an action could contribute to adaptive management under climate change.

These criteria capture a range of cultural and biological values identified by the Working Group for salmon management and recovery, enabling subsequent evaluation of the proposed *actions* to identify a set of monitoring investments that reflected the needs, understandings, and priorities of the Central Coast Nations and DFO. Together, the criteria are intended to help support the identification of priority *actions* for implementation.

TABLE 1. Overarching evaluation criteria, applied to all actions.

Evaluation Criteria	Low = 1	Med = 2	High = 3
Community support	Low degree of support from Central Coast First Nations	Moderate support from Central Coast First Nations	High degree of support from Central Coast First Nations
Strengthens connections to salmon (eg. harvest, education, culture)	Does not strengthen community connections to salmon	Strengthens community connects to salmon modestly or indirectly	Creates tangible and immediate opportunity to strengthen community connections to salmon
DFO support and engagement	Low degree of support from DFO, collaborative implementation unlikely	Moderate support from DFO, potential for collaborative implementation	High support from DFO, opportunity for collaborative implementation
Community participation	Limited opportunities for meaningful community involvement	Provides opportunities for community participation	Has a high degree of community participation and leadership in delivery
Builds or maintains capacity	Does not create capacity	Modest benefits to community capacity for monitoring and stewardship	Substantial direct benefits to community capacity for monitoring and stewardship
Costs	High costs and limited potential to leverage existing funding	Moderate costs once leveraging, exiting programs and new funding are considered	Can be funded from existing resources or has a high likelihood of being funded
Realistic and achievable	Achievability uncertain and poses high risk of failure	Likely achievable, but may pose challenges	Action is realistic and likely to succeed
Reduces biological risks to salmon	Does not reduce biological risks to wild salmon	Delivers indirect or modest reductions in biological risk	Provides immediate and tangible reductions in biological risks

TABLE 2. Overarching evaluation criteria, applied to actions associated with specific goals.

Goal	Evaluation Criteria	Low = 1	Med = 2	High = 3
GOAL 1	**Supports collaborative management**	Does not support collaborative management	Supports collaborative management modestly or indirectly	Directly supports collaborative management
	Strengthens community participation	Does not strengthen community participation in salmon stewardship	Supports community participation modestly or indirectly	Directly supports community participation
GOAL 2	**Detecting trends in population status**	Unlikely to improve ability to detect changes in population status	Contributes modestly, or indirectly to evaluating status	Directly relevant and necessary for evaluating status
	Informs management actions	Does not inform management and recovery actions	Informs management and recovery indirectly or incrementally	Fills management relevant knowledge gaps for planning and recovery
GOAL 3	**Quantifying harvest**	Unlikely to improve estimates of harvest	Beneficial but will not on its own produce estimates harvest	Action contributes directly to estimates of CU- or population-level harvest
	Informs management actions	Does not inform management and recovery actions	Informs management and recovery indirectly or incrementally	Fills management relevant knowledge gaps for planning and recovery
GOAL 4	**Leverages existing or new climate data to improve understanding**	Does not improve understanding of climate impacts	Generates or collates data that can support new understanding	Contributes management-relevant understanding of climate impacts
	Supports adaptive management	Does not support adaptive management to address climate change	Contributes modestly or indirectly to adaptive management	Directly supports adaptive management

3.5 STEP 5 – Evaluate Monitoring Actions

STEP 5 in our SDM approach was to work with the Central Coast Nations and DFO staff to qualitatively evaluate the benefit of all proposed monitoring *actions*, using the criteria developed in **STEP 4** (May–July 2020). To facilitate the evaluation of all *actions* in the *Monitoring Framework* by reviewers, we developed a spreadsheet with all *strategies* and *actions* identified in **STEPS 1–4**. The *actions* were then evaluated using qualitative scores of "low," "medium," and "high" (see Tables 1 & 2 for further details on how we defined these scores). For each action, the first two evaluation criteria, "Community support" and "Strengthens connections to salmon," were evaluated only by First Nations' stewardship staff. Likewise, only DFO staff scored the "DFO support and engagement" criteria. The remaining five overarching criteria and two goal-specific criteria were then assigned scores by all reviewers.

We equated qualitative scores of "high," "medium," and "low" with three, two, and one point(s), respectively. Final scores for each *action* were calculated as the sum of the average score applied to each of the 10 criteria, and scores were rounded to the nearest integer value. Because not all *actions* could be put forth for implementation due to capacity and resource constraints, only *actions* that received scores of 24 points or more were included in the final *Monitoring Framework* (see Section 4 for full details on the *strategies* and *actions* included in the final *Monitoring Framework*). This threshold allowed projects with wide ranging benefits and support from the Central Coast Nations and DFO to be advanced to the implementation phase.

A total of 201 of the 285 proposed *actions* received scores of 24 or more, meaning that they were included in the *Monitoring Framework*. An additional 13 *actions* were included (despite receiving less than 24 points) because they are considered a 'prerequisite' for other *actions*. This resulted in a total of 214 *actions* being included in the *Monitoring Framework*. Two of the original 43 *strategies* were not included because none of the accompanying *actions* received 24 points or more resulting in a total of 41 *strategies* being included in the *Monitoring Framework*. Evaluation scores for all of the proposed 285 *actions* and their corresponding *strategies* can be found in Appendix 4, Tables A3–A15.

3.6 STEP 6 – Implement Monitoring Framework and Adapt

STEP 6 in our SDM approach will be to use the evaluations completed in **STEP 5** to further prioritize monitoring and stewardship *actions*, develop and carry out a plan for collaborative implementation, and to learn from this initial implementation phase and adapt future monitoring efforts accordingly. Prioritizing monitoring and stewardship *actions* will be informed by how each *action* scores relative to the evaluation criteria established in **STEP 5** and will also be shaped by the availability of funding to support implementation. Starting in Spring 2021, PSF will work with the Central Coast Nations, CCIRA, DFO, and other regional research partners to pursue funding in support of priority monitoring and stewardship *actions*. We hope that the *Monitoring Framework* outlined in Section 4 below serves as a living document for guiding ongoing efforts for monitoring and stewardship, and that the Nations and DFO will use it as a starting point for co-management discussions and collaborative monitoring to be developed under the Fisheries Resources Reconciliation Agreement.

4 The Central Coast Salmon Monitoring Framework

This *Monitoring Framework* represents the shared vision of the Kitasoo/Xai'xais, Nuxalk, Heiltsuk, and Wuikinuxv Nations, as articulated by members of the Working Group. The framework also reflects input from DFO staff in North Coast Stock Assessment, Fish Management, the Salmon Enhancement Program, and the Aboriginal Fisheries Strategy Program, as well as Charter Patrolmen who have been monitoring salmon populations in the regions for three decades.

This section presents the details of the *Monitoring Framework* including the 214 monitoring *actions* that received high scores as a part of our evaluation (Section 3.5), or were considered prerequisites for other *actions*, along with information on the rationale behind including each *strategy* in the final *Monitoring Framework*. Many of *actions* within the *Monitoring Framework* are specific to an individual geography or reflect the immediate priorities of one of the four Central Coast Nations involved in this project. Other *actions* are intended to be implemented across the entire Central Coast project area. This list of monitoring, management, and community-building *actions* includes both ongoing programs and proposed new investments. Importantly, the framework does not preclude other future investments in salmon monitoring or stewardship that fell outside of the scope of this *Monitoring Framework* (see Section 3.6).

A subset of *actions* are dependent on the implementation of other *actions*. For example, in STRATEGY 2.2.1 *Develop a regional plan for marking and monitoring hatchery populations,* ACTION A "Evaluate costs and feasibility of CWT versus PBT approaches as part of a regional approach for estimating exploitation rates and juvenile-to-adult survival for hatchery populations of Chinook and coho" is a prerequisite for ACTION B "Evaluate potential for recovery of CWT tags versus PBT in mixed-stock fisheries outside of the Central Coast (e.g. Alaska, Haida Gwaii)" — and ACTION B is dependent on the successful implementation of ACTION A. **Prerequisite** and **dependent** *actions* are noted throughout the *Monitoring Framework*.

Photo by Jason Moody. Nuxalk sockeye project at Lonesome Lake.

GOAL 1

Strengthen Central Coast Community Participation in Stewardship & Collaborative Salmon Management

On the Central Coast, collaborative management of Pacific salmon fisheries is soon to be formalized between eight coastal First Nations — including the Kitasoo/Xai'xais, Nuxalk, Heiltsuk, and Wuikinuxv Nations — and DFO, through the Fisheries Resources Reconciliation Agreement. In the coming years, these First Nations and DFO will work together to develop annual Integrated Fishery Management Plans. The *actions* identified under this *goal* reflect the emerging need to invest in collaborative fisheries management and highlight several opportunities to build technical capacity, increase community participation, and develop management objectives for Pacific salmon fisheries.

Objective 1.1 *Build technical capacity for collaborative salmon management.*

Strategy 1.1.1 Address gaps in infrastructure, training, capacity, and funding.

Identifying the equipment, training, personnel, and infrastructure needed for effective community-led monitoring of salmon is a critical first step forward for the Central Coast *Monitoring Framework*.

ACTIONS

A Address infrastructure, equipment, and training needs for monitoring programs within each of the Central Coast First Nations communities.

- I Hire and train full-time salmon-focused fisheries staff to work in the Wuikinuxv Fisheries Program to support ongoing salmon work.
- II Work with partners and funders to support purchase of an ocean-going boat for the Wuikinuxv Fisheries Program.
- III Work with partners and funders to support purchase of a truck and ocean-going boat for Nuxalk Fisheries to conduct marine and in-river catch monitoring.
- IV Hire and train two seasonal staff to run a Nuxalk recreational fisheries monitoring program in Bella Coola.
- V Work with HIRMD to identify infrastructure and staffing needs for salmon monitoring.
- VI Hire and train full-time salmon-focused fisheries staff to work in the KXSA to support salmon monitoring.

Strategy 1.1.2 Create technical working groups to provide scientific and logistical support for monitoring and collaborative salmon management.

One key element of collaborative management is the development of technical working groups to identify and interpret data on salmon status, integrate Indigenous knowledge into management planning, and support collaborative decision-making. By forming a technical working group, developing the terms and procedures that guide the group, and beginning to identify data and analyses needed to support decision-making, the Central Coast First Nations can set the stage for effective data-driven collaborative management that reflects their values and needs. Co-governance processes have been established for the management of crab fisheries on the Central Coast, providing a pilot to guide the development of a salmon technical working group and collaborative governance tables for salmon.

ACTIONS

A Develop structure and working principles for a technical working group.

B Recruit members to the technical working group.

C Convene technical working group to provide support for the development of plans under the Fisheries Resources Reconciliation Agreement and Integrated Fishery Management Plans, rooted in both scientific and Indigenous knowledge.

Strategy 1.1.3 Improve coordination and knowledge sharing across Central Coast First Nations, CCIRA, DFO, and partners.

First Nations on the Central Coast contribute core capacity and resources every year to monitoring salmon populations, providing data to DFO to support shared conservation and management objectives. However, this data often does not get shared back to the communities in a meaningful, accessible, or timely way. Additionally, there is a desire for more knowledge sharing and exchange among the Nations on regional salmon monitoring efforts. First Nations community members consistently state that more regular reporting from DFO back to stewardship offices and the community is needed. This strategy is focused on developing a process and format for DFO and First Nations salmon monitoring programs to make annual reports back to the communities, to ensure that the data and interpretation is delivered in the most useful way possible. Along with annual reporting, there is a need to create a repository of reports and other technical documents that are accessible to stewardship staff, DFO, and research partners.

ACTIONS

A Establish post-season technical meeting similar to the North Coast post-season review to present findings, successes, and lessons from salmon monitoring programs that year. Include First Nations stewardship programs, regional DFO staff, research partners, and funders.

B Create a standardized format for annual and timely reporting back to communities on escapement, survival, catch, and other key data on salmon populations (e.g. using the Pacific Salmon Explorer).

C Report back annually to Central Coast Nations, summarizing key findings of salmon monitoring and stewardship work across the Central Coast, interpreting trends, and supporting the salmon technical working group (see STRATEGY 1.1.2).

D Increase coordination between Central Coast First Nations and DFO through the Central Coast in-season management table.

Objective 1.2 *Increase opportunities for community outreach, engagement, and participation in stewardship and collaborative salmon management.*

Strategy 1.2.1 Work with communities to develop an engagement strategy to support outreach to community members and provide updates on the status of salmon on the Central Coast.

Community outreach needs to be a foundational element of any plan to monitor and protect salmon. By linking opportunities for outreach, knowledge sharing, and participation to existing youth, culture, and community programs, the *Monitoring Framework* can reach community members who might otherwise be unaware of efforts to monitor and steward salmon. This outreach can build understanding and interest among youth and other community members in salmon stewardship work, ensuring that the next generation has the skills and inspiration to play a leading role in salmon stewardship.

ACTIONS

A Run annual pre- and post-season community meetings with each Nation to involve community members in decision-making and share information on salmon status and management.

B Create short, visually accessible, and informative annual reports with materials tailored to a non-scientific audience that highlight salmon stewardship work, opportunities for community participation, and key findings for each year (e.g. community flyer).

Strategy 1.2.2 Align monitoring with cultural, educational, and stewardship programs to build synergies and increase community participation.

Existing land-based learning, youth, and cultural programs provide unique opportunities to connect salmon monitoring and stewardship with people. Aligning salmon monitoring activities like DNA and scale collection, fish tagging, and other sampling with these programs, can create opportunities for knowledge sharing and community outreach through salmon monitoring initiatives. This strategy provides opportunities for deeper youth and community engagement in salmon monitoring and stewardship.

ACTIONS

A Work with existing Supporting Emerging Aboriginal Stewards (SEAS) youth internship programs in each community to create internships and host field activities where youth can participate in salmon stewardship.

B Provide annual access to training (e.g. bear safety, First Aid, Small Vessel Operator Proficiency) for summer interns from Central Coast Nations.

C Support involvement of Nuxalk Rediscovery Camp in monitoring and sampling FSC catch at Dean and Kimsquit rivers.

D Work with community organizations in Bella Bella to develop salmon-focused community programming and monitoring initiatives in Kunsoot and Kadjusdis rivers that meet cultural, educational, and scientific objectives.

E Work with KXSA, SEAS, and the Kitasoo community school to offer opportunities for youth of all ages to engage with salmon stewardship through participation in monitoring, cultural, and educational programs, and harvesting salmon.

F Work with Koeye camp — a Heiltsuk-run cultural-environmental summer camp at the Koeye River — to offer opportunities for youth of all ages to engage with salmon stewardship through participation in monitoring, cultural, and educational programs, and harvesting salmon.

G Work with SEAS, the Wuikinuxv Health Department, and the village school to offer opportunities for youth of all ages to engage with salmon stewardship through participation in monitoring, cultural, and educational programs, and harvesting salmon.

Objective 1.3 *Ensure that local and traditional knowledge guide salmon monitoring, planning, and fisheries management.*

Strategy 1.3.1 Develop and implement an outreach strategy to increase involvement of local and traditional knowledge holders in salmon management.

Observations and values grounded in the multi-generational connections of the Central Coast First Nations to the ocean, rivers, and salmon in their territories are foundational elements of sustainable fisheries management. This strategy is focused on working with stewardship offices in each community, local and traditional knowledge holders, and research partners to document the values and approaches that should guide collaborative

salmon management. Reporting back to the hereditary and elected leadership of each Nation on how their traditional and local ecological knowledge (TLEK) is shaping the development of collaborative management plans is also a key component of this strategy.

ACTIONS

A Create guidelines with methods for connecting TLEK to decision-making and management. Make this a living document so it can evolve over time based on input, needs, and opportunities.

B Each Nation documents their traditional knowledge, practice, and laws related to salmon in their territory (e.g. Sputc (Eulachon) book by Nuxalk Stewardship Office).

C Annually, facilitate workshops with existing advisory committees of local knowledge holders (e.g. marine use and food fish committees), including hereditary leadership and local fishers, to provide opportunities for reporting and feedback on salmon stewardship initiatives.

Strategy 1.3.2 Work with stewardship offices and First Nations fishers to evaluate community needs and objectives related to salmon.

Understanding community needs and defining management objectives with First Nations and DFO partners is fundamental to creating effective and equitable systems of collaborative management. Working with the Kitasoo/Xai'xais, Nuxalk, Heiltsuk, and Wuikinuxv Nations and CCIRA, this strategy focuses on determining the needs, values, objectives, and processes that can help to guide new management agreements.

ACTIONS

A Hold workshops with stewardship staff, fishers, and traditional knowledge holders to identify management objectives and develop principles to guide collaborative management of salmon.

B Synthesize findings from existing studies of community food fish needs, and update FSC catch goals where needed.

C Develop management objectives that reflect community needs and values, as well as biological outcomes desired by Central Coast Nations.

Strategy 1.3.3 Identify and prioritize populations that are socially, culturally, and economically important to the Central Coast First Nations to ensure that these populations are part of ongoing monitoring.

Resources for salmon monitoring are finite, and there is a need to work with the Central Coast communities to prioritize where and how monitoring investments will be made. Working with the stewardship offices of each Nation, this strategy focuses on prioritizing salmon populations for escapement monitoring, juvenile monitoring, and DNA baseline collections based on input from the Nation about the social, cultural, and economic importance of salmon populations in the region.

ACTIONS

A Work with Central Coast Nations, CCIRA, and DFO to develop processes for community consultation and strategic prioritization of populations for monitoring. (Prerequisite for ACTION B.)

B Use processes developed in action a to identify locally important salmon populations for escapement monitoring, juvenile monitoring, and DNA baseline collections. (Dependent on ACTION A.)

Objective 1.4 *Develop escapement goals for priority salmon populations to guide precautionary management of fisheries.*

Strategy 1.4.1 Create a regional framework for developing escapement goals that is guided by traditional ecological knowledge, community values, and ecosystem needs.

Developing escapement goals is a first step towards transparent, data-driven fisheries management that protects the productivity and diversity of salmon populations for future generations. Currently, escapement goals have only been identified for a handful of salmon populations on the Central Coast. Given the paramount importance of escapement goals for precautionary fisheries management, there is a need to identify a process for collaborative development of escapement goals that includes First Nations values, data on escapement and catch, existing biological status assessments (e.g. such as those shown on the Pacific Salmon Explorer), and the ecosystem values that salmon support. Bringing together the Central Coast First Nations, DFO, and research partners this strategy focuses on developing this process, identifying data sources, and initiating the development of escapement goals for ongoing management of Central Coast salmon fisheries.

ACTIONS

A Review where existing escapement goals have been developed for Central Coast populations. (Prerequisite for ACTION B.)

B Initiate community-led planning process with all four First Nations and DFO to prioritize populations and develop escapement goals. (Dependent on ACTION A.)

Strategy 1.4.2 (not included)

All actions under this strategy received less than 24 points and is therefore not included in the final *Monitoring Framework*.

Strategy 1.4.3 Work with First Nations and DFO to develop decision rules for in-season fisheries management.

Transparent fisheries management requires that First Nations and DFO articulate their needs, objectives, and decision-making process for collaborative management. Developing 'simple decision guidelines' is one approach to this challenge, whereby fisheries managers and fishers articulate management objectives, identify sources of information to guide decision-making (e.g. forecasted or actual escapement, total catch), establish thresholds or decision triggers for management based on shared understanding of the biological and social objectives, and implement management based these guidelines. A process to develop 'simple decision guidelines' was convened in the early 2000s for Bella Coola River Chinook fisheries. However, this process did not include the Nuxalk Nation and the management recommendations were never fully implemented. Working with Central Coast Nations and DFO, this strategy takes a similar approach to identify in-season management procedures based on mutually agreed upon objectives and decision triggers.

ACTIONS

A Articulate fisheries management objectives and procedures for in-season management.

B Define management guidelines based on in-season data and assessments of status.

GOAL 2

Strengthen Ability to Detect & Respond to Changes in Status of Central Coast Salmon

On-the-ground monitoring of salmon populations is foundational for fisheries management, status assessment, and salmon conservation planning. However, on the remote Central Coast, monitoring efforts are often impeded by the costs and logistical challenges of maintaining consistent monitoring programs for hundreds of salmon populations. Accordingly, there is an outstanding need to take a more strategic approach to monitoring efforts that estimate total escapement, quantify hatchery contributions to escapement and catch, and monitor juvenile abundance. The following actions lay out a strategic plan for investments in salmon monitoring that build on current strengths, including infrastructure and capacity for monitoring, existing time series of spawner or juvenile abundance, and hatchery programs where managers can readily mark hatchery fish for estimates of catches in mixed-stock fisheries. The *actions* that fall under this *goal* are focused on collecting information that enables First Nations and DFO fisheries managers to track and respond to changes in the status of Central Coast salmon populations. The level of detail included for each *action* varies, depending on whether a given *action* builds on existing programs or is focused on developing new initiatives. Consequently, follow-up investments of resources and time will be needed so that each of the Central Coast Nations can identify the specific details of monitoring programs to be implemented over the coming years. Collectively, the *actions* outlined under this *goal* will strengthen the foundations for collaborative management of sustainable fisheries by allowing the Nations and DFO to more accurately track the status of salmon populations in the region.

Objective 2.1 *Quantify escapement, spawn timing, and age-at-return for priority salmon populations.*

Strategy 2.1.1 Develop a statistical sampling design for escapement monitoring based on Central Coast indicator streams and other populations identified as socially, culturally, and economically important to Central Coast First Nations.

Annual escapement monitoring is important for managing fisheries and understanding status and trends among salmon CUs. There is a need to develop a strategic regional plan for escapement monitoring that applies both intensive (e.g. weir or mark-recapture in a few populations) and extensive (e.g. annual spawner surveys in many populations) monitoring to leverage existing resources and capacity, and to identify areas for greater investment in escapement monitoring. This strategy focuses on evaluating trade-offs between sampling intensity and extent (e.g. number of surveys per population versus number of populations counted) in order to come up with a strategic regional plan for escapement monitoring.

ACTIONS

A Develop standardized monitoring methods for escapement monitoring to ensure comparability between years and populations.

B Work with DFO and Charter Patrolmen to understand location and extent of historic spawner survey efforts to inform planning for future escapement monitoring.

C Develop statistically robust escapement monitoring design for salmon CUs to determine optimal monitoring frequency and intensity of monitoring needed to ensure that all CUs have current estimates of biological status and that data are collected for all priority populations (see STRATEGY 1.3.3).

Strategy 2.1.2 Maintain and strengthen escapement monitoring programs using standardized mark-recapture, overflight, and stream walk methods for populations identified in STRATEGY 2.1.1.

Existing escapement monitoring programs provide valuable information for management and status assessment. However, the long-term erosion of resources for monitoring salmon populations, coupled with the large number of populations and remote nature of many Central Coast watersheds, limits our ability to make informed decisions regarding salmon management and recovery across much of the region. Working with the Central Coast First

Nations and building on current monitoring efforts, this strategy focuses on implementing the monitoring design developed in STRATEGY 2.1.1 to carry out a coordinated and strategic regional escapement monitoring program for the Central Coast.

ACTIONS

A Conduct mark-recapture experiments within sockeye, chum, and pink indicator streams to quantify residence time, estimate total escapement, and provide expansions from area-under-the-curve (AUC) to total escapement.

- I Maintain the Koeye River weir as a key site for annual sockeye salmon escapement monitoring using mark-resight methods and fall spawner surveys.
- II Conduct rotational mark-recapture experiments within chum, pink, and sockeye salmon indicator streams to validate assumptions about residence times and expansions from AUC-based estimates.

B Invest in increased capacity and coordination for First-Nations-led stream walk programs.

- I Support Wuikinuxv and DFO to increase community participation in sockeye salmon surveys.
- II Support Wuikinuxv Fisheries to hire and train staff to count chum and pink salmon from priority populations in Rivers Inlet.
- III Work with Kitasoo/Xai'xais Stewardship office and DFO to continue stream walks to quantify escapement for priority chum, pink, and sockeye salmon populations.
- IV Support HIRMD, DFO, and research partners to continue stream walks to monitor escapement for priority sockeye, chum, and pink salmon streams.
- V Support Nuxalk Fisheries and DFO to maintain and expand Atnarko River escapement monitoring to include spawning areas above Tenas, Elbow, and Rainbow Lakes.
- VI Support Nuxalk Fisheries and DFO to conduct repeated surveys annually for escapement monitoring of Chinook, coho, pink, and sockeye salmon in tributaries of the Bella Coola River (e.g. Salloomt, Thorsen, Necleetsconnay, Nusatsum, Nuxalk Ponds, etc).
- VII Evaluate opportunities to monitor escapement of Kimsquit River sockeye and Chinook returns via overflight index surveys. Calibrate overflight surveys with snorkel surveys in lakeshore and lake outlet.
- VIII Evaluate opportunities for improved Chinook escapement monitoring in tributaries of Wuikinuxv Lake via overflight surveys.

C Maintain escapement monitoring via walk and overflight surveys for coho salmon in populations with existing time series of surveys (e.g. Necleetsconnay, Roscoe, Quartcha, Scribner, Green, Wale Creek, Aaltanash, Tyler Cascade, Martin River, Elcho Creek, Chuckwalla).

D Support Nuxalk Nation, DFO, and Bella Coola valley residents to continue escapement monitoring of coho salmon spawners using visual surveys and conduct mark-recapture for coho in a tributary of the lower Bella Coola to estimate abundance, observer efficiency, and residence time. Thorsen has been identified as a likely tributary to monitor but, pending evaluation, Necleetsconnay or other tributaries may be selected.

E Restore overflight surveys of Chinook, coho, chum, and pink salmon to monitor escapement in Chuckwalla and Kilbella rivers.

F Support ongoing overflight surveys of Kimsquit, Kwatna, and Dean River chum salmon for in-season management and escapement monitoring.

G Support ongoing escapement monitoring using ground-based and overflights for sockeye, chum, pink, and coho salmon in DFO Pacific Fishery Management Areas 6/7.

Strategy 2.1.3 Apply new tools and technologies to improve salmon escapement monitoring in populations where conventional count methods are ineffective.

Visual surveys that are currently used for escapement monitoring in many locations across the Central Coast are of limited value in large rivers, during high water, or where glacially turbid water limits visibility. Furthermore, access to many spawning areas is difficult, especially for salmon species that spawn further upstream. Several emerging technologies can provide cost-effective solutions that leverage existing personnel and resources and improved escapement data in locations where visual surveys are impractical. These technologies include sonar and camera-based enumeration, both of which are already being applied at a handful of locations across the Central Coast.

ACTIONS

A Identify opportunities to support ongoing sonar-based monitoring in the Wannock River.

I Work with Wuikinuxv, DFO, and funders to establish long-term funding for the Wannock River sonar program. (Prerequisite for all subactions under ACTION A.)

