Independent Scientific Review Panel
for the Northwest Power and Conservation Council
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Review of the Yakama Nation's Revised Master Plan for Yakima Subbasin Summer- and Fall-run Chinook, Coho Salmon and Steelhead

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Note on ISRP Membership

This review occurred during a significant transition of ISRP membership. Dave Heller, Robert Naiman, Greg Ruggerone, Steve Schroder, Carl Schwarz, and Chris Wood have completed their terms but participated in this review to ensure continuity and understanding of this complex program. Their positions were recently filled by Richard Carmichael, Patrick Connolly, Kurt Fresh, Josh Korman, Tom Quinn, and James Seeb.

Steve Schroder and Greg Ruggerone were recently appointed as unaffiliated members of the Hatchery Scientific Review Group (HSRG), for which their role is to provide impartial, independent advice. They have not yet completed any reviews for the HSRG and were not involved in creating the HSRG guidelines or applying the guidelines to the Yakima River Master Plan.

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Background

In response to the Northwest Power and Conservation Council's November 6, 2019 request, the ISRP reviewed the Yakama Nation's *Revised Master Plan for Yakima Subbasin Summer- and Fall-run Chinook, Coho Salmon and Steelhead* (Volume I and Volume II, Appendices; hereafter "Revised Plan"). The Master Plan is for Project #1988-115-25, *Yakima River Design and Construction-Yakima/Klickitat Fisheries Project (YKFP)*. This is the ISRP's fourth review related to this Master Plan (see ISRP 2018-6, ISRP 2013-8, and 2012-13). The Yakama Nation's October 2019 cover letter to the Council includes a succinct summary of the sequence of Council and ISRP reviews since 2012 that led up to this 2019 Master Plan.

This comprehensive 2019 Revised Master Plan addresses: 1) all the proposed coho and Chinook harvest and conservation actions of the original master plan that were not fully implemented, 2) issues raised in previous ISRP reviews (i.e., ISRP 2013-8), and 3) specifics associated with the Holmes Ranch site (i.e., Melvin R. Sampson Coho Facility) as requested by the Council (ISRP 2018-6)—see Appendix K. The 2019 Master Plan also includes proposed facility upgrades for the coho and Chinook programs as well as those associated with the previously reviewed and recommended steelhead kelt projects (Project #2007-401-00, *Kelt Reconditioning and Reproductive Success Evaluation Research*, see ISRP 2016-12; Project #2008-458-00*, Upper Columbia Kelt Reconditioning Program*, see ISRP 2014-9). Because the kelt component was previously reviewed by the ISRP and received a recommendation to proceed by the Council, the ISRP is not reviewing that component of the 2019 Master Plan in this Step review. Additionally, some facility needs for one of the Chinook components (John Day Mitigation project) are still under consideration and will likely be submitted for review in the future. Those improvements will be funded by the Zone 6 Fisheries CRITFC Accord Project (Project #2008-527-00).

The 2019 Revised Master Plan is a revision of the plan first reviewed by the ISRP in 2012. The Revised Plan describes how five hatchery programs in the Yakima River Basin will be implemented. Coho salmon are the focus of two of these endeavors. In one case, an integrated coho hatchery program is being used to provide conservation and harvest benefits. The second coho effort uses a segregated hatchery effort to increase harvest opportunities in Zone 6 and within the Yakima subbasin. Similarly, integrated and segregated hatchery programs for Chinook salmon are the center of two additional hatchery efforts. The integrated summer/fall Chinook hatchery program is intended to provide both conservation and harvest benefits. The segregated hatchery program produces upriver bright fall Chinook (the John Day Mitigation project) that will be used to increase harvest opportunities. None of these coho and Chinook populations are listed under the ESA. The fifth hatchery component is directed toward reconditioning wild steelhead kelts. Steelhead in the Yakima subbasin are listed as threatened under the ESA. The kelt reconditioning project is a conservation effort conceived to increase the abundance of steelhead spawners in the subbasin.

A cover letter accompanying the revised Master Plan describes the primary changes that occurred in the 2012 Master Plan:

- Coho Programs (Chapter 2). Following the Council's recommendation for the Melvin R. Sampson (Holmes Ranch integrated) coho program component in the 2012 Plan, design and environmental review for that component proceeded, and in 2018, Bonneville commenced construction of the integrated program facility after coordination with the Yakama Nation. We confirmed with the Council that construction of the coho facility had commenced in October 2018. We expect that facility to be ready for program implementation early in 2020. Facilities associated with the segregated component of the coho program are to be located at the Prosser Hatchery and are part of the 2019 Master Plan.

- Summer- and Fall-run Chinook Programs (Chapter 3). The summer- and fall-run Chinook programs remain consistent with the 2012 Plan with two exceptions. The Yakima Upriver Bright Harvest Program (John Day Mitigation or JDM fall Chinook) will continue to be implemented at the Prosser Hatchery for the foreseeable future; acclimation and release of these fish from (a) site(s) in the lower Yakima River is no longer being considered in the Master Planning process. The Marion Drain facility is proposed to be phased out and a new facility for summer-run Chinook is proposed to be constructed at a to-be-determined site above the confluence of the Naches and Yakima Rivers.

- Steelhead Kelt Reconditioning (Chapter 4). Facility upgrades for the steelhead kelt reconditioning project, which has been conducted at the Prosser Hatchery in cooperation with the Columbia River Inter-Tribal Fish Commission since 1999 (Project #2007-401-00, *Kelt Reconditioning and Reproductive Success Evaluation Research*- reviewed in December 2016), are included in this 2019 Master Plan and are also aligned to the reviews and recommendations from the Council on January 12, 2010 and November 14, 2014 (Project #2008-458-00, *Upper Columbia Kelt Reconditioning Program*).

Additionally, the Yakama Nation notes the following:

- The 2019 Master Plan also contains a log and responses to all ISRP review received to date on all aspects of all of these programs (Chapter 4 and Appendix K) with emphasis on 2018-06.

- The 2019 Master Plan is proposed to be "expense neutral" with respect to Operations and Maintenance (1997-013- 25 - *Yakima River Operations and Maintenance (O&M) for Hatcheries and Acclimation Sites-Yakima/Klickitat Fisheries Project (YKFP)*)and Monitoring and Evaluation (#1995-063-25, *Yakima River Monitoring and Evaluation- Yakima/Klickitat Fisheries Project (YKFP))* costs (note that scientific review recommendations, if accepted, could impose additional costs).

- As noted above, the revised 2019 Master Plan includes facility upgrades required for the portion of the *U.S. versus Oregon*/U.S. Army Corps of Engineers (COE) John Day Mitigation (JDM) fall Chinook program that occurs at Prosser Hatchery. In September 2019, the COE issued a "Draft integrated limited reevaluation report and environmental assessment, The Dalles and John Day mitigation". The Prosser Hatchery currently hosts final acclimation and rearing of 1.7 million subyearling and 210,000 yearling John Day Mitigation (JDM) fall Chinook. This production is identified in the draft EA as part of the preliminary preferred alternative. Finally, CRITFC Accord Project 2008-527-00 has been approved by CRITFC commissioners to be used for capital upgrades to support JDM production hosted at Prosser Hatchery.

In 2013, the ISRP found the Master Plan "Meets Scientific Review (Qualified)." Six issues were identified in the ISRP's qualification that the Council requested the Yakama Nation to address in Step 2 (Council October 10, 2013 decision letter):

1. the transition from Phase 3 to Phase 4
2. management of harvests and spawning escapement
3. the likelihood of implementing the expected habitat restoration plans (Integrated Plan)
4. management of the overall program in light of high uncertainty in the extent of habitat actions and fish responses to actions
5. the need for a robust monitoring and evaluation program to support a management decision framework, and
6. overall program size.

