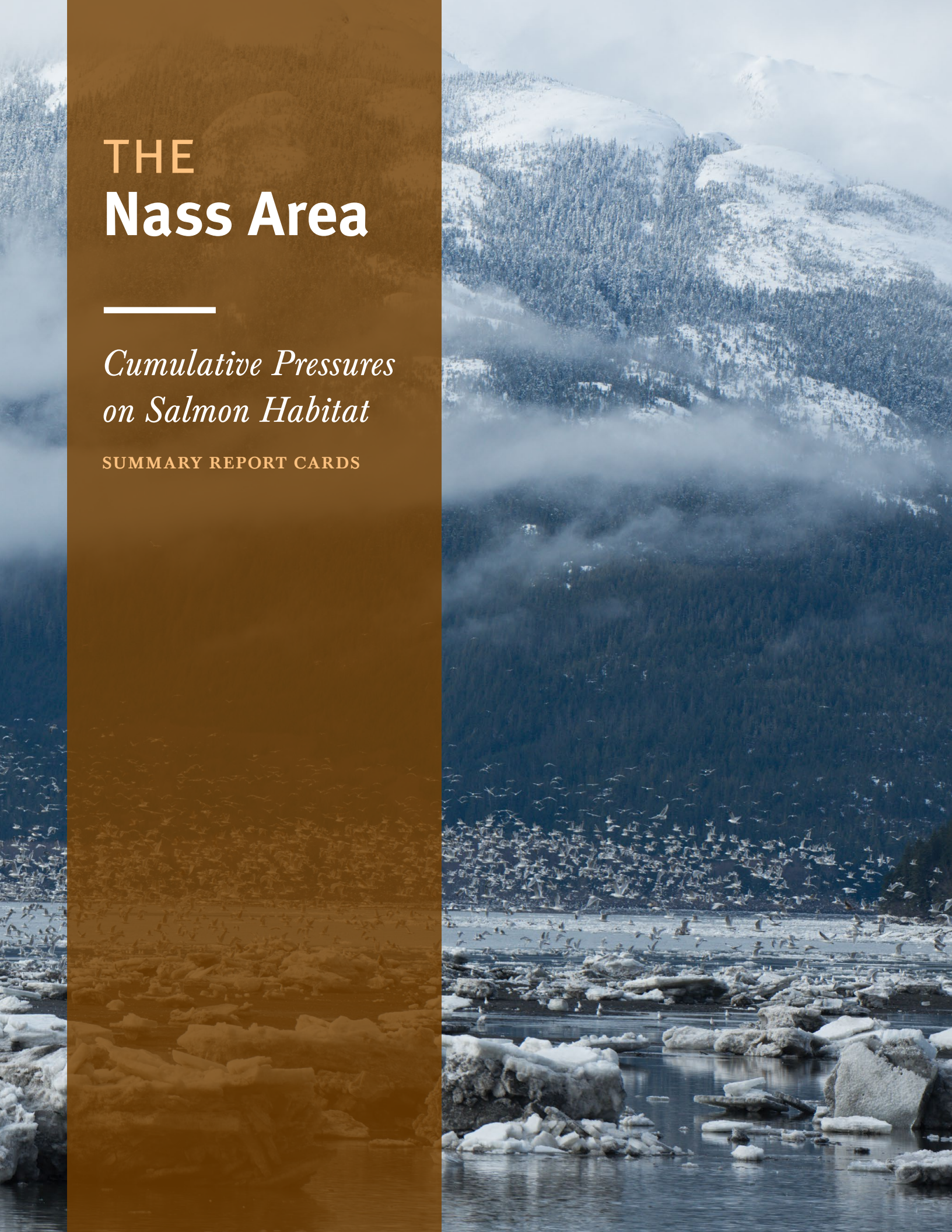


THE Nass Area

Cumulative Pressures on Salmon Habitat

SUMMARY REPORT CARDS

For citation: Pacific Salmon Foundation. 2016. *The Nass Area: Cumulative Pressures on Salmon Habitat (summary report cards)*, Vancouver, BC.

THE

Nass Area

Cumulative Pressures
on Salmon Habitat

SUMMARY REPORT CARDS

2016

Contents

About this Project

The Nass River watershed in northern British Columbia (BC) is one of the most important salmon watersheds in Canada.

Known as the "River of Abundance," in reference to its large runs of salmon and eulachon, the Nass covers an area of 20,700 km² and flows 380 km from the Coast Mountains to Portland Inlet on the Pacific Ocean. The watersheds draining into Portland Canal and Observatory Inlet comprise an additional 6,000 km² and along with the Nass River watershed make up the "Nass Area." The Nass Area is home to five species of Pacific salmon (sockeye, coho, Chinook, chum, and pink), as well as steelhead, and provides extensive spawning and rearing habitat for multiple genetically and geographically distinct populations of wild salmon, called Conservation Units (CUs).

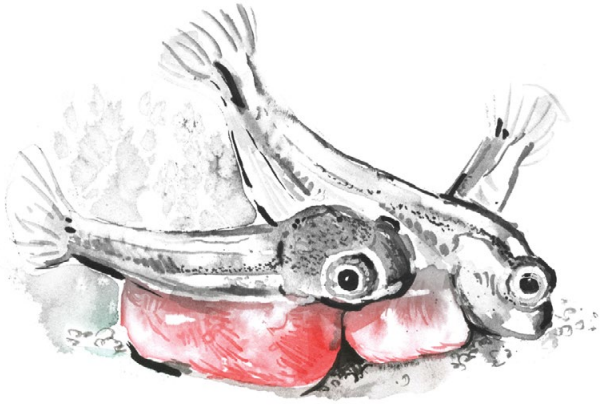
Under Canada's Wild Salmon Policy, management of Pacific salmon species is to be based on CUs. A CU is defined as a group of wild salmon sufficiently isolated from other groups that, if lost, is very unlikely to re-colonize naturally within an acceptable time frame, such as a human lifetime or a specified number of salmon generations. A CU may contain one or more salmon populations with the maintenance of CUs requiring the management of multiple populations and the protection of fish habitat for several localized spawning groups. There are currently 22 CUs defined by Fisheries and Oceans Canada (DFO) for the Nass Area: eight lake-type sockeye, two river-type sockeye, two Chinook, three chum, three coho, and four pink.

In recent years, concerns have been raised regarding the vulnerability of salmon populations and their freshwater habitats to increasing natural and anthropogenic pressures. Cumulative pressures from multiple land-use activities, in combination with changing environmental conditions, can alter

landscape and watershed processes, disrupt fish habitats, and ultimately affect the survival, distribution, and abundance of wild salmon populations.

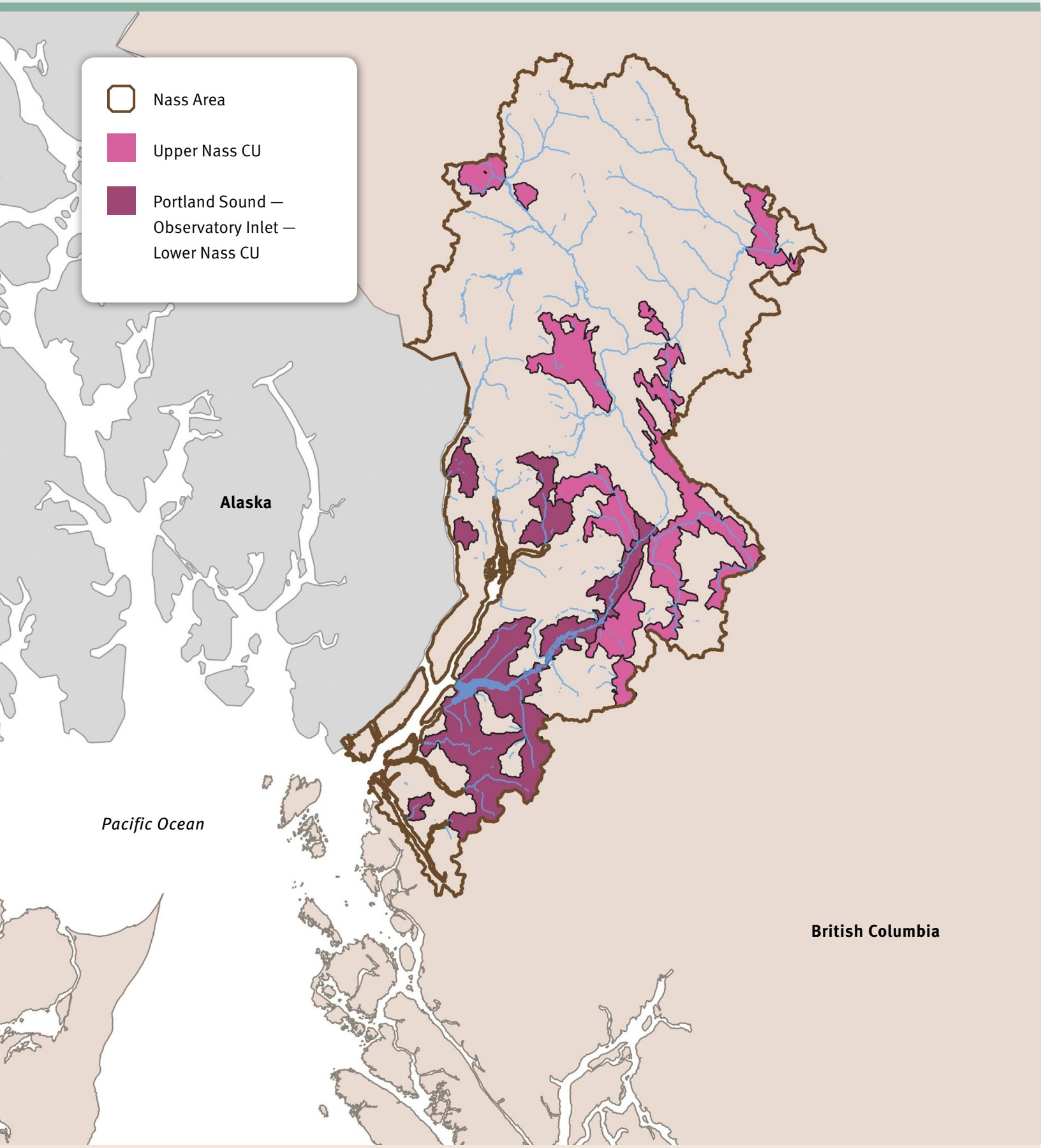
Through direction from the Nisga'a Lisims Government, and in collaboration with Gitanyow, Gitxsan, and Lax Kw'alaams First Nations, DFO, BC Ministry of Environment, ESSA Technologies, and other local experts, the Pacific Salmon Foundation coordinated an assessment of landscape-scale pressures on salmon habitat in the Nass Area. This project assessed pressures on habitats used by salmon during migration, spawning, rearing, and incubation life-stages, as well as the relative vulnerability of salmon CUs to those pressures. Using the best available data, a "report card" was generated for each of the 22 Nass salmon CUs.

Collectively, the report cards provide a snapshot of the current risks to salmon habitat in the Nass Area from different human and environmental pressures. This type of coarse-scale assessment is useful for building a common understanding of the pressures on freshwater salmon habitats and for informing land-use planning decisions and developing strategies that mitigate risks to freshwater salmon habitat.



Chinook

Chinook: Map of Conservation Units (CUs)



Chinook: Portland Sound — Observatory Inlet — Lower Nass

Introduction

This project summarizes pressures on the habitat used by Nass salmon Conservation Units (CU) during their freshwater life history stages (migration, spawning and rearing), as well as their relative vulnerability to those pressures. For an explanation of the indicators shown here, please see the accompanying *Report Card Summaries*. Full methods and results can be found in the main report, *Cumulative Pressures on Nass Salmon Habitat: Technical Report* (2016).

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Narrative

- There are two Chinook salmon CUs in the Nass Area: 1) Upper Nass (UNR) and 2) Portland Sound-Observatory Inlet-Lower Nass (LNR-P).
- The Upper Nass CU is one of the wild indicator stocks identified by the Pacific Salmon Commission and consists of at least ten genetically distinct populations (~ 17 spawning groups) in the Upper Nass River watershed, upstream of and including Tseax River.
- The Upper Nass CU is a relatively healthy group of completely natural populations with no history of enhancement and likely very little, if any, straying from other enhanced systems.
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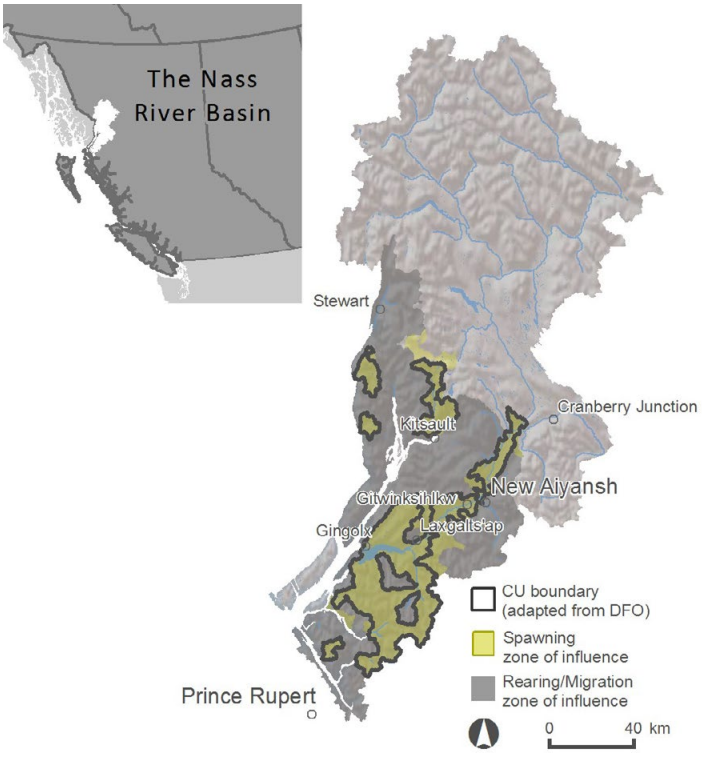
Location



Summary of habitat vulnerabilities & pressures

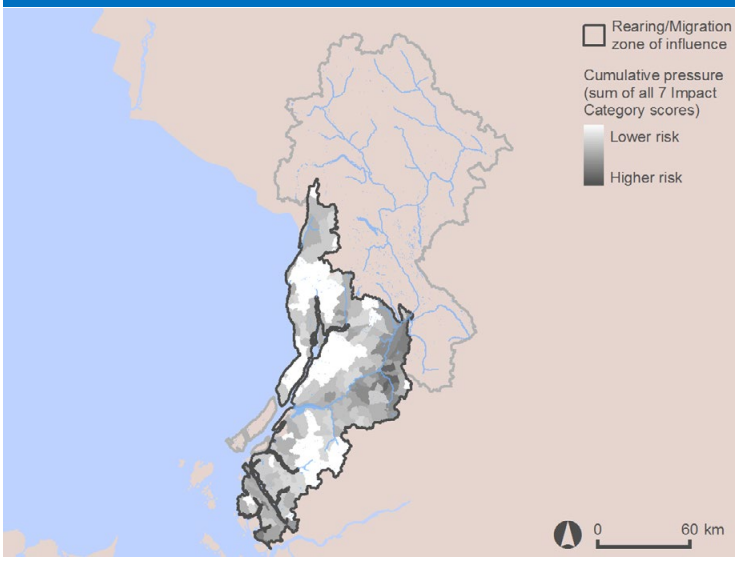
Pressure indicators were grouped into seven relatively independent habitat "impact categories" representing key factors affecting general watershed condition:

- Hydrologic Processes (Forest disturbance; Equivalent Clearcut Area)
- Vegetation Quality (Insect and disease defoliation; Riparian disturbance)
- Surface Erosion (Road development)
- Fish passage/Habitat connectivity (Stream crossing density)
- Water quantity (Water licenses)
- Human development footprint (Total land cover alteration; Impervious surfaces; Linear development; Mining development)
- Water quality (Wastewater discharges)

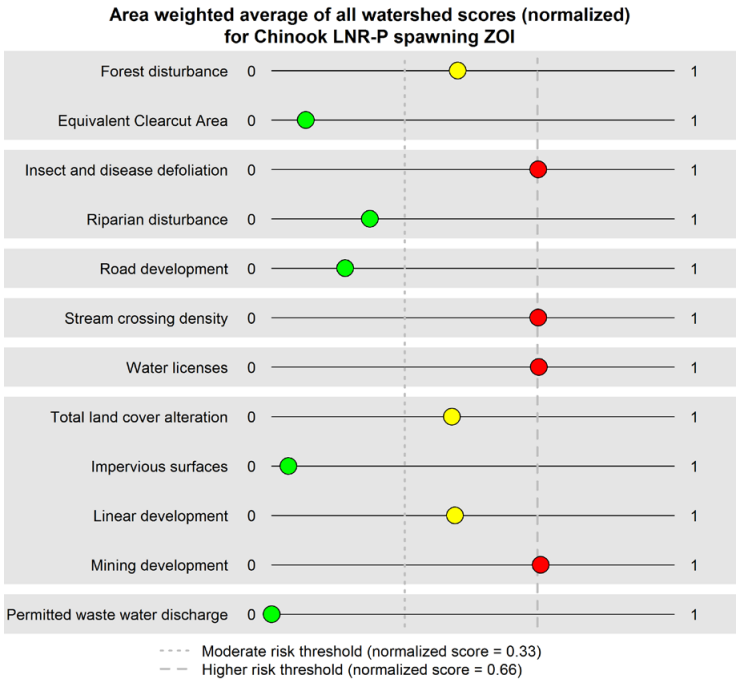
Indicators were also developed reflecting relative vulnerability to habitat pressures within the life stage-specific "zones of influence" defined for each CU:

- Rearing/Migration ZOI: Accessible stream length; Length and percentage of accessible streams considered flow sensitive - all seasons
- Spawning ZOI: Total spawning length; Length and percentage of spawning reaches considered flow sensitive (summer period - spawning, winter period - incubation)

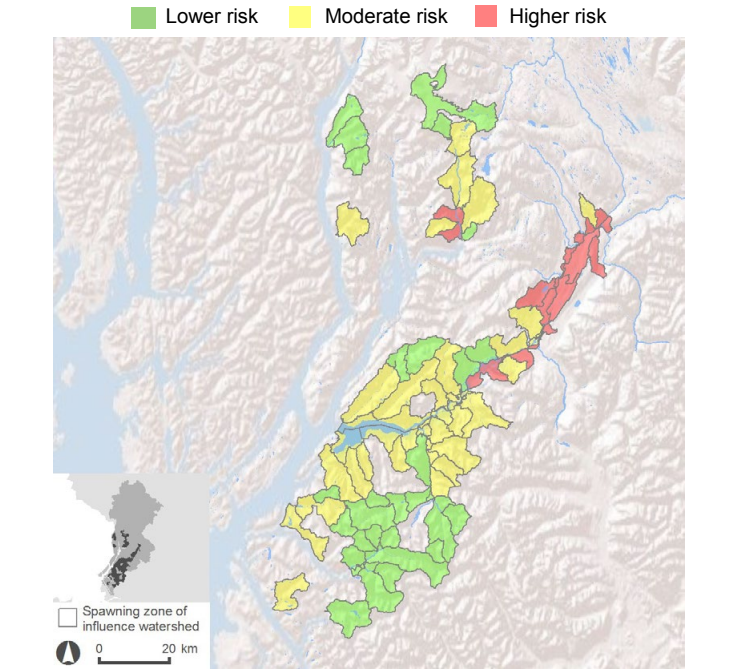
Cumulative pressure—rearing/migration



Summary of pressure indicators—spawning

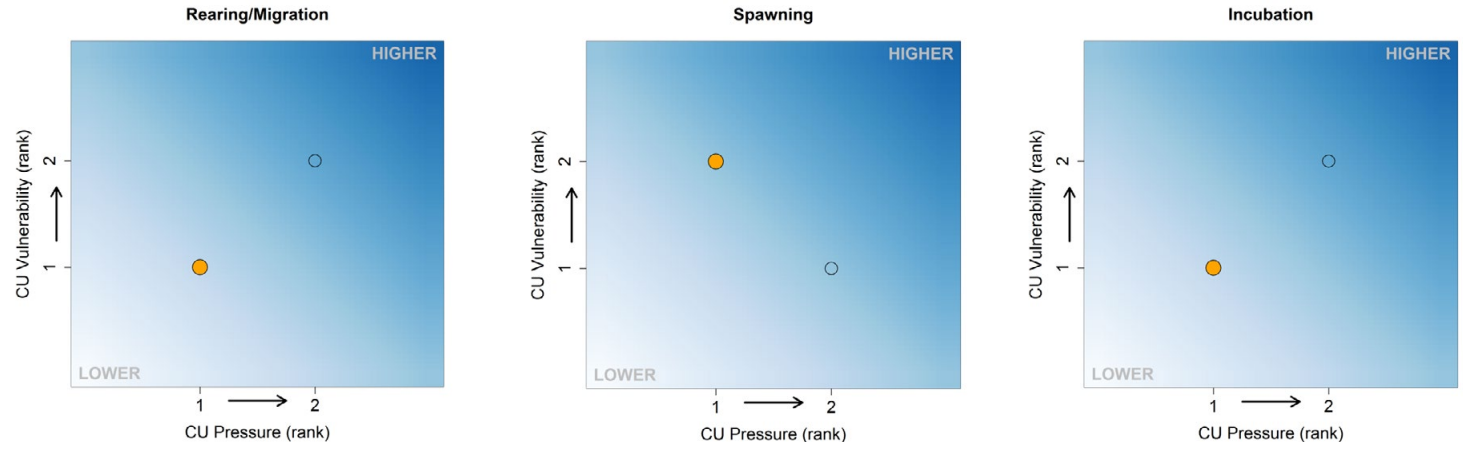


Cumulative pressure—spawning



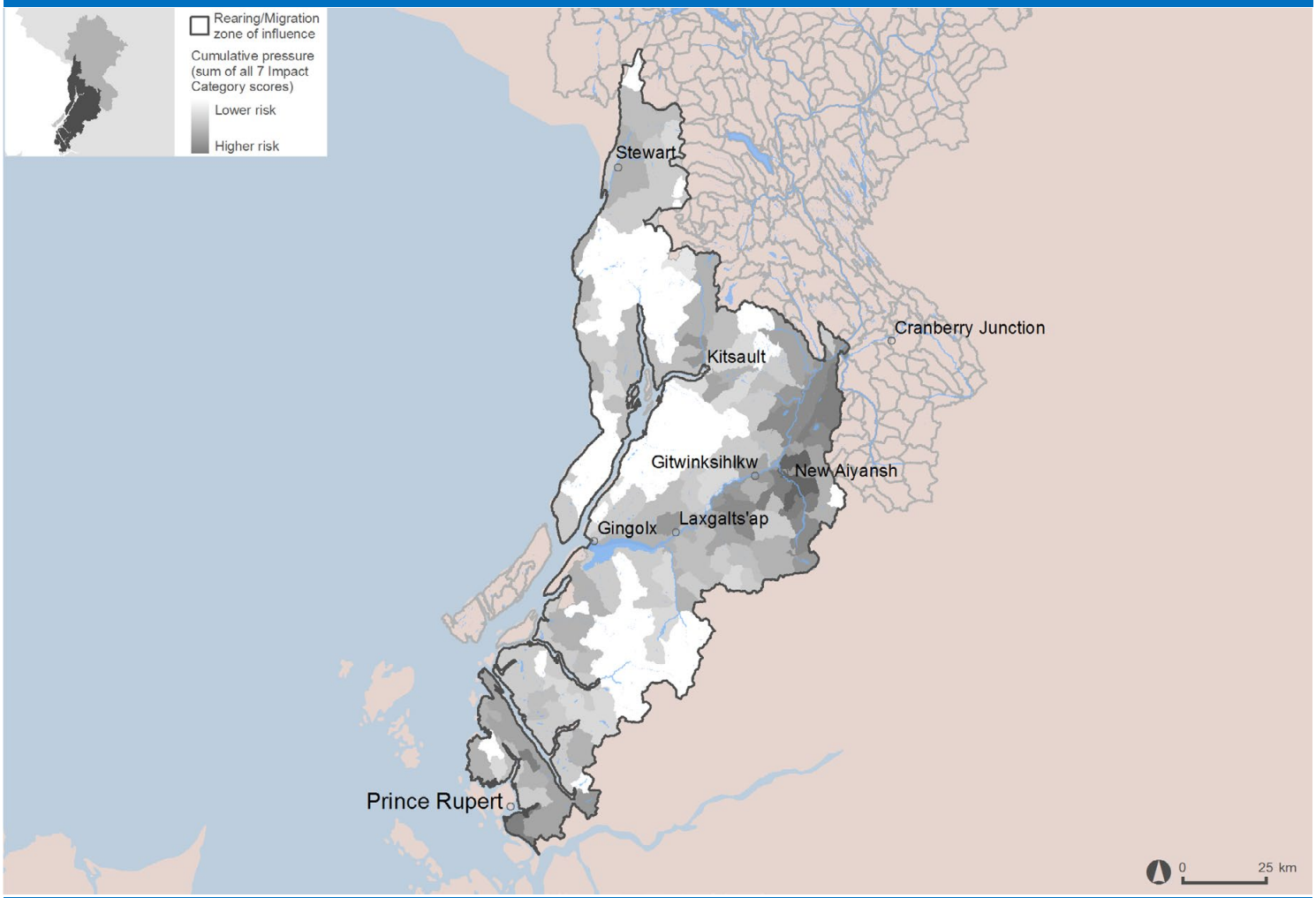
Integrated vulnerability/habitat pressures—rearing/migration, spawning, & incubation

● = Portland Sound-Observatory Inlet-Lower Nass ○ = other Chinook CUs



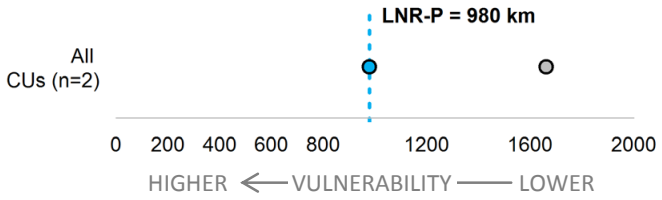
Rearing/Migration vulnerability & pressure

Rearing/Migration period pressures

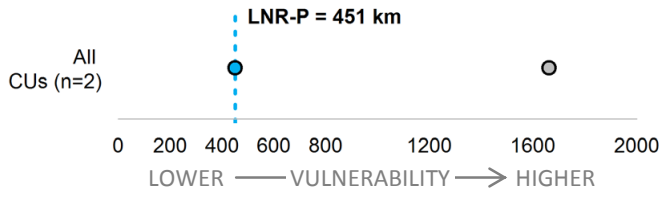


Rearing/Migration period vulnerability

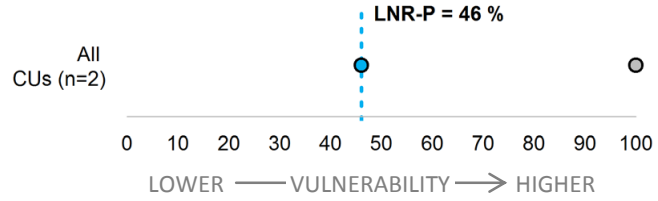
Salmon accessible habitat (km)



Flow sensitive accessible habitat (km) (all seasons)



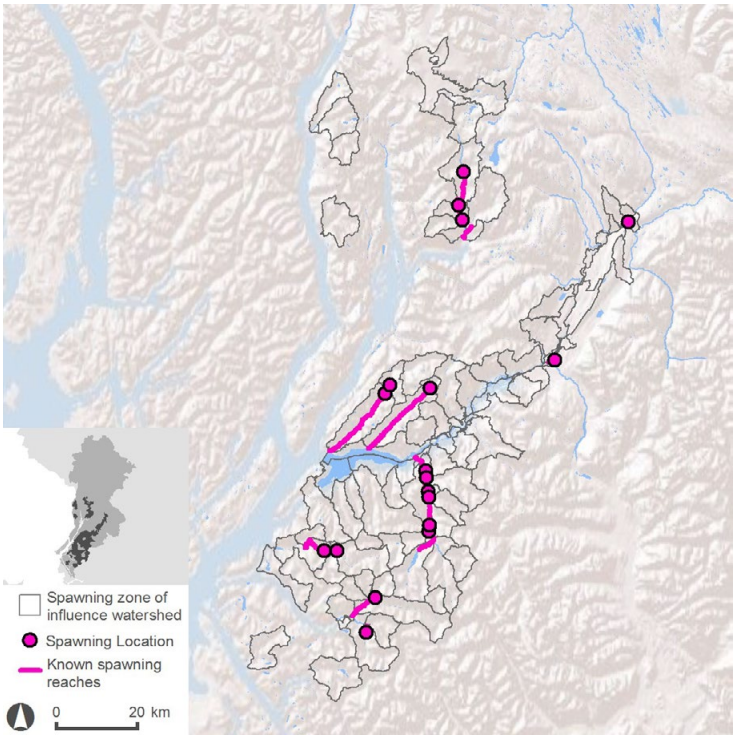
Flow sensitive accessible habitat (%) (all seasons)



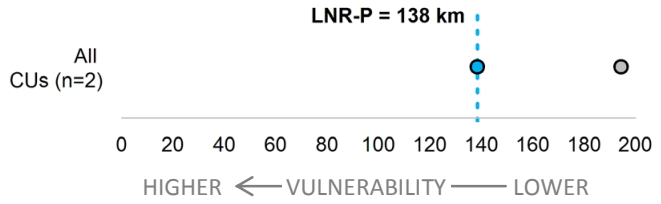
Spawning & incubation vulnerability

Spawning period vulnerability

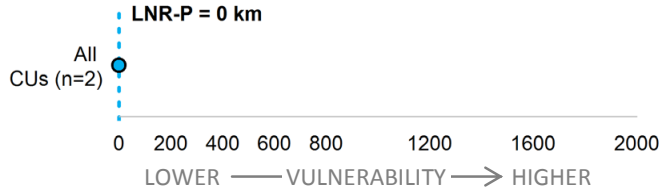
Spawning locations



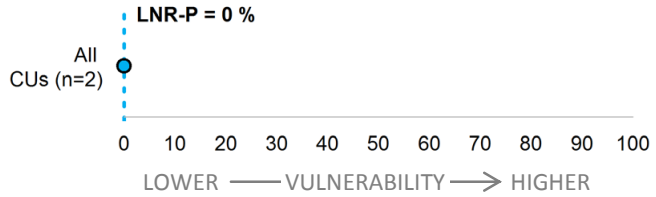
Total spawning length (km)



Spawning reaches summer flow sensitive - spawn timing (km)

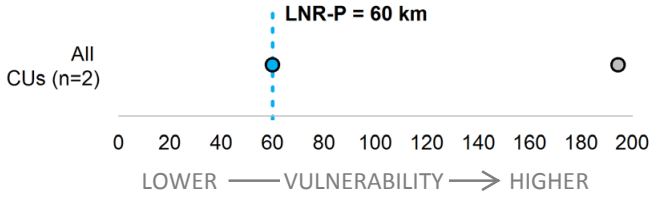


Spawning reaches summer flow sensitive - spawn timing (%)

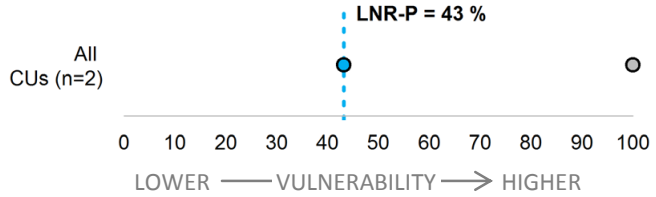


Incubation period vulnerability

Spawning reaches winter flow sensitive - incubation timing (km)



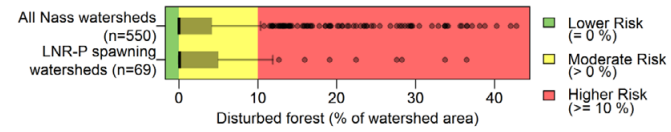
Spawning reaches winter flow sensitive - incubation timing (%)

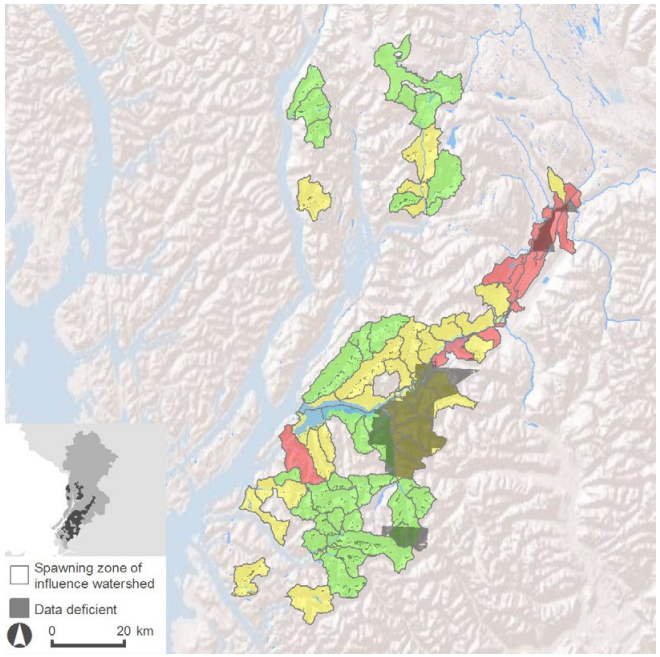


Spawning pressure

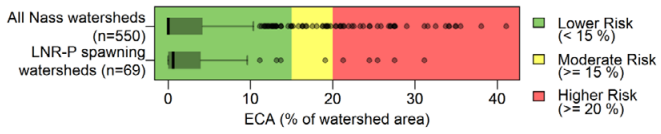
Hydrologic Processes

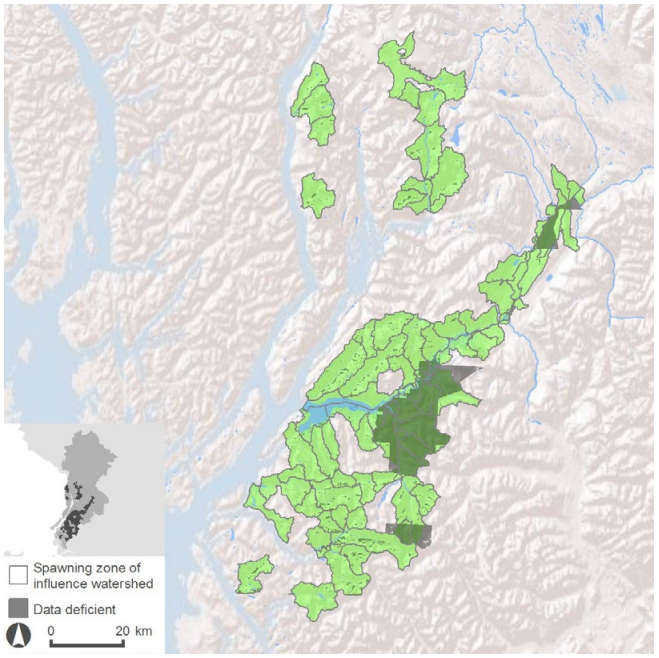
Forest disturbance





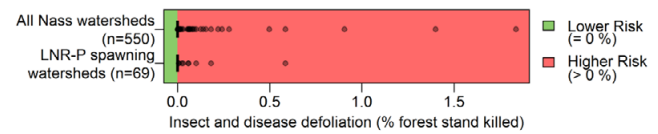
Equivalent Clear-cut Area

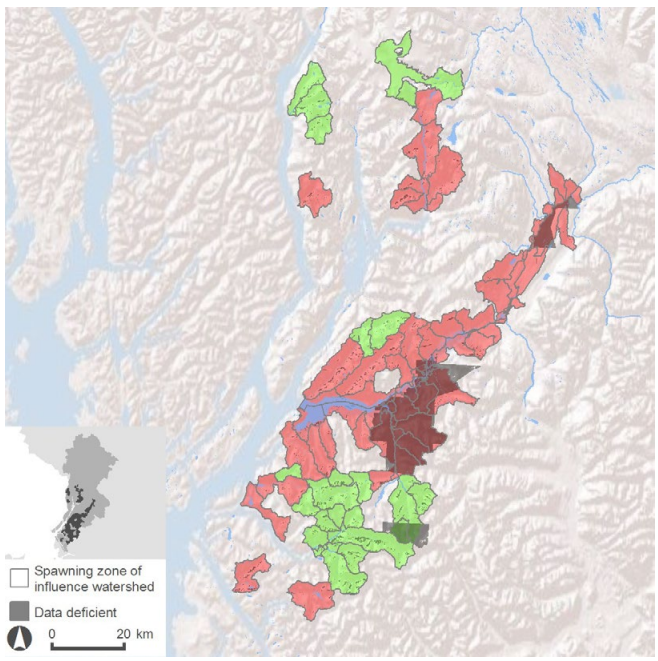




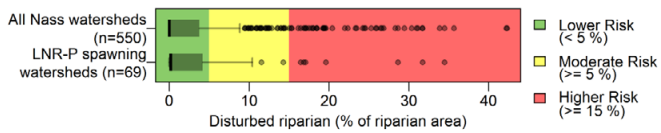
Vegetation Quality

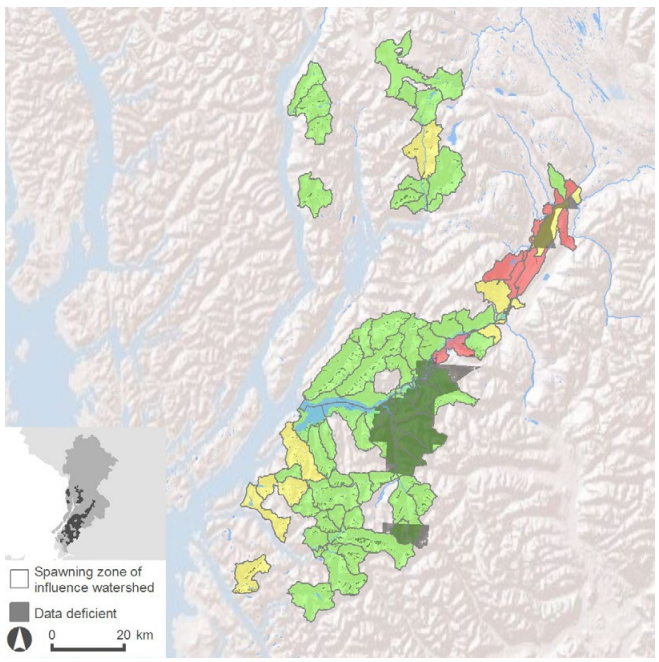
Insect and disease defoliation





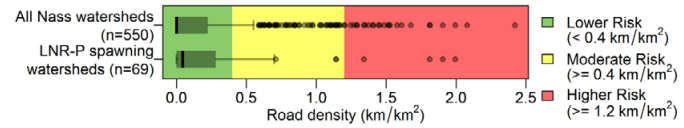
Riparian disturbance

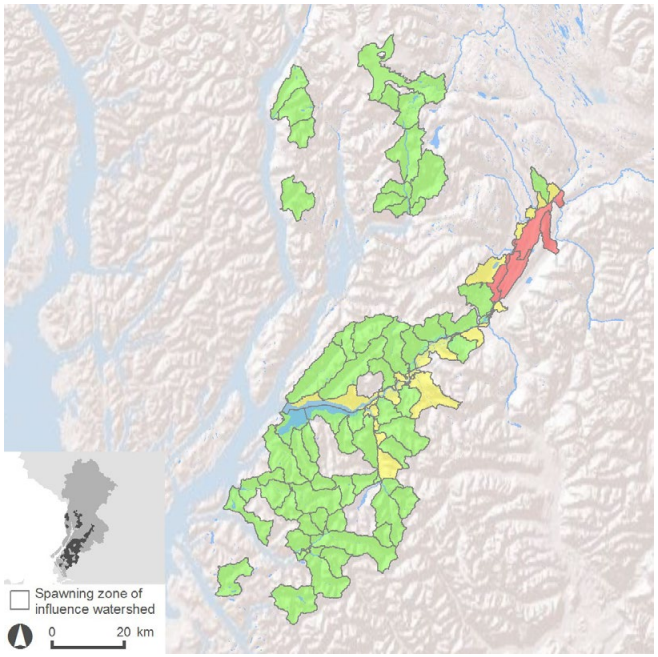




Surface Erosion

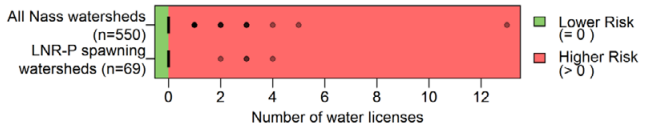
Road development

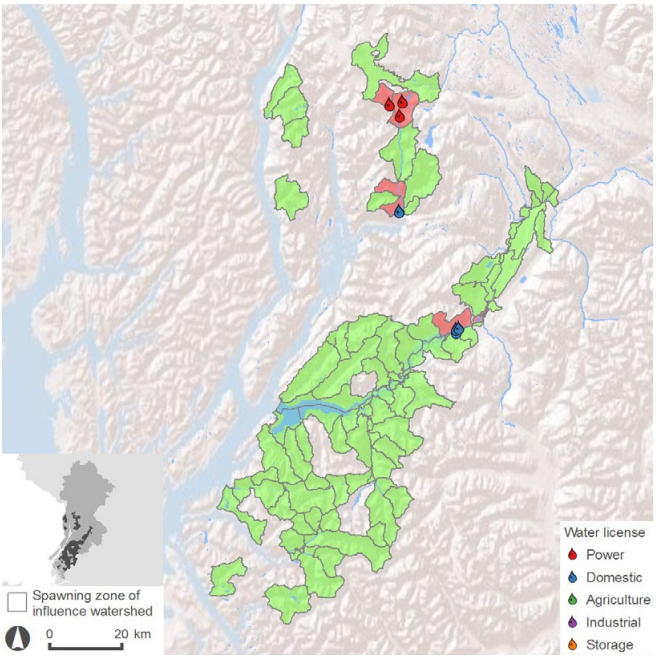




Water Quantity

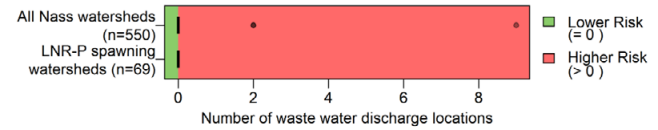
Number of water licenses

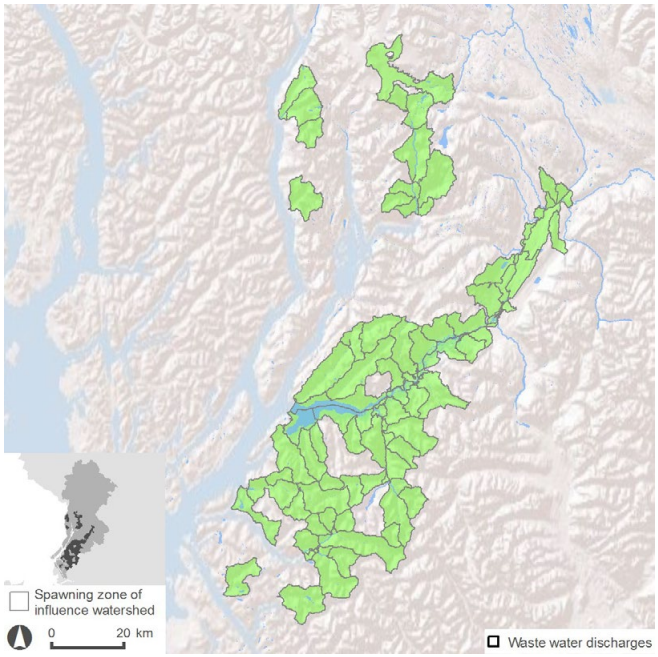




Water Quality

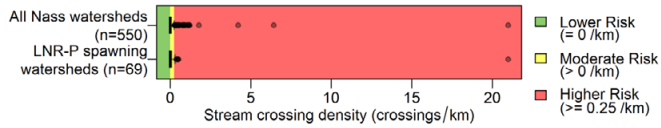
Permitted waste water discharges

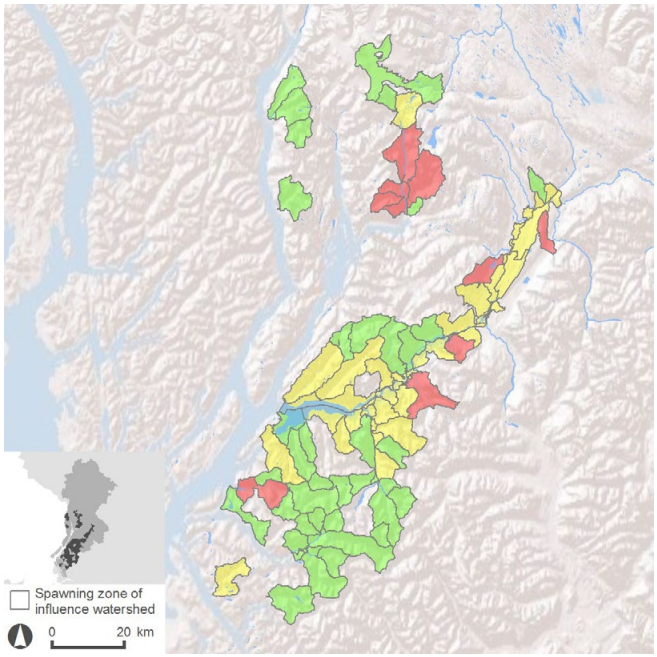




Fish Passage/Habitat Connectivity

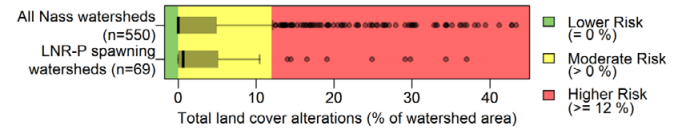
Stream crossing density

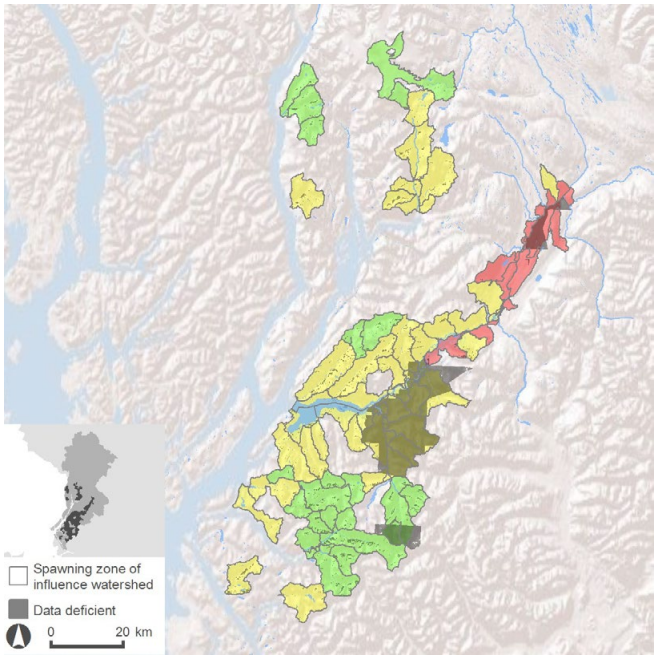




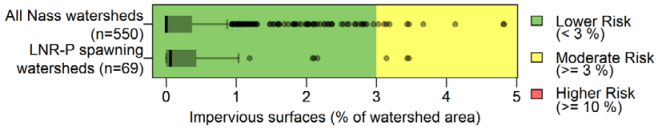
Human Development Footprint

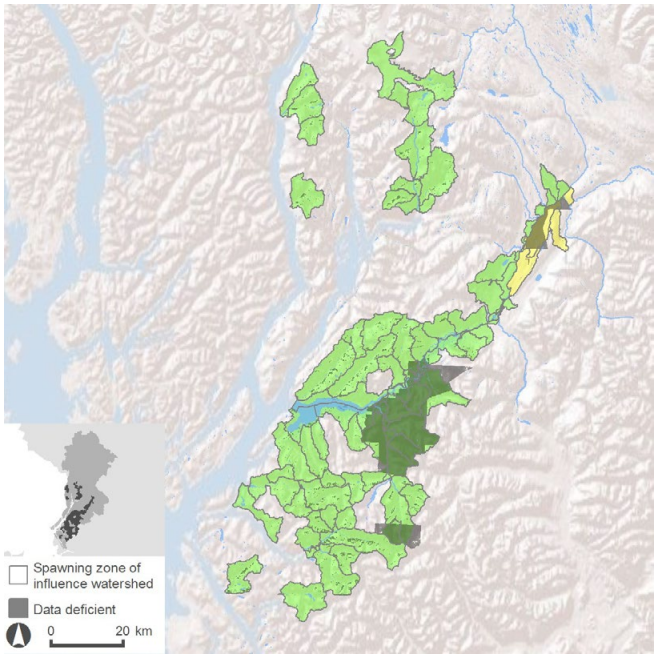
Total land cover alteration



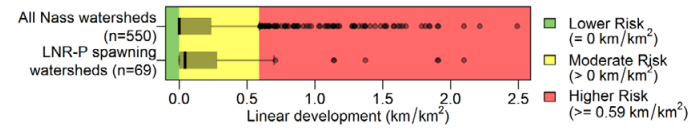


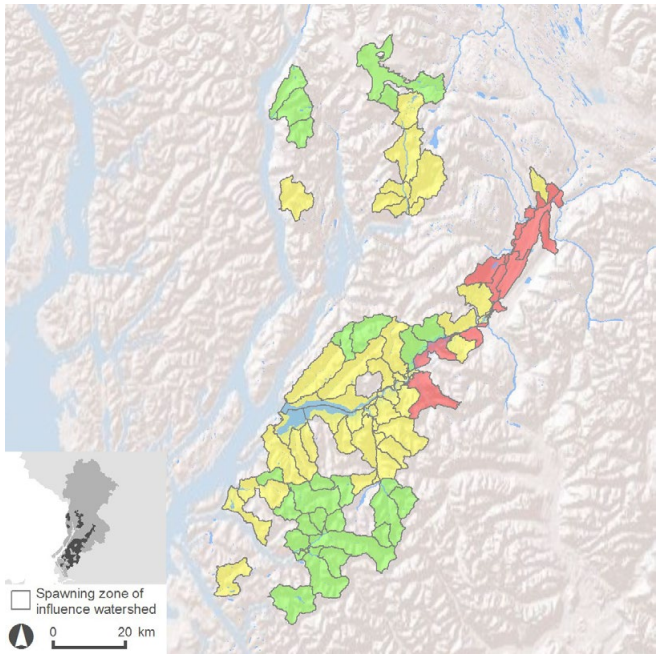
Impervious surfaces



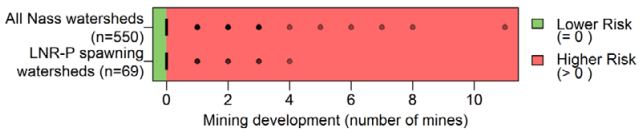


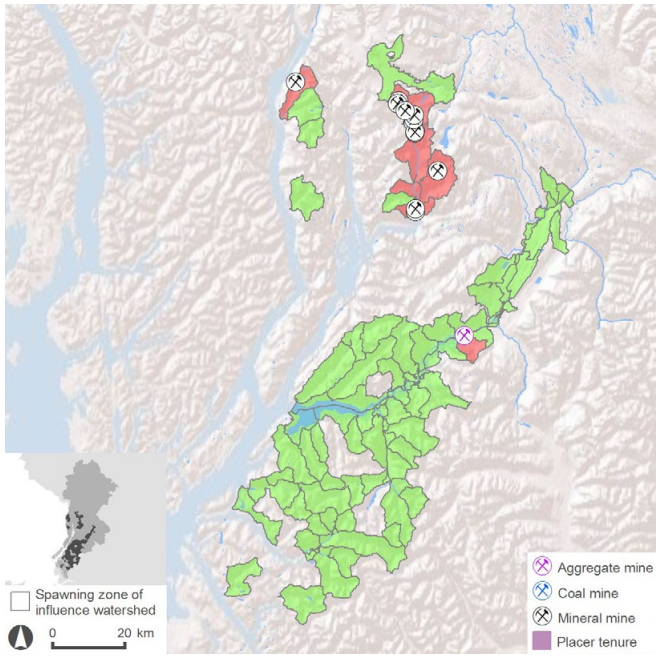
Linear development





Mining development (total number of mines)

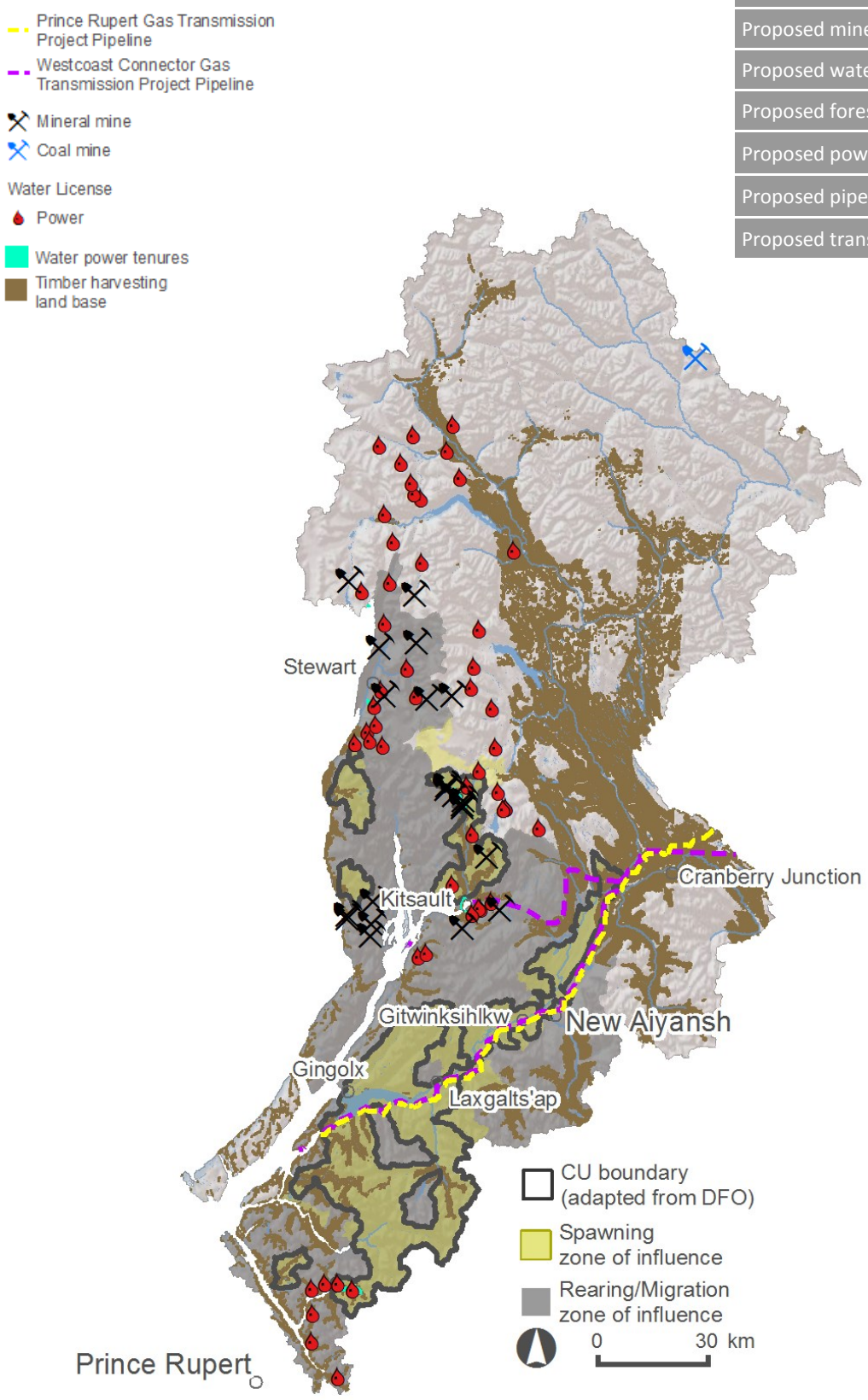




Future pressure

Proposed resource development projects (as of 2016)

Nass Drainage Summary	
	Totals
Proposed coal mines (#)	1
Proposed mineral mines (#)	22
Proposed water licenses (#)	58
Proposed forestry (km^2)	3,323 km^2
Proposed power tenures	Wind 0 km^2, water 15 km^2
Proposed pipelines (km)	386 km
Proposed transmission lines	0 km



Chinook: Upper Nass

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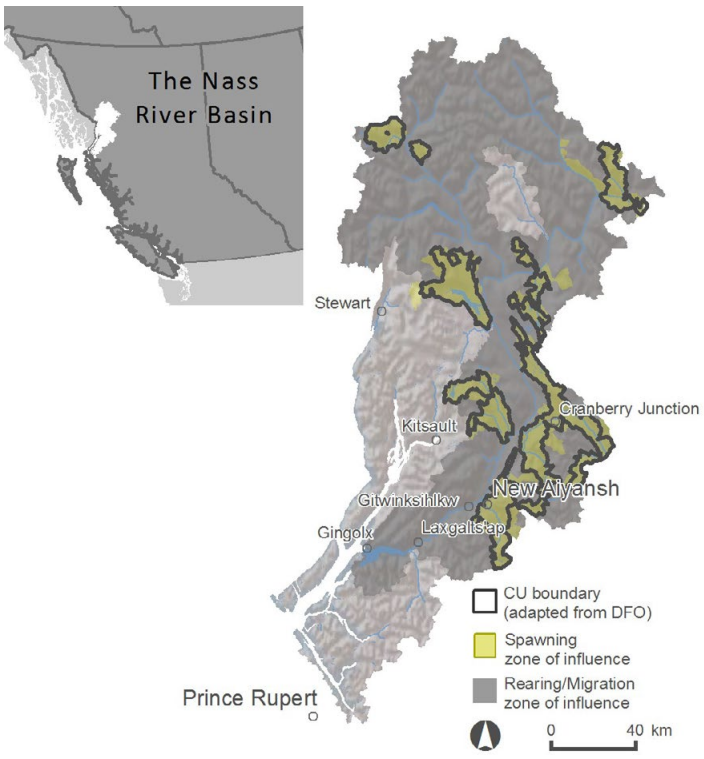
- Considerably less is known about the Portland Sound-Observatory Inlet-Lower Nass CU.

Location



Summary of habitat vulnerabilities & pressures

Pressure indicators were grouped into seven relatively independent habitat "impact categories" representing key factors affecting general watershed condition:

- Hydrologic Processes (Forest disturbance; Equivalent Clearcut Area)
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Indicators were also developed reflecting relative vulnerability to habitat pressures within the life stage-specific "zones of influence" defined for each CU:

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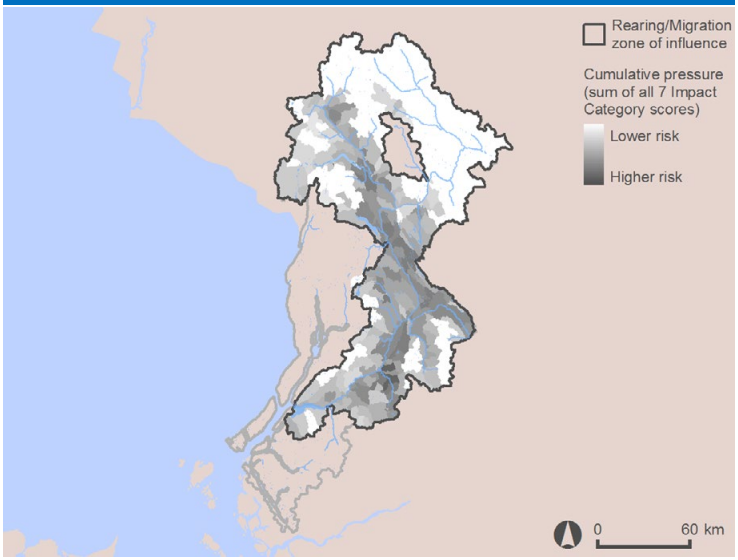
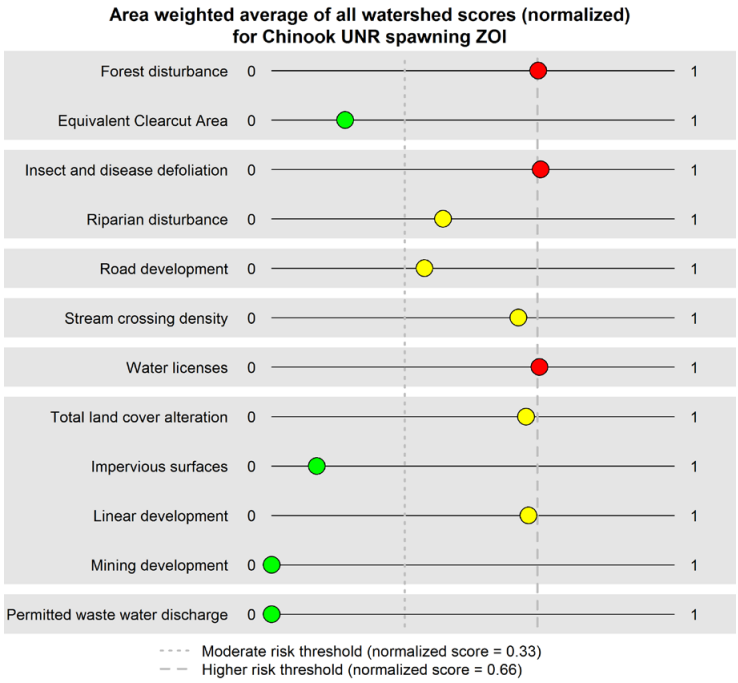
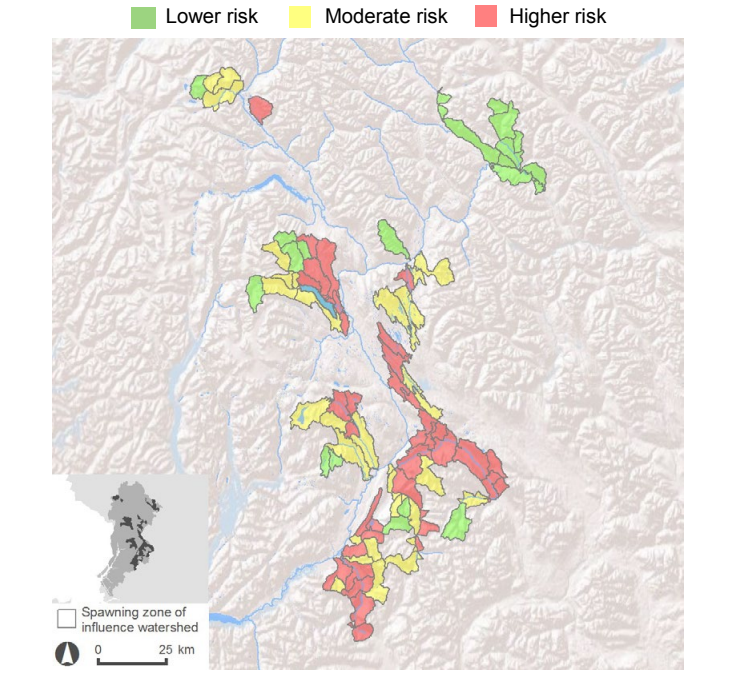
Cumulative pressure—rearing/migration



Summary of pressure indicators—spawning

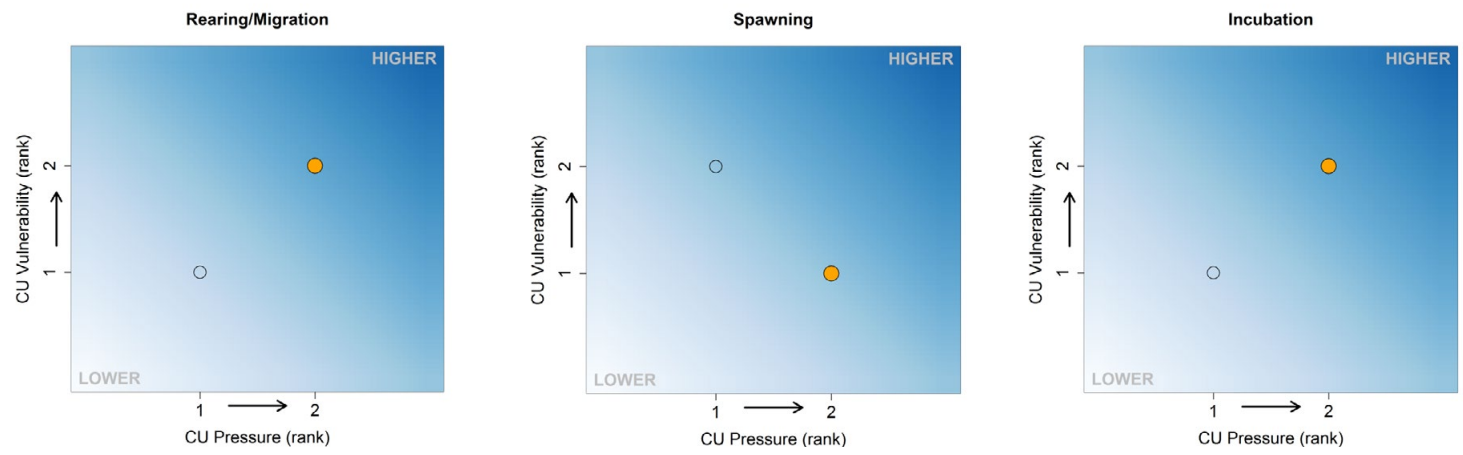


Cumulative pressure—spawning



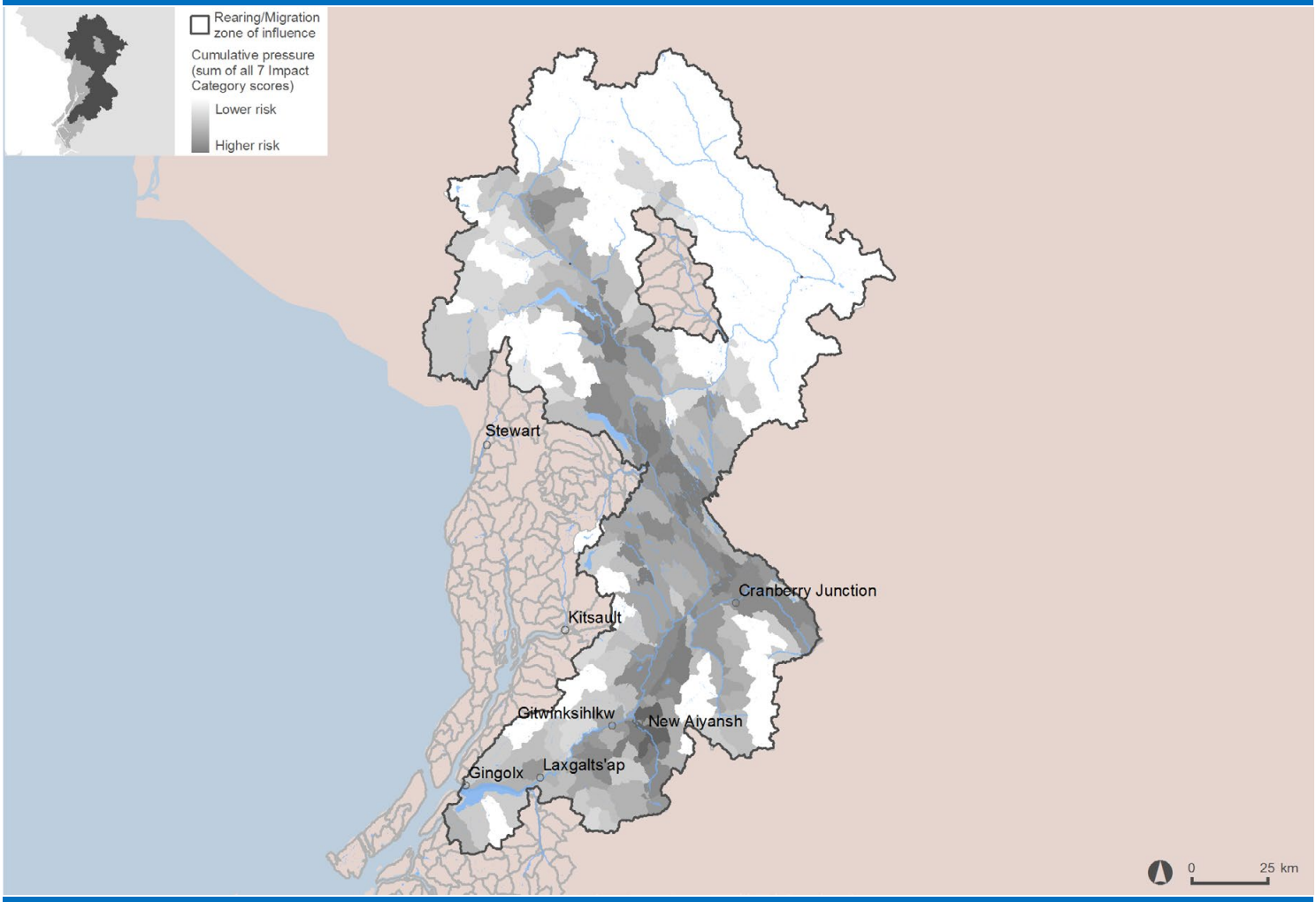
Integrated vulnerability/habitat pressures—rearing/migration, spawning, & incubation

● = Upper Nass ○ = other Chinook CUs



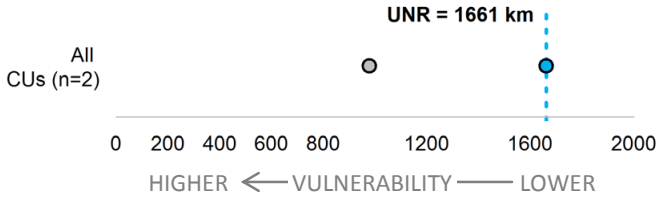
Rearing/Migration vulnerability & pressure

Rearing/Migration period pressures

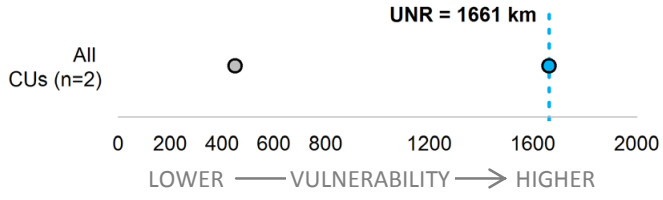


Rearing/Migration period vulnerability

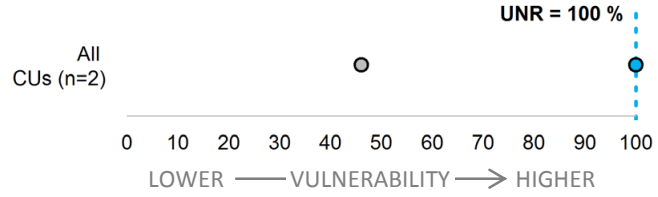
Salmon accessible habitat (km)



Flow sensitive accessible habitat (km) (all seasons)



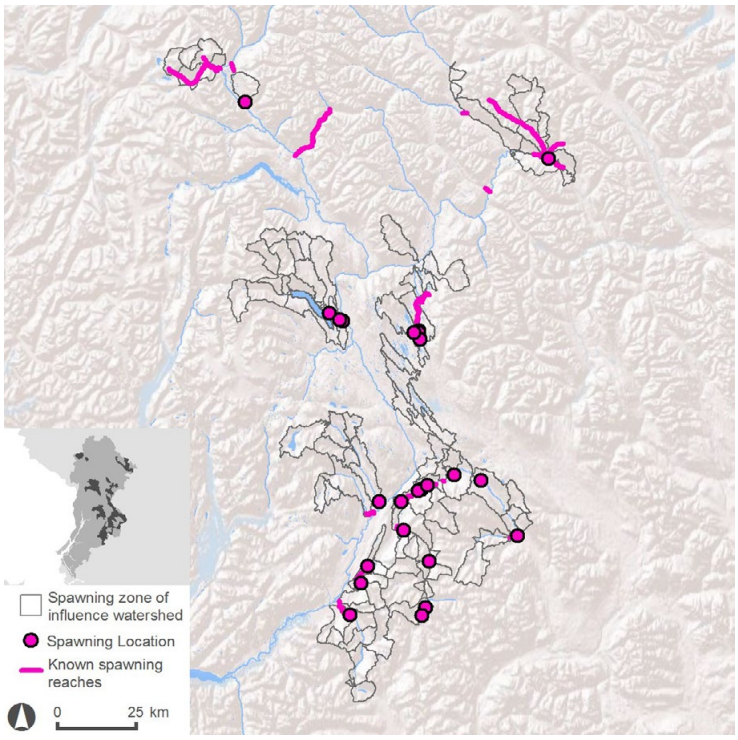
Flow sensitive accessible habitat (%) (all seasons)



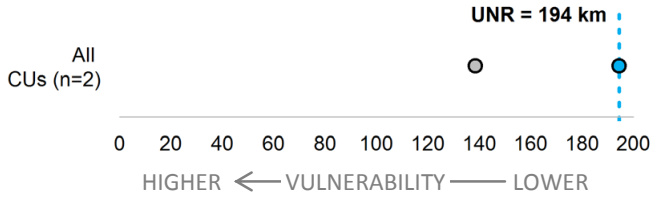
Spawning & incubation vulnerability

Spawning period vulnerability

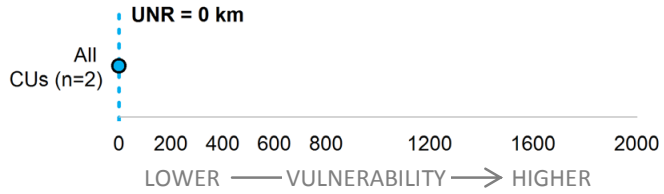
Spawning locations



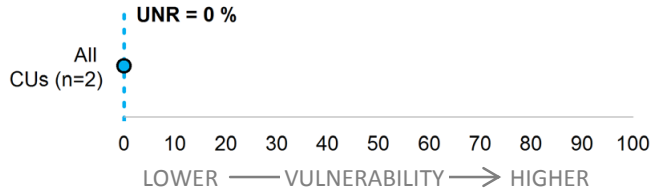
Total spawning length (km)



Spawning reaches summer flow sensitive - spawn timing (km)



Spawning reaches summer flow sensitive - spawn timing (%)



Incubation period vulnerability

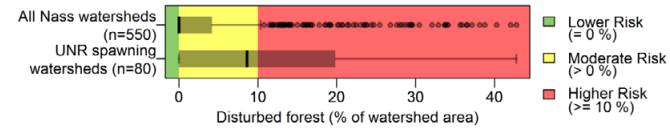
Spawning reaches winter flow sensitive - incubation timing (km)

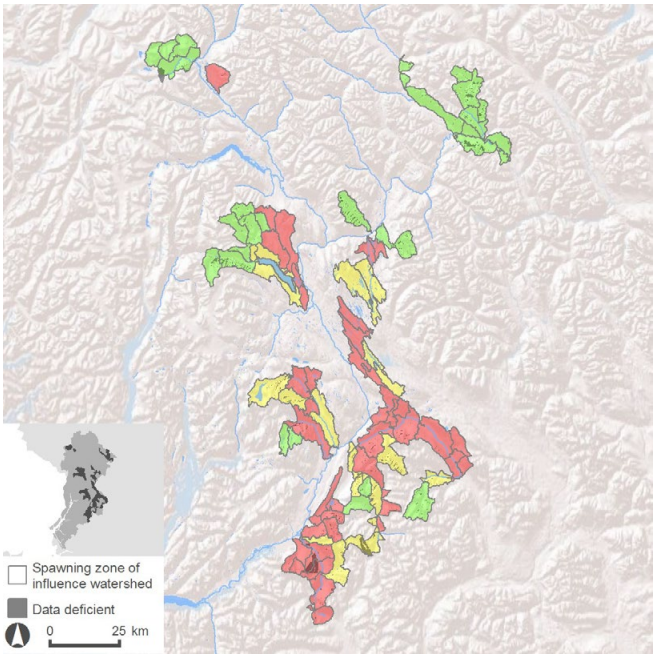
Spawning reaches winter flow sensitive - incubation timing (%)

Spawning pressure

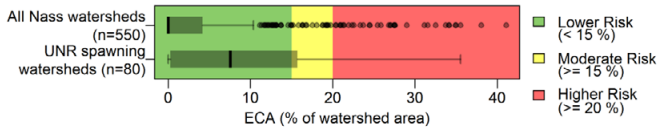
Hydrologic Processes

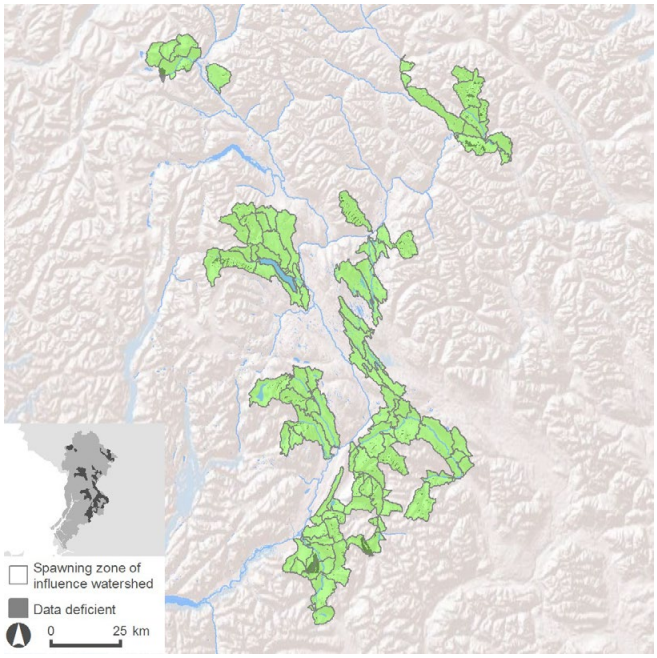
Forest disturbance





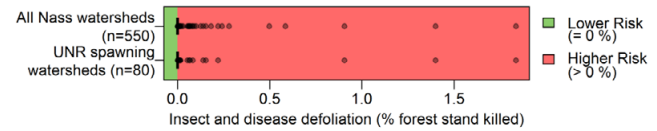
Equivalent Clear-cut Area

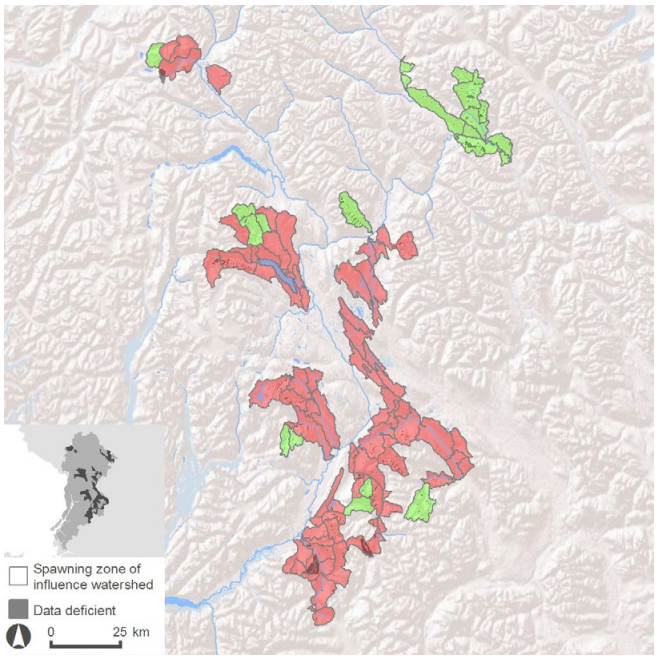




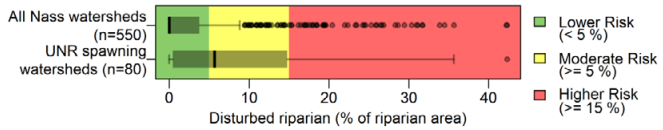
Vegetation Quality

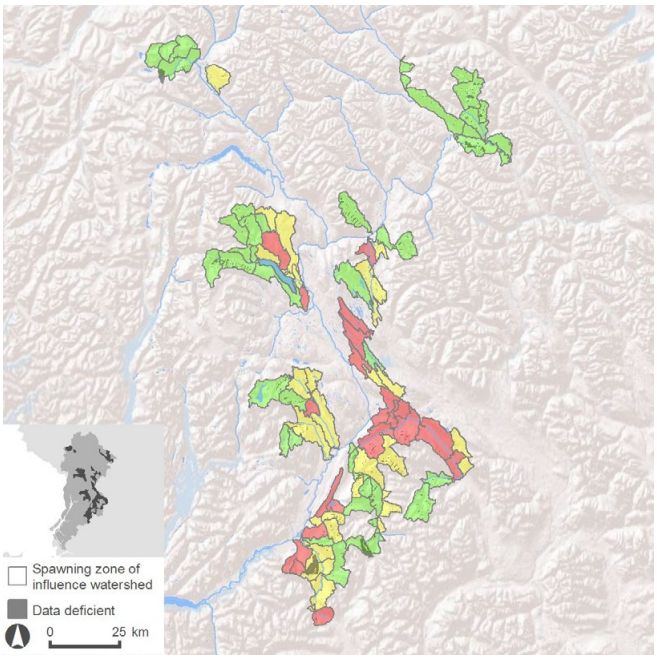
Insect and disease defoliation





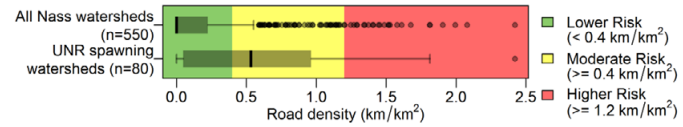
Riparian disturbance

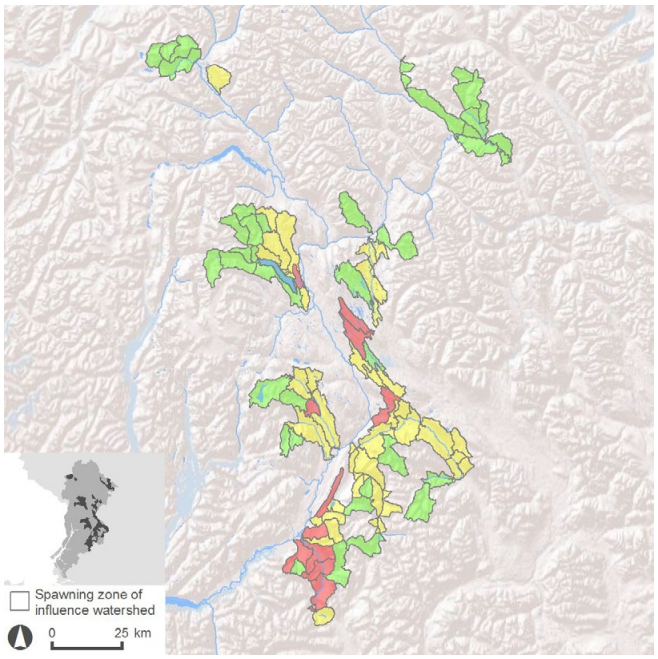




Surface Erosion

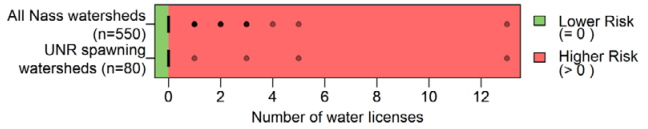
Road development

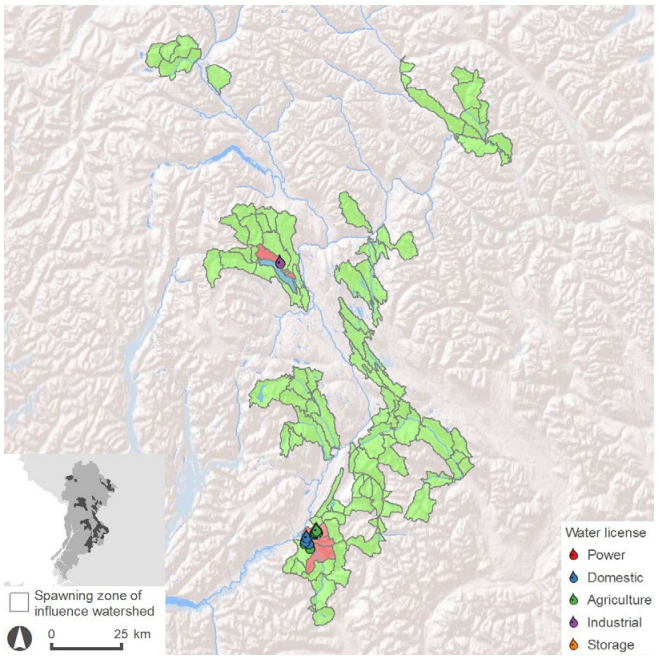




Water Quantity

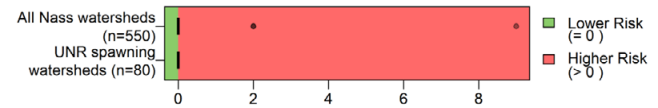
Number of water licenses

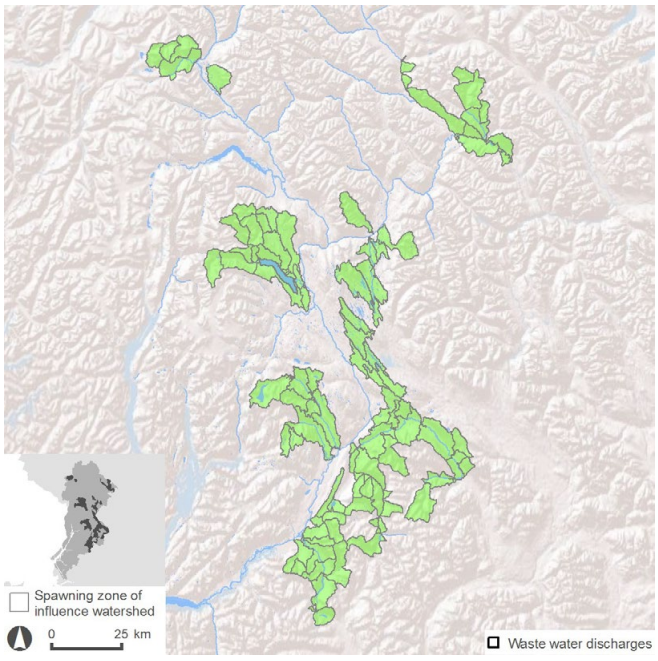




Water Quality

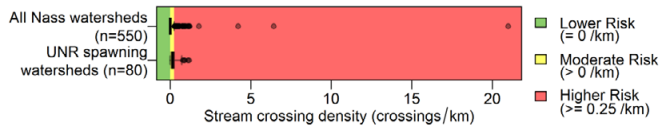
Permitted waste water discharges

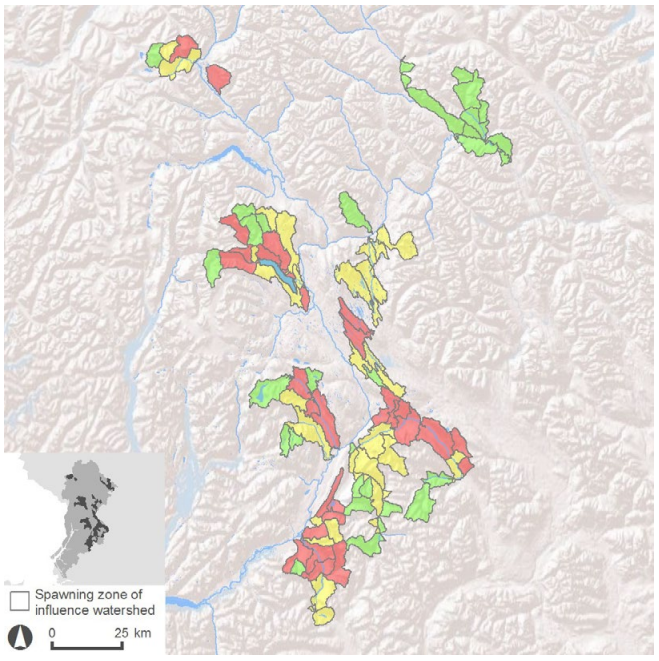




Fish Passage/Habitat Connectivity

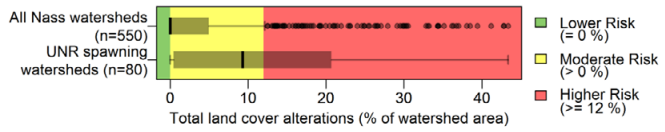
Stream crossing density

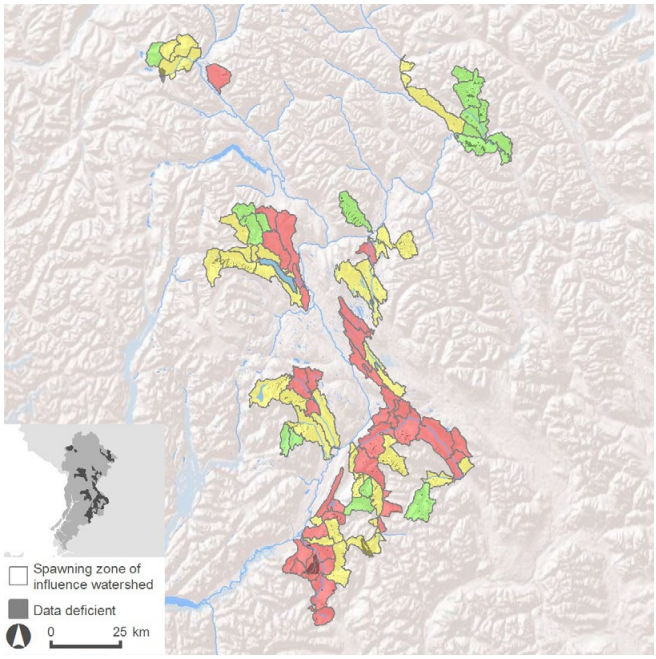




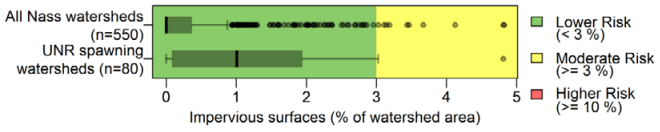
Human Development Footprint

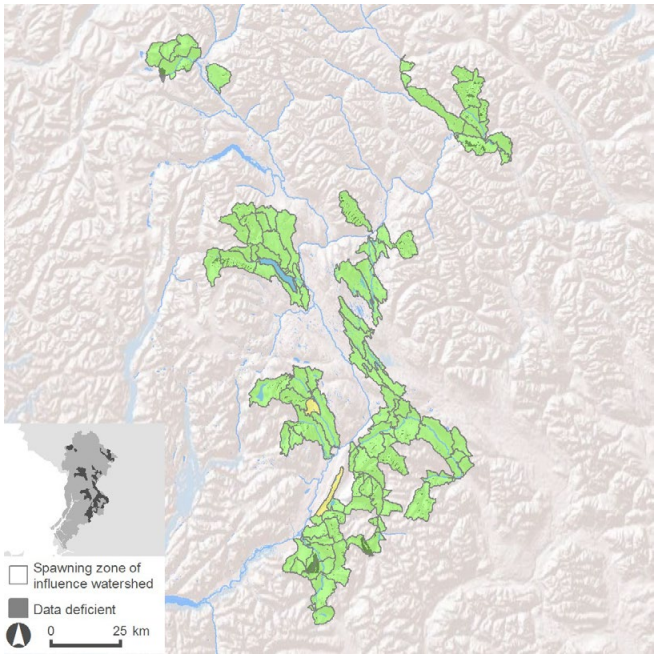
Total land cover alteration



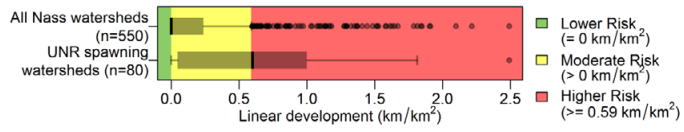


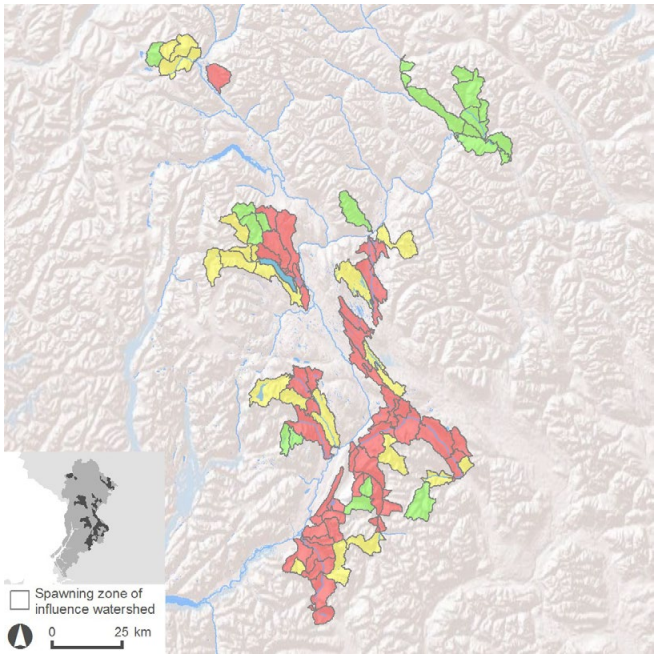
Impervious surfaces



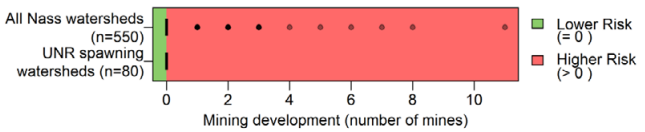


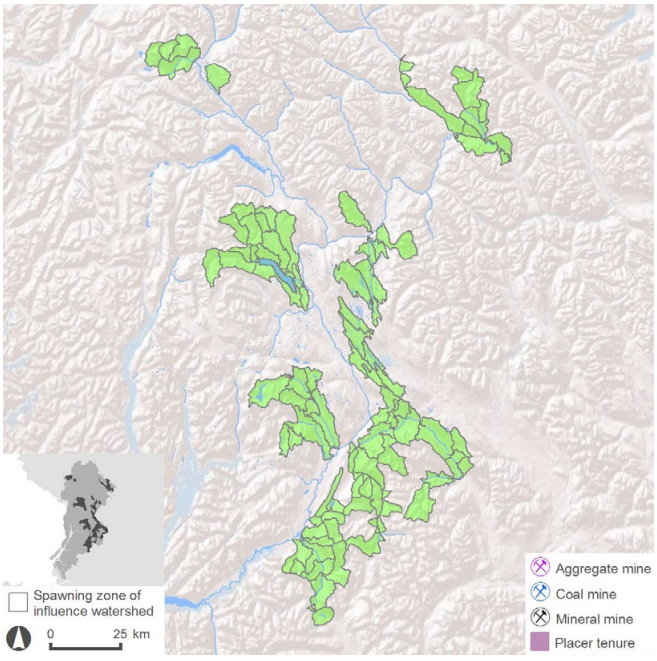
Linear development





Mining development (total number of mines)

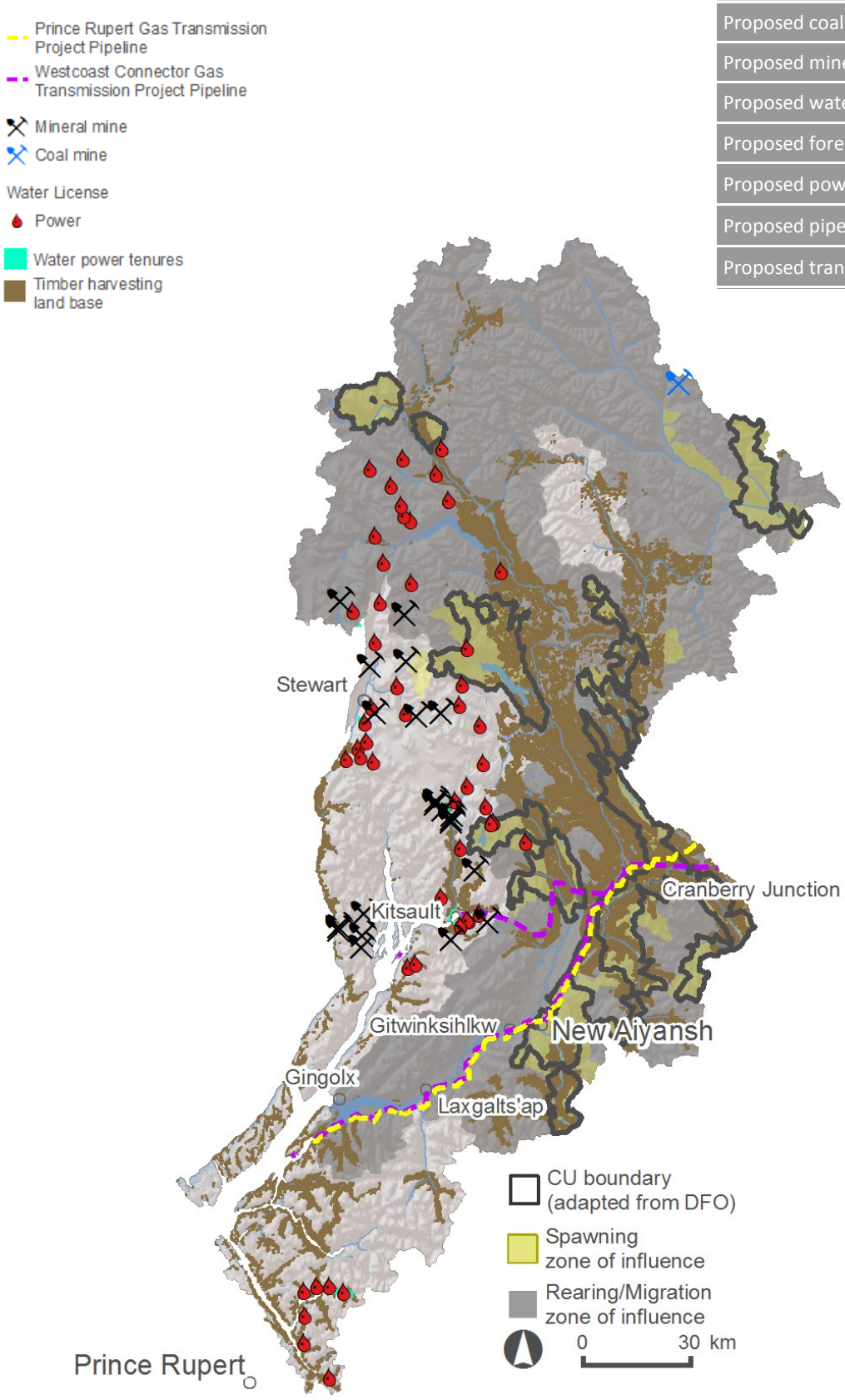




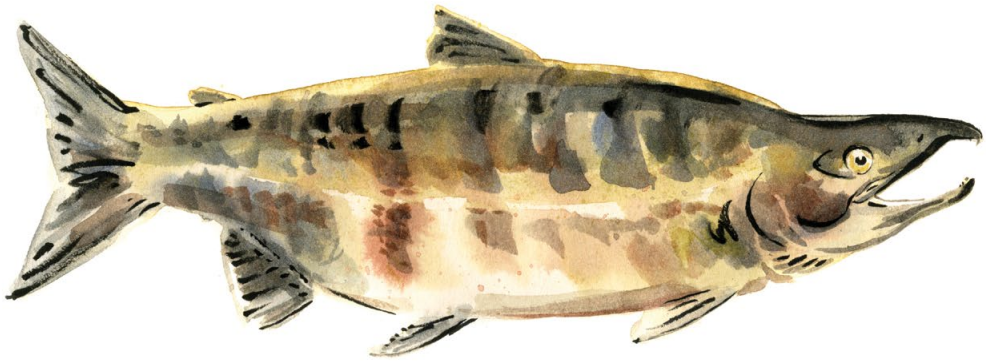
Future pressure

Proposed resource development projects (as of 2016)

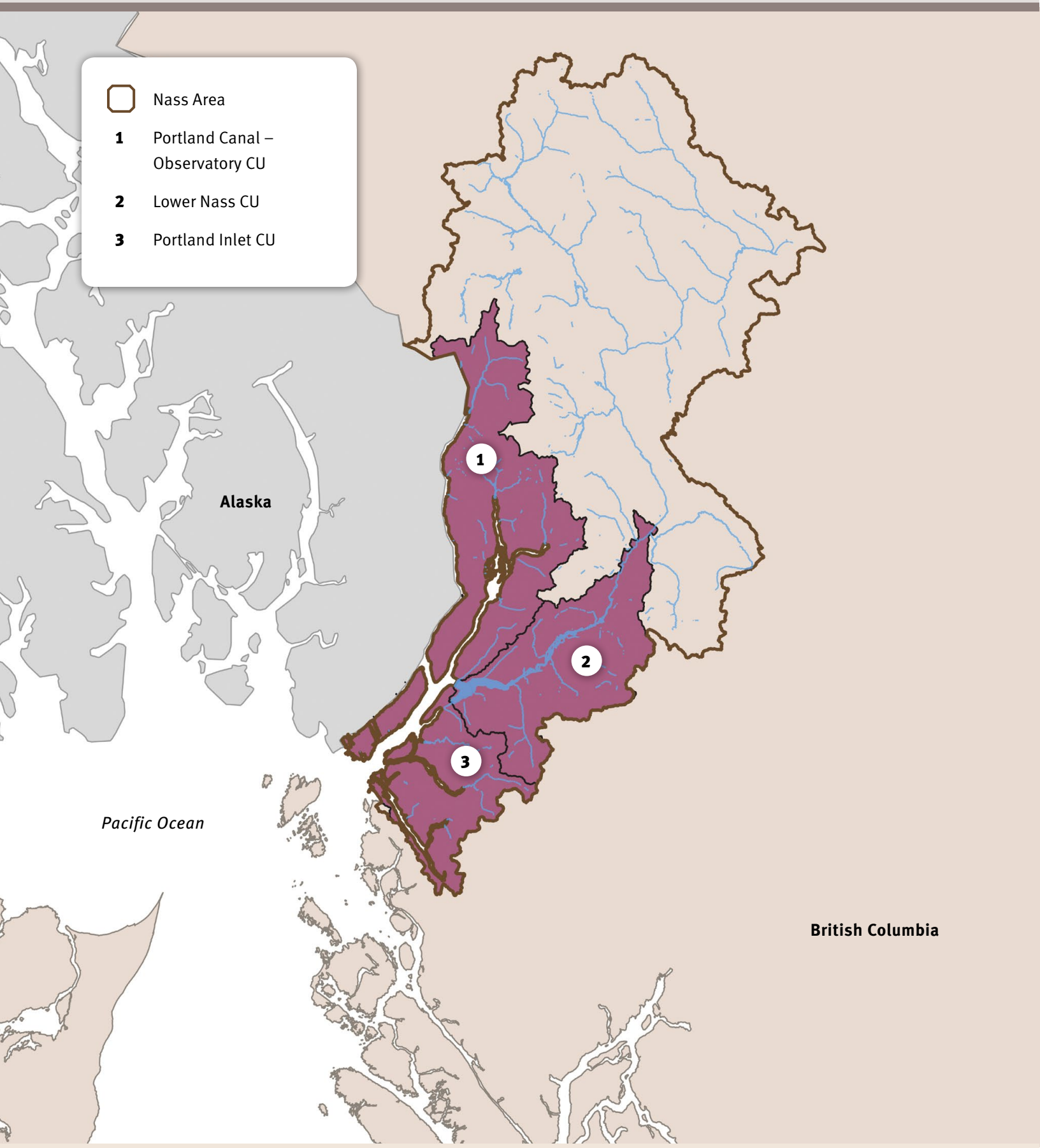
Nass Drainage Summary	
	Totals
Proposed coal mines (#)	1
Proposed mineral mines (#)	22
Proposed water licenses (#)	58
Proposed forestry (km^2)	3,323 km^2
Proposed power tenures	Wind 0 km^2, water 15 km^2
Proposed pipelines (km)	386 km
Proposed transmission lines	0 km



Chum



Chum: Map of Conservation Units (CUs)



Chum: Portland Inlet

Introduction

This project summarizes pressures on the habitat used by Nass salmon Conservation Units (CU) during their freshwater life history stages (migration, spawning and rearing), as well as their relative vulnerability to those pressures. For an explanation of the indicators shown here, please see the accompanying *Report Card Summaries*. Full methods and results can be found in the main report, *Cumulative Pressures on Nass Salmon Habitat: Technical Report* (2016).

Definitions

Conservation Unit (CU): A group of wild salmon sufficiently isolated from other groups that, if extirpated, is very unlikely to re-colonize naturally within an acceptable timeframe.

Pressure indicator: Measurable extent/intensity of natural processes or human activities that can induce changes in habitat condition/state.

Vulnerability indicator: Measures of habitat quantity or quality used to represent the intrinsic habitat vulnerability/sensitivity to watershed disturbances for each life-stage.

Zone of influence (ZOI): Areas adjacent to and upstream/upslope of habitats used by salmon CUs that represent the geographic extent for capture/ measurement of pressure and vulnerability indicators.

Status: Condition of habitat relative to a defined indicator benchmark.

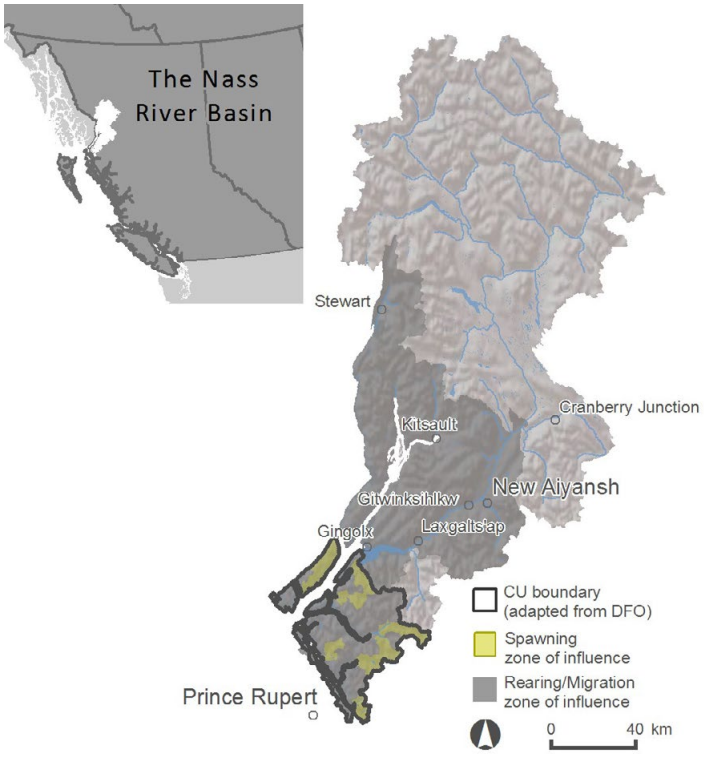
Risk: Likelihood of adverse effects to salmon habitats within a defined zone of influence. Levels of increasing risk are defined based on the extent/ intensity of impacts relative to defined benchmarks of concern.

Benchmark: A standard (quantified metric) against which habitat condition can be measured or judged, and by which status can be compared over time and space to determine the risk of adverse effects.

Narrative

- There are three chum salmon CUs in the Nass Area: 1) Lower Nass (LNASS), 2) Portland Inlet (PortIN), and 3) Portland Canal-Observatory Inlet (PCOb). There are over 50 discrete spawning populations of chum salmon in all three CUs combined.
- Nass Area chum salmon are currently identified by Fisheries and Oceans Canada as a stock of concern with returns currently falling below the provisional escapement target of 45,000.
- Juvenile chum typically spend very little time in freshwater, beginning their downstream migration to sea almost immediately after emerging from the gravel as fry.
- Nass Area chum salmon return to their natal stream to spawn between three and five years of age, with most fish maturing at four years of age.

Location



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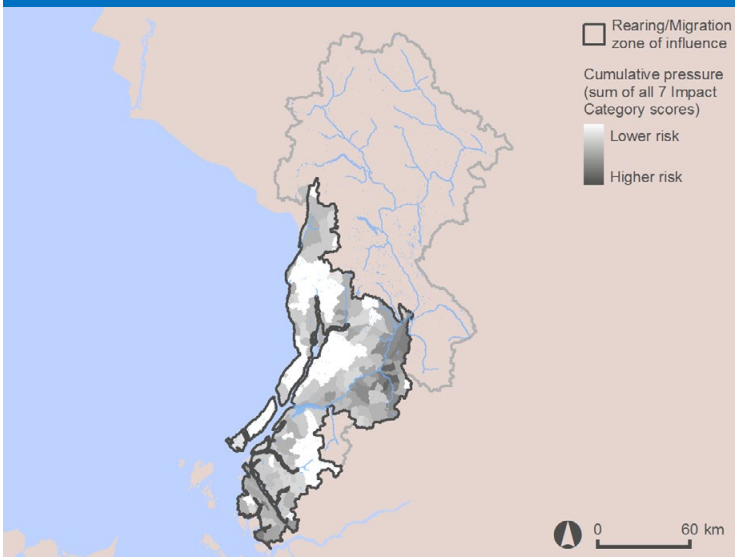
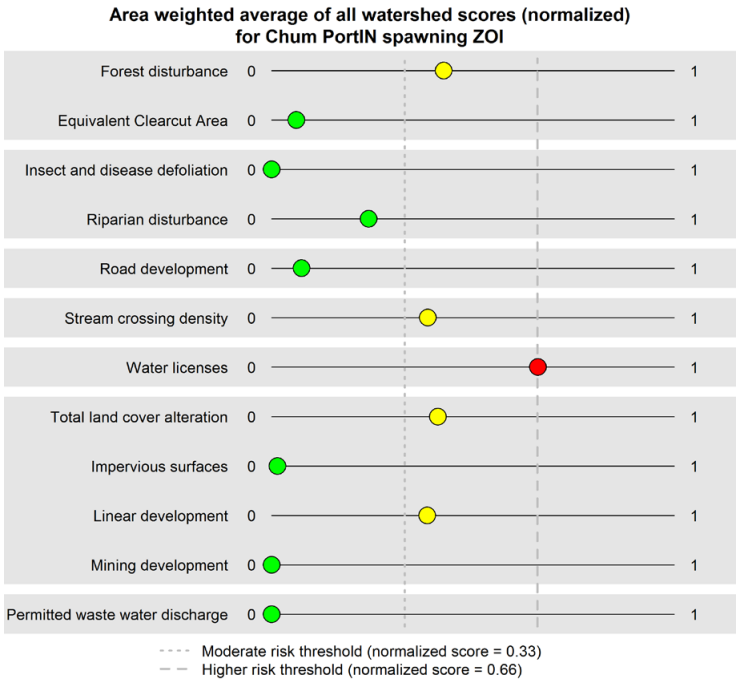
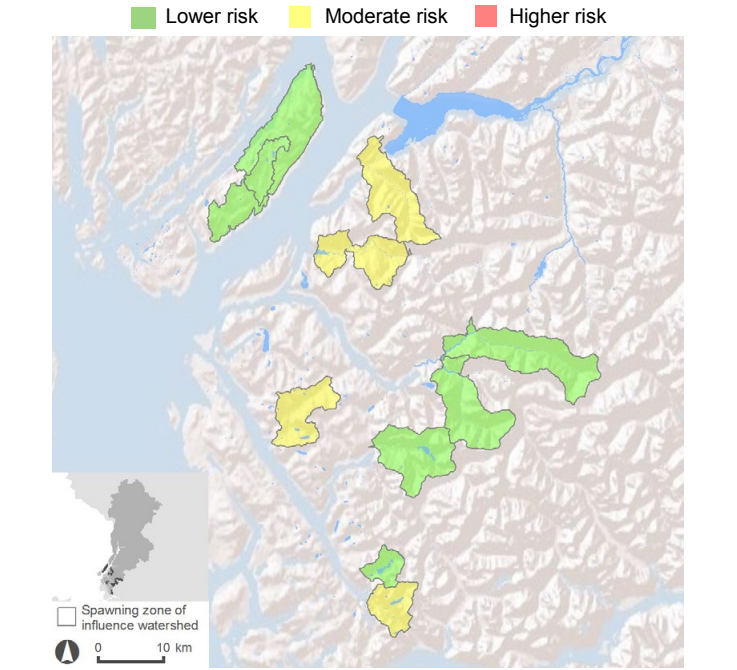
Cumulative pressure—rearing/migration



Summary of pressure indicators—spawning

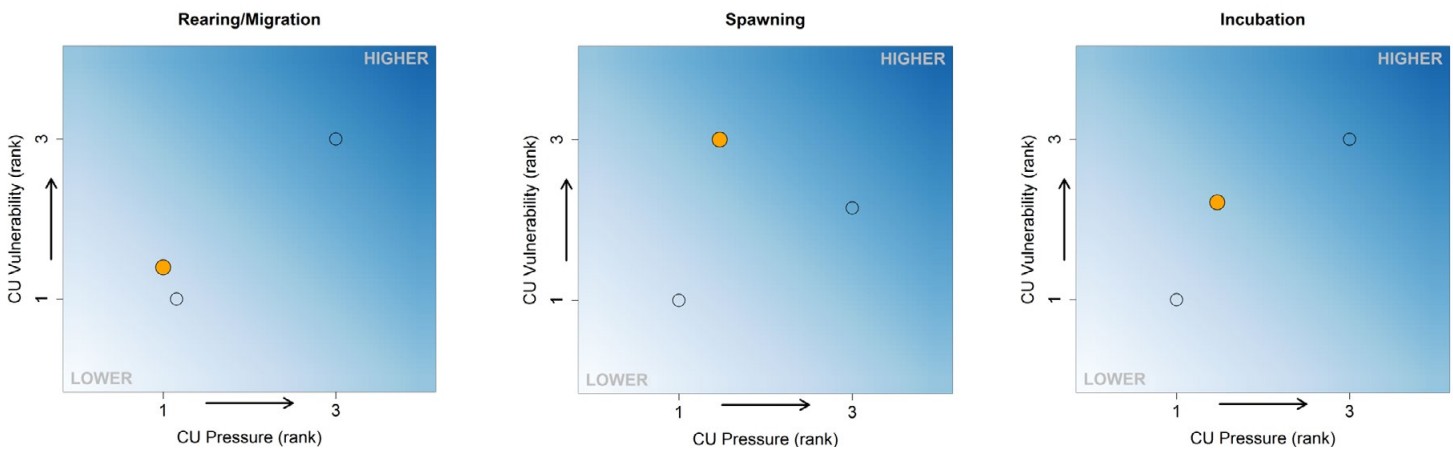


Cumulative pressure—spawning



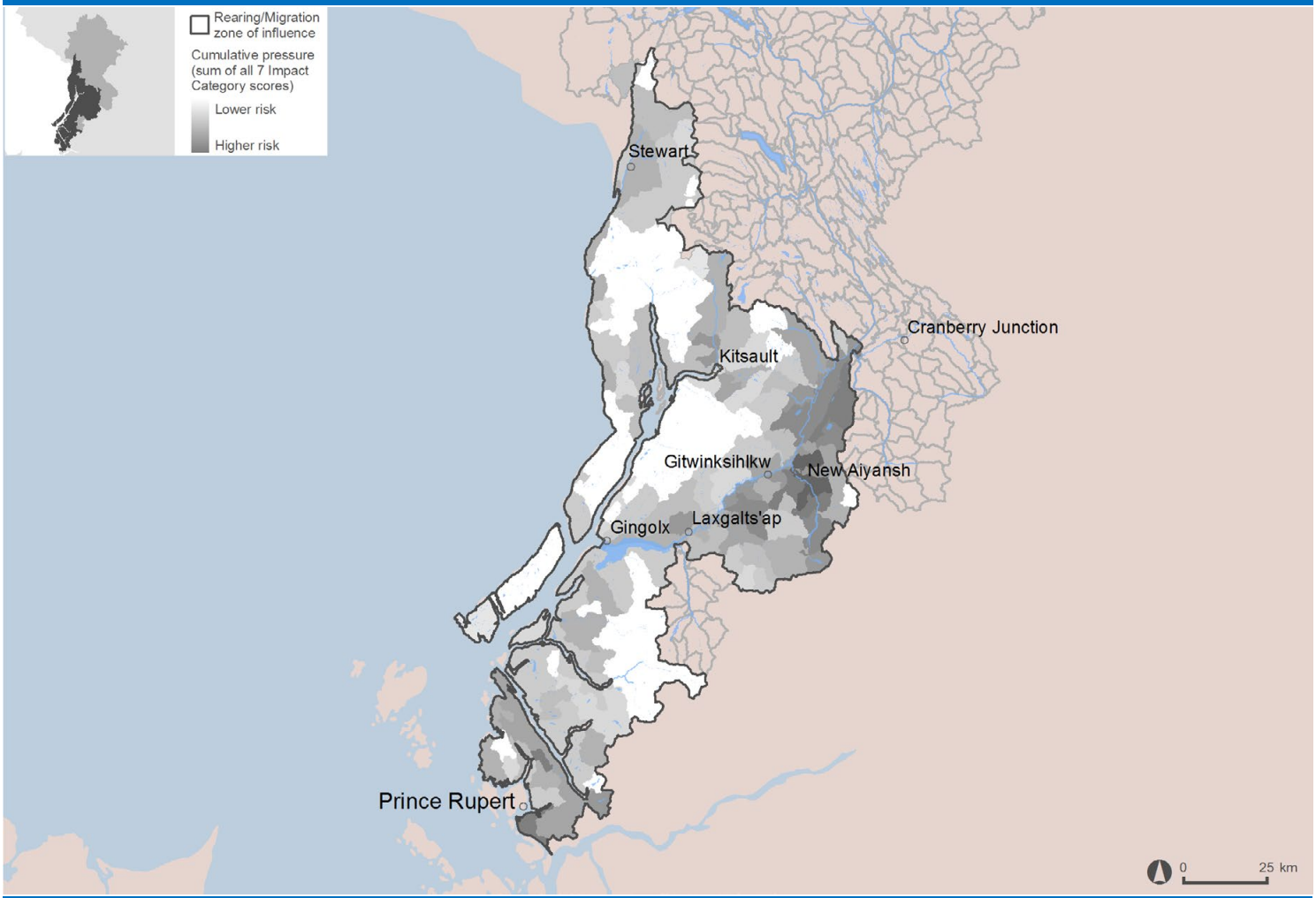
Integrated vulnerability/habitat pressures—rearing/migration, spawning, & incubation

● = Portland Inlet ○ = other Chum CUs



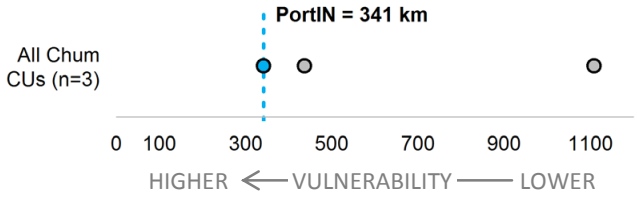
Rearing/Migration vulnerability & pressure

Rearing/Migration period pressures

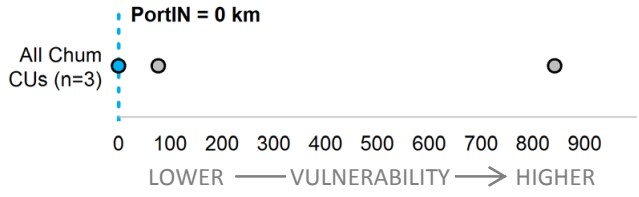


Rearing/Migration period vulnerability

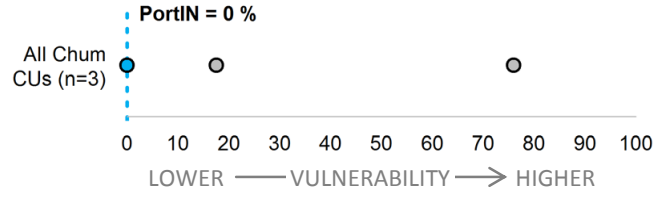
Salmon accessible habitat (km)



Flow sensitive accessible habitat (km) (all seasons)



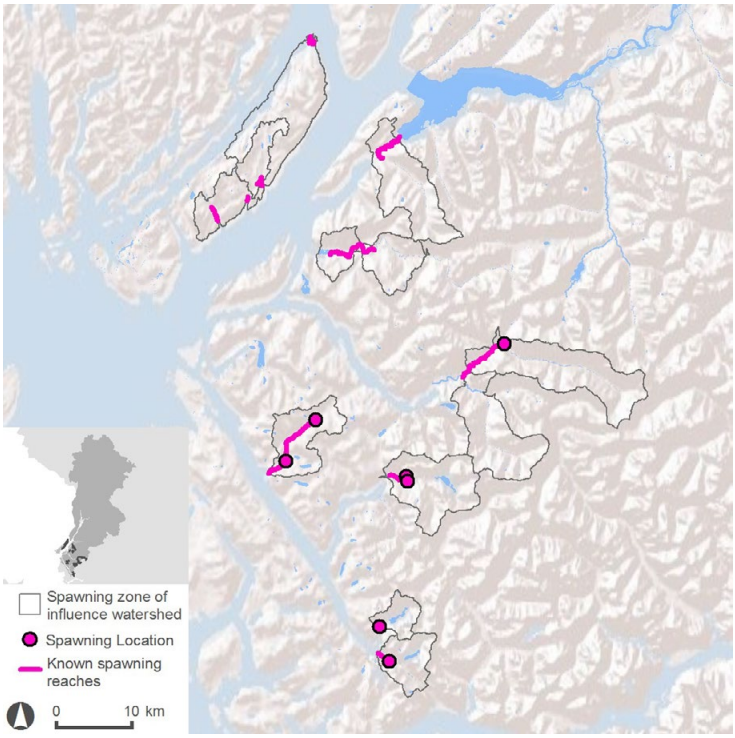
Flow sensitive accessible habitat (%) (all seasons)



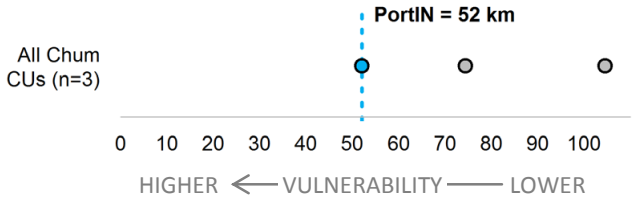
Spawning & incubation vulnerability

Spawning period vulnerability

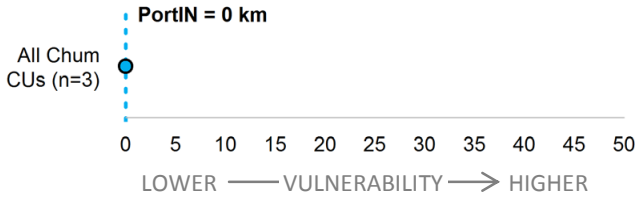
Spawning locations



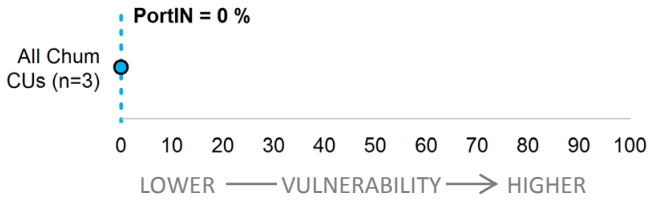
Total spawning length (km)



Spawning reaches summer flow sensitive - spawn timing (km)

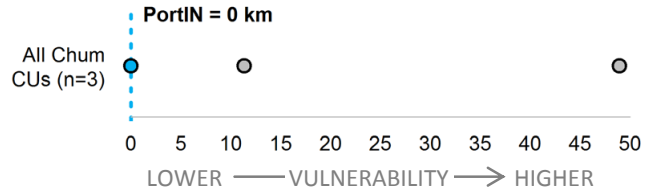


Spawning reaches summer flow sensitive - spawn timing (%)

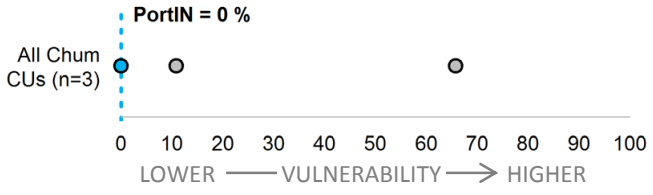


Incubation period vulnerability

Spawning reaches winter flow sensitive - incubation timing (km)



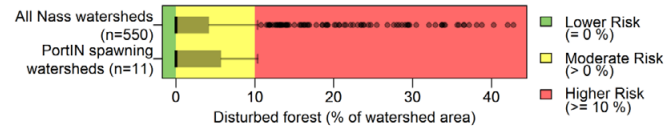
Spawning reaches winter flow sensitive - incubation timing (%)

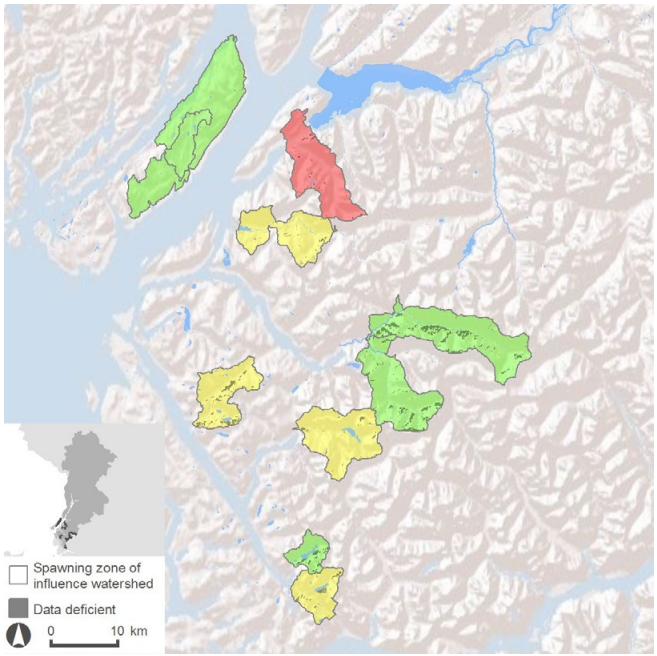


Spawning pressure

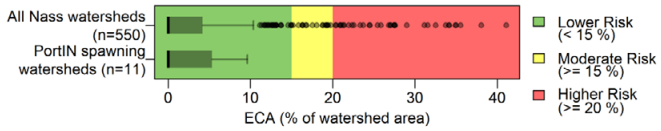
Hydrologic Processes

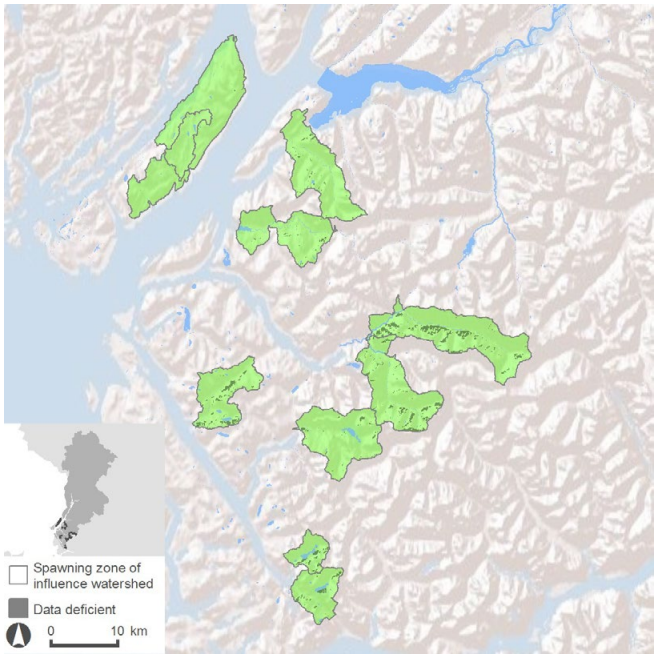
Forest disturbance





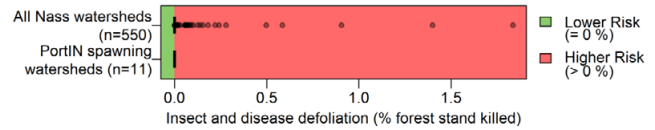
Equivalent Clear-cut Area

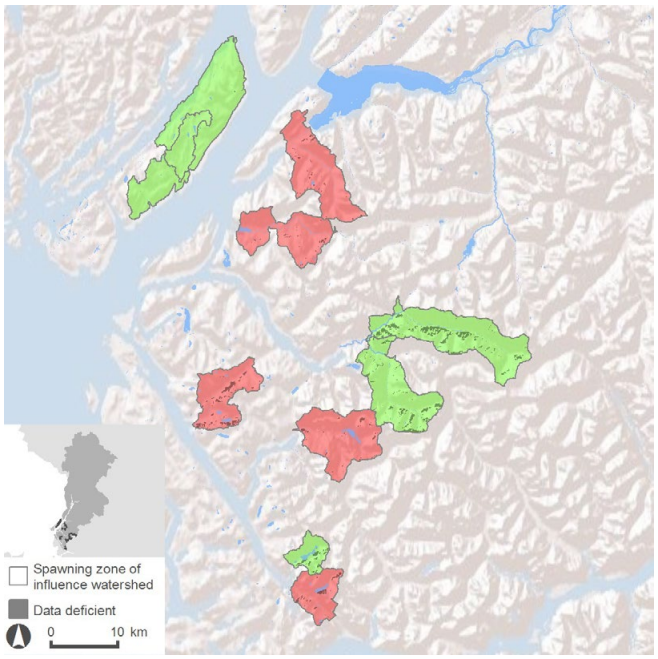




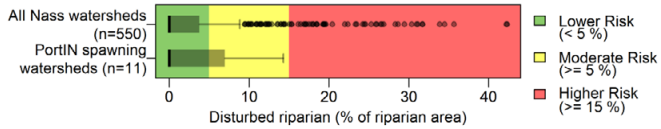
Vegetation Quality

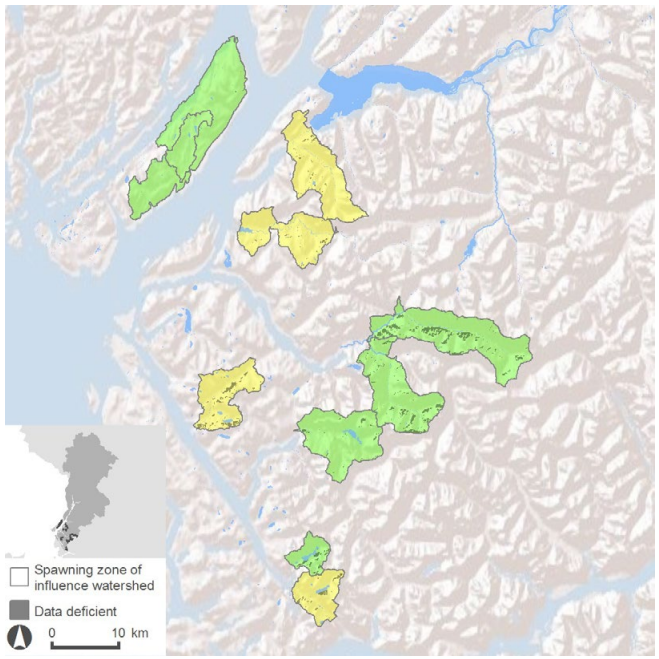
Insect and disease defoliation





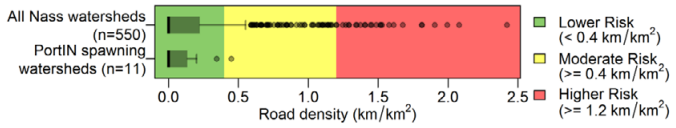
Riparian disturbance

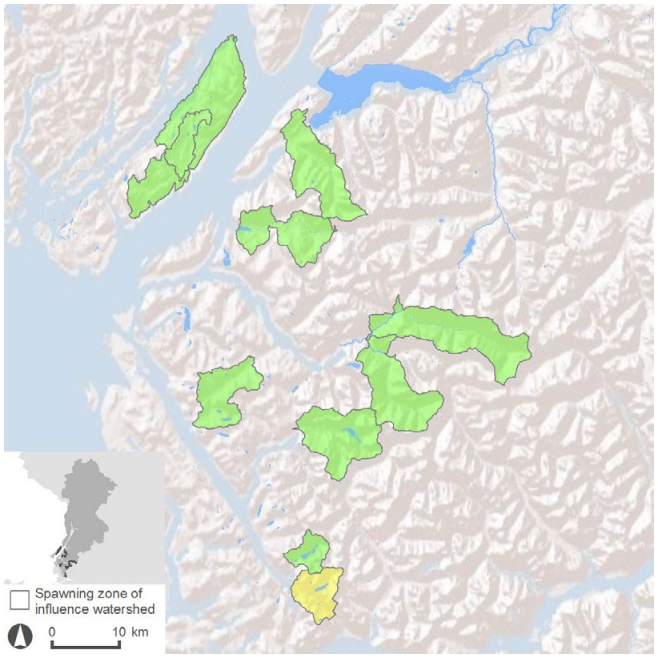




Surface Erosion

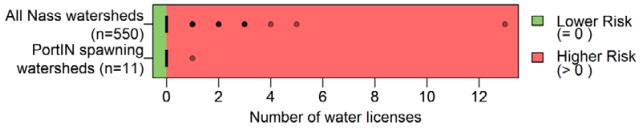
Road development

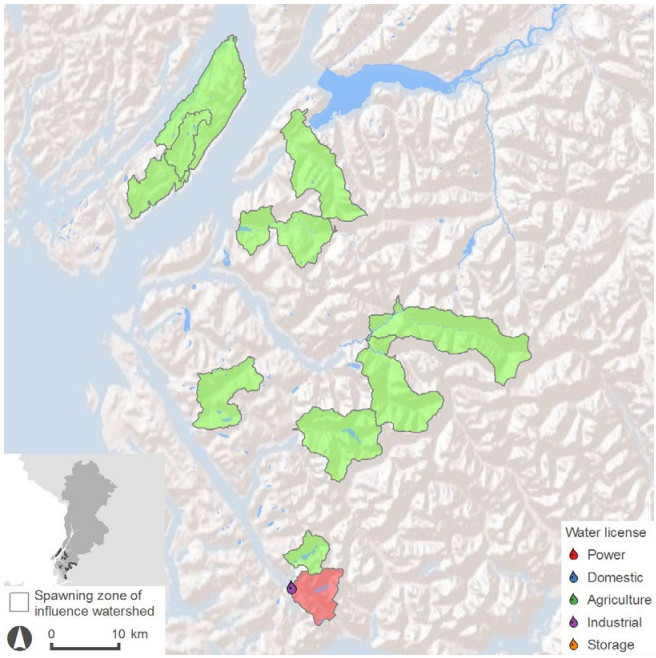




Water Quantity

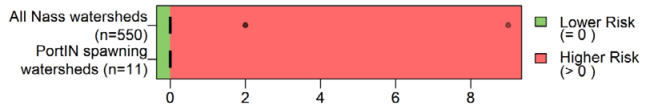
Number of water licenses

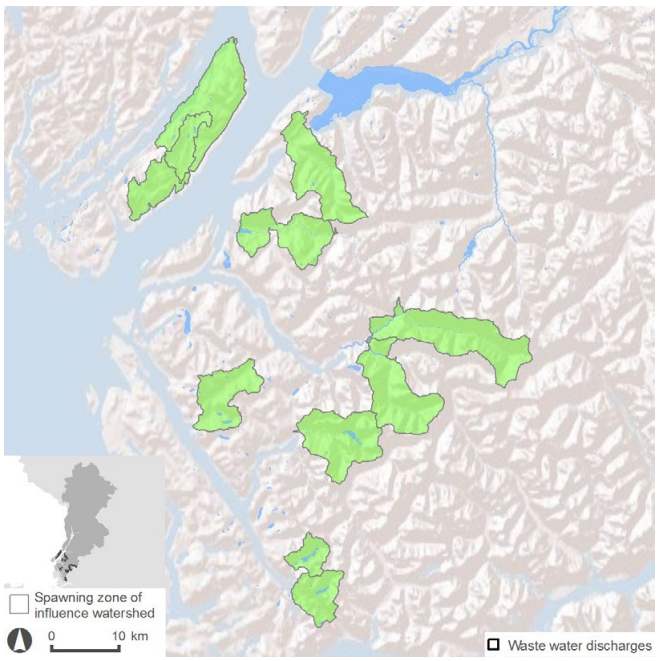




Water Quality

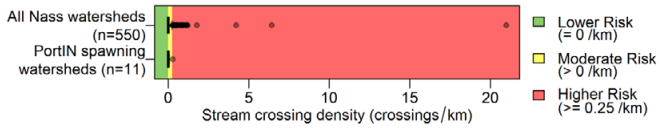
Permitted waste water discharges

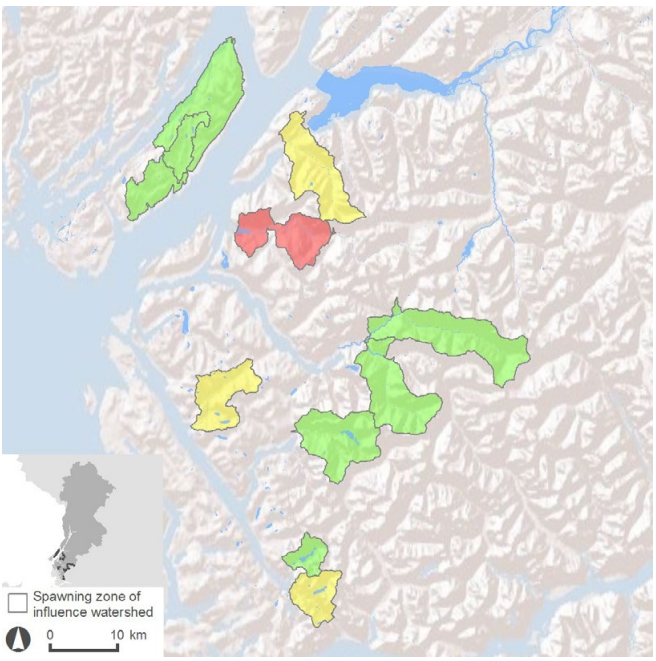




Fish Passage/Habitat Connectivity

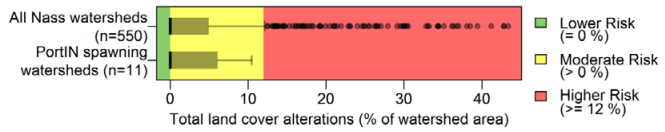
Stream crossing density

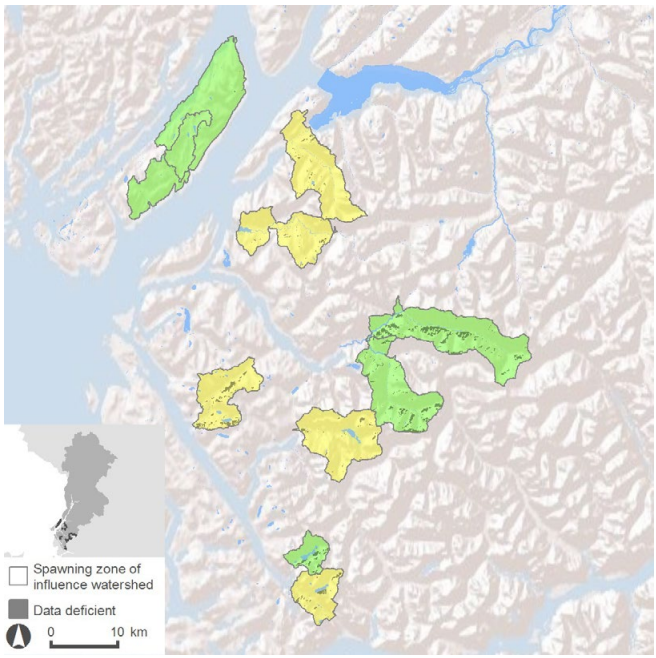




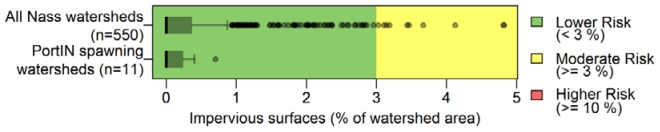
Human Development Footprint

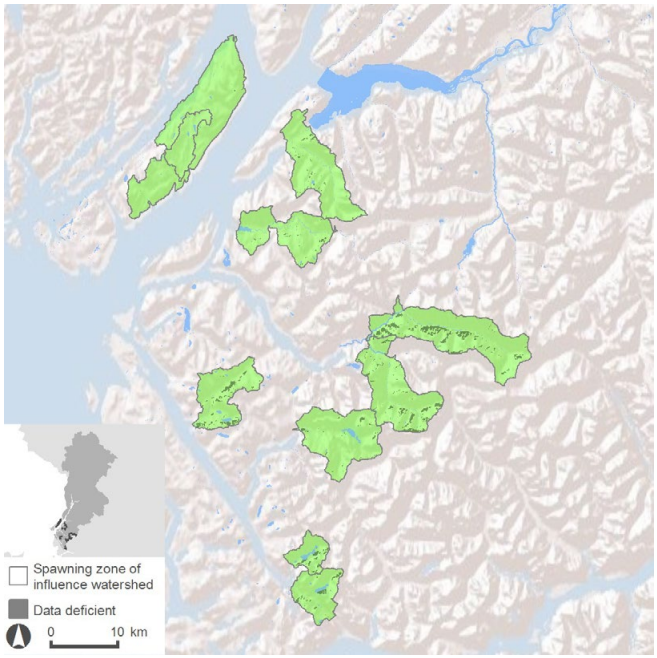
Total land cover alteration



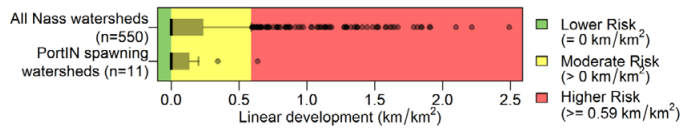


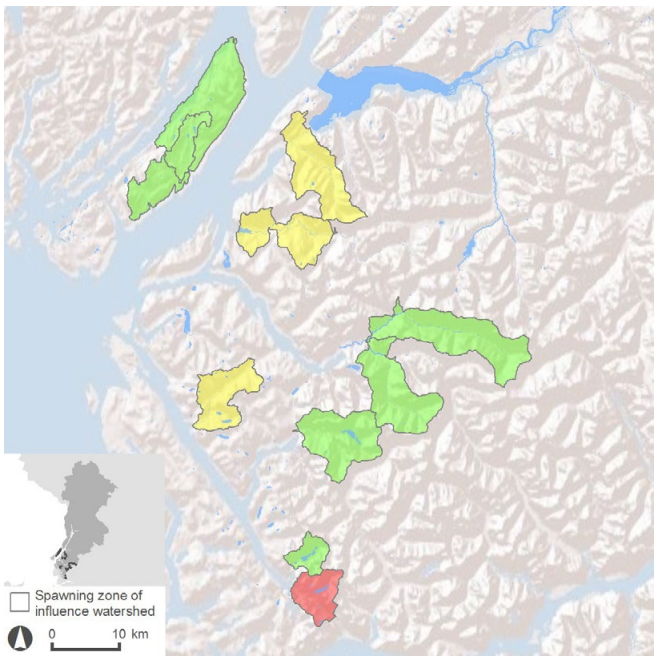
Impervious surfaces



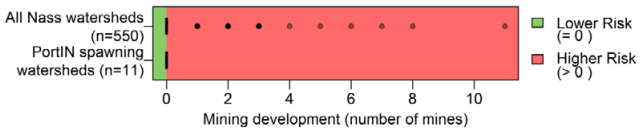


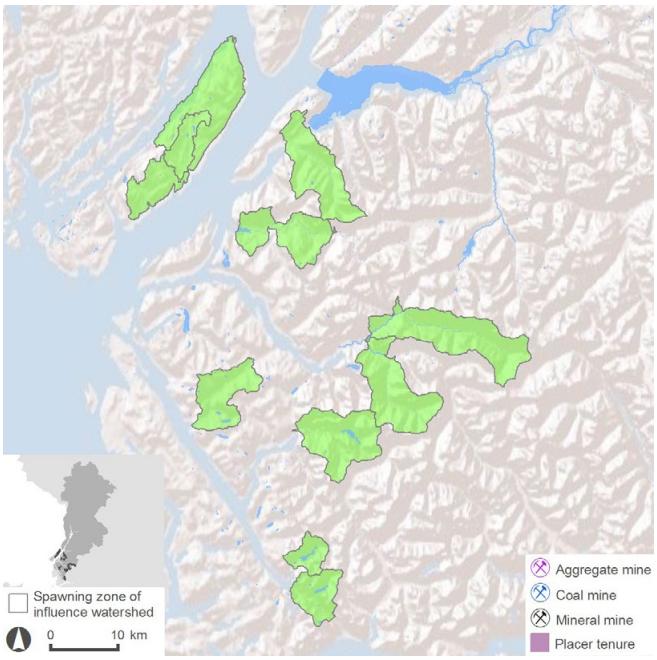
Linear development





Mining development (total number of mines)

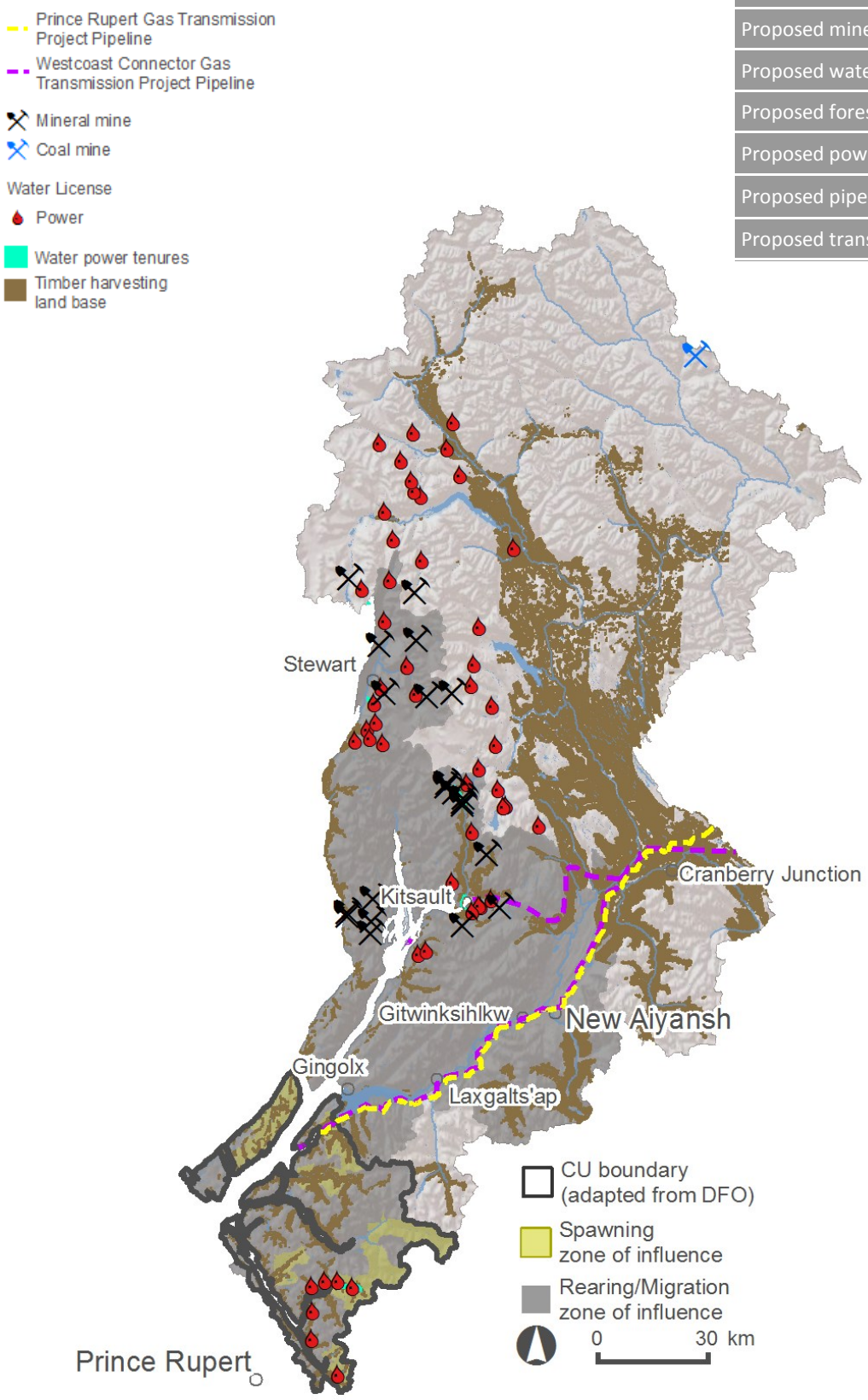




Future pressure

Proposed resource development projects (as of 2016)

Nass Drainage Summary	
	Totals
Proposed coal mines (#)	1
Proposed mineral mines (#)	22
Proposed water licenses (#)	58
Proposed forestry (km^2)	3,323 km^2
Proposed power tenures	Wind 0 km^2, water 15 km^2
Proposed pipelines (km)	386 km
Proposed transmission lines	0 km



Chum: Lower Nass

Introduction

This project summarizes pressures on the habitat used by Nass salmon Conservation Units (CU) during their freshwater life history stages (migration, spawning and rearing), as well as their relative vulnerability to those pressures. For an explanation of the indicators shown here, please see the accompanying *Report Card Summaries*. Full methods and results can be found in the main report, *Cumulative Pressures on Nass Salmon Habitat: Technical Report* (2016).