II Provide support for Wuikinuxv test fishery program, and consider extending this program through to mid-October and investing in variable-mesh gillnet to estimate species and size composition for coho and chum migration. (Dependent on ACTION A.I.)

III Derive estimates of coho escapement from Wannock sonar counts. (Dependent on ACTION A.I.)

IV Support ongoing Chinook deadpitch in Wannock River to calibrate sonar-based estimates of escapement to historic time series. (Dependent on ACTION A.I)

B Support Nuxalk-Fisheries-led sonar project to estimate salmon escapement in the Atnarko River.

I Work with Nuxalk and DFO to understand program needs. (Prerequisite for ACTION B.II.)

II Support ongoing sonar enumeration and data analysis for escapement monitoring in the Atnarko River. (Dependent on ACTION B.I.)

C Develop and apply computer-vision deep learning models to automate identification and counting of salmon from video and sonar data outputs.

D Develop and apply tools for camera-based monitoring of escapement at weirs and fish ladders.

I Install cameras in the Koeye River weir to support the generation of in-season estimates of sockeye, coho, chum, and pink salmon escapement.

II Develop camera-based monitoring program in Kadjusdis River fish ladder to monitor sockeye, coho, chum, and pink escapements.

III Evaluate opportunities for camera-based escapement monitoring at Kunsoot, Kwakusdis, Neekas, and Quatlena rivers.

IV Evaluate opportunities for camera-based monitoring in Kitasoo/Xai'xais territory to quantify sockeye and coho escapements in a culturally important watershed selected through a community consultation process.

V Work with Wuikinuxv to evaluate potential for weir and camera-based escapement monitoring for chum, pink, and coho in Johnston Creek.

VI Evaluate opportunities for camera-based monitoring of escapement and mark-rate in enhanced Tankeeah and Mary Cove sockeye populations.

Strategy 2.1.4 Estimate population-specific age structure and life history.

Diversity in age and life-history are foundational elements of resilience in wild salmon populations. Understanding age structure is also critical for population assessment and fisheries management since reconstructing spawner-recruitment relationships depends on having accurate data on the age composition of each population. In most salmon populations on the Central Coast, age and life-history data have been collected inconsistently or not at all. This data gap has created uncertainty in efforts to analyze existing spawner-recruitment time series. A number of monitoring programs already collect scales or otoliths, and others can be leveraged to provide more widespread sampling to determine age structure among Central Coast salmon populations and CUs. Efforts are also needed to streamline sample processing, digitization, aging, and data storage.

ACTIONS

A Support and expand ongoing annual collections of age data in Central Coast salmon escapement monitoring.

- I Support ongoing sampling of scales from chum, coho, and sockeye sampled at the Koeye weir, and work with research partners to maintain capacity for digitizing scale collections for reading.
- II Support ongoing sampling of scales, otoliths, and DNA for all species in spawning areas of the Atnarko and Bella Coola rivers annually.
- III Support ongoing sampling of scales and DNA from Chinook captured for broodstock in the Chuckwalla and Kilbella rivers.

B Support community-run programs to collect scales and DNA from Chinook, chum, coho, and sockeye captured in FSC, recreational, and commercial fisheries.

- I Support ongoing collection of scales and DNA from fish caught in Nuxalk FSC fisheries.
- II Support ongoing sampling of scales and DNA from chum, coho, and sockeye caught in Wuikinuxv test fishery and by FSC fishers in the Wannock River.
- III Support Klemtu SEAS program to collect scales and DNA during annual salmon derby.
- IV Support ongoing scale and DNA collections by the Heiltsuk dockside monitoring program.

Strategy 2.1.5 Generate annual escapement estimates of all monitored populations.

Quantifying annual escapement and understanding ongoing changes in wild salmon populations requires that data be collected and analyzed using consistent methodology. Across the Central Coast region, salmon data have been collected and analyzed using a variety of methods and approaches over time. Building upon existing approaches, this strategy involves exploring new statistical approaches for estimating annual escapement for data-limited populations.

ACTIONS

A Analyze available count data using hierarchical AUC model to estimate escapement, track changes in spawn timing, and leverage lower frequency count data by sharing information across populations and years.

B Develop models to calibrate ongoing surveys or mark-recapture estimates of escapement with new sonar-based estimates of escapement.

- I Evaluate and test approaches for linking sonar-based estimates of sockeye escapement in the Wannock River to long-term count data from tributaries of Wuikinuxv Lake.
- II Develop calibration models to link Atnarko sonar counts to ongoing Chinook mark-recapture data and long-term count data for sockeye.

C Develop genetic mark-recapture program that uses GSI to expand counts from the Atnarko sonar to total Bella Coola-wide escapement for Chinook, chum, coho, and sockeye.

D Apply quantitative tools for linking high-intensity mark-recapture monitoring to lower intensity monitoring methods like AUC count surveys.

Objective 2.2 *Quantify contribution of hatchery-origin fish to estimates of catch and escapement for all Central Coast CUs.*

Strategy 2.2.1 Develop a regional plan for marking and monitoring hatchery populations.

Currently, only the Percy Walkus Hatchery marks juvenile salmon using adipose clipping and CWT marking. At this hatchery, all coho and chum are marked, but only a subset of Chinook are adipose-clipped and marked with CWT. Coho from the Kitasoo, McLoughlin, and Snootli

hatcheries were marked in the past, however these marking programs were discontinued more than a decade ago. Consequently, there are currently no coho marked with CWT at Central Coast hatcheries. In addition to CWT marking, parentage-based tagging (PBT) can enable estimates of catch by sampling DNA from hatchery broodstock, sampling DNA from fisheries catches in subsequent years, and using genetic analyses to identify hatchery progeny and assign them to their population of origin. Working with hatcheries across the Central Coast, this strategy focuses on developing a plan for broader application of CWT or PBT marking to support improved understanding of fishery impacts, abundance, and survival among hatchery indicator populations.

ACTIONS

A Evaluate costs and feasibility of CWT versus PBT approaches as part of a regional strategy for estimating exploitation rates and juvenile-to-adult survival for hatchery enhanced Chinook and coho populations. (Prerequisite for STRATEGY 2.2.2.)

B Evaluate potential for recovery of CWT tags versus PBT in mixed-stock fisheries outside of the Central Coast (e.g. Alaska, Haida Gwaii). (Prerequisite for STRATEGY 2.2.2.)

C Identify hatchery indicator populations (e.g. Snootli, McLoughlin, Kitasoo, Atnarko Ponds, Percy Walkus), and work with hatcheries to identify associated infrastructure or capacity needed for mass marking and monitoring these programs.

D Evaluate opportunities for adipose clipping or otolith thermal marking sockeye in enhanced Mary Cove and Tankeeah populations.

Strategy 2.2.2 Implement an expanded marking program for hatchery fish.

Adipose clipping, otolith thermal marking, and PBT can help improve information on the contribution of regional hatcheries to catch and escapement for Central Coast CUs. Broader application of CWT and otolith marking would enable estimates of exploitation in Alaskan and northern BC fisheries, data which are currently lacking for Central Coast coho and chum salmon. Wider application of mass marking would also support improved hatchery broodstock collections and reduce the risk of domestication selection in hatchery populations, since hatchery managers can avoid adipose-clipped hatchery-origin spawners in their broodstock.

ACTIONS

(All actions below are dependent on STRATEGY 2.2.1, ACTION A and ACTION B.)

A Reinstate Belarko coho salmon rearing program (50,000–100,000 juveniles), and mark juveniles to enable estimates of exploitation rates and juvenile-to-adult survival.

B Implement annual adipose clipping and CWT marking of juvenile salmon at regional hatcheries.

- I Work with Percy Walkus Hatchery staff to support marking of all Chinook.
- II Work with Snootli Creek Hatchery to reinstate mass-marking of coho and maintain marking efforts for Chinook and chum.
- III Work with Kitasoo Creek Hatchery to reinstate marking of juvenile coho.
- IV Work with McLoughlin Hatchery to reinstate marking of juvenile coho.
- V Depending on the availability of funding for annual marking, implement rotating (e.g. every 2 years) CWT marking program for coho at regional hatcheries to quantify exploitation in Alaskan and northern BC Fisheries.

C Support application of PBT in all Central Coast hatchery programs for estimates of exploitation rate, survival, and straying among hatchery indicator populations.

- I Support Kitasoo Hatchery to sample DNA from coho for PBT.
- II Support Snootli Hatchery and Nuxalk to sample Chinook, coho, and sockeye broodstock for PBT.
- III Support McLoughlin Hatchery to sample coho and chum for PBT.

D Maintain current CWT marking at Snootli Creek Hatchery for Atnarko, Salloomt, and Nusatsum Chinook.

E Maintain current CWT marking of Chinook at Percy Walkus Hatchery.

F Support efforts to otolith thermal mark chum and sockeye at Snootli Hatchery.

Strategy 2.2.3 Strengthen escapement monitoring for hatchery populations using mark-recapture, spawning surveys, and sonar.

Hatcheries play a key role in many ongoing salmon monitoring activities. However, in some places a lack of resources and support has led to the erosion of monitoring for hatchery-enhanced populations. The absence of data on the number of salmon from hatchery-enhanced populations that return to spawning streams currently limits our ability to quantify exploitation rates or estimate juvenile-to-adult survival rates, data that would otherwise be critical for managing salmon fisheries. Working with First Nations, hatchery managers, and DFO, this strategy focuses on strengthening and reviving escapement monitoring among hatchery populations.

ACTIONS

A Support ongoing Chinook mark-recapture programs in the Atnarko River to quantify escapement of hatchery and wild Chinook.

B Maintain ongoing mark-recapture programs to estimate chum escapement in Snootli Creek, and work with Snootli Hatchery and DFO Stock Assessment staff to organize and analyze these data.

C Work with Nuxalk and DFO Stock Assessment staff to build capacity for coho escapement monitoring in the Atnarko River using the Adaptive Resolution Imaging Sonar (ARIS) to quantify escapement for enhanced Belarko ponds coho population.

D Work with Nuxalk and DFO Stock Assessment staff to support otolith collections from chum spawners in the Bella Coola and Atnarko systems to quantify hatchery contributions.

E Work with Wuikinuxv, Percy Walkus Hatchery, and research partners to evaluate alternatives for monitoring Chinook escapement and mark-rate in Chuckwalla and Killbella rivers.

F Work with Kitasoo hatchery to quantify mark-rate, and tag returning coho for mark-recapture estimates of escapement from fall spawner surveys and carcass surveys.

G Work with McLoughlin hatchery to quantify mark-rate, and tag returning coho for mark-recapture estimates of escapement from fall spawner surveys and carcass surveys.

H Monitor escapement and quantify hatchery contribution to enhanced sockeye populations.

- I Maintain ongoing escapement monitoring and otolith collections in Mary Cove.
- II Maintain ongoing escapement monitoring and otolith collections in Tankeeah.
- III Maintain and expand annual escapement monitoring and otolith collections in the Lower Atnarko and Atnarko Lakes spawning areas.

Strategy 2.2.4 Estimate hatchery contribution to fisheries and escapement and quantify juvenile-to-adult survival.

Increased investments in mass marking and population monitoring in CWT indicator populations will enable estimates of catch, escapement, and juvenile-to-adult survival for hatchery-reared salmon. With support from PSF, DFO, and research partners, the data generated by monitoring programs in CWT indicator populations provide valuable insights into exploitation rates in fisheries from Alaska to the Central Coast, information which is

currently lacking for many areas of the Central Coast. In addition, by estimating the number of hatchery fish that are caught and return to spawn every year, this strategy will allow managers to estimate juvenile-to-adult survival rates for fish released from the hatchery.

ACTIONS

A Conduct regular sampling as part of community-run catch monitoring to sample DNA for GSI, mark-rate estimates, and PBT analysis.

B Work with community catch monitoring initiatives and DFO to collect otoliths from commercially caught chum starting in 2023.

C Use GSI and mark-rate data from Nuxalk bio-sampling program to estimate contribution of Atnarko ponds enhancement to coho escapement in the Bella Coola River.

D Conduct regular escapement monitoring, DNA, and otolith sampling at broodstock collection locations and in populations adjacent to quantify hatchery contribution and estimate stray rates of hatchery origin fish.

Objective 2.3 *Quantify juvenile abundance and juvenile-to-adult survival.*

Strategy 2.3.1 Implement life-cycle monitoring programs to quantify juvenile salmon abundance and juvenile-to-adult survival.

Salmon traverse diverse habitats during their migratory life cycle, linking freshwater habitat with nearshore and pelagic marine ecosystems. Understanding ongoing changes in these habitats, and their effect on salmon populations, requires monitoring programs to quantify abundance and survival across freshwater and marine life stages. Life-cycle monitoring programs are commonplace elsewhere (e.g. Oregon Coast, USA[55]) but are scarce on the Central Coast. Currently, the abundance of downstream-migrating juvenile salmon is monitored at two locations on the Central Coast — Mary Cove Creek and the Koeye River. In the Koeye River, around 4,000 sockeye and coho juvenile salmon are marked with uniquely identifiable passive integrated transponder (PIT) tags each spring, and these fish are subsequently detected during their return migration as adults. Thus far, the program has produced estimates of juvenile-to-adult survival for 2015 through 2018 outmigrants. Working with Central Coast First Nations, DFO, and research partners, this strategy focuses on supporting ongoing downstream trapping programs and applying these approaches more broadly to help provide critical insight into freshwater productivity and juvenile-to-adult survival for Central Coast salmon populations.

ACTIONS

A Support downstream trapping projects to quantify juvenile abundance and timing of out-migrating sockeye, coho, chum, and pink salmon.

- I Work with Wuikinuxv to reinstate downstream trapping in the Wannock River to quantify timing, size, and condition of Chinook, coho, and sockeye juveniles and index juvenile abundance.
- II Work with Kitasoo Fisheries to support ongoing downstream trapping of juvenile salmon at Mary Cove creek.
- III Work with Kitasoo Fisheries to analyze long-term time series of juvenile-to-adult data for sockeye in Mary Cove creek.
- IV Maintain ongoing juvenile trapping in the Koeye River to quantify annual abundance for coho and sockeye juveniles. Evaluate opportunities for downstream trapping elsewhere in Heiltsuk territory.

B Support new and existing PIT tagging projects to estimate juvenile-to-adult survival.

- I Sustain ongoing juvenile trapping and PIT tagging work in the Koeye River to quantify marine survival for coho and sockeye salmon. Evaluate methods for sharing data on marine survival between Koeye and nearby populations.

C Implement short-term (e.g. three year) downstream trapping and PIT tagging projects to quantify juvenile abundance for all species, estimate marine survival, and provide data for expansion of camera-based counts in fish ladders and weirs (see STRATEGY 2.1.3 and STRATEGY 2.1.4).

D Support ongoing nearshore marine juvenile sampling in Kitasoo/Xai'xais territory to understand migration routes, timing and risks from salmon aquaculture, log dumping, and other marine habitat impacts.

Strategy 2.3.2 Build a rotational lake sampling program to quantify juvenile sockeye abundance.

For lake-type sockeye salmon with limited escapement data, late-summer juvenile surveys have shown promise for evaluating population status and estimating freshwater rearing capacity. In the Skeena Watershed, the Skeena Fisheries Commission performs annual juvenile surveys using a dual-beam sonar unit and tow net to quantify sockeye juvenile abundance, size, and condition. In recent years, the Wuikinuxv Nation has hired the Skeena Fisheries Commission to perform late-winter surveys in Owikeno Lake to quantify juvenile sockeye abundance, and support development of updated escapement goals. This strategy focuses on developing a program for annual surveys of sockeye lakes on the Central Coast,

similar to the programs mentioned above. This program will provide improved information on rearing conditions, population status, and support adaptive management of fisheries and recovery enhancement program.

ACTIONS

A Acquire dual-beam sonar unit for sockeye rearing lake survey program, to be run by Central Coast Nations, DFO, and research partners. (Prerequisite for ACTION C.)

B Synthesize existing data, evaluate regional importance, and identify community priorities for sockeye rearing lakes on the Central Coast and prioritize lakes for sampling. (Prerequisite for ACTION C.)

C Identify sockeye rearing lakes across the Central Coast for rotational sampling. Include eight new lakes monitored annually, and an additional 16 lakes to be sampled on a five-year rotation. (Dependent on ACTION A and ACTION B.)

D Estimate sockeye rearing capacity for 25 sockeye rearing lakes based on habitat area, productivity, and juvenile-to-adult relationships. (Dependent on ACTION A and ACTION C.)

E Develop adaptive management plan for sockeye broodstock collection and fry releases in Atnarko Lakes based on lake capacity, juvenile density, and escapement.

Objective 2.4 *Quantify current impacts and risks associated with pathogens and how these impacts affect survival.*

Strategy 2.4.1 Connect Central Coast Nations with BC-wide efforts to track and understand salmon diseases.

Rapid advances in technology have enabled high-throughput sampling to screen for a wide range of viral and bacterial pathogens in salmon and other wildlife. Led by Dr. Kristi Miller, the Marine Ecological Genomics and Adaptation group (part of the Molecular Genetics Lab at DFO) is a world leader in salmon genomics and disease. In addition, the Okanagan Nation Alliance has a new Fisheries Laboratory that provides critical information and data on the effectiveness and impact of fisheries management decisions, and the health of the returning sockeye. Working with Central Coast First Nations, PSF, the Okanagan Nation Alliance, and DFO, this strategy involves convening a round table of First Nations fishery managers, DFO staff, and research partners to develop a plan for regular pathogen surveillance on the Central Coast.

ACTIONS

A Connect Central Coast Nations with Dr. Kristi Miller and the new Okanagan Nation Alliance Fisheries Lab about potential opportunities for salmon pathogen work.

B Convene salmon pathogen roundtable with Central Coast Nations, DFO, and PSF staff currently focused on pathogens.

C Create plan for regional pathogen surveillance in juvenile and adult salmon of all species.

Strategy 2.4.2 Develop and implement pathogen surveillance programs to track salmon diseases in juvenile and adult salmon and quantify disease impacts on survival.

While samples for pathogen screening have been collected sporadically over the years, there is a need for more systematic pathogen sampling programs. This strategy focuses on working with the Central Coast Nations to understand risks posed by pathogens, and develop an annual sampling program for pathogen screening to evaluate regional patterns of pathogen presence and prevalence. These data will allow for the evaluation of potential opportunities to link insights into the distribution and intensity of diseases into frameworks for managing and recovering wild salmon.

ACTIONS

A Sample spawning adult salmon and fish caught in FSC, commercial, and recreational fishers for pathogen screening.

B Create secure database for storing and managing pathogen screening data.

C Evaluate regional correlations in pathogen prevalence across life stages and species.

Objective 2.5 *Create standardized tools and processes for data collection, sharing, assessment, and reporting.*

Strategy 2.5.1 Establish more efficient processes for data collection, data sharing, and dissemination of information.

Current salmon monitoring efforts use a patchwork of tools for data collection, entry, and storage, creating barriers to data management, sharing, and analyses. Creating systems for digital data entry that are built on successful regional models like the CoastTracker (a tablet-based data entry platform developed by CFN) can enable more efficient data entry and transfer, allowing First Nations stewardship staff to spend more time on field work and informed decision-making. More effective data storage and access can be achieved by leveraging shared data management systems like the Regional Monitoring System managed by CFN, or PSF's Pacific Salmon Explorer and Salmon Data Library.

ACTIONS

A Support expanded use of existing centralized data management systems for sharing salmon monitoring data. Evaluate potential platforms and partnerships for data management.

B Create tools for electronic data entry to enable more efficient data collection and entry into databases. Build off existing platforms and protocols used by Central Coast Nations, DFO, and CCIRA (e.g. based on SIL forms and using CoastTracker). Link these data to a centralized database.

C Develop protocols and agreements for in-season data sharing and visualization of escapement data (e.g. on the Pacific Salmon Explorer) between Nations, DFO, and research partners.

Strategy 2.5.2 Establish standardized methods for assessment to use for pre-season planning, and in-season management.

Coordination and streamlining of data collection, sample processing, analysis, and reporting through the implementation of the *Monitoring Framework* will produce in-season and annual estimates of escapement, catch numbers, and population composition in regional fisheries. Timely delivery of management-relevant information (e.g. salmon escapement, fisheries catches) back to the Central Coast Nations and DFO is essential for collaborative management. This strategy addresses the need for timely standardized annual

reporting on salmon escapement, and fisheries catches, with information presented in formats and on timelines agreed upon by the Central Coast First Nations, DFO, and partner organizations.

ACTIONS

A Refine annual estimates of CU-specific catch in recreational and FSC fisheries based on interview data and creel surveys.

B Work with Central Coast Nations and DFO to implement in-season updates on CU-level run forecasts and catch.

C Deliver weekly updates on escapement for priority populations.

D Use the Pacific Salmon Explorer to deliver annual reports on salmon escapement and support collaborative management.

GOAL 3

Strengthen Catch Monitoring for Central Coast Salmon

Throughout the process of developing the *Monitoring Framework*, the Central Coast First Nations and DFO repeatedly emphasized the need for better information on catches of Central Coast salmon in fisheries along the entire Pacific Coast. Salmon originating from streams on the Central Coast migrate across the Pacific Ocean for thousands of kilometers, passing through fisheries in Alaska and BC before returning to their natal rivers. These fisheries catch an unknown proportion of returning adult spawners, with the exception of two Chinook indicator populations where hatchery fish are marked with CWT and adipose fin clips (Atnarko and Wannock).

Given the depressed status of some Central Coast salmon populations, ongoing mixed-stock fisheries pose unquantified — and possibly substantial — conservation risks. Furthermore, in the absence of coordinated catch monitoring programs, catches from recreational fisheries targeting coho and Chinook are unquantified. The Central Coast Nations and DFO have begun to build programs to address gaps in catch monitoring. The following sections detail a comprehensive set of strategies needed to quantify catch in recreational and FSC fisheries across the Central Coast, improve DNA baselines for GSI, and apply these baselines to quantify population-specific catch in regional mixed-stock fisheries. These data can inform collaborative management, and conservation efforts aimed at reducing exploitation of at-risk populations.

Objective 3.1 *Build a comprehensive genetic stock identification baseline.*

Strategy 3.1.1 Identify gaps in genetic baselines for priority populations and develop a plan to expand baseline coverage.

Having fully developed GSI baselines is critical for management and monitoring of mixed-stock fisheries. When baseline coverage is sparse, salmon cannot be reliably assigned to their population or CU of origin. A preliminary review of DFO genetic baselines for the Central Coast revealed that of the 995 streams with records of escapement monitoring, only 137 have at least 50 genetic samples, the minimum requirement for assigning fish to their CU in a mixed-stock analysis. Furthermore, many major populations are lacking genetic baselines, especially for coho salmon which are caught in mixed-stock recreational, commercial, and FSC fisheries. For example, major regional coho-producing rivers such as Kimsquit, Dean, Chuckwalla, Kilbella, Kwatna, Koeye, and Canoona are all lacking samples in existing genetic baselines. This strategy is focused on identifying gaps in current baselines, and prioritizing populations for DNA sampling to fill these gaps, a critical step towards better monitoring and management of Central Coast salmon fisheries.

ACTIONS

A Review existing data from DFO to identify gaps in the current GSI baseline across all CUs. (Prerequisite for ACTION C.)

B Work with DFO Stock Assessment staff and the DFO Molecular Genetics Lab to evaluate the source, quality, and age of existing genetic baselines to identify populations for resampling. (Prerequisite for ACTION C.)

C Review list of indicator streams (see Pacific Salmon Explorer) and use approach identified in STRATEGY 1.3.3 to identify salmon populations to prioritize for DNA sampling. (Dependent on ACTION A and ACTION B.)

D Develop and share prioritized list of salmon populations for DNA sampling with Central Coast Nations, DFO, and CCIRA.

Strategy 3.1.2 Implement program to collect genetic baselines from priority spawning populations.

Increased sampling of DNA during escapement surveys and/or targeted sampling of key populations provides an easy way to improve current deficiencies in the coverage of genetic baseline across Central Coast salmon CUs. This strategy involves identifying opportunities

and resources to build DNA baselines in unsampled salmon populations. In addition to sampling dead, spawning, or staging adults in their stream or river of origin, there is a need to evaluate the potential for sampling juveniles to develop genetic baselines. Currently, the DFO Molecular Genetics Lab does not accept juvenile samples because of the potential to sample sibling pairs (which increase sampling costs since one sibling is typically removed from the baseline), and the perception that natural selection during ocean migrations results in higher assignment success from mixed-stock fisheries when baseline collections are limited to adult samples. Sampling juveniles would be advantageous because they are readily accessible to sampling crews year-round, making it easier to capture sufficient numbers of individuals for genetic baselines ($n > 50$). Sampling juveniles from a handful of populations that are currently represented in the baseline will enable comparisons of assignment success when using adult, juvenile, and mixed life-stage baselines. This information will enable the development of a regional strategy to build complete genetic baselines.

ACTIONS

A Identify opportunities to add genetic sampling into existing escapement surveys.

B Provide sampling equipment to community and DFO count crews for DNA baseline collections.

C Create and use standard data-entry tools to document location, time, life stage, and other relevant biological data for DNA sample collections.

D Collect DNA baselines for priority Chinook, chum, coho, and sockeye populations.

Strategy 3.1.3 Apply genetic analyses to expanded DNA baseline to evaluate population structure, run timing, escapement, and CU designations.

Emerging genetic tools are providing new opportunities to understand population structure and apply GSI to improve understanding of exploitation rates, escapement, timing, and stray rates. Among the most important developments are new SNP genetic panels with up to 500 unique genetic markers that have been developed by DFO for Chinook, chum, and coho salmon. SNP panel development is nearly complete for sockeye and is planned for even- and odd-year pinks in the near future. One important application of these SNP panels will be analyzing existing sample collections from population aggregates in the Bella Coola and Wannock rivers to quantify subpopulation level differences in run timing, and their contributions to total escapement over time. With representative genetic sampling of in-river fisheries to determine the contribution of genetically distinct subpopulations, escapement estimates from well-monitored populations like Atnarko Chinook can be reliably expanded to produce estimates of total Bella Coola River Chinook escapement.

ACTIONS

A Support development of sockeye genetic panels and baselines to enable more accurate population assignment in mixed-stock samples.

B Apply GSI to mixed-stock fisheries on the Central Coast on an annual basis to provide estimates of population composition of salmon catches for collaborative management.

C Apply GSI to quantify escapement and catch of each major subpopulation of salmon within the Bella Coola River population aggregate.