In ISRP 2018-6, the ISRP found that the proponents presented a well-conceived plan for coho salmon reintroduction and supplementation in the Yakima subbasin. However, the ISRP noted that some important details were missing or unclear, and recommended a fully revised version of the 2012 Master Plan to facilitate an accurate review by the ISRP and to maintain accountability in this final stage of the Step Review process. Accordingly, the ISRP requested that the proponents address the following eight issues about coho in a revised Master Plan:

1. Explain why so many (1,200) coho must be collected for use as broodstock in the segregated program.
2. Provide more details about the biological metrics to be monitored during transition from Phase 3 and Phase 4, how they are expected to change, and how the transition will be triggered.
3. Consider the feasibility and possible benefits of developing separate broodstocks to promote adaptation to the Naches River and Upper Yakima River – major tributaries that exhibit very different biophysical environments.
4. Provide more detail about the locations of release sites for the integrated program, how sites are prioritized, the numbers of parr and translocated adults to be released at each site, and how differences in performance related to release site will be evaluated.
5. Address previous ISRP concerns (ISRP 2013-8 and 2012-13) that the projected increases in both productivity and smolt capacity are based on assumptions that may be overly optimistic.
6. Describe decision rules for coho harvest management, and show they are consistent with spawning targets for unclipped fish (natural origin returns), particularly if natural origin returns are substantially less than expected.
7. Provide more details about contingency plans and decision trees to guide adaptive management if outcomes are not as expected.
8. Describe any proposed changes to infrastructure at, or utilization of, the Prosser Hatchery. (The proponents state that previous ISRP questions about the water supply system and concrete raceways at the Prosser Hatchery are now "out of date" due to subsequent project revisions).

ISRP Overall Recommendation for the Revised Master Plan

ISRP Recommendation: Response Requested. The revised Master Plan did not fully address all of the ISRP's Qualifications from our previous review.

The ISRP commends the proponents for well written and comprehensive revisions to the 2012 Master Plan and for including responses to previous ISRP comments in the 2019 Master Plan's Appendix K to document the history of these important efforts. The Revised Plan provides new information about the segregated and integrated hatchery programs for coho and Chinook salmon, and it adequately addresses some but not all responses to ISRP (ISRP 2018-6).

The primary purpose of the proposed coho and Chinook hatchery programs is to increase harvest of coho and Chinook salmon in the Zone 6 and Yakima River Basin fisheries. Additionally, the integrated coho and summer/fall Chinook programs are designed to meet the conservation objectives of re-establishing locally adapted populations upstream of Prosser Dam and increasing the spatial and temporal diversity of the naturally spawning populations. Hatchery operations and objectives in the Revised Plan are generally well described and meet most of the ISRP's scientific criteria.

Most ISRP concerns involve the use of the integrated hatcheries to re-establish natural populations of coho and summer/fall Chinook salmon above Prosser Dam, and the extent to which self-sustaining populations could be established, given current habitat conditions and exploitation rates in existing fisheries. This endeavor is complicated and challenging because coho and summer Chinook salmon were extirpated from this area, and fall Chinook runs currently are severely depressed. Ultimately, the success of re-establishing self-sustaining natural populations above Prosser Dam during the final stages of the program will depend on the success of planned habitat restoration activities, sustainable harvest rates on the less productive natural populations that co-mingle with more productive populations (mostly hatchery), and successful implementation of the integrated hatchery programs that enable fish to adapt to the local environment and increase survival.

The ISRP requests that the proponents address the following list of specific issues within the next six months. If requested, we are willing to meet with the project proponents and Council staff to discuss these issues. Most issues refer to both the integrated coho and summer/fall Chinook programs. In the ISRP Comments section below, we explain the rationale for each request and provide additional suggestions that the proponents should consider as they develop their response. We recognize that some of the issues presented below will not be faced until later stages of the project. Nevertheless, developing approaches for how they may be addressed will serve as important starting points for the proponents as the project moves forward.

Recommended Analyses to Inform Management

1. Describe how productivity and capacity of naturally spawning coho and summer/fall Chinook salmon will be evaluated and tracked over time. Estimating capacity and productivity is important to realize the project goal of eventually establishing productive, self-sustaining populations of these species. Consequently, we urge the proponents to use existing data (smolts per spawner and adult returns per spawner) to develop empirically-based spawner escapement goals that can guide management of the number of hatchery and natural origin salmon on the spawning grounds and thereby promote adaptation of the developing natural population. Ideally, these evaluations would inform outplanting in the two primary subbasins (e.g., Naches and Upper Yakima drainages), which likely have different capacities and productivities.

2. Clarify how the fitness factors for hatchery salmon (0.5 and 0.8 depending on Phase or stock origin) were used to adjust EDT capacity estimates for determining "optimal" numbers of parr, smolts, and adults to be stocked into streams. Did these fitness assumptions lead to greater outplant numbers? Our concern is that this approach may lead to juvenile releases and adult outplants that exceed capacity, leading to reduced growth and survival and/or early emigration.

3. Justify the use of "effective pHOS" when calculating PNI or use actual pHOS, as recommended by the National Marine Fisheries Service (NMFS). Effective pHOS should be used only when there is strong evidence that hatchery and natural origin salmon are not interbreeding on the spawning grounds. Revise the program as necessary to meet PNI objectives during Phase 4.

4. Revise PNI scores by explicitly accounting for natural spawning by segregated hatchery salmon (both outplanted and strays) which represent a third genetic component of the overall integrated population (segregated and integrated hatchery salmon plus natural origin salmon). Revise program to meet PNI objectives during Phase 4.

5. Justify why planned releases of juvenile summer and fall Chinook salmon (3.4 million per year) are so much higher than the reported capacity during the Transition Phase (1.34 million) and Long-term Phase (3 million). This high density has a strong potential to depress growth and survival of both hatchery and natural salmon, and/or lead to early emigration downstream.

6. In the genetics monitoring and evaluation plan, describe how parentage-based tagging (PBT) will be used to monitor natural salmon, as noted in the response to ISRP (Appendix K). PBT is not mentioned in the monitoring and evaluation plan (Appendix A).

Recommended Management Considerations to Achieve Sustainability Goals

7. Consider culling hatchery salmon from the segregated programs at Prosser and Rosa dams when the number of integrated hatchery and natural origin spawners exceeds the capacity of the system to support them (e.g., the empirically derived spawner goal). Consider this action for "surplus" hatchery salmon from the integrated programs, as well, as a means to promote local adaptation and to ameliorate density effects on productivity.

8. Given that hatcheries often produce more jacks than natural spawning salmon produce, and that age at maturation is in part heritable, consider managing (culling) hatchery jacks (coho and Chinook) at Prosser and Rosa dams so that their rate of interbreeding with older salmon on the spawning grounds remains at a natural level.

9. Clarify the strategy, criteria, and actions for transitioning between Phase 3 and Phase 4 of the integrated coho program. The current description of the Phase 3 to Phase 4 transition suggests that the program could continually flip-flop between Phase 3 and Phase 4 protocols in response to variable abundances of natural origin coho returns (NOR), even after most restoration has been completed. The broodstock management strategy and protocols could be simplified and more easily understood if the Phase 4 management strategy was defined as a long period of time encompassing multiple generations of coho salmon to allow adequate time to evaluate results of Phase 4 implementation strategies. Within this multi-generational time period natural production would be emphasized along with hatchery protocols that promote continued local adaptation and natural production, even when NOR coho fall below the Phase 4 threshold. In addition, we recommend that the program avoid returning to stocking of segregated coho salmon during periodic population declines after transitioning to Phase 4, as this will interfere with the program's effort to produce locally adapted coho.

