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Reducing Uncertainties in Managing in British Columbia Waters: Applying an Adaptive Management Mindset on the South, Central and North Coasts

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Reducing Uncertainties in Managing British Columbia Waters:

Applying an Adaptive Management Mindset

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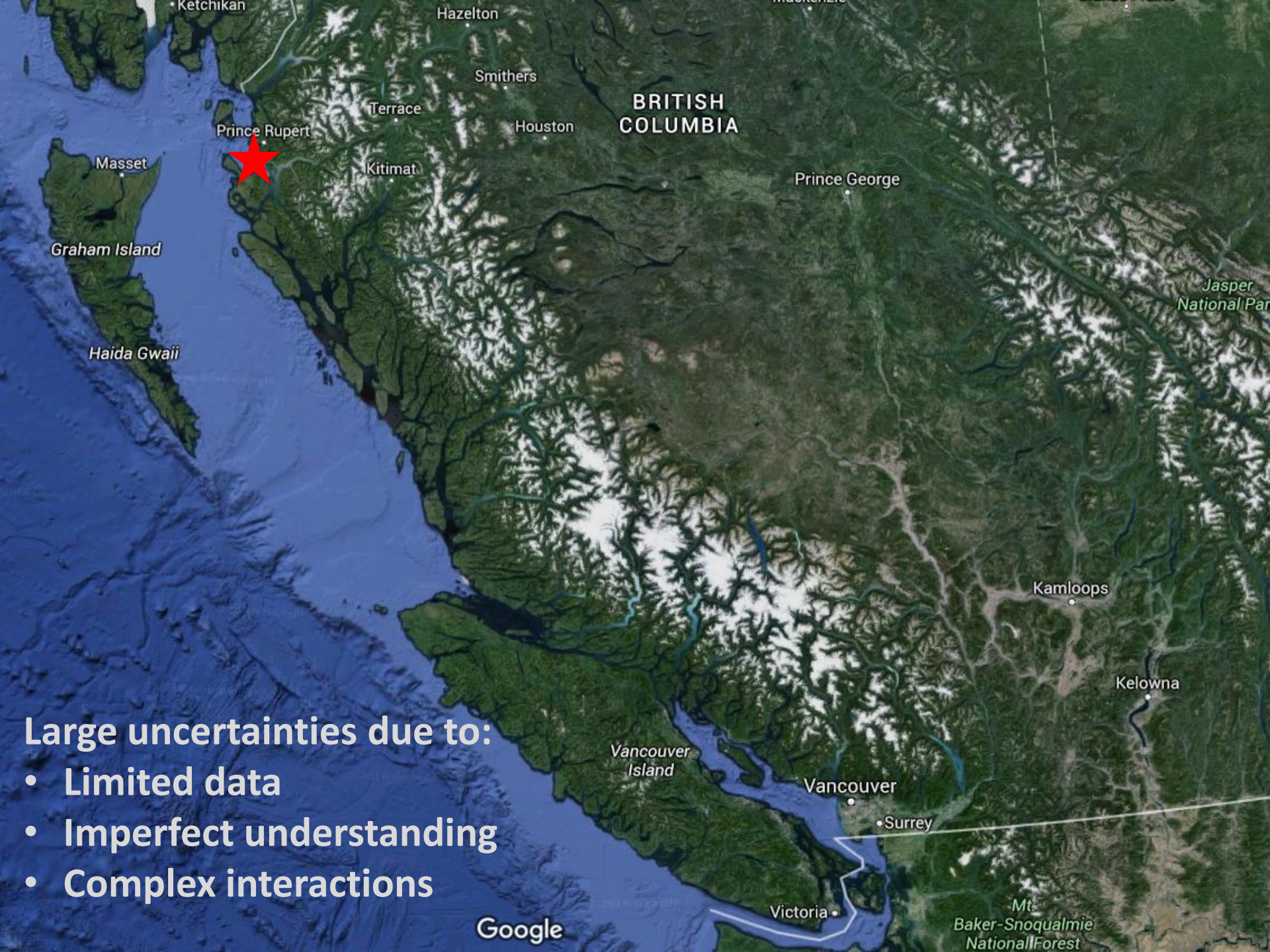
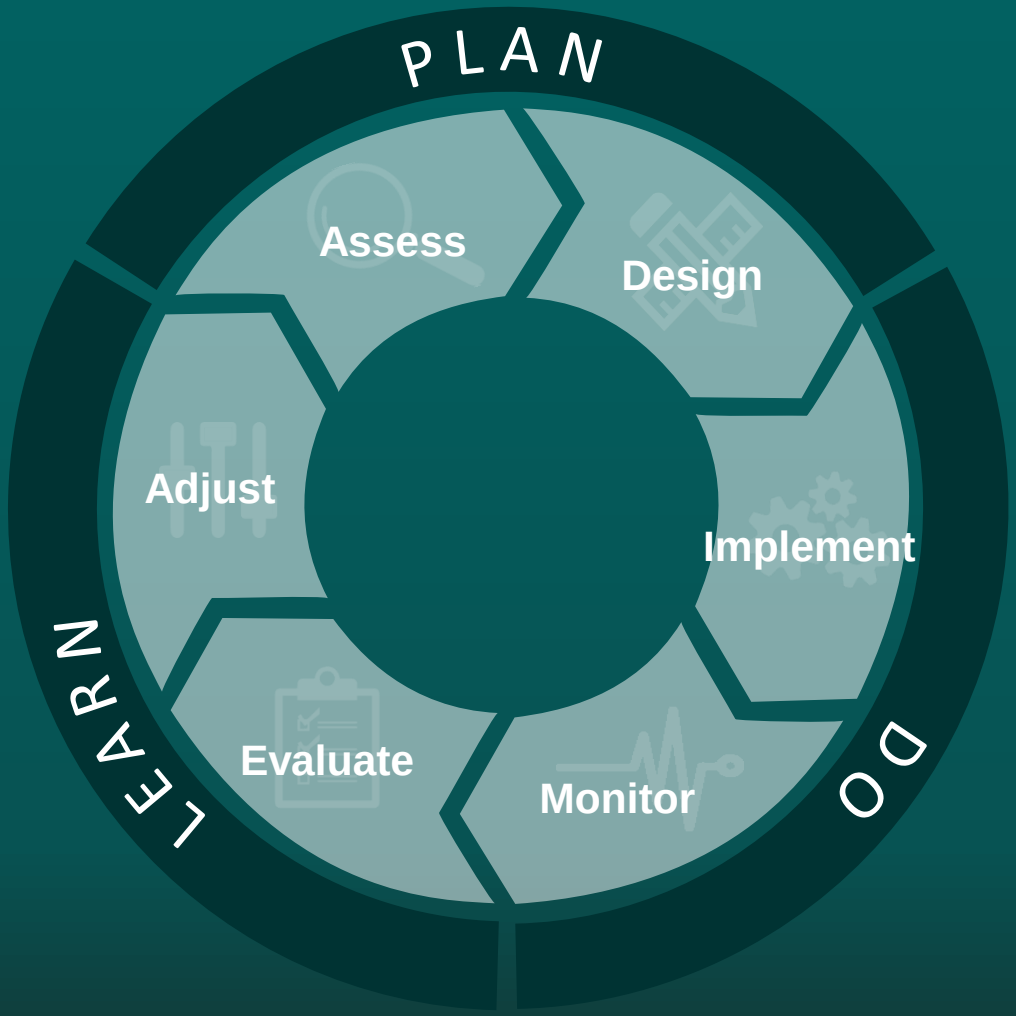


