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UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF OREGON

NORTHWEST ENVIRONMENTAL DEFENSE CENTER, WILDEARTH GUARDIANS, and **NATIVE FISH SOCIETY**,

Plaintiffs,

v.

U.S. ARMY CORPS OF ENGINEERS and **NATIONAL MARINE FISHERIES SERVICE**,

Defendants.

CITY OF SALEM and MARION COUNTY,

Intervenors.

Case No. 3:18-cv-00437-HZ

Fifth Declaration of Kirk Schroeder in Support of Plaintiffs' Motion for Permanent Injunctive Relief

I, Kirk Schroeder, declare as follows:

1. I have personal knowledge of the facts set forth below and if called as a witness I would and could truthfully testify to these facts.

2. I was asked by the Plaintiffs in this litigation to provide my expert opinion on the impacts of the Willamette Project on threatened Upper Willamette River Chinook salmon and steelhead.

3. I provided four previous declarations in support of Plaintiffs' Motions for Preliminary Injunction, Summary Judgment, and Remedies. *See* ECF Nos. 37, 76, 97, and 119.

4. My First Declaration describes my professional qualifications and experience. ECF No. 37, ¶¶ 3–8. In brief, I have spent 40 years researching and monitoring salmon and steelhead, 36 of which I was employed with the Oregon Department of Fish and Wildlife ("ODFW"). I have substantial experience with Willamette River salmonids, as I assisted and then led the Willamette Spring Chinook Research Project from 1996–2013. I have continued to work with the Willamette River research project, write research papers for professional journals, and interact with project personnel on various activities associated with the Willamette basin.

5. I have reviewed the Corps' Response to Plaintiffs' Motion on Remedies along with accompanying declarations, primarily the Second Declaration of Richard Piaskowski and the Declaration of Gregory Taylor. In this declaration, I rebut some of the arguments that the Corps and its employees makes in those declarations.

6. This declaration, as with my previous declarations, includes my expert opinions and is based on my professional experience, materials referenced, and general knowledge of Willamette River salmonids and their habitat.

Status and Trends of Upper Willamette River Chinook Salmon and Steelhead

7. Before I summarize the status and trends of Upper Willamette River (UWR) Chinook salmon and steelhead, I feel it is important to address what is called the "shifting baseline syndrome", which is the phenomenon whereby contemporary abundances and habitat conditions are accepted as reflecting historical conditions.[1] As species decline and populations decrease, the baseline shifts downward with each successive generation of fisheries managers and becomes an inappropriate reference point for assessing decreases or setting recovery targets. Another factor is that populations often decreased decades before robust estimates of population numbers were made so that historic levels are largely unknown. Because viability assessments and recovery targets are often based on data from the immediate past, they may not represent the true status or trend of a species or population, or their true production potential. Thus, it is important to remember the numbers of salmon and steelhead that once returned to the Willamette River because otherwise any improvement from extremely depressed conditions may be touted as a success if inappropriate reference points are used.

8. I will first address a couple of errors in the second Piaskowski declaration regarding numbers and comparisons before summarizing status and trends. For winter steelhead, Mr. Piaskowski conflates two different counts of winter steelhead at Willamette Falls in his comparisons of returns among years. ECF No. 134 ¶ 9. He correctly reports the number of late winter run steelhead as 543 and 1,233 in 2017 and 2018, respectively, but then uses the total steelhead count (early run plus late run) for 2020 or 5,510 fish. However, only the late run winter steelhead are considered as the native run. The actual count of late run of winter steelhead in

[1] D. Pauly 1995. Anecdotes and the shifting baseline syndrome of fisheries. Trends in Ecology and Evolution 10:430; *see also* R.F. Thurow, T. Copeland, and B.N. Oldemeyer. 2020. Wild salmon and the shifting baseline syndrome: application of archival and contemporary redd counts to estimate the historical Chinook salmon (*Oncorhynchus tshawytscha*) production potential in the central Idaho wilderness. Canadian Journal of Fisheries and Aquatic Sciences 77:651–665.

2020 was 3,718 (not 5,510) as is correctly shown in Figure 1 of my fourth declaration. ECF No. 119 ¶ 12.

9. Next, Mr. Piaskowski compares the total number of winter steelhead in 2020 to 5-, 10-, 20-, and 50-year averages of 1961–2019 [sic]. ECF No. 134 ¶ 9. However, the count of late run winter steelhead was not available until 1971, so to get a 50-year average one would have to include the 1970 count when only early run steelhead were counted. He then states that the 2020 count was higher than the 5-, 10-, and 20-year average. ECF No. 134 ¶ 9. However, the only way the 2020 count could be higher than the 20-year average is if the **total** 2020 count is compared to the 20-year average **late run** count. In fact, when just late run counts are compared, the 20-year average count was 20% higher than the 2020 count, and the 2020 late run count was 57% of the 49-year average, not 86% of the 50-year average as he reported.

10. However, regardless of these errors, comparing a single year's return to previous averages is a meaningless measure for assessing the status of a population, much less a trend. In fact, Mr. Piaskowski later acknowledges this when he quotes from McElhany et al. (2000):[2] "Salmon are short-lived species with wide year-to-year abundance variations that contribute to uncertainty about average abundance and trends. For these reasons, it would not be prudent to base abundance criteria on a single high or low observation." ECF No. 134 ¶ 102. If one was going to use the single 2020 count (3,178) as some measure of population status, it would make more sense to compare it to the highest count of late run winter steelhead (18,495) or the mean of the five highest counts (16,465) than to the previous year's count.

11. For Chinook salmon, Mr. Piaskowski includes the hatchery portion of the Willamette Falls fish counts to state that the run increased from 20,617 in 2019 to 33,888 in

[2] P. McElhany, M.H. Ruckelshaus, M.J. Ford, T.C. Wainwright, and E.P. Bjorksedt. 2000. Viable salmonid populations and the recovery of evolutionarily significant units. Technical Memorandum NMFS-NWFSC-42. (page 14)

2020. ECF No. 134 ¶ 12. Note that the 2019 count is for adults and jacks, whereas the 2020 number is just adults; the count of adults and jacks was 35,012 in 2020. Again, regardless of the numbers used and errors, these single-year comparisons are meaningless for assessing status or trends.

12. As stated in my previous declaration, the current number of wild Chinook salmon that return each year (less than 10,000) is a fraction of the historic estimates of about 300,000–500,000 fish based on harvest and egg takes.[3] ECF No. 119 ¶ 10. Also, as noted in my previous declaration, UWR spring Chinook was the only ESU among the six Chinook salmon ESUs in the Pacific Northwest with a recent risk trend of "declining" in the 2015 NMFS 5-year status review. ECF No. 119 ¶ 10.