Definitions

Conservation Unit (CU): A group of wild salmon sufficiently isolated from other groups that, if extirpated, is very unlikely to re-colonize naturally within an acceptable timeframe.

Pressure indicator: Measurable extent/intensity of natural processes or human activities that can induce changes in habitat condition/state.

Vulnerability indicator: Measures of habitat quantity or quality used to represent the intrinsic habitat vulnerability/sensitivity to watershed disturbances for each life-stage.

Zone of influence (ZOI): Areas adjacent to and upstream/upslope of habitats used by salmon CUs that represent the geographic extent for capture/measurement of pressure and vulnerability indicators.

Status: Condition of habitat relative to a defined indicator benchmark.

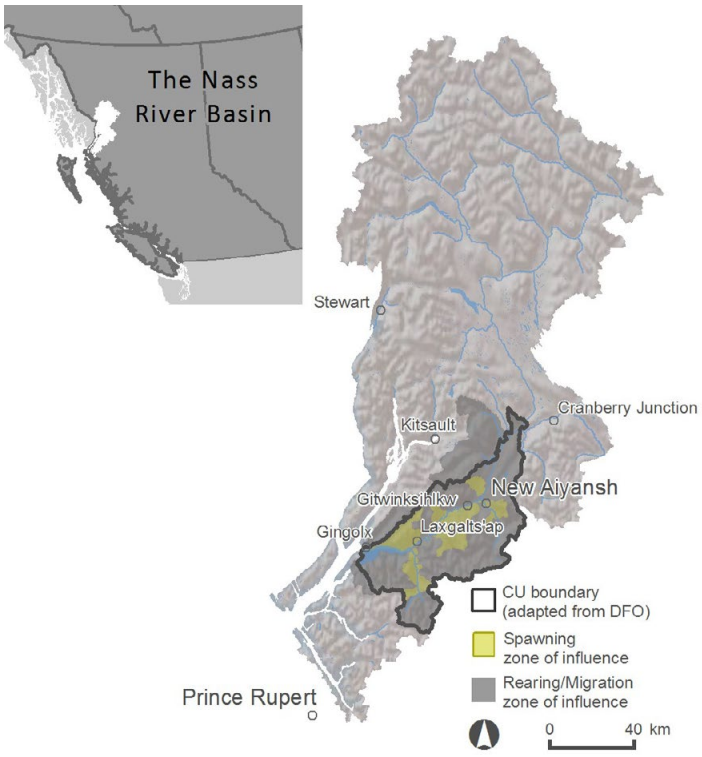
Risk: Likelihood of adverse effects to salmon habitats within a defined zone of influence. Levels of increasing risk are defined based on the extent/intensity of impacts relative to defined benchmarks of concern.

Benchmark: A standard (quantified metric) against which habitat condition can be measured or judged, and by which status can be compared over time and space to determine the risk of adverse effects.

Narrative

- There are three chum salmon CUs in the Nass Area: 1) Lower Nass (LNASS), 2) Portland Inlet (PortIN), and 3) Portland Canal-Observatory Inlet (PCOb). There are over 50 discrete spawning populations of chum salmon in all three CUs combined.
- Nass Area chum salmon are currently identified by Fisheries and Oceans Canada as a stock of concern with returns currently falling below the provisional escapement target of 45,000.
- Juvenile chum typically spend very little time in freshwater, beginning their downstream migration to sea almost immediately after emerging from the gravel as fry.
- Nass Area chum salmon return to their natal stream to spawn between three and five years of age, with most fish maturing at four years of age.

Location



Summary of habitat vulnerabilities & pressures

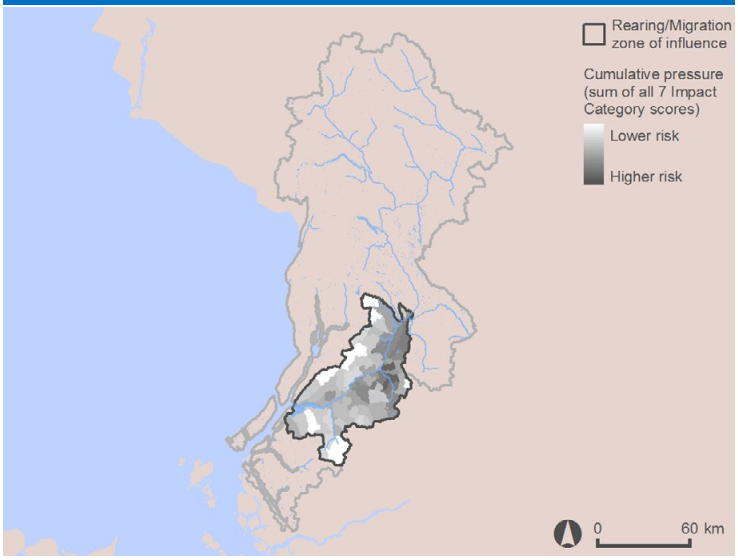
Pressure indicators were grouped into seven relatively independent habitat "impact categories" representing key factors affecting general watershed condition:

- Hydrologic Processes (Forest disturbance; Equivalent Clearcut Area)
- Vegetation Quality (Insect and disease defoliation; Riparian disturbance)
- Surface Erosion (Road development)
- Fish passage/Habitat connectivity (Stream crossing density)
- Water quantity (Water licenses)
- Human development footprint (Total land cover alteration; Impervious surfaces; Linear development; Mining development)
- Water quality (Wastewater discharges)

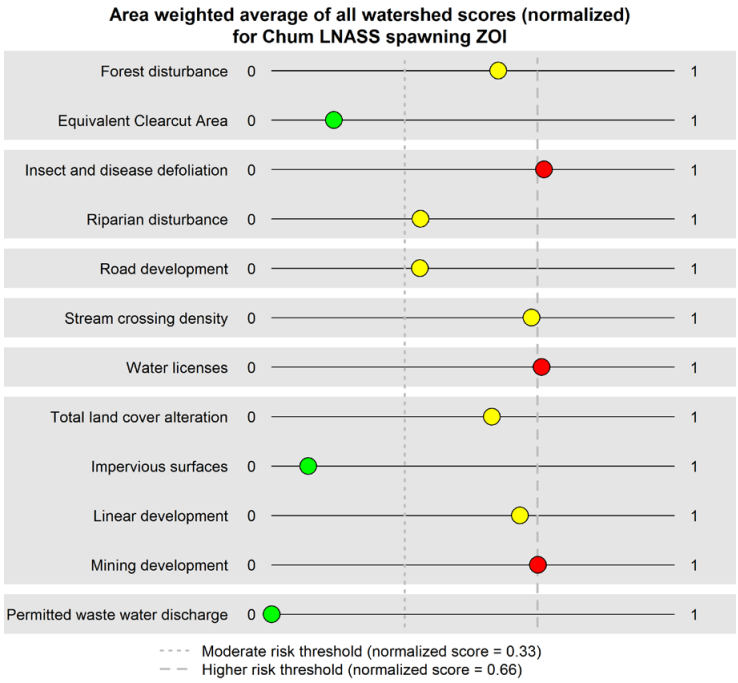
Indicators were also developed reflecting relative vulnerability to habitat pressures within the life stage-specific "zones of influence" defined for each CU:

- Rearing/Migration ZOI: Accessible stream length; Length and percentage of accessible streams considered flow sensitive - all seasons
- Spawning ZOI: Total spawning length; Length and percentage of spawning reaches considered flow sensitive (summer period - spawning, winter period - incubation)

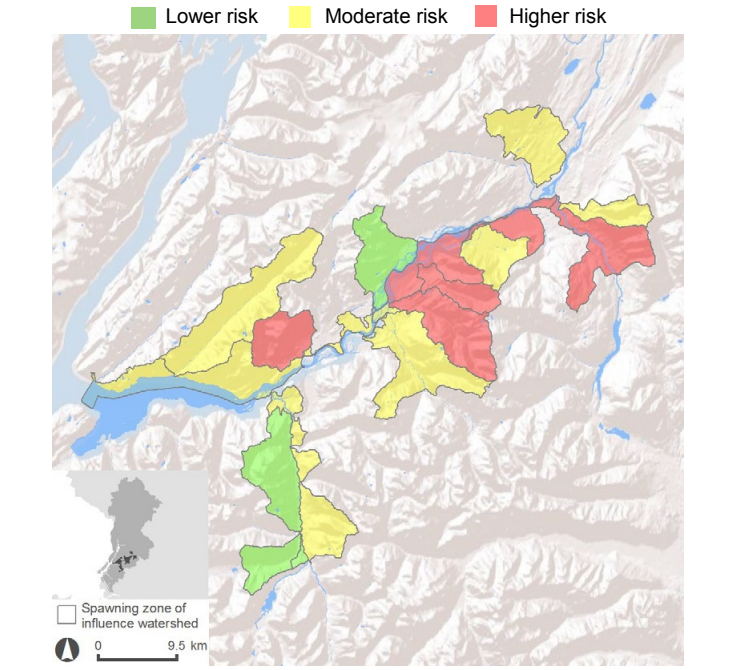
Cumulative pressure—rearing/migration



Summary of pressure indicators—spawning

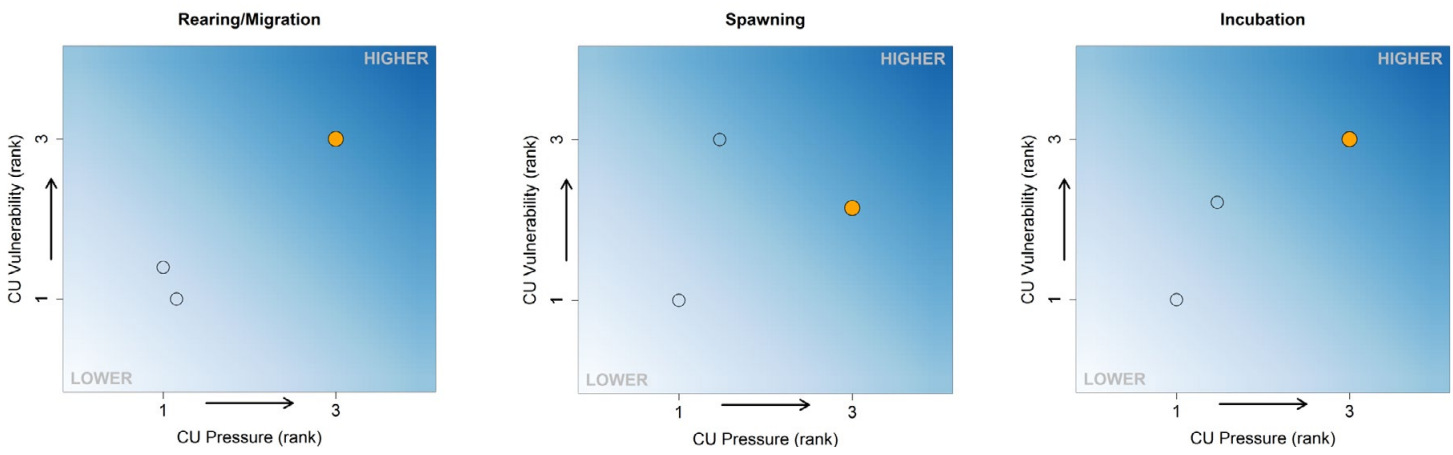


Cumulative pressure—spawning



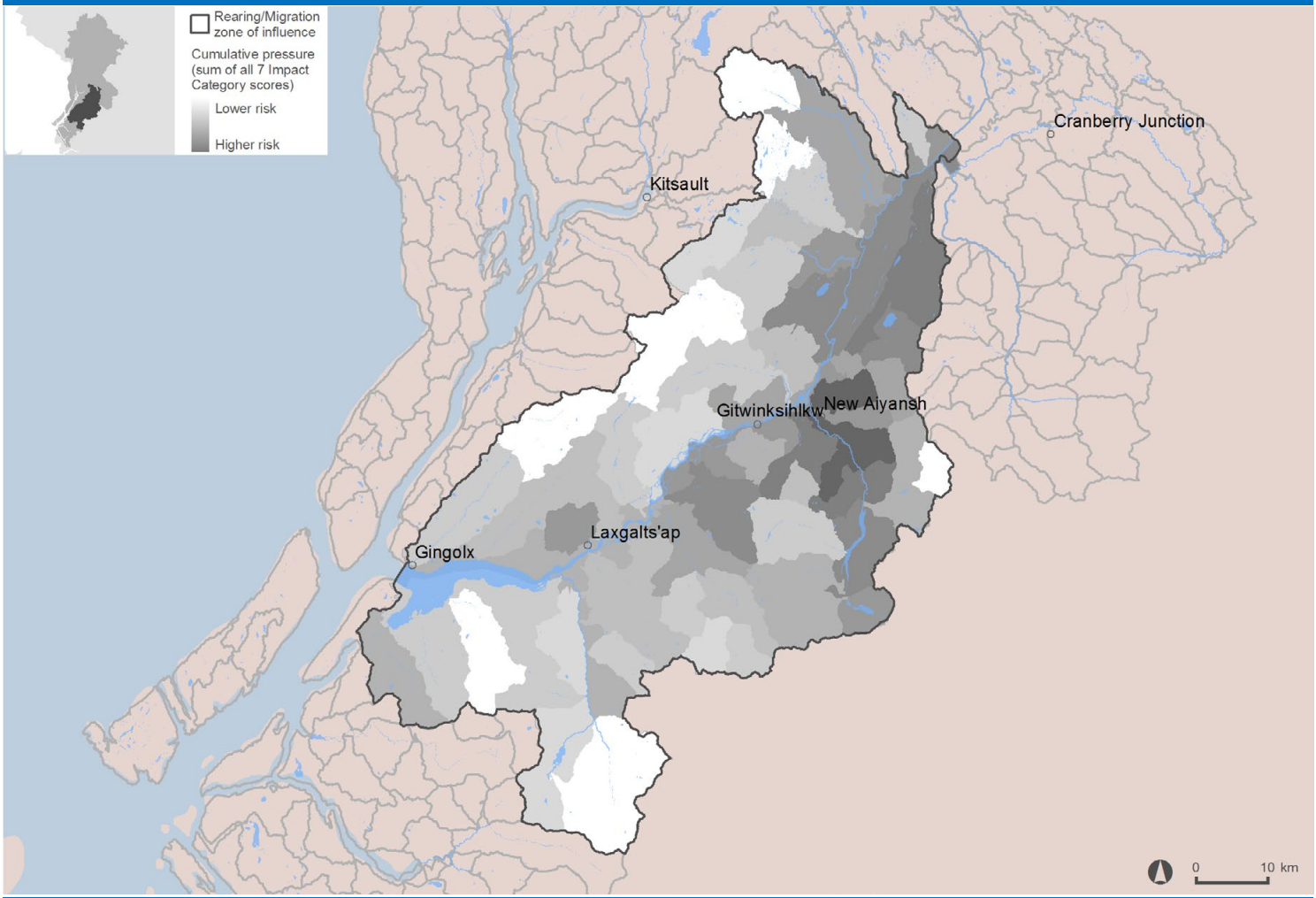
Integrated vulnerability/habitat pressures—rearing/migration, spawning, & incubation

● = Lower Nass ○ = other Chum CUs



Rearing/Migration vulnerability & pressure

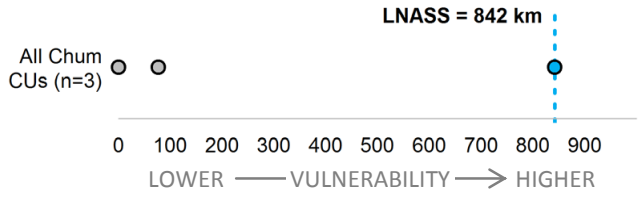
Rearing/Migration period pressures



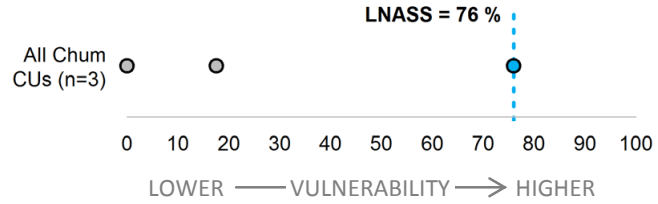
Rearing/Migration period vulnerability

Salmon accessible habitat (km)

Flow sensitive accessible habitat (km) (all seasons)



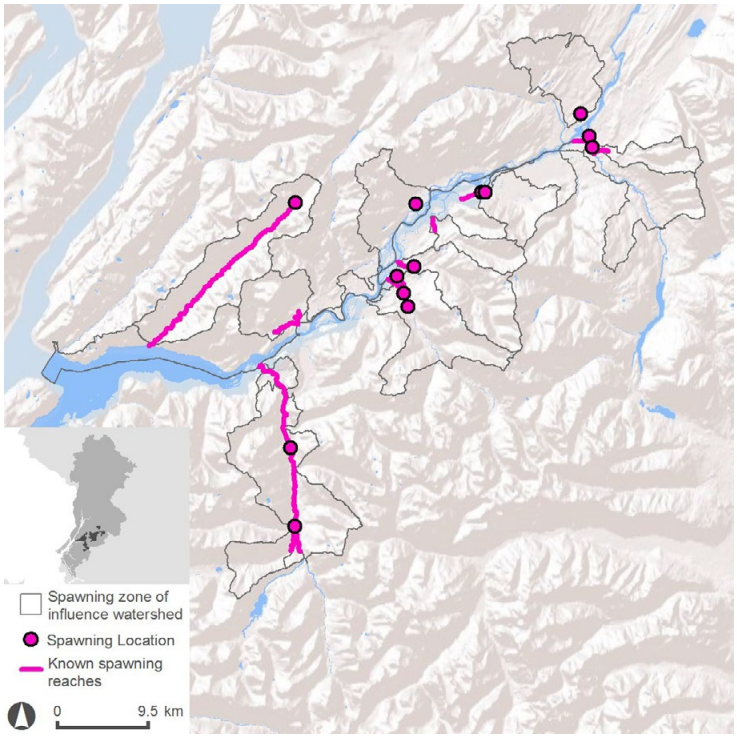
Flow sensitive accessible habitat (%) (all seasons)



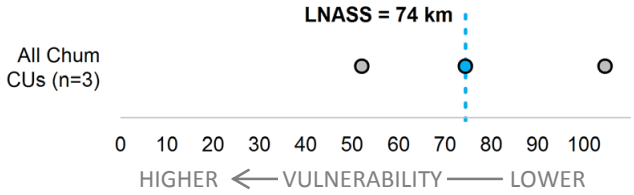
Spawning & incubation vulnerability

Spawning period vulnerability

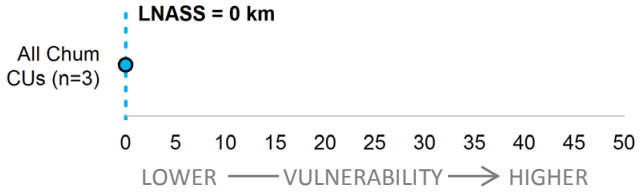
Spawning locations



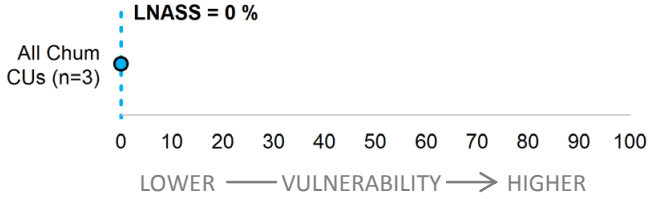
Total spawning length (km)



Spawning reaches summer flow sensitive - spawn timing (km)



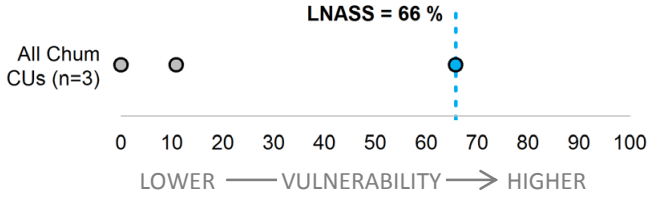
Spawning reaches summer flow sensitive - spawn timing (%)



Incubation period vulnerability

Spawning reaches winter flow sensitive - incubation timing (km)

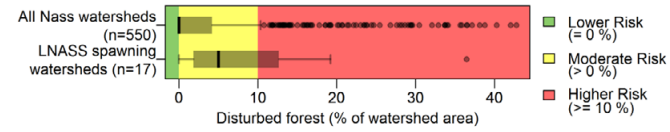
Spawning reaches winter flow sensitive - incubation timing (%)

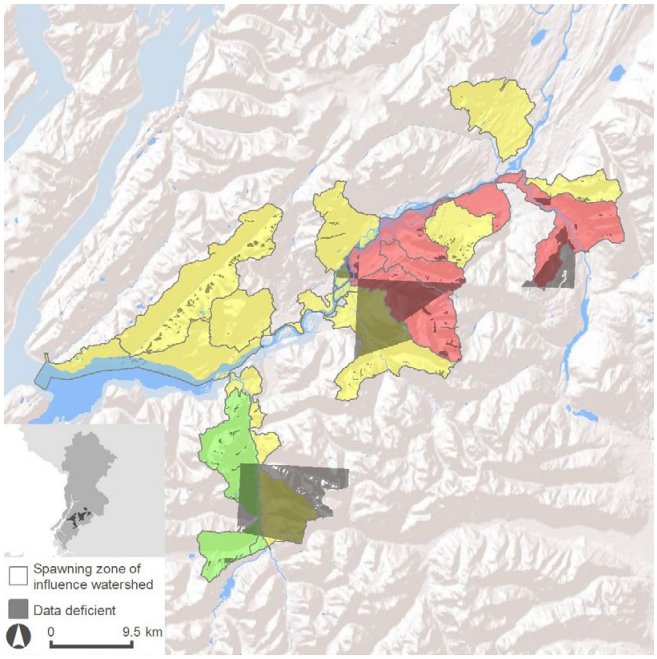


Spawning pressure

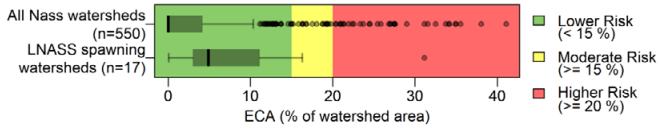
Hydrologic Processes

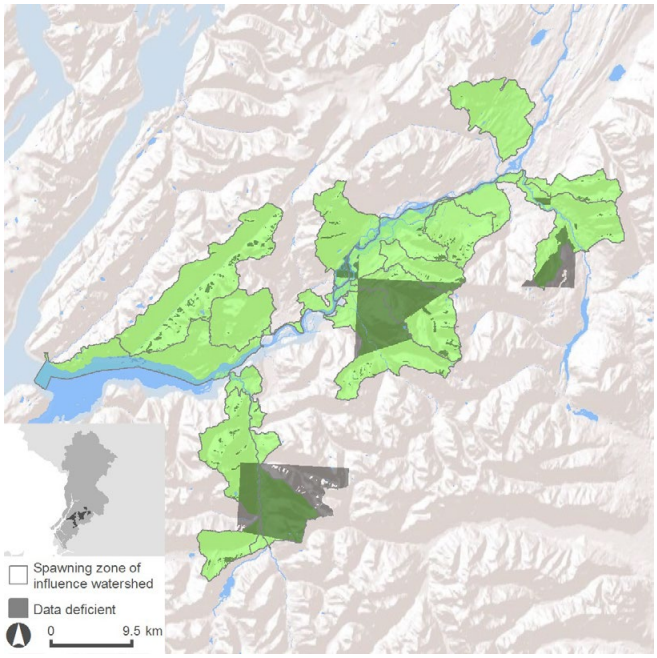
Forest disturbance





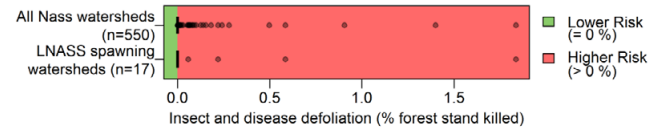
Equivalent Clear-cut Area

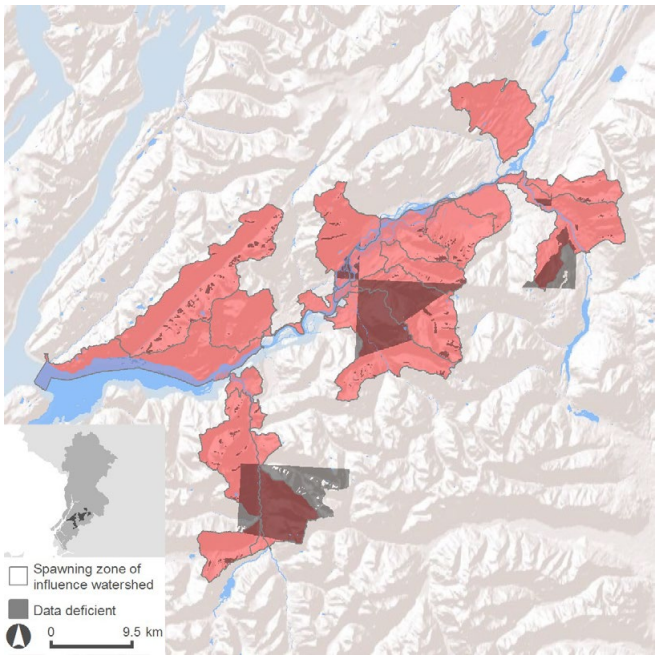




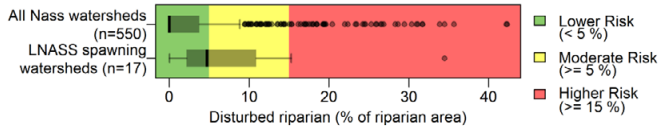
Vegetation Quality

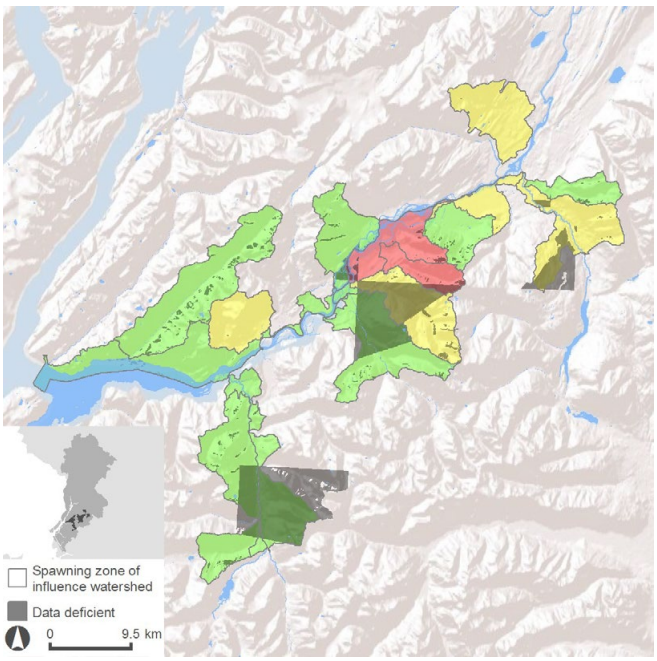
Insect and disease defoliation





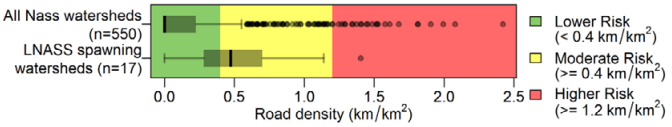
Riparian disturbance

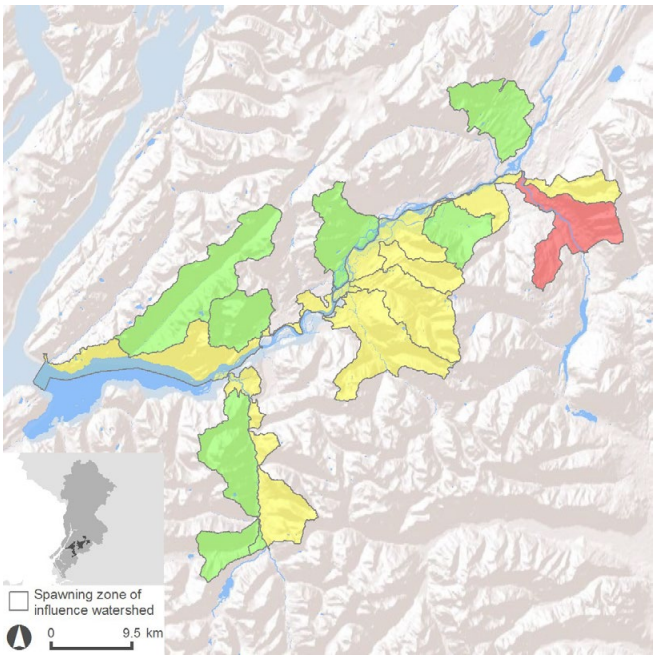




Surface Erosion

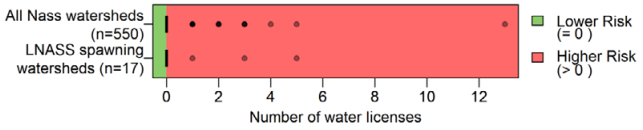
Road development

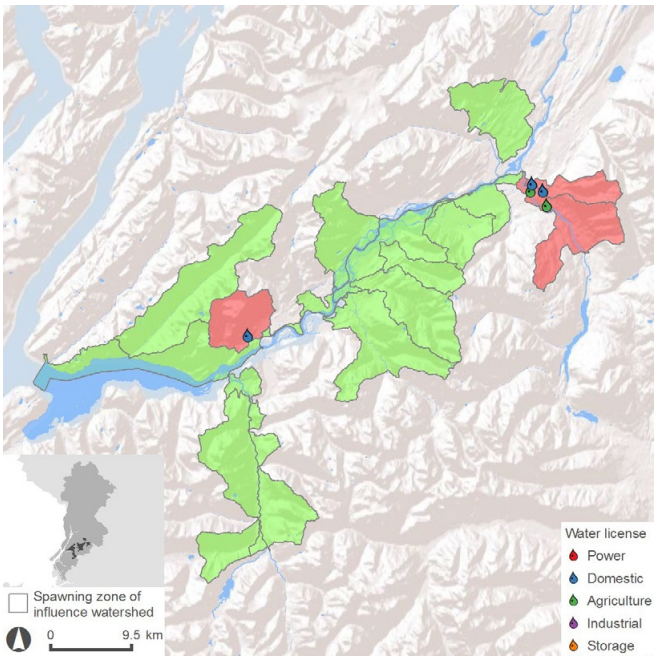




Water Quantity

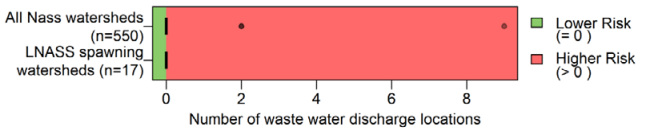
Number of water licenses

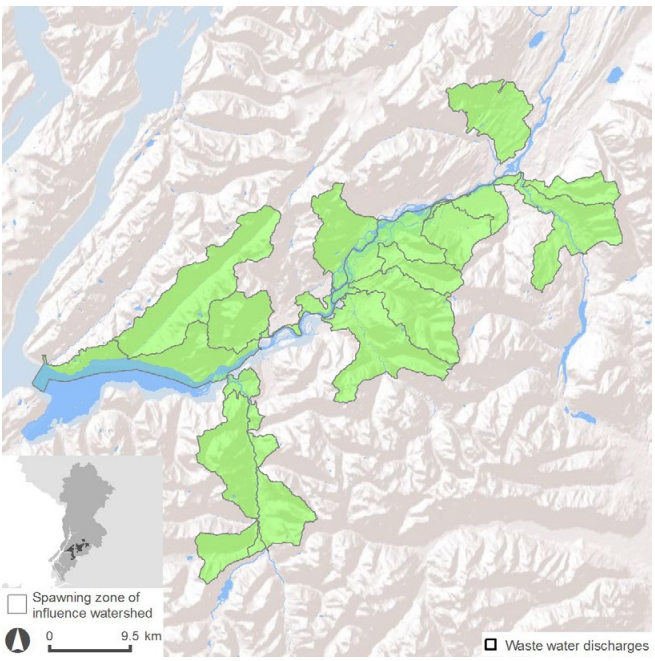




Water Quality

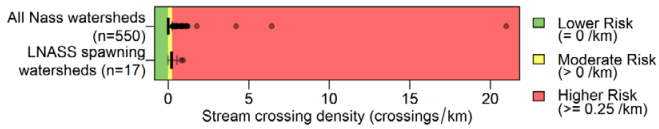
Permitted waste water discharges

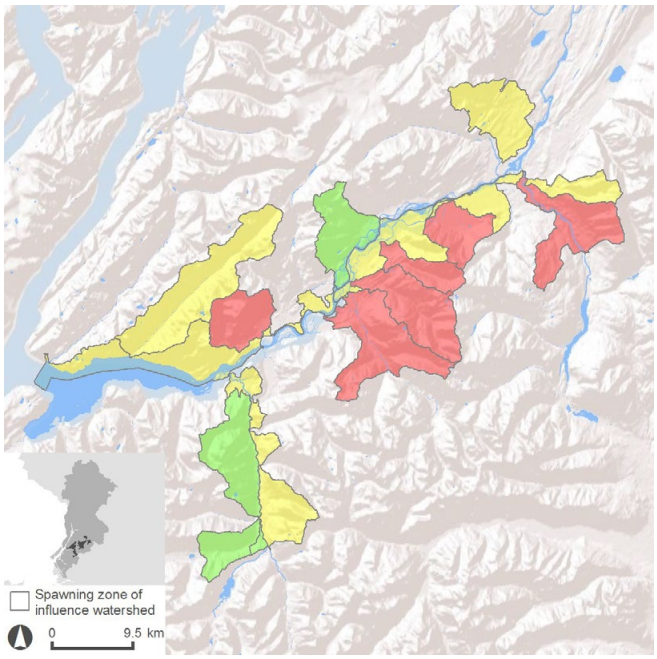




Fish Passage/Habitat Connectivity

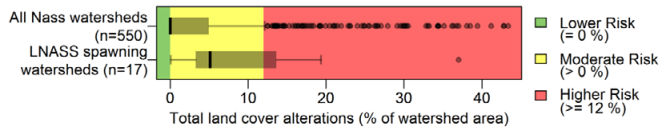
Stream crossing density

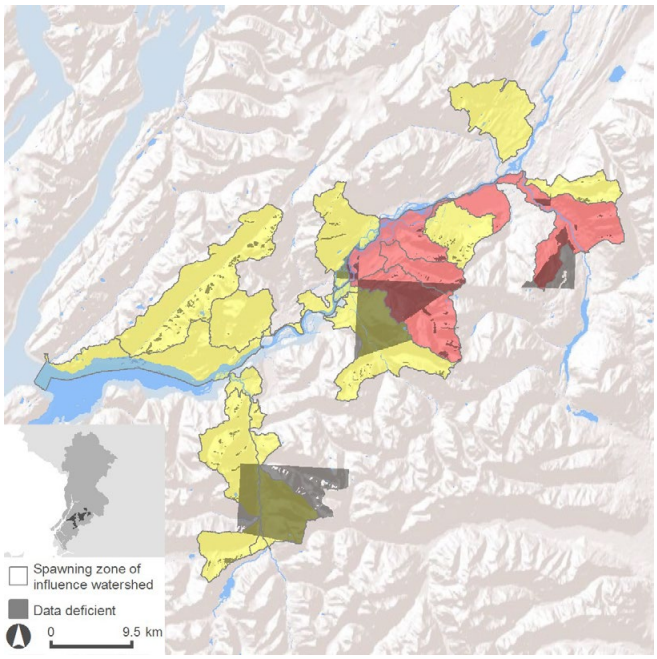




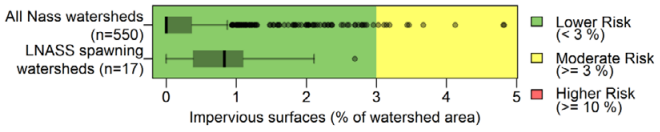
Human Development Footprint

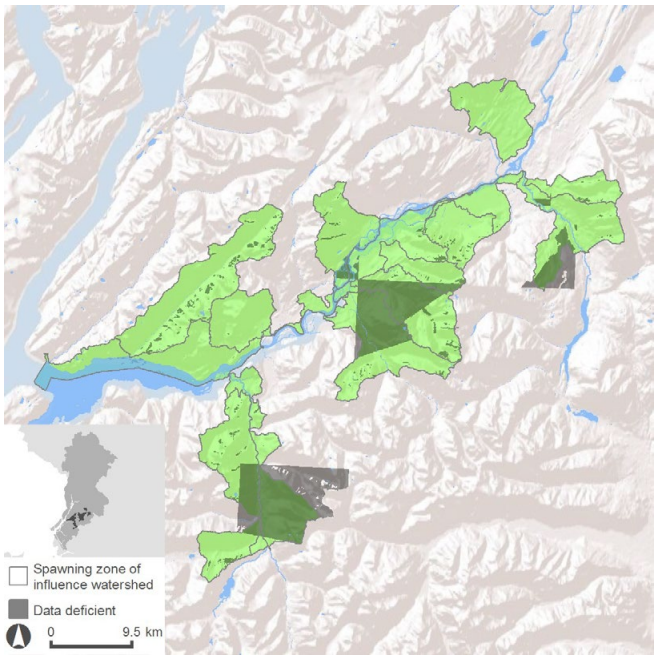
Total land cover alteration



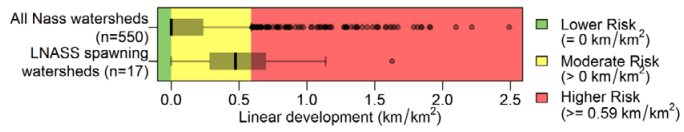


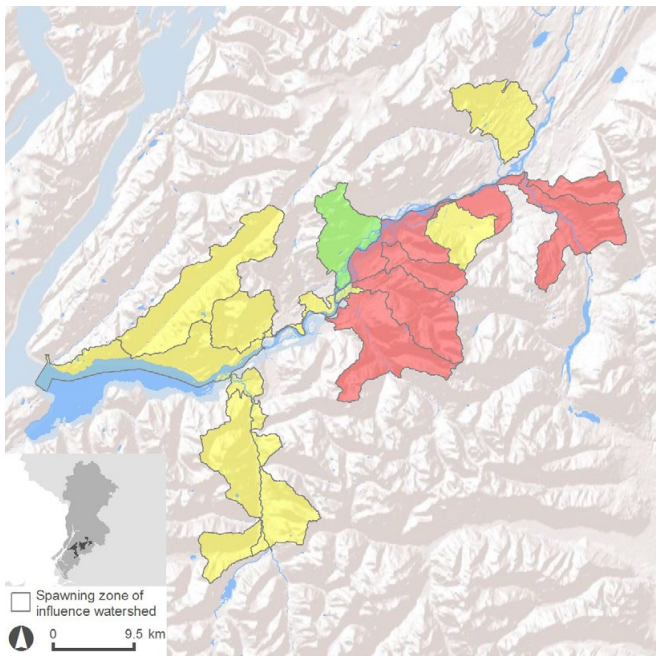
Impervious surfaces



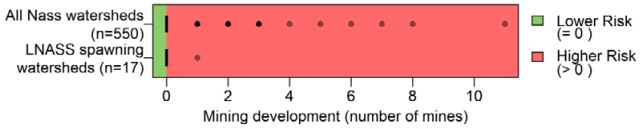


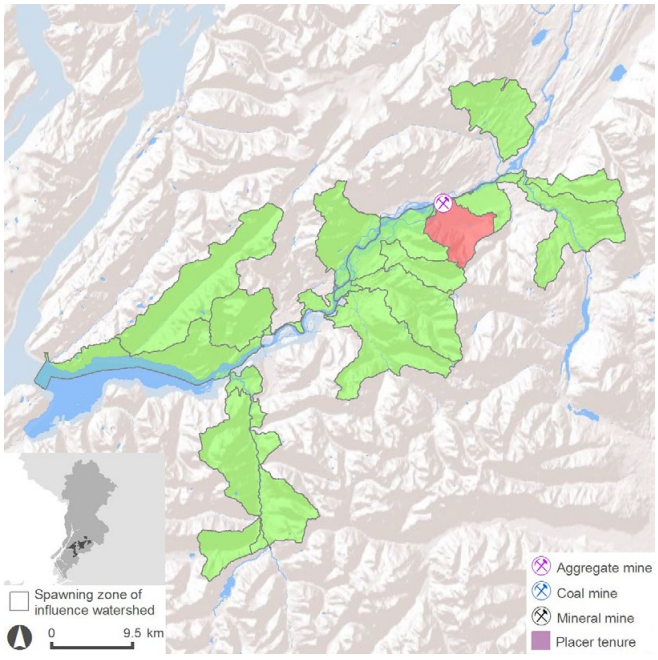
Linear development





Mining development (total number of mines)

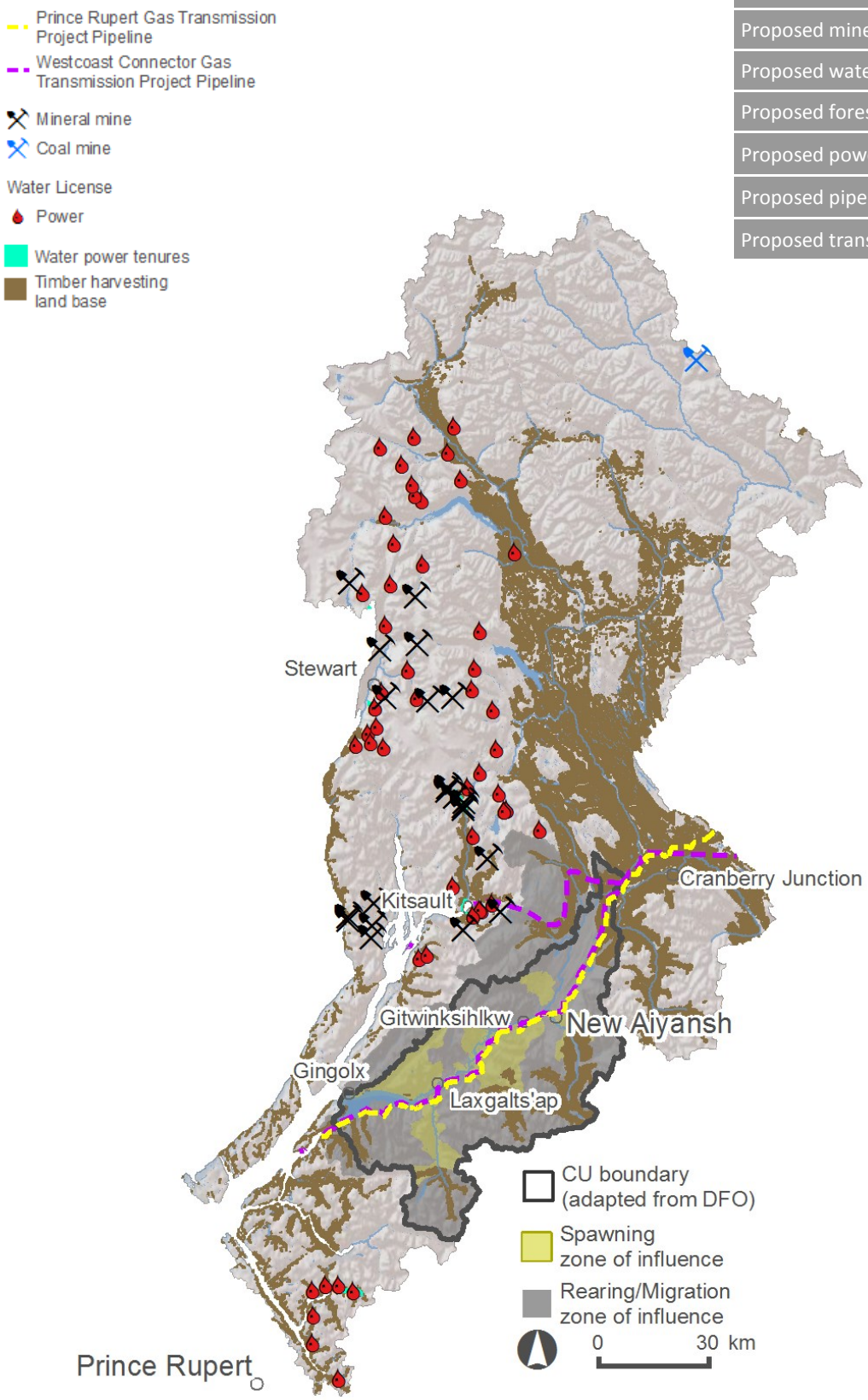




Future pressure

Proposed resource development projects (as of 2016)

Nass Drainage Summary	
	Totals
Proposed coal mines (#)	1
Proposed mineral mines (#)	22
Proposed water licenses (#)	58
Proposed forestry (km^2)	3,323 km^2
Proposed power tenures	Wind 0 km^2, water 15 km^2
Proposed pipelines (km)	386 km
Proposed transmission lines	0 km



Chum: Portland Canal — Observatory

Introduction

This project summarizes pressures on the habitat used by Nass salmon Conservation Units (CU) during their freshwater life history stages (migration, spawning and rearing), as well as their relative vulnerability to those pressures. For an explanation of the indicators shown here, please see the accompanying *Report Card Summaries*. Full methods and results can be found in the main report, *Cumulative Pressures on Nass Salmon Habitat: Technical Report* (2016).

Definitions

Conservation Unit (CU): A group of wild salmon sufficiently isolated from other groups that, if extirpated, is very unlikely to re-colonize naturally within an acceptable timeframe.

Pressure indicator: Measurable extent/intensity of natural processes or human activities that can induce changes in habitat condition/state.

Vulnerability indicator: Measures of habitat quantity or quality used to represent the intrinsic habitat vulnerability/sensitivity to watershed disturbances for each life-stage.

Zone of influence (ZOI): Areas adjacent to and upstream/upslope of habitats used by salmon CUs that represent the geographic extent for capture/measurement of pressure and vulnerability indicators.

Status: Condition of habitat relative to a defined indicator benchmark.

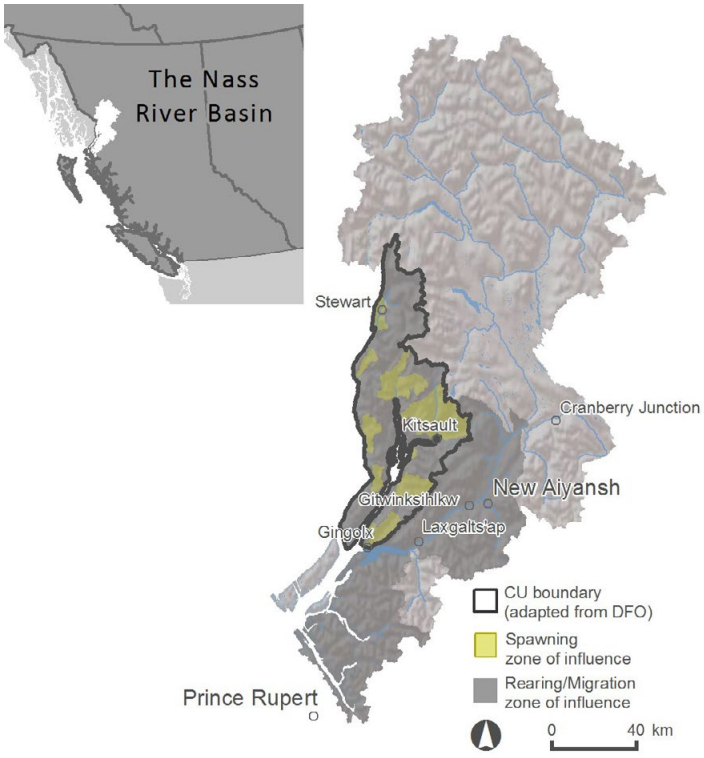
Risk: Likelihood of adverse effects to salmon habitats within a defined zone of influence. Levels of increasing risk are defined based on the extent/intensity of impacts relative to defined benchmarks of concern.

Benchmark: A standard (quantified metric) against which habitat condition can be measured or judged, and by which status can be compared over time and space to determine the risk of adverse effects.

Narrative

- There are three chum salmon CUs in the Nass Area: 1) Lower Nass (LNASS), 2) Portland Inlet (PortIN), and 3) Portland Canal-Observatory Inlet (PCOb). There are over 50 discrete spawning populations of chum salmon in all three CUs combined.
- Nass Area chum salmon are currently identified by Fisheries and Oceans Canada as a stock of concern with returns currently falling below the provisional escapement target of 45,000.
- Juvenile chum typically spend very little time in freshwater, beginning their downstream migration to sea almost immediately after emerging from the gravel as fry.
- Nass Area chum salmon return to their natal stream to spawn between three and five years of age, with most fish maturing at four years of age.

Location



Summary of habitat vulnerabilities & pressures

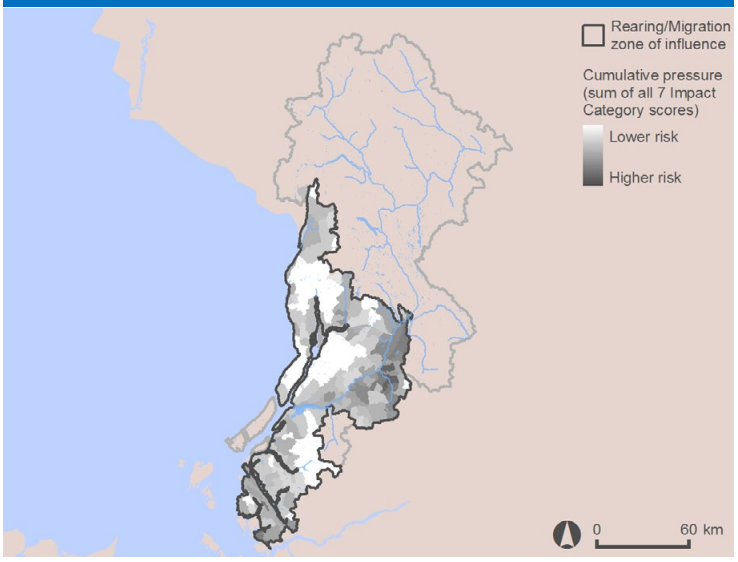
Pressure indicators were grouped into seven relatively independent habitat "impact categories" representing key factors affecting general watershed condition:

- Hydrologic Processes (Forest disturbance; Equivalent Clearcut Area)
- Vegetation Quality (Insect and disease defoliation; Riparian disturbance)
- Surface Erosion (Road development)
- Fish passage/Habitat connectivity (Stream crossing density)
- Water quantity (Water licenses)
- Human development footprint (Total land cover alteration; Impervious surfaces; Linear development; Mining development)
- Water quality (Wastewater discharges)

Indicators were also developed reflecting relative vulnerability to habitat pressures within the life stage-specific "zones of influence" defined for each CU:

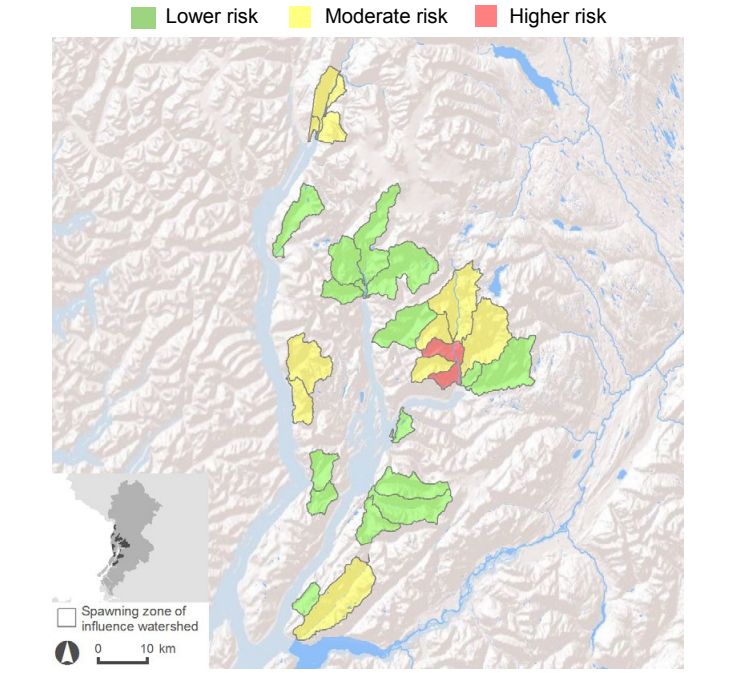
- Rearing/Migration ZOI: Accessible stream length; Length and percentage of accessible streams considered flow sensitive - all seasons
- Spawning ZOI: Total spawning length; Length and percentage of spawning reaches considered flow sensitive (summer period - spawning, winter period - incubation)

Cumulative pressure—rearing/migration



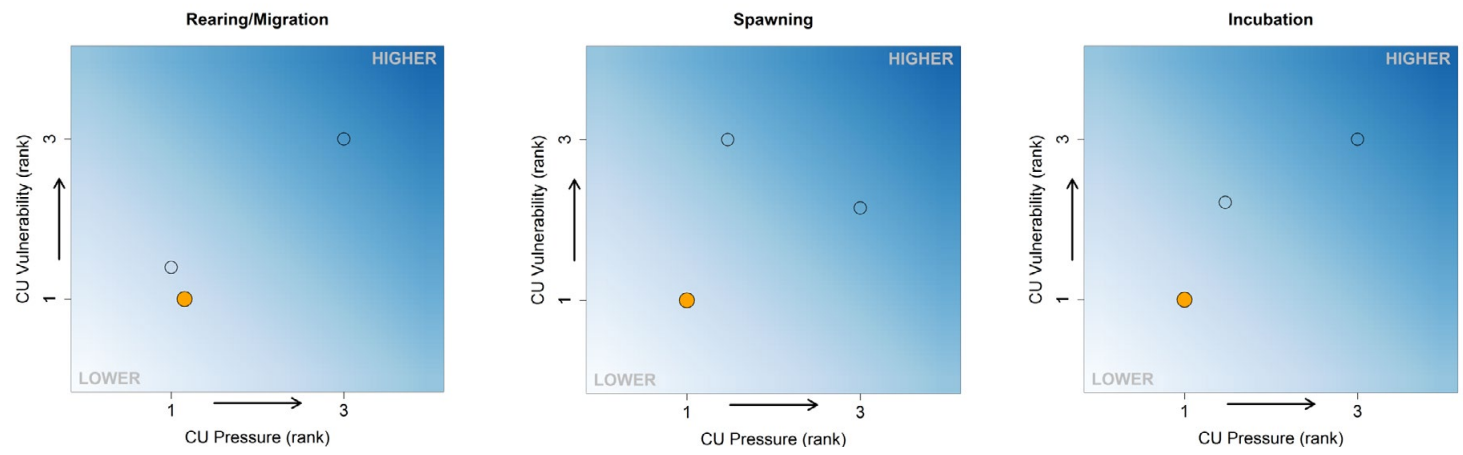
Summary of pressure indicators—spawning

Cumulative pressure—spawning



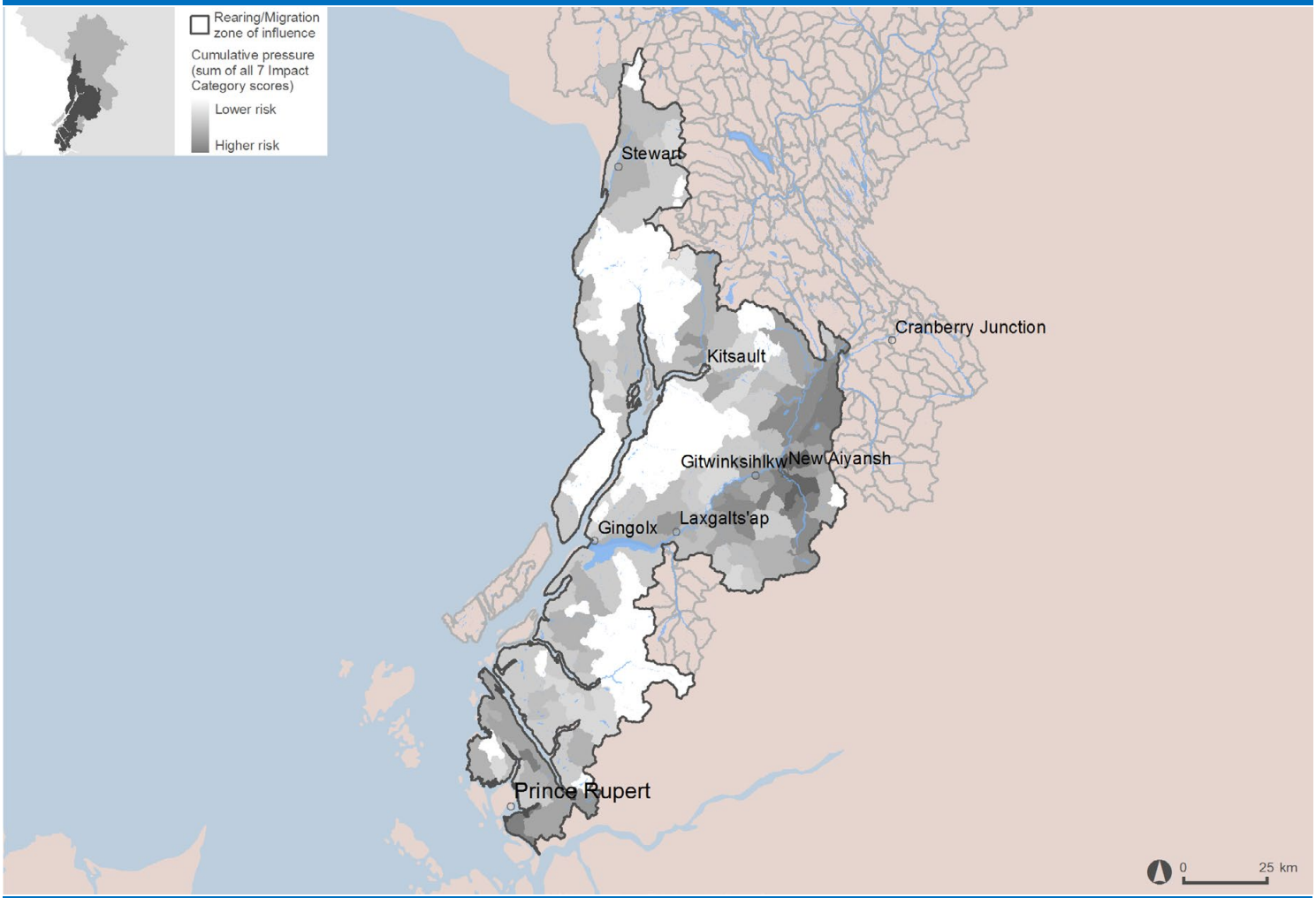
Integrated vulnerability/habitat pressures—rearing/migration, spawning, & incubation

● = Portland Canal-Observatory ○ = other Chum CUs



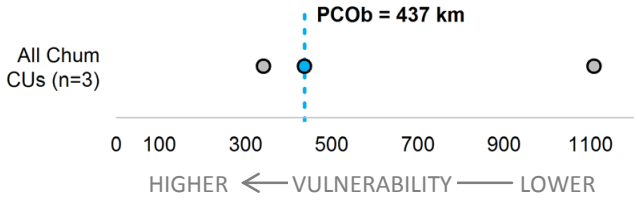
Rearing/Migration vulnerability & pressure

Rearing/Migration period pressures

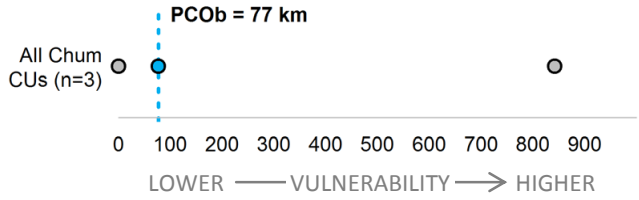


Rearing/Migration period vulnerability

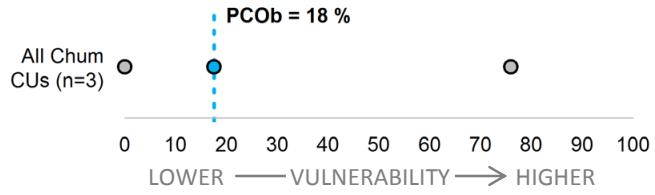
Salmon accessible habitat (km)



Flow sensitive accessible habitat (km) (all seasons)



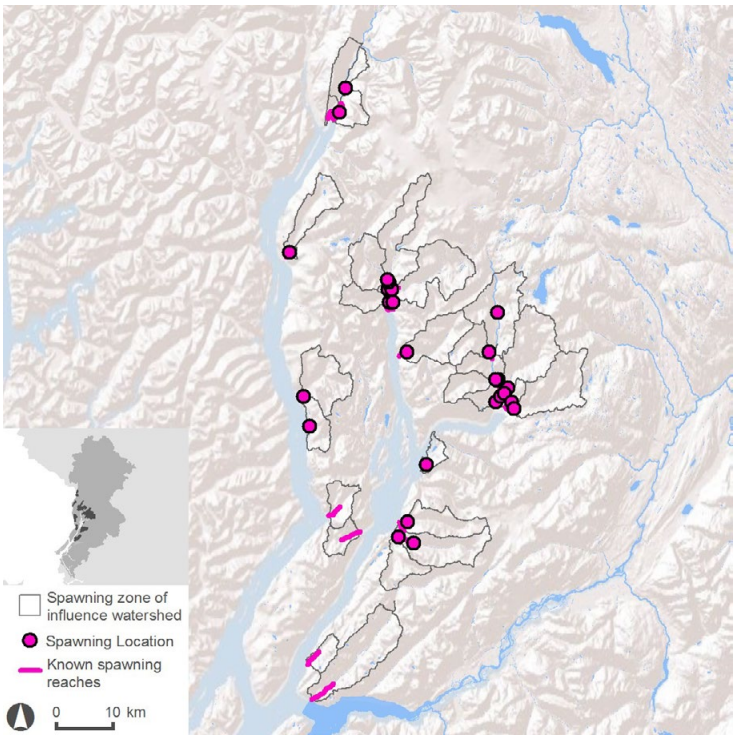
Flow sensitive accessible habitat (%) (all seasons)



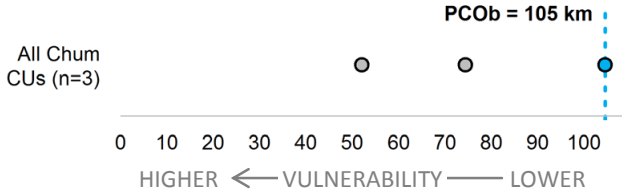
Spawning & incubation vulnerability

Spawning period vulnerability

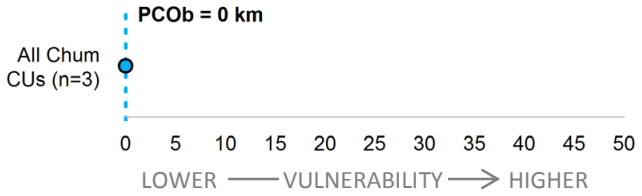
Spawning locations



Total spawning length (km)



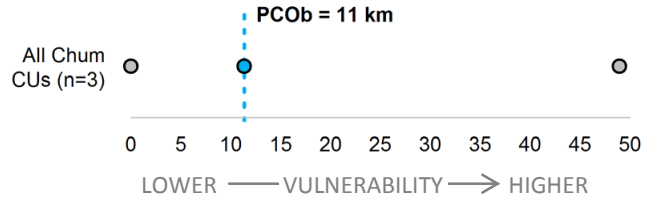
Spawning reaches summer flow sensitive - spawn timing (km)



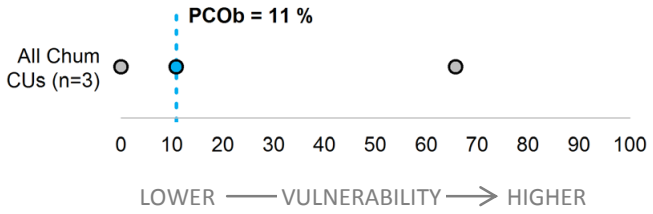
Spawning reaches summer flow sensitive - spawn timing (%)

Incubation period vulnerability

Spawning reaches winter flow sensitive - incubation timing (km)



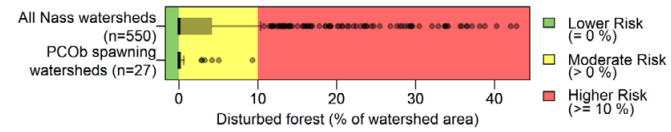
Spawning reaches winter flow sensitive - incubation timing (%)

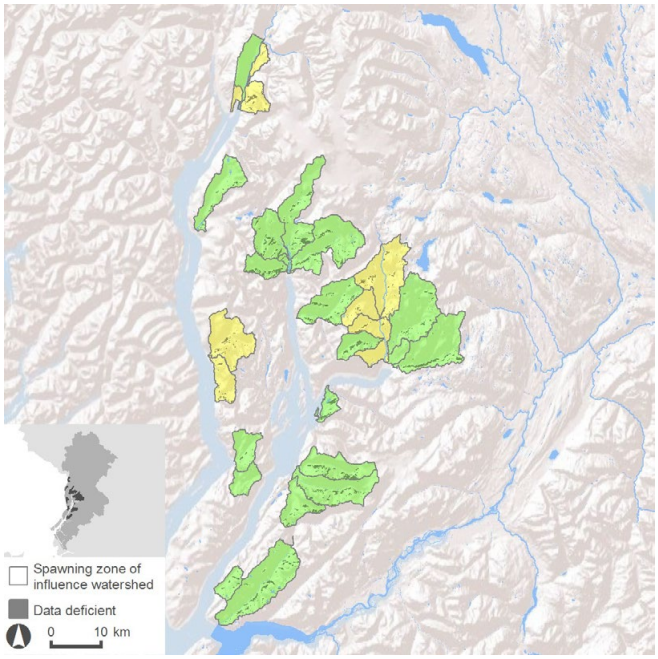


Spawning pressure

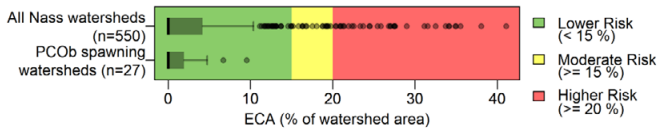
Hydrologic Processes

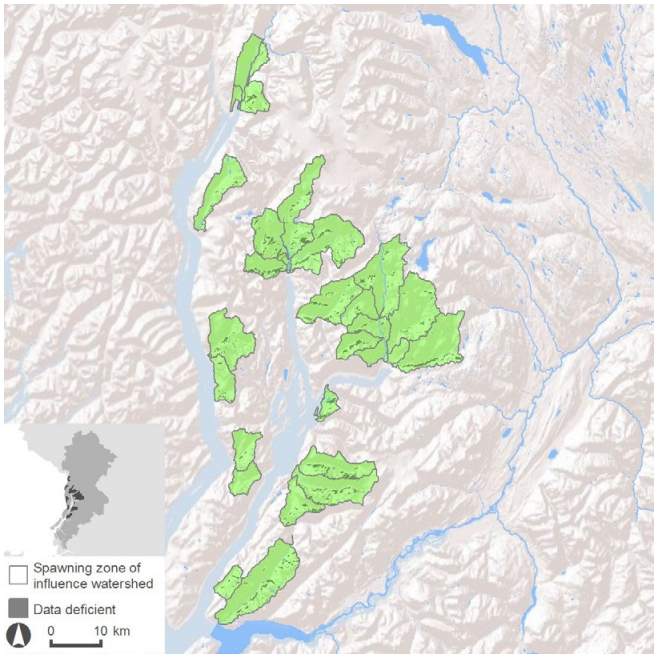
Forest disturbance





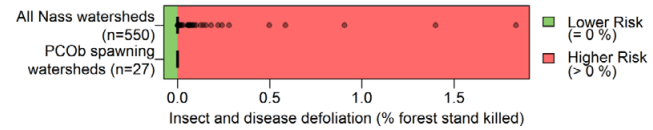
Equivalent Clear-cut Area

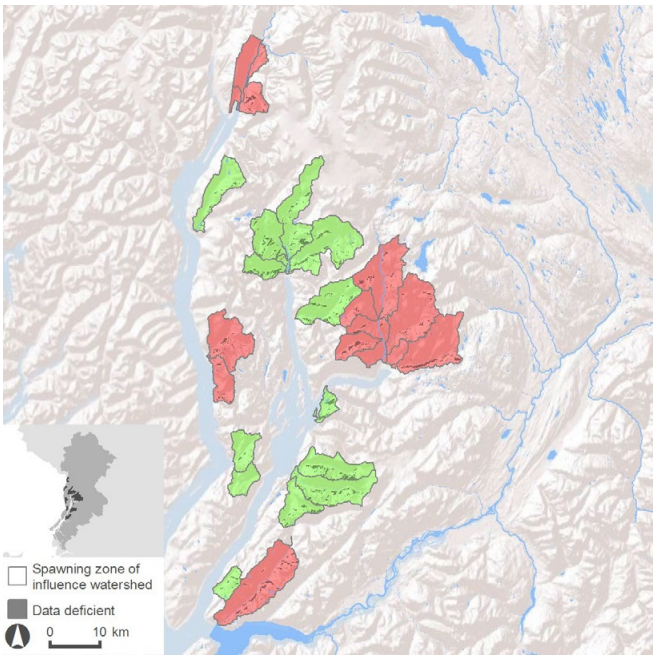




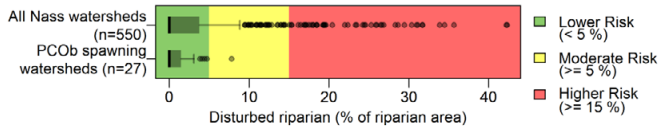
Vegetation Quality

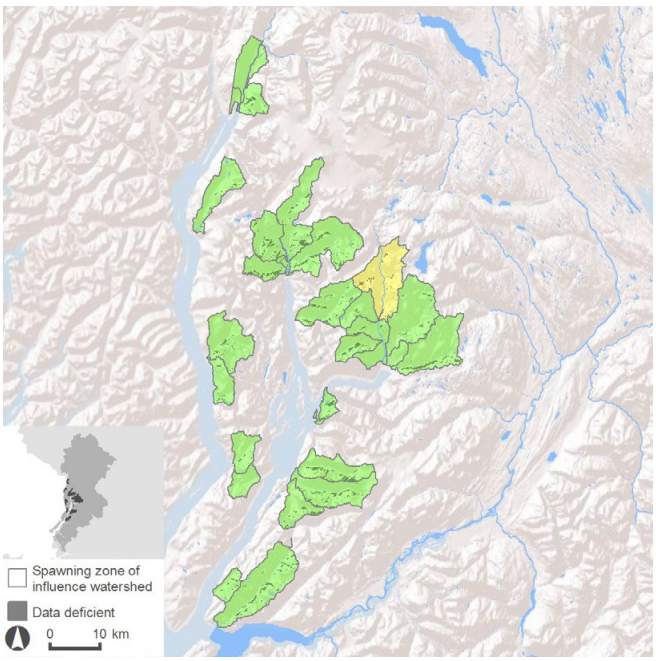
Insect and disease defoliation





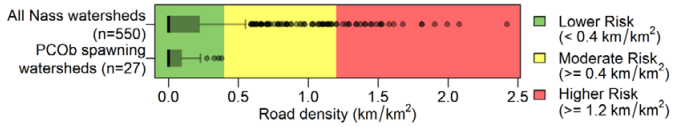
Riparian disturbance

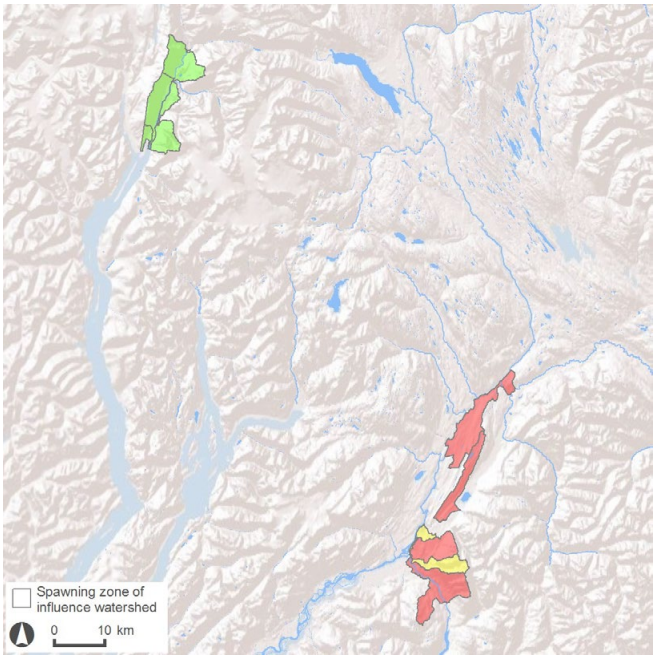




Surface Erosion

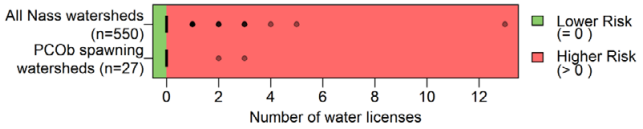
Road development

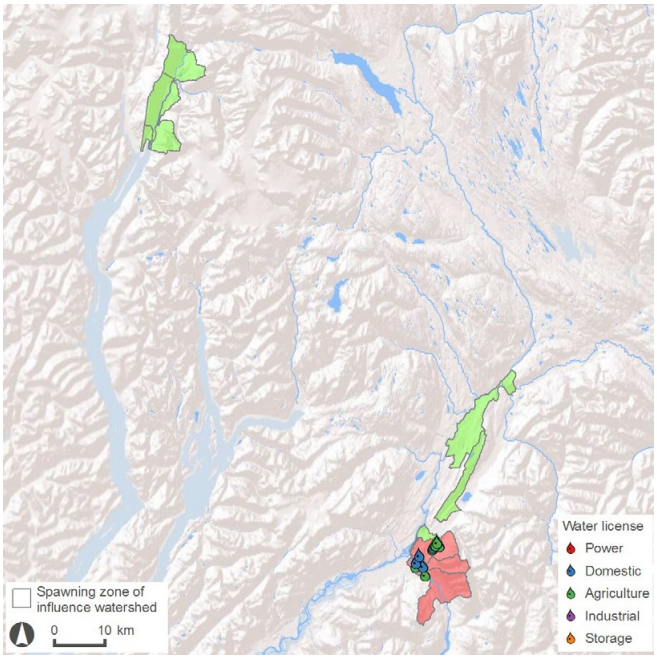




Water Quantity

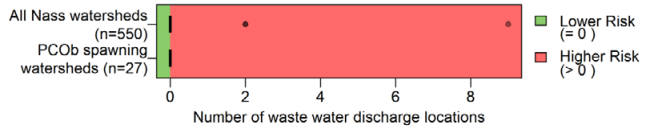
Number of water licenses

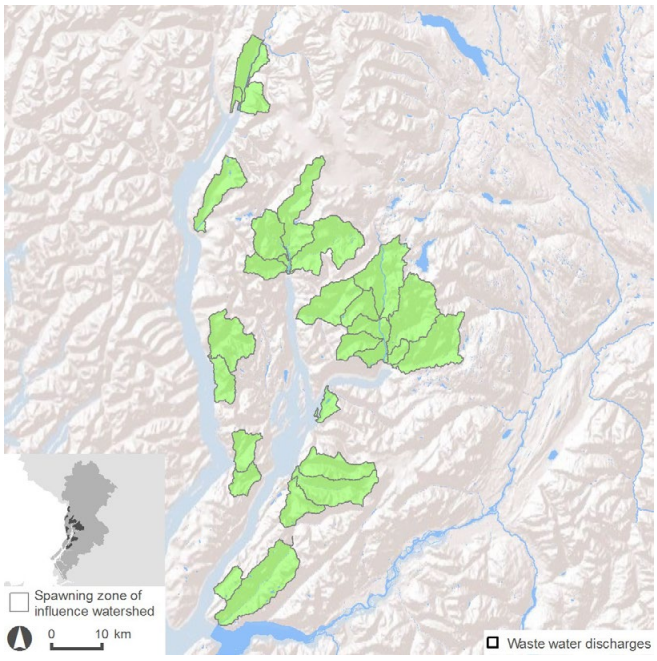




Water Quality

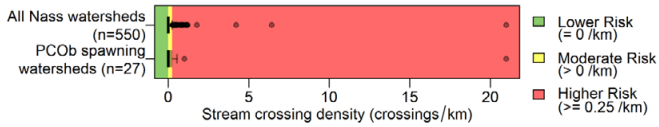
Permitted waste water discharges

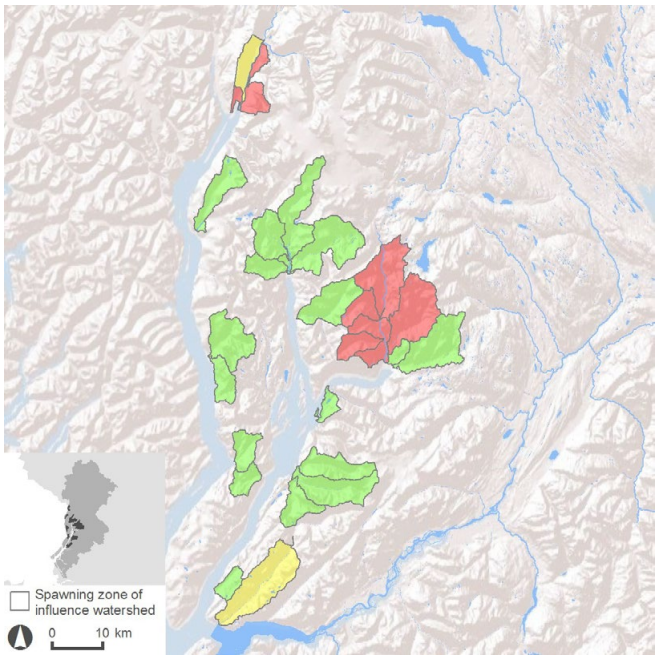




Fish Passage/Habitat Connectivity

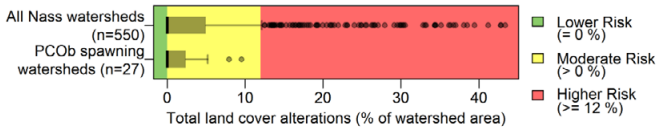
Stream crossing density

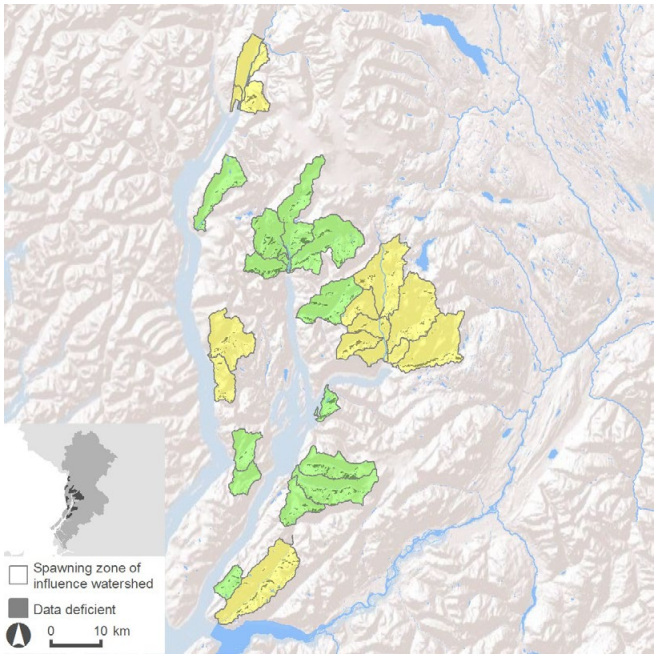




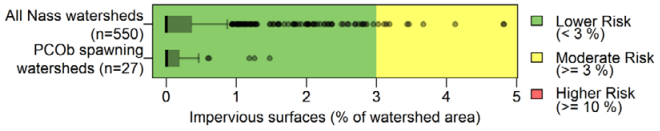
Human Development Footprint

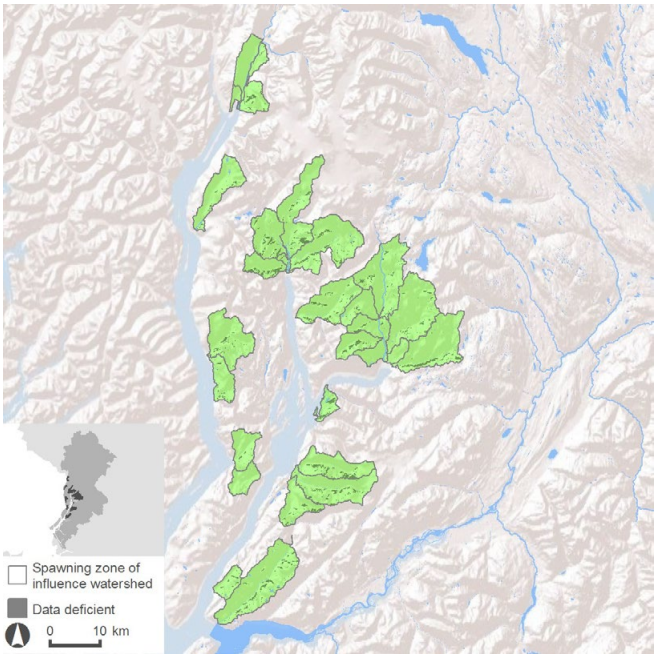
Total land cover alteration



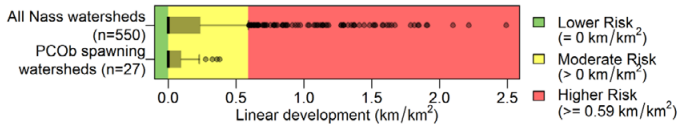


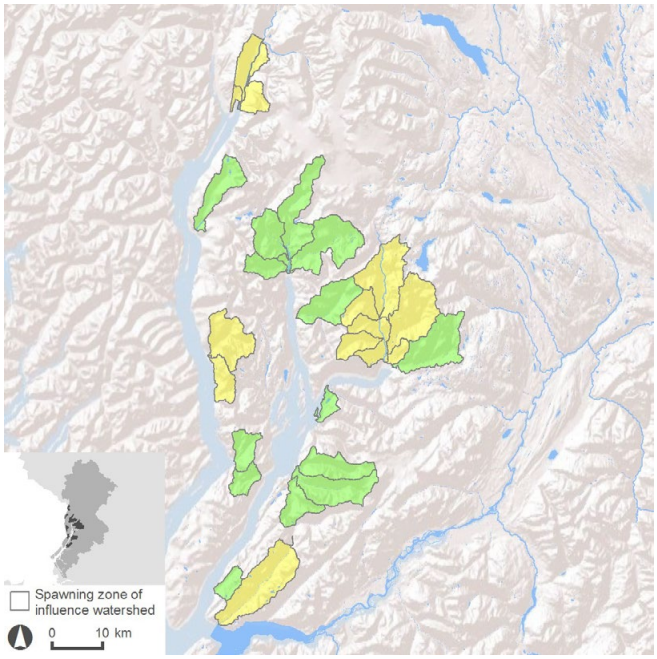
Impervious surfaces



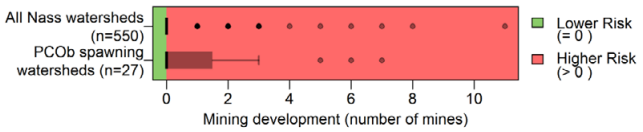


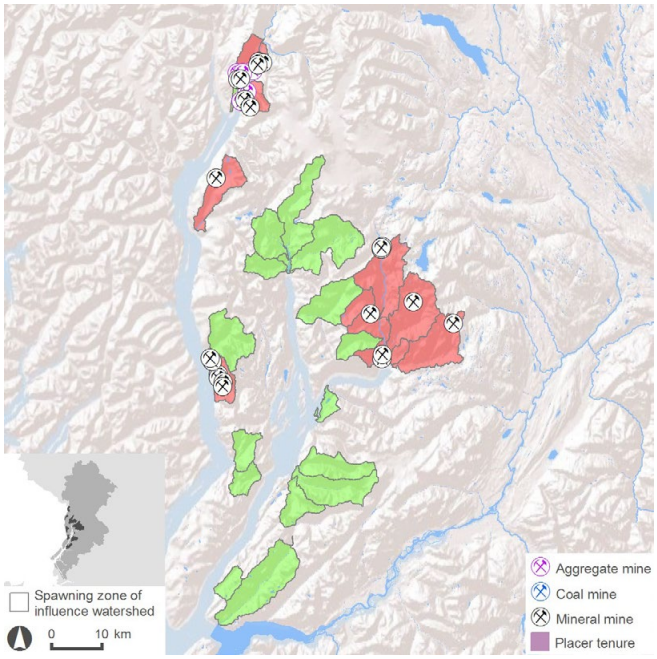
Linear development





Mining development (total number of mines)





Future pressure

Proposed resource development projects (as of 2016)

Nass Drainage Summary	
	Totals
Proposed coal mines (#)	1
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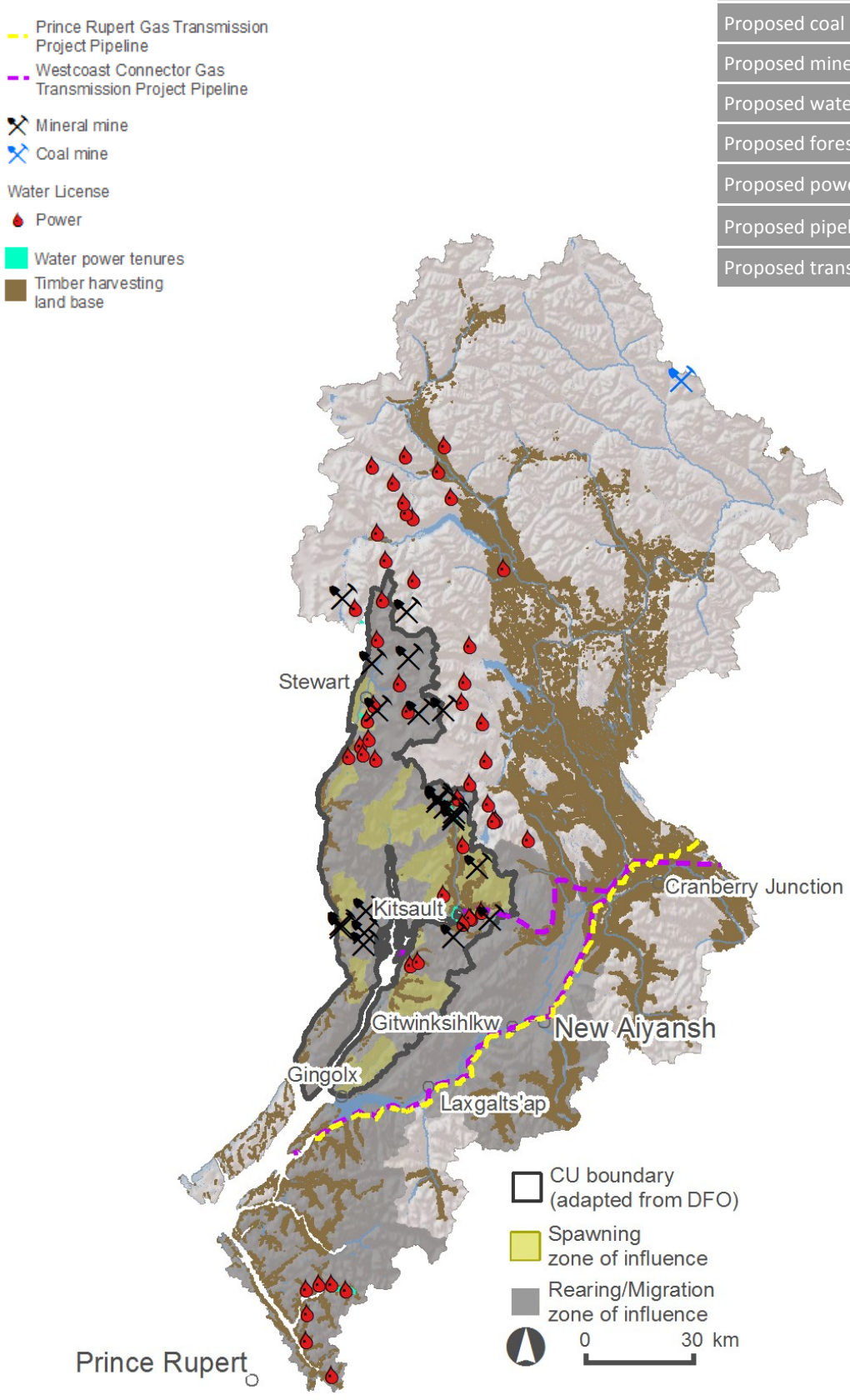
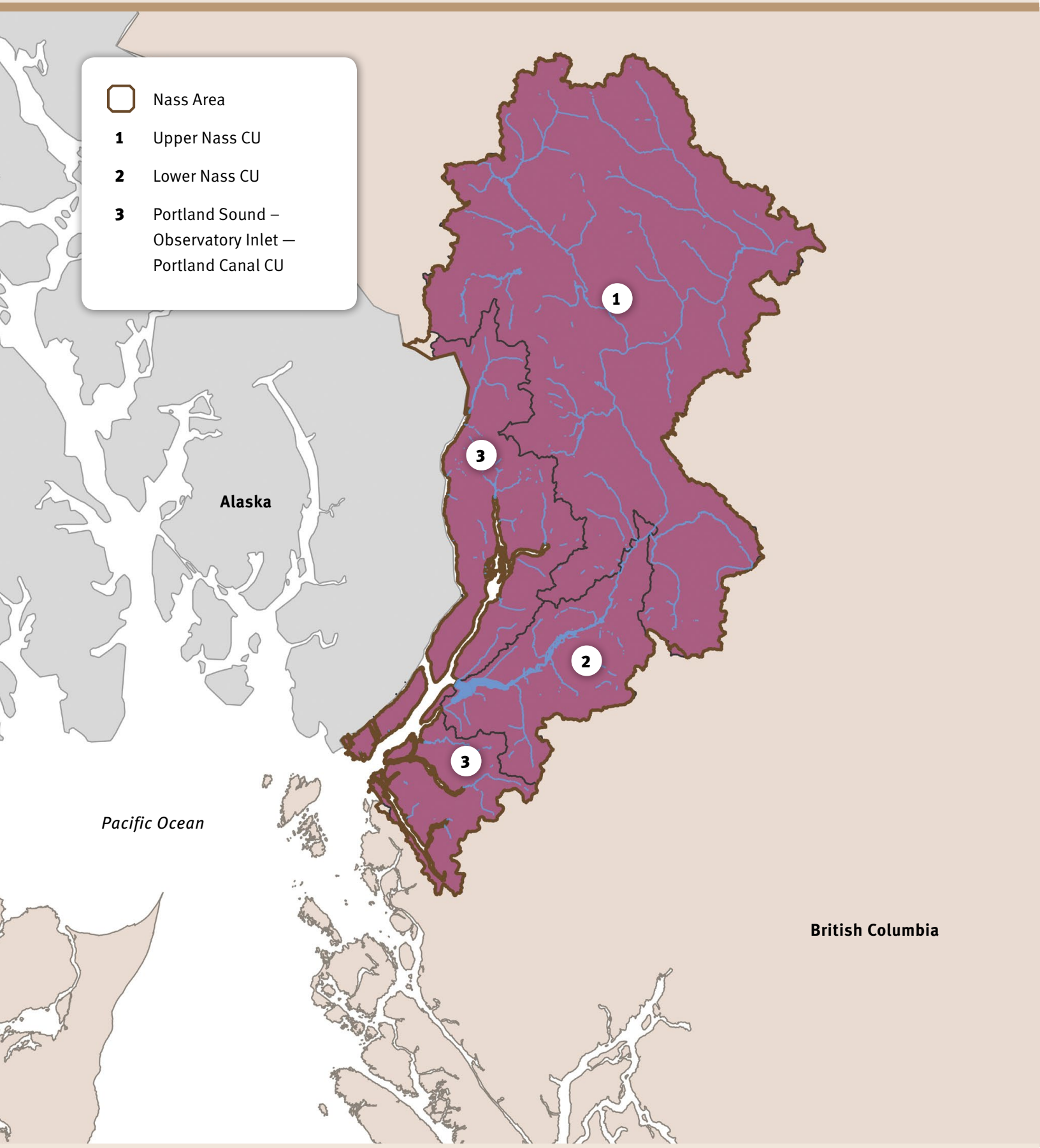


Coho

Coho: Map of Conservation Units (CUs)



Coho: Lower Nass

Introduction

This project summarizes pressures on the habitat used by Nass salmon Conservation Units (CU) during their freshwater life history stages (migration, spawning and rearing), as well as their relative vulnerability to those pressures. For an explanation of the indicators shown here, please see the accompanying *Report Card Summaries*. Full methods and results can be found in the main report, *Cumulative Pressures on Nass Salmon Habitat: Technical Report* (2016).

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Narrative

- There are three coho salmon CUs in the Nass Area: 1) Upper Nass (UNASS), 2) Lower Nass (LNASS), and 3) Portland Sound-Observatory Inlet-Lower Nass (PORT). There are approximately 100 discrete spawning populations in all three CUs combined.
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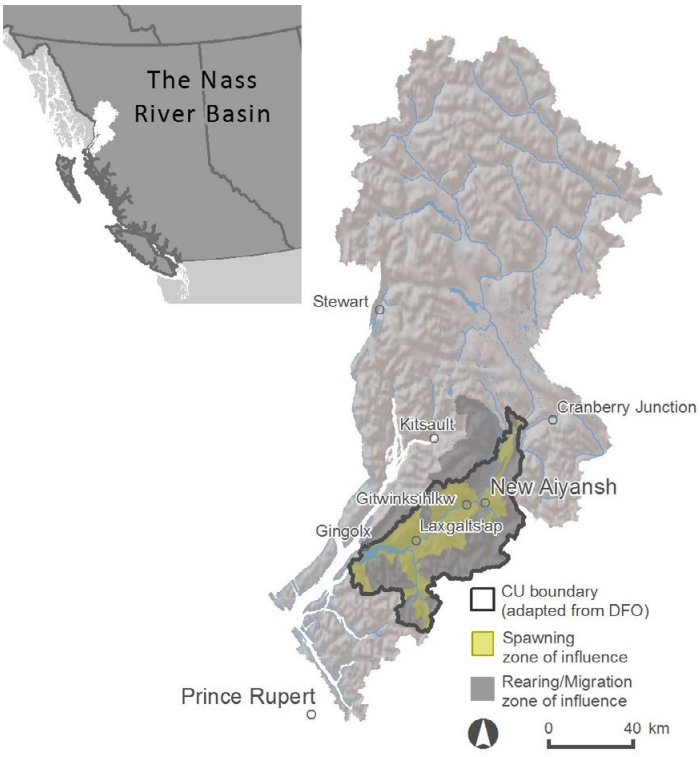
- Adult returns of Nass Area coho salmon have been relatively healthy for the past several decades.

Location



Summary of habitat vulnerabilities & pressures

Pressure indicators were grouped into seven relatively independent habitat "impact categories" representing key factors affecting general watershed condition:

- Hydrologic Processes (Forest disturbance; Equivalent Clearcut Area)
- Vegetation Quality (Insect and disease defoliation; Riparian disturbance)
- Surface Erosion (Road development)
- Fish passage/Habitat connectivity (Stream crossing density)
- Water quantity (Water licenses)
- Human development footprint (Total land cover alteration; Impervious surfaces; Linear development; Mining development)
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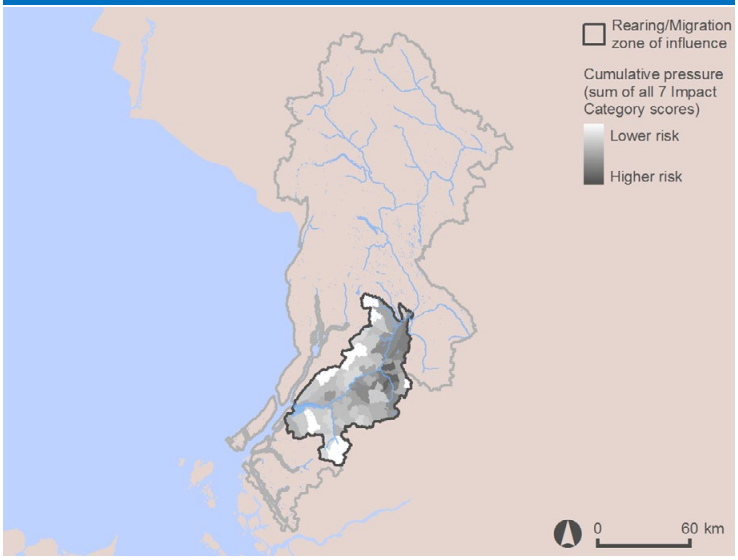
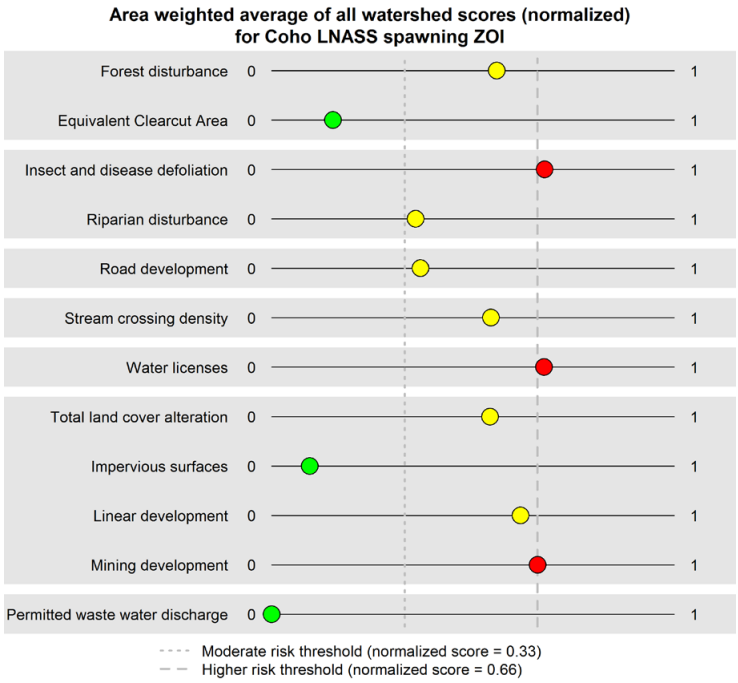
Indicators were also developed reflecting relative vulnerability to habitat pressures within the life stage-specific "zones of influence" defined for each CU:

- Rearing/Migration ZOI: Accessible stream length; Length and percentage of accessible streams considered flow sensitive - all seasons
- Spawning ZOI: Total spawning length; Length and percentage of spawning reaches considered flow sensitive (summer period - spawning, winter period - incubation)

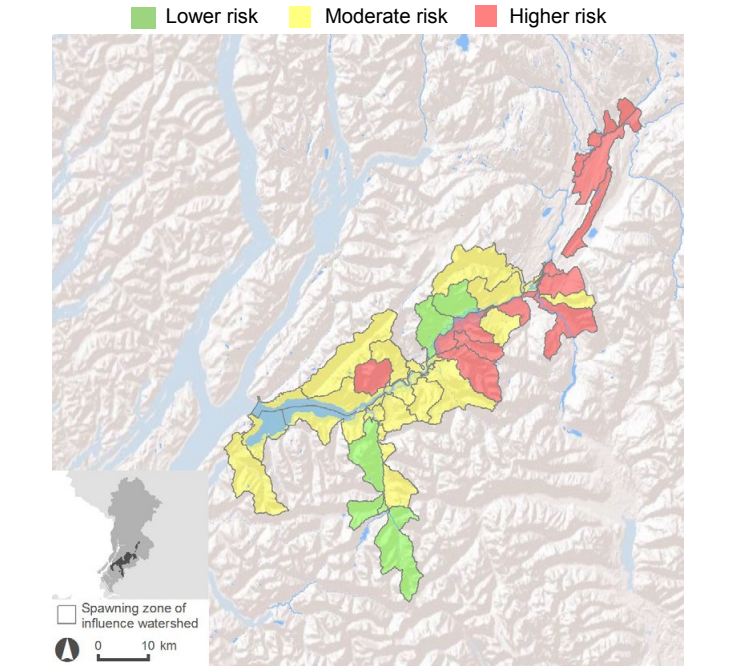
Cumulative pressure—rearing/migration



Summary of pressure indicators—spawning

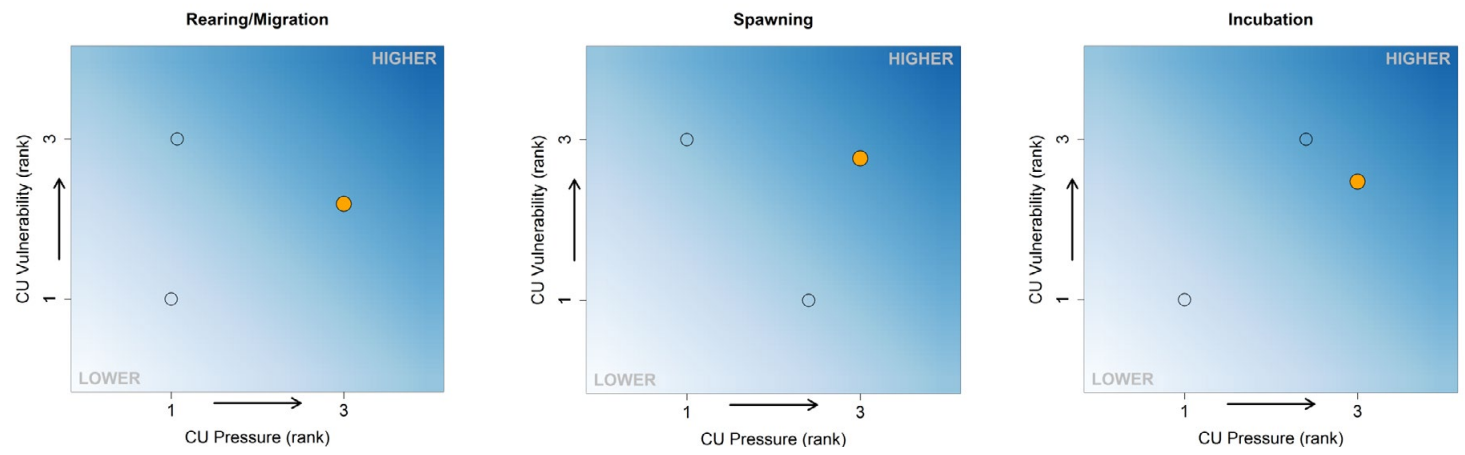


Cumulative pressure—spawning



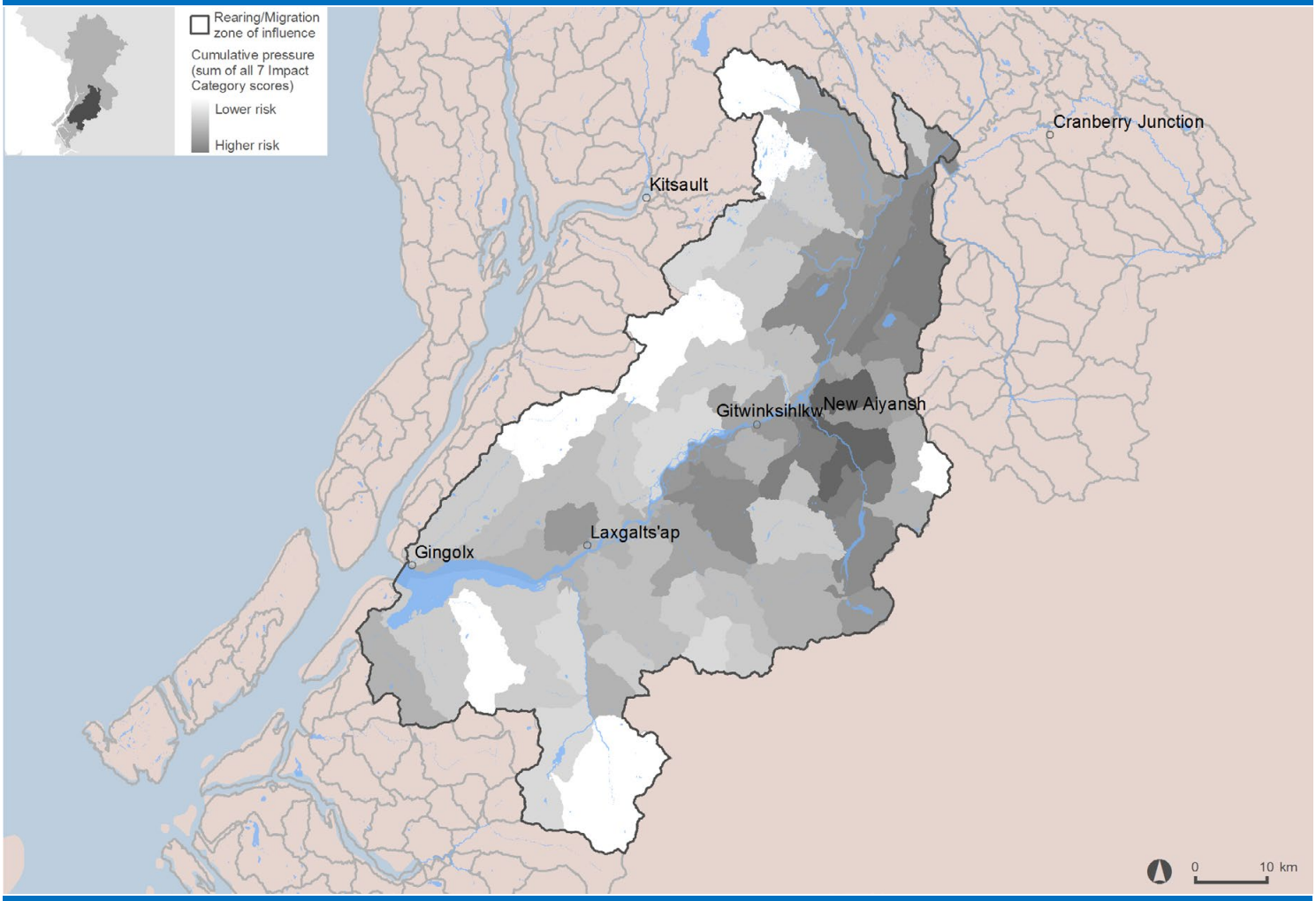
Integrated vulnerability/habitat pressures—rearing/migration, spawning, & incubation

● = Lower Nass ○ = other Coho CUs



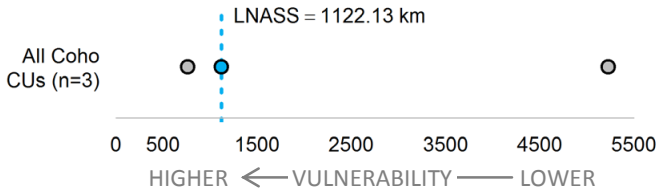
Rearing/Migration vulnerability & pressure

Rearing/Migration period pressures

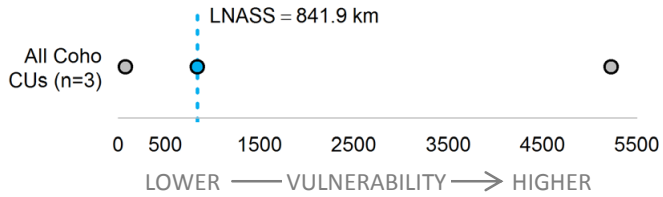


Rearing/Migration period vulnerability

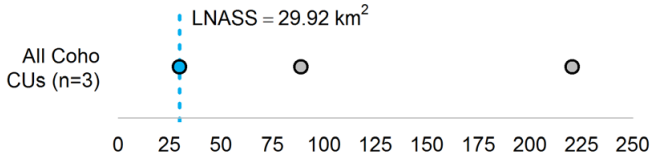
Salmon accessible habitat (km)



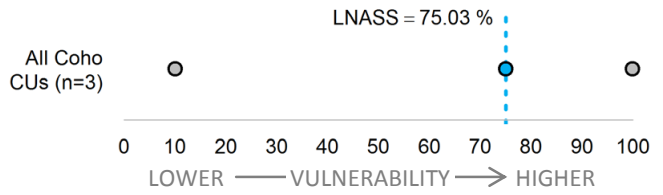
Flow sensitive accessible habitat (km) (all seasons)



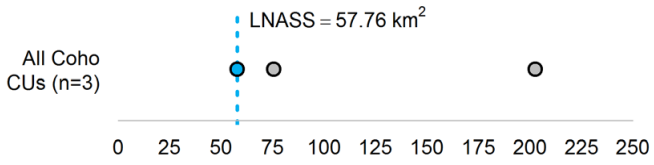
Lake area (km^2)



Flow sensitive accessible habitat (%) (all seasons)



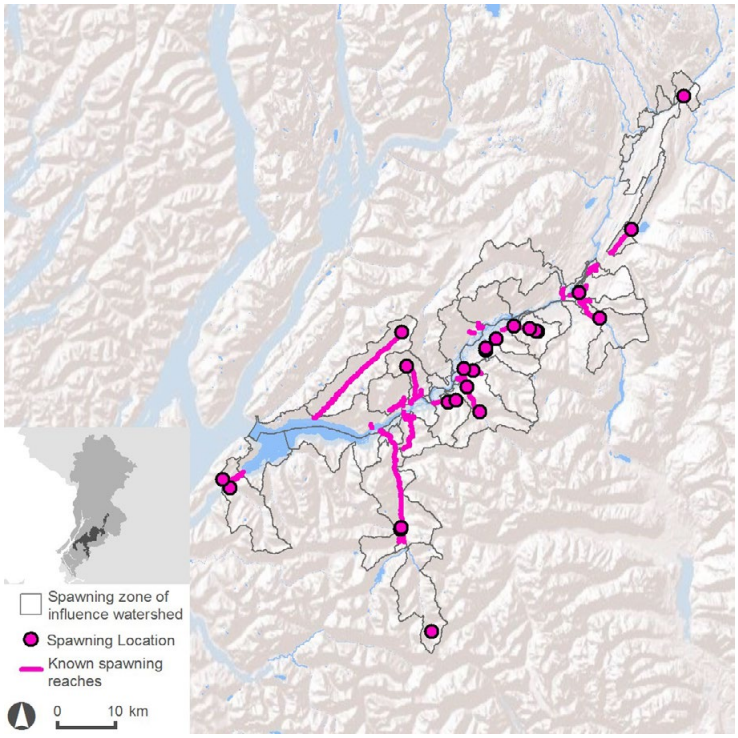
Wetland area (km^2)



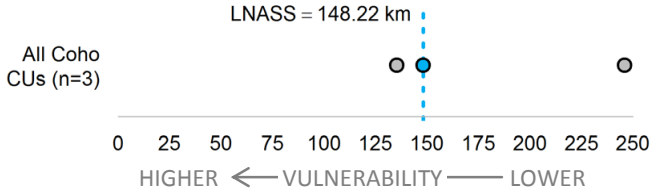
Spawning & incubation vulnerability

Spawning period vulnerability

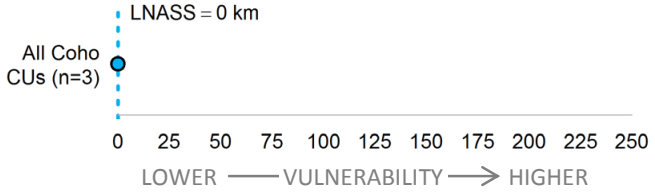
Spawning locations



Total spawning length (km)



Spawning reaches summer flow sensitive - spawn timing (km)



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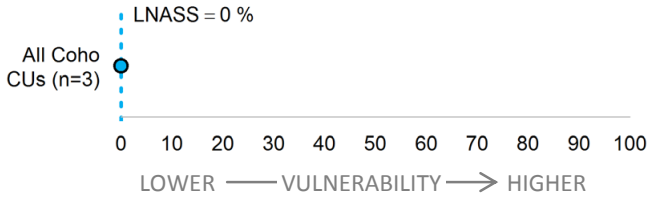
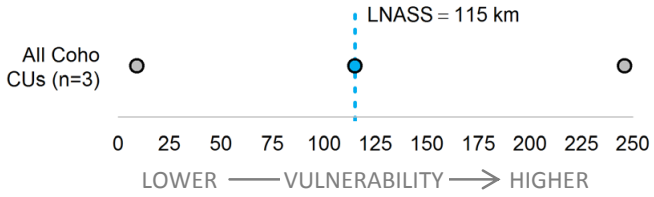
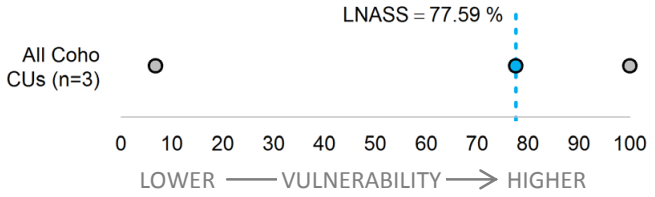


Incubation period vulnerability

Spawning reaches winter flow sensitive - incubation timing (km)



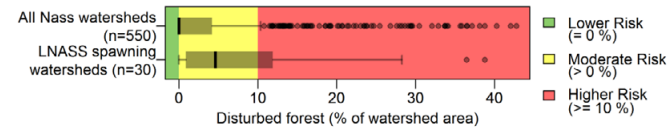
Spawning reaches winter flow sensitive - incubation timing (%)

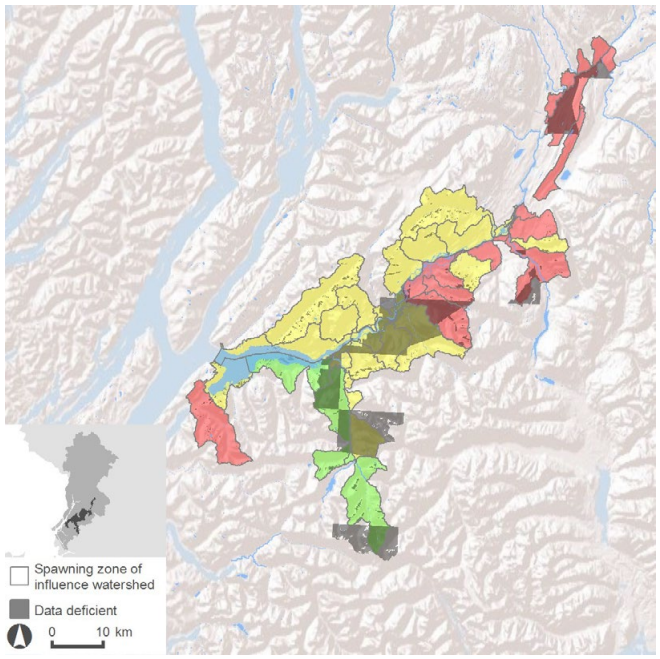


Spawning pressure

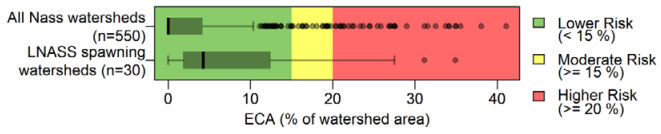
Hydrologic Processes

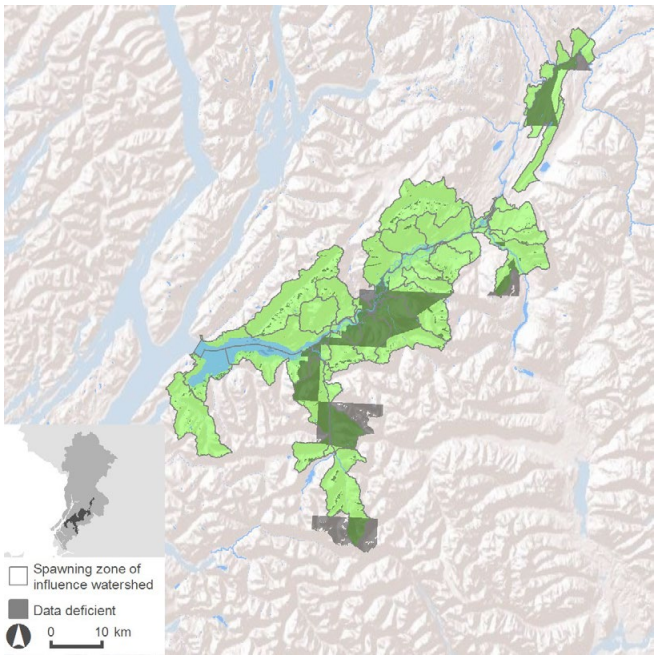
Forest disturbance





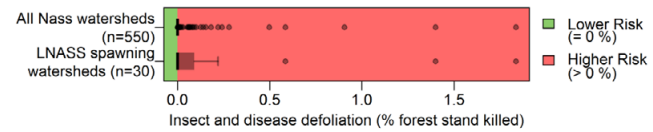
Equivalent Clear-cut Area

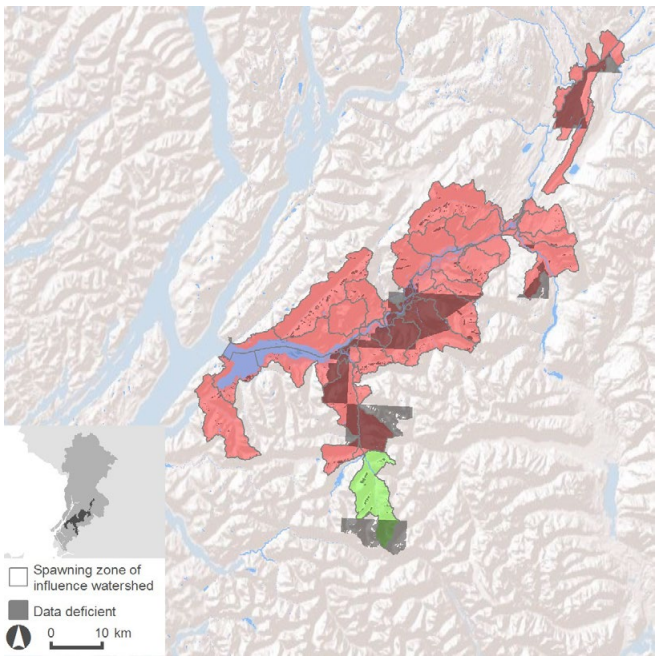




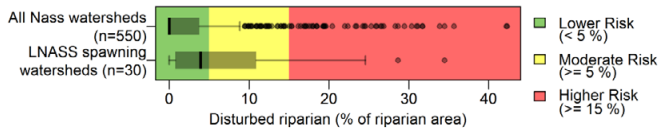
Vegetation Quality

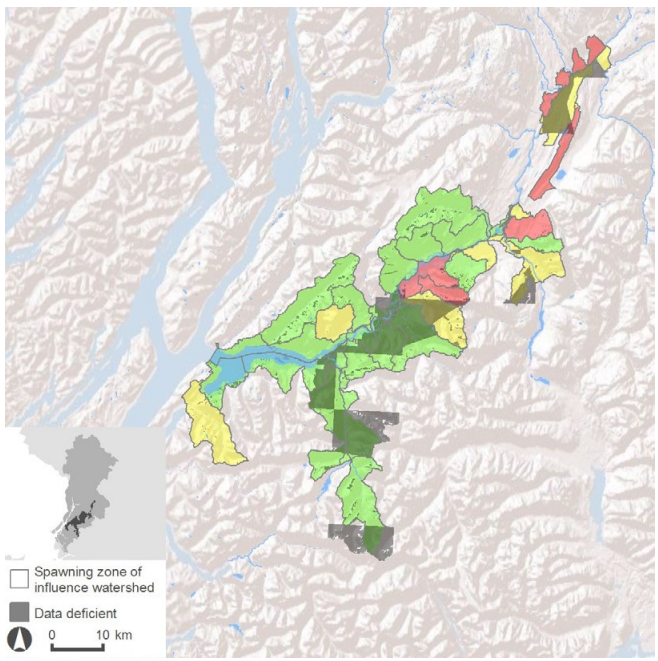
Insect and disease defoliation





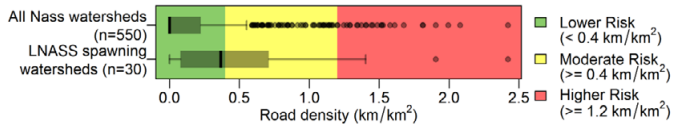
Riparian disturbance

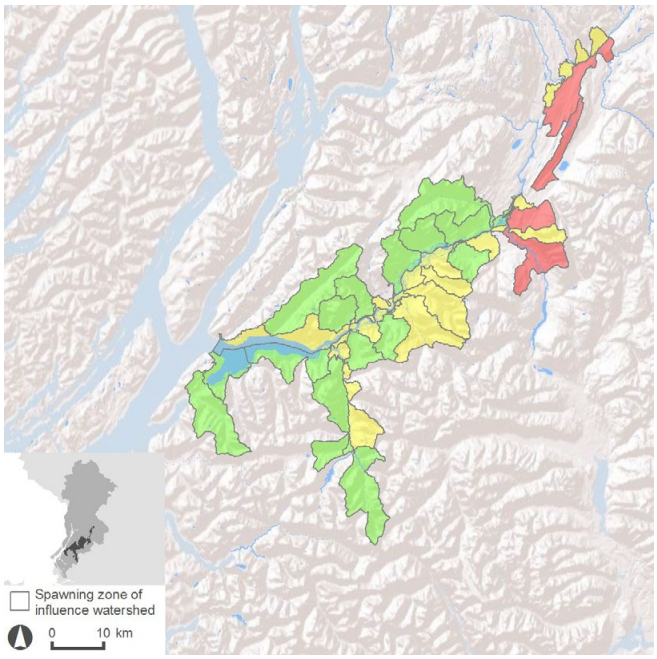




Surface Erosion

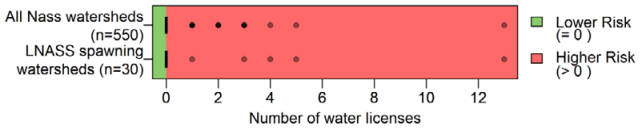
Road development

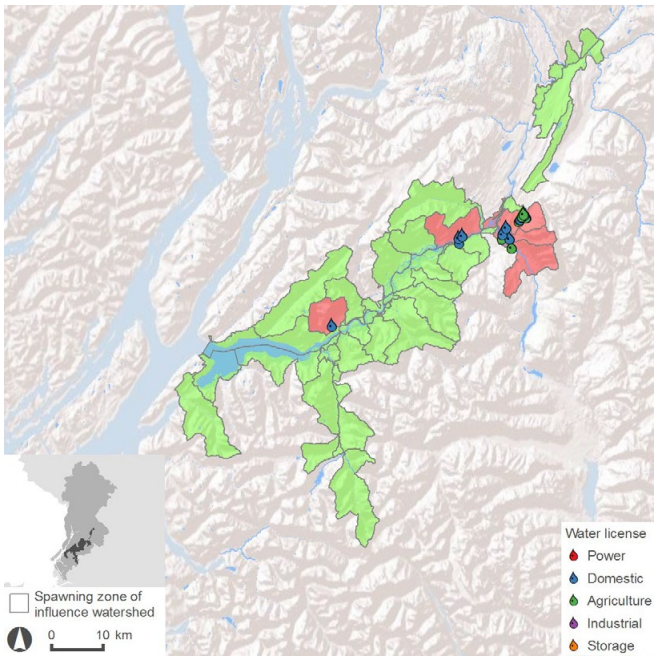




Water Quantity

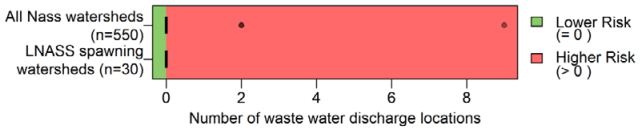
Number of water licenses

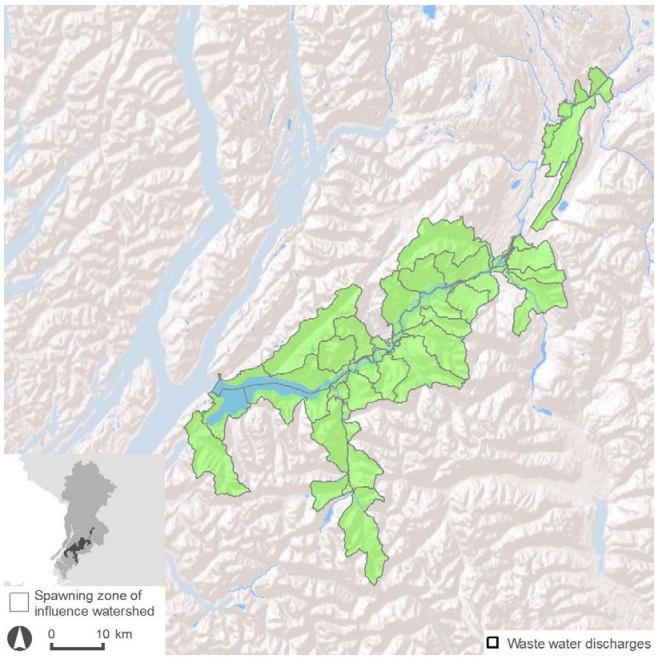




Water Quality

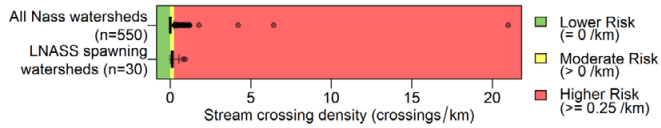
Permitted waste water discharges

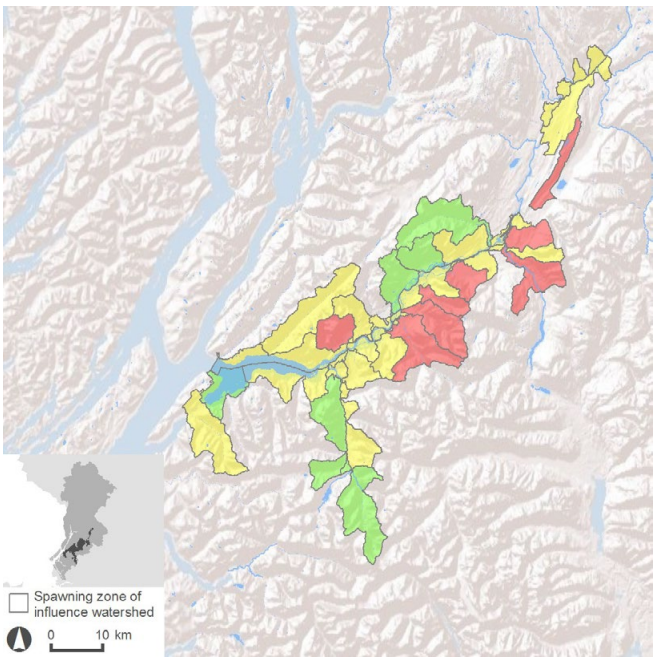




Fish Passage/Habitat Connectivity

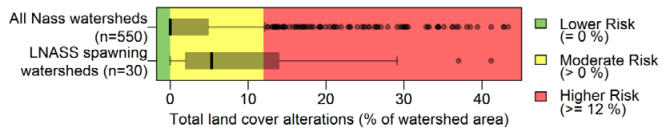
Stream crossing density

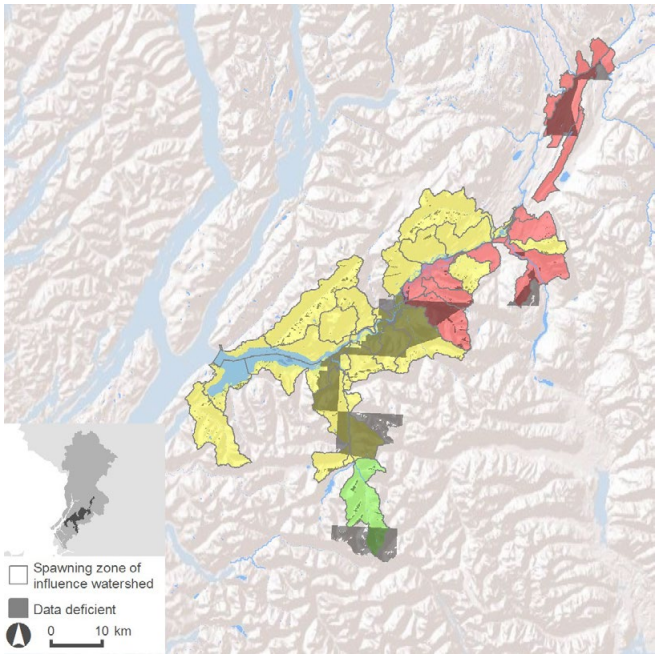




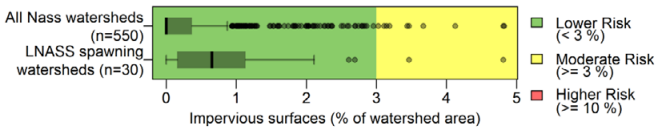
Human Development Footprint

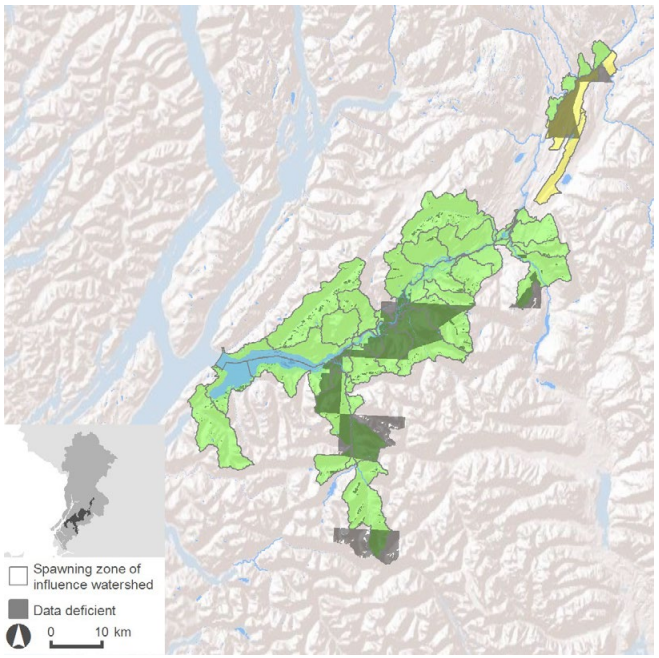
Total land cover alteration



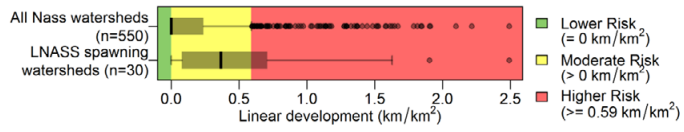


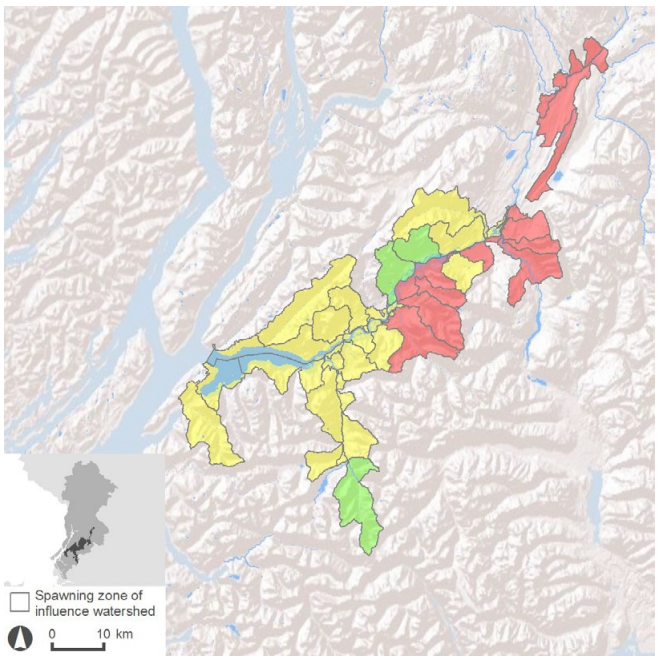
Impervious surfaces



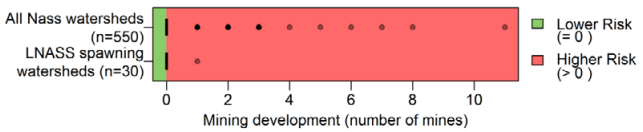


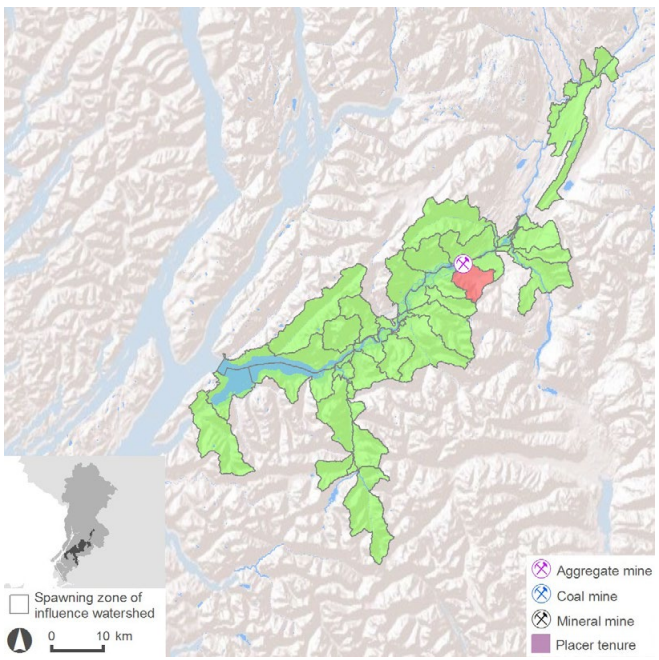
Linear development





Mining development (total number of mines)





