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Proceedings of the PSARC Salmon Subcommittee Meeting, April 14, 2005

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April 14, 2005
Nanaimo, B.C.

Al Cass
PSARC Chair

Fisheries and Oceans Canada
Pacific Scientific Advice Review Committee
Pacific Biological Station
Nanaimo, B.C. V9T 6N7

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PACIFIC SCIENTIFIC ADVICE REVIEW COMMITTEE (PSARC)
SALMON SUBCOMMITTEE MEETING

SUMMARY

Allowable Harm Assessment of Interior Fraser Coho

Interior Fraser coho have been recommended for listing as ‘endangered’ under the Species at Risk Act (SARA) by the Committee on the Status of Endangered Wildlife (COSEWIC). This working paper provided advice relating to survival and recovery targets in compliance with the requirement for DFO to provide an Allowable Harm Assessment as part of the SARA permitting framework. The Subcommittee accepted the paper with minor revisions.

SOMMAIRE

Évaluation des dommages admissibles concernant le saumon coho de l’intérieur du Fraser

Le Comité sur la situation des espèces en péril au Canada (COSEPAC) a recommandé l’inscription du saumon coho de l’intérieur du Fraser à la liste des espèces en voie de disparition en vertu de la *Loi sur les espèces en péril* (LEP). Le présent document de travail présente des conseils relatifs aux objectifs de survie et de rétablissement conformément à l’obligation pour le MPO de présenter une évaluation des dommages admissibles dans le cadre de la délivrance de permis en vertu de la LEP. Le Sous-comité a accepté ce document avec des révisions mineures.

INTRODUCTION

DETAILED COMMENTS FROM THE REVIEW

S2005-01 Allowable Harm Assessment of Interior Fraser Coho.

M. Folkes, B. Ionson and J. Irvine

"Accepted with minor revisions"

Subcommittee Discussion

The Working Paper was reviewed and accepted with major revisions at the March 3 2005 Salmon PSARC meeting. The conditions of acceptance included an opportunity for the Subcommittee to review the revisions. Revisions were submitted to the PSARC Secretariat in late March 2005 and then emailed to all participants in the March 3rd PSARC meeting. Participants were asked to indicate whether the revised Working Paper met the conditions of the Subcommittee. The requested revisions were to:

1) include a table of data inputs and commentary on their sources;

2) sample the like-last-year (LLY) forecast of the coho marine survival probability distribution to simulate interior Fraser coho (IFC) marine survival in both short (2-year) and long-term (3-generation) projections of spawning escapements;

3) include an auto-regressive component in the simulated long-term projections. The data series of marine survival estimates are highly autocorrelated (ρ=0.7);

4) terminate any simulated projection if the spawning escapement fell below the biologically-based limit reference point, and;

5) calculate the probability of recovery (population growth) as the proportion of the trials at the end of each simulated scenario that exceeded the initial 2002-2004 geometric mean escapement.

Nine responses were received by email and all respondents agreed the Working Paper met the five conditions listed above. The purpose of the April 14 meeting was to briefly review the revisions and to formulate Subcommittee advice. There were various minor editorial issues that the Authors agreed to include in a further revision of the Working Paper otherwise the Subcommittee concluded that the approach was sound.

The Subcommittee discussion focused on data uncertainties and the model structure used to project probabilities of survival and recovery as defined in the terms of reference for Allowable Harm Assessments. The simulations depend on IFC escapement estimates and surrogate marine survival rates. A Monte Carlo simulation

model used boot-strapped residuals from a Ricker and Beverton-Holt smolt-recruitment relationship to project smolt production and distributions of marine survival to estimate subsequent adult coho recruitment. Increments of exploitation rates were imposed on the recruits to simulate the effects of fishing on future spawner abundance over a range of exploitation rates.

The Subcommittee noted that the Fraser Canyon and Upper Fraser escapement values are merely extrapolations from proportions of the North + South Thompson estimates for years prior to 1998. The Subcommittee asked the Authors to include more discussion of the assumptions used to derive the data for the five populations in the Designated Unit (DU) and the corresponding uncertainty. The Subcommittee noted that the available escapement data are largely based on visual surveys and that the quality of the data is variable throughout the series. The Authors agreed to revise the Working Paper accordingly to specifically clarify the various sources of uncertainty in the escapement estimates. The authors and the Subcommittee both acknowledged, however, that the IFC Allowable Harm Assessment was not intended to be a comprehensive status assessment and noted that such a review is due. The last IFC assessment was reviewed in 2000.

