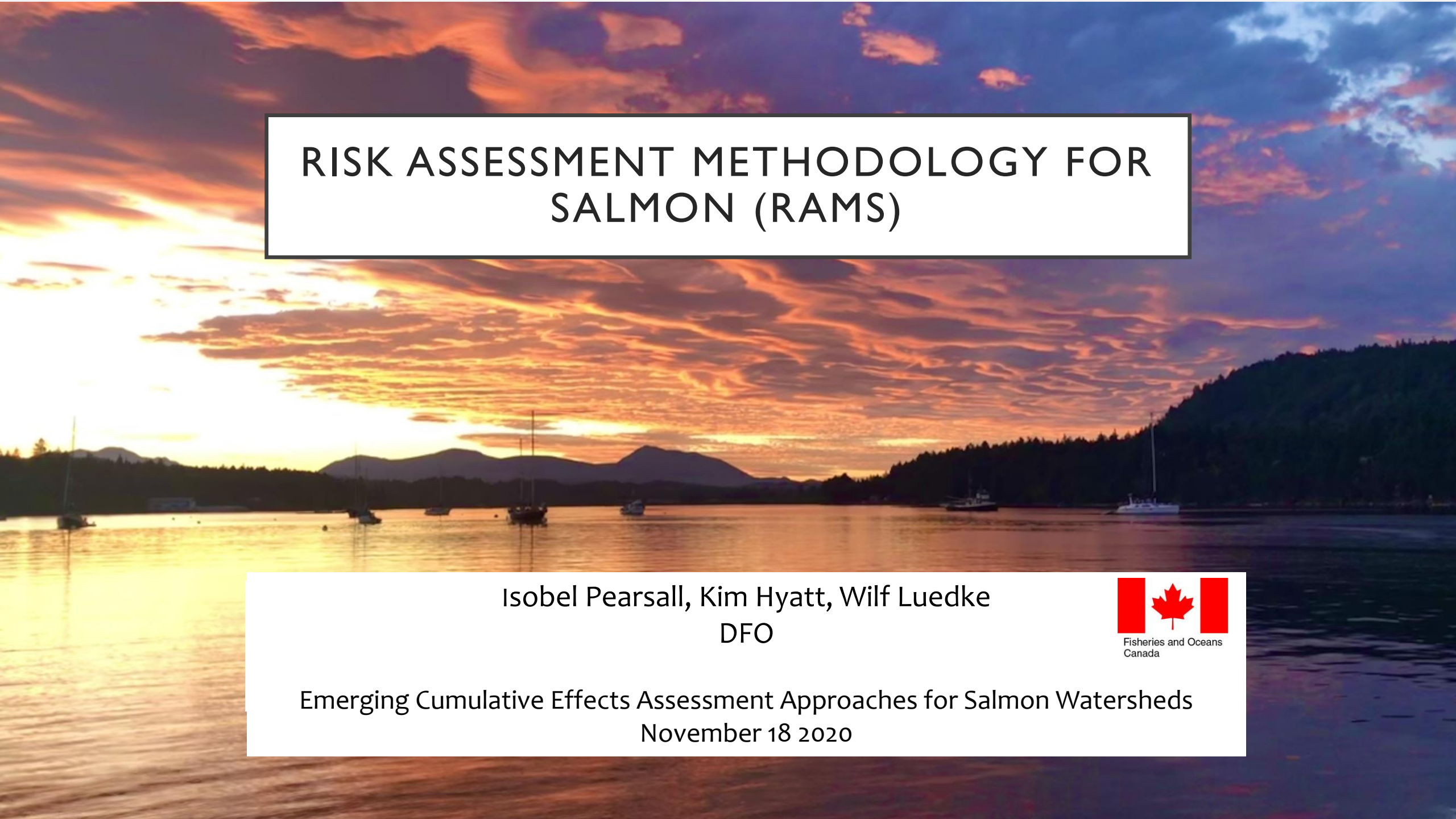

RISK ASSESSMENT METHODOLOGY FOR SALMON (RAMS)

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DFO

Fisheries and Oceans Canada

Emerging Cumulative Effects Assessment Approaches for Salmon Watersheds
November 18 2020

RAMS

- What is RAMS?
  - A method designed to determine and prioritize the factors limiting the productive capacity of Pacific Salmon stocks/ populations/ CUs
  - Adapted from Hobday et al. (2007) approach
- Why?
  - DFO's Wild Salmon Policy objectives
  - Fisheries Act requirements under Bill C-68 - need to assess risk of cumulative impacts from multiple categories of threats
- How?
  - A process based on Vision/goals -> Status -> Limiting Factors -> Options -> Action Plan
  - Integrating expertise from stock and habitat specialists with LEK/IK to achieve consensus on risks and actions
  - Simple, scalable, adaptive, precautionary and repeatable process