Large uncertainties due to:

- **Limited data**
- **Imperfect understanding**
- **Complex interactions**

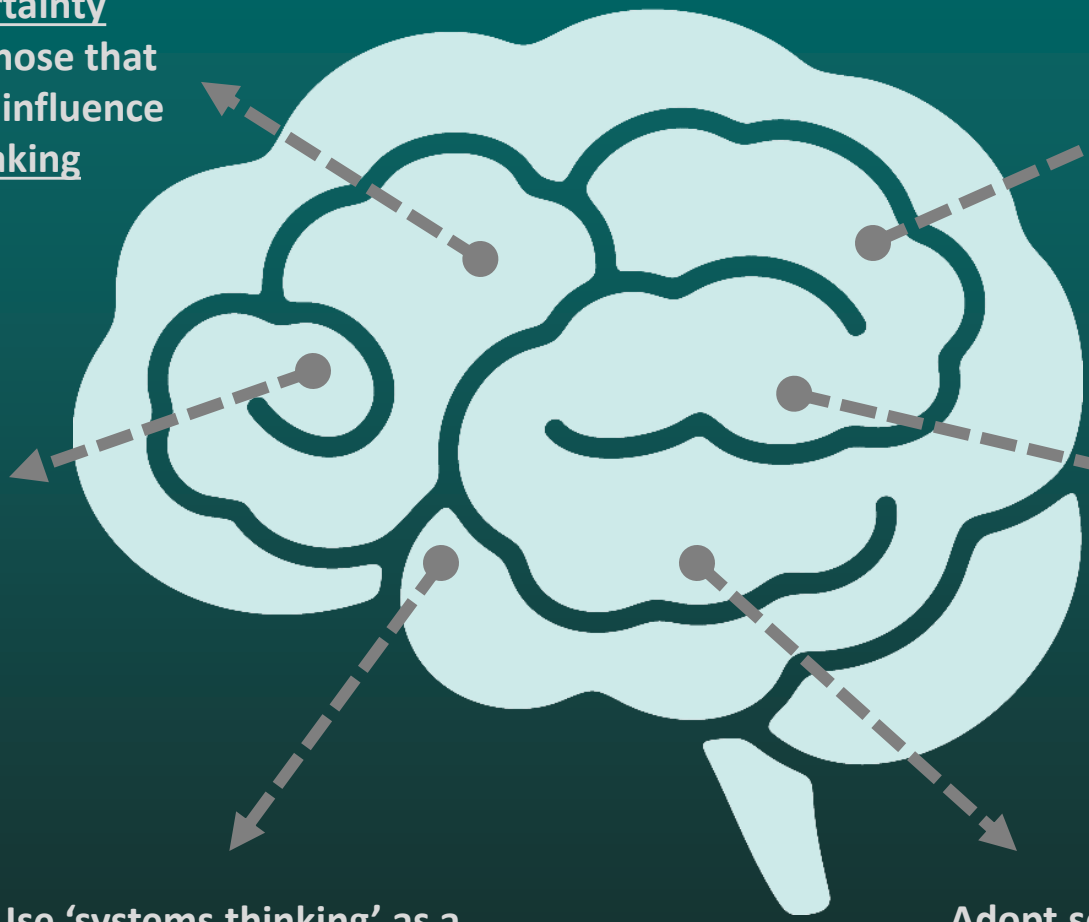
Adaptive Management (AM) Cycle



People with an AM Mindset…

Embrace uncertainty and focus on those that have the most influence on decision making