The Subcommittee acknowledged that the marine survival estimates used to estimate IFC smolt production and model the IFC DU are surrogates from non-IFC populations (Black Creek and the Salmon River in the lower Fraser). The Subcommittee noted that the marine survival used in the simulations is critically important and that the use of a surrogate time series undoubtedly adds to the overall uncertainty of the results but that the increase in uncertainty cannot be quantified.

The Subcommittee discussed the implications of using different smolt-recruitment functions. The Ricker model predicts lower smolts production at low escapements and fewer adult recruits at modeled high escapements compared to the Beverton-Holt model. The Subcommittee observed, therefore, that the Ricker model is more precautionary. The differences between the two models were small particularly given the high uncertainties in escapement and marine survival and management uncertainty in meeting harvest targets.

The Subcommittee discussed the estimates of spawning capacity presented in the Working Paper and noted that there are many uncertainties and that there was no scientific consensus on the escapement required to seed the available habitat. The authors agreed to clarify their discussion of capacity to acknowledge those uncertainties. The Subcommittee noted, however, that the estimates of capacity are not germane to the Working Paper because habitat is likely not limiting population growth at the present time. The Subcommittee noted that estimates of habitat capacity will become important as IFC rebuild and and the focus shifts to management targets and allowable fishing.

The Subcommittee noted that the biologically-based reference point identified by the IFC Recovery Team (2004) was specified as a range of 20,000 to 25,000 spawners

for the DU. The Subcommittee recommended that the Authors use the more precautionary mid-point of 23,000 spawners rather than 20,000 spawners in the revised Working Paper. The Authors agreed.

The Subcommittee discussed two issues related to the assessment of risk for Allowable Harm Assessments for a species such as coho. First, most habitat impacts are localized at the sub-population level or at even finer scales and such impacts are not easily incorporated into assessments at the DU level. The Subcommittee agreed that impacts at the subpopulation level are a potential concern and noted that this is why the Recovery Team recommended that more than half the subpopulations within each population be viable before the DU is considered recovered. Consideration of the impacts and threats posed by habitat impacts such as water withdrawal for irrigation await a full status assessment.

Second and in the context of short-lived, exploited and actively managed species such as IFC, the Subcommittee expressed concerns with the length of the listing process. If management agencies respond promptly to developing conservation problems then population recovery is possible before the listing process can conclude. For example, the Subcommittee discussed the implications of recent increases in escapement noting that the running 3-year geometric mean for the DU has remained above the 20,000-25,000 benchmark since 2000. In the context of the Wild Salmon Policy, and based on the 3-year geometric mean, IFC are no longer in the critical Red Zone but are in the Amber Zone of cautious management. Although the escapement to the DU in one year of the last three (2003) was still below the lower escapement benchmark, imminent extinction appears unlikely.

To help in formulating advice, the Subcommittee requested the Authors provide survival and recovery probabilities by exploitation rate in a decision table. Ensuing discussion centered on the information to include in the table. The Subcommittee agreed that because the incidental harm permitting period is two years, as prescribed by SARA, that a 2-year projection period to assess the probability of survival and recovery under assumed future levels of exploitation is appropriate. The Subcommittee also agreed that the Ricker smolt-recruitment relationship and the 2004 like-last-year (LLY) forecast distribution of marine survival should be the inputs into the simulations model. An additional decision table for a 3-generation (9-year) projection period would be useful for assessing longer-term survival and recovery probabilities. The later should be based on the same LLY marine survival forecast distribution with the inclusion of an auto-regressive term to account for the autocorrelation in the historical marine survival rate series. Projections presented in the Working Paper indicate that the probability of survival and recovery are highly sensitive to assumptions about future marine survival rates. The Subcommittee noted that the 3-generation projections are more uncertain than 2-year projections because uncertainty in future marine survival rates increases with time. In addition, longer term projections with fixed annual exploitation rates, as used in the simulations, do not account for increasing opportunity to annually adjust exploitation in response to variable IFC abundance over time.

Other instruction to the Authors

The Subcommittee noted that the use of terms such as “recovery”, “population growth” and survival” used in the Working Paper need to be used in a consistent manner throughout document. Furthermore, referring to benchmarks of capacity such as S_{MSY} as targets or objectives can be misleading. The Authors agreed to re-word the text accordingly in that regard and to cite the Bradford and Wood (2004) PSARC Working Paper that assesses the rationale for the biologically-based limit reference point for IFC.