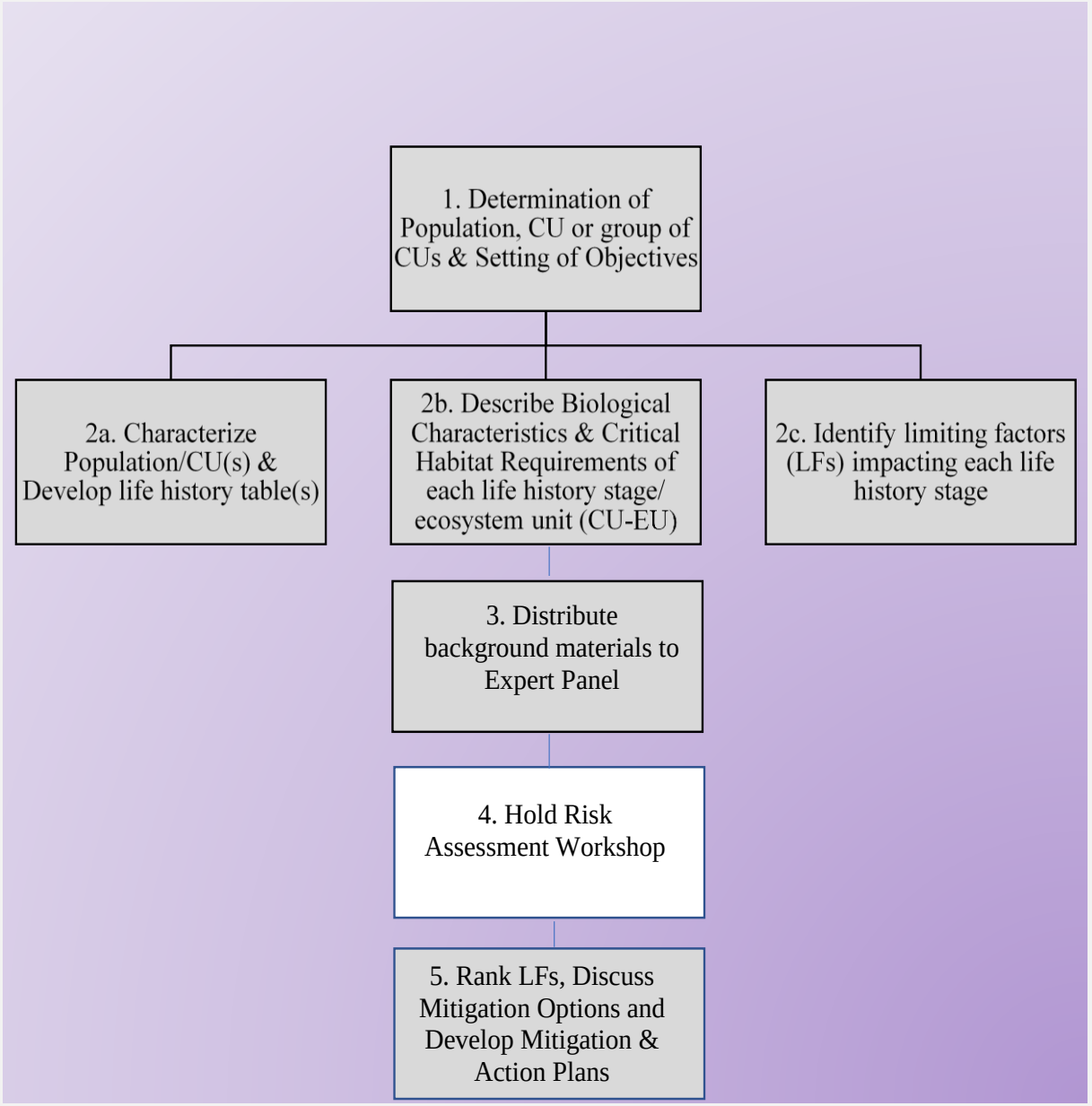
WHERE: VARIOUS SCALES

- Cowichan Chinook
- Sakinaw Sockeye
- WCVI Chinook Management Unit:
  - SWVI CU; 11 watersheds in San Juan, Barkley, Clayoquot.
  - Nootka-Kyuquot CU; 7 watersheds
  - Quatsino CU; planned
  - Marine RAMS begun
- WCVI Sockeye:
  - 3 Sockeye CUs in Barkley
  - Kennedy Lake Sockeye CU
- Nanaimo River Chinook
- Salmon River Coho, Nicola Watershed Chinook planned

RAMS PROCESS SIMPLIFIED

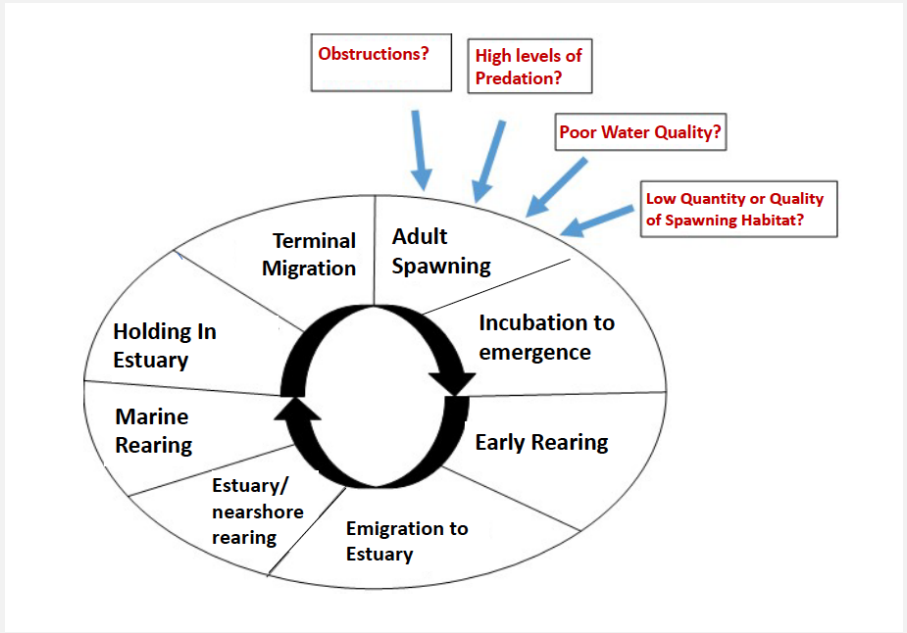
Winning conditions require:

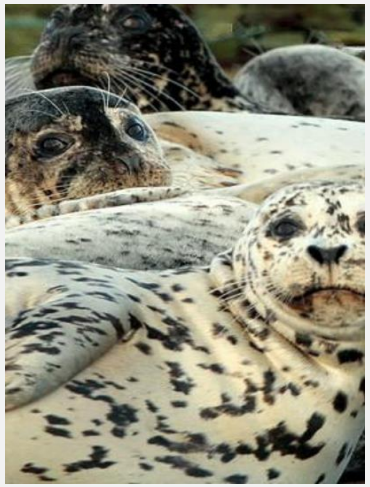
- Effective Governance
- Policy Framework
- Knowledge to id risks
- Willingness to act
- Funding
- Capacity to monitor



WHAT ARE LIMITING FACTORS?