- I Work with DFO Molecular Genetics Lab to evaluate sub-population differentiation for Chinook, chum, coho, and sockeye in the Bella Coola River using existing genetic baselines. (Prerequisite for ACTION C.II through ACTION C.V.)
- II Apply GSI to sockeye samples from the FSC fishery to determine the contribution of each sub-population to total Atnarko River sockeye escapement. (Dependent on ACTION C.I.)
- III Apply GSI to coho, chum, and Chinook from FSC and recreational fisheries to determine the contribution of Atnarko and other sub-populations within the Bella Coola River watershed, and then quantify total escapement of each species to the Bella Coola River. (Dependent on ACTION C.I.)
- IV Use samples from the Nuxalk in-river FSC fishery to quantify seasonal composition of Chinook populations for each section of the Bella Coola River. Identify areas and times of higher interception risk for Salloomt and Nusatsum Chinook. (Dependent on ACTION C.I.)
- V Apply GSI on samples from the spawning areas, and from FSC and commercial caught salmon to quantify contribution of enhanced and wild chum sub-populations to catch and escapement. (Dependent on ACTION C.I.)

D Apply GSI to quantify escapement and catch of each major sub-population within the aggregated sockeye population in Owikeno Lake.

- I Evaluate sub-population differentiation for Owikeno Lake sockeye using new SNP panels and existing genetic baselines. (Prerequisite for ACTION D.II.)
- II Apply GSI on sockeye caught in the Wannock River test fishery to determine the contribution of sockeye sub-populations to total Owikeno sockeye escapement. (Dependent on ACTION D.I.)

Objective 3.2 *Quantify CU-specific recreational, commercial, and food, social, ceremonial catch.*

Strategy 3.2.1 Establish standardized methods and tools for catch monitoring on the Central Coast.

Monitoring the number of salmon caught in recreational, commercial, and FSC fisheries is currently conducted through a patchwork of location-specific projects on the Central Coast; in many instances estimates of total catch are not available. This data gap creates considerable unquantified risk for Central Coast salmon populations. Coordination among the Central Coast Nations and DFO to develop standardized approaches for catch monitoring will help to provide quantitative estimates of catch in all fisheries. This strategy will support catch monitoring programs with sampling equipment, study design, and training, to maximize the information generated by existing catch monitoring programs and identify opportunities to improve the reliability of catch data.

ACTIONS

A Develop sampling protocol for fin clips, scale collections, and other sampling (e.g. sex, length, location, hatchery mark).

B Purchase and assemble sampling kits for First Nations sampling crews annually.

C Coordinate sampling and catch monitoring amongst Central Coast First Nations and DFO.

D Develop study design and methods guidebook with community catch monitoring initiatives, based on standardized protocols for data collection and quantification of catch, fishing effort, bycatch, and population composition in recreational, commercial, and FSC fisheries.

E Continue Guardian Watchman patrols to quantify recreational and FSC fishing effort. Work to understand current boat survey data and opportunities to link these data to catch monitoring.

F Provide standard digital data entry tools to community catch monitoring programs.

G Create annual reports on population-specific estimates of catch in all fisheries (FSC, recreational, commercial).

Strategy 3.2.2 Strengthen and expand dockside and in-river catch monitoring programs for FSC fisheries in each Central Coast community.

First Nations are responsible for monitoring their own FSC catches and reporting these data back to DFO co-managers. Currently these programs involve a variety of methods and approaches. Working with each Nation to understand how existing FSC catch monitoring works in their community, there is a need to identify opportunities for increased investments in FSC monitoring initiatives that can more reliably quantify and sample catch.

ACTIONS

A Identify successful existing catch monitoring initiatives across Central Coast communities and work with communities to strengthen these programs through enhanced monitoring resources or support with project design and analysis.

B Design projects with each community to sample fin clips and scales from fish caught in FSC fisheries.

C Supply community catch sampling programs with equipment to scan for CWTs and collect salmon heads for population identification when present.

D Continue dockside interviews and catch sampling in Bella Bella to monitor FSC catch, effort, fisher observations, and collect mixed-stock samples for GSI.

- I Continue dockside interview program to gather data about fisher trips, catch, and sample DNA and scales from FSC caught fish.
- II Incorporate regular visits to McLoughlin Bay to quantify effort and catch of hatchery produced coho.
- III Adapt study design to include phone-based interview protocol and support fishers to sample DNA and scales from their catch.

E Conduct ongoing in-river FSC fishery monitoring in Bella Coola to obtain annual estimates of FSC catch, fishing effort, and fisher observations.

- I Extend current in-river monitoring and biosampling through mid-October to capture in-river coho fisheries.
- II Conduct regular boat-based surveys to calibrate boat trailer counts to total FSC fishing effort.

F Work with Kitasoo/Xai'xais to support and expand current FSC monitoring initiatives and identify opportunities to strengthen survey methodology to make estimates of catch.

G Work with Wuikinuxv to understand current FSC monitoring and where additional resources or support may be helpful.

Strategy 3.2.3 Strengthen and expand dockside and in-river creel surveys to monitor catch in recreational fisheries.

Recreational fisheries on the Central Coast have grown in their size and importance in recent years, however monitoring of the recreational fishery is generally lacking, outside of First Nations catch monitoring initiatives and mandatory catch reporting for fishing lodges. This strategy involves designing and implementing First-Nations-led creel survey programs that quantify effort and catch in recreational fisheries, and create standardized data entry and reporting protocols to provide timely information to First Nations and DFO fishery managers.

ACTIONS

A Across all First Nations communities, sample fin clips and scales from fish caught in recreational fisheries to estimate population composition and age structure for recreationally caught salmon.

B Expand Heiltsuk dockside monitoring program to include more interviews in Shearwater and weekly visits to area lodges.

C Implement saltwater creel survey, boat trailer count, and catch sampling for recreational fishers leaving from and returning to Bella Coola to obtain estimates of total catch and fishing effort.

D Work with Guardian Watchmen programs from each community to develop and apply a coordinated survey methodology to quantify effort in recreational fisheries across the Central Coast.

E Expand Nuxalk-led monitoring of in-river recreational fisheries in Bella Coola to obtain annual estimates of catch, releases, and fishing effort.

- I Extend river monitoring to mid-October to capture in-river coho fisheries.
- II Conduct regular boat-based surveys to calibrate roadside surveys of effort to total recreational fishing effort.

F Work with lodges to conduct DNA and scale sampling of their catches and quantify hatchery mark-rate among recreationally caught salmon.

G Work with DFO to provide regular reports to the Nations on the number of salmon caught at fishing lodges.

H Work with Kitasoo/Xai'xais and North King Lodge to sample salmon from Kitasoo/Xai'xais territory.

I Work with Wuikinuxv to understand the need and opportunity for greater investments in recreational fishery monitoring.

Strategy 3.2.4 Strengthen and expand commercial catch monitoring and sampling for genetic stock identification and CWT recovery.

Monitoring and reporting of commercial catch are done using fisher logbooks that are required for commercial license holders. Thus, the total number of fish caught and delivered to processors is well enumerated. However, there are concerns about under-reporting of bycatch. In addition, genetic samples for GSI are only collected sporadically from commercial catches. Working with First Nations and DFO catch monitoring initiatives in each community, this strategy involves evaluating opportunities to work with commercial fishers to sample and quantify bycatch, and increasing the regularity of catch sampling when fish are delivered to processors.

ACTIONS

A Identify opportunities for more regular sampling of DNA and scales from commercially caught salmon.

B Coordinate with fish plants and commercial fishers from Central Coast communities to improve DNA and scale sampling for commercial catch and quantification of bycatch in commercial openings.

C Hire and train independent observers from Central Coast communities to work with fishers to sample and count non-target species caught during fishery openings.

Strategy 3.2.5 Use GSI data to quantify CU- and population-level catches in recreational, commercial, and FSC fisheries.

Broader application of GSI tools is needed to quantify CU- and population-level catches in Central Coast fisheries. Creating more streamlined processes for submitting and running genetic samples collected by First-Nations-run catch monitoring projects will support the application of GSI to mixed-stock fisheries on an annual basis to quantify catch and understand population-level differences in run timing, migration routes, and fishery impacts. Once genetic baselines have been expanded to a more representative set of populations, the DFO Molecular Genetics Lab can reanalyze samples collected in major regional mixed-stock fisheries to improve estimates of catch for Central Coast salmon.

ACTIONS

A Work with DFO Molecular Genetics Lab and First Nations to streamline processing of fin clips for GSI.

B Send samples from each community catch-monitoring program to DFO Molecular Genetics Lab annually to determine mixed-stock catch composition and identify hatchery-origin fish with PBT.

C Work with DFO Molecular Genetics Lab to rerun mixed-stock fishery samples with updated baseline (e.g. Haida Gwaii, Central Coast recreational and commercial, existing test fishery samples for coho, Chinook, chum, and sockeye).

Objective 3.3 *Characterize the vulnerability of individual salmon populations to overfishing to inform understanding of fishery and conservation trade-offs.*

Strategy 3.3.1 Quantify population-level impacts of historic and contemporary mixed-stock fisheries on Central Coast salmon CUs.

For Central Coast salmon, catch is unquantified at the population-level, however the vulnerability and sensitivity to fishery impacts likely differs across populations and CUs. Leveraging improved genetic baselines (STRATEGY 3.2.5) and historic sampling efforts (e.g. scale and fin tissue and CWT marking), past fishery impacts can be reconstructed to understand the contribution of individual populations and CUs to historic catches. This strategy involves identifying the characteristics associated with high vulnerability to fisheries, for example run timing, body size, and age. The strategy also involves reconstructing how fishery impacts have influenced the current status of Central Coast salmon.

ACTIONS

A Apply GSI to quantify mixed-stock composition and evaluate population-specific catch in ongoing commercial fisheries in DFO Pacific Fishery Management Area 8.

B Apply GSI to recreational and FSC caught salmon to quantify mixed-stock composition, run timing, and spatial distribution of salmon populations in marine waters.

C Work with FSC fishers to conduct small-scale test fisheries in parts of Pacific Fishery Management Area 8 (subareas 8-4 and 8-5) with active commercial gillnet fisheries. Use smaller mesh sizes (e.g. sockeye nets used for FSC), and compare population composition, size, and sex of fish caught to those captured in commercial fisheries to evaluate for population, size, or sex selectivity in commercial fisheries interceptions.

Strategy 3.3.2 Apply simulation-based analytical tools to estimate demographic risks associated with a range of exploitation rates.

Management strategy evaluation (MSE) is a simulation-based analytical approach that is commonly used to evaluate trade-offs and opportunities associated with different fisheries management strategies. By developing a set of linked biological, fisheries, and governance models and running simulations forward in time, MSE provides a tool to evaluate biological, cultural and economic outcomes against a range of management alternatives. For example, the Central Coast Nations may want to quantify the benefit of incorporating more in-season data into management by evaluating the risk of population declines in forward-looking simulations when in-season data are/aren't applied to management decisions. MSE also allows managers to quantify of the value of a shift towards more terminal or selective fisheries by tracking the amount of fishing opportunity relative to the impacts on non-target species in simulations. These models can also be applied in the context of environmental change, for example evaluating the performance of fisheries management under future climate trajectories.

ACTIONS

A Compile existing data on escapement, run timing, catch, and community use into a dataset that can be used for MSE. (Prerequisite for ACTION B.)

B Support Central Coast Nations and DFO to develop an MSE that quantifies multi-species conservation risks and opportunities associated with a range of fishing scenarios and in-season management procedures. (Dependent on ACTION A.)

- I Evaluate DFO Pacific Fishery Management Area 8 commercial fisheries.
- II Evaluate DFO Pacific Fishery Management Area 6/7/8/9 mixed-stock population and FSC fisheries.

Strategy 3.3.3 Develop in-season indicators of run size and catch based on in-season escapement and catch monitoring.

Increasingly unpredictable returns and declining productivity across many species of wild salmon make it difficult to predict abundance pre-season, challenging the development of fisheries management plans. This uncertainty, coupled with high fleet mobility, license stacking, and closures of other recreational and commercial fisheries in the province create conservation risks for many depressed salmon populations in the Central Coast. In-season information on escapement and fisheries catches can serve as valuable in-season indicators of run strength, supporting collaborative adaptive management. This strategy will support the four Central Coast First Nations in developing in-season catch and escapement

monitoring, by building on existing programs and datasets to evaluate a range of in-season indicators of run size and catch.

ACTIONS

A Work with community catch monitoring programs to implement digital data entry and in-season analysis for run forecasting and adaptive management.

B Build in-season forecasting models from catch-per-unit-effort (CPUE) or in-season escapement monitoring projects.

- I Analyze Nuxalk CPUE and Atnarko Chinook escapement to update in-season escapement forecast by end of 2021.
- II Incorporate data on population composition in different areas of the Bella Coola watershed to enable in-season estimates of catch on Atnarko, Salloomt, and Nusatsum Chinook.
- III Analyze tagging, count, and survival data from the Koeye weir to develop models for in-season forecasting and fisheries management.
- IV Work with Wuikinuxv and research partners to develop in-season forecasting capability for Owikeno Lake salmon using Wannock River sonar and test fishery.

C Evaluate correlation between catches of Chinook and coho at fishing lodges and escapement to regional indicator streams.

Strategy 3.3.4 Identify opportunities for implementing selective fishing technologies in salmon monitoring and fishing.

Traditionally on the Central Coast, most salmon were caught in terminal fisheries using in-river weirs, fish traps, or other traditional fishing technologies. Today, most fish are captured in mixed-stock marine fisheries with a few notable exceptions, including in-river gillnet fisheries in and around Wuikinuxv Village and Bella Coola. Throughout the Central Coast, there is a growing recognition that in-river fishing technologies can support selective fisheries and provide important opportunities for salmon monitoring. This strategy focuses on identifying specific opportunities where traditional in-river selective fishing technologies can be utilized to support FSC fisheries as well as support long-term monitoring and data collection.

ACTIONS

I Convene knowledge-sharing workshops related to the use of terminal and selective fishing technologies.

II Pilot the application of selective fishing tools such as weirs, beach seines, and purse seines to capture fish for monitoring actions in a few select locations.

III Establish a fund to support and grow investments in terminal and selective gears for fishing, monitoring, and research.

GOAL 4

Strengthen Understanding of Current and Future Climate Pressures on Central Coast Salmon

Climate change is rapidly impacting salmon throughout their range, and in both their freshwater and marine life stages. There is an urgent need to develop a plan to monitor and mitigate the effects of climate change on salmon habitats. Numerous actions can be taken to increase the resilience of salmon to climate change, however these efforts must be informed by a common understanding of how climate change is unfolding at local scales and where the impacts of climate change are the most acute. This *goal* reflects deep concerns amongst the Working Group and the Central Coast communities about the potential consequences of anthropogenic climate change on salmon. The *strategies* and *actions* in this section aim to build a coordinated approach to tracking and forecasting climate conditions, and managing impacts so that salmon social-ecological systems can remain resilient in the face of climate change.

Objective 4.1 *Evaluate current climate pressures on estuary, marine, and freshwater salmon habitats.*

Strategy 4.1.1 Identify and compile data on current and historical climate monitoring on the Central Coast.

Over the years, there have been numerous efforts to collected climate-related environmental data on the Central Coast. However, these data have not been organized into a centralized database that could support retrospective analyses. This strategy seeks to compile existing climate data in a centralized database, building a foundation for understanding current

climate change pressures and guiding new investments in climate monitoring to ensure continuity with crucial programs.

ACTIONS

A Compile historical climate-related data (e.g. temperature data) from Stream Inspection Logs and other historical data sources. (Prerequisite for STRATEGY 4.1.2.)

B Summarize the available data and data gaps by habitat type (estuarine, marine, freshwater). (Prerequisite for STRATEGY 4.1.2.)

Strategy 4.1.2 Identify climate indicators that can be used to help monitor current climate pressures on salmon.

This strategy focuses on identifying a suite of climate indicators that can be used by the Central Coast Nations to evaluate current climate conditions and ongoing climate change impacts. This information will be central to developing locally relevant adaptation and mitigation approaches.

ACTIONS

(All actions below are dependent on STRATEGY 4.1.1, ACTION A and ACTION B.)

A Compile list of candidate climate indicators that can be used to monitor current climate conditions. (Prerequisite for STRATEGY 4.1.3.)

B Assess the availability of data to inform climate indicators. (Prerequisite for STRATEGY 4.1.3.)

C Identify final list of climate indicators for long-term monitoring. (Prerequisite for STRATEGY 4.1.3.)

Strategy 4.1.3 Establish and implement a Central-Coast-wide climate monitoring strategy.

Given the diverse range of freshwater and marine habitats occupied by salmon on the Central Coast, any effort to monitor and manage climate impacts on salmon requires a plan to capture ongoing variability and change across these diverse landscapes. Drawing on diverse ways of knowing, from the observations of the Central Coast Nations to targeted environmental monitoring in critical salmon habitats, this strategy involves the development of a locally-tailored approaches for monitoring climate change in salmon habitats across the Central Coast.

ACTIONS

(All actions below are dependent on STRATEGY 4.1.2, ACTION A, ACTION B, and ACTION C.)

A Establish a coordinated regional strategy for climate monitoring in priority salmon watersheds on the Central Coast, using the climate indicators identified in STRATEGY 4.1.2.

B Support communities and research partners in collecting data and sharing via a centralized data platform.

C Evaluate where current climate pressures are posing a high risk to salmon by comparing climate data to established benchmarks (or reference points).

Strategy 4.1.4 (not included)

All actions under this strategy received less than 24 points and is therefore not included in the final *Monitoring Framework*.

Strategy 4.1.5 Develop and evaluate conservation and management strategies to mitigate the impacts of climate change.

Developing management strategies to promote resilient salmon social-ecological systems is a priority that has been articulated by all Central Coast First Nations. However, managing for resilience requires that all entities — Central Coast Nations, DFO, research partners, and others — have a shared understanding of the pace, distribution, and consequences of climate change on salmon. This strategy seeks to generate an annual report on current climate conditions affecting Central Coast salmon, and their anticipated impacts. The annual report will facilitate discussions and planning to identify approaches for mitigating and managing the impacts of climate change.

ACTIONS

A Produce annual report on current climate conditions and their observed and anticipated impacts on Central Coast salmon populations.

B Identify and evaluate potential climate change adaption and mitigation approaches for Central Coast salmon.

5 Conclusion

The goal of this project was to collaboratively develop a coordinated and strategic plan for salmon monitoring and stewardship on the Central Coast that reflects the priorities of the Kitasoo/Xai'xais, Nuxalk, Heiltsuk, and Wuikinuxv First Nations and DFO. After engaging with salmon experts from each of the Nations and DFO, Charter Patrolmen, and members of the four main Central Coast communities — Klemtu, Bella Coola, Bella Bella, and Wuikinuxv Village — four overarching *goals*, accompanied by 13 *objectives*, 41 *strategies*, and 214 *actions*, were identified to provide long-term benefits to Pacific salmon and the communities that depend on them.

By working through an SDM approach over the past year (October 2019 – October 2020), we were able to develop the *Central Coast Salmon Monitoring & Stewardship Framework* in a structured and transparent manner with each step in the approach building off the last. The four overarching *goals* developed by the Working Group helped guide us in identifying *objectives*, *strategies*, and *actions* to support monitoring of Central Coast salmon. Through our structured approach, we also identified evaluation criteria which allowed the Central Coast Nations and DFO to systematically evaluate all possible *actions*. While reviewers' scores reflected the different values and needs of their communities or organization, a large number of *actions* received high scores, indicating that they were shared priorities across the Central Coast. For example, "develop structure and working principles for a technical working group" to provide logistical and scientific support (ACTION A under STRATEGY 1.1.2) was one of the highest scored *actions*. A number of the highly scored *actions* involve restoring programs that had previously lost funding, for example "restore overflight surveys of Chinook, coho, chum, and pink salmon to monitor escapement in the Chuckwalla and Kilbella rivers" (ACTION E under STRATEGY 2.1.2). Other highly scored *actions* focus on introducing new technologies to improve monitoring, for example, "develop and apply computer-vision deep learning models to automate identification and counting of salmon from video and sonar data outputs" (ACTION C under STRATEGY 2.1.3).

Page 81 photo by Byrant DeRoy. Page 82 photo by Will Atlas.

The *Monitoring Framework* laid out in Section 4 represents a holistic vision of salmon monitoring and fisheries management that depends not only on data collection and Western science, but also includes local and traditional ecological knowledge and investment in First Nations leadership. Initially, we expected the *Monitoring Framework* to be focused on salmon escapement and catch monitoring, which were well known to be lacking on the Central Coast. However, during the initial steps of the project, it became apparent that coordination and information sharing were generally lacking between DFO and the Central Coast Nations, and the Nations had a need for greater technical capacity. Without improved coordination, information sharing, and technical capacity, success of new monitoring programs, attempts to use the resulting data for in-season and post-season analyses, and evidence-based decision-making would remain an ongoing challenge. As a result, GOAL 1 — *Strengthen Central Coast community participation in stewardship and collaborative salmon management* — emerged as key to the success of all subsequent *goals*. GOAL 2 and GOAL 3 address critical data gaps related to salmon escapement and catch monitoring, while GOAL 4 tackles the need to improve our understanding of climate pressures on salmon on the Central Coast. By investing in salmon and the First Nations communities who steward them, this work seeks to move beyond prescriptive approaches to addressing environmental challenges and towards greater collaboration that empowers First Nations communities, governments, and their many partners to meet shared goals around salmon conservation and management.

The soon to be ratified Fisheries Resources Reconciliation Agreement represents a critical step towards rectifying long-standing imbalances in governance authority over salmon and their habitats, putting First Nations and Canadian governments on equal footing when planning for sustainable fisheries. While fisheries reconciliation represents a turning point in Indigenous-colonial relationships and creates new opportunities for First Nations leadership of salmon monitoring and management, these changes in governance alone cannot guarantee resilience of Pacific salmon. In the absence of additional salmon escapement and catch monitoring, in-season fisheries management, and a better understanding of climate change pressures, opportunities for sustainable salmon fisheries will very likely continue to dwindle.

The *Monitoring Framework* detailed in Section 4 represents one of many steps towards a resilient salmon social-ecological system on the Central Coast, built on the shared priorities of First Nations and Canadian governments and learnings from both Indigenous and scientific knowledge. By reflecting the priorities, needs, and expertise of the Kitasoo/Xai'xais, Nuxalk, Heiltsuk, and Wuikinuxv Nations, DFO, Charter Patrolmen, and coastal communities — and their collective commitment to Pacific salmon — the investments in salmon monitoring and stewardship identified in the *Monitoring Framework* can catalyze the sustainability of salmon on the Central Coast.

Glossary of Acronyms

ARIS ▸ Adaptive Resolution Imaging Sonar
ARIS is the newest imaging sonar system manufactured by Sound Metrics Corporation, the creators of the Dual Frequency Identification Sonar (DIDSON). Imaging sonars use multiple sound beams to generate a visual representation of underwater objects, allowing fish to be visually identified, counted and measured for determining abundance, size, and swimming behavior. DIDSONs are gradually being phased out, and the newer ARIS offers better image resolution for fish counting and measurements.

AUC ▸ Area-under-the-curve
The AUC is a method used to convert period counts of mature salmon in streams into an estimate of escapement (i.e. the number of mature salmon that escape marine fisheries). Escapements are estimated by dividing the integral of the escapement curve by the average residence time of fish in the survey area.

CCIRA ▸ Central Coast Indigenous Resource Alliance
In 2010, CCIRA was established by the Heiltsuk, Kitasoo/Xai'xais, Nuxalk, and Wuikinuxv Nations to uphold Indigenous laws and ensure sustainable use and stewardship of natural resources, protecting resource health for future generations.

CFN ▸ Coastal First Nations
The CFN Great Bear Initiative is an alliance of nine BC First Nations — Wuikinuxv, Heiltsuk, Kitasoo/Xai'xais, Nuxalk, Gitga'at, Metlakatla, Old Massett, Skidegate, and Council of the Haida Nation — that promotes community self-sufficiency and sustainable economic development on the North and Central Coast and Haida Gwaii.

CU ▸ Conservation Unit
A geographically, ecologically, and genetically distinct population of wild Pacific salmon. A CU can contain one or more populations. The unit created under Canada's Wild Salmon Policy to enable DFO to identify and manage for the maintenance of salmon diversity.

CPUE ▸ Catch per unit effort
CPUE is an indirect measure of the abundance of a target species. Changes in the CPUE are inferred to signify changes to the target species' true abundance.

CWT ▸ Coded-wire-tag
Tags which are surgically implanted in juvenile salmon and redetected when the fish are caught in fisheries. CWTs have codes identifying the hatchery of origin and the year of release, allowing fishery managers in BC to estimate fishery exploitation rates for CWT marked salmon, typically from hatcheries.

DFO ▸ Fisheries and Oceans Canada
Formerly, the Department of Fisheries and Oceans, and still widely referred to as DFO, Fisheries and Oceans Canada is the federal government branch responsible for fisheries and oceans in Canada.

FSC ▸ Food, Social, and Ceremonial
The Doctrine of Priority states that after conservation needs are met, First Nations' have priority access for Food, Social and Ceremonial (FSC).

GSI ▸ Genetic stock identification
Analysis of genetic samples collected from a mixture of fish, whereby panels of genetic markers are used to identify genetic distinct populations using baseline information on allele frequencies in the populations could potentially be intercepted in the fishery.

HIRMD ▸ Heiltsuk Integrated Resource Management Department
In 2010, the Heiltsuk First Nation established the HIRMD to manage stewardship activities within Heiltsuk territory. Today HIRMD is responsible for fisheries, lands, marine use, and a range of other stewardship focused activities.

KXSA ▸ **Kitasoo/Xai'xais Stewardship Authority**
The KXSA has been established by the Kitasoo/Xai'xais First Nation to oversee land and marine use planning, manage the Guardian Watchmen and youth programs, conduct scientific research, and manage activities related to Indigenous Rights and Title.

MSE ▸ **Management strategy evaluation**
MSE is a simulation-based analytical approach that is commonly used to evaluate trade-offs and opportunities associated with different fisheries management strategies.

PBT ▸ **parentage-based tagging**
PBT uses molecular-based approaches to conduct large-scale parentage assignments and has resulted in the unprecedented ability to genetically identify millions of hatchery-origin salmonids. It is an efficient alternative for mass tagging and may replace CWT using a single genetic assay that can scan several hundred single-nucleotide polymorphisms at once.

PIT ▸ **Passive Integrated Transponder**
PIT tags are tracking tags that do not require power. Instead, they have an internal microchip that gets activated when it passes close to a special antenna. The antenna is connected to a computer that records the identity of the tag and the time that it passed by the antenna. PIT tags have been identified as a potential alternative to CWTs.

