Comments on PFMC SRKW Workgroup Draft Risk Assessment of Sept 11 2019

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The SRKW workgroup has initiated an important review of PFMC Chinook fisheries and their implications for SRKW. However, the composition of the workgroup indicates that it is not an independent scientific group. It is composed principally of tribal and state fish and wildlife staff whose prime responsibilities are fisheries management. Only a few of the team members, principally NMFS science staff, have the strong technical capabilities in salmon and ecosystem modeling to produce a quantitative assessment of the risk PFMC (Council) Chinook salmon fisheries pose to the survival of the Southern Resident Killer Whale (SRKW) DPS. As such, there are constraints to receiving the products of the workgroup as appropriate to accomplishing this critical task.

The Draft Report (DR) provides a reasonable summary of the status of the SRKW population, its component pods (J, K, and L), and acknowledges the dependence of the population on Chinook salmon. Importantly, the DR acknowledges the evidence accumulated over the past decade that demonstrate significant correlations between various indices of annual Chinook salmon abundance and demographic vital rates of SRKW. Unfortunately, the authors of the DR prevaricate about the significance of this dependence due to inability of the analyses to establish a clear causal relationship between Chinook abundance and SRKW demography.

The DR needs a clear, strong statement regarding the critically endangered status of the SRKW DPS (see DFO's 2019 SAR and PVA model outputs that indicate ongoing population decline with a 26% probability of quasi-extinction (one sex) within 75-97 years https://www.dfo-mpo.gc.ca/csas-sccs/Publications/SAR-AS/2019/2019_030-eng.html.) and the associated need for immediate management measures to arrest further decline.

The DR should be clear at the outset that this constitutes a conservation emergency. The benefit of the doubt regarding candidate management measures under the control of the Council must

favor the DPS in accordance with the priority that society places on ESA-listed endangered populations.

The DR's description of the management structure of the Council Chinook fisheries under the current Pacific Salmon Plan (PSP) reveals the shortcomings of the data. This applies to annual Chinook salmon abundance and distribution, and fishery impacts on Chinook stocks known or potentially important to foraging SRKW within their existing and proposed critical habitat.

Similarly, the DR provides evidence concerning the uncertainty of the relationship of various indices of Chinook salmon abundance to SRKW demographics. This uncertainty is due to two primary factors: uncertainties regarding the accuracy and appropriateness of the individual indices of Chinook abundance and distribution, and uncertainties concerning the strength of association between Chinook abundance or distribution indices and specific SRKW demographic parameters. Among the former uncertainties, are uncertainties regarding the age-distribution of Chinook, maturation rates, and the abundance and proportion of immature Chinook in the several stocks subject to Council fisheries. The latter uncertainties are due primarily to small sample sizes which themselves are due to the low population size of the SRKW population and its component pods. These uncertainties are further compounded by the interaction of lack of Chinook prey and other factors known to pose threats to the viability of the SRKW population, in particular vessel noise and toxics contamination. Inevitably, therefore, there is considerable noise in much of the demographic data pertaining to the relationships between SRKW demographics and indices of Chinook prey.

The decision to rely primarily on the results of the Shelton model (Shelton et al. 2018) to characterize coast-wide Chinook distribution seems reasonable, although it too, like FRAM, is compromised by having to rely nearly entirely on hatchery CWT data. However, Shetlon et al.'s results show that there is considerable uncertainty in the estimates of the annual abundance and spatial distribution of particular stocks or combinations of stocks that cannot be resolved without additional research and data acquisition. Even with such research, it is unclear that additional precision in estimates of stock-specific abundance and spatio-temporal distribution will resolve the issues surrounding fine-scale adjustments of Chinook harvest to the benefit of SRKW. This

highlights the importance of developing a value-of-information analysis as a component of the risk assessment, which is absent in the DR.

This reinforces the importance of emergency reductions in Council Chinook salmon fisheries that should not be delayed until additional research resolves these uncertainties. Such reductions would also be consistent with according SRKW the benefit of the doubt and appropriately placing the burden of proof on Chinook fisheries. Research and monitoring can be undertaken simultaneously with harvest reductions.

These uncertainties also provide evidence that there is a limit to the ability of stock assessment to provide the level of detailed information necessary to conservatively manage individual Chinook populations and stock aggregates in coastal mixed-stock fisheries. The current plight of the SRKW DPS provides clear evidence that this has, and will probably continue to be, the case.

In addition, there is lack of data and associated uncertainty regarding the age-structure and maturation rates of Chinook stocks in both the FRAM and the Shelton et al. model. The DR does acknowledge that SRKW prefer larger, older age 4+ Chinook salmon and notes that ocean mixed-stock Chinook fisheries encounter and harvest immature, particularly age 2 and 3 Chinook. But there is no effort made to consider addressing ocean fisheries as a means to rebuild an older, more historical age structure of Chinook populations within SRKW proposed or existing critical habitat. Given, the uncertainties noted, there seems good reason to doubt that restoring the historical age/size structure of Chinook can be undertaken while continuing with coastal mixed-stock Council (and more generally PST) Chinook fisheries. Thus, the DR should consider that the mixed-stock nature of these fisheries themselves pose a risk to the survival of the SRKW DPS.

