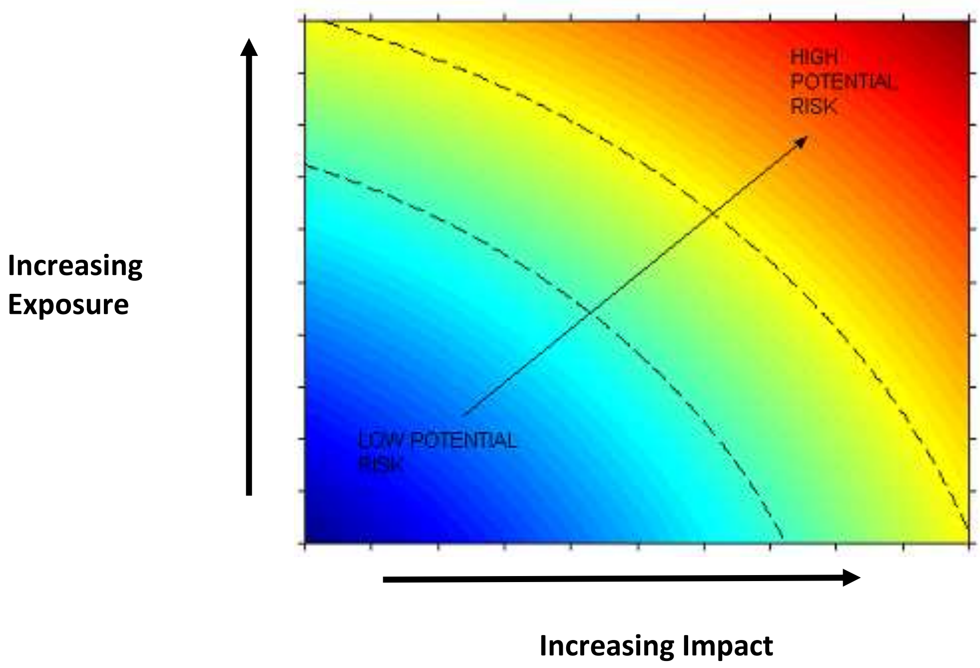
Cowichan Workshop 1

LEVEL 1 RISK ASSESSMENT- SCORING METHODOLOGY

The following scoring methodology will be used to score and rank limiting factors impacting Cowichan River chinook salmon. There will be time periods assessed for scoring risk, firstly, “current conditions”, and secondly “future conditions- 50 years in the future”. Carrying out the analysis over these two time periods allows us to examine how the impacts of various stressors are predicted to, or could change under ongoing climate change.

Computation of Risk

The framework for this risk-assessment is based on accepted methods from the Government of Canada Treasury Board and Hobday[1] (2011). These have been adapted to salmon in watersheds by evaluating the biological risk to each life history stage. Biological risk is determined from two variables: Exposure and Impact. The term “exposure” is synonymous with the term “likelihood” which is used in some risk assessment methodologies, while the term “impact” is synonymous with the term “consequence”. The first axis, exposure, is related to the exposure of a particular life history stage to a particular stressor, and the other axis is related to the impact on that life history stage as a result of exposure to that stressor. The following graph shows how biological risk increases as both exposure and impact increase.



Biological risk is defined as the percent change in the return of chinook to the river, but should also consider changes in key biological characteristics such as age at maturity, sex composition, fecundity, and run timing of the chinook population.

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[1] Hobday, et al. 2011. Ecological Risk Assessment for the Effects of Fishing. Fisheries Research 108 (2011) 372–384

Scoring the "Exposure" Term

Exposure is based on combining 1) the spatial scale of the limiting factor, and 2) the temporal scale of the limiting factor. The methodology will require you to use your expert opinion and/or knowledge of data or reports as you score each of these terms, and then discuss with others in your group to develop a consensus value. Rationale and/or citation of existing data and/or reports should be documented.

Spatial Scale Score

Different limiting factors/stressors are rated in terms of the spatial scale of their effects. For Cowichan chinook, the spatial scale of impact is estimated as the percentage of the critical habitat required by a particular life history stage/or the percentage of the population itself that is impacted by the stressor (Table 1). A full rationale should be provided for this score. By critical habitat, we mean any area of habitat that is necessary for the survival or recovery of Cowichan chinook.