One Subcommittee member questioned the values in Table 1 of the Working Paper and the authors agreed to check their calculations of percent change in the escapement trends for North and South Thompson coho. The Authors were also asked to explicitly describe the algorithms (i.e. COSEWIC formulae) used to quantify the rate of decline in IFC escapement estimates.

The Authors agreed to update the figures and text in the Working Paper to include 2004 values that show trends in recruits/spawner and population growth rate.

The Subcommittee was concerned that some of the comparisons of current and past numbers that used percentage changes in escapements exaggerated such changes. The Subcommittee asked the authors to clarify the discussion on the recent versus historical escapements using a figure that shows the frequency distribution of escapement data and recent levels relative to the median or mean of the distribution.

Subcommittee Conclusions

The Working Paper was accepted with minor revisions.

The Subcommittee concluded that the approach used by the Authors to assess the probability of survival and recovery was sound in the context of the terms of reference for the Allowable Harm Assessment. The Subcommittee agreed that a more comprehensive treatment of all data including those related to habitat would be required to assess the stock status of interior Fraser coho.

The Subcommittee concluded that the Ricker stock-recruitment model should be used in the development of a decision table showing survival and recovery probabilities at relevant exploitation rate intervals because it is more conservative than the Beverton-Holt model.

The Subcommittee concluded that the 2004 like-last-year probability distribution of the marine survival forecast be used to model marine survival in development of the decision table. The long-term projections should also include an auto-regressive term to simulate the level of autocorrelation estimated in the marine survival time series.

The Subcommittee concluded that because uncertainty in marine survival and management increases with time, there is less confidence in the 9-year projections compared to the 2-year projections. The high autocorrelation in marine survival rates suggests that the recent lower than average survival rates will prevail for the next few years (i.e. like-last-year marine survival forecast distribution). The decision table (Table 1A) shows that for the 2-year projections, the probability of survival at a 13% exploitation rate (present status quo management regime) is 90% compared to 95% with zero harvest. The difference between the probability of positive population growth R for the interval $1 < R \leq 1.5$ at a 13% exploitation rate is 53% compared to 57% with zero harvest. Differences of that magnitude are small given the uncertainty in the data and the management system.

The 9-year projections are not only more uncertain but are more pessimistic than the 2-year scenario. This is because there is more opportunity for projected escapements to fall below the survival and recovery benchmarks with time. Furthermore, in the 2-year projections, the probabilities of survival and recovery are based on a 3-year geometric mean that includes the constant and relatively high observed escapement in 2004. The decision table (Table 1B) reveals that differences in survival and recovery probabilities across likely exploitation rates are very small (<2%).

The importance of future marine survival on status of IFC cannot be understated. The Subcommittee concluded that maintaining spawning escapement levels above the biologically-based limit reference point will increase the probability of positive population growth should marine survive rates remain above mid-1990 levels (>2%). Negative population growth is probable even in the absence of fishing if marine survival rates fall.

Subcommittee Recommendations

1. The Subcommittee recommended that the decision table (Table 1) be used to assess the effect of exploitation on the probability of survival and recovery of IFC.

2. The Subcommittee recommended that a status assessment of IFC is required and should include a comprehensive treatment of all data including those related to habitat impacts on freshwater productivity and capacity.

Table 1. Effect of exploitation rate on probability of survival and recovery. The shaded rows indicate the present fishery breakpoints by exploitation rate (see footnotes).

A. Short term (2-year) projection

Exploitation Rate (ER)	*Probability of survival (remaining above 23,000 spawners)*	*Absolute change in the probability of survival from status quo ER (13%)*	*Probability of recovery (growth beyond recent 3-year mean escapement) based on the ratio R of terminal series:initial escapement*				
			R≤0.5	*0.5< R ≤1.0*	*1.0< R ≤1.5*	*1.5< R ≤2.0*	*R >2.0*
0%	95%	4.8%	0.00%	24%	57%	16%	2%
10%[a]	92%	1.5%	0.02%	33%	54%	11%	1%
11%[b]	91%	0.9%	0.01%	34%	54%	10%	1%
12%	90%	0.2%	0.00%	35%	54%	10%	1%
13%[c]	90%	0.0%	0.01%	36%	53%	10%	1%
14%	90%	-0.2%	0.02%	38%	52%	10%	1%
15%	89%	-1.1%	0.01%	39%	51%	9%	1%
25%[d]	82%	-8.5%	0.04%	52%	43%	5%	0%

