PACIFIC SALMON COMMISSION

ESTABLISHED BY TREATY BETWEEN CANADA
AND THE UNITED STATES OF AMERICA
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600 – 1155 ROBSON STREET
VANCOUVER, B.C. V6E 1B5
TELEPHONE: (604) 684-8081
FAX: (604) 666-8707

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MEMO

To: Alex Hall and others

From: Steve Latham

CC:

Re: Using test fisheries and other questions/comments following SRKW workshop 2

Information on fishing times and locations, relative Chinook (and other prey) availability, and Chinook (and other prey) sizes and ages could be obtained from PSC and DFO test fisheries. Some data from 2011 are attached to provide an example; similar data are available in decreasing amounts going back to 1986. I have included a few figures below. Test fisheries for sockeye and pink salmon include Areas 12 and 13 purse seine and gill net (upper and lower Johnstone Strait), Area 20 purse seine and gill net (northern Juan de Fuca Strait), Area 5 gill net (southern Juan de Fuca Strait, not shown), Area 7 reef net (San Juan Islands, not shown), Area 29 troll (Strait of Georgia, not shown), and others; they tend to cover the summer period from July to early September. Test fisheries are conducted with vessels and gear that are equivalent or similar to those used in the prosecution of commercial fisheries. In some summers (e.g., 2007 and 2009), test fisheries represent the dominant 'commercial' salmon fishery operations in these areas. DFO conducts a test fishery targeting chum salmon in autumn after the conclusion of the sockeye & pink salmon test fishery in Area 12 (not shown).

The potential value of information from test fisheries for SRKW analyses is indicated in the panel's response to workshop 1 (http://essa.com/media/killerwhale/KW-Workshop-1-Science-Panel-Response-FINAL-111511.pdf; section 8.1): "The most useful data presented to us concerning size-selectivity of killer whales were presented in Ford's foraging talk and are based on Ford & Ellis (2006) … age composition of Chinook was based on test seine fisheries in the immediate vicinity of the foraging whales." The test fishery in question is the Area 12 purse seine (although Chinook ages were not taken from test samples, see below), and I believe the foraging data for comparison were from NRKW. I have summarized catch per effort data for Areas 12, 13, and 20 test fisheries by week. To 'standardize' the effort, I calculated the average effort per day within each test fishery then summed up the total number of 'average-day' equivalents in each week. Catches were also summed by week. Thus, CPE (y-axis) indicates the catch on a typical day within each week of the year (x-axis). In addition to abundance, catchability likely changes with date, but catchability may vary similarly for both SRKW and test fishing gear. Therefore, it is possible that these data could be used to index availability of various prey species by date <u>within</u> test fisheries. With care, this may also be done among years to evaluate longer term changes in relative prey availability. (Note that data are summarized coarsely; much more precise information on time and location of test fishing is available, see attachment.) Overlapping such information with available presence/absence, abundance, or activity budget data on orcas might yield information on a variety of relevant questions (including possible acoustic displacement of the orcas).

The data in this form cannot be used to estimate abundance of prey species as the PSC does with sockeye salmon (the Albion test fishery in the Fraser River is used to estimate Chinook abundance, but to my knowledge migration rate and route information are not known for the purpose of reconstructing abundance in particular marine areas), and the data cannot be used to compare relative availability of prey species among areas. Catchability differs greatly among areas and gear, and even gear within a type tend to differ among areas (examples: the seine net in Area 20 is considerably larger than the seine nets in Johnstone Strait, the Area 5 gill net is larger and constructed differently than the Area 12 gill nets). PSC test fisheries target Fraser River sockeye and, in odd-numbered years, pink salmon. Thus the mesh size of gill nets is smaller than the maximum girth of average sockeye and pink salmon (and so will be ineffective on Chinook, particularly larger

individuals), trollers fish patterns and flashers that are effective for sockeye and pink salmon, and seines are fished in locations where sockeye and pink salmon shoal. Ford & Ellis (2006) cite Candy & Quinn (1999) for estimating Chinook depths of 25-64 m versus sockeye depths of 15 m. Owing simply to the construction and deployment of seine nets used in Johnstone Strait, catches will be biased against Chinook – the bottom of a seine net while towed would be at 36-40 m depth, but would only be effectively fishing down to 24-30 m (Chris Ashton, Fraser River Panel member for Area B, pers. comm.; he adds that sockeye and pinks are targeted on the Vancouver Island side of the strait whereas he thinks Chinook salmon tend to use the mainland side). Therefore even though, for example, the apparent difference in chum salmon in Johnstone Strait versus Juan de Fuca Strait is intriguing, comparisons among species and areas are problematic.