Encourage diverse and collaborative processes for resolving uncertainties

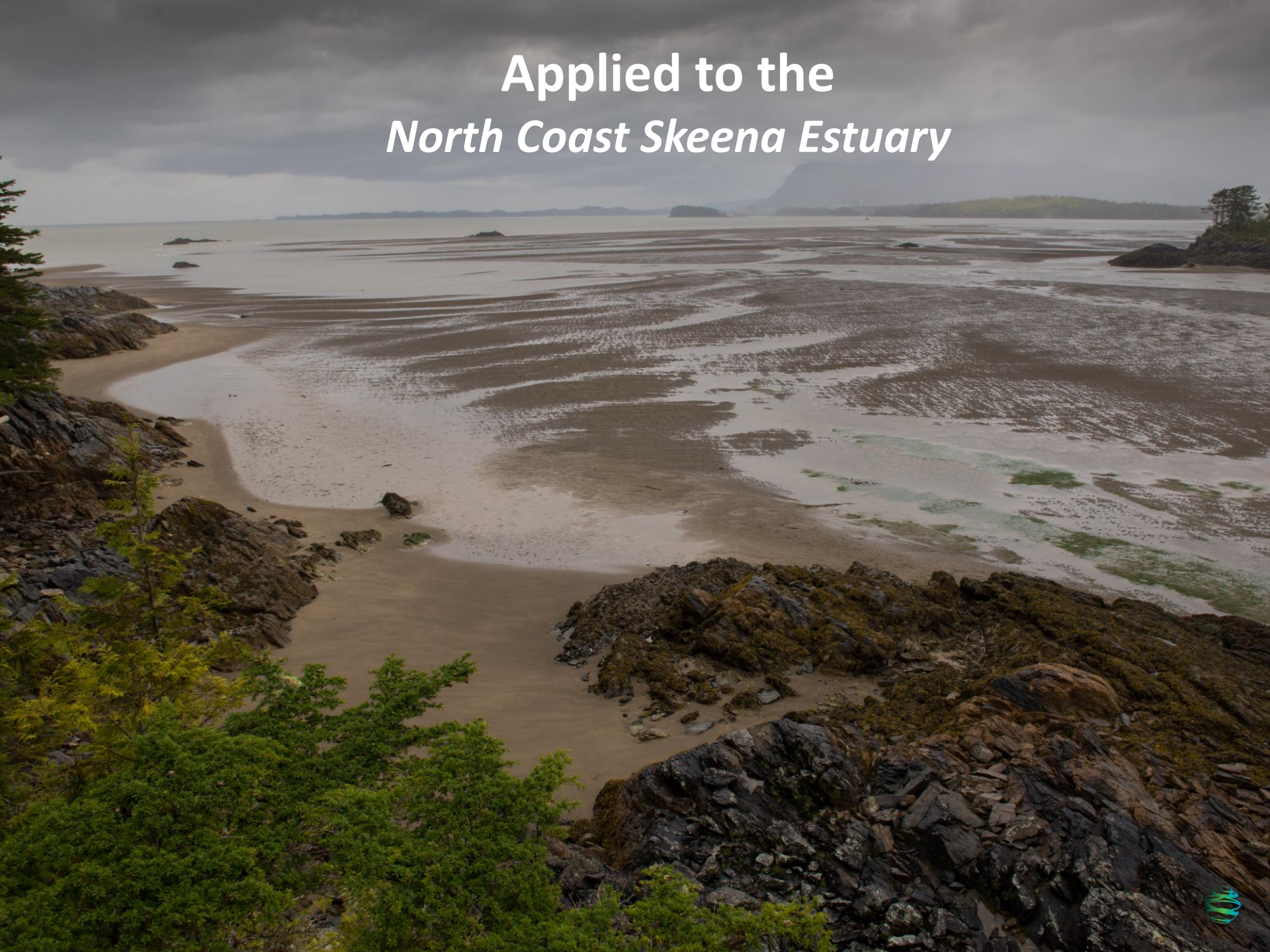


Are clear about their fundamental management objectives

Commit to monitoring, learning, and adjusting their actions

Use 'systems thinking' as a way to analyze complex social-ecological systems

Adopt scientifically rigorous approaches for developing and testing hypotheses


Applied to the
North Coast Skeena Estuary