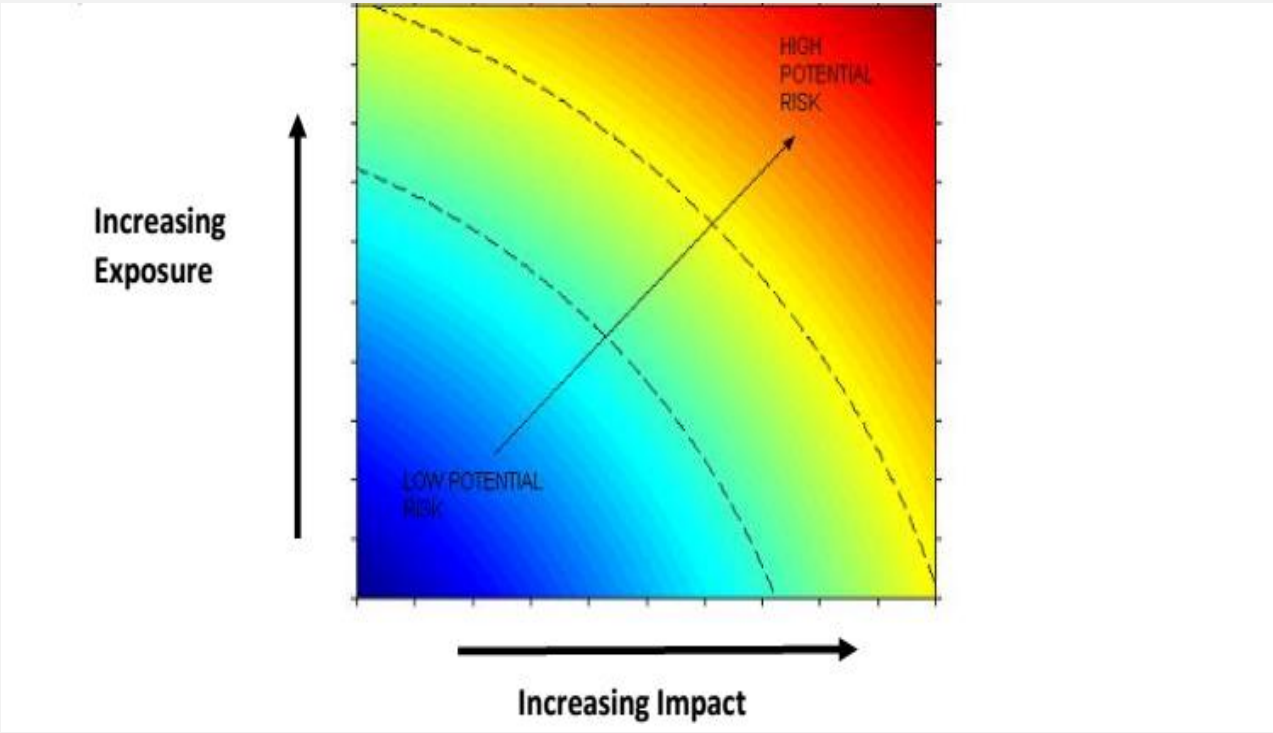
- Alternative hypotheses for losses of productivity and capacity resulting in declines
- LFs impact critical habitat and different life history stages of Pacific salmon





HOW TO ASSESS RISK

- Risk = Exposure*Consequence
- Exposure (likelihood) 1-5- spatial, temporal
- Consequence (impact) 1-5
- 2 time passes- current & 50 years into future



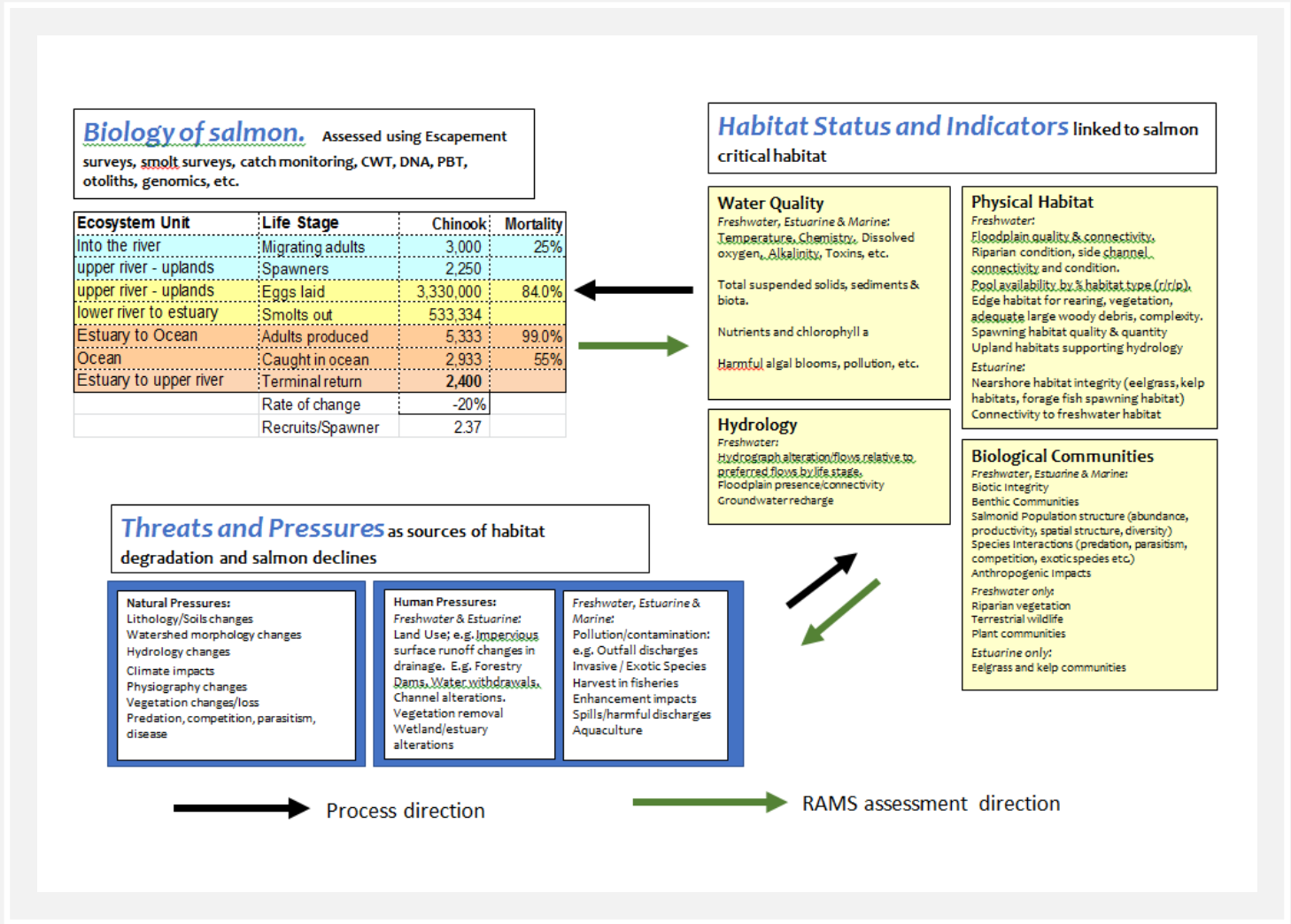
RAMS USES A LIFE CYCLE MODEL TO ASSESS BENEFIT OF REDUCING MORTALITY AT EACH LIFE STAGE.