10. Reconsider development of separate coho and summer Chinook broodstocks and outplant strategies to promote adaptation in the Naches River and Yakima River. The current broodstock strategies do not recognize the unique features of these watersheds. Compare risks and benefits, and assess expense, of a broodstock strategy that takes the unique aspects of the watersheds into account. For instance, the application of CWTs in different body locations could be used to differentiate hatchery juveniles released into Naches and upper Yakima River sites.

11. Develop (or clarify) an experimental or planned strategy for releasing parr, smolts, and adults into specific streams in the upper basin. The proponents' response included much useful information, but the ISRP was confused by the proposed stocking approach in which stream release locations for some life stages appear to change randomly from year to year. The Revised Plan was unclear on how the approach would be evaluated.

12. Clarify how harvest rates on unmarked NOR and hatchery origin (HOR) coho salmon will be reduced to 20% in Zone 6 if they are co-mingling with marked segregated hatchery coho that are being harvested at 35%. Is this reduction feasible given that the Zone 6 fishery is not mark-selective and Zone 6 fisheries management involves multiple co-managers and a very complex season setting process?

13. Clarify whether or not coho hatchery facilities have the capacity to quickly shift from parr to smolt production, as proposed in a response to ISRP.

ISRP Comments

Issue 1. Coho: Do the revised integrated and segregated coho hatchery programs described in Chapter 2 of the Revised Master Plan meet scientific review requirements? Were previous comments by the ISRP on these hatchery efforts adequately addressed (see above comments and Appendix K in Volume II)?

Chapter 2 of the revised Master Plan (Revised Plan) provides a comprehensive overview of the efforts to re-establish coho in the Yakima subbasin. The Revised Plan indicates that the primary purpose of the coho reintroduction effort is to increase tribal harvest opportunities. A secondary goal is to create naturally spawning and self-sustaining populations of coho in the upper Yakima and Naches rivers. Four program phases are described in the Revised Plan that are designed to accomplish these overarching goals. Two of the four phases have been completed. The results of Phase 1 and 2 have served as the foundation for Phases 3 and 4, which are the focus of the Revised Plan.

ISRP comments below focus on the proponents' response to each issue raised by the ISRP (2018-6), plus a few additional comments on the Revised Plan. The issues are shown in **bold** text.

Address previous ISRP concerns (ISRP 2013-8 and 2012-13) that the projected increases in both productivity and smolt capacity are based on assumptions that may be overly optimistic.

The Revised Plan and its response to ISRP partially address the ISRP question of whether the Revised Plan and associated restoration and harvest management efforts will support a self-sustaining natural coho population in the Yakima Basin. The Revised Plan states in Section 2.5.1 (p. 34) that *"The integrated program also has an objective to reestablish a self-sustaining, naturally-spawning population of Coho in the Yakima River."* The Revised Plan and associated restoration efforts intend to achieve this goal while also producing fish for harvest. The ISRP recognizes that development of a productive and sustainable natural coho population is a lofty goal, given that coho salmon were extirpated from this watershed decades ago. Nevertheless, this is consistent with the 2014 Fish and Wildlife Program principles, which state that *"Program goals and objectives should be designed to achieve the ecosystem functions necessary to restore healthy, self-sustaining, and harvestable populations of native fish and wildlife in the Columbia River Basin."*

Although the Revised Plan seems to imply that it is creating a self-sustaining natural-origin (NO) population of coho salmon, the modeling output indicates NO coho salmon are not self-sustainable in Phase 3 and, more importantly, will not be self-sustainable even in Phase 4 when productivity and capacity are assumed to be greater due to restoration activities and some adaptation of coho to the natural environment. Instead, the NO population is only sustained by replenishment with hatchery salmon. This result might be expected during the rebuilding Phase 3, but the Program should strive to create an opportunity for future sustainability in Phase 4 by maintaining genetic diversity and managing PNI to promote local adaptation and recolonization. We note that achieving a self-sustaining natural population may be difficult given that some principle factors controlling productivity, such as dam passage, interception rates in mixed-stock fisheries, and ocean conditions, are beyond control of the proponents.

We base this sustainability assessment on data presented in Table 2-24, which includes output from "All H Analyzer" (AHA) modelling. For example, in Phase 3, ~1,512 NOR coho return to the watershed (after harvest) from ~4,460 parent spawners, leading to an unsustainable return per spawner (R/S) of 0.34[1]. The overall harvest rate in ocean and river fisheries is expected to be ~34% (Table 2-23). The pre-fishery return per spawner during Phase 3 is ~0.51, indicating a non-sustainable population of 4,460 spawners (HOR and NOR) even when no harvests are allowed. This low productivity is not unexpected during Phase 3 because many benefits of restoration and local adaptation have yet to achieve their anticipated positive effects.

Phase 4 does not seem to produce a self-sustaining coho population, even though substantial benefits of restoration and coho adaptation are assumed to have occurred, leading to greater coho productivity and capacity. During Phase 4, a parent spawning escapement of 4,069 spawners (HOR and NOR) is expected to produce a pre-fishery recruitment 5,049 NO coho, suggesting the NO component could be self-sustaining, on average, as long as the total fishery exploitation rate is no more than 20% (Table 2-24). However, because the overall harvest rate on NOR coho is assumed to increase to 47% in phase 4, only 2,676 NOS coho are expected to reach the spawning grounds, and consequently, this NOS component remains unsustainable (R/S = 0.66). Approximately 2,203 hatchery salmon will be needed to boost the total spawning escapement to 4,069 coho spawners, to match the total escapement in the previous generation. Given the production values in the Revised Plan and the assumed harvest rates, the program is unlikely to produce a self-sustaining natural coho population during Phase 4.

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[1] A self-sustaining population is defined as having a R/S of 1 or more, on average. If the population is harvested, R/S must be greater than 1 in order to potentially maintain the spawning population

Density dependence is reportedly incorporated into the AHA modeling, but no graphs or analyses were presented, such as plots of NO recruitment or NO recruits per spawner (R/S) versus NOS. Presently, based on Ecosystem Diagnosis & Treatment (EDT) analyses, the assumed spawning capacity is 5,101 coho salmon during Phase 3 and 8,723 coho salmon during Phase 4 compared with current escapement of 4,921 coho salmon (HOR and NOR), on average. Our simple evaluation of model outputs above indicates the EDT-based productivity and capacity estimates are too high, since the NO population is not sustainable at these levels. The ISRP cautions that EDT and AHA model outputs are not considered predictive; they are most useful for exploratory purposes and for comparing relative outcomes (i.e., ranking) from scenarios involving different assumptions. This is why analyses of existing data are important.

The success of the integrated hatchery, harvest augmentation, and salmon re-introduction program ultimately depends on the underlying natural productivity and capacity of coho salmon, a key uncertainty in the Yakima Basin. The proponent's response to the ISRP recognizes the need to examine empirically derived measures of productivity and capacity (Appendix K, page 12), but this has yet to occur even though key data are already available. For example, marking of hatchery salmon has allowed the proponents to distinguish NOR and HOR at Prosser Dam since 2001 (Table 2-7). Smolt counts are available but the quality of these data is reportedly low. Ideally, the proponents should monitor density effects on NO productivity (i.e., plot natural Smolts per Spawner versus Spawners) to evaluate effectiveness of habitat restoration and adaptation of coho to the environment in a density dependence framework (ISAB 2015-1). Additionally, empirical spawner-recruit relationships should be examined to develop a spawning escapement goal that reflects the capacity of the system and is self-sustainable. These relationships are commonly used in fisheries science to estimate productivity and capacity, which are key metrics when managing harvests and spawning abundances of salmon. The ISRP recognizes that there are data-quality issues (e.g., Chandler smolt trap), which is common in fisheries datasets, but these types of analyses still can be highly informative.