PSF ▸ **Pacific Salmon Foundation**
PSF, founded in 1987, is a federally incorporated non-profit charitable organization dedicated to the conservation and restoration of wild Pacific salmon and their natural habitats in BC and the Yukon.

SDM ▸ **Structured decision-making**
SDM is an organized approach to identifying and evaluating creative options and making choices in complex decision situations. SDM is designed to deliver insight to decision makers about how well their objectives may be satisfied by potential alternative courses of action. It helps find 'win-win' solutions across groups, clarifies the irreducible trade-offs that may exist between alternate potential courses of action and helps to communicate how people view these various options.

SEAS ▸ **Supporting Emerging Aboriginal Stewards**
SEAS Community Initiative is a youth program initiated by First Nation community partners together with Nature United. Local programs are designed to engage, develop, prepare and empower Indigenous youth to become the next generation of stewards in their communities and territories.

SNP ▸ **Single nucleotide polymorphisms**
An SNP is a variation at a single position in a DNA sequence among individuals. They have shown promise for improved reliability in genetic stock identification and can often be used to differentiate proximal salmon populations that are indistinguishable using older microsatellite and allozyme markers.

TLEK ▸ **Traditional and local ecological knowledge**
There is no clear answer as to the difference between traditional ecological knowledge (TEK) and local ecological knowledge (LEK). Here we define TLEK as TEK is most often defined by Berkes (1999). TLEK is a cumulative body of knowledge, practice and belief evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment. TLEK is place-based and geographically specific, and is most often found among societies that have engaged in natural resource use in a particular place over a long time period, such as indigenous peoples.

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Appendices

Photo by Bryant DeRoy.

APPENDIX 1

Salmon Conservation Units in the Central Coast Project Area

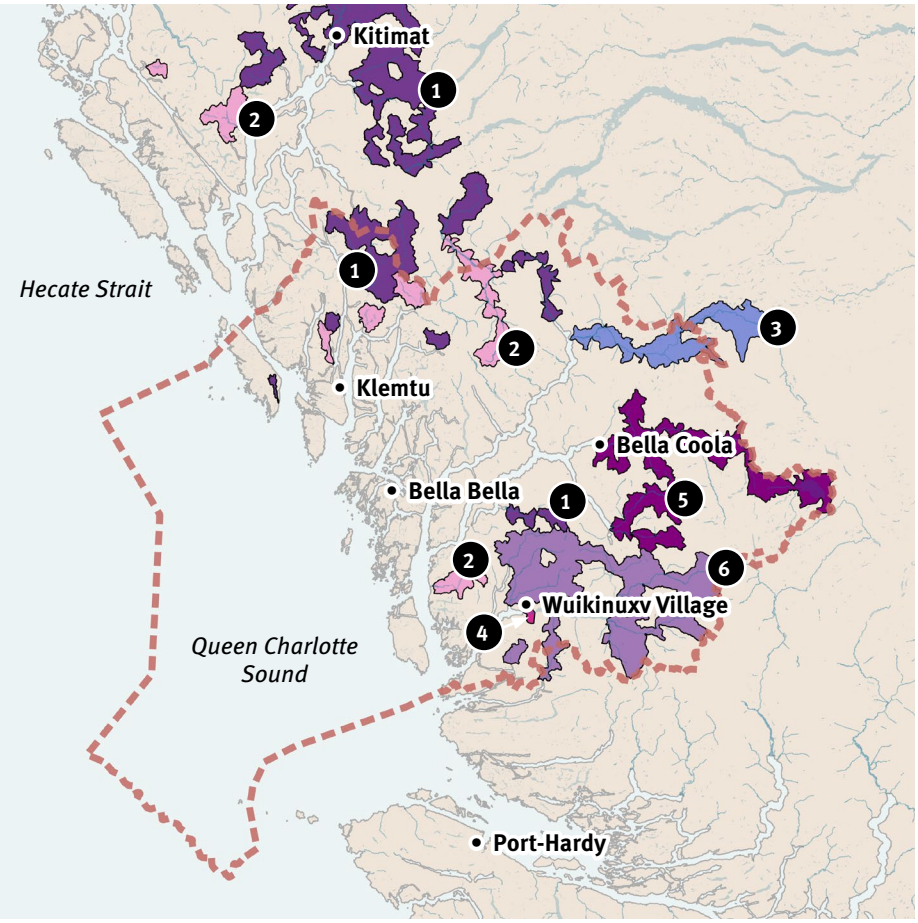
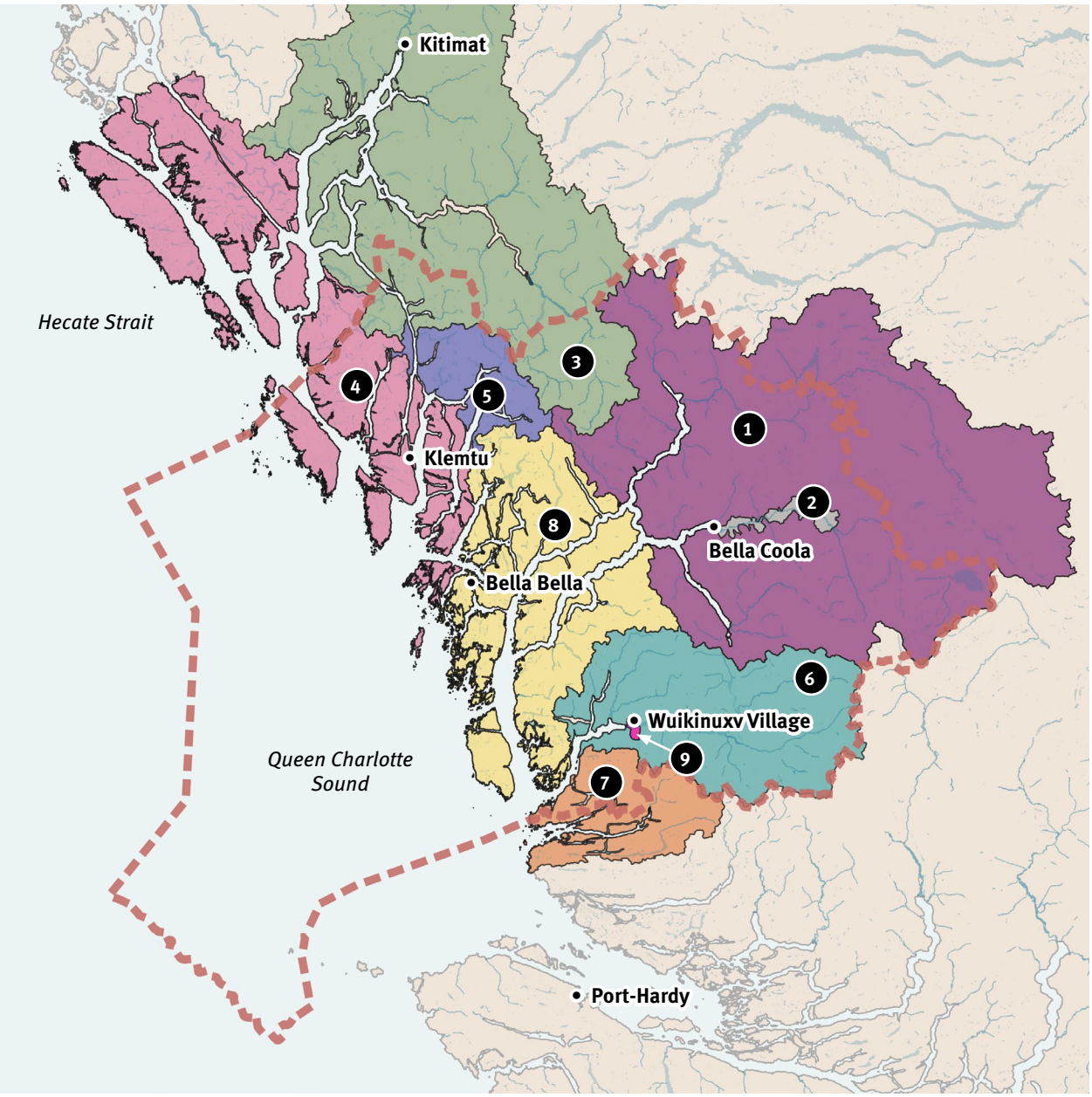


FIGURE A.1. Geographic boundaries of Chinook salmon Conservation Units overlapping with the Central Coast project area.



1	Bella Coola – Dean Rivers	6	Rivers Inlet
2	Bella Coola – Bentinck	7	Smith Inlet
3	Douglas – Gardner	8	Spiller – Fitz Hugh – Burke
4	Hecate Lowlands	9	Wannock
5	Mussel – Kynock		Project Area

FIGURE A.2. Geographic boundaries of chum salmon Conservation Units overlapping with the Central Coast project area.

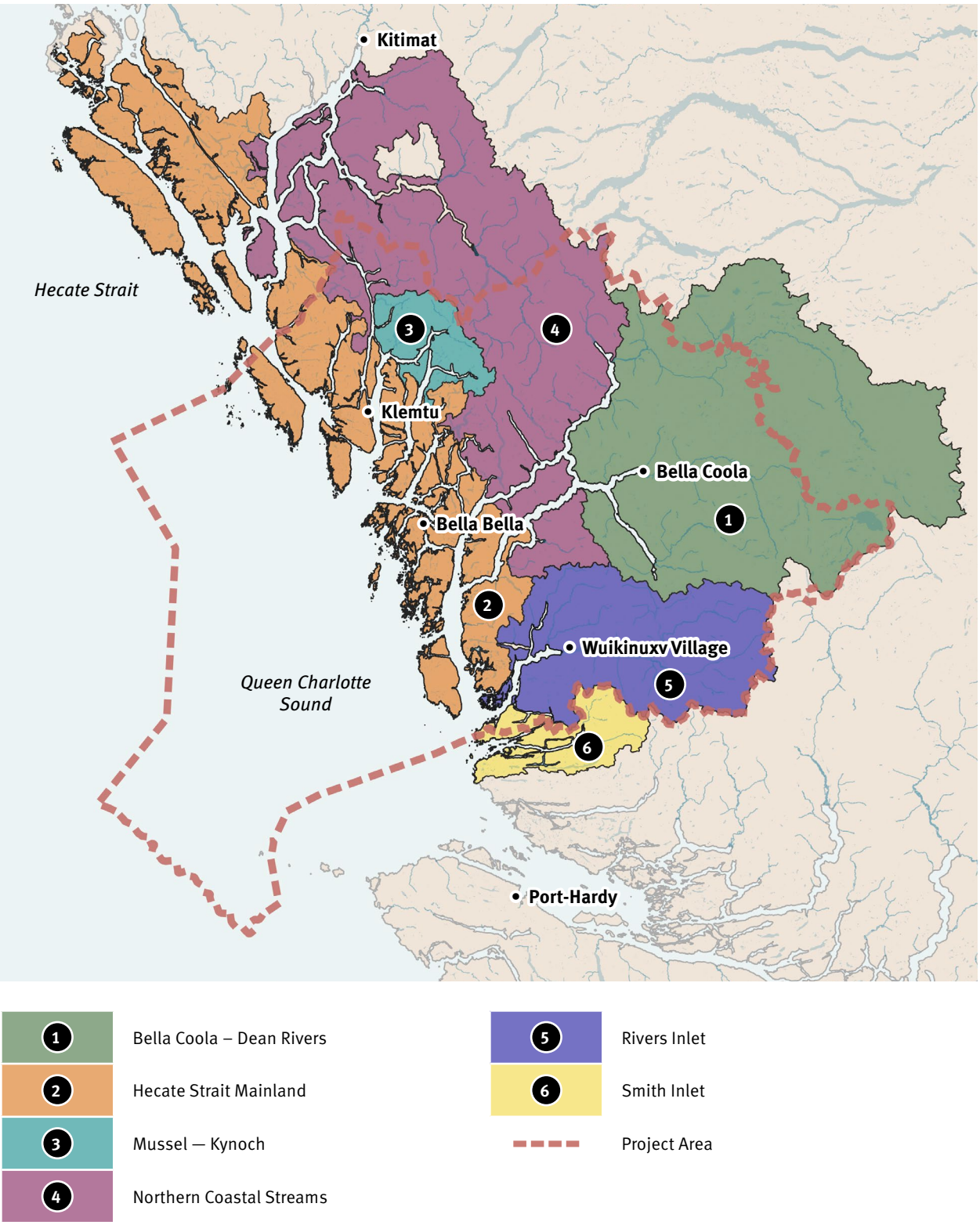


FIGURE A.3. Geographic boundaries of coho salmon Conservation Units overlapping with the Central Coast project area.

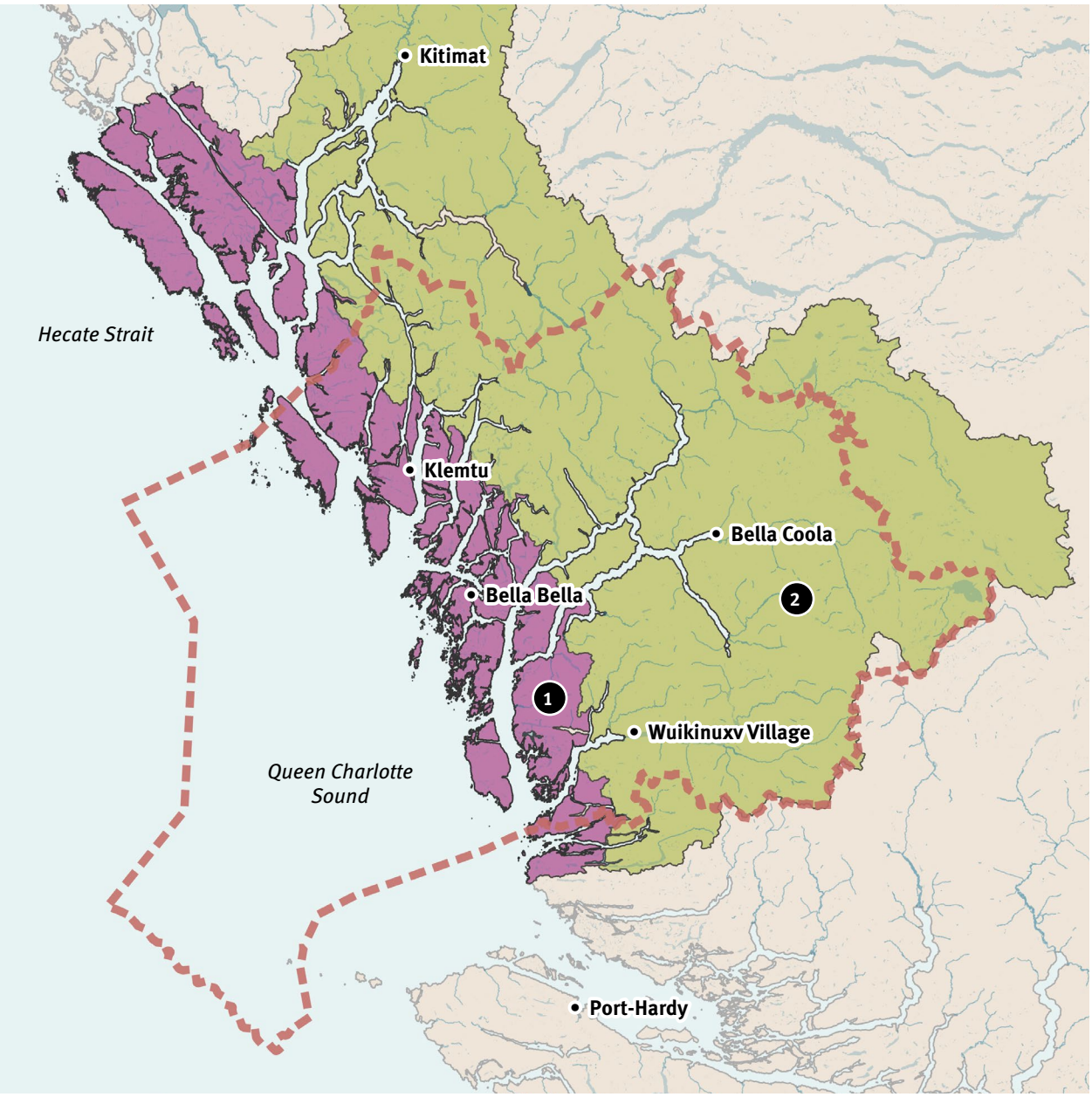


FIGURE A.4. Geographic boundaries of pink (even) salmon Conservation Units overlapping with the Central Coast project area.

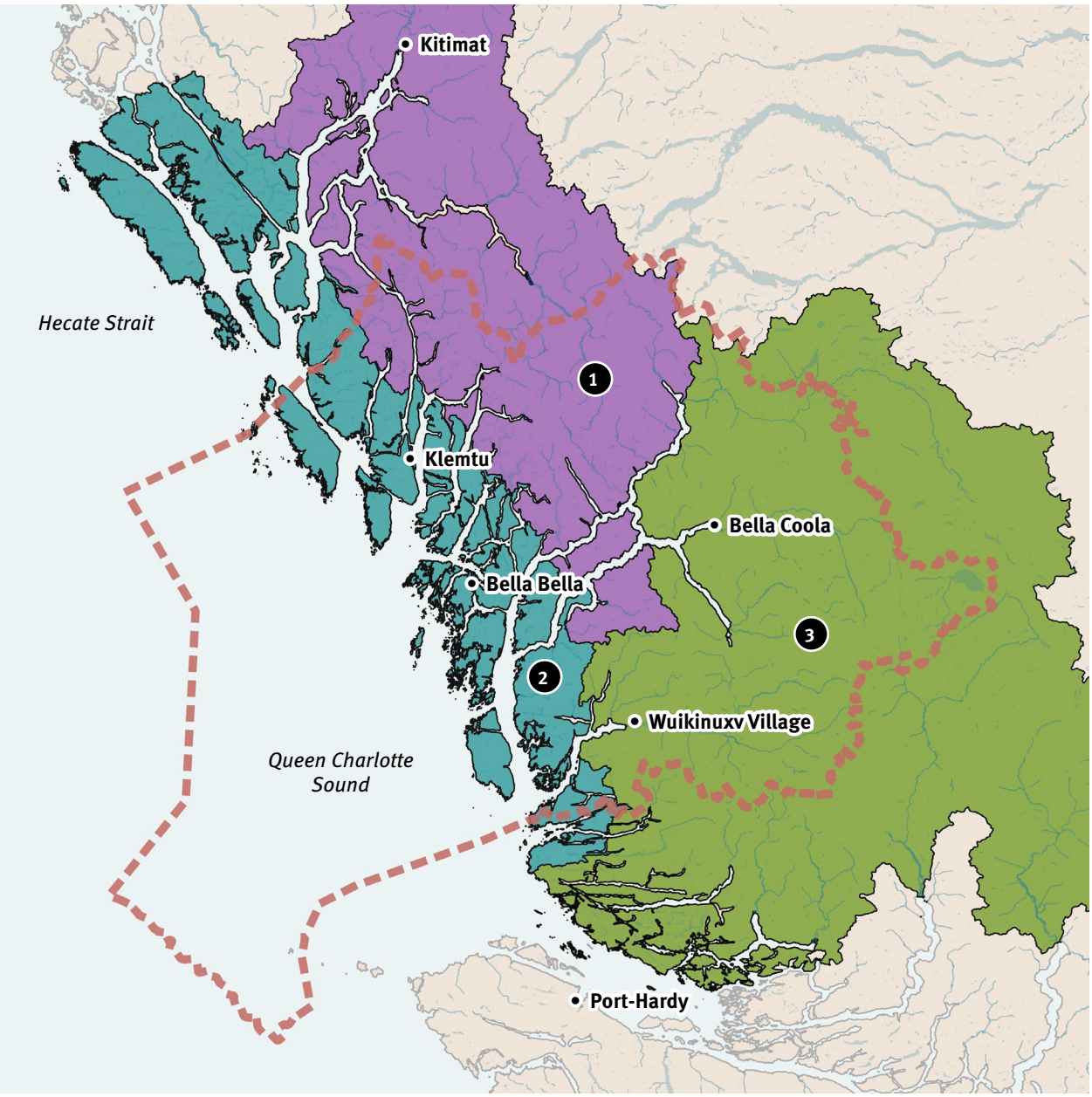
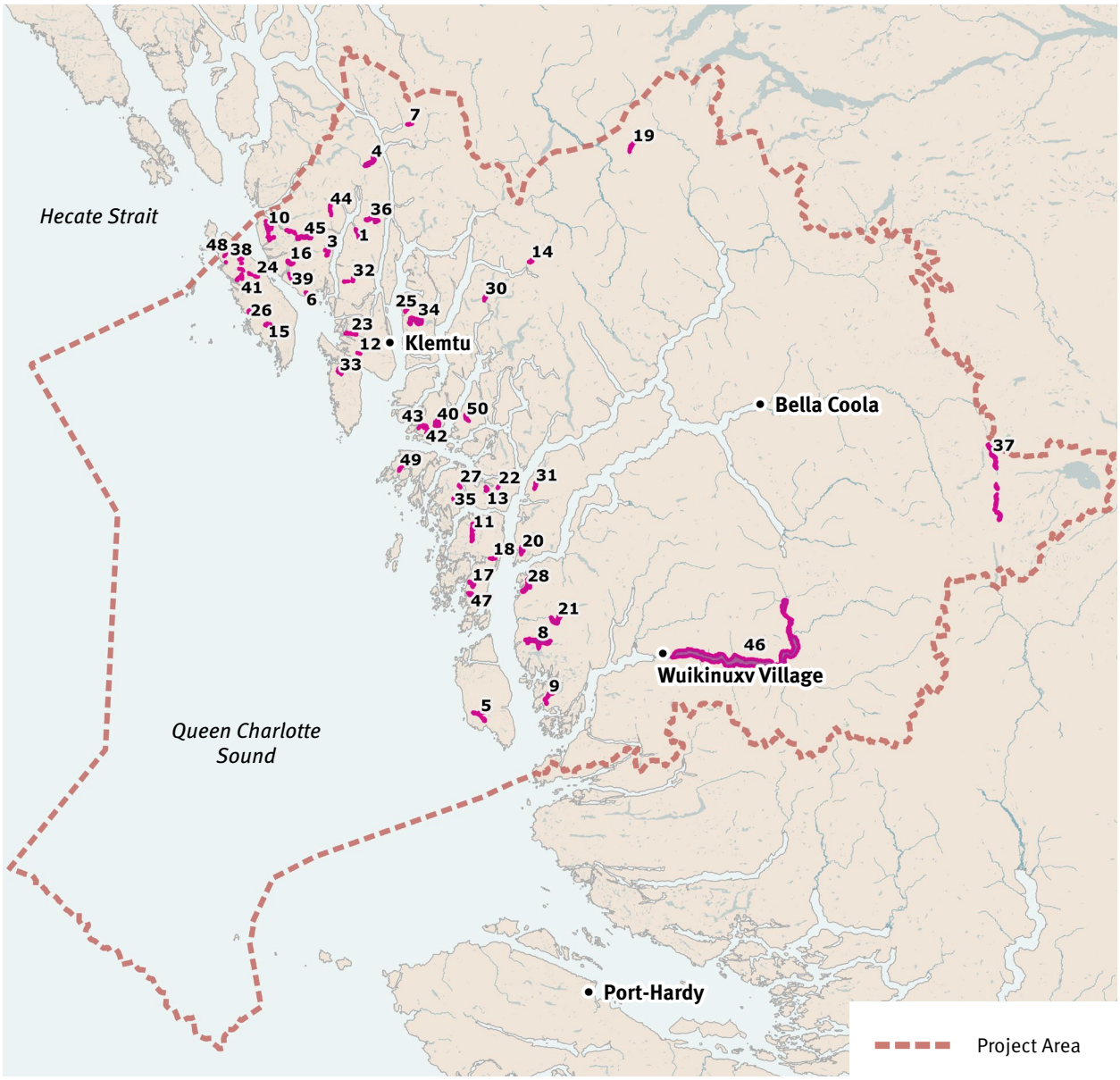


FIGURE A.5. Geographic boundaries of pink (odd) salmon Conservation Units overlapping with the Central Coast project area.



1	Bloomfield	11	Fannie Cove	21	Koeye	31	Port John	41	Treneman Creek
2	Borrowman Creek	12	Higgins Lagoon	22	Kunsoot River	32	Powles Creek	42	Tuno Creek East
3	Busey Creek	13	Kadjusdis River	23	Kwakwa Creek	33	Price Creek	43	Tuno Creek West
4	Canoona	14	Kainet Creek	24	Limestone Creek	34	Roderick	44	Tyler Creek
5	Chic Chic	15	Kdelmashan Creek	25	Mary Cove Creek	35	Ship Point Creek	45	Wale Creek
6	Dallain Creek	16	Kent Inlet Lagoon Creek	26	Mcdonald Creek	36	Soda Creek	46	Wannock (Owikeno)
7	Dome	17	Kildidt Creek	27	Mcloughlin	37	South Atnarko Lakes	47	Watt Bay
8	Elizabeth	18	Kildidt Lagoon Creek	28	Namu	38	Stannard Creek	48	West Creek
9	Elsie / Hoy	19	Kimsquit	29	Owikeno	39	Talamoosa Creek	49	Yaaklele Lagoon
10	Evinrude Inlet	20	Kisameet	30	Pine River	40	Tankeeah River	50	Yeo

FIGURE A.6. Geographic boundaries of sockeye (lake-type) salmon Conservation Units overlapping with the Central Coast project area. (Note that #29 has the same spatial extent as #46, and so it not shown.)

