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MEMORANDUM

TO: Tucker Jones, ODFW

FROM: Michele DeHart

DATE: January 10, 2019

SUBJECT: Comments on Welch et al manuscript "*The coast-wide collapse in marine survival of west coast Chinook and steelhead: slow moving catastrophe or deeper failure?*"

In response to your request the Fish Passage Center (FPC) staff has reviewed the unpublished manuscript submitted to PLoS-One: "*The coast-wide collapse in marine survival of west coast Chinook and steelhead: slow moving catastrophe or deeper failure?*". This unpublished manuscript was submitted to support recommendations to the Northwest Power and Conservation Council (NPCC) Fish and Wildlife Program amendment process, by David Welch of Kintama Consulting.

The FPC review of this manuscript found significant flaws in the underlying assumptions, veracity of claims, and a general lack of quantitative analysis that renders its conclusions speculative at best, and clearly demonstrates a lack of understanding for the data used in this manuscript. We found significant errors in every aspect of this manuscript, beginning with the type of data they used for comparison, the methodology which was used to compare populations of salmonids, and the subsequent conclusions they draw from these comparisons. Our overall determination is that the authors' conclusions are not supportable by the available body of scientific work on this topic, and therefore, the Welch recommendations to the NPCC Fish and Wildlife Program are without scientific merit, scientific foundation, and are unsupportable. The following are some of the critical flaws in this manuscript which render its conclusions erroneous, followed by more detailed explanations of specific comments.

- The datasets Welch et al collate are not all directly comparable.

- Differences between CWT and PIT-Tag estimators are briefly discussed in the comparison of SARs, but the authors do not account for variability in methodology or accuracy of population specific estimates used.
  - Similarly, juvenile survival data are collected from a combination of PIT and acoustic tags (JSATS and VEMCO). The study designs utilizing these tag types vary in minimum tag size, tag burden, tag life, reach length, and detection locations. Juvenile survival estimates from these tagging studies are not directly comparable. In fact, an earlier FPC review of the cited manuscript (Welch 2008) clearly showed that the Welch et al analysis was critically flawed, resulting in unfounded conclusions (FPC 2008).
  - Comparisons are of wildly different systems, populations, tag types, and regions with no attempt to control for other covariates that affect SARs.
  - Most of the data highlighted by the authors comes from specific stocks in the Columbia River, while ignoring other Columbia River stocks, and completely ignoring California stocks.
- The authors provide no quantitative analysis to show that the differences in population SAR's they describe are: a.) correlated across the range they reference and/or b.) attributable to specific ocean conditions experienced across and between populations.
- The authors do not address the considerable body of scientific evidence that establishes the importance of freshwater migration, rearing conditions, and estuary transitions on marine survival and smolt to adult return rates. The authors ignore available data and analyses that do not support their claims, most notably McCann et. al. (2017), Michel et al (2018), Haeseker et al (2012), Lacroix (2008), Romer et. al. (2012), and Melnychuk et. al. (2014).
- The authors contend that survival in impounded sections of the Columbia and Snake Rivers is similar or better than many undammed rivers based on their extrapolation of in-river direct survival estimates to a survival rate per 100km. This extrapolation is inappropriate when considering the average migration distance outside of the Columbia and Fraser river datasets is 19km. The comparison of migration corridor survival to post release and estuary survival is erroneous at best, and grossly misleading at worst.
- Welch et. al. compares the average median SAR's for populations located in different regions and attributes all differences exclusively to marine conditions, and any similarity between populations, as well, to marine conditions. This direct comparison of SARs representing widely variable degrees of freshwater residency, rearing conditions, migration experiences, and tag types is not appropriate. Without adequately accounting for freshwater stages, marine influence on SARs is confounded by post release, migration, and estuary transition survivals, all shown to have significant effects on overall smolt-to-adult return rates. (McCann et. al. 2017, Melnychuk et. al. 2014, Romer et al. 2012, Michel et. al. 2018, Lacroix 2008)
- The manuscript does not include quantitative analysis that attempts to describe how different or similar any two populations or regions are to each other, and no attempt to then ascribe or correlate differences or similarities to marine conditions, beyond noting that the average median population SAR value <u>looks</u> similar to the average median of the Snake River populations in some regions. The considerable body of scientific information on variability in SAR distributions, habitat and migration characteristics, and outmigration timing are completely ignored as explanatory variables.