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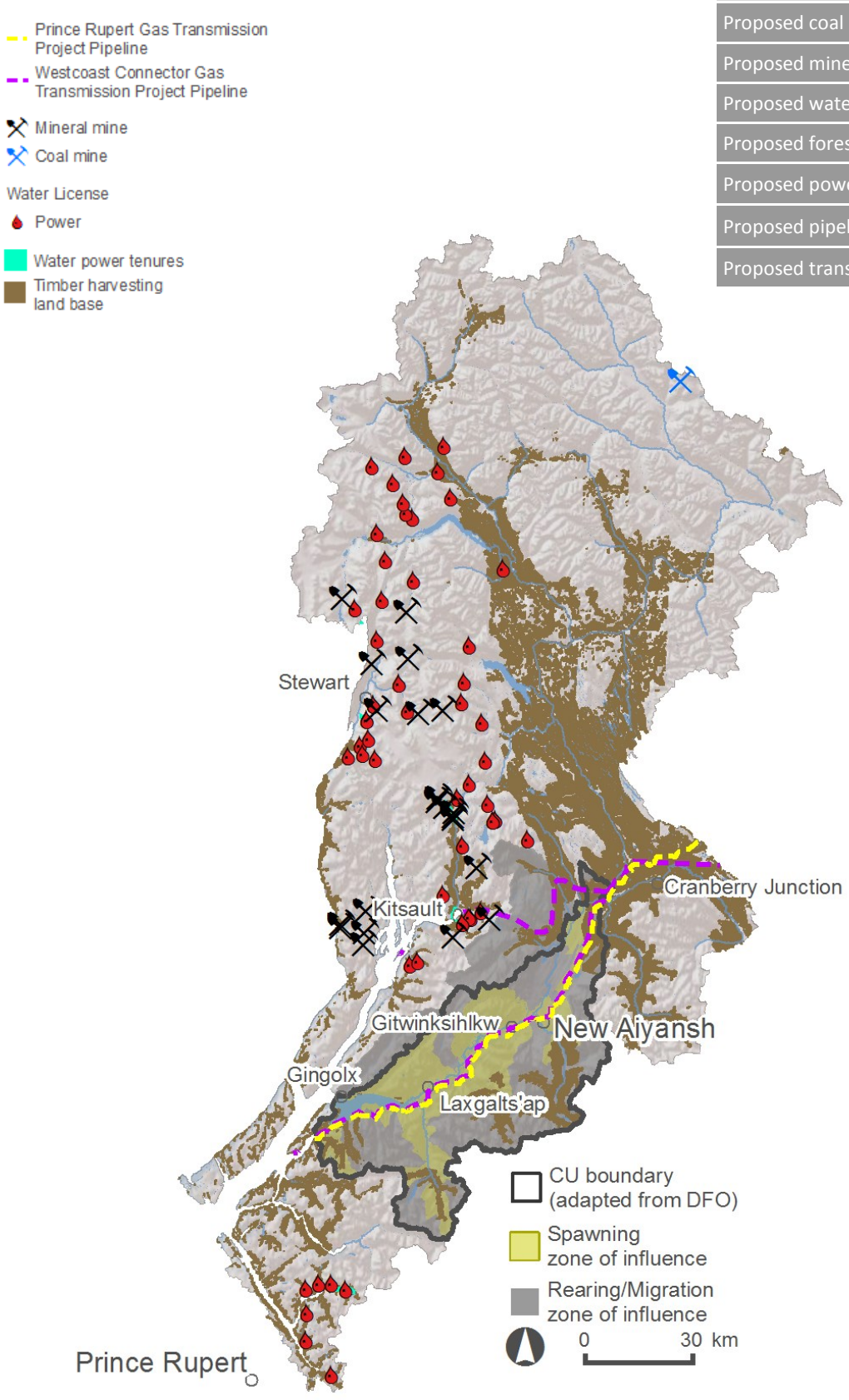

Coho: Upper Nass

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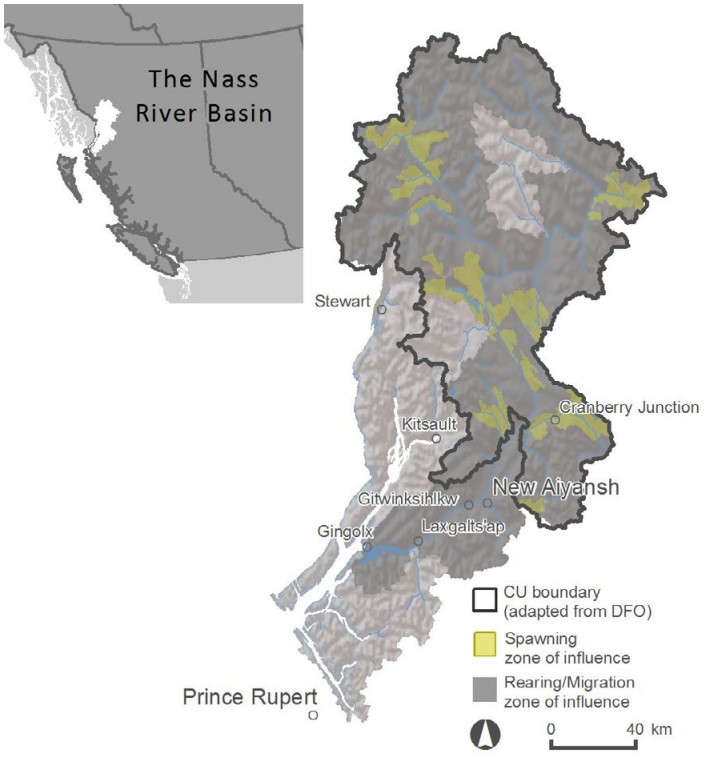

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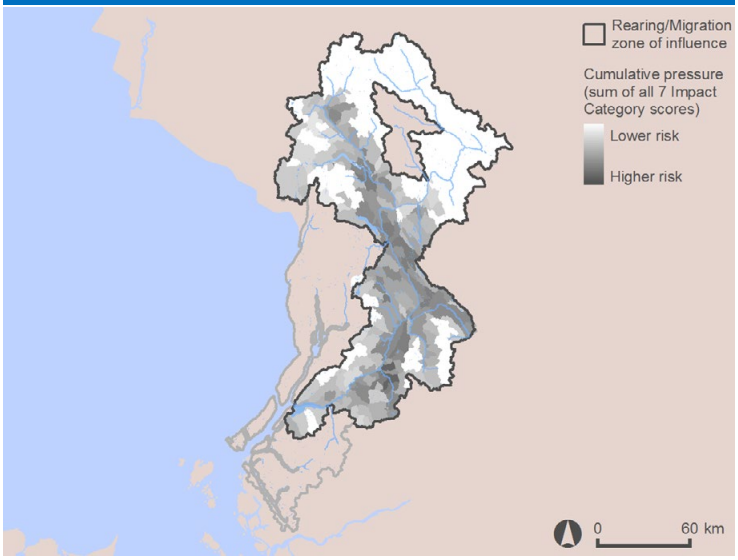
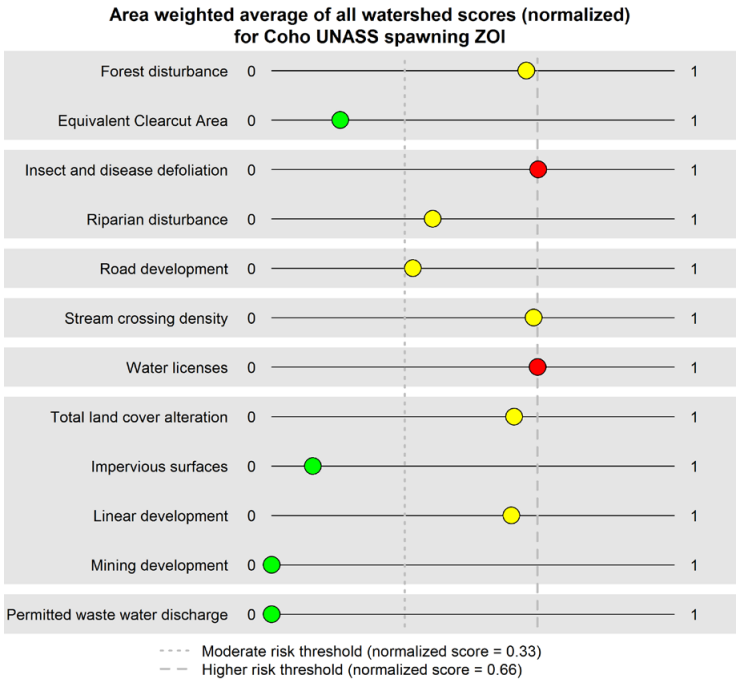
- Spawning ZOI: Total spawning length; Length and percentage of spawning reaches considered flow sensitive (summer period - spawning, winter period - incubation)

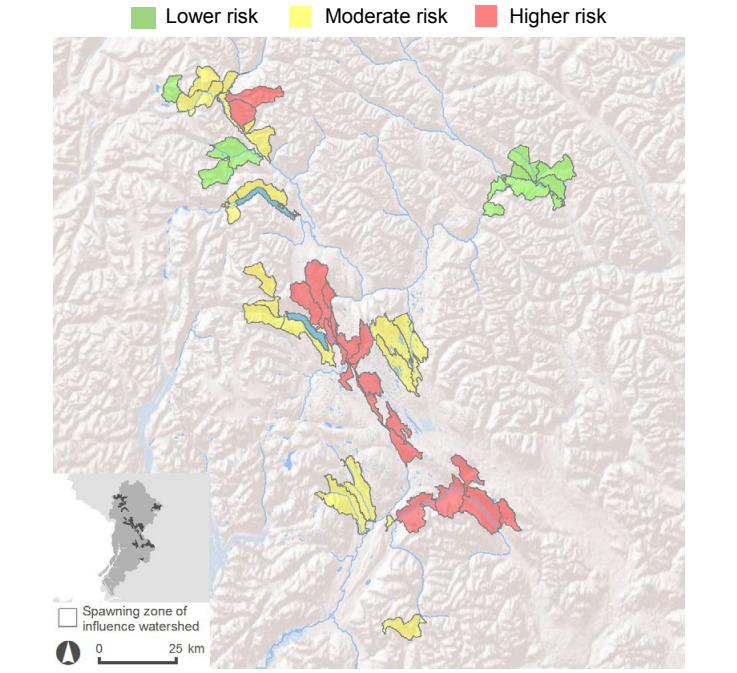
Cumulative pressure—rearing/migration



Summary of pressure indicators—spawning

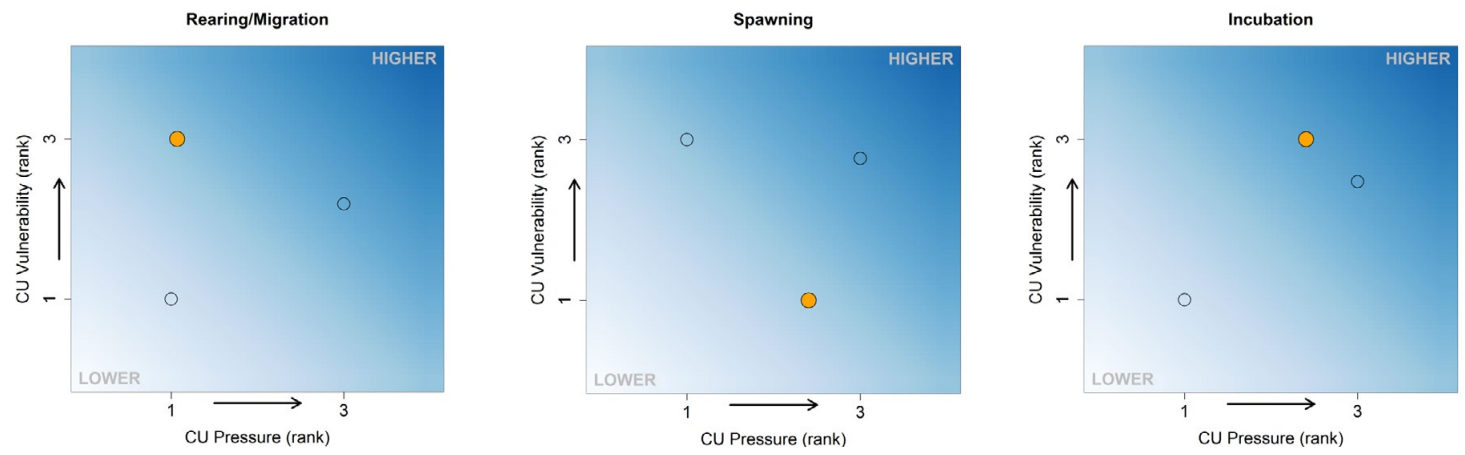


Cumulative pressure—spawning



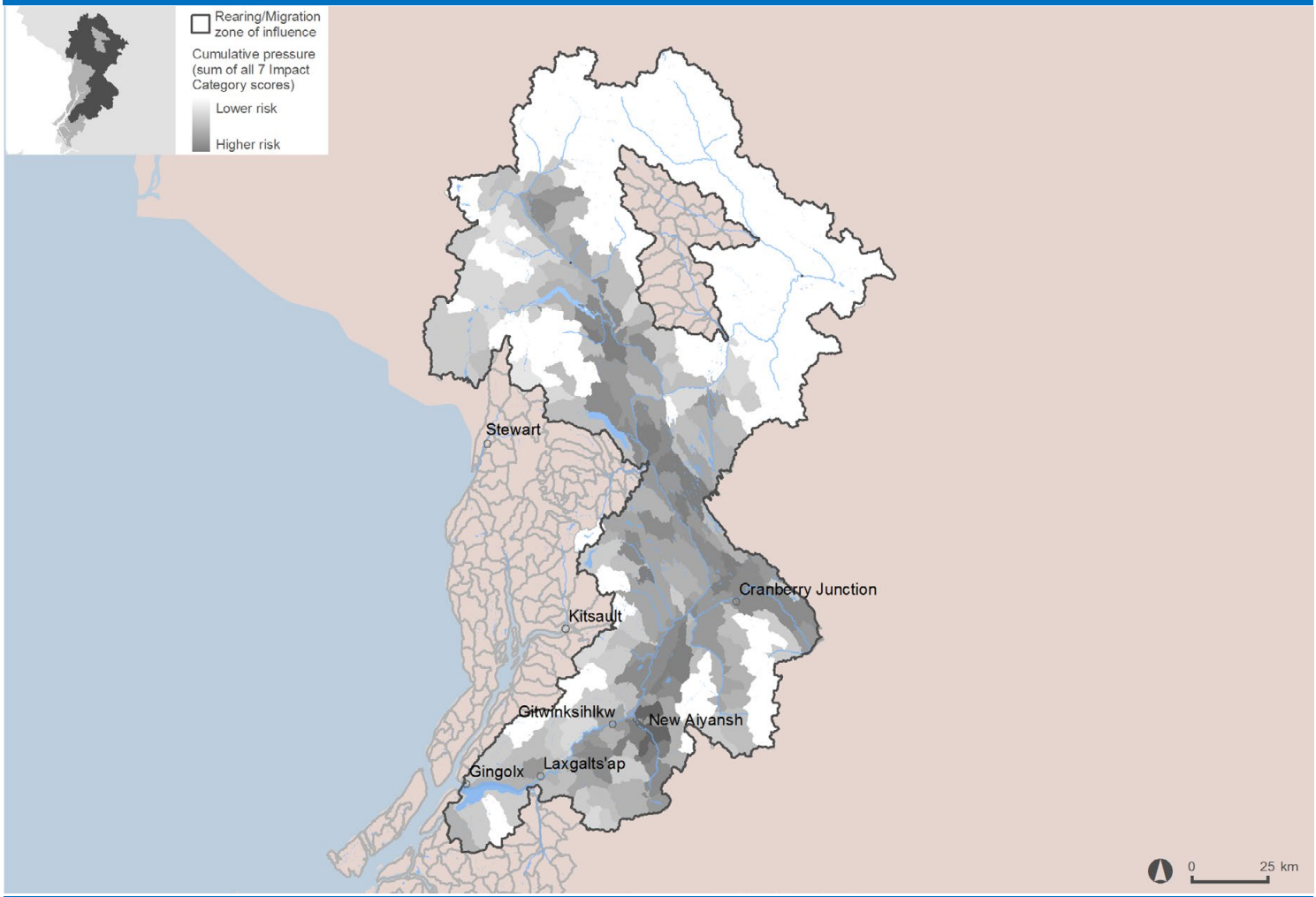
Integrated vulnerability/habitat pressures—rearing/migration, spawning, & incubation

● = Upper Nass ○ = other Coho CUs



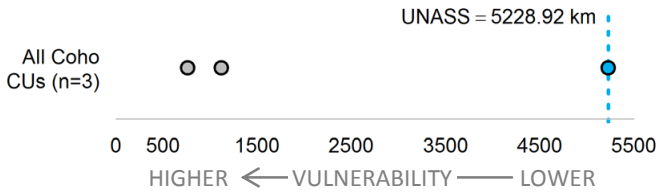
Rearing/Migration vulnerability & pressure

Rearing/Migration period pressures

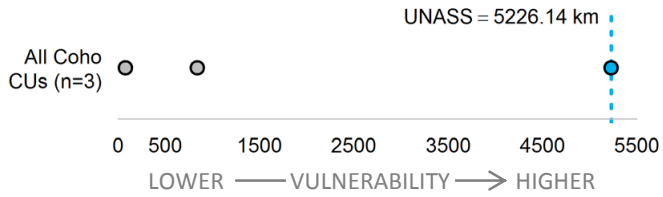


Rearing/Migration period vulnerability

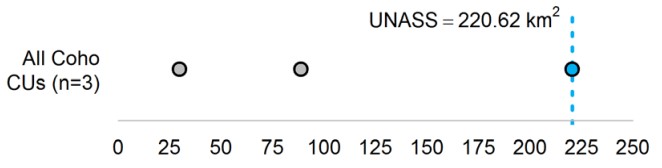
Salmon accessible habitat (km)



Flow sensitive accessible habitat (km) (all seasons)

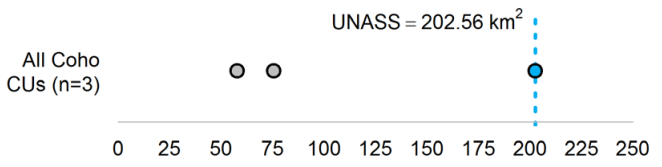


Lake area (km^2)



Flow sensitive accessible habitat (%) (all seasons)

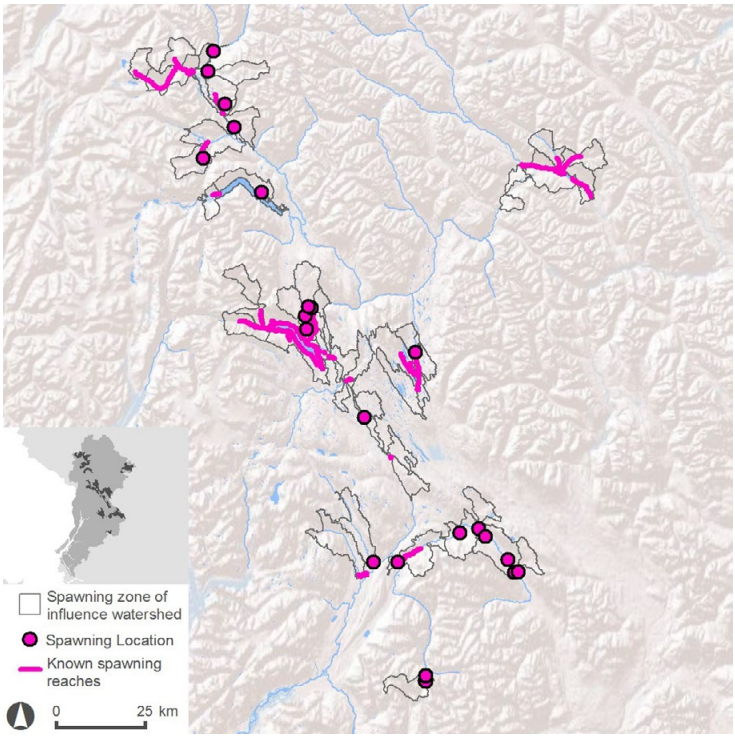
Wetland area (km^2)



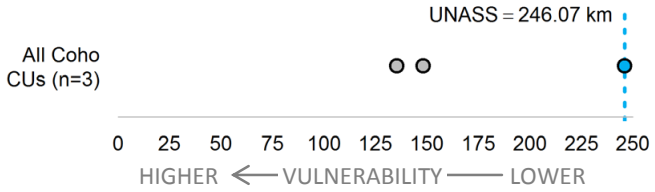
Spawning & incubation vulnerability

Spawning period vulnerability

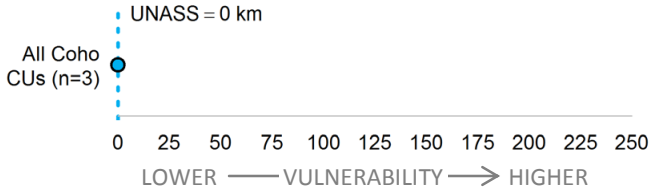
Spawning locations



Total spawning length (km)



Spawning reaches summer flow sensitive - spawn timing (km)



Spawning reaches summer flow sensitive - spawn timing (%)

Incubation period vulnerability

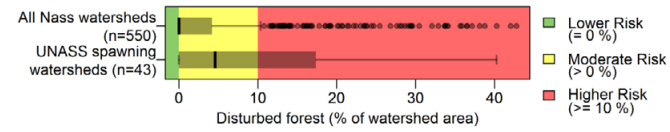
Spawning reaches winter flow sensitive - incubation timing (km)

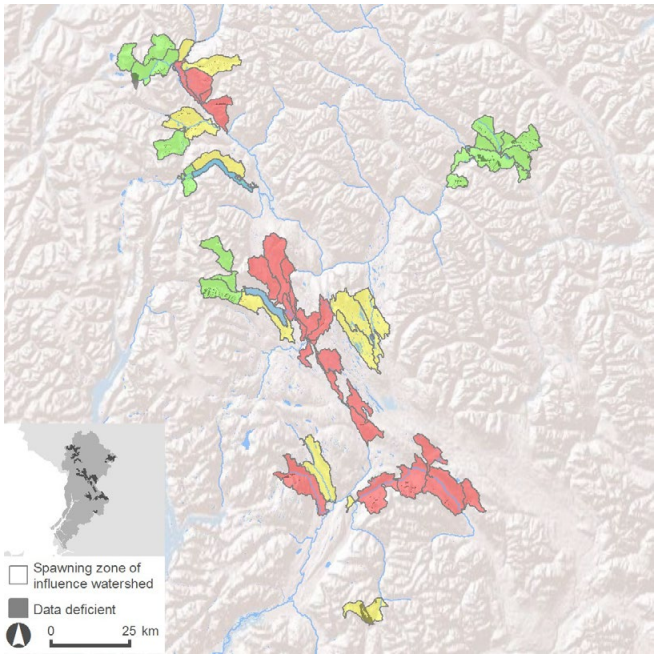
Spawning reaches winter flow sensitive - incubation timing (%)

Spawning pressure

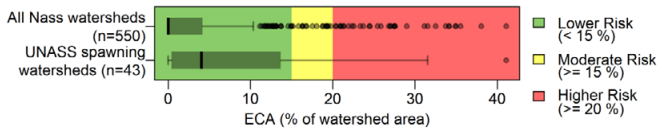
Hydrologic Processes

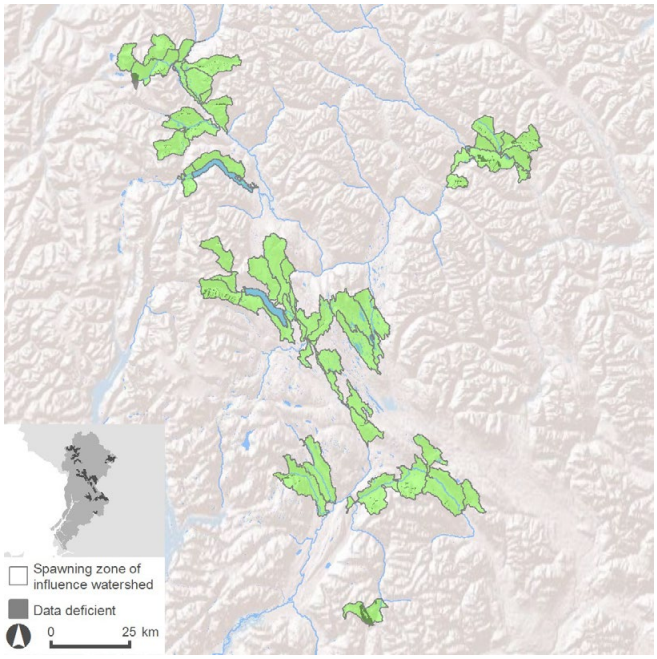
Forest disturbance





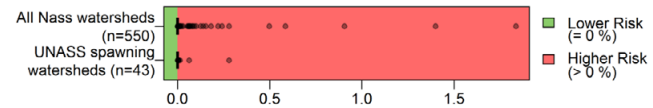
Equivalent Clear-cut Area

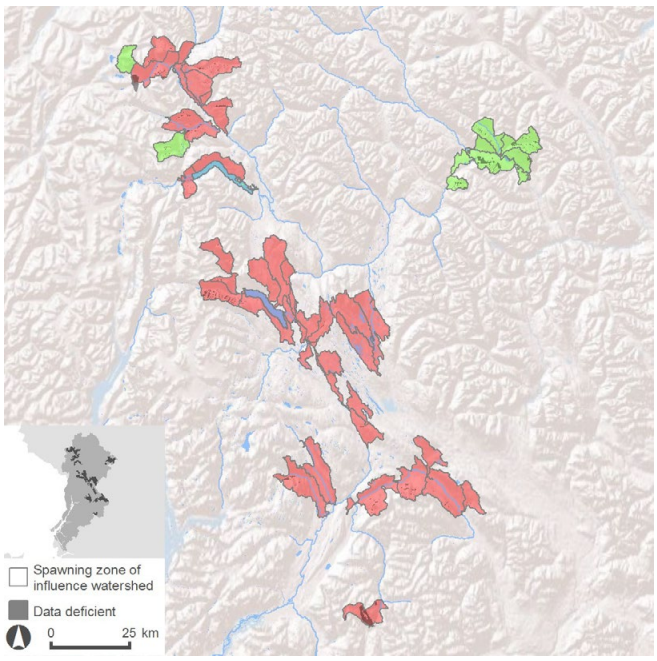




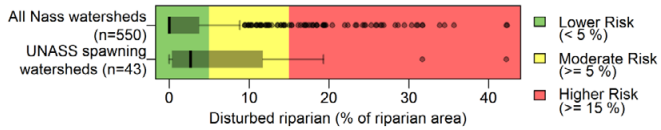
Vegetation Quality

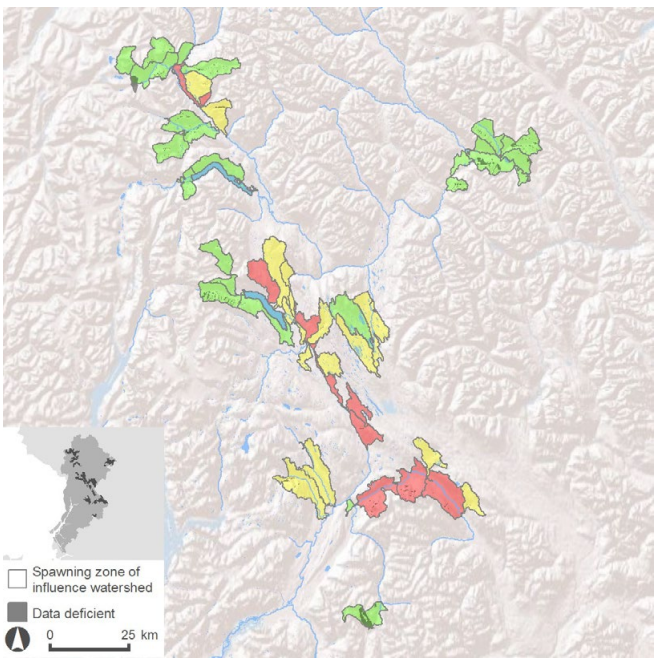
Insect and disease defoliation





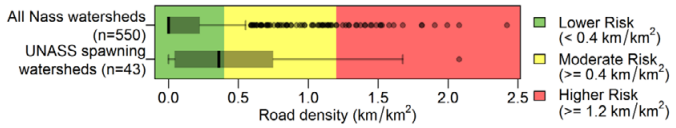
Riparian disturbance

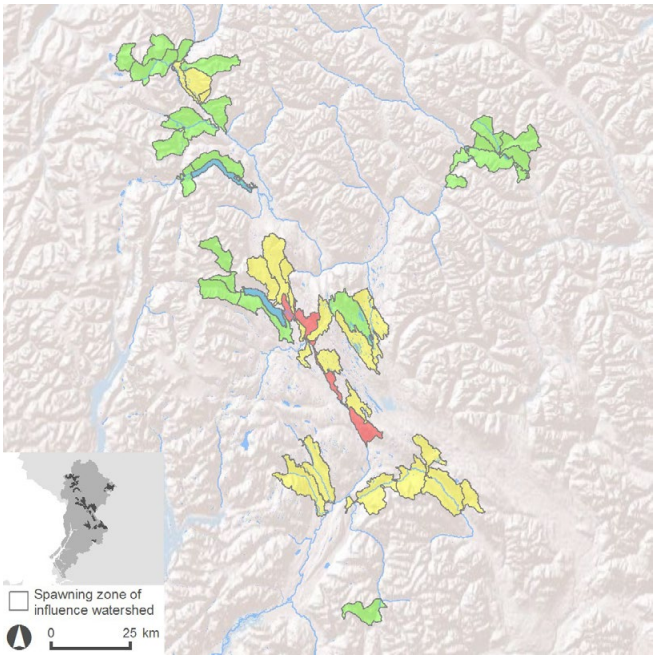




Surface Erosion

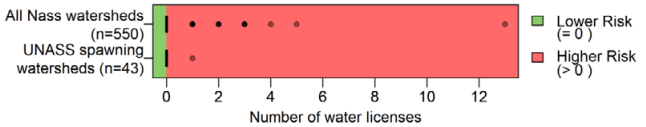
Road development

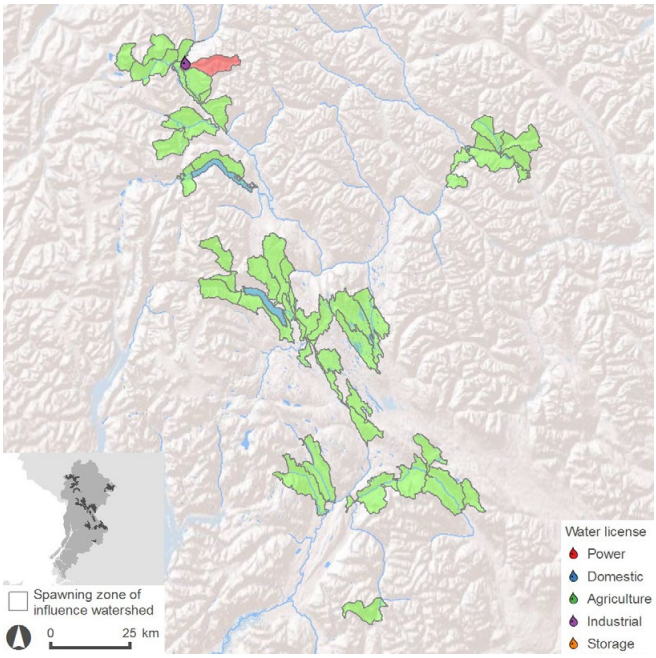




Water Quantity

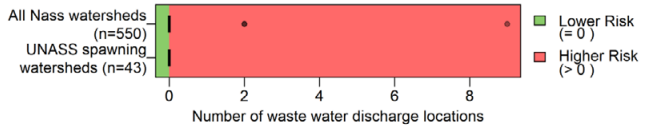
Number of water licenses

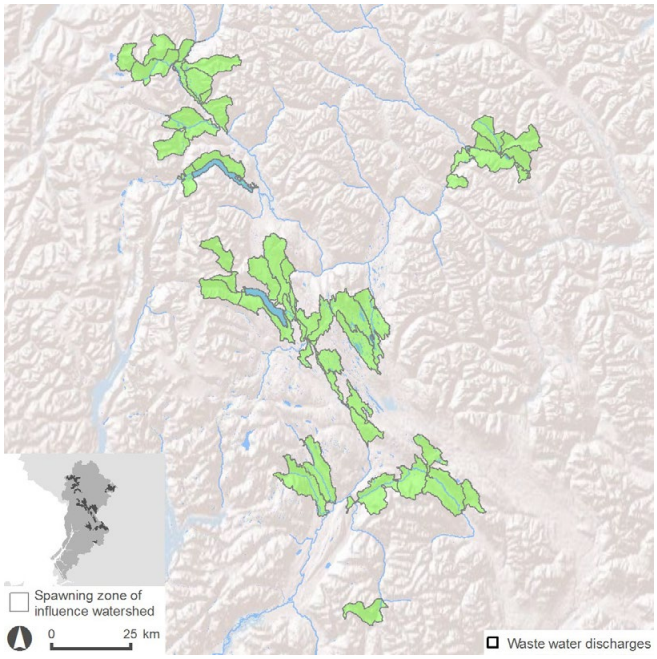




Water Quality

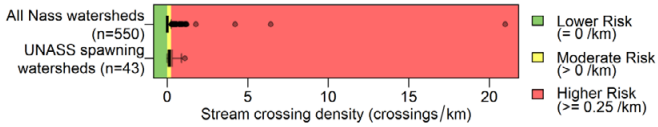
Permitted waste water discharges

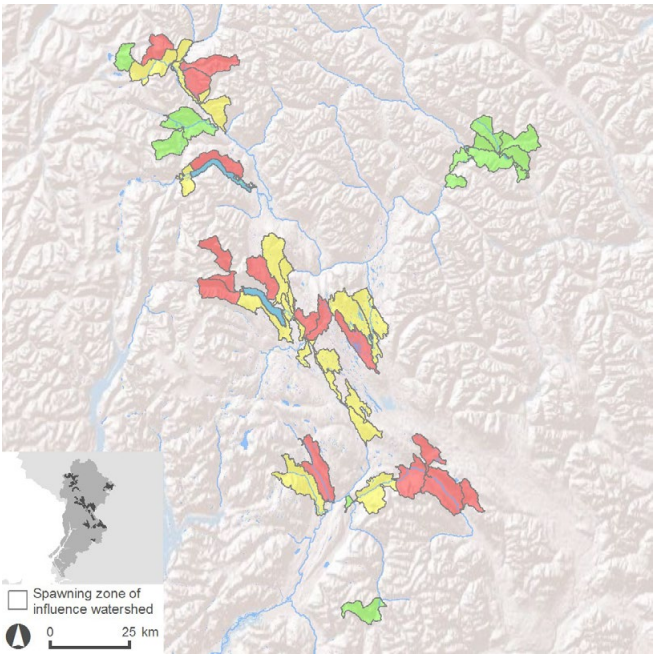




Fish Passage/Habitat Connectivity

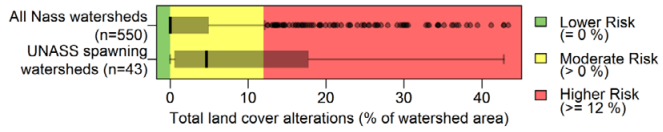
Stream crossing density

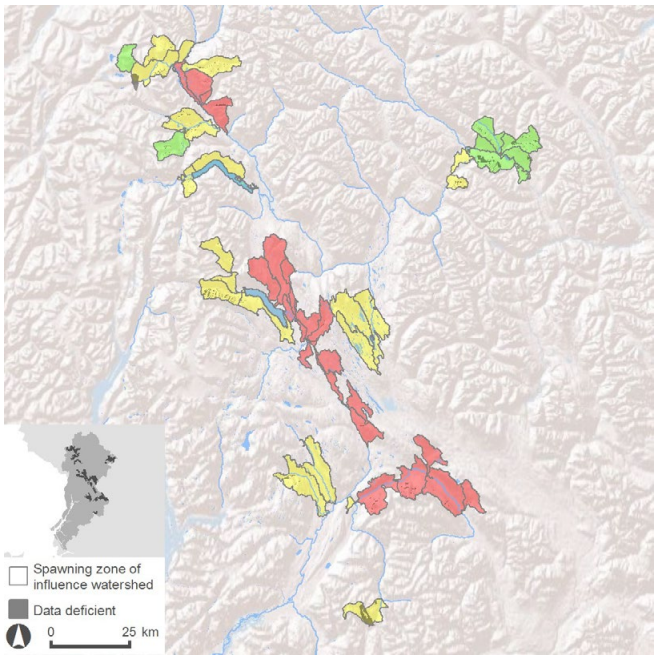




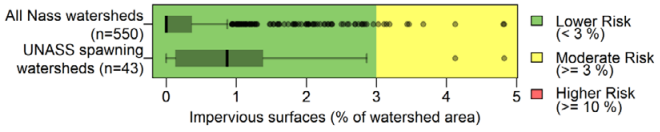
Human Development Footprint

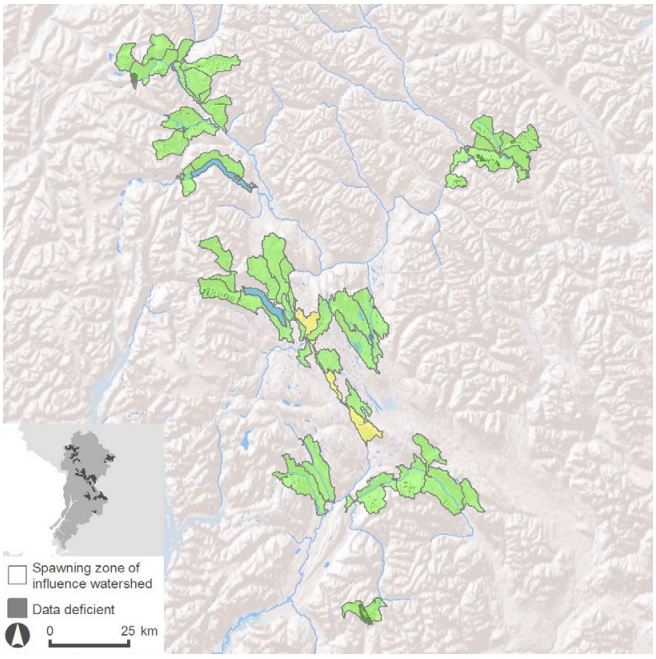
Total land cover alteration



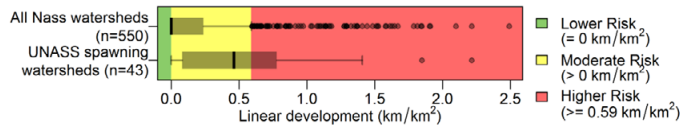


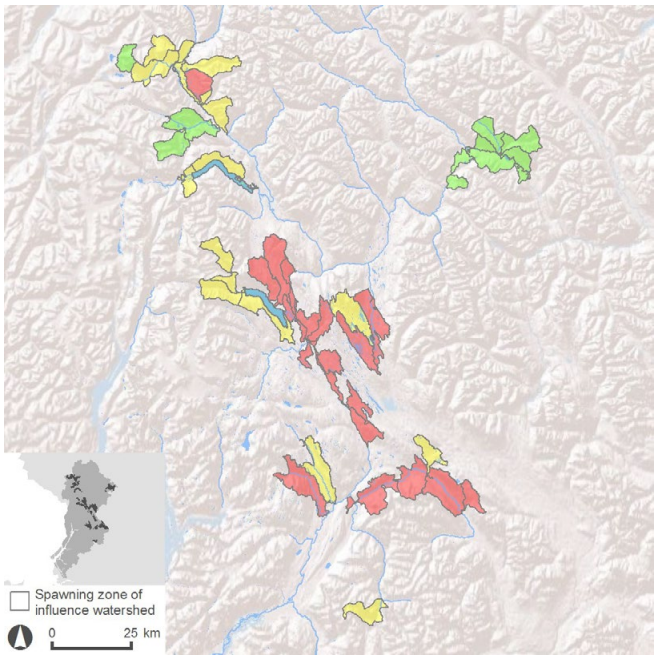
Impervious surfaces



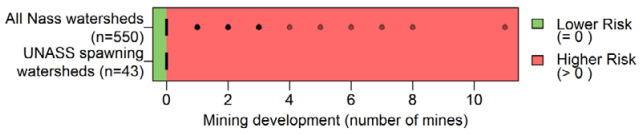


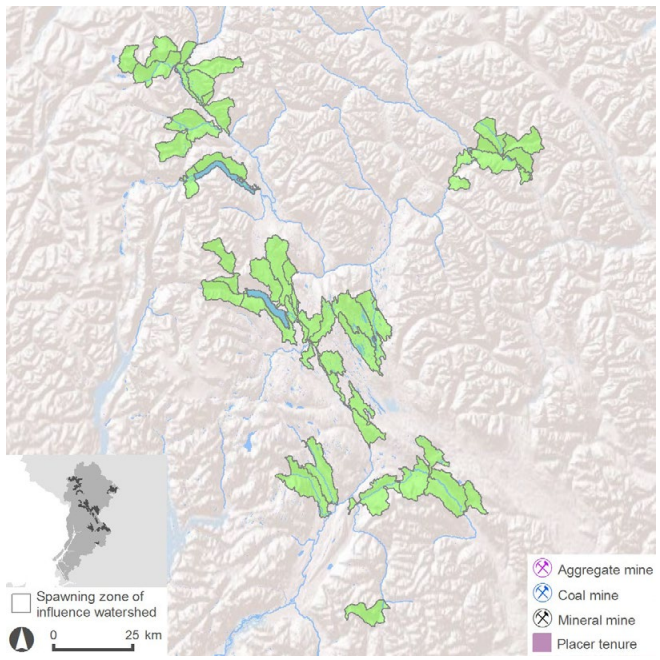
Linear development





Mining development (total number of mines)

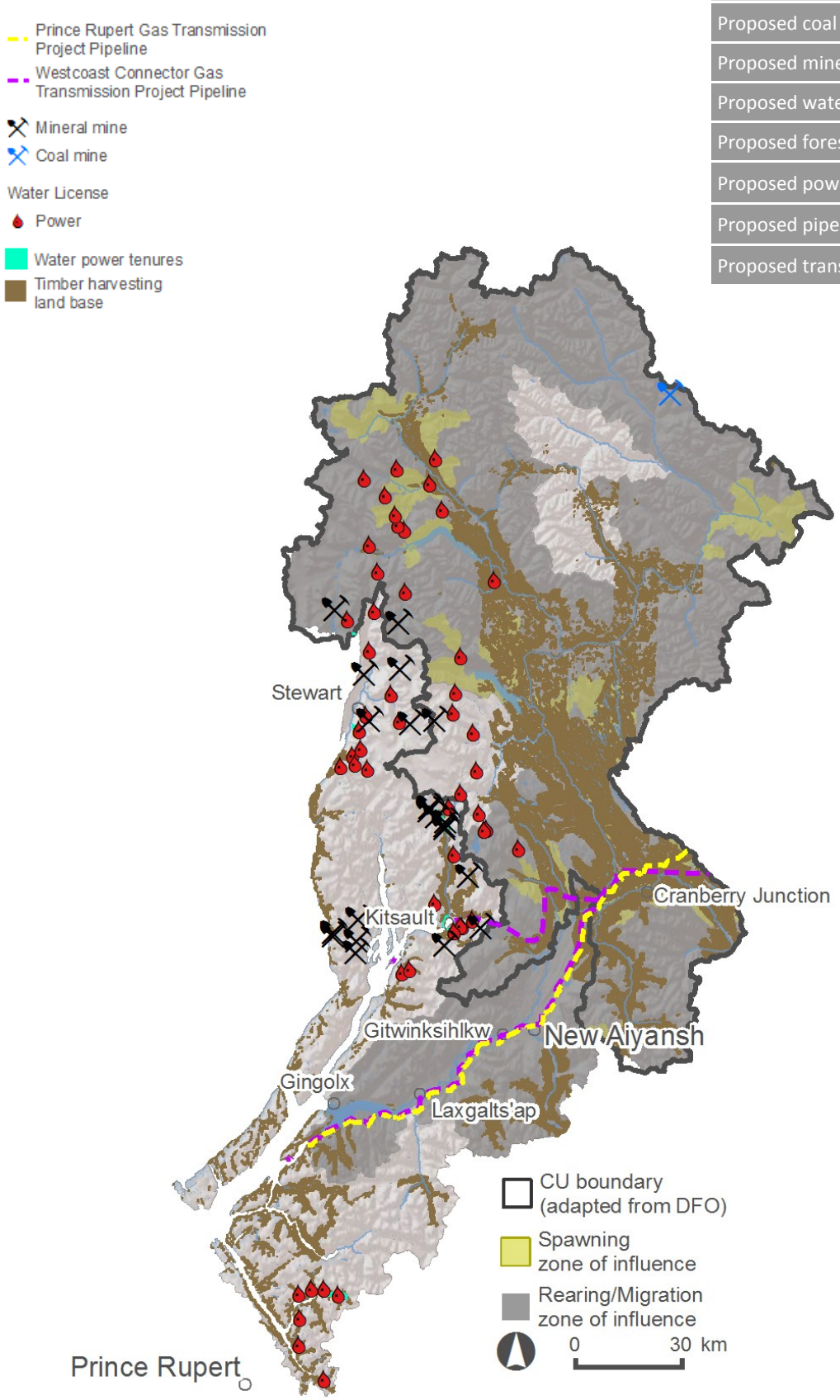




Future pressure

Proposed resource development projects (as of 2016)

Nass Drainage Summary	
	Totals
Proposed coal mines (#)	1
Proposed mineral mines (#)	22
Proposed water licenses (#)	58
Proposed forestry (km^2)	3,323 km^2
Proposed power tenures	Wind 0 km^2, water 15 km^2
Proposed pipelines (km)	386 km
Proposed transmission lines	0 km



Coho: Portland Sound — Observatory Inlet — Portland Canal

Introduction

This project summarizes pressures on the habitat used by Nass salmon Conservation Units (CU) during their freshwater life history stages (migration, spawning and rearing), as well as their relative vulnerability to those pressures. For an explanation of the indicators shown here, please see the accompanying *Report Card Summaries*. Full methods and results can be found in the main report, *Cumulative Pressures on Nass Salmon Habitat: Technical Report* (2016).

Definitions

Conservation Unit (CU): A group of wild salmon sufficiently isolated from other groups that, if extirpated, is very unlikely to re-colonize naturally within an acceptable timeframe.

Pressure indicator: Measurable extent/intensity of natural processes or human activities that can induce changes in habitat condition/state.

Vulnerability indicator: Measures of habitat quantity or quality used to represent the intrinsic habitat vulnerability/sensitivity to watershed disturbances for each life-stage.

Zone of influence (ZOI): Areas adjacent to and upstream/upslope of habitats used by salmon CUs that represent the geographic extent for capture/measurement of pressure and vulnerability indicators.

Status: Condition of habitat relative to a defined indicator benchmark.

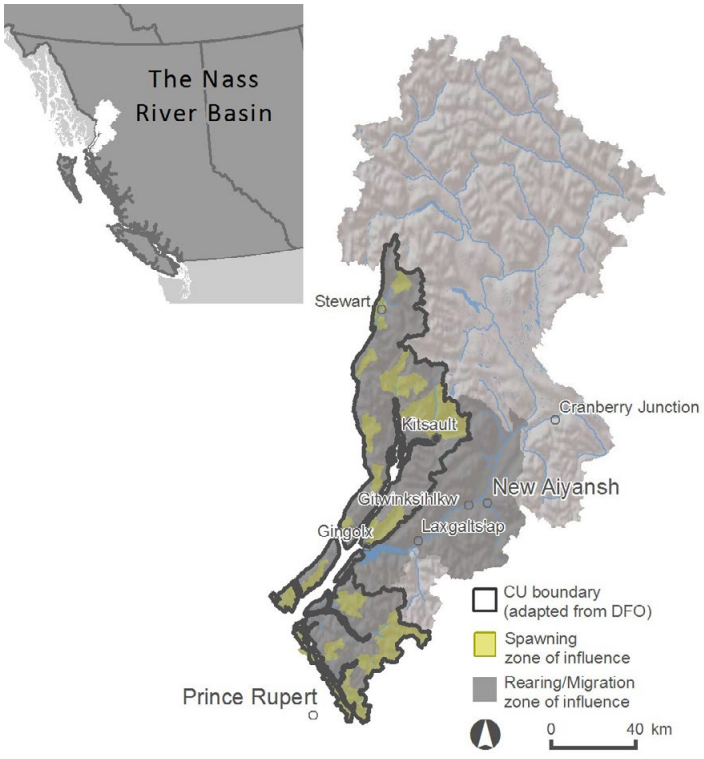
Risk: Likelihood of adverse effects to salmon habitats within a defined zone of influence. Levels of increasing risk are defined based on the extent/intensity of impacts relative to defined benchmarks of concern.

Benchmark: A standard (quantified metric) against which habitat condition can be measured or judged, and by which status can be compared over time and space to determine the risk of adverse effects.

Narrative

- There are three coho salmon CUs in the Nass Area: 1) Upper Nass (UNASS), 2) Lower Nass (LNASS), and 3) Portland Sound-Observatory Inlet-Lower Nass (PORT). There are approximately 100 discrete spawning populations in all three CUs combined.
- Nass Area coho salmon return to their natal stream to spawn between three and four years of age, with most fish maturing at four years of age having spent between one and three years of their life in freshwater.
- Adult returns of Nass Area coho salmon have been relatively healthy for the past several decades.

Location



Summary of habitat vulnerabilities & pressures

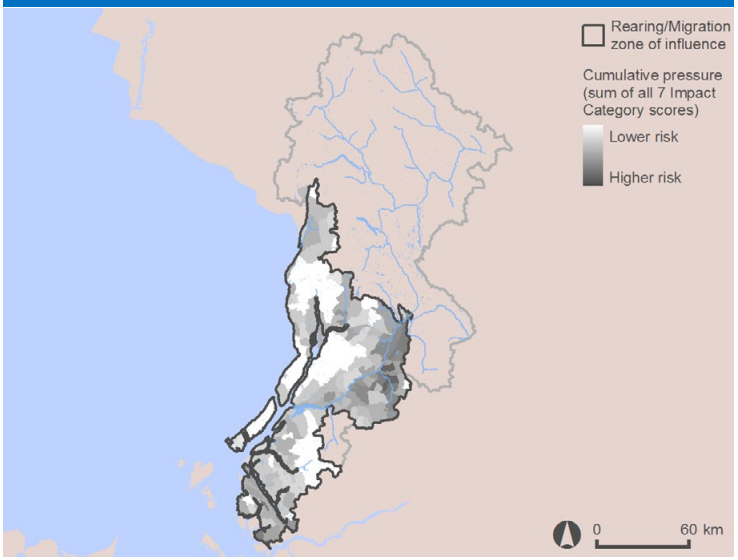
Pressure indicators were grouped into seven relatively independent habitat "impact categories" representing key factors affecting general watershed condition:

- Hydrologic Processes (Forest disturbance; Equivalent Clearcut Area)
- Vegetation Quality (Insect and disease defoliation; Riparian disturbance)
- Surface Erosion (Road development)
- Fish passage/Habitat connectivity (Stream crossing density)
- Water quantity (Water licenses)
- Human development footprint (Total land cover alteration; Impervious surfaces; Linear development; Mining development)
- Water quality (Wastewater discharges)

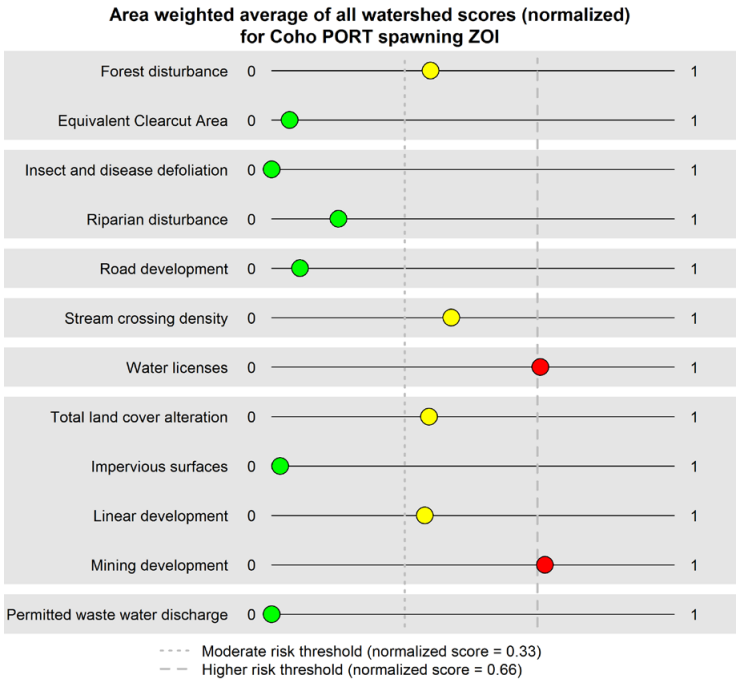
Indicators were also developed reflecting relative vulnerability to habitat pressures within the life stage-specific "zones of influence" defined for each CU:

- Rearing/Migration ZOI: Accessible stream length; Length and percentage of accessible streams considered flow sensitive - all seasons
- Spawning ZOI: Total spawning length; Length and percentage of spawning reaches considered flow sensitive (summer period - spawning, winter period - incubation)

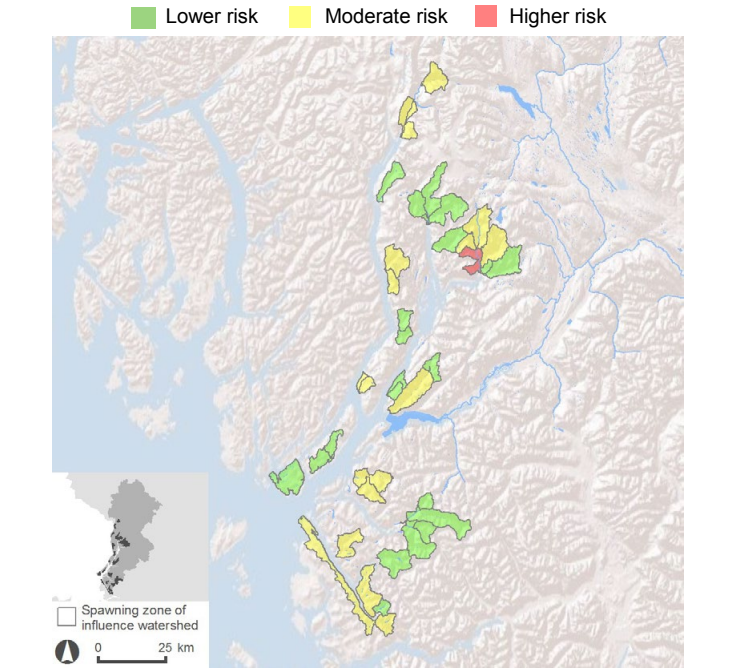
Cumulative pressure—rearing/migration



Summary of pressure indicators—spawning

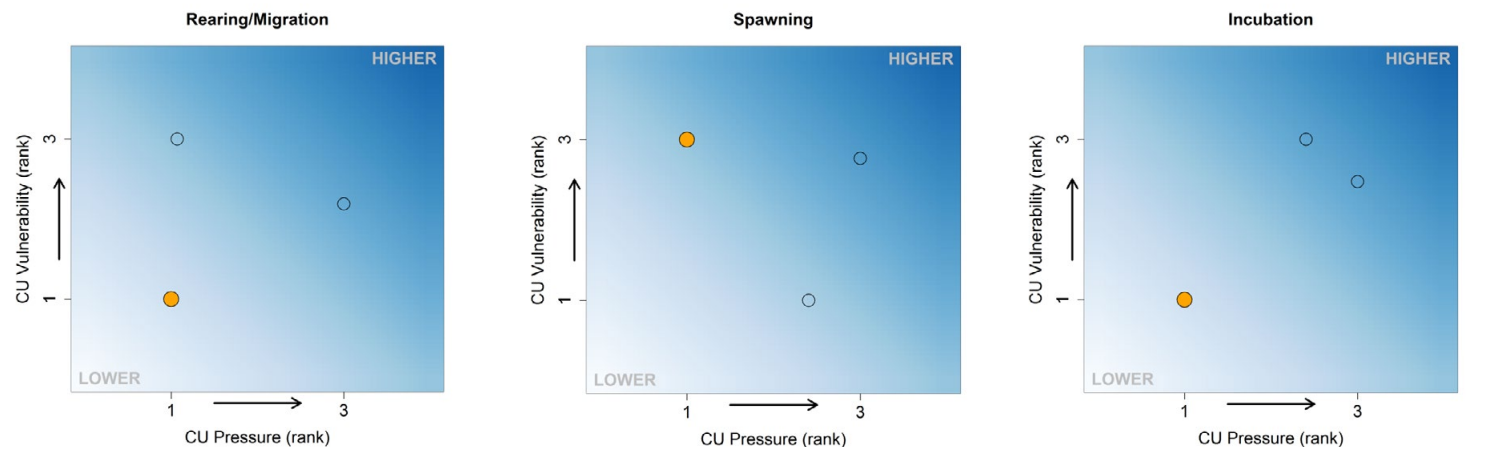


Cumulative pressure—spawning



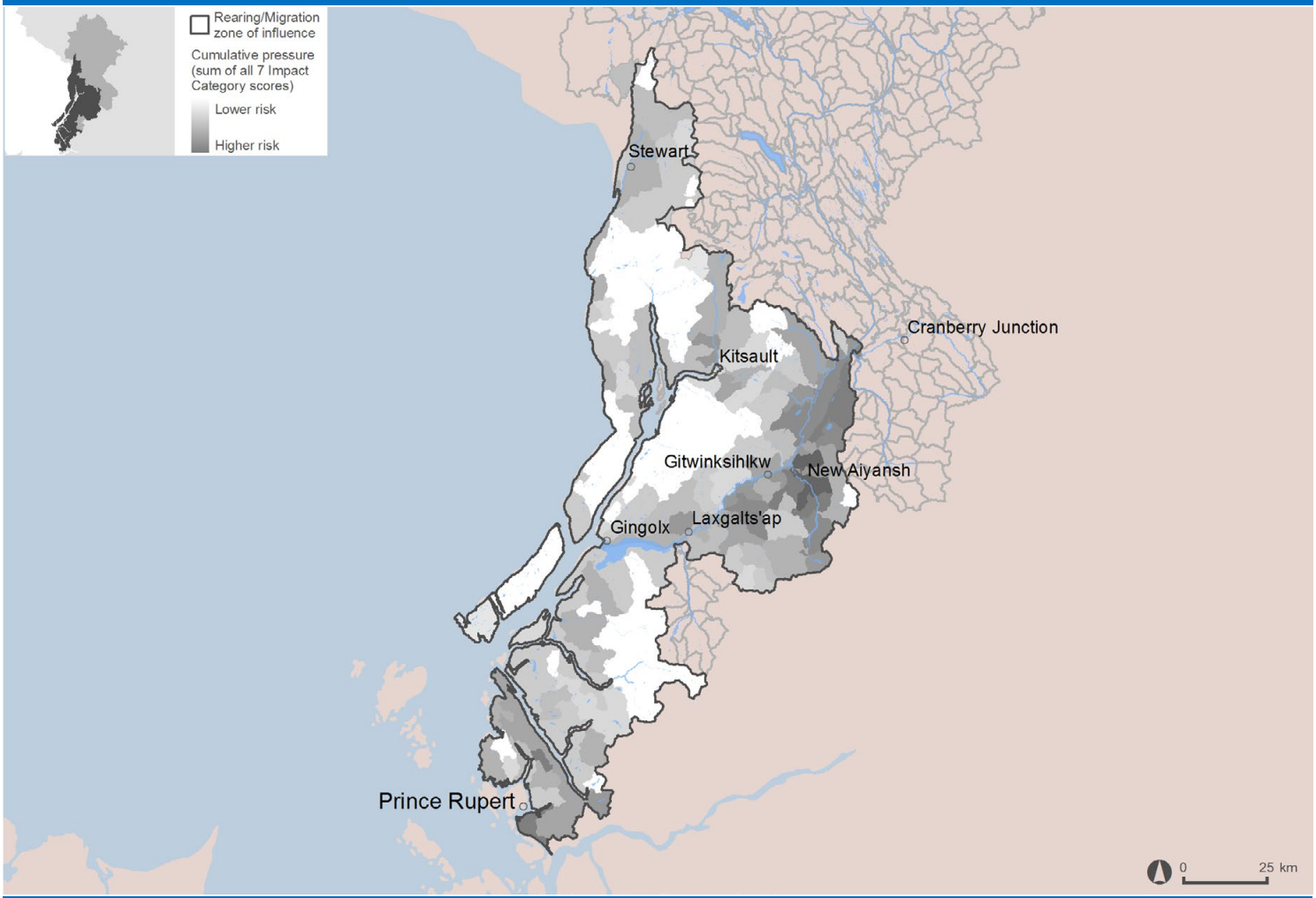
Integrated vulnerability/habitat pressures—rearing/migration, spawning, & incubation

● = Portland Sound-Observatory Inlet-Portland Canal ○ = other Coho CUs



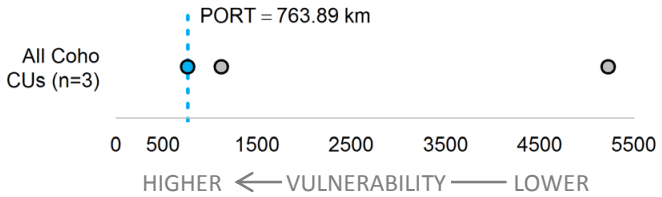
Rearing/Migration vulnerability & pressure

Rearing/Migration period pressures

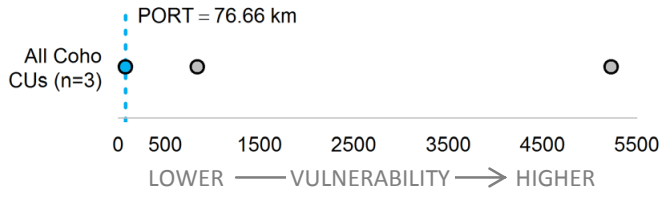


Rearing/Migration period vulnerability

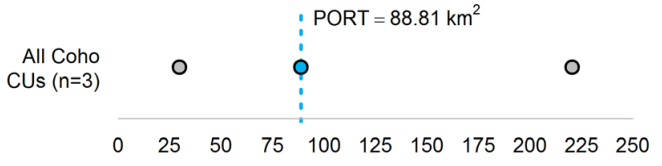
Salmon accessible habitat (km)



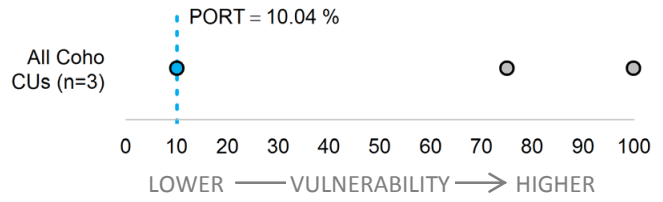
Flow sensitive accessible habitat (km) (all seasons)



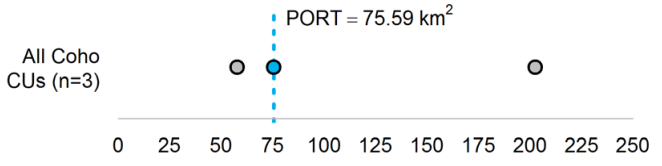
Lake area (km^2)



Flow sensitive accessible habitat (%) (all seasons)



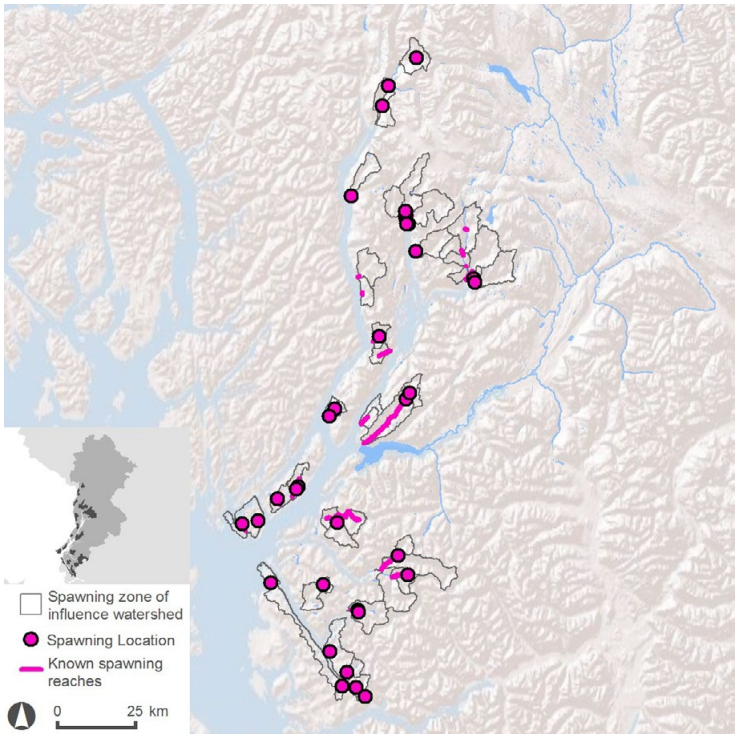
Wetland area (km^2)



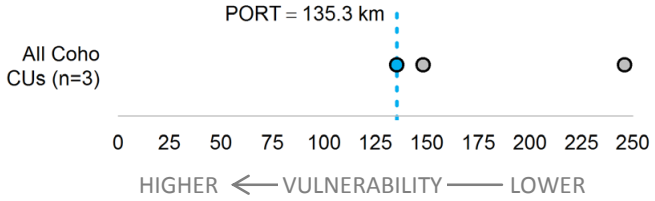
Spawning & incubation vulnerability

Spawning period vulnerability

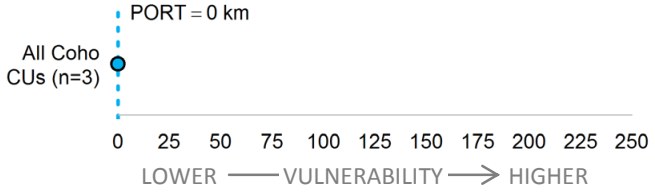
Spawning locations



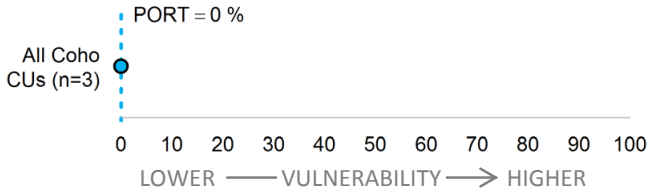
Total spawning length (km)



Spawning reaches summer flow sensitive - spawn timing (km)

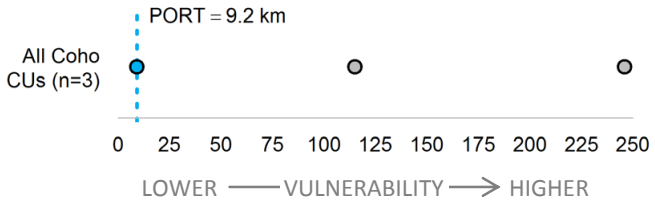


Spawning reaches summer flow sensitive - spawn timing (%)

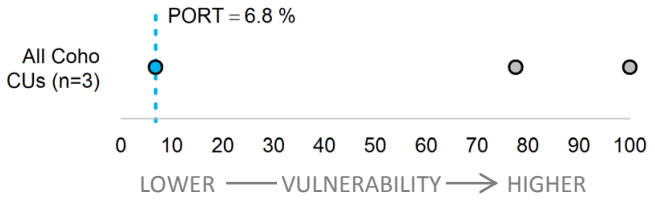


Incubation period vulnerability

Spawning reaches winter flow sensitive - incubation timing (km)



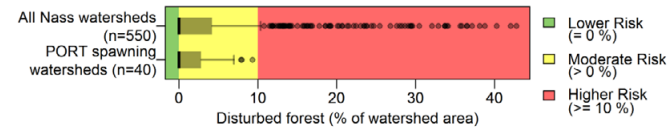
Spawning reaches winter flow sensitive - incubation timing (%)

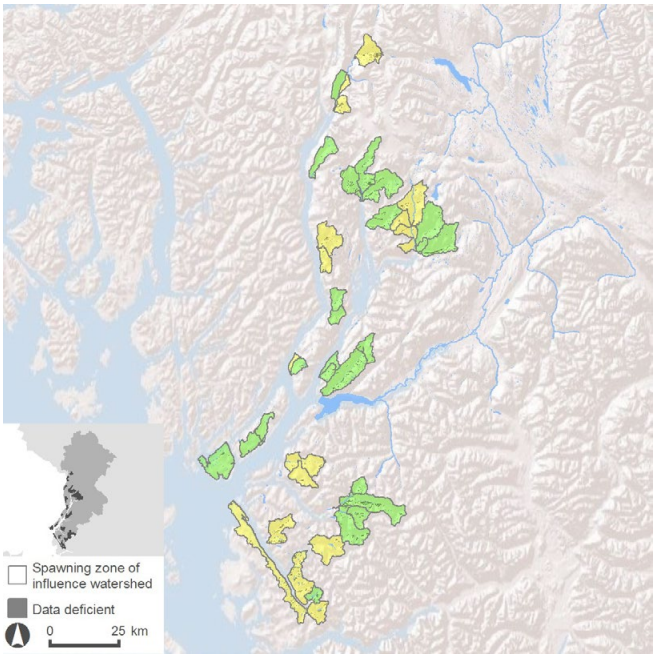


Spawning pressure

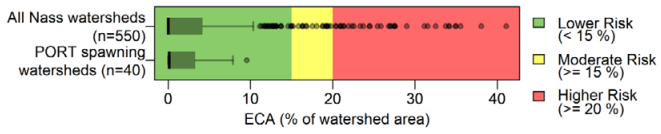
Hydrologic Processes

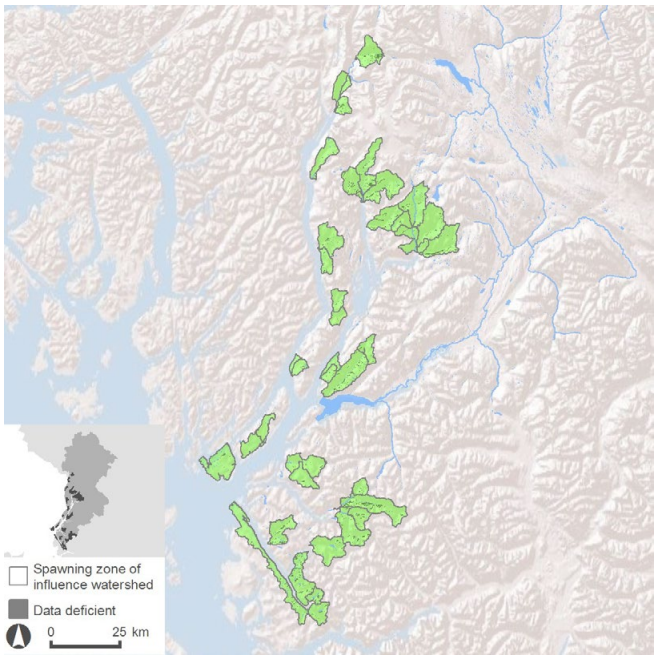
Forest disturbance





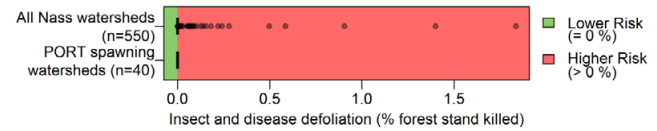
Equivalent Clear-cut Area

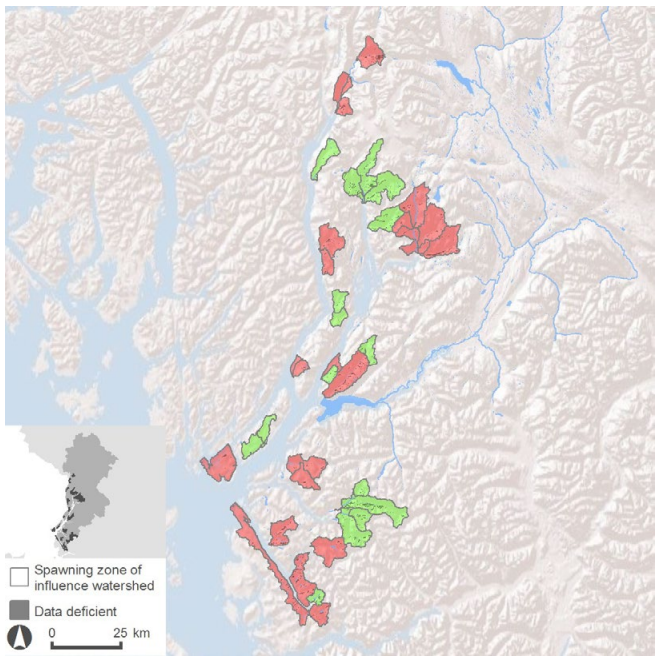




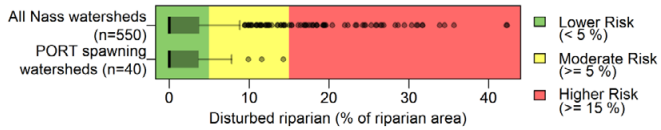
Vegetation Quality

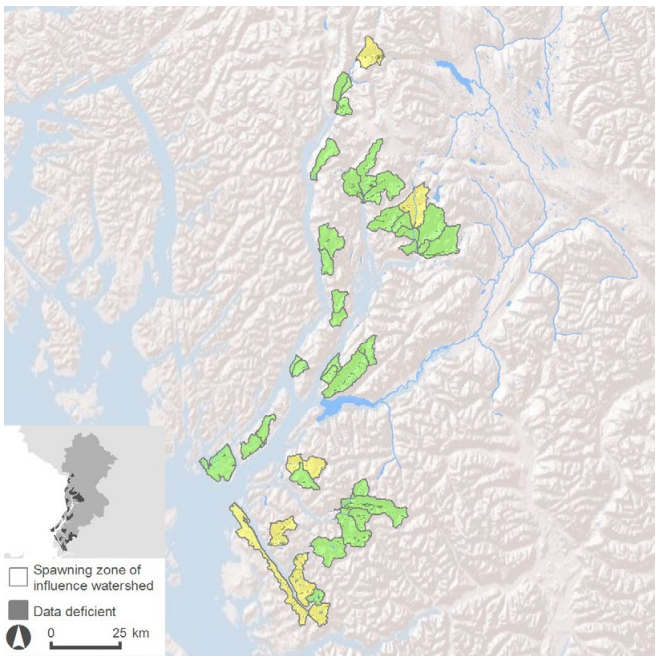
Insect and disease defoliation





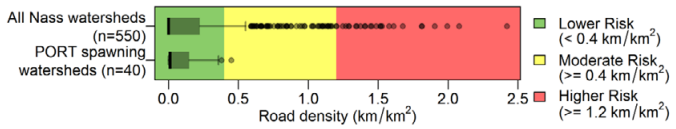
Riparian disturbance

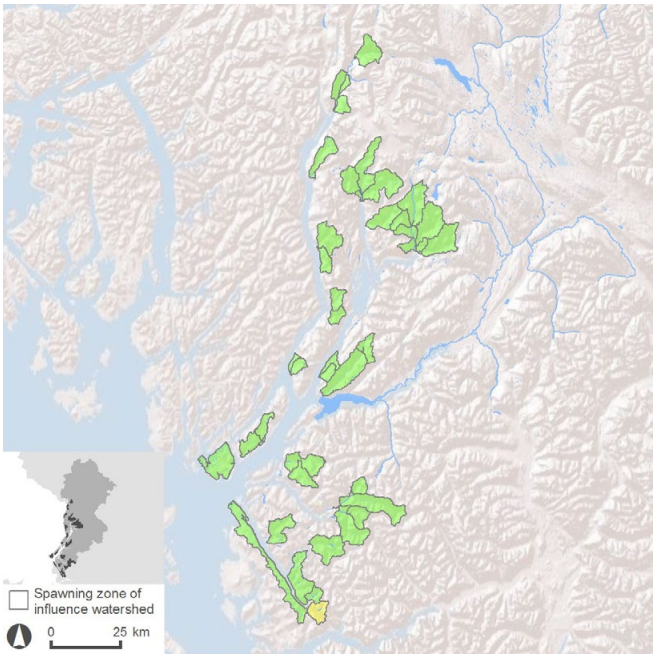




Surface Erosion

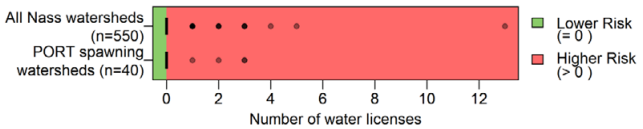
Road development

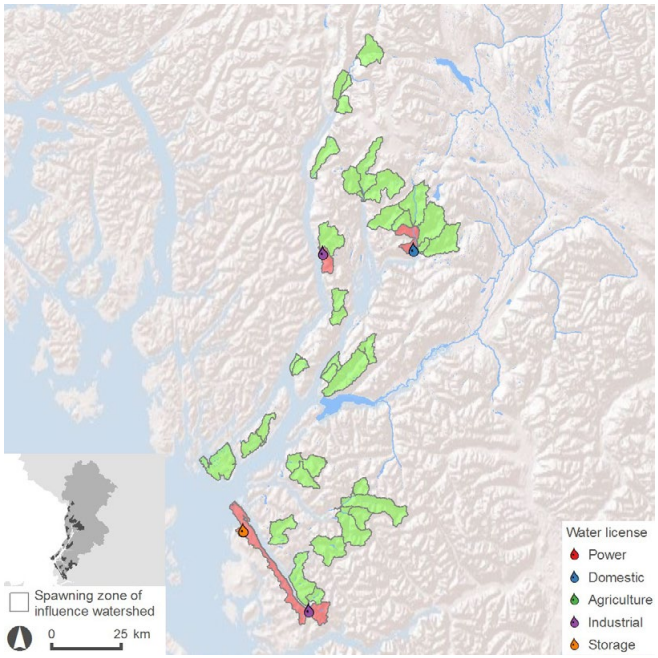




Water Quantity

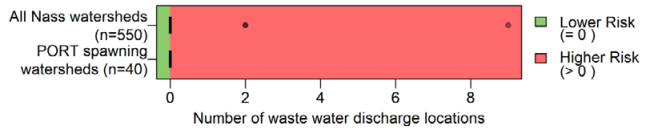
Number of water licenses

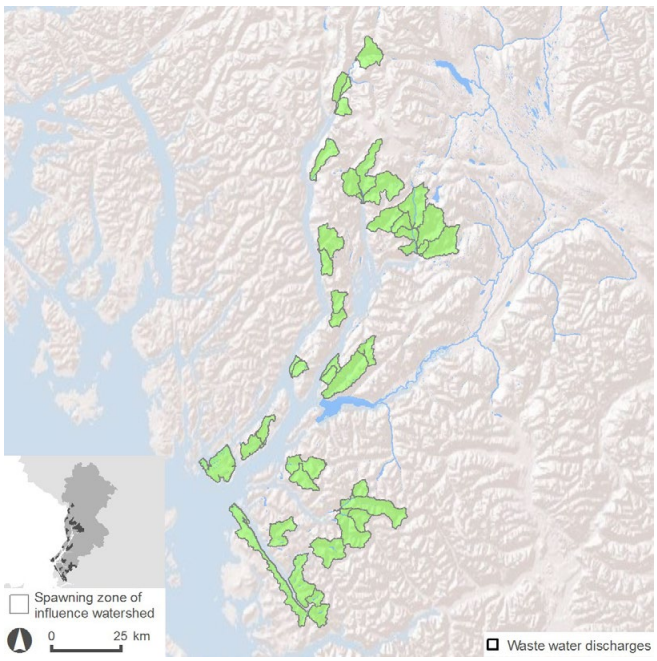




Water Quality

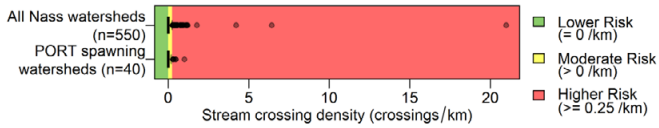
Permitted waste water discharges

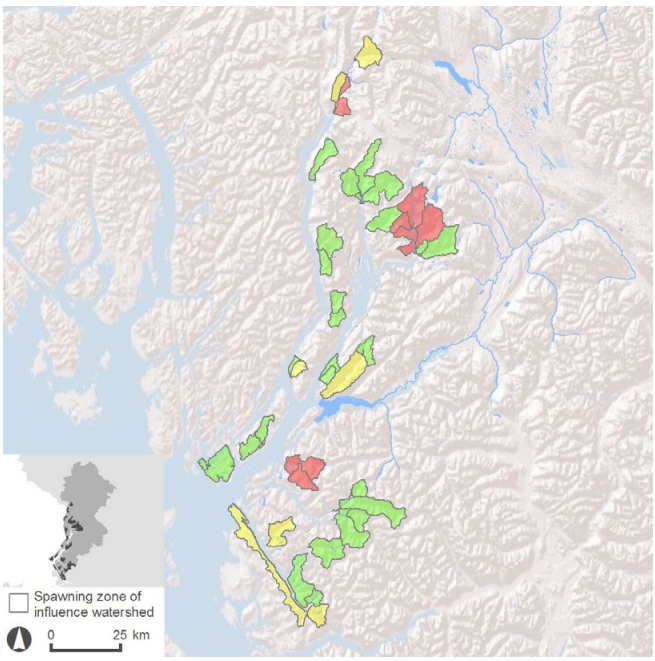




Fish Passage/Habitat Connectivity

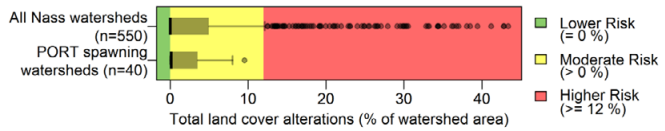
Stream crossing density

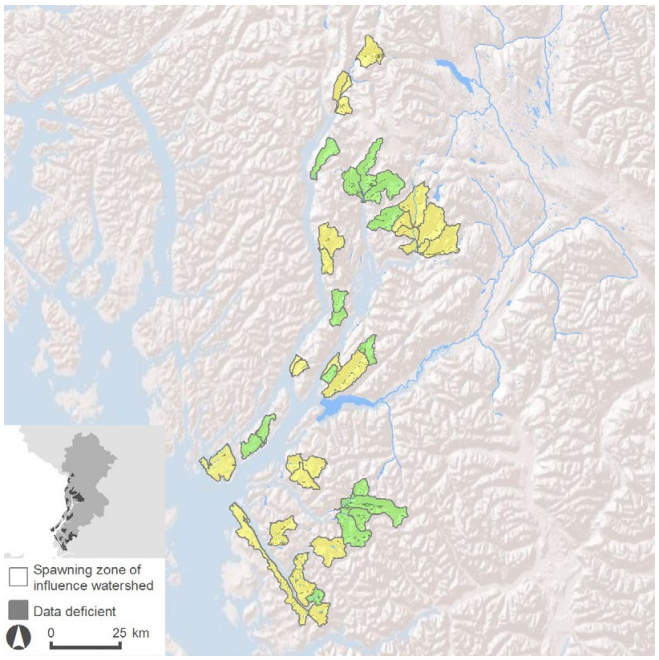




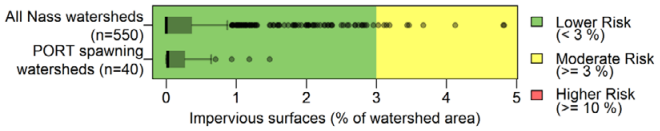
Human Development Footprint

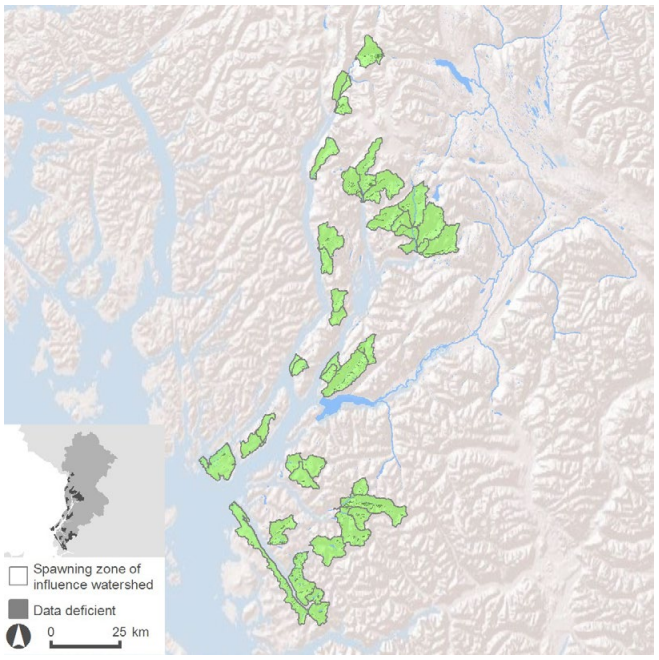
Total land cover alteration



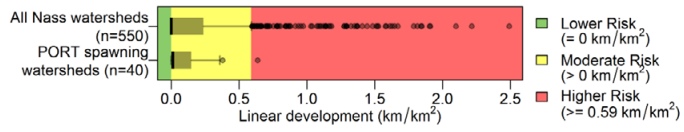


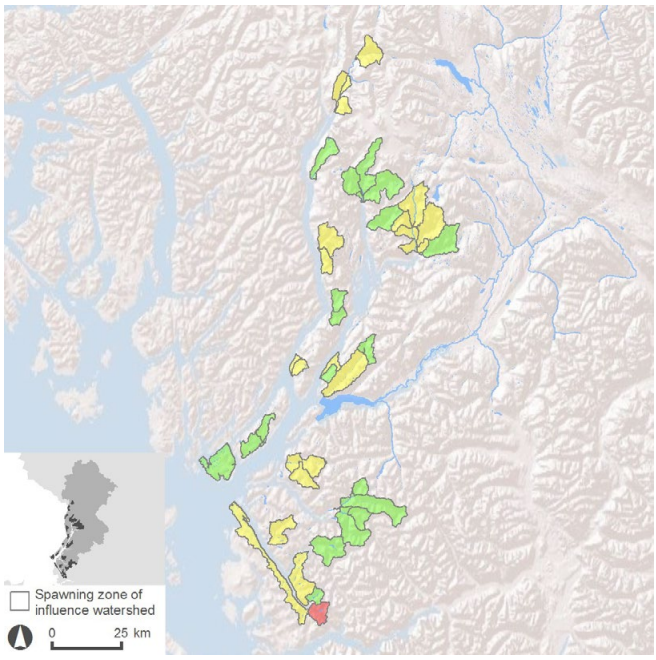
Impervious surfaces



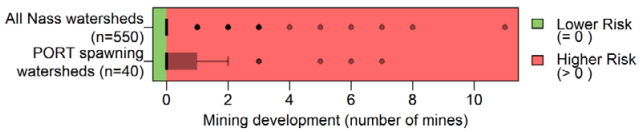


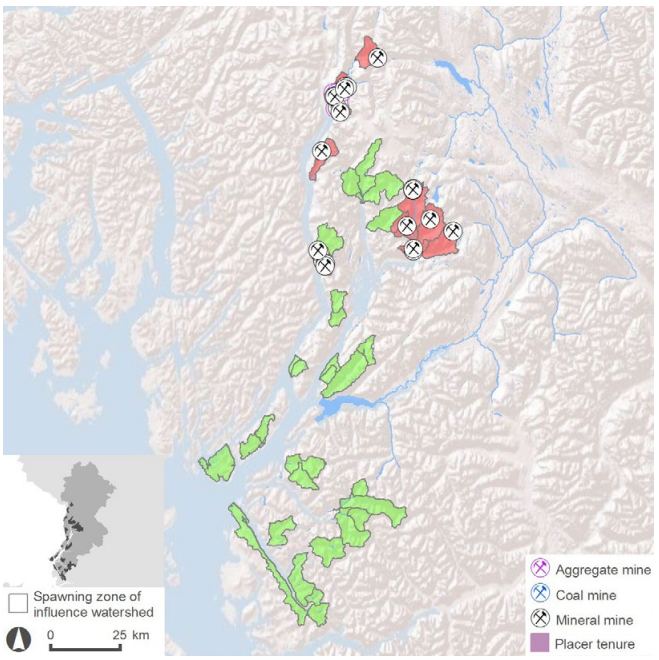
Linear development





Mining development (total number of mines)

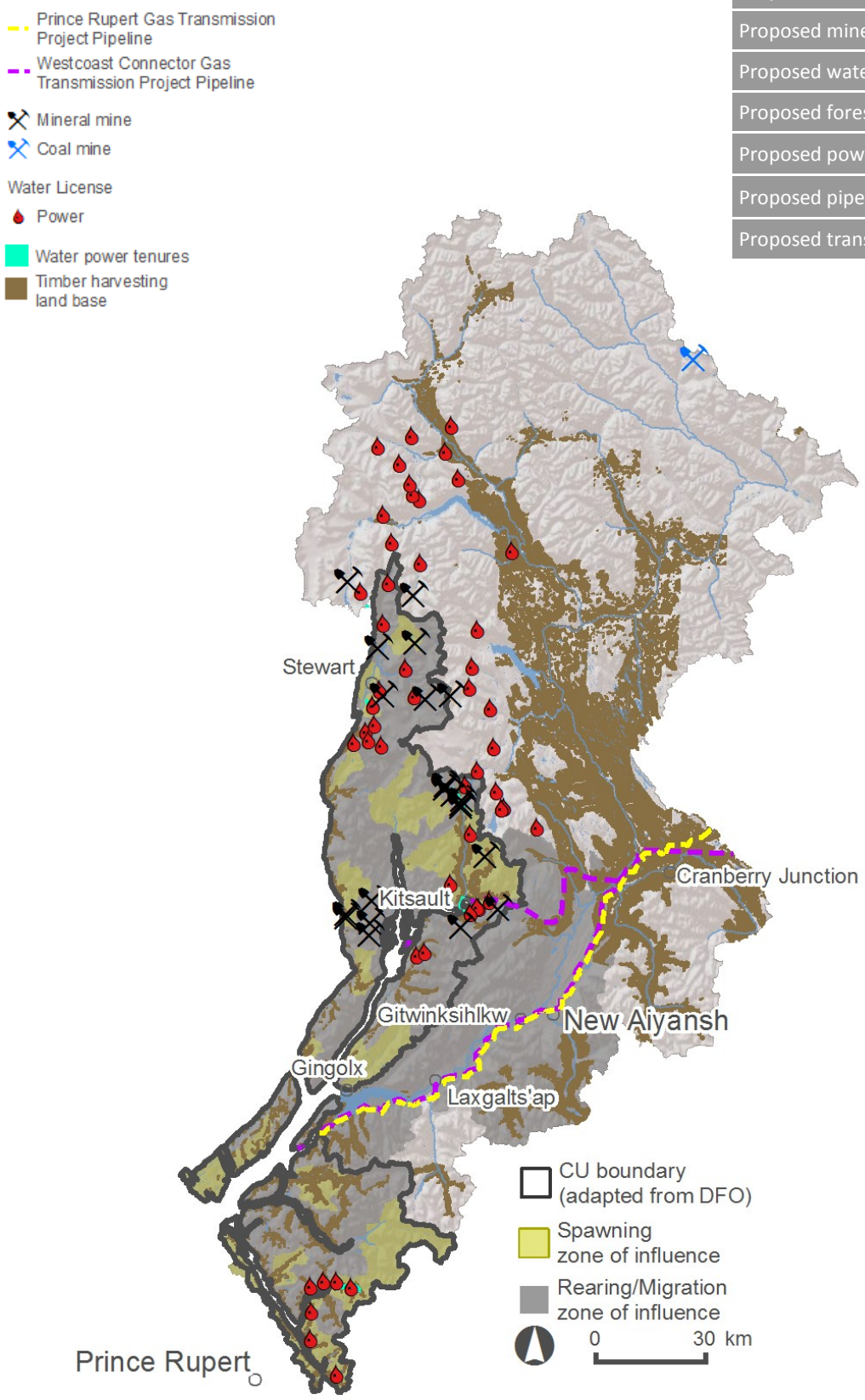




Future pressure

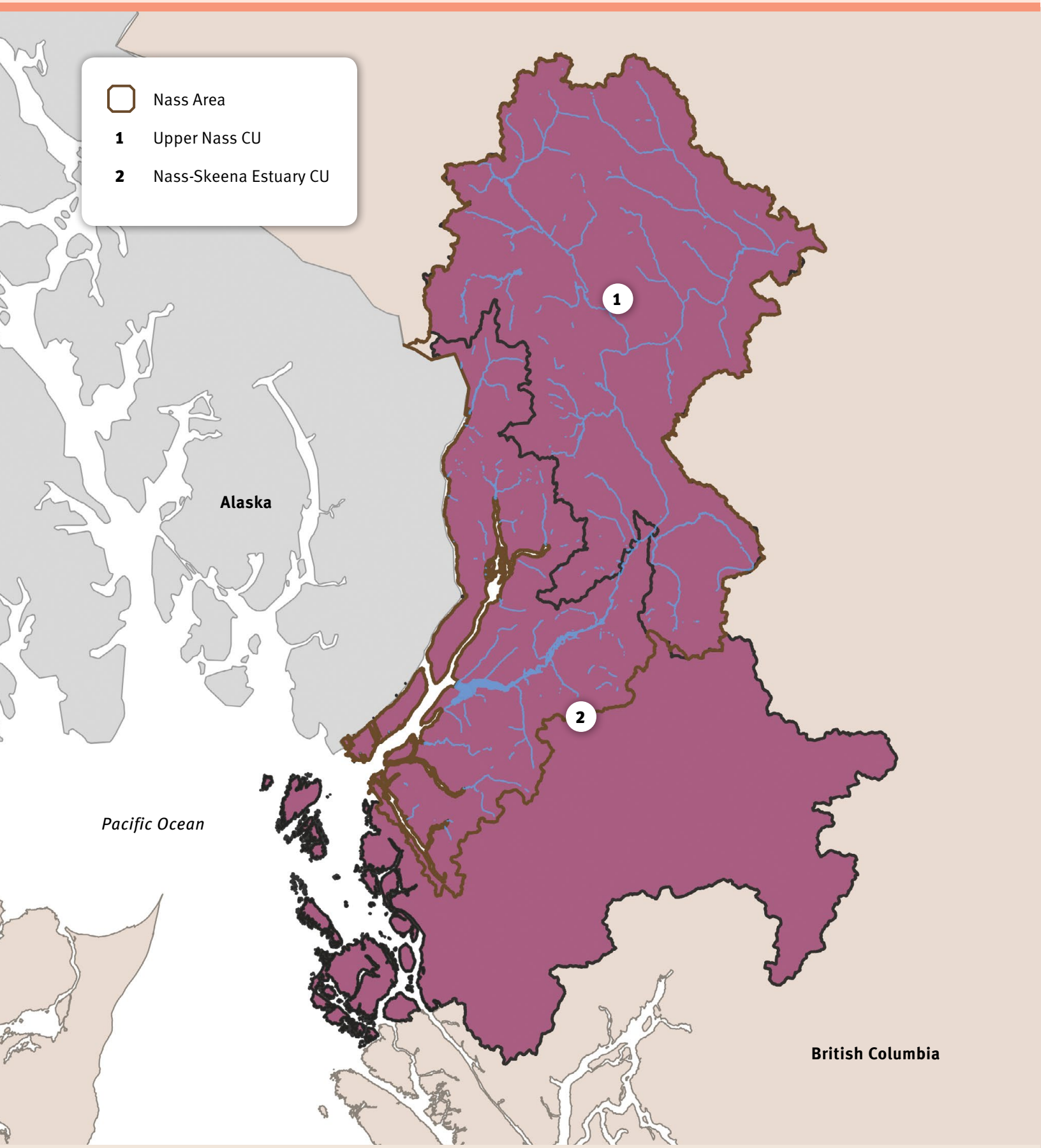
Proposed resource development projects (as of 2016)

Nass Drainage Summary	
	Totals
Proposed coal mines (#)	1
Proposed mineral mines (#)	22
Proposed water licenses (#)	58
Proposed forestry (km^2)	3,323 km^2
Proposed power tenures	Wind 0 km^2, water 15 km^2
Proposed pipelines (km)	386 km
Proposed transmission lines	0 km

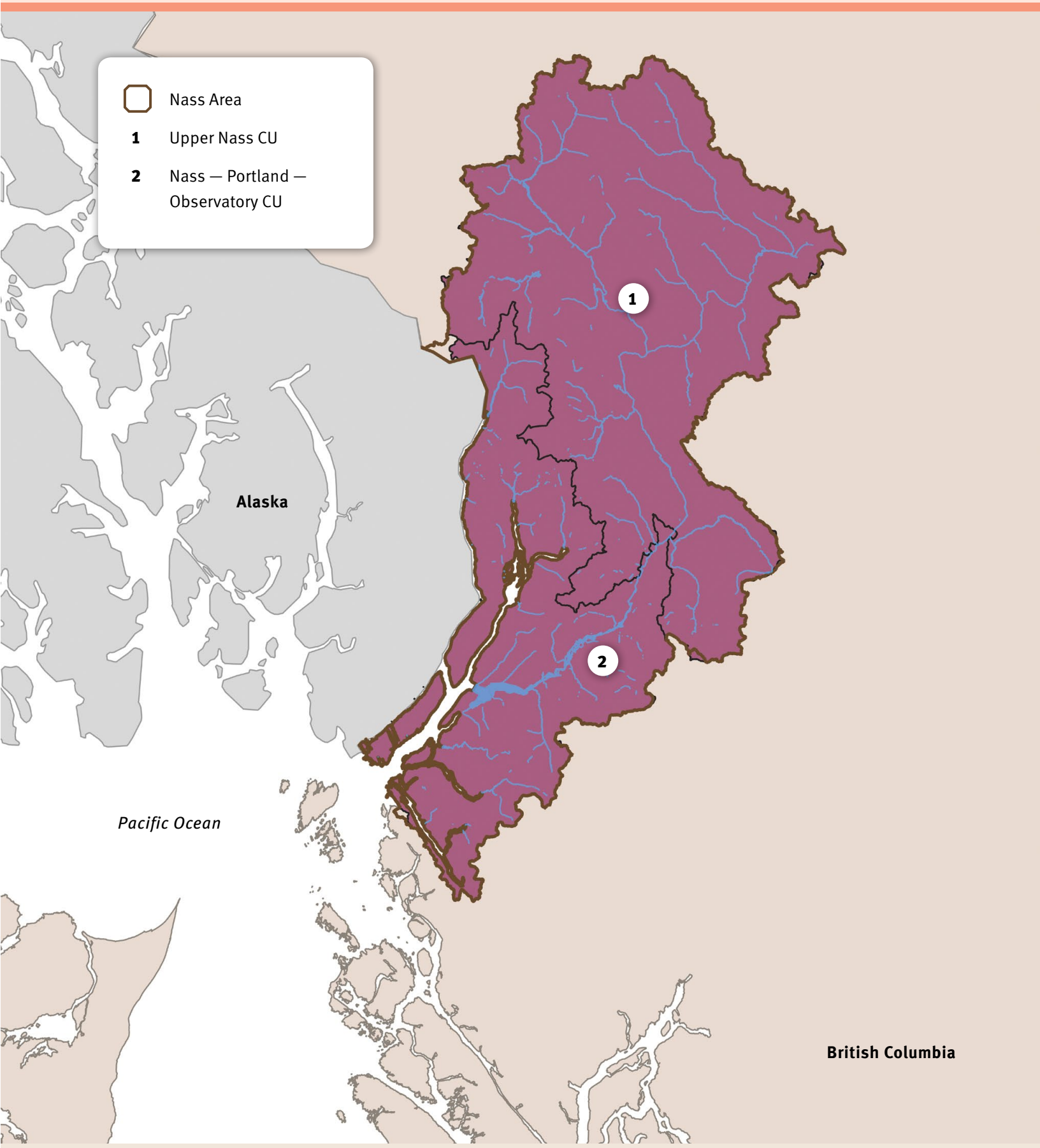


Pink

Pink (even): Map of Conservation Units (CUs)



Pink (odd): Map of Conservation Units (CUs)



Pink: Even-Year Upper Nass

Introduction

This project summarizes pressures on the habitat used by Nass salmon Conservation Units (CU) during their freshwater life history stages (migration, spawning and rearing), as well as their relative vulnerability to those pressures. For an explanation of the indicators shown here, please see the accompanying *Report Card Summaries*. Full methods and results can be found in the main report, *Cumulative Pressures on Nass Salmon Habitat: Technical Report* (2016).

Definitions

Conservation Unit (CU): A group of wild salmon sufficiently isolated from other groups that, if extirpated, is very unlikely to re-colonize naturally within an acceptable timeframe.

Pressure indicator: Measurable extent/intensity of natural processes or human activities that can induce changes in habitat condition/state.

Vulnerability indicator: Measures of habitat quantity or quality used to represent the intrinsic habitat vulnerability/sensitivity to watershed disturbances for each life-stage.

Zone of influence (ZOI): Areas adjacent to and upstream/upslope of habitats used by salmon CUs that represent the geographic extent for capture/measurement of pressure and vulnerability indicators.

Status: Condition of habitat relative to a defined indicator benchmark.

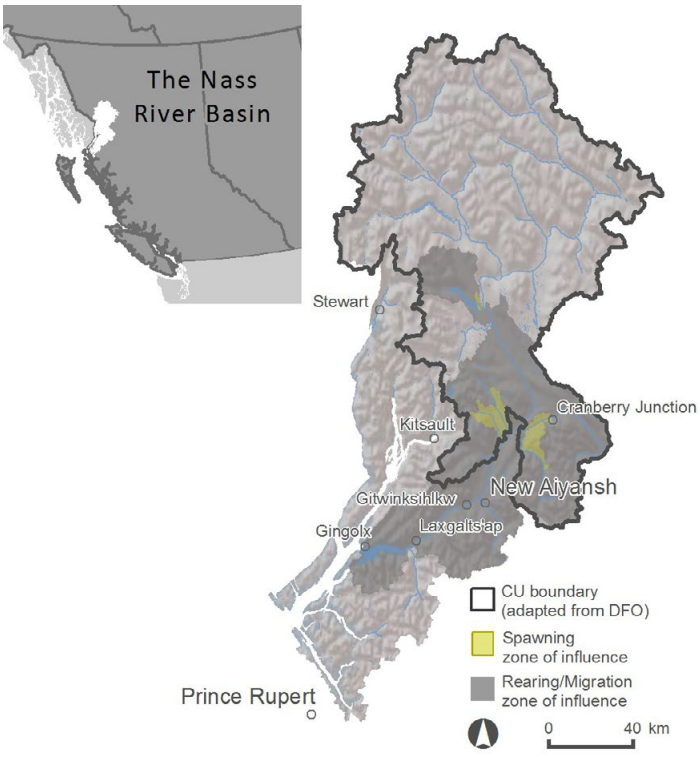
Risk: Likelihood of adverse effects to salmon habitats within a defined zone of influence. Levels of increasing risk are defined based on the extent/intensity of impacts relative to defined benchmarks of concern.

Benchmark: A standard (quantified metric) against which habitat condition can be measured or judged, and by which status can be compared over time and space to determine the risk of adverse effects.

Narrative

- There are four pink salmon CUs found in the Nass Area: 1) Even-Year Nass-Skeena Estuary (NSKEst), 2) Even-Year Upper Nass (UNASS-Even), 3) Odd-Year Upper Nass (UNASS-Odd), and 4) Odd-Year Nass-Portland-Observatory (NR-PORT-OBS). There are over 80 discrete spawning populations across all four CUs.
- Nass Area pink salmon have a fixed, two-year lifespan, most of which is spent in the ocean as pink salmon begin their migration to the ocean immediately after they emerge from the gravel as fry.
- While variable across river systems, Nass Area pink salmon tend to be dominant on the odd-year cycle, although in recent years (post 2009) the odd-year dominance has become less pronounced.

Location



Summary of habitat vulnerabilities & pressures

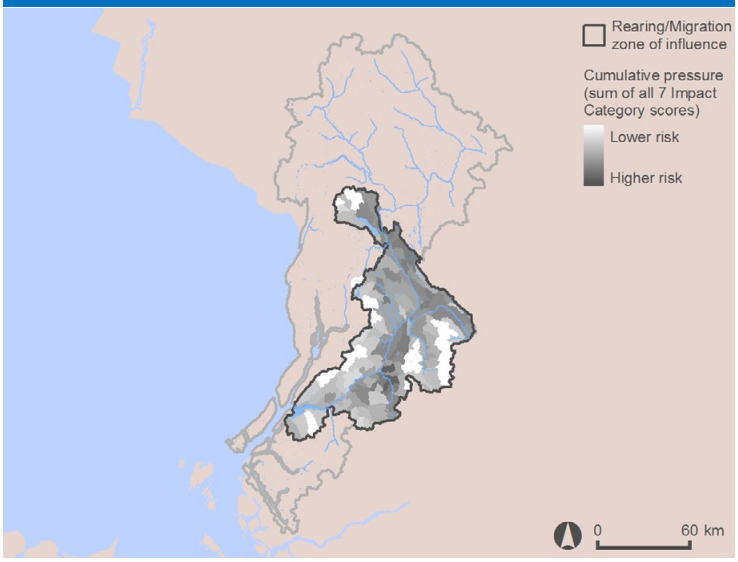
Pressure indicators were grouped into seven relatively independent habitat "impact categories" representing key factors affecting general watershed condition:

- Hydrologic Processes (Forest disturbance; Equivalent Clearcut Area)
- Vegetation Quality (Insect and disease defoliation; Riparian disturbance)
- Surface Erosion (Road development)
- Fish passage/Habitat connectivity (Stream crossing density)
- Water quantity (Water licenses)
- Human development footprint (Total land cover alteration; Impervious surfaces; Linear development; Mining development)
- Water quality (Wastewater discharges)

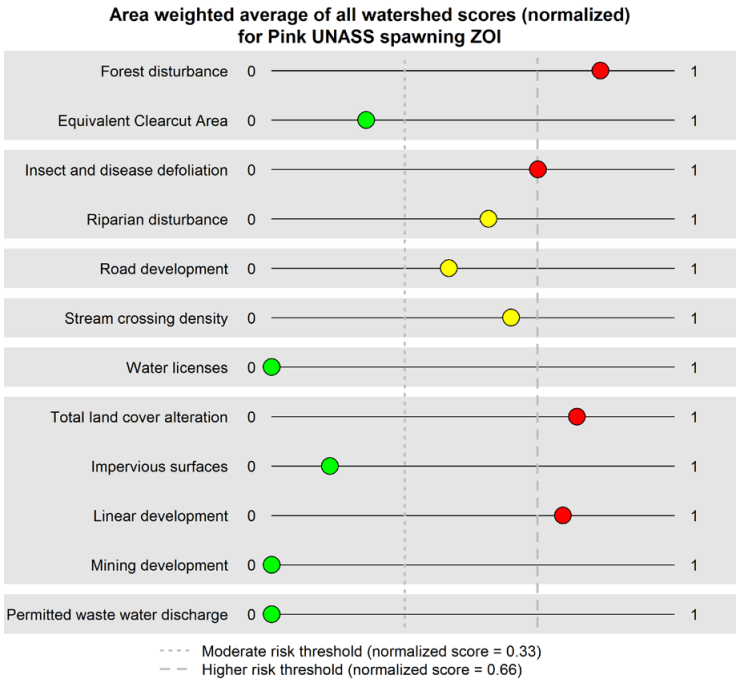
Indicators were also developed reflecting relative vulnerability to habitat pressures within the life stage-specific "zones of influence" defined for each CU:

- Rearing/Migration ZOI: Accessible stream length; Length and percentage of accessible streams considered flow sensitive - all seasons
- Spawning ZOI: Total spawning length; Length and percentage of spawning reaches considered flow sensitive (summer period - spawning, winter period - incubation)

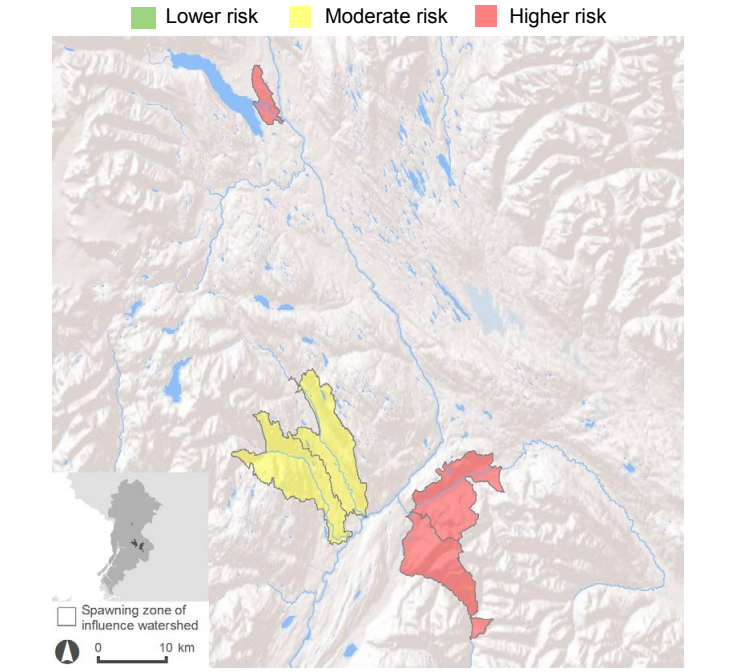
Cumulative pressure—rearing/migration



Summary of pressure indicators—spawning

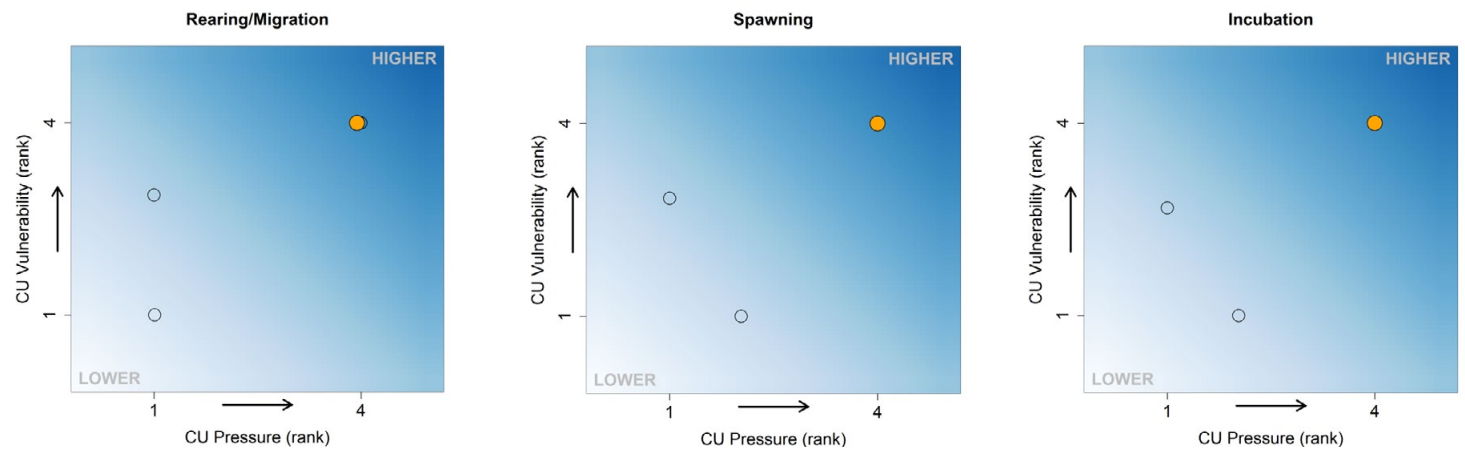


Cumulative pressure—spawning



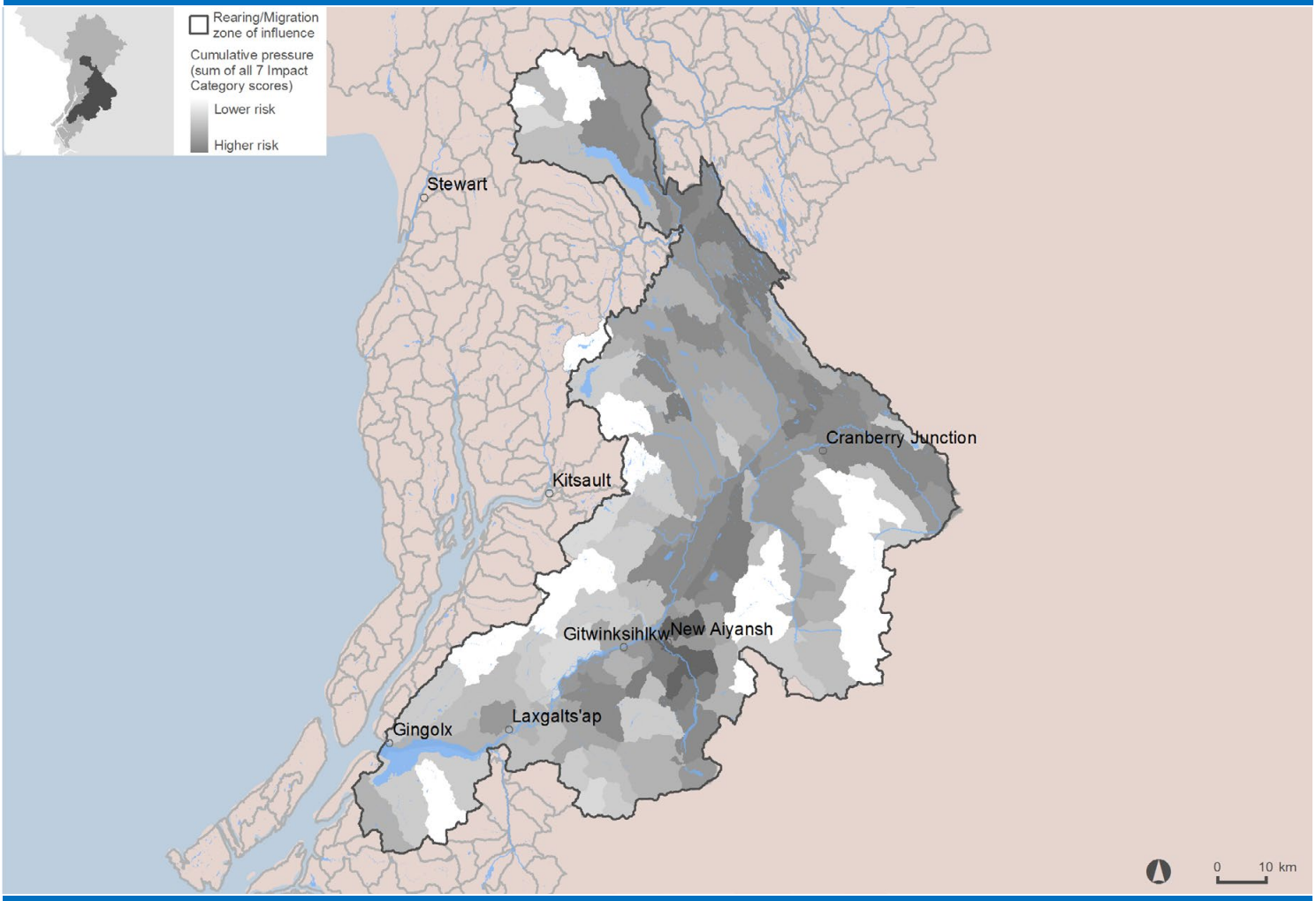
Integrated vulnerability/habitat pressures—rearing/migration, spawning, & incubation

● = Upper Nass ○ = other Pink CUs



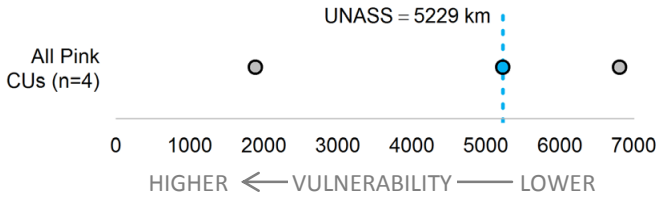
Rearing/Migration vulnerability & pressure

Rearing/Migration period pressures



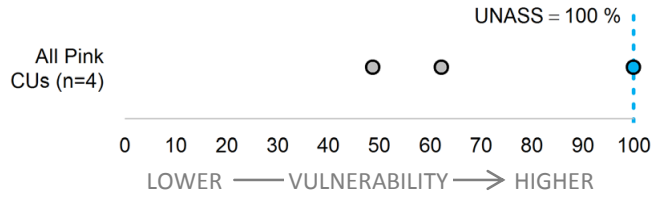
Rearing/Migration period vulnerability

Salmon accessible habitat (km)



Flow sensitive accessible habitat (km) (all seasons)

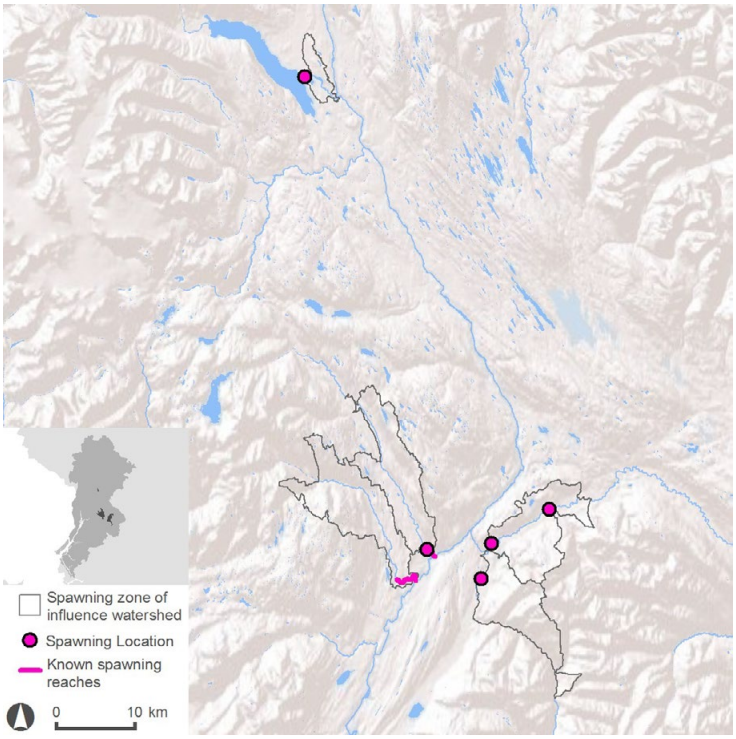
Flow sensitive accessible habitat (%) (all seasons)



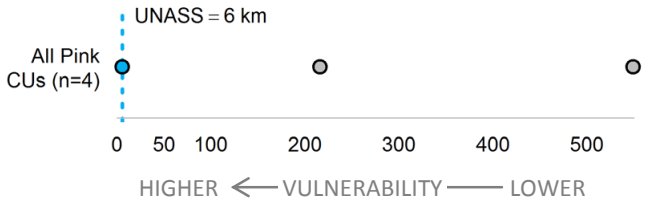
Spawning & incubation vulnerability

Spawning period vulnerability

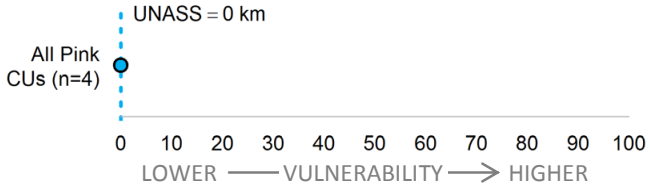
Spawning locations



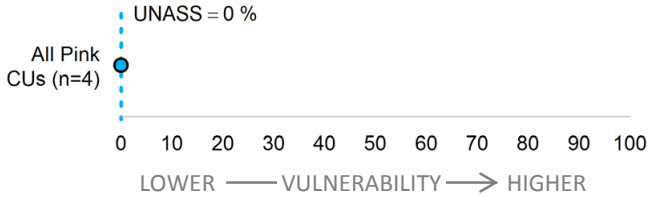
Total spawning length (km)



Spawning reaches summer flow sensitive - spawn timing (km)

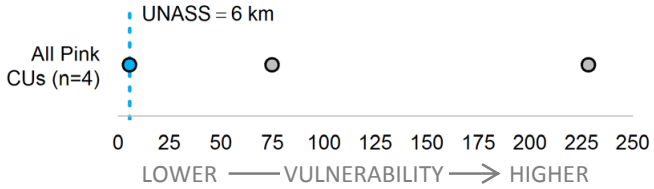


Spawning reaches summer flow sensitive - spawn timing (%)



Incubation period vulnerability

Spawning reaches winter flow sensitive - incubation timing (km)

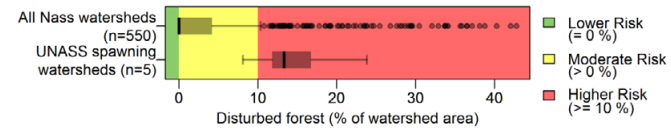


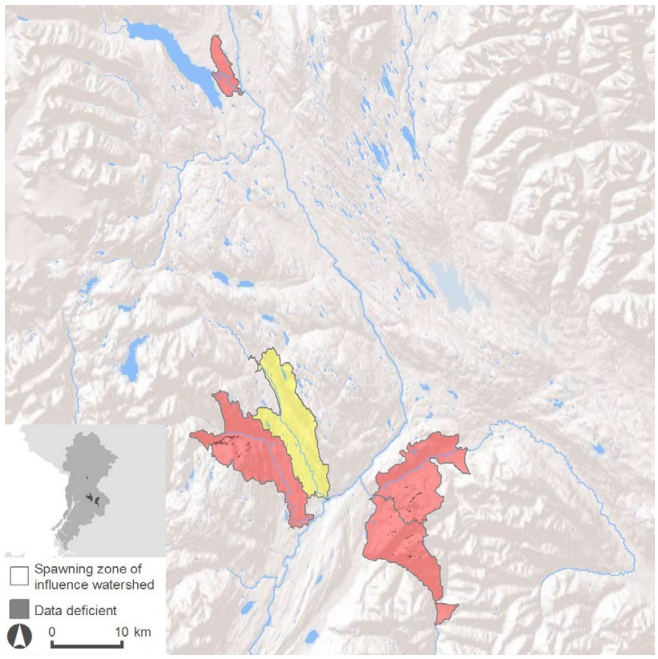
Spawning reaches winter flow sensitive - incubation timing (%)

Spawning pressure

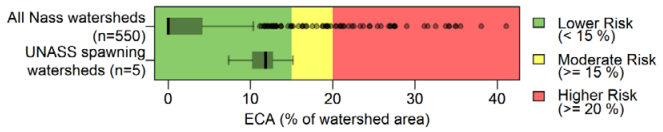
Hydrologic Processes

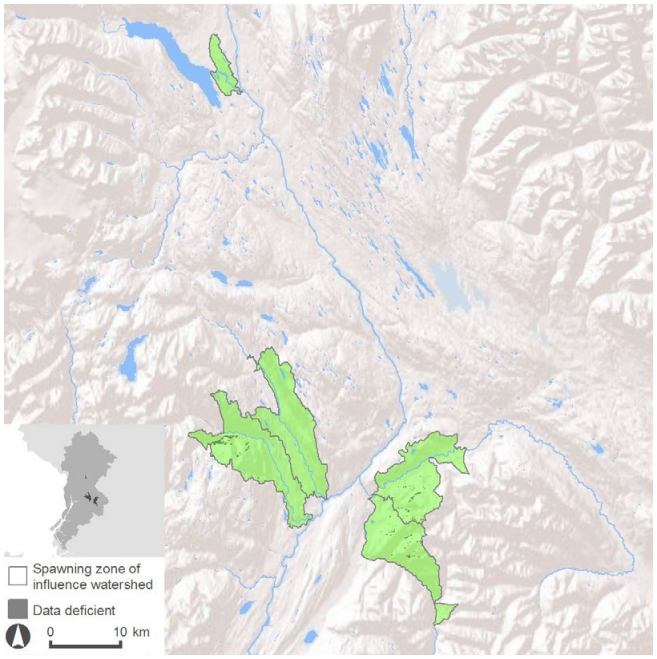
Forest disturbance





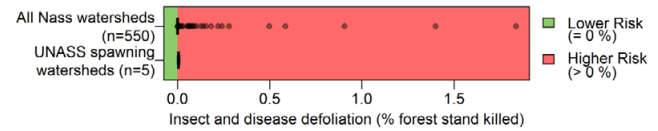
Equivalent Clear-cut Area

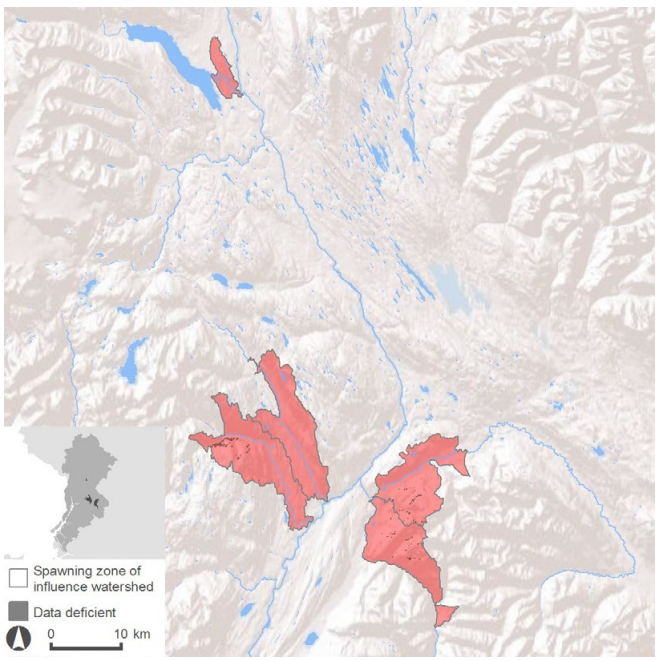




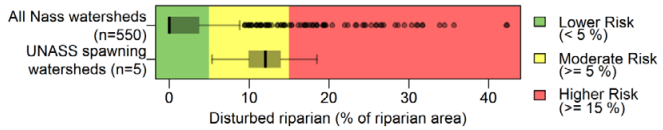
Vegetation Quality

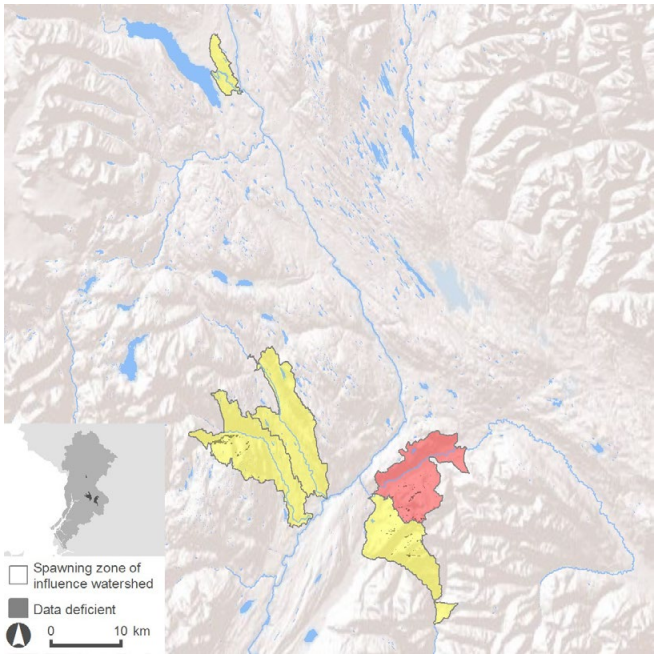
Insect and disease defoliation





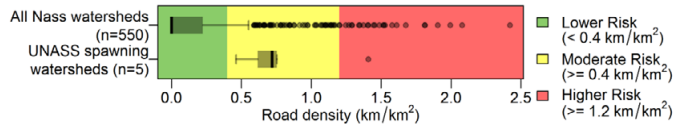
Riparian disturbance

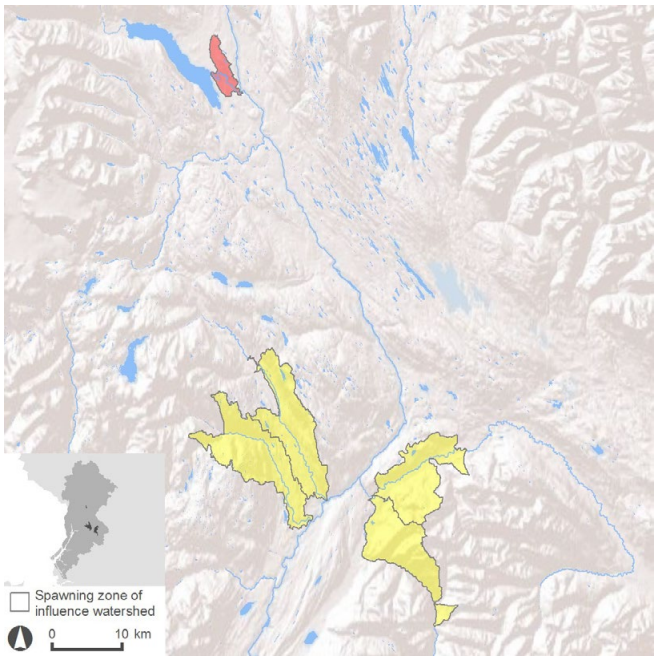




Surface Erosion

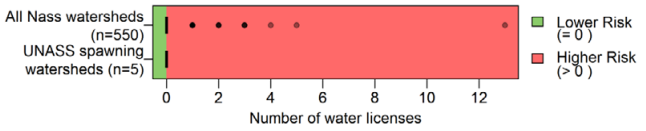
Road development

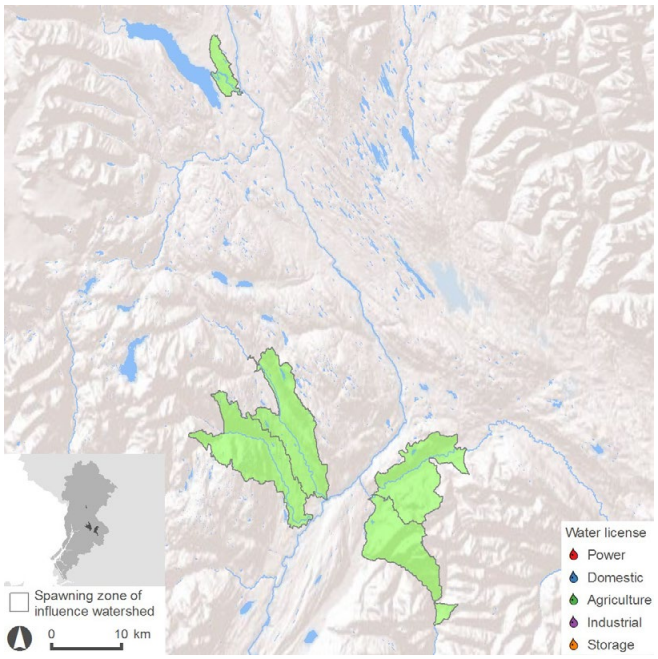




Water Quantity

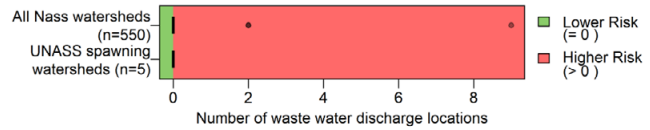
Number of water licenses

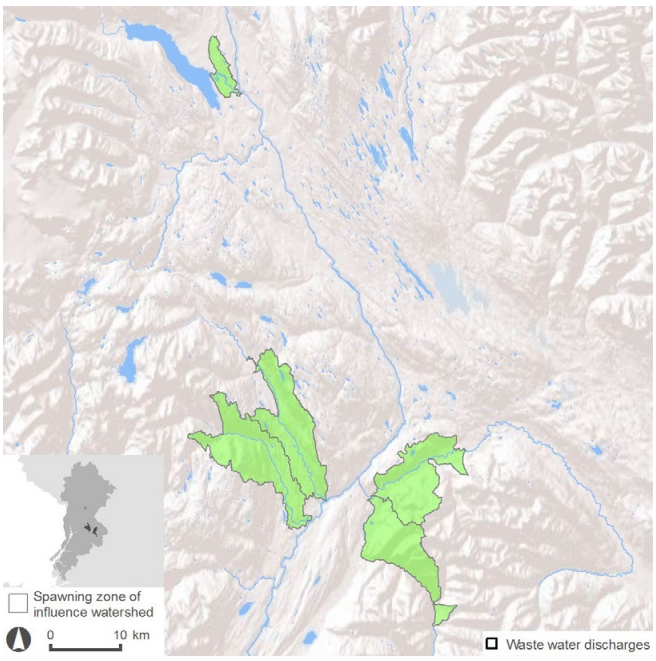




Water Quality

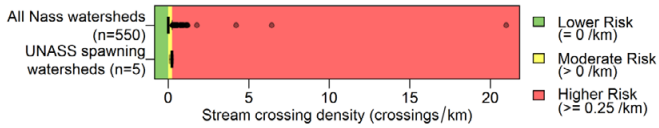
Permitted waste water discharges

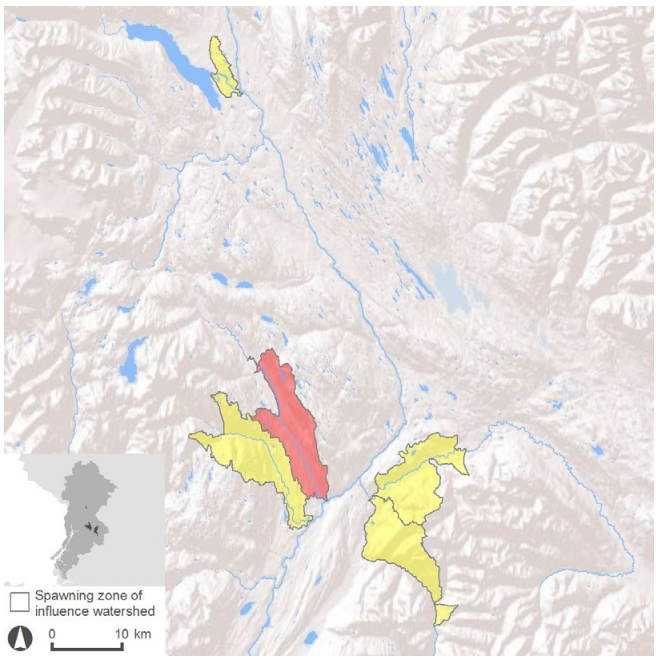




Fish Passage/Habitat Connectivity

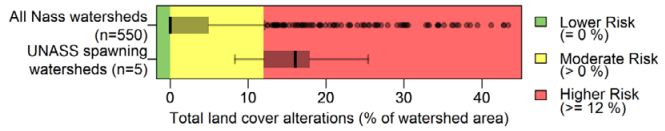
Stream crossing density

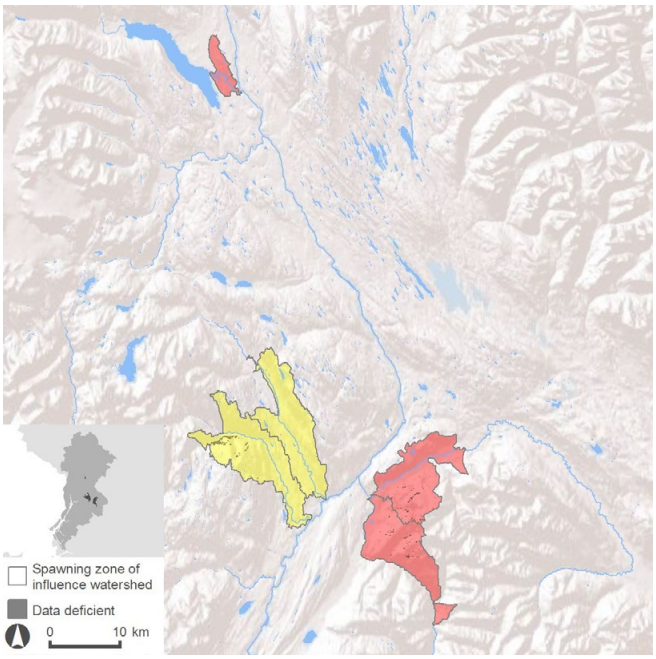




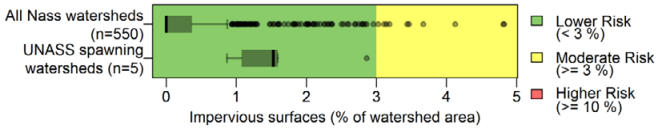
Human Development Footprint

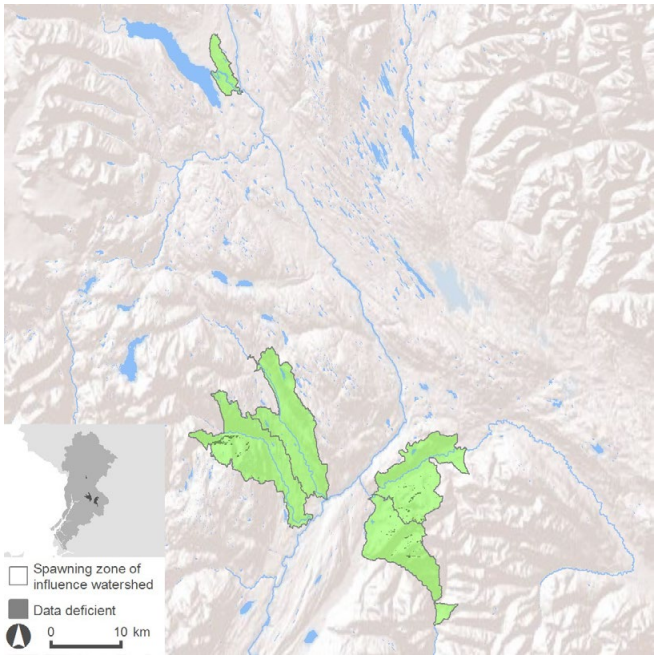
Total land cover alteration



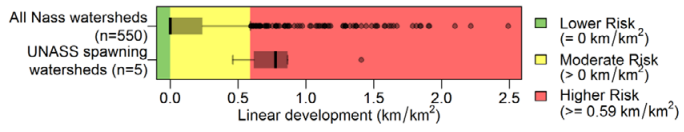


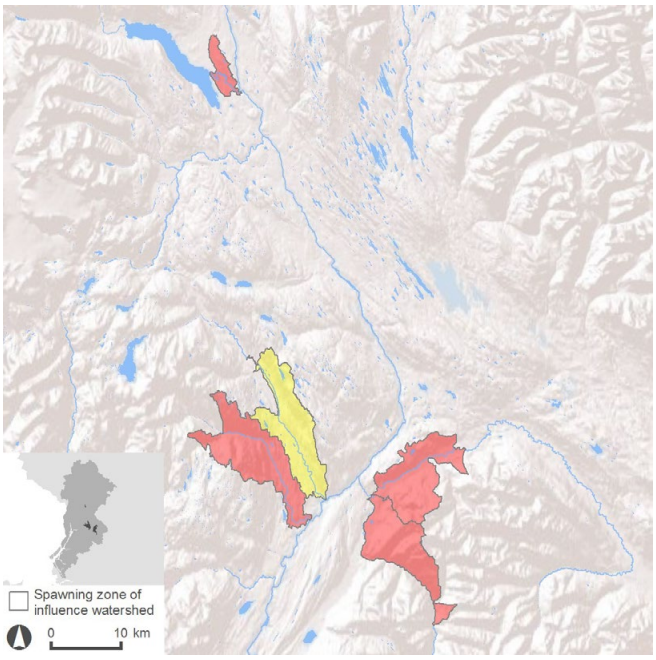
Impervious surfaces



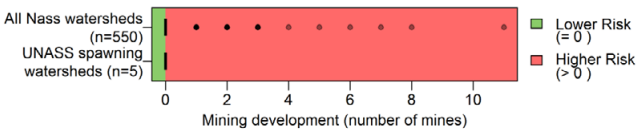


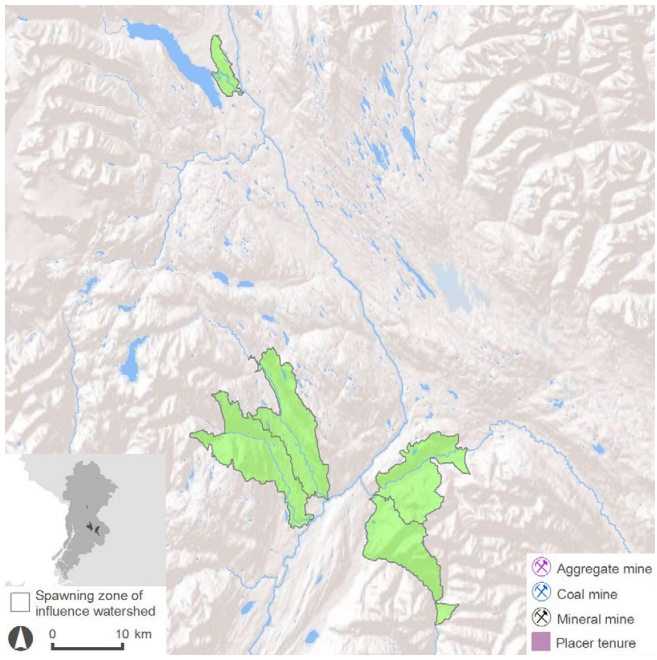
Linear development





Mining development (total number of mines)

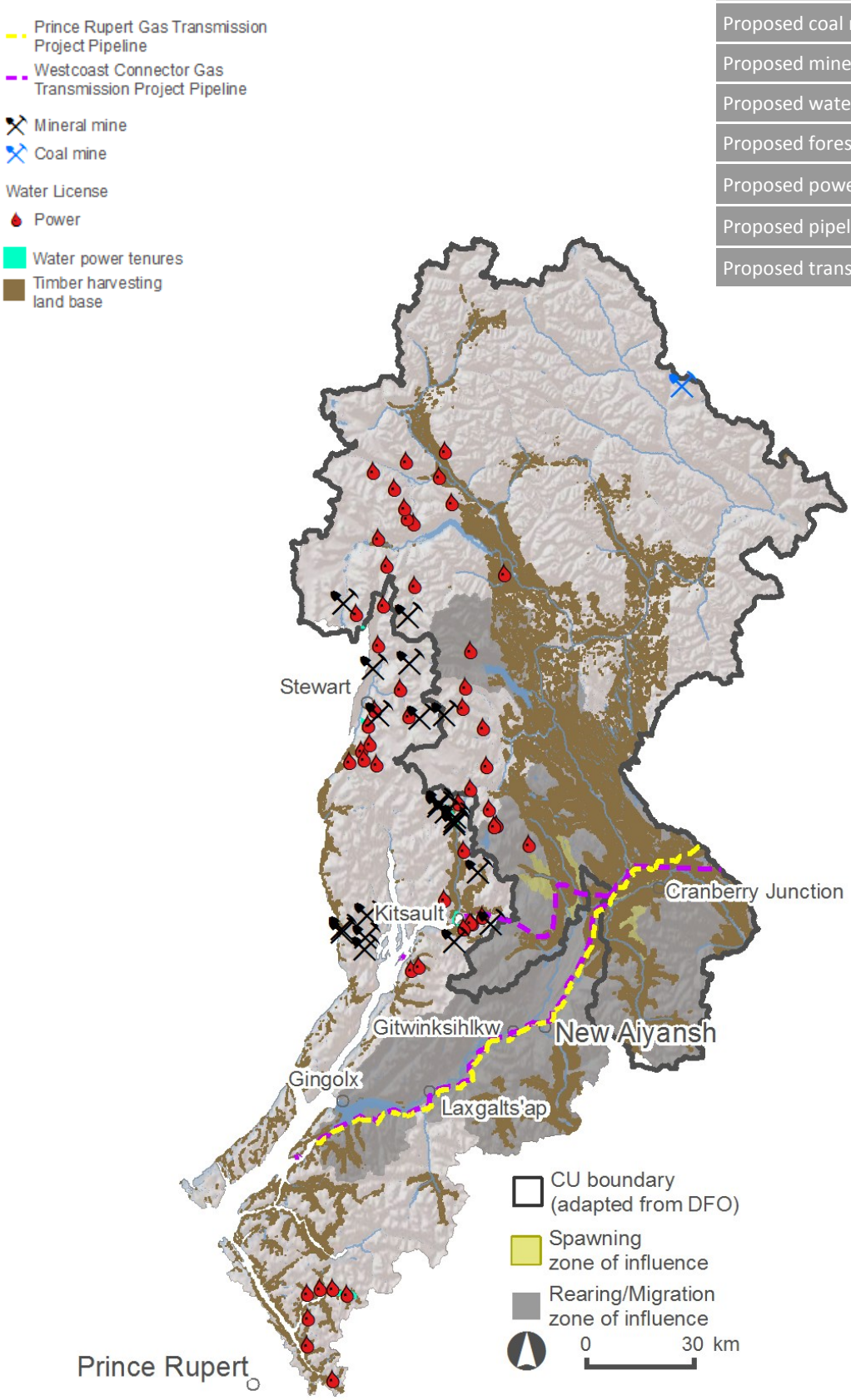




Future pressure

Proposed resource development projects (as of 2016)

Nass Drainage Summary	
	Totals
Proposed coal mines (#)	1
Proposed mineral mines (#)	22
Proposed water licenses (#)	58
Proposed forestry (km^2)	3,323 km^2
Proposed power tenures	Wind 0 km^2, water 15 km^2
Proposed pipelines (km)	386 km
Proposed transmission lines	0 km



Pink: Even-Year Nass-Skeena Estuary

Introduction

This project summarizes pressures on the habitat used by Nass salmon Conservation Units (CU) during their freshwater life history stages (migration, spawning and rearing), as well as their relative vulnerability to those pressures. For an explanation of the indicators shown here, please see the accompanying *Report Card Summaries*. Full methods and results can be found in the main report, *Cumulative Pressures on Nass Salmon Habitat: Technical Report* (2016).