13. About 70% of the Chinook salmon that return to UWR basin are presently hatchery fish. Hatchery Chinook salmon in the UWR were derived from local populations, retain genetic similarities to the wild populations, and are considered as part of the ESU. Hatchery fish may provide some conservation benefits such as helping to sustain depressed populations, reintroducing fish into historic habitat, and increasing marine-derived nutrients in watersheds. However, I stress the numbers of wild fish as opposed to the total number of wild and hatchery fish because the number of hatchery fish returning to the basin is not a true reflection of the status of populations. Although the number of returning hatchery fish can be affected by large-scale influences such as ocean conditions, adult returns are also a product to some degree of the numbers of juvenile hatchery fish released, which conceivably could be increased to boost the total number of returning Chinook salmon. In addition, the juvenile hatchery fish are not subject to the same threats or limiting factors as wild fish (e.g., hatchery

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[3] J. Myers, C. Busack, D. Rawling, and A. Marshall. 2006. Historical population structure of Willamette and lower Columbia River Basin Pacific salmonids. Technical Memorandum NMFS-NWFSC 73.

smolts migrate quickly once released, therefore spending little time in freshwater habitats outside the hatchery environment).

14. As explained in McElhany (2000), "a population that depends on naturally spawning hatchery fish for its survival is not viable by our definition".[4] They further state that their focus is on naturally produced fish because the focus of the Endangered Species Act is on natural populations in native ecosystems.[5] Therefore, as explained in my Second Declaration, hatchery fish are not a substitute or a long-term conservation strategy for wild fish, and the continued reliance on hatchery origin fish to conserve populations puts the long-term viability of wild populations at risk. ECF No. 76 ¶¶ 2–8. Thus, the status and trend of the wild UWR population is imperative for understanding threats and harm to UWR Chinook salmon.

15. As pointed out in my fourth declaration, the number of wild spring Chinook has decreased since 2002 (first year that estimates could be made). ECF No. 119 ¶¶ 18–20. Although an exact count of wild Chinook at Willamette Falls was not possible until 2002, some inferences can be made about their number when counts began at the Falls in 1946. The mean number of spring Chinook salmon was 40,379 in 1946–1956 with high counts of 53,000 to over 75,000.[6] It is important to remember that salmon runs had already been affected by harvest, water pollution, and other factors by then.[7] Hatchery salmon have been reared and released in the Willamette Basin since the late 1800s but it was not until the 1950s to mid-1970s that advances in fish culture techniques such as feed and disease treatment resulted in release of smolts (as opposed to

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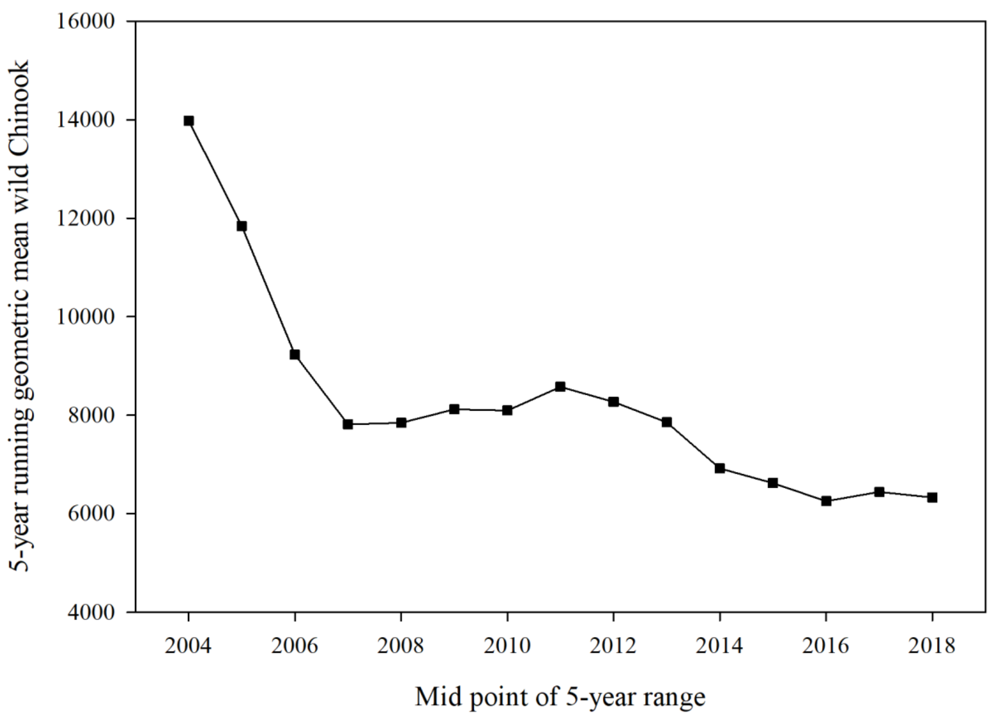
[4] McElhany et al. 2000 (page 9)
[5] McElhany et al. 2000 (page 13)
[6] The early counts of adult salmon were approximate. Counts were made as adult salmon migrated from one pool to the one above in the open fishway, counts were conducted from 7 AM to 8 PM, and four nighttime counts were made to develop expansion factors. During high water in early spring, fish were counted from shore until the edge of the fishway was accessible. See D.R. Johnson. 1948. Size of the Willamette River spring Chinook salmon run, 1947. Oregon Fish Commission 1(1):18–21.
[7] E.g., "Pollution in the Willamette River is a State shame." *in* R.E. Dimick and F. Merryfield. The fishes of the Willamette River system in relation to pollution. Engineering Experiment Station Bulletin 20:7–55, Oregon State College, Corvallis, OR.

fry or fingerlings) and a higher survival of juvenile salmon.[8] These advances were accompanied by large increases in the numbers released and standardized fish culture practices. Therefore, it can be assumed that the majority of the fish returning in 1946–1956 were wild fish.

16. The number of wild Chinook salmon increased in 2019 and 2020, but these numbers still represent a decrease from recent years and certainly from historic levels (*note*: 2020 is a preliminary estimate based on the number of unclipped fish counted at the Falls and the mean percentage of unclipped hatchery fish in 2008–2019). The most recent 5-year geometric mean was 6,331 wild Chinook (2016–2020, with preliminary estimate for 2020), a decrease of 19% from the previous 5-year period (7,856) and a decrease of 55% from 2002–2006 (13,983). The 5-year running geometric mean shows that the trend of the UWR wild population has declined and is currently flat at a low level (Figure 1).