All of this argues for a fully Bayesian risk assessment framework capable of providing probability distributions of the risks posed to SRKW by Council Chinook fisheries. Unfortunately, the risk assessment approach outlined in the DR does not adopt such an approach. The most probable outcome of this failure as the workgroup continues, is to significantly under-estimate the risk Council Chinook fisheries pose to SRKW.

The current model runs reported in section 5, page 47, should be reconfigured using a Bayesian framework so that the results of the regressions can be stated as posterior probability

distributions, and not uninformative and problematic frequentist p-values and associated confidence intervals (CIs). Such revised analyses would clearly and properly display the uncertainties of the analyses (and associated model assumptions) which is necessary to display the risk posed to SRKW by failing to appropriately revise Chinook harvest rules. This would also make transparent the burden of proof that is being placed on the SRKW.

In commenting on the statistical significance of the fitted regressions (based on a traditional frequentist statistical approach) the DR acknowledges that "especially when the data are noisy or confounding variables are not accounted for, it is possible for a real effect to be present despite the data having a pattern no more extreme than one that could be explained by chance alone (large p-value). Given the lack of statistical significance, the results should be interpreted with caution. Nevertheless, in almost all cases the fitted relationships were of the expected sign (i.e. survival and fecundity increased with increasing Chinook abundance while occurrence of peanut-head decreased with increasing Chinook abundance)" (p. 47).

Bayesian regression analyses would produce probability distributions of the fitted relationships (instead of dubious p-values and CIs) and require that threshold probabilities be identified for concluding that no action on Chinook harvest is warranted. More appropriate still, is to embed such regression analyses in a broader Bayesian population viability analysis (PVA) that would provide a probability distribution of time to extinction or quasi-extinction. This would reflect the manner in which the Chinook indices-SRKW demographic indices regression contribute to the overall extinction risk, and hence how managers are weighting the risk that Chinook abundances and distributions pose to SRKW persistence. In view of the fact that three PVAs on SRKW have been published (Velez-Espino et al. 2014, Lacy et al. 2017, Clarke-Murray et al. 2019) it is surprising and disappointing that neither the workgroup or NMFS have incorporated their findings or undertaken an 'official' PVA themselves. Such considerations could provide guidance on the critical decision facing the workgroup.

The ESA accords the greatest benefit of the doubt to populations listed as endangered. In particular, in any jeopardy evaluation, the burden is to show that the proposed action will not jeopardize the continued existence of the listed population(s). It is clear from the recent history of the SRKW DPS and the management of Chinook salmon harvest under the PST and PSP (which govern Council Chinook fisheries) that the current fishing regimes remove prey from a

food-stressed SRKW DPS. The only uncertainties concern which fisheries adversely affect which Chinook salmon stocks and by how much, when and where, with respect to the prey requirements of foraging SRKW. The burden of these uncertainties must fall on the fisheries, not on endangered whales. This is especially so in the current context, where the immediate management emergency is to take actions that have the greatest probability of bounding the SRKW DPS away from its decline toward extinction. This requires stabilizing the population growth rate, which is currently negative (lambda ~ 0.99, equal to an annual decline in DPS abundance of 1% per year (Velez-Espino et al. 2014, Lacey et al. 2017, Clarke-Murray et al. 2019).

Further, in light of the renewal of the PST, the burden of Chinook harvest reductions that may be undertaken to attempt to halt the decline of the SRKW DPS must fall on the Council fisheries. The April 9 2019 NMFS Biological Opinion concerning the Consultation on the Delegation of Management Authority for Specified Salmon Fisheries to the State of Alaska makes it clear that NMFS considers Treaty Chinook fisheries as configured pursuant to the 2019 Pacific Salmon Treaty to jeopardize ESA-listed Puget Sound Chinook and SRKW[1]. NMFS's finding that there is a need to further mitigate the effects of Chinook harvest beyond what is provided for in the Treaty is tacit admission that, absent the proposed mitigation measures, NMFS would have had to conclude jeopardy. Regardless of the proposed mitigation measures (which are conjectural and dependent on uncertain future funding), the BiOp makes it clear that Chinook harvest poses jeopardy to SRKW, and since Treaty harvest measures have therein been given ESA take coverage, the burden for further necessary modifications in US coastal Chinook fisheries falls on the Council fisheries.