Definitions

Conservation Unit (CU): A group of wild salmon sufficiently isolated from other groups that, if extirpated, is very unlikely to re-colonize naturally within an acceptable timeframe.

Pressure indicator: Measurable extent/intensity of natural processes or human activities that can induce changes in habitat condition/state.

Vulnerability indicator: Measures of habitat quantity or quality used to represent the intrinsic habitat vulnerability/sensitivity to watershed disturbances for each life-stage.

Zone of influence (ZOI): Areas adjacent to and upstream/upslope of habitats used by salmon CUs that represent the geographic extent for capture/measurement of pressure and vulnerability indicators.

Status: Condition of habitat relative to a defined indicator benchmark.

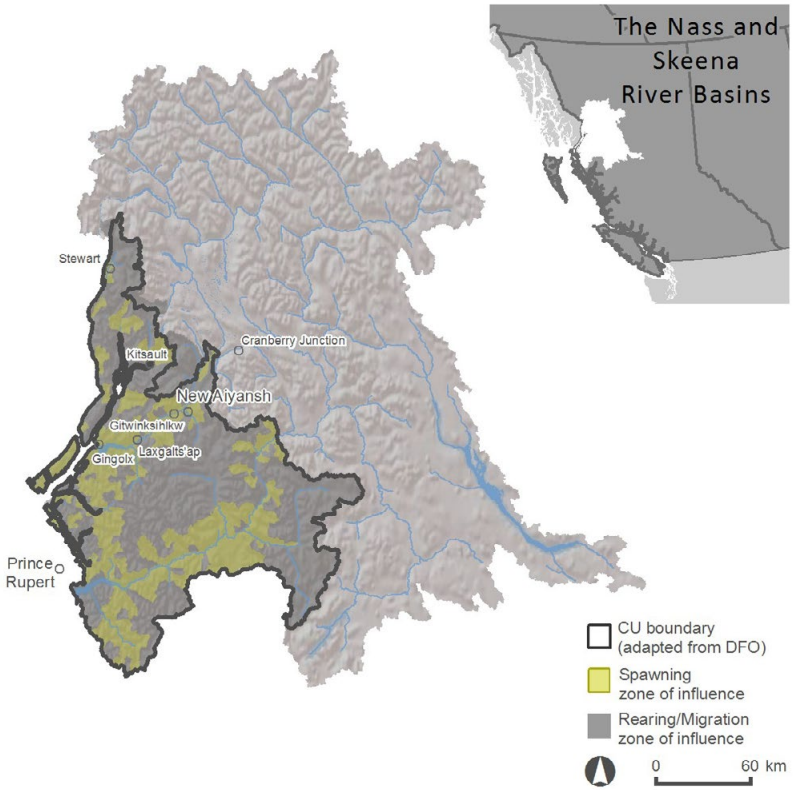
Risk: Likelihood of adverse effects to salmon habitats within a defined zone of influence. Levels of increasing risk are defined based on the extent/intensity of impacts relative to defined benchmarks of concern.

Benchmark: A standard (quantified metric) against which habitat condition can be measured or judged, and by which status can be compared over time and space to determine the risk of adverse effects.

Narrative

- There are four pink salmon CUs found in the Nass Area: 1) Even-Year Nass-Skeena Estuary (NSKEst), 2) Even-Year Upper Nass (UNASS-Even), 3) Odd-Year Upper Nass (UNASS-Odd), and 4) Odd-Year Nass-Portland-Observatory (NR-PORT-OBS). There are over 80 discrete spawning populations across all four CUs.
- The Nass-Skeena Estuary Pink (even) CU is characterized by coastal fjords with approximately 50% of the tributaries of the Nass and Skeena Rivers draining glaciers and icefields.
- Nass Area pink salmon have a fixed, two-year lifespan, most of which is spent in the ocean as pink salmon begin their migration to the ocean immediately after they emerge from the gravel as fry.
- While variable across river systems, Nass Area pink salmon tend to be dominant on the odd-year cycle, although in recent years (post 2009) the odd-year dominance has become less pronounced.

Location



Summary of habitat vulnerabilities & pressures

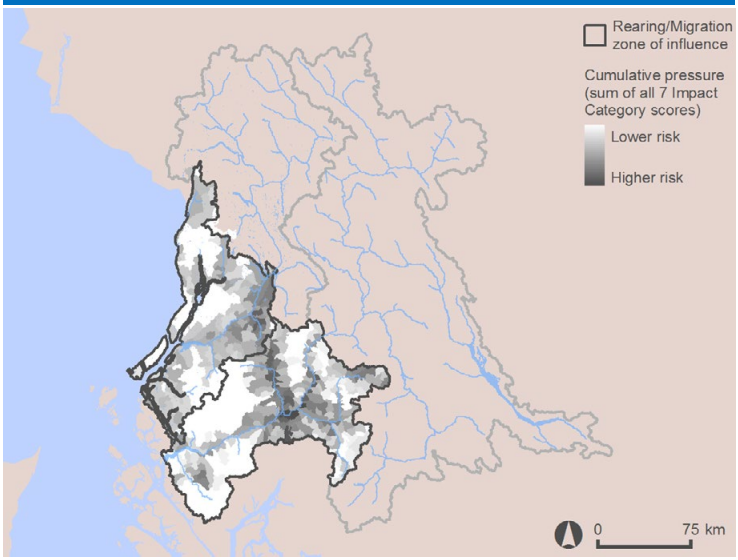
Pressure indicators were grouped into seven relatively independent habitat "impact categories" representing key factors affecting general watershed condition:

- Hydrologic Processes (Forest disturbance; Equivalent Clearcut Area)
- Vegetation Quality (Insect and disease defoliation; Riparian disturbance)
- Surface Erosion (Road development)
- Fish passage/Habitat connectivity (Stream crossing density)
- Water quantity (Water licenses)
- Human development footprint (Total land cover alteration; Impervious surfaces; Linear development; Mining development)
- Water quality (Wastewater discharges)

Indicators were also developed reflecting relative vulnerability to habitat pressures within the life stage-specific "zones of influence" defined for each CU:

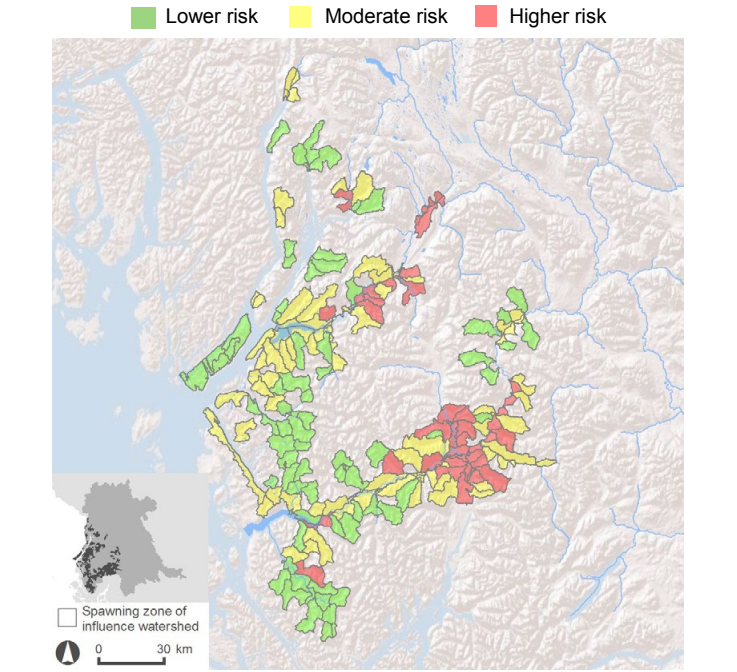
- Rearing/Migration ZOI: Accessible stream length; Length and percentage of accessible streams considered flow sensitive - all seasons
- Spawning ZOI: Total spawning length; Length and percentage of spawning reaches considered flow sensitive (summer period - spawning, winter period - incubation)

Cumulative pressure—rearing/migration



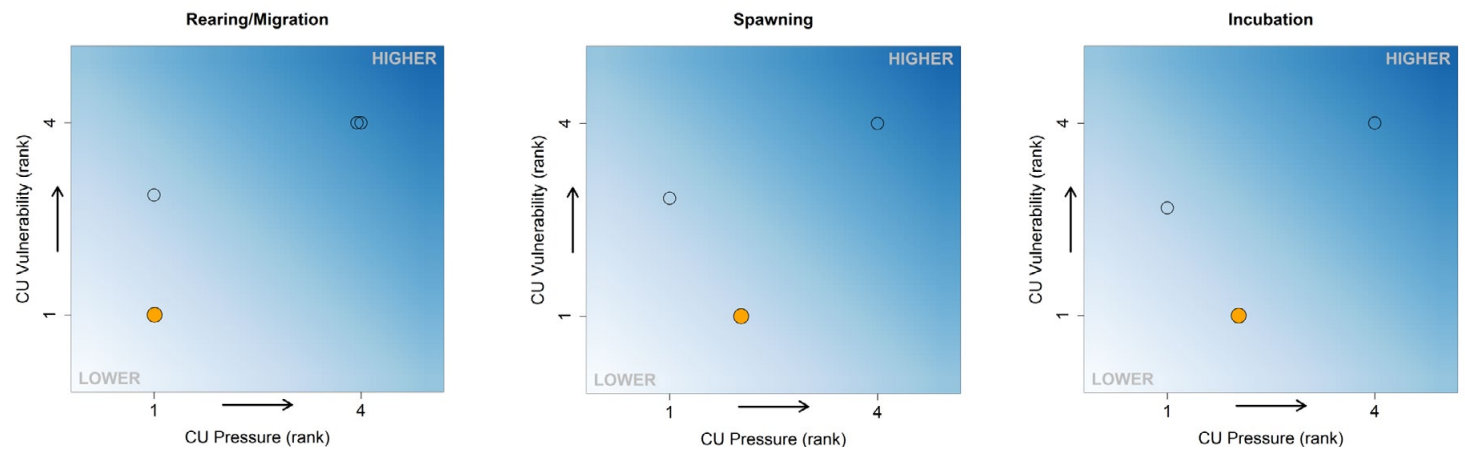
Summary of pressure indicators—spawning

Cumulative pressure—spawning



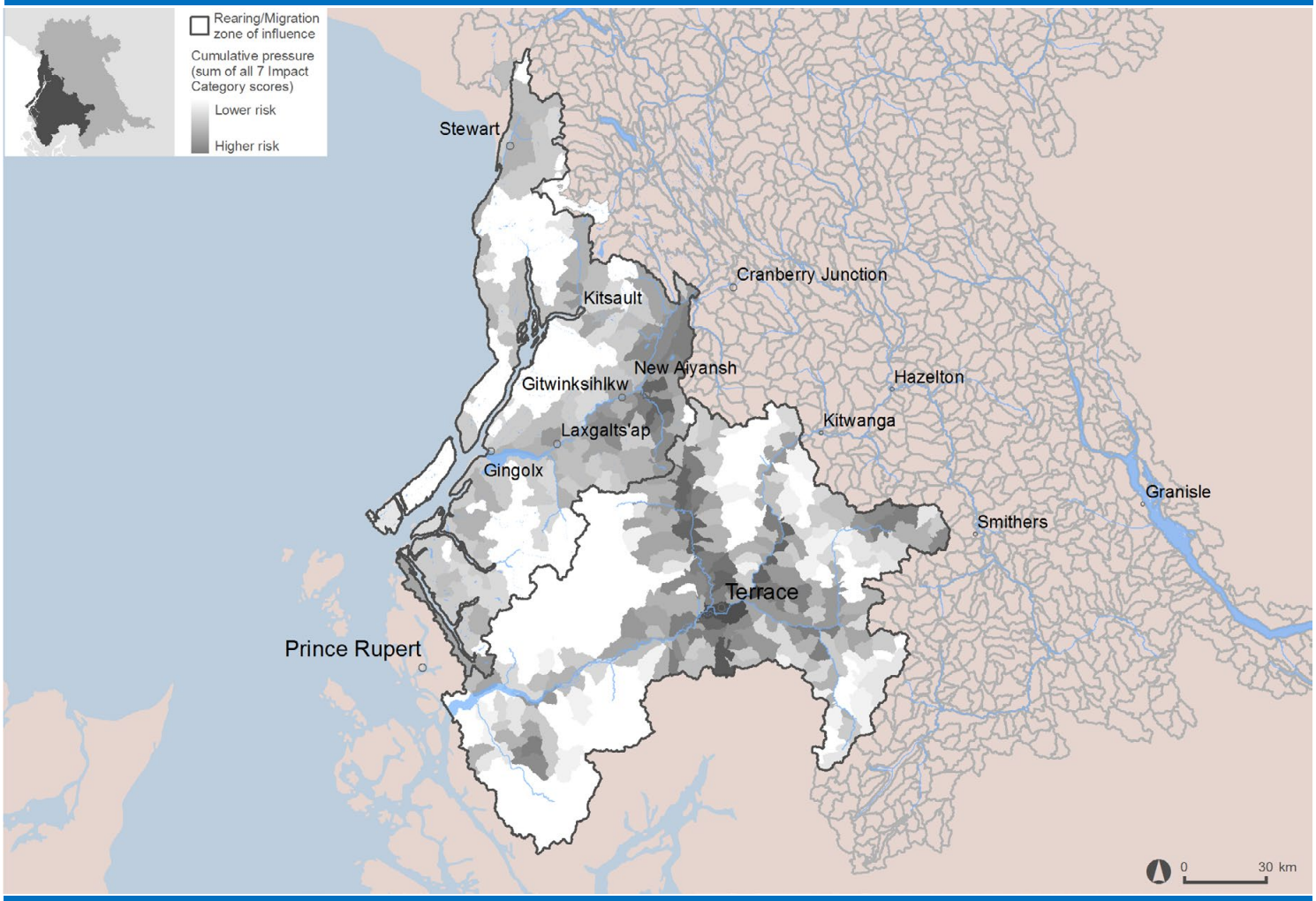
Integrated vulnerability/habitat pressures—rearing/migration, spawning, & incubation

● = Nass-Skeena Estuary ○ = other Pink CUs



Rearing/Migration vulnerability & pressure

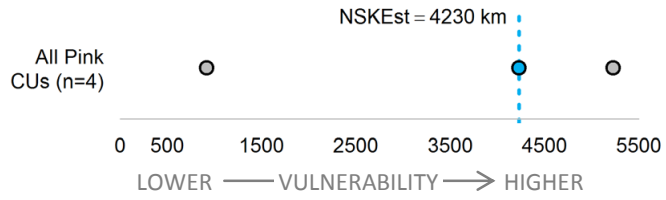
Rearing/Migration period pressures



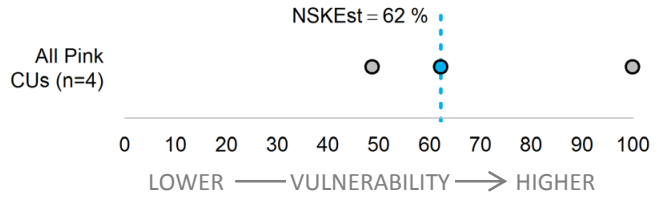
Rearing/Migration period vulnerability

Salmon accessible habitat (km)

Flow sensitive accessible habitat (km) (all seasons)



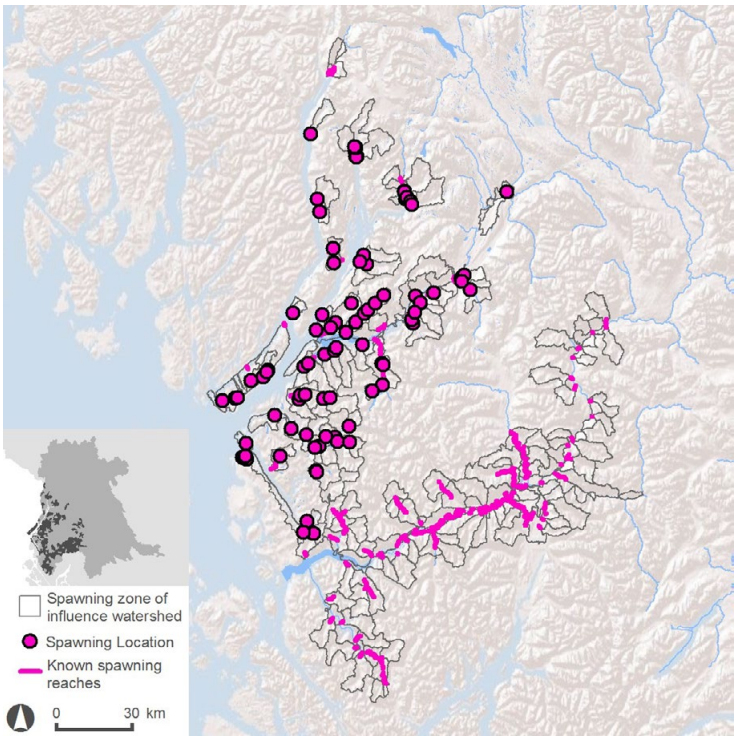
Flow sensitive accessible habitat (%) (all seasons)



Spawning & incubation vulnerability

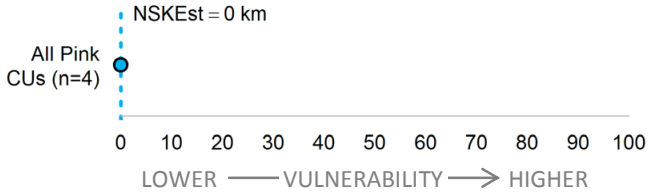
Spawning period vulnerability

Spawning locations

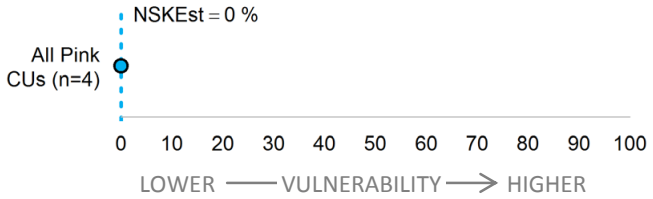


Total spawning length (km)

Spawning reaches summer flow sensitive - spawn timing (km)

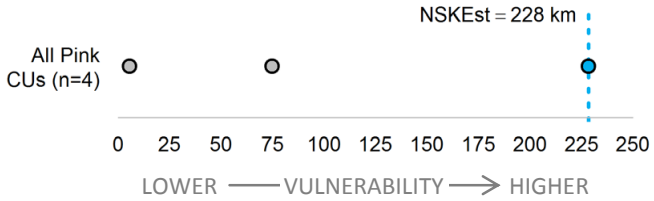


Spawning reaches summer flow sensitive - spawn timing (%)

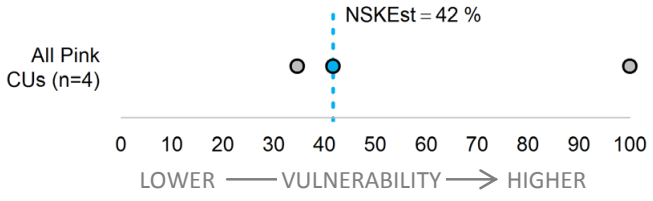


Incubation period vulnerability

Spawning reaches winter flow sensitive - incubation timing (km)



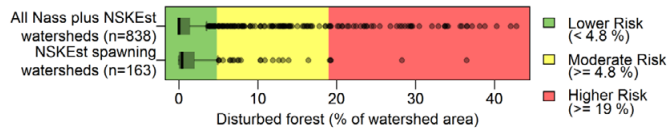
Spawning reaches winter flow sensitive - incubation timing (%)

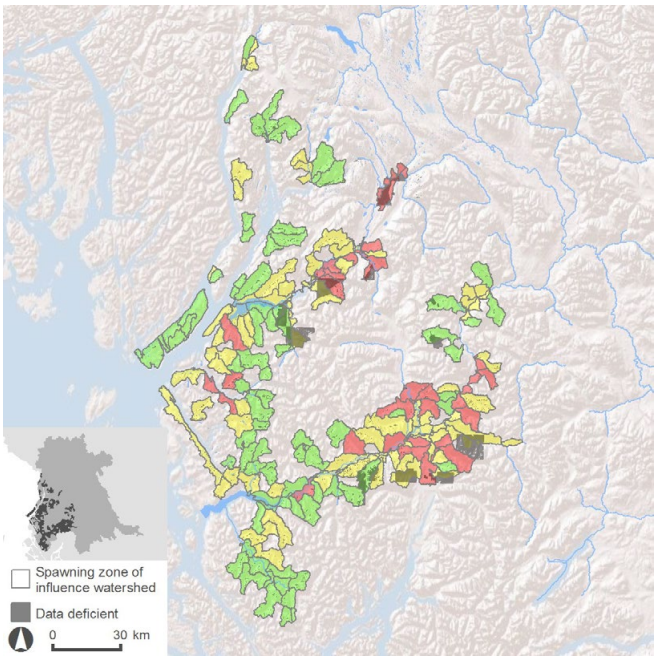


Spawning pressure

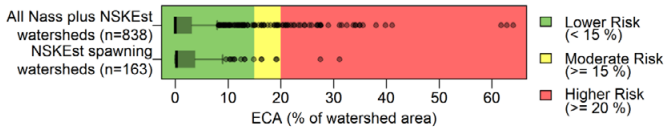
Hydrologic Processes

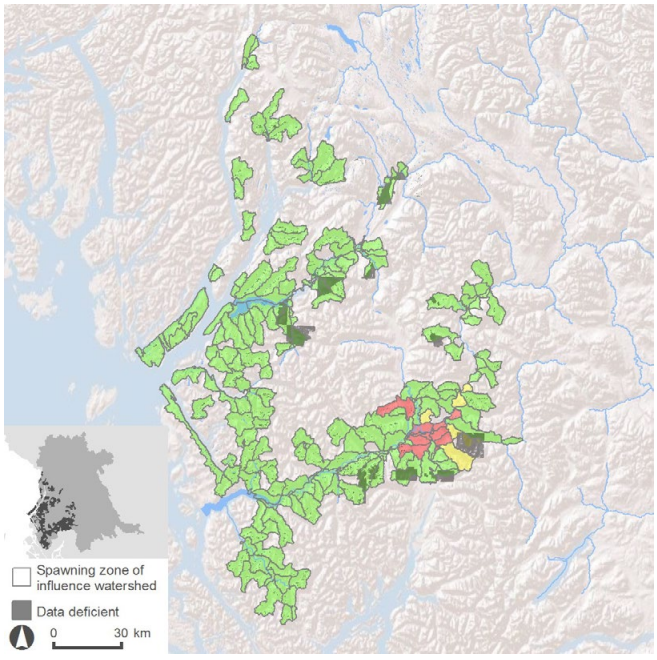
Forest disturbance





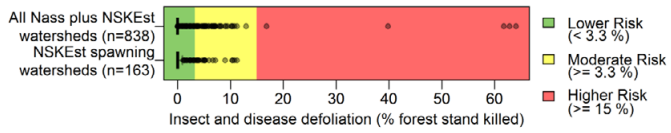
Equivalent Clear-cut Area

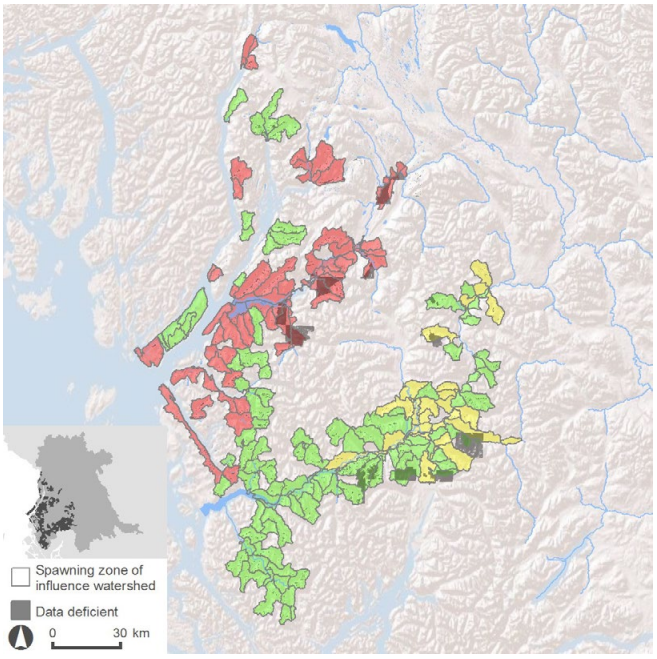




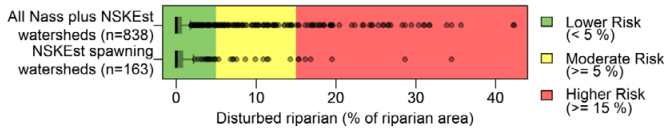
Vegetation Quality

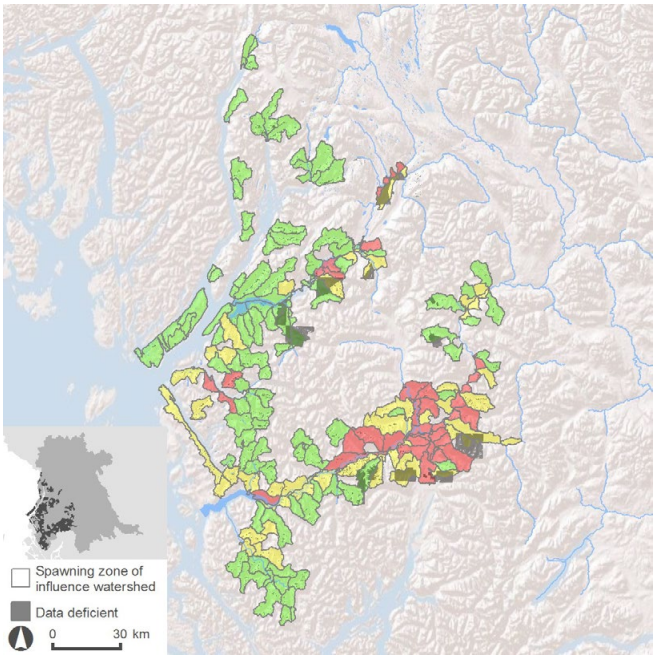
Insect and disease defoliation





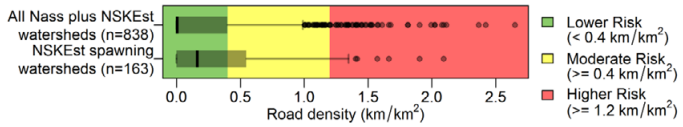
Riparian disturbance

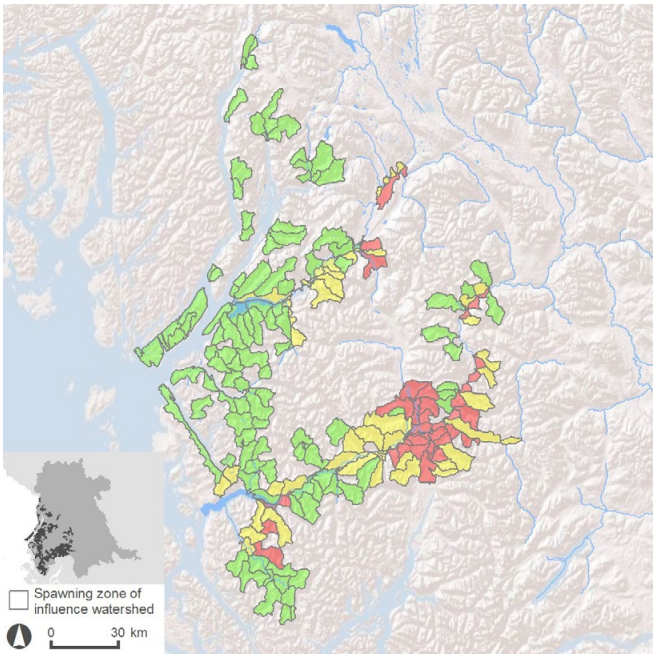




Surface Erosion

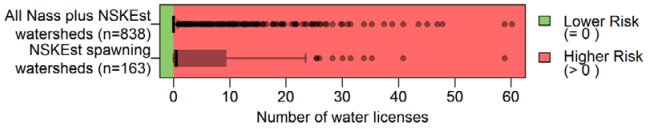
Road development

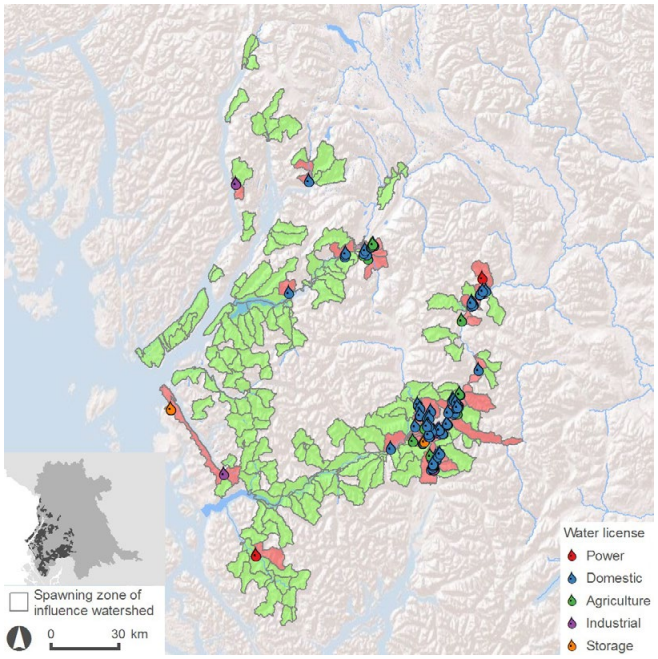




Water Quantity

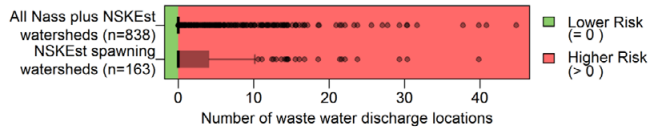
Number of water licenses

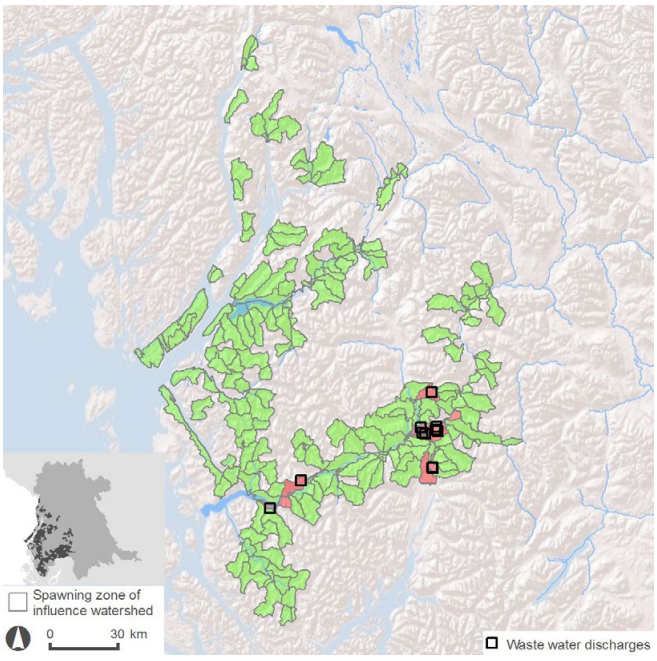




Water Quality

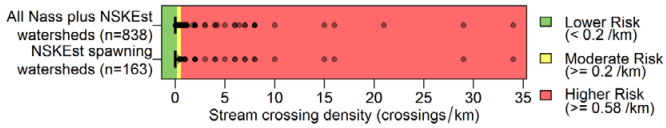
Permitted waste water discharges

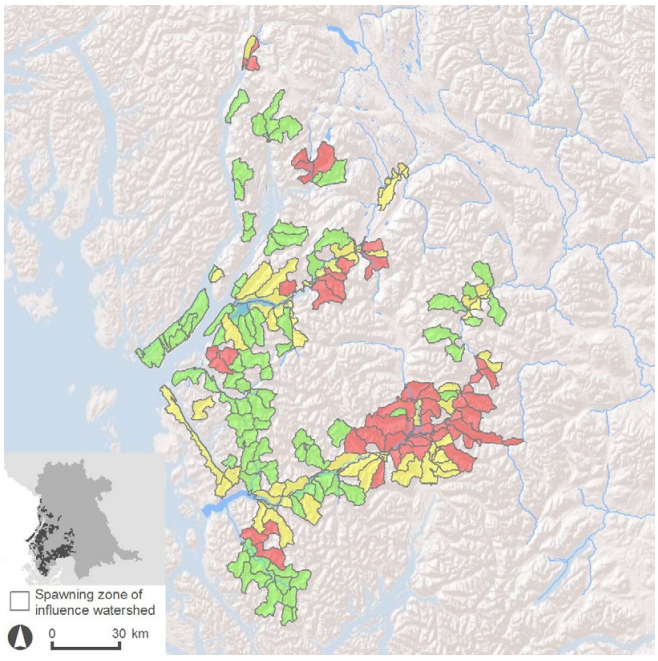




Fish Passage/Habitat Connectivity

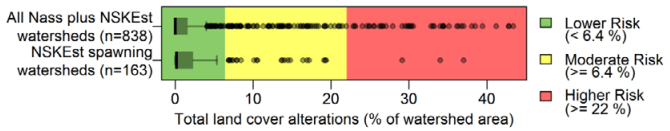
Stream crossing density

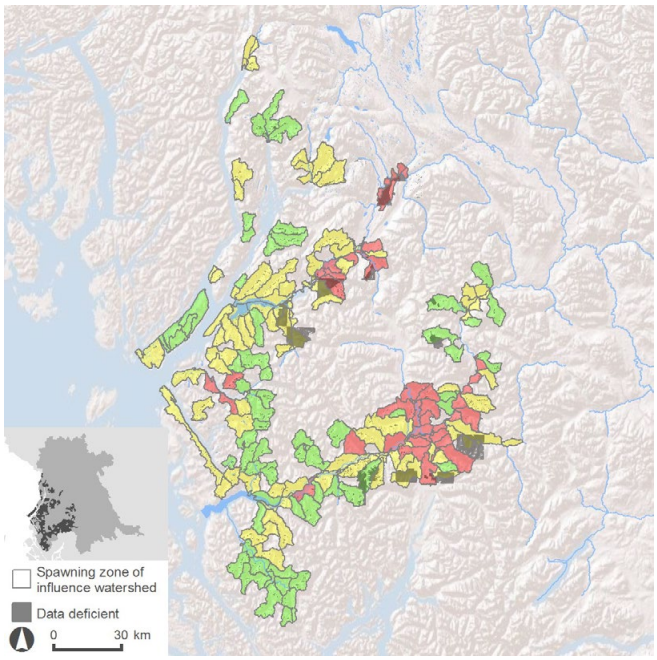




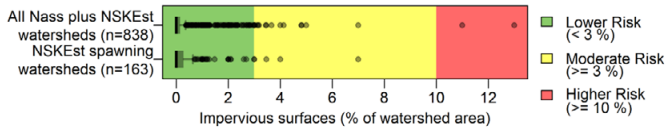
Human Development Footprint

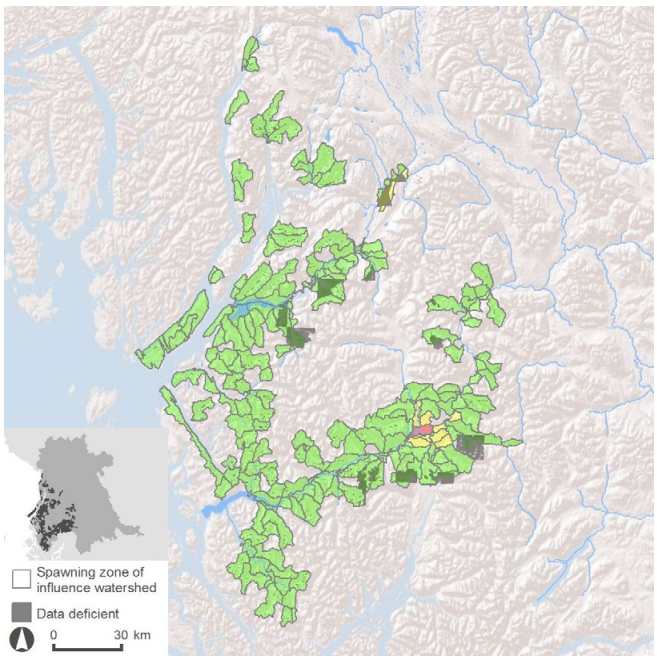
Total land cover alteration



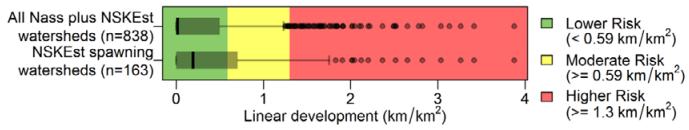


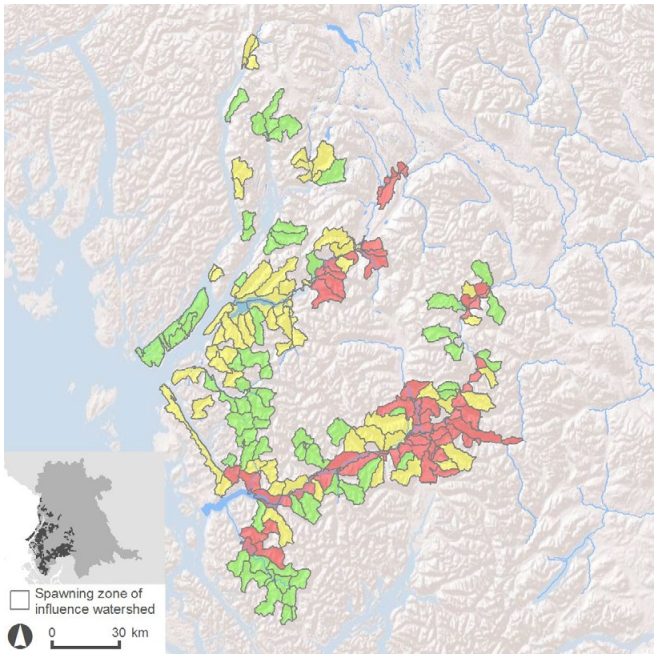
Impervious surfaces



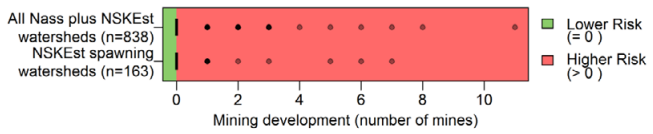


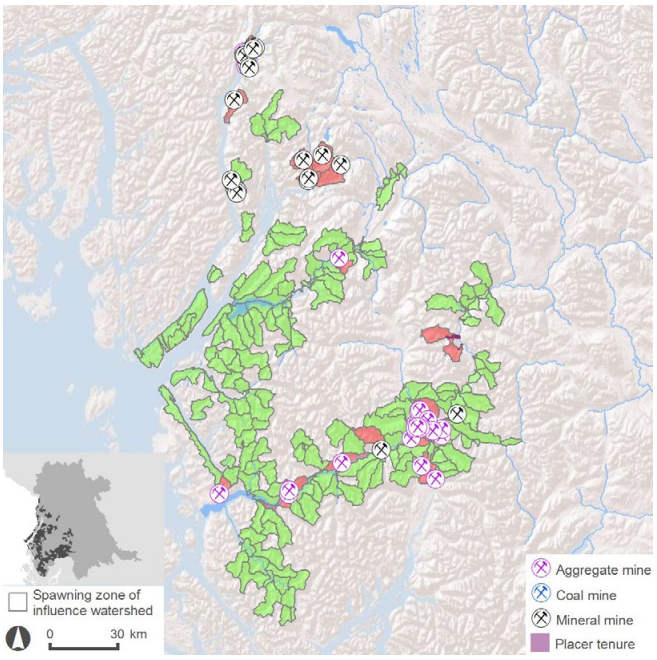
Linear development





Mining development (total number of mines)

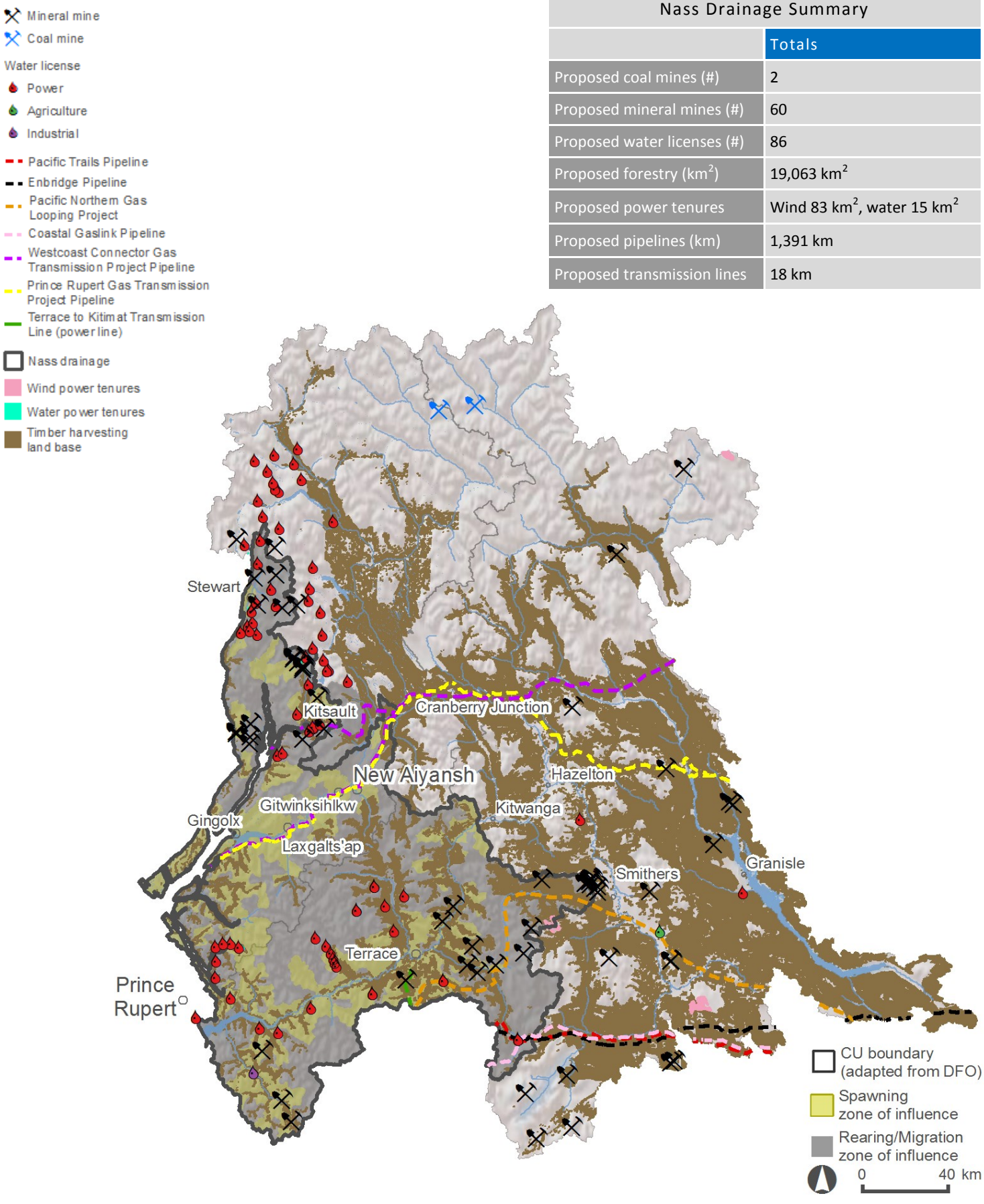




Future pressure

Proposed resource development projects (as of 2016)

Nass Drainage Summary	
	Totals
Proposed coal mines (#)	2
Proposed mineral mines (#)	60
Proposed water licenses (#)	86
Proposed forestry (km^2)	19,063 km^2
Proposed power tenures	Wind 83 km^2, water 15 km^2
Proposed pipelines (km)	1,391 km
Proposed transmission lines	18 km



Pink: Odd-Year Nass — Portland Observatory

Introduction

This project summarizes pressures on the habitat used by Nass salmon Conservation Units (CU) during their freshwater life history stages (migration, spawning and rearing), as well as their relative vulnerability to those pressures. For an explanation of the indicators shown here, please see the accompanying *Report Card Summaries*. Full methods and results can be found in the main report, *Cumulative Pressures on Nass Salmon Habitat: Technical Report* (2016).

Definitions

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Narrative

- There are four pink salmon CUs found in the Nass Area: 1) Even-Year Nass-Skeena Estuary (NSKEst), 2) Even-Year Upper Nass (UNASS-Even), 3) Odd-Year Upper Nass (UNASS-Odd), and 4) Odd-Year Nass-Portland-Observatory (NR-PORT-OBS). There are over 80 discrete spawning populations across all four CUs.
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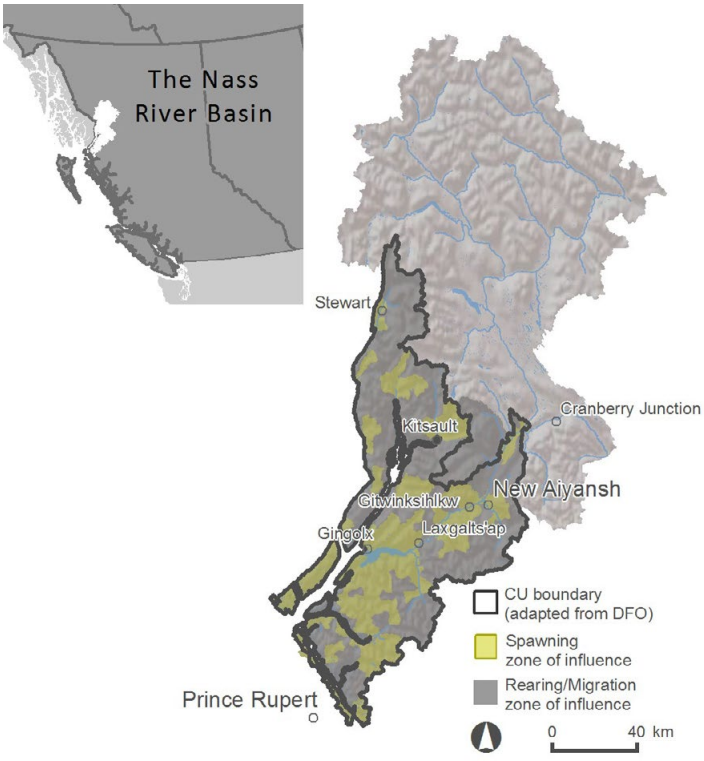

Summary of habitat vulnerabilities & pressures

Pressure indicators were grouped into seven relatively independent habitat "impact categories" representing key factors affecting general watershed condition:

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- Vegetation Quality (Insect and disease defoliation; Riparian disturbance)
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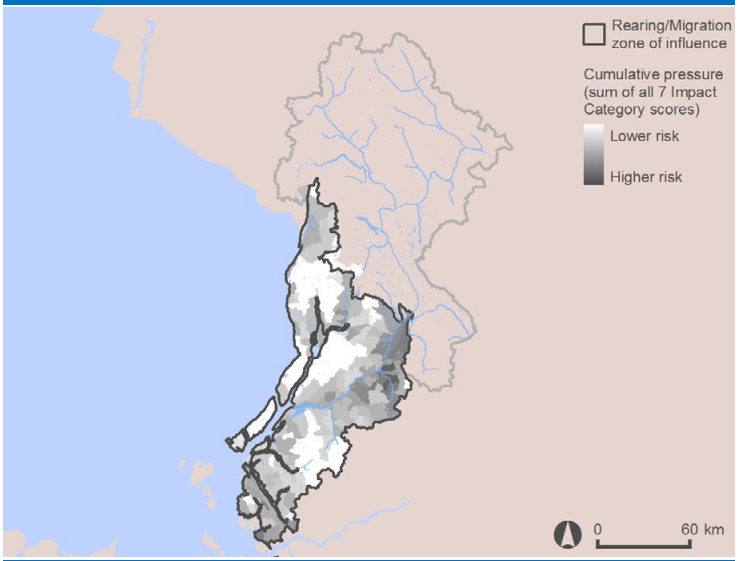
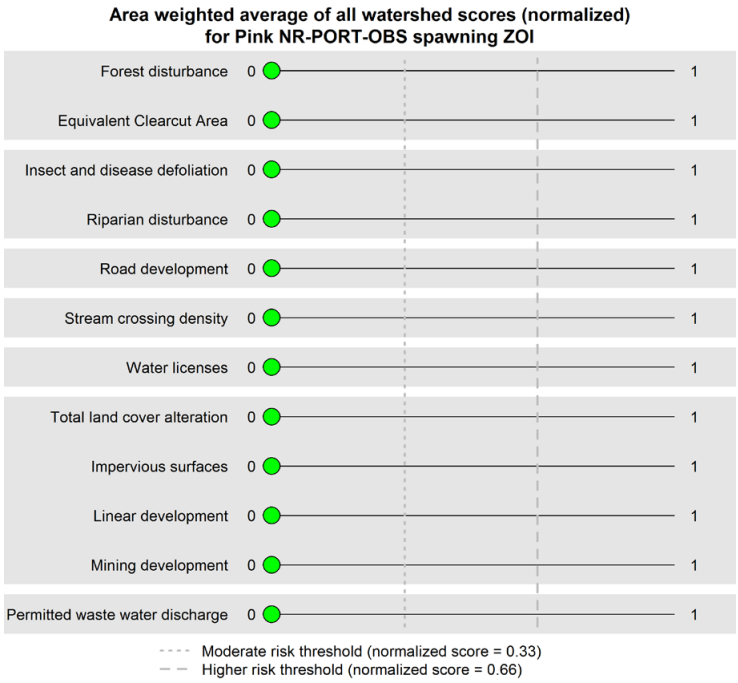
Cumulative pressure—rearing/migration



Summary of pressure indicators—spawning



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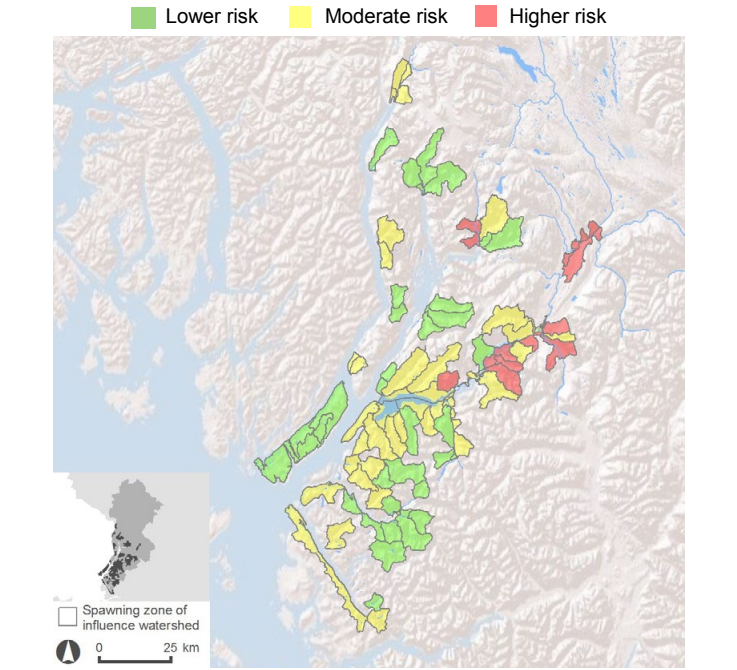
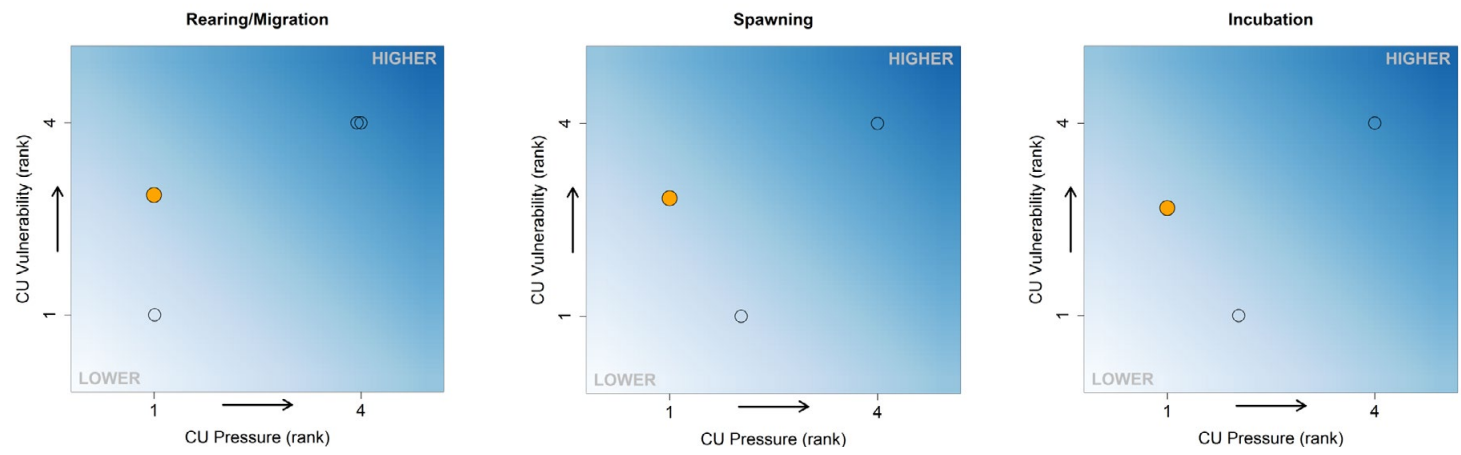


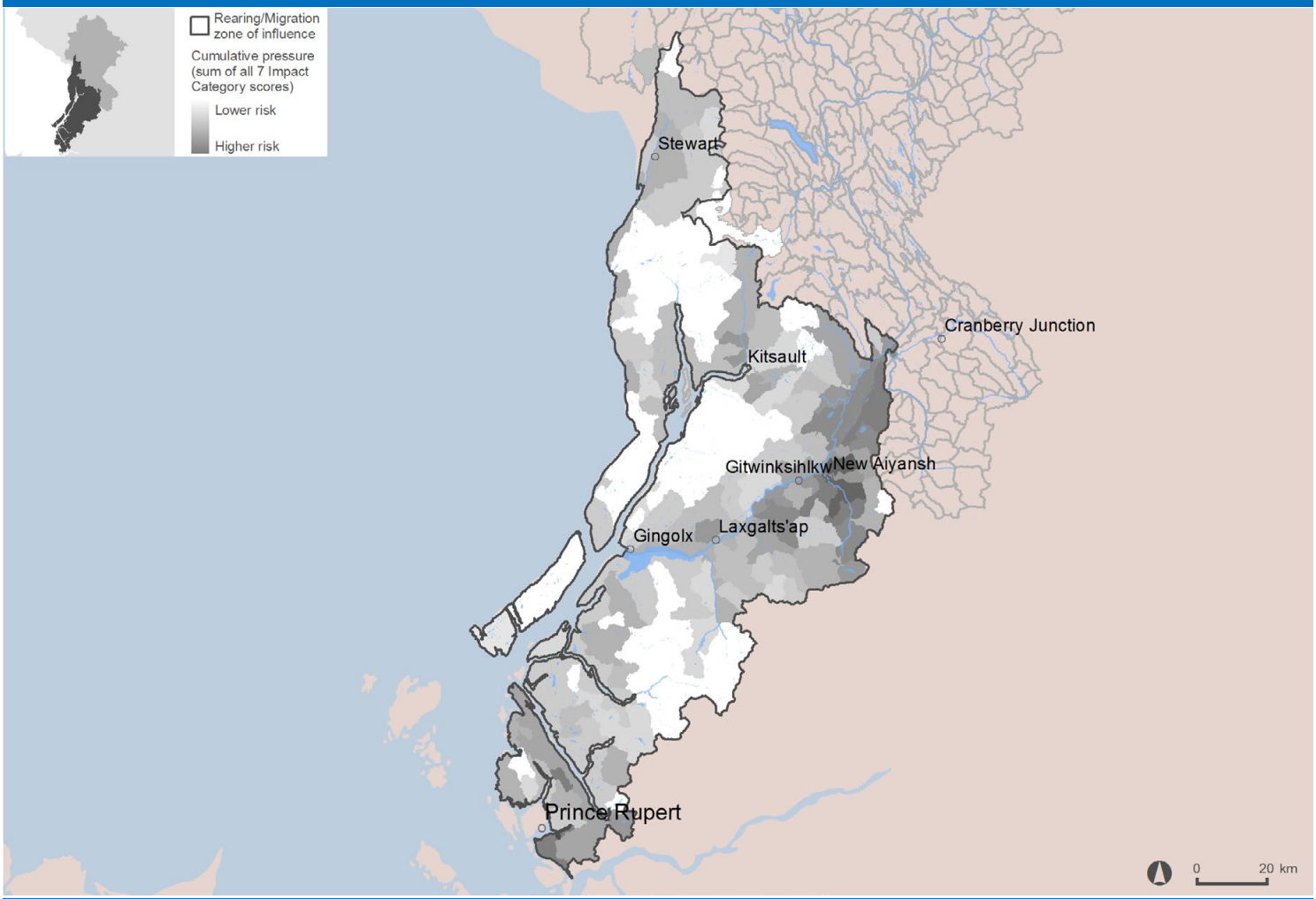
Integrated vulnerability/habitat pressures—rearing/migration, spawning, & incubation

● = Nass-Portland-Observatory ○ = other Pink CUs



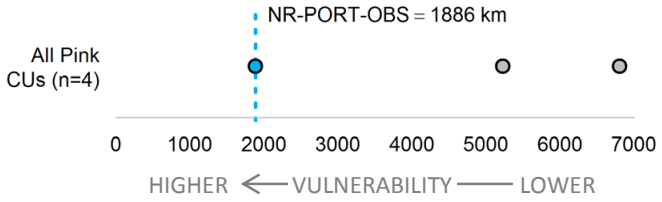
Rearing/Migration vulnerability & pressure

Rearing/Migration period pressures

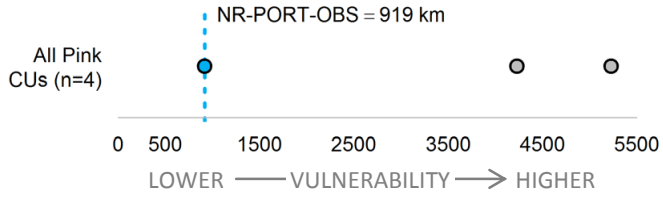


Rearing/Migration period vulnerability

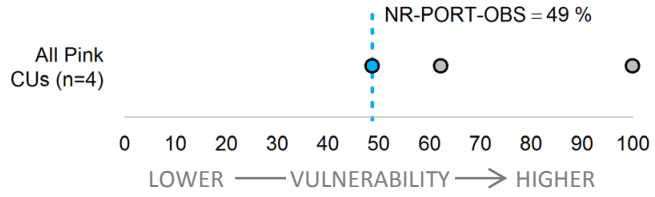
Salmon accessible habitat (km)



Flow sensitive accessible habitat (km) (all seasons)



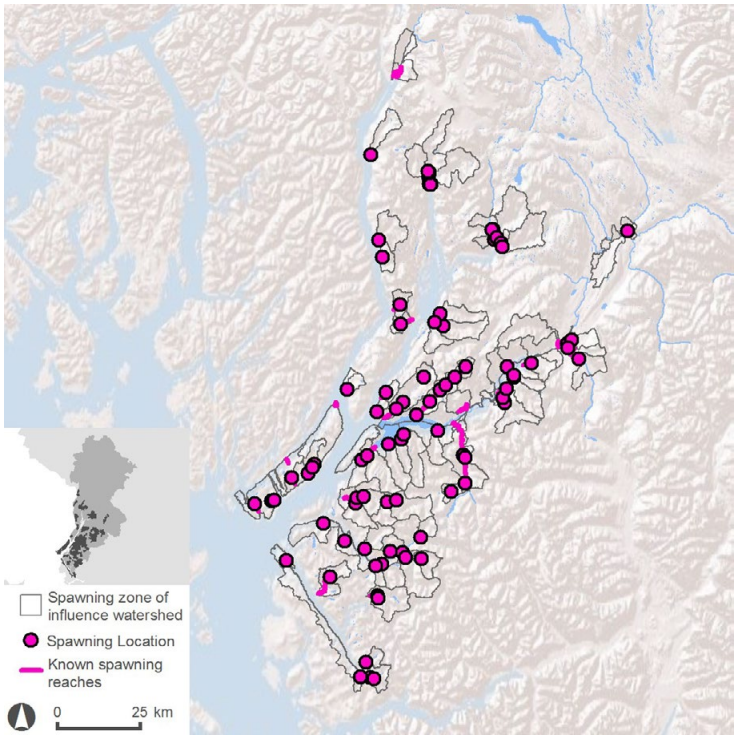
Flow sensitive accessible habitat (%) (all seasons)



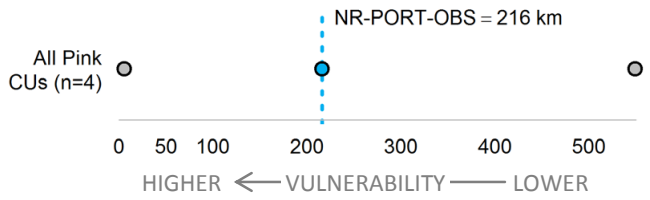
Spawning & incubation vulnerability

Spawning period vulnerability

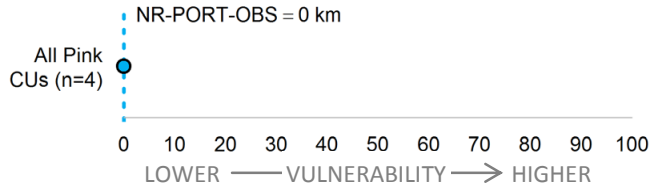
Spawning locations



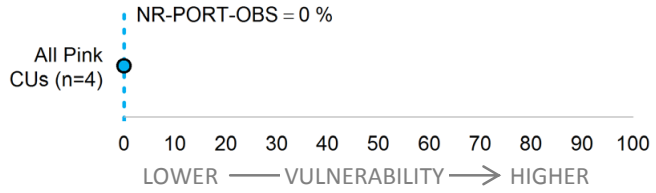
Total spawning length (km)



Spawning reaches summer flow sensitive - spawn timing (km)

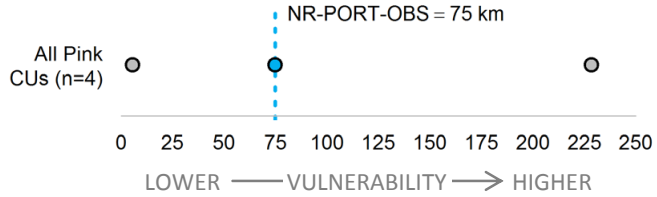


Spawning reaches summer flow sensitive - spawn timing (%)

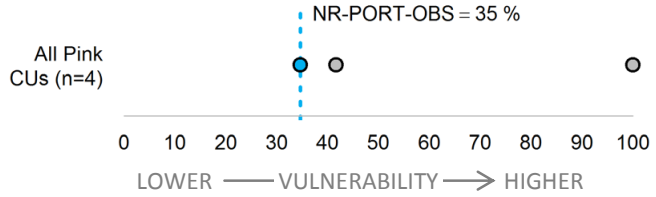


Incubation period vulnerability

Spawning reaches winter flow sensitive - incubation timing (km)



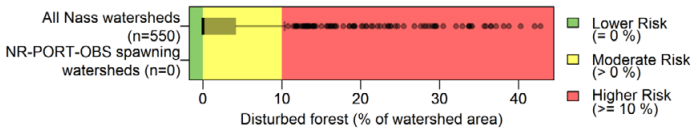
Spawning reaches winter flow sensitive - incubation timing (%)

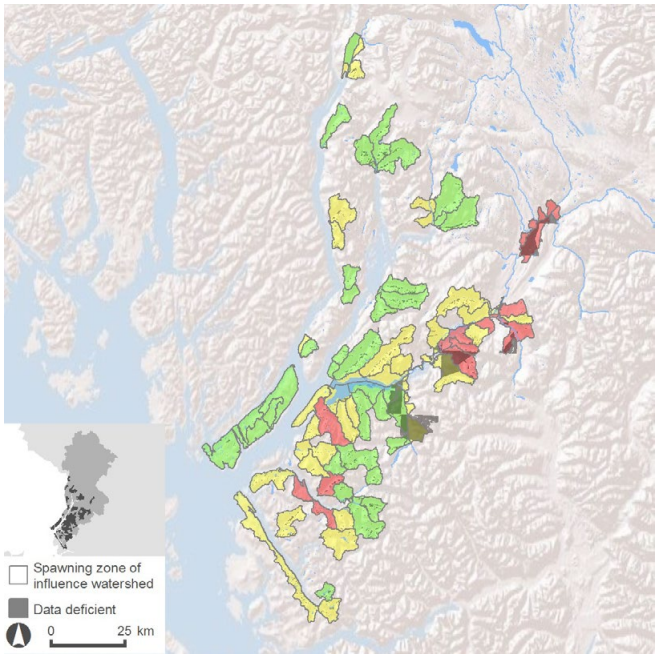


Spawning pressure

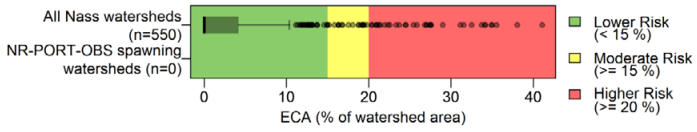
Hydrologic Processes

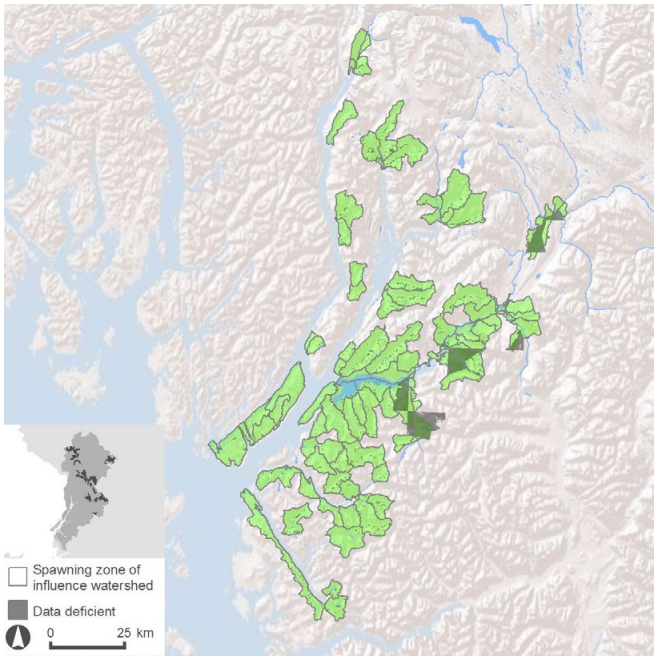
Forest disturbance





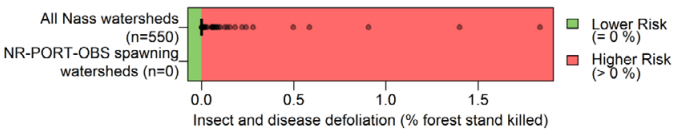
Equivalent Clear-cut Area

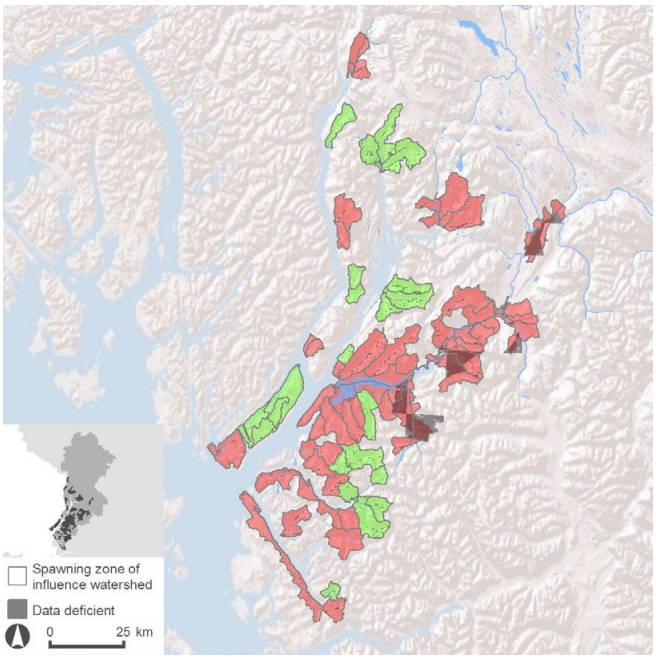




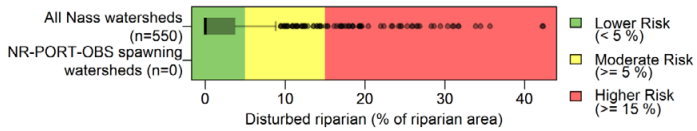
Vegetation Quality

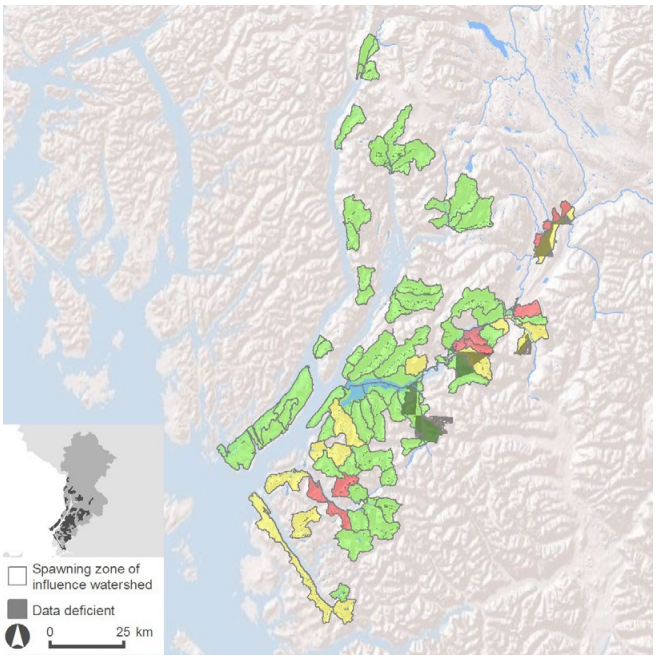
Insect and disease defoliation





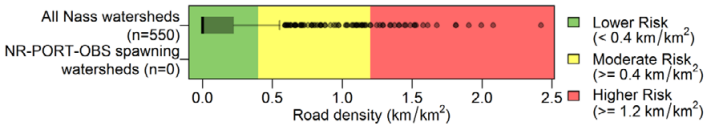
Riparian disturbance

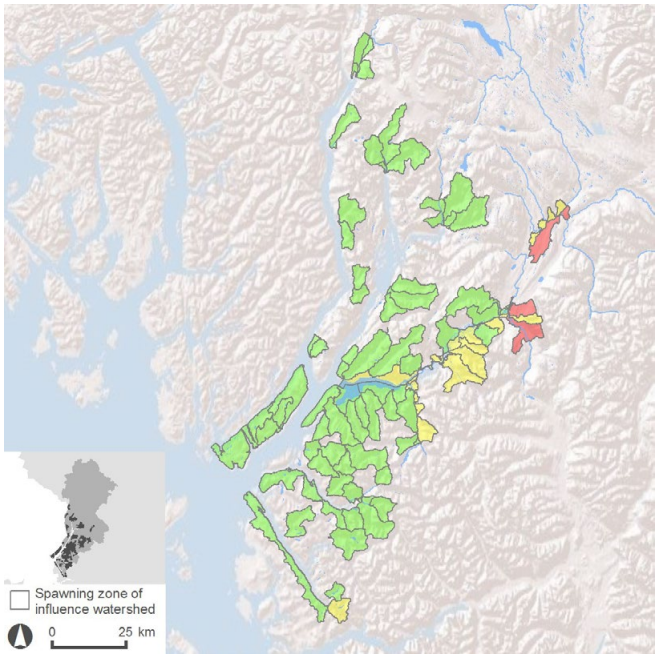




Surface Erosion

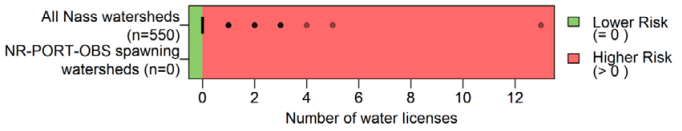
Road development

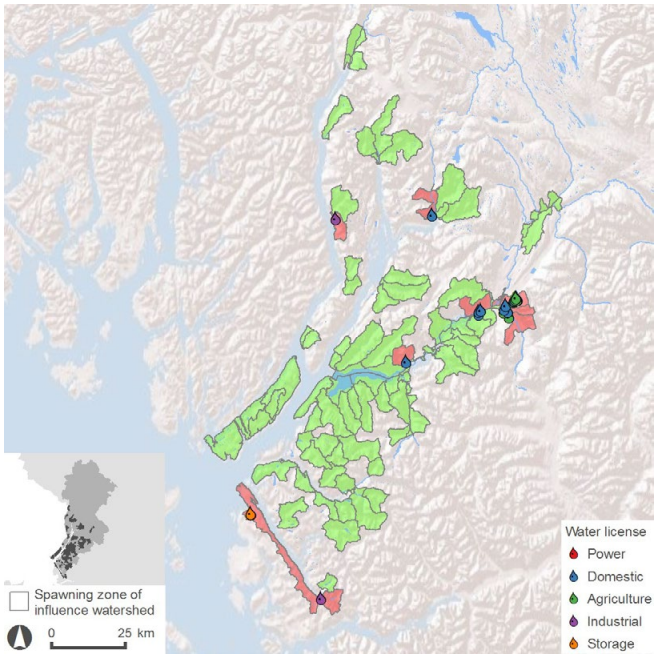




Water Quantity

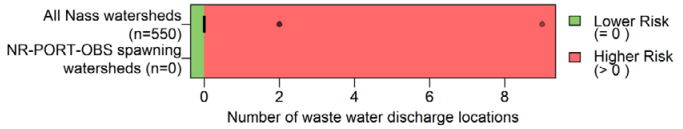
Number of water licenses

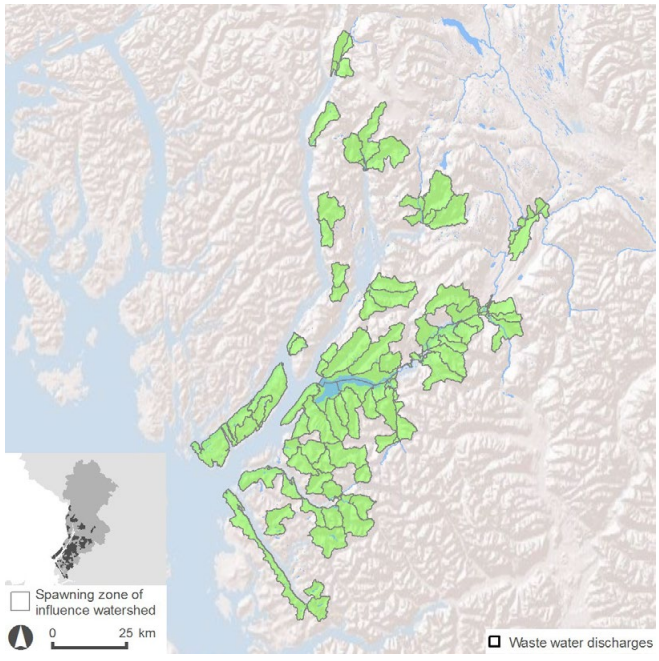




Water Quality

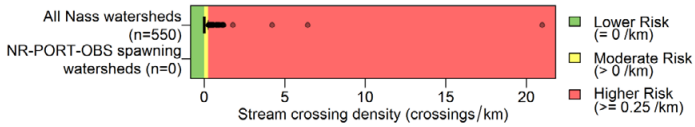
Permitted waste water discharges

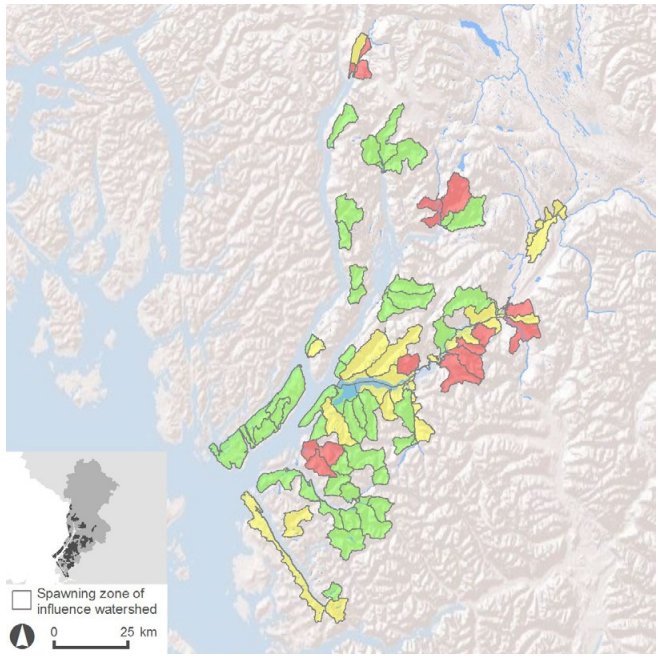




Fish Passage/Habitat Connectivity

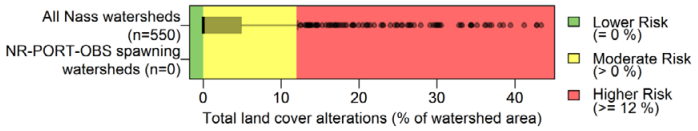
Stream crossing density

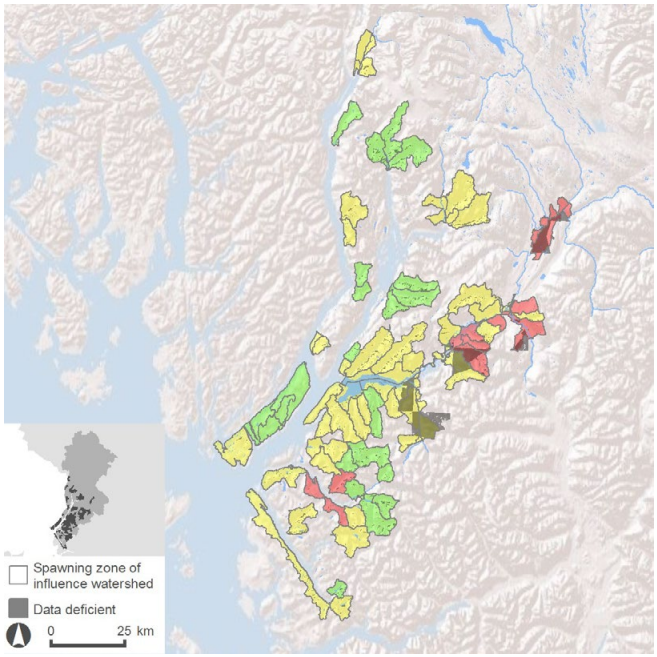




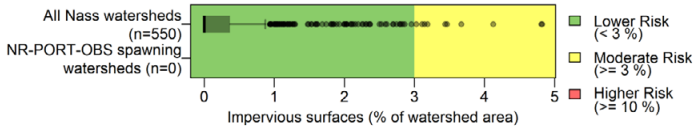
Human Development Footprint

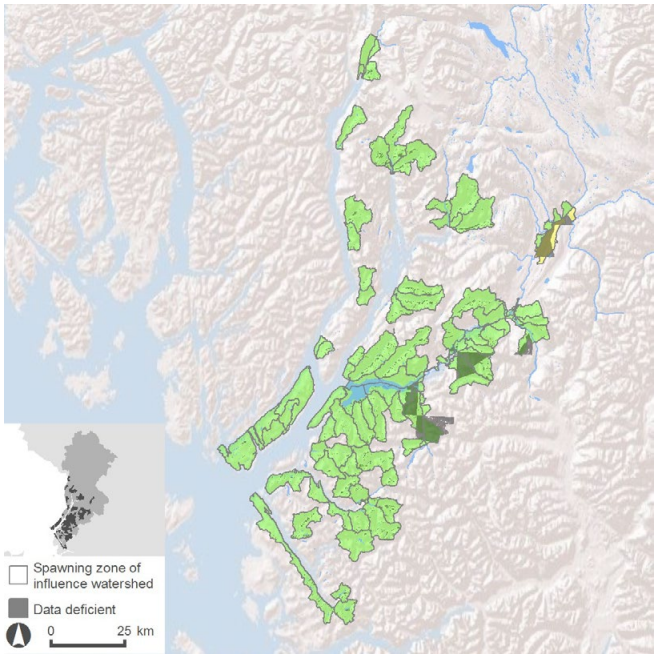
Total land cover alteration



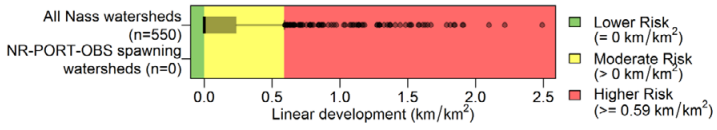


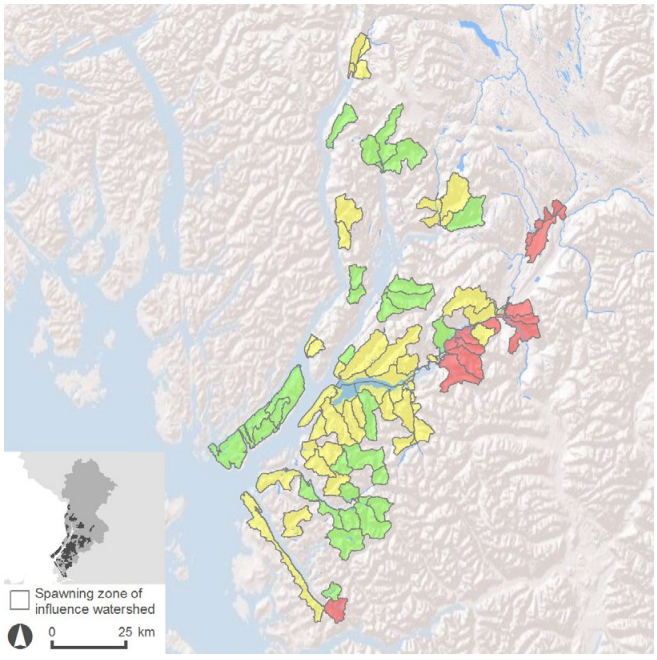
Impervious surfaces



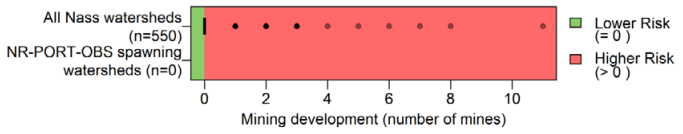


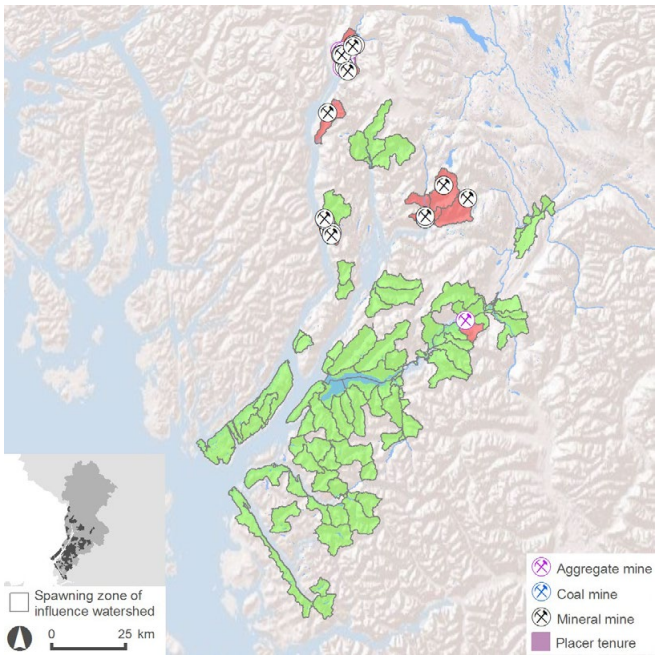
Linear development





Mining development (total number of mines)

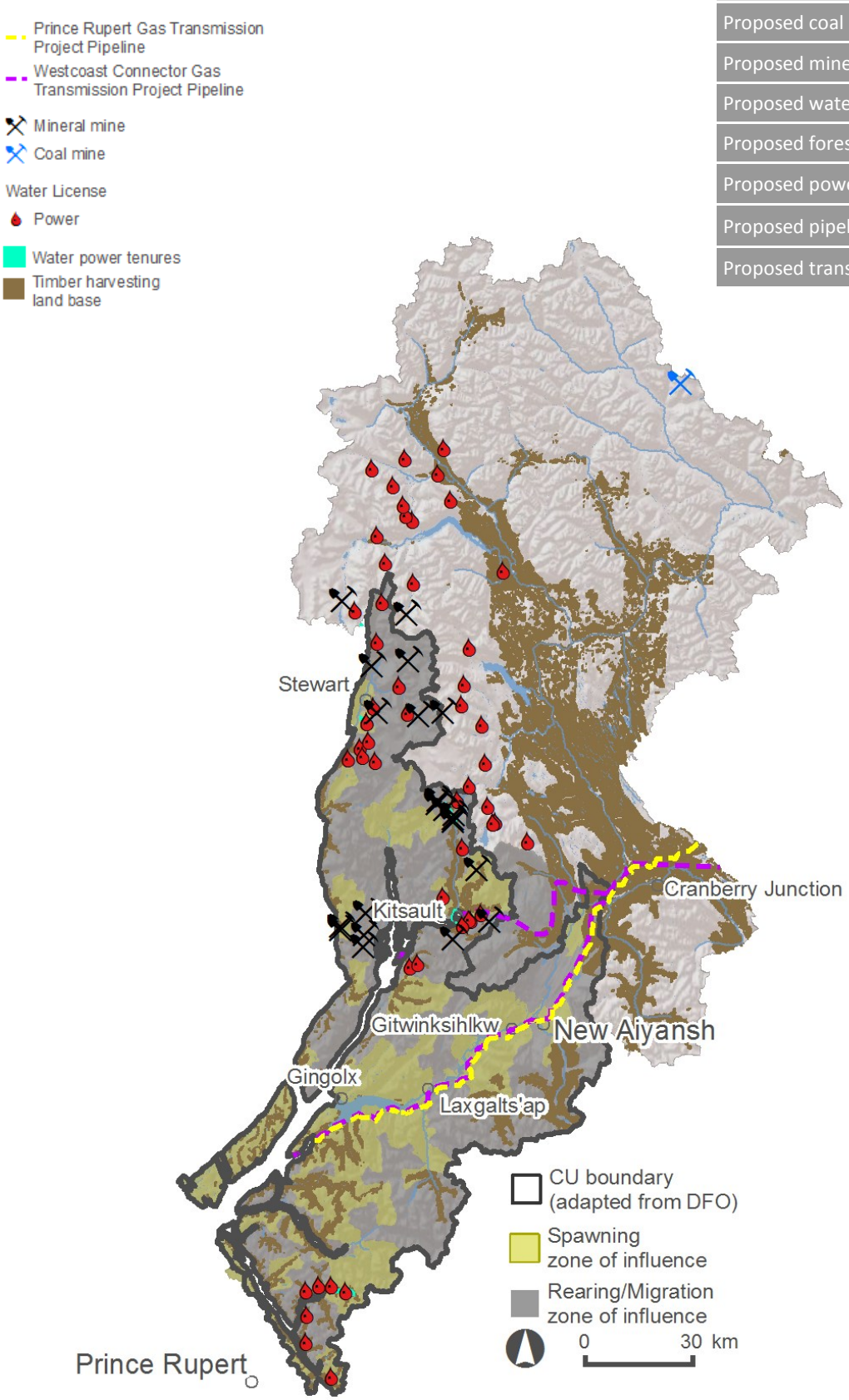




Future pressure

Proposed resource development projects (as of 2016)

Nass Drainage Summary	
	Totals
Proposed coal mines (#)	1
Proposed mineral mines (#)	22
Proposed water licenses (#)	58
Proposed forestry (km^2)	3,323 km^2
Proposed power tenures	Wind 0 km^2, water 15 km^2
Proposed pipelines (km)	386 km
Proposed transmission lines	0 km



Pink: Odd-Year Upper Nass

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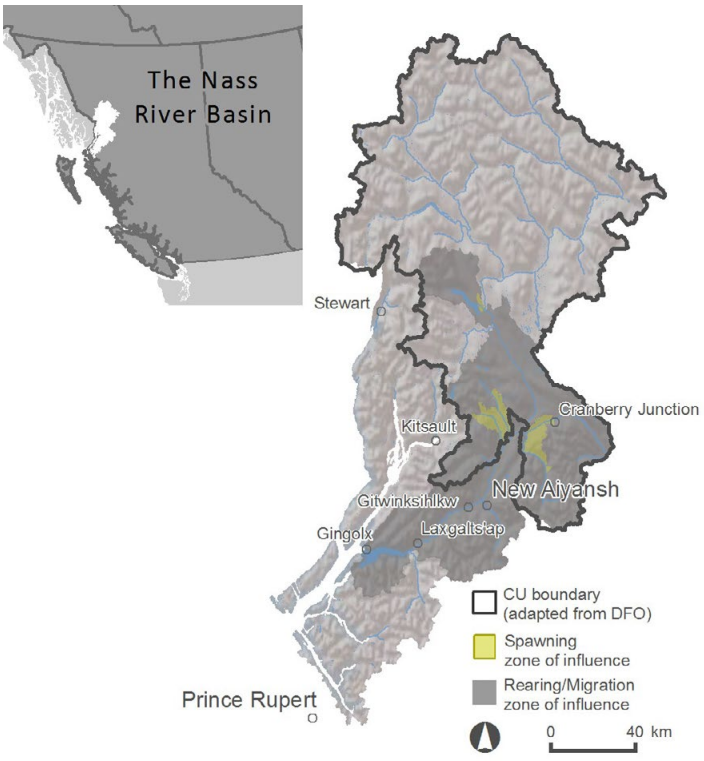

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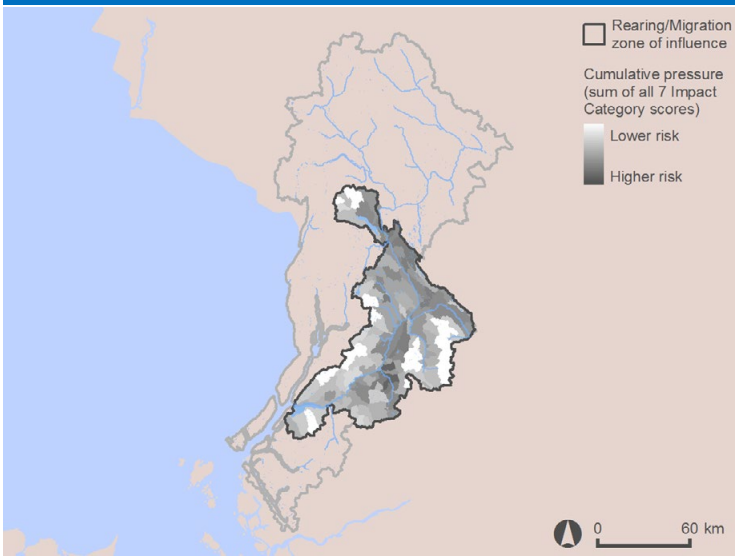
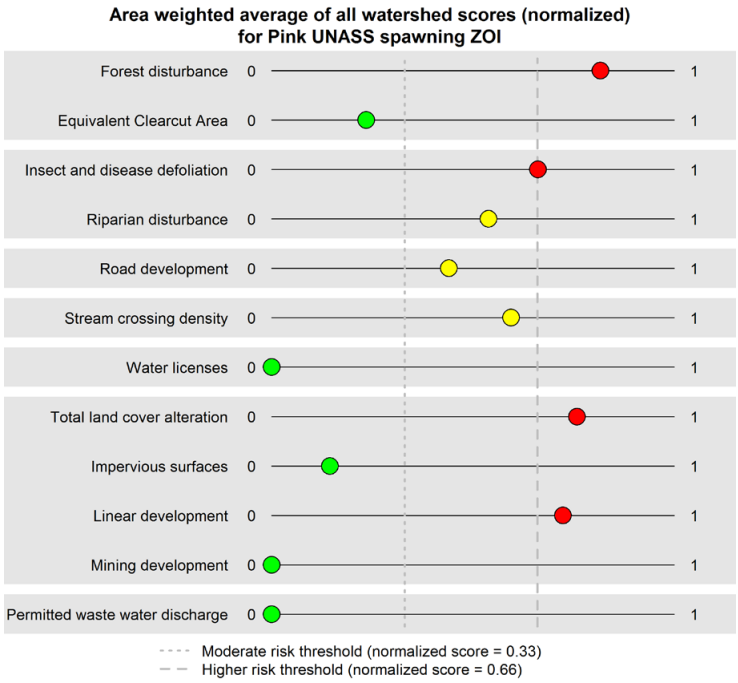
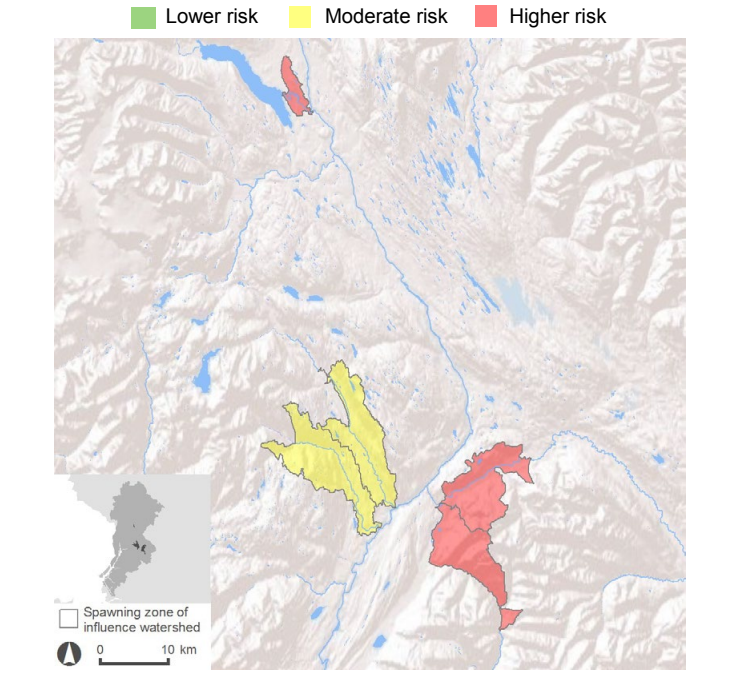
Cumulative pressure—rearing/migration



Summary of pressure indicators—spawning

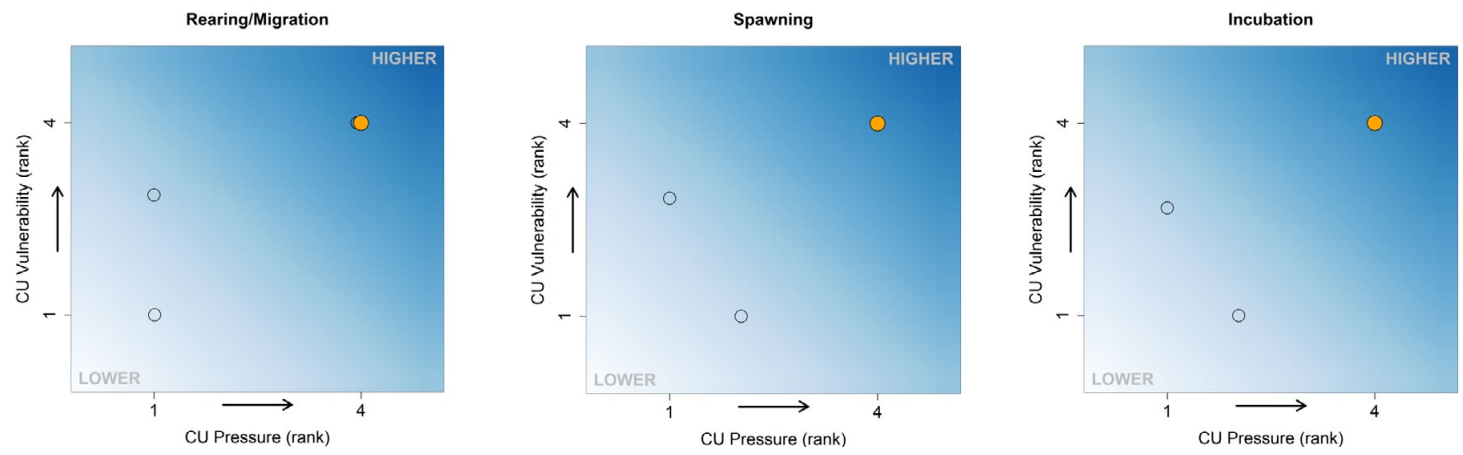


Cumulative pressure—spawning



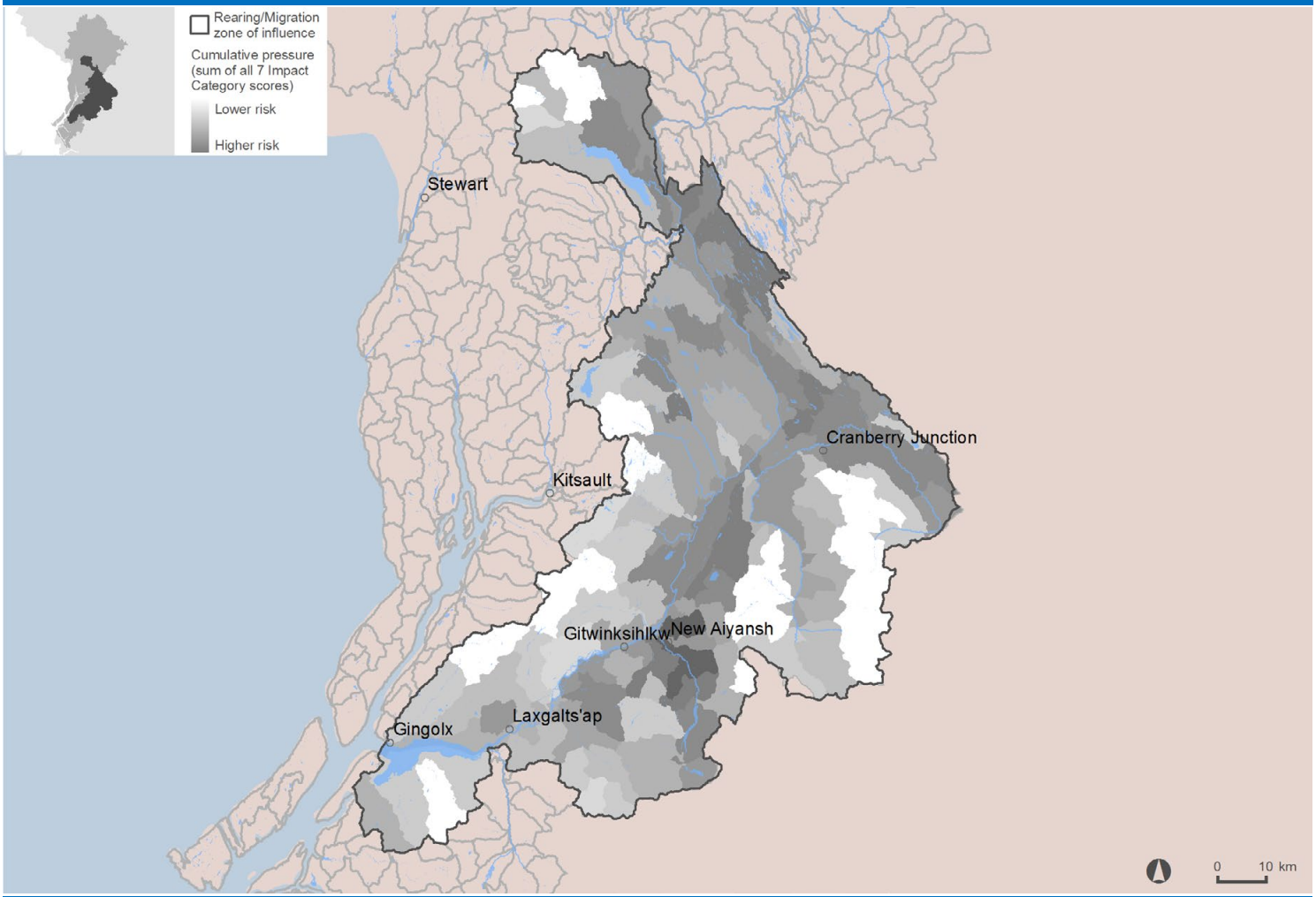
Integrated vulnerability/habitat pressures—rearing/migration, spawning, & incubation

● = Upper Nass ○ = other Pink CUs



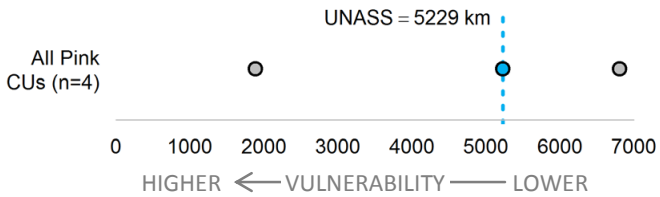
Rearing/Migration vulnerability & pressure

Rearing/Migration period pressures



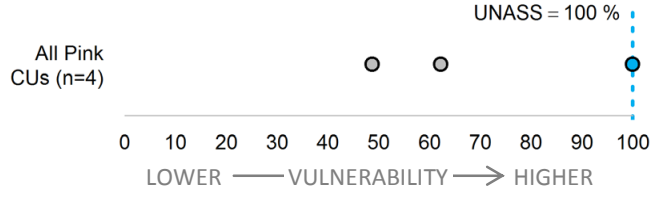
Rearing/Migration period vulnerability

Salmon accessible habitat (km)



Flow sensitive accessible habitat (km) (all seasons)

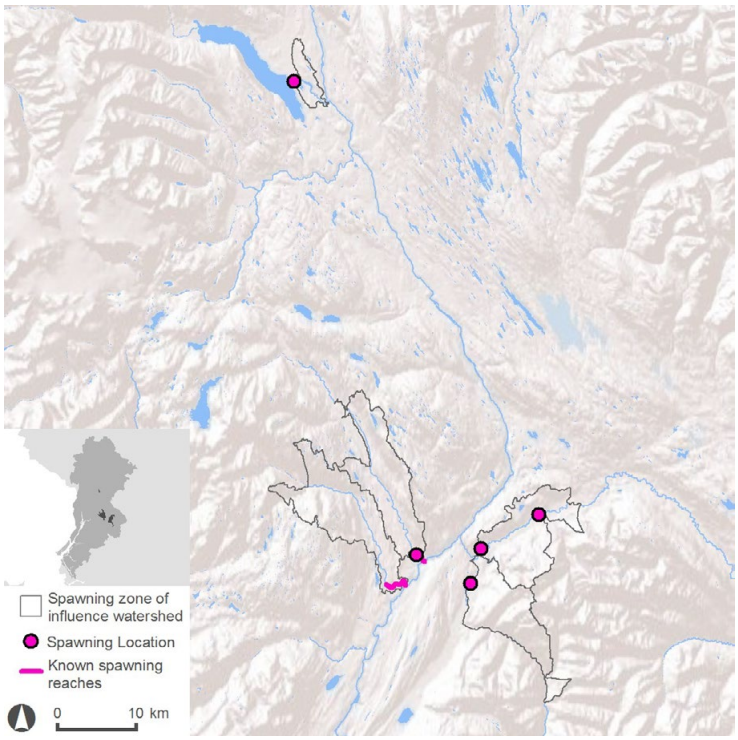
Flow sensitive accessible habitat (%) (all seasons)



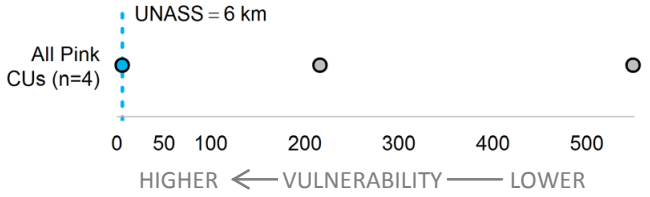
Spawning & incubation vulnerability

Spawning period vulnerability

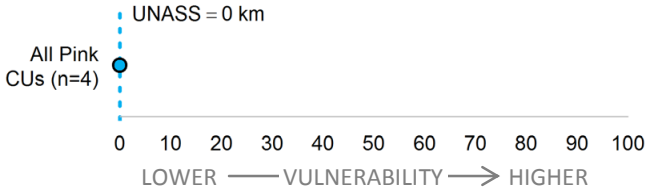
Spawning locations



Total spawning length (km)



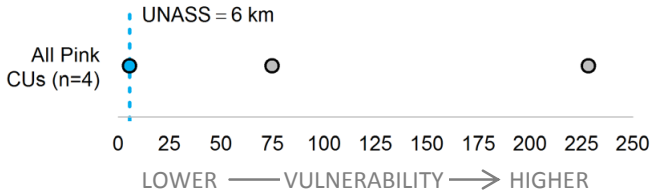
Spawning reaches summer flow sensitive - spawn timing (km)



Spawning reaches summer flow sensitive - spawn timing (%)

Incubation period vulnerability

Spawning reaches winter flow sensitive - incubation timing (km)

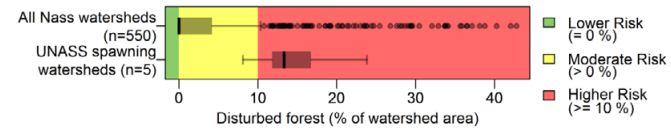


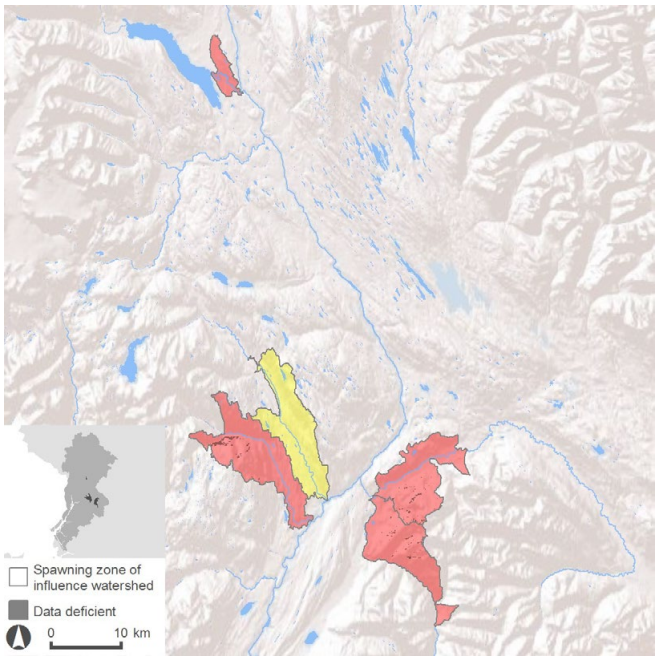
Spawning reaches winter flow sensitive - incubation timing (%)

Spawning pressure

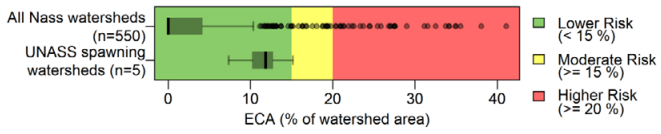
Hydrologic Processes

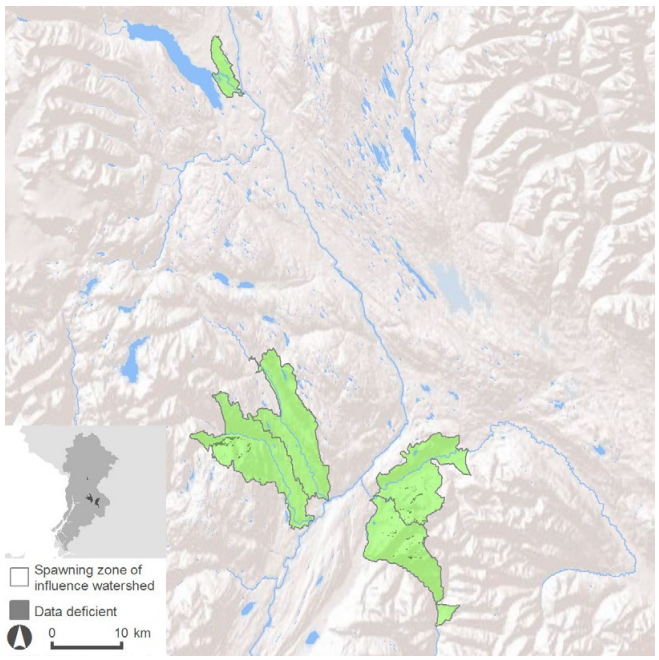
Forest disturbance





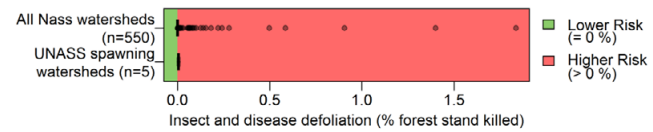
Equivalent Clear-cut Area

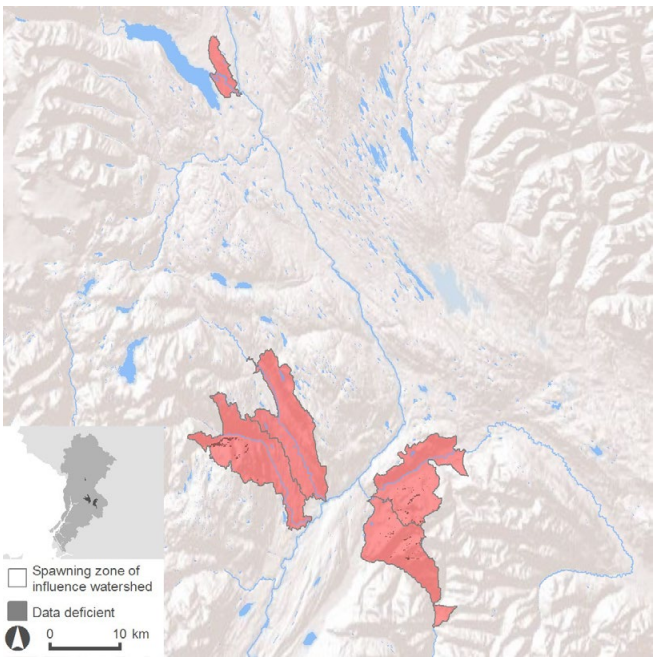




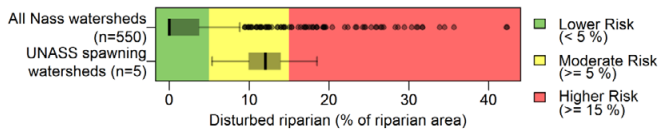
Vegetation Quality

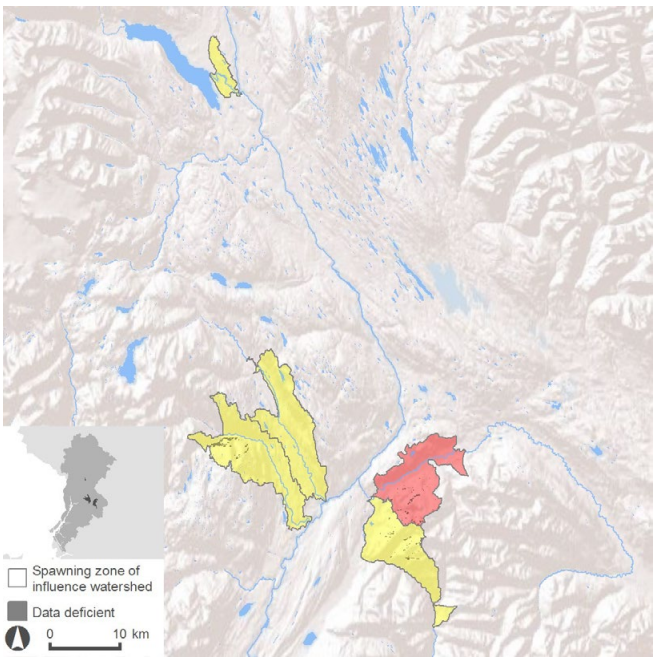
Insect and disease defoliation





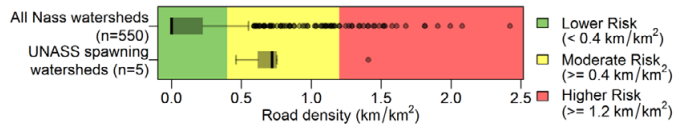
Riparian disturbance

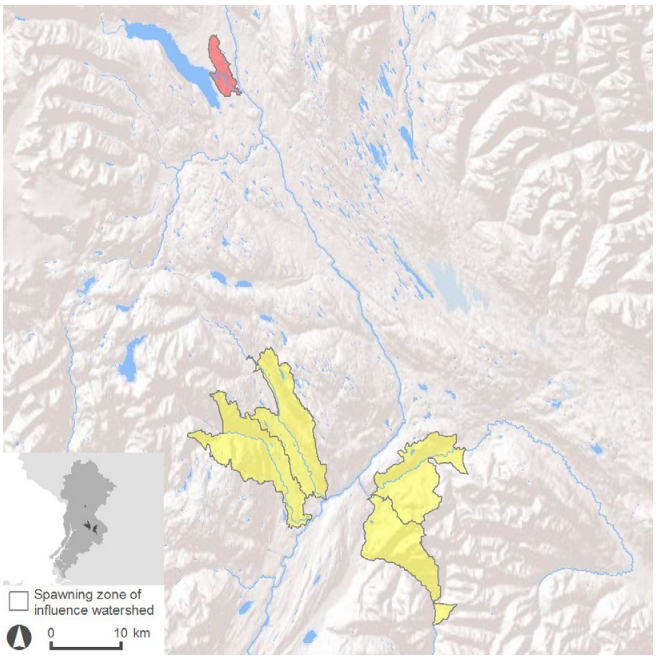




Surface Erosion

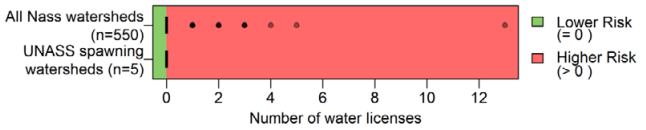
Road development

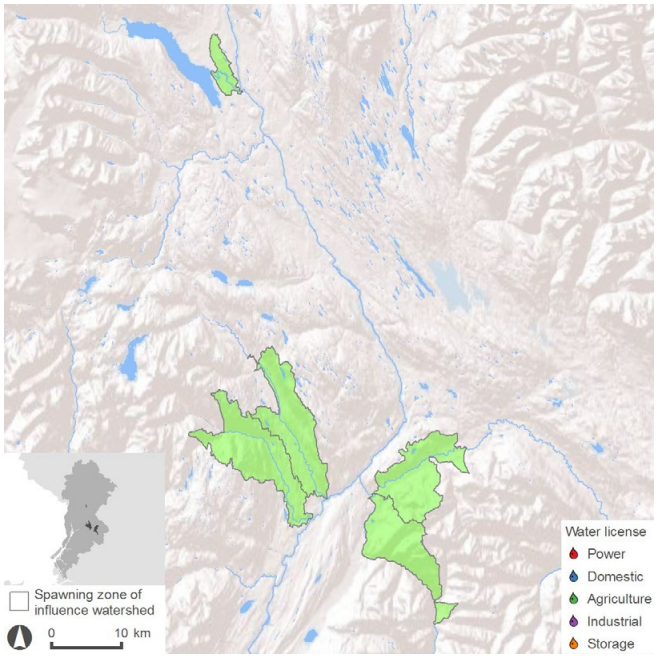




Water Quantity

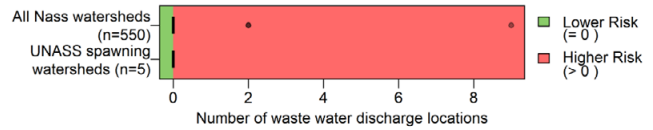
Number of water licenses

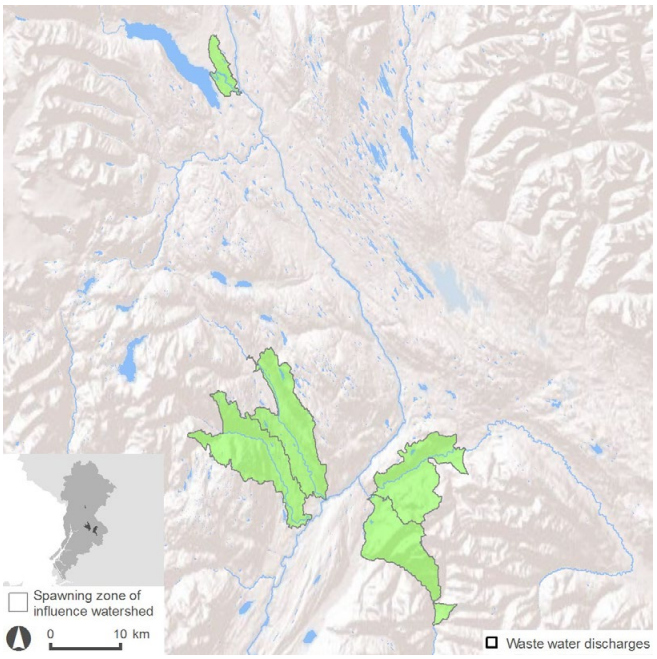




Water Quality

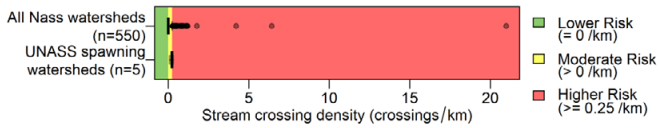
Permitted waste water discharges

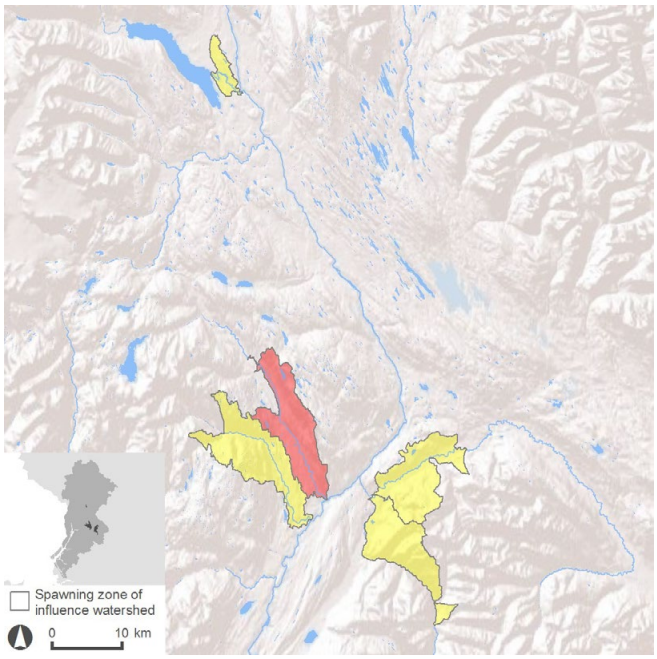




Fish Passage/Habitat Connectivity

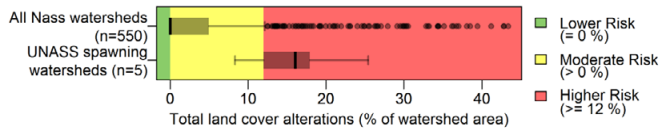
Stream crossing density

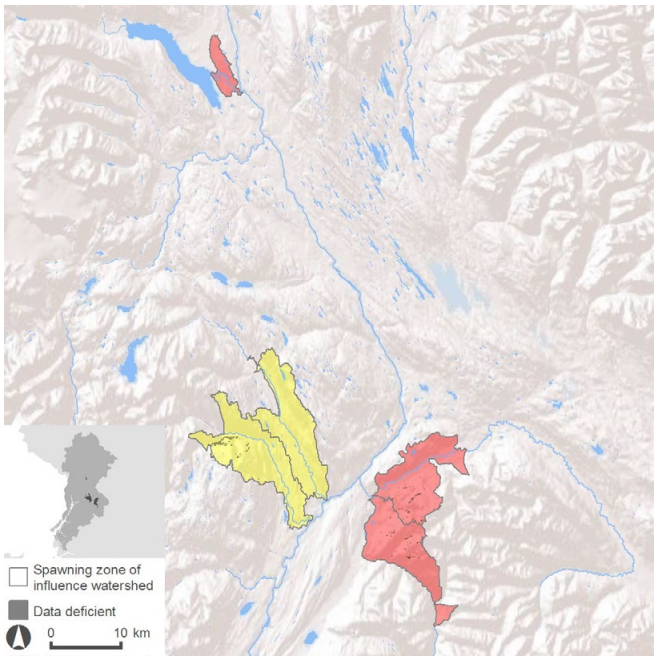




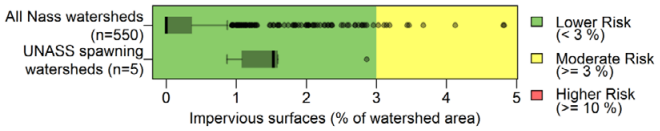
Human Development Footprint

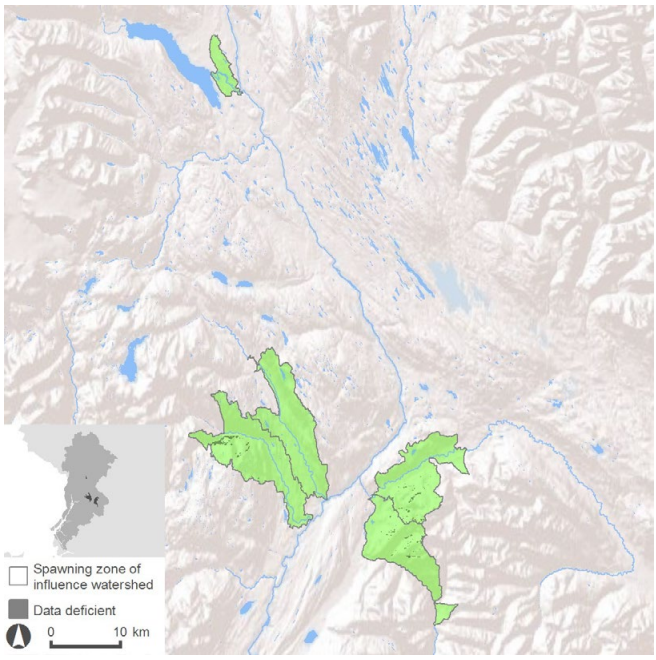
Total land cover alteration



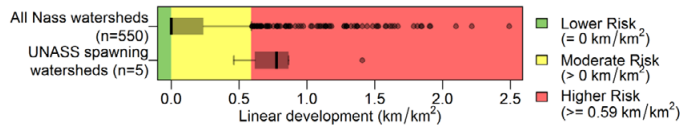


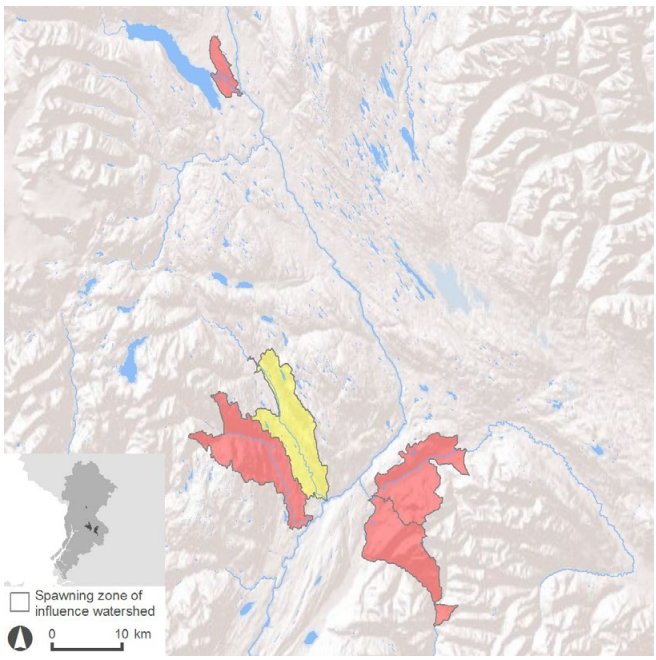
Impervious surfaces



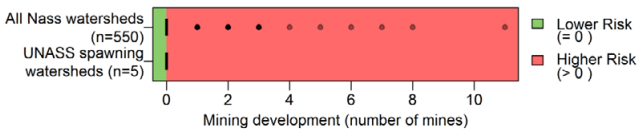


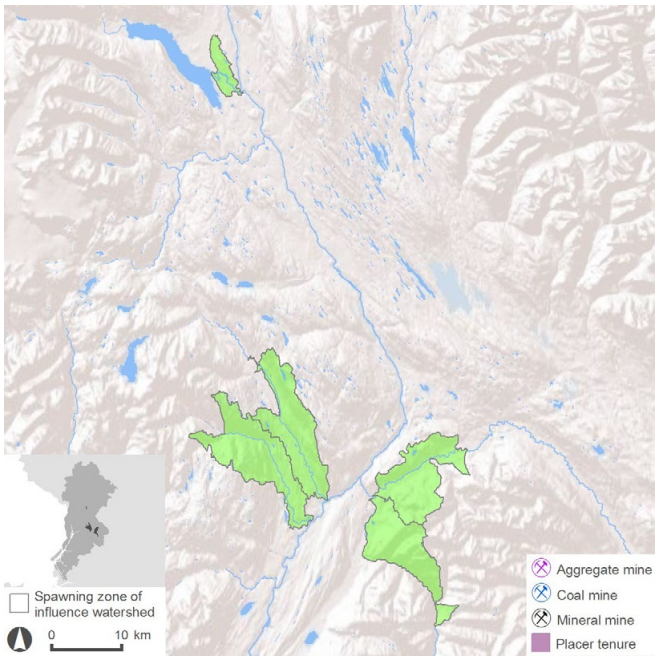
Linear development





Mining development (total number of mines)

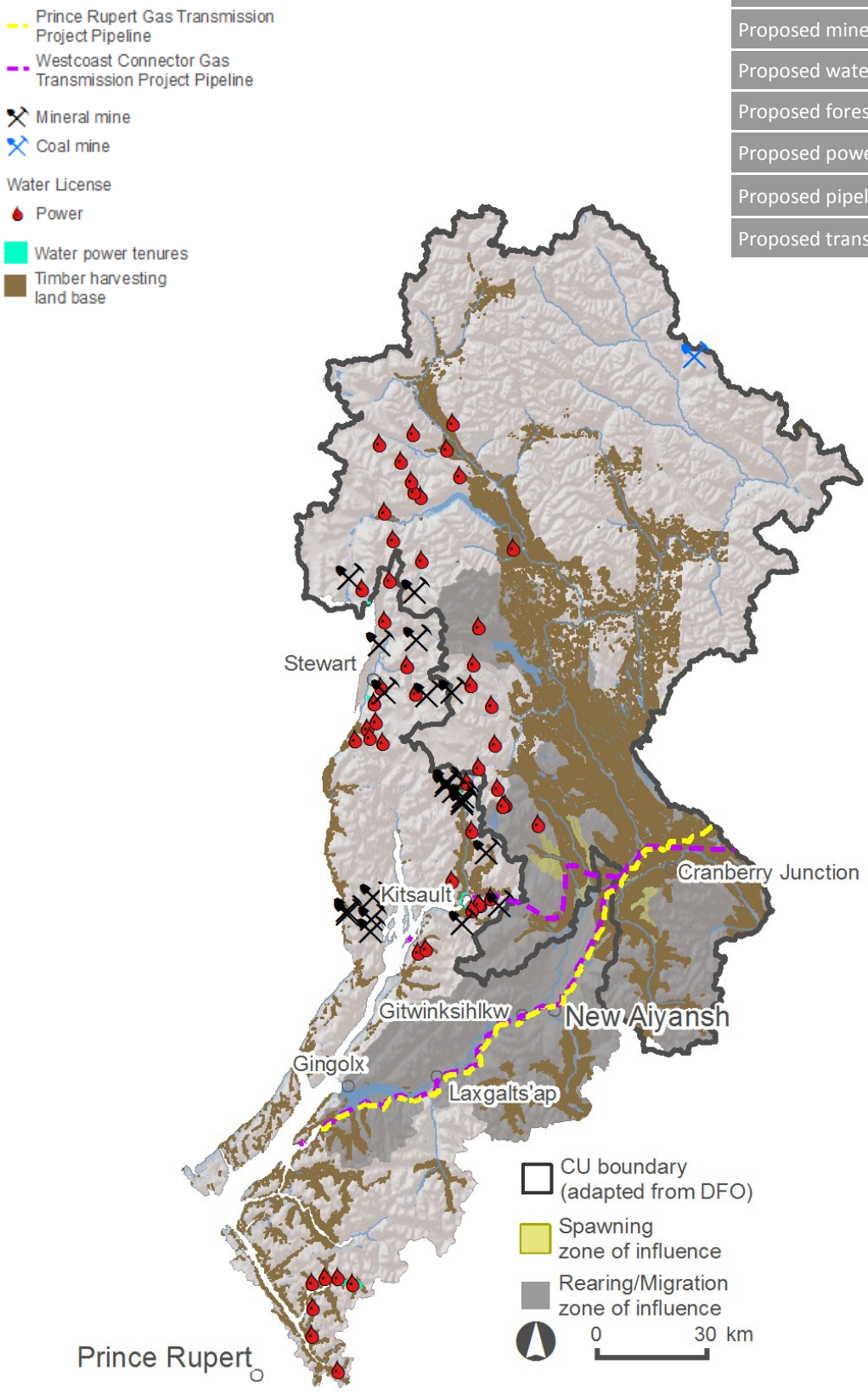




Future pressure

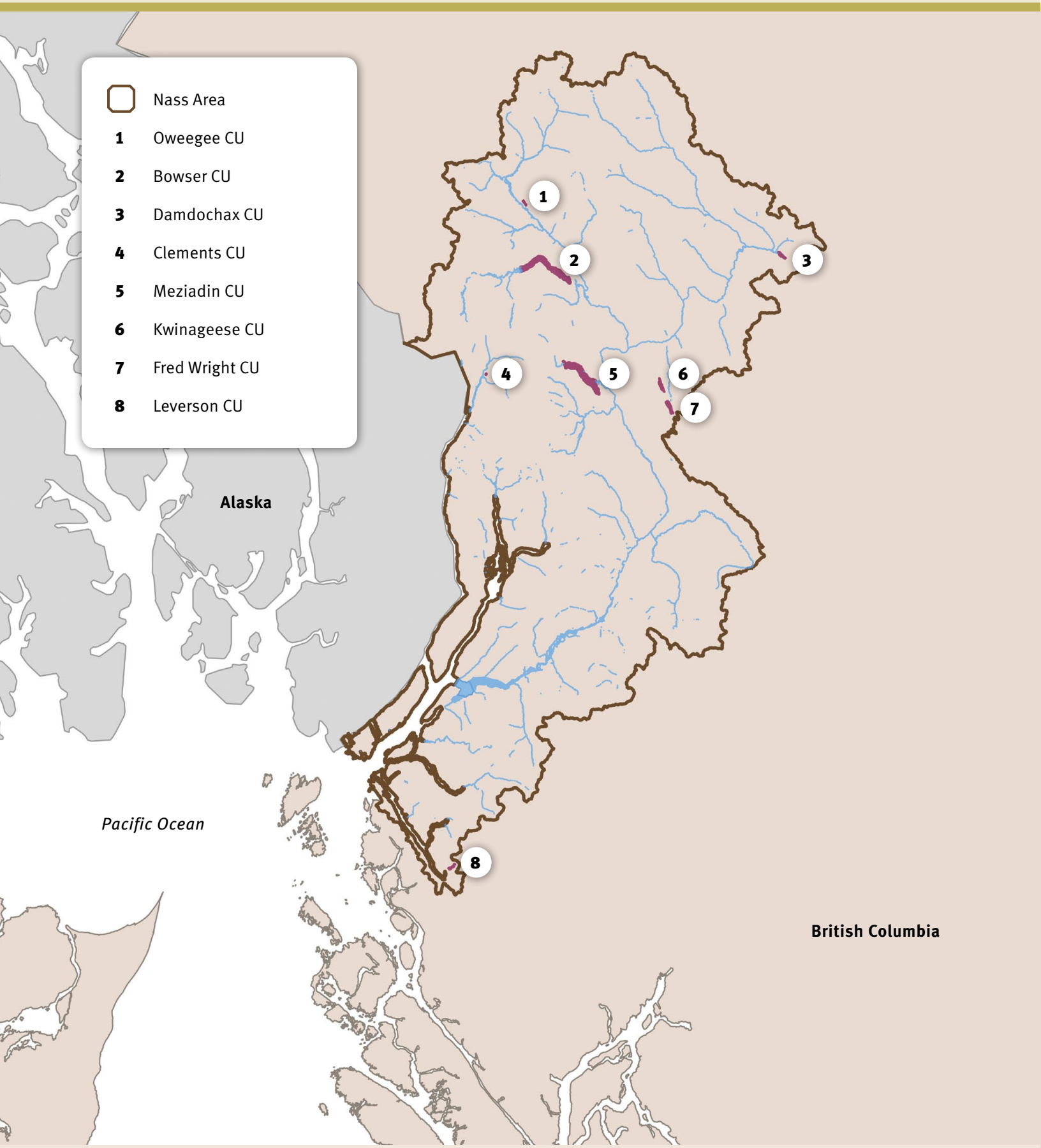
Proposed resource development projects (as of 2016)

Nass Drainage Summary	
	Totals
Proposed coal mines (#)	1
Proposed mineral mines (#)	22
Proposed water licenses (#)	58
Proposed forestry (km^2)	3,323 km^2
Proposed power tenures	Wind 0 km^2, water 15 km^2
Proposed pipelines (km)	386 km
Proposed transmission lines	0 km

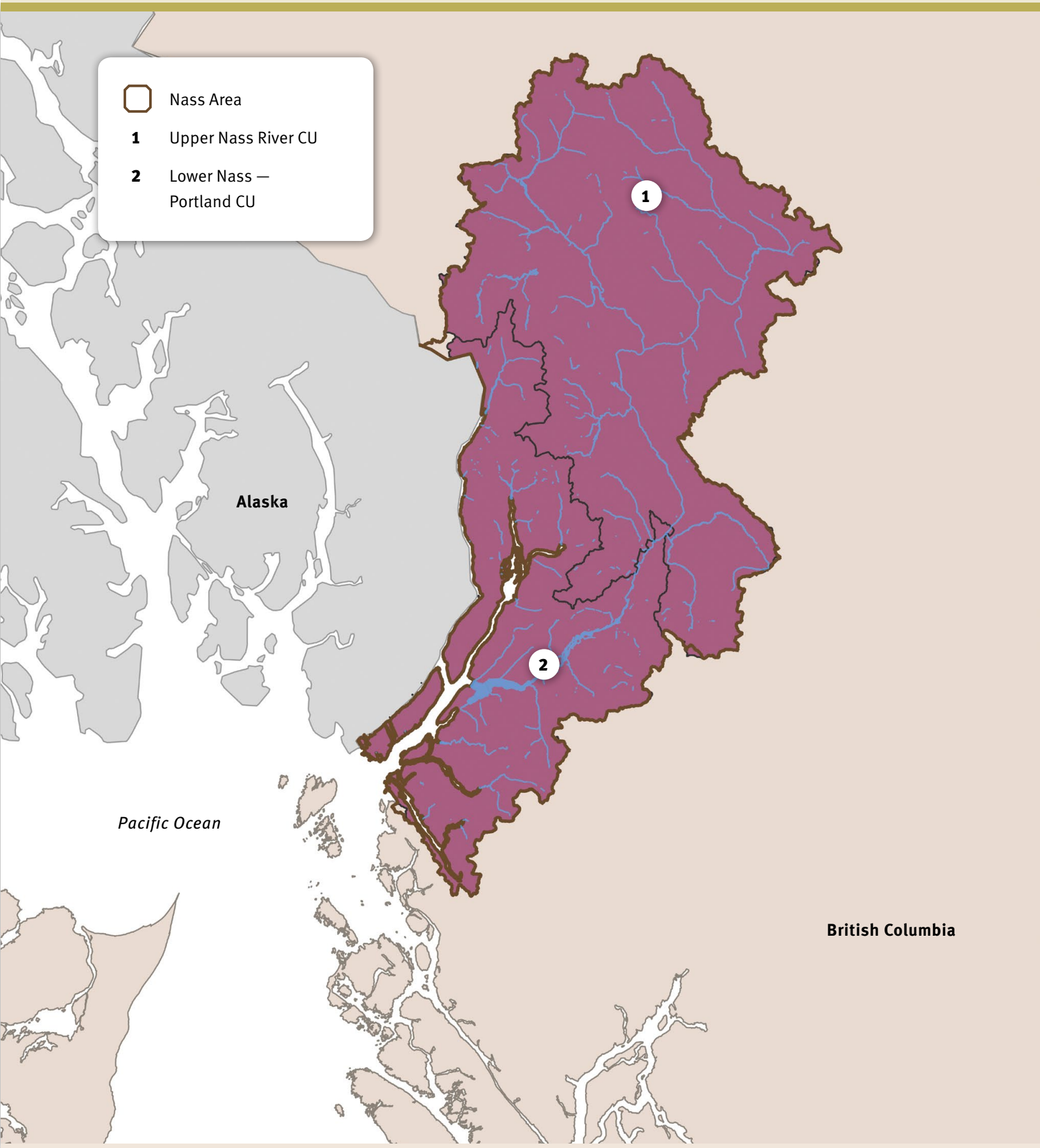


Sockeye

Lake Sockeye: Map of Conservation Units (CUs)



River-Type Sockeye: Map of Conservation Units (CUs)



Lake Sockeye: Clements

Introduction

This project summarizes pressures on the habitat used by Nass salmon Conservation Units (CU) during their freshwater life history stages (migration, spawning and rearing), as well as their relative vulnerability to those pressures. For an explanation of the indicators shown here, please see the accompanying *Report Card Summaries*. Full methods and results can be found in the main report, *Cumulative Pressures on Nass Salmon Habitat: Technical Report* (2016).