[8] C. Mahnken, G. Ruggerone, W. Waknitz, and T. Flagg. 1998. A historical perspective on salmonid production from Pacific Rim hatcheries. North Pacific Anadromous Fish Commission Bulletin 1:38–53; *see also* E. Leitritz and R. C. Lewis. 1976. Trout and salmon culture (hatchery methods). California Department of Fish and Game, Fish Bulletin 164.

Figure 1. Five-year running geometric mean of wild spring Chinook salmon at Willamette Falls, 2002–2020. Note estimate of wild fish in 2020 is preliminary and is from the number of unclipped fish counted at the falls and the 2008–2019 mean of unclipped hatchery fish.

17. Abundance of winter steelhead by run type is not available prior to 1971, so it is important to note that historic abundance is unknown. However, over 10,000 late run winter steelhead (considered the native run) returned on average in 1971–1988 compared to an average of about 3,200 in 2008–2020. This represents a decrease of almost 70% just from the immediate past and the decrease from historic numbers would be much higher.

18. Upper Willamette winter steelhead was the only steelhead ESU among the six steelhead ESUs in the Pacific Northwest with a recent risk trend of "declining" in the 2015 NMFS status review. Recent analyses of the effect of pinniped predation on an already low abundance of winter steelhead suggested that the risk of extinction had increased for all populations.[9] Hatcheries produce out-of-basin summer steelhead for recreational fishing within the basin. These hatchery fish do not aid in the conservation of the species.

19. Available data indicate that late run winter steelhead have decreased over a relatively short time frame, that peaks of the 5-year running geometric mean have been short-lived, and that the abundance level of the peaks have decreased over time (Figure 2). Therefore, although the late run has certainly been increasing in the last few years from an abysmal low run of just 543 adults (compared to a high of about 18,500 adults in 1971), we do not know if this modest increase will continue or simply peak at a relatively low level.

[9] M.. Falcy. 2017. Population viability of Willamette River winter steelhead; an assessment of the effect of sea lions at Willamette Falls. Oregon Department of Fish and Wildlife.

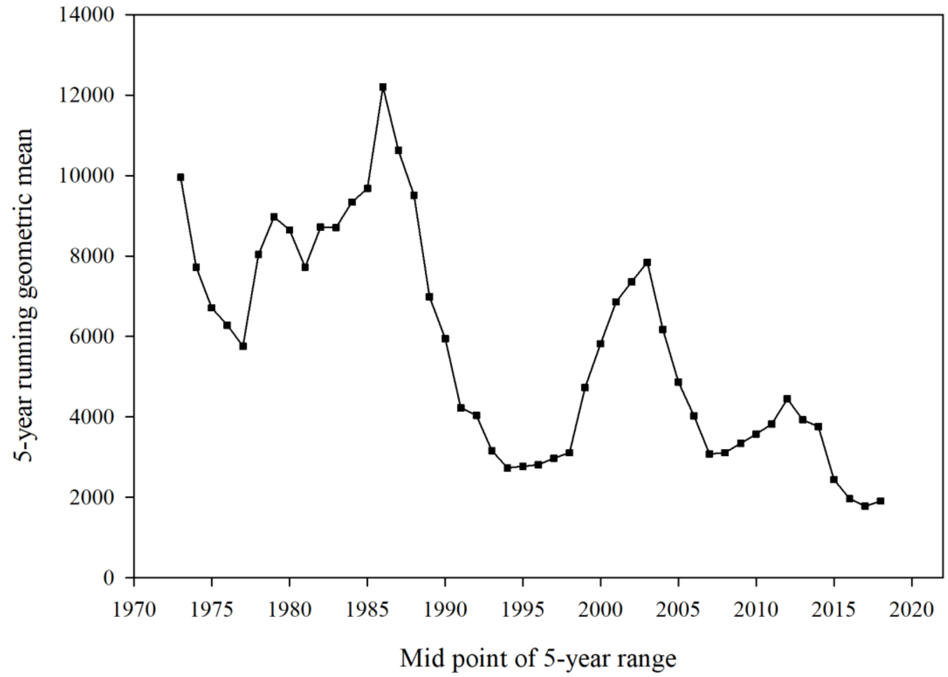


Figure 2. Five-year running geometric mean of late run winter steelhead counted at Willamette Falls, 1971–2020.

20. The 5-year geometric mean abundance of winter steelhead was lower in the most recent period (1,908 in 2016–2020) than in any previous 5-year period, with a decrease of 51% from the previous 5-year period (3,926 in 2011–2015) and a decrease of 81% from the high 5-year period in 1971–1975 (9,959).

Irreparable Harm

21. The Corps contends that since the populations are not at imminent risk of extinction, the populations will not suffer irreparable harm if they maintain their current status. The Corps also cites ocean conditions as a dominant factor affecting UWR salmon and steelhead. I disagree. The harm of the Willamette Valley Project to Chinook salmon and steelhead populations is ongoing and has been cumulative over decades, resulting in their present precarious state. It is likely the species will remain in a precarious state unless actions are taken

that will meaningfully improve passage at the Corps' dams. Although populations have shown some improvement in the most recent years, this does not demonstrate an absence of harm from the dams and their operations, and populations remain in a precarious state. For example, the trend in winter steelhead indicates not just a long-term decline in numbers, but also a decline in peaks, which are presumably a response to more favorable freshwater or ocean conditions. These data would suggest that cumulative effects of the Willamette Valley Project (WVP) have hampered the ability of populations to respond to favorable conditions.

22. Although ocean conditions are an important factor that affects salmon and steelhead populations, returns of adult salmon and steelhead are also dependent on the number of smolts that enter the ocean. Therefore freshwater factors that affect the number and survival of smolts are important and benefits will be derived from actions that increase freshwater survival. As stated recently, "not even the best ocean conditions can resurrect a dead fish."[10]

23. In addition, populations of salmon and steelhead in the Clackamas and Sandy basins have shown a general upward trend in adult returns compared to the general downward trend for UWR salmon and steelhead. This suggests factors other than large-scale ocean conditions are differentially affecting regional populations. As mentioned in my fourth declaration, improvements for juvenile and adult fish passage have been implemented in the Clackamas and Sandy basins, and the contrast to UWR populations—where meaningful passage improvements have yet to be implemented— provides at least circumstantial evidence that the WVP is a primary factor in the continued decline of UWR salmon and steelhead. ECF No. 119 ¶ 23.

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[10] M. DeHart, Fish Passage Center Memorandum. Technical Review of Welch et al. (2020), titled, A synthesis of the coast-wide decline in survival of West Coast Chinook Salmon (*Oncorhynchus tshawytscha*, Salmonidae). *See also* H. Schaller, C. Petrosky, and M. Filardo (2020) for review of Welch et al. paper.