[1] The 2019 BiOP admittedly does not explicitly use the term 'jeopardy'. The exact language is "… the status of Puget Sound Chinook salmon and SRKWs have declined in recent years. A key objective of the U.S. Section during the negotiating process for a new Agreement was therefore to achieve harvest reductions to help address ongoing conservation concerns for Puget Sound Chinook and coincidentally provide benefits for SRKWs", and continues "Further reductions [in Chinook harvest in PST fisheries] are proposed in conjunction with the 2019 Agreement, but there was a practical limit to what could be achieved through the bilateral negotiation process. As a consequence, and in addition to the southeast Alaska, Canadian, and SUS fishery measures identified in the 2019 PST Agreement, the U.S. Section generally recognized that more would be required to mitigate the effects of harvest and other limiting factors that contributed to the reduced status of Puget Sound Chinook salmon and SRKWs" (pp. 9-10).

Accordingly, the risk assessment to be undertaken (or completed) by the working group must identify changes to Council fisheries that, in conjunction with PST Chinook fisheries beyond the control of the Council, alleviate jeopardy to the SRKW. This requires, as already noted, that the risk assessment be framed as a population viability analysis (PVA) that produces SRKW population trajectories and associated extinction probabilities under the current conditions and under candidate management changes to Council Chinook fisheries, starting with a default complete closure of Council Chinook fisheries for a minimum period of time based on SRKW demography. This will likely be at least 5 and more reasonably 10 years, if not more.

Further, the criterion for the target response by SRKW needed to avoid jeopardy should not be a population growth rate of 2.3% /yr. for 28 years required under the SRKW Recovery Plan. This growth rate is inappropriate to a declining small population on the verge of an extinction vortex. Rather, the issue is to arrest the decline and preserve the reproductive potential of SRKW. This suggests that the target short-term annual population growth rate should be on the order of 1% over the next 10 to 20 years. An annual growth rate of one-half of one percent (0.005) would succeed in stabilizing the SRKW at slightly above the current number (73), provided the variance in that growth rate can be made sufficiently small. A steady average annual population growth rate of 0.005 would result in an average SRKW population of 81 individuals at the end of 20 years (compared to the current population of 73). A growth rate of 0.01 would achieve this population size in 10 years and a population size of 89 in 20 years. Modest as this would be, it is a significant step in the right direction compared to the recent negative population trend. An annual population growth rate in the range of one-half to one percent (0.005 to 0.01) appears to have a high probability of being achieved by the termination of all council directed Chinook fisheries. This also indicates that analyses (e.g., Hilborn et al. 2012, and Velez-Espino et al. 2014) that have concluded that further reduction or even closures of coastal Chinook fisheries are unlikely to achieve (in the near term at least) the NMFS SRKW Recovery Plan target annual population growth rate of 2.3% are misleading, if not misguided. The emergency conservation issue is not how to achieve an immediate annual growth rate of 2.3%, but rather the more urgent and appropriate goal to arrest the recent decline, stabilize the population and facilitate its slow rebuilding.

References

Hilborn, R., S. P. Cox, F. M. D. Gulland, D. G. Hankin, N. T. Hobbs, D. E. Schindler, and A. W. Trites. 2012. The Effects of Salmon Fisheries on Southern Resident Killer Whales: Final Report of the Independent Science Panel. November 30, 2012. Prepared with the assistance of D.R. Marmorek and A.W. Hall, ESSA Technologies Ltd., Vancouver, B.C. for NMFS, Seattle, Washington and Fisheries and Oceans Canada (Vancouver. BC). 87p.

Lacy, R.C., R. Williams, E. Ashe, K.C. Balcomb, L.J. N. Brent, C.W. Clark, D.P. Croft, D.A. Giles, M. MacDuffee and P.C. Paquet. 2017. Evaluating anthropogenic threats to endangered killer whales to inform effective recovery plans. *Scientific Reports* 7, Article no: 14119doi:10.1038/s41598-017-14471-0

Murray, C.C., Hannah, L.C., Doniol-Valcroze, T., Wright, B., Stredulinsky, E., Locke, A., and R. Lacy. 2019. Cumulative Effects Assessment for Northern and Southern Resident Killer Whale Populations in the Northeast Pacific. DFO Can. Sci. Advis. Sec. Res. Doc. 2019/056. x. + 88 p.

NMFS 2019. Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response Consultation on the Delegation of Management Authority for Specified Salmon Fisheries to the State of Alaska NMFS Consultation Number: WCR-2018-10660.

Shelton, A. O., Satterthwaite, W. H., Ward, E. J., Feist, B. E., and Burke, B. 2019. Using hierarchical models to estimate stock-specific and seasonal variation in ocean distribution, survivorship, and aggregate abundance of fall run Chinook salmon. Canadian Journal of Fisheries and Aquatic Science 76:95-108.

Vélez-Espino, L.A., J.K.B. Ford, H.A. Araujo, G. Ellis, C.K. Parken and R. Sharma. 2014b. Relative importance of Chinook salmon abundance on resident killer whale population growth and viability. *Aquatic Conservation: Marine and Freshwater Ecosystems*.