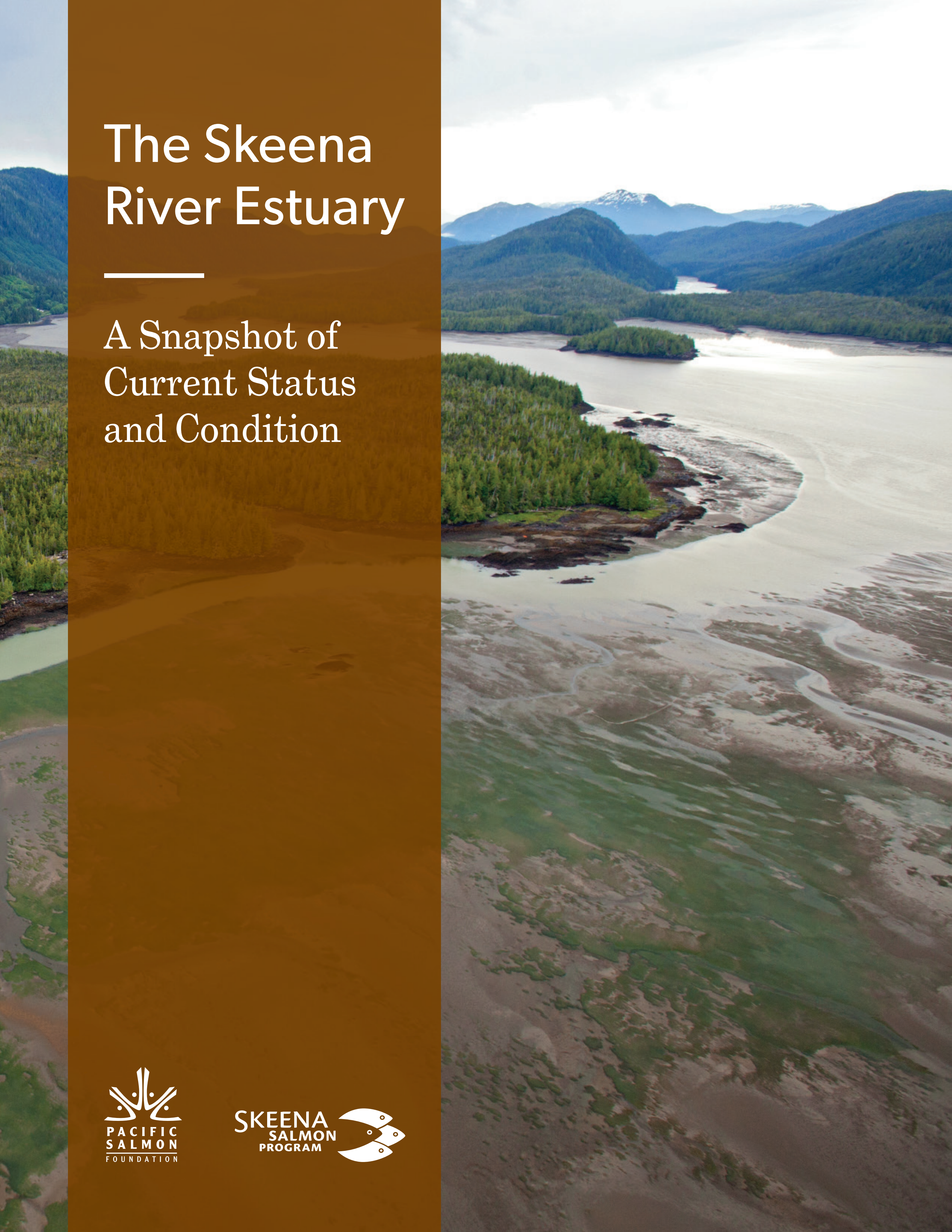


The Skeena River Estuary

A Snapshot of Current Status and Condition

PACIFIC SALMON FOUNDATION

SKEENA SALMON PROGRAM

The Pacific Salmon Foundation undertook an assessment of the health and condition of the Skeena River estuary from the perspective of salmon. Specifically, we asked:

- ***What are the key pressures on salmon habitat?***
- ***What is the status of salmon habitat in the Skeena River estuary?***
- ***What are critical gaps in our understanding of the Skeena River estuary?***

With input from a regional technical advisory committee, we generated a snapshot of the current status of the estuary, established a baseline for monitoring changes in the condition of the estuary over time, and developed a framework for evaluating key pressures on salmon habitat in the Skeena River estuary.

This project revealed considerable gaps in information for the Skeena River estuary, highlighting the need for increased monitoring and assessment of trends in estuary indicators. We recommend that future monitoring efforts focus on four priority topics:

- ***The distribution and abundance of juvenile salmon.***
- ***The growth and condition of juvenile salmon.***
- ***The extent of eelgrass.***
- ***The density and diversity of salmon food.***

Addressing these knowledge gaps should be an immediate priority for government agencies, First Nations, and all stakeholders with an interest in the Skeena River estuary. By building our collective knowledge of Skeena salmon and their habitats, local communities will be better equipped to identify conservation priorities for the region.

Photo Credit : Paul Colangelo

Project Overview

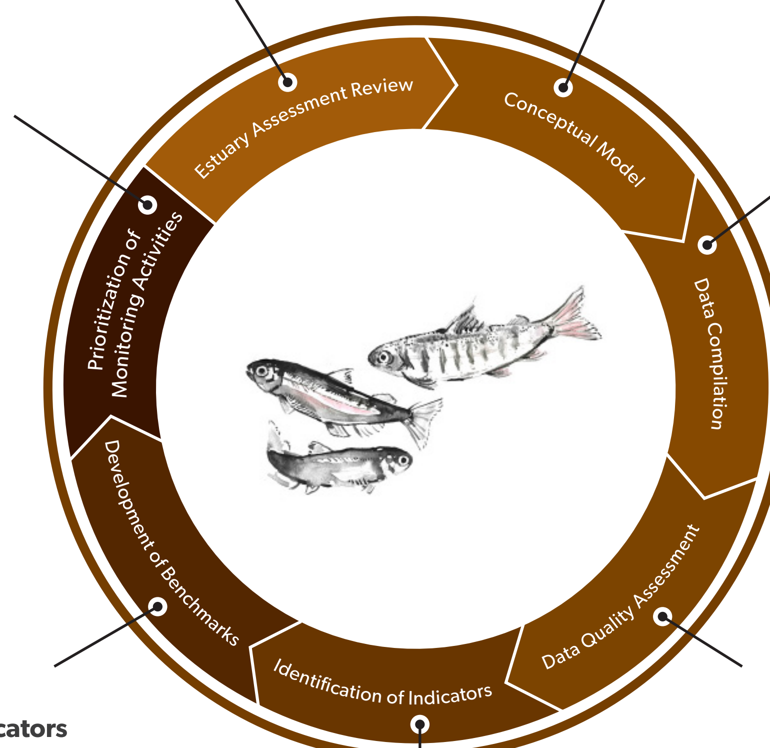
This project assessed key pressures on salmon habitat in the Skeena River estuary. We used benchmarks to assess the status of salmon habitat indicators and identified critical knowledge gaps and future monitoring needs. The assessment was supported by a comprehensive effort to compile the best available data for the Skeena River estuary, which are stored in a centralized online database that is accessible to the public on the Skeena Salmon Program website.

Estuary Assessment Review
A literature review of other estuary assessments informed the design of the framework for the assessment.

Conceptual Model
A salmon-focused conceptual model was developed to provide a common understanding of the key factors influencing salmon populations in the Skeena River estuary.

Prioritization of Monitoring Activities
Gaps and limitations in the available data were identified to inform priorities for future monitoring and critical data collection needs.

Data Compilation
Existing relevant datasets were identified, compiled, and made available to the public through an online database.



Development of Benchmarks & Assessment of Indicators
Benchmark values were identified and used to assess the status of each estuary indicator.

Data Quality Assessment
A data quality assessment was undertaken to systematically and objectively review the quality of datasets relevant to the Skeena River estuary.

Identification of Indicators
Indicators were identified to assess key pressures on salmon habitat and the health and status of the estuary.

Illustration Credit : Aimée van Drimmelen

Pacific Salmon & The Skeena Watershed

The Skeena watershed in northern British Columbia is one of the most productive and biologically diverse watersheds in Canada. With an area of 55,000 km^2, it is the second largest salmon-producing watershed in the province (after the Fraser). The Skeena supports five species of Pacific salmon (sockeye, pink, chinook, coho, and chum) and provides spawning and rearing habitat for over 50 genetically and geographically distinct populations of wild salmon, called Conservation Units. As these populations return to their natal streams, spawn and die, they become an important source of marine nutrients for freshwater and riparian ecosystems.

The Skeena's abundant and diverse salmon populations have supported First Nations for millennia, with wild salmon featuring prominently in First Nations cultures and economies. Skeena salmon populations also support commercial fisheries, tidal and freshwater recreational fisheries, and numerous tourism and recreational opportunities.

Over time, however, cumulative pressures from human activities, in combination with changing ocean conditions, can alter water quality, degrade important freshwater and marine habitats, and reduce food availability for juvenile salmon populations as they transit through the Skeena River estuary. Understanding and documenting the current status of key pressures on salmon habitat in the Skeena River estuary is an essential part of evaluating and tracking potential changes in habitat status over time and identifying strategies to minimize risks to wild salmon populations.