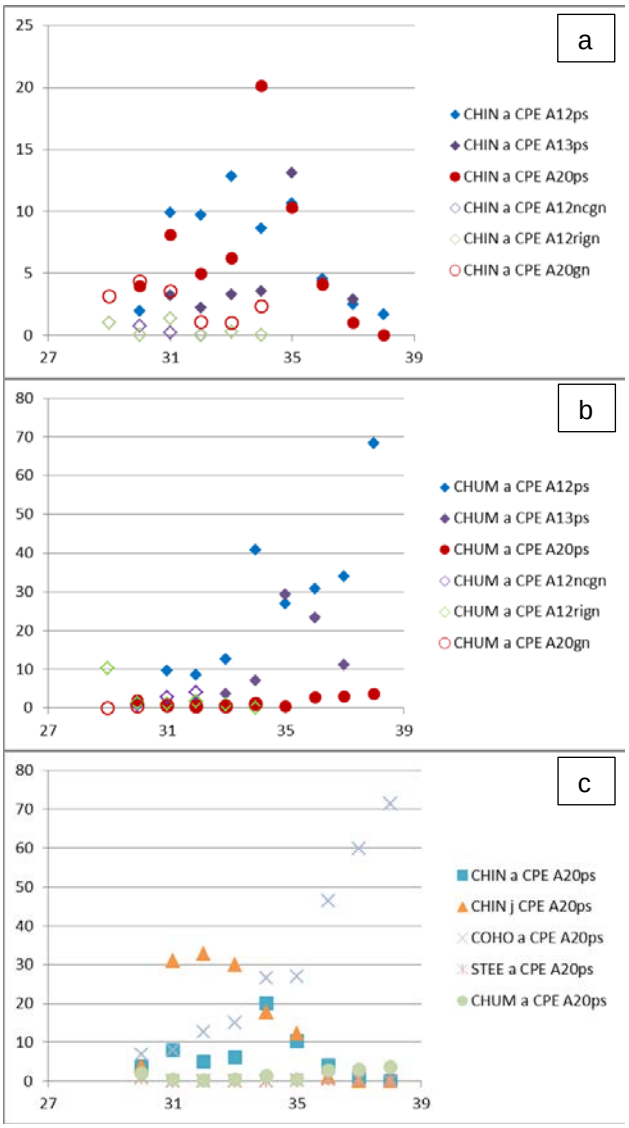

Figure 1. 'Standardized' catch per effort (y-axis) by week of the year (Sunday-Saturday, x-axis) for 2011 test fisheries in areas 12, 13, and 20. Figure 1a shows CPE for Chinook adults in purse seines (filled symbols) and gill nets (open symbols); Figure 1b similarly shows CPE for chum salmon. A12ncgn and A12rign represent test fisheries occurring in the vicinity of Naka Creek (southern Area 12) and Round Island (northern Area 12), respectively. Figure 1c shows CPE by week for various potential prey (Chinook adults, Chinook 'jacks', coho adults, steelhead adults, and chum adults) plotted together for just one test fishery (Area 20 purse seine).

Other caveats should be noted when attempting to use data from the test fisheries. For example, reliability of data for some prey species may vary with gear and year. Besides inherent variation among observers and

resulting differences in quality of species identification, gill nets may tend to have better species identification than purse seines because the gill netted fish are handled (whereas seines may release fish without bringing them aboard), estimates are likely to be better in even- than odd-years (because pink salmon may dominate purse seine sets and the presence of other species may be obscured), and small fish are less likely to be assessed accurately (particularly as Chinook jacks can look superficially like pink salmon, and very small fish may be caught in the bunt of a purse seine and not closely observed). This list of important caveats is not exhaustive, and any serious application of test fishing data should be done in collaboration with DFO or PSC test fishing biologists.

Collection of data from fish sampled by a test fishery would enhance the utility of species composition estimates (as a verification tool on species identification) and other parameter estimates. From one of the Response Papers (Ward-2012-selectivity-update.pdf) we have: "This update follows from Ward et al. 2010, "*Modeling killer whale prey size selection based upon available data*". In that analysis, Ward et al. had used 87 scale samples, collected by NMFS over the period 2004-2008. Three age compositions were considered in their analysis – the coded wire tag age structure (CWT), the age structure in the PSC test fishery, and the age structure in the FRAM assessment model (using the year 2002 as an example)." I had concerns regarding data taken from "the PSC test fishery", and several of these have been itemized above. After briefly questioning some of this following Mike Ford's talk (Ford-other-responses-talk.pdf), my current understanding is that no Chinook age data were obtained from the test fishery – ages were estimated by the CTC model. I believe this means that the age composition of Chinook available to orcas, particularly in areas where SRKW diet has been assessed, is very poorly known, even worse than previously thought.

To my knowledge, scale samples or size estimates have only rarely been collected from Chinook (or any species other than sockeye and pink salmon) in the marine test fisheries, although DFO's fall chum test fishery consistently takes samples. If size or age information at particular times and places is deemed essential, sampling requests should be submitted to the agencies running test fishing operations. Then, if samples will be collected, steps would need to be taken to understand how representative those samples are. Additional effort would be required for observers to obtain representative samples with respect to size. More problematically, as argued above, test fisheries themselves can be selective and this selection can operate on size even within species. This is more serious if fish of the same species behave and choose habitat differently at various sizes or ages. (Such differences have been detected by in-river test fisheries.) This issue may be particularly important if juvenile and maturing individuals are sympatric, as in Chinook. To the extent that test fisheries remain the same over time, however, biases may be somewhat stable and therefore facilitate interpretation as long as the context is understood.

