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MEMORANDUM

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FROM: Michele DeHart

DATE: August 4, 2015

RE: Technical Review Comments on May 29, 2015, DRAFT Report *Avian Predation on Juvenile Salmonids in the Columbia River: A Spatial and Temporal Analysis of Impacts in Relation*

The Fish Passage Center received a copy of the May 25, 2015, draft report *Avian Predation on Juvenile Salmonids in the Columbia River: A Spatial and Temporal Analysis of Impacts in Relation* by Evans et al. The FPC is providing the following technical review comments for the fishery management agencies in their consideration of the potential management application of the authors' conclusions from this report. Our review comments are summarized in the following list of points and detailed discussion. Overall, the conclusions from this report should be considered with caution and do not support management applications because they rely on two unproven assumptions regarding the cause of fish mortality.

- There are significant fundamental problems with the analytical approach used by the authors to estimate avian predation which seriously weaken the subsequent report conclusions.

- The two primary assumptions in the analytical approach are unproven, and determine the conclusions.
- The authors do not actually establish the level of mortality caused by birds.
- The authors neglect to address the effects of marking and handling, particularly of acoustic tagged fish, and the potential that those effects increase vulnerability to bird predation.
- The authors do not address the scientifically well-established mechanism of compensatory predation.
- The authors do not address or analyze the well-established effects of flow, water velocity, travel time, and fish condition on vulnerability to bird predation.

Specific Discussion

Two key assumptions of their approach must be addressed prior to accepting their conclusions about avian predation based on PIT-tag recoveries and management effects of reducing bird populations. **The first assumption is that PIT-tags deposited on bird colonies represent mortality ultimately caused by birds.** Even though the authors use the term **"proximate cause of mortality"** in attempt to dampen their reliance on this basic assumption, they often drop the word, proximate when discussing the results; attempting to diminish the importance of the qualifying adjective and the implications of this assumption to report conclusions. **Second, the authors assume that reducing avian colonies would benefit juvenile salmon survival, although they must also assume that predation is not compensatory—that other predators would not increase predation to fill the void left when birds are removed from the system.** A large body of scientific data and analyses exists on the subject of compensatory mortality and predation. The authors have completely ignored the mechanisms of compensatory mortality and the implications for the actual benefits which could be expected to accrue from removal of bird colonies.

The use of the phrase **"proximate cause of mortality"** is simply an acknowledgment that the real cause of mortality and/or the contributing factors to mortality are not considered in this analysis. When considering management actions, fisheries managers must address the actual, not proximate causes of fish mortality. A clear analysis of benefits from actions should be presented so that real effectiveness and expected benefits can be weighed among various management alternatives.

Basing bird colony management on this study could greatly overestimate the benefits to juvenile salmon of reductions in bird colony size. Based on recovering tags at bird colonies the authors seem to understand they cannot determine the ultimate cause of mortality, thus the use of

proximate which is both telling and misleading. More accurately, the authors could claim that birds are the proximate cause of PIT-tags being deposited on the bird colonies. The authors can only hope to establish that PIT-tags found on bird colonies represent the ultimate source of mortality if the tags that end up on the island were from fish that would otherwise have survived. The authors re-state the key assumption in their analysis in the final sentence of their report; "Assuming that birds are not consuming large numbers of dead or moribund fish and that other predators do not compensate for the niche created by a reduction in predation from particular colonies, management of piscivorous colonial water birds will likely enhance survival of juvenile salmonids." The authors cannot determine to what extent these assumptions are true. They have no way to determine what proportion of juvenile salmonid PIT-tags that ended up on the colonies would have died in the absence of avian predators. The authors must assume that mortality is not compensatory, which based upon the large body of scientific data and analyses is not true.

A growing body of scientific data and analyses has established that hydroelectric project passage and river passage conditions such as water velocity and flow increases the predation vulnerability of the fish; this means that the mortality assigned to the birds is overstated, and presents a serious weakness in the analytical approach presented by the authors of this report. Dam passage affects survival probability, fish condition, and fish travel time. All of these mechanisms could lead to increased predation vulnerability by birds. The ultimate cause of mortality is the key underlying concern, not just the proximate cause of the tags being deposited on the bird islands. Perhaps it is intentional that the authors used the word proximate, since it connotes "that which is closest to the observed result." But closest to a result in this case (tags deposited on bird colonies) does not equate to ultimate cause, and the authors do not attempt to separate predation from effects of dam operations/fish passage on predation vulnerability.

The authors neglected to take into account the relationship between dam operations and bird predation. Higher flows in 2014 and the drawdown of Wanapum pool resulted in more rapid water transit times and faster fish travel times than took place in 2012. They do not attempt to analyze the relationship between bird predation, flow and spill operations. In their discussion section the authors suggest that there is a very strong inference that reduced bird populations and estimated predation rates in 2014 was what allowed Grant County to meet their at-dam survival standards, without giving any consideration to the spill, flow and drawdown of Wanapum. They discuss that more predation occurs in forebay and tailraces of dams. They do not consider project operations like increased spill passage that can reduce forebay delay and therefore exposure to predators.