B. Long-term (3-generation) projection

Exploitation Rate (ER)	*Probability of survival (remaining above 23,000 spawners)*	*Absolute change in the probability of survival from recent ER (13%)*	*Probability of recovery (growth beyond recent 3-year mean escapement) based on the ratio R of terminal series:initial escapement*				
			R≤0.5	*0.5< R ≤1.0*	*1.0< R ≤1.5*	*1.5< R ≤2.0*	*R >2.0*
0%	58%	8%	2%	45%	13%	10%	30%
10%[a]	52%	2%	3%	51%	12%	10%	25%
11%[b]	52%	1%	3%	51%	13%	10%	24%
12%	51%	0%	3%	52%	12%	10%	24%
13%[c]	51%	0%	2%	52%	12%	10%	23%
14%	50%	-1%	2%	53%	12%	10%	22%
15%	49%	-1%	3%	53%	12%	10%	22%
25%[d]	41%	-9%	3%	61%	11%	8%	18%

a: US fishing only
b: no Canadian sport
c: status quo
d: permissible total exploitation at next step (moderate abundance) in PST Annex Agreement

APPENDIX 1: Working Paper Summary

S2005-01 Allowable Harm Assessment of Interior Fraser Coho.

M. Folkes, B. Ionson and J. Irvine

In 2002 COSEWIC designated Interior Fraser River coho (IFC) as “endangered”. IFC could become legally listed in 2005 under the Species At Risk Act (SARA). This Working Paper responds to a request to assess the potential for incidental harm permitting. Questions addressed in the Working Paper were: 1) What is the present/recent species trajectory? 2) What is the present/recent species status? 3) What is the expected order of magnitude/target for recovery? 4) What is the general time frame for recovery to the target? And 5) What is the maximum human-induced mortality which the species can sustain and not jeopardize survival or recovery of the species?

When IFC were assessed by COSEWIC, the rate of decline during the 3 most recent generations (1990-2000) was ~60%, within COSEWIC’s endangered status criteria range. We recalculated rates of change using updated information - the 3 most recent generations of North and South Thompson coho (1994-2000) increased by ~70%.

An immediate biological recovery goal of 20,000-25,000 wild spawners (3 year geometric mean) set by the Interior Fraser Coho Recovery Team was exceeded during 2001-2003 (34,000) and 2002-2004 (~30,400). Yet, escapements remain low relative to historical highs, and the most recent escapement did not achieve brood levels.

We assessed harvest impacts on escapement in both a two year and three generation (nine years) time frame, considering the sensitivity to assumptions about the form of the smolt-recruitment relationship using a Ricker and Beverton-Holt smolt-recruitment function. Marine survival and its uncertainty were represented using surrogate estimates from wild coho from Black Creek (East Coast Vancouver Island) and the Salmon River (lower-Fraser). Simulated projections of marine survival sampled distributions of recent low survivals as well as long-term distributions that included regimes of high and low survivals.

Recognizing that the Beverton-Holt model likely better represents density dependent smolt production dynamics than the Ricker model, we only provide Beverton-Holt results. Under current exploitation rates (ER~13%), the probabilities of survival (remaining above 23,000 wild spawners) over the next 2 yrs > 90% with either Like-Last-Year (LLY) or recent marine survivals. Probabilities of survival over the next 2 yrs also exceeds 90% at 20% ER. Over 3 generations, there is a 71-74% probability of remaining above 23,000 spawners at the current exploitation rate. This drops by 5-7% if ER is increased to 20%. In the longer term, maintaining current exploitation rates could result in one of every four years having a generational average escapement below the desired benchmark needed to conserve genetic and demographic diversity in the DU.

The ratio of final and starting escapements indicates the impact of harvest. The probabilities of achieving specific escapement ratios are referred to as *terminal probabilities*, and are presented in both the short and longer term trajectories. Longer term probabilities of remaining above recent escapements range between 61 and 68% at the current ER. This probability drops by 5-7% if ER is increased to 20%. Thus at current exploitations, we can expect one out of every three years to have a generational mean escapement lower than current levels.

APPENDIX 2: PSARC Salmon Subcommittee Meeting Agenda, April 14, 2005

PSARC Salmon Subcommittee Agenda
April 14, 2005
1:00-4:30
Nanaimo BC

1:00-4:00	Review of working paper*, Allowable Harm Assessment of Interior Fraser Coho*– Authors: M. Folkes, B. Ionson and J. Irvine

APPENDIX 3: List of Attendees

MEETING PARTICIPANTS

Al Cass, Meeting Chair
Blair Holtby
Chuck Parken
Diana Dobson
Jim Irvine
Kent Simpson
Kim West
Michael Folkes
Mike Chamberlain
Richard Bailey
Rick McNichol