Capacity to support parr, smolt, and adult outplants. Although it is difficult to determine exactly how "optimal" parr, adult outplant, and smolt production numbers were developed in the Revised Plan, the following statements appear to apply to all life stage releases: *"adjustments were made to release numbers to account for reduced fitness factor of hatchery fish."* These adjustments were made *"to natural production estimates from the EDT model."* Fitness factors for hatchery fish are typically generated from comparisons of adult spawner-to-adult recruit ratios of hatchery fish versus natural fish spawning in rivers (relative reproductive success). It is unclear how the assumed 50% reduced fitness factor for hatchery salmon was applied when estimating "optimal" numbers of parr, smolts, and adults to be stocked into streams in Phase 3. If the fitness factor of 50% was applied as an increasing factor, then release numbers are likely well above the carrying capacity (especially for parr and adult outplants). If so, density effects may help explain why the AHA model produces a R/S that is well below replacement (i.e., unsustainable).

The logic behind the proposed stocking approach needs justification. Stocking adjustments may be needed if the numbers cannot be supported by analysis of existing and forthcoming data. Many of the streams that receive these hatchery fish may have adult and juvenile NO coho salmon, and the addition of hatchery fish could displace NO coho, reduce their growth and survival, and reduce productivity through breeding with natural origin adults. Perhaps the proponents may be thinking that ~50% of the juveniles and adults die before interacting with NO coho. This logic does not seem reasonable, especially for adult coho that may compete for mates and for spawning areas. In addition, no life-stage specific survival data (e.g., parr-to-smolt, adult outplant-to-spawner) are presented to characterize mortality of hatchery releases by life stage or through time following release.

The Plan needs to clarify the stocking strategy for Phase 4. A fitness factor of 0.8 is assumed for Phase 4 compared with 0.5 for Phase 3 (Table 2-20). It is unclear how or if the 0.8 fitness was applied to recalculate "optimal" release numbers of parr, smolt and adults for Phase 4, given that juvenile outplant numbers remain unchanged between Phase 3 and Phase 4.

Tables 2-24 and 2-25 have errors that must be fixed: 1,000 segregated HOR are shown to be transplanted during Phase 4, but the footnote says these transplants will be discontinued in Phase 4. Importantly, PNI could be substantially increased by eliminating adult outplants in Phase 4, thus increasing the probability of achieving the PNI objective. On page 55, the plan implies that segregated hatchery coho, which are produced without natural coho in the hatchery broodstock, would be managed to limit their influence on natural spawning coho: *"pHOS will be limited to less than five percent."* This is inconsistent with the proposed stocking of 1,000 segregated coho during Phase 3 (~22% of all spawners), and 360 "stray" segregated coho during Phase 4 (9% of total) (Table 2-24).

Consideration of ongoing habitat degradation when estimating productivity and capacity. Although there are major plans to improve habitat quality in the Yakima Basin, we did not see information describing how ongoing and future habitat degradation was incorporated into the EDT-AHA modeling. Habitat degradation may stem from many human actions, including population growth, and natural processes. Degradation scenarios can and should be modeled in the EDT-AHA framework, including climate change scenarios.

Provide more details about the biological metrics to be monitored during transition from Phase 3 and Phase 4, how they are expected to change, and how the transition will be triggered.

Although details have been added to the Phase 3 and Phase 4 broodstock management strategy, criteria and actions for transitioning between Phase 3 and Phase 4 remain unclear.

This should be clarified in the response so that the transition from Phase 3 to Phase 4 is well defined. The Revised Plan states that the transition to Phase 4 will occur when the 3-year running average of NOR coho at Prosser Dam reaches 2,400 fish and when there are enough NOR coho at Prosser Dam to achieve collection of 810 NOR broodstock (2,700 NOR coho @ 30% collection rate). We note that this scenario leads to removal of 34% of NOR's (810/2,400 coho), not 30% as identified in text.

On page 32 Section 2.4.3-1, the MP states, *"If fewer than 800 natural origin fish are available for broodstock in any given year due to reduced natural-origin returns, the program would revert to Phase 3 protocols."* Substantial year-to-year variability in returns of NO coho salmon will undoubtedly occur during both Phase 3 and Phase 4, even after substantial habitat restoration. With significant annual variability in NOR, it appears likely that the proposed management protocols would frequently bounce back and forth between Phase 3 and Phase 4. Reverting back to Phase 3 protocols will result in reduced PNI values, reduced local adaptation, and loss of local adaptation capital that was gained during Phase 4 implementation. How will the program respond to high variability in NOR? For example, although the Revised Plan calls for 100% pNOB in Phase 4, would pNOB be allowed to decline when fewer than 3,000 NOR return, as suggested in Table 2-16, or would total broodstock numbers decline to maintain 100% pNOB while taking no more than 30% of the NOR population? Likewise, when NOR abundance has reached 2,400 fish during three consecutive years and the program transitions to Phase 4, would pNOB be less than 100% in order to limit removal of NOR for broodstock to 30%?

How will year-to-year fluctuation in NOR coho affect decisions to translocate segregated hatchery coho to the spawning grounds? Translocation of 1,000 segregated hatchery coho to the spawning grounds appears to stop in Phase 4, but there are inconsistencies regarding this issue in Table 2-24. The ISRP's opinion is that the Revised Plan should not re-initiate outplanting of segregated hatchery coho after the transition to Phase 4, which is likely to offset gains in adaptation over the years. Instead, the escapement should be managed for a sustainable NO coho population using NOR spawners to the extent possible and integrated hatchery salmon when needed to seed the spawning grounds to the empirically derived level that tends to maximize smolt production and adult returns while also maintaining a sustainable NO population. We recommend removal of stray segregated hatchery coho (100% fin clipped) at Prosser Dam even if returns of NOR coho and integrated HOR coho are low.

Issues involving "effective pHOS" and PNI calculations. The Revised Plan has a PNI goal of 0.67 during Phase 4 and no specific PNI goal for Phase 3. Instead, in Phase 3, the plan is to have pNOB up to 30% and unlimited hatchery salmon on the spawning grounds as indicated by the term, "unmanaged pHOS." AHA modeling results indicate a PNI of 0.31 and 0.67 in Phase 3 and Phase 4, respectively (Table 2-24). As noted elsewhere, the ISRP recommends that pHOS be managed every year so that numbers of hatchery fish do not exceed the capacity of the habitat to support natural production.

Importantly, these PNI calculations use "effective pHOS" rather than actual pHOS, leading to an inflated PNI score and the perception of greater adaptation of salmon to the local environment. The Revised Plan assumes that the fitness factor of out-of-basin hatchery coho salmon spawning naturally (HOS) is 50% that of NOS coho salmon, increasing to 80% for locally derived hatchery coho during Phase 3 and 4 (Table 2-24). Effective pHOS is then assumed to be 50% or 80% of actual (census) pHOS. However, NMFS cautions that such adjustments to pHOS should not be made unless there is good evidence (e.g., from parentage-based tagging) to indicate that hatchery fish are NOT interbreeding with natural salmon. If hatchery salmon are interbreeding with natural salmon, then the Ford model from which the PNI formula is derived already accounts for genetic effects that reduce reproductive fitness of hatchery salmon. Below is a quote written by NMFS scientists in recent Biological Opinions involving hatcheries (text provided by Craig Busack, NOAA Fisheries):