Definitions

Conservation Unit (CU): A group of wild salmon sufficiently isolated from other groups that, if extirpated, is very unlikely to re-colonize naturally within an acceptable timeframe.

Pressure indicator: Measurable extent/intensity of natural processes or human activities that can induce changes in habitat condition/state.

Vulnerability indicator: Measures of habitat quantity or quality used to represent the intrinsic habitat vulnerability/sensitivity to watershed disturbances for each life-stage.

Zone of influence (ZOI): Areas adjacent to and upstream/upslope of habitats used by salmon CUs that represent the geographic extent for capture/measurement of pressure and vulnerability indicators.

Status: Condition of habitat relative to a defined indicator benchmark.

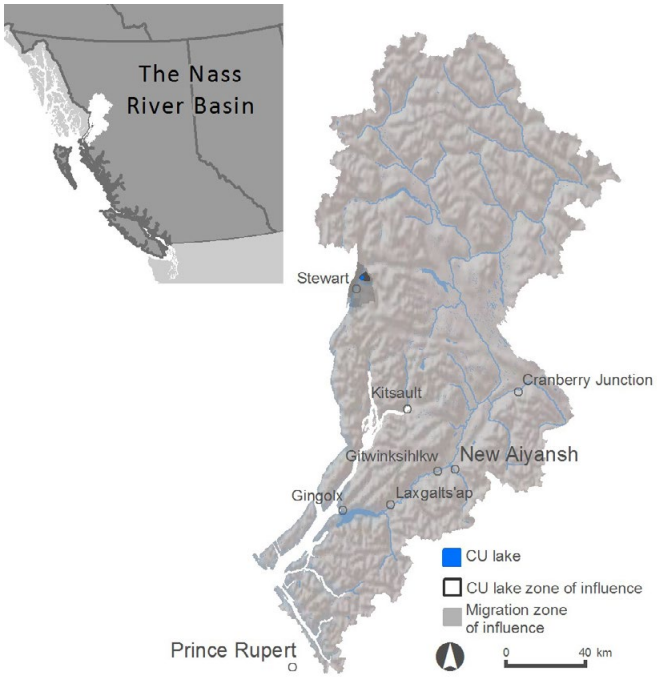
Risk: Likelihood of adverse effects to salmon habitats within a defined zone of influence. Levels of increasing risk are defined based on the extent/intensity of impacts relative to defined benchmarks of concern.

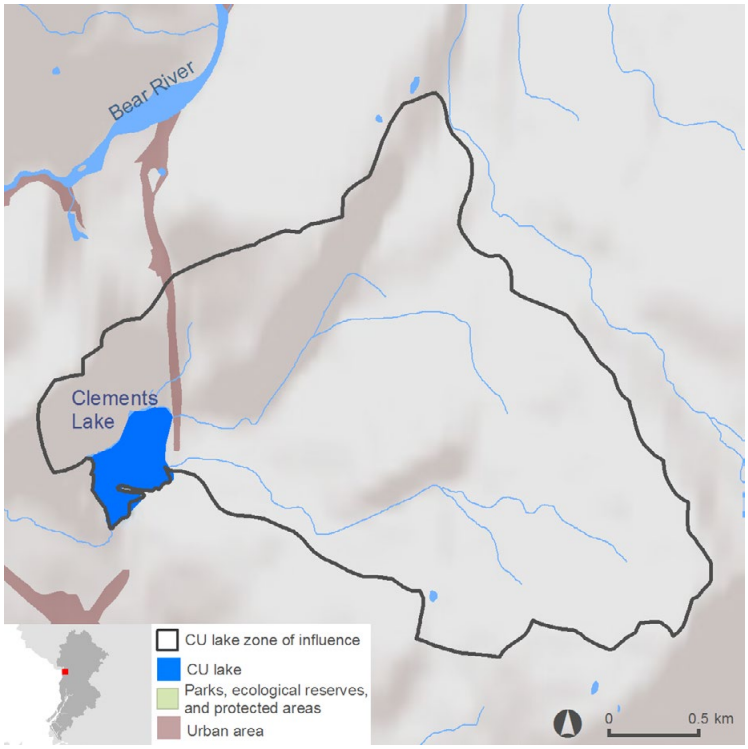
Benchmark: A standard (quantified metric) against which habitat condition can be measured or judged, and by which status can be compared over time and space to determine the risk of adverse effects.

Narrative

- There are ten sockeye salmon CUs in the Nass Area: two are river-type CUs (Upper Nass—UNR and Lower Nass-Portland—LNR-P) and eight are lake-type (Clements, Leverson, Bowser, Damdochax, Fred Wright, Kwinageese, Meziadin, and Oweegee).
- Nearly all of the sockeye salmon production in the Nass Area comes from the lake-type CUs in the upper watershed (i.e. Meziadin, Bowser, Damdochax, Fred Wright, Kwinageese, and Oweegee).
- Nass Area sockeye salmon exhibit variable life history characteristics, with the majority being lake-type and spending one full year rearing in a lake.
- A marine-type population, where salmon go to sea in their first year, is found in some lower Nass tributaries.
- Nass Area sockeye salmon predominantly reside at sea for one to four years, with the majority spending either two or three years at sea.

Location





Summary of habitat vulnerabilities & pressures

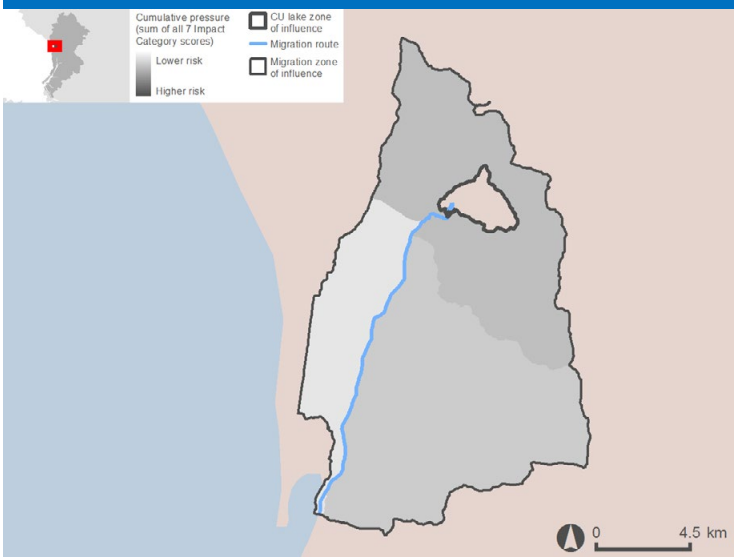
Pressure indicators were grouped into seven relatively independent habitat "impact categories" representing key factors affecting general watershed condition:

- Hydrologic Processes (Forest disturbance; Equivalent Clearcut Area)
- Vegetation Quality (Insect and disease defoliation; Riparian disturbance)
- Surface Erosion (Road development)
- Fish passage/Habitat connectivity (Stream crossing density)
- Water quantity (Water licenses)
- Human development footprint (Total land cover alteration; Impervious surfaces; Linear development; Mining development)
- Water quality (Wastewater discharges)

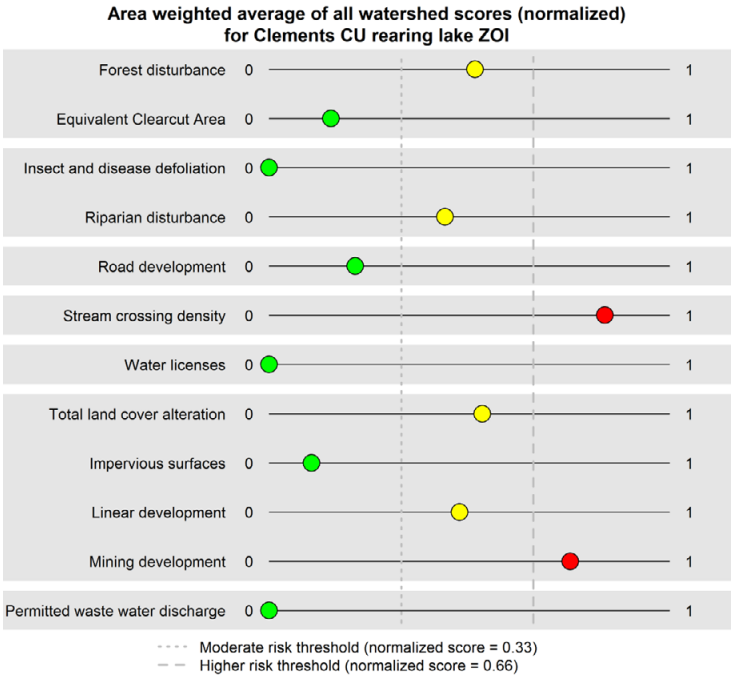
Indicators were also developed reflecting relative vulnerability to habitat pressures within the life stage-specific "zones of influence" defined for each lake sockeye CU:

- Migration (Total migration distance; Length and percentage of migration route summer flow sensitive)
- Spawning (Total spawning length; Spawning length in tributary, lake or mainstem; Ratio of lake influenced to total spawning length; Length of accessible habitat)
- Rearing (Rearing lake area)

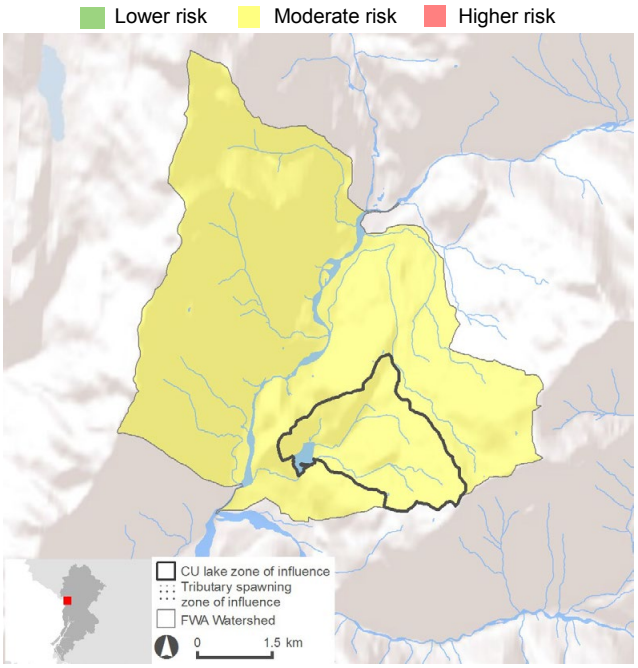
Cumulative pressure—migration



Summary of pressure indicators—rearing

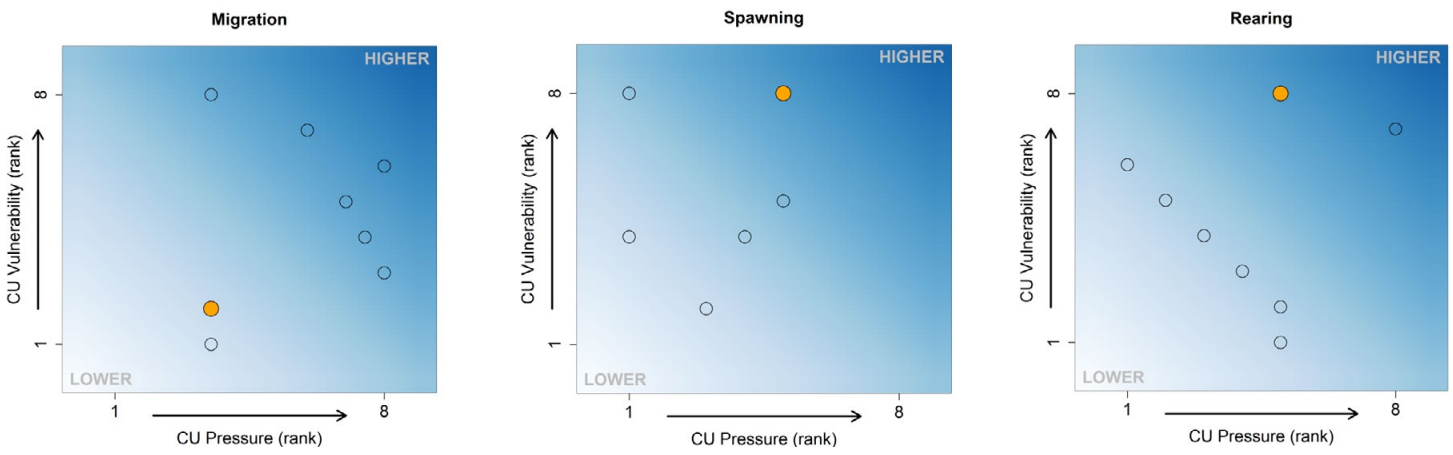


Cumulative pressure—rearing & spawning



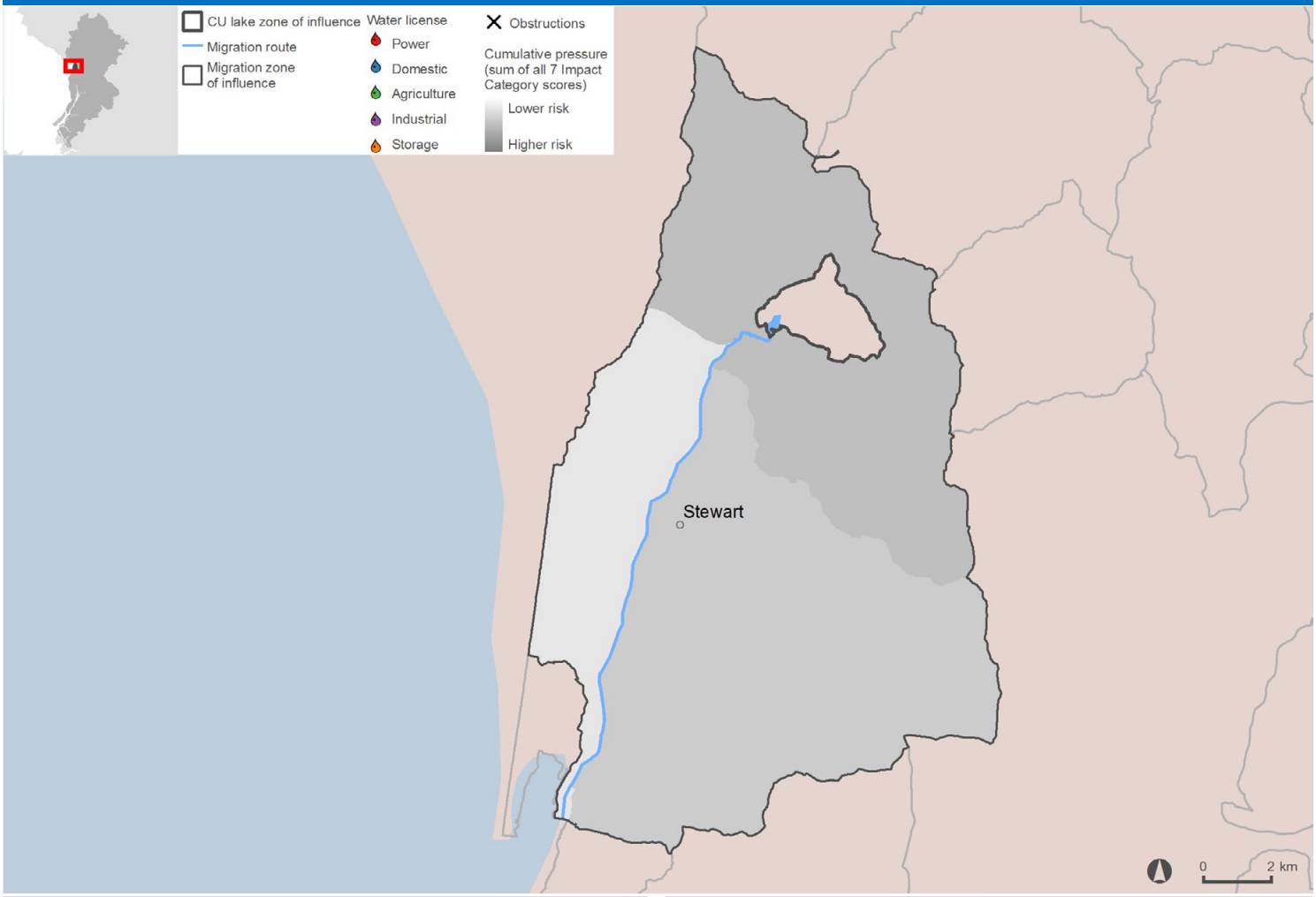
Integrated vulnerability/habitat pressures—migration, spawning, & rearing

● = Clements ○ = other lake sockeye CUs

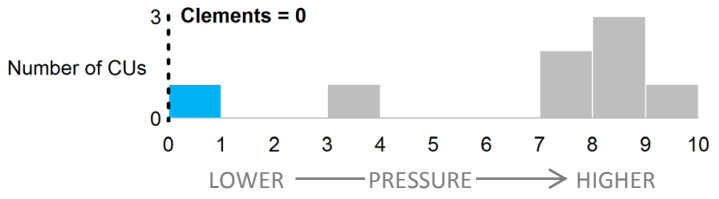


Migration vulnerability & pressure

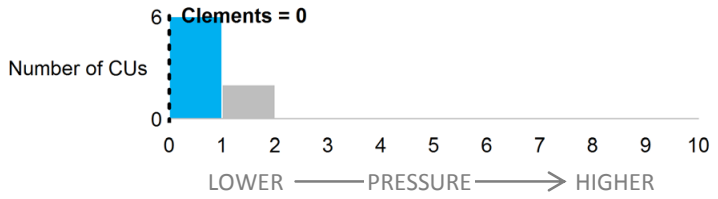
Migration period pressures



Number of obstructions along migration route

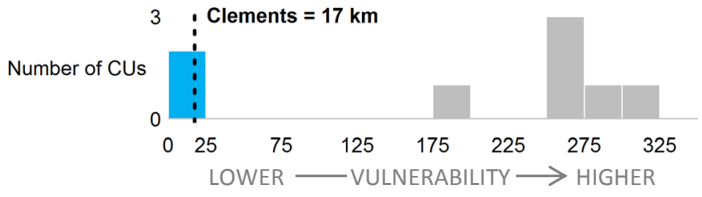


Number of water licenses along migration ZOI

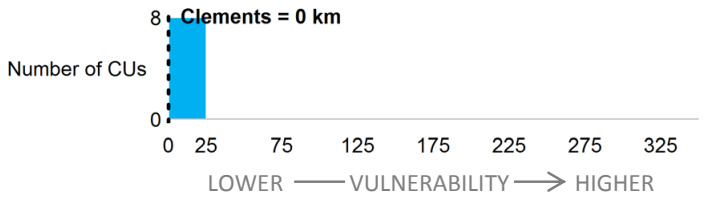


Migration period vulnerability

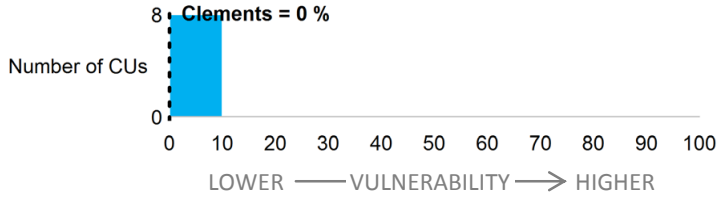
Migration distance (km)



Migration route - summer low flow sensitive (km)



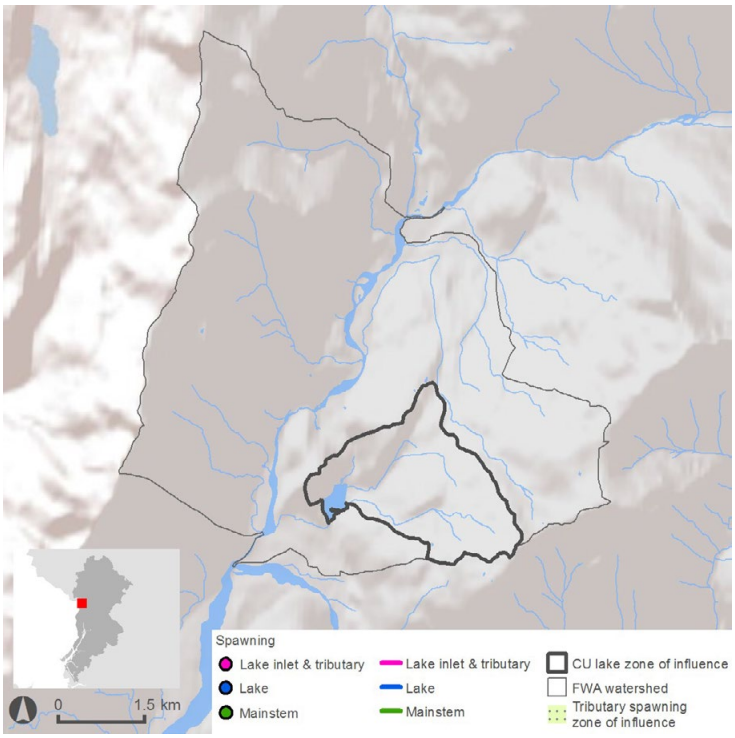
Migration route - summer low flow sensitive (%)



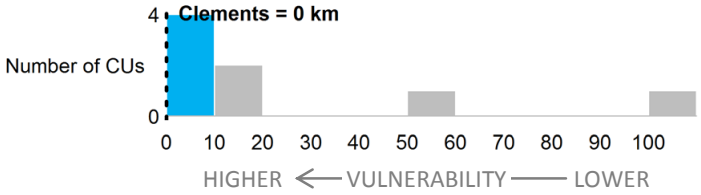
Spawning & rearing vulnerability

Spawning period vulnerability

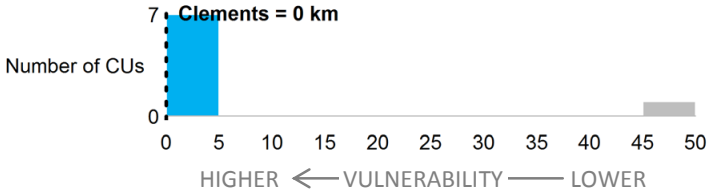
Spawning locations



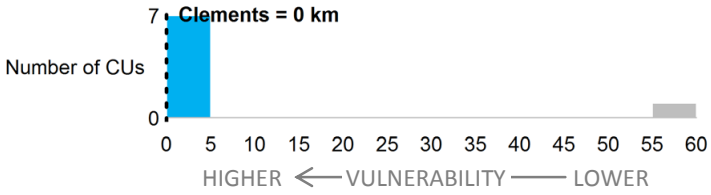
Total (mainstem, trib & lake) spawning length (km)



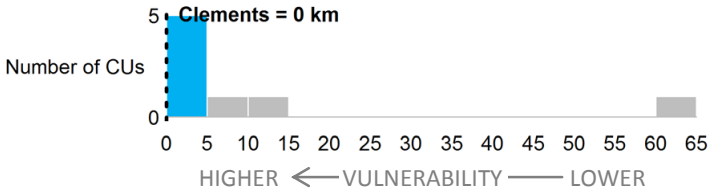
Length of lake shore spawning areas (km)



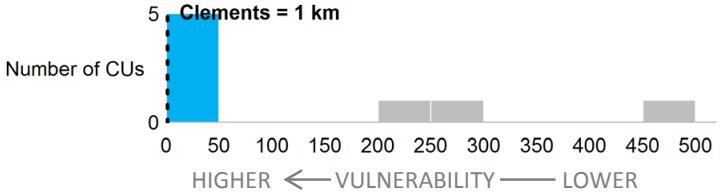
Mainstem spawning length (km)



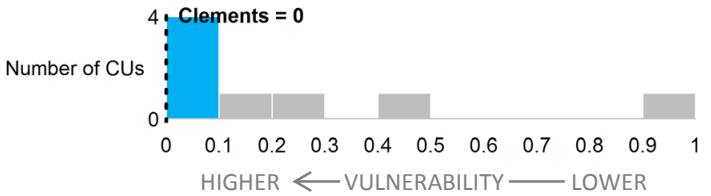
Tributary and lake inlet spawning length (km)



Salmon accessible habitat (km)

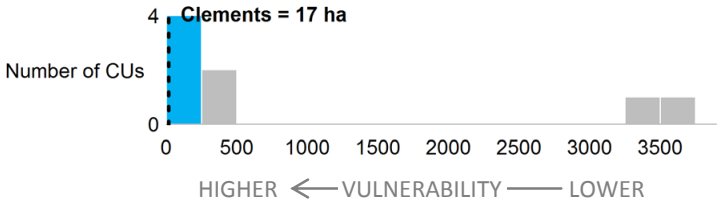


Ratio of lake influenced to total spawning



Rearing period vulnerability

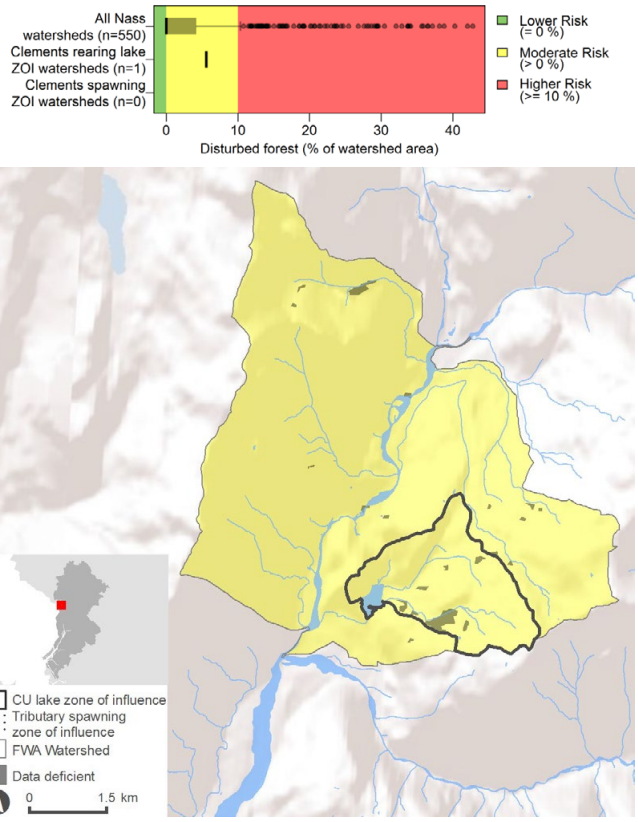
Area of nursery lakes (ha)



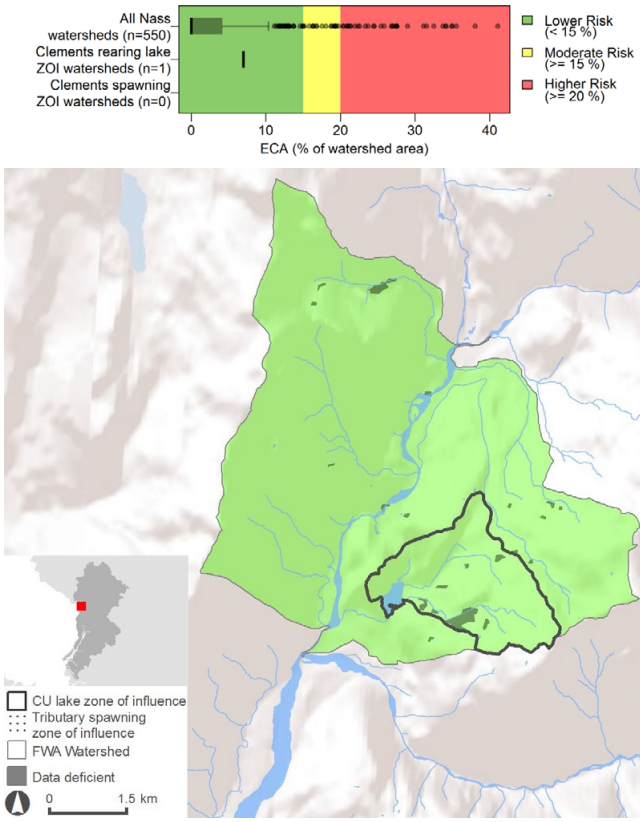
Spawning & rearing pressure

Hydrologic Processes

Forest disturbance

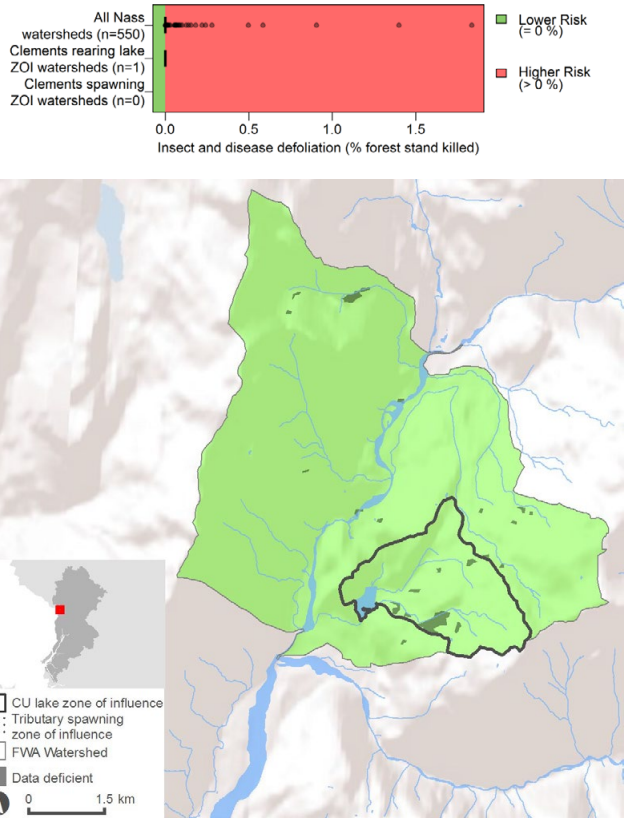


Equivalent Clear-cut Area

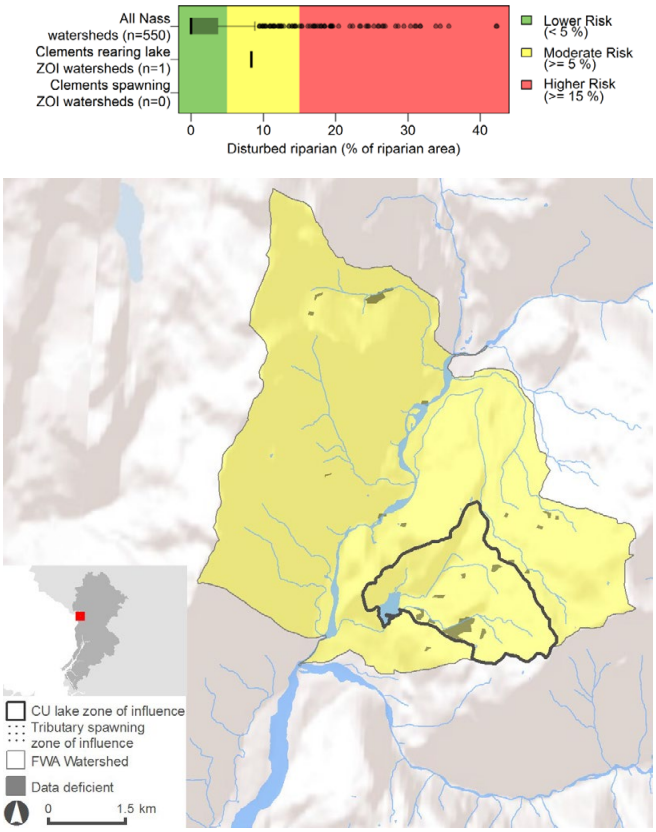


Vegetation Quality

Insect and disease defoliation

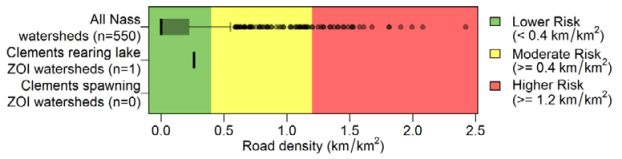


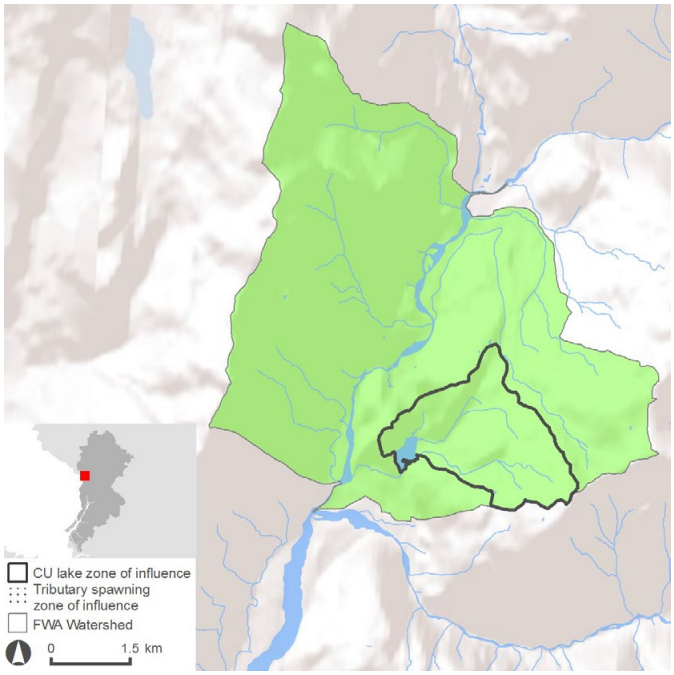
Riparian disturbance



Surface Erosion

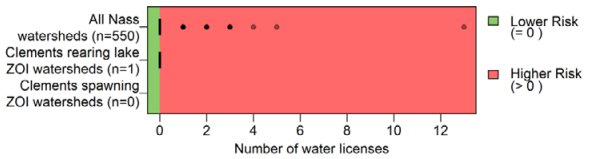
Road development

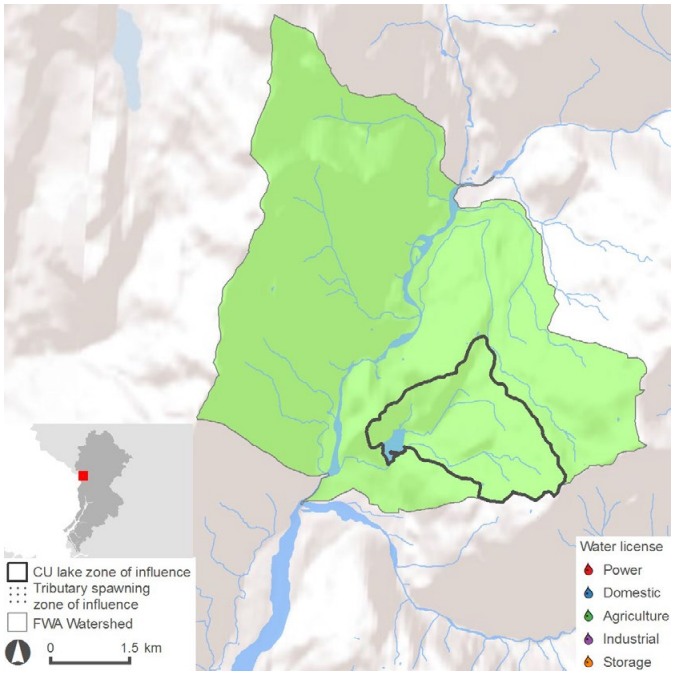




Water Quantity

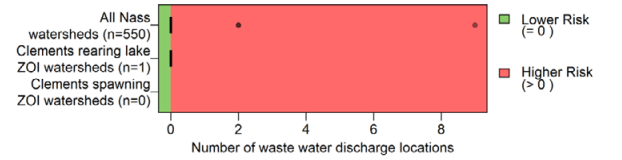
Number of water licenses

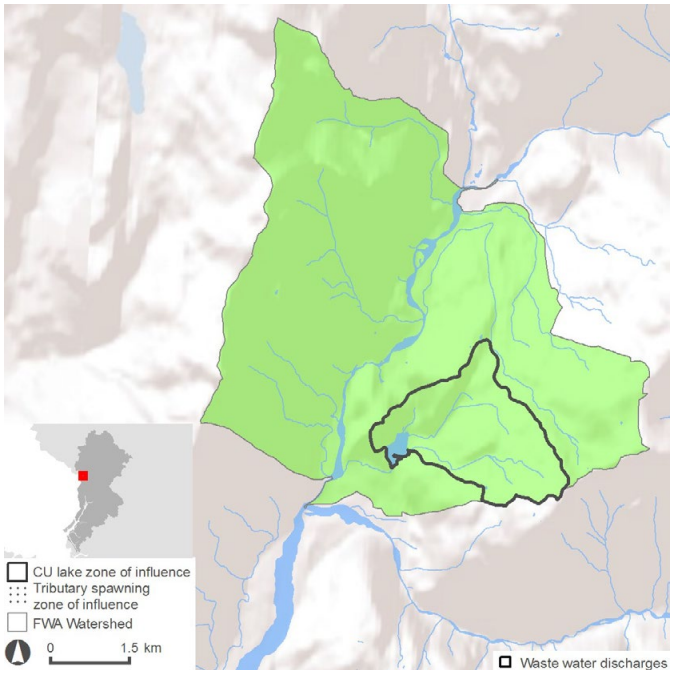




Water Quality

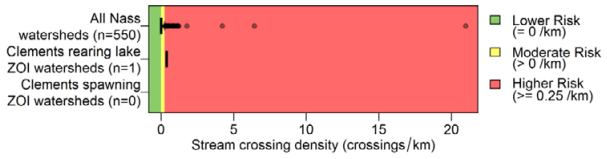
Permitted waste water discharges

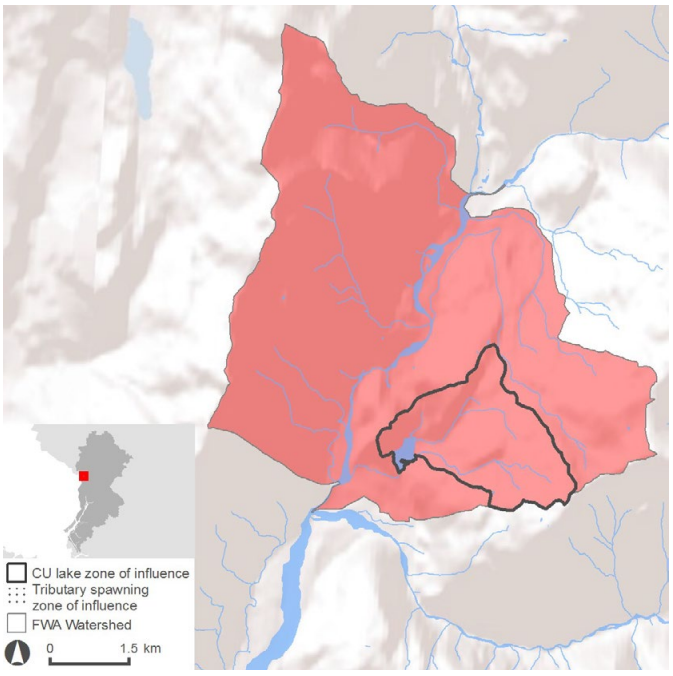




Fish Passage/Habitat Connectivity

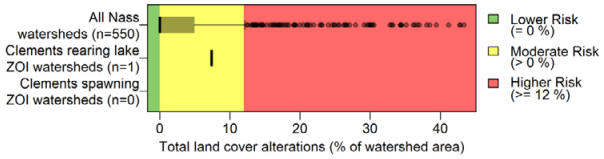
Stream crossing density

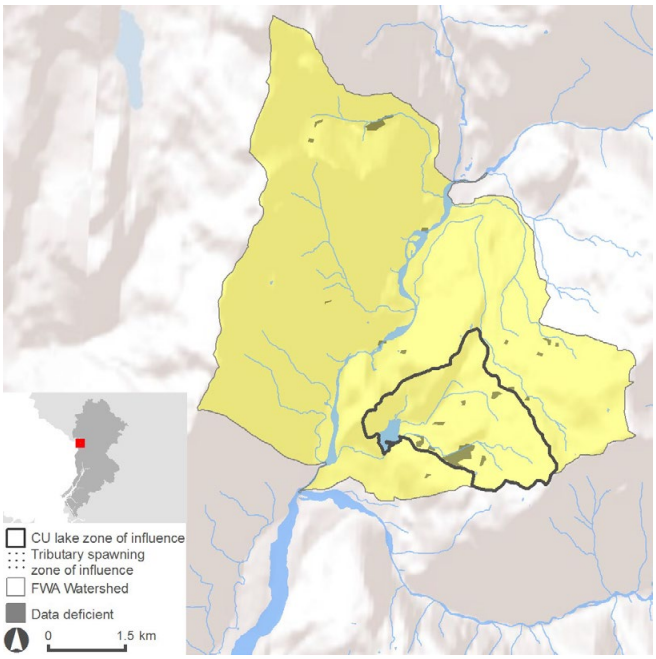




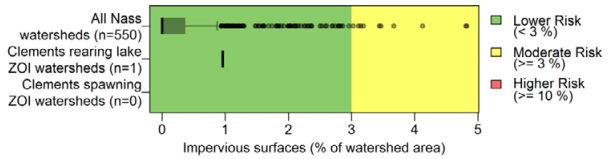
Human Development Footprint

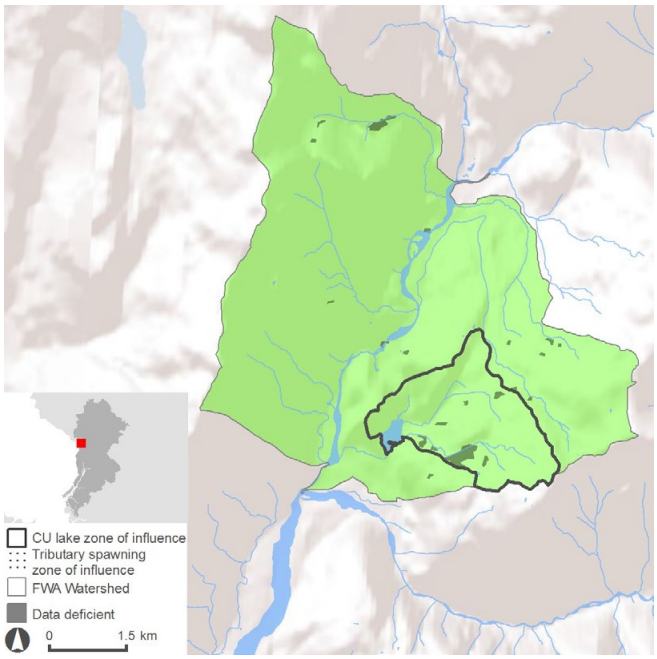
Total land cover alteration



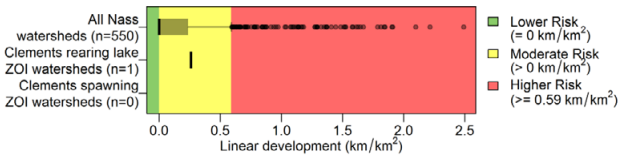


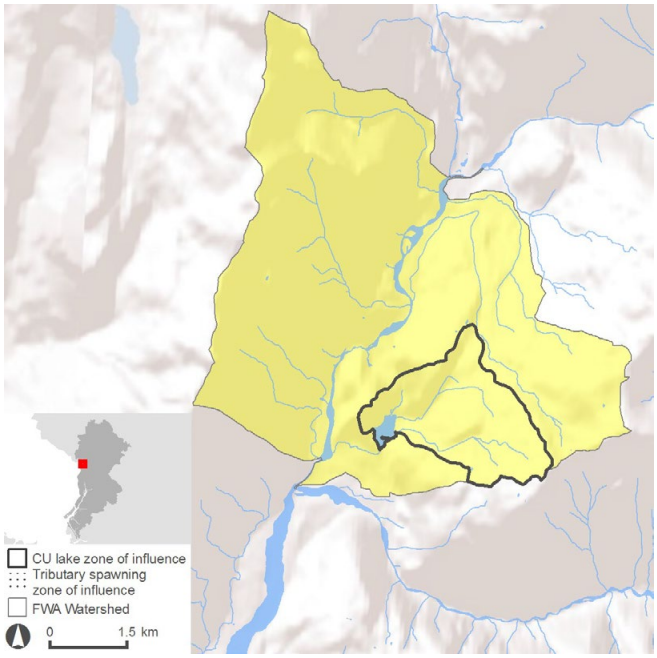
Impervious surfaces



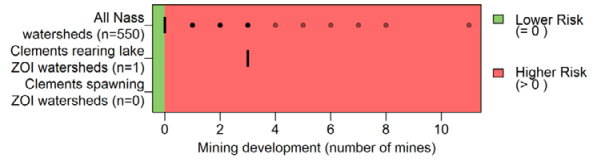


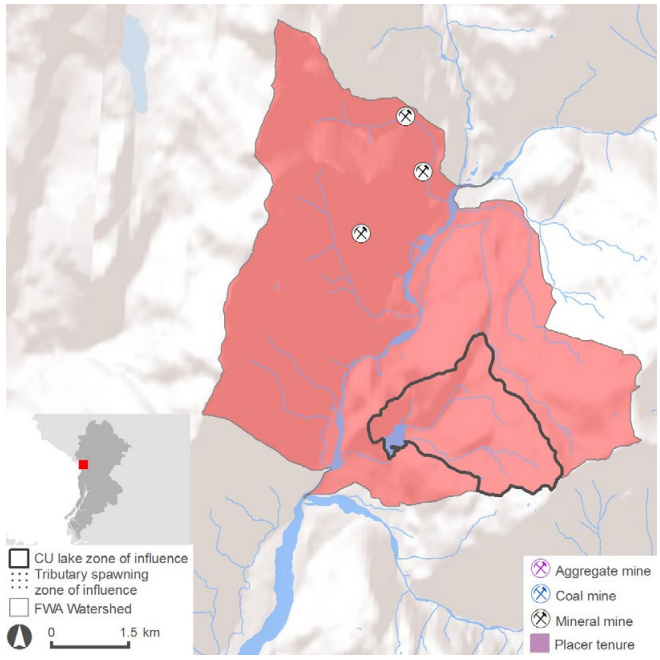
Linear development





Mining development (total number of mines)

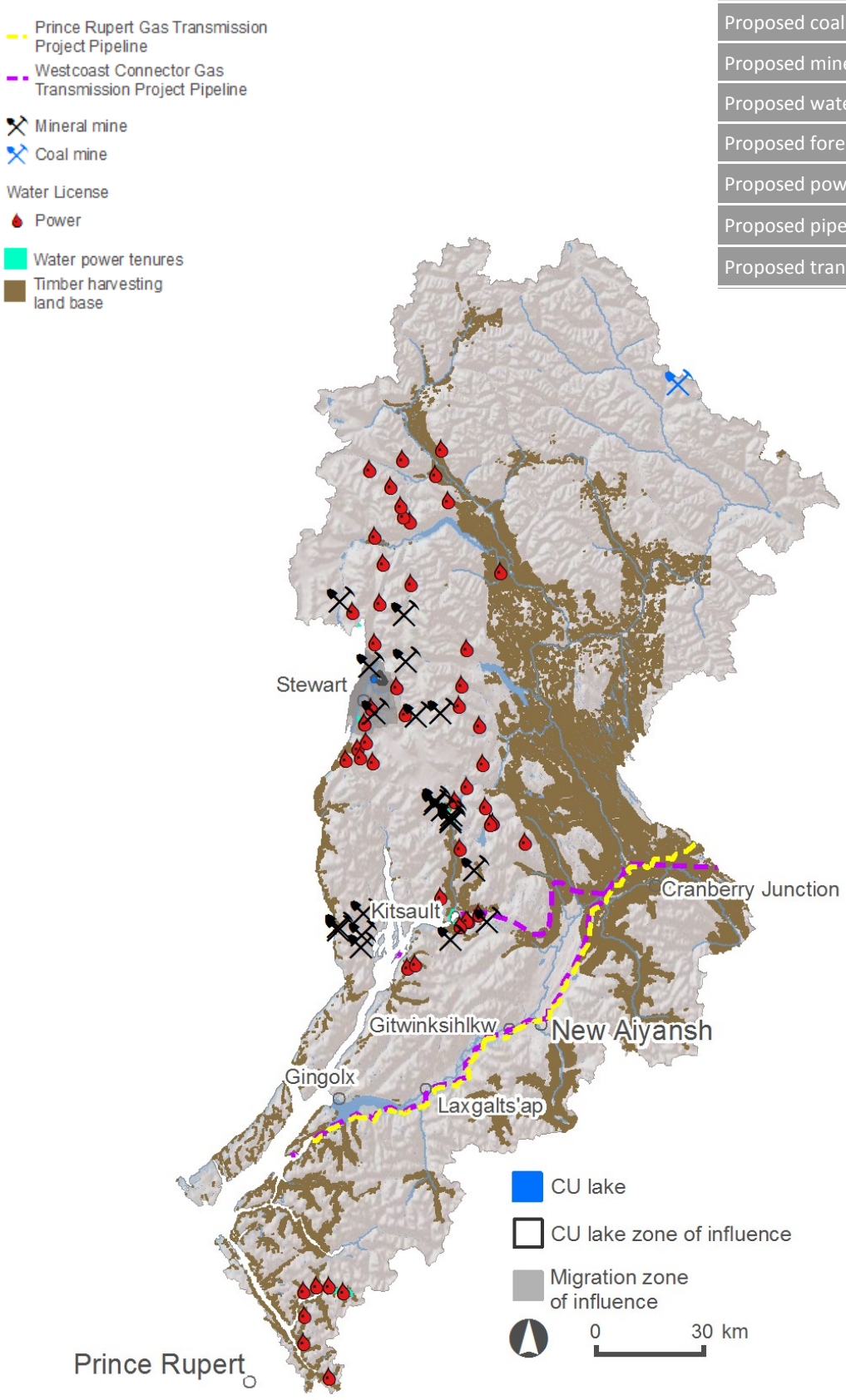




Future pressure

Proposed resource development projects (as of 2016)

Nass Drainage Summary	
	Totals
Proposed coal mines (#)	1
Proposed mineral mines (#)	22
Proposed water licenses (#)	58
Proposed forestry (km^2)	3,323 km^2
Proposed power tenures	Wind 0 km^2, water 15 km^2
Proposed pipelines (km)	386 km
Proposed transmission lines	0 km



Lake Sockeye: Leverson

Introduction

This project summarizes pressures on the habitat used by Nass salmon Conservation Units (CU) during their freshwater life history stages (migration, spawning and rearing), as well as their relative vulnerability to those pressures. For an explanation of the indicators shown here, please see the accompanying *Report Card Summaries*. Full methods and results can be found in the main report, *Cumulative Pressures on Nass Salmon Habitat: Technical Report* (2016).

Definitions

Conservation Unit (CU): A group of wild salmon sufficiently isolated from other groups that, if extirpated, is very unlikely to re-colonize naturally within an acceptable timeframe.

Pressure indicator: Measurable extent/intensity of natural processes or human activities that can induce changes in habitat condition/state.

Vulnerability indicator: Measures of habitat quantity or quality used to represent the intrinsic habitat vulnerability/sensitivity to watershed disturbances for each life-stage.

Zone of influence (ZOI): Areas adjacent to and upstream/upslope of habitats used by salmon CUs that represent the geographic extent for capture/measurement of pressure and vulnerability indicators.

Status: Condition of habitat relative to a defined indicator benchmark.

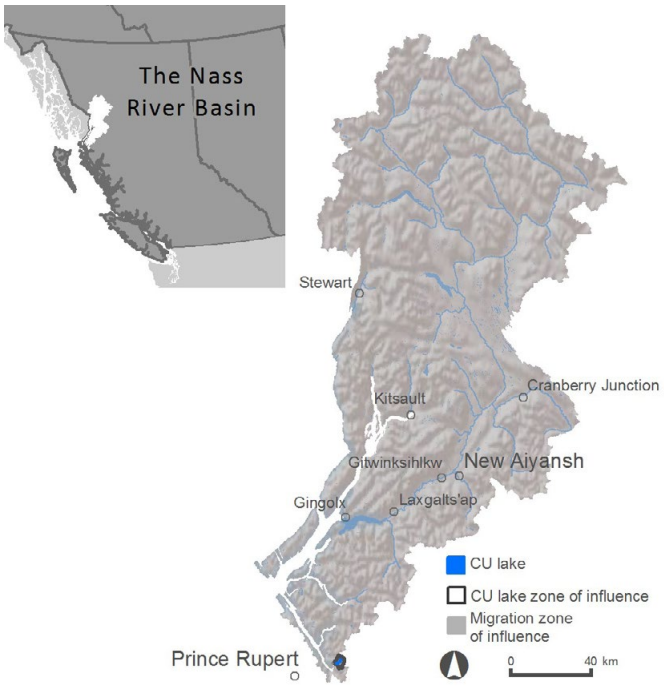
Risk: Likelihood of adverse effects to salmon habitats within a defined zone of influence. Levels of increasing risk are defined based on the extent/intensity of impacts relative to defined benchmarks of concern.

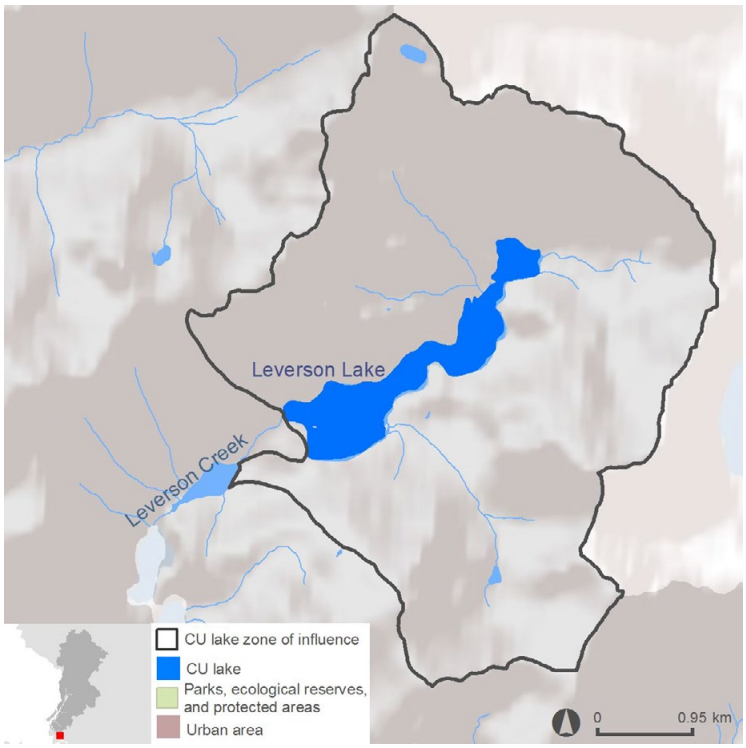
Benchmark: A standard (quantified metric) against which habitat condition can be measured or judged, and by which status can be compared over time and space to determine the risk of adverse effects.

Narrative

- There are ten sockeye salmon CUs in the Nass Area: two are river-type CUs (Upper Nass—UNR and Lower Nass-Portland—LNR-P) and eight are lake-type (Clements, Leverson, Bowser, Damdochax, Fred Wright, Kwinageese, Meziadin, and Oweegee).
- Nearly all of the sockeye salmon production in the Nass Area comes from the lake-type CUs in the upper watershed (i.e. Meziadin, Bowser, Damdochax, Fred Wright, Kwinageese, and Oweegee).
- Nass Area sockeye salmon exhibit variable life history characteristics, with the majority being lake-type and spending one full year rearing in a lake.
- A marine-type population, where salmon go to sea in their first year, is found in some lower Nass tributaries.
- Nass Area sockeye salmon predominantly reside at sea for one to four years, with the majority spending either two or three years at sea.

Location





Summary of habitat vulnerabilities & pressures

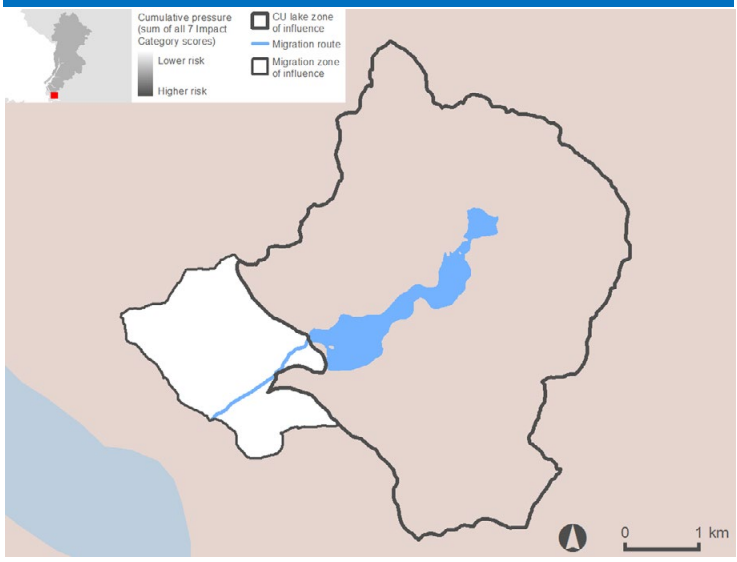
Pressure indicators were grouped into seven relatively independent habitat "impact categories" representing key factors affecting general watershed condition:

- Hydrologic Processes (Forest disturbance; Equivalent Clearcut Area)
- Vegetation Quality (Insect and disease defoliation; Riparian disturbance)
- Surface Erosion (Road development)
- Fish passage/Habitat connectivity (Stream crossing density)
- Water quantity (Water licenses)
- Human development footprint (Total land cover alteration; Impervious surfaces; Linear development; Mining development)
- Water quality (Wastewater discharges)

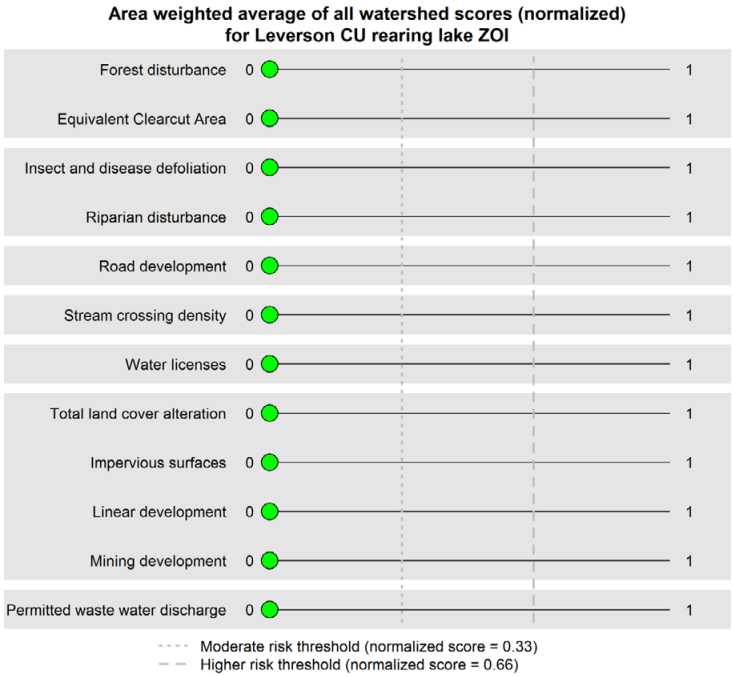
Indicators were also developed reflecting relative vulnerability to habitat pressures within the life stage-specific "zones of influence" defined for each lake sockeye CU:

- Migration (Total migration distance; Length and percentage of migration route summer flow sensitive)
- Spawning (Total spawning length; Spawning length in tributary, lake or mainstem; Ratio of lake influenced to total spawning length; Length of accessible habitat)
- Rearing (Rearing lake area)

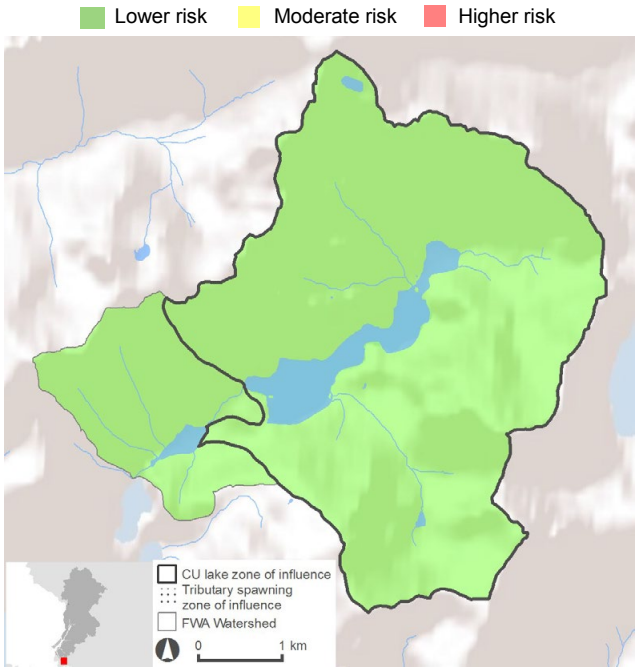
Cumulative pressure—migration



Summary of pressure indicators—rearing

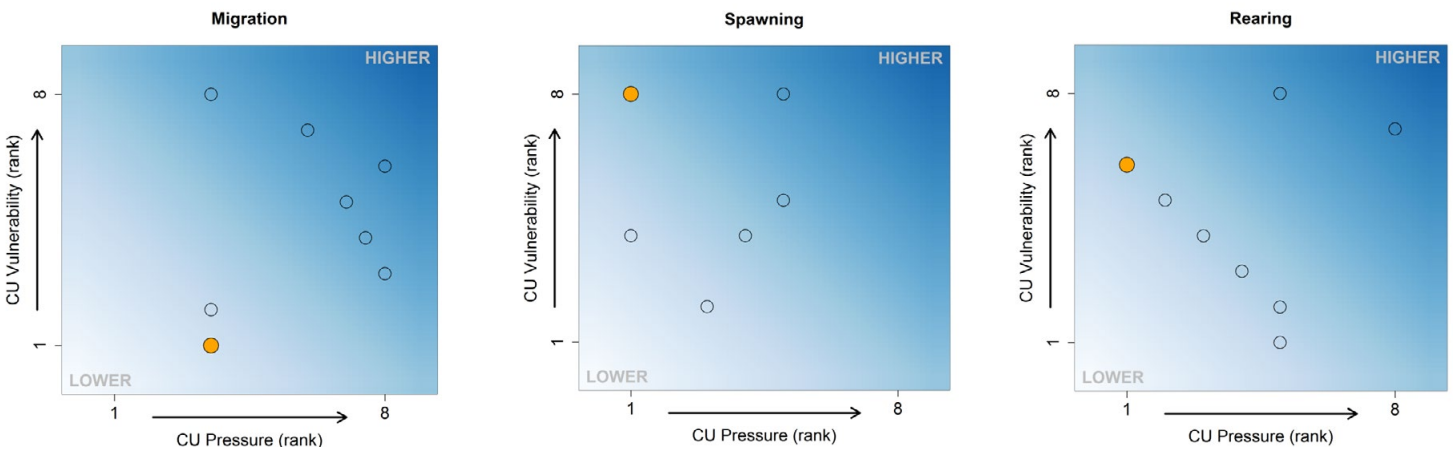


Cumulative pressure—rearing & spawning



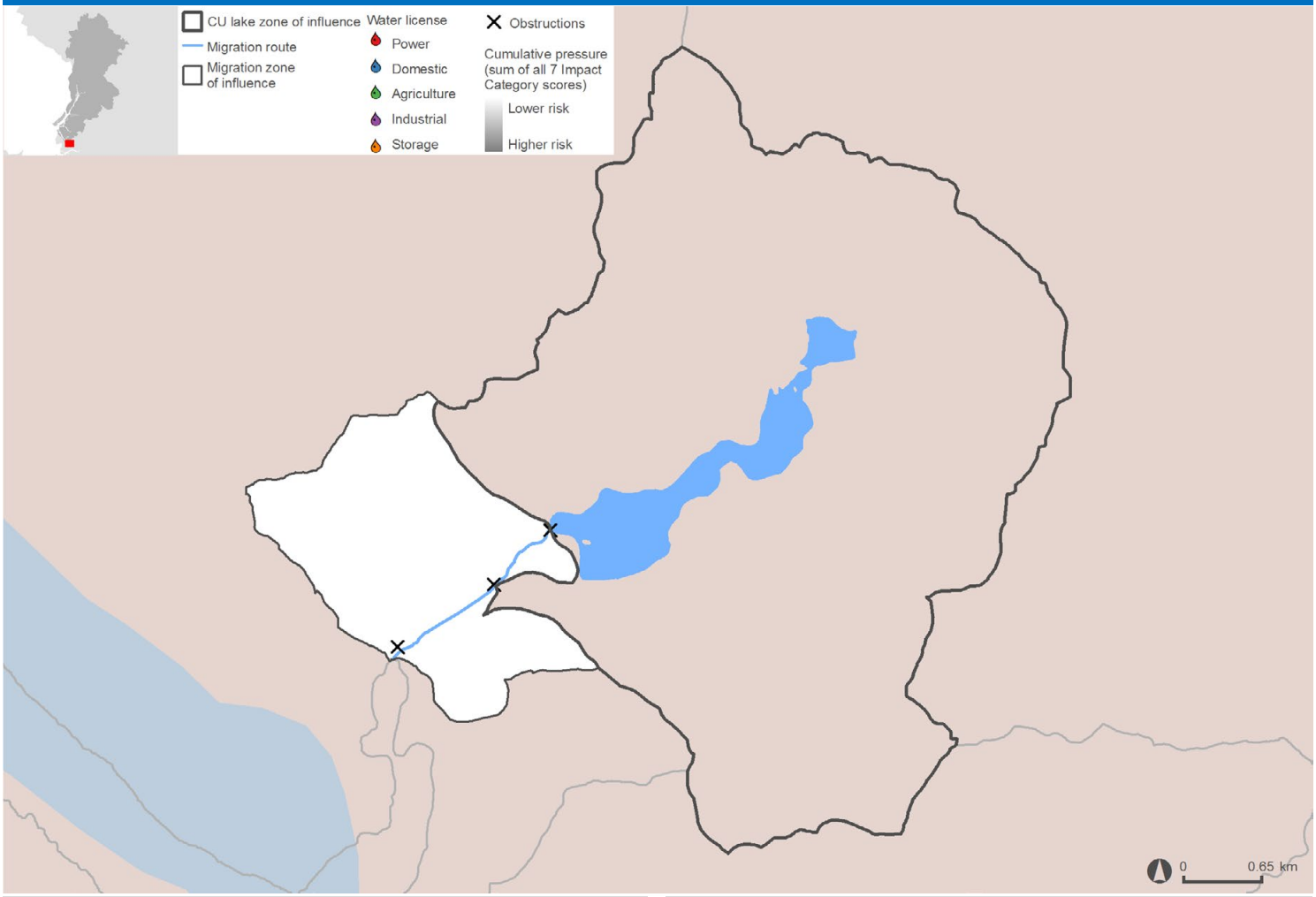
Integrated vulnerability/habitat pressures—migration, spawning, & rearing

● = Leverson ○ = other lake sockeye CUs

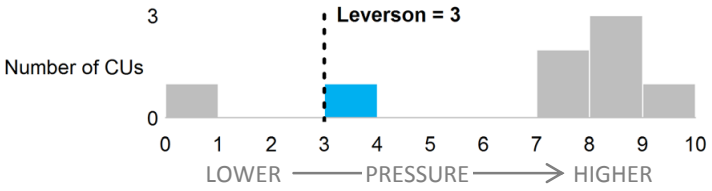


Migration vulnerability & pressure

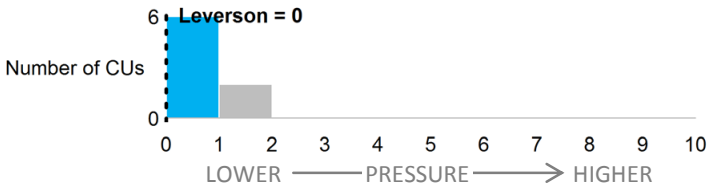
Migration period pressures



Number of obstructions along migration route

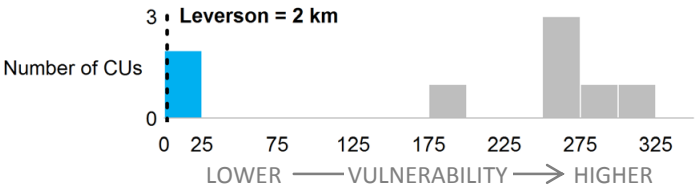


Number of water licenses along migration ZOI

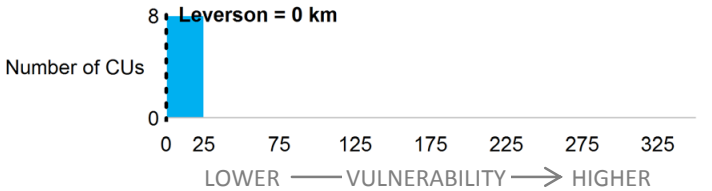


Migration period vulnerability

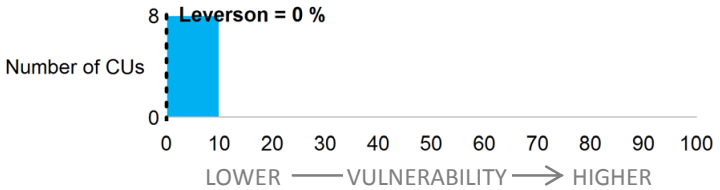
Migration distance (km)



Migration route - summer low flow sensitive (km)



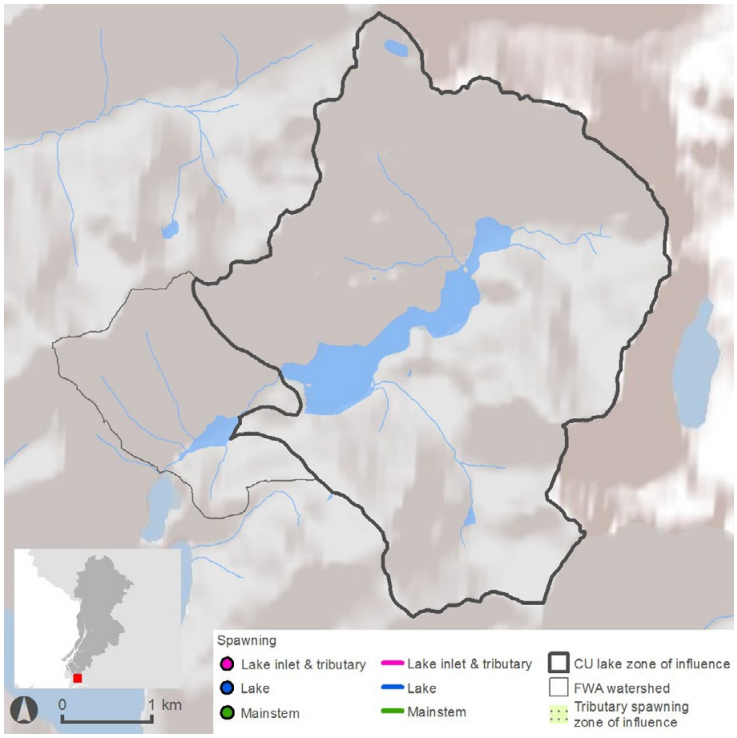
Migration route - summer low flow sensitive (%)



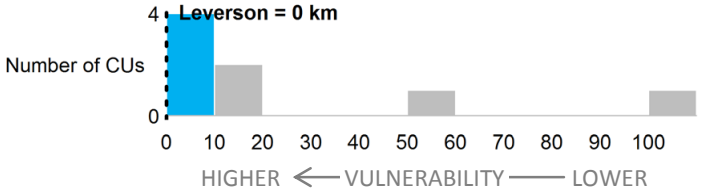
Spawning & rearing vulnerability

Spawning period vulnerability

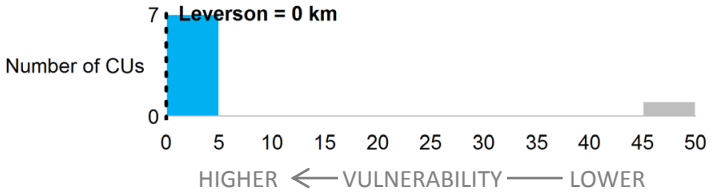
Spawning locations



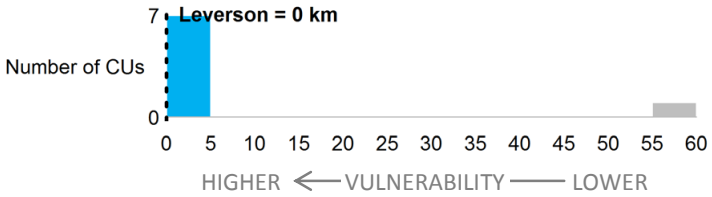
Total (mainstem, trib & lake) spawning length (km)



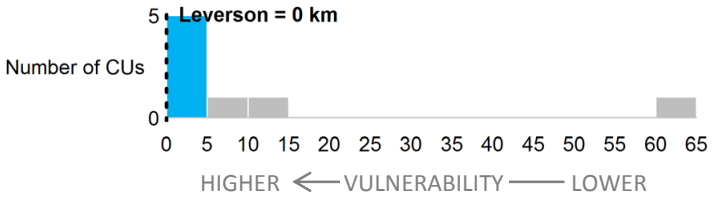
Length of lake shore spawning areas (km)



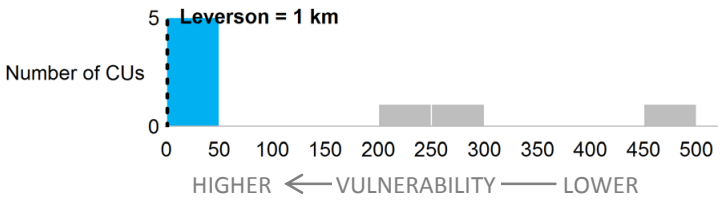
Mainstem spawning length (km)



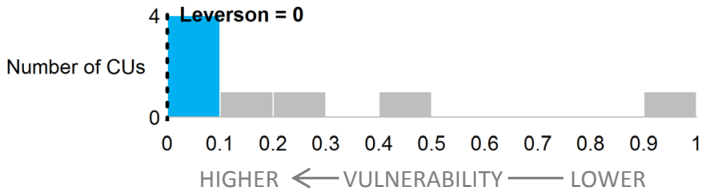
Tributary and lake inlet spawning length (km)



Salmon accessible habitat (km)

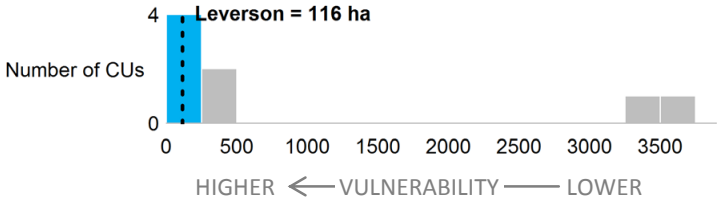


Ratio of lake influenced to total spawning



Rearing period vulnerability

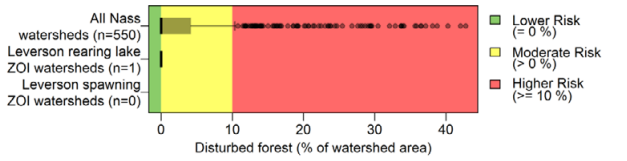
Area of nursery lakes (ha)

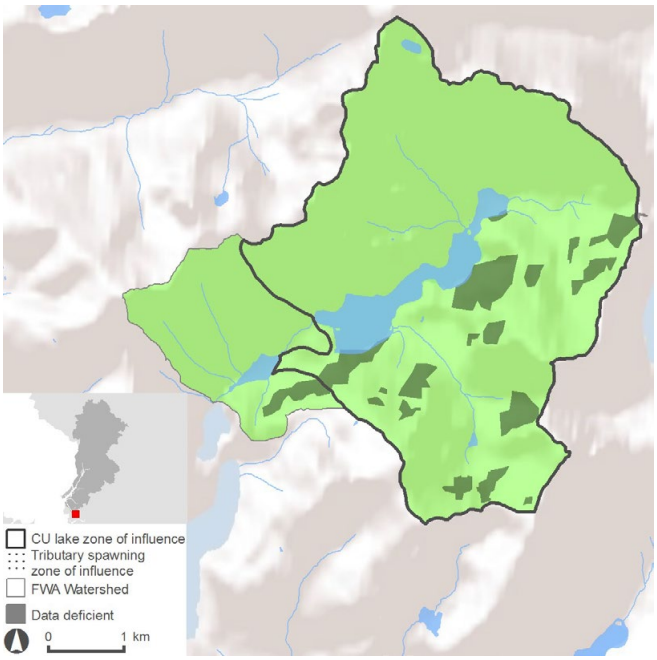


Spawning & rearing pressure

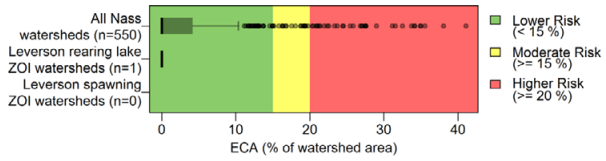
Hydrologic Processes

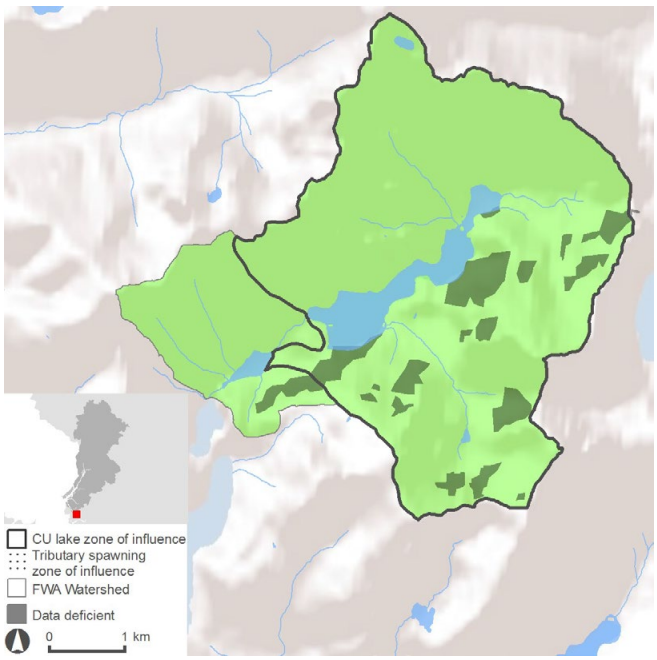
Forest disturbance





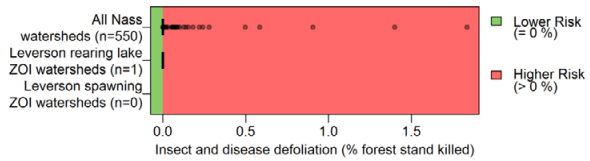
Equivalent Clear-cut Area

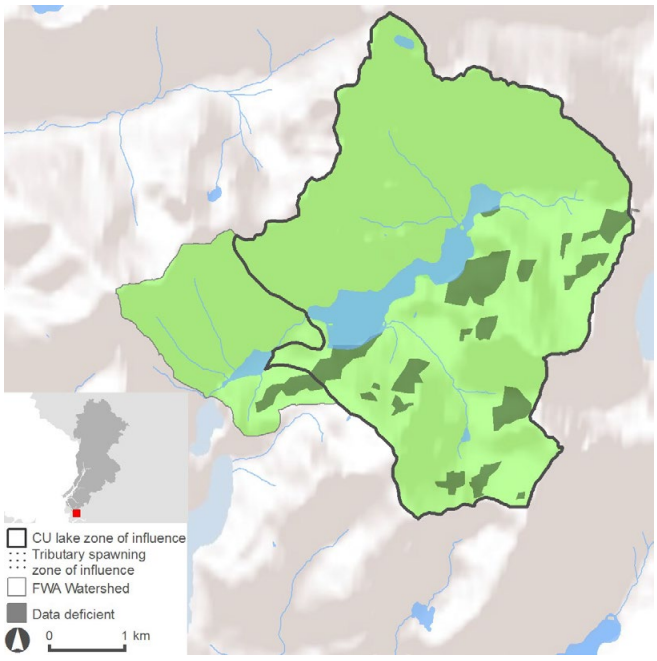




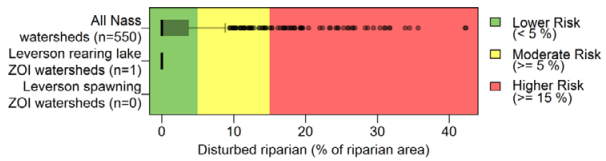
Vegetation Quality

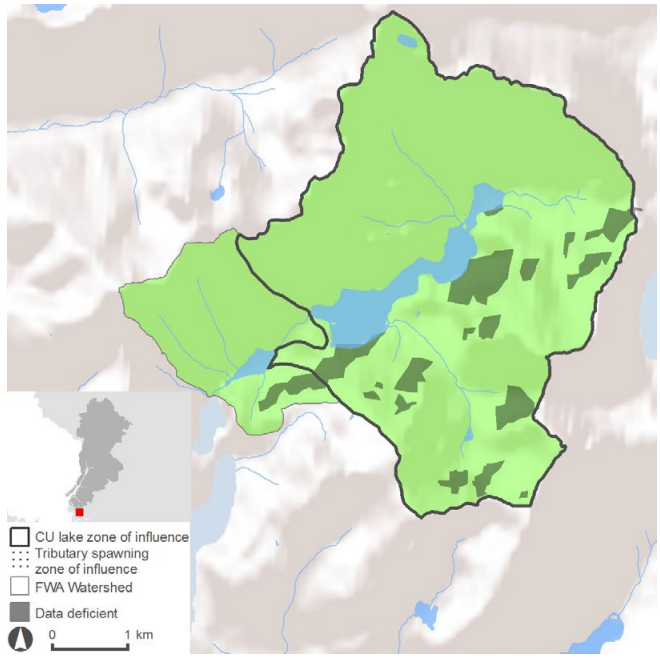
Insect and disease defoliation





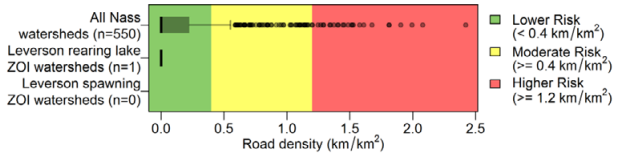
Riparian disturbance

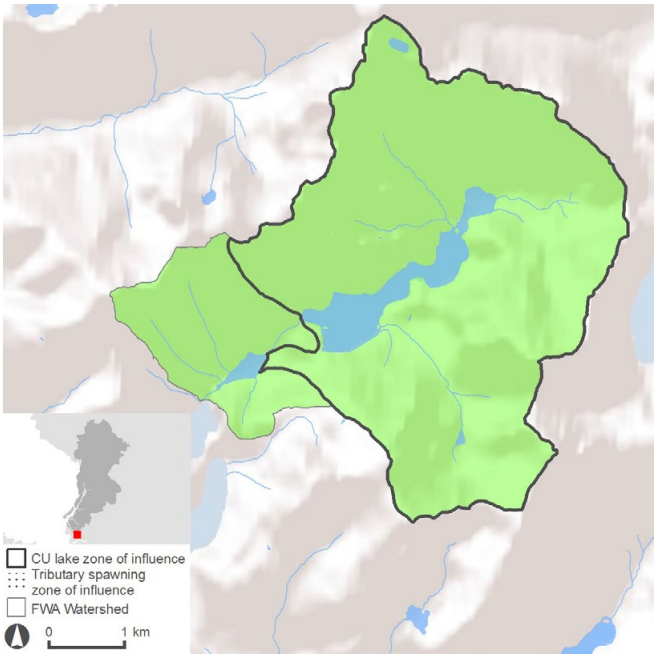




Surface Erosion

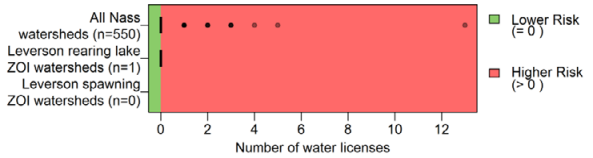
Road development

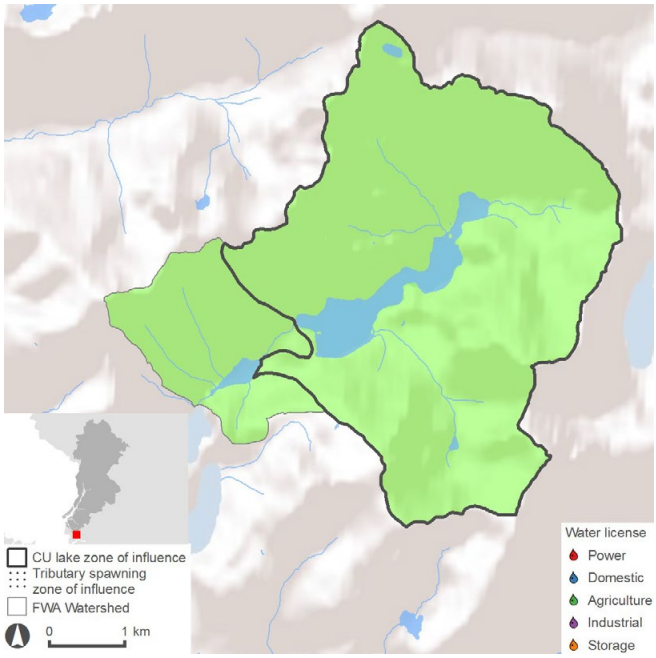




Water Quantity

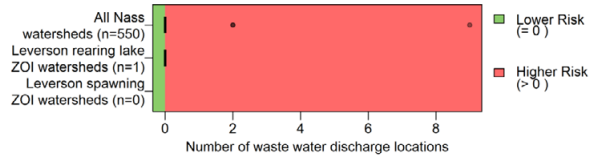
Number of water licenses

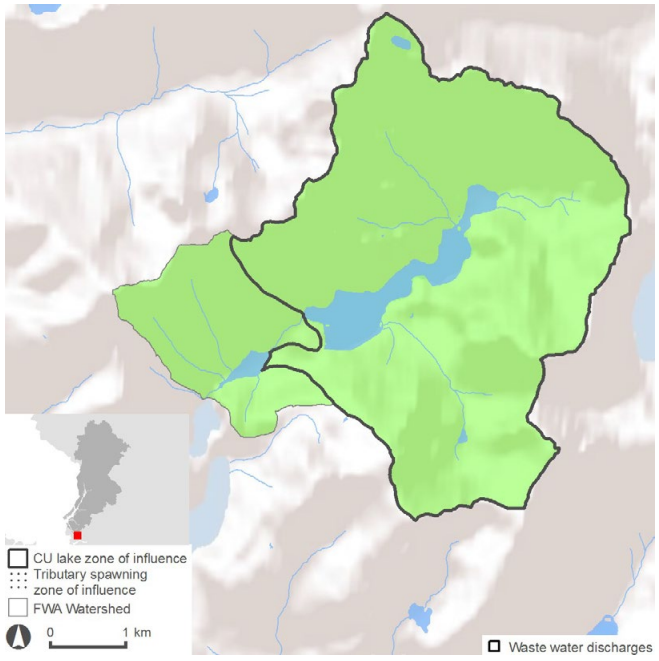




Water Quality

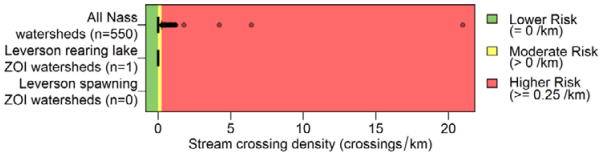
Permitted waste water discharges

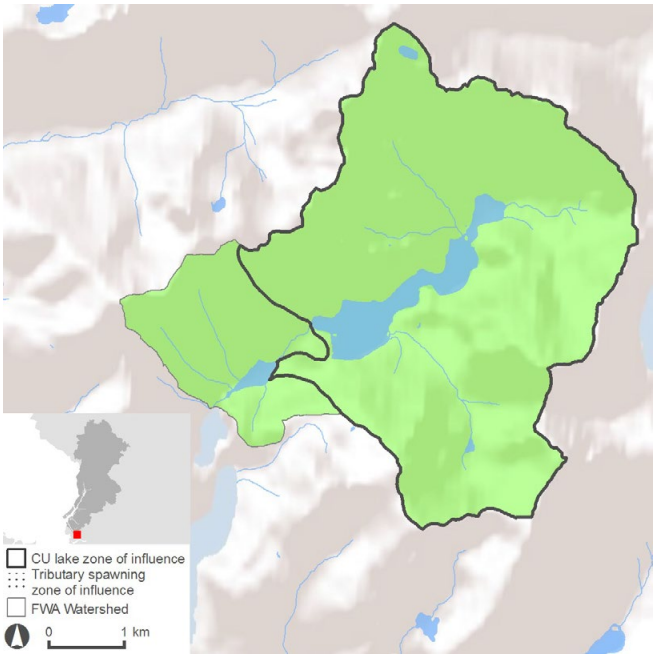




Fish Passage/Habitat Connectivity

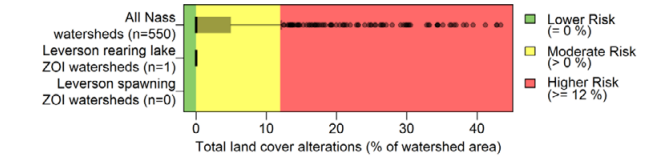
Stream crossing density

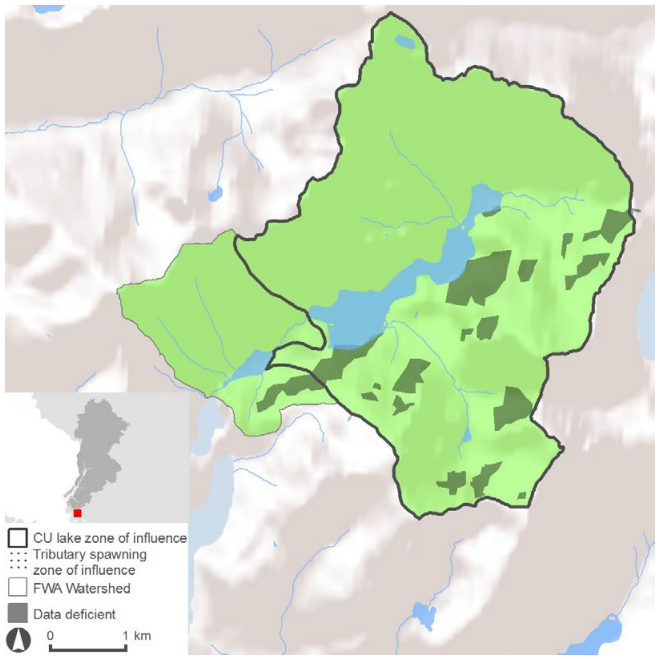




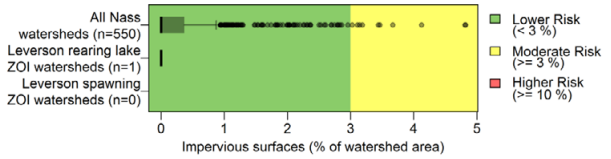
Human Development Footprint

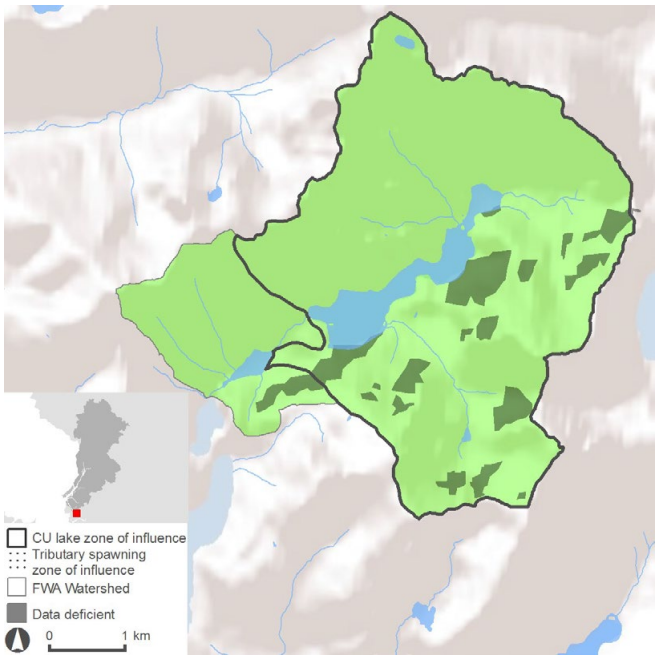
Total land cover alteration



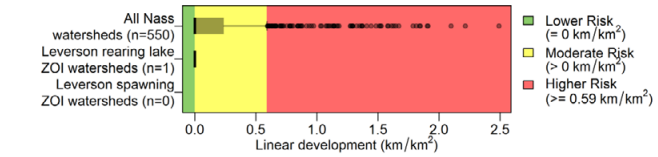


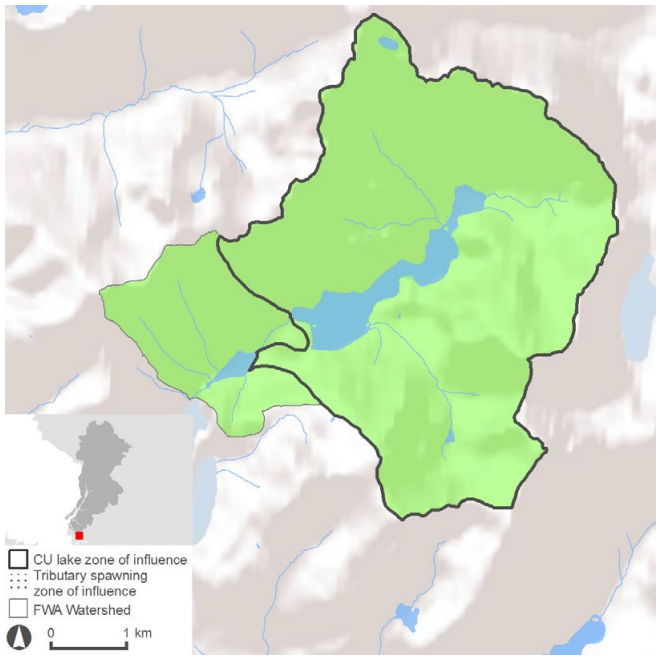
Impervious surfaces



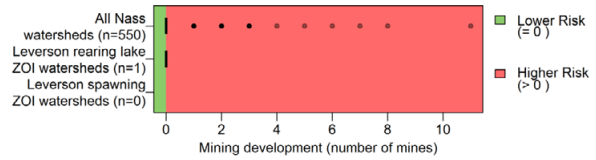


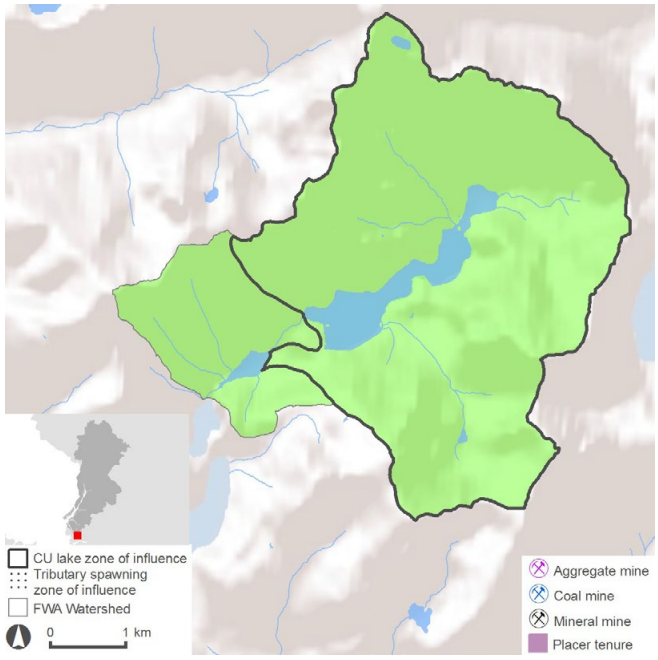
Linear development





Mining development (total number of mines)

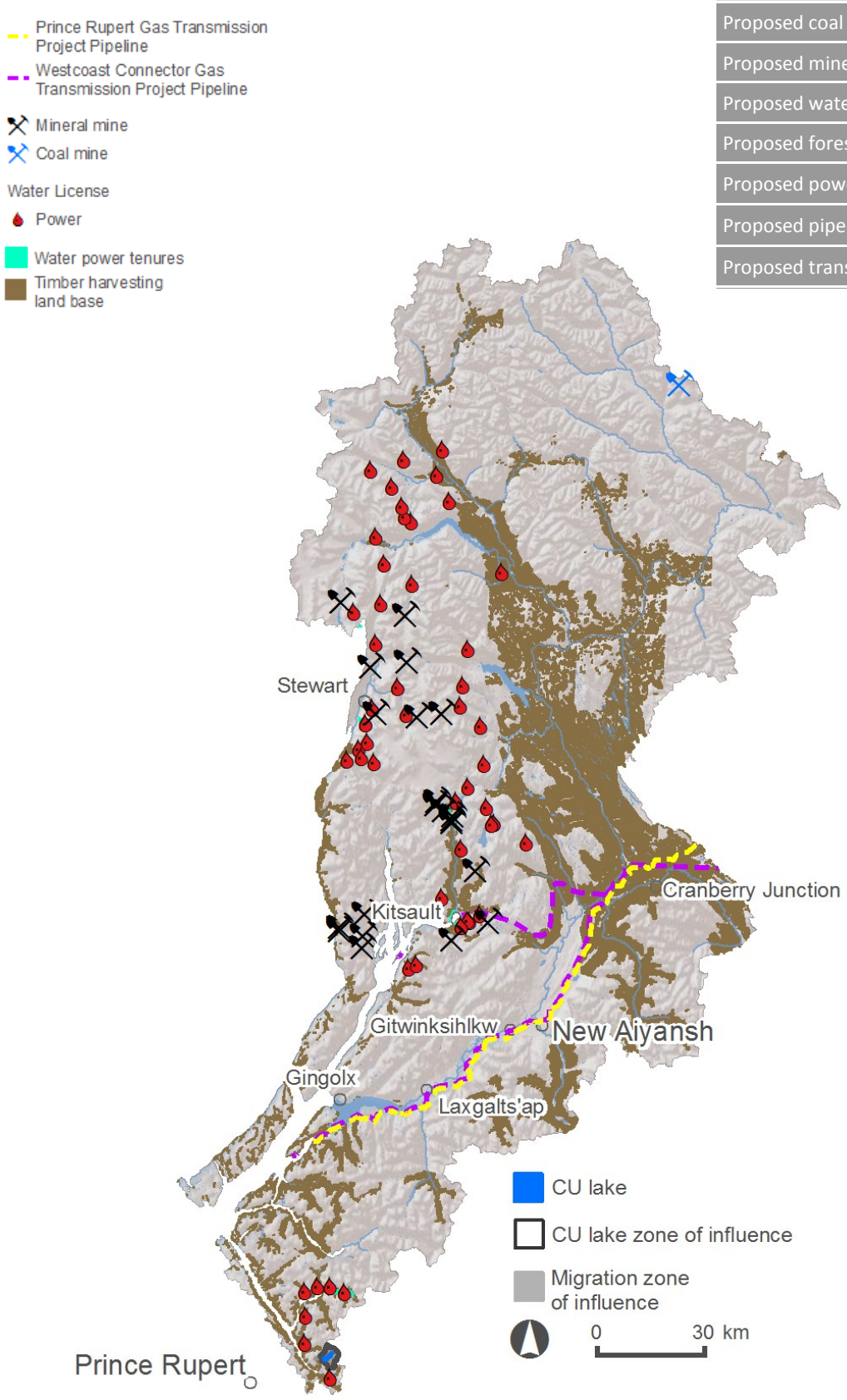




Future pressure

Proposed resource development projects (as of 2016)

Nass Drainage Summary	
	Totals
Proposed coal mines (#)	1
Proposed mineral mines (#)	22
Proposed water licenses (#)	58
Proposed forestry (km^2)	3,323 km^2
Proposed power tenures	Wind 0 km^2, water 15 km^2
Proposed pipelines (km)	386 km
Proposed transmission lines	0 km



Lake Sockeye: Bowser

Introduction

This project summarizes pressures on the habitat used by Nass salmon Conservation Units (CU) during their freshwater life history stages (migration, spawning and rearing), as well as their relative vulnerability to those pressures. For an explanation of the indicators shown here, please see the accompanying *Report Card Summaries*. Full methods and results can be found in the main report, *Cumulative Pressures on Nass Salmon Habitat: Technical Report* (2016).

Definitions

Conservation Unit (CU): A group of wild salmon sufficiently isolated from other groups that, if extirpated, is very unlikely to re-colonize naturally within an acceptable timeframe.

Pressure indicator: Measurable extent/intensity of natural processes or human activities that can induce changes in habitat condition/state.

Vulnerability indicator: Measures of habitat quantity or quality used to represent the intrinsic habitat vulnerability/sensitivity to watershed disturbances for each life-stage.

Zone of influence (ZOI): Areas adjacent to and upstream/upslope of habitats used by salmon CUs that represent the geographic extent for capture/measurement of pressure and vulnerability indicators.

Status: Condition of habitat relative to a defined indicator benchmark.

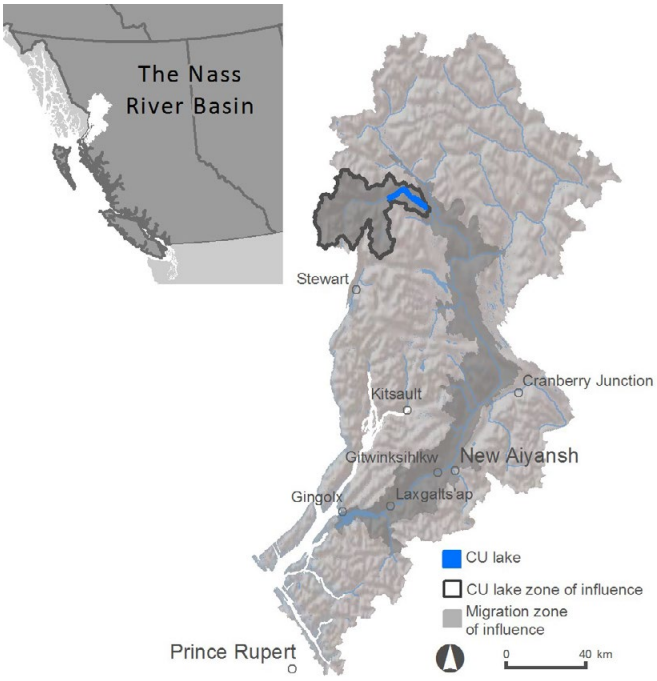
Risk: Likelihood of adverse effects to salmon habitats within a defined zone of influence. Levels of increasing risk are defined based on the extent/intensity of impacts relative to defined benchmarks of concern.

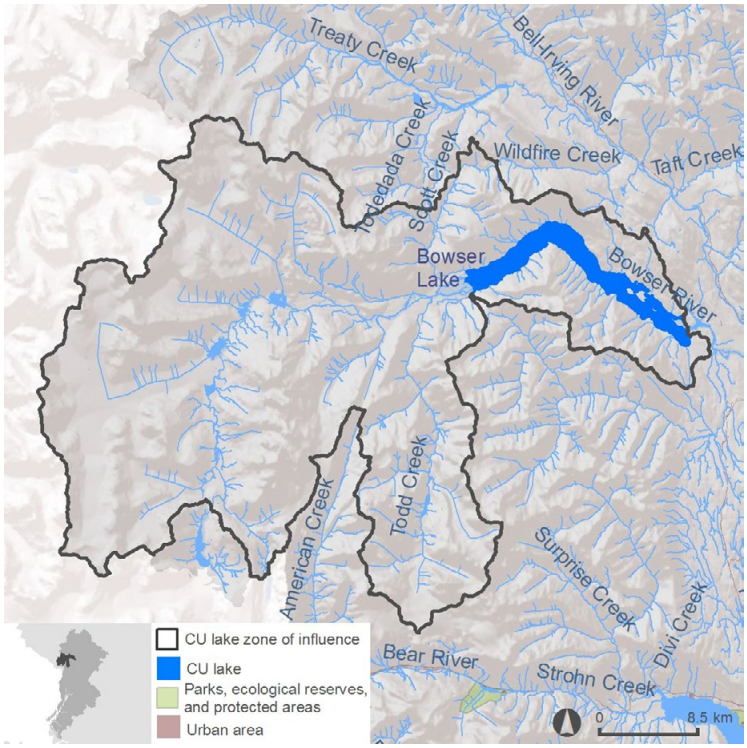
Benchmark: A standard (quantified metric) against which habitat condition can be measured or judged, and by which status can be compared over time and space to determine the risk of adverse effects.

Narrative

- There are ten sockeye salmon CUs in the Nass Area: two are river-type CUs (Upper Nass—UNR and Lower Nass-Portland—LNR-P) and eight are lake-type (Clements, Leverson, Bowser, Damdochax, Fred Wright, Kwinageese, Meziadin, and Oweegee).
- Nearly all of the sockeye salmon production in the Nass Area comes from the lake-type CUs in the upper watershed (i.e. Meziadin, Bowser, Damdochax, Fred Wright, Kwinageese, and Oweegee).
- Nass Area sockeye salmon exhibit variable life history characteristics, with the majority being lake-type and spending one full year rearing in a lake.
- A marine-type population, where salmon go to sea in their first year, is found in some lower Nass tributaries.
- Nass Area sockeye salmon predominantly reside at sea for one to four years, with the majority spending either two or three years at sea.