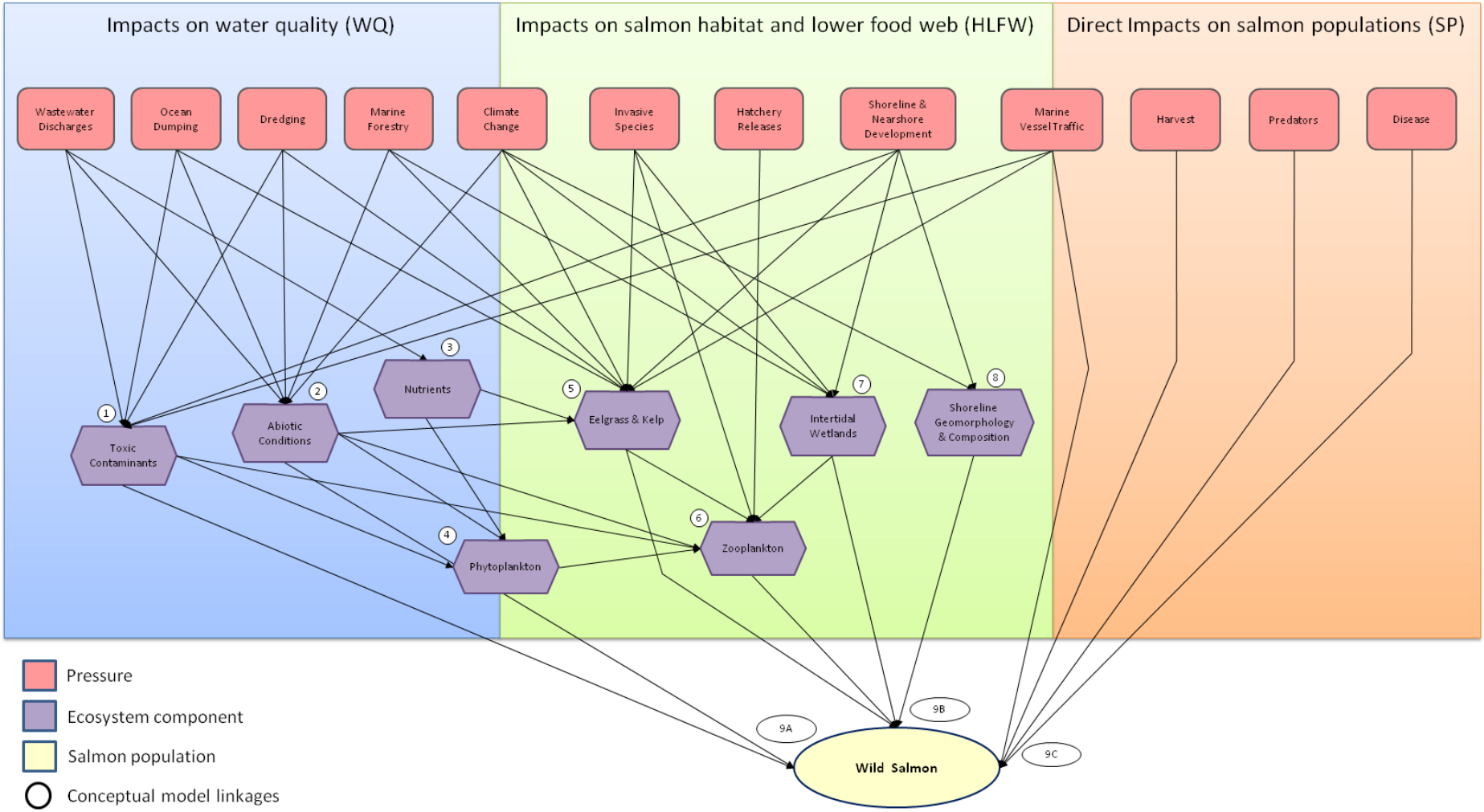
BC Cases:
North Coast Skeena Estuary

Uncertainty & Decision Making
Current status of habitat & How pressures may affect habitat

Collaborative Processes
Technical Advisory Committee

Clear Objectives
Minimize impacts on salmon habitat

'Systems Thinking'
Skeena estuary conceptual model



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Monitoring, Learning, & Adjusting
Indicators and benchmarks
Existing data