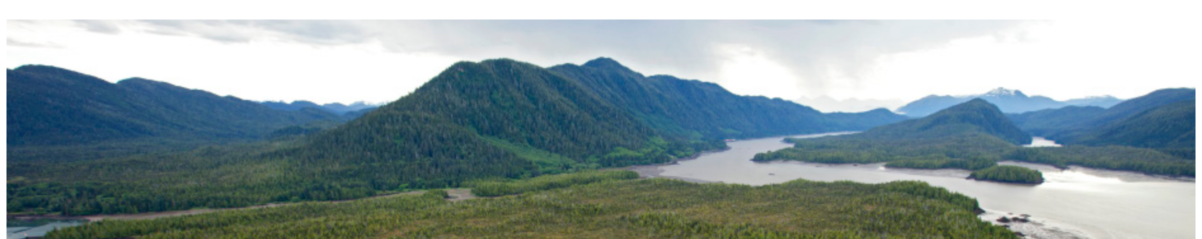
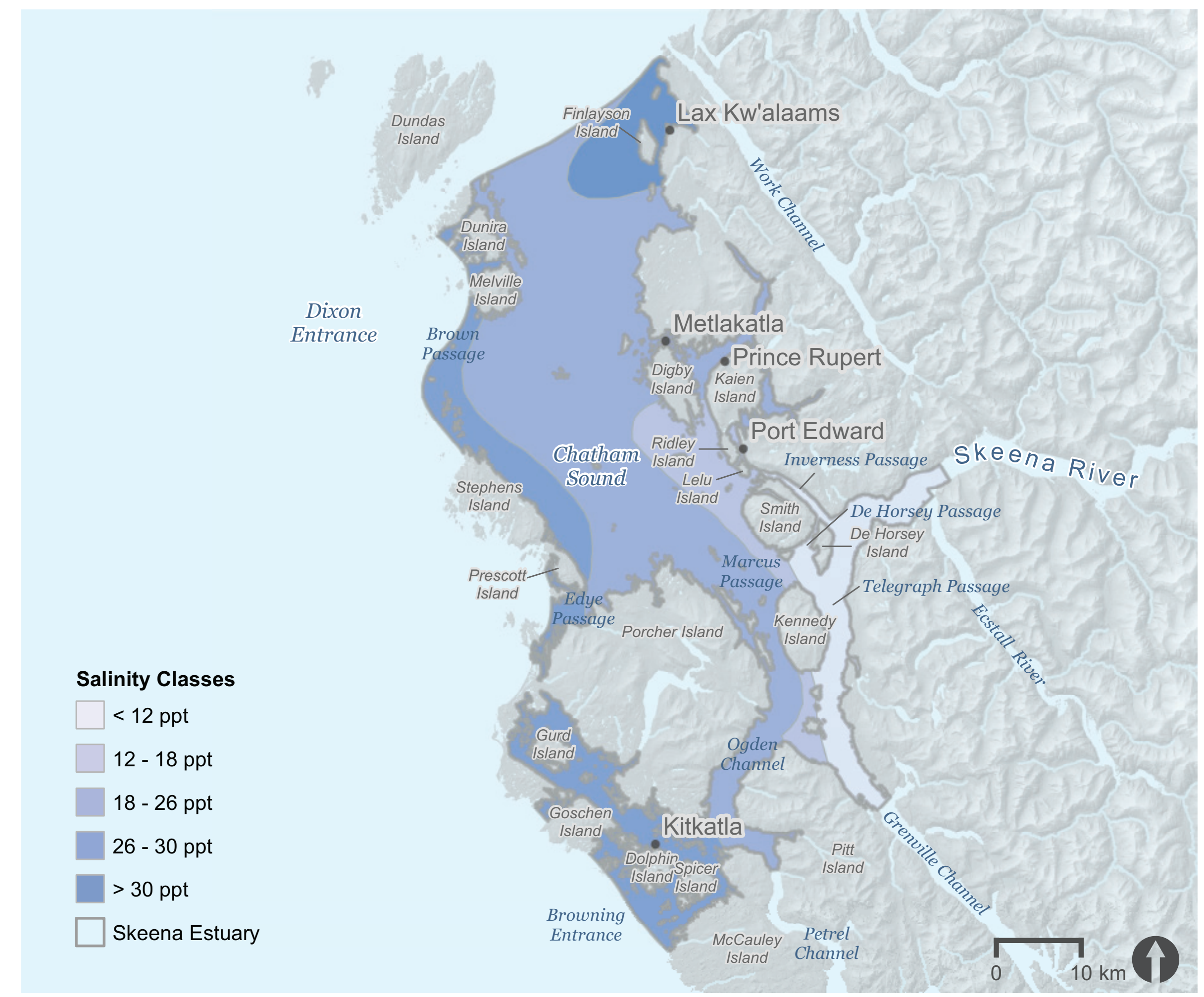


Photo Credit : Brian Huntington

The Skeena River Estuary

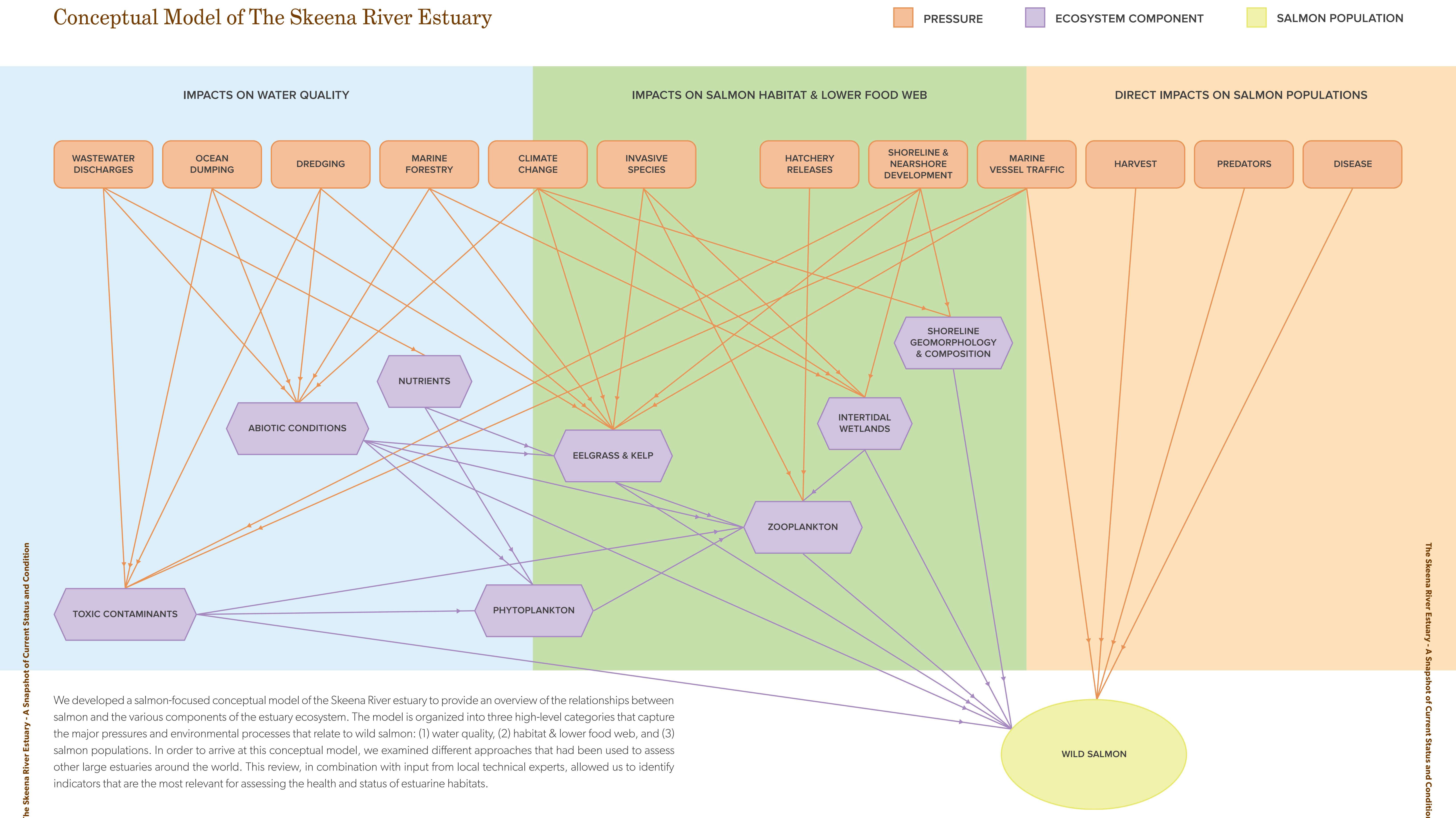
The Skeena River estuary is comprised of extensive mudflats and shallow intertidal passages that provide important nursery habitat for juvenile salmon. Hundreds of millions of juvenile salmon travel through the Skeena River estuary as they migrate out to sea. As they leave freshwater and enter the ocean, juvenile salmon encounter differences in topography, salinity, water temperature, turbidity, tides and currents, food abundance, and predator populations. Estuaries act as critical nursery habitats and transition zones where juvenile salmon can grow rapidly and gradually adapt to their new saltwater environment. They also provide refuge from predators due to high turbidity, estuarine vegetation (such as eelgrass and kelp beds), and riparian vegetation. Growth attained in the estuary can influence whether juvenile salmon survive to a reproductive age.

Maintaining the integrity and function of these estuarine habitats is important for supporting healthy and productive Skeena salmon populations. However, there is limited information on how long juvenile salmon spend in the Skeena River estuary, the extent of eelgrass habitat, and the availability of food for juvenile salmon. These knowledge gaps hinder our ability to both assess the status of estuarine habitats for Skeena salmon and employ strategies for protecting and mitigating threats to these important habitats.



Skeena estuary boundary and salinity classes: As juvenile salmon transit through the Skeena River estuary out to sea, they experience a range of salinities with differing levels of productivity and habitat suitability. To reflect these differences, we partitioned the estuary into five distinct salinity classes.

Conceptual Model of The Skeena River Estuary



We developed a salmon-focused conceptual model of the Skeena River estuary to provide an overview of the relationships between salmon and the various components of the estuary ecosystem. The model is organized into three high-level categories that capture the major pressures and environmental processes that relate to wild salmon: (1) water quality, (2) habitat & lower food web, and (3) salmon populations. In order to arrive at this conceptual model, we examined different approaches that had been used to assess other large estuaries around the world. This review, in combination with input from local technical experts, allowed us to identify indicators that are the most relevant for assessing the health and status of estuarine habitats.

Estuary Report Card

For each of the selected indicators, benchmarks were identified as points of reference against which the value of each indicator was compared. Using the established benchmarks, each indicator was given a status designation within each of the five salinity zones: good (green), fair (yellow), poor (red), or insufficient data (grey). In some cases, benchmarks were not available and average or absolute values were used. In addition to assessing the status of each indicator, we also evaluated the relevance of each dataset to our project, as well as its scientific quality. The datasets were given a data quality score of * (poor quality) to *** (high quality). This data quality rating facilitated an objective evaluation of each of the available datasets.

Photo Credits : Tavish Campbell

Water Quality
Human activities can alter physical and chemical properties within the estuary, which indirectly affect salmon.

Habitat & Lower Food Web
Salmon can be indirectly affected by pressures that alter the habitats they inhabit or the organisms they consume.

Direct Pressures on Salmon Populations
Pressures, such as the abundance of predators, can directly affect salmon populations.

Wild Salmon
The health, abundance, and diversity of wild salmon populations reflect the cumulative effects of the suite of pressures acting directly or indirectly upon them.