Location





Summary of habitat vulnerabilities & pressures

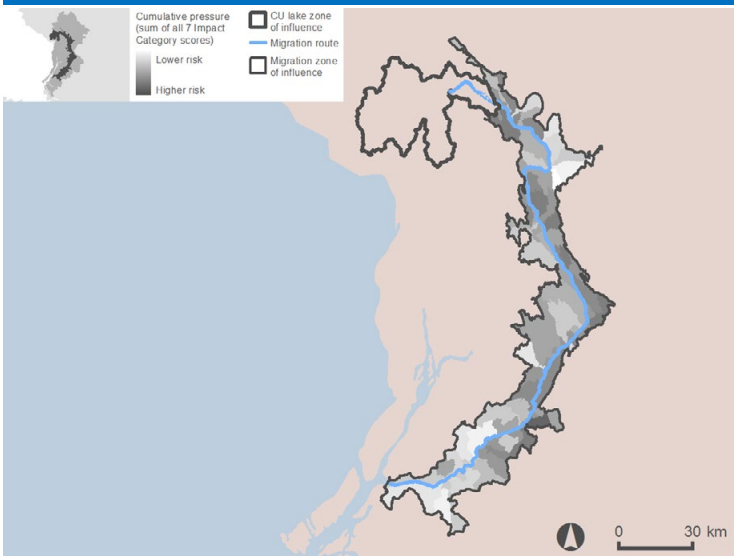
Pressure indicators were grouped into seven relatively independent habitat "impact categories" representing key factors affecting general watershed condition:

- Hydrologic Processes (Forest disturbance; Equivalent Clearcut Area)
- Vegetation Quality (Insect and disease defoliation; Riparian disturbance)
- Surface Erosion (Road development)
- Fish passage/Habitat connectivity (Stream crossing density)
- Water quantity (Water licenses)
- Human development footprint (Total land cover alteration; Impervious surfaces; Linear development; Mining development)
- Water quality (Wastewater discharges)

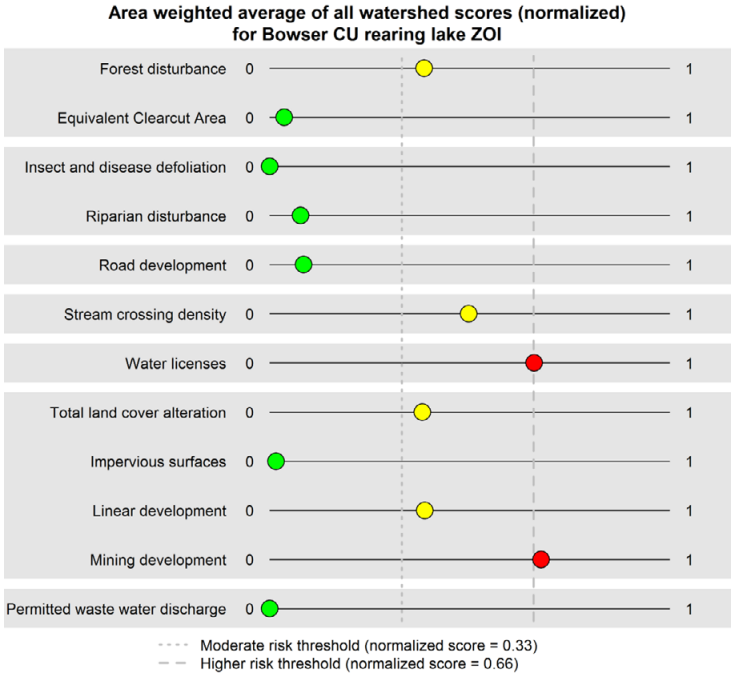
Indicators were also developed reflecting relative vulnerability to habitat pressures within the life stage-specific "zones of influence" defined for each lake sockeye CU:

- Migration (Total migration distance; Length and percentage of migration route summer flow sensitive)
- Spawning (Total spawning length; Spawning length in tributary, lake or mainstem; Ratio of lake influenced to total spawning length; Length of accessible habitat)
- Rearing (Rearing lake area)

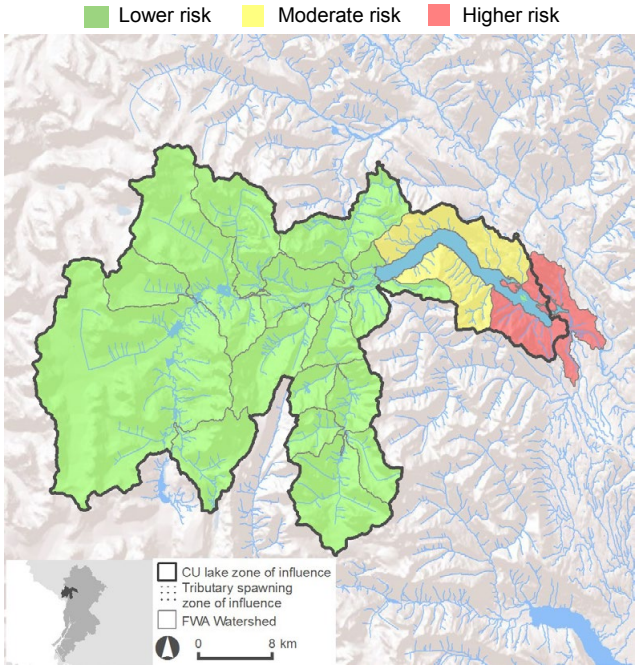
Cumulative pressure—migration



Summary of pressure indicators—rearing

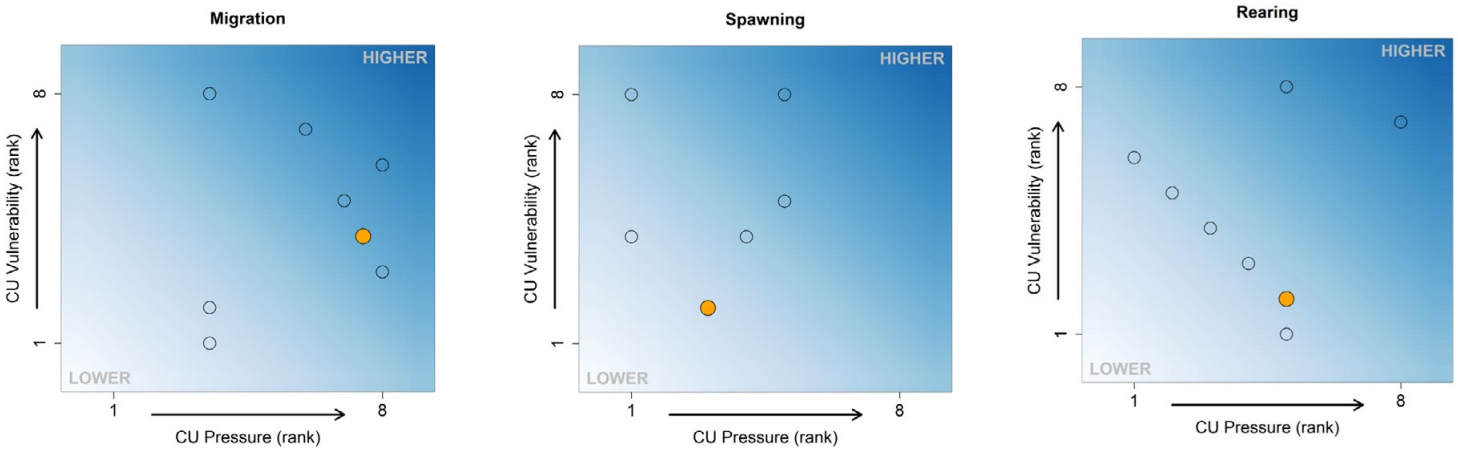


Cumulative pressure—rearing & spawning



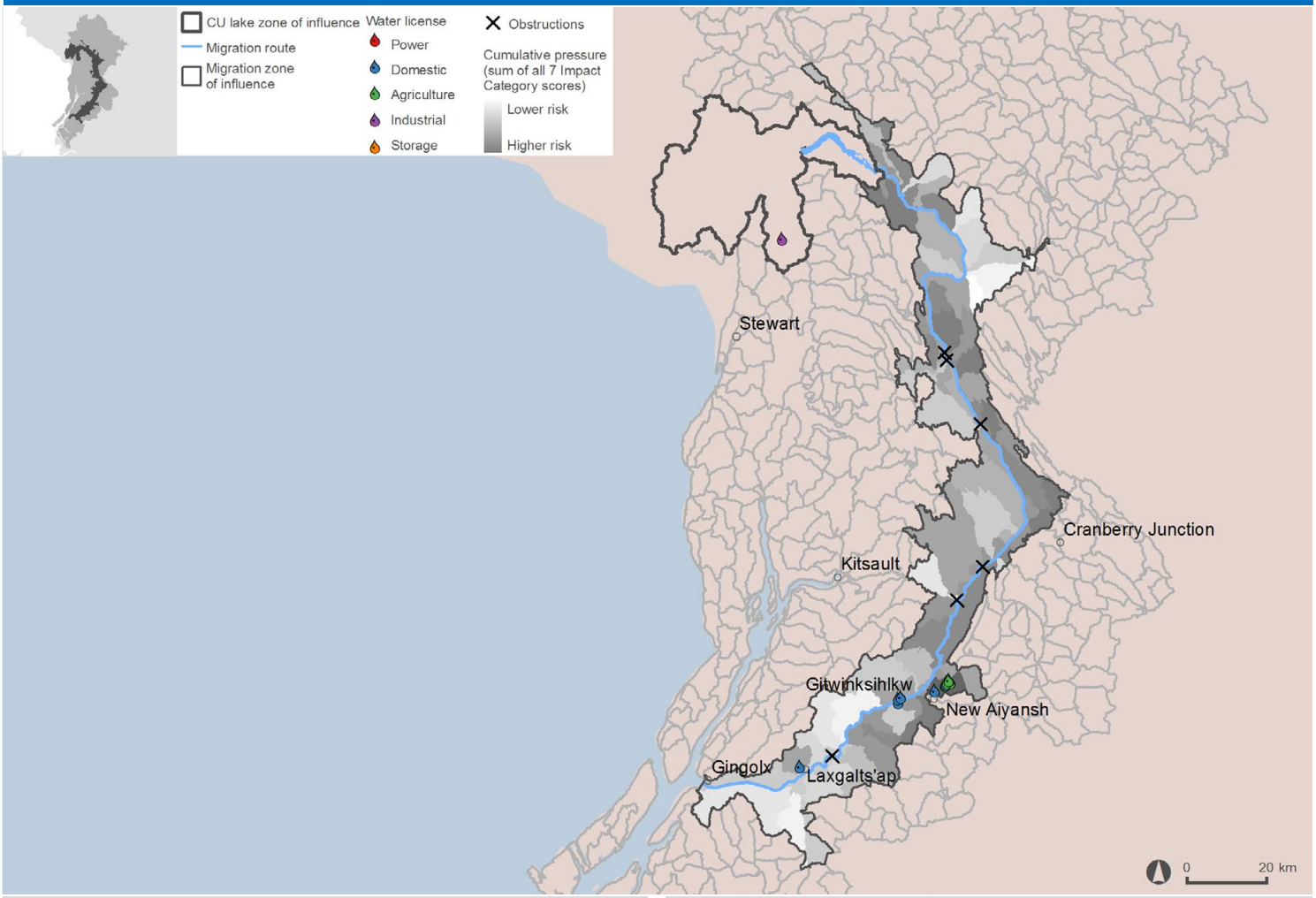
Integrated vulnerability/habitat pressures—migration, spawning, & rearing

● = Bowser ○ = other lake sockeye CUs

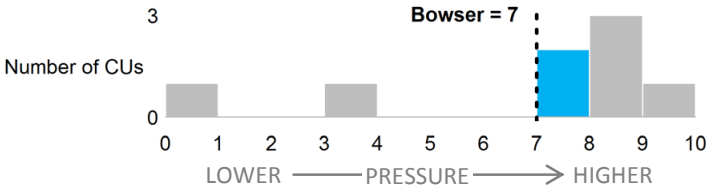


Migration vulnerability & pressure

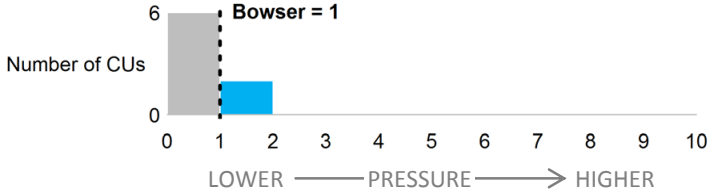
Migration period pressures



Number of obstructions along migration route

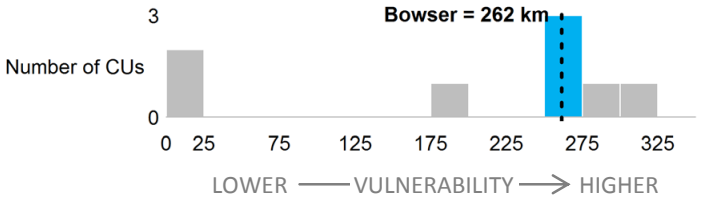


Number of water licenses along migration ZOI

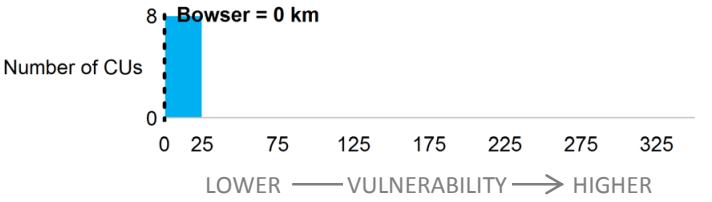


Migration period vulnerability

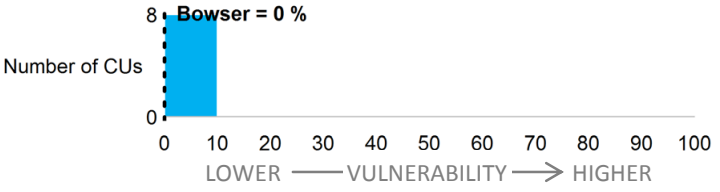
Migration distance (km)



Migration route - summer low flow sensitive (km)



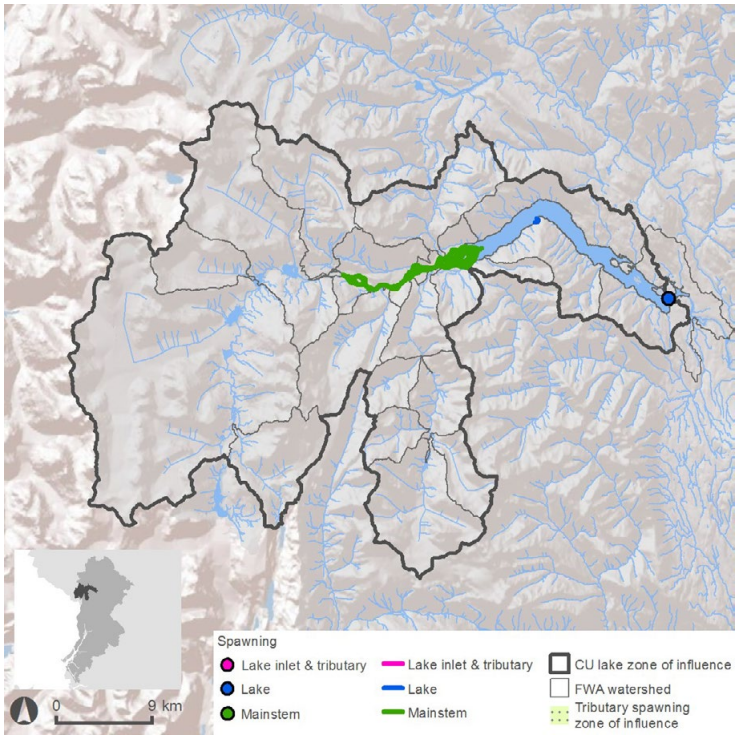
Migration route - summer low flow sensitive (%)



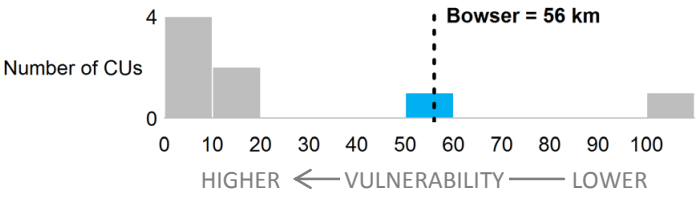
Spawning & rearing vulnerability

Spawning period vulnerability

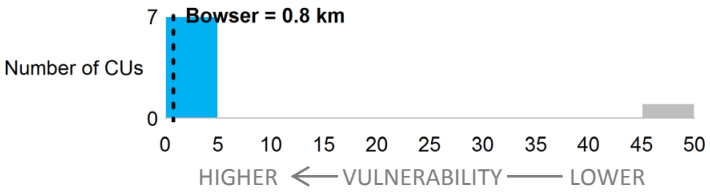
Spawning locations



Total (mainstem, trib & lake) spawning length (km)

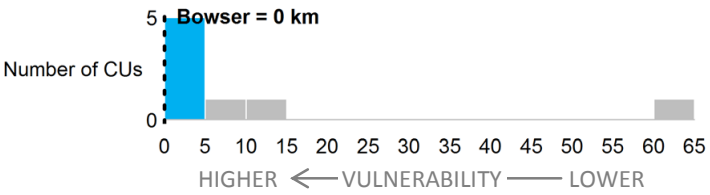


Length of lake shore spawning areas (km)

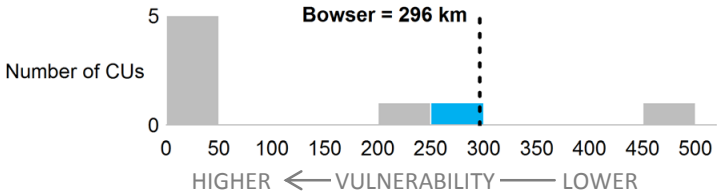


Mainstem spawning length (km)

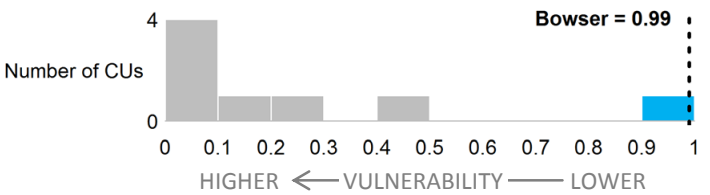
Tributary and lake inlet spawning length (km)



Salmon accessible habitat (km)

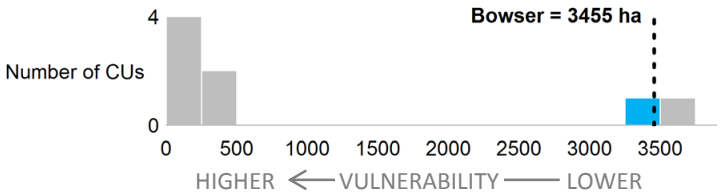


Ratio of lake influenced to total spawning



Rearing period vulnerability

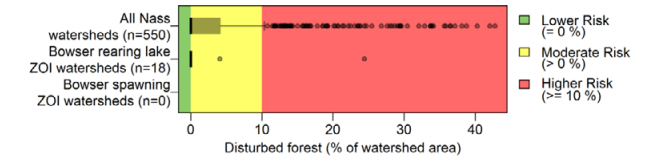
Area of nursery lakes (ha)

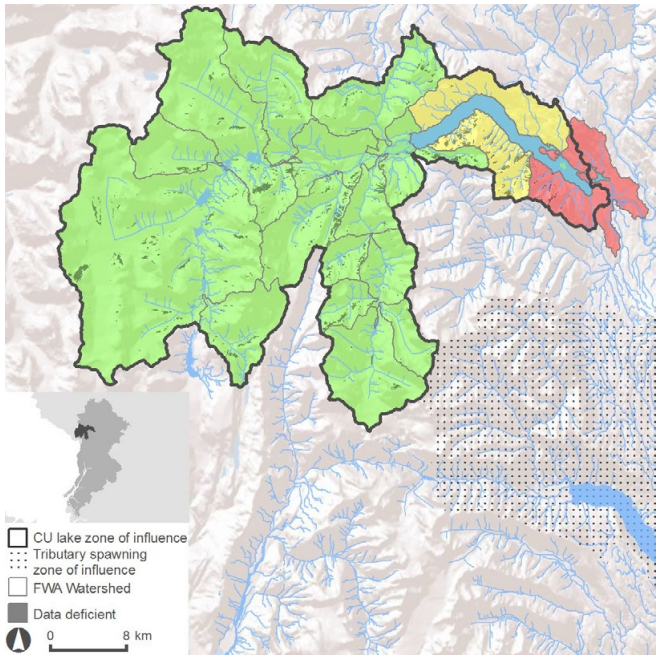


Spawning & rearing pressure

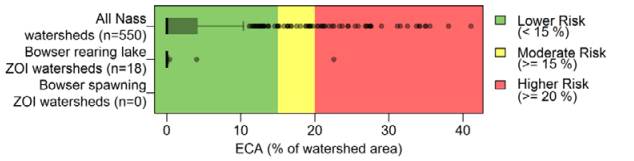
Hydrologic Processes

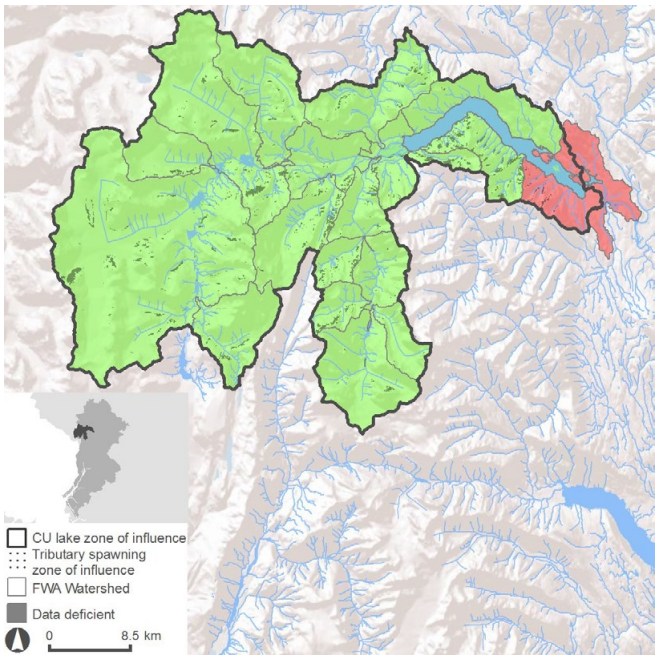
Forest disturbance





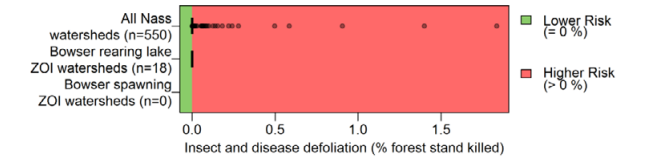
Equivalent Clear-cut Area

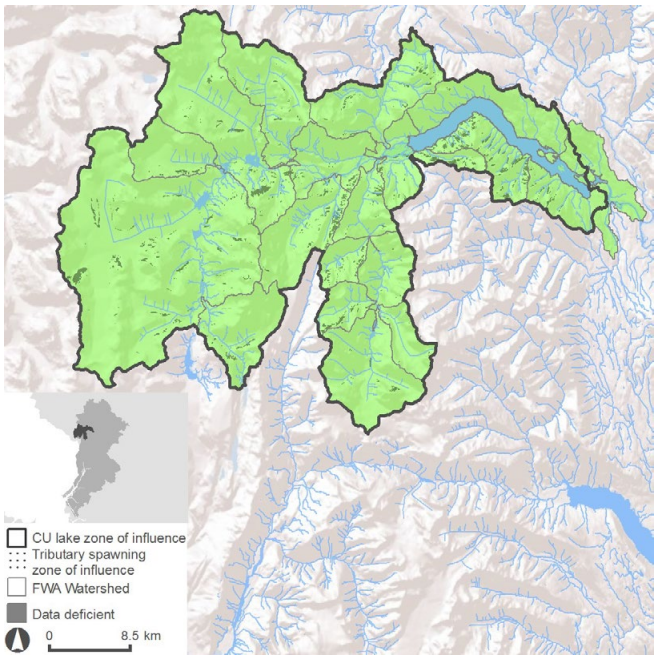




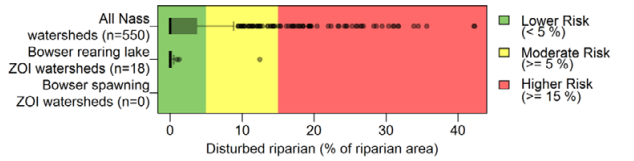
Vegetation Quality

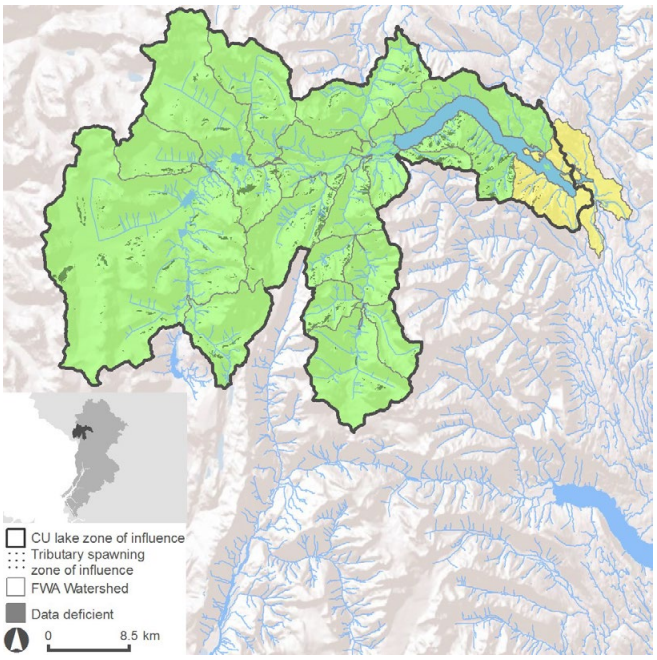
Insect and disease defoliation





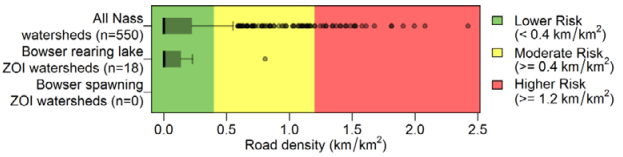
Riparian disturbance

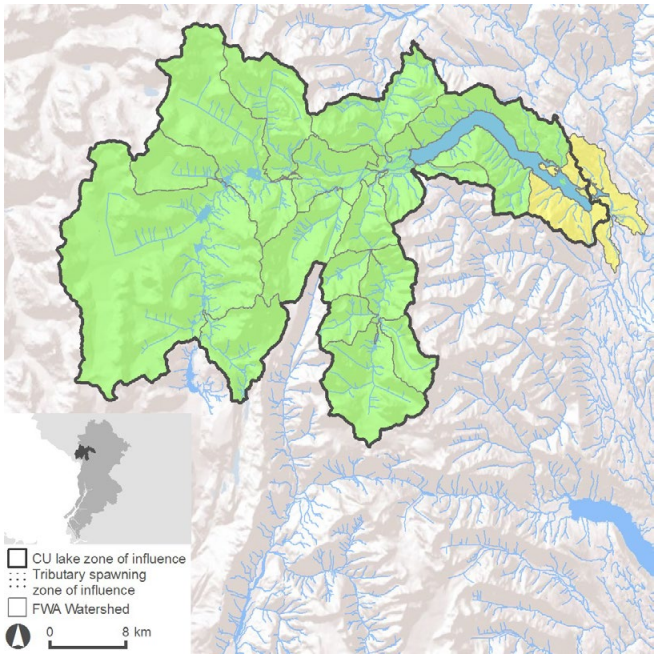




Surface Erosion

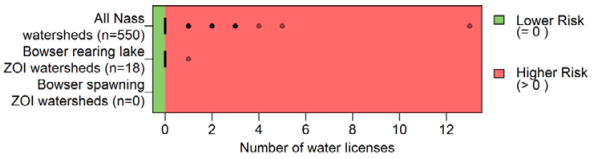
Road development

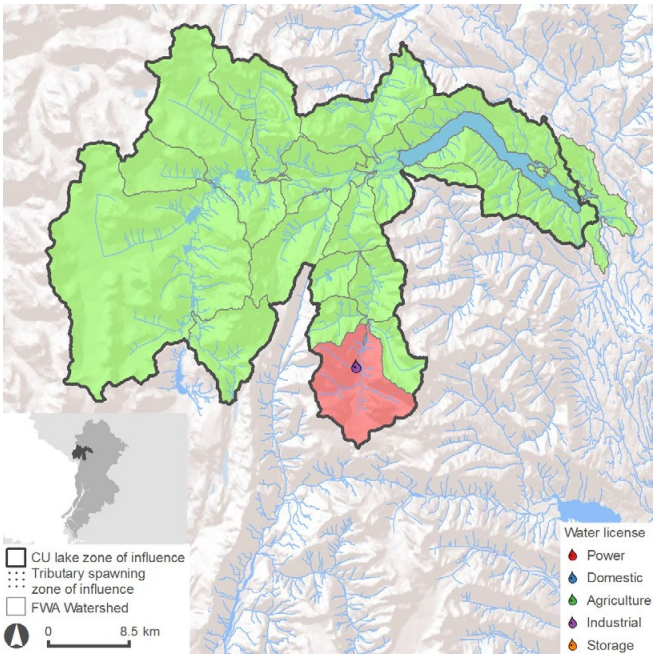




Water Quantity

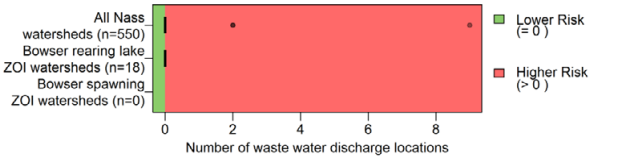
Number of water licenses

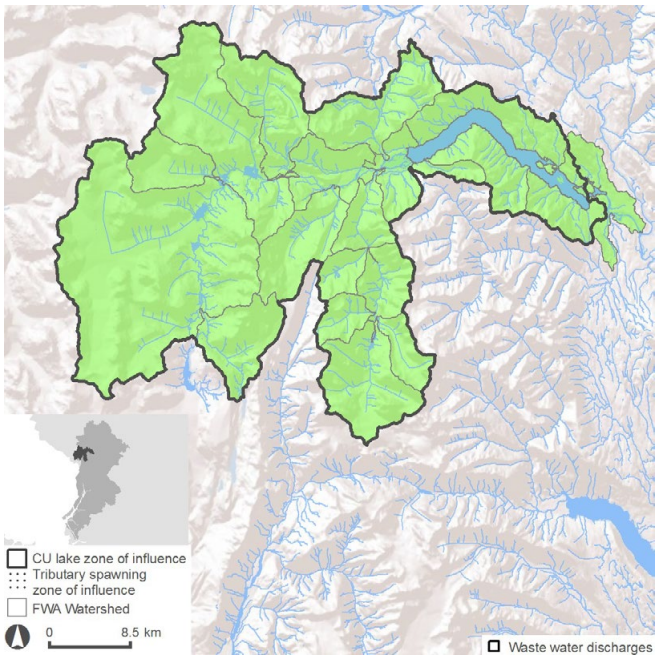




Water Quality

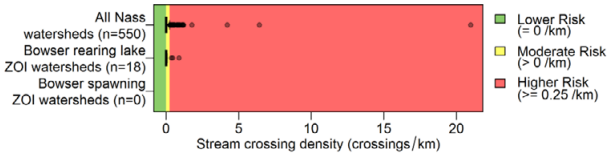
Permitted waste water discharges

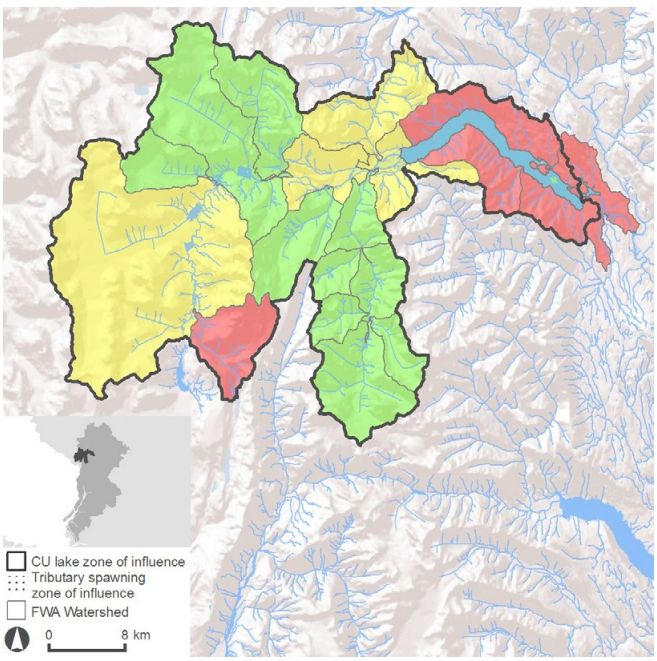




Fish Passage/Habitat Connectivity

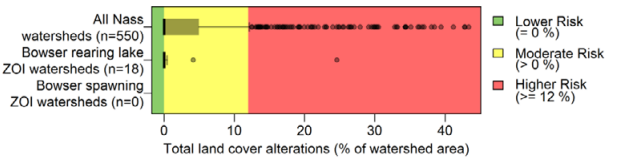
Stream crossing density

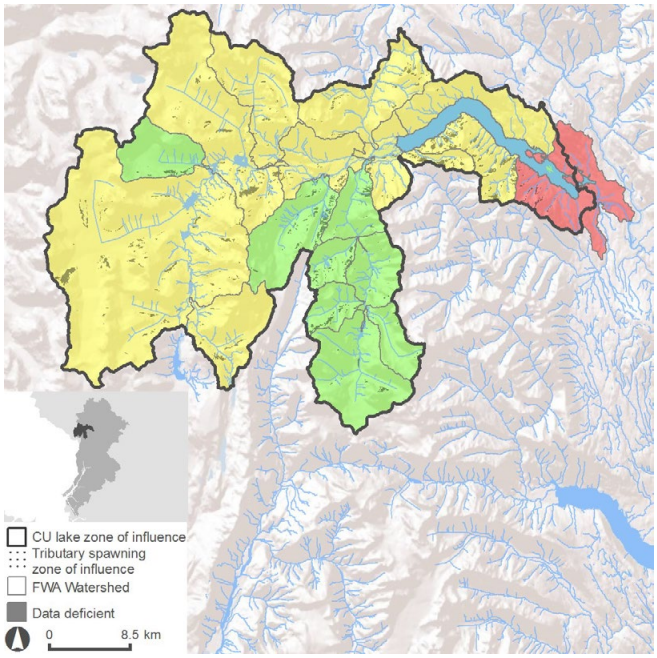




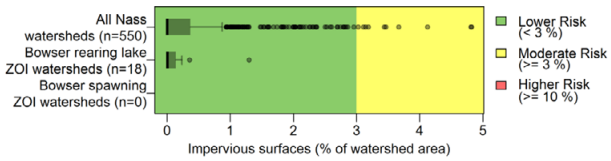
Human Development Footprint

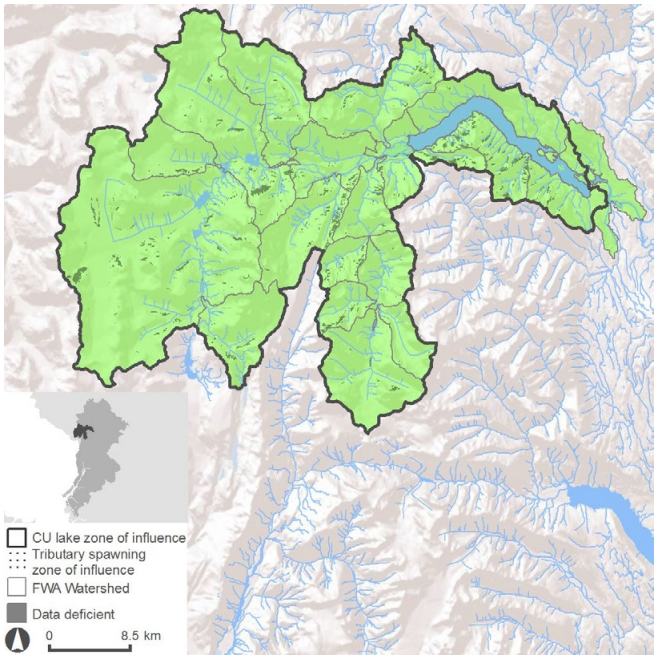
Total land cover alteration



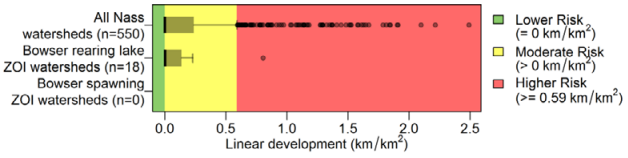


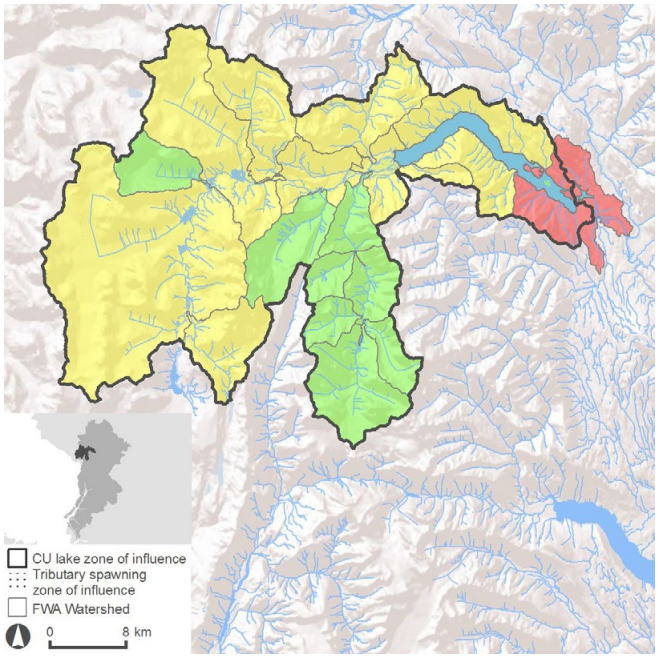
Impervious surfaces



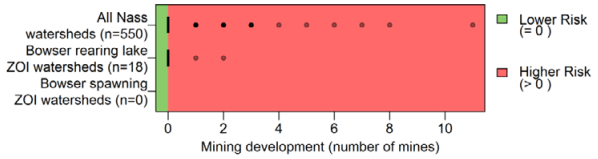


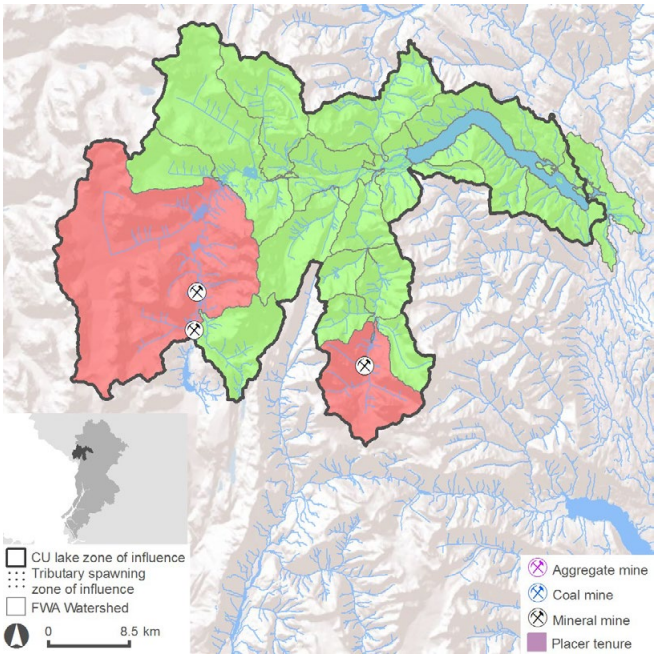
Linear development





Mining development (total number of mines)

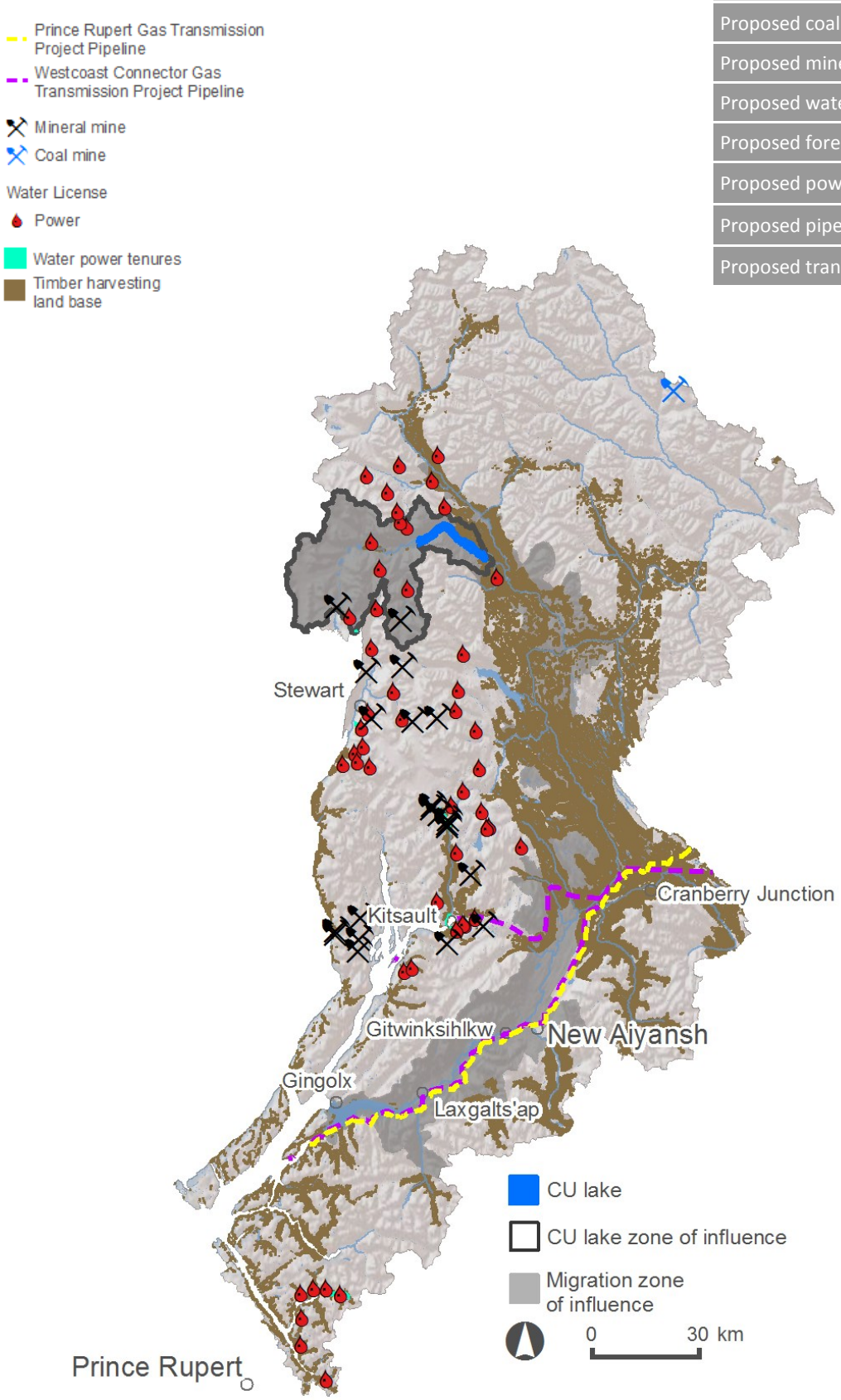




Future pressure

Proposed resource development projects (as of 2016)

Nass Drainage Summary	
	Totals
Proposed coal mines (#)	1
Proposed mineral mines (#)	22
Proposed water licenses (#)	58
Proposed forestry (km^2)	3,323 km^2
Proposed power tenures	Wind 0 km^2, water 15 km^2
Proposed pipelines (km)	386 km
Proposed transmission lines	0 km



Lake Sockeye: Damdochax

Introduction

This project summarizes pressures on the habitat used by Nass salmon Conservation Units (CU) during their freshwater life history stages (migration, spawning and rearing), as well as their relative vulnerability to those pressures. For an explanation of the indicators shown here, please see the accompanying *Report Card Summaries*. Full methods and results can be found in the main report, *Cumulative Pressures on Nass Salmon Habitat: Technical Report* (2016).

Definitions

Conservation Unit (CU): A group of wild salmon sufficiently isolated from other groups that, if extirpated, is very unlikely to re-colonize naturally within an acceptable timeframe.

Pressure indicator: Measurable extent/intensity of natural processes or human activities that can induce changes in habitat condition/state.

Vulnerability indicator: Measures of habitat quantity or quality used to represent the intrinsic habitat vulnerability/sensitivity to watershed disturbances for each life-stage.

Zone of influence (ZOI): Areas adjacent to and upstream/upslope of habitats used by salmon CUs that represent the geographic extent for capture/measurement of pressure and vulnerability indicators.

Status: Condition of habitat relative to a defined indicator benchmark.

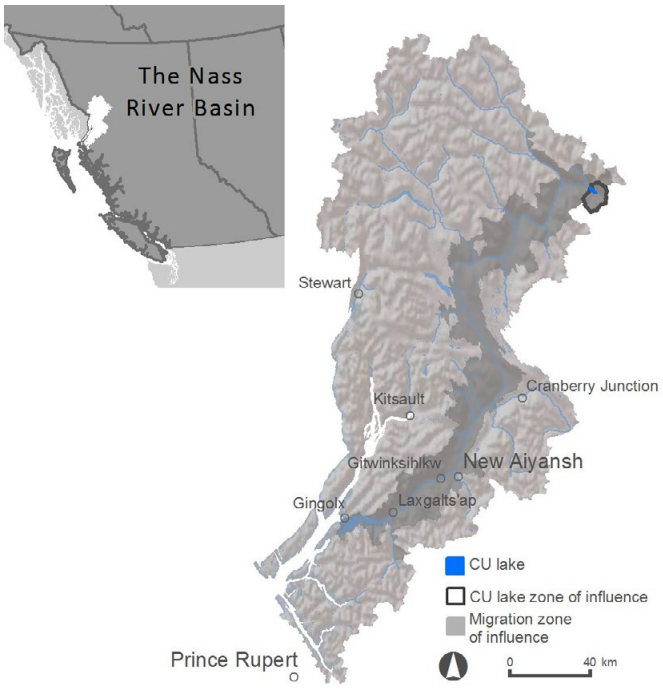
Risk: Likelihood of adverse effects to salmon habitats within a defined zone of influence. Levels of increasing risk are defined based on the extent/intensity of impacts relative to defined benchmarks of concern.

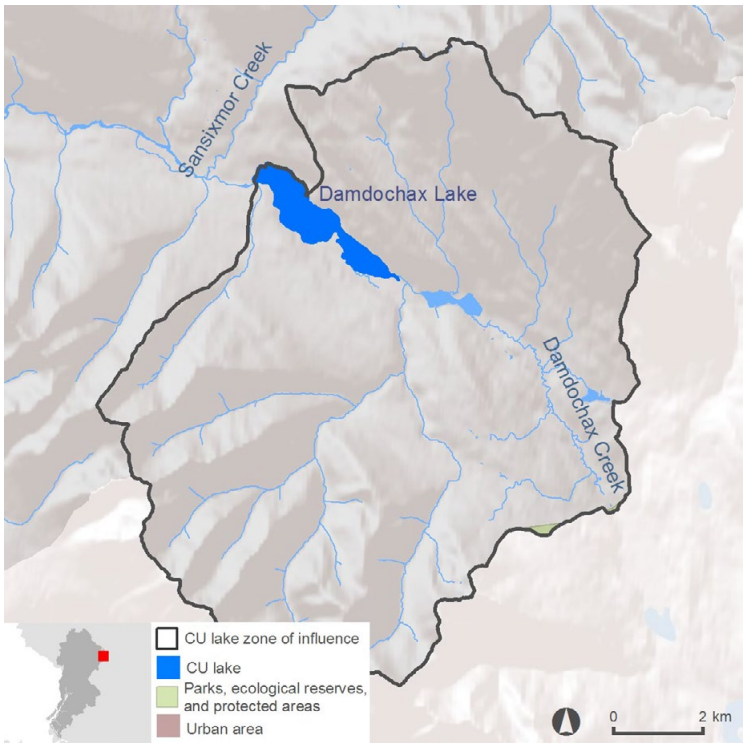
Benchmark: A standard (quantified metric) against which habitat condition can be measured or judged, and by which status can be compared over time and space to determine the risk of adverse effects.

Narrative

- There are ten sockeye salmon CUs in the Nass Area: two are river-type CUs (Upper Nass—UNR and Lower Nass-Portland—LNR-P) and eight are lake-type (Clements, Leverson, Bowser, Damdochax, Fred Wright, Kwinageese, Meziadin, and Oweegee).
- Nearly all of the sockeye salmon production in the Nass Area comes from the lake-type CUs in the upper watershed (i.e. Meziadin, Bowser, Damdochax, Fred Wright, Kwinageese, and Oweegee).
- Nass Area sockeye salmon exhibit variable life history characteristics, with the majority being lake-type and spending one full year rearing in a lake.
- A marine-type population, where salmon go to sea in their first year, is found in some lower Nass tributaries.
- Nass Area sockeye salmon predominantly reside at sea for one to four years, with the majority spending either two or three years at sea.

Location





Summary of habitat vulnerabilities & pressures

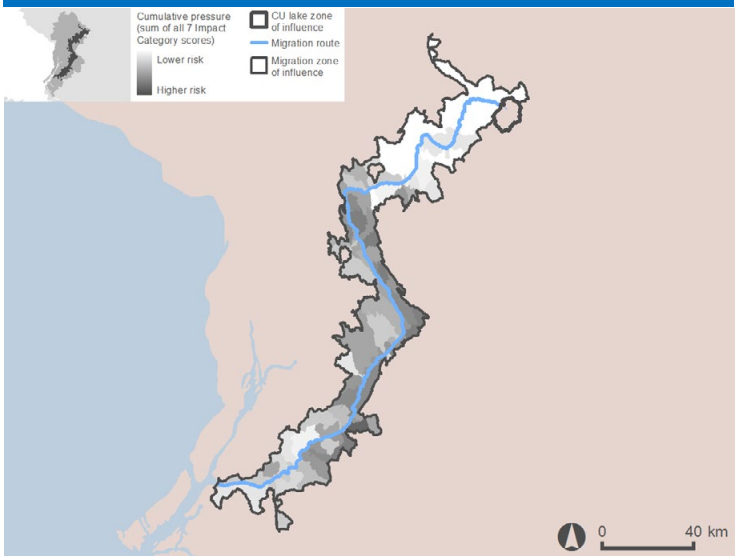
Pressure indicators were grouped into seven relatively independent habitat "impact categories" representing key factors affecting general watershed condition:

- Hydrologic Processes (Forest disturbance; Equivalent Clearcut Area)
- Vegetation Quality (Insect and disease defoliation; Riparian disturbance)
- Surface Erosion (Road development)
- Fish passage/Habitat connectivity (Stream crossing density)
- Water quantity (Water licenses)
- Human development footprint (Total land cover alteration; Impervious surfaces; Linear development; Mining development)
- Water quality (Wastewater discharges)

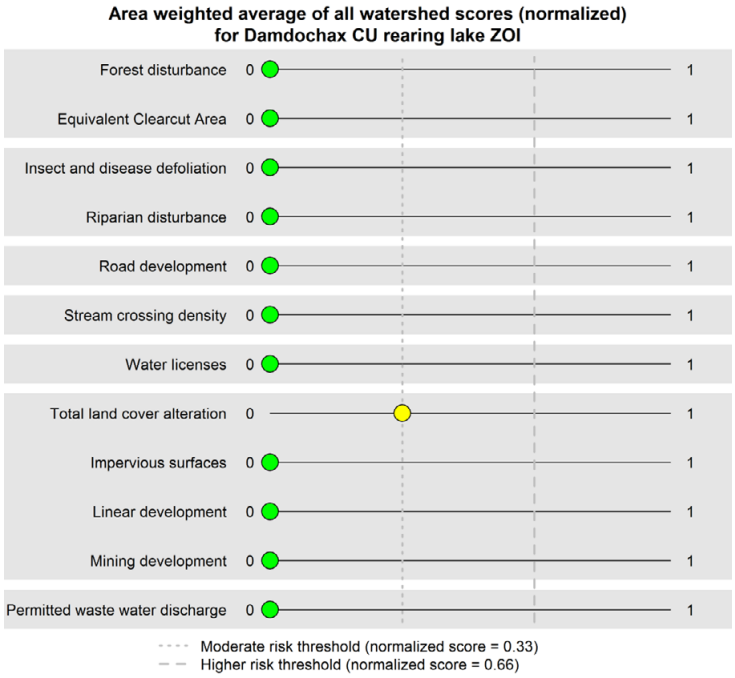
Indicators were also developed reflecting relative vulnerability to habitat pressures within the life stage-specific "zones of influence" defined for each lake sockeye CU:

- Migration (Total migration distance; Length and percentage of migration route summer flow sensitive)
- Spawning (Total spawning length; Spawning length in tributary, lake or mainstem; Ratio of lake influenced to total spawning length; Length of accessible habitat)
- Rearing (Rearing lake area)

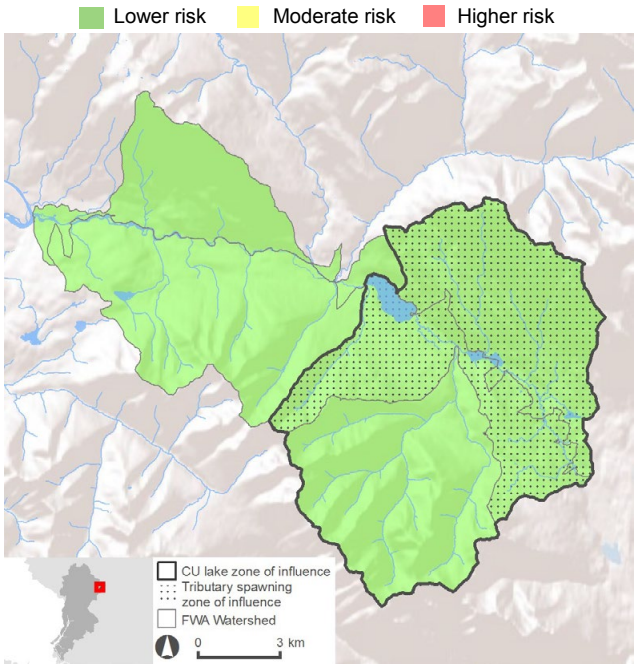
Cumulative pressure—migration



Summary of pressure indicators—rearing

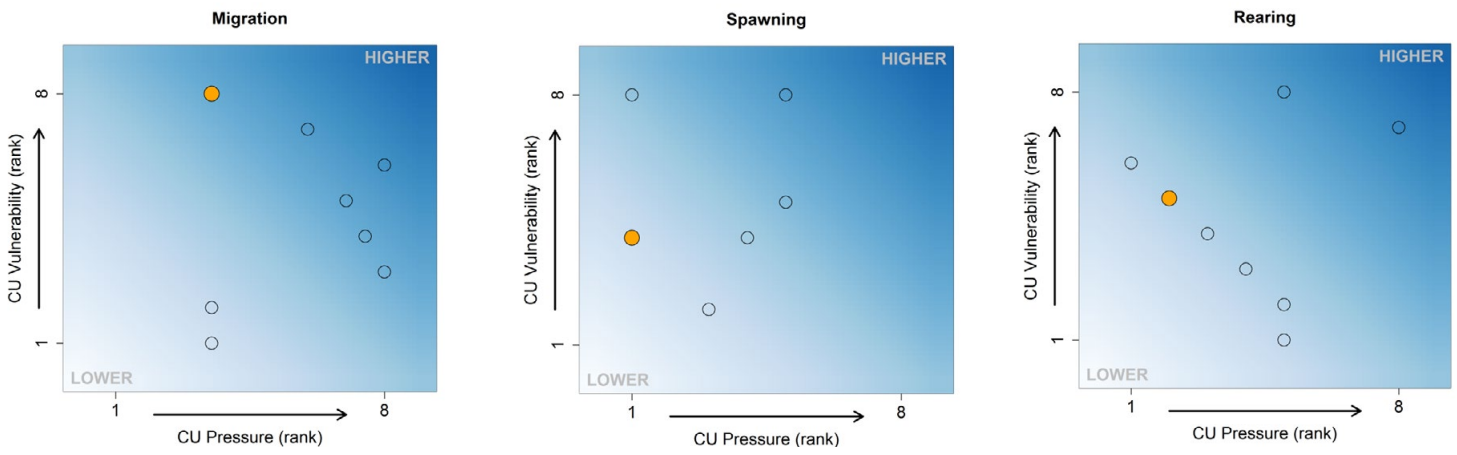


Cumulative pressure—rearing & spawning



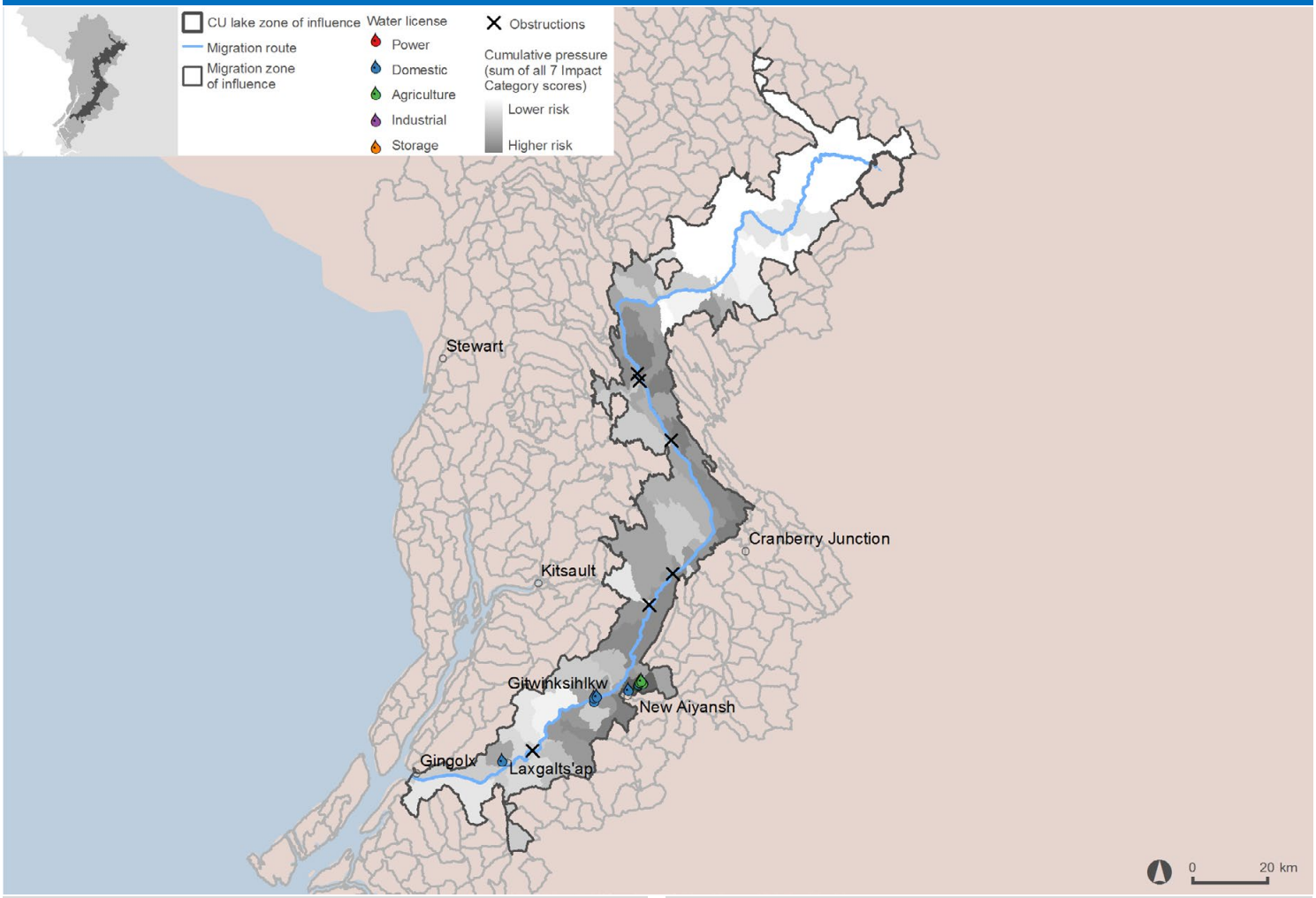
Integrated vulnerability/habitat pressures—migration, spawning, & rearing

● = Damdochax ○ = other lake sockeye CUs

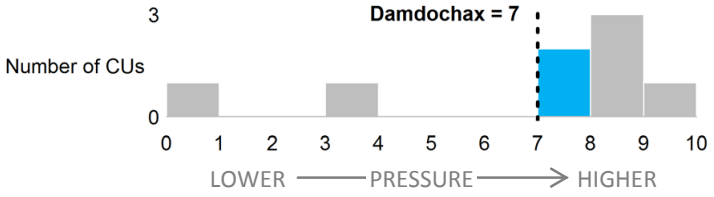


Migration vulnerability & pressure

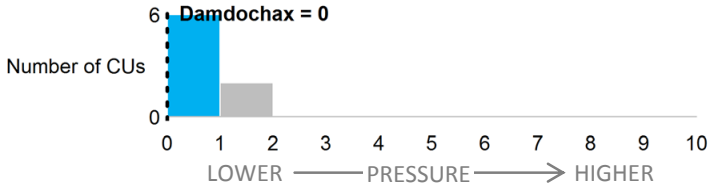
Migration period pressures



Number of obstructions along migration route

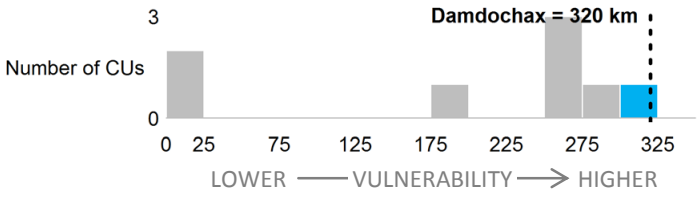


Number of water licenses along migration ZOI

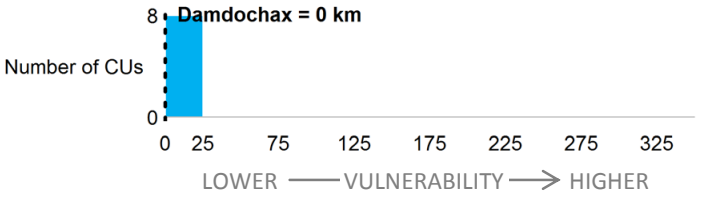


Migration period vulnerability

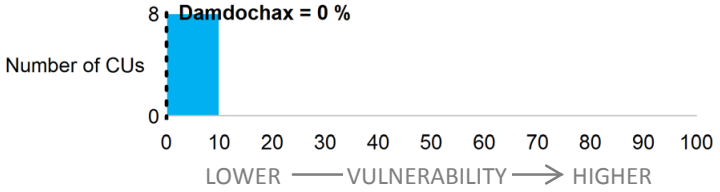
Migration distance (km)



Migration route - summer low flow sensitive (km)



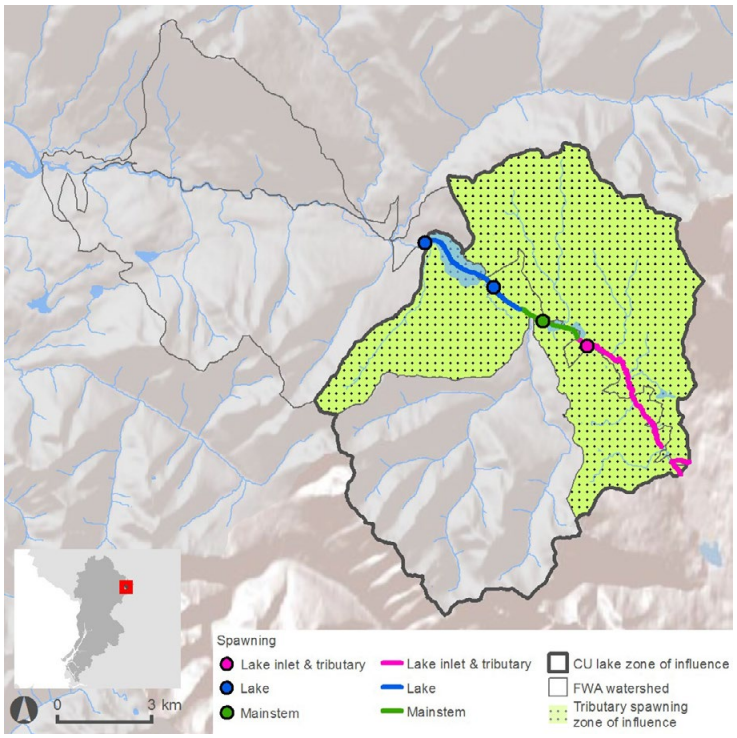
Migration route - summer low flow sensitive (%)



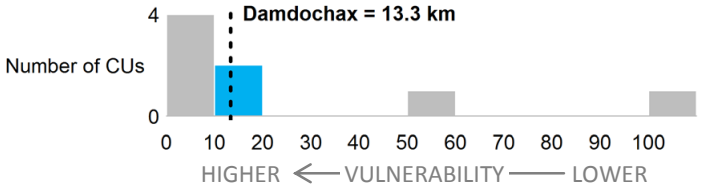
Spawning & rearing vulnerability

Spawning period vulnerability

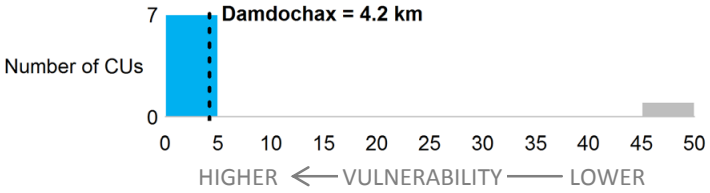
Spawning locations



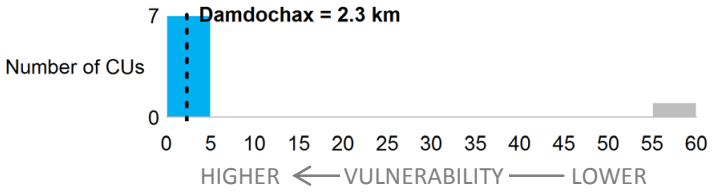
Total (mainstem, trib & lake) spawning length (km)



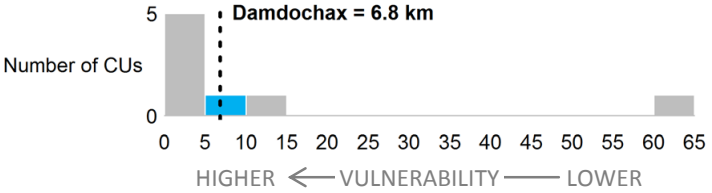
Length of lake shore spawning areas (km)



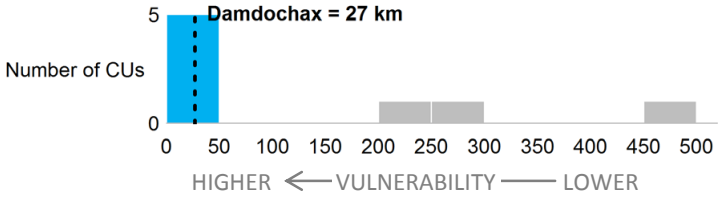
Mainstem spawning length (km)



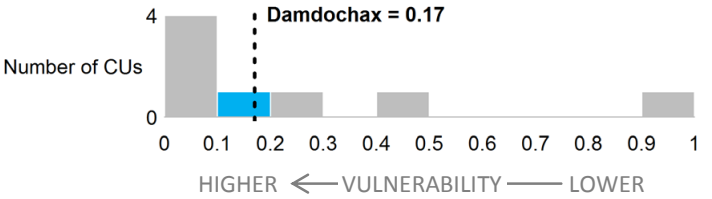
Tributary and lake inlet spawning length (km)



Salmon accessible habitat (km)

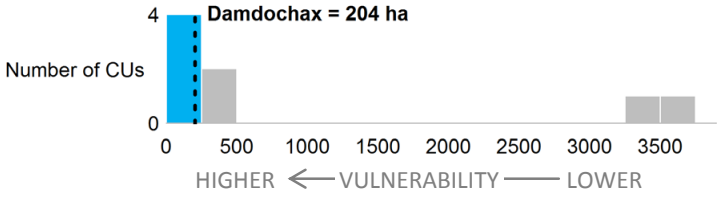


Ratio of lake influenced to total spawning



Rearing period vulnerability

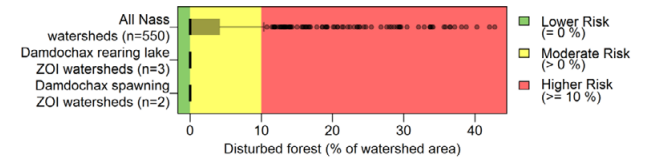
Area of nursery lakes (ha)

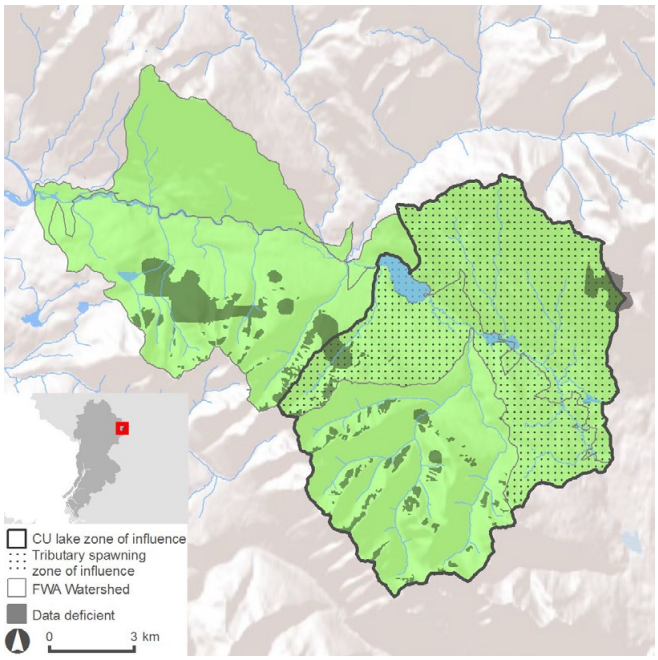


Spawning & rearing pressure

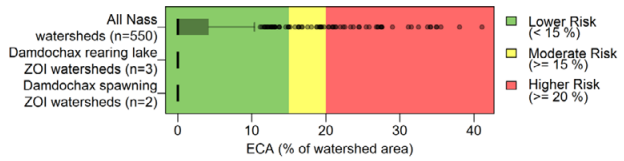
Hydrologic Processes

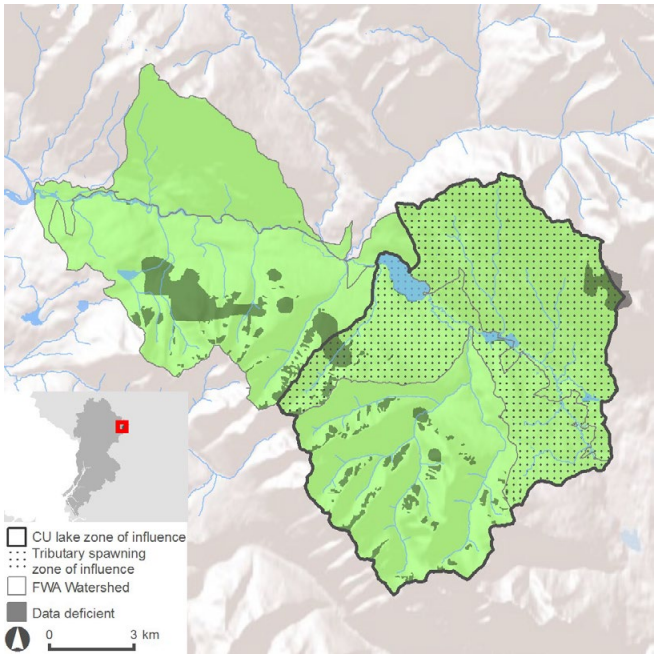
Forest disturbance





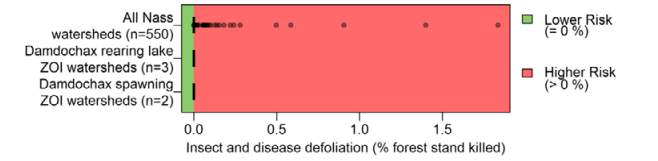
Equivalent Clear-cut Area

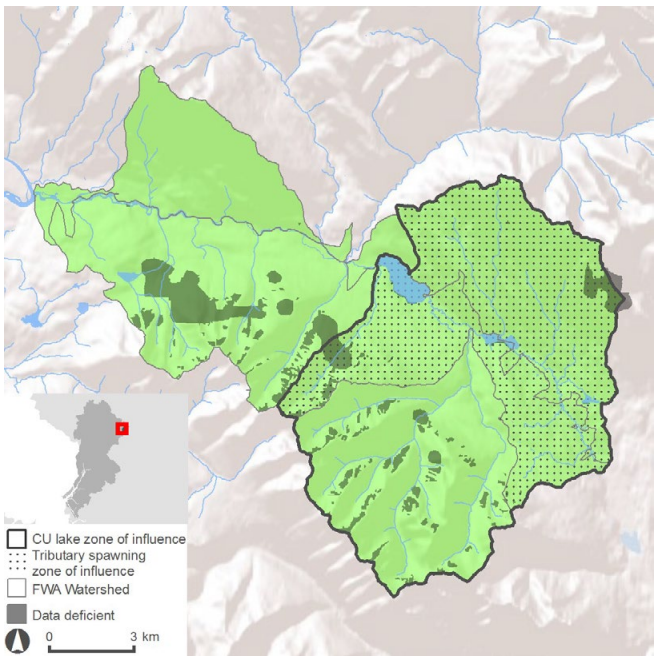




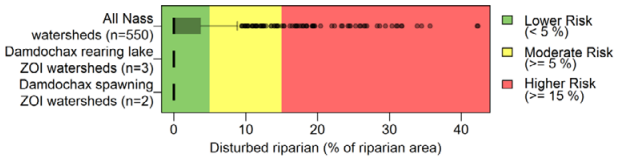
Vegetation Quality

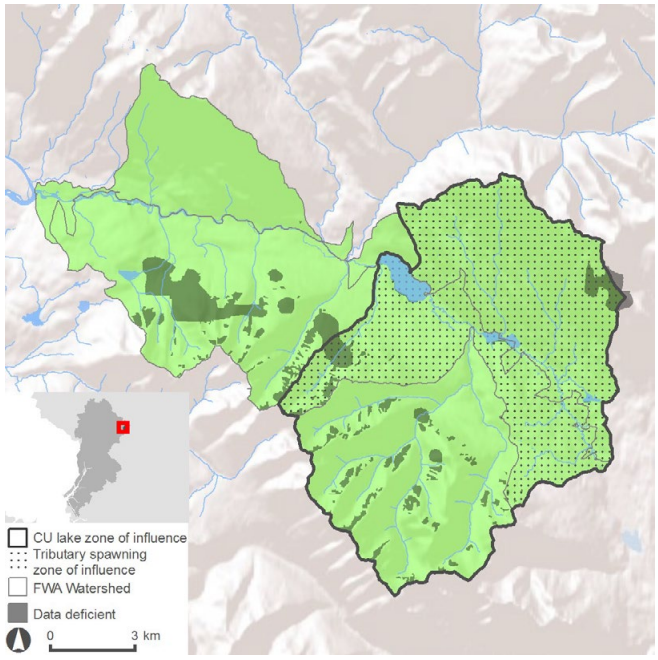
Insect and disease defoliation





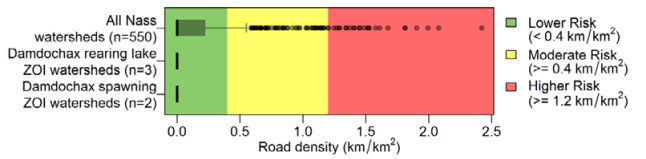
Riparian disturbance

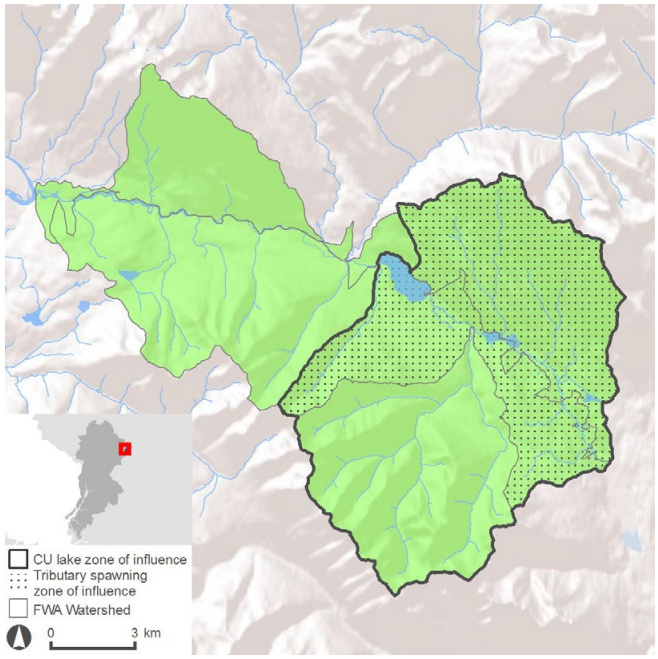




Surface Erosion

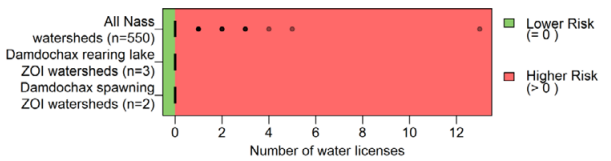
Road development

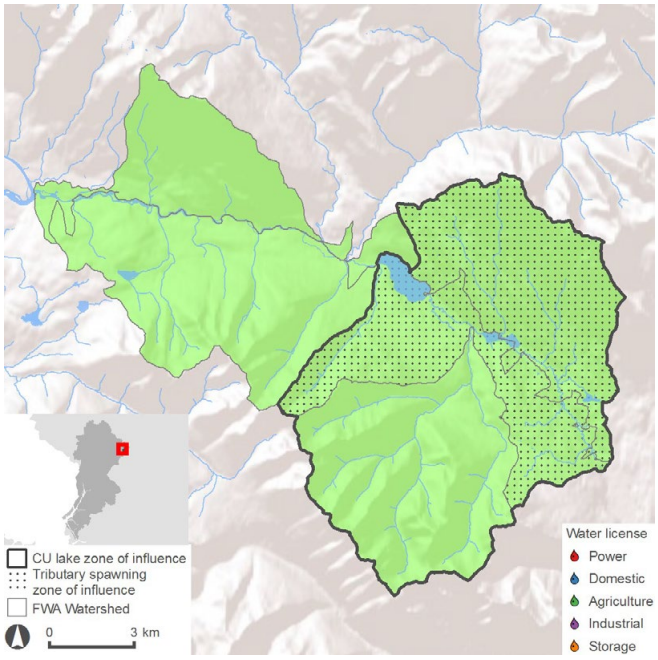




Water Quantity

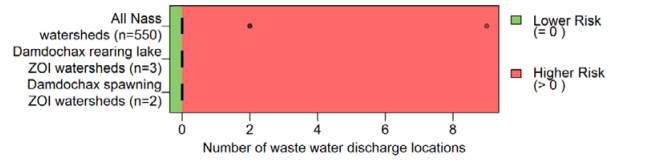
Number of water licenses

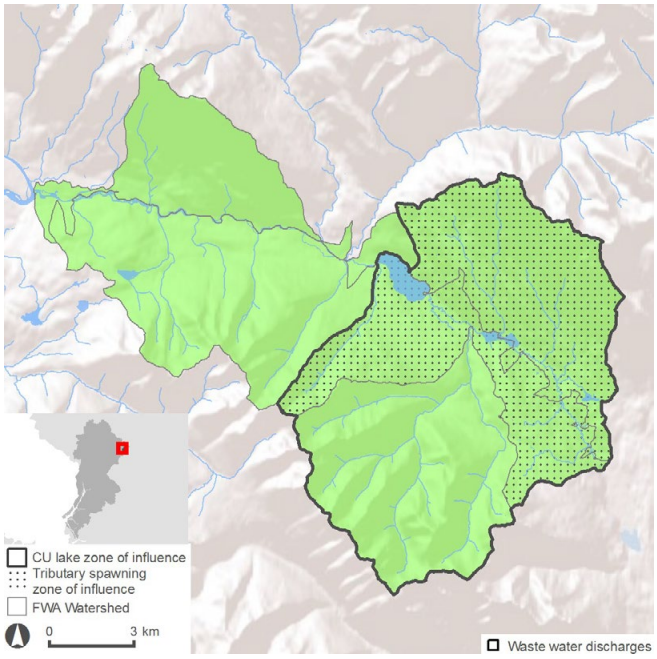




Water Quality

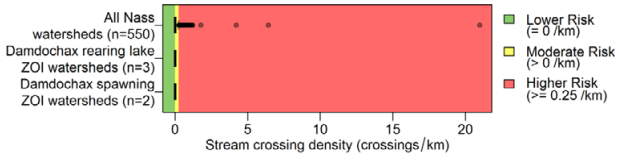
Permitted waste water discharges

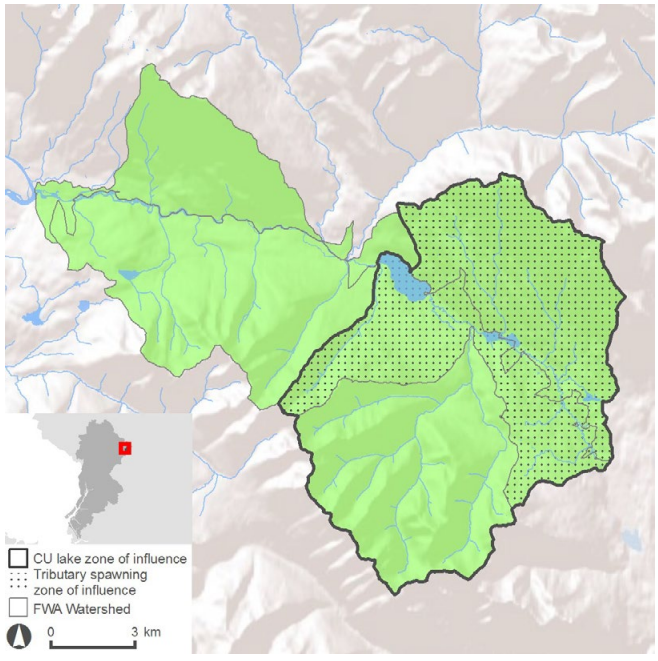




Fish Passage/Habitat Connectivity

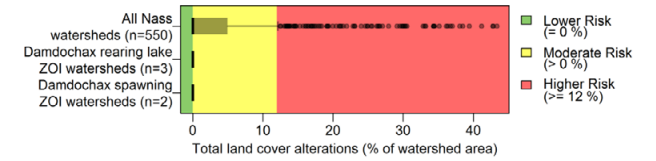
Stream crossing density

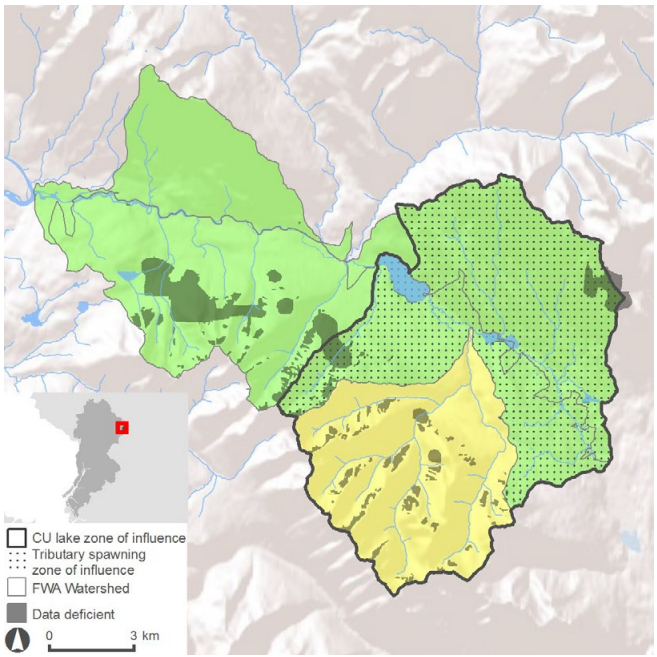




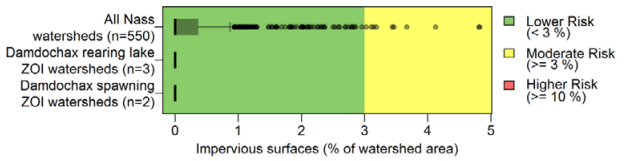
Human Development Footprint

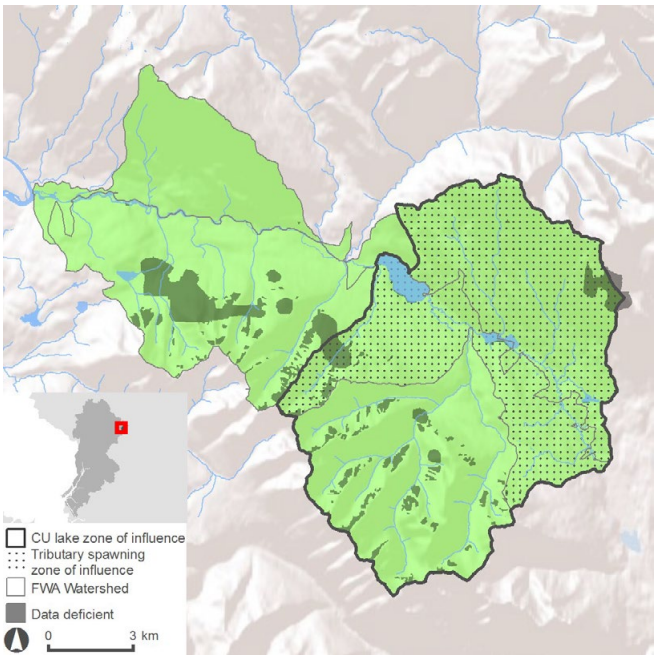
Total land cover alteration



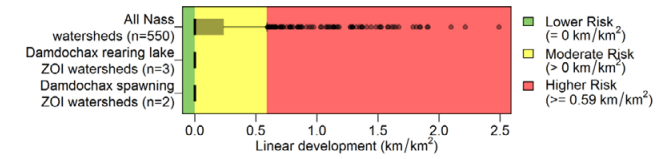


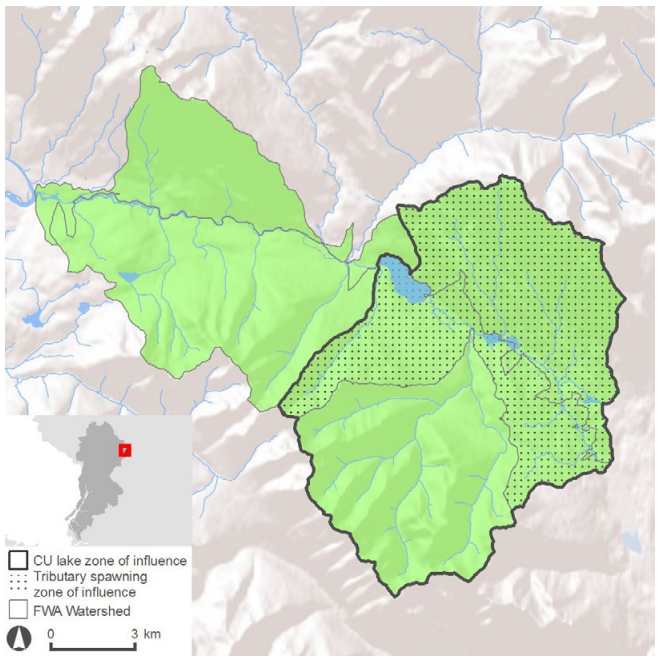
Impervious surfaces



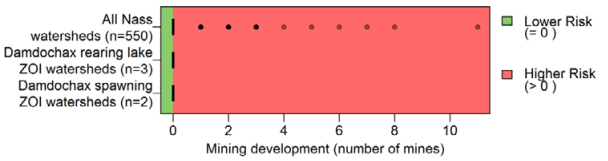


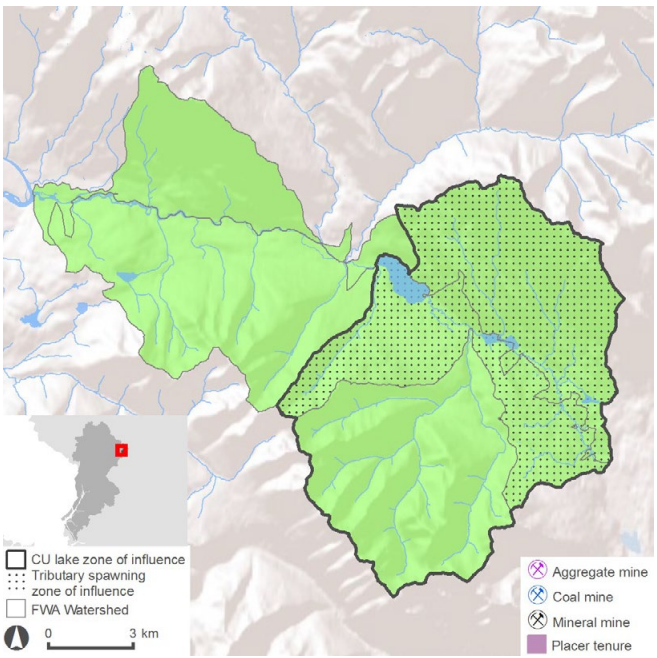
Linear development





Mining development (total number of mines)

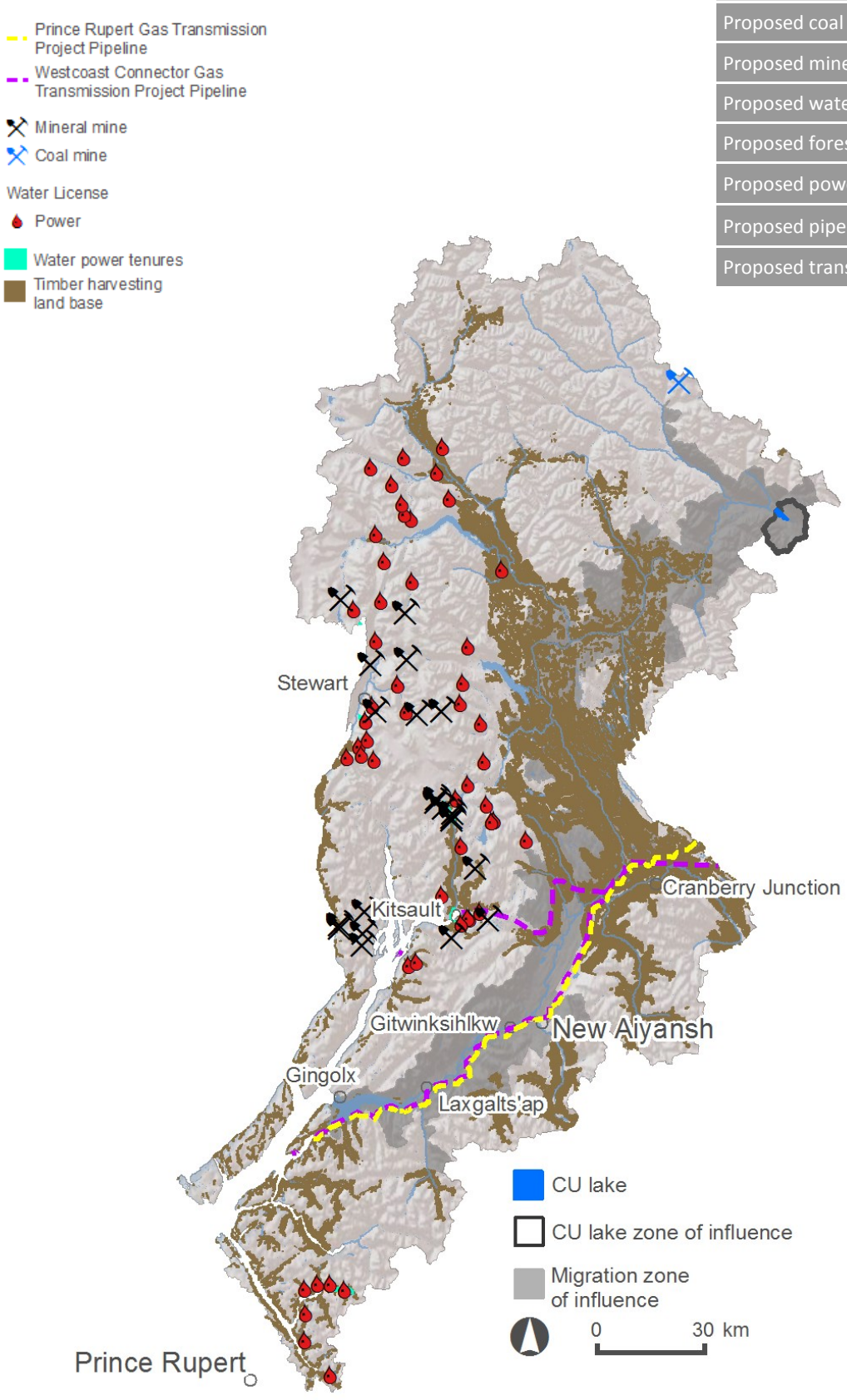




Future pressure

Proposed resource development projects (as of 2016)

Nass Drainage Summary	
	Totals
Proposed coal mines (#)	1
Proposed mineral mines (#)	22
Proposed water licenses (#)	58
Proposed forestry (km^2)	3,323 km^2
Proposed power tenures	Wind 0 km^2, water 15 km^2
Proposed pipelines (km)	386 km
Proposed transmission lines	0 km



Lake Sockeye: Fred Wright

Introduction

This project summarizes pressures on the habitat used by Nass salmon Conservation Units (CU) during their freshwater life history stages (migration, spawning and rearing), as well as their relative vulnerability to those pressures. For an explanation of the indicators shown here, please see the accompanying *Report Card Summaries*. Full methods and results can be found in the main report, *Cumulative Pressures on Nass Salmon Habitat: Technical Report* (2016).

Definitions

Conservation Unit (CU): A group of wild salmon sufficiently isolated from other groups that, if extirpated, is very unlikely to re-colonize naturally within an acceptable timeframe.

Pressure indicator: Measurable extent/intensity of natural processes or human activities that can induce changes in habitat condition/state.

Vulnerability indicator: Measures of habitat quantity or quality used to represent the intrinsic habitat vulnerability/sensitivity to watershed disturbances for each life-stage.

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Status: Condition of habitat relative to a defined indicator benchmark.

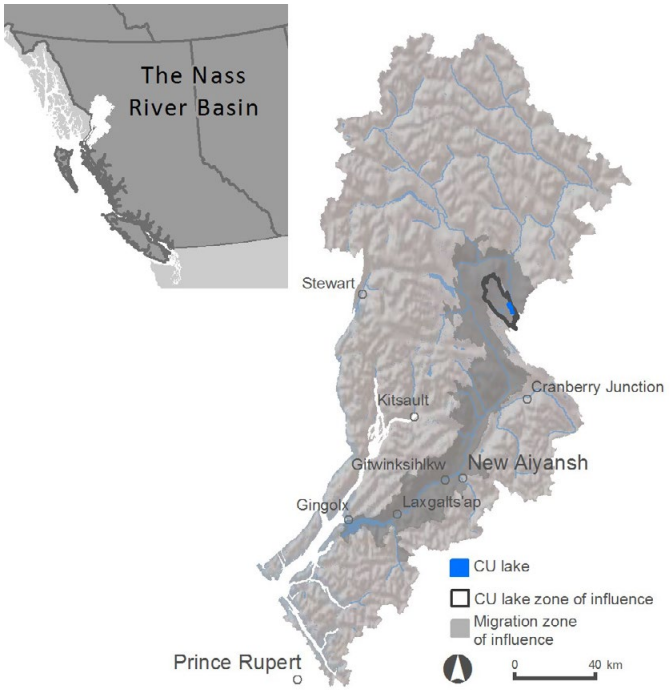
Risk: Likelihood of adverse effects to salmon habitats within a defined zone of influence. Levels of increasing risk are defined based on the extent/intensity of impacts relative to defined benchmarks of concern.

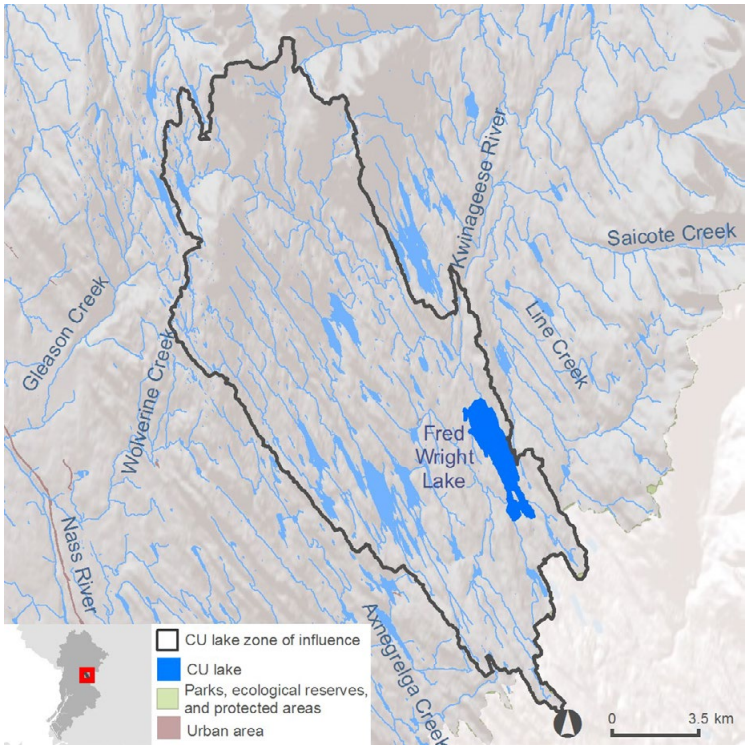
Benchmark: A standard (quantified metric) against which habitat condition can be measured or judged, and by which status can be compared over time and space to determine the risk of adverse effects.

Narrative

- There are ten sockeye salmon CUs in the Nass Area: two are river-type CUs (Upper Nass—UNR and Lower Nass-Portland—LNR-P) and eight are lake-type (Clements, Leverson, Bowser, Damdochax, Fred Wright, Kwinageese, Meziadin, and Oweegee).
- Nearly all of the sockeye salmon production in the Nass Area comes from the lake-type CUs in the upper watershed (i.e. Meziadin, Bowser, Damdochax, Fred Wright, Kwinageese, and Oweegee).
- Nass Area sockeye salmon exhibit variable life history characteristics, with the majority being lake-type and spending one full year rearing in a lake.
- A marine-type population, where salmon go to sea in their first year, is found in some lower Nass tributaries.
- Nass Area sockeye salmon predominantly reside at sea for one to four years, with the majority spending either two or three years at sea.

Location





Summary of habitat vulnerabilities & pressures

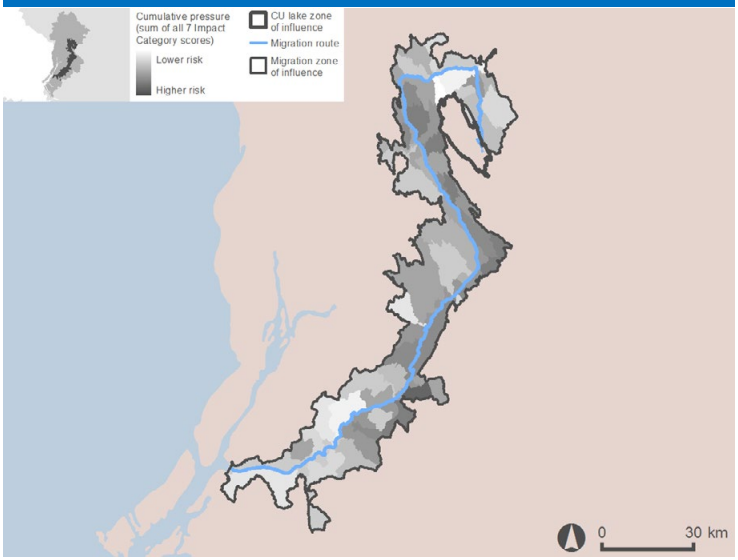
Pressure indicators were grouped into seven relatively independent habitat "impact categories" representing key factors affecting general watershed condition:

- Hydrologic Processes (Forest disturbance; Equivalent Clearcut Area)
- Vegetation Quality (Insect and disease defoliation; Riparian disturbance)
- Surface Erosion (Road development)
- Fish passage/Habitat connectivity (Stream crossing density)
- Water quantity (Water licenses)
- Human development footprint (Total land cover alteration; Impervious surfaces; Linear development; Mining development)
- Water quality (Wastewater discharges)

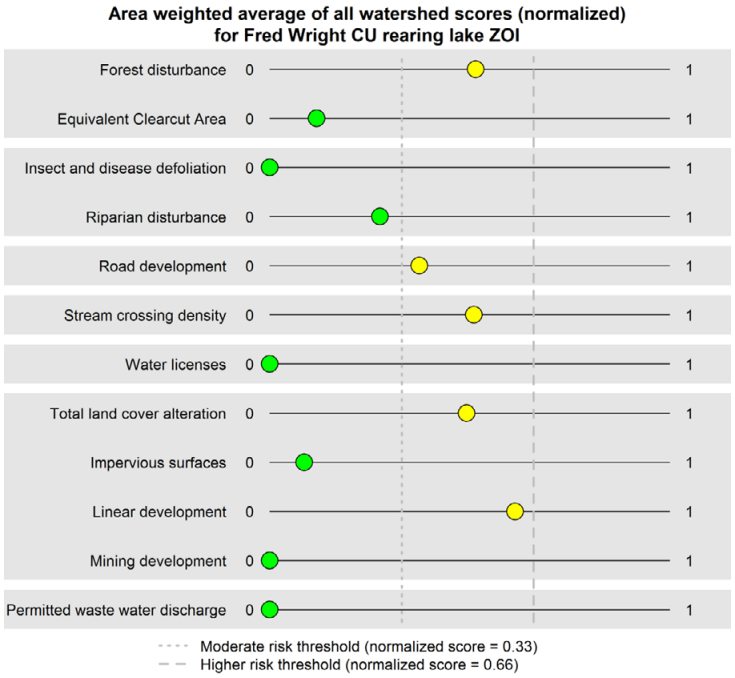
Indicators were also developed reflecting relative vulnerability to habitat pressures within the life stage-specific "zones of influence" defined for each lake sockeye CU:

- Migration (Total migration distance; Length and percentage of migration route summer flow sensitive)
- Spawning (Total spawning length; Spawning length in tributary, lake or mainstem; Ratio of lake influenced to total spawning length; Length of accessible habitat)
- Rearing (Rearing lake area)

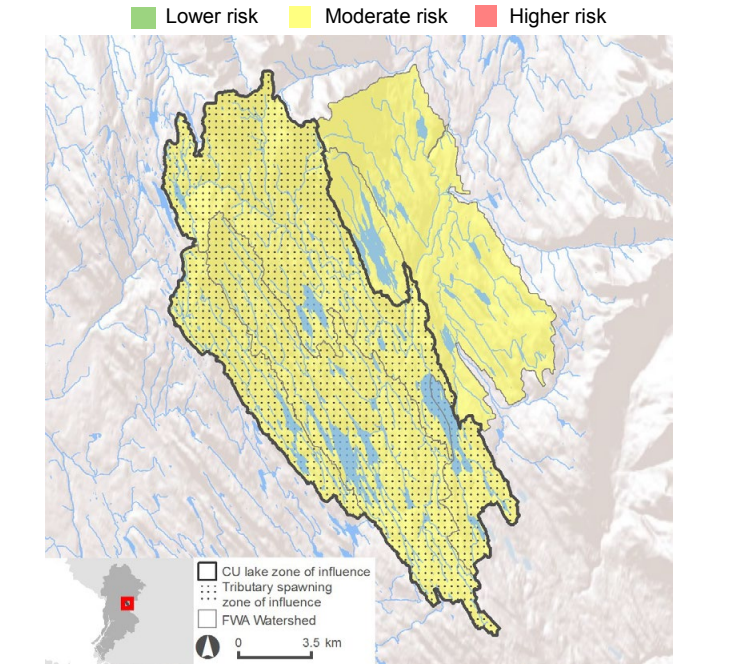
Cumulative pressure—migration



Summary of pressure indicators—rearing

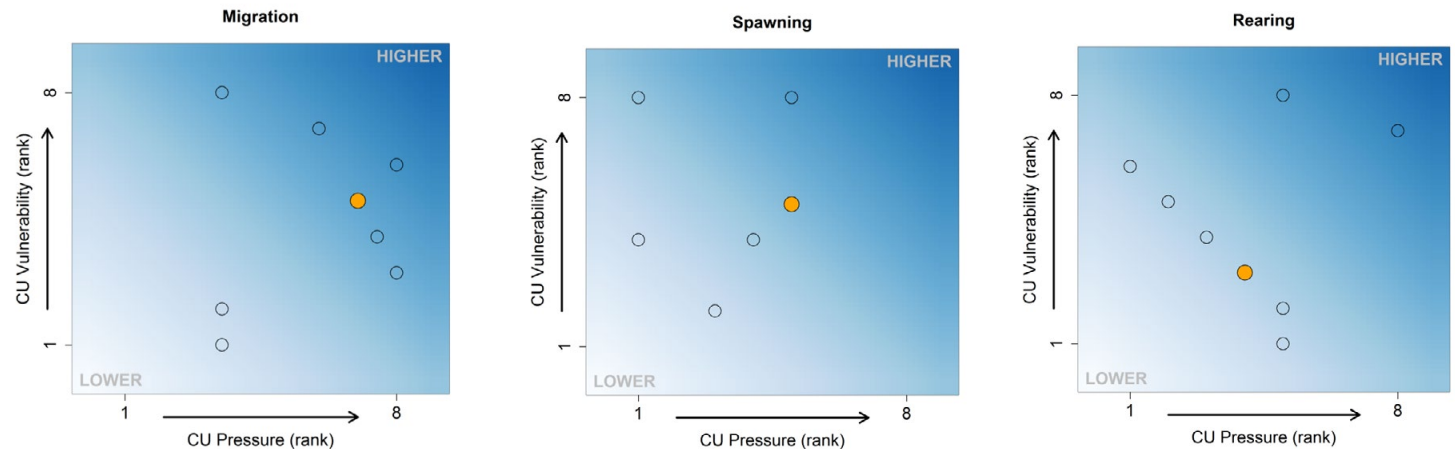


Cumulative pressure—rearing & spawning



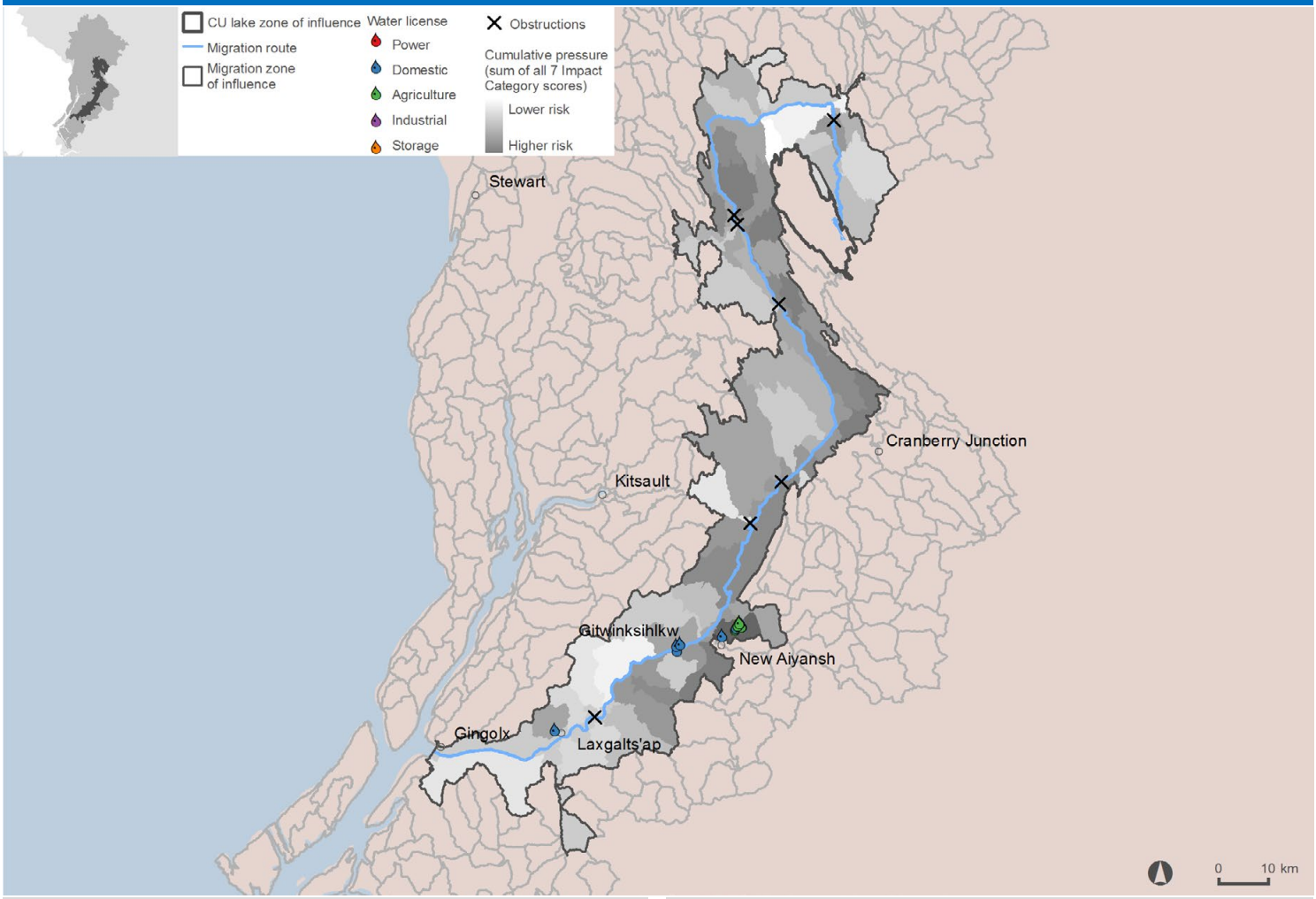
Integrated vulnerability/habitat pressures—migration, spawning, & rearing

● = Fred Wright ○ = other lake sockeye CUs

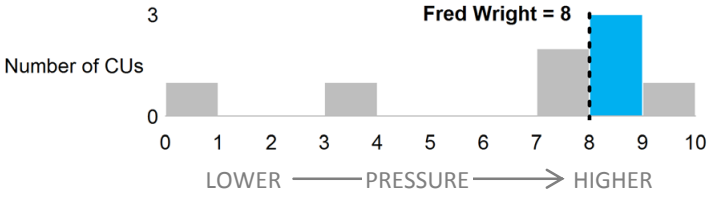


Migration vulnerability & pressure

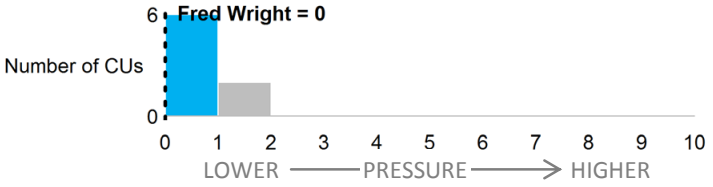
Migration period pressures



Number of obstructions along migration route

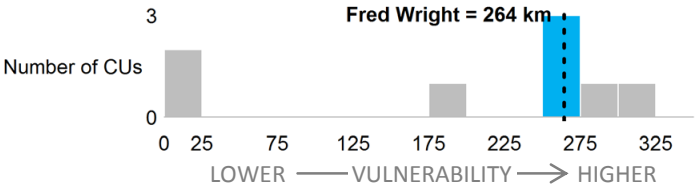


Number of water licenses along migration ZOI

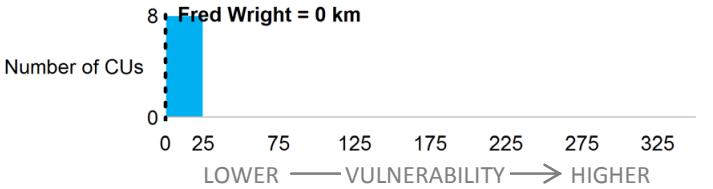


Migration period vulnerability

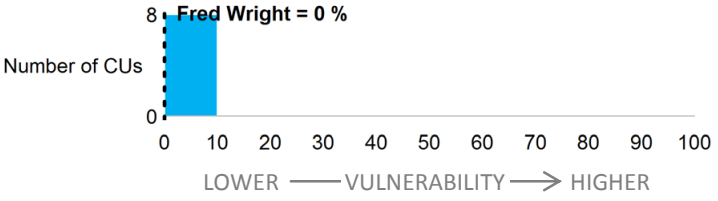
Migration distance (km)



Migration route - summer low flow sensitive (km)



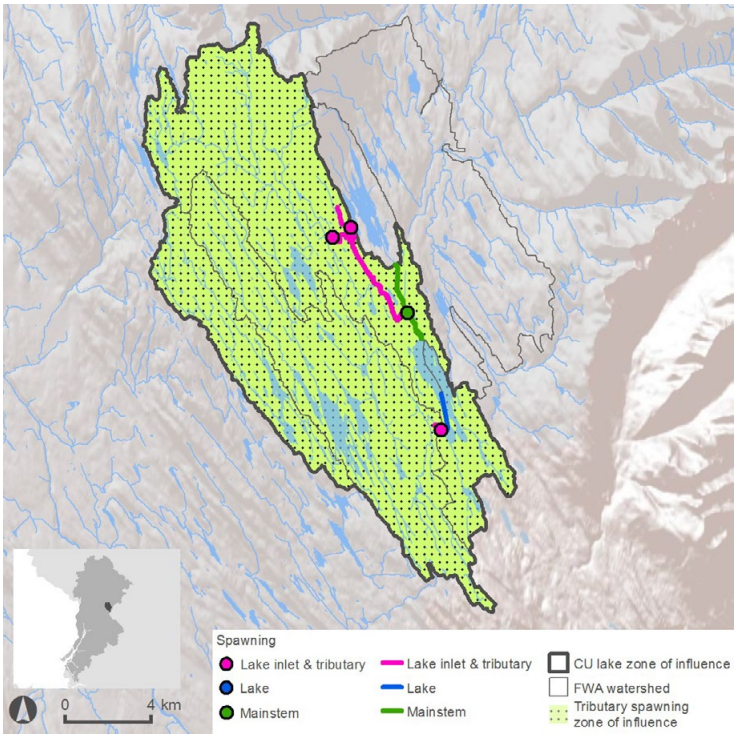
Migration route - summer low flow sensitive (%)



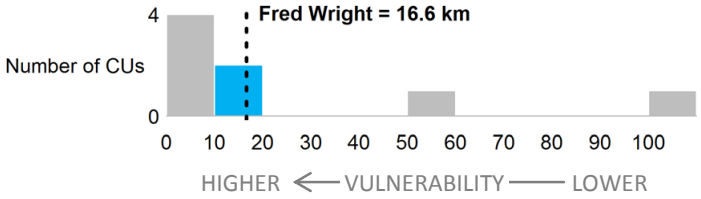
Spawning & rearing vulnerability

Spawning period vulnerability

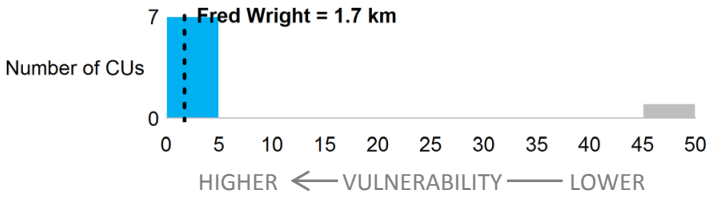
Spawning locations



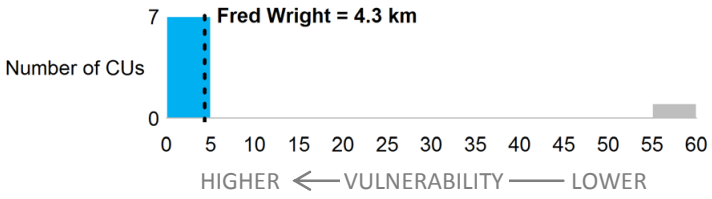
Total (mainstem, trib & lake) spawning length (km)



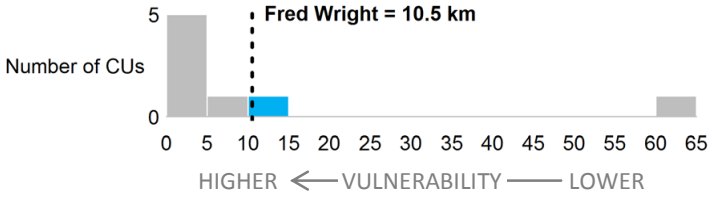
Length of lake shore spawning areas (km)



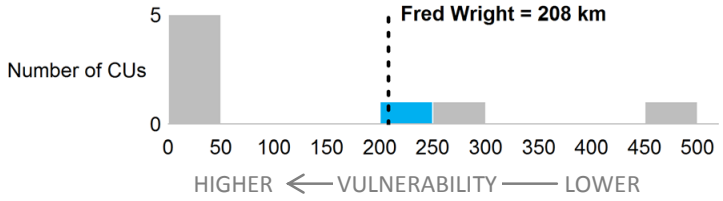
Mainstem spawning length (km)



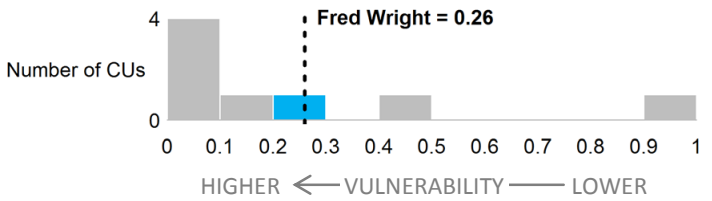
Tributary and lake inlet spawning length (km)



Salmon accessible habitat (km)

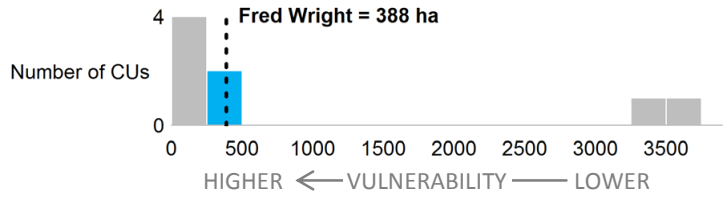


Ratio of lake influenced to total spawning



Rearing period vulnerability

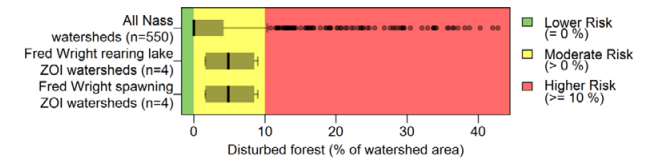
Area of nursery lakes (ha)

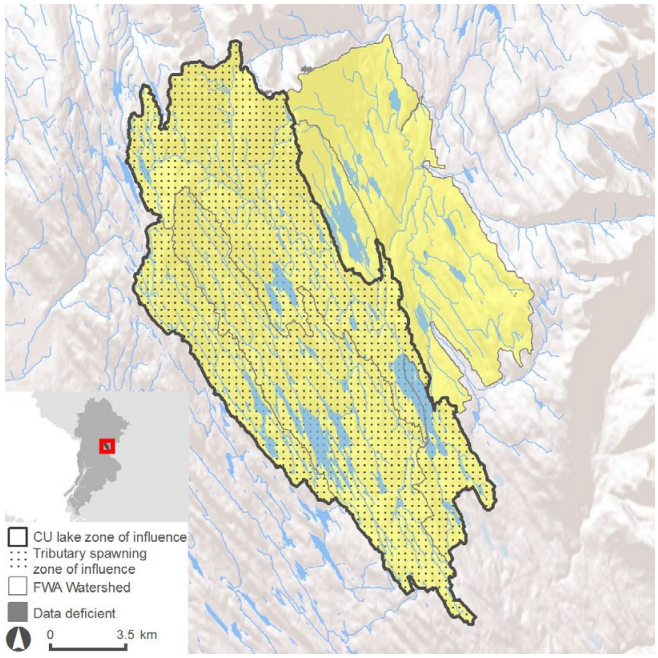


Spawning & rearing pressure

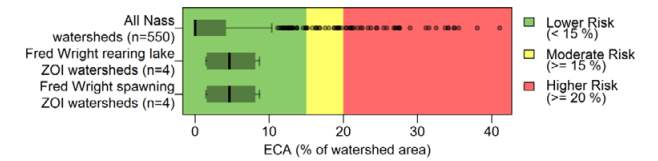
Hydrologic Processes

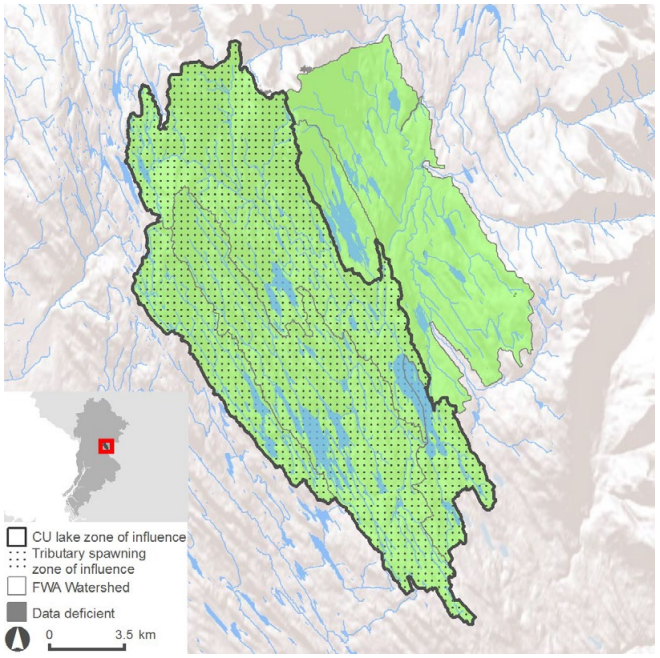
Forest disturbance





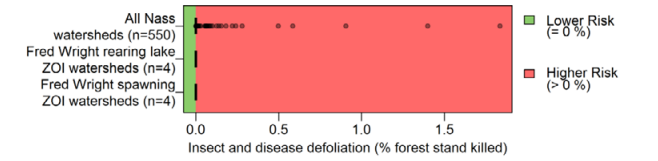
Equivalent Clear-cut Area

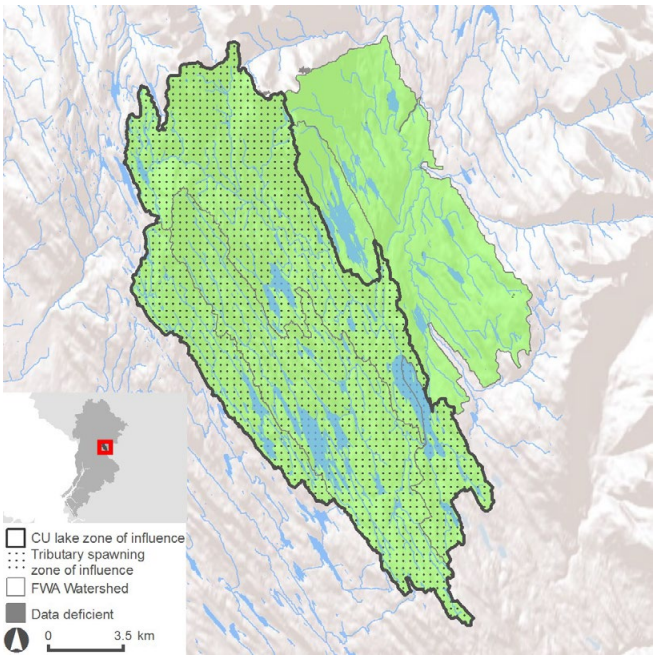




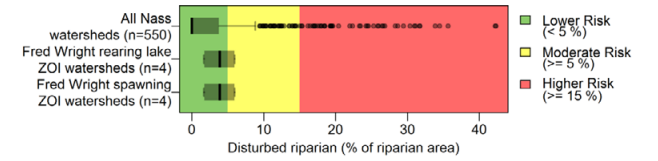
Vegetation Quality

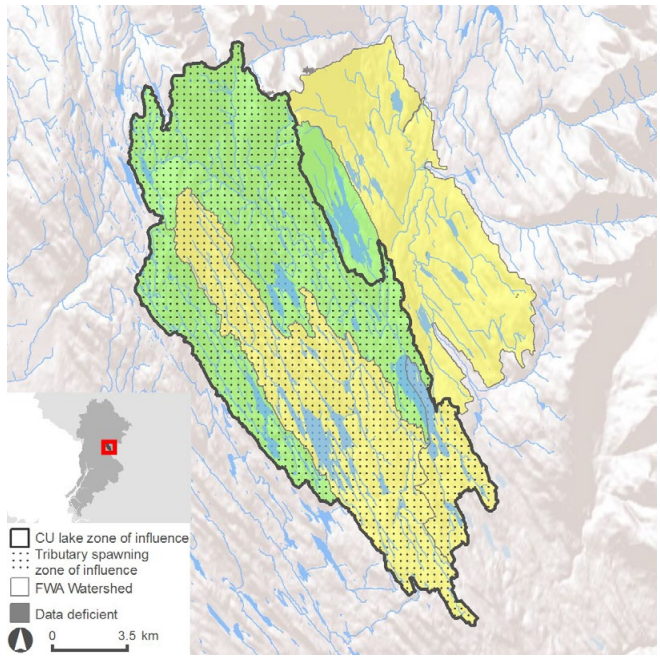
Insect and disease defoliation





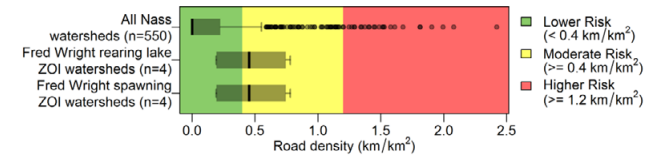
Riparian disturbance

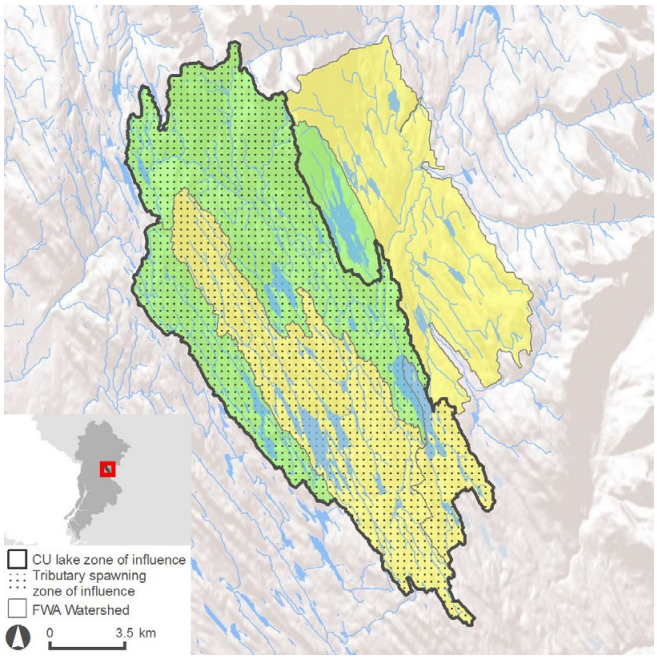




Surface Erosion

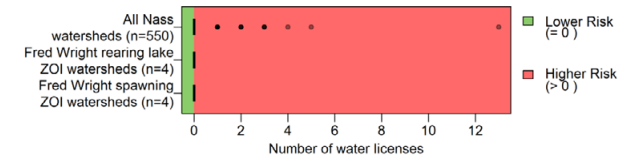
Road development

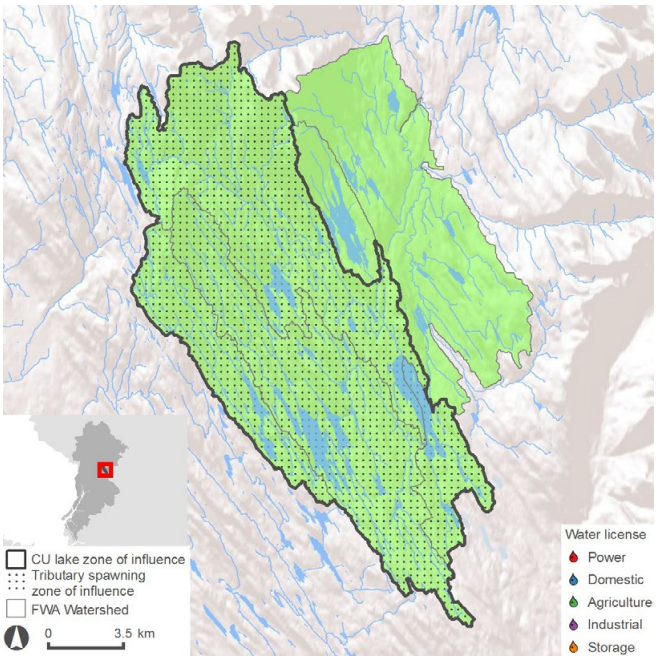




Water Quantity

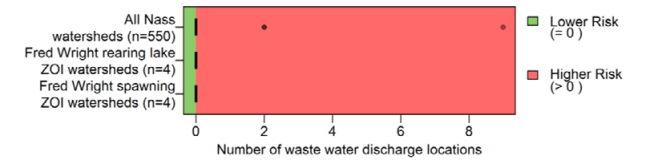
Number of water licenses

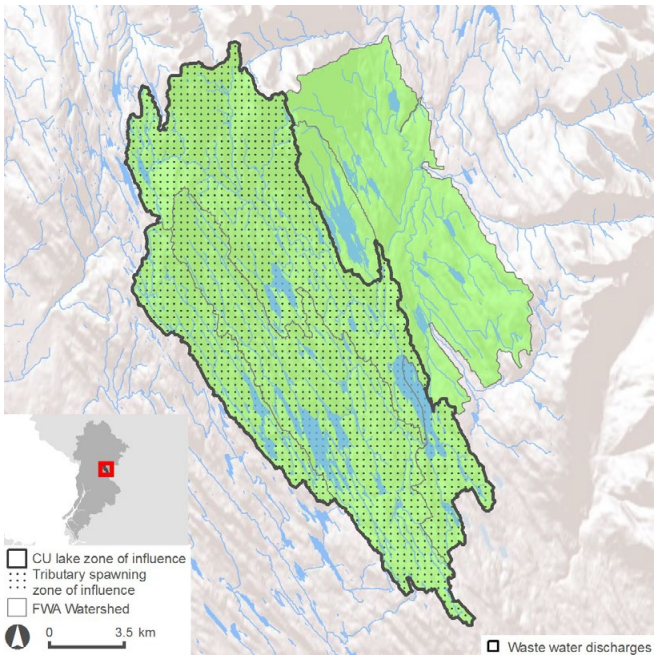




Water Quality

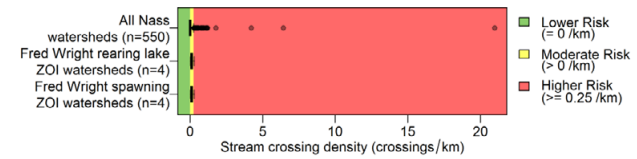
Permitted waste water discharges

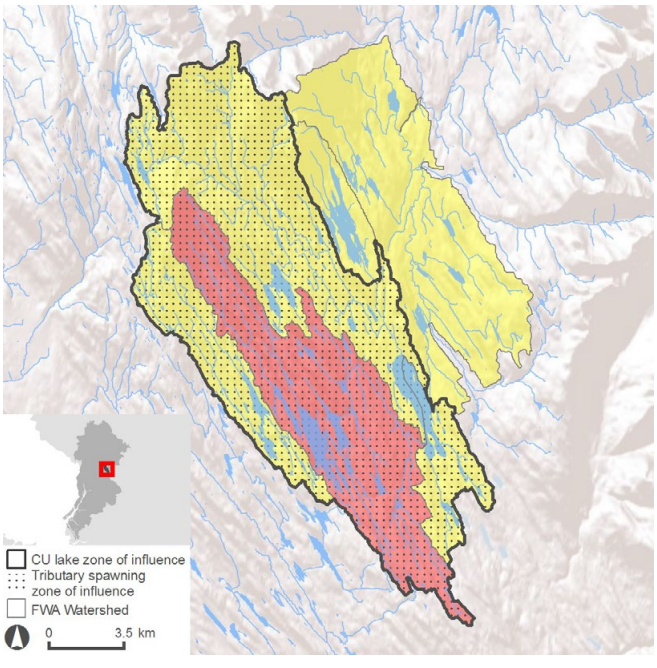




Fish Passage/Habitat Connectivity

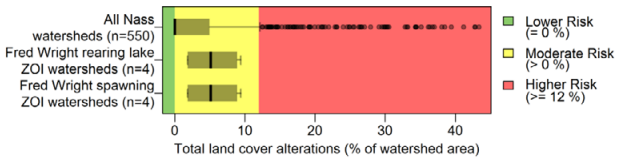
Stream crossing density

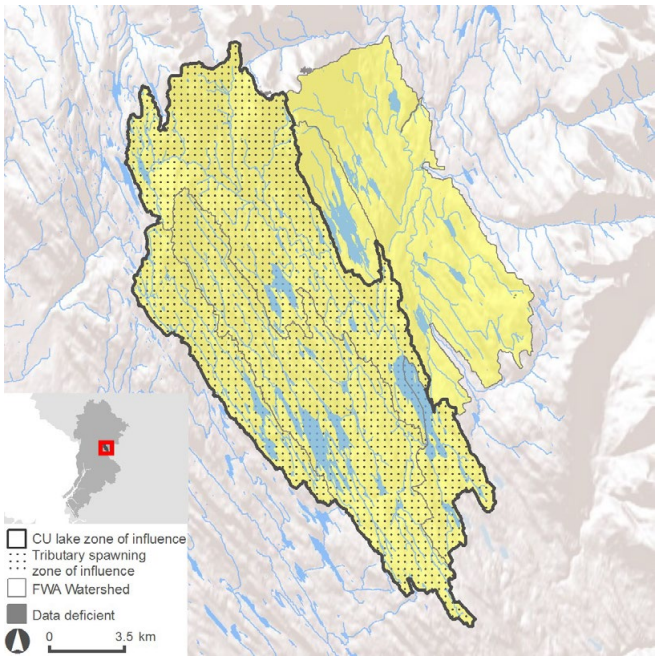




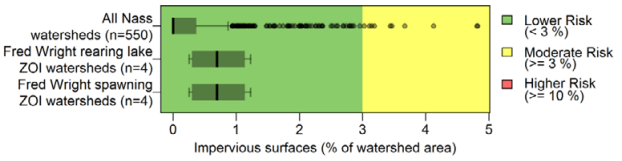
Human Development Footprint

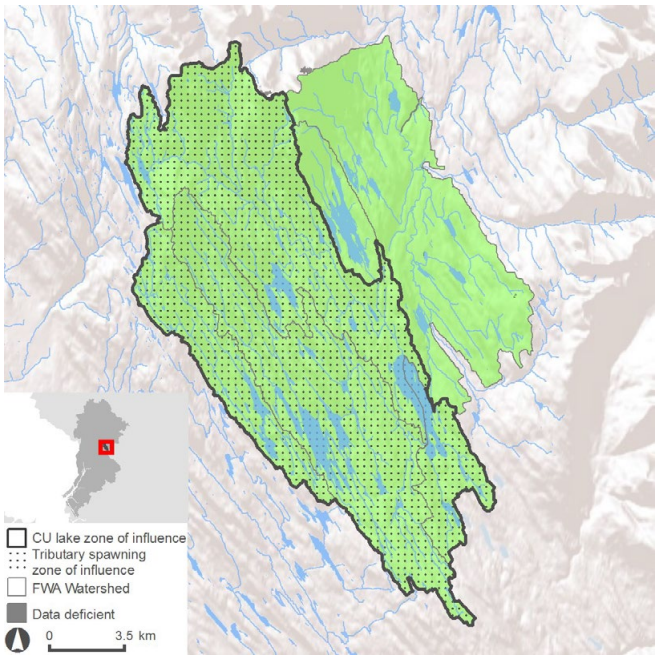
Total land cover alteration



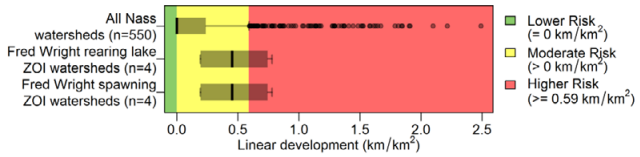


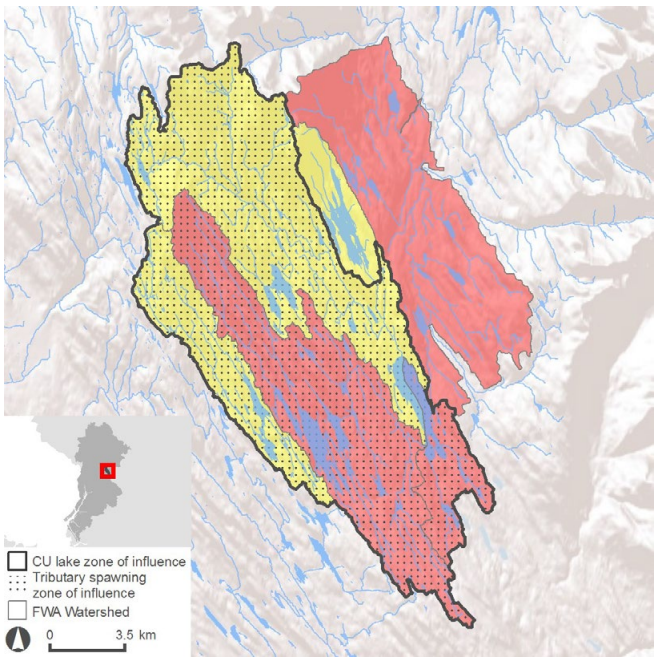
Impervious surfaces



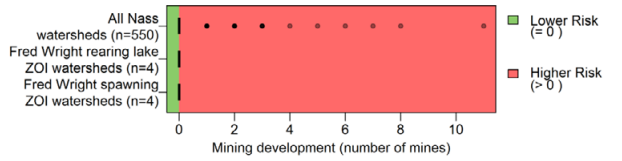


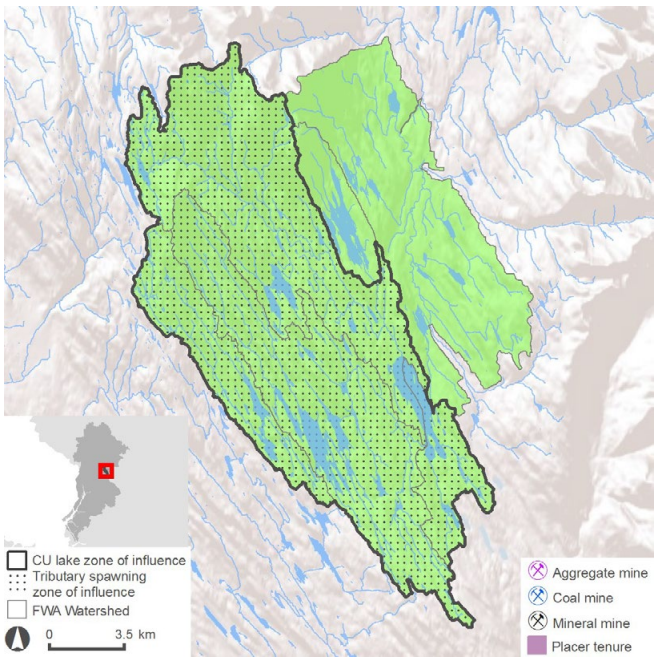
Linear development





Mining development (total number of mines)





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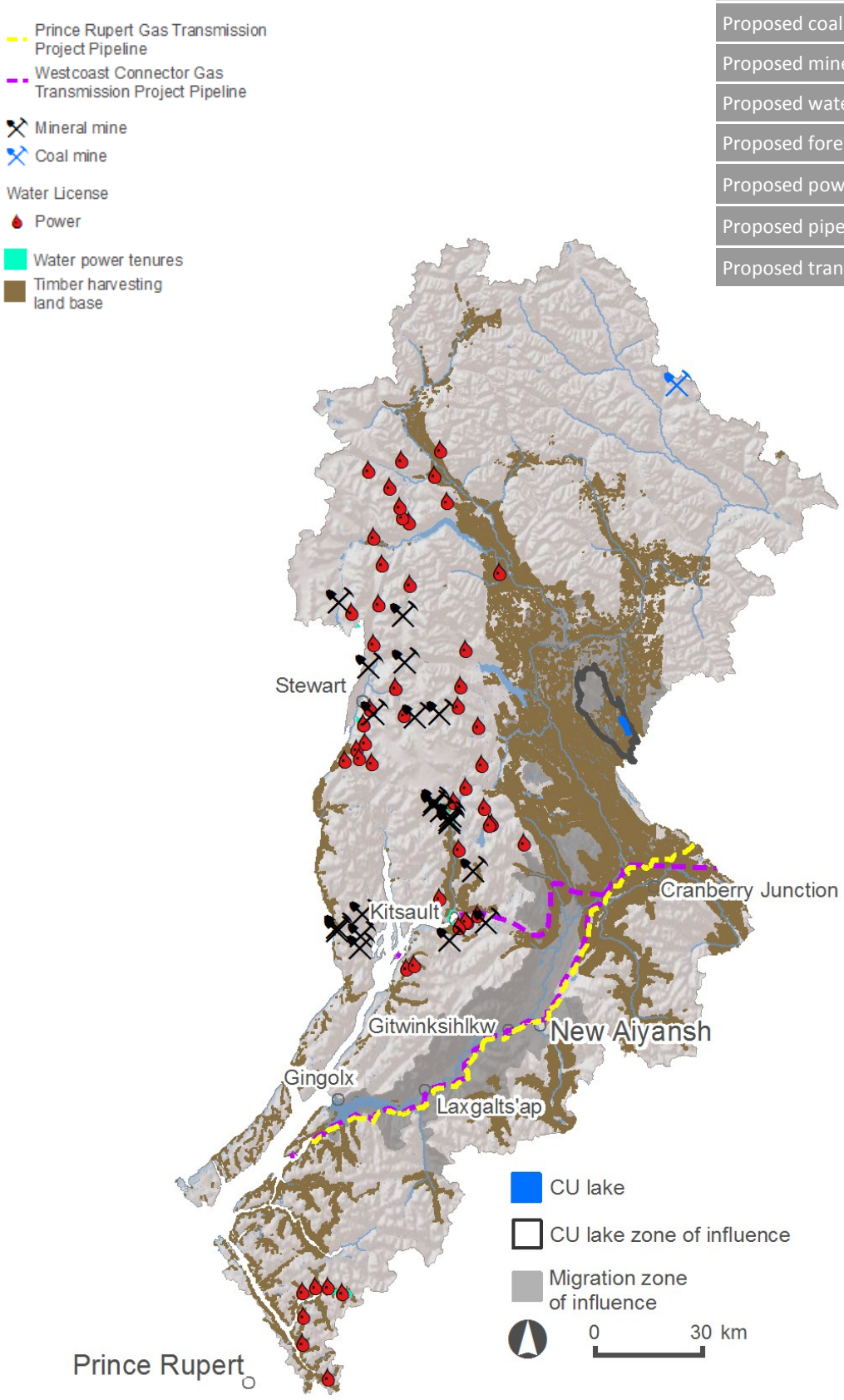

Lake Sockeye: Kwinageese

Introduction

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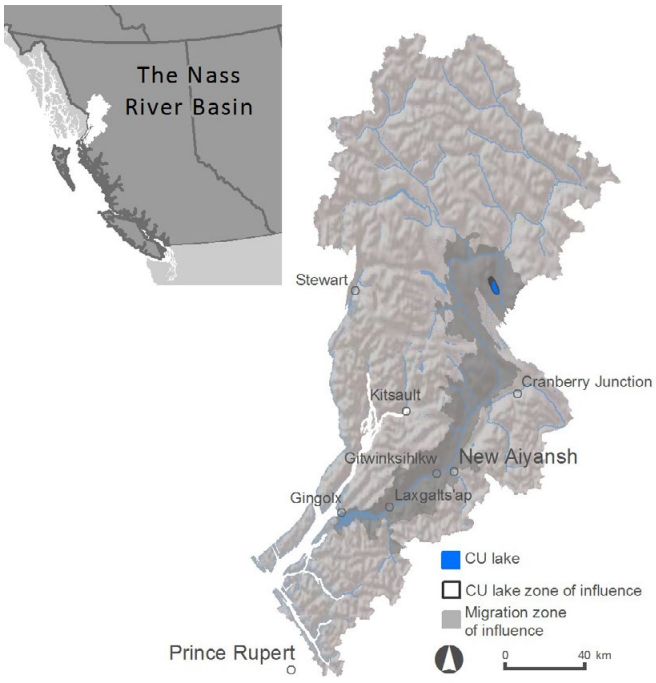
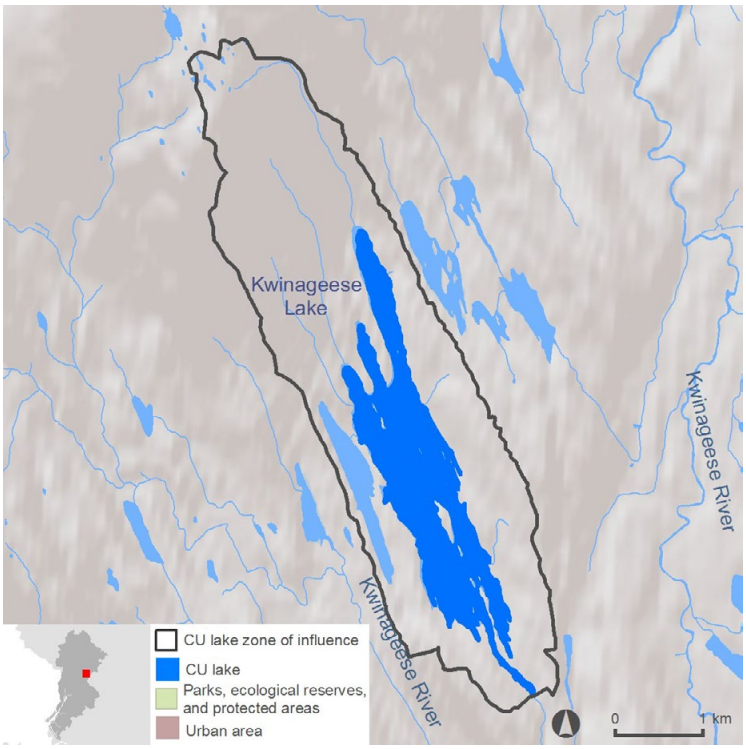
- Nass Area sockeye salmon predominantly reside at sea for one to four years, with the majority spending either two or three years at sea.