Previous publications by the authors suggest that survival was reduced for fish with compromised condition such as descaling and fin injuries. Evans et al. (2014) analyzed the effects of fish condition on adult return rates. They found that injury and disease were good predictors of adult return rates. Hostetter et al. (2011) found that descaling was associated with decreased survival. Bypass systems are sources of fish injury and descaling. This analysis seems to ignore those previous findings, suggesting instead that bird predation vulnerability is

unrelated to fish health (injuries and disease) and, therefore, the proportions of fish passing via turbine or bypass (those routes that are known to cause the greatest amount of injuries) would not be worthy of investigation as the proximate cause of injury leading to mortality. Even though the PIT-tags end up in bird colonies, there was an unknown proportion of those tags from fish that were either injured, stunned, or disoriented (in bypasses or turbines), or delayed in forebays, or were even dead and were subsequently capture by the birds. The authors cannot determine this proportion and choose to attribute all to birds.

Since the study took advantage of dual tagged fish, the acoustic tags histories should include route of passage information for all the fish. The authors should evaluate the proportions of fish that passed by each route at each dam and how that affected the probability of tagged fish being predated. Any information gleaned from that could at least provide some indication of the possible interaction between route of passage and likelihood of predation. There are still logical problems to overcome to determine avian predation by route of passage, but the results could provide some clues as to the effects of the fish route of passage at the dams on fish vulnerability to bird predation.

The double-tagging may have influenced avian predation rates and overall mortality estimates. The study should use PIT-only fish of similar size and condition to evaluate whether the double-tagging or additional tag burden caused by the acoustic tag influenced results. The truck transportation and release of fish upstream from their collection site may have similarly influenced results by increasing avian predation rates. A comparison of mortality rates between those reported in Evans et al 2015 and NOAA reach survival estimates (2014) showed that NOAA estimated that in 2012 PIT-tagged only fish showed a much lower mortality rate per kilometer (since fish travel time data were not available) in the same reaches. NOAA reported survival rates from Lower Monumental Dam to McNary Dam of 0.811. That translates to a mortality of 0.0016 per km. Evans et al. 2015 report mortality of 0.35 for dual tagged fish in nearly the same reach, for a mortality rate of 0.0038 per km which is nearly two-and-a-half times higher than that of PIT-tag only fish. This difference suggests that the acoustic tagged fish may exhibit some bias related to reduced survival relative to PIT-tagged fish, and thus the double-tagged fish could bias estimates of avian predation as well.

There were no tag-life corrections used within the study. It is unclear how study results would change if tag-life corrections had been made.

Deposition probabilities were assumed to be equal to those estimated from East Sand Island. There were no studies conducted on deposition probabilities for inland colonies for this analysis. Strong priors were used despite differences that may exist between inland and East Sand Island. This issue was recognized by Assumption A5 and the authors did state, “If, however, deposition probabilities of tagged smolts used in this study differed significantly from those reported in Hostetter et al. (2015), predation probabilities could be biased to an unknown degree.” It seems

that weaker priors should have been used to reflect this uncertainty in deposition probabilities for inland colonies.

It is troublesome that the authors "estimated positive rates of predation even when no direct evidence existed; i.e., when none of the tags whose detection history ended in a given segment were recovered on the colony of interest." This suggests that priors on detection probability and/or deposition probability may have been too strong or inappropriately specified.

It appears that an assumption on the independence of release location and predation probabilities is also required. Fish released immediately above colonies may have higher predation probabilities than fish released further upstream. This assumption does not appear to have been recognized or evaluated. It is unclear how violations of this assumption may have influenced the results.

Table A1 indicates that one steelhead was detected on the Foundation Island cormorant colony in 2012. Table B1 indicates that the Foundation Island cormorant predation mortality was 5.4% based on 1,002 tagged fish alive released at an upstream array. It does not make sense how one detected steelhead tag out of 1,002 can be expanded to a predation rate of 5.4%. This may indicate an error or other issues with the methods used to quantify avian predation mortality. Other small numbers of detections also appear to have been expanded to an unreasonable degree.

Using acoustically tagged fish may overestimate natural predation rates due to the effects of handling and tag burden on fish behavior. Dual-tagged fish carry a significant tag burden when compared to PIT-tagged or untagged fish, which can have impacts on swimming speed and ability, making smolts more susceptible to piscivorous or avian predation. Tagged smolts for these studies have gone through an extensive process involving capture in a juvenile bypass or gatewell system, tagging, overnight holding, trucking, and release by boat (mainstem Columbia and Snake rivers) or helicopter (Upper Columbia). Compared to smolts migrating naturally through the system, they may suffer from disorientation—an impact which has not been evaluated in any tagging experiments used in this study.

The potential impacts of handling and tagging are not limited to the immediate release of study fish. In 2012, smolts tagged above John Day had significantly lower survival between The Dalles Dam and Bonneville Dam when compared to fish tagged downstream. Fish tagged upstream have a longer migration with the acoustic tag, and may be more susceptible to predation than those tagged downstream. The potential for this bias is not examined in this study.

Due to the size of acoustic tags, smolts must be larger than 95 mm and in good condition to be candidates for tagging. Size limitations most severely affect subyearling Chinook populations. In 2014, the number of subyearling Chinook rejected due to size limitations was not reported. However, graphical analysis indicates that more than 30% of subyearling Chinook smolts were not tagged due to size (FPC Memo February 3, 2015). The run-at-large is not represented by

acoustic tagging efforts, and the potential biases in resulting predation data should be explicit in the report.

Tagged smolts used in performance testing are released in equal sample sizes across the river, a distribution that does not reflect the actual passage of smolts migrating naturally downriver. The effects of predation on tagged fish released in shallower parts of the river have been discussed at numerous SRWG meetings. The locations of release groups are different between different years of testing, and may affect predation rates (FPC Memo March 19, 2013).

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