24. Mr. Piaskowski declares that demographic risk is "negligible" because UWR populations are "well above" the trigger levels for unacceptable risk of extinction. ECF No. 134 ¶¶ 13 and 117. These trigger levels were estimates set in the 2011 Recovery Plan for population viability models, and were considered the critical risk thresholds (CRT), below which a population would be considered to go into an extinction vortex from which it could not recover. When the viability models are run for 100-year periods and run for multiple times (e.g., 1,000 iterations), the number of times during the iterations that the simulated population drops below the CRT within a 100-year period is used to estimate the extinction probability for that population. CRT values are set very low for salmon and steelhead because life history traits, diversity, overlapping generations, and large reproductive capacity of anadromous salmon and steelhead help to buffer populations against extinction. However, these threshold values or triggers represent the rock bottom level for a population[11] and are far below what would be considered reasonable abundance levels that would help prevent populations from losing diversity and the capacity to adapt to changing conditions, which in turn would make them more vulnerable to extinction. Therefore, I disagree with Mr. Piaskowski's opinion that CRT values are an appropriate indicator of population status or that populations that are above these values could sustain years of additional harm from the WVP including lack of access to high quality habitat and lack of juvenile fish passage at dams.

25. As stated in my fourth declaration, populations that remain at low levels of abundance are more vulnerable to chance (stochastic) events that can drive abundance lower. ECF No. 119 ¶ 24. McElhany et al. (2000) stated that small populations are more at risk than

[11] CRT for Chinook salmon was set at 150 adults for the North and South Santiam and Middle Fork Willamette and 250 adults for the McKenzie; winter steelhead was set at 200 adults for the North and South Santiam.

large populations.[12] Recovery can be more difficult when populations remain at low levels of abundance because of factors such as lost diversity, overall loss in productivity, and vulnerability to demographic and environmental events.[13] Preliminary findings from our research on the role of life history diversity in UWR spring Chinook populations suggest that the capacity of life history diversity to help stabilize populations was lost if populations were already at low abundance and then further decreased.[14] Therefore, low levels of abundance can harm populations over time and result in the loss of stability, loss of spatial structure, and increased synchrony in spawning or migration that would make them more vulnerable to changes in environments or stochastic events.[15] Without meaningful actions, UWR salmon and steelhead populations are likely to remain in a precarious state and at increased risk from unexpected environmental events such as fires and floods. Immediate actions are needed to achieve progress in re-establishing populations into their historic habitats in order to reduce the risks of populations to catastrophic events and to increase their probability of recovery.

26. For example, natural origin adult salmon outplanted in the South Santiam River in 2010 suffered an almost complete reproductive failure because of a flood event. The habitat upstream of Foster is of marginal quality because the river is high gradient and lacks substrate and large wood for spawning and rearing. The only other available habitat for wild salmon in the South Santiam Basin is downstream of Foster, which is of poor quality. Because wild spring Chinook are at a very low level of abundance, this brood year failure further jeopardized the

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[12] McElhany 2000 p.54

[13] R. Lande. 1993. Risk of population extinction from demographic and environmental stochasticity and random catastrophes. American Naturalist 142:911–927.; J.A. Hutchings. 2015. Thresholds for impaired species recovery. Proceedings of the Royal Society B 282:20150654.

[14] R.K. Schroeder, L.D. Whitman, and B. Cannon. In prep. Life history diversity of wild spring Chinook salmon and effects on population stability, Willamette River, Oregon.

[15] D.J. Isaak, R.F. Thurow, B.E. Rieman, and J.G. Dunham. 2003. Temporal variation in synchrony among Chinook salmon (*Oncorhynchus tshawytscha*) redds counts from a wilderness area in central Idaho. Canadian Journal of Fisheries and Aquatic Sciences 60:840–848..; J.W. Moore, M. McClure, L.A. Rogers, and D.E. Schindler. 2010. Synchronization and portfolio performance of threatened salmon. Conservation Letters 3:340–348.

population. The highest quality habitat for Chinook salmon in the South Santiam Basin is upstream of Green Peter Dam. Without immediate actions to re-establish salmon upstream of Green Peter Dam, the population will remain at risk of reproductive failure. To date, there have been no measures implemented to re-establish salmon upstream of the dam and the Corps proposes only to further study the issue, which was supposed to have occurred under the 2008 BiOp. Although there are uncertainties about the best methods for reintroduction upstream of Green Peter Dam, outplanting hatchery fish would provide critical information to begin answering questions. Continued inaction puts the wild salmon population at high risk.

27. Of the four attributes NMFS identified for assessing viability of populations (abundance, productivity, diversity, and spatial structure), abundance and productivity were treated as a single attribute because they are so closely interrelated, and abundance is the measure used because it is more readily measured. NMFS acknowledged that a mix of quantitative and qualitative measures were necessary to assess diversity and spatial structure because of difficulty in explicitly modeling them relative to extinction risk.

28. In arguing that UWR populations are at low risk, Mr. Piaskowski relies on recent increases in abundance and cites the higher weight that this attribute receives in viability assessment. ECF No. 134 ¶¶ 8, 116. In deriving extinction risk, viability analysis uses available information to evaluate and rank each attribute on a 0–4 scale, with 0 being the highest probability of extinction. The attribute ranks are then averaged with abundance/productivity receiving more weight than diversity or spatial structure to give a single score. The weighting of abundance/productivity reflects its importance in determination of risk, partly because these attributes have been more thoroughly studied so their role in the process of extinction is better understood. Emphasis on abundance also reflects that it can be more directly measured than

productivity, diversity, or spatial structure. The various teams assessing population viability and extinction risk recognized the interrelatedness of all the attributes and the influence of diversity and spatial structure on abundance/productivity and vice versa. At the basic level, extinction results when the population falls to zero, but populations that fall to a low level of abundance can encounter reproductive failure from many factors (e.g., loss of diversity, spatial isolation, environmental catastrophes) that inevitably leads to extinction. Although abundance is a key indicator of risk, viability analyses also incorporate the other attributes of diversity and spatial structure. The abundance of UWR salmon and steelhead populations is low and they have suffered the loss of spatial structure and diversity because they lack access to historic habitat and effective passage at WVP dams. All these factors continue to threaten the populations and increase their risk of extinction.