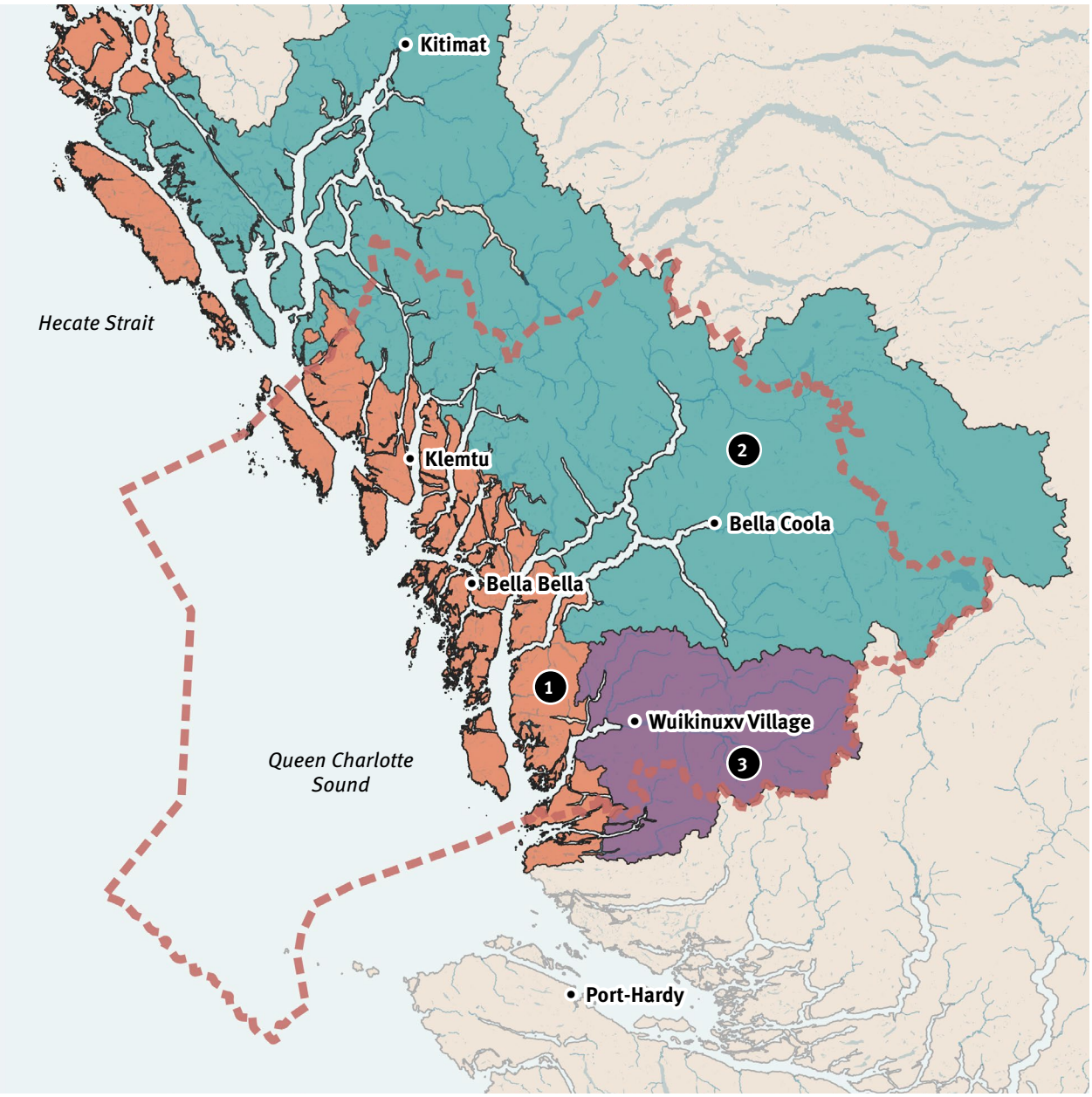


FIGURE A.7. Geographic boundaries of sockeye (river-type) salmon Conservation Units overlapping with the Central Coast project area.

APPENDIX 2

Summary of Salmon Monitoring in the Central Coast Project Area

TABLE A.1. A summary of escapement monitoring, juvenile salmon monitoring, and genetic baseline collections among Chinook, chum, coho, pink, and sockeye salmon Conservation Units (CUs) within the Central Coast project area. Note that some of these CUs span the entire North and Central Coast of BC and so portions of the CU fall outside the project area. The information provided here is constrained to the portion of the CU that overlaps with the project area, with the exception of current abundance estimates which are for the entire CU. Information in this table was gathered during our comprehensive review of historical and ongoing salmon monitoring efforts on the Central Coast, as well as from interviews with Central Coast First Nations, DFO, and Charter Patrolmen.

- Note that some CUs are marked with a bullet "•" in the left column. Portions of these CUs fall outside the project area. We report only the number of populations and status of monitoring within the project area.
- **Current Abundance** is an estimate of the current spawner abundance for the CU — calculated as the geometric mean over the most recent generation — based on data in the Pacific Salmon Explorer (current to 2017). Note that data from streams outside of the project area, but within the CU boundary are included in this estimate.
- **Number of Survey Streams** is a tally of the number of indicator and non-indicator streams with at least one year of spawner survey data for the CU as identified in the Pacific Salmon Explorer, as well as a small number of additional streams that have been monitored by DFO or First Nations in the region.
- **Years of Escapement Data** is the maximum number of years that any stream within the CU has been surveyed since 1950.
- **Most Recent Survey Year** is the most recent year that any stream within the CU was surveyed, based on data in the Pacific Salmon Explorer (current to 2017) as well as discussions with Central Coast First Nations, DFO, and Charter Patolmen.
- **% Streams Surveyed in 2019** is the percentage of streams within the CU that were surveyed in 2019 with the exception of (pink (even-year) CUs) based on discussions with Central Coast First Nations, DFO, and Charter Patolmen.
- **% Streams with GSI Baseline** was the information sourced from the DFO Molecular Genetics Lab (Ben Sutherland).

Conservation Unit	Current Abundance	Number of Survey Streams	Escapement Monitoring			Juvenile Monitoring		Genetic Data
			Years of Escapement Data	Most Recent Survey Year	% Streams Surveyed in 2019	Most Recent Survey Year	% Streams Surveyed in 2019	% Streams with GSI Baseline
Chinook								
Bella Coola – Bentinck	**22,821** (2013–2017)	7	65	2019	43%	n/a	0%	50%
Dean River •	**2,217** (2013–2017)	5	53	2017	0%	n/a	0%	60%
NCC – Early Timing •	**891** (2013–2017)	16	45	2008	0%	n/a	0%	0%
NCC – Late Timing •	data deficient	9	9	1994	0%	n/a	0%	0%
Rivers Inlet •	data deficient	13	53	2014	0%	n/a	0%	31%
Wannock	**6,468** (2013–2017)	1	66	2019	100%	n/a	0%	100%

Conservation Unit	Current Abundance	Number of Survey Streams	Escapement Monitoring			Juvenile Monitoring		Genetic Data
			Years of Escapement Data	Most Recent Survey Year	% Streams Surveyed in 2019	Most Recent Survey Year	% Streams Surveyed in 2019	% Streams with GSI Baseline
Chum								
Bella Coola – Dean Rivers •	**193,293** (2014–2017)	22	67	2019	26%	n/a	0%	18%
Bella Coola River – Late	**22,032** (2014–2017)	7	17	2019	86%	n/a	0%	25%
Douglas – Gardner •	**152,789** (2014–2017)	8	67	2019	50%	n/a	0%	0%
Hecate Lowlands •	**58,484** (2014–2017)	73	67	2019	15%	2000	1%	10%
Mussel – Kynoch	**51,692** (2014–2017)	14	70	2019	36%	n/a	0%	6%
Rivers Inlet	**3,334** (2014–2017)	15	63	2019	20%	n/a	0%	8%
Smith Inlet •	**10,458** (2014–2017)	5	62	2017	0%	n/a	0%	0%
Spiller – Fitz Hugh – Burke	**197,474** (2014–2017)	69	69	2019	38%	n/a	0%	23%
Wannock	data deficient	1	44	1997	0%	n/a	0%	0%
Coho								
Bella Coola – Dean Rivers •	**21,964** (2014–2017)	30	60	2019	40%	n/a	0%	20%
Hecate Strait Mainland •	**73,085** (2014–2017)	103	51	2016	1%	2020	3%	6%
Mussel – Kynoch	**5,121** (2014–2017)	14	48	2016	0%	n/a	0%	7%
Northern Coastal Streams •	**137,078** (2014–2017)	25	62	2019	20%	n/a	0%	24%
Rivers Inlet	data deficient	24	47	2017	0%	n/a	0%	8%
Smith Inlet •	**11,608** (2014–2017)	1	1	1955	0%	n/a	0%	0%
Pink (even-year)								
Hecate Lowlands •	**263,258** (2016–2017)	108	38	2018*	11%	2000	1%	5%
Hecate Strait – Fjords •	**5,784,381** (2016–2017)	91	34	2018*	19%	n/a	0%	15%

* For this review, the most recent survey year for pink (even-year) salmon is 2018.

Conservation Unit	Current Abundance	Number of Survey Streams	Escapement Monitoring			Juvenile Monitoring		Genetic Data
			Years of Escapement Data	Most Recent Survey Year	% Streams Surveyed in 2019	Most Recent Survey Year	% Streams Surveyed in 2019	% Streams with GSI Baseline
Pink (odd-year)								
Hecate Strait – Fjords •	**159,0166** (2016–2017)	51	35	2019	33%	n/a	0%	20%
Hecate Strait – Lowlands •	**214,950** (2016–2017)	108	35	2019	18%	1999	1%	8%
Homathko – Kliniklini – Smith – Rivers – Bella Coola – Dean •	**8,022,923** (2016–2017)	40	32	2019	8%	n/a	0%	18%
Sockeye (river-type)								
Northern Coastal Streams •	data deficient	31	26	2017	0%	n/a	0%	0%
Northern Coastal Fjords •	data deficient	35	30	2017	0%	n/a	0%	3%
Rivers – Smith Inlets •	data deficient	5	3	1985	0%	n/a	?	?
Sockeye (lake-type)								
Bloomfield	**471** (2013–2017)	1	61	2014	0%	n/a	0%	100%
Borrowman Creek	data deficient	1	35	1997	0%	n/a	0%	0%
Busey Creek	data deficient	1	9	1964	0%	n/a	0%	0%
Canoona	**2,937** (2013–2017)	1	47	2019	100%	n/a	0%	100%
Chic Chic	data deficient	1	0	n/a	0%	n/a	0%	0%
Dallain Creek	data deficient	1	20	1970	0%	n/a	0%	0%
Dome	data deficient	1	4	1998	0%	n/a	0%	0%
Elizabeth	data deficient	1	5	1956	0%	n/a	0%	0%
Elsie/Hoy	data deficient	1	12	1998	0%	n/a	0%	0%
Evinrude Inlet	data deficient	1	14	1987	0%	n/a	0%	0%
Fannie Cove	data deficient	1	47	2017	0%	n/a	0%	0%
Higgins Lagoon	data deficient	1	8	1985	0%	n/a	0%	0%
Kadjusdis River	**1,612** (2013–2017)	1	67	2019	100%	n/a	0%	100%
Kainet Creek	**2,423** (2013–2017)	1	65	2019	100%	n/a	0%	0%
Kdelmashan Creek	data deficient	1	24	1988	0%	n/a	0%	0%
Kent Inlet Lagoon Creek	data deficient	1	10	2012	0%	n/a	0%	100%
Kildit Creek	data deficient	1	6	1983	0%	n/a	0%	0%
Kildit Lagoon Creek	data deficient	1	1	1975	0%	n/a	0%	0%

Conservation Unit	Current Abundance	Number of Survey Streams	Escapement Monitoring			Juvenile Monitoring		Genetic Data
			Years of Escapement Data	Most Recent Survey Year	% Streams Surveyed in 2019	Most Recent Survey Year	% Streams Surveyed in 2019	% Streams with GSI Baseline
Kimsquit	data deficient	1	40	2000	0%	2007	100%	100%†
Kisameet	**700** (2013–2017)	1	34	2016	0%	n/a	0%	0%
Koeye	**8,290** (2013–2017)	1	58	2019	100%	2019	100%	100%
Kunsoot River	data deficient	1	4	1994	0%	n/a	0%	0%
Kwakwa Creek	data deficient	1	55	2012	0%	n/a	0%	100%
Limestone Creek	data deficient	1	17	1987	0%	n/a	0%	0%
Mary Cove Creek	**280**	1	58	2019	100%	2020	100%	100%
Mcdonald Creek	data deficient	1	17	1982	0%	n/a	0%	0%
McLoughlin	data deficient	1	39	1993	0%	n/a	0%	0%
Namu	**5,340** (2013–2017)	1	56	2019	100%	2006	100%	100%
Owikeno	**251,925** (2013–2017)	11	69	2019	36%	2019	100%	82%
Pine River	data deficient	1	18	1974	0%	n/a	0%	0%
Port John	**740** (2013–2017)	1	42	2018	0%	1961	100%	0%
Powles Creek	data deficient	1	22	1993	0%	n/a	0%	0%
Price Creek	data deficient	1	47	2008	0%	n/a	0%	0%
Roderick	**502** (2013–2017)	1	47	2019	100%	2014	100%	100%
Ship Point Creek	data deficient	1	29	1987	0%	n/a	0%	0%
Soda Creek	data deficient	1	0	n/a	0%	n/a	0%	0%
South Atnarko Lakes	**5,470** (2013–2017)	5	47	2019	40%	2007	40%	60%†
Stannard Creek	data deficient	1	20	1997	0%	n/a	0%	0%
Talamoosa Creek	data deficient	1	31	1998	0%	n/a	0%	0%
Tankeeah River	**9,747** (2013–2017)	1	56	2019	100%	2006	100%	100%
Treneman Creek	data deficient	1	3	1988	0%	n/a	0%	0%
Tuno Creek East	data deficient	1	37	1992	0%	n/a	0%	0%
Tuno Creek West	data deficient	1	30	1989	0%	n/a	0%	0%
Tyler Creek	data deficient	1	3	1997	0%	n/a	0%	0%
Wale Creek	data deficient	1	23	1987	0%	n/a	0%	0%
Wannock (Owikeno)	data deficient	1	48	1999	0%	n/a	0%	0%
Watt Bay	data deficient	1	1	1953	0%	n/a	0%	0%

Conservation Unit	Current Abundance	Number of Survey Streams	Escapement Monitoring			Juvenile Monitoring		Genetic Data
			Years of Escapement Data	Most Recent Survey Year	% Streams Surveyed in 2019	Most Recent Survey Year	% Streams Surveyed in 2019	% Streams with GSI Baseline
West Creek	data deficient	1	18	1986	0%	n/a	0%	0%
Yaaklele Lagoon	data deficient	1	24	1977	0%	n/a	0%	0%
Yeo	**1,032** (2013–2017)	1	54	2019	100%	n/a	0%	0%

TABLE A.2. A summary of the location and methods for catch monitoring across commercial, FSC, and recreational fisheries within the Central Coast project area. Monitoring across commercial and recreational fisheries is mandatory, and voluntary across FSC fisheries. Information in this table was gathered during our comprehensive review of historical and ongoing salmon monitoring efforts on the Central Coast, as well as from interviews with Central Coast First Nations, DFO, and Charter Patrolmen.

- **Conservation Units** that are listed here are those that overlap with the locations of catch monitoring data collection. In most instances there are 'multiple' CUs that overlap and so not all are listed.
- **Data Collection Method** is the primary method used to collect catch monitoring data. In many instances the onus for data collection is on the fisher (e.g. vessel logbook) or the fishing lodge that houses recreational fishers (e.g. lodge logbook) rather than an independent observer.
- **Data Collection Ongoing** indicates whether data collection is occurring as of 2019. Additional information regarding the start date or pilot year is provided, where available.

Salmon Species	Monitoring Location	Conservation Unit(s)	Data Collection Method	Data Collection Ongoing
Commercial Fisheries				
Chinook	Fitzhugh Sound	multiple	vessel logbook	yes
	Bella Coola Gillnet Area	Bella Coola Bentick	vessel logbook	yes
	Dean Channel	Dean and Kimsquit	vessel logbook	yes
Chum	Fitzhugh Sound	multiple	vessel logbook	yes
	Bella Coola Gillnet Area	multiple	vessel logbook	yes
	Dean Channel	Bella Coola Dean	vessel logbook	yes
Coho	Fitzhugh Sound	multiple	vessel logbook	yes
	Bella Coola Gillnet Area	Bella Coola Dean	vessel logbook	yes
	Dean Channel	Bella Coola Dean	vessel logbook	yes
Pink	Fitzhugh Sound	multiple	vessel logbook	yes
	Bella Coola Gillnet Area	multiple	vessel logbook	yes
	Dean Channel	Hecate Strait-Fjord	vessel logbook	yes
Sockeye	Fitzhugh Sound	multiple	vessel logbook	yes
	Bella Coola Gillnet Area	multiple	vessel logbook	yes
	Dean Channel	Kimsquit	vessel logbook	yes
Food, Social, Ceremonial Fisheries				
Chinook	Bella Coola	Bella Coola Bentick	variable methods	yes
	Klemtu	multiple	variable methods	yes
	Bella Bella	multiple	variable methods	yes; pilot in 2019
	Bella Bella	multiple	creel survey	yes
Chum	Bella Coola	Bella Coola-Dean Rivers	variable methods	yes
	Klemtu	multiple	variable methods	yes
	Bella Bella	multiple	variable methods	yes; pilot in 2019
	Bella Bella	multiple	creel survey	yes
Coho	Bella Coola	Bella Coola Dean	variable methods	yes
	Klemtu	multiple	variable methods	yes
	Bella Bella	multiple	variable methods	yes; pilot in 2019
	Bella Bella	multiple	creel survey	yes; pilot in 2019
Pink	Bella Bella	multiple	creel survey	yes

Salmon Species	Monitoring Location	Conservation Unit(s)	Data Collection Method	Data Collection Ongoing
Sockeye	Bella Coola	Atnarko	variable methods	yes
	Klemtu	multiple	variable methods	yes
	Bella Bella	multiple	variable methods	yes; pilot in 2019
	Bella Bella	multiple	creel survey	yes; since 2011
	Wannock River	Owikeno	test fishery for CPUE	yes; pilot in 2019
Recreational Fisheries				
Chinook	Bella Bella	multiple	creel survey	yes; started in 1974
	Dean River	Dean	creel survey	yes
	Legacy Lodge	multiple	lodge logbook	yes
	North King Lodge	multiple	lodge logbook	yes
	King Pacific Lodge	multiple	lodge logbook	yes
	Shearwater Lodge	multiple	lodge logbook	yes
	Central Coast Adventures	multiple	lodge logbook	yes
	Joe's Salmon Lodge	multiple	lodge logbook	yes
	Ole's Fishing Lodge	multiple	lodge logbook	yes
	Hakai Land and Sea	multiple	lodge logbook	yes
	Hakai Lodge	multiple	lodge logbook	yes
	Rivers Lodge	multiple	lodge logbook	yes
	Rivers Inlet Sportsman Club	multiple	lodge logbook	yes
	Black Gold Lodge	multiple	lodge logbook	yes
	Duncanby Landing	multiple	lodge logbook	yes
	Bella Coola River	Bella Coola Bentick	creel survey	no; pilot in 2019
Chum	Bella Bella	multiple	creel survey	yes; pilot in 2019
Coho	Bella Bella	multiple	creel survey	yes
	Legacy Lodge	multiple	lodge logbook	yes
	North King Lodge	multiple	lodge logbook	yes
	King Pacific Lodge	multiple	lodge logbook	yes
	Shearwater Lodge	multiple	lodge logbook	yes
	Central Coast Adventures	multiple	lodge logbook	yes
	Joe's Salmon Lodge	multiple	lodge logbook	yes
	Ole's Fishing Lodge	multiple	lodge logbook	yes
	Hakai Land and Sea	multiple	lodge logbook	yes
	Hakai Lodge	multiple	lodge logbook	yes
	Rivers Lodge	multiple	lodge logbook	yes
	Rivers Inlet Sportsman Club	multiple	lodge logbook	yes
	Black Gold Lodge	multiple	lodge logbook	yes
	Duncanby Landing	multiple	lodge logbook	yes
	Bella Coola River	Bella Coola Dean	creel survey	no; pilot in 2019
Pink	Bella Bella	multiple	creel survey	yes; started in 1974
Sockeye	Bella Bella	multiple	creel survey	yes

APPENDIX 3

Semi-Structured Interview Questions

From November 2019 to January 2020, PSF staff conducted a series of semi-structured interviews with regional salmon experts to elicit local perspectives on critical data gaps that hinder annual salmon population assessment, identify outstanding needs for salmon monitoring and stewardship, and the current context for salmon management and decision-making in the region. For each interview, we used the following standard set of semi-structured questions as a starting point for discussion (see Section 3.1.2 for further details on these interviews and their outcomes).

Questions

1 What are the greatest threats to wild salmon in your area?

2 Do you think that greater investments in monitoring and stewardship could help understand and address these more effectively? If yes, how do you envision these investments address the threats you've identified above?

3 What type of investments in salmon monitoring (e.g. what actions) could help support your community/organization's goals around salmon stewardship and management?

4 Do you know of any salmon monitoring activities that either used to occur or are still ongoing in your community/organization? Were/are these activities important to you, to the community?

   a) What worked or didn't work about these past and current efforts?

   b) Why or why not?

   c) Key learnings for future efforts?

5 What do you see as the primary reasons that salmon monitoring is important? Encourage them to think big picture, whether it's governance, broad management, or community outcomes they hope to promote.

6 What should we take into consideration when measuring the benefits or drawbacks of a particular stewardship or monitoring activity? e.g. benefits to the community, to salmon abundance, to management, to governance goals of the Nation.

7 Do you trust that management decisions related to salmon are made with the best available information?

8 What do you see as the most significant gaps in understanding of salmon on the Central Coast?

9 Do these gaps or others create uncertainties in harvesting salmon sustainably? Please elaborate on how.

10 What actions do you think could help reduce those uncertainties? Do you think that more information could support more effective management by your Nation/agency? Examples?

11 What do you think could be done to strengthen trust and engagement with salmon management?

12 Do you think your community/organization has the tools and information it needs to adapt to the effects of climate change on wild salmon? If not, what new tools and information would be helpful?

13 What changes in the current system of management or monitoring could support more equitable co-management of salmon?

14 Would you say that coordination and data-sharing is currently a barrier to co-management?

15 If so do you have any specific recommendations for how to better coordinate data collection?

16 Is data management a challenge for your community/organization? If yes, would the development of a centralized and secure data management system be something you would value?

17 Do you know of any conservation or recovery actions currently underway that could be fine-tuned or improved by increased monitoring?

18 Can you think of any opportunities to incorporate the collection of environmental data in other salmon-focused monitoring efforts? E.g. on habitat, climate, ocean conditions, etc.

APPENDIX 4

Final Evaluation Scores for All Proposed Monitoring

From May to July 2020, the Central Coast Nations and DFO staff qualitatively evaluated the benefit of all proposed monitoring *actions*, using the evaluation criteria developed in **step 4** of our SDM approach section (see Section 3.5). To facilitate the evaluation of all *actions*, we developed a series of spreadsheets with all *actions* identified throughout the project. Each *action* was then linked to corresponding evaluation criteria. The *actions* were evaluated using qualitative scores of "low," "medium," and "high" which we equated with three, two, and one point(s), respectively. Final scores for each *action* were calculated as the sum of the average score applied to each of the 10 criteria, and scores were rounded to the nearest integer value. Because not all *actions* could be put forth for implementation due to capacity and resource constraints, only *actions* that received scores of 24 points or more were included in the final *Monitoring Framework*. *Actions* that received less than 24 points are greyed out in each table. Note that a handful or *actions* were included in the final *Monitoring Framework* (despite receiving less than 24 points) because they are considered a 'prerequisite' for other *actions*.

TABLE A.3. Evaluation scores for all proposed actions under Goal 1, Objective 1.1. These final scores have been averaged across all respondents.

Objective 1.1 *Build technical capacity for collaborative salmon management.*

Objective 1.1 Actions	Overarching Criteria							Goal Specific Criteria			Final Scores			
	Community support	*Strengthens connections to salmon*	*DFO support and engagement*	*Community participation*	*Builds or maintains capacity*	*Costs*	*Realistic and achievable*	*Reduces biological risks to salmon*	*Leverages existing or new data to improve understanding*	*Supports adaptive management*	*High*	*Med*	*Low*	*Total*
Strategy 1.1.1. Address gaps in infrastructure, training, capacity and funding.														
ACTION A.I Hire and train full-time fisheries staff in Wuikinuxv village to support ongoing salmon work.	high	high	high	med	high	med	high	high	high	high	8	2	0	**28**
ACTION A.II Support purchase of ocean-going boat for Wuikinuxv fisheries program.	high	high	med	med	high	med	med	med	med	high	4	6	0	**24**
ACTION A.III Support purchase of a truck for Nuxalk fisheries program to conduct catch monitoring.	high	high	low	high	high	med	high	med	high	high	7	2	1	**26**
ACTION A.IV Hire two seasonal staff to run Nuxalk recreational-fishery monitoring.	high	med	high	high	high	med	high	med	high	high	7	3	0	**27**
ACTION A.V Work with HIRMD to identify and support infrastructure and capacity needs.	high	high	med	high	high	med	high	low	high	high	7	2	1	**26**
ACTION A.VI Support for full-time staff at KXSA to support salmon monitoring.	high	high	high	high	high	med	high	low	high	high	8	1	1	**27**
Strategy 1.1.2. Create technical working group to provide scientific and logistical support for monitoring and collaborative salmon management.														
ACTION A Work with Central Coast Nations and CCIA to develop structure and working principles for salmon technical working group	high	med	high	high	high	high	high	med	high	high	8	2	0	**28**
ACTION B Recruit members to the technical working group.	high	med	high	med	med	high	med	low	high	high	5	4	1	**24**

Objective 1.1 Actions	Overarching Criteria							Goal Specific Criteria			Final Scores			
	Community support	*Strengthens connections to salmon*	*DFO support and engagement*	*Community participation*	*Builds or maintains capacity*	*Costs*	*Realistic and achievable*	*Reduces biological risks to salmon*	*Leverages existing or new data to improve understanding*	*Supports adaptive management*	*High*	*Med*	*Low*	*Total*
ACTION C Provide scientific support for Fisheries Reconciliation and IFMP development through collaborative management process.	high	med	high	med	med	high	high	med	high	med	5	5	0	**25**
Strategy 1.1.3. Improve coordination and knowledge sharing across Central Coast Nations, CCIRA, DFO and partners.														
ACTION A Establish regular knowledge exchanges between Central Coast program staff, with visits to key project locations.	med	med	high	med	high	high	high	low	med	med	4	5	1	**23**
ACTION B Provide training opportunities within each community that focus on learning survey methods from experienced Charter Patrolmen.	med	med	med	med	high	high	high	low	med	high	4	5	1	**23**
ACTION C Create centralized platform for announcing and promoting training opportunities related to salmon monitoring and marine safety certifications.	med	med	med	med	high	high	high	low	med	high	4	5	1	**23**
ACTION D Establish pre-season annual retreat among salmon monitoring staff to facilitate skills sharing, coordination, and standardization of efforts.	med	med	med	med	high	med	med	low	high	high	3	6	1	**22**
ACTION E Establish post-season technical meeting similar to the North Coast post-season review to present findings, successes, and lessons from salmon monitoring programs that year.	high	med	high	med	high	med	high	low	high	high	6	3	1	**25**
ACTION F Use Pacific Salmon Explorer tool to create standardize reporting back to communities on escapement, survival, catch, and other key data on salmon populations.	high	high	low	med	med	high	high	med	high	med	5	4	1	**24**
ACTION G Create a digital archive/ library of salmon related information for each community to ensure that new folks have access to information and past work.	high	high	low	low	med	high	high	low	med	med	4	3	3	**21**

Objective 1.1 Actions	Overarching Criteria							Goal Specific Criteria			Final Scores			
	Community support	*Strengthens connections to salmon*	*DFO support and engagement*	*Community participation*	*Builds or maintains capacity*	*Costs*	*Realistic and achievable*	*Reduces biological risks to salmon*	*Leverages existing or new data to improve understanding*	*Supports adaptive management*	*High*	*Med*	*Low*	*Total*
ACTION H Provide capacity to make annual reports back to Central Coast Nations summarizing key findings, interpreting trends, and supporting the Central Coast First Nations technical team.	high	med	med	low	high	high	high	low	high	high	6	2	2	**24**
ACTION I Work with First Nations and DFO to support greater participation and coordination through Central Coast in-season management table.	high	med	med	high	med	high	high	med	high	high	6	4	0	**26**

TABLE A.4. Evaluation scores for all proposed actions under Goal 1, Objective 1.2.