Table 1. Spatial Impact Score Guide

Score	Single population (by life history stage)
Low (1)	Less than 10% of the critical habitat /population is impacted
Moderate (2)	10-20% of the critical habitat /population is impacted
Medium (3)	30-40% of the critical habitat /population is impacted
High (4)	50%-70% of the critical habitat /population is impacted
Very High (5)	80% or more of the critical habitat /population is impacted

Temporal Scale Score

The frequency at which an identified factor limits production of the species is called the "temporal score". The 5 categories of temporal frequency are described in Table 2 below. Your opinion on the temporal score should be supported by a short written rationale and/or citation of documented knowledge such as data or report.

Table 2. Temporal Impact Score Guide

Score	Temporal Impact
Low (1)	Once per decade (Very rare)
Moderate (2)	Twice per decade (Occurs but uncommon)
Medium (3)	Three to four times per decade (Sometimes occurs)
High (4)	5-7 times per decade (Frequent)
Very High (5)	8 + times per decade (Continual)

Scoring the "Impact" Term

The "impact" score is based on the expected magnitude of impact of the factor on the subsequent adult return.

Chinook have a complex life history, with each stage susceptible to a myriad of factors which ultimately affect the number of adults returning to the river. To determine an impact score for Cowichan chinook we provide the following guide of current estimated mortalities in three key life phases.

- From arrival at the estuary to spawning it is estimated that on average 20% of adult Cowichan chinook die.
- In the marine phase we know that the 5 year average smolt to age 2 marine mortality is 99% while the 5 year average fishery related mortality is 63%.
- For the egg to smolt phase, by deduction for a stable population, we now estimate the mortality to be in the range of 82%.

Ecosystem Units	Life Stage	Chinook	Mortality
Estuary to upper river	Migrating adults	3,000	20%
upper river - uplands	Spawners	2,403	
upper river - uplands	Egg - fry	4,445,550	82%
lower river to near shore	Fry - Smolts	815,003	
Estuary to Ocean	Adults produced	8,108	99%
Ocean	Caught in ocean	5,108	63%
Estuary to upper river	Terminal return	**3,000**	
	Rate of change	0%	

Experts should be able to further delineate mortalities in these 3 phases based on available knowledge of limiting factors from this watershed or other stocks/watersheds (see appendix 2). This expert opinion will be used to assess potential contribution of each limiting factor on mortality rates in one of the 3 life phases. For example, some experts might suggest that seals in the estuary account for about 15% mortality on migrating adults. Removing this limiting factor would result in a 5% mortality from remaining limiting factors in this phase or a 19% change in the subsequent return to the terminal area.

The impact scores related to change in subsequent return to river are shown in Table 3. Longer term change resulting from impacts on sex ratio, fecundity, age of maturity, size, etc. could be significant.

Each expert participant will be asked to provide an impact score for each limiting factor, and then the group as a whole will be required to agree on a score which will be entered into the Excel spreadsheet for that particular limiting factor. Again, the full rationale for how a particular consequence score was derived must be provided. If there is disagreement amongst the experts, or if key information is lacking, the Hobday method assigns the highest impact score to that particular stressor.

Table 3. Impact criteria to score potential risk.

Level	Score	Description
Minor	1	Less than 10% decline in population returns
Moderate	2	11-20% decline in population returns
Major	3	21-30% decline in population returns
Severe	4	31-50% decline in population returns
Critical	5	50% + decline in population returns

Record the uncertainty/confidence levels in scores

There is always some level of uncertainty associated with predicting impacts of any stressor or limiting factor on fish or fish habitat. Uncertainty can arise due to a lack of information, or could arise when predicting the effectiveness of new or innovative mitigation measures. In addition, there may be synergistic effects where two or more effects in combination express an effect greater than would have been expressed individually. These are difficult to identify and hence have the potential of being overlooked or underestimated. Acknowledging this uncertainty does not preclude making sound management decisions, but the uncertainty does need to be described and taken into account at this risk assessment stage.

Thus, this risk assessment methodology requires that workshop participants provide confidence ratings for the risk scores that are produced from the Level 1 risk assessment. These ratings may be 1 (low confidence) or 2 (medium confidence) or 3 (high confidence) (Table 4).