Willamette Project Impacts

29. My previous declarations explain how the Willamette Project negatively impacts UWR Chinook salmon and steelhead in each of the four major tributaries. ECF No. 37 ¶¶ 15–32; ECF No. 76 ¶¶ 9–12, 28; ECF No. 97 ¶¶ 15–31, 46–48; ECF No. 119 ¶¶ 26–36. The Corps barely acknowledges these impacts and looks for other sources of harm to explain the precarious state of these species. This ignores the weight of evidence, the key issues I have repeatedly explained, and that NMFS has cited.[16]

30. First, the lack of access to historic habitat upstream of the Corps' dams is the major factor within the Willamette River Basin that is driving the status of listed Chinook salmon and winter steelhead. Dam operations continue to disrupt the life history of the listed species by causing poor water quality downstream of dams, lack of effective and safe passage for

[16] E.g., 2019 Hatchery BiOp. "the federal dams and reservoirs continue to pose the greatest concerns for spring Chinook salmon." (page 191)

juvenile fish at dams, and altered habitat downstream of dams from flow management and lack of wood and gravel recruitment.

31. Second, although some changes have been made to the operation of the dams since the 2008 BiOp, the aggregate effect of operations have had numerous negative impacts throughout the Willamette Basin that have resulted in continued degradation of fish habitat and ongoing harm to UWR Chinook and steelhead.

32. Third, all of the attributes considered as critical for long-term viability of the salmon and steelhead populations continue to be affected by operations of the dams. Effects include: abundance and productivity levels well below recovery levels; lack of spatial structure because of blocked access to historic habitats and loss of downstream passage for juvenile fish to disperse and migrate naturally; loss of genetic diversity because of low abundance of adults and presence of hatchery fish; and disruption to rearing and migratory life histories.

33. Fourth, our research has shown that life history diversity at both the adult and juvenile stages provides stability and resilience to populations. Life history diversity of populations has been reduced under current conditions and operations of the dams. Under projected effects of climate change in the Willamette Basin, protection of life history diversity will be critical for maintaining spring Chinook and winter steelhead populations.

34. In my professional opinion, progress toward recovering UWR Chinook salmon and winter steelhead from their present precarious state will not be possible as long as these fish are restricted to habitats downstream of the dams, which represents a fraction of their historic range. Dams have resulted in a loss of about 20–90% of historic habitats. Measures to provide passage at dams have generally failed to meet any of the criteria for viability in increasing abundance/productivity, spatial structuring, and diversity. Permanent solutions for juvenile fish

passage at dams remain elusive. No operational changes have been proposed that allow fish to express their full range of life histories.

35. The primary effects of dams and dam operations, such as blocked access to historic habitat and changes in water temperature and flows downstream of dams, have largely continued without substantial change for decades. Although other factors have contributed to the decline of the species, including climate change and associated effects on freshwater and ocean environments, dams and dam operations have exacerbated these effects. The altered habitats caused by dams and dam operations have diminished the capacity of the species to adjust to changing conditions by blocking access to upper watersheds where environments are more favorable and by degrading habitats downstream of dams.

36. The Corps does not address these significant and underlying problems. Mr. Piaskowski instead places inappropriate weight on other secondary issues of hatchery fish and reservoir rearing that I address below.

Hatchery Fish

37. Mr. Piaskowski devoted several pages of his declaration to hatchery fish, assigning blame to these programs for causing harm on one hand, but then relying on returns of hatchery Chinook salmon to mask the low levels of wild populations. It should be noted that NMFS recently completed an assessment of UWR hatchery programs through a federal EIS and issued the 2019 Hatchery BiOp with associated Hatchery Genetics and Management Plans (HGMPs), and presumably the Corps had the opportunity for input into this process.[17]

[17] 2019 Hatchery BiOp, Evaluation of hatchery programs for spring Chinook salmon, summer steelhead, and rainbow trout in the upper Willamette River basin. NMFS Consultation Number WCR-2018-9781; 2019 FEIS to analyze impacts of NOAA's National Marine Fisheries Service proposed approval of Hatchery and Genetic Management Plans for spring Chinook salmon, steelhead, and rainbow trout in the Upper Willamette River basin pursuant to Section 7 and 4(d) of the Endangered Species Act.

38. I will address some of the issues raised in the Piaskowski declaration below with additional comments later that relate to specific issues within a subbasin. First, it is important to recognize that the existing UWR hatchery programs are a direct result of the construction of Corps dams; i.e., hatchery programs were established to mitigate the loss of wild fish due to the loss of habitat upstream of the dams. Second, hatchery fish can have harmful and beneficial effects on wild fish depending on the status of populations and the scope and management of hatchery programs. Third, deleterious effects of the hatchery programs should be assessed relative to other threats and limiting factors. Fourth, several measures have been taken to reduce the effects of hatchery fish and additional measures will be implemented under the 2019 Hatchery BiOp to reduce harm.

39. Hatchery fish can negatively affect wild populations. Hatchery fish can interbreed with wild fish causing genetic introgression and loss of fitness in the native population and the effect is greatest when hatchery fish and wild fish are genetically dissimilar. Other negative effects include competition and predation from hatchery fish, disease transfer from hatchery fish (or hatchery facilities) to wild fish populations, and masking the status of populations (i.e., hatchery fish that cannot be identified, if present in large numbers, could mask the true status of the wild population).

40. Conversely, hatchery programs can provide some benefits such as providing fishery opportunities and a source for re-introducing fish into historic habitat for conservation and recovery, especially if the hatchery fish were originally derived from the local population. Hatchery fish that are genetically similar to the wild population can also help to stabilize a depressed population and served as a bridge until conservation and recovery strategies are implemented and realized. In addition, hatchery fish can increase marine nutrients in a watershed

where the number of wild fish is small either directly by hatchery fish spawning in the wild or by the placement of hatchery-spawned fish and surplus hatchery fish into the watershed.

41. The effect of hatchery programs on listed species should be assessed relative to other threats and risks. NMFS noted that "the federal dams and reservoirs continue to pose the greatest concerns for spring Chinook salmon" and "elimination of the majority of the historic habitat has substantially decreased the habitat capacity and productivity for these populations [North and South Santiam winter steelhead]."[18] Therefore, the primary focus of measures to alleviate harm caused by the WVP should be on the most significant threats.

42. Mr. Piaskowski asserts that "fish managers have thus far resisted addressing [hatchery risk] factors." ECF No. 134 ¶ 121. Further, he states that use of hatchery fish to mitigate for habitat is not defensible without substantial improvements to habitat quality or access. ECF No. 134 ¶ 122. But that is precisely the point of Plaintiffs' request for this injunction. The Corps has yet to make substantial improvements in habitat quality or access to historic habitats that would improve the status of wild salmon and steelhead populations such that hatchery mitigation was unnecessary. Piaskowski would have the Corps reduce or eliminate its mitigation responsibility without any assurance that improvement to the species or access to habitat would occur.