- Even within the very limited attempt at analysis, logical inconsistencies and selective attribution abound. Many of the conclusions drawn by Welch et al can only be reached when comparing some, but not all of the data available, and only then by also comparing them using spurious and questionably informative metrics such as survival rate per 100km, and the average median SAR value over datasets representing disproportionate time series and data richness.
- The time series of SARs for John Day River and Yakima River, both Columbia River tributaries, do not support the authors’ conclusions regarding ocean survival.

Specific comments:

<u>SAR and marine survival are interchangeable:</u>
"We use the term SAR and marine survival interchangeably because, as we will demonstrate, the majority of the SAR is determined in the ocean." Pg 5

Smolt-to-Adult return rates (SAR) and marine survival are not equivalent. The author's use of these terms interchangeably is incorrect and indicates a serious lack of understanding of the data. There is a considerable body of scientific evidence showing that freshwater migration experience, post release mortality, and estuary transitions are significant drivers of overall SARs (McCann et. al. 2017, Melnychuk et. al. 2014, Goetz et. al. 2015, Michel et. al. 2018). Using acoustic tags Romer et. al. (2012) concluded that more than 50% of Oregon steelhead marine mortality was actually occurring in the estuary alone, prior to ocean entry. In California, Michel et. al. (2018) showed that freshwater conditions were the primary driver of SARs of Central Valley Chinook populations, with marine conditions only explaining SAR variability in years with "abnormally unfavorable marine conditions". Furthermore, the authors also fail to recognize their claim is likely founded on the lack of sensitivity in SARs due to their limited variability (only from 0-5%) in their selected data set. The contention that marine survival is exactly the same as smolt-to-adult return rate is in no way supported by the presented data or existing scientific literature, and the authors do not provide any convincing demonstration that their claim is true.

<u>Survival is similar or better in dammed vs undammed rivers:</u>
".. survival rates in the dammed and undammed sections of river (the hydrosystem and LRE) are largely similar" Pg. 10

Welch et. al. contend that in-river survival in undammed rivers from Oregon to Alaska is similar or worse than in-river survival for Snake River populations. One of their primary metrics cited as evidence of this is the standardized survival per 100km of river travelled.

> "*Keogh River steelhead had particularly low [survival] rates; the release site was located only 300[m] from the river mouth and survival ranged between 72-95%, resulting in an estimated survival rate per 100 km close to zero*." *Pg 11*

This type of logical leap demonstrates how extrapolating far out-of-set is not always informative when comparing non-equivalent data-sets. The subsequent inference that impounded reach survival is no different or better than free flowing river reaches based on this metric is a gross oversimplification, and ignores the enormous body of work that has shown the opposite. This manuscript blatantly ignored considerable variability in survival between distinct freshwater reaches (McCann et. al. 2017), initial post release mortality (Goetz el. al. 2015), and within estuaries prior to ocean entry (Melnychuk et. al. 2014, Goetz et. al. 2015, Romer et. al. 2012, Michel et. al. 2018). With the average migration distance of the datasets outside the Columbia River more than an order of magnitude smaller than the migration distance of the Snake River populations used, it is baffling that Welch et.al. did not identify this flagrant oversight in their comparisons and subsequent conclusions.

No Region outside the Columbia River achieves the SAR recovery targets of 2%-6%:

The 2-6% SARs required for recovery for Snake River populations is a metric describing survival between Lower Granite Dam and Lower Granite Dam. It was specifically developed for listed spring/summer Chinook populations in the Snake River, with a median SAR of 2% required to meet the NMFS interim 100 year survival standard (Marmorek et. al. 1998). Because this is specific to Columbia basin populations, this metric would not necessarily be appropriate for hatchery to hatchery returns of other populations, as those may encompass more of the life cycle of a population than the LGR to LGR metric does. Additionally, the authors do not present analyses or data that conclude that this 2-6% SAR goal is appropriate for all Alaska, California, Washington and Oregon populations. With such widely variable freshwater and estuarine habitats, migration distances, flow regimes, nearshore ocean conditions, and fisheries pressure across the range and time frame addressed in this paper, applying this metric is unlikely to be relevant unless comparisons are methodologically consistent with the CSS estimates.