> *NMFS feels that adjustment of census pHOS by RRS should be done very cautiously, not nearly as freely as the HSRG document would suggest. The basic reason is quite simple: the Ford (2002) model, the foundation of the HSRG gene flow guidelines, implicitly includes a genetic component of RRS. In that model, hatchery fish are expected to have RRS < 1 (compared to natural fish) due to selection in the hatchery. A component of reduced RRS of hatchery fish is therefore already incorporated in the model and by extension the calculation of PNI. Therefore reducing pHOS values by multiplying by RRS will result in underestimating the relevant pHOS and therefore overestimating PNI. Such adjustments would be particularly inappropriate for hatchery programs with low pNOB, as these programs may well have a substantial reduction in RRS due to genetic factors already incorporated in the model.*
>
> *In some cases, adjusting pHOS downward may be appropriate, however, particularly if there is strong evidence of a non-genetic component to RRS. An example of a case in which an adjustment by RRS might be justified is that of Wenatchee spring Chinook salmon (Williamson et al. 2010) where, the spatial distribution of natural-origin and hatchery-origin spawners differs, and the hatchery-origin fish tend to spawn in poorer habitat. However, even in a situation like this it is unclear how much of an adjustment would be appropriate. By the same logic, it might also be appropriate to adjust pNOB in some circumstances. For example, if hatchery juveniles produced from natural-origin broodstock tend to mature early and residualize (due to non-genetic effects of rearing), as has been documented in some spring Chinook salmon and steelhead programs, the "effective" pNOB might be much lower than the census pNOB.*

The PNI scores in the Yakima basin that use effective pHOS should be re-calculated unless strong evidence, as stated by NMFS above, is presented in the response to ISRP. In Phase 3, census pHOS is expected to be 84%, the pNOB target is 30%, and the corresponding PNI would be 0.26 rather than 0.31. In Phase 4, actual pHOS is expected to drop to 61% and the pNOB target increases to 100%, so the corresponding PNI is 0.62 rather than 0.67. These values indicate that the system is dominated by hatchery fish in Phase 3, so that adaptation by NO coho to the local environment would be minimal. In Phase 4, the PNI goal of 0.67 would no longer be reached when using the observed pHOS values, indicating the need to cull some hatchery coho at Prosser or Rosa dams to meet the PNI objective. As noted elsewhere in our memo, culling of surplus hatchery fish and managing spawning escapement at Prosser and Rosa dams should be considered by the proponents to maximize smolt production and adult returns while also creating the opportunity for a sustainable NO population.

An important issue regarding the simple assumption in the Revised Plan that hatchery salmon fitness is 50% or 80% of the natural population is that these values are <u>relative to the existing natural population in a highly modified environment</u>, not a NO population in relatively pristine habitat. The proponents obviously recognize that coho and Chinook were extirpated from the Yakima Basin. Insufficient time and isolation from hatchery fish have occurred for the natural spawning populations to evolve and adapt to local conditions. The integrated hatchery plan is just beginning. In other words, the 50% and 80% fitness values probably over-estimate any true difference in relative reproductive success between hatchery and natural spawners in the watershed, at least for the near future. Furthermore, the PNI score is not an instantaneous measure of population condition, rather it approximates the equilibrium point at which the population would arrive after many generations (Busack 2015). Additionally, a PNI score of 0.67, for which this and many other integrated programs strive, should not be considered to represent a population that is well adapted to the natural environment. Rather, this PNI value reflects a population that, at equilibrium, is still less adapted to the environment than a wild population but is more adapted to the local environment than segregated hatchery salmon.

Additionally, the PNI score may be biased high because the influence of segregated coho salmon has not been considered. During Phase 3, the Revised Plan calls for the stocking of 1,000 **segregated** hatchery coho into the upper basin where a key goal is to develop a natural spawning population using an integrated hatchery approach. Presumably, <u>surplus</u> integrated hatchery fish, as shown in Table 2-24, might be used instead of segregated coho, but this approach is not clearly described in the Revised Plan. While there is some attempt to stock adults into streams that do not receive juvenile stocking, it is clear that both hatchery adults and juveniles will be stocked into many of the same streams in the upper basin. Furthermore, some **segregated** hatchery coho will likely spawn with NOR or integrated hatchery coho, likely leading to reduced fitness of hybrid progeny.

Stocking of **segregated** adult hatchery coho will lower the reported PNI score because the current calculations in Table 2-24 appear to only account for the integrated population and not the stocking of 1,000 **segregated** hatchery coho from the lower river (where pNOB is essentially 0). Translocation (and straying) of **segregated** adult hatchery coho to the upper basin could 1) inhibit adaptation of the integrated coho population to the local environment, 2) reduce overall productivity of coho spawning in the upper basin, and 3) reduce the probability of reaching Phase 4, which relies upon much higher productivity of natural spawning coho.

The ISRP recommends that the Revised Plan use the approach developed by Busack (2015) to extend the Ford model and PNI calculations to three or more populations. This approach allows the incorporation of segregated coho, integrated coho, and natural origin coho into the PNI score. The ISRP also recommends that stocking (and straying) of **segregated** hatchery fish into the upper basin should be terminated after Phase 3 becomes operational and integrated fish are produced (100% fin-clipped segregated fish can be culled at Prosser Dam). Surplus integrated coho should be used instead of segregated coho salmon whenever possible. As discussed above, and noted in the Revised Plan Appendix, an empirically derived spawning escapement goal is needed to guide management of the spawning escapement so that "surplus" hatchery salmon can be removed.

As partial justification for predicting the achievement of proposed PNI objectives, the authors stated that the hatchery strategy being used is similar to *"that of the Levi George spring chinook hatchery program, which has maintained an average PNI of 0.66."* (Section 2.4.3.1). There are no comparisons of the critical parameters driving PNI levels between the coho and Chinook programs that justify this inference.

There is some inconsistency and confusion in use of the terms "stray rate" and pHOS. In Table 2-19, the segregated program pHOS value is stated as <5% stray rate during Phase 4. The most widely accepted definition of stray rate for hatchery fish is the proportion of fish that return to locations other than the release location (i.e., straying from their natal site). In contrast, pHOS is the proportion of natural spawners that are hatchery origin (i.e., straying into a non-natal site). Stray rates of 5% can produce pHOS values that are much greater than 5% when natural spawners are scarce compared to hatchery returns. Indeed, Table 2-24 shows that the expected number of segregated coho straying upstream of Prosser Dam is 360 fish, or 8.8% of the escapement. Ultimately, given that the program can control the number of segregated coho salmon straying upstream of Prosser Dam, we recommend a pHOS performance measure of zero for segregated coho during Phase 4 rather than using a stray rate of 5% (see Table 2-19).

Consider the feasibility and possible benefits of developing separate broodstocks to promote adaptation to the Naches River and Upper Yakima River – major tributaries that exhibit very different biophysical environments.

This suggestion does not appear to be fully considered based on the proponent's responses in the Revised Plan. The response states that differential marking may allow incorporation of some level of local adaptation, but it is unclear exactly how these marked fish would be used to enhance adaptation. For example, no separate broodstock development alternatives were identified or evaluated in the response and this suggestion was dismissed based on cost and apparent feasibility. Nevertheless, the application of CWTs in different body locations could be used to differentiate hatchery juveniles released into Naches and upper Yakima River sites.

Although it may be challenging and possibly more costly, the proponents should develop alternatives and compare risks and benefits, including cost, to evaluate alternatives that might lead to greater adaptation of coho salmon to the Naches versus upper Yakima watersheds. This analysis should include examining the benefits of eliminating segregated adult outplants into one or both rivers. Adult outplants and straying of segregated fish will reduce potential local adaptation and survival benefits and adversely affect PNI objectives.

Provide more detail about the locations of release sites for the integrated program, how sites are prioritized, the numbers of parr and translocated adults to be released at each site, and how differences in performance related to release site will be evaluated.

The proponents provided a detailed list of considerations and guidance for deciding life stage and location, and a table of prioritized release locations by life stage. The number of fish to be released, life stage, and location depends on *"a number of factors that include habitat conditions and presence of sensitive species within tributaries."* Good general guidance and criteria are provided, and Table 2-15 is beneficial; however, the Revised Plan should provide additional examples of how the criteria are used to make specific decisions. A decision tree and examples of results of application would be useful.