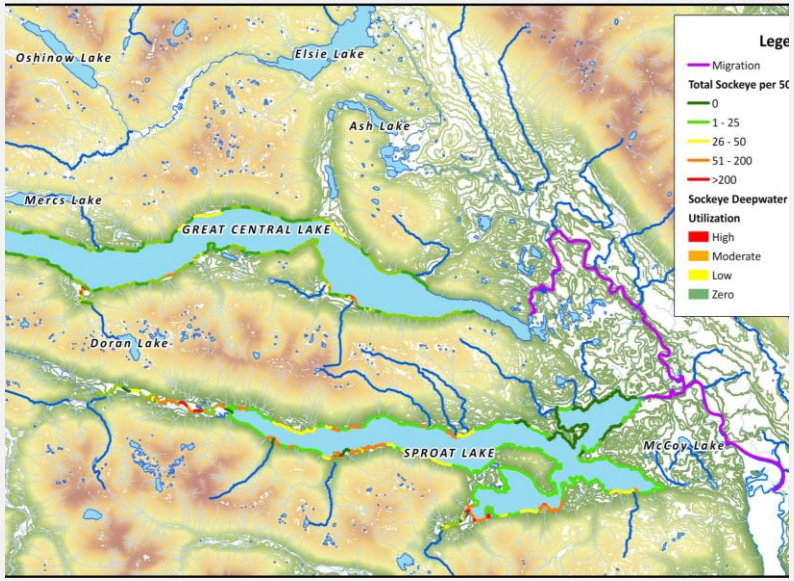
time period	life stage	Chinook	Mortality	Potential limiting factors
March - July	terminal return	500	10.0%	LF1: estuary predation
April - July	upstream migration		3.0%	LF2: delay or limited access; LF3: obstructions; LF4: aggradation; LF5: loss of habitat
April - July	upstream migration		1.0%	LF6: high temp; LF7: water quality
May - June	upstream migration		7.0%	LF8: illegal fishing
Sept - Oct	Spawning		8.0%	LF9: habitat quality; LF10: Disturbance; LF11: disease
Sept - Oct	Spawning	350	1.0%	LF12: spawner predation
Oct - Feb	egg incubation	700,000	33.7%	LF13: sediment; LF14: early emergence; LF15: dewater redds; LF16: scour
Oct - Feb	egg incubation		8.0%	LF18: overspawn; LF19: natural egg predation
Oct - Feb	egg incubation		0.0%	LF20: redd disturbance (non-human); LF21: redd disturbance (human)
Feb - July	early rearing		12.0%	LF22: water quality; LF23: instream complexity; LF24: low water; LF25: high water
Feb - July	early rearing		18.0%	LF26: lack of food; LF27: competition - invasive species; LF28: competition - native species; LF29: predation
Feb - July	early rearing		5.0%	LF30: disturbance; LF30.5: Aquifer drawdowns
Feb - July	early rearing		2.0%	LF31: disease
Feb - July	early rearing	114,450	5.0%	LF32: hatchery introgression
April - July	estuary rearing		25.0%	LF33: lack of food; LF34: predation; LF35: competition/predation from exotics
April - July	estuary rearing		25.0%	LF37A-C: foreshore, intertidal and subtidal habitat;
April - July	estuary rearing	56,081	1.0%	LF38: industrial affects; LF39: disturbance
Aug - Year 2	early ocean rearing		25.0%	LF40: lack of food; LF41: water quality
Aug - Year 2	early ocean rearing	2,289	22.0%	LF42: competition; LF43: nearshore predation
Year 2 - 4	Ocean rearing		0.7%	LF44: offshore predation; LF45: competition with invasives
Year 2 - 4	Ocean rearing	801	0.6%	LF46: offshore habitat; LF47: pollutants; LF48: disease; LF49: harmful algae blooms
Year 2 - 4	Ocean rearing	500	37.6%	LF50: fishing
	Terminal return	500		
	Rate of Change	0.0%		