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Impact Category	Indicator	Indicator Type	Measurement Unit	Dataset	Benchmarks			Citation for Benchmark
					Good	Fair	Poor	
WQ	Wastewater Discharge Sites	P	# of discharge permits	BC MoE – Wastewater Discharges	Absent		Present	*n/a – (TAC consulted*
	Disposal at Sea Sites	P	# of disposal at sea sites	EC – Disposal at Seat Sites	Absent		Present	*n/a - (TAC consulted)*
	Dredging Extent	P	area dredged	*data unavailable for this project or does not exist*	*No specific benchmarks*			*n/a*
	Log Boom Sites	P	# of log storage/handling permits	Tantalus Crown Tenures – Log Storage & Handling	Absent		Present	*n/a - (TAC consulted)*
	Water Column Chemical Contaminants – Arsenic	EC	arsenic concentration (mg/L)	PR Harbour Water Quality Sampling	<0.0125		>0.0125	CCME 1996
	Water Column Chemical Contaminants – Mercury	EC	mercury concentration (mg/L)	PR Harbour Water Quality Sampling	<0.000016		>0.000016	CCME 1996
	Water Column Chemical Contaminants – Naphthalene	EC	naphthalene concentration (µg/L)	PR Harbour Water Quality Sampling	<0.0014		>0.0014	CCME 1996
	Water Column Bacterial Contaminants – Enterococci	EC	enterococci concentration (CFU/100mL)	PR Harbour Water Quality Sampling	<4	4-11	>11	BC MOE 2001
	Water Column Bacterial Contaminants – Fecal Coliform	EC	fecal coliform concentration (CFU/100mL)	PR Harbour Water Quality Sampling	<14	14-43	>43	BC MOE 2001
	Sediment Chemical Contaminants	EC	concentration of key sediment contaminants	*data unavailable for this project or does not exist*	*n/a*			*n/a*
	Turbidity or Total Suspended Sediments (TSS)	EC	total suspended sediment concentration (mg/L)	PR Harbour Water Quality Sampling	<25	25-80	>80	DFO 2000
	Dissolved Oxygen (DO)	EC	dissolved oxygen concentration (mg/L)	PR Harbour Water Quality Sampling	>5	2-5	<2	US EPA 2012

Minimize impacts on salmon habitat

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Scientifically Rigorous Approaches
Data quality assessment
Monitoring recommendations

Dataset	Relevance Score	Scientific Quality Score
Wastewater Discharges	✶✶✶	✶✶✶
Disposal at Sea Sites	✶✶✶	✶✶✶
Log Storage & Handling	✶✶✶	✶✶✶
PRH Water Quality Sampling	✶✶	✶✶
Shoreline Development	✶✶	✶✶✶
Marine Vessel Traffic	✶✶	✶✶✶
Intertidal Wetlands	✶✶	✶✶✶
BCMCA – Chlorophyll a	✶✶	✶✶✶
BC Shorezone Bioband	✶✶	✶✶✶
Brstad CASI - Eelgrass	✶	✶✶✶
Chatham Sound Study - Eelgrass	✶✶✶	✶✶✶
BCMCA - Eelgrass	✶✶✶	✶✶✶
WWF - Eelgrass	✶✶	✶✶✶
PRH Foreshore Habitat Classification	✶✶	✶✶✶
GeoBC - Kelp	✶✶	✶✶✶
Zooplankton	✶	✶✶
Riparian Vegetation	✶✶	✶✶✶
Harbour Seal Haulouts	✶✶	✶✶✶