Regarding release numbers, the Plan should clarify how they were determined and how the 50% fitness factor was applied (see our discussion of this issue in the Capacity section above). The statement, *"We do not plan to use the same release strategy in the same location in any given year,"* is unclear. "Release strategy" in the Revised Plan refers to the life stage of fish released (parr, smolt, adult outplants). The justification for this seemingly random release approach is needed. How is it consistent with the life stage-location criteria and guidance? The Revised Plan should develop an "experimental strategy" to test the effectiveness of fish stocking while controlling for year effects and habitat conditions. For evaluation and comparison purposes, limiting possible confounding effects is important. Thus, replication of a release strategy across years in the same location would represent a better experimental design approach compared with a highly variable approach.

More detail is needed regarding parr planting strategies and monitoring of parr release success. On page 32, the Plan states, *"Parr plants may be discontinued periodically in some tributaries and streams monitored"* and *"This approach allows biologists to continually probe the ability of the system to produce naturally sustainable coho without hatchery intervention."* More discussion is needed to describe how periodic discontinuation will help assess ability to sustain natural production.

Additional detail and information are needed to clarify how the proposed juvenile release and adult outplant numbers were determined. Section 2-4.3, page 26 states that, *"The program may shift to releasing all smolts (i.e., up to 700,000 smolts) if the combined parr and smolt release strategy does not meet adult return objectives, or if drought conditions preclude* *summer parr release."* Additional information should be provided to show that facilities are available and capable of rapidly switching from producing 200,000 smolts and 500,000 parr to 700,000 smolts. Rearing space and water requirements for 700,000 smolts are far greater than for 500,000 parr. How exactly would this change be accomplished given the proposed facilities?

The ISRP asks whether any consideration has been given to releasing smolts from both programs after dusk or during darkness. Releases during darkness can be challenging for personnel but are known to improve hatchery smolt survival during the initial period after release. The Revised Plan states that parr releases will be made directly into the stream. Will just one release location be used, or will an effort be made (if access is available) to scatter-plant the fish throughout a receiving stream?

Describe decision rules for coho harvest management, and show they are consistent with spawning targets for unclipped fish (natural origin returns), particularly if natural origin returns are substantially less than expected.

The Revised Plan (p. 56) re-states the NPCC principle that *"Production for harvest is a legitimate management objective of artificial production, but to minimize adverse impacts on natural populations associated with harvest management of artificially produced populations, harvest rates and practices must be dictated by the requirements to sustain naturally-spawning populations."* The ISRP agrees with this statement. However, on page 57, the Revised Plan states *"Because Yakima River Coho are captured in the same fisheries as naturally produced Coho from the lower Columbia, harvest rates are deemed protective. The implementation of mark-selective fisheries for Coho in the ocean and mainstem Columbia River (below McNary) will decrease harvest rates on naturally produced adults while at the same time allowing higher harvest rates on marked hatchery fish*." Table 2-23 indicates the harvest rate on NOR coho returning to the Yakima River in the ocean and lower Columbia River is 18%, which seems reasonably low. But additional harvests occur in Zone 6 and a few fish are taken in the Yakima Basin. Harvest rates that support sustainable natural populations depend on the productivity of those populations (Hilborn and Walters 1992). Productive populations can support greater harvest rates than less productive populations, which complicates the management of mixed-stock fisheries.

In Zone 6, the anticipated harvest rate on NOR coho is 20% during Phase 3, increasing to 35% in Phase 4. These rates lead to an overall harvest rate of 34% and 47% during Phase 3 and 4, respectively (Table 2-23). As noted above, these harvest rates contribute to the inability of the natural spawning population to sustain itself at the proposed spawning levels. Hatchery supplementation is needed to maintain the proposed spawning escapement in both Phase 3 and 4. Thus, the Revised Plan does not eventually lead to a self-sustaining population in Phase 4 as implied. Further analysis of existing data could help determine how to achieve this goal, though sustainability likely requires reduced harvest rates, which is contrary to the primary goal. Furthermore, the Revised Plan does not address the ISRP question of whether overall harvest rates will be reduced when projections of NOR coho are low. A more complete description of how harvest rates will be reduced in Zone 6 during Phase 3 is needed given the number of co-managers that influence harvests in Zone 6 as well as the complex annual season setting process.

Table 2-23 and accompanying text (p. 39) states that the harvest rate on NOR and integrated HOR during Phase 3 will be reduced from the current 35% (NOR and HOR) to 20% in Zone 6. However, the harvest rate on co-mingling segregated hatchery coho salmon in Zone 6 will remain at 35%. Table 2-23 and page 620 (Volume 2) states that the Zone 6 fishery would remain non-selective for marked coho salmon. How is it possible to reduce the harvest rates on NOR and integrated HOR from 35% to 20% while maintaining a 35% harvest rate on segregated hatchery coho without a mark-selective fishery? If this is an error, how does this error affect modeling outcomes?

Management of HOS and composition of spawning escapement remains unclear. The only management actions that are considered for regulating the number of integrated HOS are in-basin and out-of-basin harvest removal, reducing hatchery juvenile release numbers, or reducing adult outplant numbers. There is no plan to control HOS by removal at Prosser Dam or Rosa Dam collection facilities. The Plan states, *"In Phases 3 and 4, all escaping fish (after broodstock collection) will be allowed to return to the spawning grounds…"* Although unclear, it appears this includes strays from the segregated program, since Table 2-24 shows an expected 360 segregated hatchery strays during Phase 4. Removal of segregated hatchery strays should be implemented to assist in improving PNI towards the objective of 0.67 (Phase 4) and reducing the genetic risk to natural origin spawners in the Integrated Program area. Furthermore, after development of empirically based escapement levels that support maximum juvenile production and adult returns, Prosser Dam and Rosa Dam collection facilities should be used to cull "surplus" fish, starting with segregated coho and then integrated coho while passing all natural-origin coho upriver. This approach would increase productivity of the natural population in two ways: 1) removing hatchery fish that are less effective spawners, as assumed by the Revised Plan, and 2) reducing density dependence by removing "surplus" spawners that contribute relatively little to future production. This approach would also lead to lower pHOS and to a higher PNI score.

Manage hatchery jacks at Prosser and Rosa dams. There is an absence of discussion and criteria related to how hatchery jacks (both coho and Chinook) will be managed within the natural escapement management strategy. Hatchery-reared salmon have been shown in many cases to produce a far greater proportion of jacks than their natural counterparts largely in response to more rapid growth in the hatchery. Given heritability in age-at-return, the proponents should consider controlling hatchery jack escapement at Prosser and Rosa dams at a level like that described for use in hatchery broodstock (equal to natural levels).

We note that this is a complex issue because the reproductive success of jacks in natural populations depends on the abundance and types of males they are competing with for spawning opportunities. Their overall genetic contributions may be substantial if few older and larger males are present and correspondingly low when such males are numerous. Furthermore, jack return rates listed in Table 2-7 suggest that approximately 7% of hatchery coho return as jacks compared with 11% of the natural coho (males and females combined). This counterintuitive finding, which might reflect poor marking of hatchery coho resulting in inflated NO jack returns, should be addressed. The proponents should describe the rationale and management of returning integrated (and segregated) hatchery jacks (coho and Chinook) destined to escape and spawn naturally.

Explain why so many (1,200) coho must be collected for use as broodstock in the segregated program.

This concern was adequately addressed with a recalculation, resulting in a reduction of broodstock required from 1200 to 600 coho salmon. Parameters (fecundity, egg-to-fry survival, etc.) used to calculate the revised broodstock requirement appear to be reasonable.