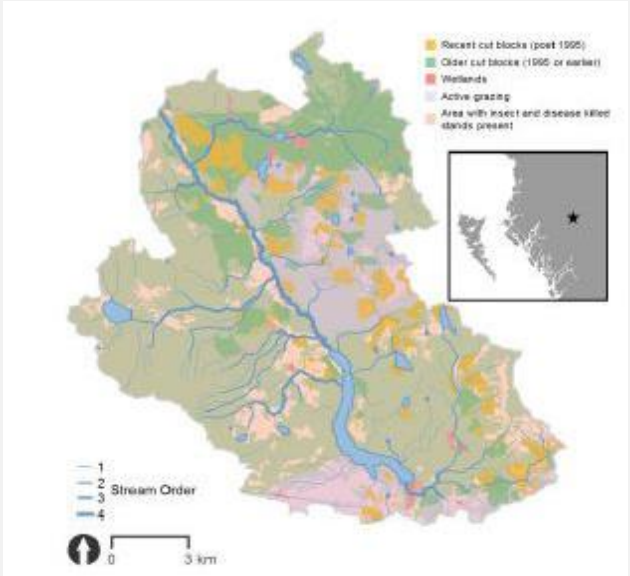
Assess biological impact by eliminating or reducing that source of mortality.

HOW TO VIEW RISK

- Stock specialists focus on salmon stocks
- Habitat specialists focus on habitat indicators
- RAMS focus on salmon interactions with critical habitat
- SARA focus on threats







STOCK, HABITAT & ECOSYSTEM STATUS

-Collate historical and current stock status and biological characteristics

-Gather information such as fishery impacts, fish health, hatchery influence, etc.

-High level habitat indicator status (e.g. ESSA report cards, Pacific Salmon Explorer) -> detailed Habitat Status Reports

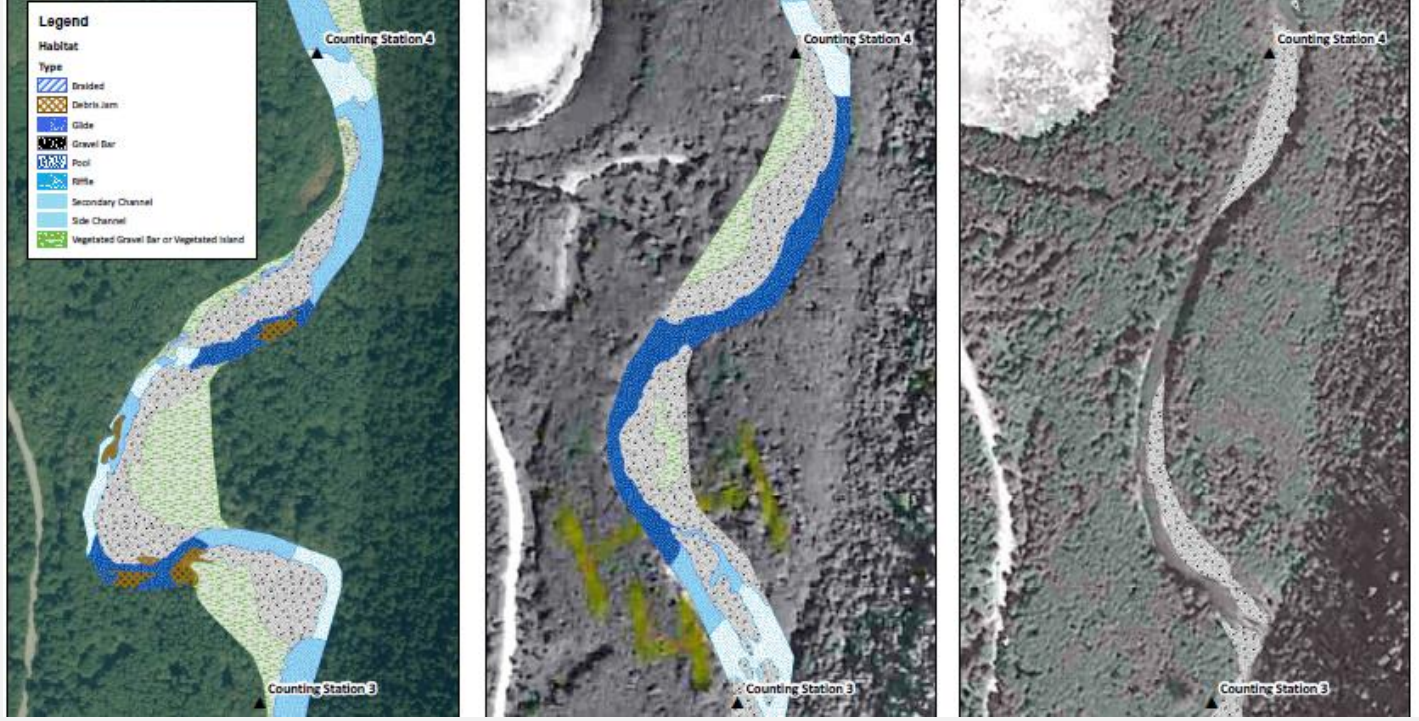
-Status of critical habitat and changes over time