Objective 1.2 *Increase opportunities for community outreach, engagement, and participation in stewardship and collaborative salmon management.*

Objective 1.2 Actions	Overarching Criteria							Goal Specific Criteria			Final Scores			
	Community support	*Strengthens connections to salmon*	*DFO support and engagement*	*Community participation*	*Builds or maintains capacity*	*Costs*	*Realistic and achievable*	*Reduces biological risks to salmon*	*Leverages existing or new data to improve understanding*	*Supports adaptive management*	*High*	*Med*	*Low*	*Total*
Strategy 1.2.1. Support communities to develop a community engagement strategy to support outreach to community members and provide updates on the status of salmon on the Central Coast.														
ACTION A Develop a youth-focused outreach, education, and activation strategy that taps social media, school programs, and summer student employment programs.	high	high	med	high	med	med	med	low	med	med	3	6	1	**22**
ACTION B Run annual pre- and post-season community meetings with each Nation to involve community in decision-making and ensure information on salmon status and management reaches community members.	high	high	med	high	med	high	high	med	high	high	7	3	0	**27**
ACTION C Create short, accessible and informative annual reports for community members highlighting salmon stewardship work, opportunities for community participation, and key findings for each year.	high	high	med	med	med	high	high	low	high	med	5	4	1	**24**
ACTION D Make presentations or participate at community events and programs (e.g. oceans day, salmon celebrations, festivals, camps, etc) to build greater awareness and participation among community members, particularly youth.	med	med	med	med	med	med	med	low	med	med	0	9	1	**19**

Objective 1.2 Actions	Overarching Criteria							Goal Specific Criteria			Final Scores			
	Community support	*Strengthens connections to salmon*	*DFO support and engagement*	*Community participation*	*Builds or maintains capacity*	*Costs*	*Realistic and achievable*	*Reduces biological risks to salmon*	*Leverages existing or new data to improve understanding*	*Supports adaptive management*	*High*	*Med*	*Low*	*Total*
Strategy 1.2.2. Align monitoring with cultural, educational and stewardship programs to build synergies and increase community participation.														
ACTION A Work with Supporting Emerging Aboriginal Stewards (SEAS) programs in each community to create internships and host field activities where youth can participate in salmon stewardship.	high	high	high	high	high	high	high	low	med	high	8	1	1	**27**
ACTION B Create First Nations Fisheries internship program with students from SEAS programs in each community, or with independent funding and programming.	high	high	high	high	high	med	med	low	med	high	6	3	1	**25**
ACTION C Provide annual access to training (e.g. bear safety, First Aid, SVOP) for summer interns from Central Coast Nations.	high	high	high	high	high	med	med	low	med	med	5	4	1	**24**
ACTION D Work with schools and summer programs in each community to host field trips related to salmon stewardship.	high	high	med	high	med	high	high	low	med	med	5	4	1	**24**
ACTION E Support involvement of Nuxalk cultural rediscovery camp in monitoring and sampling FSC catch at Dean and Kimsquit Rivers	high	high	med	high	med	med	high	med	med	high	5	5	0	**25**
ACTION F Work with community organizations in Bella Bella to develop salmon-focused programming and monitoring in Kunsoot and Kadjusdis Rivers that meet cultural, educational and scientific objectives.	high	high	med	high	high	med	med	med	med	high	5	5	0	**25**
ACTION G Work with KXSA, SEAS and Kitasoo community school to offer opportunities for youth of all ages to engage with salmon stewardship through participation in monitoring, cultural and educational programs, and harvesting.	high	high	med	high	med	high	high	low	med	high	6	3	1	**25**

Objective 1.2 Actions	Overarching Criteria							Goal Specific Criteria			Final Scores			
	Community support	*Strengthens connections to salmon*	*DFO support and engagement*	*Community participation*	*Builds or maintains capacity*	*Costs*	*Realistic and achievable*	*Reduces biological risks to salmon*	*Leverages existing or new data to improve understanding*	*Supports adaptive management*	*High*	*Med*	*Low*	*Total*
ACTION H Work with Koeye camp to offer opportunities for youth of all ages to engage with salmon stewardship through participation in monitoring, cultural and educational programs, and harvesting.	high	high	med	high	med	high	high	low	low	high	6	2	2	**24**
ACTION I Work with SEAs program, Wuikinuxv Health Department and village school to offer opportunities for youth of all ages to engage with salmon stewardship through participation in monitoring, cultural and educational programs, and harvesting.	high	high	med	high	med	high	high	low	med	high	6	3	1	**25**

TABLE A.5. Evaluation scores for all proposed actions under Goal 1, Objective 1.3.

Objective 1.3 *Ensure that local and traditional knowledge guide salmon monitoring, planning, and fisheries management.*

Objective 1.3 Actions	Overarching Criteria							Goal Specific Criteria			Final Scores			
	Community support	*Strengthens connections to salmon*	*DFO support and engagement*	*Community participation*	*Builds or maintains capacity*	*Costs*	*Realistic and achievable*	*Reduces biological risks to salmon*	*Leverages existing or new data to improve understanding*	*Supports adaptive management*	*High*	*Med*	*Low*	*Total*
Strategy 1.3.1. Develop and implement an outreach strategy to increase involvement of local and traditional knowledge holders in management.														
ACTION A Create protocols with methods for connecting TEK and LEK to decision-making and management.	high	high	high	high	med	med	med	low	high	high	6	3	1	**25**
ACTION B Work with each Nation to document traditional knowledge, practice and laws related to salmon in their territory (e.g. Eulachon book written by Nuxalk and Rachelle Beveridge).	high	high	high	high	med	med	med	low	high	high	6	3	1	**25**
ACTION C Facilitate workshops with advisory councils of local knowledge holders on an annual basis, to provide opportunities for reporting and feedback on salmon stewardship initiatives.	high	high	high	high	med	high	med	low	high	high	7	2	1	**26**
ACTION D Work with community stewardship offices to use social media tools for connecting with network of local and traditional knowledge holders and share information.	med	med	med	high	med	high	high	low	high	med	4	5	1	**23**
Strategy 1.3.2. Evaluate community needs and objectives related to salmon with input from local First Nations fishers and stewardship offices.														
ACTION A Hold workshops with stewardship staff, fishers, and traditional knowledge holders to identify management objectives and develop principles to guide collaborative management.	high	high	med	high	med	med	med	med	high	high	5	5	0	**25**
ACTION B Synthesize findings from existing studies of community food fish needs, and work with Nations where needed to update FSC catch goals.	high	high	high	high	low	high	high	low	high	med	7	1	2	**25**

Objective 1.3 Actions	Overarching Criteria							Goal Specific Criteria			Final Scores			
	Community support	*Strengthens connections to salmon*	*DFO support and engagement*	*Community participation*	*Builds or maintains capacity*	*Costs*	*Realistic and achievable*	*Reduces biological risks to salmon*	*Leverages existing or new data to improve understanding*	*Supports adaptive management*	*High*	*Med*	*Low*	*Total*
ACTION C Initiate community-based research to evaluate current barriers to harvesting salmon among Central Coast Nations.	high	med	high	high	med	med	med	low	high	med	4	5	1	**23**
ACTION D Develop management objectives that reflect community needs and values, as well as biological outcomes desired by Central Coast Nations.	high	med	med	high	med	med	high	med	high	high	5	5	0	**25**
Strategy 1.3.3. Identify and prioritize populations that are important to the Central Coast First Nations and ensure that these populations are part of ongoing monitoring.														
ACTION A Work with Central Coast First Nations stewardship programs to develop processes for community consultation and strategic prioritization of populations for monitoring. (Prerequisite for ACTION B.)	high	high	med	high	med	high	high	low	high	high	7	2	1	**26**
ACTION B Use established processes to identify locally important salmon populations for escapement monitoring, juvenile enumeration and life-cycle monitoring, and DNA baseline collections. (Dependent on ACTION A.)	high	med	high	med	med	high	high	low	high	high	6	3	1	**25**
Strategy 1.3.4. Incorporate local knowledge into catch monitoring and in-season management.														
ACTION B Build on existing interview procedures to reach people not interviewed dockside and gather current information on catch, effort, and build historical understanding of salmon fisheries	med	med	med	high	med	med	high	med	med	high	3	7	0	**23**
ACTION C Analyze data from catch monitoring initiatives to understand correlation between FSC catch, fisher perceptions of run strength, total catch and annual spawner abundance.	med	med	med	med	med	med	high	med	high	med	2	8	0	**22**
ACTION D Use the above information to develop qualitative indicators of run size for in-season management.	med	med	med	med	med	med	med	med	high	med	1	9	0	**21**

TABLE A.6. Evaluation scores for all proposed actions under Goal 1, Objective 1.4.

Objective 1.4 *Develop escapement goals for priority salmon populations to guide precautionary management of fisheries.*

Objective 1.4 Actions	Overarching Criteria							Goal Specific Criteria			Final Scores			
	Community support	*Strengthens connections to salmon*	*DFO support and engagement*	*Community participation*	*Builds or maintains capacity*	*Costs*	*Realistic and achievable*	*Reduces biological risks to salmon*	*Leverages existing or new data to improve understanding*	*Supports adaptive management*	*High*	*Med*	*Low*	*Total*
Strategy 1.4.1. Create regional framework for developing spawner escapement goals that incorporates traditional ecological knowledge, community values, and ecosystem needs.														
ACTION A Review where existing escapement goals have been developed for Central Coast stocks. (Prerequisite for ACTION B.)	med	low	high	low	low	high	high	med	med	low	3	3	4	**19***
ACTION B Initiate community-led planning process with all four Nations and DFO to prioritize populations and develop escapement goals. (Dependent on ACTION A.)	med	med	high	high	med	med	high	high	high	med	5	5	0	**25**
ACTION C Identify and apply tools to articulate catch management objectives, long-term goals, and risk tolerance.	med	med	med	med	low	high	high	med	high	med	3	6	1	**22**
ACTION D Review existing data on predator and ecosystem needs, and build off this understanding to incorporate ecosystem values into escapement goal framework.	med	med	low	low	low	med	med	med	med	low	0	6	4	**16**
Strategy 1.4.2. Build analytical tools to help identify escapement goals for data-limited populations.														
ACTION A Apply habitat-based approaches for estimating carrying capacity in data-limited coho, sockeye and Chinook populations.	high	med	high	low	low	med	high	med	med	low	3	4	3	**20**

* This action has been included in the final *Monitoring Framework*, despite receiving less than 24 points, because it is considered a 'prerequisite' for other actions.

Objective 1.4 Actions	Overarching Criteria							Goal Specific Criteria			Final Scores			
	Community support	*Strengthens connections to salmon*	*DFO support and engagement*	*Community participation*	*Builds or maintains capacity*	*Costs*	*Realistic and achievable*	*Reduces biological risks to salmon*	*Leverages existing or new data to improve understanding*	*Supports adaptive management*	*High*	*Med*	*Low*	*Total*
ACTION B Develop Integrated Population Models for data-limited populations to link diverse datasets and understand CU- and population-level variation in productivity and abundance over time.	med	med	high	low	low	med	med	med	med	low	1	6	3	**18**
ACTION C Develop simulations to evaluate trade offs between management objectives identified by communities and DFO, ecosystem values, and conservation risks.	med	med	med	low	low	low	med	med	med	low	0	6	4	**16**
Strategy 1.4.3. Work with First Nations and DFO to develop decision rules for in-season fishery management.														
ACTION A Work with First Nations and DFO to articulate fishery management objectives and procedures	high	med	med	high	med	high	high	med	high	high	6	4	0	**26**
ACTION B Develop in-season indicators of status across priority populations based on catch or escapement	high	med	med	low	med	high	high	med	high	med	4	5	1	**23**
ACTION C Define management guidelines based on in-season data and assessments of status.	high	med	med	high	med	high	med	high	high	med	5	5	0	**25**

TABLE A.7. Evaluation scores for all proposed actions under Goal 2, Objective 2.1.

Objective 2.1 *Quantify escapement, spawn timing, and age-at-return for priority salmon populations.*

Objective 2.1 Actions	Overarching Criteria							Goal Specific Criteria			Final Scores			
	Community support	*Strengthens connections to salmon*	*DFO support and engagement*	*Community participation*	*Builds or maintains capacity*	*Costs*	*Realistic and achievable*	*Reduces biological risks to salmon*	*Leverages existing or new data to improve understanding*	*Supports adaptive management*	*High*	*Med*	*Low*	*Total*
Strategy 2.1.1. Develop statistical sampling design for escapement monitoring based on Central Coast indicator streams and other populations identified as socially, culturally, and economically important to Central Coast First Nations.														
ACTION A Develop standardized monitoring methods for escapement monitoring to ensure comparability between years and populations.	high	med	high	med	med	high	high	low	high	med	5	4	1	**24**
ACTION B Work with DFO and charter patrol to understand location and extent of historic counting efforts to ensure consistency with First Nations counts	med	med	high	med	med	high	high	low	high	high	5	4	1	**24**
ACTION C Work with DFO Stock Assessment Division and Nations to update and share 'methods guide' with communities.	med	med	high	med	med	high	high	low	high	med	4	5	1	**23**
ACTION D Catalogue streams with ongoing escapement monitoring, methods used, and how data are expanded to estimate total abundance.	med	med	high	low	low	med	med	med	high	med	2	6	2	**20**
ACTION E Develop statistically robust escapement monitoring design for salmon CUs to determine optimal monitoring frequency and intensity of all indicator populations.	med	med	high	med	high	med	high	med	high	med	4	6	0	**24**
ACTION F Use simulation analyses to examine how different combinations of streams and monitoring intensities (e.g. number of creek walks, number of locations with weirs or sonar) influence escapement estimates and uncertainty for CUs.	med	med	med	low	med	med	high	med	high	med	2	7	1	**21**

Objective 2.1 Actions	Overarching Criteria							Goal Specific Criteria			Final Scores			
	Community support	*Strengthens connections to salmon*	*DFO support and engagement*	*Community participation*	*Builds or maintains capacity*	*Costs*	*Realistic and achievable*	*Reduces biological risks to salmon*	*Leverages existing or new data to improve understanding*	*Supports adaptive management*	*High*	*Med*	*Low*	*Total*
Strategy 2.1.2. Maintain and strengthen escapement monitoring programs using standardized mark-recapture, overflight, and stream walk methods for populations identified in Strategy 2.1.1.														
ACTION A.I Maintain the Koeye River weir as a key site for annual sockeye escapement monitoring using mark-resight methods and spawner counts.	med	high	high	high	high	med	med	med	high	med	5	5	0	**25**
ACTION A.II Conduct rotational mark-recapture experiments in chum and pink indicator populations to quantify residence time, estimate total spawner abundance, and provide expansions from AUC	med	med	high	med	high	med	high	med	high	med	4	6	0	**24**
ACTION B.I Work with Wuiknuxv and DFO to increase community participation in sockeye counting.	high	high	high	high	high	high	high	med	med	med	7	3	0	**27**
ACTION B.II Hire and train staff from Wuikinuxv Fisheries to count chum and pink from a priority population in Rivers Inlet.	high	high	high	high	high	med	high	med	med	med	6	4	0	**26**
ACTION B.III Work with Kitasoo/Xai'xais and DFO to continue stream walks to quantify escapement for priority sockeye, chum and pink populations.	med	med	high	high	med	high	high	med	high	med	5	5	0	**25**
ACTION B.IV Work with HIRMD, DFO, and partners to continue stream walks to quantify escapement for priority sockeye, chum and pink populations.	high	med	high	high	med	med	high	med	high	med	5	5	0	**25**
ACTION B.V Work with Nuxalk Fisheries and DFO to maintain and expand Atnarko River stream walk and overflight counts to include spawning areas above Tenas, Elbow and Rainbow Lakes.	high	high	high	high	high	med	high	high	high	med	8	2	0	**28**
ACTION B.VI Work with Nuxalk Fisheries and DFO to maintain and expand stream walk counts in tributaries of the Bella Coola River (e.g. Salloomt, Thorsen, Necleetsconnay, etc)	high	high	med	med	med	high	high	med	high	med	5	5	0	**25**

Objective 2.1 Actions	Overarching Criteria							Goal Specific Criteria			Final Scores			
	Community support	*Strengthens connections to salmon*	*DFO support and engagement*	*Community participation*	*Builds or maintains capacity*	*Costs*	*Realistic and achievable*	*Reduces biological risks to salmon*	*Leverages existing or new data to improve understanding*	*Supports adaptive management*	*High*	*Med*	*Low*	*Total*
ACTION B.VII Monitor Kimsquit River sockeye and Chinook returns via overflight index counts. Calibrate overflight counts with snorkel counts in lakeshore and outlet.	high	med	med	med	high	med	med	high	high	med	4	6	0	**24**
ACTION B.VIII Evaluate opportunities for improved Chinook escapement monitoring in tributaries of Wuikinuxv Lake via overflight count.	high	high	low	high	med	high	med	high	med	med	5	4	1	**24**
ACTION C Maintain walk and overflight counts for coho in populations with existing timeseries of counts	high	high	high	low	low	high	high	high	med	high	7	1	2	**25**
ACTION D Work with Nuxalk Nation and DFO to implement mark-recapture for coho in a lower Bella Coola tributary. Evaluate potential for MR in Thorsen and Necleetsconnay coho.	high	high	high	high	high	high	med	high	high	high	9	1	0	**29**
ACTION E Restore overflight counts of chinook, chum, pink and coho escapement in Chuckwalla and Kilbella Rivers.	high	high	high	low	low	med	high	med	high	high	6	2	2	**24**
ACTION F Support ongoing overflight counts of Kimsquit, Kwatna, and Dean River chum for in-season management and escapement monitoring.	high	med	high	low	low	high	high	high	med	high	6	2	2	**24**
ACTION G Support ongoing ground-based and overflights for sockeye, chum, pink and coho in Areas 6/7.	high	med	high	low	low	high	high	med	high	high	6	2	2	**24**
ACTION H.I Restore Dean River Chinook escapement monitoring — reinstate overflight counts	med	med	high	low	low	med	med	med	med	high	2	6	2	**20**
ACTION H.II Run mark-recapture study for Dean Chinook with radio telemetry and visual tags to understand spatial distribution of spawning and make mark-recapture estimates.	low	med	med	med	high	low	low	med	high	high	3	4	3	**20**

Objective 2.1 Actions	Overarching Criteria							Goal Specific Criteria			Final Scores			
	Community support	*Strengthens connections to salmon*	*DFO support and engagement*	*Community participation*	*Builds or maintains capacity*	*Costs*	*Realistic and achievable*	*Reduces biological risks to salmon*	*Leverages existing or new data to improve understanding*	*Supports adaptive management*	*High*	*Med*	*Low*	*Total*
Strategy 2.1.3. Apply new tools and technologies to improve salmon escapement monitoring in populations where conventional count methods are ineffective.														
ACTION A.I Work with Wuikinuxv, DFO, and funders to create long-term stable funding for the Wannock River sonar program. (Prerequisite for all subactions under ACTION A.)	med	med	high	med	high	med	high	med	high	high	5	5	0	**25**
ACTION A.II Provide support for Wuikinuxv test fishery program, extend this program through to mid-October to estimate species and size composition for coho and chum runs. (Dependent on ACTION A.I.)	high	high	med	high	high	med	med	med	high	med	5	5	0	**25**
ACTION A.III Derive estimates of chum and coho escapement from Wannock sonar counts. (Dependent on ACTION A.I.)	med	high	med	high	high	med	med	med	high	med	4	6	0	**24**
ACTION A.IV Evaluate potential to transition ongoing sockeye spawner enumeration to sonar led by Wuikinuxv Nation and partners. (Dependent on ACTION A.I.)	low	low	low	med	high	med	med	low	med	med	1	5	4	**17**
ACTION A.V Support ongoing Chinook deadpitch in Wannock River to calibrate sonar-based estimate of escapemenet to historic timeseries. (Dependent on ACTION A.I.)	med	med	high	high	high	high	high	med	high	high	7	3	0	**27**
ACTION B.I Work with Nuxalk and DFO to understand sonar program needs. (Prerequisite for ACTION B.II.)	high	med	high	high	high	med	high	med	high	high	7	3	0	**27**
ACTION B.II Implement strategies to support ongoing Nuxalk-led sonar enumeration and data analysis. (Dependent on ACTION B.I.)	high	high	high	high	high	med	high	med	high	high	8	2	0	**28**
ACTION C Develop and apply computer-vision models to automate identification and counting of salmon from video and sonar.	high	med	high	low	high	high	high	med	high	med	6	3	1	**25**

Objective 2.1 Actions	Overarching Criteria							Goal Specific Criteria			Final Scores			
	Community support	*Strengthens connections to salmon*	*DFO support and engagement*	*Community participation*	*Builds or maintains capacity*	*Costs*	*Realistic and achievable*	*Reduces biological risks to salmon*	*Leverages existing or new data to improve understanding*	*Supports adaptive management*	*High*	*Med*	*Low*	*Total*
ACTION D Work with Wuikinuxv Nation and partners to streamline data processing from Wannock sonar for in-season managemnet.	med	med	med	med	med	high	med	med	med	med	1	9	0	**21**
ACTION E.I Install cameras in the Koeye River weir for in-season estimates of salmon escapement.	high	med	high	med	high	high	high	high	high	high	8	2	0	**28**
ACTION E.II Develop camera-based monitoring in the Kadjusdis River fish ladder to monitor salmon escapement.	high	high	high	high	high	med	high	high	med	high	8	2	0	**28**
ACTION E.III Evaluate opportunities for camera-based monitoring at Kunsoot, Kwakusdis, Neekas, and Quatlena.	high	high	low	high	high	med	high	high	high	high	8	1	1	**27**
ACTION E.IV Evaluate opportunities for camera-based monitoring in Kitasoo/ Xai'xais territory.	med	low	high	high	med	high	high	med	high	high	6	3	1	**25**
ACTION E.V Design and implement short-term PIT tagging studies to determine what proportion of each species ascend fish ladders versus leap falls at a range of water levels and temperatures. Expand fish ladder camera counts based on these data.	med	med	high	med	med	med	med	med	high	high	3	7	0	**23**
ACTION E.VI Work with Wuikinuxv to evaluate potential for weir and camera-based enumeration of salmon in Johnston Creek.	med	high	high	high	high	med	high	med	high	high	7	3	0	**27**
ACTION E.VII Evaluate opportunities for camera-based monitoring of escapement and mark-rate in enhanced Tankeeah and Mary Cove sockeye populations.	high	high	low	high	high	med	med	med	high	high	6	3	1	**25**
ACTION J Evaluate opportunities to use sonar counting in the Dean River for estimates of Chinook and steelhead.	med	med	high	med	high	low	med	med	high	high	4	5	1	**23**
ACTION K Evaluate status of smaller Chinook populations using eDNA, counts, and juvenile sampling.	med	med	med	med	med	low	med	med	high	med	1	8	1	**20**

Objective 2.1 Actions	Overarching Criteria							Goal Specific Criteria			Final Scores			
	Community support	*Strengthens connections to salmon*	*DFO support and engagement*	*Community participation*	*Builds or maintains capacity*	*Costs*	*Realistic and achievable*	*Reduces biological risks to salmon*	*Leverages existing or new data to improve understanding*	*Supports adaptive management*	*High*	*Med*	*Low*	*Total*
Strategy 2.1.4. Estimate population-specific age structure and life history.														
ACTION A Review all ongoing initiatives that collect and analyze scale or otoliths for life history information.	med	med	med	low	med	high	high	low	high	low	3	4	3	**20**
ACTION B.I Support ongoing sampling of scales salmon sampled at the Koeye weir. Work with partners to maintain capacity for digitizing collections for reading and analysis.	high	med	med	med	high	med	high	med	high	med	4	6	0	**24**
ACTION B.II Support ongoing sampling of scales, otoliths, & DNA for all species in Atnarko and Bella Coola River spawning areas annually.	high	high	high	med	high	med	high	med	high	med	6	4	0	**26**
ACTION B.III Support ongoing sampling of scales and DNA from Chinook captured for broodstock in the Chuckwalla and Kilbella rivers.	med	med	high	med	high	med	high	med	high	med	4	6	0	**24**
ACTION C Identify indicator/ priority populations without age data and work with DFO and First Nations spawner count programs to collect otoliths and DNA.	med	med	med	high	high	med	high	med	med	low	3	6	1	**22**
ACTION D.I Support ongoing collection of scales and DNA from fish caught in Nuxalk FSC fisheries.	high	high	high	high	high	high	high	med	high	med	8	2	0	**28**
ACTION D.II Support ongoing sampling of scales and DNA from salmon caught in Wuikinuxv test fishery and by FSC fishers in the Wannock River.	med	med	med	high	high	high	high	med	high	med	5	5	0	**25**
ACTION D.III Support Klemtu SEAS program to collect scales and DNA during annual salmon derby.	high	high	high	high	high	high	high	med	high	med	8	2	0	**28**
ACTION D.IV Support ongoing scale and DNA collections by the Heiltsuk dockside monitoring program.	high	high	high	high	high	high	high	med	high	med	8	2	0	**28**
ACTION D.V Use genetic stock assignment to determine life-history for CUs across the Central Coast from mixed-stock samples collected above.	med	med	low	med	med	low	med	high	high	high	3	5	2	**21**

Objective 2.1 Actions	Overarching Criteria							Goal Specific Criteria			Final Scores			
	Community support	*Strengthens connections to salmon*	*DFO support and engagement*	*Community participation*	*Builds or maintains capacity*	*Costs*	*Realistic and achievable*	*Reduces biological risks to salmon*	*Leverages existing or new data to improve understanding*	*Supports adaptive management*	*High*	*Med*	*Low*	*Total*
ACTION E Develop scale photography, reading and digitization lab(s) to be housed at Central Coast stewardship offices or research facilities.	med	med	med	med	med	low	med	low	med	med	0	8	2	**18**
ACTION F Create digital repository for scale images and database of life-history data for salmon populations on the Central Coast that builds upon existing databases.	med	med	med	low	med	med	med	low	med	med	0	8	2	**18**
Strategy 2.1.5. Generate annual escapement estimates of all monitored populations.														
ACTION A Analyze available count data using Bayesian P-spline area-under-the-curve (AUC) model to estimate escapement, changes in spawn timing, and leverage count data by sharing information across populations and years.	high	med	high	low	med	med	high	med	high	high	5	4	1	**24**
ACTION B.I Evaluate and test approaches to link sonar counts of sockeye in the Wannock River to long-term count data from tribs of Wuikinuxv Lake.	med	med	high	low	med	high	high	med	high	high	5	4	1	**24**
ACTION B.II Develop calibration models to link Atnarko sonar counts to ongoing chinook mark-recapture, and long-term count data for sockeye.	high	high	high	low	med	med	high	med	high	high	6	3	1	**25**
ACTION C Develop genetic mark-recapture that uses genetic stock identification (GSI) to expand counts from the Atnarko sonar to total Bella Coola-wide escapement for each species.	high	high	high	low	med	high	high	med	high	high	7	2	1	**26**
ACTION D.I Link mark-recapture estimates for Koeye sockeye to regional AUC counts to develop multi-population model that borrows information from Koeye	med	med	high	low	low	high	med	low	high	med	3	4	3	**20**
ACTION D.II Link mark-recapture estimates for Snootli Creek chum, with data from AUC counts in Thorsen, Salloomt, and Nooklikonnik Creeks.	high	high	high	low	med	high	high	med	high	med	6	3	1	**25**

TABLE A.8. Evaluation scores for all proposed actions under Goal 2, Objective 2.2.