	Indicator	Salinity Zone (in ppt)					Data Quality	
		< 12	12-18	18 - 26	26 - 30	> 30	Relevance	Scientific
Water Quality	Wastewater Discharge Sites						★★★	★★★
	Disposal at Sea Sites						★★★	★★★
	Dredging Extent							
	Log Boom Sites						★★★	★★★
	Water Column Chemical Contaminants - Arsenic						★★	★★
	Water Column Chemical Contaminants - Mercury						★★	★★
	Water Column Chemical Contaminants - Naphthalene						★★	★★
	Water Column Bacterial Contaminants - Enterococci						★★	★★
	Water Column Bacterial Contaminants - Fecal Coliform						★★	★★
	Sediment Chemical Contaminants							
	Turbidity or Total Suspended Sediments (TSS)						★★★	★★
	Dissolved Oxygen (DO)						★★	★★
	pH						★★	★★
	Sea Surface Temperature (SST)[1]		7.8°C	8.1°C			★★	★★
	UV							
	Phosphorus Concentration (P)						★★	★★
	Nitrate Concentration (N)						★★	★★
Habitat & Lower Food Web	Invasive Species Distribution or Abundance							
	Shoreline & Nearshore Development Extent						★★	★★★
	Hatchery Salmon Abundance							
	Marine Vessel Traffic Density – all vessel sizes[1]	35hrs	73hrs	109hrs	15hrs	27hrs	★★	★★★
	Marine Vessel Traffic Density – vessels > 200m[1]	0.4hrs	7.2hrs	4.9hrs	1.6hrs	0hrs		
	Intertidal Wetlands Extent						★★	★★★
	Chlorophyll a Concentration – direct sampling						★★	★★
	Chlorophyll a Concentration – remote sensing						★★	★★★
	Algae Bloom Number or Extent							
	Native Eelgrass Extent - # of beds[2]	1	295	419	173	65	★★	★★★
	Native Eelgrass Extent - % shoreline[2]	1%	11%	39%	44%	6%		
	Native Macroalgae Extent - # of beds[2]	17	62	229	478	15	★★	★★★
	Native Macroalgae Extent - % shoreline[2]	2%	6%	30%	60%	6%		
	Zooplankton Density or Diversity[1]	$14.4/m^3$	$22.8/m^3$	$74.5/m^3$			★	★★
	Intact Riparian Vegetation Extent						★★	★★★
Salmon Populations	Commercial Harvest	*Assessed in other PSF projects*						
	Recreational Harvest							
	Predatory Fish Distribution or Abundance							
	Marine Mammal Distribution or Abundance						★★	★★★
	Predatory Seabird Distribution or Abundance							
	Disease & Pathogen Prevalence							
Wild Salmon	Adult Salmon Abundance	*Assessed in other PSF projects*						
	Smolt Survival	*Assessed in other PSF projects*						
	Smolt Growth							
	Smolt Density							
	Smolt Residence Time							

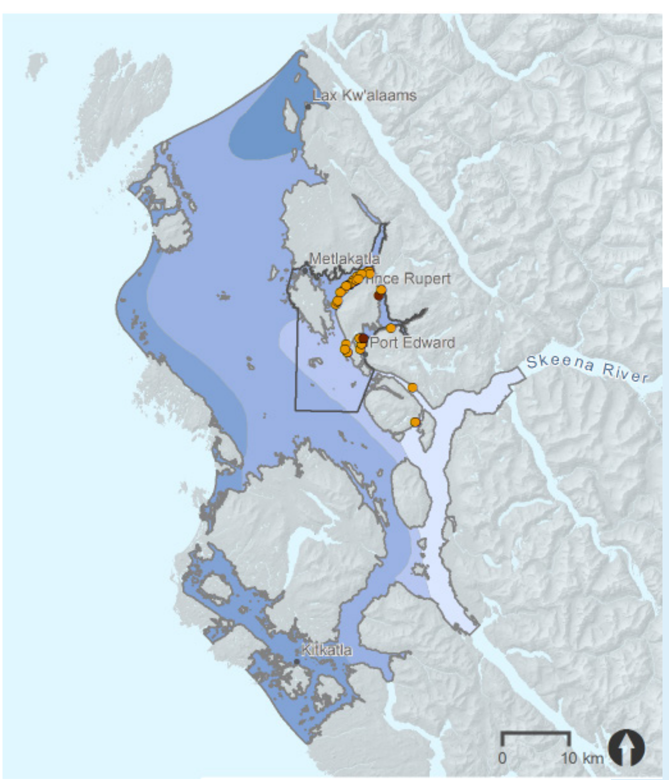
[1] In the absence of benchmarks, average values are reported.
[2] In the absence of benchmarks, absolute values are reported.

Good | Fair | Poor | Insufficient Data (see Data Gaps & Monitoring Priorities)

Status of Estuary Indicators

The maps on the following pages display the status of each of the estuary indicators using the datasets that were available at the time this project was undertaken. This collection of indicators provides information about the degree of stress on estuarine habitats from human-related and natural pressures, as well as information about the current condition of the water, food, habitat, and salmon populations within the estuary. These maps help to identify baseline conditions against which future changes in the status of individual indicators can be evaluated over time. The data used for this assessment are available publicly through the Skeena Salmon Program website.

Photo Credit : Tavish Campbell



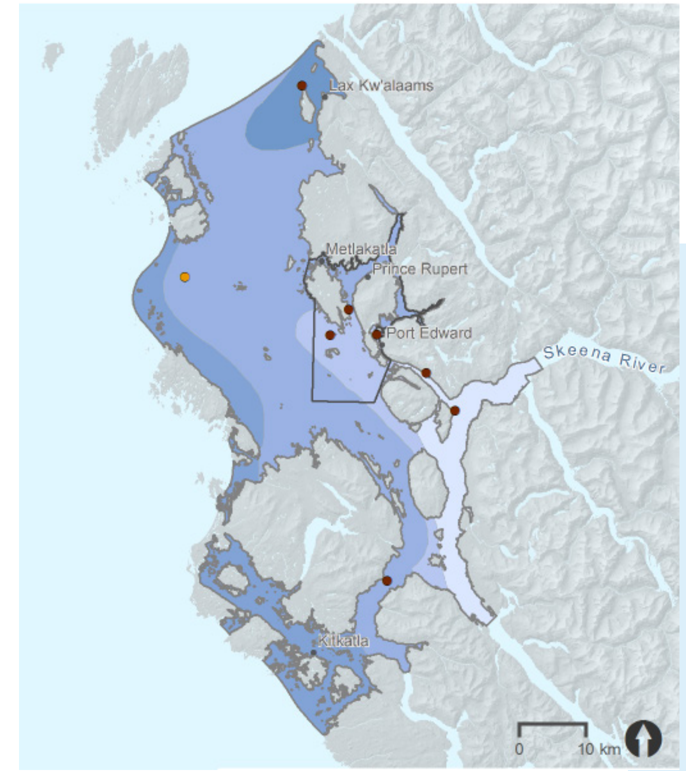
Wastewater Discharge Sites

Wastewater may contain high concentrations of chemical and bacterial contaminants and nutrients that can alter water quality, thereby affecting the productivity of eelgrass beds and salmon growth and survival.

Water Discharges (2015)
- Effluent
- Refuse

Salinity Classes
- < 12 ppt
- 12 - 18 ppt
- 18 - 26 ppt
- 26 - 30 ppt
- > 30 ppt

- Prince Rupert Port Authority Jurisdiction
- Skeena Estuary



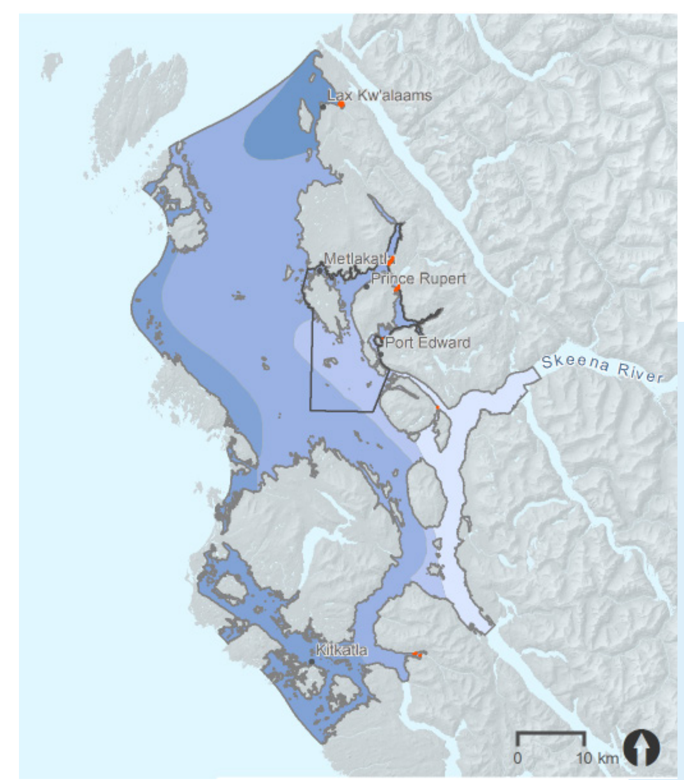
Disposal at Sea Sites

Ocean dumping may introduce chemical and bacterial contaminants and nutrients that can alter water quality, thereby affecting the productivity of eelgrass beds as well as salmon growth and survival.

Disposal at Sea Sites (2013)
Status
- Active
- Historical

Salinity Classes
- < 12 ppt
- 12 - 18 ppt
- 18 - 26 ppt
- 26 - 30 ppt
- > 30 ppt

- Prince Rupert Port Authority Jurisdiction
- Skeena Estuary



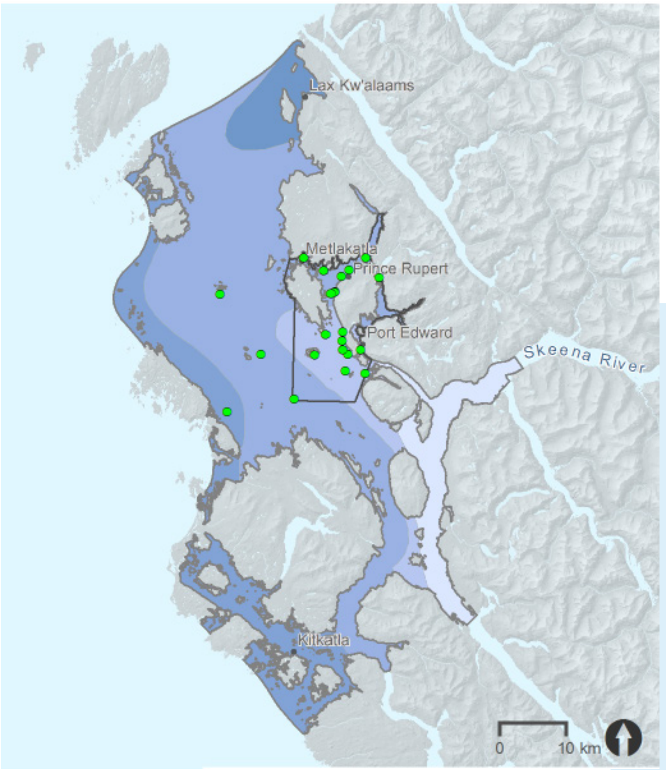
Log Boom Sites

The introduction of excessive wood debris, reduced productivity by shading marine vegetation, or physical alteration from grounded logs may reduce water quality in nearshore habitat at log booming sites.