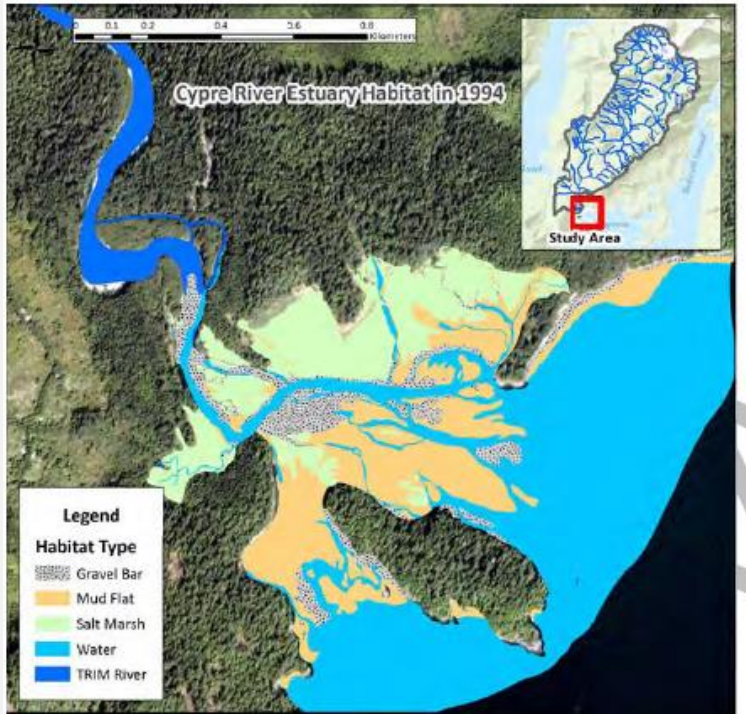
-Pressure and State indicators

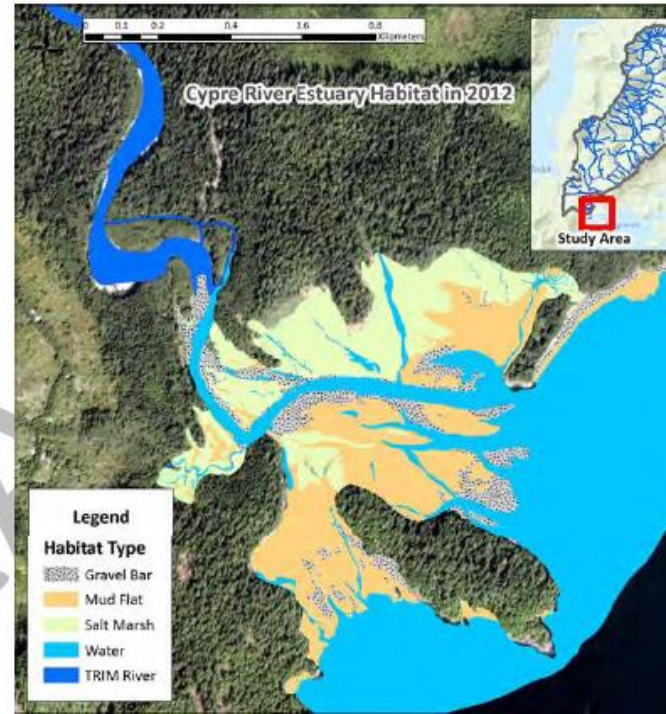
-Climate projections

HOLD RISK WORKSHOP

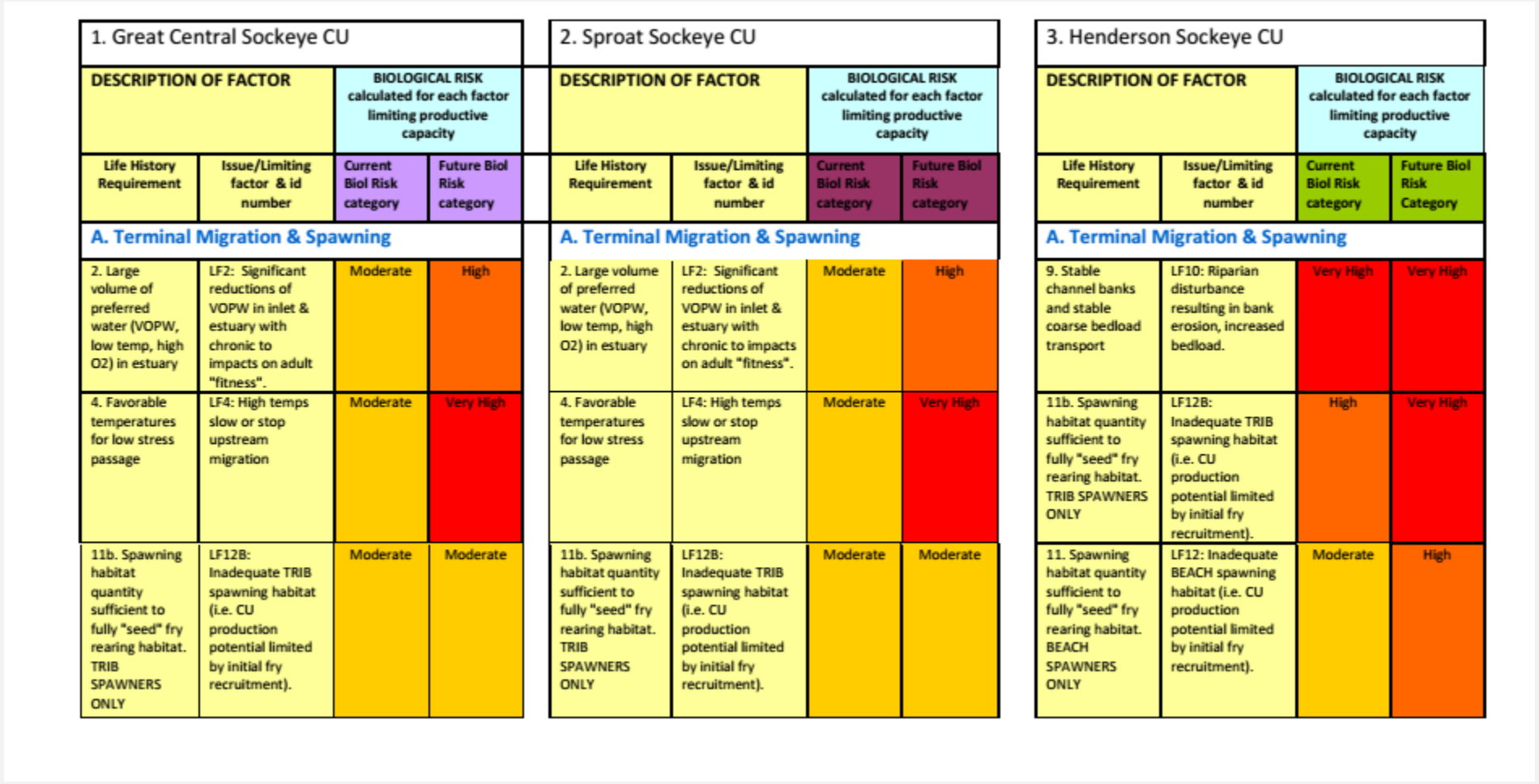
- Include technical, local & traditional expertise
- Develop common understanding
- Identify and rank the major limiting factors posing risk to the productivity of salmon in the watershed/CU
- Identify knowledge gaps
- Develop a plan to mitigate high-risk components through a series of action items
- Identify funding sources