Objective 2.2 *Quantify contribution of hatchery-origin fish to estimates of catch and escapement for all Central Coast CUs.*

Objective 2.2 Actions	Overarching Criteria							Goal Specific Criteria			Final Scores			
	Community support	*Strengthens connections to salmon*	*DFO support and engagement*	*Community participation*	*Builds or maintains capacity*	*Costs*	*Realistic and achievable*	*Reduces biological risks to salmon*	*Leverages existing or new data to improve understanding*	*Supports adaptive management*	*High*	*Med*	*Low*	*Total*
Strategy 2.2.1. Develop a regional plan for mass-marking and monitoring hatchery populations.														
ACTION A Evaluate costs and feasibility of CWT v. PBT approaches as part of a regional strategy for estimating exploitation rates and juvenile-to-adult survival for indicator stocks of coho, chinook, and chum. (Prerequisite for STRATEGY 2.2.2.)	med	med	med	low	med	high	high	med	med	med	2	7	1	**21***
ACTION B Evaluate potential for recovery of PBT v. CWT tags in mixed-stock fisheries outside of the Central Coast (e.g. Alaska, Haida Gwaii). (Prerequisite for STRATEGY 2.2.2.)	med	med	low	low	med	high	high	med	med	med	2	6	2	**20***
ACTION C Identify hatchery indicator populations, and associated infrastructure or capacity needed to maximize information generated by these programs.	med	med	high	med	high	med	high	high	high	high	6	4	0	**26**
ACTION D Evaluate opportunities for adipose clipping or otolith thermal marking sockeye in enhanced Mary Cove and Tankeeah populations.	high	med	low	high	high	med	high	high	med	med	5	4	1	**24**

* This action has been included in the final *Monitoring Framework*, despite receiving less than 24 points, because it is considered a 'prerequisite' for other actions.

Objective 2.2 Actions	Overarching Criteria							Goal Specific Criteria			Final Scores			
	Community support	*Strengthens connections to salmon*	*DFO support and engagement*	*Community participation*	*Builds or maintains capacity*	*Costs*	*Realistic and achievable*	*Reduces biological risks to salmon*	*Leverages existing or new data to improve understanding*	*Supports adaptive management*	*High*	*Med*	*Low*	*Total*
Strategy 2.2.2. Implement and expanded mass-marking program for hatchery fish. (All actions below are dependent on STRATEGY 2.2.1. ACTIONS A and B.)														
ACTION A Reinstate Belarko spawning channel coho rearing program, with mass marking of juveniles to enable estimates of exploitation rate and juvenile-to-adult survival.	high	high	med	med	high	med	high	med	high	high	6	4	0	**26**
ACTION B Develop capacity at Percy Walkus Hatchery for coho enhancement and mass-marking of Johnston Creek coho for indicator stock.	med	med	low	med	high	med	high	med	high	high	4	5	1	**23**
ACTION C Implement annual adipose clipping and CWT marking of juvenile salmon at regional hatcheries	high	med	high	med	med	med	high	high	high	high	6	4	0	**26**
ACTION C.I Work with DFO Salmon Enhancement Program, Snootli and other regional hatcheries to find funds to support purchase of a mass-marking trailer.	med	med	med	low	med	low	med	high	high	med	2	6	2	**20**
ACTION C.II Work with Percy Walkus Hatchery to support CWT marking and adipose clipping of all Chinook	med	med	med	med	high	med	med	high	high	high	4	6	0	**24**
ACTION C.III Work with Snootli Creek hatchery to reinstate mass-marking of coho and maintain marking efforts for Chinook and chum.	med	high	high	med	high	med	high	high	med	med	5	5	0	**25**
ACTION C.IV Work with Kitasoo Creek hatchery to reinstate CWT marking and adipose clipping for juvenile coho.	high	med	high	high	high	med	high	high	med	high	7	3	0	**27**
ACTION C.V Work with McLoughlin hatchery to reinstate CWT markig and adipose clipping of juvenile coho.	high	med	high	high	high	med	high	high	high	high	8	2	0	**28**
ACTION C.VI Implement rotating (eg. every 2 years) CWT marking for coho and chum at Central Coast hatcheries to quantify catch in Alaskan and BC Fisheries.	high	med	high	med	high	med	high	high	high	high	7	3	0	**27**

Objective 2.2 Actions	Overarching Criteria							Goal Specific Criteria			Final Scores			
	Community support	*Strengthens connections to salmon*	*DFO support and engagement*	*Community participation*	*Builds or maintains capacity*	*Costs*	*Realistic and achievable*	*Reduces biological risks to salmon*	*Leverages existing or new data to improve understanding*	*Supports adaptive management*	*High*	*Med*	*Low*	*Total*
ACTION D Support application of PBT in hatcheries to estimate exploitation rate, survival, and straying among hatchery indicator populations.	med	med	high	med	high	med	high	high	high	high	6	4	0	**26**
ACTION D.I Support Kitasoo Hatchery to sample DNA from coho and chum broodstock for PBT	med	med	high	med	high	med	high	high	high	high	6	4	0	**26**
ACTION D.II Support Snootli hatchery and Nuxalk to sample Chinook, chum, coho and sockeye broodstock for PBT.	med	high	high	med	high	med	high	med	high	med	5	5	0	**25**
ACTION D.III Support McLoughlin hatchery to sample coho and chum for PBT.	high	med	high	high	high	med	high	high	high	high	8	2	0	**28**
ACTION D.IV Support Percy Walkus hatchery to maintain DNA sampling of Chinook broodstock and expand sampling to chum as enhancement gets underway.	med	med	high	med	med	med	high	med	high	med	3	7	0	**23**
ACTION E Maintain current CWT marking at Snootli Creek hatchery for Atnarko, Salloomt, and Nusatsum Chinook.	high	high	high	med	med	high	high	high	high	high	8	2	0	**28**
ACTION F Maintain current CWT marking of Chinook at Percy Walkus hatchery.	med	med	high	med	med	high	high	high	high	med	5	5	0	**25**
ACTION G Support efforts to otolith thermal mark chum and sockeye at Snootli Hatchery	high	high	high	low	med	high	high	med	med	high	6	3	1	**25**
2.2.3. Strengthen escapement monitoring for hatchery populations using mark-recapture, spawning ground counts and sonar.														
ACTION A Support ongoing Chinook mark-recapture in the Atnarko River	high	high	high	med	high	high	high	med	high	high	8	2	0	**28**
ACTION B Maintain ongoing mark-recapture to estimate chum escapement in Snootli Creek.	med	high	high	low	high	high	high	med	high	high	7	2	1	**26**

Objective 2.2 Actions	Overarching Criteria							Goal Specific Criteria			Final Scores			
	Community support	*Strengthens connections to salmon*	*DFO support and engagement*	*Community participation*	*Builds or maintains capacity*	*Costs*	*Realistic and achievable*	*Reduces biological risks to salmon*	*Leverages existing or new data to improve understanding*	*Supports adaptive management*	*High*	*Med*	*Low*	*Total*
ACTION C Work with Nuxalk and DFO StAD to build capacity for coho escapement monitoring in the Atnarko using the ARIS sonar to quantify returns to Atnarko ponds indicator stock.	med	high	high	high	high	med	med	med	high	high	6	4	0	**26**
ACTION D Work with Nuxalk and DFO StAD to support otolith collections from spawning areas in the Bella Coola and Atnarko to quantify hatchery contributions.	med	high	high	med	med	high	high	med	med	high	5	5	0	**25**
ACTION E Work with Wuikinuxv, Percy Walkus Hatchery, and research partners to evaluate alternatives for monitoring Chinook returns and mark-rate in Chuckwalla and Killbella.	med	med	high	med	high	med	med	med	high	high	4	6	0	**24**
ACTION F Work with Kitasoo Hatchery to quantify mark rate, and tag returning coho for mark-recapture estimates from spawner and carcass surveys.	med	med	high	high	high	high	high	med	high	high	7	3	0	**27**
ACTION G Work with McLoughlin hatchery to quantify mark rate, and tag returning coho for mark-recapture estimates from spawner and carcass surveys.	high	med	high	high	high	med	high	med	high	high	7	3	0	**27**
ACTION H Monitor escapement and quantify hatchery contribution to enhanced sockeye populations.	high	med	high	high	high	med	high	med	high	high	7	3	0	**27**
ACTION H.I Maintain ongoing spawner counts and otolith collections in Mary Cove.	high	high	med	high	high	high	high	med	high	high	8	2	0	**28**
ACTION H.II Maintain ongoing spawner counts and otolith collections in Tankeeah.	high	high	med	high	high	high	high	med	high	high	8	2	0	**28**
ACTION H.III Maintain and expand annual spawner counts and otolith collections in Atnarko spawning areas.	high	high	high	high	high	med	high	med	high	high	8	2	0	**28**
ACTION I Conduct regular spawner counts with DNA and otolith sampling in populations adjacent to hatcheries to estimate contribution of hatchery fish.	med	med	high	med	high	med	high	high	med	high	5	5	0	**25**

Objective 2.2 Actions	Overarching Criteria							Goal Specific Criteria			Final Scores			
	Community support	*Strengthens connections to salmon*	*DFO support and engagement*	*Community participation*	*Builds or maintains capacity*	*Costs*	*Realistic and achievable*	*Reduces biological risks to salmon*	*Leverages existing or new data to improve understanding*	*Supports adaptive management*	*High*	*Med*	*Low*	*Total*
Strategy 2.2.4. Estimate hatchery contribution to catch and escapement, and quantify juvenile-to-adult survival.														
ACTION A Conduct regular sampling as part of community-run catch monitoring to sample DNA for genetic stock ID, mark-rate estimates and PBT analysis.	high	med	high	high	high	high	high	high	med	high	8	2	0	**28**
ACTION B Work with community catch monitoring initiatives and DFO to collect otoliths from commercially caught chum starting in 2023.	high	med	high	high	high	med	high	high	med	high	7	3	0	**27**
ACTION C Use GSI and mark-rate data from Nuxalk biosampling program to estimate contribution of Atnarko ponds enhancement to coho escapement in the Bella Coola River.	med	high	high	low	med	med	high	high	high	high	6	3	1	**25**
ACTION D Use estimates of Chinook, coho, chum and sockeye escapement, and mark-rates estimated from fishery recoveries to estimate catch, juvenile-to-adult survival (or fry-to-adult for sockeye & chum) among juveniles released from hatcheries.	med	med	high	low	med	med	med	med	high	high	3	6	1	**22**

TABLE A.9. Evaluation scores for all proposed actions under Goal 2, Objective 2.3.

Objective 2.3 *Quantify juvenile abundance and juvenile-to-adult survival.*

Objective 2.3 Actions	Overarching Criteria							Goal Specific Criteria			Final Scores			
	Community support	*Strengthens connections to salmon*	*DFO support and engagement*	*Community participation*	*Builds or maintains capacity*	*Costs*	*Realistic and achievable*	*Reduces biological risks to salmon*	*Leverages existing or new data to improve understanding*	*Supports adaptive management*	*High*	*Med*	*Low*	*Total*
Strategy 2.3.1. Implement life-cycle monitoring programs to quantify juvenlie abundance and juvenile-to-adult survival support outreach to community members and provide updates on the status of salmon on the Central Coast.														
ACTION A.I Work with Wuikinuxv to reinstate downstream trapping in the Wannock River to quantify timing, size, and condition of juvenile sockeye, coho and Chinook salmon and index juvenile abundance.	med	med	high	high	high	med	high	low	high	med	5	4	1	**24**
ACTION A.II Work with Kitasoo Fisheries to support ongoing downstream trapping at Mary Cove.	high	med	med	high	high	high	high	low	high	med	6	3	1	**25**
ACTION A.III Work with Kitasoo Fisheries to analyze long-term timeseries of juvenile-to-adult data for sockeye in Mary Cove creek.	high	med	high	low	med	high	high	med	high	med	5	4	1	**24**
ACTION A.IV Work with Snootli Hatchery and Nuxalk fisheries to implement downstream trapping in the Salloomt River, use mark-recapture to quantify abundance and timing.	low	med	med	high	high	med	med	med	high	med	3	6	1	**22**
ACTION A.V Work with Nuxalk fisheries to resume trapping and habitat monitoring in Nuxalk ponds.	high	high	low	high	med	med	high	med	low	med	4	4	2	**22**
ACTION A.VI Maintain ongoing juvenile trapping in the Koeye River to quantify annual abundance for coho and sockeye juveniles.	high	med	high	med	high	med	high	med	high	med	5	5	0	**25**
ACTION B.I Sustain ongoing juvenile trapping and PIT tagging work in the Koeye River to quantify annual juvenile abundance and marine survival for coho and sockeye salmon.	high	med	high	med	high	med	high	med	high	med	5	5	0	**25**

Objective 2.3 Actions	Overarching Criteria							Goal Specific Criteria			Final Scores			
	Community support	*Strengthens connections to salmon*	*DFO support and engagement*	*Community participation*	*Builds or maintains capacity*	*Costs*	*Realistic and achievable*	*Reduces biological risks to salmon*	*Leverages existing or new data to improve understanding*	*Supports adaptive management*	*High*	*Med*	*Low*	*Total*
ACTION B.II Install two PIT tag antennas in the Salloomt River and implement annual tagging of coho and Chinook to estimate juvenile-to-adult survival.	low	high	med	med	high	med	high	med	high	med	4	5	1	**23**
ACTION C Implement short-term trapping and PIT tagging projects to quantify fry and juvnile abundance for all species, estimate marine survival, and provide data for expansion of camera-based counts in fish ladders/ weirs. (see STRATEGIES 2.1.3 and 2.1.4.)	high	med	high	med	high	med	med	med	high	high	5	5	0	**25**
ACTION D Support ongoing nearshore marine juvenile sampling in Kitasoo Xai'xais territory to understand migration routes, timing and risks aquaculture placement, log dumping, and other marine habitat impacts.	high	low	high	high	high	high	high	med	med	high	7	2	1	**26**
Strategy 2.3.2. Build a rotational lake sampling program to quantify sockeye fry abundance.														
ACTION A Acquire dual-beam sonar unit for sockeye rearing lake survey program, to be run by Central Coast Nations, DFO, and research partners. (Prerequisite for ACTION E.)	med	med	high	med	high	low	med	med	high	med	3	6	1	**22***
ACTION B Hire a First Nations technical lead for project and train fisheries staff from each community to conduct limnological assessments and sonar-based surveys of late-summer fry densities.	high	med	high	med	high	low	med	med	high	low	4	4	2	**22**
ACTION C Synthesize existing data, evaluate regional importance, and identify community priorities for sockeye rearing lakes to sample. (Prerequisite for ACTION E.)	med	med	high	high	med	high	high	low	med	med	4	5	1	**23†**

* This action has been included in the final *Monitoring Framework*, despite receiving less than 24 points, because it is considered a 'prerequisite' for other actions.

† This action has been included in the final *Monitoring Framework*, despite receiving less than 24 points, because it is considered a 'prerequisite' for other actions.

Objective 2.3 Actions	Overarching Criteria							Goal Specific Criteria			Final Scores			
	Community support	*Strengthens connections to salmon*	*DFO support and engagement*	*Community participation*	*Builds or maintains capacity*	*Costs*	*Realistic and achievable*	*Reduces biological risks to salmon*	*Leverages existing or new data to improve understanding*	*Supports adaptive management*	*High*	*Med*	*Low*	*Total*
ACTION D Support ongoing late-winter sonar surveys in Wuikinuxv Lake to quantify juvenile sockeye abundance.	med	med	high	low	med	med	high	med	high	high	4	5	1	**23**
ACTION E Identify sockeye rearing lakes across the Central Coast for rotational sampling. Include 8 new lakes monitored annually, and 16 lakes to be sampled on a five-year rotation. (Dependent on ACTIONS A and C.)	med	med	high	high	high	high	high	med	med	med	5	5	0	**25**
ACTION F Collect data on physical and biological conditions in 25 sockeye rearing lakes to evaluate limiting factors and build baselines to track environmental change.	med	med	high	med	high	low	high	med	high	med	4	5	1	**23**
ACTION G Estimate sockeye capacity for 25 rearing lakes based on habitat area, productivity and spawner-to-fry relationships.	med	med	high	med	high	low	high	high	high	med	5	4	1	**24**
ACTION H Develop adaptive management plan for sockeye broodstock collection and fry releases in Atnarko Lakes based on lake capacity, fry density, and spawner abundance.	high	high	high	med	high	high	high	high	high	high	9	1	0	**29**

TABLE A.10. Evaluation scores for all proposed actions under Goal 2, Objective 2.4.

Objective 2.4 *Quantify current impacts and risks associated with pathogens and how these impacts affect survival.*

Objective 2.4 Actions	Overarching Criteria							Goal Specific Criteria			Final Scores			
	Community support	*Strengthens connections to salmon*	*DFO support and engagement*	*Community participation*	*Builds or maintains capacity*	*Costs*	*Realistic and achievable*	*Reduces biological risks to salmon*	*Leverages existing or new data to improve understanding*	*Supports adaptive management*	*High*	*Med*	*Low*	*Total*
Strategy 2.4.1. Connect Central Coast Nations with BC-wide efforts to track and understand salmon diseases.														
ACTION A Connect Central Coast Nations with Dr. Kristi Miller, and new ONA pathogen lab about potential opportunities for salmon pathogen work.	high	med	med	high	high	high	high	high	med	med	6	4	0	**26**
ACTION B Convene salmon pathogen roundtable with Central Coast Nations, DFO, and PSF staff currently focused on pathogens.	med	med	med	high	high	med	high	high	med	med	4	6	0	**24**
ACTION C Create plan for regional pathogen surveillance in juvenile and adult salmon of all species.	high	med	med	high	high	med	high	high	med	med	5	5	0	**25**
Strategy 2.4.2. Develop and implement pathogen surveillance programs to track salmon diseases in juvenile and adult salmon and quantify disease impacts on survival.														
ACTION A Run existing pathogen samples adult sockeye in the Koeye River from 2018, evaluate disease effects on survival to spawning using PIT telemetry data from individuals that were sampled for disease.	high	med	med	med	med	high	high	low	low	med	3	5	2	**21**
ACTION B Conduct annual monitoring for pathogens in juvenile salmon collected in downstream trapping and nearshore marine sample projects.	high	med	med	high	high	low	med	med	med	high	4	5	1	**23**
ACTION C Sample FSC caught salmon of all species in each community for pathogen screening.	high	med	med	high	high	low	high	med	med	high	5	4	1	**24**
ACTION D Create secure database for storing and managing pathogen data.	med	med	med	low	high	med	high	high	high	high	5	4	1	**24**

Objective 2.4 Actions	Overarching Criteria							Goal Specific Criteria			Final Scores			
	Community support	*Strengthens connections to salmon*	*DFO support and engagement*	*Community participation*	*Builds or maintains capacity*	*Costs*	*Realistic and achievable*	*Reduces biological risks to salmon*	*Leverages existing or new data to improve understanding*	*Supports adaptive management*	*High*	*Med*	*Low*	*Total*
ACTION E Evaluate regional correlations in pathogen prevalence across life stages and species	med	med	med	low	high	med	high	high	high	high	5	4	1	**24**
ACTION F Develop analytical approaches to understanding the effects of pathogens on survival and productivity for all species of salmon on the Central Coast.	med	low	med	low	high	med	high	high	med	high	4	4	2	**22**

TABLE A.11. Evaluation scores for all proposed actions under Goal 2, Objective 2.5.

Objective 2.5 *Create standardized tools and processes for data collection, sharing, assessment, and reporting.*

Objective 2.5 Actions	Overarching Criteria							Goal Specific Criteria			Final Scores			
	Community support	*Strengthens connections to salmon*	*DFO support and engagement*	*Community participation*	*Builds or maintains capacity*	*Costs*	*Realistic and achievable*	*Reduces biological risks to salmon*	*Leverages existing or new data to improve understanding*	*Supports adaptive management*	*High*	*Med*	*Low*	*Total*
Strategy 2.5.1. Establish more efficient processes for data collection, data sharing, and dissemination of information.														
ACTION A Support expanded use of existing centralized data management systems, (e.g. Pacific Salmon Explorer and PSF Salmon Data Library) for sharing salmon monitoring data.	med	med	high	high	high	med	high	med	med	med	4	6	0	**24**
ACTION B Create tools for electronic data entry to enable more efficient data collection and entry into databases. Build off existing platforms and protocols used by Central Coast Nations, DFO and CCIRA.	med	med	high	med	high	med	high	med	med	med	3	7	0	**23**
ACTION B.I Identify and partner with existing efforts to develop digital data entry tools for escapement and catch monitoring specific to the Central Coast (eg. based on CoastTracker).	high	med	high	high	high	med	high	med	med	high	6	4	0	**26**
ACTION B.II Record survey tracks during stream counting (eg. Guardian Watchmen patrols) to automatically estimate the extent counted and archive information on effort and location.	high	med	high	high	med	med	med	low	high	med	4	5	1	**23**
ACTION C Develop protocols and agreements for in-season data sharing and visualization of escapement data (e.g. on Pacific Salmon Explorer) between Nations, DFO and research partners.	med	med	low	high	med	med	high	high	high	high	5	4	1	**24**

Objective 2.5 Actions	Overarching Criteria							Goal Specific Criteria			Final Scores			
	Community support	*Strengthens connections to salmon*	*DFO support and engagement*	*Community participation*	*Builds or maintains capacity*	*Costs*	*Realistic and achievable*	*Reduces biological risks to salmon*	*Leverages existing or new data to improve understanding*	*Supports adaptive management*	*High*	*Med*	*Low*	*Total*
Strategy 2.5.2. Establish standardized methods for assessment to use for pre-season planning and in-season management.														
ACTION A Develop and apply statistical models to refine annual estimates of CU-specific catch in recreational and FSC fisheries from interview data and creel surveys.	high	med	high	low	med	med	high	high	high	high	6	3	1	**25**
ACTION B Develop and streamline DNA sample collection, processing and reporting to support in-season catch estimates for each CU.	med	med	med	med	med	med	med	high	high	high	3	7	0	**23**
ACTION C Work with Central Coast Nations and DFO to implement in-season updates on CU-level run forecasts and catch.	med	med	med	med	med	high	med	high	high	high	4	6	0	**24**
ACTION D Develop new visualization tools for the Pacific Salmon Explorer that enable access to in-season data and enable comparisons to historical data and biological escapement goals.	med	high	low	low	med	med	high	med	high	high	4	4	2	**22**
ACTION E Deliver weekly updates on escapement for priority populations.	med	high	med	med	med	med	high	high	high	high	5	5	0	**25**
ACTION F Create annual reports on escapement and stock-specific estimates of catch in all fisheries (FSC, recreational, commercial).	high	med	high	med	high	med	high	med	high	med	5	5	0	**25**

TABLE A.12. Evaluation scores for all proposed actions under Goal 3, Objective 3.1.

Objective 3.1 *Build a comprehensive genetic stock identification baseline.*

Objective 3.1 Actions	Overarching Criteria							Goal Specific Criteria			Final Scores			
	Community support	*Strengthens connections to salmon*	*DFO support and engagement*	*Community participation*	*Builds or maintains capacity*	*Costs*	*Realistic and achievable*	*Reduces biological risks to salmon*	*Leverages existing or new data to improve understanding*	*Supports adaptive management*	*High*	*Med*	*Low*	*Total*
Strategy 3.1.1. Identify gaps in genetic baselines for priority populations and develop a plan to expand baseline coverage.														
ACTION A Review existing data from DFO to identify gaps in the current GSI baseline across all CUs. (Prerequisite for ACTION C.)	med	med	high	low	med	high	high	med	med	med	3	6	1	**22***
ACTION B Work with DFO StAD and Molecular Genetics Lab to evaluate the source, quality and age of existing genetic baselines to identify populations for resampling. (Prerequisite for ACTION C.)	med	low	high	low	low	high	high	med	med	med	3	4	3	**20***
ACTION C Review list of indicator populations and work with Central Coast First Nations to identify populations to prioritize for sampling. (Dependent on ACTIONS A and B.)	high	med	high	high	med	high	high	med	med	med	5	5	0	**25**
ACTION D Develop and share prioritized list of salmon populations for sampling.	high	med	high	high	med	high	high	med	med	med	5	5	0	**25**
Strategy 3.1.2. Implement program to collect genetic baselines from spawning populations.														
ACTION A Identify opportunities to add genetic sampling into existing spawner surveys.	med	med	high	high	med	high	high	med	med	med	4	6	0	**24**
ACTION B Develop methods guide and provide training in each Central Coast community for tissue sampling.	med	med	high	high	high	high	high	low	low	low	5	2	3	**22**
ACTION C Provide sampling equipment to community and DFO count crews for DNA baseline collections.	high	med	high	high	high	high	high	med	med	med	6	4	0	**26**

* This action has been included in the final *Monitoring Framework*, despite receiving less than 24 points, because it is considered a 'prerequisite' for other actions.