Log Storage and Handling (2015)
- Tenure Area

Salinity Classes
- < 12 ppt
- 12 - 18 ppt
- 18 - 26 ppt
- 26 - 30 ppt
- > 30 ppt

- Prince Rupert Port Authority Jurisdiction
- Skeena Estuary



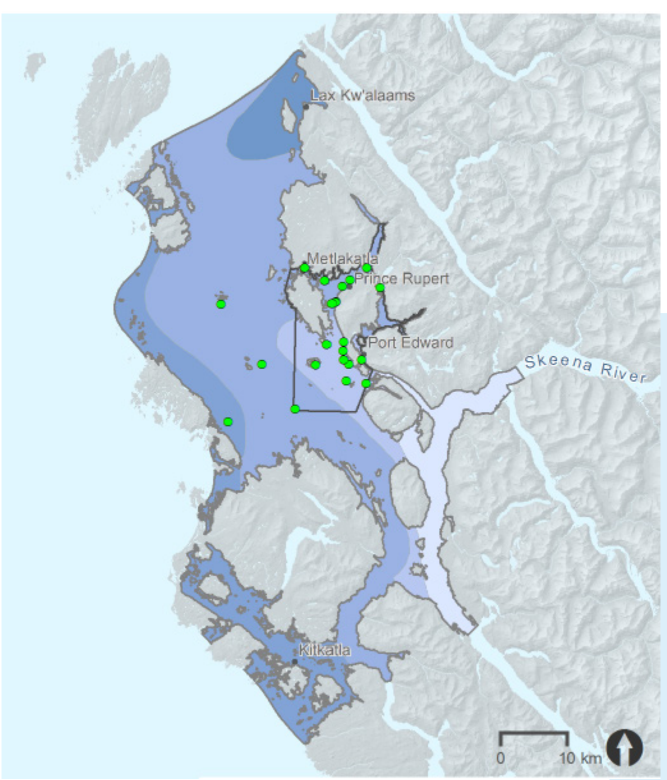
Water Column Chemical Contaminants – Arsenic

High levels of contaminants can impact water quality by lowering pH and increasing the presence of dissolved metals in the estuary. If sufficiently toxic, contaminants may adversely affect the growth and survival of juvenile salmon and their prey.

Arsenic (Spring 2013)
- < 0.0125 mg/L
- > 0.0125 mg/L

Salinity Classes
- < 12 ppt
- 12 - 18 ppt
- 18 - 26 ppt
- 26 - 30 ppt
- > 30 ppt

- Prince Rupert Port Authority Jurisdiction
- Skeena Estuary



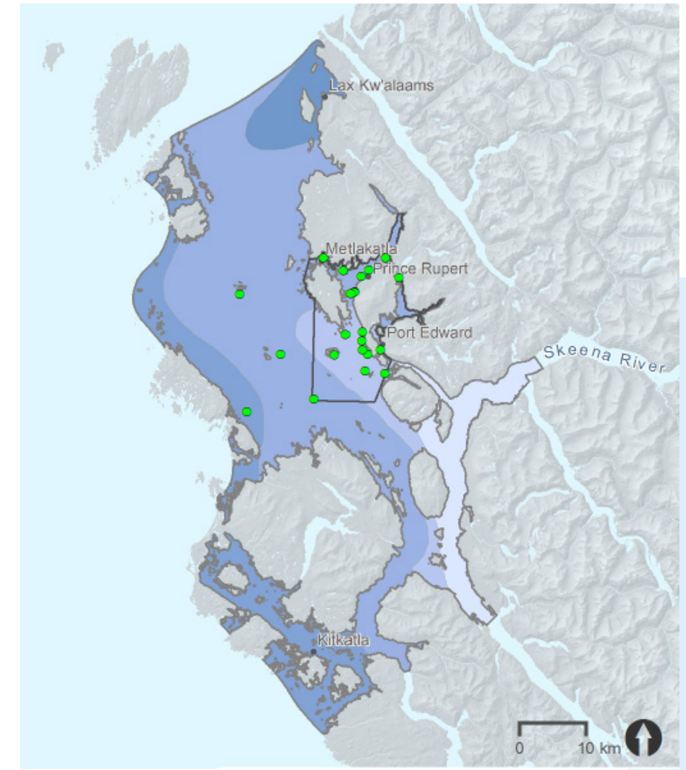
Water Column Chemical Contaminants – Mercury

High levels of contaminants can impact water quality by lowering pH and increasing the presence of dissolved metals in the estuary. If sufficiently toxic, contaminants may adversely affect the growth and survival of juvenile salmon and their prey.

Mercury (Spring 2013)
- < 0.000016 mg/L
- > 0.000016 mg/L

Salinity Classes
- < 12 ppt
- 12 - 18 ppt
- 18 - 26 ppt
- 26 - 30 ppt
- > 30 ppt

- Prince Rupert Port Authority Jurisdiction
- Skeena Estuary



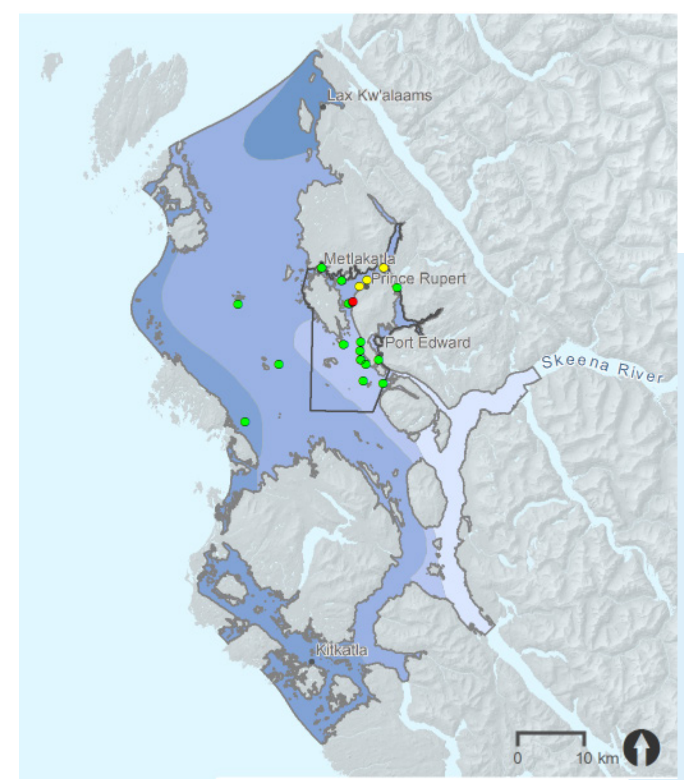
Water Column Chemical Contaminants – Naphthalene

High levels of contaminants can impact water quality in the estuary. If sufficiently toxic, napthalene may adversely affect the growth and survival of juvenile salmon and their prey.

Naphthalene (Spring 2013)
- < 0.0014 µg/L
- > 0.0014 µg/L

Salinity Classes
- < 12 ppt
- 12 - 18 ppt
- 18 - 26 ppt
- 26 - 30 ppt
- > 30 ppt

- Prince Rupert Port Authority Jurisdiction
- Skeena Estuary



Water Column Bacterial Contaminants – Enterococci

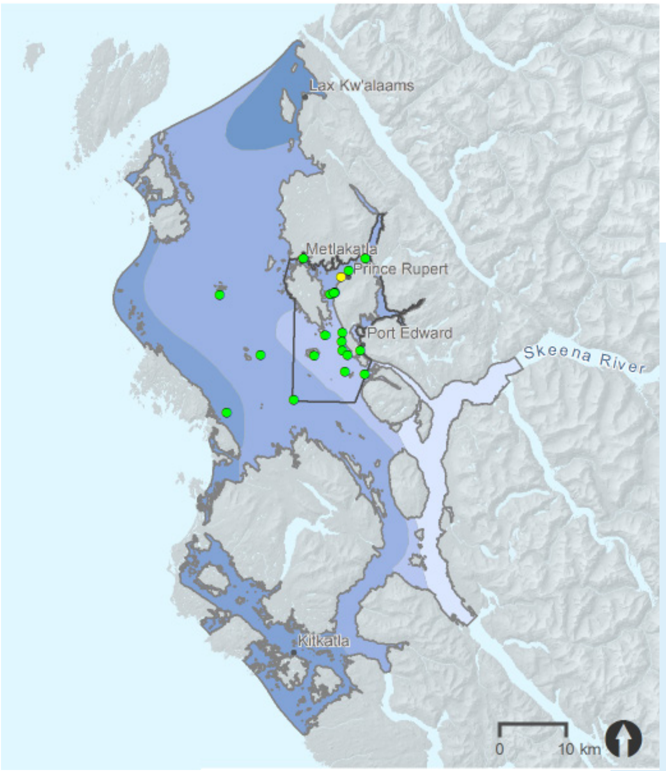
High concentrations of bacterial contaminants can reduce water quality in the estuary and create poor conditions for salmon growth and survival.

Enterococci (Spring 2013)
- < 4 CFU/100 mL
- 4 - 11 CFU/100 mL
- > 11 CFU/100 mL

Salinity Classes
- < 12 ppt
- 12 - 18 ppt
- 18 - 26 ppt
- 26 - 30 ppt
- > 30 ppt

- Prince Rupert Port Authority Jurisdiction
- Skeena Estuary

Water Column Bacterial Contaminants – Fecal Coliform



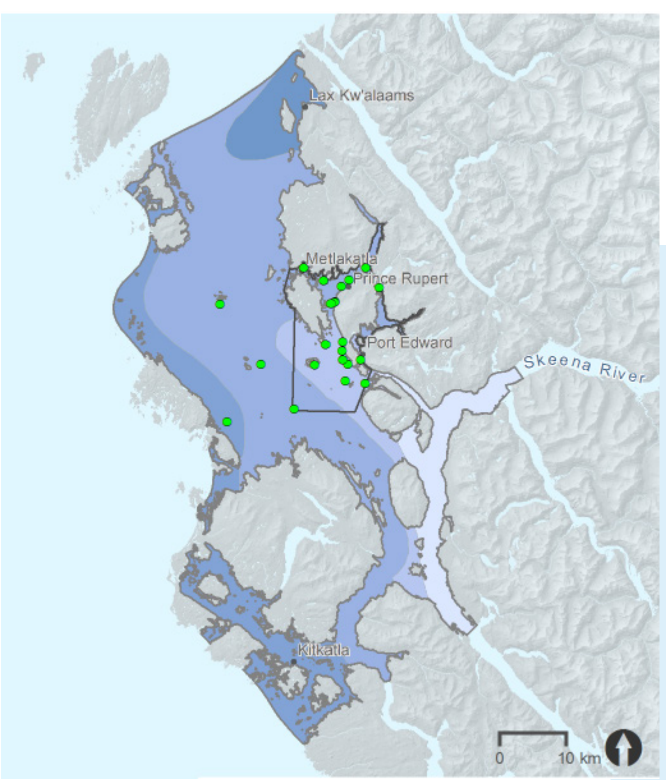
High concentrations of bacterial contaminants can reduce water quality in the estuary and create poor conditions for salmon growth and survival.