Furthermore, in addition to the inherent incompatibility of directly comparing non-equivalent SAR estimates, Welch et. al. also does not adequately account for the differences in SARs obtained when using variable methodologies and tag types. While the authors do acknowledge there are differences between PIT-tag and CWT derived SAR estimates, they do not subsequently use that observation to temper their comparisons or conclusions. The collated data used in this manuscript encompass CWT, PIT-tag, and acoustic telemetry derived SAR estimates. A previous Fish Passage Center review (FPC 2008) of Welch et. al. (2008), found significant flaws in tagging/study methodology that led to substantial tagging effects and violations of implicit assumptions. Without addressing and accounting for these differences in tag type and methodology, the conclusions reached by comparing such disparate estimates are of limited utility.

Median SAR comparisons and regime shift:

The authors contend that a regime shift in marine conditions is responsible for a broad decline in SAR’s from Oregon to Alaska. However, the author’s never describe a mechanism, or a quantitative analysis to support their contention. The author’s compare median SAR values across regions, and regime periods to conclude that they are all observationally roughly similar to Snake River populations. And further, that regime shift is the primary driver of variability, as indicated by changes in average median SAR values between “regimes”. However, no quantitative attempt to describe this difference is made, beyond noting the average median values differ. Fig 8 of the manuscript clearly shows high variability (up 60x the normalized Snake River SARs) in many populations, throughout and within the four “marine regimes” they cite. However, there is no attempt to describe what is driving this variability, and no attempt to explain why this same variability is not seen in the Snake River populations by comparison. The author’s also state that:

"From the time of the major ocean regime shift in 1977 forwards, no substantial recovery in SARs is evident in any region." Pg. 13

However, there are multiple examples of SARs recovering within the Columbia River, including John Day and Yakima River Chinook (McCann et. al. 2017), which consistently fluctuate between 1-12%. As well as multiple Chinook and steelhead populations with SARs that satisfy this criteria in Oregon, Washington, and British Columbia that are cited in this manuscript (Fig 4 & 8). This selective attribution of the authors chosen conclusion is not supported by the data presented. If broadly, marine regime shifts were the only variable driving variability in SARs, you would expect to see similar levels of variability between populations. Even within the datasets they provide, there are substantial differences in SAR variability between populations, regardless of which marine regime the data are subset from. Based on these observations, the author's contention is unsupportable without inclusion of a quantitative analysis that causatively links variability in SARs solely to some metric of marine regime shift.

<u>Overall Conclusions:</u>

Welch et al conclude that essentially no freshwater life history stages have an effect on overall population productivity, and furthermore, little effort has gone into understanding ocean survival as it relates to salmon restoration efforts in the Pacific Northwest.

"Overall, these studies demonstrate a consistent pattern: a strong proclivity to preferentially identify and work on freshwater habitat, even in cases where marine survival has been identified as either the sole or most serious detriment to population growth." Pg. 40

This conclusion ignores the extensive work done within the Columbia River Basin that acknowledges and accounts for the effects of ocean productivity on SARs, in addition to a multitude of freshwater factors. The Comparative Survival Study (CSS), a large monitoring program that estimates SARs and the impacts of hydrosystem operations on populations in the Columbia River Basin, have incorporated ocean productivity indices in their modelling of SARs for many years (McCann et al., 2017, Haeseker et al. 2012). Parameters estimated in the CSS allow for partitioning of SARs estimates of marine survival rates; from the stage smolts enter the estuary to adult return, (Haeseker et al. 2012), and first year ocean survival rates, (Wilson 2003, Zabel et al. 2006, Petrosky and Schaller 2010, McCann et al. 2017). These survival rates can then be used to evaluate ocean and smolt migration factors that may influence ocean survival. The NPCC (NPCC 2009, NPCC 2014) also adopted a strategy to identify the effects of ocean conditions on anadromous fish survival and use this information to evaluate and adjust inland actions. The NPCC noted that while we cannot control the ocean, we can monitor ocean conditions and related salmon survival and take actions to improve the likelihood that Columbia River salmon can survive varying ocean conditions. A better understanding of the conditions salmon face in the ocean can suggest which factors will be most critical to survival, and thus provide insight as to which actions taken inland will provide the greatest restoration benefit.

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