43. Mr. Piaskowski's contention that fish managers have not taken action to reduce the threat of hatchery programs is not true. Several substantial measures have been implemented before and after the species were listed. All hatchery spring Chinook were released with an adipose fin clip and an otolith thermal mark beginning with the 1998 brood year. This allowed

[18] 2019 Hatchery BiOp (pages 191–192); *see also* 2009 Hatchery Scientific Review Group (page 46): "Options for improving the integrated hatchery programs in [UWR] ESU are limited due to the low number of natural-origin fish in the subbasin. This is generally the result of limited access to quality habitat cut off by flood control and hydropower development. Options for improving hatchery programs or achieving conservation goals are limited until this issue is addressed."

for implementation of a catch-and-release fishery to reduce the effect of sport fisheries after a study showed that mortality would be relatively low when unclipped wild fish were released.[19] More importantly, the marking program allowed for an accurate assessment of the wild population. Other actions have included reducing numbers of hatchery fish released, releasing part of the hatchery production out of the Willamette Basin (Youngs Bay terminal fishery) or into a subbasin with no wild salmon or steelhead populations (Coast Fork Willamette), advancing spawn timing of hatchery summer steelhead to minimize overlap with winter steelhead, and reducing or eliminating recycling of hatchery adults.

Juvenile Fish Movement and Rearing in Reservoirs

44. The Corps' employees make some assumptions about juvenile fish movement and rearing in reservoirs and argue against expanding passage opportunities because of the size and presumed high survival of large smolts that rear in the reservoirs.

45. First, the Corps argues against early spill at dams because of how juvenile fish have been observed moving into and through reservoirs. ECF No. 134 ¶¶ 49, 79, 88; ECF No. 133 ¶ 22. They claim that few juvenile fish are present near the dam in spring compared to June and therefore spring spill would not benefit juvenile fish passing the dams. However, the data do show some fish near dams earlier than June, and the figure used to justify waiting until June does not show a particularly large number at the dam in June for most of the reservoirs. ECF No. 134 *Figure 2, page* 41. In addition the general distribution of juveniles is likely influenced by reservoir management and alternative operations could change the distribution and timing of reservoir movement. For instance, extended drawdown periods and delayed refill could shorten

[19] R.B. Lindsay, R.K. Schroeder, K.R. Kenaston, R.N. Toman, and M..A. Buckman. 2004. Hooking mortality by anatomical location and its use in estimating mortality of spring Chinook salmon caught and released in a river sport fishery. North American Journal of Fisheries Management 24:367–378

the length of the reservoirs and earlier spill in the spring could trigger movement of juveniles toward the dam sooner than under current operations.

46. Based on our study of migration of juvenile spring Chinook in the McKenzie River where adults have access to historic spawning and rearing habitat, newly-emergent fry undertake long downstream migration into the lower reaches of the McKenzie River and into the Willamette River generally in February through March. They rear in these habitats and migrate as subyearling smolts in May and June in most years. The Corps proposes to wait until June to spill for downstream passage and argues that delaying spill until then will allow for spill to continue longer into summer. However, if juvenile fish are entrapped and not passed downstream until early summer, they would be entering an environment that is warming and may reach the Columbia estuary and ocean at the wrong time. This is another example of how dam operations are often mismatched with the downstream migratory behavior and life history of Chinook salmon, which would decrease life history diversity.

47. Second, the Corps presents biological arguments against providing downstream passage for fry and fingerling salmon because a) fish would have higher survival in the reservoir than downstream, and b) fish in reservoirs have higher growth and higher survival.

48. The initial argument assumes that fry/fingerlings passed downstream would enter degraded habitat and therefore have low survival. ECF No. 134 ¶ 124. But to the degree that habitat is degraded, at least some of the present condition can be attributable to the operation of the Corps' dams due to a lack of recruitment of large wood and substrate to form suitable habitat for juvenile salmon. Furthermore, juvenile salmon do successfully rear downstream of the dams, including in the Willamette River, with their highest presence in fall through spring and early summer. In fact, the subyearling life history relies almost exclusively on downstream habitat and

this life history has contributed more to the adult returns than yearling smolts in some years. Therefore, the area downstream of dams is important in sustaining life history diversity that, in turn, provides resilience to the populations.

49. To compare the overall survival of fish entrapped as fry in reservoirs to those passed downstream would require accounting for fry-to-smolt mortality in each respective environment. For example, fry and fingerling salmon that enter and are entrapped in reservoirs can have high mortality from factors such as predation.[20] Unless this mortality is accounted for, it would be difficult to make a valid comparison of the overall benefits of reservoir rearing versus passing fry and fingerling salmon downstream. In addition, juvenile salmon can become heavily infested with copepods in reservoirs,[21] which attach to the gills and can decrease fitness and survival within reservoirs and later after fish leave the reservoirs.[22]

50. Mr. Piaskowski and Mr. Taylor contend that higher growth rate in reservoirs leads to higher smolt-to-adult survival. ECF No. 134 ¶ 124; ECF No. 133 ¶ 39. They cite our Willamette juvenile Chinook study, and Piaskowski also cites Zabel (correctly, Zabel and Achord).[23] Our study did not address the effect of fish size or growth on survival and in fact we did not present any data on length or size (e.g., condition factor). The only reference to growth was a hypothesis in the Discussion section that fry migrating to the Willamette would be in habitat capable of allowing them to attain the growth necessary to smolt as subyearlings, but we

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[20] *See* F.R. Monzyk, R. Emig, J.D. Romer, and T.A. Friesen. 2014. Life-history characteristics of juvenile Chinook salmon rearing in Willamette Valley reservoirs. ODFW report prepared for U.S. Army Corps of Engineers W9127N-10-2-0008.

[21] F.R. Monzyk, T.A. Friesen, and J.D. Romer. 2015. Infection of juvenile salmonids by *Salmincola californiensis* (Copepoda:Lernaeopodidae) in reservoirs and streams of the Willamette River Basin, Oregon. Transactions of the American Fisheries Society 144:891–902.

[22] E.g., J.W. Beeman, A.C. Hansen, and J.M. Sprando. 2015. Observational data on the effects of infection by the copepod *Salmincola californiensis* on the short- and long-term viability of juvenile Chinook salmon (*Oncorhynchus tshawytscha*) implanted with telemetry tags. Animal Biotelemetry 3:20.