Issue 2. Summer/Fall Chinook: Do the revised integrated summer/fall and segregated upriver bright fall Chinook hatchery programs described in Chapter 3 of the Revised Plan meet scientific review criteria? Were previous comments by the ISRP on these hatchery programs adequately addressed (see Appendix K in Volume II)?

Revised Plan Summary. Chapter 3 of the Revised Plan provides a thorough description of the segregated Upriver Bright (URB) fall and integrated summer/fall Chinook programs. The primary purpose of both programs is to expand tribal and non-tribal harvest opportunities per U.S. v Oregon and other treaty agreements. The integrated summer/fall hatchery effort also addresses a secondary objective to increase the spatial and temporal abundance of naturally spawning summer and fall Chinook in the Yakima subbasin. The proponents indicate that Transition and Long-term phases will be used to accomplish the objectives of their Chinook programs. The Transition Phase is projected to last <25 years while the Long-term Phase is expected to last for an indefinite amount of time (>25 years).

The segregated URB Chinook program is a straightforward harvest enhancement effort. The URB program began in 1983 and has evolved over the years. Initially, URB Chinook juveniles from the Little White Salmon and Priest Rapids hatcheries (Hanford Reach stock) were directly released into the Yakima River or were released from acclimation sites. About a decade later, within-basin hatchery operations began, first at the Prosser (1994) and a few years later at Marion Drain hatcheries (1997). Annual releases of ~ 2 million juvenile URB Chinook have occurred in the Yakima subbasin since 1997. These releases are predominately subyearlings, although in 2017 and 2018 substantial numbers (>100 K) of yearlings were also reared and liberated. Almost all fish have been released from the Prosser Hatchery. However, some were also released from the Tribe's Marion Drain Hatchery and from several ponds in the subbasin. The Revised Plan describes how the URB segregated fall Chinook program will proceed in the future.

The integrated summer/fall Chinook program is more complicated than the URB Chinook program. It has two components, one dedicated to fall Chinook and the other to summer Chinook. The primary goal of the integrated program is to provide additional harvest opportunities. A secondary, long-term goal is to create self-sustaining natural populations of both races in the Yakima subbasin. Eventually, due to overlaps in maturation timing and spawning locations, the two races are expected to cross in nature and re-create the historical bimodal timing of the summer/fall population. A key uncertainty in the proposed approach is whether the use of these two stocks and subsequent interbreeding could lead to outbreeding depression if they have different genetic characteristics and different life history strategies. Planned improvements to hatchery infrastructure as well as substantial habitat restoration will be needed to potentially accomplish the ultimate objectives of the integrated Chinook program.

Habitat Capacity. The proponents recognize (page 77 in Volume 1) that "*Given current habitat conditions and fishery exploitation rates (> 60 percent), the Yakima Basin cannot sustain natural production of summer/fall Chinook without significant habitat improvements. Harvest levels are not expected to decrease in the short term, and the habitat improvements needed to increase population productivity to a level that can withstand this harvest rate are not expected in the near term.*" Several ISRP comments below are related to the secondary goal of the Program to create an opportunity for self-sustaining populations of Chinook salmon to develop in the Yakima Basin by using an integrated hatchery approach.

Justify release numbers of juvenile hatchery Chinook salmon given habitat capacity and natural production. Smolt capacity estimates, based on EDT analysis and assumptions, appear to be much lower than total proposed releases of integrated summer/fall Chinook and segregated fall Chinook salmon. For example, during the Transition Phase, the estimated/assumed smolt capacity per year is 0.838 million summer Chinook and 0.5 million fall Chinook (Table 3-16). However, during the Transition Phase, the following releases will occur: 1.0 million integrated summer Chinook, 0.5 million subyearling integrated fall Chinook, and 1.9 million subyearling/yearling segregated fall Chinook, leading to a total of 3.4 million juveniles released into the basin per year compared with a cumulative summer/fall capacity of 1.338 million (assuming capacities are additive but see comment below). Approximately 50% of summer Chinook will be released into acclimation sites above the confluence of the Naches and Yakima rivers, and the remaining fish will be released at Prosser along with juvenile fall Chinook salmon. Habitat use by juvenile Chinook will vary with life stage, run type, and release location. Subyearling Chinook will likely move down river over time and intermingle with other summer/fall Chinook salmon and other species.

The proponents should identify the discrepancy in release (3.4 million) versus capacity numbers (1.34 million) and justify the large release. This justification should consider the number of naturally produced salmon in the system not just hatchery fish. We recognize that the proponents want to saturate the degraded habitat with juvenile salmon during the Transition Phase, but these release numbers are very high relative to estimated habitat carrying capacity, suggesting that productivity (survival) could be very low in response to density dependent limitations. Additionally, high densities could cause many Chinook (natural and hatchery origin) to disperse downriver and compete for resources with downstream fishes. Predators may be attracted to the large numbers of hatchery fish released into the river each spring. Furthermore, as discussed with coho above, the proponents should describe how the 0.5 and 0.8 fitness factors were used to modify capacity estimates and influence proposed release numbers.

During the Long-term Phase, capacity is assumed to increase to 1.9 million summer Chinook and 1.1 million fall Chinook salmon in response to restoration efforts (3 million combined). Planned releases during this period are the same as during the transition period (3.4 million), which remain above the assumed carrying capacity for juvenile Chinook salmon (3.0 million combined) during the Long-term Phase. Justification for exceeding the assumed capacities during the Long-term Phase should be described in greater detail. The effect of exceeding capacity is that growth and survival of Chinook salmon will likely decline, and the high Chinook abundances could also affect other species in the watershed, including increasing abundances of predators that are already known to consume many salmonids in the watershed.

Separate capacity estimates were presented for juvenile summer and fall Chinook salmon. Are the spawning and rearing habitats of summer versus fall Chinook different enough that the respective estimates of smolt capacity can be treated as additive? How would different proportions of subyearlings and yearling smolts from natural production affect the estimates of capacity? It would be helpful to include a table to compare the magnitudes of proposed juvenile releases as proportions of the estimated smolt capacity and to discuss more explicitly why, in this context, the proposed releases are considered reasonable. The evaluation should consider anticipated natural production during the Transition Phase (~278,146 summer Chinook smolts and 163,860 fall Chinook smolts) and Long-term Phase (~697,619 summer Chinook smolts and 292,096 fall Chinook smolts).

Sustainable harvest rates for Chinook salmon. Previous ISRP reviews raised questions about the expected harvest rates on NOR summer (60%) and fall (54%) Chinook salmon and the harvest effect on sustainability of the natural Chinook populations. Most of the Chinook are harvested in ocean and lower river fisheries. The proponent's response indicates that the assumed harvest rates appear to support a sustainable Chinook run in the Okanogan and so presumably the NOR Chinook return to the Yakima watershed is sustainable. A key ISRP question is whether the NOR Chinook runs (and NOR coho run) are sustainable at a 54% or 60% harvest rate without supplementation with hatchery spawners. Monitoring and evaluation are needed to evaluate the assumption of sustainability.

Does the AHA model output indicate sustainability of natural Chinook salmon? Data from Table 3-23 can be used to evaluate sustainability of natural spawning Chinook salmon in the Yakima Basin based on the AHA modeling output. In other words, does the number of progeny returning to the spawning grounds equal or exceed the parent spawning population? The modeling data indicate that the integrated summer and fall Chinook programs are not sustainable during either the Transition Phase or the Long-term Phase. For example, the R/S for summer Chinook during the Transition Phase is 1,357/3,701 = 0.37, improving to 3,050/4983 = 0.61 during the Long-term Phase. R/S values <1 indicate that the spawning population is not replacing (i.e., sustaining) itself in the face of existing harvest rates of ~60%. The pre-fishery R/S values for these two populations are ~0.92 (transition) and ~1.5 (long-term), indicating the potential for a sustainable natural-origin summer run population during the Long-term Phase if harvests on NOR Chinook are reduced.