Fecal Coliform (Spring 2013)
- < 14 CFU/100 mL
- 14 - 43 CFU/100 mL
- > 43 CFU/100 mL

Salinity Classes
- < 12 ppt
- 12 - 18 ppt
- 18 - 26 ppt
- 26 - 30 ppt
- > 30 ppt

- Prince Rupert Port Authority Jurisdiction
- Skeena Estuary

Turbidity or Total Suspended Sediments



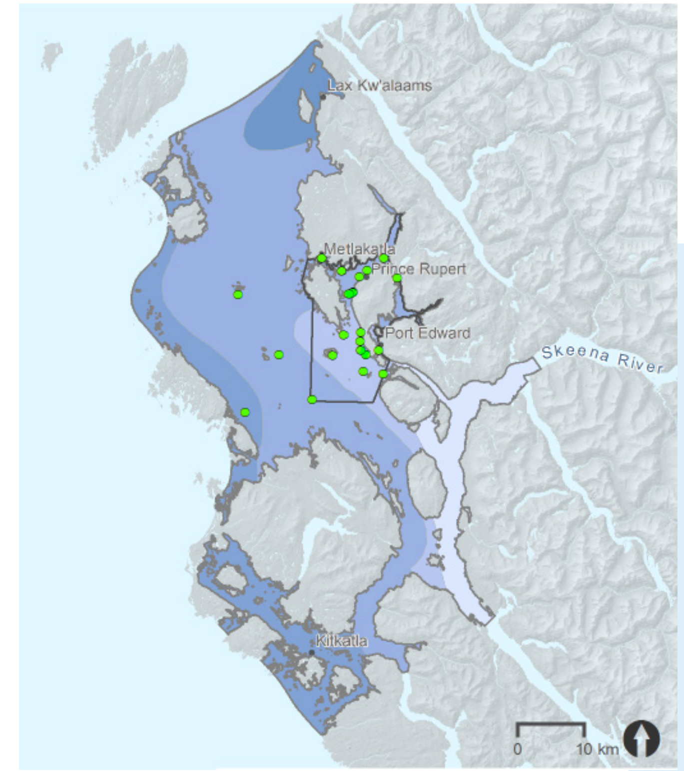
High levels of sediment and turbidity can reduce water quality in the estuary. Both of these conditions may affect the growth of eelgrass beds, the availability of food, and the survival of juvenile salmon.

Total Suspended Sediments (Spring 2013)
- < 25 mg/L
- 25 - 80 mg/L
- > 80 mg/L

Salinity Classes
- < 12 ppt
- 12 - 18 ppt
- 18 - 26 ppt
- 26 - 30 ppt
- > 30 ppt

- Prince Rupert Port Authority Jurisdiction
- Skeena Estuary

Dissolved Oxygen



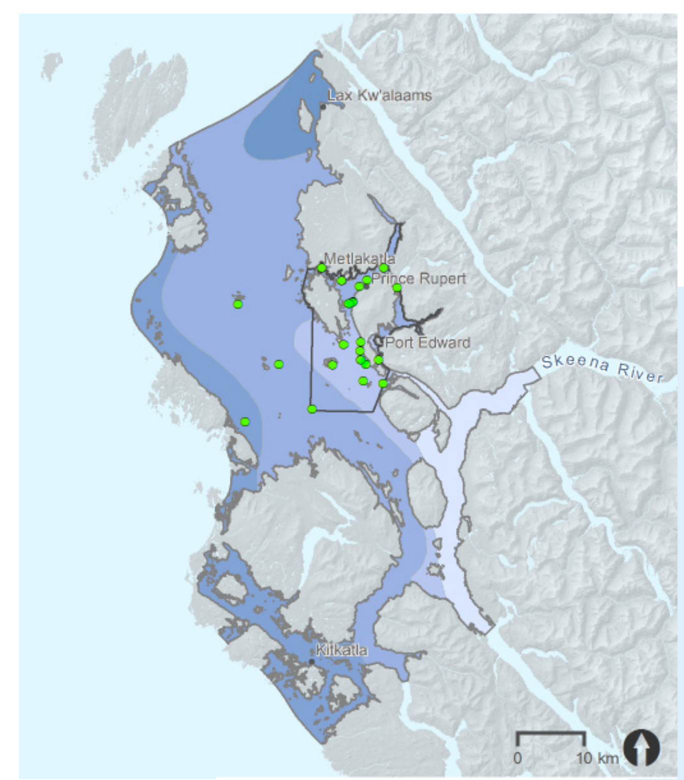
Low levels of dissolved oxygen can affect the growth and development of juvenile salmon, as well as their swimming, feeding, and reproductive ability. Under extreme conditions, low dissolved oxygen concentrations can be lethal to salmon.

Dissolved Oxygen (Spring 2013)
- > 5 mg/L
- 2 - 5 mg/L
- < 2 mg/L

Salinity Classes
- < 12 ppt
- 12 - 18 ppt
- 18 - 26 ppt
- 26 - 30 ppt
- > 30 ppt

- Prince Rupert Port Authority Jurisdiction
- Skeena Estuary

pH



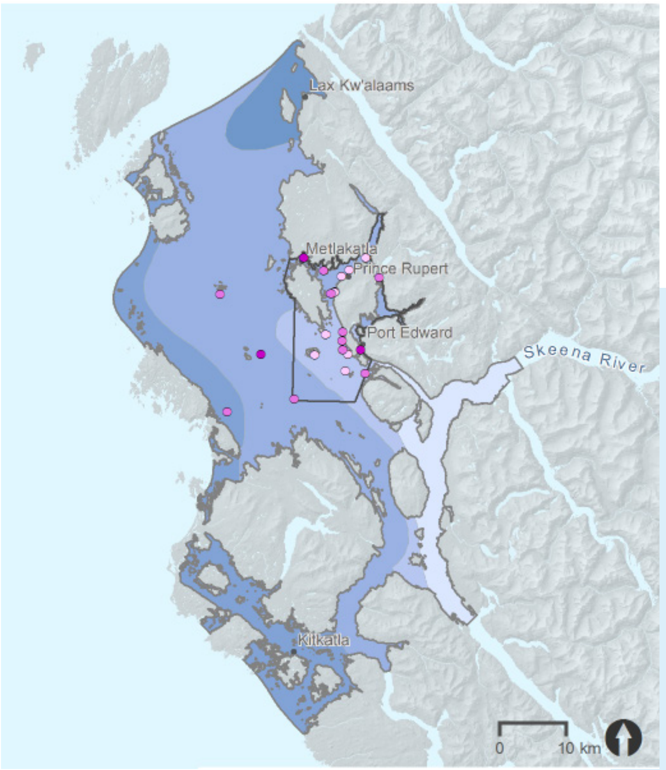
Salmon populations are adversely impacted by both acute and chronic exposure to low pH. Changes in pH could create local conditions in the estuary below the tolerance range for salmon growth and survival.

pH (Spring 2013)
- 7.0 - 8.7
- < 7.0 or > 8.7

Salinity Classes
- < 12 ppt
- 12 - 18 ppt
- 18 - 26 ppt
- 26 - 30 ppt
- > 30 ppt

- Prince Rupert Port Authority Jurisdiction
- Skeena Estuary

Sea Surface Temperature



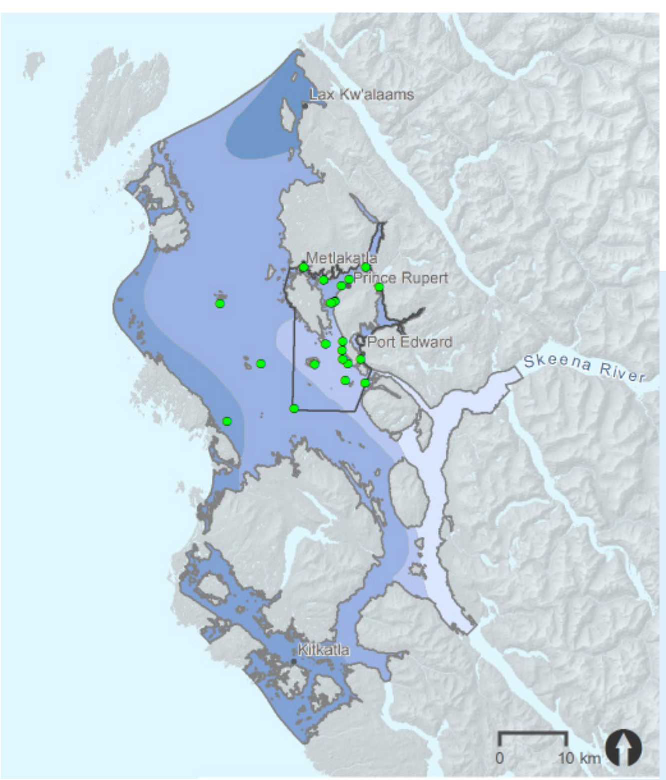
Broad-scale changes in sea surface temperature could limit the distribution and growth of eelgrass beds and alter species assemblages within coastal ecosystems. Changes in prey distribution, habitat availability, and the presence of new predators could directly impact the health and survival of juvenile salmon.

Sea Surface Temperature (Spring 2013)
- 6.4 - 7.6°C
- 7.6 - 8.6°C
- 8.6 - 9.9°C

Salinity Classes
- < 12 ppt
- 12 - 18 ppt
- 18 - 26 ppt
- 26 - 30 ppt
- > 30 ppt

- Prince Rupert Port Authority Jurisdiction
- Skeena Estuary

Phosphorus Concentration



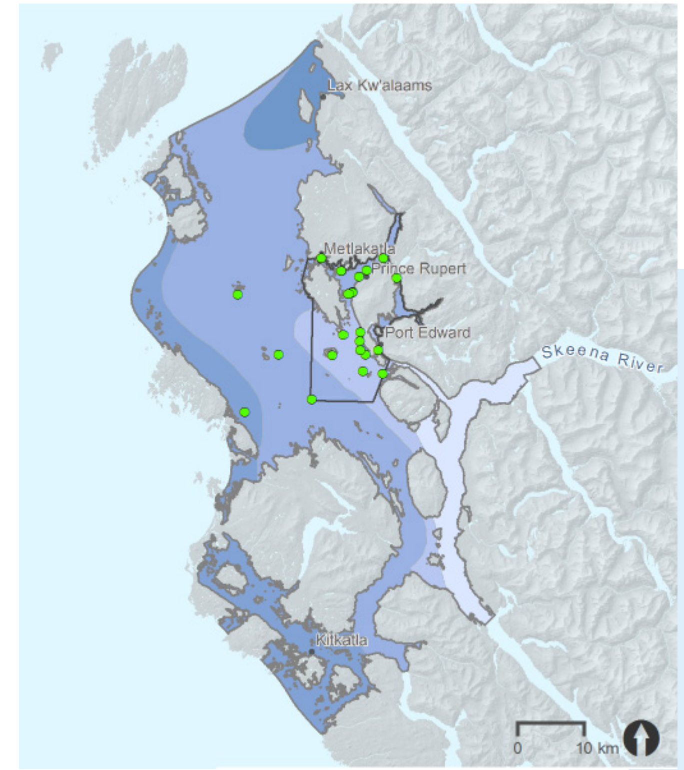
Excessive nutrient levels can stimulate phytoplankton growth and contribute to the development of noxious algae blooms in coastal ecosystems. This condition can deplete dissolved oxygen in the water column, potentially harming juvenile salmon and aquatic vegetation.