…stuary

Uncerta…
Decisio…
Current …
How pre…
habitat …

Collaborative Processes
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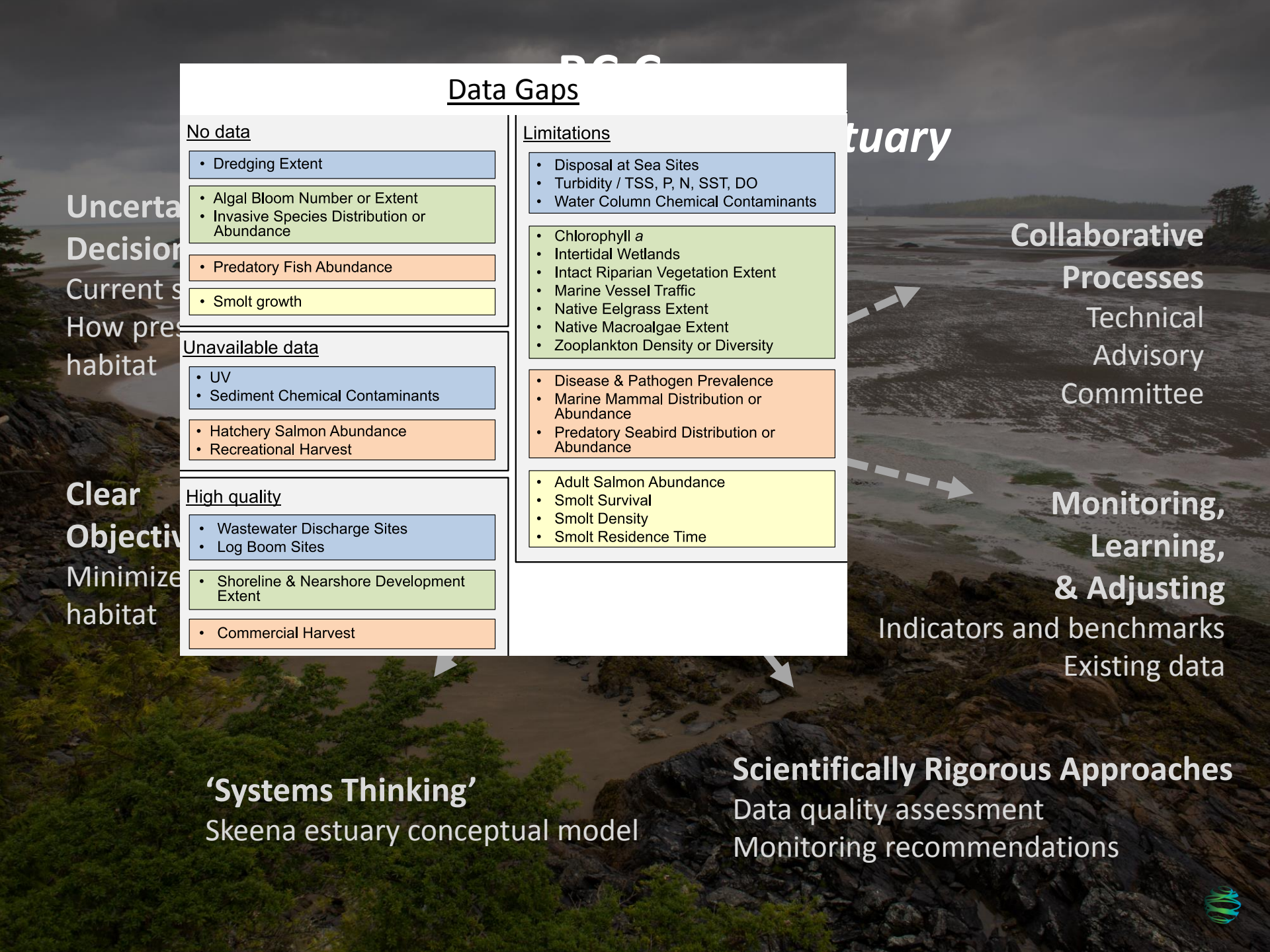
Data Gaps
No data
Dredging Extent
Algal Bloom Number or Extent
Invasive Species Distribution or Abundance
Predatory Fish Abundance
Smolt growth
Unavailable data
UV
Sediment Chemical Contaminants
Hatchery Salmon Abundance
Recreational Harvest
High quality
Wastewater Discharge Sites
Log Boom Sites
Shoreline & Nearshore Development Extent
Commercial Harvest
Limitations
Disposal at Sea Sites
Turbidity / TSS, P, N, SST, DO
Water Column Chemical Contaminants
Chlorophyll a
Intertidal Wetlands
Intact Riparian Vegetation Extent
Marine Vessel Traffic
Native Eelgrass Extent
Native Macroalgae Extent
Zooplankton Density or Diversity
Disease & Pathogen Prevalence
Marine Mammal Distribution or Abundance
Predatory Seabird Distribution or Abundance
Adult Salmon Abundance
Smolt Survival
Smolt Density