Another potential approach for increasing life cycle productivity of these populations and potentially achieving a sustainable natural population is to reduce the spawning population by harvesting more hatchery fish destined for the spawning grounds. The estimated contribution of hatchery Chinook salmon to the natural spawning population is 62-68% during the Transition Phase and about 45-48% during the Long-term Phase, indicating that many additional hatchery fish may be available for harvest. Both segregated and integrated hatchery fish could be selectively culled as needed at Prosser Dam and Rosa Dam, and shared with Tribal members if quality is sufficient. Ultimately, a lower harvest rate on NOR Chinook, reduced spawning abundance (by selectively harvesting more hatchery fish), and improved habitat conditions are needed to achieve sustainable natural populations. Empirically derived recruitment data should be used to develop metrics needed to support sustainable natural populations. According to the proponents, this was not possible in the past because hatchery Chinook salmon were not all marked. However, the Revised Plan states that 100% of hatchery Chinook will be marked or tagged (100% CWT for integrated, and 100% adipose clip and 10% CWT of segregated Chinook). The ISRP commends the proponents for marking/tagging 100% of hatchery salmon so that adequate data can be collected to monitor, evaluate, and improve the program over time.

Early maturation of yearling fall Chinook. The proponents state that releasing fall Chinook as yearlings rather than subyearlings increases smolt-to-adult survival but also promotes early maturation, observed as a higher proportion of age-2 returns. They seem to conclude that this tradeoff is worthwhile but do not show an explicit analysis to support this conclusion, including information on size and age at return. Does smaller size and higher survival of returns from yearlings sufficiently offset larger size and lower survival of returns from subyearling? Further justification is needed for the yearling fall Chinook releases.

HSRG recommendations. Text (on page 92 of Volume 1) indicates that Alternative C recommended by the HSRG was rejected because *"the HSRG's recommendations do not address the summer-run component of the summer/fall Chinook population and would not achieve the Tribe's spatial and temporal diversity goals. The HSRG's analysis would also not meet the Tribe's long-term harvest goals. Therefore, this alternative was eliminated from* *further consideration."* For completeness, the proponents should specify why the HSRG's recommendations are not consistent with spatial and temporal diversity goals and harvest goals.

Issue 3. Adaptive Management: Does the Adaptive Management process presented in Chapter 5 of the Revised Plan provide the proponents with an approach that can be used to evaluate and modify program actions in a timely and appropriate manner? Have contingency actions/options been described to meet probable challenges?

Chapter 5 provides an adequate description of the adaptive management process. Fig 5-1 depicts key steps in the annual planning process, but it does not highlight *a priori* contingency planning and the iterative cycle of adaptive management over successive years. However, the text clearly and appropriately describes requirements for (1) annual meetings to review key assumptions, status and trends, and decision rules, and (2) peer review of a "state of the program" report every 5 years to document progress and evaluate scientific support for either continuing or adjusting the approach described in the Revised Plan.

Issue 4. Monitoring and Evaluation (M&E): Will the Monitoring and Evaluation plan described in Appendix J in Volume II provide adequate information to support the program's adaptive management process?

The proponent's M&E plan is designed to provide assessments on project performance within eight major topic areas: hatchery, harvest, spawning escapement, productivity, ecological interactions, predation, disease, and genetic monitoring. The plan lists the monitoring and evaluation objectives under each of these principal areas. A brief summary of the approaches and specific tasks used to meet the information needs of each objective is provided.

Significant improvements have been made in the 2019 monitoring and evaluation program that should benefit the adaptive management program. In the past, the proponents stated that they were unable to mark/tag 100% of hatchery Chinook salmon. This deficiency prevented estimation of natural origin versus hatchery origin smolt production and adult returns, thereby significantly limiting evaluations of program success. However, the 2019 Revised Plan indicates summer/fall hatchery Chinook salmon will soon be 100% marked or tagged so that origin can be identified. Stock-specific data and other data shown in Table 5-1 and in Appendix J are needed to monitor and evaluate Program objectives, especially with respect to the productivity and viability of the natural spawning populations.

More detailed descriptions, however, are needed in a few sections of Appendix J. In particular, the section on productivity monitoring and evaluation (A.4) does not adequately explain how natural smolt production will be assessed to (1) evaluate density dependence during the spawner to smolt phase, and (2) track changes in productivity and capacity parameters associated with habitat restoration (or degradation). It is especially important to monitor and evaluate changes in the smolt-per-spawner metric (natural production) because this part of the life cycle will be most influenced by the hatchery program and restoration efforts. Additionally, size of naturally produced smolts in relation to juvenile abundance (natural and hatchery plants) and parent spawning abundance should be used to inform effectiveness of habitat actions within a density-dependence framework (ISAB 2015-1).

The proponents should also evaluate the sustainability of the natural spawning coho and Chinook populations across the entire life cycle and develop spawning escapement goals that have the potential for maximizing production of natural smolts and adult returns. The proponents should consider using a similar life cycle modeling framework that is used for the Wenatchee and Grande Ronde Basin Chinook salmon, which would provide valuable insights into the sustainability issue. These evaluations are needed because AHA modelling output indicates that the current Revised Plan does not support self-sustaining natural populations (i.e., R/S < 1), based on the estimated numbers of HOR and NOR salmon on the spawning grounds, the anticipated harvests rates, and the number of NO progeny that migrate beyond Prosser dam to spawn. Productivity and capacity values for coho and Chinook salmon are currently based on EDT assumptions, which appear to overestimate these metrics that are critical for managing sustainable salmon populations. Please see more details on this topic above. The Monitoring and Evaluation Plan should describe how productivity and capacity of natural spawning salmon will be evaluated and tracked over time.

Additional clarification is needed in the following sections of the M&E plan. The section on genetic monitoring and evaluation (A.8) provides only a high-level summary and does not mention any use of parent-based tagging (which seems inconsistent with the proponent's response to the ISRP comments in Appendix K). The genetics monitoring and evaluation plan should describe how parent-based tagging will be used. The text in Task A.6.1.3 should describe how the impact of predation by piscivorous fish will be “indexed”. Describe in Task A.1.2.8 what “phenotypic characteristics” of broodstock will be documented. Will 11-Ketotestosterone levels to be tracked in Task A.1.6.6 to predict the likely proportion of minijacks among smolt releases?

Issue 5. Facility Upgrades: Are the proposed hatchery upgrades, facility additions, and operation schedules offered in Chapter 6 of the Revised Plan adequately described and justified?

Complete descriptions of existing infrastructure and planned improvements at each of the project’s hatchery facilities are described. The Revised Plan provides a cogent rationale for the proposed upgrades and additional infrastructure based on increased hatchery production, the planned use of multiple release locations, and the need to replace facilities/structures that are approaching the end of their functionality. The operation schedules presented in Appendix D are clearly written and provide good guidance for facility usage during adult holding, spawning, incubation, rearing, and release periods.

The use of Partial Recirculating Aquaculture System (PRAS) and circular rearing tanks as opposed to flow-through raceways for fish rearing at the Prosser Hatchery is new. The Revised Plan describes the advantages of using PRAS. It is expected to reduce water usage by 75% and will allow groundwater to be used at the Prosser Hatchery during the rearing period. Water velocity and gas mixtures in the circular tanks supported by PRAS are also expected to improve fish quality. Because PRAS is new to the project, the operations plan calls for a low rearing density. We support that recommendation and suggest that rearing densities at Prosser Hatchery and at the Melvin R. Sampson Coho Hatchery be even lower than those recommended, at least initially. Then hatchery staff can examine fish performance in PRAS rearing vessels and make an informed decision to increase or maintain fish densities.

References

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