Total Dissolved Phosphorus (Spring 2013)
- < 0.07 mg/L
- 0.07 - 0.1 mg/L
- > 0.1 mg/L

Salinity Classes
- < 12 ppt
- 12 - 18 ppt
- 18 - 26 ppt
- 26 - 30 ppt
- > 30 ppt

- Prince Rupert Port Authority Jurisdiction
- Skeena Estuary

Nitrate Concentration



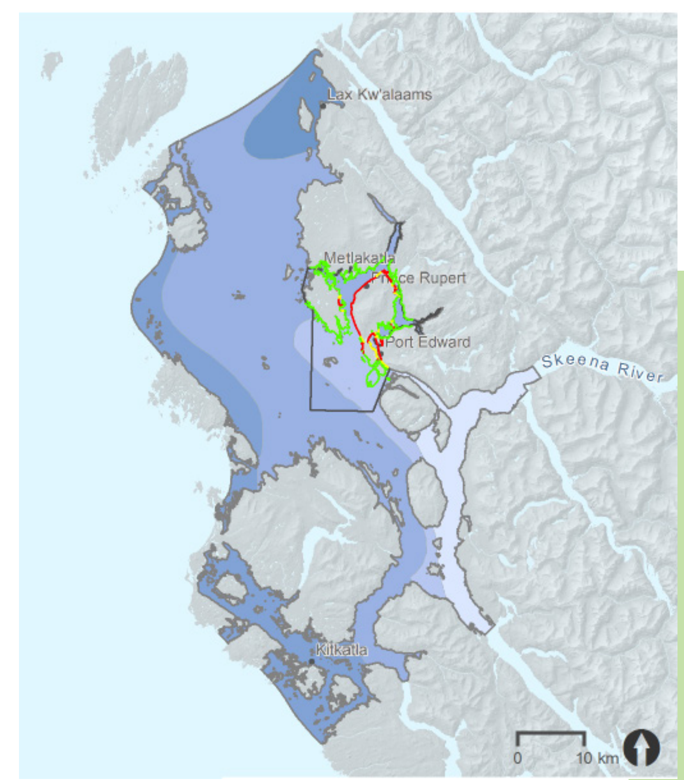
Excessive nutrient levels can stimulate phytoplankton growth and contribute to the development of noxious algae blooms in coastal ecosystems. This condition can deplete dissolved oxygen in the water column, potentially harming juvenile salmon and aquatic vegetation.

Nitrate Concentration (Spring 2013)
- < 200 mg/L
- > 200 mg/L

Salinity Classes
- < 12 ppt
- 12 - 18 ppt
- 18 - 26 ppt
- 26 - 30 ppt
- > 30 ppt

- Prince Rupert Port Authority Jurisdiction
- Skeena Estuary

Shoreline & Nearshore Development

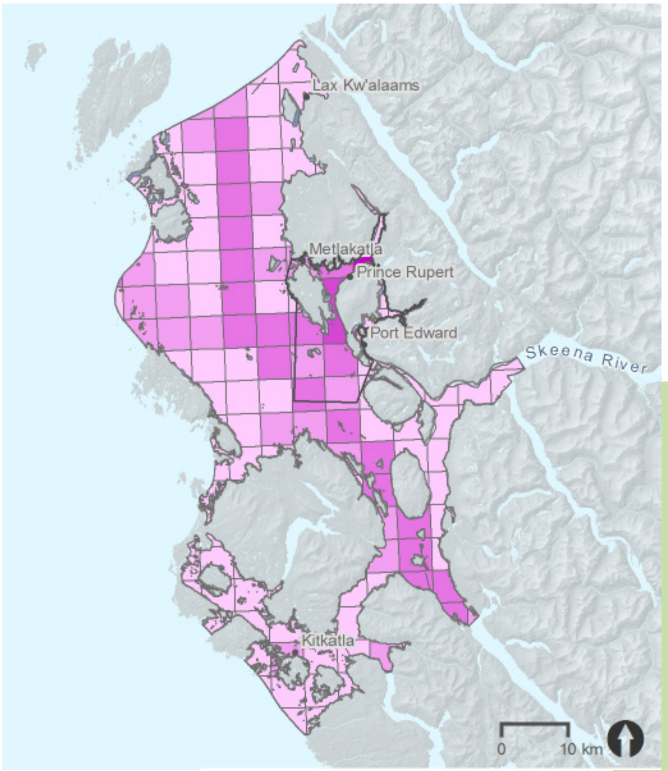


Filling, diking, dredging, and infrastructure development can damage or alter important nearshore or estuarine habitat, including riparian vegetation and eelgrass beds. Early marine survival of wild salmon depends on sheltered, intact coastal habitats as well as abundant food resources found in these habitats.

Shoreline Development (1996 - 2000)
- < 10%
- 10 - 50%
- > 50%

Salinity Classes
- < 12 ppt
- 12 - 18 ppt
- 18 - 26 ppt
- 26 - 30 ppt
- > 30 ppt

- Prince Rupert Port Authority Jurisdiction
- Skeena Estuary



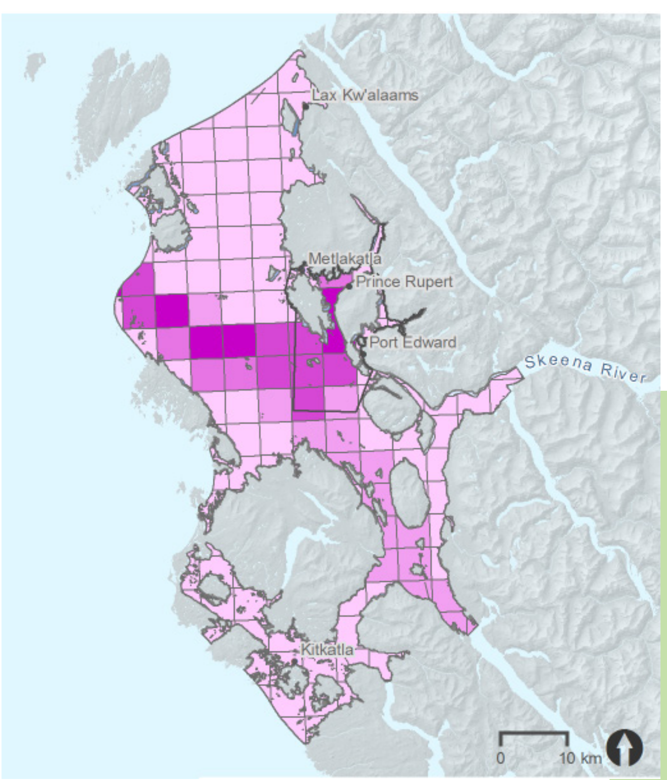
Marine Vessel Traffic Density - All Vessel Sizes

High vessel traffic density can put increased stress on juvenile salmon through degraded water quality (from releases of chemical contaminants) and increased ambient noise that both alter juvenile salmon behavior and physically disturb estuarine habitat.

Marine Vessel Traffic (All Vessel Sizes) (2010)

- 0 - 102.4 hrs
- 102.4 - 280.8 hrs
- 280.8 - 575.7 hrs
- 575.7 - 887.4hrs
- 887.4 - 1800.8 hrs

- Prince Rupert Port Authority Jurisdiction
- Skeena Estuary



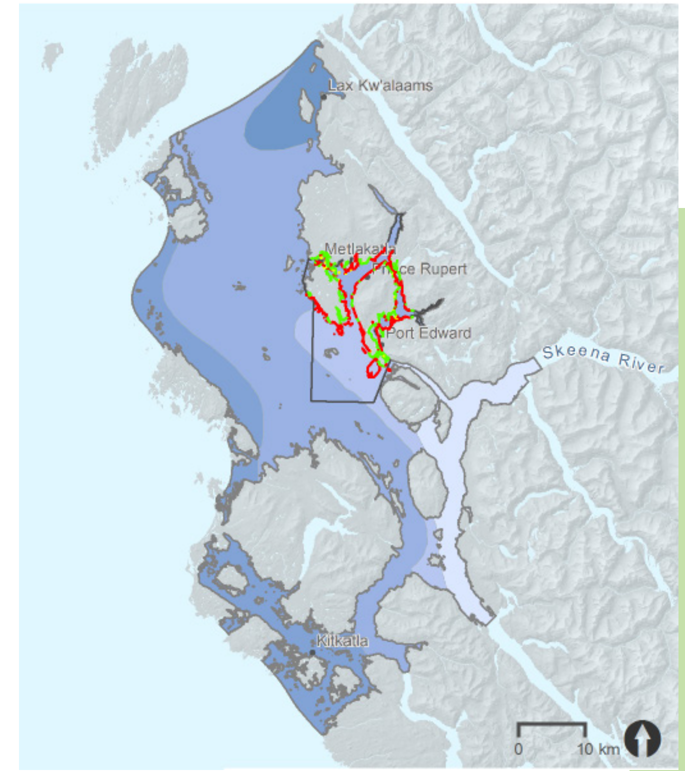
Marine Vessel Traffic Density - Vessels >200m

High vessel traffic density can put increased stress on juvenile salmon through degraded water quality (from releases of chemical contaminants) and increased ambient noise that both alter juvenile salmon behavior and physically disturb estuarine habitat.

Marine Vessel Traffic (Vessels >200m) (2010)

- 0 - 2.0 hrs
- 2.0 - 6.8 hrs
- 6.8 - 21.3 hrs
- 21.3 - 65.3hrs
- 65.3 - 113.6 hrs

- Prince Rupert Port Authority Jurisdiction
- Skeena Estuary



Intertidal Wetlands Extent

Local shoreline development can lead to temporary or permanent loss of estuarine intertidal wetlands, which are an important nearshore habitat for juvenile salmon.

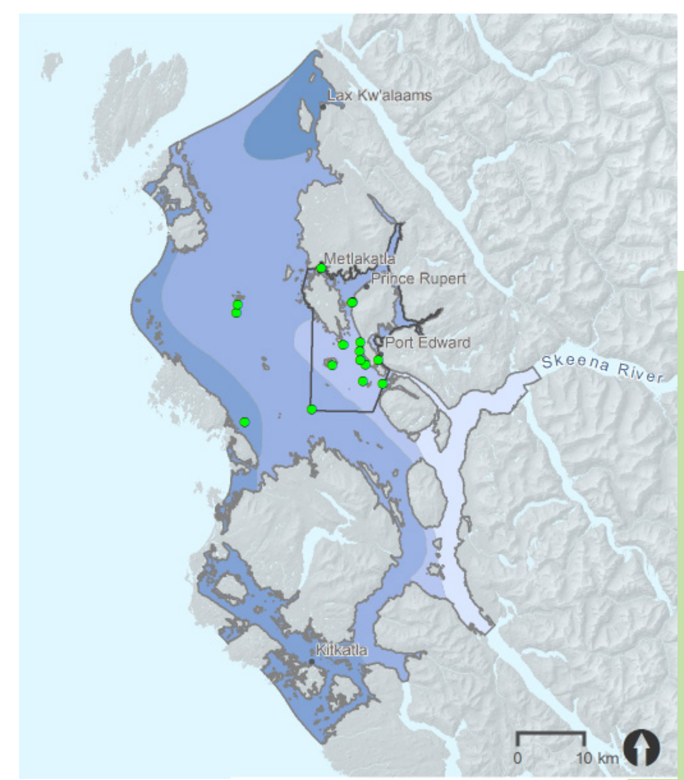
Intertidal Wetlands (2010 & Earlier)

- > 50%
- 10 - 50%
- < 10%

Salinity Classes

- < 12 ppt
- 12 - 18 ppt
- 18 - 26 ppt
- 26 - 30 ppt
- > 30 ppt

- Prince Rupert Port Authority Jurisdiction
- Skeena Estuary



Chlorophyll *a* Concentration - Direct Sampling

Early marine survival of wild salmon is dependent on abundant prey resources, which depend on primary production. Estuarine primary productivity, as indicated by chlorophyll *a* concentrations, is regulated by a range of environmental conditions that could be disrupted by local or global perturbations.