Table 4. Confidence Scores

Confidence	**Rationale**
Low	• Data exist but are considered poor, or conflicting, or • No data exist, or • Substantial disagreement among experts
Med	• Data exist but some key gaps • Some disagreement between experts
High	• Data exist and are considered sound, or • Consensus between experts, or • Risk is constrained by logical consideration

Current and Future Trends

Workshop participants will also be asked to provide scores for the following:

Current Trend -Is this stressor currently increasing, decreasing or showing no trend? This will be scored between 1 (decreasing) and 5 (strongly increasing).

Future Trend -Is this stressor predicted to decrease, increase or remain the same in the future (50 years from present)? This will require workshop participants to discuss the predicted impacts of climate change. This will be scored between 1 (decreasing) and 5 (strongly increasing).

Appendix 1: Calculations

Tables 1-4 above provide the information such that workshop participants can provide the 4 required scores. These scores are entered into an Excel spreadsheet, and the final exposure and risk values are automatically generated. This appendix outlines how these values are derived.

Exposure

The scores for temporal and spatial scale collected above allows for an overall level 1 ranking score to be provided for **Exposure**, which is a measure of exposure to a particular stressor (Table 5). We simply take the product of the spatial and temporal scale scores, and the resulting value indicates an overall exposure level from between 1 and 5. This calculation will be made automatically in the Excel spreadsheet once the group has entered the consensus spatial and temporal scale scores.

Table 5. Level 1 Ranking- Exposure Scores

Exposure	Product of spatial and temporal scale scores
Low (1)	1
Moderate (2)	2 to 5
Medium (3)	6 to 9
High (4)	12 to 16
Very High (5)	20 to 25

Biological Risk

The overall biological risk associated with a limiting factor is based on the product of the exposure and impact terms as shown in Table 6 below. These scores are calculated automatically in the Excel spreadsheet once the temporal, spatial, and impact scores have been entered for that limiting factor. This concludes the Level 1 risk assessment. The Hobday risk assessment methodology suggests an increasing need for additional assessment as biological risk increases. Level 2 risk assessment involves additional analyses of existing data, determining possible relationships between the limiting factor and the stock, modeling of impact, and in depth evaluation of options. Level 3 risk assessment will likely include additional field monitoring.

Table 6. Risk categories and scoring- are based on values of exposure and impact

Biological Risk	Value	Action
Low (1)	1	No enhanced management needed; short justification
Moderate (2)	2 to 5	Full justification needed; no specific enhanced management strategy needed
Medium (3)	6 to 9	Some additions to current management needed, Level 2 risk assessment and full performance report needed
High (4)	12 to 16	Increases to current management probably needed, Level 2 risk assessment and full performance report needed
Very High (5)	20 to 25	Significant additional management needed, Level 2 risk assessment and full performance report needed

Appendix 2: Life history model

SIMPLE MODEL OF COWICHAN CHINOOK LIFE HISTORY

known: 5 year average smolt-adult marine survival is 1%; fishery related mortality is 63%
assumption: simple model based on wild only, one main age class.
assumption: hatchery indicator represents wild population wrt marine survival and exploitation rate
assumption: Smsy=6500=target. Capacity=7800 based on Parken. Lower benchmark=20%Smsy=1300 return.
assumptions: no compensation at higher level of spawners, no depensatory factors
assumption: no effect of hatchery

time period	life stage	Chinook	Mortality	potential limiting factors
Aug-Sep	terminal return	3,000	0.110	predation, poaching, salt water stress on eggs
Sep-Oct	inriver migrants	2,670	0.100	water temp stress, predation, poaching, broodstock
late oct - early	natural spawners	2,403	0.000	predation, water temp, habitat availability
late oct - Feb	eggs in gravel	4,445,550	0.700	scour, siltation, predation, freezing, dewater, oxygen, overspawn
Feb	alevin	1,333,665	0.300	predation, freezing, desication
March-June	fry migrating down	933,566	0.100	predation (pred or lack of cover), food, competition
April-July	smolts lower river	840,209	0.030	predation, cover, food, competition
May-Aug	smolts in estuary	815,003	0.500	predation, cover, food, competition
Aug-Jan	nearshore juveniles	407,501	0.969	predation, cover, food, competition
Year 2-4	feeders-adults	12,474	0.350	predation prior to return to Cowichan Bay
Year 2-4	mature adults	8,108	0.630	fishery
	terminal return	3,000		
	Rate of change	0%		