[23] Schroeder et al. 2016; R.W. Zabel and S. Achord. 2004. Relating size of juveniles to survival with and among populations of Chinook salmon. Ecology 85:795–806.

did not address smolt-to-adult survival. Zabel compiled data on groups of tagged fish that were detected farther downstream and reported that mean length and condition factor were poor indicators of population survival, that length of individual fish was a factor but that survival varied by site and year effects of the tagged fish. Piaskowski further contends that the large Fall Creek smolts have "higher smolt-to-adult survival rates to [sic] most other UWR Chinook subpopulations." ECF No. 134 ¶ 96. However, he provides no data and cites the 2015 Status Review, which does not have smolt-to-adult survival rates for any UWR population, contains just a single reference to the 2010–2014 mean adult-to-adult return rate of 0.97 for Fall Creek, and contains no adult-to-adult return rate for any other UWR population.[24]

51. In general, larger fish may have higher survival but the data are lacking to make definitive statements comparing survival of reservoir-reared fish to river-reared fish. In addition, other factors influence survival such as water temperature, flow, and estuarine and ocean conditions that may be independent of fish size or may vary annually. More importantly, larger smolts can have higher mortality risk during dam passage,[25] and size of juvenile fish can influence the age at return, with larger fish returning at a younger age[26], which could lower the reproductive potential of a population. Because many factors can affect survival, controlled studies would be needed to assess effects of entrapped juvenile salmon on population productivity by comparing the performance of fish passed early at the dams to those entrapped in the reservoir and passed later.

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[24] 2015 Status Review (page 206)

[25] E.g., M.L. Keefer, G.A. Taylor, D.F. Gartletts, C.K. Helms, G.A. Gauthier, T.M. Pierce, and C.C. Caudill. 2012. Reservoir entrapment and dam passage mortality of juvenile Chinook salmon in the Middle Fork Willamette River. Ecology of Freshwater Fish 21:222–234.

[26] E.g., I.A. Tattam, J.R. Ruzycki, J.L. McCormick, R.W. Carmichael. Length and condition of wild Chinook salmon smolts influence age at maturity. Transactions of the American Fisheries Society 144:1237–1248.

52. For these reasons, I disagree with the Corps' rationale that entrapping juvenile salmon and steelhead in reservoirs would be more beneficial than providing passage for different life stages of salmon and steelhead.

Interim Measures

53. As stated in my Fourth Declaration, I disagree that the measures proposed by the Corps will be enough to protect the listed species from further harm in the coming years. ECF No. 119 ¶¶ 44–72. In my professional opinion more aggressive and immediate actions are needed to address passage at dams, particularly for juvenile fish, while minimizing harm to fish spawning and rearing downstream of dams. The adoption of measures in the pending BiOp and implementation of permanent passage solutions are years away. Much time has been lost since the species were listed in 1999, which has resulted in the continued decline of the species. Therefore, meaningful interim measures are needed to reduce harm and to provide information so that permanent solutions can be more quickly developed and implemented.

54. The Corps' proposals for juvenile fish passage represent relatively minor tweaks to ongoing operations and do not include measures such as extended deep drawdowns in fall or early spring spill to provide more favorable conditions for juvenile fish passage. Because of the uncertainties about fish passage, experimental actions should be implemented and monitored with the objective of collecting as much information in as little time as possible to accelerate the pace of implementation and to accumulate knowledge that will aid the conservation and recovery of the species, and the implementation of effective recovery measures.

55. I believe the interim measures should build on results of previous studies[27] that conclude the following: a) passage efficiency and survival are generally higher for fish using spillways or ROs than powerhouse routes, b) deep drawdowns of reservoirs improve migration by shortening the length of the reservoir and providing current to attract fish to forebays, c) drawdowns make it easier for fish to access RO entrances by reducing the depth fish must sound, and d) passage in fall and spring is important to accommodate different migratory life histories.

56. The Corps contends that its interim measures are sufficient to prevent further harm to the listed species in the next few years. Its position is partly based on the assumption that ocean conditions are the controlling factor. ECF No. 134 ¶¶ 9, 12–13, 115, 117, 127–128. This rationale and others such as using high pre-spawning mortality and low survival in reservoirs to avoid taking aggressive actions apparently seeks to absolve the Corps of any responsibility for ongoing harm or the need to reduce that harm. As I mentioned earlier, although large-scale factors may affect populations, the increasing trend of salmon and steelhead in the Clackamas and Sandy as opposed to the decreasing trend of UWR populations suggests a detrimental and ongoing effect of WVP operations. Additionally, the downward trend in peak counts also indicates that the response of populations to favorable conditions may be diminishing, which might point to ongoing and long-term cumulative effects of WVP on salmon and steelhead.

57. The Corps acknowledges that actions such as surface spill and late fall drawdowns would "improve survival of juveniles passing downstream of dams". E.g., ECF No. 134 ¶ 123. Yet, it does not propose measures to implement these actions in the South Fork McKenzie or Middle Fork Willamette. Nor does it propose to undertake other meaningful actions such as starting the long overdue passage at Green Peter Dam.

[27] Summarized by A.C. Hansen, T.J. Kock, and G.S. Hansen. 2017. Synthesis of downstream fish passage at projects owned by the U.S. Army Corps of Engineers in the Willamette River Basin, Oregon. U.S. Geological Survey Open File Report 2017-1101.

58. In the paragraphs below, I provide specific comments on the Corps' response to proposed interim measures by the Plaintiffs. In general, many of the Plaintiffs' measures are based on operations proposed by the Corps with certain modifications such as extending the dates of some measures or the hours of turbine shutdowns. As such, to the degree that the Corps argues against implementation of the Plaintiffs' measures, it is often arguing against its own proposals. In fact, the Corps does acknowledge that several of the Plaintiffs' measures would provide benefits. In my professional opinion, the approach of interim measures should be more than minor tweaks of status quo operations. Rather, interim measures should be significant actions that can reduce harm to the populations such as improving passage for juvenile fish, coupled with an experimental approach for some measures to advance progress toward permanent solutions.

North Santiam

59. Passage for juvenile salmon and steelhead at Detroit and Big Cliff dams is imperative for recovering these species in the North Santiam Basin. The Plaintiffs propose to spill in the spring, draw down Detroit Reservoir in fall to use the lower regulating outlets (ROs) for temperature control, and prioritize use of upper ROs over turbines to increase passage through the ROs.

60. The Corps acknowledges that reduced turbine operations will benefit fish and the Plaintiffs' proposal calls for longer periods of turbine shutdown than that provided by the Corps' proposal. The Plaintiffs' measures call for maintaining Detroit Reservoir at or below minimum conservation pool from November 1 to February 1 and turning off turbines from 4 pm to 8 am to facilitate juvenile fish passage through the ROs. Plaintiffs also propose an earlier drawdown

than normal to achieve an elevation of 1450 by November 1 to use the lower ROs for temperature control during the month of November.