Location





Summary of habitat vulnerabilities & pressures

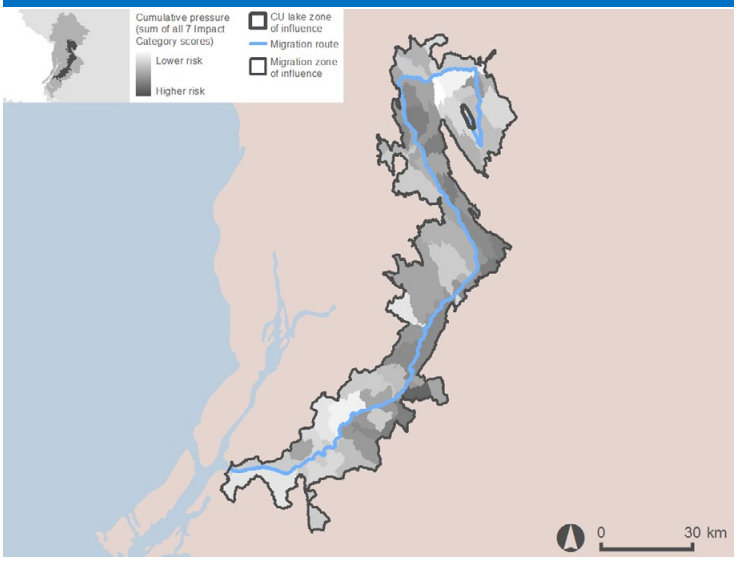
Pressure indicators were grouped into seven relatively independent habitat "impact categories" representing key factors affecting general watershed condition:

- Hydrologic Processes (Forest disturbance; Equivalent Clearcut Area)
- Vegetation Quality (Insect and disease defoliation; Riparian disturbance)
- Surface Erosion (Road development)
- Fish passage/Habitat connectivity (Stream crossing density)
- Water quantity (Water licenses)
- Human development footprint (Total land cover alteration; Impervious surfaces; Linear development; Mining development)
- Water quality (Wastewater discharges)

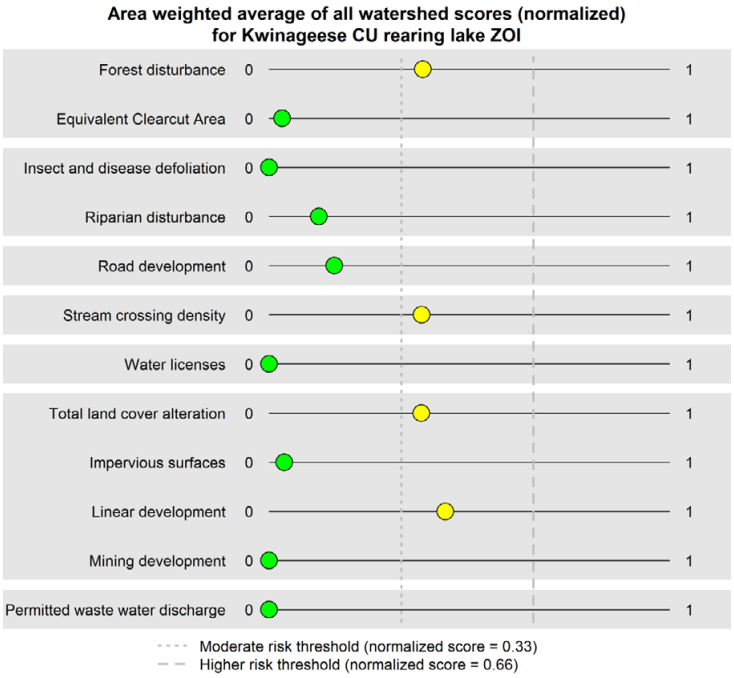
Indicators were also developed reflecting relative vulnerability to habitat pressures within the life stage-specific "zones of influence" defined for each lake sockeye CU:

- Migration (Total migration distance; Length and percentage of migration route summer flow sensitive)
- Spawning (Total spawning length; Spawning length in tributary, lake or mainstem; Ratio of lake influenced to total spawning length; Length of accessible habitat)
- Rearing (Rearing lake area)

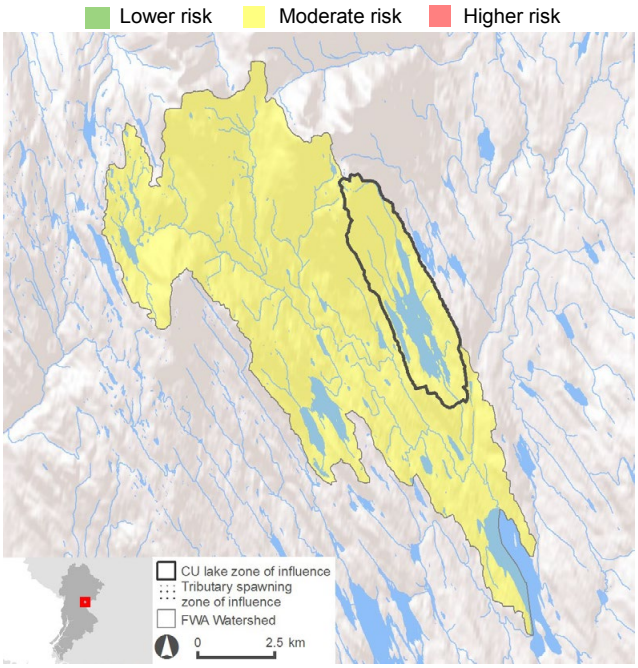
Cumulative pressure—migration



Summary of pressure indicators—rearing

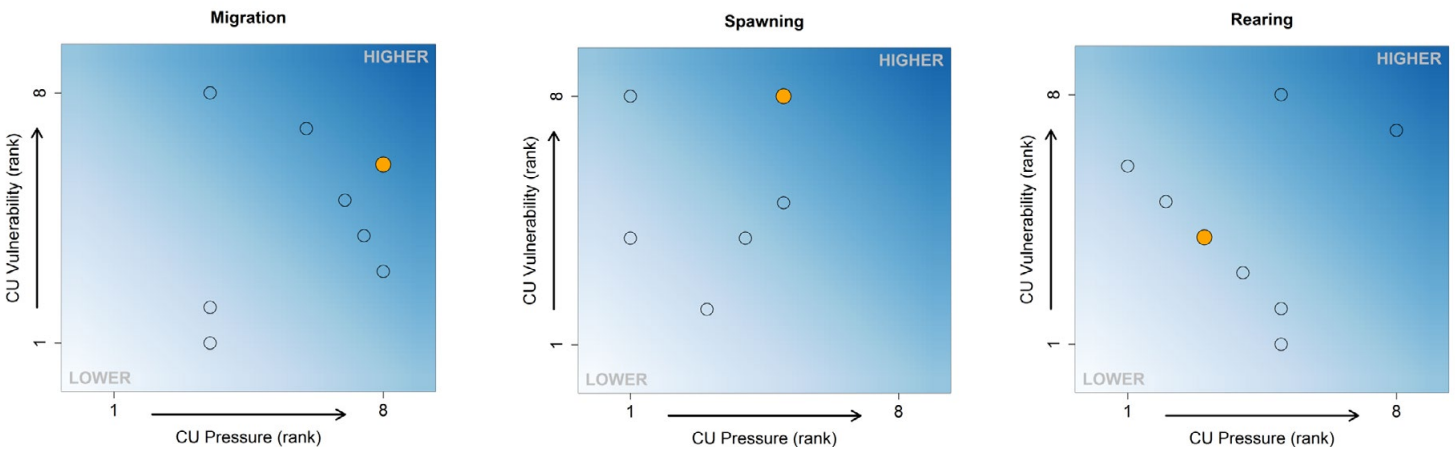


Cumulative pressure—rearing & spawning



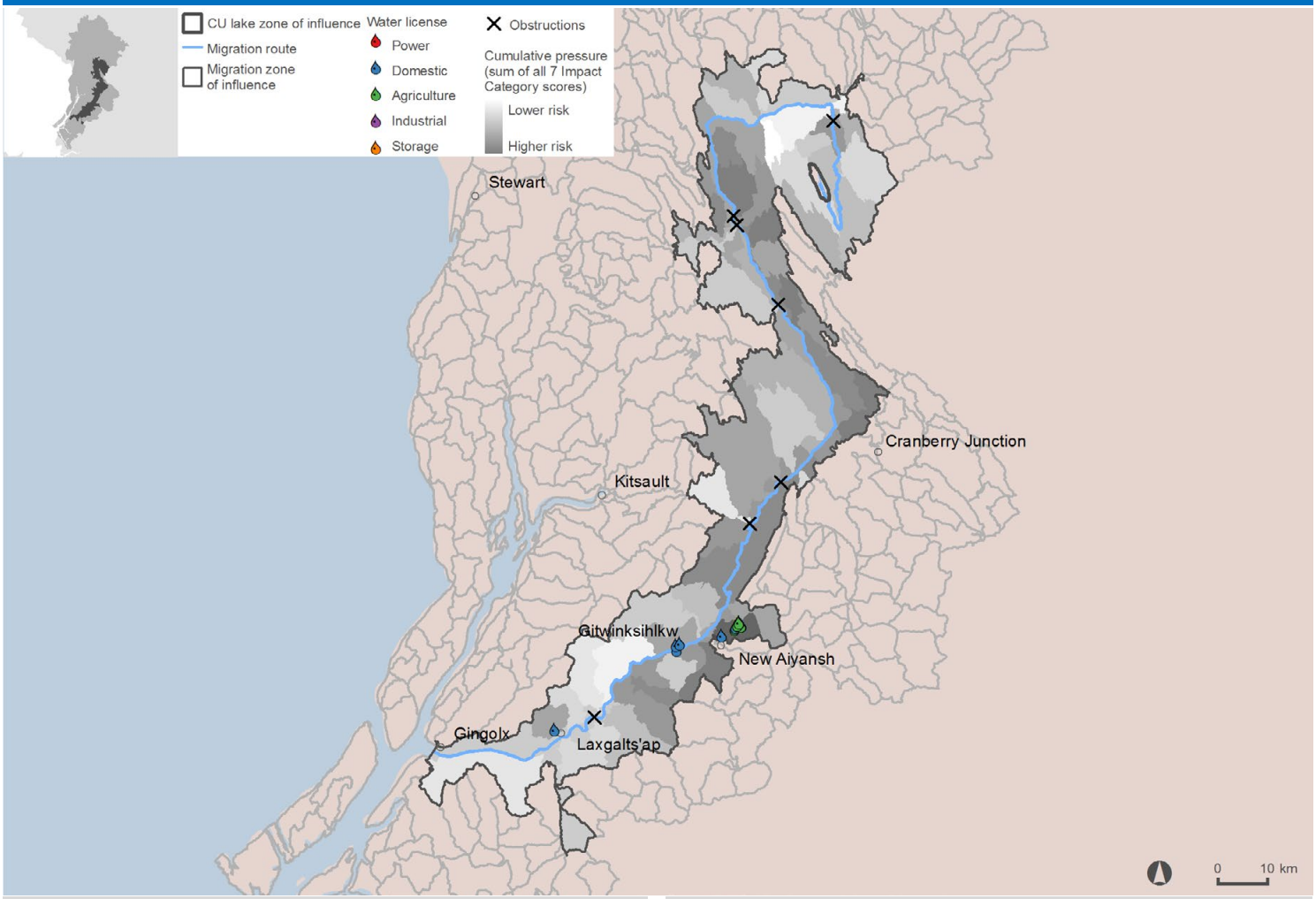
Integrated vulnerability/habitat pressures—migration, spawning, & rearing

● = Kwinageese ○ = other lake sockeye CUs

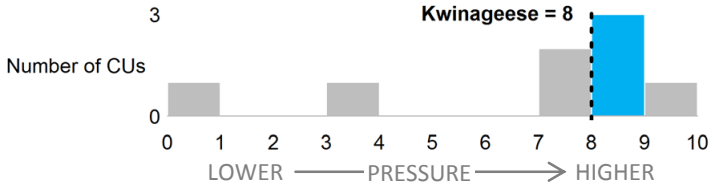


Migration vulnerability & pressure

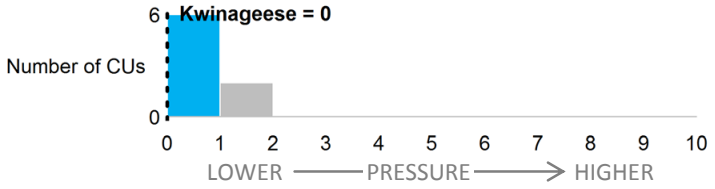
Migration period pressures



Number of obstructions along migration route

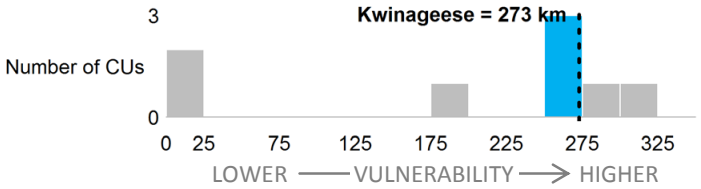


Number of water licenses along migration ZOI

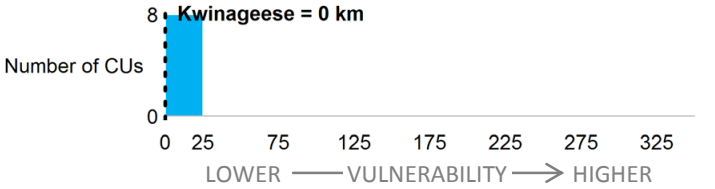


Migration period vulnerability

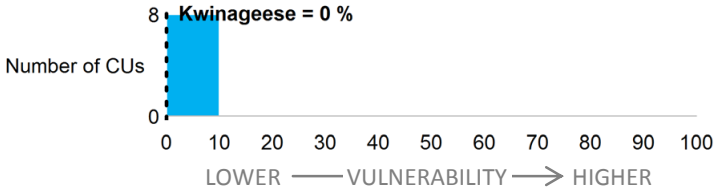
Migration distance (km)



Migration route - summer low flow sensitive (km)



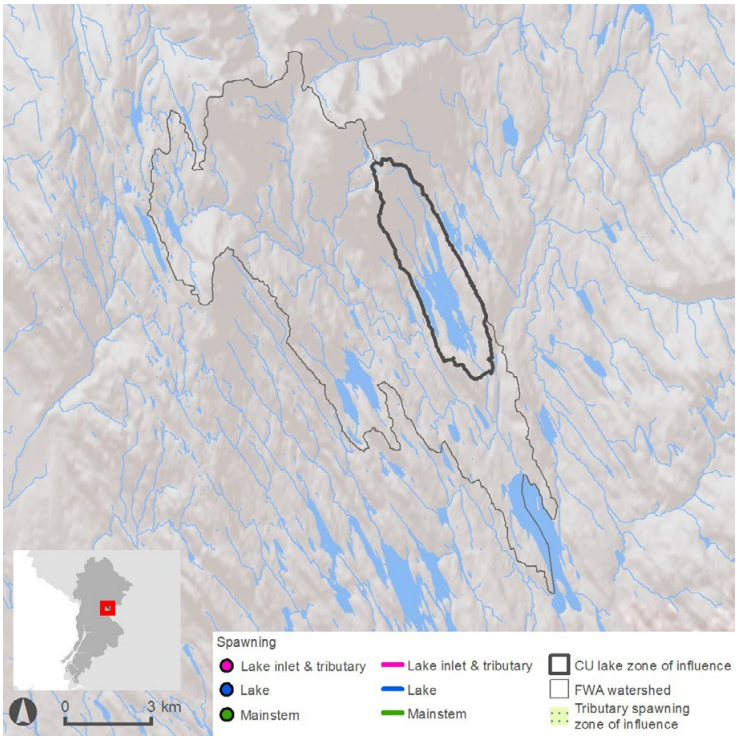
Migration route - summer low flow sensitive (%)



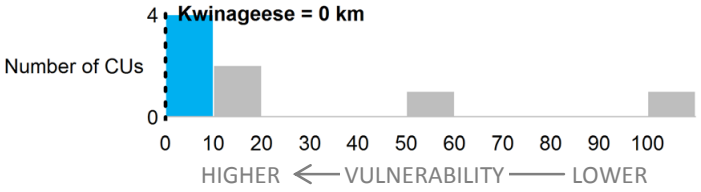
Spawning & rearing vulnerability

Spawning period vulnerability

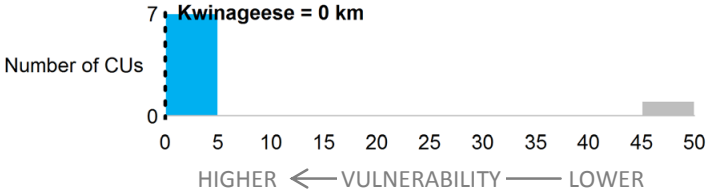
Spawning locations



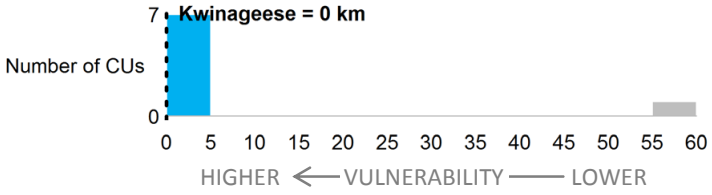
Total (mainstem, trib & lake) spawning length (km)



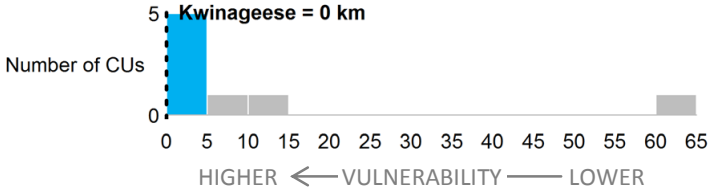
Length of lake shore spawning areas (km)



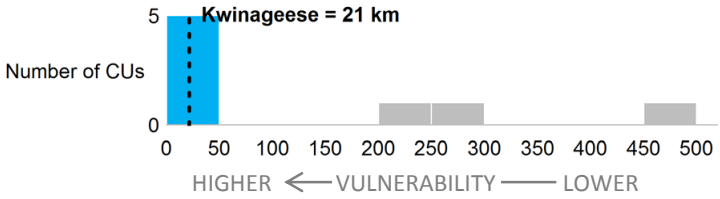
Mainstem spawning length (km)



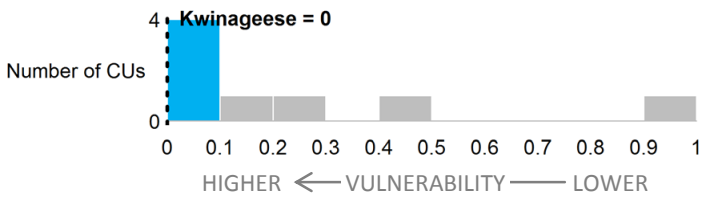
Tributary and lake inlet spawning length (km)



Salmon accessible habitat (km)

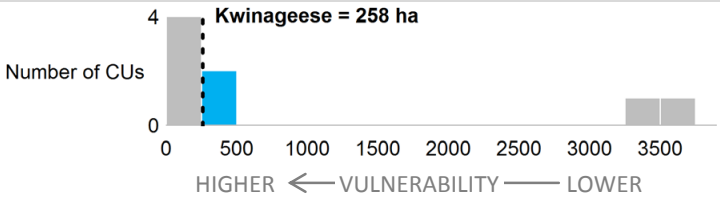


Ratio of lake influenced to total spawning



Rearing period vulnerability

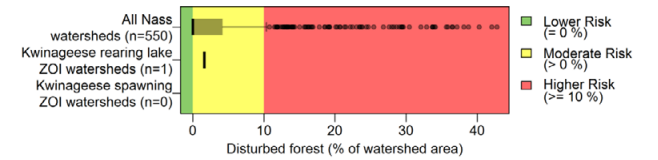
Area of nursery lakes (ha)

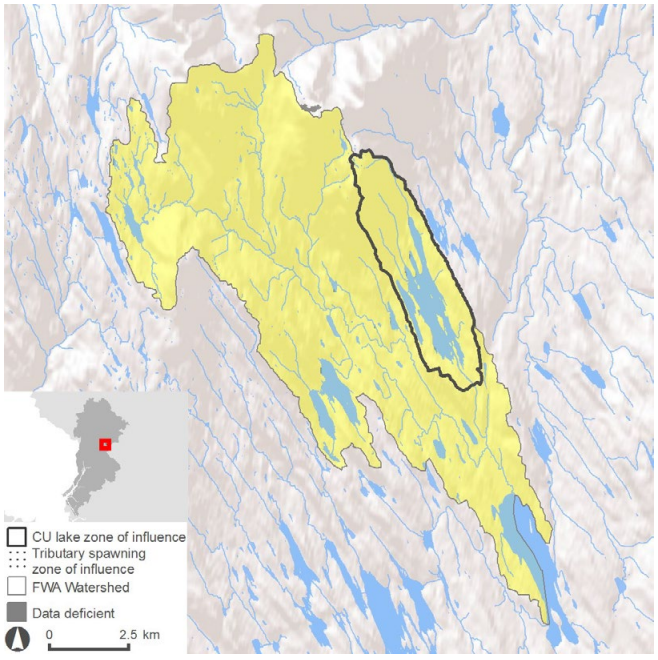


Spawning & rearing pressure

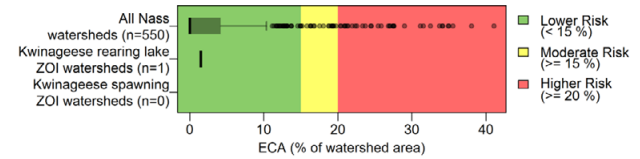
Hydrologic Processes

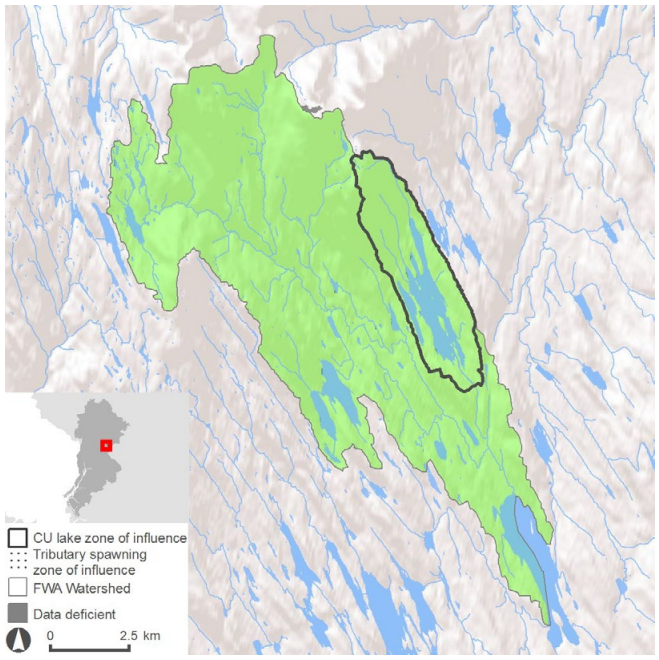
Forest disturbance





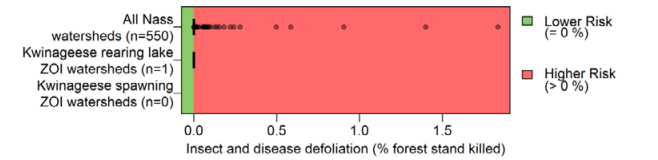
Equivalent Clear-cut Area

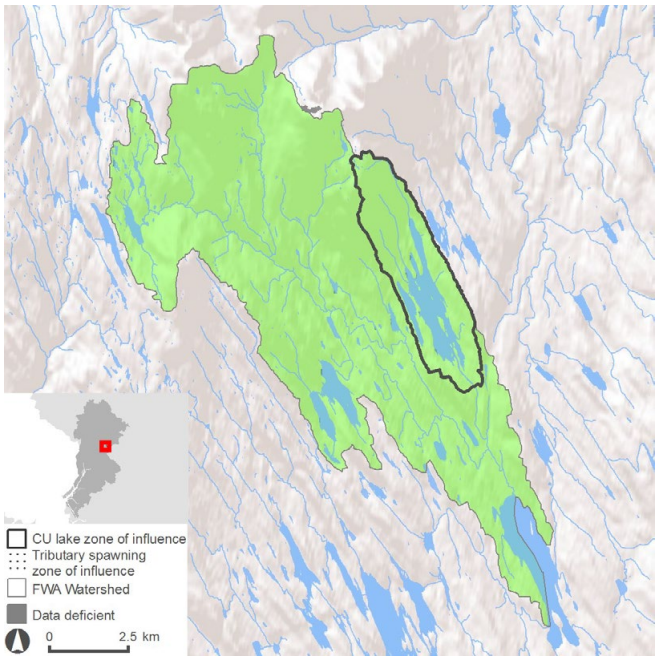




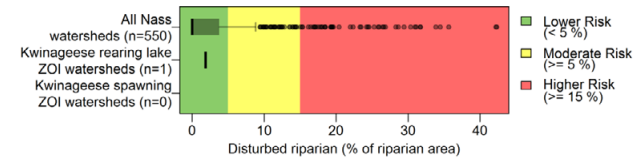
Vegetation Quality

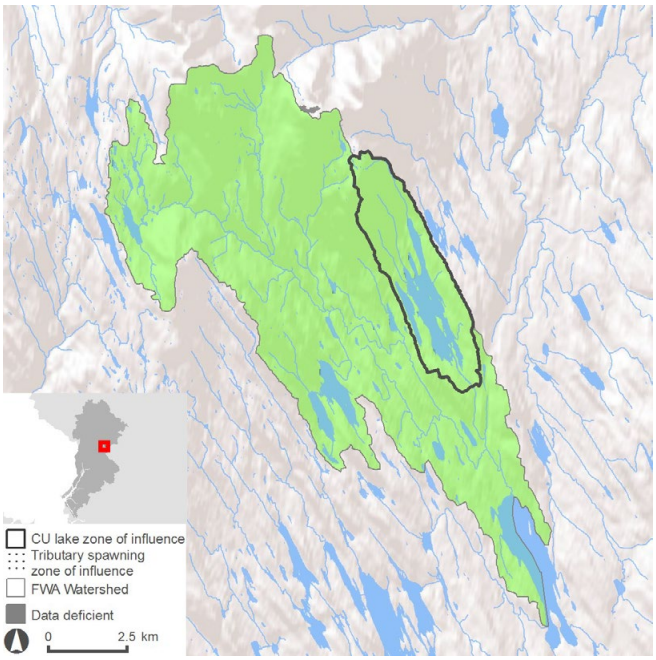
Insect and disease defoliation





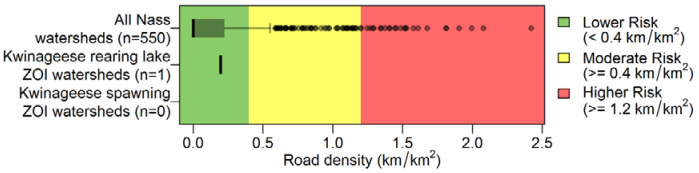
Riparian disturbance

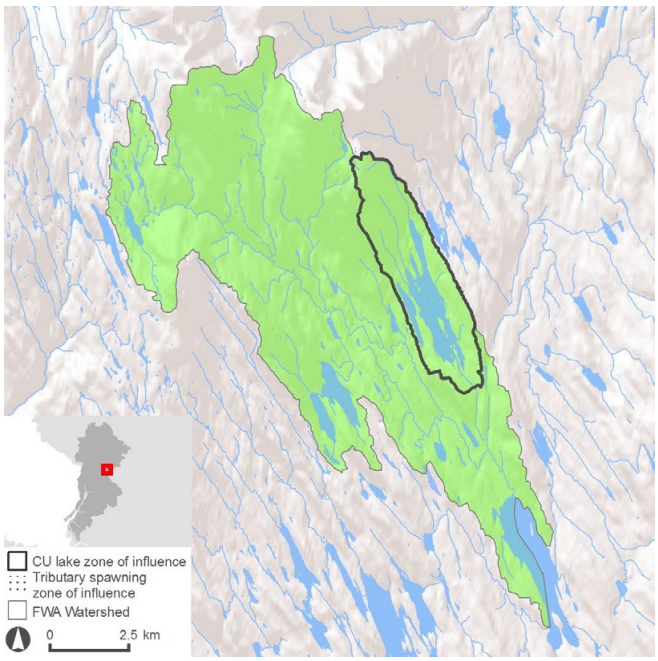




Surface Erosion

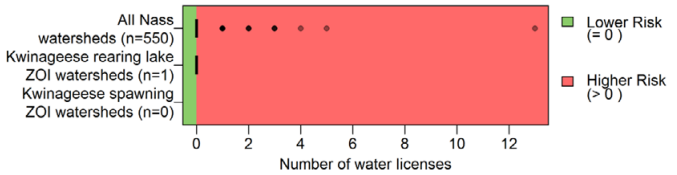
Road development

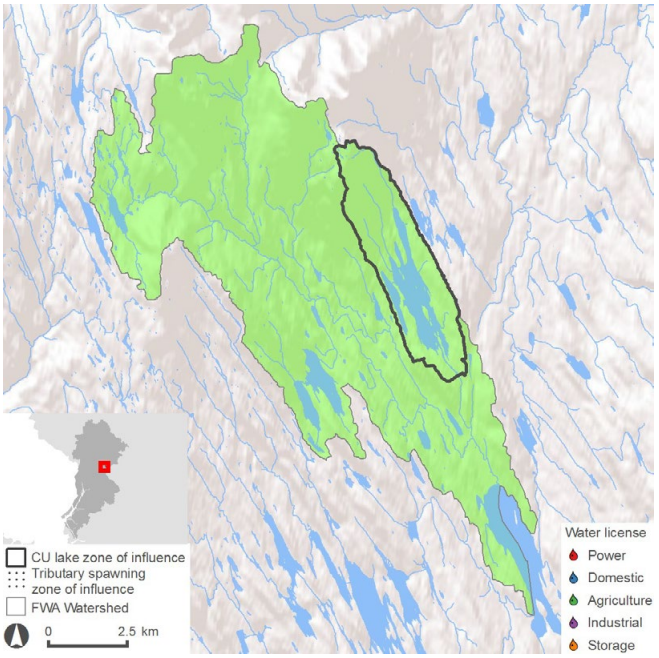




Water Quantity

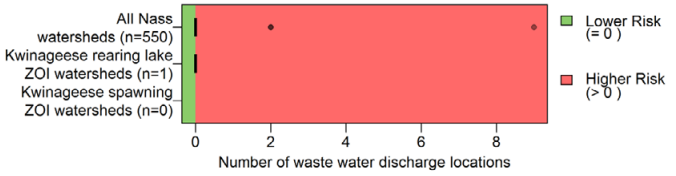
Number of water licenses

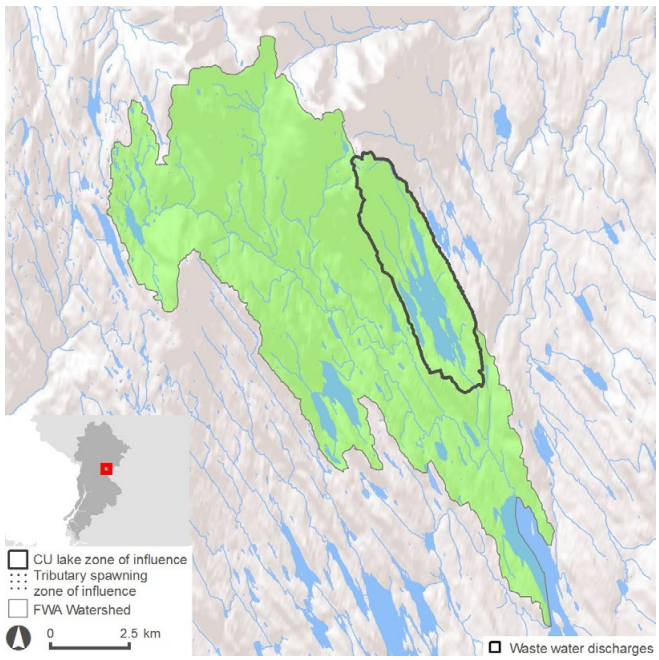




Water Quality

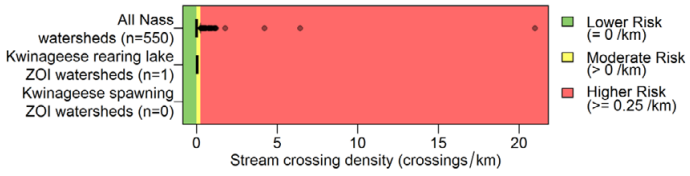
Permitted waste water discharges

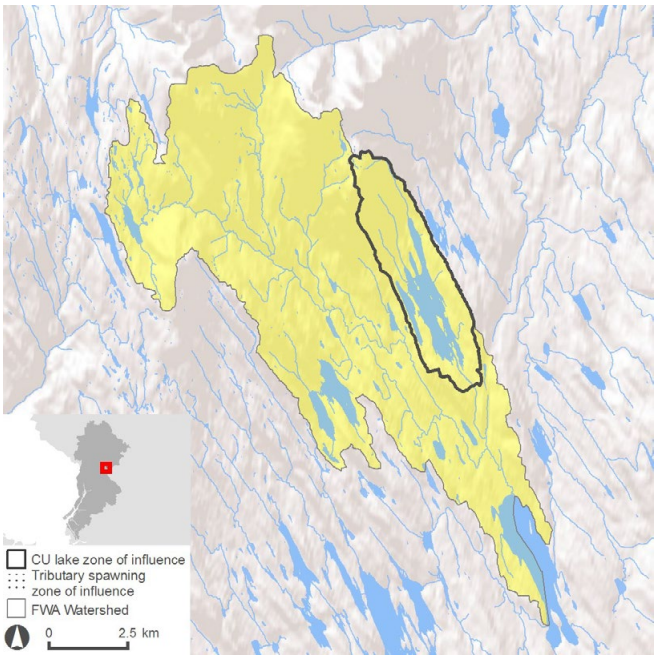




Fish Passage/Habitat Connectivity

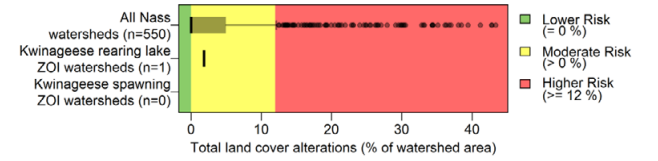
Stream crossing density

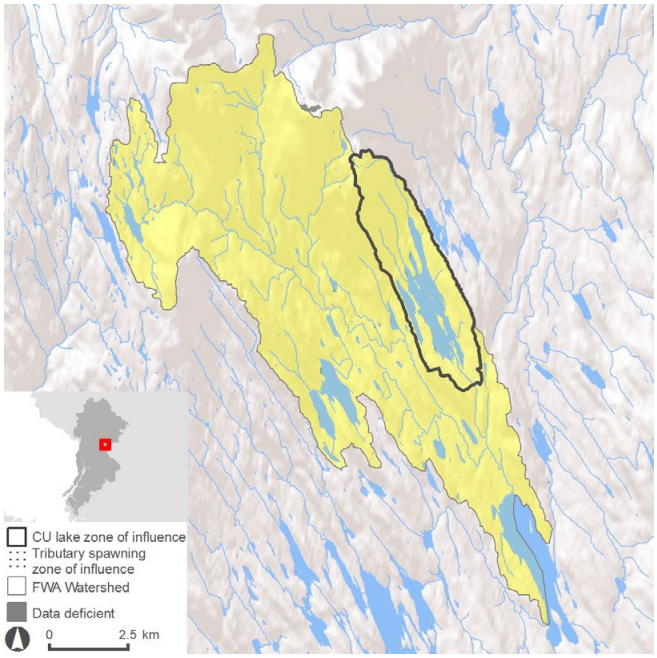




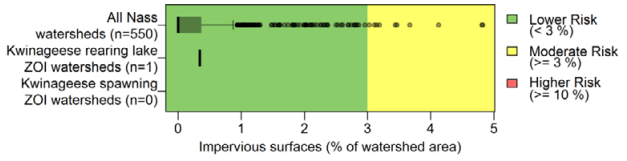
Human Development Footprint

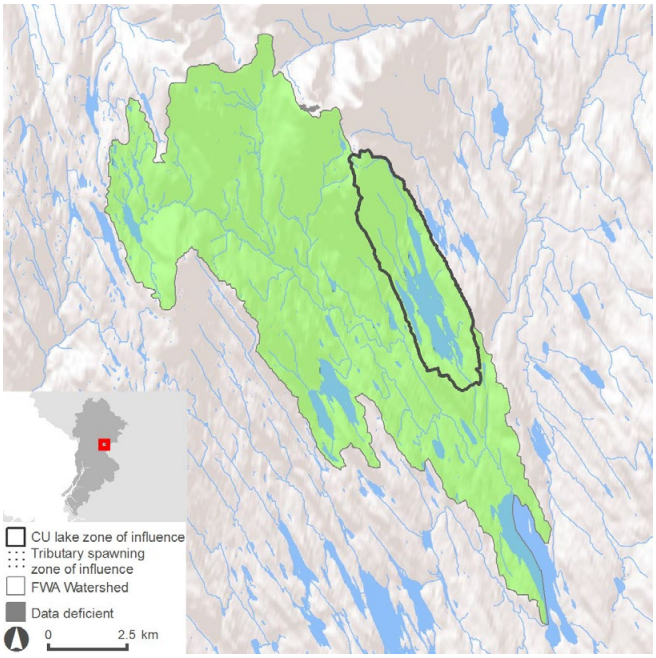
Total land cover alteration



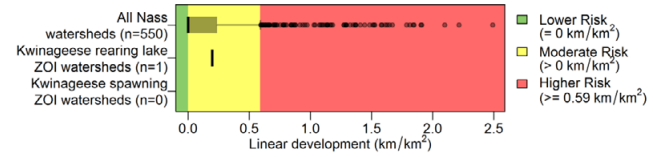


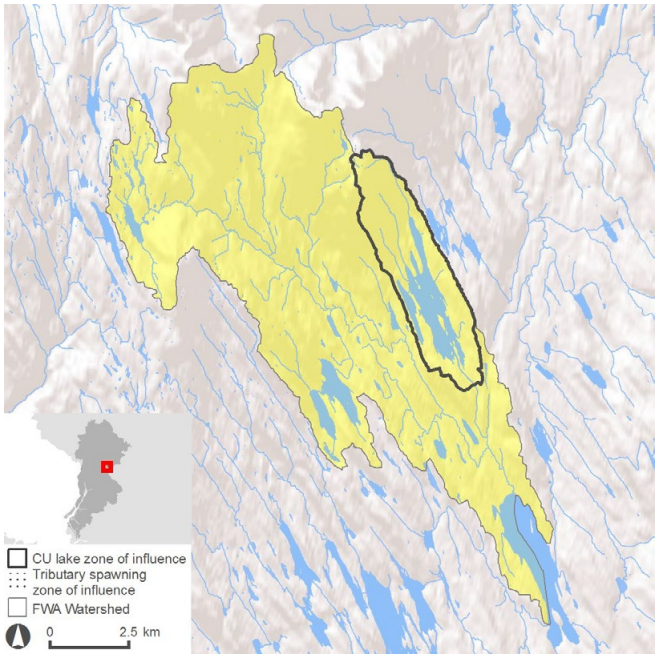
Impervious surfaces



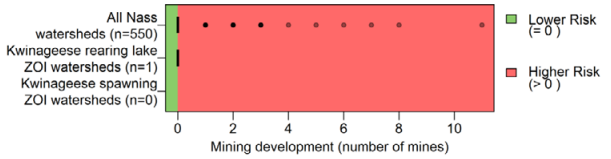


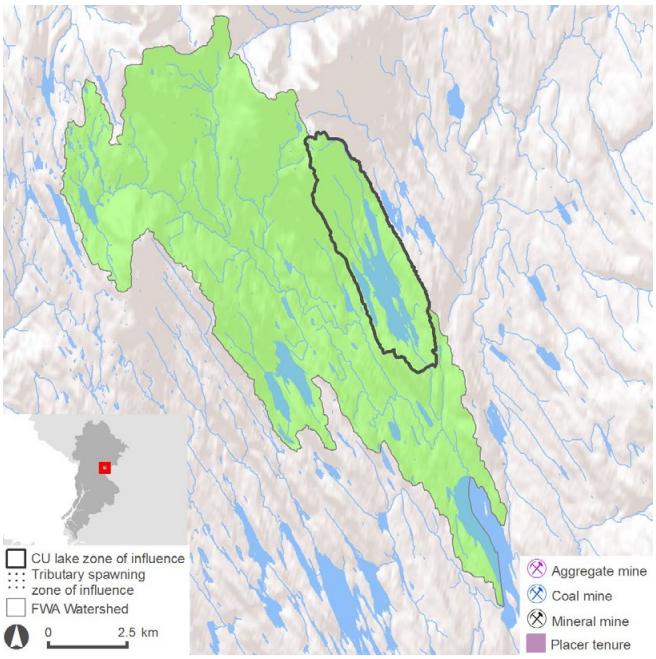
Linear development





Mining development (total number of mines)

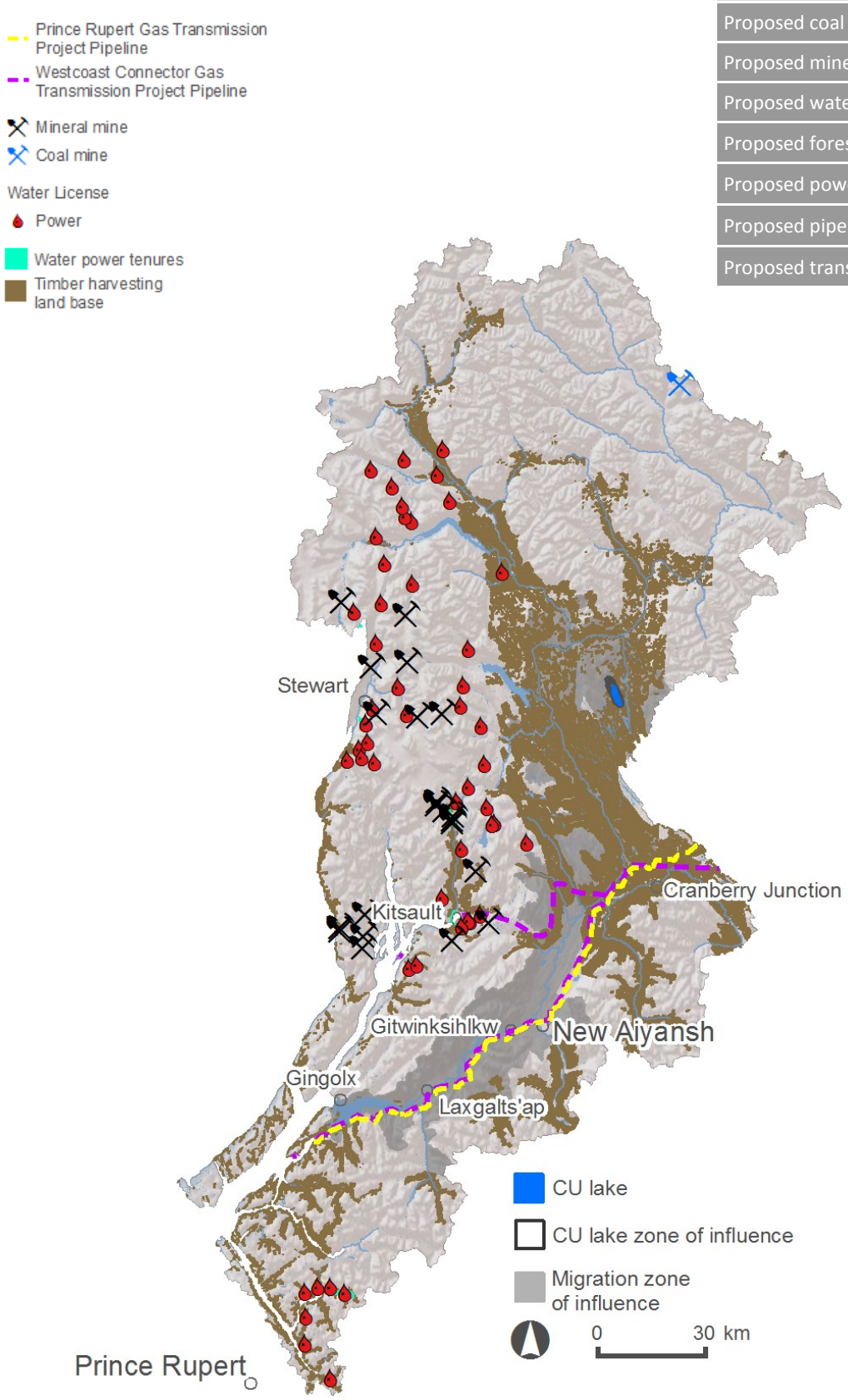




Future pressure

Proposed resource development projects (as of 2016)

Nass Drainage Summary	
	Totals
Proposed coal mines (#)	1
Proposed mineral mines (#)	22
Proposed water licenses (#)	58
Proposed forestry (km^2)	3,323 km^2
Proposed power tenures	Wind 0 km^2, water 15 km^2
Proposed pipelines (km)	386 km
Proposed transmission lines	0 km



Lake Sockeye: Meziadin

Introduction

This project summarizes pressures on the habitat used by Nass salmon Conservation Units (CU) during their freshwater life history stages (migration, spawning and rearing), as well as their relative vulnerability to those pressures. For an explanation of the indicators shown here, please see the accompanying *Report Card Summaries*. Full methods and results can be found in the main report, *Cumulative Pressures on Nass Salmon Habitat: Technical Report.* (2016).

Definitions

Conservation Unit (CU): A group of wild salmon sufficiently isolated from other groups that, if extirpated, is very unlikely to re-colonize naturally within an acceptable timeframe.

Pressure indicator: Measurable extent/intensity of natural processes or human activities that can induce changes in habitat condition/state.

Vulnerability indicator: Measures of habitat quantity or quality used to represent the intrinsic habitat vulnerability/sensitivity to watershed disturbances for each life-stage.

Zone of influence (ZOI): Areas adjacent to and upstream/upslope of habitats used by salmon CUs that represent the geographic extent for capture/measurement of pressure and vulnerability indicators.

Status: Condition of habitat relative to a defined indicator benchmark.

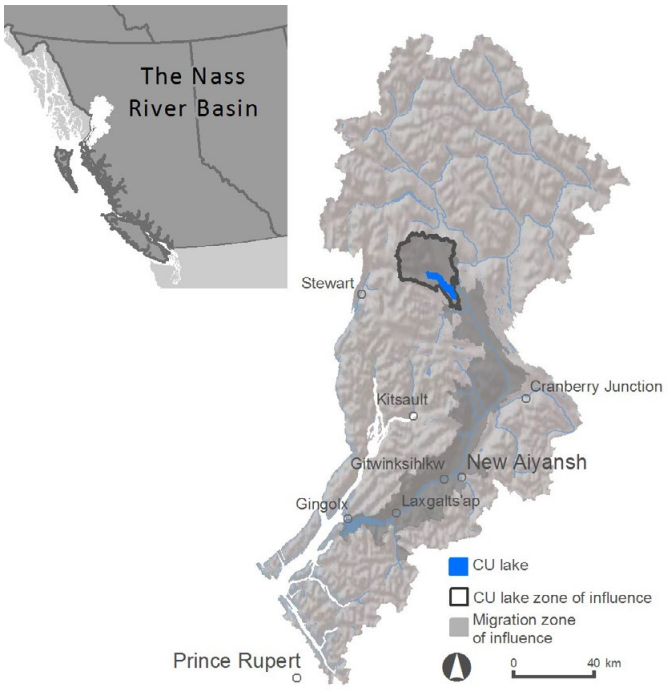
Risk: Likelihood of adverse effects to salmon habitats within a defined zone of influence. Levels of increasing risk are defined based on the extent/intensity of impacts relative to defined benchmarks of concern.

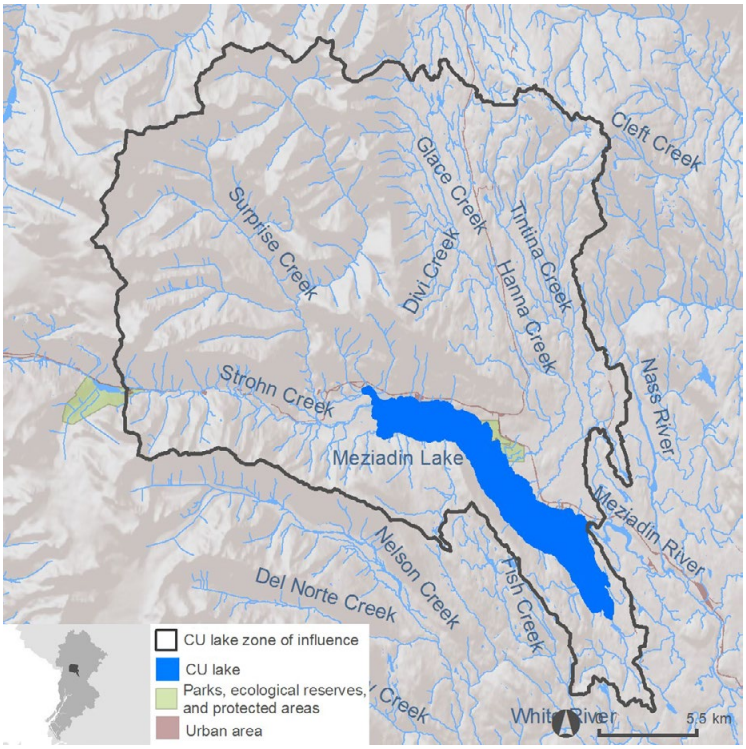
Benchmark: A standard (quantified metric) against which habitat condition can be measured or judged, and by which status can be compared over time and space to determine the risk of adverse effects.

Narrative

- There are ten sockeye salmon CUs in the Nass Area: two are river-type CUs (Upper Nass—UNR and Lower Nass-Portland—LNR-P) and eight are lake-type (Clements, Leverson, Bowser, Damdochax, Fred Wright, Kwinageese, Meziadin, and Oweegee).
- Nearly all of the sockeye salmon production in the Nass Area comes from the lake-type CUs in the upper watershed (i.e. Meziadin, Bowser, Damdochax, Fred Wright, Kwinageese, and Oweegee).
- Nass Area sockeye salmon exhibit variable life history characteristics, with the majority being lake-type and spending one full year rearing in a lake.
- A marine-type population, where salmon go to sea in their first year, is found in some lower Nass tributaries.
- Nass Area sockeye salmon predominantly reside at sea for one to four years, with the majority spending either two or three years at sea.

Location





Summary of habitat vulnerabilities & pressures

Pressure indicators were grouped into seven relatively independent habitat "impact categories" representing key factors affecting general watershed condition:

- Hydrologic Processes (Forest disturbance; Equivalent Clearcut Area)
- Vegetation Quality (Insect and disease defoliation; Riparian disturbance)
- Surface Erosion (Road development)
- Fish passage/Habitat connectivity (Stream crossing density)
- Water quantity (Water licenses)
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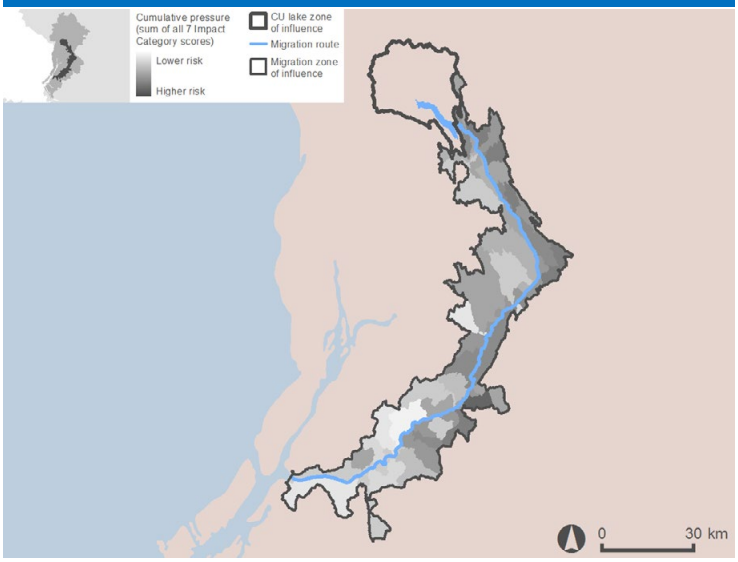
- Water quality (Wastewater discharges)

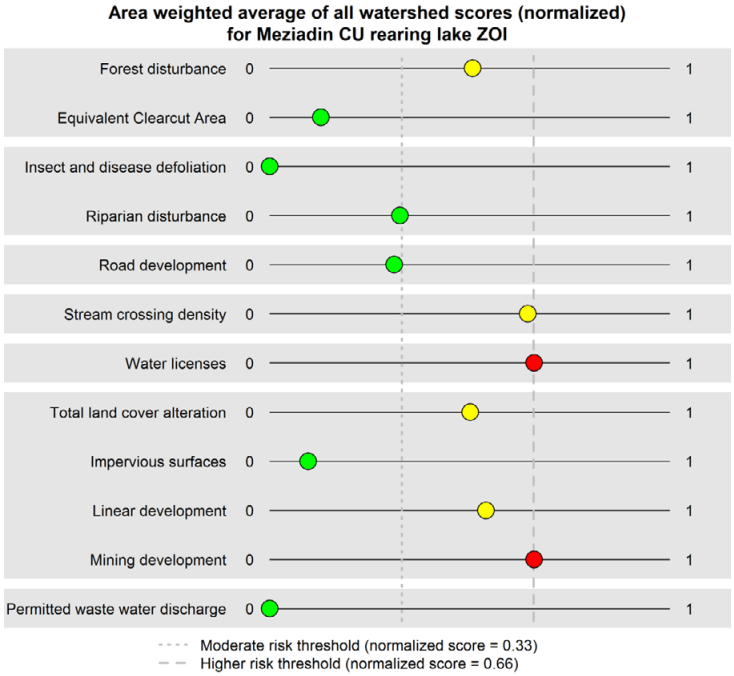
Indicators were also developed reflecting relative vulnerability to habitat pressures within the life stage-specific "zones of influence" defined for each lake sockeye CU:

- Migration (Total migration distance; Length and percentage of migration route summer flow sensitive)
- Spawning (Total spawning length; Spawning length in tributary, lake or mainstem; Ratio of lake influenced to total spawning length; Length of accessible habitat)
- Rearing (Rearing lake area)

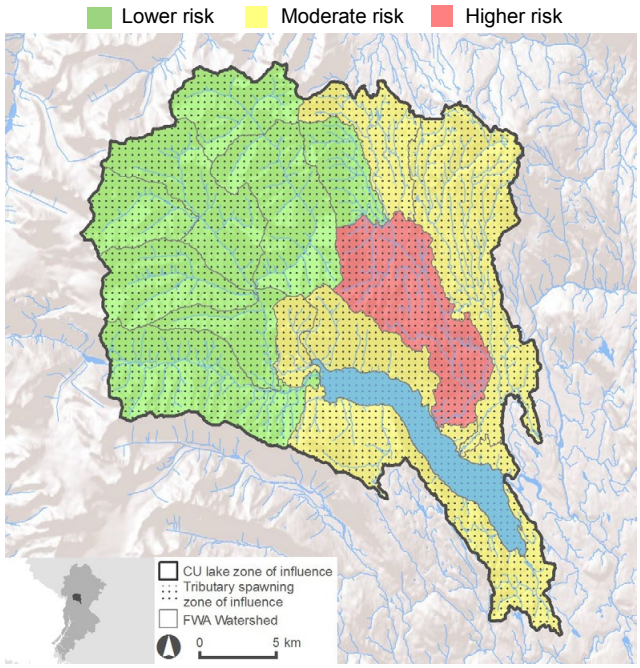
Cumulative pressure—migration



Summary of pressure indicators—rearing

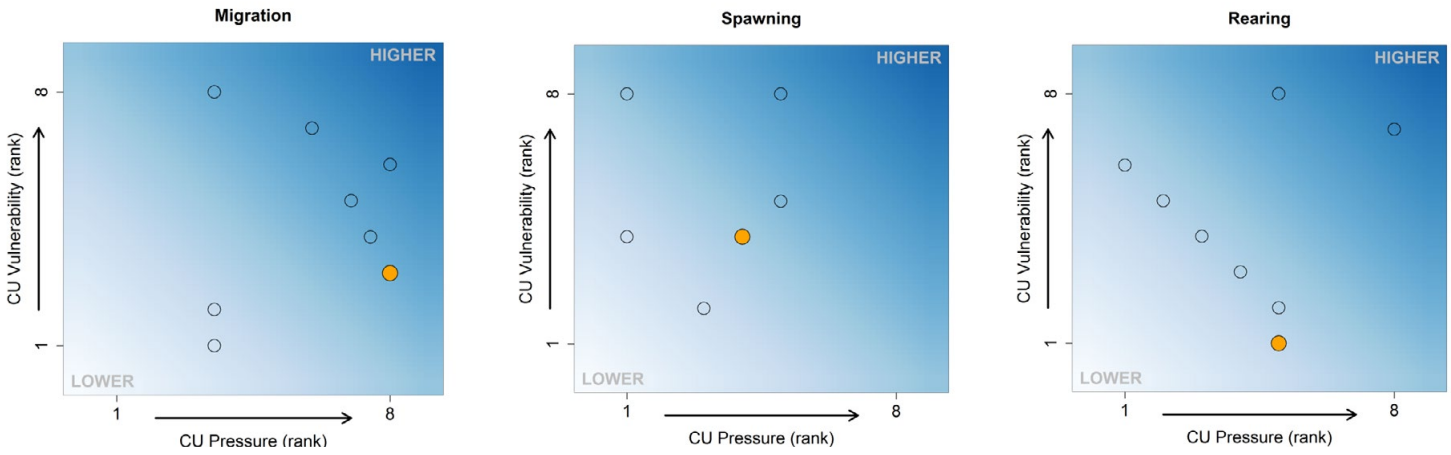


Cumulative pressure—rearing & spawning



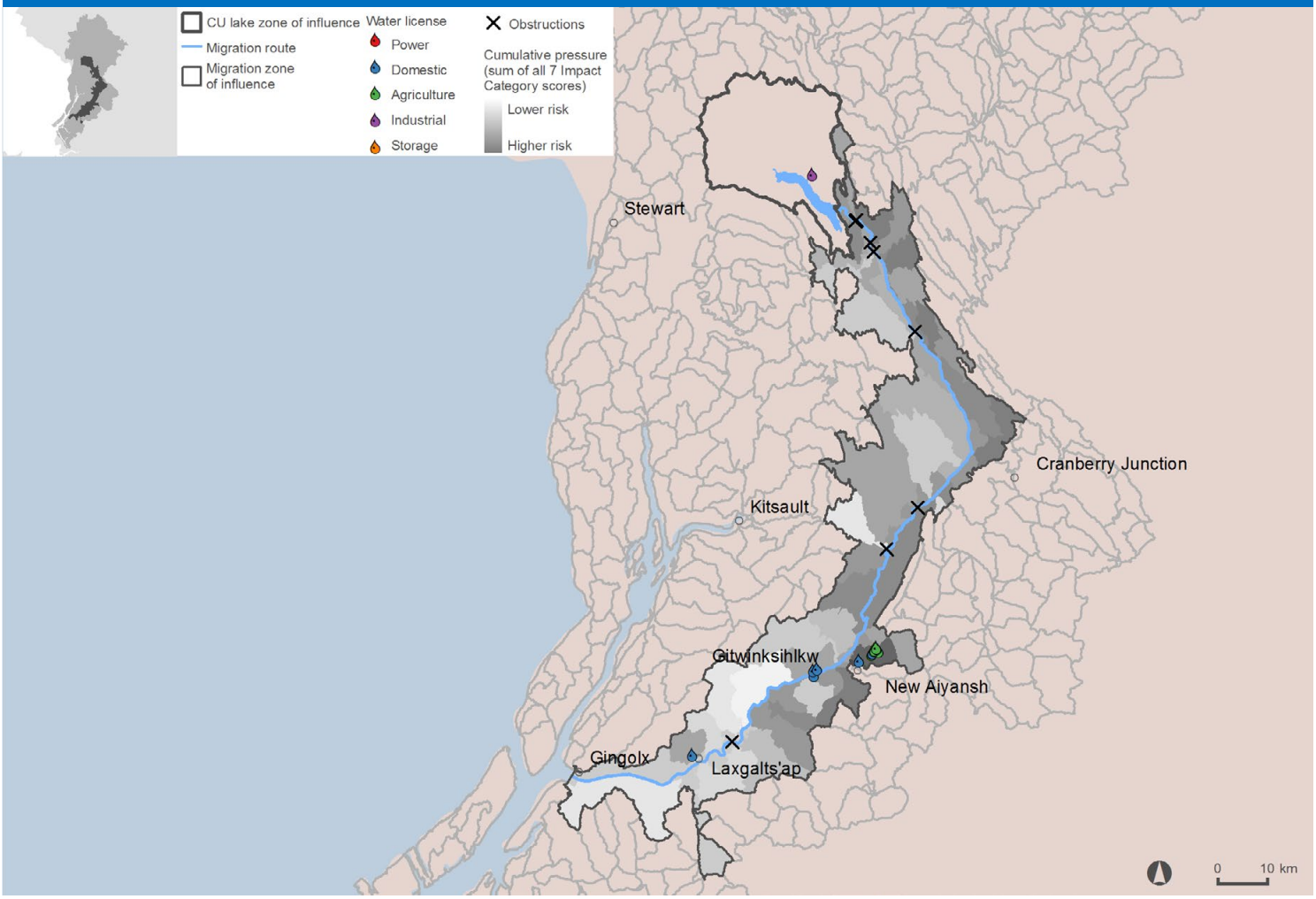
Integrated vulnerability/habitat pressures—migration, spawning, & rearing

● = Meziadin ○ = other lake sockeye CUs

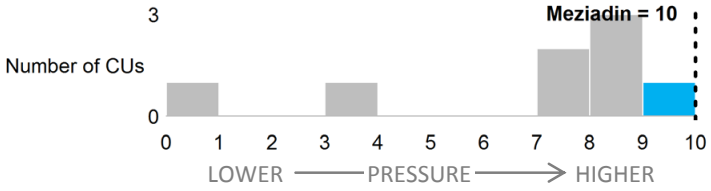


Migration vulnerability & pressure

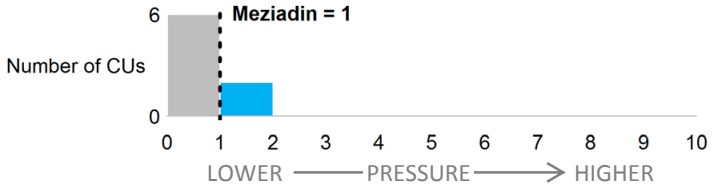
Migration period pressures



Number of obstructions along migration route

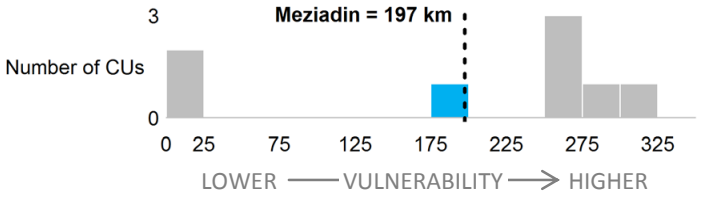


Number of water licenses along migration ZOI

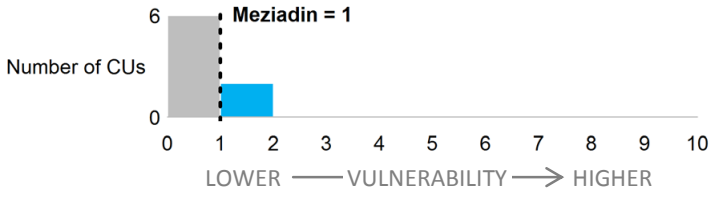


Migration period vulnerability

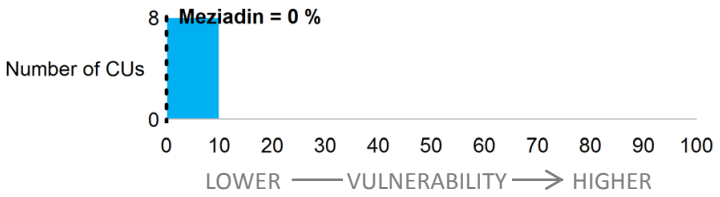
Migration distance (km)



Migration route - summer low flow sensitive (km)



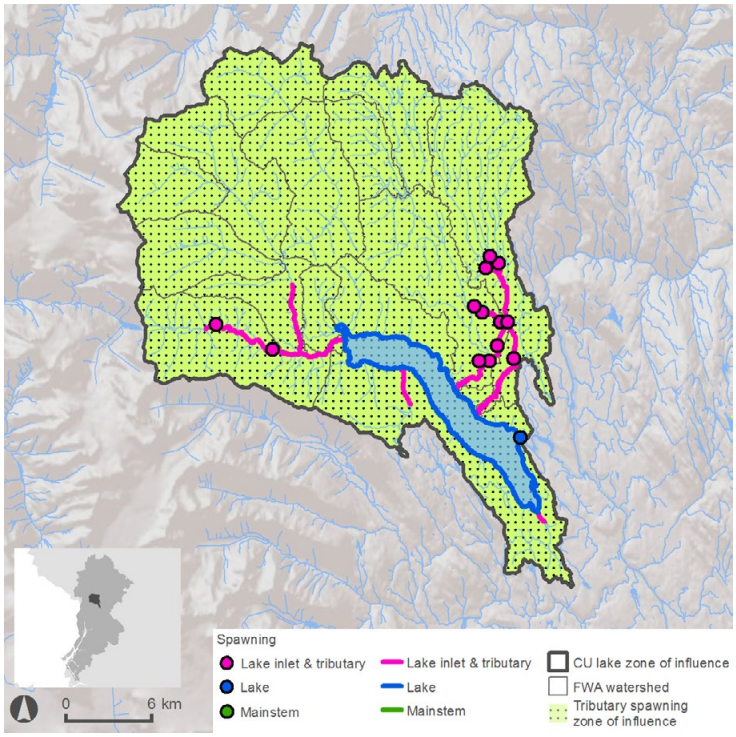
Migration route - summer low flow sensitive (%)



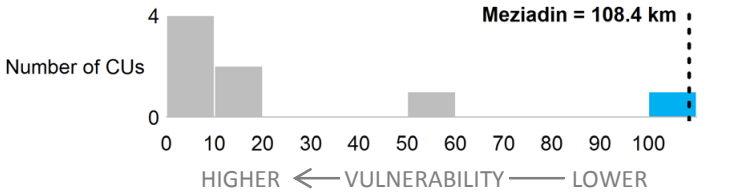
Spawning & rearing vulnerability

Spawning period vulnerability

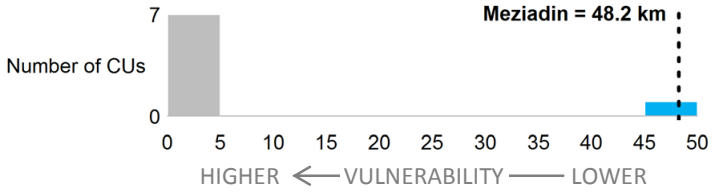
Spawning locations



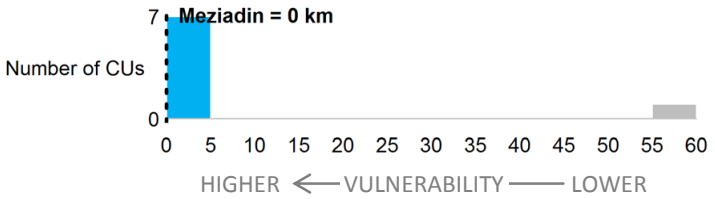
Total (mainstem, trib & lake) spawning length (km)



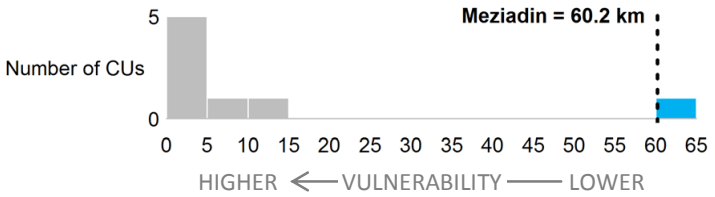
Length of lake shore spawning areas (km)



Mainstem spawning length (km)

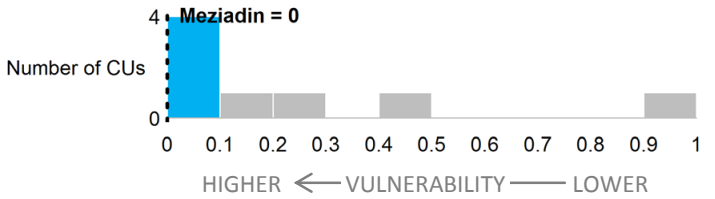


Tributary and lake inlet spawning length (km)



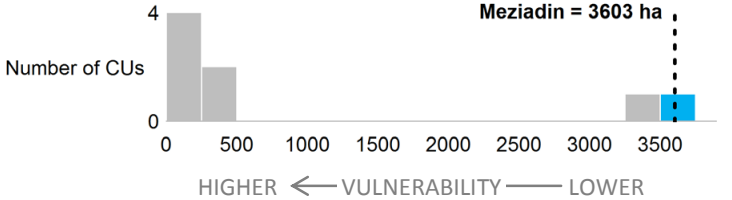
Salmon accessible habitat (km)

Ratio of lake influenced to total spawning



Rearing period vulnerability

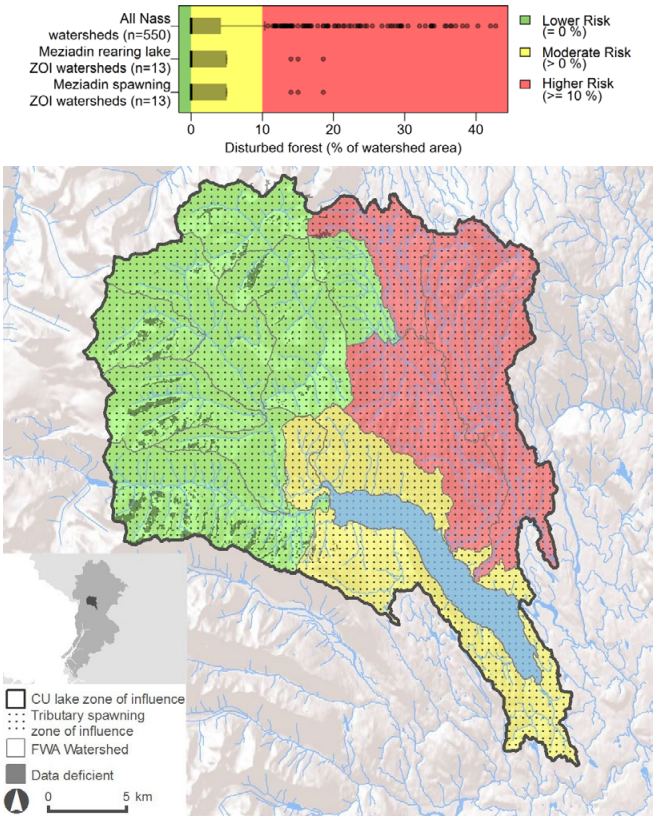
Area of nursery lakes (ha)



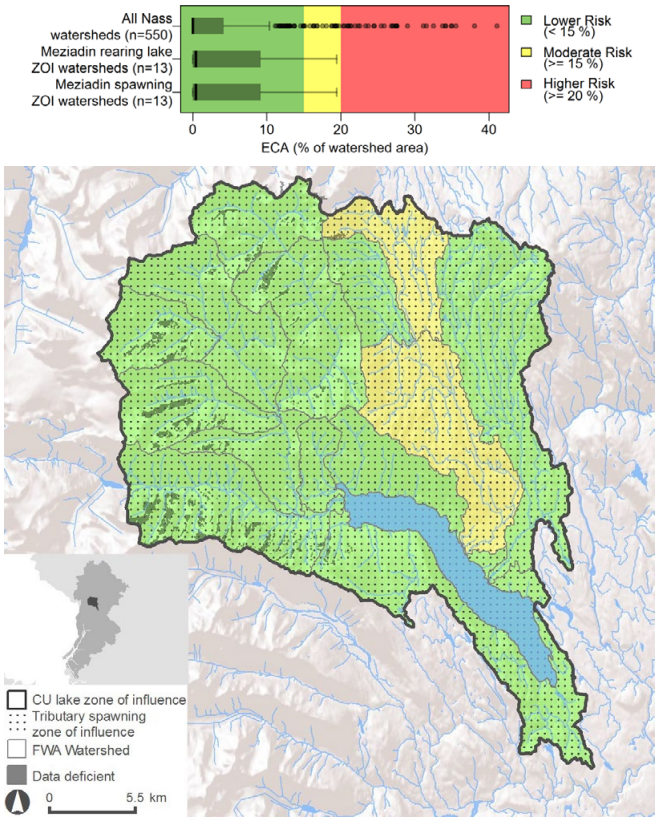
Spawning & rearing pressure

Hydrologic Processes

Forest disturbance

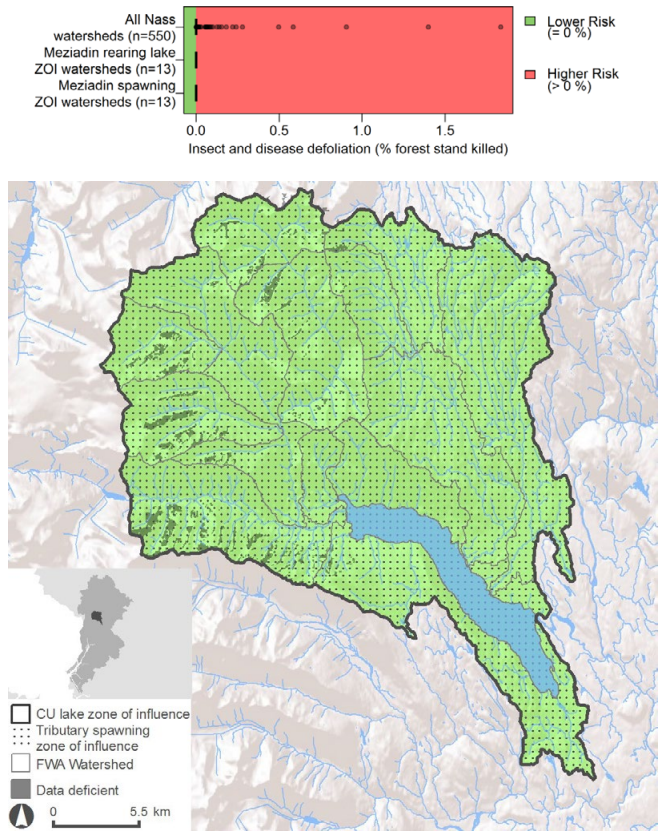


Equivalent Clear-cut Area

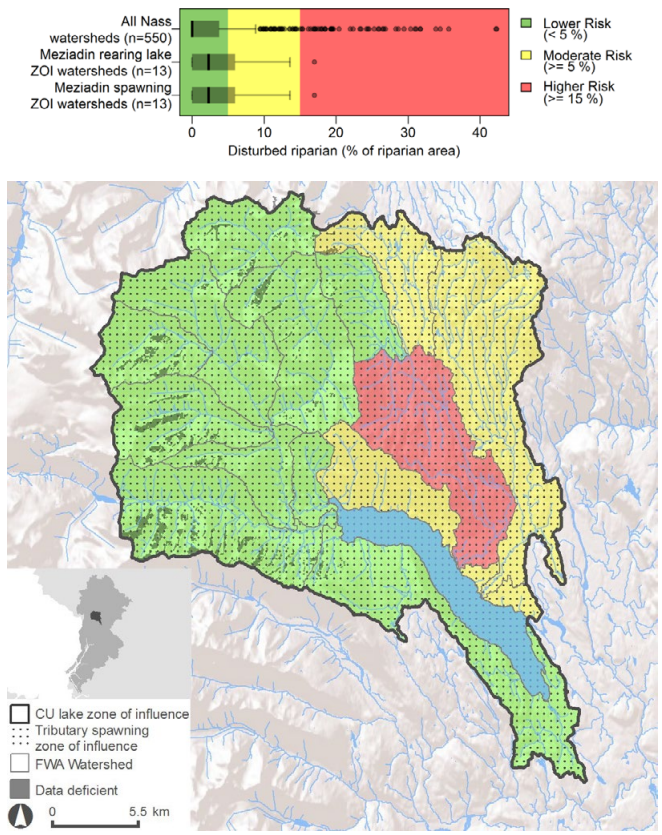


Vegetation Quality

Insect and disease defoliation

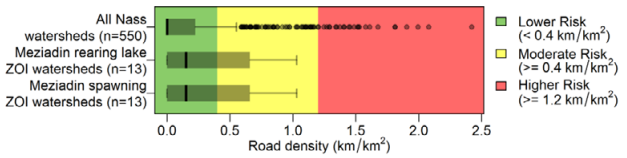


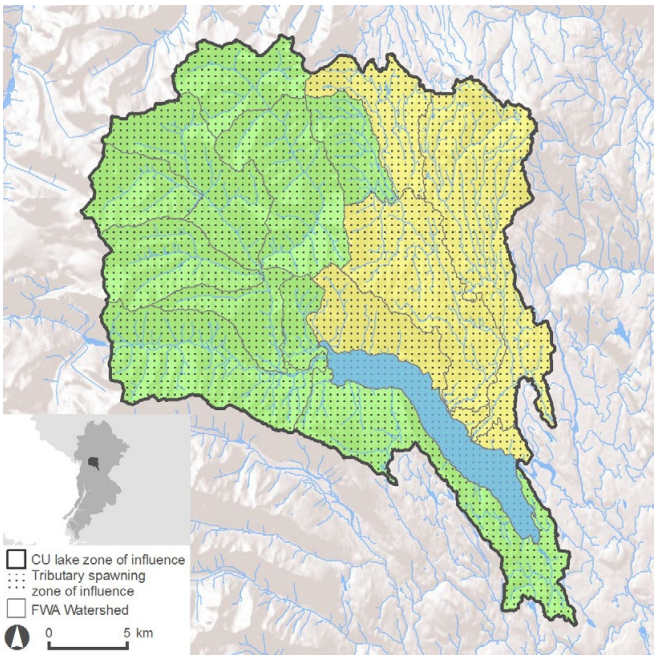
Riparian disturbance



Surface Erosion

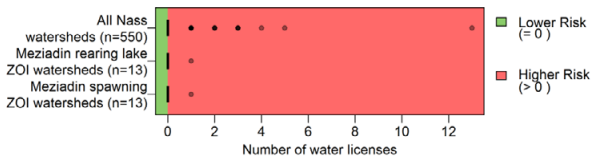
Road development

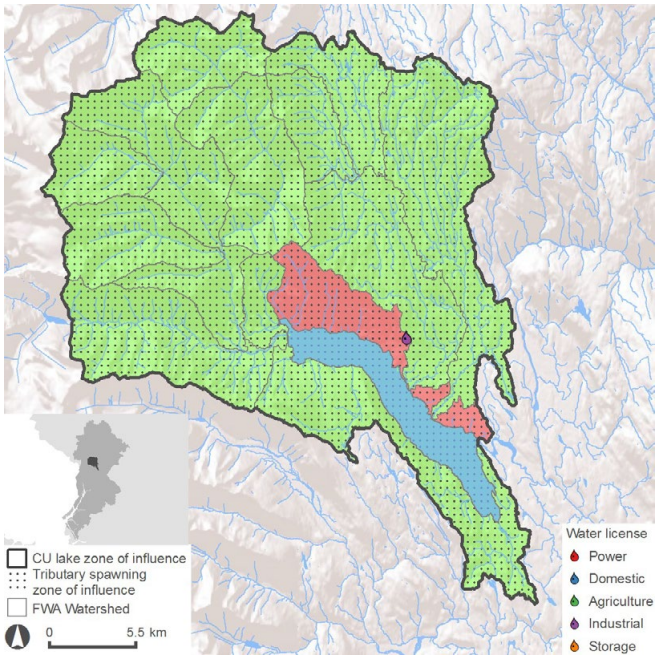




Water Quantity

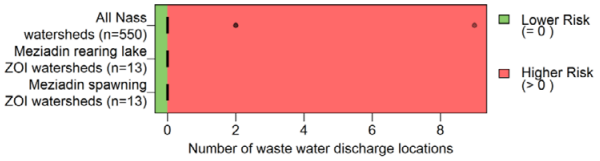
Number of water licenses

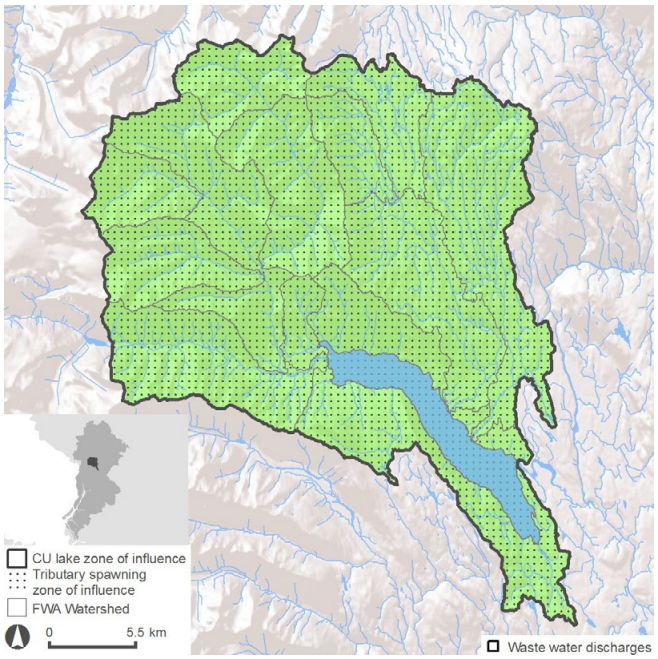




Water Quality

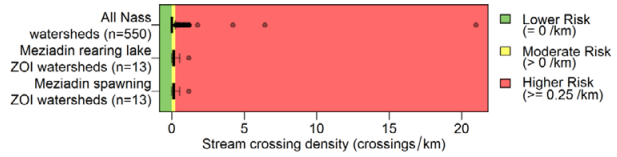
Permitted waste water discharges

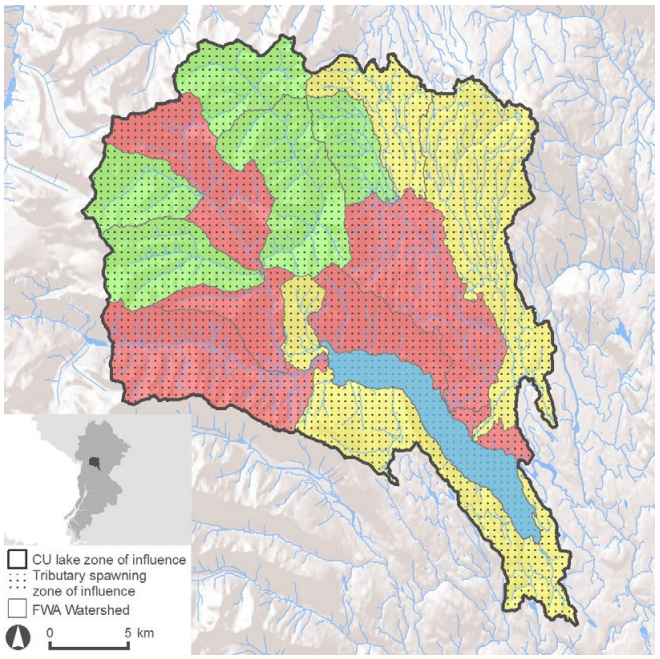




Fish Passage/Habitat Connectivity

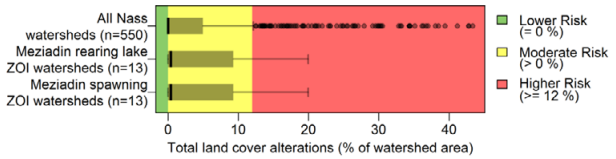
Stream crossing density

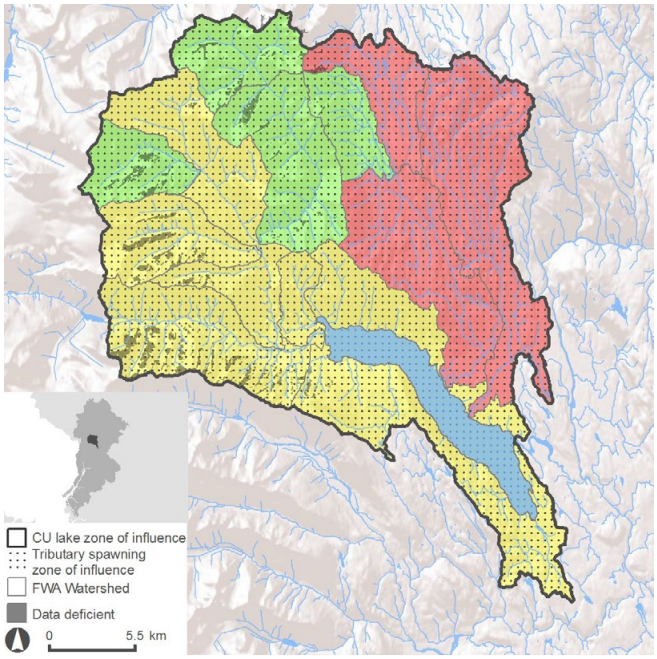




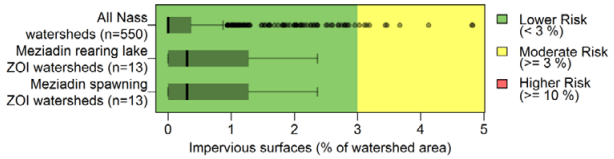
Human Development Footprint

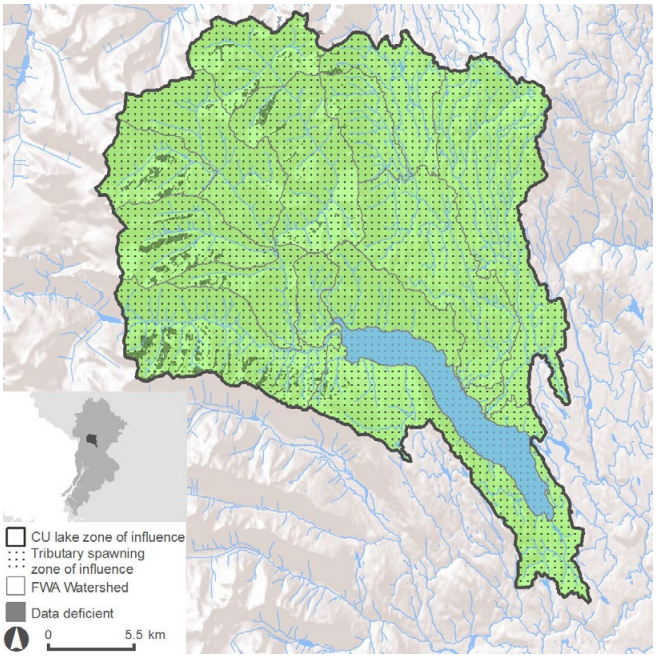
Total land cover alteration



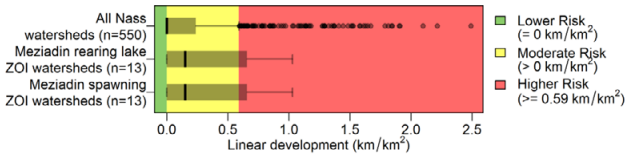


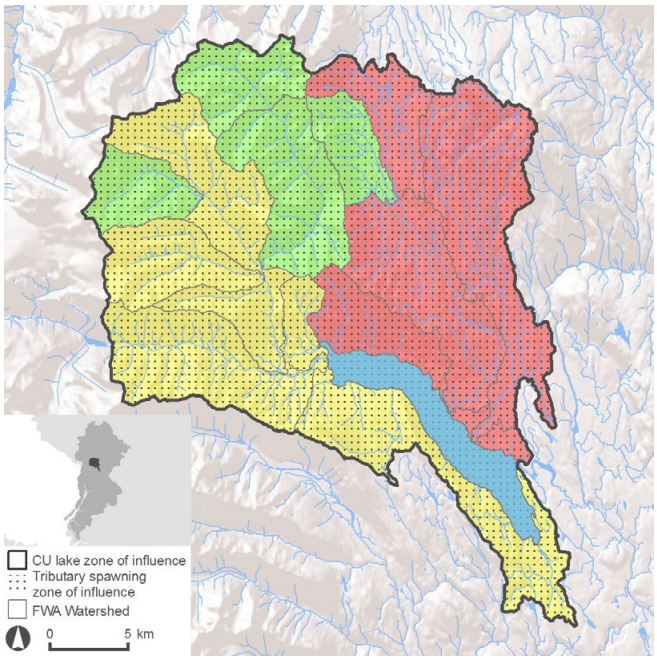
Impervious surfaces



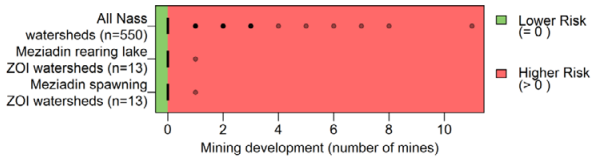


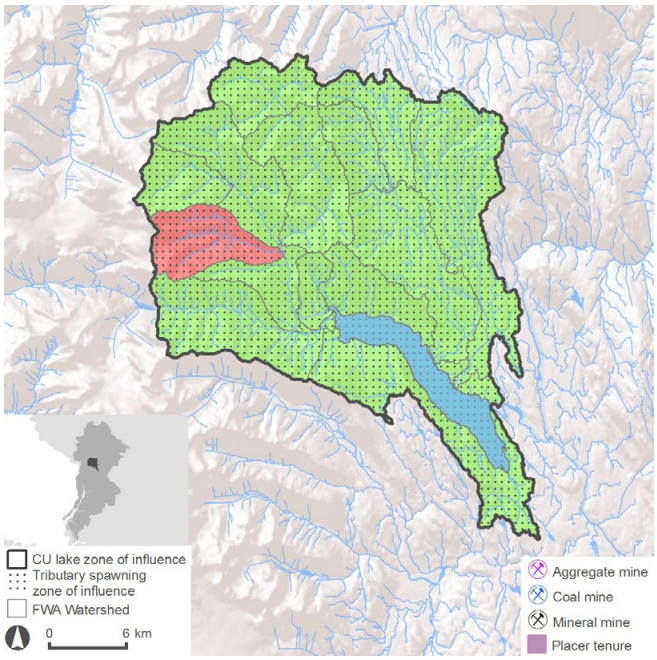
Linear development





Mining development (total number of mines)

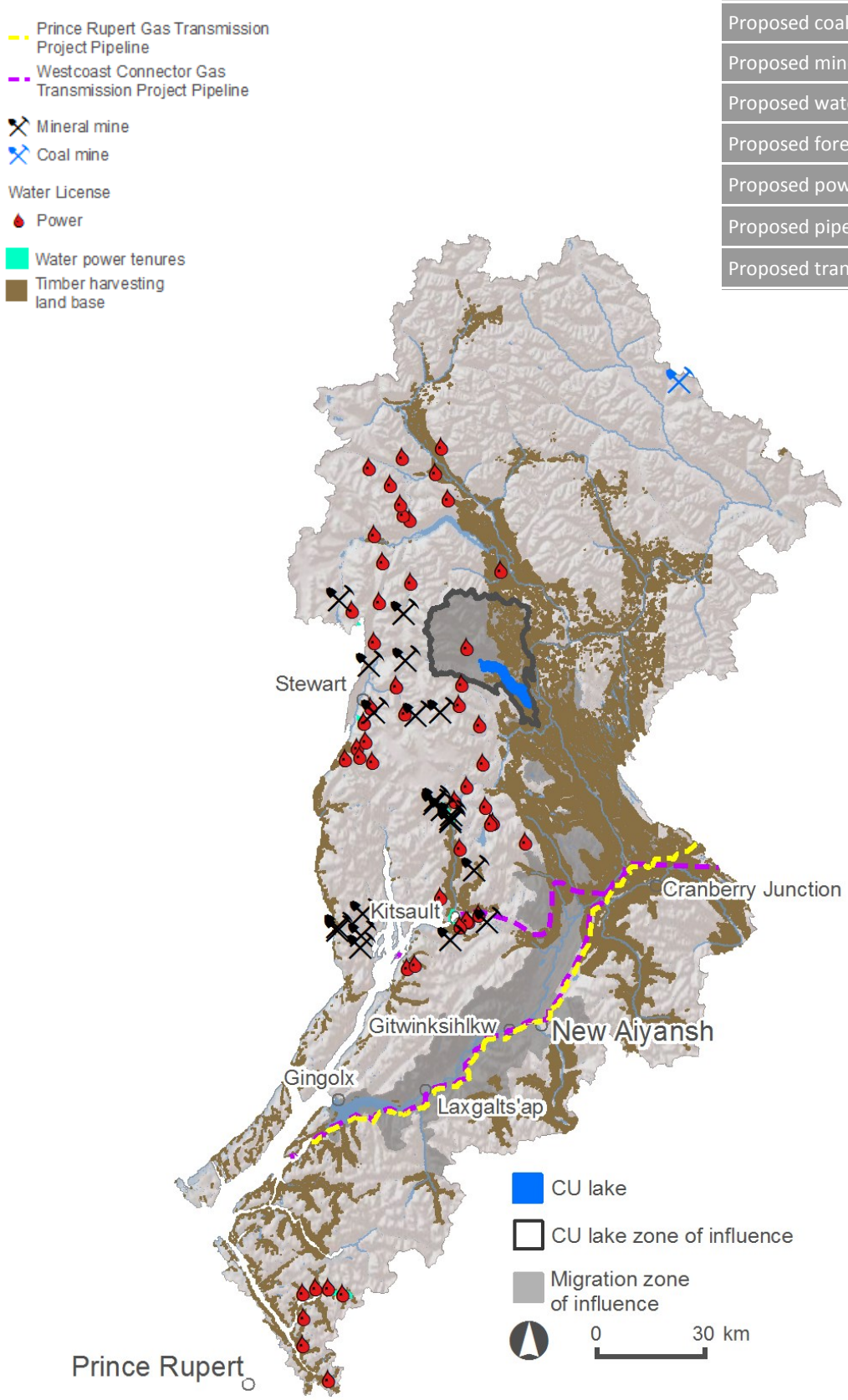




Future pressure

Proposed resource development projects (as of 2016)

Nass Drainage Summary	
	Totals
Proposed coal mines (#)	1
Proposed mineral mines (#)	22
Proposed water licenses (#)	58
Proposed forestry (km^2)	3,323 km^2
Proposed power tenures	Wind 0 km^2, water 15 km^2
Proposed pipelines (km)	386 km
Proposed transmission lines	0 km



Lake Sockeye: Oweegee

Introduction

This project summarizes pressures on the habitat used by Nass salmon Conservation Units (CU) during their freshwater life history stages (migration, spawning and rearing), as well as their relative vulnerability to those pressures. For an explanation of the indicators shown here, please see the accompanying *Report Card Summaries*. Full methods and results can be found in the main report, *Cumulative Pressures on Nass Salmon Habitat: Technical Report* (2016).

Definitions

Conservation Unit (CU): A group of wild salmon sufficiently isolated from other groups that, if extirpated, is very unlikely to re-colonize naturally within an acceptable timeframe.

Pressure indicator: Measurable extent/intensity of natural processes or human activities that can induce changes in habitat condition/state.

Vulnerability indicator: Measures of habitat quantity or quality used to represent the intrinsic habitat vulnerability/sensitivity to watershed disturbances for each life-stage.

Zone of influence (ZOI): Areas adjacent to and upstream/upslope of habitats used by salmon CUs that represent the geographic extent for capture/measurement of pressure and vulnerability indicators.

Status: Condition of habitat relative to a defined indicator benchmark.

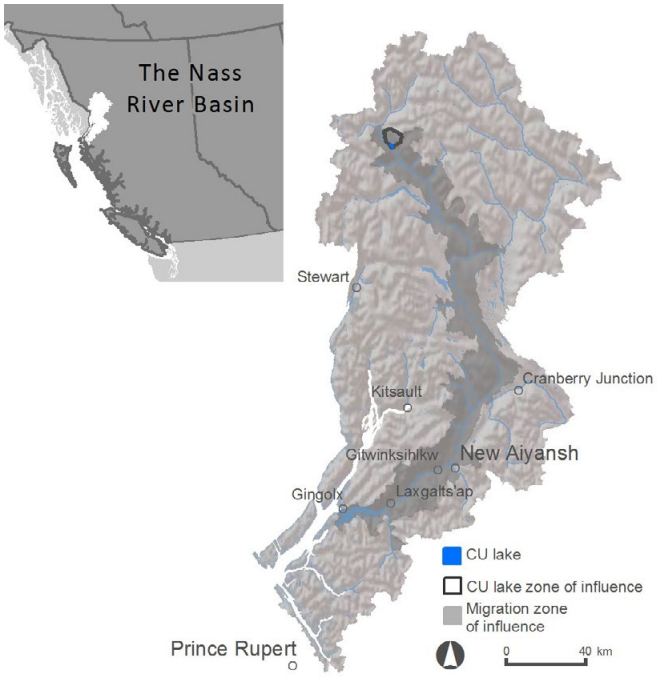
Risk: Likelihood of adverse effects to salmon habitats within a defined zone of influence. Levels of increasing risk are defined based on the extent/intensity of impacts relative to defined benchmarks of concern.

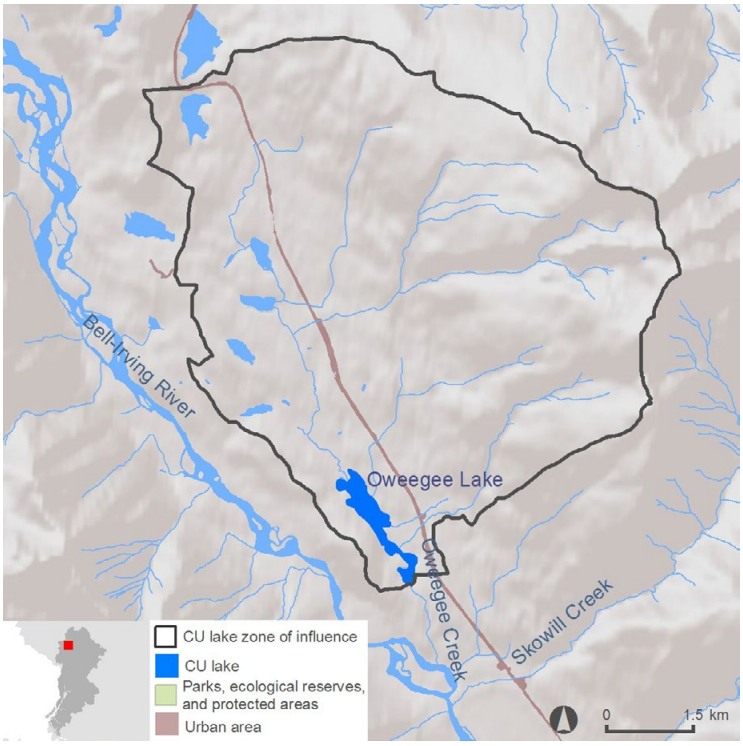
Benchmark: A standard (quantified metric) against which habitat condition can be measured or judged, and by which status can be compared over time and space to determine the risk of adverse effects.

Narrative

- There are ten sockeye salmon CUs in the Nass Area: two are river-type CUs (Upper Nass—UNR and Lower Nass-Portland—LNR-P) and eight are lake-type (Clements, Leverson, Bowser, Damdochax, Fred Wright, Kwinageese, Meziadin, and Oweegee).
- Nearly all of the sockeye salmon production in the Nass Area comes from the lake-type CUs in the upper watershed (i.e. Meziadin, Bowser, Damdochax, Fred Wright, Kwinageese, and Oweegee).
- Nass Area sockeye salmon exhibit variable life history characteristics, with the majority being lake-type and spending one full year rearing in a lake.
- A marine-type population, where salmon go to sea in their first year, is found in some lower Nass tributaries.
- Nass Area sockeye salmon predominantly reside at sea for one to four years, with the majority spending either two or three years at sea.

Location





Summary of habitat vulnerabilities & pressures

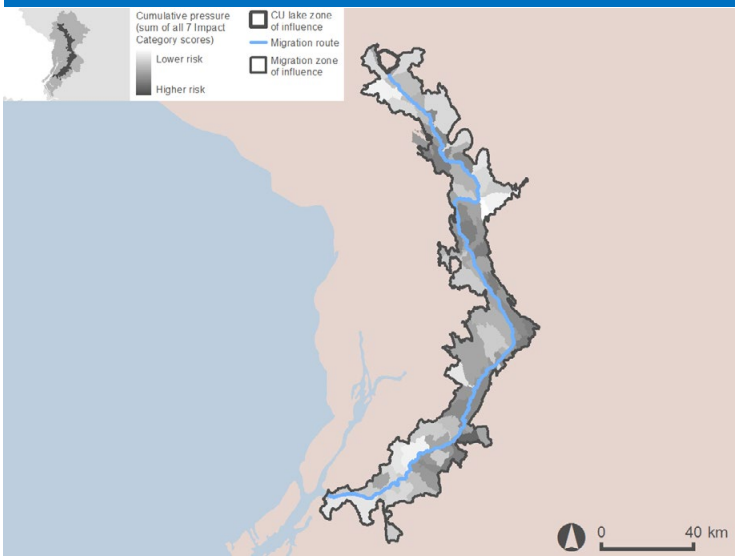
Pressure indicators were grouped into seven relatively independent habitat "impact categories" representing key factors affecting general watershed condition:

- Hydrologic Processes (Forest disturbance; Equivalent Clearcut Area)
- Vegetation Quality (Insect and disease defoliation; Riparian disturbance)
- Surface Erosion (Road development)
- Fish passage/Habitat connectivity (Stream crossing density)
- Water quantity (Water licenses)
- Human development footprint (Total land cover alteration; Impervious surfaces; Linear development; Mining development)
- Water quality (Wastewater discharges)

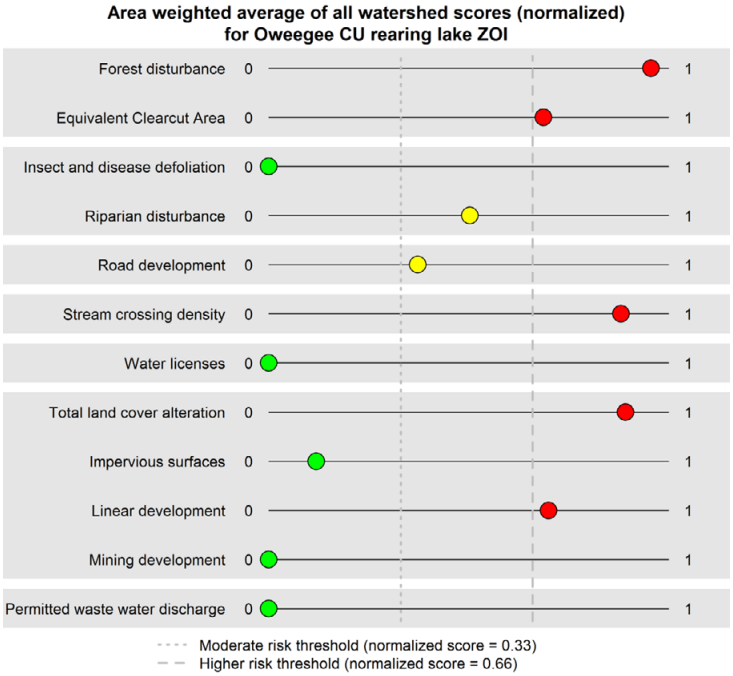
Indicators were also developed reflecting relative vulnerability to habitat pressures within the life stage-specific "zones of influence" defined for each lake sockeye CU:

- Migration (Total migration distance; Length and percentage of migration route summer flow sensitive)
- Spawning (Total spawning length; Spawning length in tributary, lake or mainstem; Ratio of lake influenced to total spawning length; Length of accessible habitat)
- Rearing (Rearing lake area)

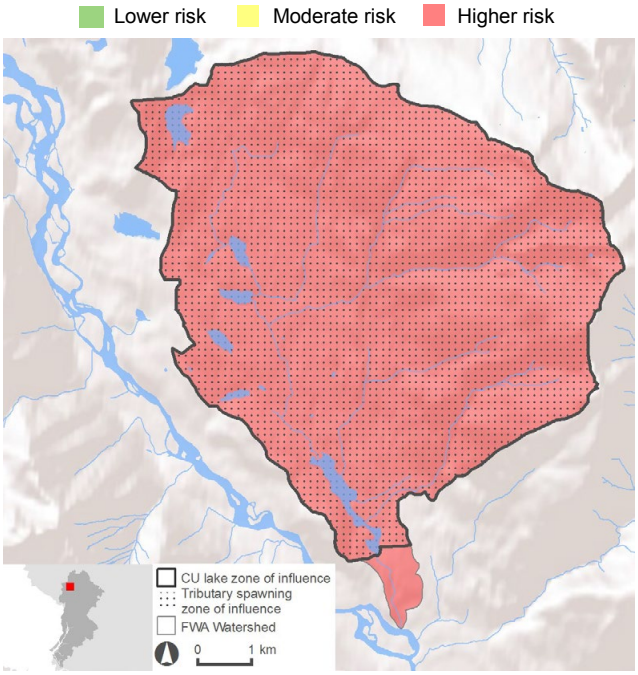
Cumulative pressure—migration



Summary of pressure indicators—rearing

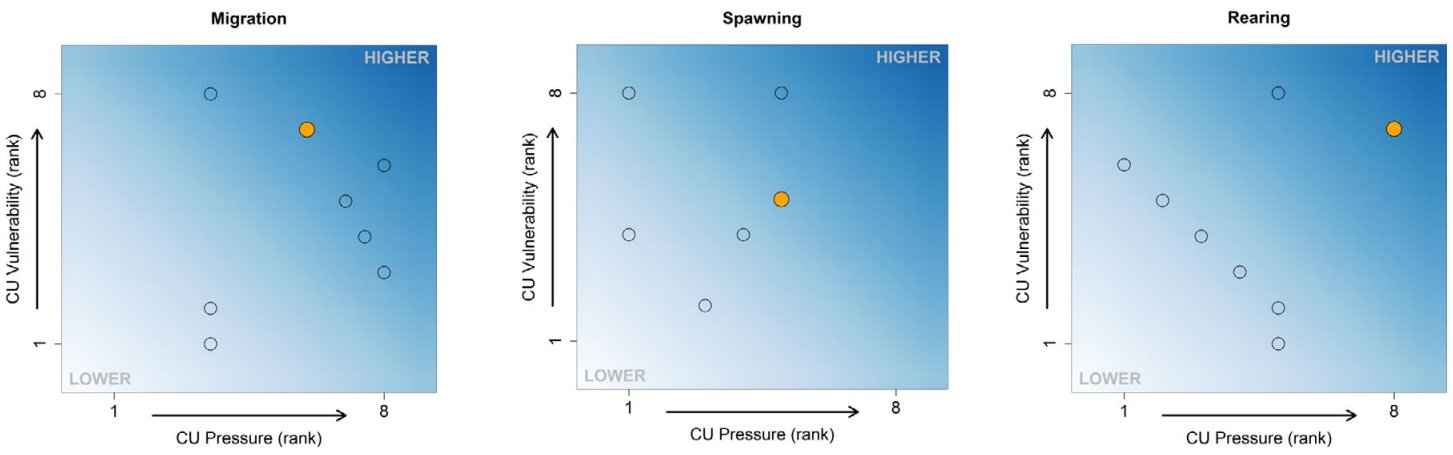


Cumulative pressure—rearing & spawning



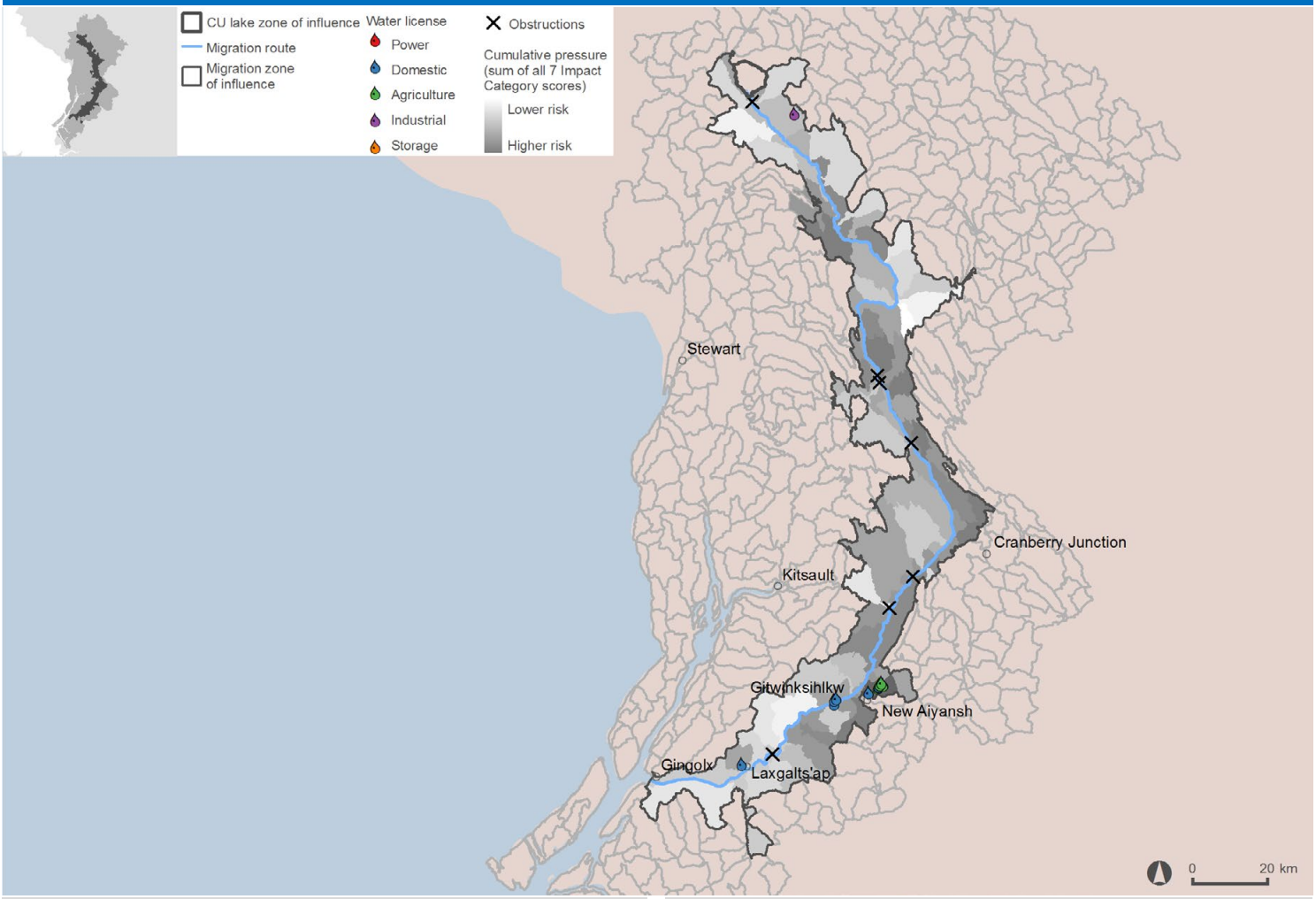
Integrated vulnerability/habitat pressures—migration, spawning, & rearing

● = Oweegee ○ = other lake sockeye CUs

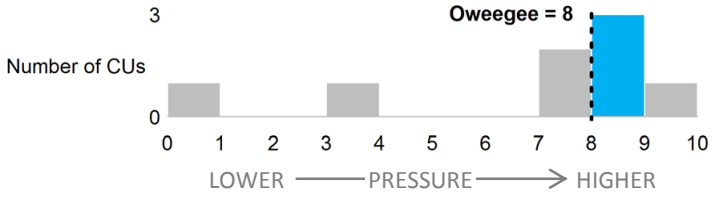


Migration vulnerability & pressure

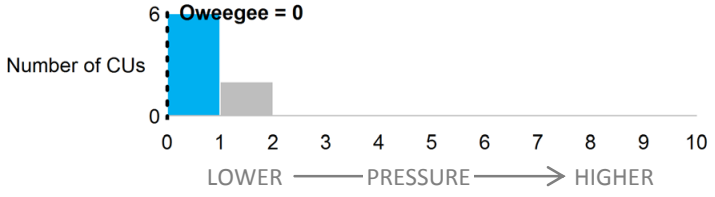
Migration period pressures



Number of obstructions along migration route

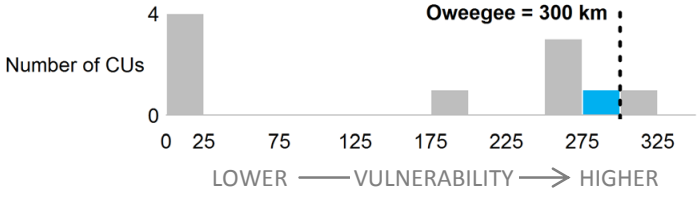


Number of water licenses along migration ZOI

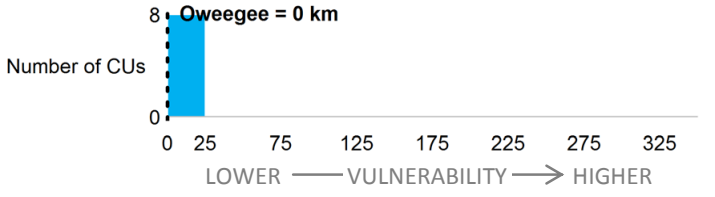


Migration period vulnerability

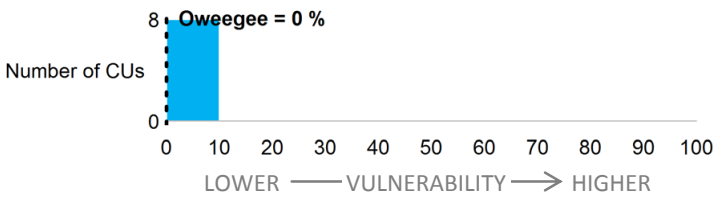
Migration distance (km)



Migration route - summer low flow sensitive (km)



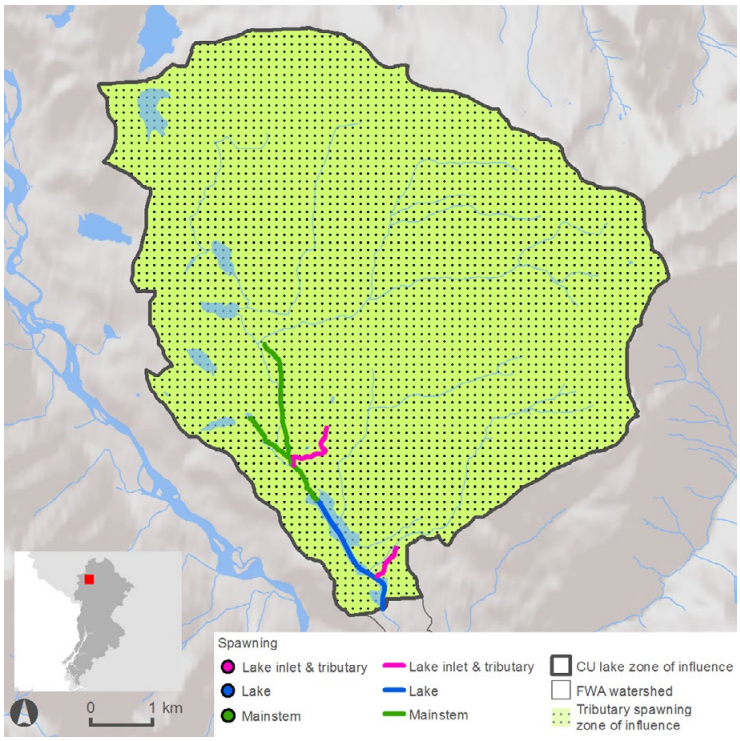
Migration route - summer low flow sensitive (%)



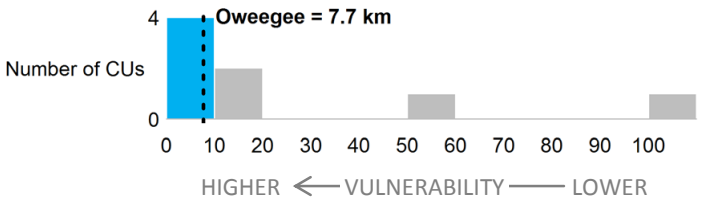
Spawning & rearing vulnerability

Spawning period vulnerability

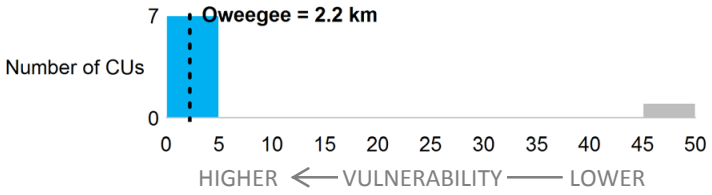
Spawning locations



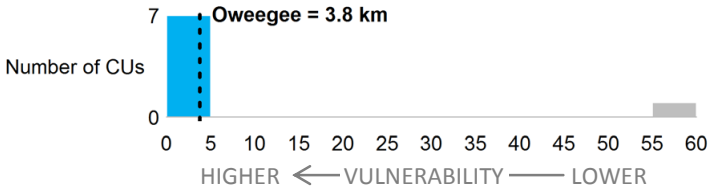
Total (mainstem, trib & lake) spawning length (km)



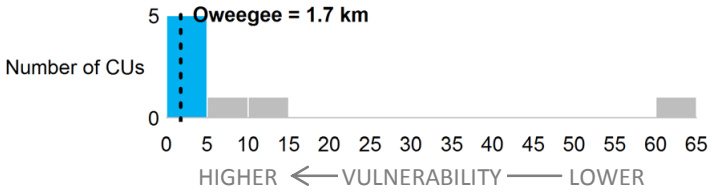
Length of lake shore spawning areas (km)



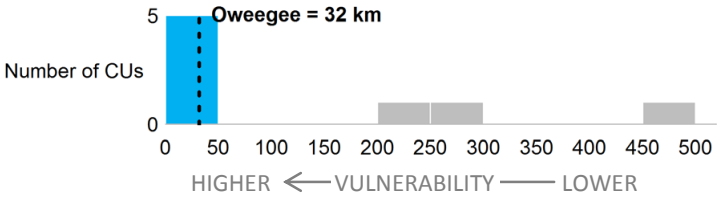
Mainstem spawning length (km)



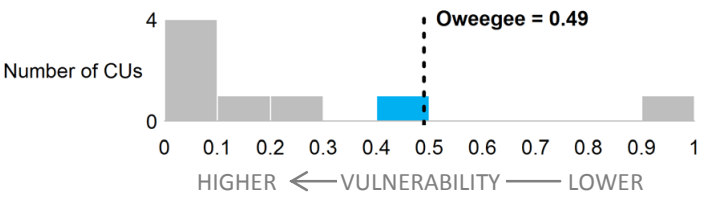
Tributary and lake inlet spawning length (km)



Salmon accessible habitat (km)

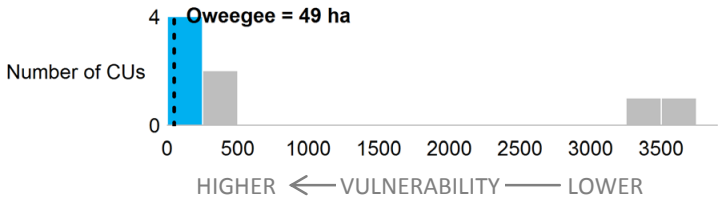


Ratio of lake influenced to total spawning



Rearing period vulnerability

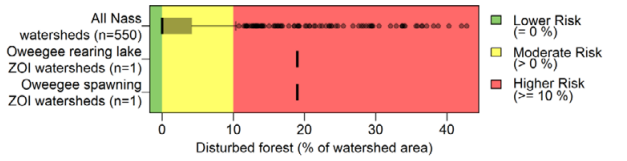
Area of nursery lakes (ha)

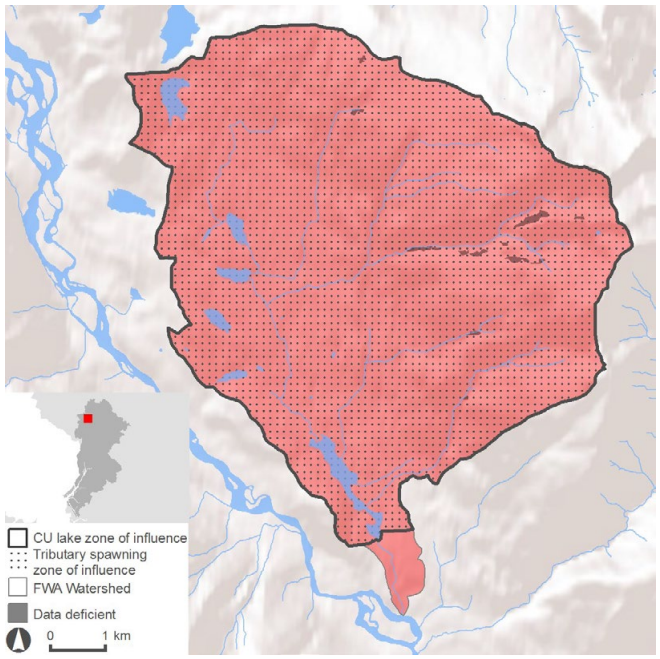


Spawning & rearing pressure

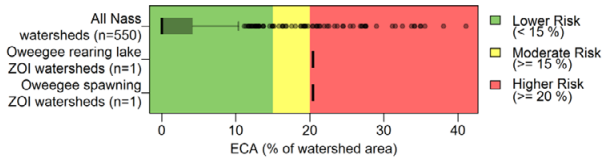
Hydrologic Processes

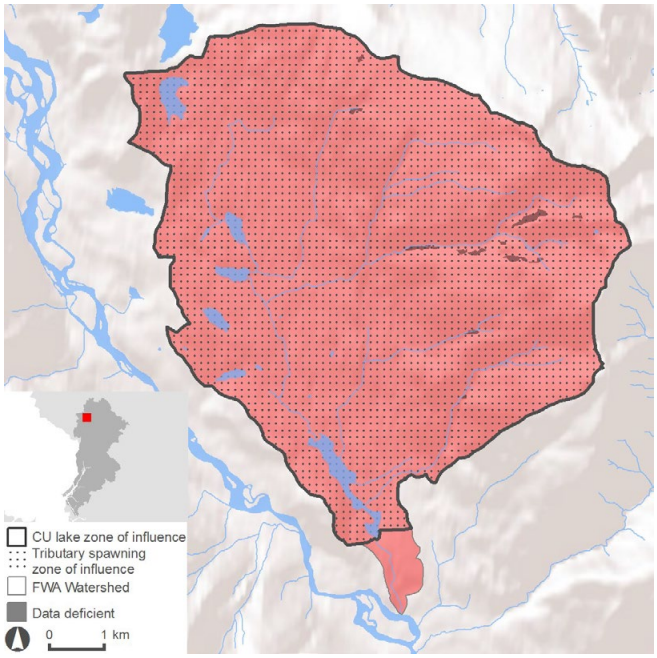
Forest disturbance





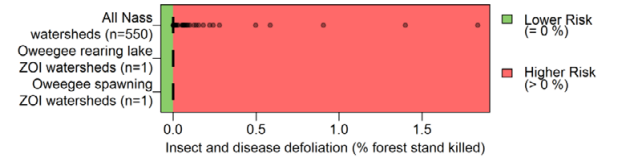
Equivalent Clear-cut Area

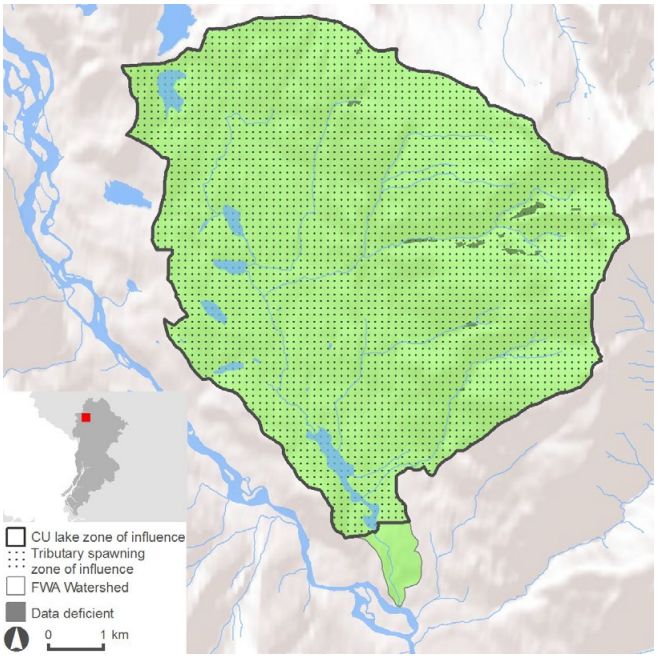




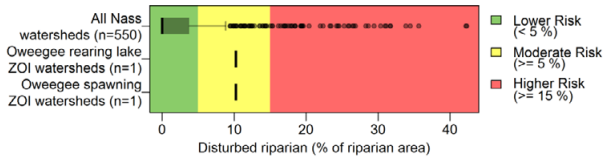
Vegetation Quality

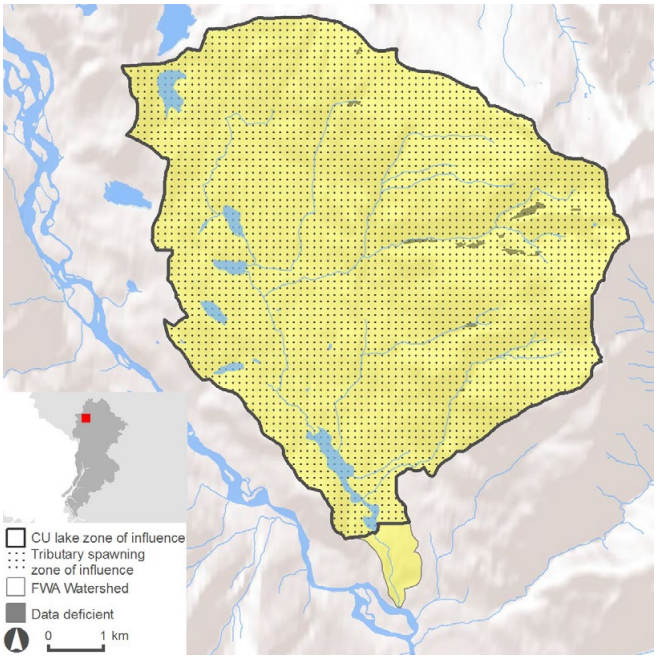
Insect and disease defoliation





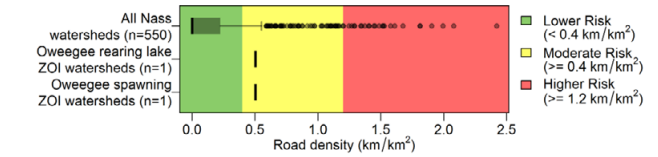
Riparian disturbance

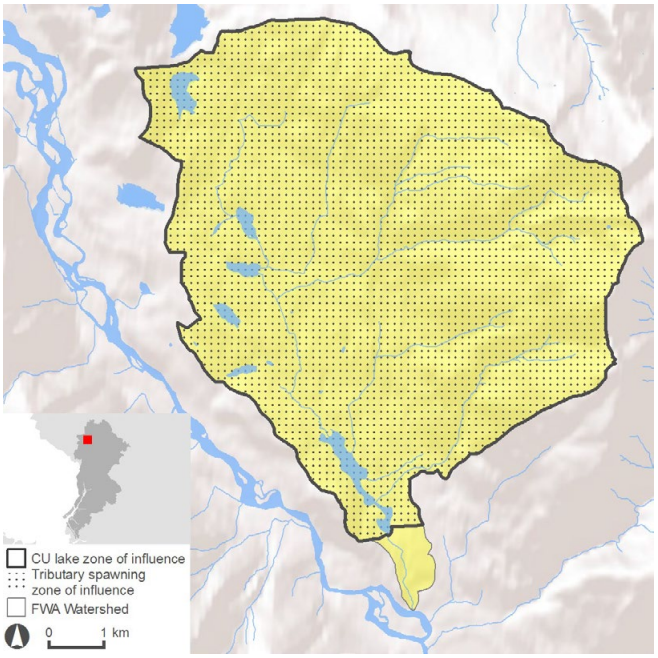




Surface Erosion

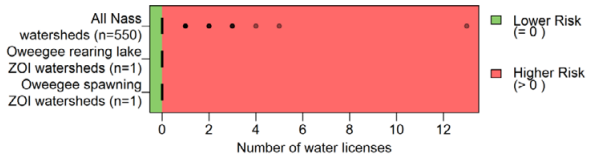
Road development

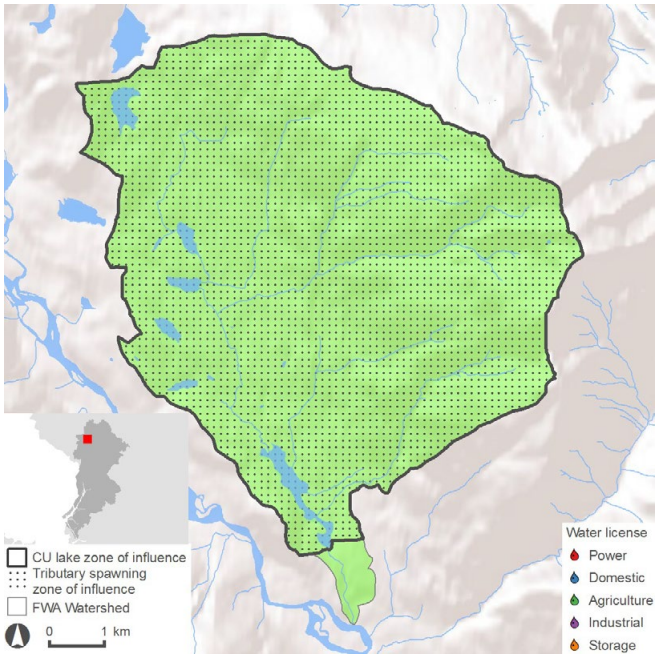




Water Quantity

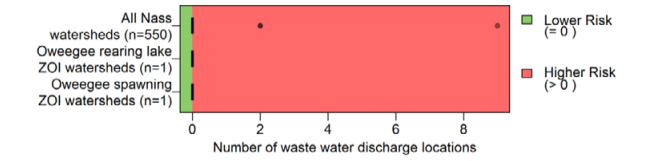
Number of water licenses

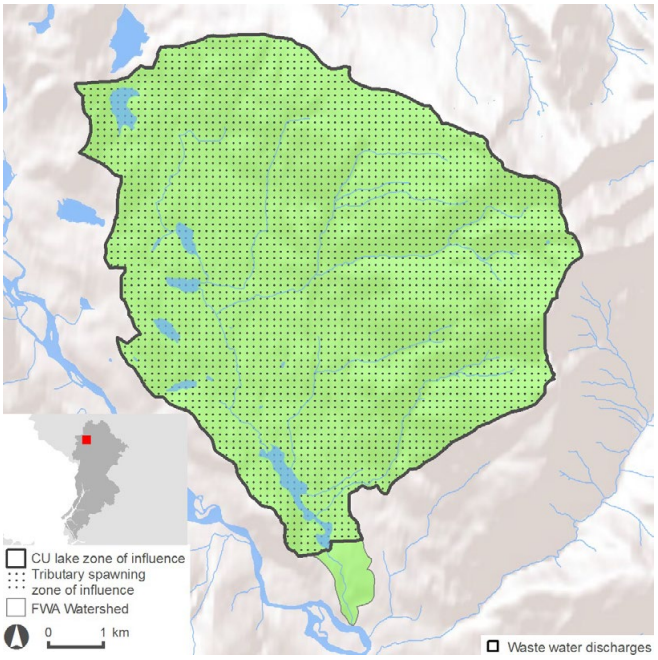




Water Quality

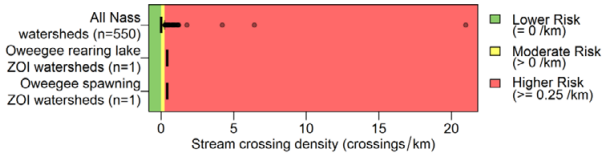
Permitted waste water discharges

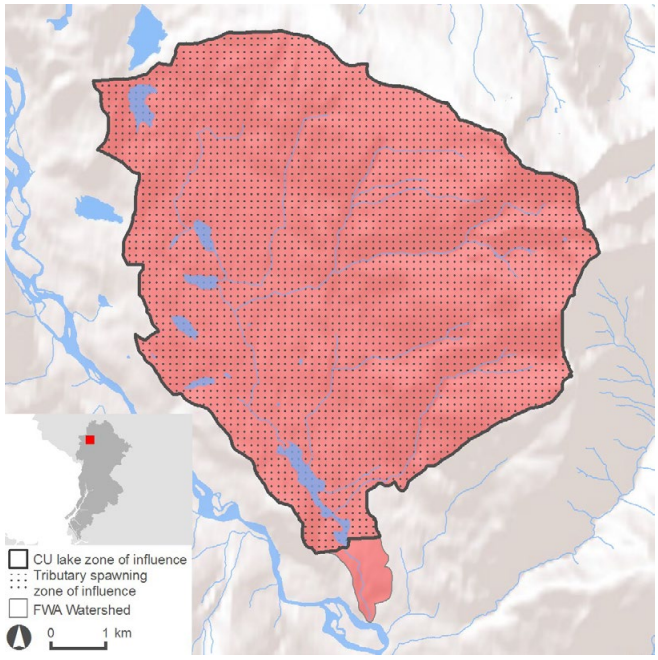




Fish Passage/Habitat Connectivity

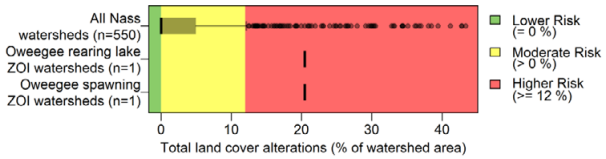
Stream crossing density

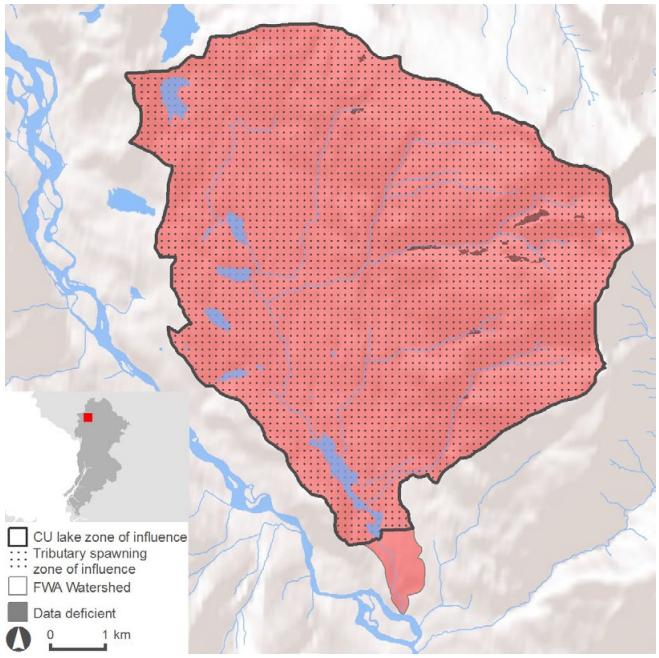




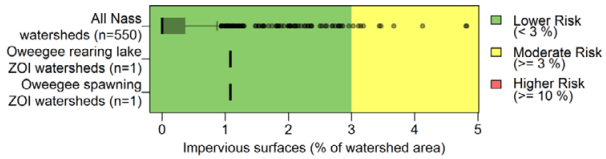
Human Development Footprint

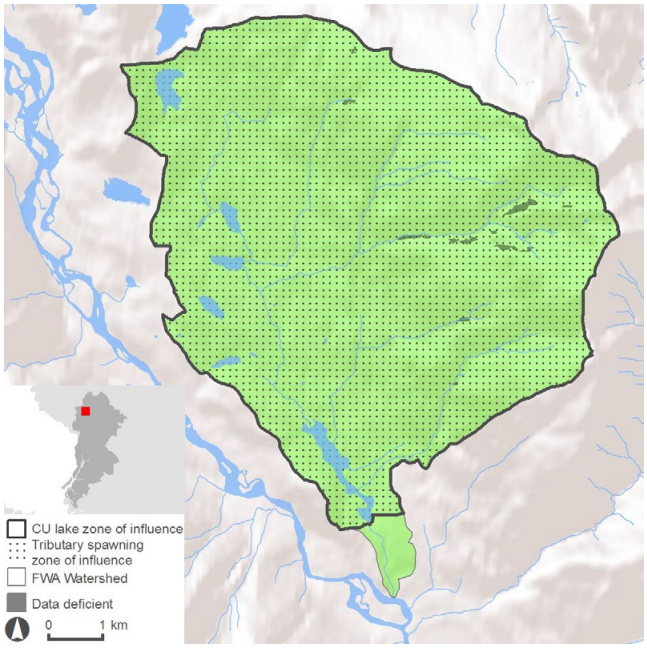
Total land cover alteration



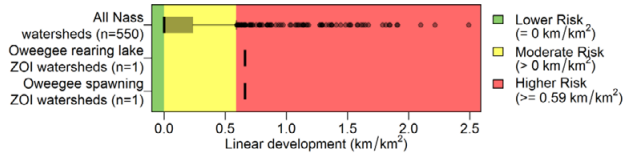


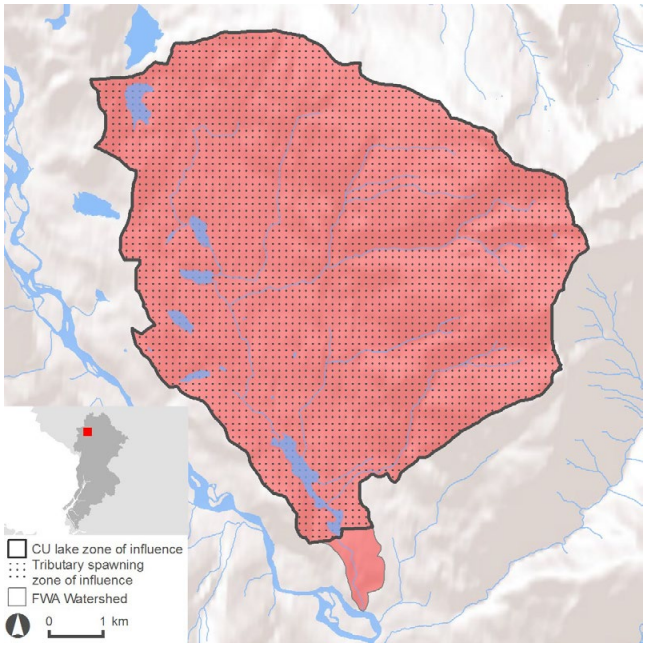
Impervious surfaces



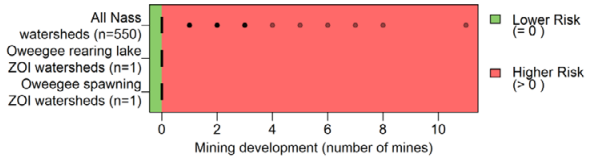


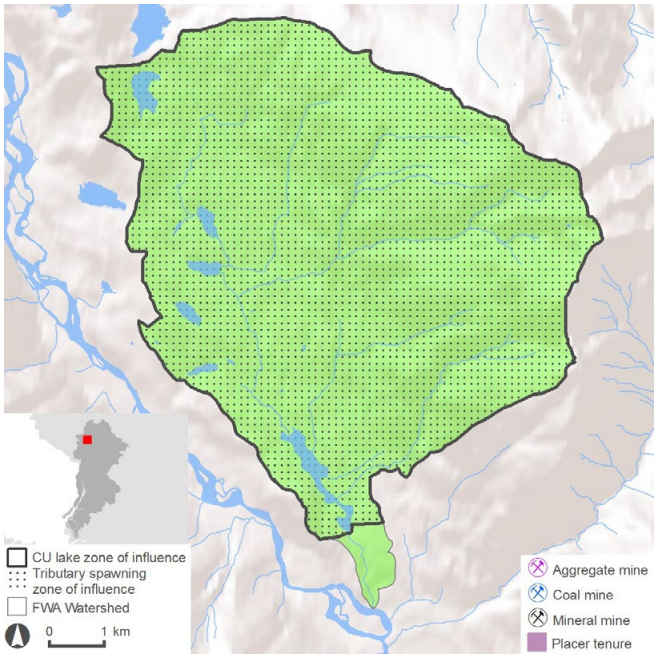
Linear development





Mining development (total number of mines)

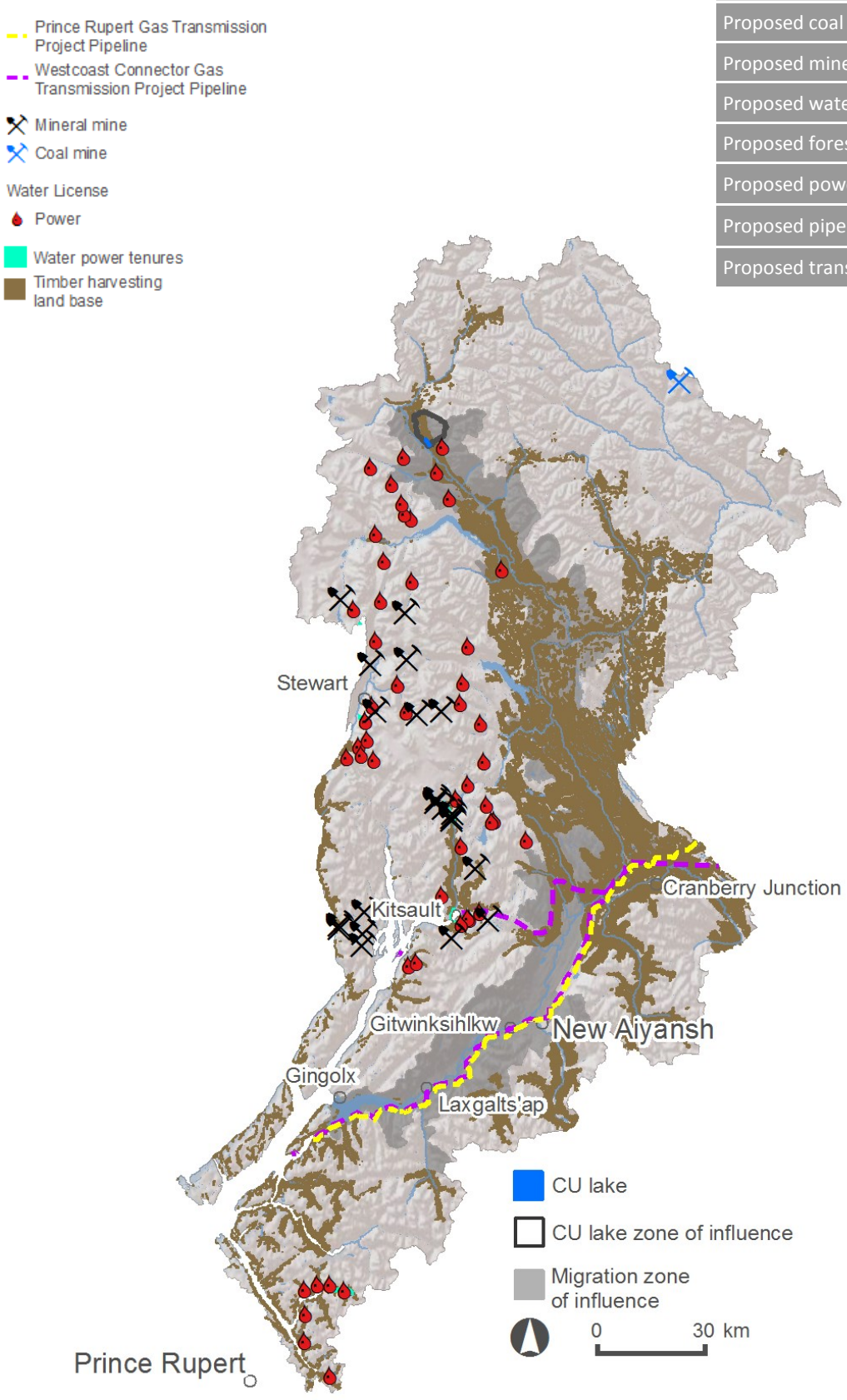




Future pressure

Proposed resource development projects (as of 2016)

Nass Drainage Summary	
	Totals
Proposed coal mines (#)	1
Proposed mineral mines (#)	22
Proposed water licenses (#)	58
Proposed forestry (km^2)	3,323 km^2
Proposed power tenures	Wind 0 km^2, water 15 km^2
Proposed pipelines (km)	386 km
Proposed transmission lines	0 km



River-Type Sockeye: Lower Nass — Portland

Introduction

This project summarizes pressures on the habitat used by Nass salmon Conservation Units (CU) during their freshwater life history stages (migration, spawning and rearing), as well as their relative vulnerability to those pressures. For an explanation of the indicators shown here, please see the accompanying *Report Card Summaries*. Full methods and results can be found in the main report, *Cumulative Pressures on Nass Salmon Habitat: Technical Report* (2016).