Objective 3.1 Actions	Overarching Criteria							Goal Specific Criteria			Final Scores			
	Community support	*Strengthens connections to salmon*	*DFO support and engagement*	*Community participation*	*Builds or maintains capacity*	*Costs*	*Realistic and achievable*	*Reduces biological risks to salmon*	*Leverages existing or new data to improve understanding*	*Supports adaptive management*	*High*	*Med*	*Low*	*Total*
ACTION D Sample juvenile coho & Chinook in watersheds with existing DNA baseline, compare assignment success from mixed-stock samples when juveniles are used. Evaluate potential for less costly juvenile sampling to replace adult sample collections for hard-to-sample populations.	med	med	low	med	med	med	high	med	med	med	1	8	1	**20**
ACTION E Create and use standard data-entry tools to document location, time, life stage and other relevant biological data for DNA sample collections.	high	low	high	high	high	high	high	med	med	med	6	3	1	**25**
ACTION F Work with First Nations, DFO and research partners to find resources and personnel to collect DNA baselines in priority populations by 2022.	high	med	high	high	high	med	high	high	high	med	7	3	0	**27**
Strategy 3.1.3. Apply genetic analyses to expanded DNA baselines to evaluate population structure, run timing, spawner escapement, and CU designations.														
ACTION A Support development of sockeye genetic panels and baselines to enable more accurate population assignment in mixed-stock samples.	high	med	high	low	med	high	high	med	high	high	6	3	1	**25**
ACTION B Apply genetic stock identification to mixed-stock fisheries on the Central Coast on an annual basis to provide estimates of stock composition of catch for collaborative management.	med	med	med	med	high	med	med	high	high	high	4	6	0	**24**
ACTION C Apply genetic stock identification to quantify escapement and catch of each major subpopulation of salmon within the Bella Coola River population aggregate.	med	high	high	med	med	med	med	med	high	high	4	6	0	**24**

Objective 3.1 Actions	Overarching Criteria							Goal Specific Criteria			Final Scores			
	Community support	*Strengthens connections to salmon*	*DFO support and engagement*	*Community participation*	*Builds or maintains capacity*	*Costs*	*Realistic and achievable*	*Reduces biological risks to salmon*	*Leverages existing or new data to improve understanding*	*Supports adaptive management*	*High*	*Med*	*Low*	*Total*
ACTION C.I Work with DFO Molecular Genetics Lab to evaluate sub-population differentiation for sockeye, coho, Chinook and chum in the Bella Coola River using existing baselines. (Prerequisite for ACTION C.II through ACTION C.V.)	med	high	high	low	low	high	high	med	med	med	4	4	2	**22**
ACTION C.II Apply GSI to sockeye samples from FSC fishery to determine contribution of each sockeye subpopulation to total Atnarko escapement. (Dependent on ACTION C.I.)	high	high	high	med	med	high	high	med	high	high	7	3	0	**27**
ACTION C.III Apply GSI to coho, chum and Chinook from FSC and sport fisheries to determine contribution Atnarko and other subpopulations and quantify total escapement. (Dependent on ACTION C.I.)	med	high	high	med	med	med	med	med	high	high	4	6	0	**24**
ACTION C.IV Use Nuxalk FSC samples to quantify seasonal chinook stock composition for each drift on the Bella Coola River. Identify areas and times of higher interception risk for Salloopmt and Nusatsum chinook. (Dependent on ACTION C.I.)	med	high	high	high	med	med	med	high	high	high	6	4	0	**26**
ACTION C.V Run samples from FSC and commercially caught salmon, quantify contribution of enhanced and wild chum subpopulations to catch and escapement. (Dependent on ACTION C.I.)	med	high	high	med	low	med	high	high	high	high	6	3	1	**25**
ACTION D Apply GSI to understand population structure, run-timing and relative abundance of salmon subpopulations within the Dean River population aggregate.	med	med	low	med	low	med	high	med	med	med	1	7	2	**19**
ACTION D.I Sample DNA from returning Chinook, steelhead, and coho in the lower Dean River to determine subpopulation composition and run timing.	med	high	low	med	med	high	high	med	med	med	3	5	1	**20**

Objective 3.1 Actions	Overarching Criteria							Goal Specific Criteria			Final Scores			
	Community support	*Strengthens connections to salmon*	*DFO support and engagement*	*Community participation*	*Builds or maintains capacity*	*Costs*	*Realistic and achievable*	*Reduces biological risks to salmon*	*Leverages existing or new data to improve understanding*	*Supports adaptive management*	*High*	*Med*	*Low*	*Total*
ACTION D.II Sample DNA from Chinook, coho, and steelhead in spawning and rearing areas across the Dean River watershed.	med	med	low	med	low	med	high	med	high	med	2	6	2	**20**
ACTION D.III Evaluate sub-population genetic and run timing differences for steelhead, Chinook and coho in the Dean Rivers using new and existing DNA baselines.	med	med	low	low	low	med	high	med	med	med	1	6	3	**18**
ACTION E Apply GSI to quantify escapement and catch of each major subpopulation within Wuikinuxv Lake sockeye population aggregate.	high	high	low	low	med	high	med	med	high	high	5	3	2	**23**
ACTION E.I Evaluate sub-population differentiation for Owikeno Lake sockeye using new SNP panels and existing genetic baselines. Run GSI on sockeye caught in the Wannock River test fishery to determine the contribution of sockeye subpopulations to total Owikeno sockeye escapement.	high	high	low	med	med	high	med	med	high	high	5	4	1	**24**
ACTION F Resample DNA baseline in subset of populations and apply genomics tools to quantify direction and rate of contemporary evolutionary changes from climate warming and other stressors.	high	med	low	high	med	med	med	high	low	high	4	4	2	**22**

TABLE A.13. Evaluation scores for all proposed actions under Goal 3, Objective 3.2.

Objective 3.2 *Quantify CU-specific recreational, commercial, and food, social, ceremonial catch.*

Objective 3.2 Actions	Overarching Criteria							Goal Specific Criteria			Final Scores			
	Community support	*Strengthens connections to salmon*	*DFO support and engagement*	*Community participation*	*Builds or maintains capacity*	*Costs*	*Realistic and achievable*	*Reduces biological risks to salmon*	*Leverages existing or new data to improve understanding*	*Supports adaptive management*	*High*	*Med*	*Low*	*Total*
Strategy 3.2.1. Establish standardized methods and tools for catch monitoring on the Central Coast.														
ACTION A Develop sampling protocol for fin clips, scale collections and other sampling (e.g. sex, length, catch location, hatchery mark).	med	med	high	high	high	high	high	med	med	med	5	5	0	**25**
ACTION B Prep and send sampling kits to First Nations sampling crews annually.	med	med	high	high	med	high	high	med	high	high	6	4	0	**26**
ACTION C Coordinate sampling and catch monitoring with Central Coast First Nations and DFO.	med	med	high	high	high	med	high	med	high	high	6	4	0	**26**
ACTION D Develop study design and methods guide with community catch monitoring initiatives, based on standardized protocols for data collection and quantification of catch, fishing effort, bycatch (interviews), and stock composition in sport, commercial and FSC fisheries.	high	med	high	high	high	high	high	high	high	high	9	1	0	**29**
ACTION E Continue Guardian Watchman patrols to quantify sport and FSC fishing effort. Work with Guardians in each community to understand current boat survey data and opportunities to link these data to catch monitoring.	med	med	high	high	med	med	high	high	high	high	6	4	0	**26**
ACTION F Provide standard digital data entry tools to community catch monitoring programs.	high	med	med	high	high	med	high	med	high	high	6	4	0	**26**

Objective 3.2 Actions	Overarching Criteria							Goal Specific Criteria			Final Scores			
	Community support	*Strengthens connections to salmon*	*DFO support and engagement*	*Community participation*	*Builds or maintains capacity*	*Costs*	*Realistic and achievable*	*Reduces biological risks to salmon*	*Leverages existing or new data to improve understanding*	*Supports adaptive management*	*High*	*Med*	*Low*	*Total*
Strategy 3.2.2. Strengthen and expand dockside and in-river catch monitoring program for FSC fisheries in each Central Coast community.														
ACTION A Work with communities to strengthen existing catch monitoring programs through enhanced resources or support with project design and analysis.	med	med	high	high	high	med	high	med	high	high	6	4	0	**26**
ACTION B Design projects with each community to sample fin clips and scales from fish caught in FSC fisheries.	med	med	high	high	high	med	high	med	high	high	6	4	0	**26**
ACTION C Supply community catch sampling programs with equipment to scan for coded wire tags and collect heads for stock ID when present.	med	med	high	high	high	high	high	med	high	high	7	3	0	**27**
ACTION D Strengthen ongoing dockside interviews and catch sampling in Bella Bella to monitor FSC catch, effort, fisher observations, and collect mixed-stock samples for GSI.	high	med	high	high	high	med	high	med	high	high	7	3	0	**27**
ACTION D.I Resume dockside interview program in 2021 to gather data about fisher trips, catch, and sample DNA and scales from FSC caught fish.	high	med	high	high	high	med	high	med	high	high	7	3	0	**27**
ACTION D.II Incorporate regular visits to McLoughlin Bay to quantify effort and catch of hatchery coho.	high	med	high	high	high	high	high	med	high	high	8	2	0	**28**
ACTION D.III Build upon 2020 changes in study design to include phone-based interview protocol and support fishers to sample DNA and scales.	high	med	high	high	high	high	high	med	high	high	8	2	0	**28**
ACTION E Support ongoing in-river FSC monitoring in Bella Coola to obtain annual estimates of FSC catch, fishing effort, and fisher observations.	high	high	high	high	high	high	high	med	high	high	9	1	0	**29**
ACTION E.I Extend in-river monitoring and biosampling through mid-October to capture in-river coho fisheries.	high	high	med	high	high	high	high	med	high	high	8	2	0	**28**
ACTION E.II Conduct regular boat-based surveys to calibrate trailer counts to total in-river fishing effort	high	high	high	high	high	high	high	med	high	high	9	1	0	**29**

Objective 3.2 Actions	Overarching Criteria							Goal Specific Criteria			Final Scores			
	Community support	*Strengthens connections to salmon*	*DFO support and engagement*	*Community participation*	*Builds or maintains capacity*	*Costs*	*Realistic and achievable*	*Reduces biological risks to salmon*	*Leverages existing or new data to improve understanding*	*Supports adaptive management*	*High*	*Med*	*Low*	*Total*
ACTION F Work with Kitasoo/Xai'xais to support and expand current FSC monitoring initiatives, and identify opportunities to strengthen survey methodology to make estimates of total catch.	med	med	high	high	high	high	high	med	high	high	7	3	0	**27**
ACTION G Work with Wuikinuxv to understand current FSC monitoring and where additional resources or support may be helpful	low	med	med	high	high	high	high	med	high	med	5	4	1	**24**
Strategy 3.2.3. Strengthen and expand dockside and in-river creel surveys to monitor catch in recreational fisheries.														
ACTION A Work with each community to sample fin clips and scales from fish caught in recreational fisheries to estimate stock composition and age structure for sport-caught salmon.	med	med	high	high	high	med	high	med	high	high	6	4	0	**26**
ACTION B Expand Heiltsuk dockside monitoring program to include more interviews in Shearwater and weekly visits to area lodges.	high	med	high	high	high	med	high	med	high	high	7	3	0	**27**
ACTION C Implement saltwater creel survey, trailer count, and catch sampling for recreational fishers leaving from and returning to Bella Coola to obtain estimates of total catch and fishing effort.	high	high	high	high	high	high	high	med	high	high	9	1	0	**29**
ACTION D Work with Guardian Watchmen programs from each community to develop and apply a coordinated survey methodology to quantify effort in sport fisheries across the Central Coast.	high	med	high	high	med	med	high	med	high	high	6	4	0	**26**
ACTION E Expand Nuxalk-led monitoring of in-river sport fisheries in Bella Coola to obtain annual estimates of sport catch, releases, and fishing effort.	high	high	high	high	med	high	high	high	high	high	9	1	0	**29**
ACTION E.I Extend river monitoring to mid-October to capture in-river sport fisheries for coho.	high	high	med	high	high	high	high	med	high	high	8	2	0	**28**

Objective 3.2 Actions	Overarching Criteria							Goal Specific Criteria			Final Scores			
	Community support	*Strengthens connections to salmon*	*DFO support and engagement*	*Community participation*	*Builds or maintains capacity*	*Costs*	*Realistic and achievable*	*Reduces biological risks to salmon*	*Leverages existing or new data to improve understanding*	*Supports adaptive management*	*High*	*Med*	*Low*	*Total*
ACTION E.II Conduct regular boat-based surveys to calibrate roadside surveys of effort to total sport fishing effort.	high	high	high	high	high	high	high	med	high	high	9	1	0	**29**
ACTION F Work with lodges to conduct DNA and scale sampling of their catches, and quantify hatchery mark-rate among sport-caught salmon.	high	high	med	low	med	high	high	med	high	high	6	3	1	**25**
ACTION G Work with DFO to provide regular reports to Nations on the number of salmon caught at fishing lodges.	high	high	med	low	med	high	high	med	high	high	6	3	1	**25**
ACTION H Work with Kitasoo/Xai'xais and North King Lodge to sample sport caught salmon from Kitasoo/Xai'xais territory	high	low	high	med	med	high	high	med	high	high	6	3	1	**25**
ACTION I Work with Wuikinuxv to understand need and opportunity for greater investments in sport fishery monitoring.	high	low	high	high	high	high	high	med	high	high	8	1	1	**27**
Strategy 3.2.4. Strengthen and expand commercial catch monitoring and sampling for genetic stock identification and CWT recovery.														
ACTION A Work with Central Coast Nations and DFO to find opportunities for more regular sampling of DNA and scales from commercially caught salmon.	high	med	med	med	high	high	high	med	high	high	6	4	0	**26**
ACTION B Coordinate with fish plants and commercial fishers from communities to improve sampling of commercial catch and quantification of bycatch in commercial openings.	high	med	med	high	high	high	high	high	high	high	8	2	0	**28**
ACTION C Hire and train independent observers from Central Coast communities to work with fishers to sample and count non-target species caught during fishery openings.	high	med	med	high	high	med	high	high	high	high	7	3	0	**27**

Objective 3.2 Actions	Overarching Criteria							Goal Specific Criteria			Final Scores			
	Community support	*Strengthens connections to salmon*	*DFO support and engagement*	*Community participation*	*Builds or maintains capacity*	*Costs*	*Realistic and achievable*	*Reduces biological risks to salmon*	*Leverages existing or new data to improve understanding*	*Supports adaptive management*	*High*	*Med*	*Low*	*Total*
Strategy 3.2.5. Use GSI data to quantify CU-level and population-specific catch in recreational, commercial, and FSC fisheries catch.														
ACTION A Work with DFO Molecular Genetics Lab and Nations to streamline processing of fin clips for genetic stock ID.	high	med	high	med	high	high	med	high	high	high	7	3	0	**27**
ACTION B Send samples from each community catch-monitoring program to DFO Molecular genetics lab annually, to determine mixed-stock catch composition and identify hatchery origin fish with parentage-based tagging (PBT).	high	med	high	high	high	med	high	high	high	high	8	2	0	**28**
ACTION C Work with DFO Molecular Genetics Lab to rerun mixed-stock fishery samples with updated baseline (e.g. Haida Gwaii, Central Coast sport and commercial).	high	high	high	low	low	high	high	high	high	high	8	0	2	**26**

TABLE A.14. Evaluation scores for all proposed actions under Goal 3, Objective 3.3.

Objective 3.3 *Characterize the vulnerability of individual salmon populations to overfishing to inform understanding of fisheries and conservation trade-offs.*

Objective 3.3 Actions	Overarching Criteria							Goal Specific Criteria			Final Scores			
	Community support	*Strengthens connections to salmon*	*DFO support and engagement*	*Community participation*	*Builds or maintains capacity*	*Costs*	*Realistic and achievable*	*Reduces biological risks to salmon*	*Leverages existing or new data to improve understanding*	*Supports adaptive management*	*High*	*Med*	*Low*	*Total*
Strategy 3.3.1. Quantify population-specific impacts of historic and contemporary mixed-stock fisheries on Central Coast salmon CUs.														
ACTION A Review existing data from coded wire tag and PBT marking projects to quantify past catch of Central Coast salmon in Alaska and Northern BC waters.	med	med	med	low	low	high	high	high	high	high	5	3	2	**23**
ACTION B Used GSI to quantify mixed-stock composition and evaluate population-specific catch impacts of ongoing commercial fisheries in Area 8.	high	med	med	med	med	med	high	high	high	high	5	5	0	**25**
ACTION C Use GSI on sport and FSC caught salmon to quantify mixed-stock composition, run-timing, and spatial distribution of salmon populations.	high	med	med	med	med	med	high	high	high	high	5	5	0	**25**
ACTION D Work with FSC fishers to conduct small-scale test fisheries in parts of Area 8 with active commercial gillnet fisheries. Use smaller mesh sizes (e.g. sockeye nets used for FSC), and compare stock composition, size, and sex of fish caught to those captured in commercial fisheries to evaluate for population, size or sex selectivity in commercial fishery interceptions.	med	med	med	high	med	high	high	high	high	high	6	4	0	**26**
Strategy 3.3.2. Apply simulation-based analytical tools to estimate demographic risks associated with a range of exploitation rates.														
ACTION A Compile existing data on escapement, run timing, catch and community use into a dataset that can be used for management strategy evaluation. (Prerequisite for ACTION B.)	high	med	med	med	med	med	high	high	med	high	4	6	0	**24**

Objective 3.3 Actions	Overarching Criteria							Goal Specific Criteria			Final Scores			
	Community support	*Strengthens connections to salmon*	*DFO support and engagement*	*Community participation*	*Builds or maintains capacity*	*Costs*	*Realistic and achievable*	*Reduces biological risks to salmon*	*Leverages existing or new data to improve understanding*	*Supports adaptive management*	*High*	*Med*	*Low*	*Total*
ACTION B Work with Central Coast Nations and DFO to develop management strategy evaluation to quantify multi-species conservation risks and opportunities associated with a range of catch scenarios and in-season catchcontrol rules. (Dependent on ACTION A.)	med	med	med	high	high	med	med	high	med	high	4	6	0	**24**
ACTION B.I Evaluate Area 8 commercial fisheries	high	med	med	high	high	med	med	high	med	high	5	5	0	**25**
ACTION B.II Evaluate Area 6/7/8 mixed-stock sport & FSC fisheries.	high	med	med	high	high	med	med	high	med	high	5	5	0	**25**
Strategy 3.3.3. Develop in-season indicators of run size and catch based on in-season escapement and catch monitoring.														
ACTION A Work with community catch monitoring programs to implement digital data entry and in-season analysis for run forecasting and adaptive management.	high	med	med	high	high	med	med	high	high	high	6	4	0	**26**
ACTION B Review examples of in-season run forecasting from around the Pacific Northwest to identify successes, failures, limitations, and opportunities to apply these tools on the central coast	med	low	med	low	med	med	high	med	low	high	2	5	3	**19**
ACTION C Build in-season forecasting models for CPUE or in-season escapement monitoring projects	high	med	med	med	high	med	med	high	low	high	4	5	1	**23**
ACTION C.I Analyze Nuxalk CPUE and Atnarko Chinook escapement to update in-season escapement forecast by end of 2021.	high	high	med	med	high	high	high	high	med	high	7	3	0	**27**
ACTION C.II Incorporate data on stock-composition in different areas of the Bella Coola to enable in-season estimates of catch on Atnarko, Salloomt, and Nusatsum Chinook.	high	high	med	med	high	med	high	high	high	high	7	3	0	**27**
ACTION C.III Analyze tagging, count and survival data from the Koeye weir to develop models for in-season forecasting and catch management.	high	med	med	med	high	high	med	high	low	high	5	4	1	**24**

Objective 3.3 Actions	Overarching Criteria							Goal Specific Criteria			Final Scores			
	Community support	*Strengthens connections to salmon*	*DFO support and engagement*	*Community participation*	*Builds or maintains capacity*	*Costs*	*Realistic and achievable*	*Reduces biological risks to salmon*	*Leverages existing or new data to improve understanding*	*Supports adaptive management*	*High*	*Med*	*Low*	*Total*
ACTION C.IV Work with Wuikinuxv and research partners to develop in-season forecasting capability for Owikeno Lake salmon using Wannock River sonar and test fishery.	high	med	med	med	high	high	med	high	low	high	5	4	1	**24**
ACTION C.V Work with Kitasoo Xai'xais to analyze FSC catch and effort data in relation to run size to evaluate the potential for in-season forecasting in priority sockeye populations.	med	low	med	med	med	high	low	high	low	high	3	4	3	**20**
ACTION D Use catch and escapement data to build models for in-season escapement forecasting to inform adaptive management of priority populations identified by First Nations and DFO.	high	med	med	med	high	med	med	high	low	high	4	5	1	**23**
ACTION E Evaluate correlation between catches of Chinook and coho at sport fishing lodges and returns to regional indicator stocks.	high	med	med	med	high	high	med	high	low	high	5	4	1	**24**
Strategy 3.3.4. Identify opportunities for implementing selective fishing technologies in salmon monitoring and catch.														
ACTION A Convene knowledge sharing workshops related to the use of terminal and selective fishing technologies.	med	high	high	high	high	med	high	high	low	med	6	3	1	**25**
ACTION B Apply selective fishing tools including weirs, beach seines, and purse seines to capture fish for monitoring actions listed above.	high	high	high	high	high	med	med	high	low	high	7	2	1	**26**
ACTION C Establish a fund to support investments in selective fishing gears for catch, monitoring, and research.	high	high	low	high	high	med	med	high	low	high	6	2	2	**24**

TABLE A.15. Evaluation scores for all proposed actions under Goal 4, Objective 4.1.

Objective 4.1 *Evaluate current climate pressures on estuary, marine, and freshwater salmon habitats.*

Objective 4.1 Actions	Overarching Criteria							Goal Specific Criteria			Final Scores			
	Community support	*Strengthens connections to salmon*	*DFO support and engagement*	*Community participation*	*Builds or maintains capacity*	*Costs*	*Realistic and achievable*	*Reduces biological risks to salmon*	*Leverages existing or new data to improve understanding*	*Supports adaptive management*	*High*	*Med*	*Low*	*Total*
Strategy 4.1.1. Identify and collate data on all current and historical climate-related monitoring on the Central Coast.														
ACTION A Compile historical climate-related information (e.g. temperature data) from Stream Inspection. Logs and other historical data sources. (Prerequisite for STRATEGY 4.1.2.)	high	low	med	low	low	med	high	low	high	med	3	3	4	**19***
ACTION B Summarize the available data and the data gaps by habitat type (estuarine, marine, freshwater). (Prerequisite for STRATEGY 4.1.2.)	med	low	med	low	low	med	high	low	high	med	2	4	4	**18***
Strategy 4.1.2. Work with Central Coast Nations to Identify climate indicators that can be used to help monitor current climate stressors on salmon. (All actions below are dependent on STRATEGY 4.1.1. ACTION A and B.)														
ACTION A Compile list of candidate climate indicators that can be used to monitor climate conditions. (Prerequisite for STRATEGY 4.1.3.)	high	med	med	med	low	high	high	low	med	med	3	5	2	**21***
ACTION B Assess the availability of data to inform climate indicators. (Prerequisite for STRATEGY 4.1.3.)	med	med	med	low	low	high	high	low	med	med	2	5	3	**19***
ACTION C Identify final list of climate indicators. (Prerequisite for STRATEGY 4.1.3.)	med	med	med	med	low	high	high	low	med	med	2	6	2	**20***

* This action has been included in the final *Monitoring Framework*, despite receiving less than 24 points, because it is considered a 'prerequisite' for other actions.

Objective 4.1 Actions	Overarching Criteria							Goal Specific Criteria			Final Scores			
	Community support	*Strengthens connections to salmon*	*DFO support and engagement*	*Community participation*	*Builds or maintains capacity*	*Costs*	*Realistic and achievable*	*Reduces biological risks to salmon*	*Leverages existing or new data to improve understanding*	*Supports adaptive management*	*High*	*Med*	*Low*	*Total*
Strategy 4.1.3. Establish and implement a Central Coast-wide climate monitoring strategy using the identified climate indicators (All actions below are dependent on STRATEGY 4.1.2. ACTIONS A, B, and C.)														
ACTION A Establish coordinated regional strategy for climate monitoring in priority salmon watersheds on the Central Coast.	high	med	med	med	high	med	high	med	high	high	5	5	0	**25**
ACTION B Support communities and research partners in collecting data and sharing via a centralized data platform.	high	med	med	med	high	med	high	med	high	high	5	5	0	**25**
ACTION C Evaluate climate data compared to established benchmarks (or reference points) to inform where current climate stressors are posing a high risk to salmon.	high	med	high	low	med	med	high	med	high	high	5	4	1	**24**
ACTION D Visualize climate data and climate-related risks to salmon online through available tools (e.g. Pacific salmon Explorer).	med	med	med	low	low	med	med	low	high	med	1	6	3	**18**
ACTION E Identify opportunities to collect climate information as part of the Guardian Watchman program or other ongoing community-led stewardship efforts.	high	med	med	med	med	med	high	low	low	high	3	5	2	**21**
Strategy 4.1.4. Evaluate the relative vulnerability of salmon CUs to future climate change projections.														
ACTION A Analyze existing climate-related datasets and create regional models to project future change and identify areas at high risks from climate change.	high	med	med	low	low	med	med	med	high	med	2	6	2	**20**
ACTION B Undertake expert-based assessments to interpret empirical data and assess life-stage specific vulnerabilities of salmon to climate change.	med	med	med	med	low	med	high	med	high	high	3	6	1	**22**

Objective 4.1 Actions	Overarching Criteria							Goal Specific Criteria			Final Scores			
	Community support	*Strengthens connections to salmon*	*DFO support and engagement*	*Community participation*	*Builds or maintains capacity*	*Costs*	*Realistic and achievable*	*Reduces biological risks to salmon*	*Leverages existing or new data to improve understanding*	*Supports adaptive management*	*High*	*Med*	*Low*	*Total*
Strategy 4.1.5. Develop and evaluate conservation and management strategies to mitigate the impacts of climate change.														
ACTION A Work with research partners to develop model for pre-season forecasting based on climate conditions.	high	med	low	low	low	med	med	med	high	high	3	4	3	**20**
ACTION B Develop in-season forecasting models that account for temperature-mediated mortality to ensure escapement goals are met.	med	low	low	low	low	med	med	high	high	high	3	3	4	**19**
ACTION C Produce annual report to First Nations and DFO on climate conditions and their effects on Central Coast salmon populations.	high	med	med	med	med	med	high	med	high	high	4	6	0	**24**

April 8, 2021