Once again, if more information is desired regarding test fisheries and the opportunities they afford for near-term or long-term collection of data or analyses, or how the information can or should not be applied, the agencies conducting them should be contacted. In addition, it is my opinion that surveys/consultation of test fishermen and other fishers could be helpful in interpreting the data. This may also apply more broadly with respect to the general question addressed by the workshop; that is, fishers should be asked about effects of salmon fisheries on SRKW.

To summarize: I have argued above that analysis of test fishery data and samples may yield important findings relevant to SRKW management, but I have also argued that these data must be interpreted with great care. Below, I will make brief suggestions on topics aside from the potential use of data from test fisheries:

During question periods at the workshops, the audience sometimes wishes to refer to a specific slide to ask questions. I recommend that all presenters number their slides to facilitate this questioning.

The workshops, particularly the last one, have focused on Chinook salmon. I wonder if it's possible that chum are as important, especially since they may differ considerably in their geographic availability to NRKW and SRKW. If this is true, and if others also feel that the potential importance of chum and chum fisheries hasn't been sufficiently explored, I hope a more in-depth evaluation of chum will be scheduled for the third workshop.

During the workshops, it has sometimes been unclear what is being referenced during presentations. This occurs geographically (I suspect “inland waters” was defined differently in several presentations), with respect to populations (Ford & Ellis collected data mostly on NRKW diet preferences, but I think these were believed to be data on SRKW diet), and possibly in other regards. Table 6 from Ford & Ellis (2006) shows that the one sockeye and two steelhead(!) in their foraging study were from the relatively few kills by SRKW that were observed. John Ford mentioned in the second workshop that SRKW don’t pilfer hook and line catches like NRKW do. There may be other differences to how these orcas interact with fish and fisheries. I recommend that differences between NRKW and SRKW should be tabulated, workshop inferences for SRKW that rely on NRKW data should be itemized, and these lists should be checked to determine whether any of the suspected differences violate assumptions of equal applicability.

In exploring density dependence, the presentation by Ward (Ward-lambda-comparison.ppt) shows model AIC values with respect density dependent effects on fecundity (slide 56). Region*totalM performs better than a null model based on (female?) age (and better than Region*totalPop). Numbers of orcas is not a sufficiently informative variable when a Chinook index is included. Ward concluded that Chinook abundance dominated any perceived density dependence. I may not be reading this correctly, but I wonder if Region*totalM performs better because males require more food and do not share. I tried to recommend that nutritional requirements by orcas be estimated from size structure of the orca populations (since required food depends strongly on body size), but I didn’t make my point clearly. Should total food required (combined NRKW and SRKW), as reconstructed from known demographic population structure, be compared to some Chinook availability index, and then the ratio of available Chinook to required Chinook be related to vital rates of SRKW? Why not?

During discussion, David Bain made a comment regarding effects of salmon fisheries on SRKW that do not involve fish removals. These included acoustic interference and other forms of disturbance. Given trends in productivity, and responses in fisheries management, I suspect that these kinds of effects <u>from fishing</u> have declined. It may be useful to determine whether or not this is the case, and the relative amount of this kind of disturbance coming from fishing operations versus other sources.

Possibly beyond the scope of this series of workshops, but strongly related is the issue of Chinook (and other prey) population dynamics. Reductions to marine fisheries catches have been examined within the context of particular years, but the effects of increased escapement have not. If terminal fisheries catches are not increased, larger spawning escapements will presumably result in larger run sizes. Is this mess of stock-recruit relationships worth addressing?

Finally, and certainly beyond the scope of the current workshops, I have been struck by how much is known regarding the whales and how little is known about the Chinook and other species upon which they rely. Unfortunately the former responds so little over observable time scales (fecundity and survival of SRKW), and uncertainties in the latter (predictability of abundance and knowledge of availability) both prevent understanding of their ecological interactions. Martha, the last passenger pigeon died in Cincinnati Zoo on Sept 1, 1914. Nearly perfect knowledge existed regarding the last passenger pigeons. But even so the cause of their extinction is uncertain such that it is unknown how or whether extinction could have been prevented after their population dropped below whatever threshold abundance may be proposed. Observational study may not be sufficient; I recommend intervention experiments with resident orcas. Feeding the orcas, reducing competition for their preferred prey, etc, should be considered in conjunction with increased effort in measuring effects on variables like body condition, hormonal state, and behaviour (in addition to fecundity and survival).

Steve Latham (Latham@psc.org)
Sockeye Stock Identification Biologist
Pacific Salmon Commission

Disclaimer: This communication has not undergone normal PSC technical review and approval procedures.