BARKLEY SOCKEYE RISK ASSESSMENT



1. Great Central Sockeye CU

DESCRIPTION OF FACTOR		BIOLOGICAL RISK calculated for each factor limiting productive capacity	
Life History Requirement	Issue/Limiting factor & id number	Current Biol Risk category	Future Biol Risk category
A. Terminal Migration & Spawning			
2. Large volume of preferred water (VOPW, low temp, high O2) in estuary	LF2: Significant reductions of VOPW in inlet & estuary with chronic to impacts on adult "fitness".	Moderate	High
4. Favorable temperatures for low stress passage	LF4: High temps slow or stop upstream migration	Moderate	Very High
11b. Spawning habitat quantity sufficient to fully "seed" fry rearing habitat. TRIB SPAWNERS ONLY	LF12B: Inadequate TRIB spawning habitat (i.e. CU production potential limited by initial fry recruitment).	Moderate	Moderate

2. Sproat Sockeye CU

DESCRIPTION OF FACTOR		BIOLOGICAL RISK calculated for each factor limiting productive capacity	
Life History Requirement	Issue/Limiting factor & id number	Current Biol Risk category	Future Biol Risk category
A. Terminal Migration & Spawning			
2. Large volume of preferred water (VOPW, low temp, high O2) in estuary	LF2: Significant reductions of VOPW in inlet & estuary with chronic to impacts on adult "fitness".	Moderate	High
4. Favorable temperatures for low stress passage	LF4: High temps slow or stop upstream migration	Moderate	Very High
11b. Spawning habitat quantity sufficient to fully "seed" fry rearing habitat. TRIB SPAWNERS ONLY	LF12B: Inadequate TRIB spawning habitat (i.e. CU production potential limited by initial fry recruitment).	Moderate	Moderate

3. Henderson Sockeye CU

DESCRIPTION OF FACTOR		BIOLOGICAL RISK calculated for each factor limiting productive capacity	
Life History Requirement	Issue/Limiting factor & id number	Current Biol Risk category	Future Biol Risk Category
A. Terminal Migration & Spawning			
9. Stable channel banks and stable coarse bedload transport	LF10: Riparian disturbance resulting in bank erosion, increased bedload.	Very High	Very High
11b. Spawning habitat quantity sufficient to fully "seed" fry rearing habitat. TRIB SPAWNERS ONLY	LF12B: Inadequate TRIB spawning habitat (i.e. CU production potential limited by initial fry recruitment).	High	Very High
11. Spawning habitat quantity sufficient to fully "seed" fry rearing habitat. BEACH SPAWNERS ONLY	LF12: Inadequate BEACH spawning habitat (i.e. CU production potential limited by initial fry recruitment).	Moderate	High

9. Stable channel banks and stable coarse bedload transport	LF10: Riparian disturbance resulting in bank erosion, increased bedload.	Low	Moderate
5. Unrestricted access through fishways, enumeration structures etc	LF5: Delays at fishways and during passage through fish counters	Low	Low
7. Open access at all points to holding and/or spawning areas.	LF8: Temperature or structural blockages delay access to beach spawning areas during late Sept-Nov spawning interval.	Low	Low
11. Spawning habitat quantity sufficient to fully "seed" fry rearing habitat. BEACH SPAWNERS ONLY	LF12: Inadequate BEACH spawning habitat (i.e. CU production potential limited by initial fry recruitment).	Low	Low
1. Safe holding habitat in estuary	LF1: Large losses from seals.	Very Low	Low
3. Adequate maintenance flows to facilitate upstream passage of spawners	LF3: Low flows delay, prevent passage at control points (e.g. Henderson rapids) & increases pre-spawn losses.	Very Low	Low

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1. Safe holding habitat in estuary	LF1: Large losses from seals.	Very Low	Low
5. Unrestricted access through fishways, enumeration structures etc	LF6: Structural Blockages	Very Low	none/Unk

1. Safe holding habitat in estuary	LF1: Large losses from seals.	Moderate	Moderate
7. Open access at all points to holding and/or spawning areas.	LF8: Temperature or structural blockages delay access to spawning areas during late Sept-Nov spawning interval.	Moderate	none/Unk
3. Adequate maintenance flows to facilitate upstream passage of spawners	LF3: Low flows delay, prevent passage at control points (e.g. Henderson rapids) & increases pre-spawn losses.	Low	High
4. Favorable temperatures for low stress passage	LF4: High temps slow or stop upstream migration	Low	High
5. Unrestricted access through fishways, enumeration structures etc	LF6: Structural Blockages	Low	Moderate
8. Adequate channel depth including frequency of deep holding pools with cover	LF9: Shallowing or loss of "predation-free", summer holding "pools" due to sediment infill.	Low	Moderate

5. Unrestricted access through fishways, enumeration structures etc	LF6: Structural Blockages	Very Low	none/Unk
6. VOPW ensures low stress, predator & pathogen free, lake refuge.	LF7. Reductions in the lake VOPW	Very Low	none/Unk
8. Adequate channel depth including frequency of deep holding pools with cover	LF9: Shallowing or loss of "predation-free", summer holding "pools" due to sediment infill.	Very Low	none/Unk
14. Lack of anthropogenic disturbance	LFnew: Direct disturbance of fish by human activities.	Very Low	none/Unk
10. Suitable water quality-levels of bacteria and toxic substances	LF11: Poor water quality	Very Low	none/Unk
12. Low levels of predation on adults.	LF13: High proportion of spawners lost to bears	Very Low	none/Unk
13. Compliance and good management	Lfnew: unreported catch / poaching / misallocation from DNA	Very Low	none/Unk