Definitions

Conservation Unit (CU): A group of wild salmon sufficiently isolated from other groups that, if extirpated, is very unlikely to re-colonize naturally within an acceptable timeframe.

Pressure indicator: Measurable extent/intensity of natural processes or human activities that can induce changes in habitat condition/state.

Vulnerability indicator: Measures of habitat quantity or quality used to represent the intrinsic habitat vulnerability/sensitivity to watershed disturbances for each life-stage.

Zone of influence (ZOI): Areas adjacent to and upstream/upslope of habitats used by salmon CUs that represent the geographic extent for capture/measurement of pressure and vulnerability indicators.

Status: Condition of habitat relative to a defined indicator benchmark.

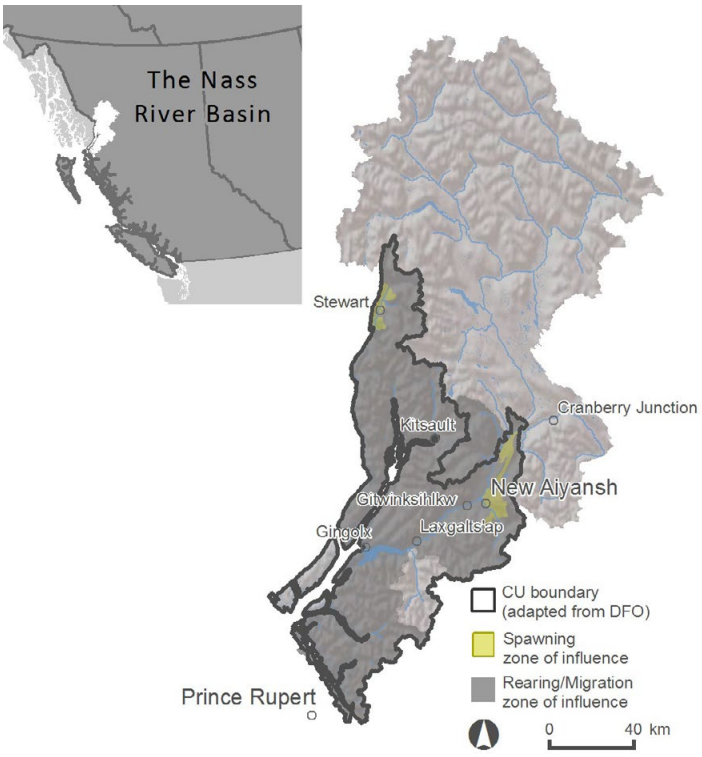
Risk: Likelihood of adverse effects to salmon habitats within a defined zone of influence. Levels of increasing risk are defined based on the extent/intensity of impacts relative to defined benchmarks of concern.

Benchmark: A standard (quantified metric) against which habitat condition can be measured or judged, and by which status can be compared over time and space to determine the risk of adverse effects.

Narrative

- There are ten sockeye salmon CUs in the Nass Area: two are river-type CUs (Upper Nass—UNR and Lower Nass-Portland—LNR-P) and eight are lake-type (Clements, Leverson, Bowser, Damdochax, Fred Wright, Kwinageese, Meziadin, and Oweegee).
- Nearly all of the sockeye salmon production in the Nass Area comes from the lake-type CUs in the upper watershed (i.e. Meziadin, Bowser, Damdochax, Fred Wright, Kwinageese, and Oweegee).
- Nass Area sockeye salmon exhibit variable life history characteristics, with the majority being lake-type and spending one full year rearing in a lake.
- A marine-type population, where salmon go to sea in their first year, is found in some lower Nass tributaries.
- Nass Area sockeye salmon predominantly reside at sea for one to four years, with the majority spending either two or three years at sea.

Location



Summary of habitat vulnerabilities & pressures

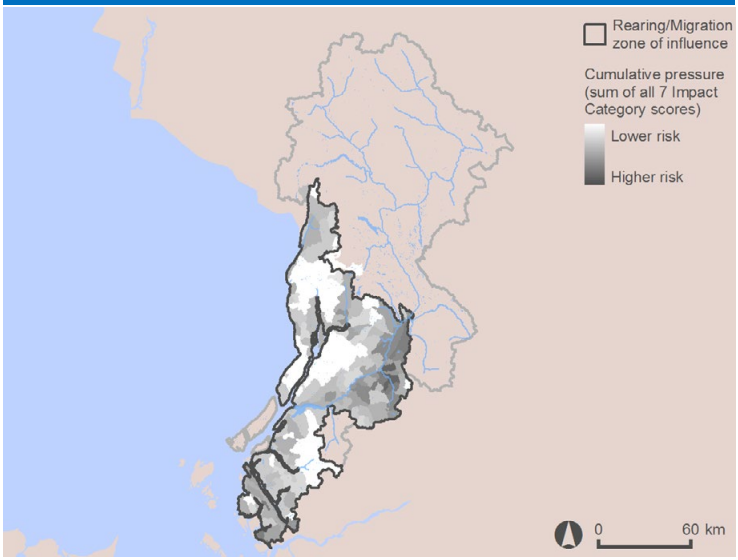
Pressure indicators were grouped into seven relatively independent habitat "impact categories" representing key factors affecting general watershed condition:

- Hydrologic Processes (Forest disturbance; Equivalent Clearcut Area)
- Vegetation Quality (Insect and disease defoliation; Riparian disturbance)
- Surface Erosion (Road development)
- Fish passage/Habitat connectivity (Stream crossing density)
- Water quantity (Water licenses)
- Human development footprint (Total land cover alteration; Impervious surfaces; Linear development; Mining development)
- Water quality (Wastewater discharges)

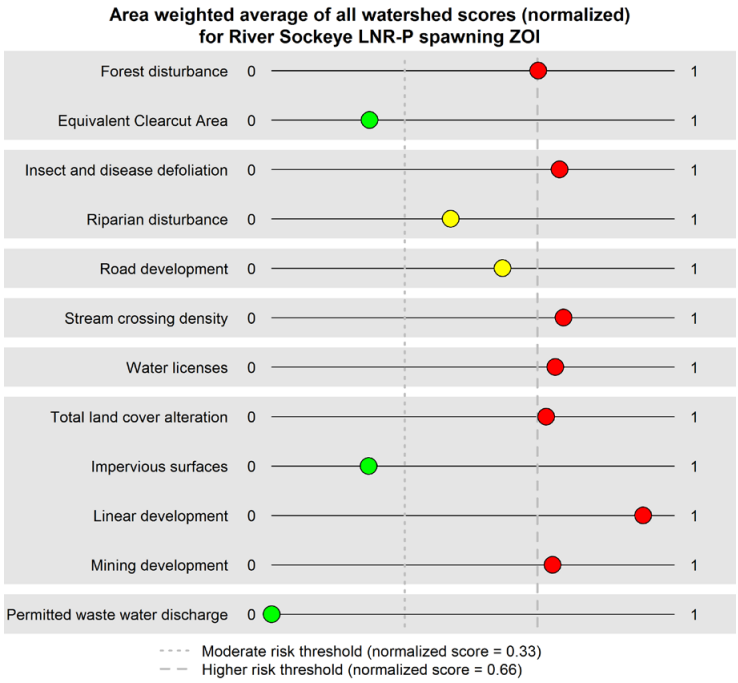
Indicators were also developed reflecting relative vulnerability to habitat pressures within the life stage-specific "zones of influence" defined for each CU:

- Rearing/Migration ZOI: Accessible stream length; Length and percentage of accessible streams considered flow sensitive - all seasons
- Spawning ZOI: Total spawning length; Length and percentage of spawning reaches considered flow sensitive (summer period - spawning, winter period - incubation)

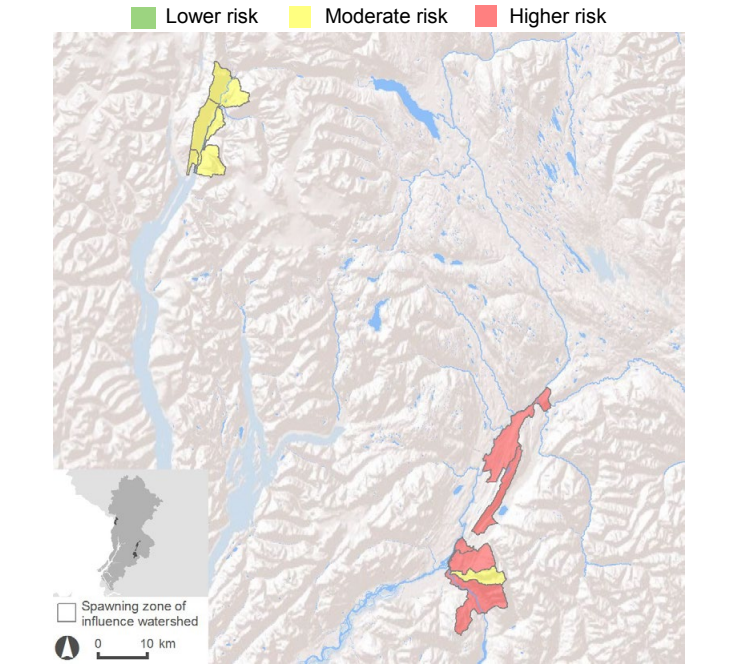
Cumulative pressure—rearing/migration



Summary of pressure indicators—spawning

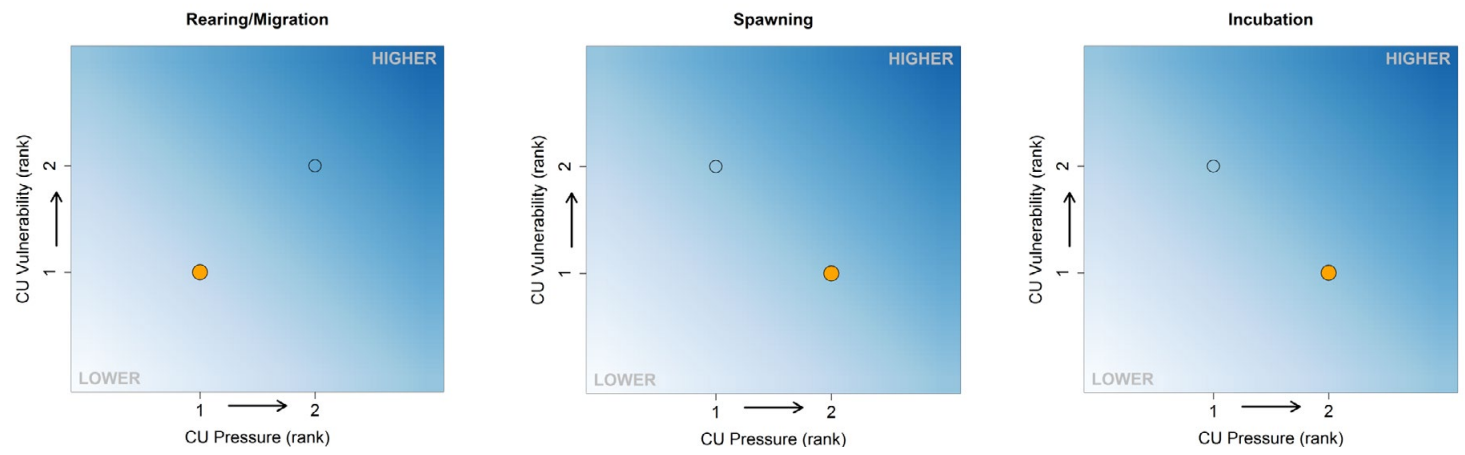


Cumulative pressure—spawning



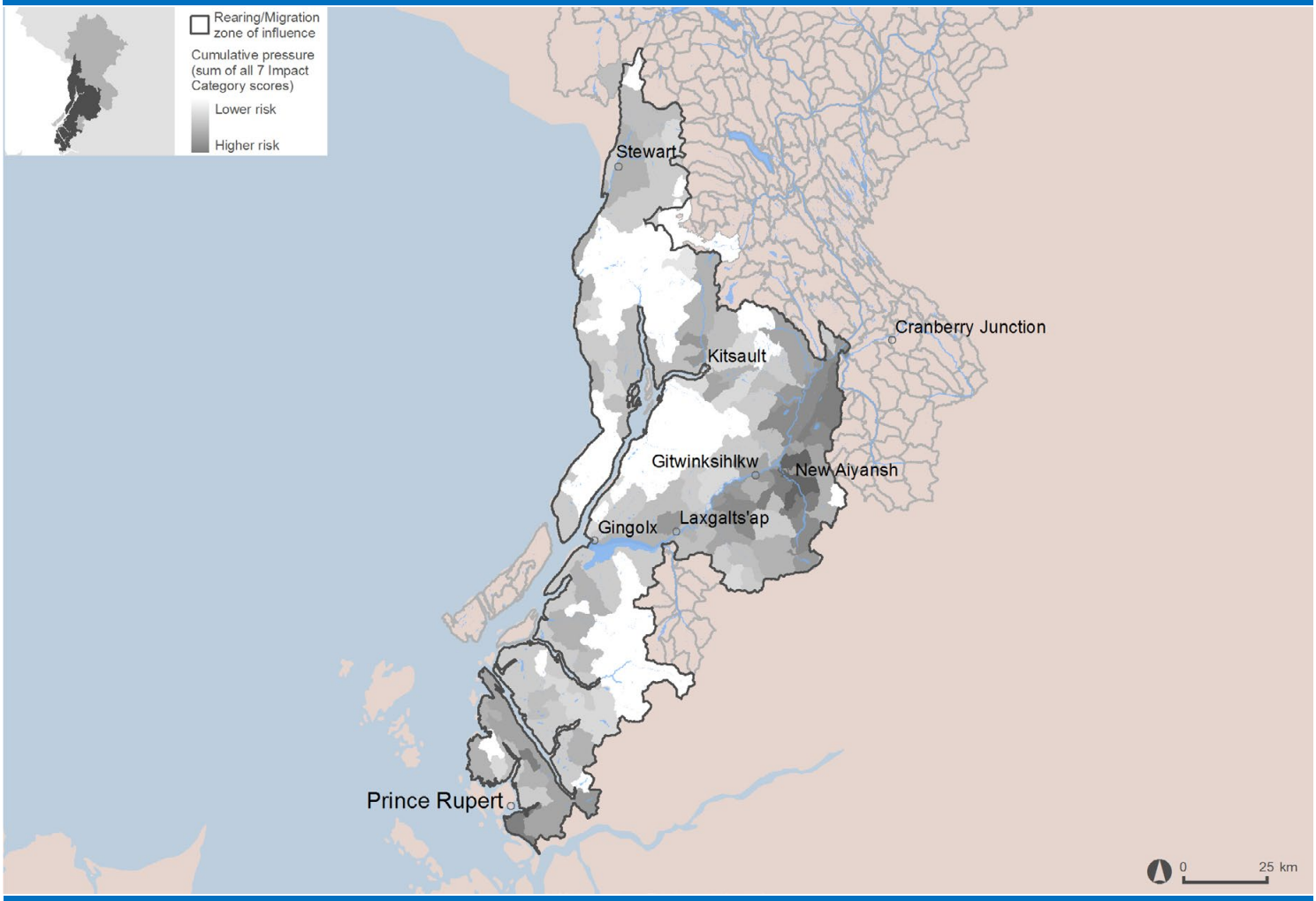
Integrated vulnerability/habitat pressures—rearing/migration, spawning, & incubation

● = Lower Nass-Portland ○ = other river sockeye CUs



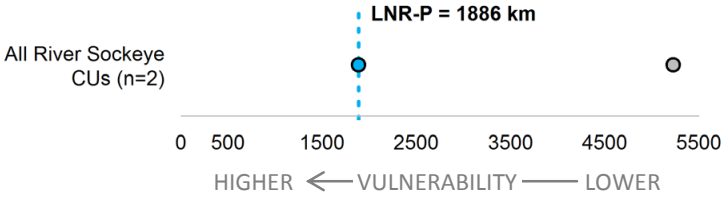
Rearing/Migration vulnerability & pressure

Rearing/Migration period pressures

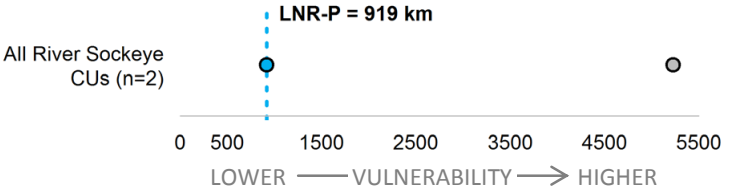


Rearing/Migration period vulnerability

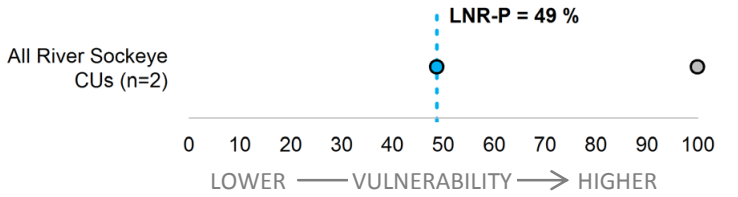
Salmon accessible habitat (km)



Flow sensitive accessible habitat (km) (all seasons)



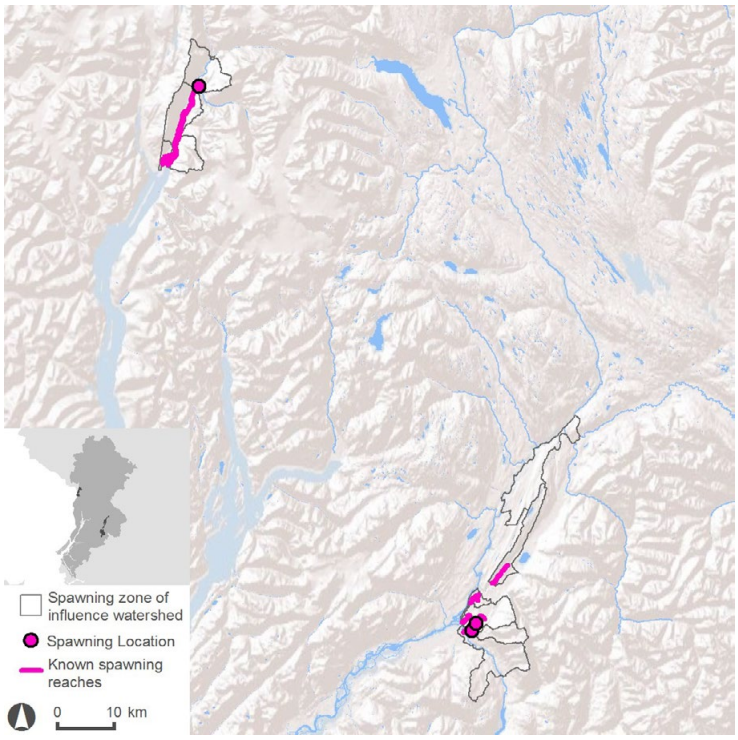
Flow sensitive accessible habitat (%) (all seasons)



Spawning & incubation vulnerability

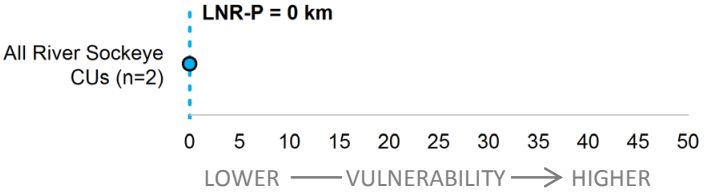
Spawning period vulnerability

Spawning locations

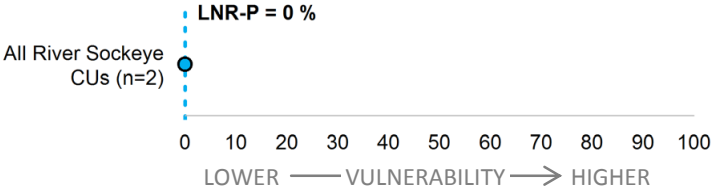


Total spawning length (km)

Spawning reaches summer flow sensitive - spawn timing (km)

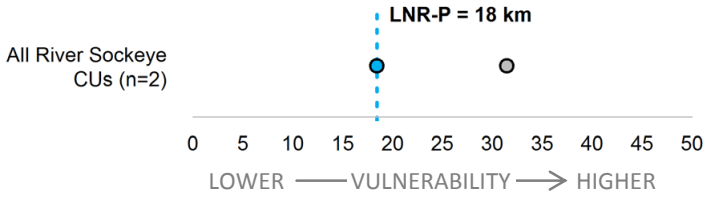


Spawning reaches summer flow sensitive - spawn timing (%)

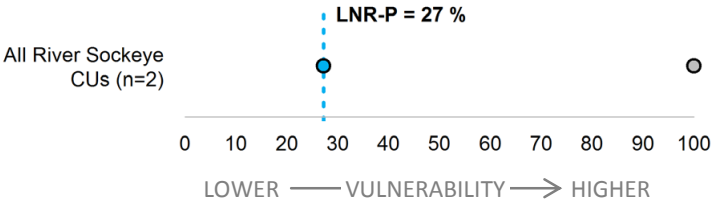


Incubation period vulnerability

Spawning reaches winter flow sensitive - incubation timing (km)



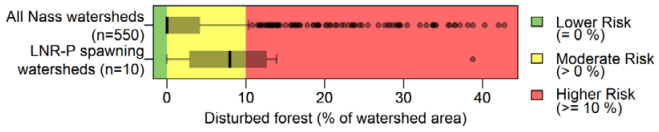
Spawning reaches winter flow sensitive - incubation timing (%)

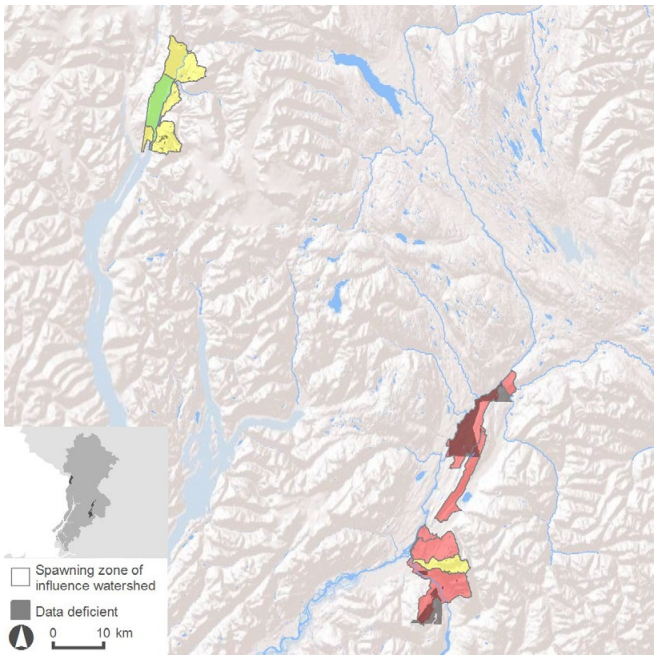


Spawning pressure

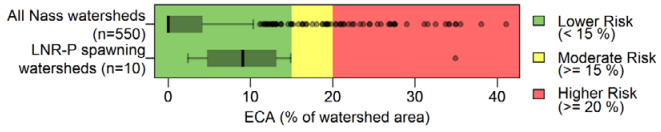
Hydrologic Processes

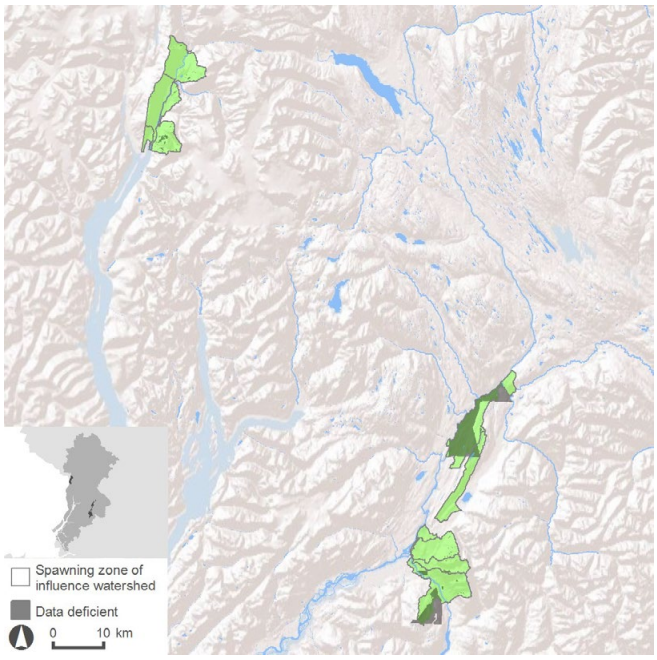
Forest disturbance





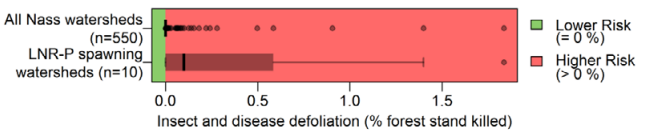
Equivalent Clear-cut Area

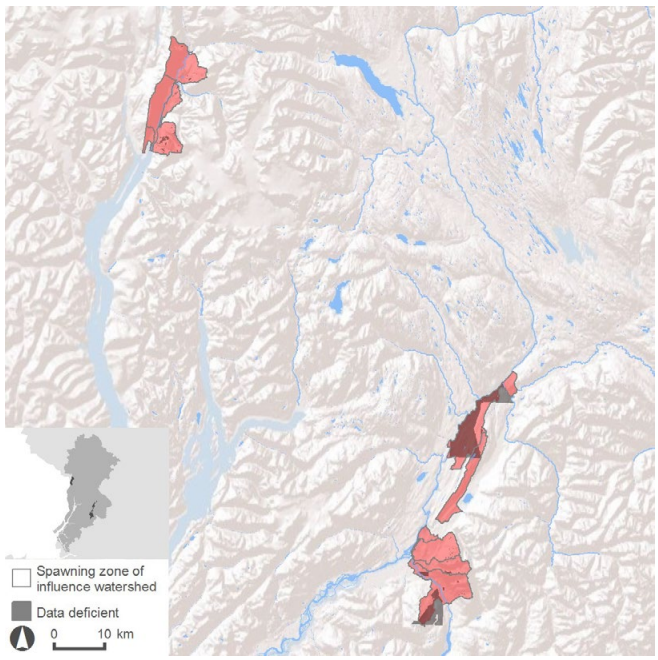




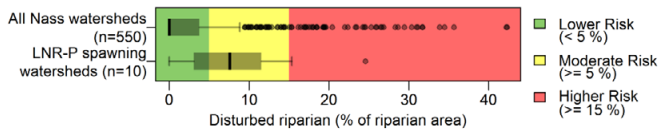
Vegetation Quality

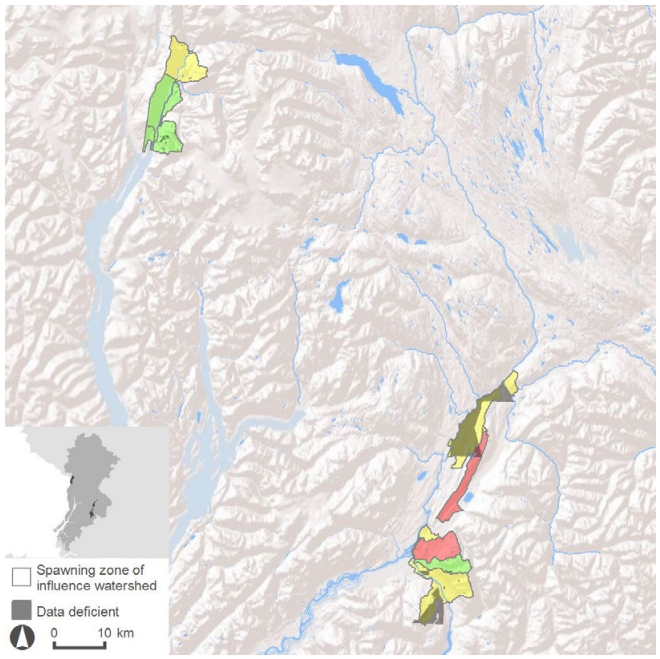
Insect and disease defoliation





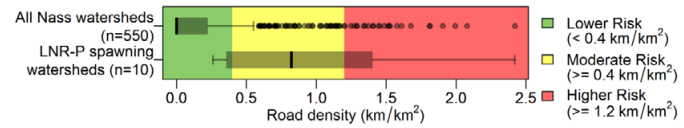
Riparian disturbance

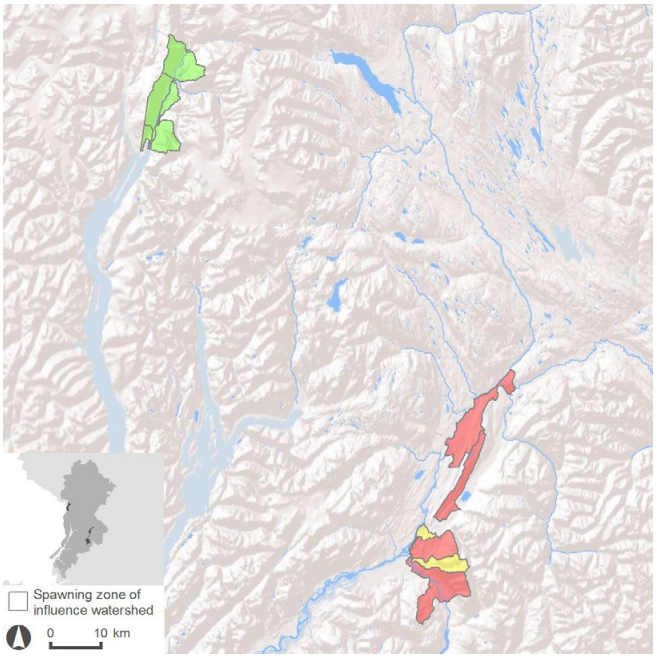




Surface Erosion

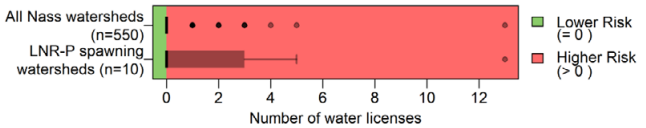
Road development

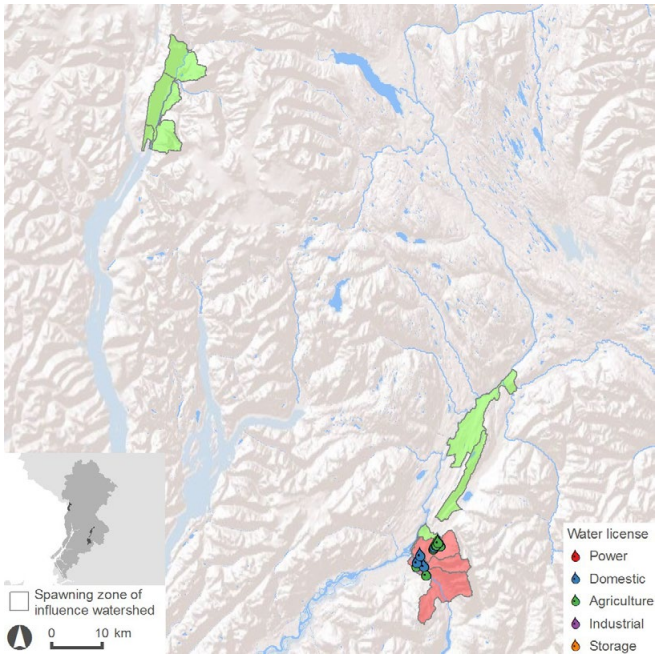




Water Quantity

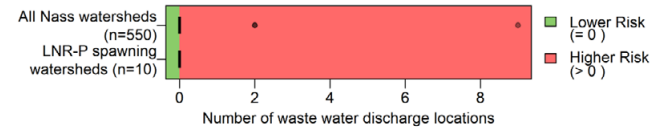
Number of water licenses

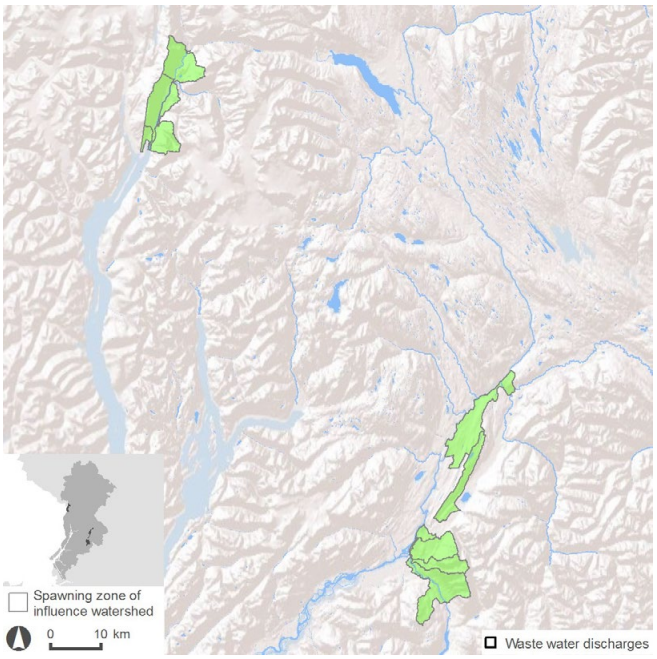




Water Quality

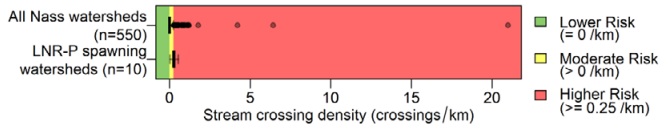
Permitted waste water discharges

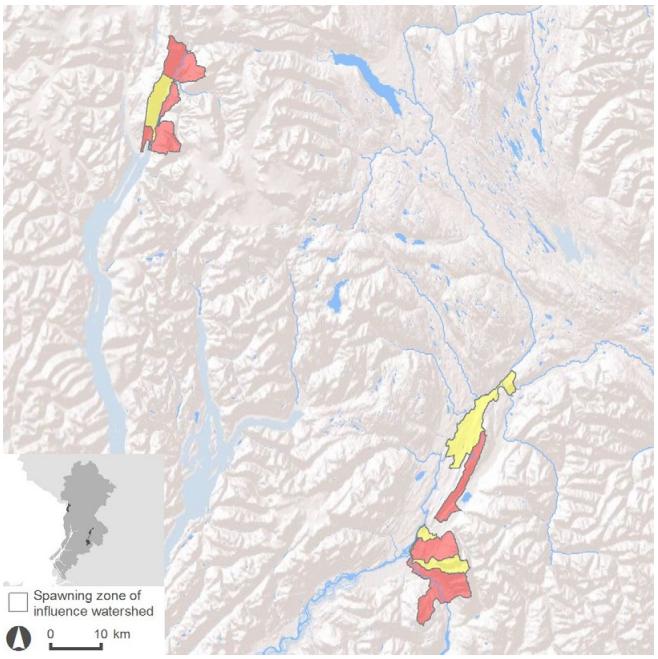




Fish Passage/Habitat Connectivity

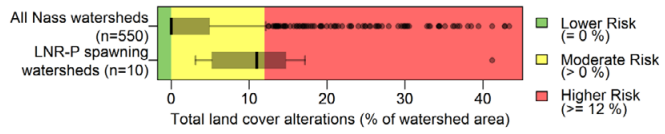
Stream crossing density

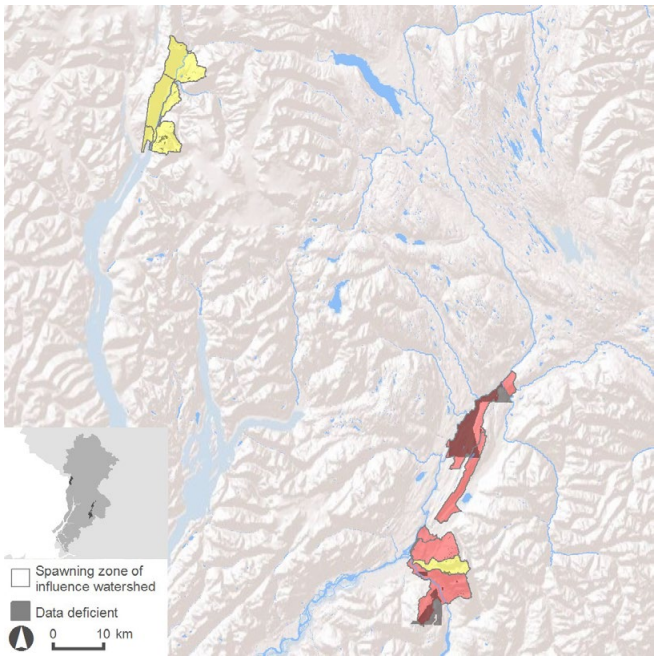




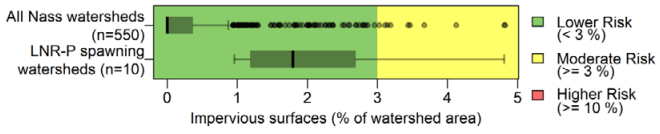
Human Development Footprint

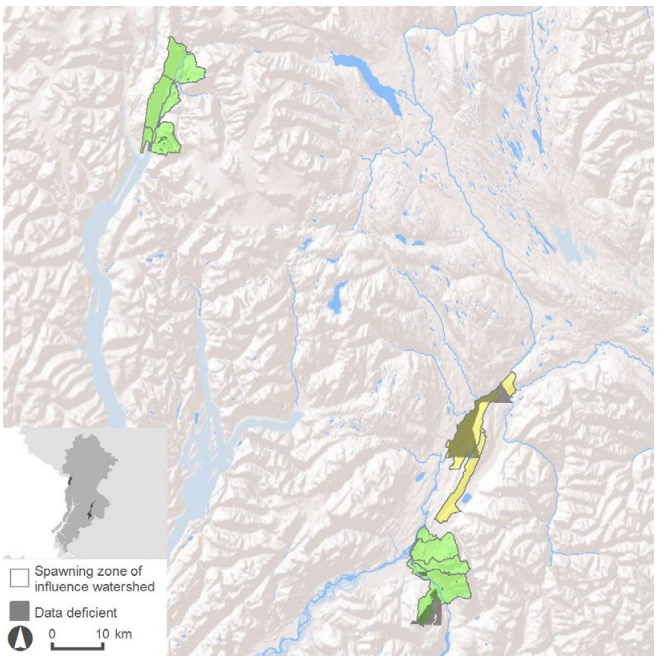
Total land cover alteration



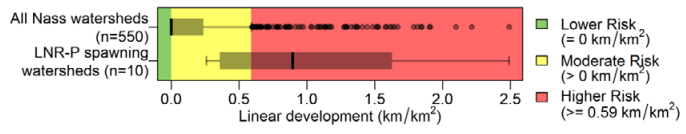


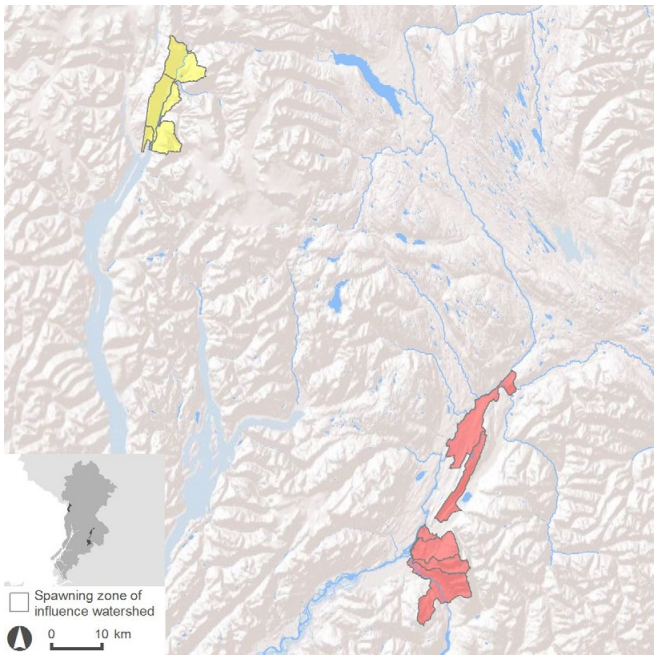
Impervious surfaces



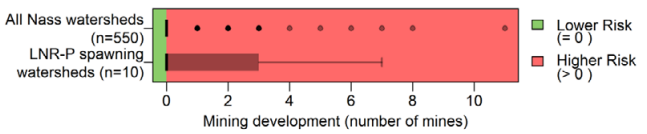


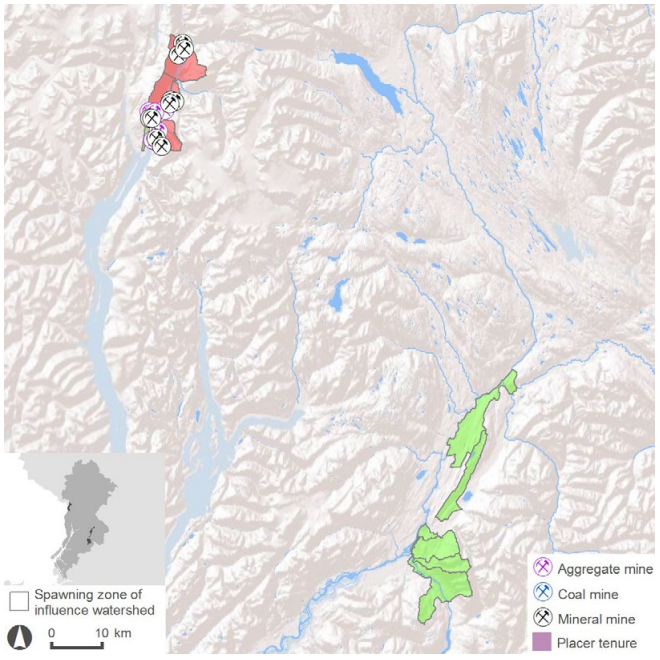
Linear development





Mining development (total number of mines)

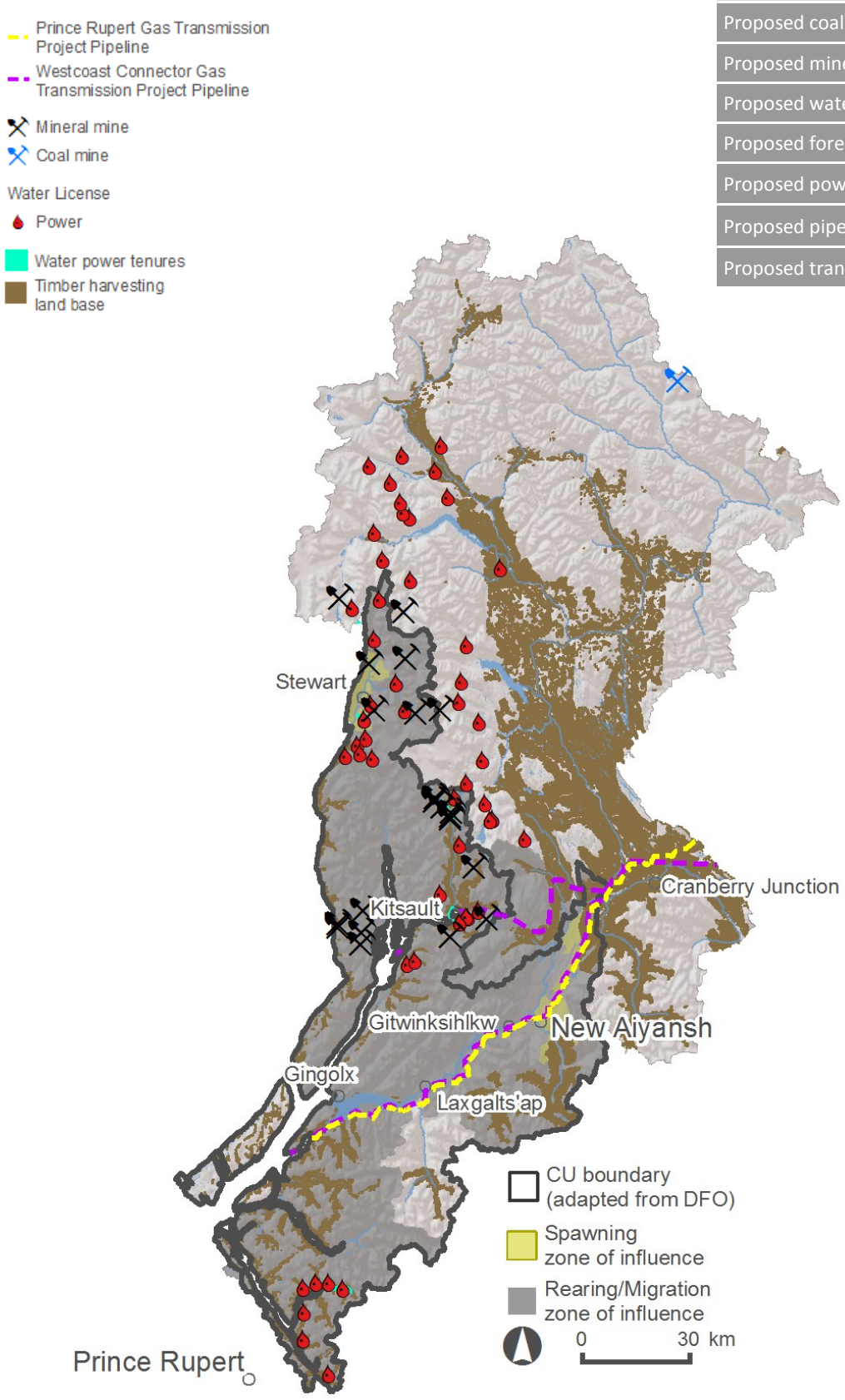




Future pressure

Proposed resource development projects (as of 2016)

Nass Drainage Summary	
	Totals
Proposed coal mines (#)	1
Proposed mineral mines (#)	22
Proposed water licenses (#)	58
Proposed forestry (km^2)	3,323 km^2
Proposed power tenures	Wind 0 km^2, water 15 km^2
Proposed pipelines (km)	386 km
Proposed transmission lines	0 km



River-Type Sockeye: Upper Nass River

Introduction

This project summarizes pressures on the habitat used by Nass salmon Conservation Units (CU) during their freshwater life history stages (migration, spawning and rearing), as well as their relative vulnerability to those pressures. For an explanation of the indicators shown here, please see the accompanying *Report Card Summaries*. Full methods and results can be found in the main report, Cumulative *Pressures on Nass Salmon Habitat: Technical Report* (2016).

Definitions

Conservation Unit (CU): A group of wild salmon sufficiently isolated from other groups that, if extirpated, is very unlikely to re-colonize naturally within an acceptable timeframe.

Pressure indicator: Measurable extent/intensity of natural processes or human activities that can induce changes in habitat condition/state.

Vulnerability indicator: Measures of habitat quantity or quality used to represent the intrinsic habitat vulnerability/sensitivity to watershed disturbances for each life-stage.

Zone of influence (ZOI): Areas adjacent to and upstream/upslope of habitats used by salmon CUs that represent the geographic extent for capture/measurement of pressure and vulnerability indicators.

Status: Condition of habitat relative to a defined indicator benchmark.

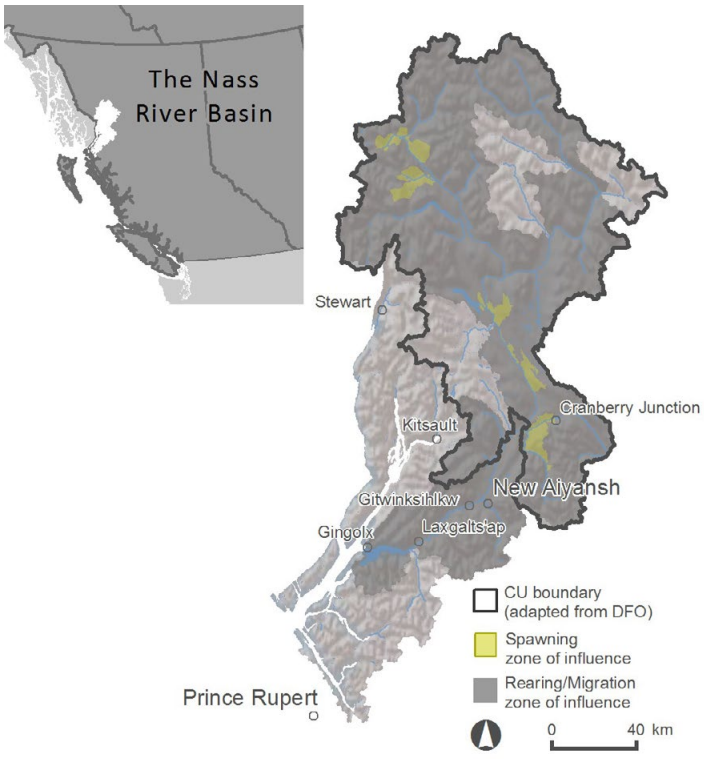
Risk: Likelihood of adverse effects to salmon habitats within a defined zone of influence. Levels of increasing risk are defined based on the extent/intensity of impacts relative to defined benchmarks of concern.

Benchmark: A standard (quantified metric) against which habitat condition can be measured or judged, and by which status can be compared over time and space to determine the risk of adverse effects.

Narrative

- There are ten sockeye salmon CUs in the Nass Area: two are river-type CUs (Upper Nass—UNR and Lower Nass-Portland—LNR-P) and eight are lake-type (Clements, Leverson, Bowser, Damdochax, Fred Wright, Kwinageese, Meziadin, and Oweegee).
- Nearly all of the sockeye salmon production in the Nass Area comes from the lake-type CUs in the upper watershed (i.e. Meziadin, Bowser, Damdochax, Fred Wright, Kwinageese, and Oweegee).
- Nass Area sockeye salmon exhibit variable life history characteristics, with the majority being lake-type and spending one full year rearing in a lake.
- A marine-type population, where salmon go to sea in their first year, is found in some lower Nass tributaries.
- Nass Area sockeye salmon predominantly reside at sea for one to four years, with the majority spending either two or three years at sea.

Location



Summary of habitat vulnerabilities & pressures

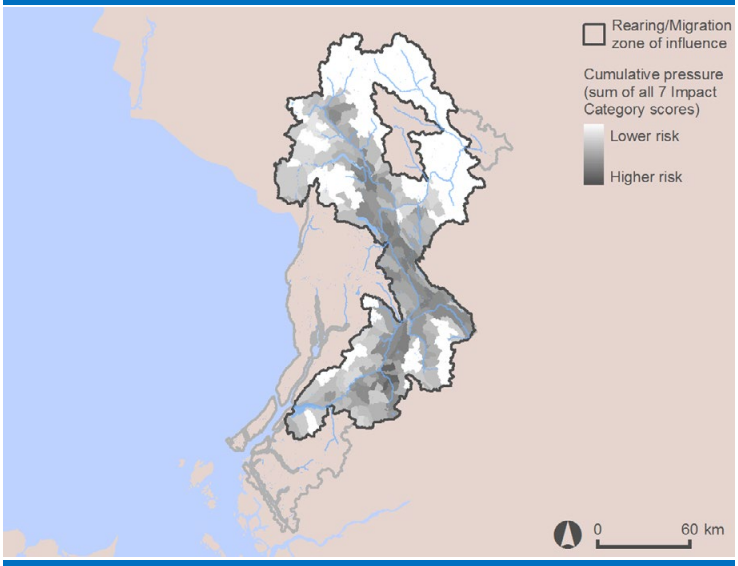
Pressure indicators were grouped into seven relatively independent habitat "impact categories" representing key factors affecting general watershed condition:

- Hydrologic Processes (Forest disturbance; Equivalent Clearcut Area)
- Vegetation Quality (Insect and disease defoliation; Riparian disturbance)
- Surface Erosion (Road development)
- Fish passage/Habitat connectivity (Stream crossing density)
- Water quantity (Water licenses)
- Human development footprint (Total land cover alteration; Impervious surfaces; Linear development; Mining development)
- Water quality (Wastewater discharges)

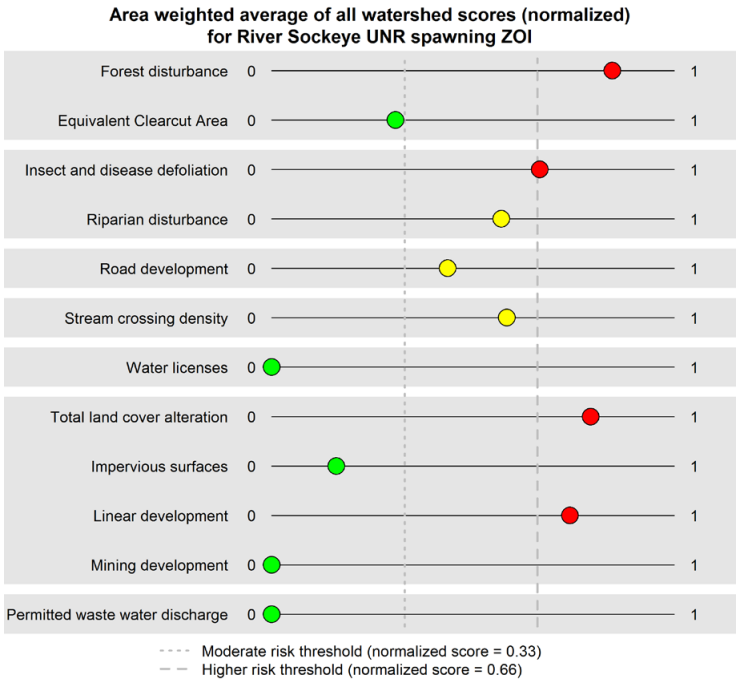
Indicators were also developed reflecting relative vulnerability to habitat pressures within the life stage-specific "zones of influence" defined for each CU:

- Rearing/Migration ZOI: Accessible stream length; Length and percentage of accessible streams considered flow sensitive - all seasons
- Spawning ZOI: Total spawning length; Length and percentage of spawning reaches considered flow sensitive (summer period - spawning, winter period - incubation)

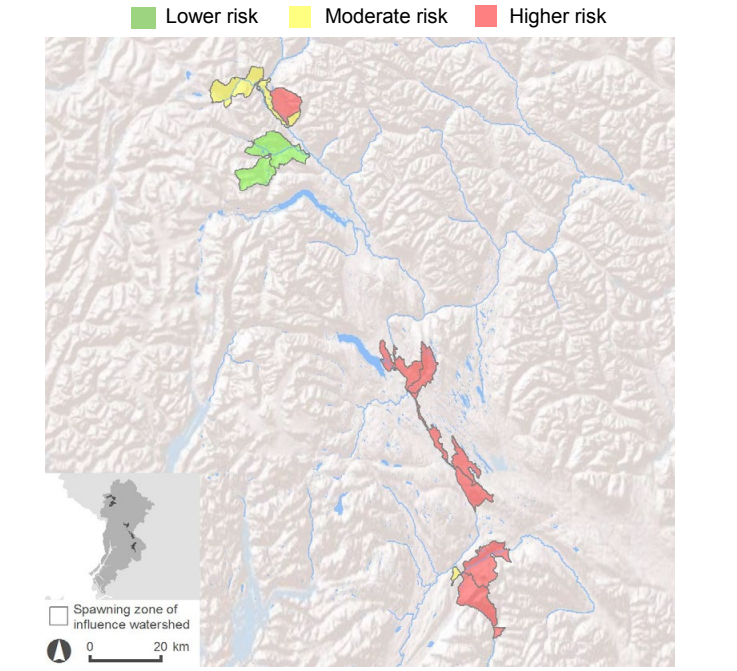
Cumulative pressure—rearing/migration



Summary of pressure indicators—spawning

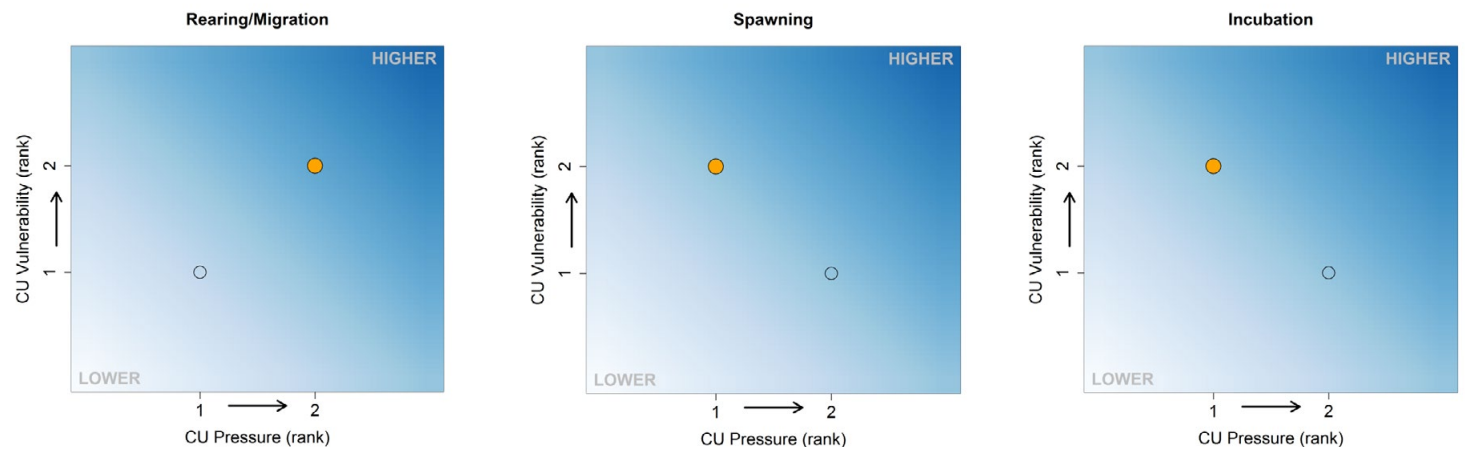


Cumulative pressure—spawning



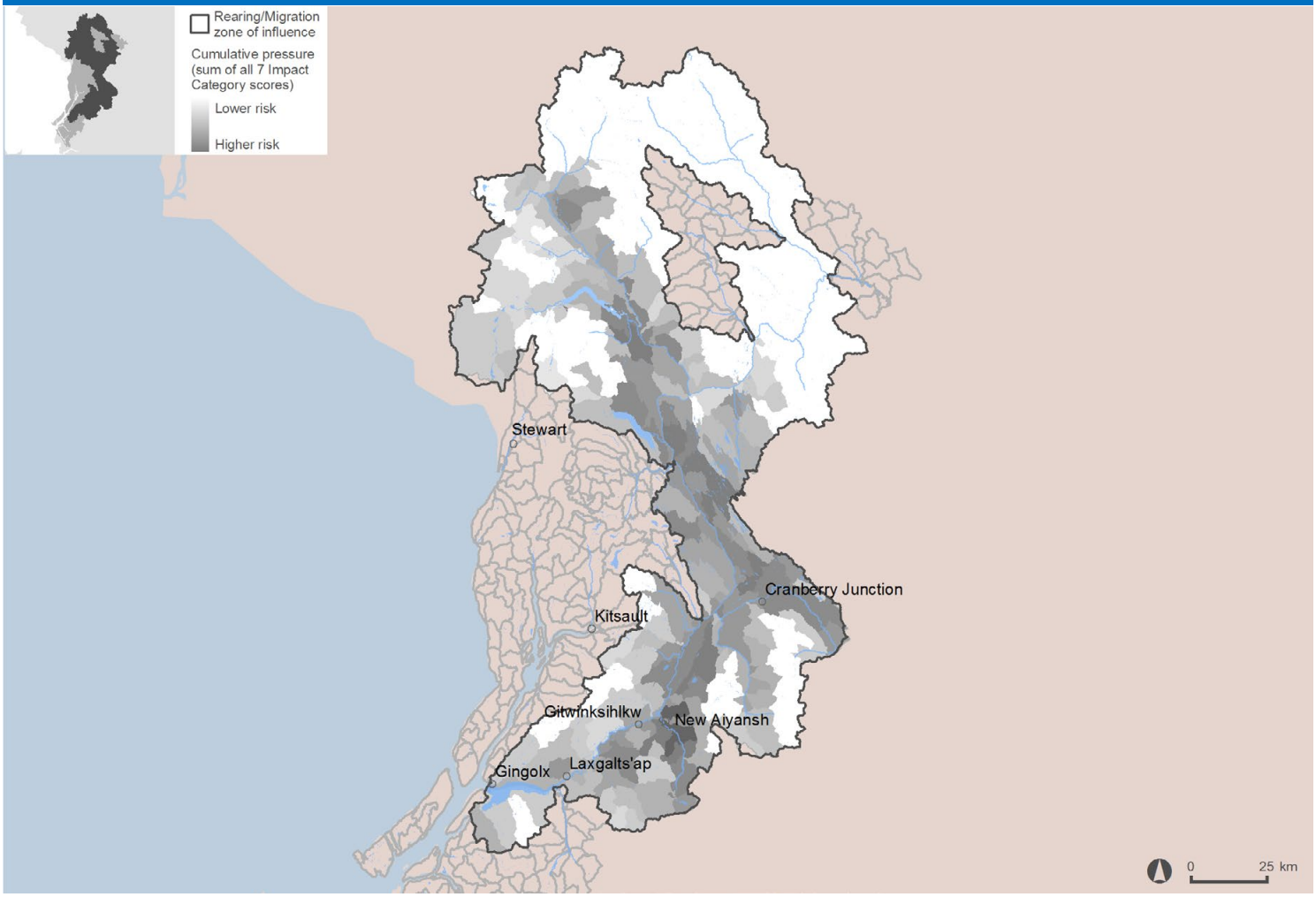
Integrated vulnerability/habitat pressures—rearing/migration, spawning, & incubation

● = Upper Nass ○ = other river sockeye CUs



Rearing/Migration vulnerability & pressure

Rearing/Migration period pressures

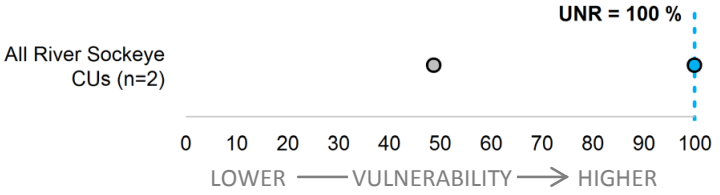


Rearing/Migration period vulnerability

Salmon accessible habitat (km)

Flow sensitive accessible habitat (km) (all seasons)

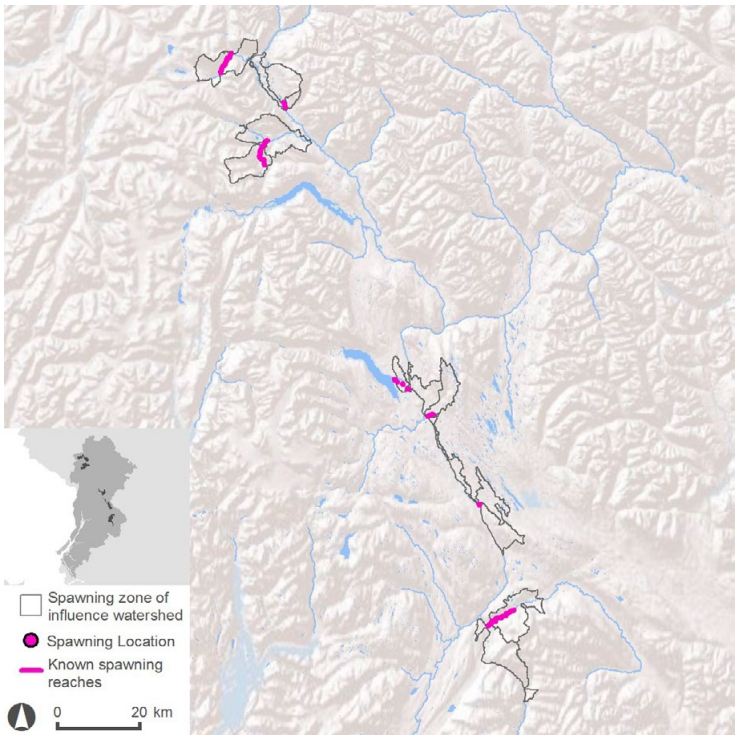
Flow sensitive accessible habitat (%) (all seasons)



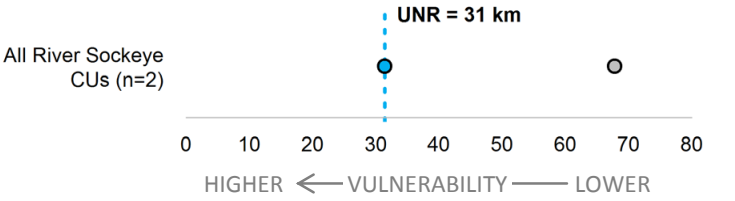
Spawning & incubation vulnerability

Spawning period vulnerability

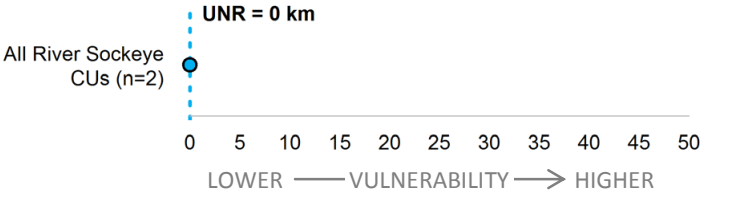
Spawning locations



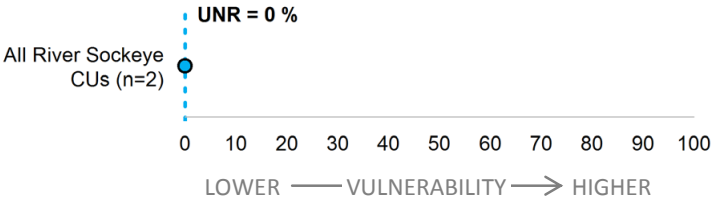
Total spawning length (km)



Spawning reaches summer flow sensitive - spawn timing (km)

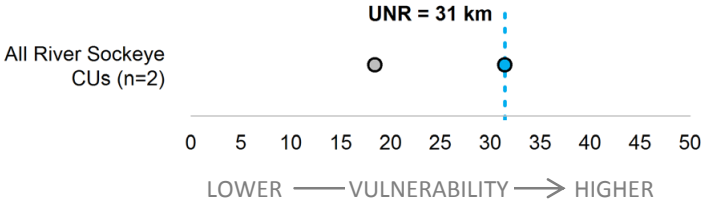


Spawning reaches summer flow sensitive - spawn timing (%)



Incubation period vulnerability

Spawning reaches winter flow sensitive - incubation timing (km)

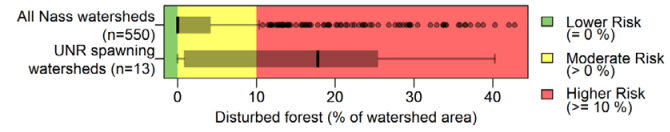


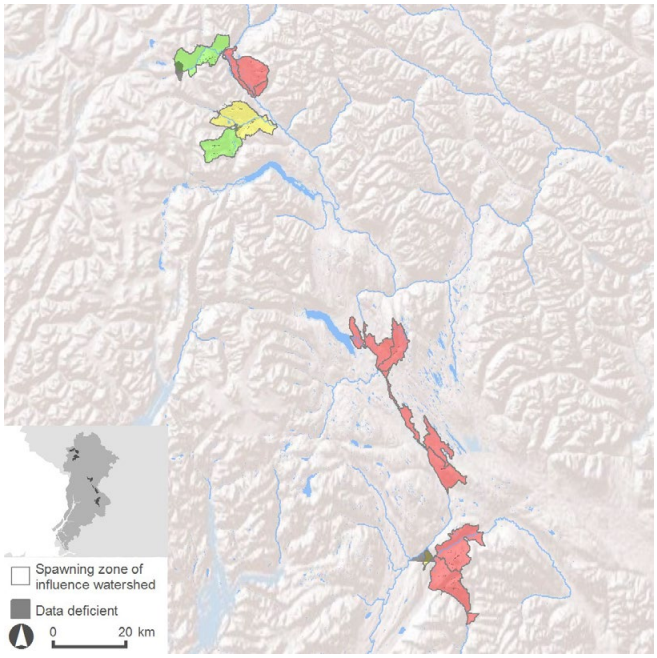
Spawning reaches winter flow sensitive - incubation timing (%)

Spawning pressure

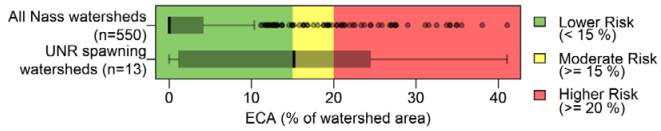
Hydrologic Processes

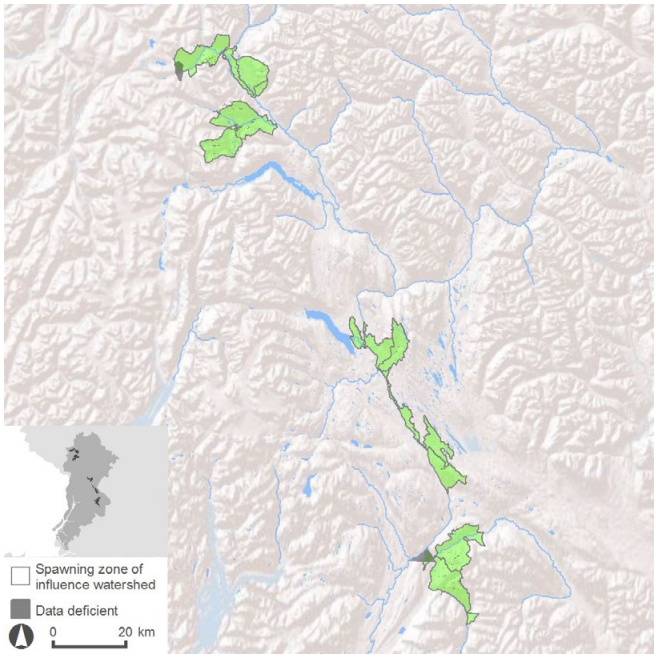
Forest disturbance





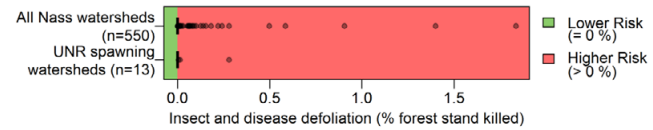
Equivalent Clear-cut Area

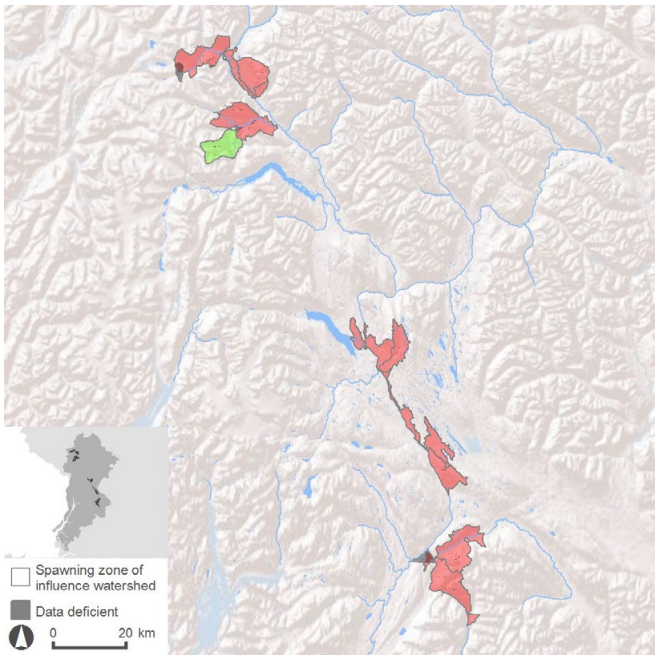




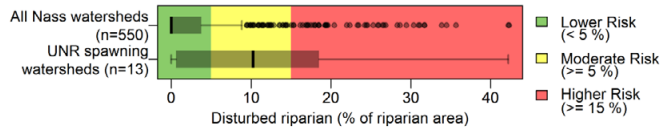
Vegetation Quality

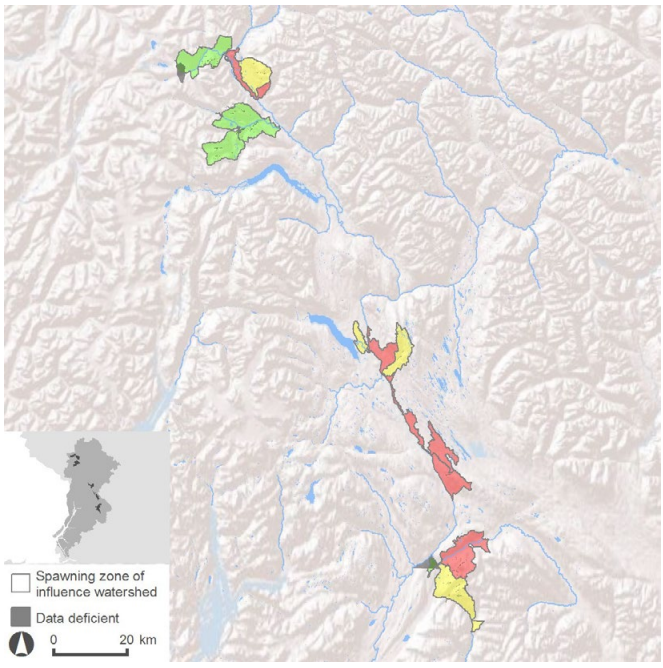
Insect and disease defoliation





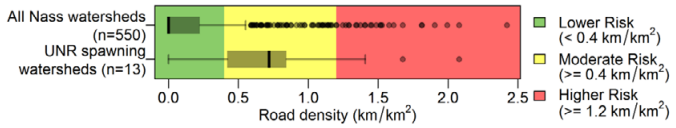
Riparian disturbance

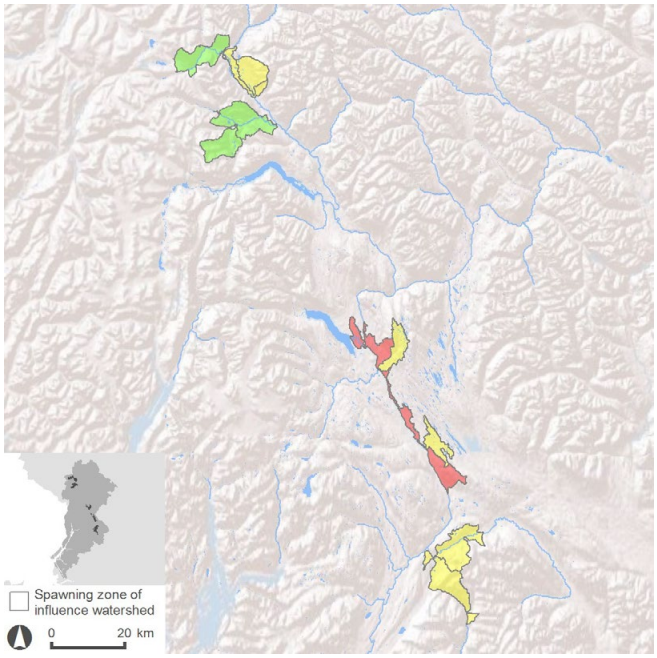




Surface Erosion

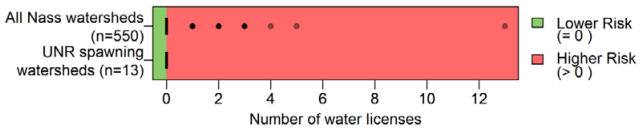
Road development

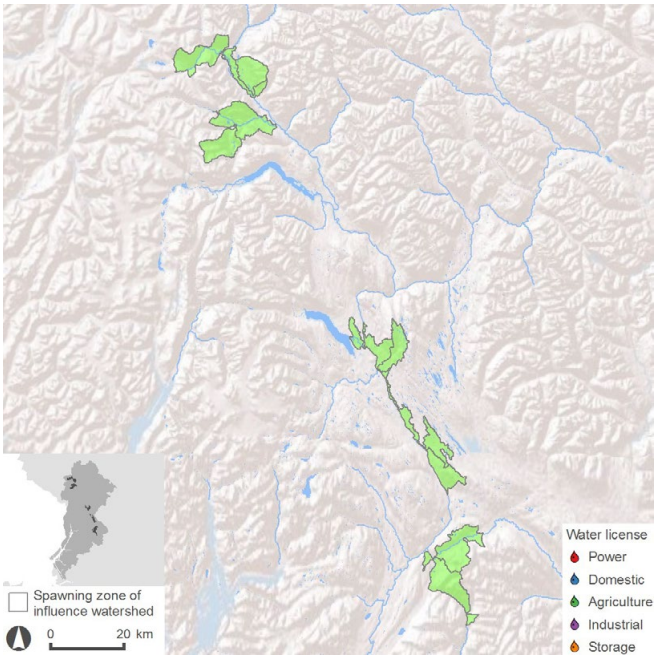




Water Quantity

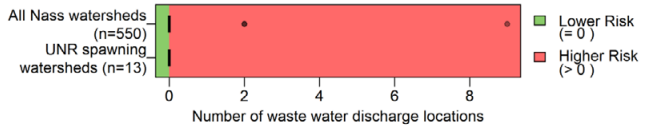
Number of water licenses

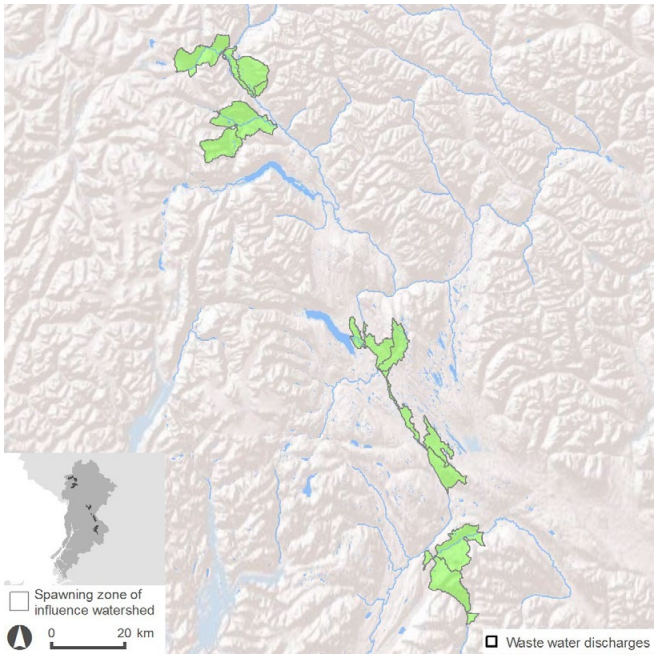




Water Quality

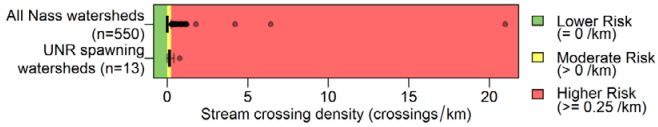
Permitted waste water discharges

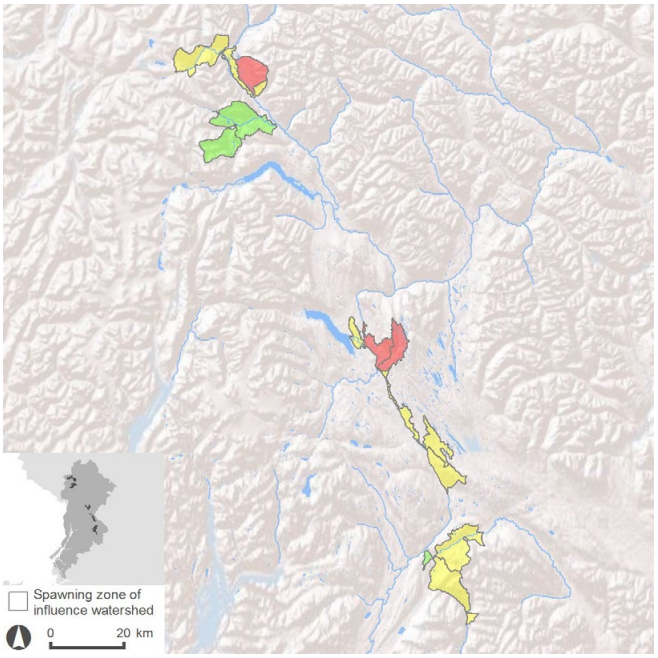




Fish Passage/Habitat Connectivity

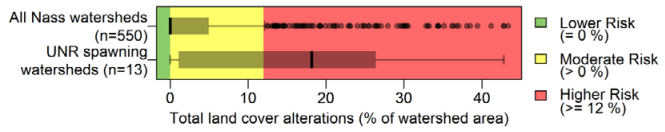
Stream crossing density

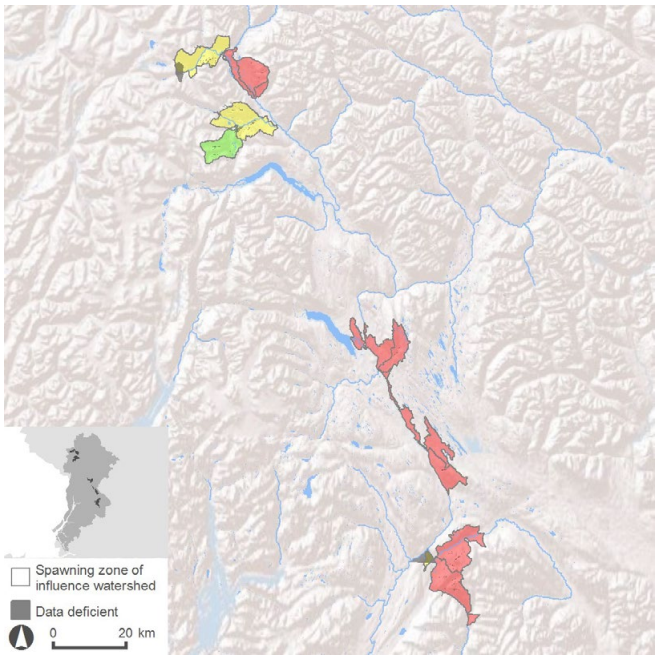




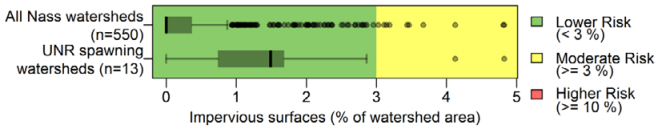
Human Development Footprint

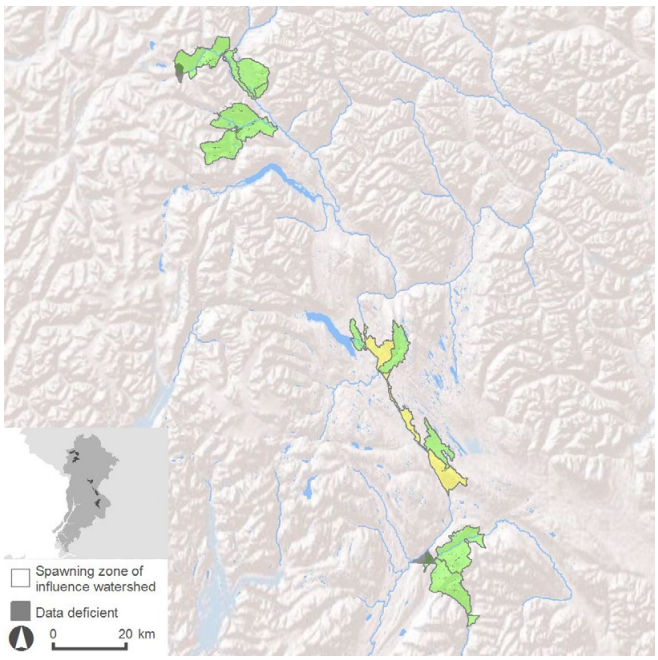
Total land cover alteration



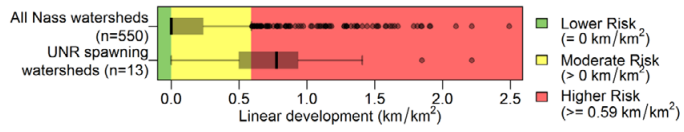


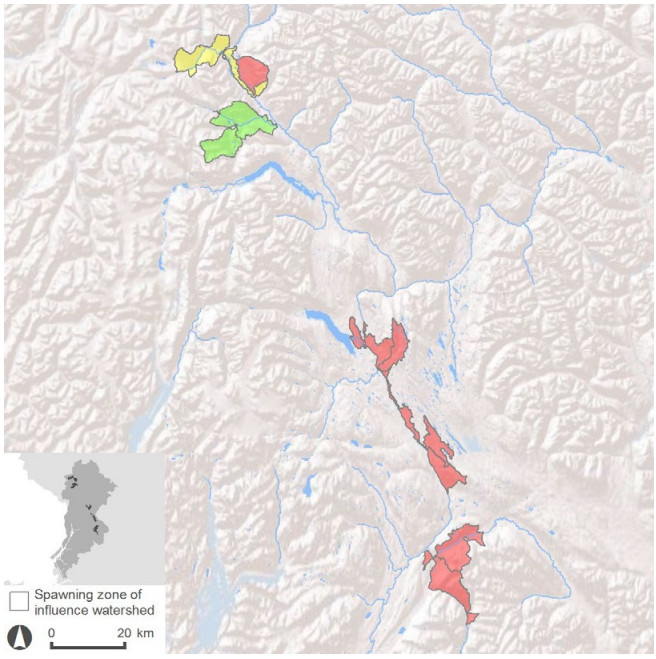
Impervious surfaces



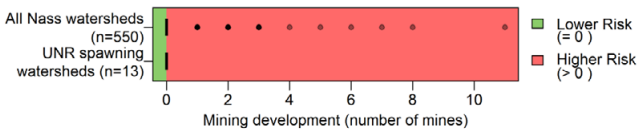


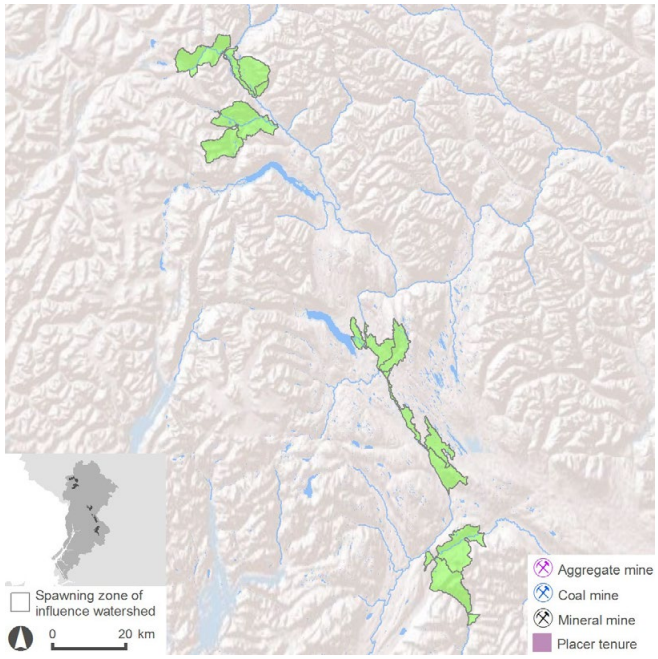
Linear development





Mining development (total number of mines)

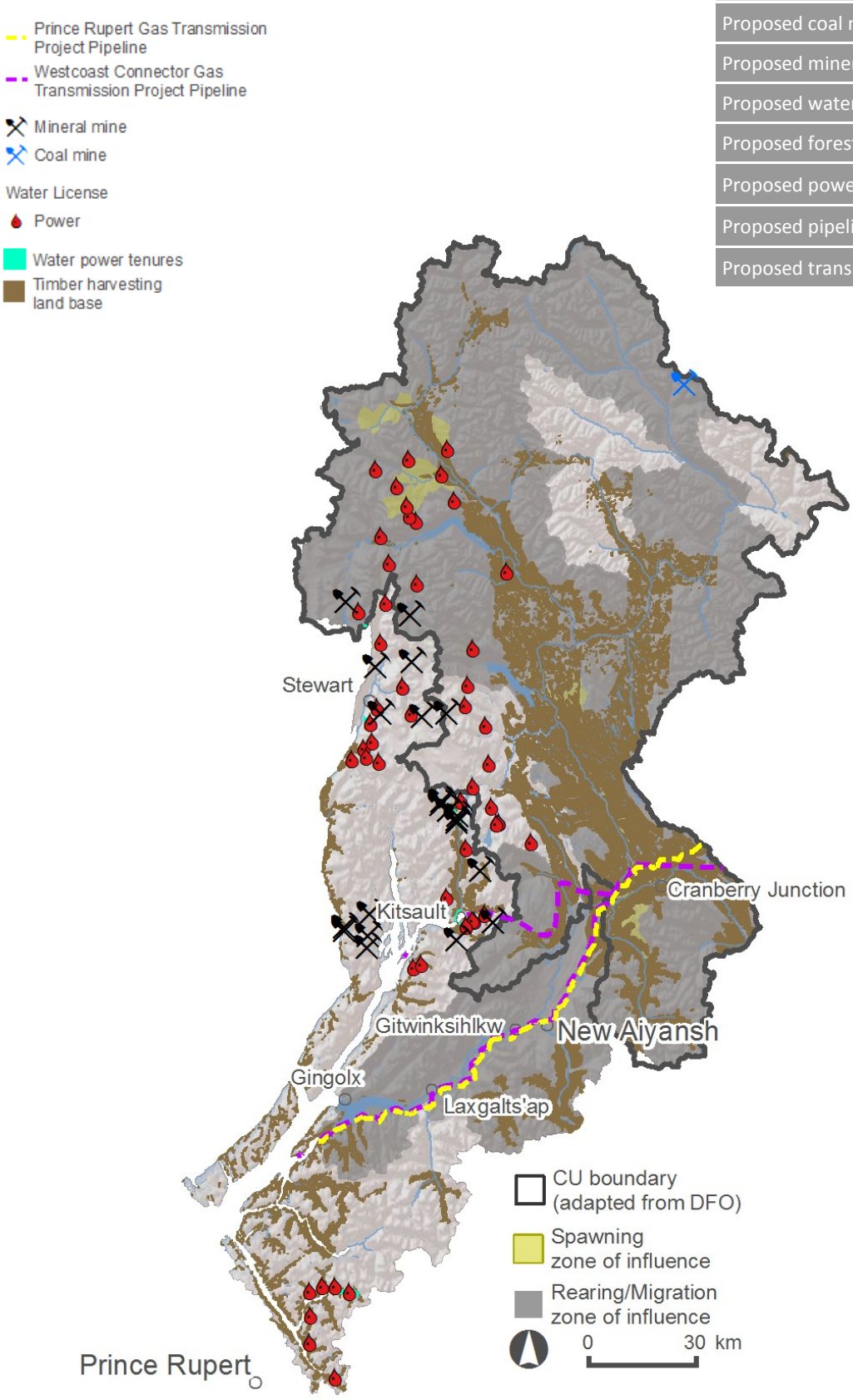




Future pressure

Proposed resource development projects (as of 2016)

Nass Drainage Summary	
	Totals
Proposed coal mines (#)	1
Proposed mineral mines (#)	22
Proposed water licenses (#)	58
Proposed forestry (km^2)	3,323 km^2
Proposed power tenures	Wind 0 km^2, water 15 km^2
Proposed pipelines (km)	386 km
Proposed transmission lines	0 km



Quick Reference Guides

Quick Reference Guide: Lake Sockeye

These Conservation Unit (CU) habitat report cards are intended to allow assessment and comparison of CU habitat 'status' based on a combination of: (1) intrinsic vulnerability of CU freshwater habitats and (2): intensity and extent of human pressures/stressors on those habitats. A full description of indicators and data sources used can be found in the main report: *Cumulative Pressures on Nass Salmon Habitat: Technical Report* (Porter et al. 2016) available from PSF at: www.skeenasalmonprogram.ca.

Page 1

1. Introduction and Definitions. Brief description of the CU reporting exercise being undertaken for assessing salmon CU habitats and definitions for key terms that are used throughout the reporting.

2. Narrative. Short bulleted descriptions of key issues affecting lake sockeye in the Nass drainage and concerns that might relate to a particular CU. This includes the principal habitat pressures on CU habitats as determined from the broad-scale analyses undertaken here, as well as more localized habitat impacts affecting the CU as identified by Nass regional experts.

3. Location (a): Map showing location of the CU rearing lake within the Nass drainage, and the location of the Nass drainage within BC. The nursery lake is shaded blue and its defined 'zone of influence' (ZOI) is indicated in black outline. The migration route between the mouth of the Nass River and the CU rearing lake outlet is indicated by the blue river line.

4. Location (b): More detailed zoomed map of the CU rearing lake showing general features of the area and the defined 'zone of influence' (ZOI) capturing the drainage area upstream from the rearing lake outlet (black outline).

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CU overview of habitat vulnerabilities & pressures

5. Description of terms. Identification of the GIS-based habitat pressure indicators, habitat pressure 'Impact Categories', and habitat vulnerability indicators developed and used for analyses of lake sockeye CU habitat status.

6. Cumulative habitat pressures (migration corridor). Map of cumulative habitat pressure scores for watersheds located along the CU migration corridor zone of influence[1]. Given the more diffuse nature of potential impacts along the migration route cumulative pressures scores are assigned to migration corridor watersheds based on the sum of the seven individual Impact Category scores for each watershed (rather than through a categorical rule set across Impact Categories)[2]. Within each watershed each Impact Category is scored as 0 (for a green Impact Category), 1 (for an amber Impact Category) or 2 (for a red Impact Category). The cumulative pressure scores for the migration corridor watersheds can therefore range from 0 to 14 and are colour gradated accordingly. Darker shaded watersheds represent areas along the migration corridor where relatively higher risk habitat impacts may be occurring.

7. CU rearing lake pressures overview 'slider'. Area weighted average of all watershed pressure indicator scores for 1:20K FWA assessment watersheds within or intersecting the CU rearing lake's ZOI. The area weighted average score is normalized for each indicator so that the lower to moderate risk threshold (t_1) occurs at 0.33 (s_m) and the moderate to higher risk threshold (t_2) is at 0.66 (s_h) on a scale of 0 to 1[3]. The greyed areas within the figure represent the separation of the individual indicators into the seven Impact Category groupings.

[1] The zone of influence for the migration corridor is defined as the 1:20K FWA assessment watersheds that either directly adjoin the CU's mainstem migration route (from lake outlet to Nass River estuary) or that are located within 1 km of the mainstem route

[2] Note that the scoring approach to risk classifications (green, amber, red) for each Impact Category is based on the same defined indicator roll-up rule set that is used for watersheds within spawning and rearing ZOIs.

[3] Where the average score $\bar{s} < t_1$, the normalized score $\bar{s}_n = \bar{s}(0.33/t_1)$; where $\bar{s} \geq t_1$, $\bar{s}_n = s_m + (s_h - s_m)[(\bar{s} - t_1)/(t_2 - t_1)]$.

8. Cumulative habitat pressures (rearing lakes & tributary spawning). Map of cumulative risk from habitat pressures for each watershed found with the ZOIs for CU rearing lakes and tributary spawning areas[4]. The cumulative risk rating is based on the risk scoring of 7 habitat pressure indicator Impact Categories (hydrologic processes, vegetation quality, surface erosion, fish passage/habitat connectivity, water quantity, human development footprint, and water quality). Categorical roll-up rule set for watersheds in rearing & spawning zones of influence: if ≥ 3 impact categories are rated as higher risk, then the watershed's cumulative risk classification = red (higher risk), else if ≥ 5 Impact Categories are rated as (lower risk) then the watershed's cumulative risk classification = green (lower risk), else the watershed's cumulative risk classification = amber (moderate risk).

9. Integrated vulnerability/habitat pressures – migration, spawning & rearing. Figures representing bivariate indices of the relative rankings across Nass lake sockeye CUs for scored cumulative habitat pressures and scored vulnerability to these pressures within lake sockeye CU ZOIs for migration, spawning and rearing. Methods used for selecting scored CU cumulative habitat pressures and vulnerabilities are different for each life stage evaluated (see Porter et. al. 2016). The larger solid blue circle in each figure represents the ranking of the particular CU relative to the other Nass lake sockeye CUs and identifies its ranked position relative to a coloured gradation representing both increasing cumulative habitat pressure and increasing vulnerability to those pressures.

Migration vulnerability and pressure

Migration period pressure

10. Migration period pressures. Detailed map of the lake sockeye CU migration corridor showing cumulative risk scoring, the location of water licenses occurring within migration corridor ZOI watersheds, as well as the locations of identified FISS and FWA obstructions along the CU migration route.

11. Number of obstructions. Total number of FISS or FWA obstructions identified along the CU migration route. Obstructions can directly impede, delay or even block passage of adult migrating salmon. The figure indicates the total number of identified obstructions along the CU migration route and illustrates the intensity of this pressure (blue bar graph) relative to other lake sockeye CUs within the Nass drainage. Data source: Provincial Obstacles to Fish Passage [updated daily – downloaded Jan 2016].

12. Licensed water allocations. Total number of permitted water licenses (for consumptive and non-consumptive extraction activities) in watersheds within the migration corridor ZOI. Diverting water for human uses can reduce water flow in streams for fish at critical times, potentially hindering/delaying the passage of migrating adult salmon and/or increasing migration stress. The figure indicates the total number of water licenses within the CU migration route ZOI and illustrates the intensity of this pressure (blue bar graph) relative to other lake sockeye CUs within the Nass drainage. Data source: BC POD with Water License Information [updated daily – Downloaded Jan 2016].

Migration period vulnerability

13. Migration distance. Total extent of CU migration, measured as distance between the mouth of the Nass River and most downstream entrance to the CU nursery lake. Longer migrations increase the risk of exposure to various stressors along the migration route. The figure indicates the total migration distance for the CU and shows the degree of this vulnerability (blue bar graph) relative to other lake sockeye CUs within the Nass drainage. Data source: DFO_BC_Sockeye_Lake_CU_V2 [2010], FWA Stream Network [2008].

14. Migration route – summer low flow sensitive (km). The total distance of the CU migration route that is considered prone to experiencing low summer (July-October) water flows with associated potential for higher water temperatures. Low flow conditions experienced over extended distances can impact fish health and can increase encounters with flow related obstacles/delays to adult fish passage. The figure indicates the total migration distance for the CU that is considered to be within a zone of summer low flow sensitivity and illustrates the degree of this vulnerability (blue bar graph) relative to other lake sockeye CUs within the Nass drainage. Data source: BC MOE ecoregional flow sensitivity map [Feb 23 2011].

15. Migration route – summer low flow sensitive (%). The total proportion of the CU migration route that is considered prone to experiencing low summer (July-October) water flows with associated potential for higher water temperatures. Low flow conditions over extended distances can impact fish health and create obstacles/delays to adult fish passage. The figure indicates the total proportion of the CU migration route that is considered to be within a zone of summer low flow sensitivity and illustrates the degree of this vulnerability (blue bar graph) relative to other lake sockeye CUs within the Nass drainage. Data source: BC MOE ecoregional flow sensitivity mapping [Feb 23 2011]

[4] The zone of influence (ZOI) for the CU rearing lake is defined as encompassing all the 1:20K FWA fundamental watersheds located upstream from the lake outlet to the bounding height of land defining the drainage area. The ZOI for a tributary spawning area is defined as the 1:20K FWA assessment watershed in which spawning is occurring and all FSW assessment watersheds upstream of the spawning watershed to the bounding height of land defining the drainage area.

Spawning and rearing vulnerability

Spawning period vulnerability

16. Spawning locations. Map of known spawning reaches and/or spawning sites for lake sockeye (lake, mainstem, and lake inlet/tributary spawning locations) within the defined CU rearing lake ZOI. Data sources: FISS [Jan 2016], local Nass spawning datasets [March 2016].

17. Total spawning length. The total length of all sockeye spawning reaches within the CU rearing lake ZOI (lake, mainstem or tributary spawning). Areas of lake spawning are also included and expressed as a linear length. Any spawning locations indicated only by points was given an estimated average linear length of 100 m (default assumption for project analyses). This compilation reflects the total quantifiable amount of habitat currently identified as being used for spawning by Nass lake sockeye, with a greater length of spawning habitat indicating a lower CU vulnerability to habitat pressures.The figure indicates the total spawning length within the CU rearing lake ZOI and illustrates the degree of this vulnerability (blue bar graph) relative to other lake sockeye CUs within the Nass drainage. Data source: FISS [Jan 2016], local Nass spawning datasets [March 2016].

18. Lakeshore spawning length. The total length of lake shore spawning occurring within the CU rearing lake. Areas of lake shore spawning are expressed as a linear length. This reflects the total amount of lake shore habitat known to be used by Nass lake sockeye, with a greater length of spawning habitat indicating a lower CU vulnerability to habitat pressures.The figure indicates the lakeshore spawning length within the CU rearing lake and illustrates the degree of this vulnerability (blue bar graph) relative to other lake sockeye CUs within the Nass drainage. Data source: FISS [Jan 2016], local Nass spawning datasets [March 2016].

19. Mainstem spawning length. The total length of all mainstem spawning reaches within the CU rearing lake ZOI. This reflects the total amount of mainstem habitat known to be used for spawning by Nass lake sockeye, with a greater length of spawning habitat indicating a lower CU vulnerability to habitat pressures.The figure indicates the length of mainstem spawning within the CU rearing lake ZOI and illustrates the degree of this vulnerability (blue bar graph) relative to other lake sockeye CUs within the Nass drainage. Data source: FISS [Jan 2016], local Nass spawning datasets [March 2016].

20. Tributary/lake inlet spawning length. The total length all trib/lake inlet spawning reaches occurring within the CU rearing lake ZOI. This reflects the total amount of trib/lake inlet habitat known to be used by Nass lake sockeye, with a greater length of spawning habitat indicating a lower CU vulnerability to habitat pressures.The figure indicates the trib/lake inlet spawning length within the CU rearing lake ZOI and illustrates the degree of this vulnerability (blue bar graph) relative to other lake sockeye CUs within the Nass drainage. Data source: FISS [Jan 2016]; local Nass spawning datasets [March 2016].

21. Ratio of lake influenced to total spawning. The total length of spawning reaches that are buffered by lake influence (i.e., lake shore or mainstem spawning) relative to the total length of all spawning reaches within the CU rearing lake ZOI. This reflects the effect of lakes to buffer against upstream habitat impacts, such that lake-influenced spawning areas would be considered relatively less vulnerable to disturbances than tributary/lake inlet spawning areas. The figure indicates the lake influenced ratio within the CU rearing lake ZOI and illustrates the degree of this vulnerability (blue bar graph) relative to other lake sockeye CUs within the Nass drainage. Data source: FISS [Jan 2016], local Nass spawning datasets [March 2016].

22. Salmon accessible habitat. The total length all 1:20K FWA defined stream reaches occurring within the CU rearing lake ZOI that are considered accessible to salmon. This reflects the total amount of stream habitat that could 'potentially' be available to lake sockeye (and other salmon species) for spawning or rearing, with a greater accessible length indicating a lower CU vulnerability to habitat pressures. The figure indicates the accessible habitat length within the CU rearing lake ZOI and illustrates the degree of this vulnerability (blue bar graph) relative to other lake sockeye CUs within the Nass drainage. Data source: BC MOE Fish Habitat model (Version 2) [March 2016]. Note that this project's depiction of accessible salmon habitat is based on a filtering of the province's default fish habitat criteria so that only stream reaches with gradients $\leq$ 10% are retained in the model (i.e. closer match to salmon passage capabilities).

Rearing period vulnerability

23. Area of nursery lakes. Total area of the lake sockeye CU nursery/rearing lake. Larger rearing lakes generally can provide more habitats to support a greater number of juvenile sockeye and should be more resilient to localized habitat impacts. The figure indicates the size of the CU rearing lake and illustrates the degree of this vulnerability (blue bar graph) relative to other lake sockeye CUs within the Nass drainage. Data source: DFO_BC_Sockeye_Lake_CU_V2 [2010].

Spawning and rearing pressure

Hydrologic Processes

24. Forest disturbance. Percentage of disturbed forest (recently logged, selectively logged, and recently burned) in each watershed within the CU rearing lake and spawning areas ZOIs. Forest disturbance can impact salmon habitat through general changes to flow patterns and annual water yields. Defined benchmarks of concern (lower, moderate, higher) for forest disturbance are based on the relative distribution of values across all Nass watersheds. Data source: VRI [updated annually, downloaded Jan 2016], RESULTS [updated daily, downloaded Jan 2016], FTEN [updated daily, downloaded Jan 2016].

25. Equivalent Clear-cut Area (ECA). The percentage of each watershed in the CU rearing lake and spawning areas ZOIs that is considered functionally/hydrologically equivalent to a clear-cut. ECA is a calculated term that reflects the potential cumulative impact on fish habitats of harvesting and second-growth forest regeneration effects on peak flow. Defined benchmarks of concern (lower, moderate, higher) for ECA are science and expert based (MOF 2001; Smith and Redding 2012). Data source: VRI [updated annually, downloaded Jan 2016], RESULTS [updated daily, downloaded Jan 2016], FTEN [updated daily, downloaded Jan 2016], LCC2000-V [2000].

Vegetation Quality

26. Insect & disease defoliation. Percentage of the forest stands in each watershed within the CU rearing lake and spawning areas ZOIs that has been defoliated by recent insect invasion or disease. Defoliation can impact salmon habitats through changes to flows and groundwater supplies from altered precipitation interception and reduced transpiration. Defined benchmarks of concern (lower, moderate, higher) for insect and disease defoliation are based on the relative distribution of values across all Nass watersheds. Data source: VRI [updated annually, downloaded Jan 2016].

27. Riparian disturbance. Percentage of the riparian zone (defined by a 30m buffer around all water bodies) in each watershed within the CU rearing lake and spawning areas ZOIs that has been altered by land use activities. Disturbance to the riparian zone can alter stream shading, water temperature, organic matter inputs and bank stability. Defined benchmarks of concern (lower, moderate, higher) for riparian disturbance are science and expert based (Stalberg et al. 2009, Tripp and Bird (2004). Data source: VRI [updated annually, downloaded Jan 2016].

Surface Erosion

28. Road development. The density of all roads in each watershed within the CU rearing lake and spawning areas ZOIs. Extensive road development can interrupt overland flow and increase fine sediment generation, impacting downstream spawning and rearing habitats. Defined benchmarks of concern (lower, moderate, higher) for road density are science and expert based (MOF 1995a &b, Stalberg et al. 2009 & Robertson et al. 2012). Data source: DRA [updated monthly, downloaded Jan 2016], FTEN [updated daily, downloaded Jan 2016].

Water Quantity

29. Water licenses. The total number of permitted water licenses (all types) for points of diversion in each watershed within the CU rearing lake and spawning areas ZOIs. Diverted water can potentially reduce flows in streams, thereby limiting fish access to or use of habitats and/or changing hydrological processes. The defined benchmark of concern (lower & higher) for water licenses is a binary measure based simply on presence/absence of the pressure in the watershed. Data source: BC Points of Diversion with Water License Information [updated daily, downloaded Jan 2016].

Water Quality

30. Permitted wastewater discharges. Total number of permitted wastewater discharge sites in each watershed within the CU rearing lake and spawning areas ZOIs. High levels of wastewater discharge have the potential to impact water quality through excessive nutrient enrichment or chemical contamination. The defined benchmark of concern (lower & higher) for wastewater discharge sites is a binary measure based simply on presence/absence of the pressure in the watershed. Data source: MOE Wastewater Discharge and Permits database [updated regularly, downloaded Jan 2016].

Fish Passage/Habitat Connectivity

31. Stream crossing density. Number of crossings per km of defined fish habitat in each watershed within the CU rearing lake and spawning areas ZOIs. Obstructions at stream crossings can impact salmon habitat conditions and hinder migration of fish or block access to useable habitats. Defined benchmarks of concern (lower, moderate, higher) for stream crossing density are based on the relative distribution of

values across all Nass watersheds. Data source: BC MOE Fish Habitat model (Version 2) [Jan 2016], FWA Stream Network [2008], DRA [updated monthly, downloaded Dec 2016].

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Human Development Footprint

32. Total land cover alteration. Land alteration (agriculture, residential/agriculture mix, recently burned, recently logged, selectively logged, mining, recreation, and urban) as a percentage of watershed area for each watershed within the CU rearing lake and spawning areas ZOIs. Land cover alteration reflects a suite of potential changes to hydrological processes and sediment generation, with potential downstream impacts on spawning and rearing habitats. Defined benchmarks of concern (lower, moderate, higher) for land cover alteration are based on the relative distribution of values across all Nass watersheds. Data source: LCC2000-V [2000], VRI [updated annually, downloaded Jan 2016], DRA [updated monthly, downloaded Jan 2016], FTEN [updated daily, downloaded Jan 2016], RESULTS [updated daily, downloaded Jan 2016], NTS [1998], Crown Tenure [updated daily, downloaded Jan 2016], Current Fire Perimeters [updated daily, downloaded Jan 2016], Historical Fire Perimeters [updated monthly, downloaded Jan 2016], BTM [1992].

33. Impervious surfaces. Percentage of each watershed within the CU rearing lake and spawning areas ZOIs that is considered impervious: a calculated term that reflects the area covered by hard man-made surfaces (e.g. asphalt, concrete, brick, etc.). Extensive impervious surfaces from urban/rural development in a watershed can impact rainwaters infiltration and groundwater recharge, and lead to stream habitat degradation through changes in geomorphology and hydrology. Impervious surfaces are also associated with increased loading of nutrients and contaminants in developed areas. Defined benchmarks of concern for impervious surfaces (lower, moderate, higher) are science and expert based (Paul and Meyer 2000; Smith 2005). Note that impervious surface co-efficients (ISC) for land surface types used for this exercise were not Nass drainage specific but were instead generalized from those used in other jurisdictions. Data source: LCC2000-V [2000], VRI [updated annually, downloaded Jan 2016], DRA [updated monthly, downloaded Jan 2016], FTEN [updated daily, downloaded Jan 2016], NTS [1998].

34. Linear development. Density of all linear construction (e.g. roads, utility corridors, pipelines, right of ways, railways, etc.) in each watershed within the CU rearing lake and spawning areas ZOIs. Linear development is a general indicator of potential human impacts on fish habitats. Defined benchmarks of concern (lower, moderate, higher) for linear development are based on the relative distribution of values across all Nass watersheds. Data source: DRA [updated monthly, accessed Jan 2016], FTEN [updated daily, access Jan 2016], NTS [NRCAN, accessed Jan 2016], Pipelines [NRCAN, Jan 2016], Electrical Transmission Lines [All data, with the exception of BC Hydro circuit 2L102 (Northwest Transmission Line), created by NRCAN, accessed March, 2016. 2L102 data provided by BC Hydro. 2L102 was digitized from the project schematic PDF map downloaded March 16, 2016 from https://www.bchydro.com/energy-in-bc/projects/ntl.html.]

35. Mining development. Total number of mines in each watershed within the CU rearing lake and spawning areas ZOIs. The general footprint of a mine and its associated processes of mining can change geomorphology and the hydrological processes of nearby water bodies. Mining can also generate deposition of fine sediments which can affect salmon survival and prey densities. The defined benchmark of concern (lower & higher) for mines is a binary measure based simply on presence/absence of the pressure in the watershed. Data source: BCGOV MEM & PR databases [updated regularly, accessed Jan 2016].

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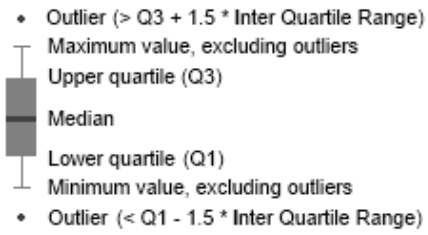
Proposed resource development projects

36. Nass overview map of the locations of proposed new resource developments within the Nass drainage (across a range of activities). Data source: Data source: MEM & PR database [March 2016], LMB Water License Points of Diversion (proposed) [March 2016], Timber Harvesting Land Base (THLB) layer [provided by Don Morgan, MOE, Feb 2016].

37. Nass summary of resource development projects. The total number or extent of proposed future resource development projects (mines, water licenses, power tenures, forestry, pipelines, transmission lines) within the Nass drainage. Data source: MEM & PR database [March 2016], LMB Water License Points of Diversion (proposed) [March 2016], Timber Harvesting Land Base (THLB) layer [provided by Don Morgan, MOE, Feb 2016], DataBC [Proposed Prince Rupert Gas Transmission Line Feb 2016], BC EAO [Proposed West Coast Connector Gas Transmission Line – digitized from project page].

Additional notes

Key to interpreting pressure indicator box plots:



Data deficient areas. Mapped areas delineated as "data deficient" are those that have incomplete coverage for the core VRI or LCC2000 GIS data used for generation of some habitat indicators. These areas are mapped explicitly to identify any watersheds that have some level of relative uncertainty around a particular habitat indicator value. These areas however have been supplemented (i.e., patched) with GIS data from alternate sources, sometimes at a coarser resolution, to allow indicator generation/scoring or else are areas lacking only minor elements of a larger suite of data components with limited influence on the final derived habitat indicator values.

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CU Habitat Report Card Summaries

These Conservation Unit (CU) habitat report cards are intended to allow assessment and comparison of CU habitat 'status' based on a combination of (1) intrinsic vulnerability of CU freshwater habitats, and (2) intensity and extent of human pressures/stressors on those habitats. A full description of indicators and data sources used for Nass salmon CUs can be found in the main report: *Cumulative Pressures on Nass Salmon Habitat: Technical Report* (Porter et al. 2016) available from PSF at: www.skeenasalmonprogram.ca.

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1. Introduction and Definitions. Brief description of the CU reporting exercise undertaken to assess salmon CU habitats and definitions for key terms that are used throughout the reporting.

2. Narrative. Short bulleted descriptions of key issues affecting the particular salmon species in the Nass drainage and concerns that might relate to a particular CU. This includes the principal habitat pressures on CU habitats as determined from the broad-scale analyses undertaken here, as well as more localized habitat impacts affecting the CU as identified by Nass regional experts.

3. Location. Map showing (i) the location of the CU boundary currently designated by DFO, (ii) spawning[1] and rearing/migration[2] zones of influence (ZOIs), as defined within this project for the Nass drainage, and (iii) the location of the Nass drainage[3] within BC. DFO's delineated CU boundary is indicated by the dark black outline, the CU spawning ZOI is indicated by yellow shading, and the CU rearing/migration ZOI is indicated by grey shading (the spawning ZOI is nested within the rearing/migration ZOI such that yellow shaded areas of the map belong to both ZOIs). Note that egg incubation occurs in the same locations as spawning (although at a different time of year); therefore, habitat within the spawning ZOI is relevant to both spawning and incubation life stages although for brevity this is labeled simply as "spawning ZOI" throughout.

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CU overview of habitat vulnerabilities & pressures

4. Description of terms. Identification of the GIS-based habitat pressure indicators, habitat pressure 'Impact Categories', and habitat vulnerability indicators developed and used for analyses of salmon CU habitat status for rearing/migration, spawning, and incubation life stages.

5. Cumulative pressure—rearing/migration. Map showing the location within the Nass drainage of the CU rearing/migration ZOI and the cumulative habitat pressure scores for watersheds located within this zone. Given the more diffuse nature of potential impacts affecting migrating salmon, the cumulative pressures scores are assigned to rearing/migration watersheds based on the sum of the seven individual Impact Category scores for each watershed (rather than through a lower, moderate, higher risk categorical rule set across Impact Categories)[4]. Within each watershed, each Impact Category is scored as 0 (for a lower risk Impact Category), 1 (for a moderate risk Impact Category), or 2 (for a higher risk Impact Category). The cumulative pressure scores for the migration corridor watersheds can therefore range from 0 to 14 and are colour-gradated accordingly. Darker shaded watersheds represent areas within the rearing/migration corridor where

[1] The spawning zone of influence (ZOI) for each CU is defined as the 1:20K FWA assessment watersheds within DFO-delineated CU boundaries that overlap or intersect with the species-identified spawning reaches.
[2] The rearing/migration ZOI for each CU is defined as all 1:20K FWA assessment watersheds within the Nass subdrainages (as delineated within the province's major watershed GIS layer) in which CU-specific spawning has been identified, plus the subdrainages along the required route from the CU spawning areas downstream through the Lower Nass subdrainage to the Nass estuary. For these salmon species, it has not been possible to identify the multiple potential localized migration routes and specific rearing areas, or to differentiate migration vs. rearing life-stage-specific differences in habitat use; consequently the CU rearing/migration life stages have been merged into a single combined and broadly-defined ZOI for habitat risk analyses. Note that for purposes of refining analyses for this project the Nass watershed, as originally delineated within the province's major watershed GIS layer, has been split into three zones (upper, middle and lower Nass).
[3] Note that for the Nass-Skeena Estuary Pink (even) CU the spatial boundary includes both the Nass and Skeena drainage
[4] Note that the scoring approach to risk classifications (green, amber, red) for each Impact Category is based on the same defined indicator roll-up rule set that is used for watersheds within spawning ZOIs.

relatively higher risk habitat impacts may be occurring.

6. Summary of pressure indicators—spawning. Area-weighted average of all watershed pressure indicator scores for 1:20K FWA (Freshwater Atlas) assessment watersheds within or intersecting the CU spawning ZOI. The area-weighted average score is normalized for each indicator so that the lower to moderate risk threshold (t_1) occurs at 0.33 (s_m) and the moderate to higher risk threshold (t_2) is at 0.66 (s_h) on a scale of 0 to 1[5]. The greyed areas within the figure represent the separation of the individual indicators into the seven Impact Category groupings.

7. Cumulative pressure—spawning. Map of cumulative risk from habitat pressures for each watershed found within the CU spawning ZOI. The cumulative risk rating is based on the risk scoring of seven habitat pressure indicator Impact Categories (hydrologic processes, vegetation quality, surface erosion, fish passage/habitat connectivity, water quantity, human development footprint, and water quality). Categorical roll-up rule set for watersheds in rearing & spawning zones of influence: if ≥ 3 impact categories are rated as higher risk, then the watershed's cumulative risk classification = red (higher risk), else if ≥ 5 Impact Categories are rated as lower risk then the watershed's cumulative risk classification = green (lower risk), else the watershed's cumulative risk classification = amber (moderate risk).

8. Integrated vulnerability/habitat pressures—rearing/migration, spawning, & incubation. Figures representing bivariate indices of the relative rankings across salmon CUs for scored cumulative habitat pressures and scored vulnerability to these pressures within CU ZOIs for rearing/migration, spawning, and incubation. Methods used for selecting scored CU cumulative habitat pressures and vulnerabilities are different for each life stage evaluated (see Porter et al. 2016). The larger solid blue circle in each figure represents the ranking of the particular CU relative to the other Nass CUs for that species, and identifies its ranked position relative to a coloured gradation representing both increasing cumulative habitat pressure and increasing vulnerability to those pressures.

Rearing/Migration vulnerability & pressures

Rearing/Migration period pressure

9. Rearing/Migration period pressures. Large-scale map of the identified CU rearing/migration areas showing cumulative rearing/migration risk scoring for watersheds within the CU's rearing/migration ZOI and more detail on the location of the ZOI within the Nass drainage.

Rearing/Migration period vulnerability

10. Salmon accessible habitat (km). The total length all 1:20K FWA-defined stream reaches occurring within the CU rearing/migration ZOI that are considered accessible to salmon. This reflects the total amount of stream habitat that could 'potentially' be available to salmon for spawning or rearing, with a greater accessible length indicating a lower CU vulnerability to habitat pressures. The figure indicates the accessible habitat length within the CU rearing/migration ZOI and illustrates the degree of this vulnerability (blue bar graph or blue dotted line, dependent on presentation format used for the species) relative to other CUs for the species within the Nass drainage. Data source: BC MOE Fish Habitat model (Version 2) [March 2016]. Note that this project's depiction of accessible salmon habitat is based on a filtering of the province's default fish habitat criteria so that only stream reaches with gradients ≤ 10% are retained in the model (i.e. closer match to salmon passage capabilities).

11. Flow sensitive accessible habitat (km) (all seasons). The total length of accessible streams within the CU rearing/migration ZOI that is considered prone to experiencing low water flows (in either summer, winter, or both seasons), with associated potential for altered water temperatures. Low flow conditions experienced over extended distances can impact fish health and can increase encounters with flow-related obstacles/delays to adult fish passage etc. The figure indicates the total stream length for the CU that is considered to be within zones of low flow sensitivity and illustrates the degree of this vulnerability (blue bar graph or blue dotted line, dependent on presentation format used for the species) relative to other CUs for the species within the Nass drainage. Data source: BC MOE ecoregional flow sensitivity map [Feb 23, 2011], BC MOE Fish Habitat model (Version 2) [March 2016].

12. Flow sensitive accessible habitat (%) (all seasons). The total proportion of the accessible stream length within the CU rearing/migration ZOI that is considered prone to experiencing low water flows (in summer, winter, or both seasons), with associated potential for altered water temperatures. Low flow conditions over extended distances can impact fish health and create obstacles/delays to adult fish passage, etc. The figure indicates the total proportion of the CU migration route that is considered to be within zones of low flow sensitivity (all seasons) and illustrates the degree of this vulnerability (blue bar graph or blue dotted line, dependent on presentation format used for the species) relative to other CUs for the species within the Nass drainage. Data source: BC MOE ecoregional flow sensitivity mapping [Feb 23, 2011], BC MOE Fish Habitat model (Version 2) [March 2016].

[5] Where the average score $\bar{s} < t_1$, the normalized score $\bar{s}_n = \bar{s}(0.33/t_1)$; where $\bar{s} \geq t_1$, $\bar{s}_n = s_m + (s_h - s_m)[(\bar{s} - t_1)/(t_2 - t_1)]$.

13. Coho CUs ONLY: Lake area (km^2). The total area of lakes present within the CU rearing/migration ZOI. Lakes can provide rearing areas and overwintering refugia for juvenile coho and buffer against impacts, with a smaller area of lakes indicating a potentially greater CU vulnerability to habitat pressures. The figure indicates the total lake area within the CU rearing/migration ZOI and illustrates the degree of this vulnerability (blue dotted line) relative to other coho CUs within the Nass drainage. Data source: FWA Lakes [2008].

14. Coho CUs ONLY: Wetland area (km^2). The total area of wetlands present within the CU rearing/migration ZOI. Wetlands can provide rearing areas and overwintering refugia for juvenile coho and buffer against impacts, with a smaller area of wetlands indicating a potentially greater CU vulnerability to habitat pressures. The figure indicates the total wetland area within the CU rearing/migration ZOI and illustrates the degree of this vulnerability (blue dotted line) relative to other coho CUs within the Nass drainage. Data source: FWA Lakes [2008].

Spawning & incubation vulnerability

Spawning period vulnerability

15. Spawning locations. Map of known spawning reaches and/or spawning sites within the CU as well as the project's defined spawning ZOI. Data source: FISS [Jan 2016], local Nass spawning datasets [March 2016].

16. Total spawning length (km). The total length of all spawning reaches within the CU, with a greater length of spawning habitat indicating a lower CU vulnerability to habitat pressures. Any spawning locations indicated only by points was given an estimated average linear length of 100 m (default assumption for project analyses). The figure indicates the total spawning length within the CU and illustrates the degree of this vulnerability (blue bar graph or blue dotted line, dependent on presentation format used for the species) relative to other CUs for the species within the Nass drainage. Data source: FISS [Jan 2016], local Nass spawning datasets [March 2016].

17. Spawning reaches summer flow sensitive – spawn timing (km). The total length of spawning reaches for the CU that occurs within areas considered to be summer (July-October) low flow sensitive (i.e. during the period of primary spawning activity), with a greater length of summer low flow sensitive habitat indicating a higher CU vulnerability to habitat pressures. The figure indicates the total length of reaches used by the CU for spawning that are considered summer low flow sensitive and illustrates the degree of this vulnerability (blue bar graph or blue dotted line, dependent on presentation format used for the species) relative to other CUs for the species within the Nass drainage. Data source: FISS [Jan 2016], local Nass spawning datasets [March 2016], BC MOE ecoregional flow sensitivity map [Feb 23, 2011].

18. Spawning reaches summer flow sensitive – spawn timing (%). The total proportion of spawning reaches for the CU that occurs within areas considered to be summer (July-October) low flow sensitive (i.e. during the period of primary spawning activity), with a greater proportion of summer low flow sensitive habitat indicating a higher CU vulnerability to habitat pressures. The figure indicates the total percentage of reaches used by the CU for spawning that are considered summer low flow sensitive and illustrates the degree of this vulnerability (blue bar graph or blue dotted line, dependent on presentation format used for the species) relative to other CUs for the species within the Nass drainage. Data source: FISS [Jan 2016], local Nass spawning datasets [March 2016], BC MOE ecoregional flow sensitivity map [Feb 23, 2011].

Incubation period vulnerability

19. Spawning reaches winter flow sensitive – incubation timing (km). The total length of spawning reaches for the CU that occurs within areas considered to be winter (November-March) low flow sensitive (i.e. during the primary period of egg incubation), with a greater length of winter low flow sensitive habitat indicating a higher CU vulnerability to habitat pressures. The figure indicates the total length of reaches used by the CU for spawning that are considered to be winter low flow sensitive and illustrates the degree of this vulnerability (blue bar graph or blue dotted line, dependent on presentation format used for the species) relative to other CUs for the species within the Nass drainage. Data source: FISS [Jan 2016], local Nass spawning datasets [March 2016], BC MOE ecoregional flow sensitivity map [Feb 23, 2011].

20. Spawning reaches winter flow sensitive – incubation timing (%). The total proportion of spawning reaches for the CU that occurs within areas considered to be winter (November-March) low flow sensitive (i.e. during the primary period of egg incubation), with a greater proportion of winter low flow sensitive habitat indicating a higher CU vulnerability to habitat pressures. The figure indicates the total percentage of reaches used by the CU for spawning that are considered to be winter low flow sensitive and illustrates the degree of this vulnerability (blue bar graph or blue dotted line, dependent on presentation format used for the species) relative to other CUs for the species within the Nass drainage. Data source: FISS [Jan 2016], local Nass spawning datasets [March 2016], BC MOE ecoregional flow sensitivity map [Feb 23, 2011].

Spawning pressure[6]

Hydrologic Processes

21. Forest disturbance. Percentage of disturbed forest (recently logged, selectively logged, and recently burned) in each watershed within the CU spawning ZOI. Forest disturbance can impact salmon habitat through general changes to flow patterns and annual water yields. Defined benchmarks of concern (lower, moderate, higher) for forest disturbance are based on the relative distribution of values across all Nass watersheds. Data source: VRI [updated annually, downloaded Jan2016], RESULTS [updated daily, downloaded Jan 2016], FTEN [updated daily, downloaded Jan 2016].

22. Equivalent Clear-cut Area (ECA). The percentage of each watershed in the CU spawning ZOI that is considered functionally/hydrologically equivalent to a clear-cut. ECA is a calculated term that reflects the potential cumulative impact on fish habitats of harvesting and second-growth forest regeneration effects on peak flow. Defined benchmarks of concern (lower, moderate, higher) for ECA are science- and expert-based (MOF 2001; Smith and Redding 2012). Data source: VRI [updated annually, downloaded Jan 2016], RESULTS [updated daily, downloaded Jan 2016], FTEN [updated daily, downloaded Jan 2016], LCC2000-V [2000].

Vegetation Quality

23. Insect and disease defoliation. Percentage of the forest stands in each watershed within the CU spawning ZOI that has been defoliated by recent insect invasion or disease. Defoliation can impact salmon habitats through changes to flows and groundwater supplies from altered precipitation interception and reduced transpiration. Defined benchmarks of concern (lower, moderate, higher) for insect and disease defoliation are based on the relative distribution of values across all Nass watersheds. Data source: VRI [updated annually, downloaded Jan 2016].

24. Riparian disturbance. Percentage of the riparian zone (defined by a 30m buffer around all water bodies) in each watershed within the CU spawning ZOI that has been altered by land use activities. Disturbance to the riparian zone can alter stream shading, water temperature, organic matter inputs, and bank stability. Defined benchmarks of concern (lower, moderate, higher) for riparian disturbance are science- and expert-based (Stalberg et al. 2009, Tripp and Bird 2004). Data source: VRI [updated annually, downloaded Jan 2016].

Surface Erosion

25. Road development. The density of all roads in each watershed within the CU spawning ZOI. Extensive road development can interrupt overland flow and increase fine sediment generation, impacting downstream spawning and rearing habitats. Defined benchmarks of concern (lower, moderate, higher) for road density are science- and expert-based (MOF 1995a & b, Stalberg et al. 2009, Robertson et al. 2012). Data source: DRA [updated monthly, downloaded Jan 2016], FTEN [updated daily, downloaded Jan 2016].

Water Quantity

26. Number of water licenses. The total number of permitted water licenses (all types) for points of diversion in each watershed within the CU spawning ZOI. Diverted water can potentially reduce flows in streams, thereby limiting fish access to or use of habitats and/or changing hydrological processes. The defined benchmark of concern (lower & higher) for water licenses is a binary measure based simply on presence/absence of the pressure in the watershed. Data source: BC Points of Diversion with Water License Information [updated daily, downloaded Jan 2016].

Water Quality

27. Permitted waste water discharges. Total number of permitted waste water discharge sites in each watershed within the CU spawning ZOI. High levels of waste water discharge have the potential to impact water quality through excessive nutrient enrichment or chemical contamination. The defined benchmark of concern (lower & higher) for waste water discharge sites is a binary measure based simply on presence/absence of the pressure in the watershed. Data source: MOE Wastewater Discharge and Permits database [updated regularly, downloaded Jan 2016].

[6] Note that for the Nass-Skeena Estuary Pink (even) CU the pressure indicator risk benchmarks used are different than for the other Nass CUs, as they employ benchmarks developed earlier for Skeena drainage watersheds (Porter et al. 2014). For the analysis of this particular Pink CU these Skeena risk benchmarks are applied to both Skeena and Nass watersheds that fall within the CU`s defined (multi-drainage) spatial boundary.

Fish Passage/Habitat Connectivity

28. Stream crossing density. Number of crossings per km of defined salmon habitat in each watershed within the CU spawning ZOI. Obstructions at stream crossings can impact salmon habitat conditions and hinder migration of salmon or block access to useable habitats. Defined benchmarks of concern (lower, moderate, higher) for stream crossing density are based on the relative distribution of values across all Nass watersheds. Data source: BC MOE Fish Habitat model (Version 2) [Jan 2016], FWA Stream Network [2008], DRA [updated monthly, downloaded Jan 2016].

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Human Development Footprint

29. Total land cover alteration. Land alteration (agriculture, residential/agriculture mix, recently burned, recently logged, selectively logged, mining, recreation, and urban) as a percentage of watershed area for each watershed within the CU spawning ZOI. Land cover alteration reflects a suite of potential changes to hydrological processes and sediment generation, with potential downstream impacts on spawning and rearing habitats. Defined benchmarks of concern (lower, moderate, higher) for land cover alteration are based on the relative distribution of values across all Nass watersheds. Data source: LCC2000-V [2000], VRI [updated annually, downloaded Dec 2012], DRA [updated monthly, downloaded Dec 2012], FTEN [updated daily, downloaded Dec 2012], RESULTS [updated daily, downloaded Dec 2012], NTS [1998], Crown Tenure [updated daily, downloaded Dec 2012], Current Fire Perimeters [updated daily, downloaded Dec 2012], Historical Fire Perimeters [updated monthly, downloaded Dec 2012], BTM [1992].

30. Impervious surfaces. Percentage of each watershed within the CU spawning ZOI that is considered impervious: a calculated term that reflects the area covered by hard man-made surfaces (e.g. asphalt, concrete, brick, etc.). Extensive impervious surfaces from urban/rural development in a watershed can impact rainwater infiltration and groundwater recharge, and lead to stream habitat degradation through changes in geomorphology and hydrology. Impervious surfaces are also associated with increased loading of nutrients and contaminants in developed areas. Defined benchmarks of concern for impervious surfaces (lower, moderate, higher) are science- and expert-based (Paul and Meyer 2000; Smith 2005). Note that impervious surface coefficients (ISC) for land surface types used for this exercise were not Nass-drainage-specific but were instead generalized from those used in other jurisdictions. Data source: LCC2000-V [2000], VRI [updated annually, downloaded Dec 2012], DRA [updated monthly, downloaded Dec 2012], FTEN [updated daily, downloaded Dec 2012], NTS [1998].

31. Linear development. Density of all linear construction (e.g. roads, utility corridors, pipelines, right of ways, railways, etc.) in each watershed within the CU spawning ZOI. Linear development is a general indicator of potential human impacts on fish habitats. Defined benchmarks of concern (lower, moderate, higher) for linear development are based on the relative distribution of values across all Nass watersheds. Data source: DRA [updated monthly, downloaded Dec 2012], FTEN [updated daily, downloaded Dec 2012], NTS [1998].

32. Mining development. Total number of mines in each watershed within the CU spawning ZOI. The general footprint of a mine and its associated processes of mining can change geomorphology and the hydrological processes of nearby water bodies. Mining can also generate deposition of fine sediments which can affect salmon survival and prey densities. The defined benchmark of concern (lower & higher) for mines is a binary measure based simply on presence/absence of the pressure in the watershed. Data source: BCGOV MEM & PR databases [updated regularly, accessed Jan 2012].

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Future pressure

Proposed resource development projects

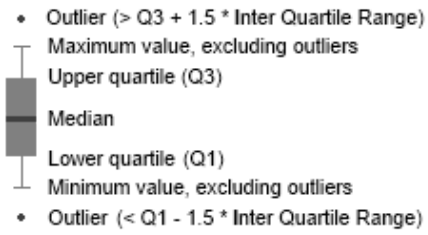
33. Nass overview map[7] of the locations of proposed new resource developments within the Nass drainage (across a range of activities). Data source: Data source: MEM & PR database [March 2016], LMB Water License Points of Diversion (proposed) [March 2016], Timber Harvesting Land Base (THLB) layer [provided by Don Morgan, MOE, Feb 2016].

34. Nass summary of resource development projects. The total number or extent of proposed future resource development projects (mines, water licenses, power tenures, forestry, pipelines, transmission lines) within the Nass drainage. Data source: MEM & PR database [March 2016], LMB Water License Points of Diversion (proposed) [March 2016], Timber Harvesting Land Base (THLB) layer [provided by Don Morgan, MOE, Feb 2016], DataBC [Proposed Prince Rupert Gas Transmission Line Feb 2016], BC EAO [Proposed West Coast Connector Gas Transmission Line – digitized from project page].

[7] Note that for the Nass-Skeena Estuary Pink (even) CU the overview map of proposed developments includes both the Nass and Skeena drainages as this CU is multi-drainage in extent.

Additional notes

Key to interpreting pressure indicator box plots:



Data deficient areas. Mapped areas delineated as "data deficient" are those that have incomplete coverage for the core VRI or LCC2000 GIS data used for generation of some habitat indicators. These areas are mapped explicitly to identify any watersheds that have some level of relative uncertainty around a particular habitat indicator value. These areas have either been supplemented (i.e., patched) with GIS data from alternate sources, sometimes at a coarser resolution, to allow indicator generation/scoring, or else are areas lacking only minor elements of a larger suite of data components with limited influence on the final derived habitat indicator values.

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More Information

For more information about this project, please see the full technical report:

Porter, M., M. Leslie-Gottschligg, K. Bryan, S. Chen, S. Casley, K. Connors, E. Jones, and L. Honka. 2016. *The Nass Area: Cumulative Pressures on Salmon Habitat (technical report)*. Pacific Salmon Foundation, Vancouver, BC.