Smolt Residence Time
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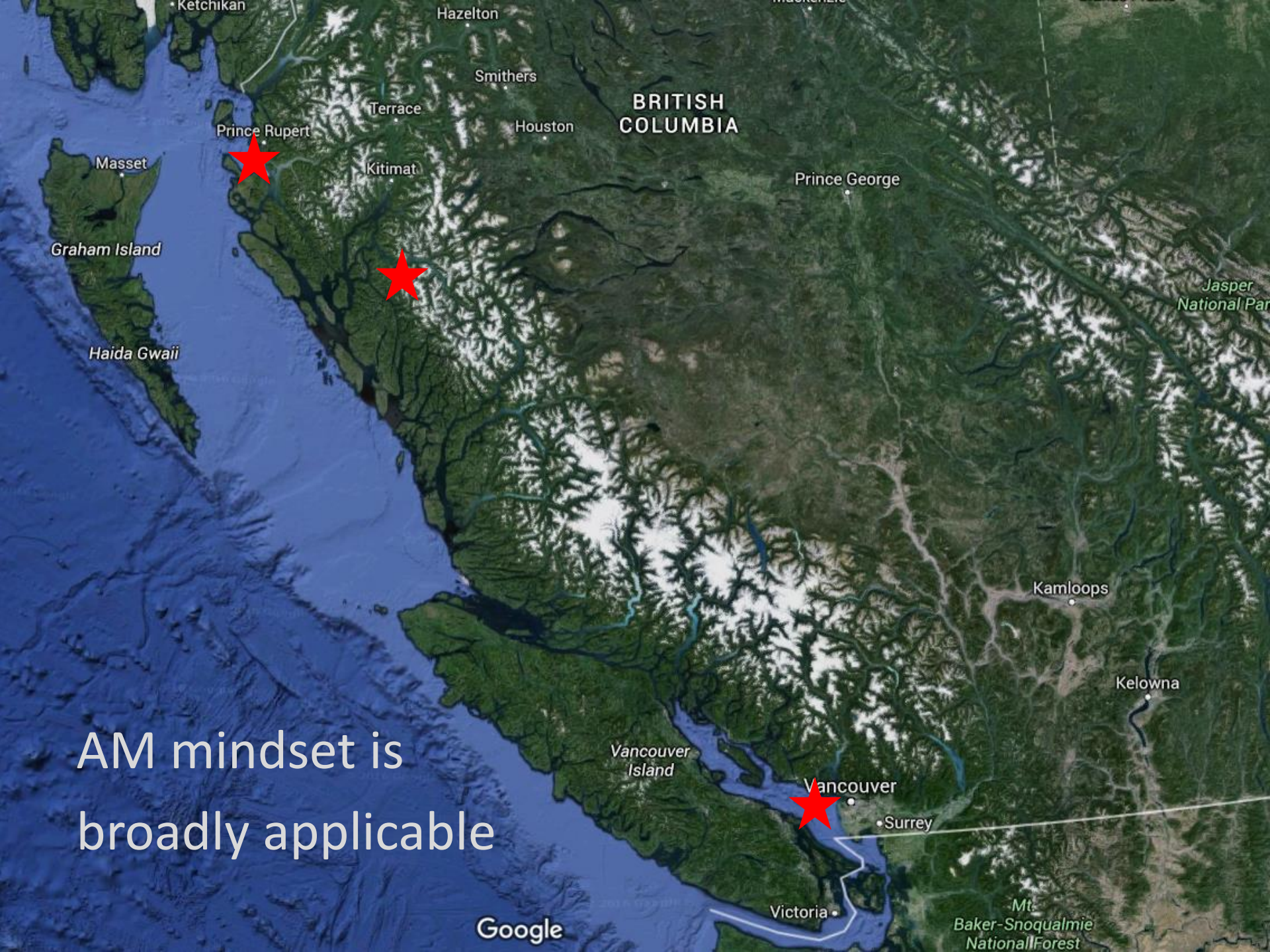

AM mindset is broadly applicable

Take Away Messages

- AM mindset broadly applicable
- AM mindset different from other paradigms
  - Focus on uncertainties & decisions
  - Experimental design
- AM mindset is beneficial
  - Learning faster
  - Reducing uncertainties
  - Adapting to changing conditions

Thank You!

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Ten benefits

Clarifying critical uncertainties

Strengthening relevance of data management and reporting

Providing greater management certainty

Inappropriate context

Evaluating effectiveness of management actions

Reducing conflicts

ALL SITUATIONS

Situations benefiting from AM mindset

Understanding cause-effect in complex systems

Improving efficiency of monitoring

Identifying alternative management actions

Hastening the learning loop

Infeasible

Empowering stakeholder and decision makers