6. VOPW ensures low stress, predator & pathogen free, lake refuge.	LF7. Reductions to lake VOPW	Very Low	Low
7. Open access at all points to holding and/or spawning areas.	LF8: Temperature or structural blockages delay access to spawning areas during late Sept-Nov spawning interval.	Very Low	none/Unk
8. Adequate channel depth including frequency of deep holding pools with cover	LF9: Shallowing or loss of "predation-free", summer holding "pools" due to sediment infill.	Very Low	none/Unk
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2. Large volume of preferred water (VOPW, low temp, high O2) in estuary	LF2: Significant reductions of VOPW in inlet & estuary with chronic to impacts on adult "fitness".	Low	Low
13. Compliance and good management	Lfnew: unreported catch / poaching / misallocation from DNA	Low	none/Unk
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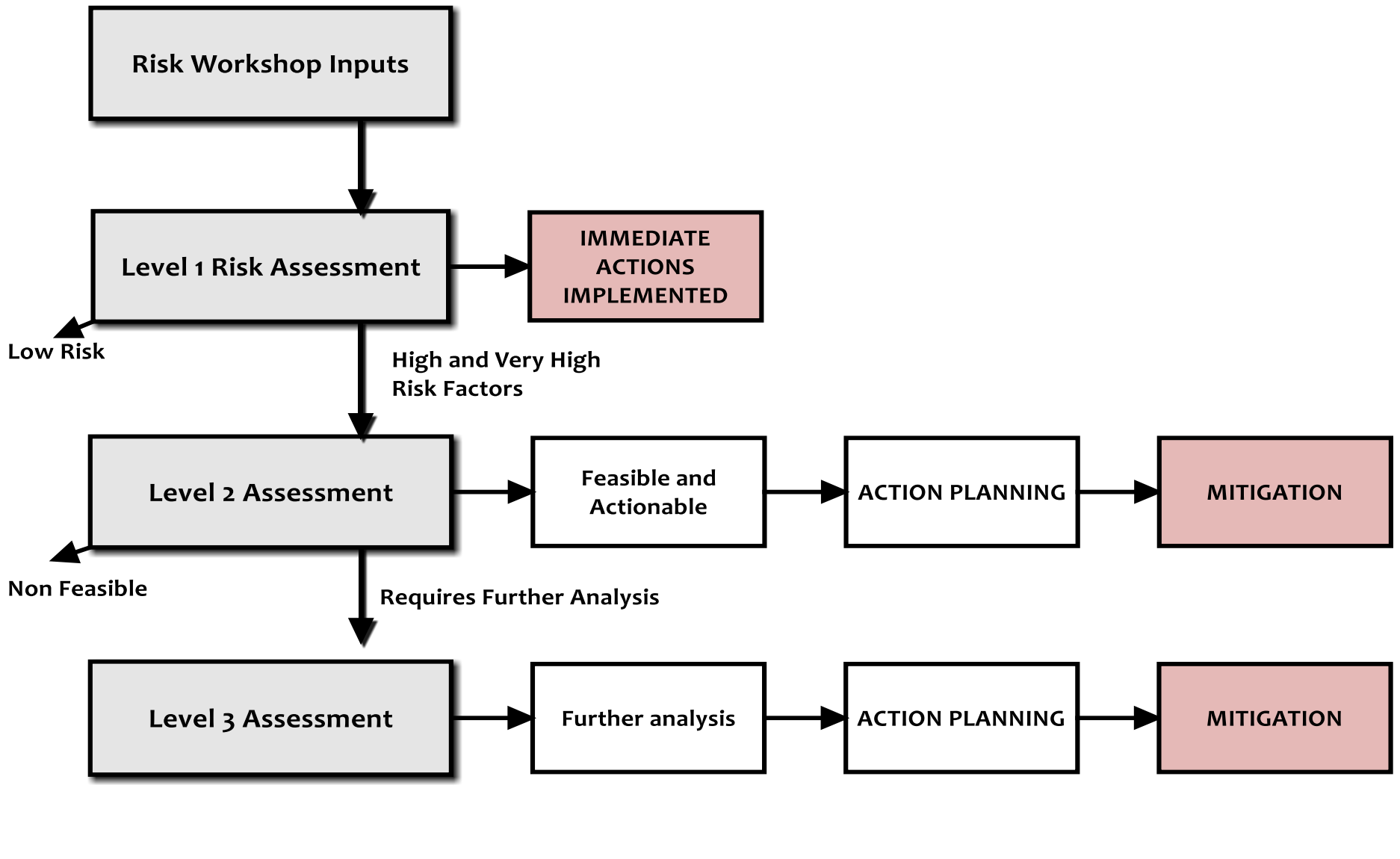
MOVING FROM RISK ASSESSMENT TO ACTION



SCENARIO BUILDING & EVALUATION

Rank scenarios of actions to address high risk / highest ranked limiting factors

	Action / Limiting factor	starting population	terminal return	initial change in terminal return in fish	**annual rate of change**
Base case	current	300	240	-60	**-20%**
Scenario 1	Reduce marine harvest by 50%	300	303	3	**1%**
Scenario 3	eliminate adult pinniped predation by 100%	300	305	5	**2%**
Scenario 2	Improve lower river rearing by 4%	300	629	329	**110%**

- Assess feasibility
- Identify lead jurisdiction
- Develop action plan for agreed actions

OUTPUTS / LEGACY

- General consensus ranked list of factors limiting productivity and knowledge gaps
- Strategic Plan ‘owned’ by local group. Incorporates prioritization and sequencing of appropriate restoration actions
- Specific action plans for highest risks, e.g. fishery plans, hatchery plans, restoration plan, water use plan, etc.

LESSONS LEARNED

- Need a simple and repeatable process
- Need to develop logical strategies for action ie. begin with upslope restoration as instream and estuarine restoration are impacted by upslope geological and hydrological processes
- Need to develop products that can be modified into funding proposals by local communities