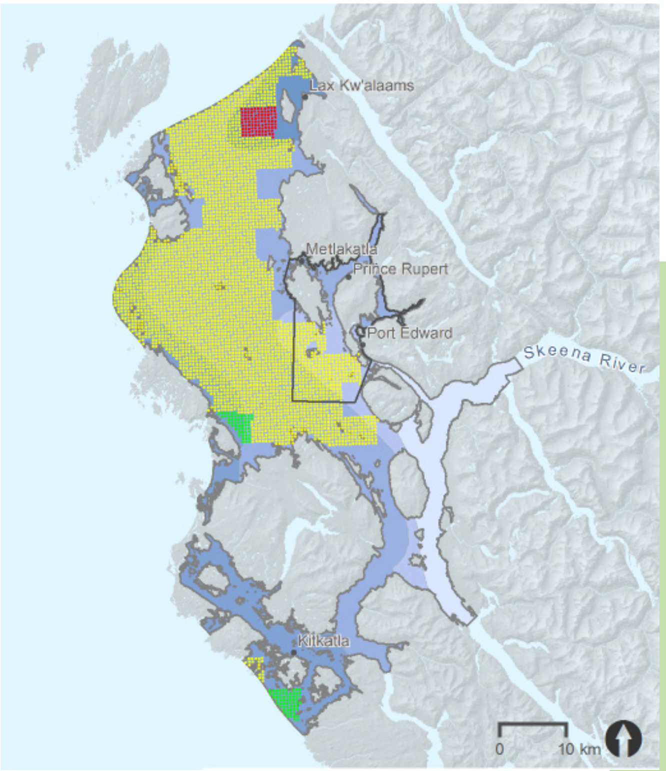
Chlorophyll *a* (Spring 2013)

- < 5 μg/L
- 5 - 20 μg/L
- > 20 μg/L

Salinity Classes

- < 12 ppt
- 12 - 18 ppt
- 18 - 26 ppt
- 26 - 30 ppt
- > 30 ppt

- Prince Rupert Port Authority Jurisdiction
- Skeena Estuary



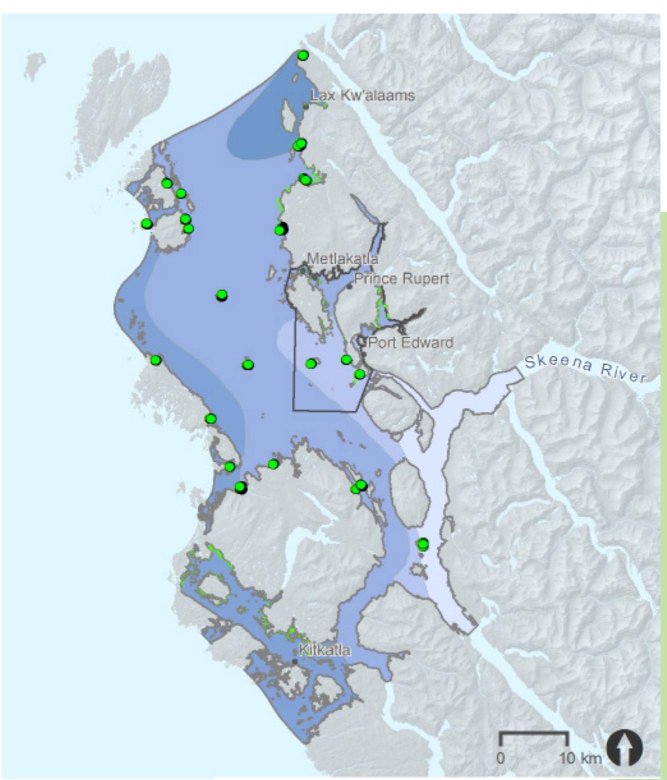
Chlorophyll *a* Concentration - Remote Sensing

Early marine survival of wild salmon is dependent on abundant prey resources, which depend on primary production. Estuarine primary productivity, as indicated by chlorophyll *a* concentrations, is regulated by a range of environmental conditions that could be disrupted by local or global perturbations.

Chlorophyll *a*
(2003 - 2006)
- < 5 μg/L
- 5 - 20 μg/L
- > 20 μg/L

Salinity Classes
- < 12 ppt
- 12 - 18 ppt
- 18 - 26 ppt
- 26 - 30 ppt
- > 30 ppt

- Prince Rupert Port Authority Jurisdiction
- Skeena Estuary



Native Eelgrass Extent - Beds

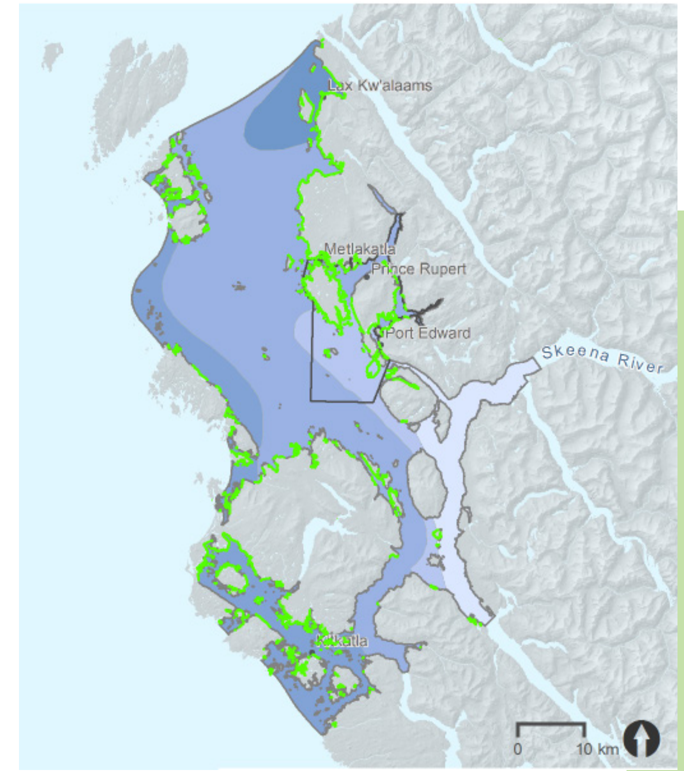
Eelgrass beds are an important nearshore habitat for juvenile salmon. They can support high biodiversity of forage fish and plankton, as well as offer shelter from predators.

Known Eelgrass Beds[1]
(1980, 2002 - 2003, 2007 - 2009, 2012)
- Eelgrass bed
- Eelgrass bed

Salinity Classes
- < 12 ppt
- 12 - 18 ppt
- 18 - 26 ppt
- 26 - 30 ppt
- > 30 ppt

- Prince Rupert Port Authority Jurisdiction
- Skeena Estuary

[1] Multiple datasets, including Borstad CASI Survey – Eelgrass, Ocean Ecology – Eelgrass, BCMCA – Eelgrass, WWF – Eelgrass



Native Eelgrass Extent - Shoreline

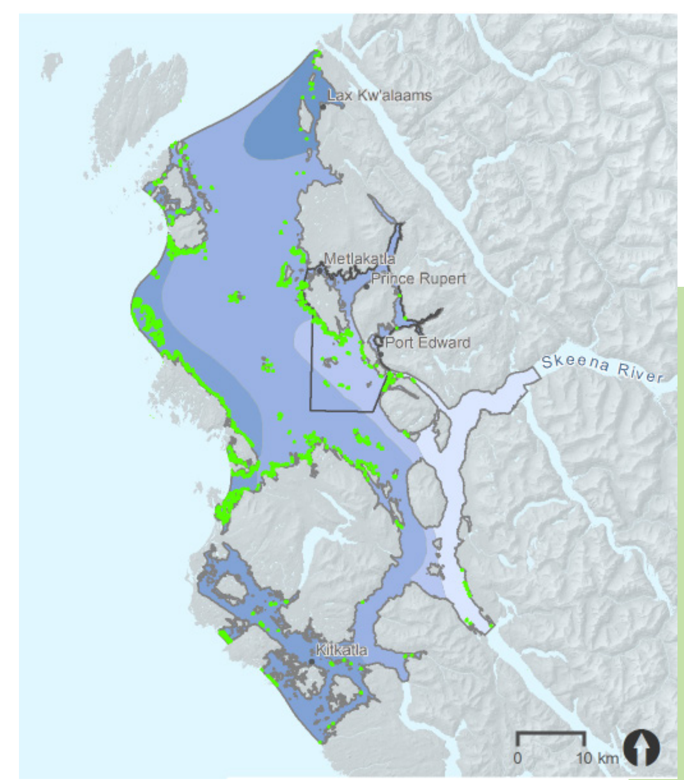
Eelgrass beds are an important nearshore habitat for juvenile salmon. They can support high biodiversity of forage fish and plankton, as well as offer shelter from predators.

Shoreline Eelgrass Presence[2]
(2002 - 2003 & 2007 - 2009)
- Eelgrass

Salinity Classes
- < 12 ppt
- 12 - 18 ppt
- 18 - 26 ppt
- 26 - 30 ppt
- > 30 ppt

- Prince Rupert Port Authority Jurisdiction
- Skeena Estuary

[2] Multiple datasets, including BC Shorezone Bioband Mapping and a derived layer by Ocean Ecology that is detailed in Ocean Ecology (2014)



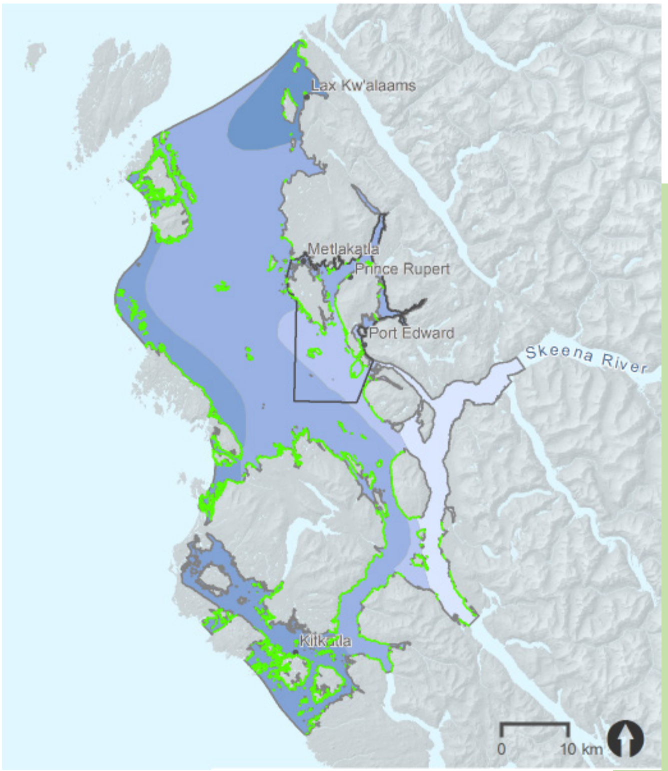
Native Macroalgae Extent - Beds

Kelp beds are an important nearshore habitat for juvenile salmon. Damage to these habitats could result in reduced growth and survival for juvenile salmon.

Known Kelp Bed
(2004)
- Kelp bed

Salinity Classes
- < 12 ppt
- 12 - 18 ppt
- 18 - 26 ppt
- 26 - 30 ppt
- > 30 ppt

- Prince Rupert Port Authority Jurisdiction
- Skeena Estuary



Native Macroalgae Extent - Shoreline

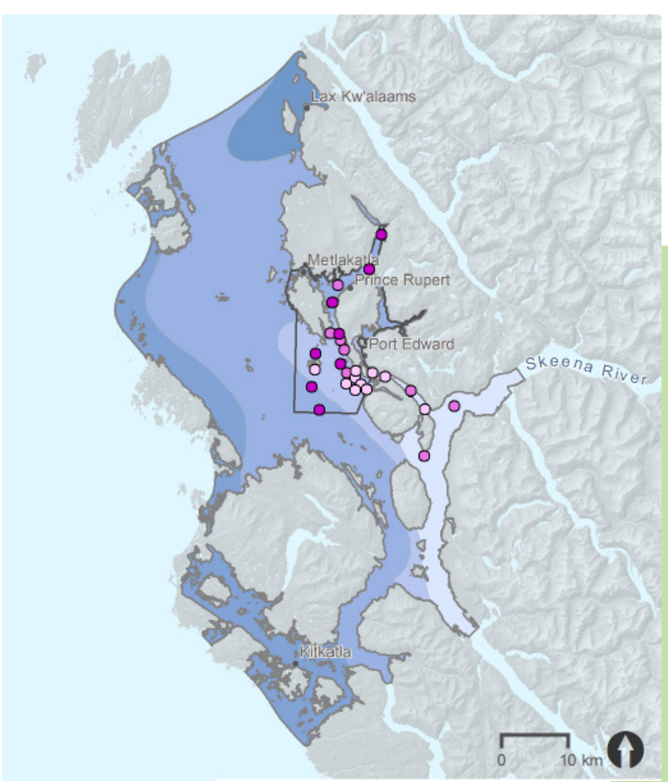
Kelp beds are an important nearshore habitat for juvenile salmon. Damage to these habitats could result in reduced growth and survival for juvenile salmon.

Shoreline Kelp Presence[1]
(1997, 1999 - 2000 & 2010)
- Kelp

Salinity Classes
- < 12 ppt
- 12 - 18 ppt
- 18 - 26 ppt
- 26 - 30 ppt
- > 30 ppt

- Prince Rupert Port Authority Jurisdiction
- Skeena Estuary

[1] Multiple datasets, including BC Shorezone Bioband Mapping and PR Harbour Foreshore Habitat Classification



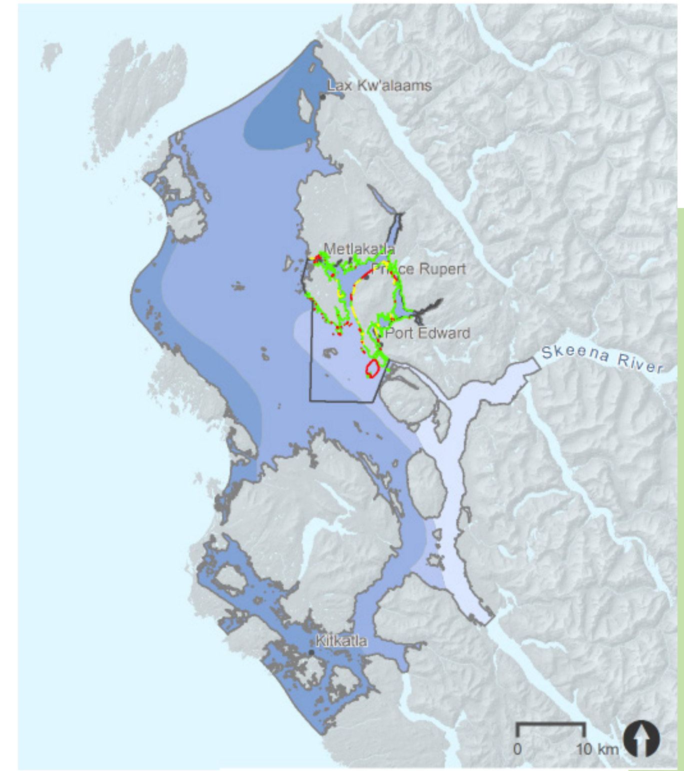
Zooplankton Density or Diversity

Zooplankton are a key food resource for juvenile salmon. Changes in primary productivity, the introduction of invasive zooplankton, or the loss of eelgrass and intertidal wetlands can affect zooplankton availability.

Zooplankton per m^3
(1972 & 1974)
- 1.38 - 12.73
- 12.73 - 28.50
- 28.50 - 132.47

Salinity Classes
- < 12 ppt
- 12 - 18 ppt
- 18 - 26 ppt
- 26 - 30 ppt
- > 30 ppt

- Prince Rupert Port Authority Jurisdiction
- Skeena Estuary



Intact Riparian Vegetation Extent

Marine riparian vegetation is an important source of insect prey for juvenile salmon and also provides shading and coverage from predators.

Riparian Vegetation
(2012)
- > 50%
- 10 - 50%
- < 10%

Salinity Classes
- < 12 ppt
- 12 - 18 ppt
- 18 - 26 ppt
- 26 - 30 ppt
- > 30 ppt

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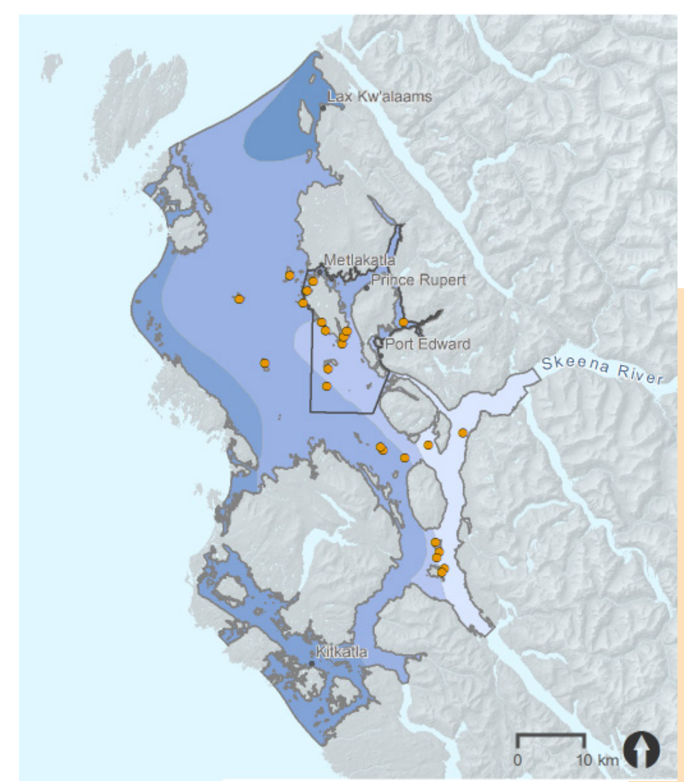
- Skeena Estuary



Marine Mammal Distribution or Abundance

Juvenile salmon are consumed by various natural predators such as marine mammals. High abundance and changes in distribution of marine mammals can increase mortality and reduce abundance of juvenile salmon.

Harbour Seal Haulouts
(1966 - 1998)
- Haulout

Salinity Classes
- < 12 ppt
- 12 - 18 ppt
- 18 - 26 ppt
- 26 - 30 ppt
- > 30 ppt

- Prince Rupert Port Authority Jurisdiction
- Skeena Estuary

Data Gaps & Monitoring Priorities

Our assessment of the Skeena River estuary revealed considerable gaps in information and data limitations across many of the estuary indicators. Based on our assessment, we recommend that future monitoring efforts address the following data gaps: (1) distribution and abundance of juvenile salmon, (2) growth and condition of juvenile salmon, (3) extent of eelgrass, and (4) density and diversity of key salmon food. A full description of each monitoring activity and proposed methodology is available in *Skeena River Estuary Assessment: Technical Report* (Pickard et al. 2015).

Moving forward, substantial resources will be required to support local efforts to collect, store, and disseminate new data, and assess changes in the status of the estuary. By advancing our scientific understanding of the Skeena River estuary in relation to juvenile salmon, we will be able to identify strategies that conserve and protect high value salmon habitats and minimize risks to wild salmon.

Photo Credit : Grant Callegari

Photo Credit : Tavish Campbell

Recommended Monitoring Activities

Distribution and Abundance of Juvenile Salmon

Field-based studies consisting of trawl and beach seine surveys can be an efficient way to evaluate the distribution and abundance of juvenile salmon throughout the estuary. By improving our understanding of where juvenile salmon spend their time, and how many individuals there are, we can better identify areas in the estuary that are critically important during this early life stage. Determining how long salmon spend in different estuarine habitats will also help us understand how particular habitats may influence their early marine survival.

Growth and Condition of Juvenile Salmon

By collecting scales, otoliths, tissue samples, and stomach content samples from juvenile salmon, we can better understand their growth and body condition across the estuary. We can use scales and otoliths to estimate average growth rates of juvenile salmon during their entire residence in the estuary, while tissue samples can generate a snapshot of growth just prior to capture. Analyzing stomach contents can determine the type and quality of food being eaten by different species of juvenile salmon. Together, these metrics can help illuminate the importance of the estuary in influencing salmon growth and body condition during this important life-history stage.

Extent of Eelgrass

Mapping the distribution of eelgrass beds, through a comprehensive one-time census, will help improve our understanding of the spatial extent of this important habitat for juvenile salmon. We recommend using primarily sidescan sonar and supplementing with other methods where practical, such as aerial photography or dive surveys. This census should be followed up with periodic field sampling to update maps of eelgrass extent as well as to track changes in the quality and distribution of eelgrass over time.

Density and Diversity of Key Salmon Food

During their time in the estuary, a juvenile salmon's ability to locate food and grow quickly can determine whether it survives to return to fresh water and reproduce. Bigger salmon are often in better condition and are less vulnerable to predators. Field studies that help determine the availability of food, primarily zooplankton prey, during this early life phase are important for predicting the growth and early marine survival of juvenile salmon. Sampling the upper part of the water column is a common way to measure the density and diversity of the available food sources for juvenile salmon.

Photo Credits 1,2 & 3 : Tavish Campbell | Photo Credit 4 : Brendan Connors

Photo Credit : Paul Colangelo

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For more information about this project, please see the full technical report: Pickard, D., M. Porter, E. Olson, B. Connors, K. Kellock, E. Jones, and K. Connors. 2015. *Skeena River Estuary Assessment: Technical Report*. Pacific Salmon Foundation, Vancouver, BC.

Citation: Pacific Salmon Foundation. 2015. *The Skeena River Estuary – A Snapshot of Current Status and Condition*. Vancouver, BC.

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SKEENA SALMON PROGRAM

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