61. One of the Corps' primary objections is that these measures would result in trade-offs related to downstream flow and water temperatures that could affect spawning of adult Chinook salmon and incubation of eggs. ECF No. 134 ¶¶ 50, 55–56; ECF No. 133 ¶¶ 18–19, 21–22, 25. First, there is obviously some flexibility in dam operations to adjust for winter and spring precipitation. Second, operations could be adjusted once seasonal conditions are known and hydrologic models are run to consider alternatives and their trade-offs.

62. One trade-off centers around the effect of dam operations on water temperature in fall and winter and its consequent effect on incubation time of eggs and emergence of fry. The Corps contends that current operations "minimize early emergence to the greatest extent possible". ECF No. 133 ¶ 19. Table 1 below shows a comparison of estimated emergence dates above and below dams for early and peak spawning dates. Although management of water temperature through dam operations may have extended incubation below the dams in some years, the range of emergence dates is highly variable and emergence is still much earlier than what would occur under conditions closer to normal temperature profiles. Therefore, under current operations emergence is still occurring at a suboptimal time in winter rather than early spring so proposed measures that might change incubation time by weeks or less would likely have little biological effect. As mentioned earlier, the effect of trade-offs would become more apparent once environmental and reservoir conditions are known, and adjustments could be made through the Technical Advisory Team process.

Table 1. Estimated mean and range of emergence dates for spring Chinook salmon downstream of Big Cliff Dam and upstream of Detroit Dam based on water temperatures measured at Niagara (downstream) and Boulder (upstream), dates of early and peak spawning, and accumulated temperature units estimated for egg development and fry emergence (1800 ATU in °F from literature & field studies), 2008–2019.

	Below Big Cliff	Above Detroit
Early spawning	**Dec 10** (Nov 23–Dec 23)	**Feb 16** (Jan 28–Mar 6)
Peak spawning	**Jan 25** (Dec 27–Feb 17)	**Apr 7** (Mar 1–Apr 23)

63. Similar to water temperature management, the effect of Plaintiffs' proposed measures to draw down the reservoir on downstream flow could be minimized through dam operations. Again, trade-offs can be assessed based on conditions and implications for spawning or incubation and adjustments could be made. Plaintiffs have clarified that early drawdown of the reservoir should start by releasing water in summer rather than fall. The Corps argues that this could elevate incubation water temperature and shorten the length of time water can be spilled and fish passed in summer. ECF No. 133 ¶ 19. But the benefit of passing juvenile salmon downstream during summer is likely small and the Corps does not present any information to indicate the relative number of juvenile salmon that would be likely to pass downstream during summer.

64. Mr. Piaskowski minimizes benefits of improving water quality downstream of Big Cliff Dam by stating that only a small proportion of the population spawns between Big Cliff and Minto Fish Facility. ECF No. 134 ¶ 57. In fact, the mean percentage of redds in this area was 24% in 2013–2019, second only to the section from Minto to Gates Bridge. He further minimizes the use of this area as sanctuary for natural origin fish by stating that these are "likely first- or

second-generation offspring of hatchery parents when considering pHOS levels in the sub-basin." ECF. No. 134 ¶ 57. First, there is inconsistency in how he considers these Chinook salmon to be close to hatchery parents compared to his treatment of similar Chinook salmon upstream of Foster Dam as a "locally-adapted, natural-origin subpopulation". I will address this in more detail below. Second, the preference of fish managers would be to have a much larger wild fish sanctuary in high quality habitat upstream of Detroit Dam but lack of progress by the Corps in providing juvenile fish passage precludes that option. Finally, effects of TDG below Big Cliff Dam are highest during flood control operations which can have a large effect on winter steelhead spawning downstream of the dam.

65. The Corps argues that few fish would be present at Detroit Dam before June 1 and therefore an early spring spill would have limited benefits. ECF No. 134 ¶¶ 49, 54–56; ECF No. 133 ¶ 22. Mr. Piaskowski includes a set of graphs showing distribution of juvenile salmon by month relative to the distance from the dam. ECF No. 134 *Figure 2, page* 41. For Detroit Reservoir the sample size is small (< 10) so little measureable difference can be detected in the number of fish near the dam by month. In addition, the graph presented actually shows more juvenile salmon in April than in June close to the dam. As mentioned earlier, changes in reservoir management such as extended drawdown and early spill could affect the distribution of juvenile fish in reservoirs and passage at the dams. In my professional opinion, these kinds of measures are worth implementing to see if they have an effect rather than default to status quo operations.

66. In my professional opinion, I believe the Plaintiffs' proposed measures will provide benefits to salmon and steelhead in the North Santiam Basin and that dam operations can be adjusted to minimize risks. However, I believe the Corps has overstated the biological risks

and minimized the benefits of the Plaintiffs' measures. At the least, these measures should be implemented on an experimental basis to increase knowledge about the potential and limitations of altering dam operations to provide juvenile fish passage so that permanent solutions can be found.

South Santiam

67. Habitat is limited in the South Santiam upstream and downstream of Foster Dam and the abundance of wild spring Chinook salmon has been very low in recent years (<300 fish in 2016–2019). Therefore, reintroduction of salmon and steelhead upstream of Green Peter Dam is a necessary measure to recover these species in this watershed, and requires more directed measures than what has occurred to date. In addition, measures are needed to address ongoing problems with collecting and transporting adult fish upstream of Foster Dam and with passing juvenile fish downstream.

68. Both Mr. Piaskowski and Mr. Taylor mistakenly characterize the Chinook salmon upstream of Foster Dam as "locally-adapted", "self-sustaining", "natural-origin", and then they use this mis-characterization to repeatedly argue against reintroduction of salmon above Green Peter Dam because returning adults or offspring of outplanted adults might jeopardize the salmon population above Foster Dam. ECF No. 134 ¶¶ 30, 60–62, 67; ECF No. 133. ¶ 26. As addressed below, the salmon outplanted upstream of Foster Dam are neither locally-adapted, natural-origin, nor self-sustaining.

69. Unclipped salmon have been passed upstream of Foster Dam since 2009 and prior to that only clipped fish were released. Adults that were progeny of the outplanted fish have returned in numbers near or above replacement levels in some years, but not in others (e.g.,

2010).[28] When unclipped fish are outplanted upstream of Foster Dam, their origin is unknown until later, therefore some of these unclipped fish can be either unclipped hatchery fish, or first- or second-generation offspring of hatchery parents.[29] Despite the similarities in the outplanting program between the North and South Santiam, Mr. Piaskowski minimizes the natural origin salmon upstream of Minto but then calls the salmon upstream of Foster Dam a "locally adapted, natural origin, subpopulation". ECF No. 134 ¶ 60. He then goes on to argue that the possibility of unclipped salmon from release of hatchery Chinook upstream of Green Peter Dam would jeopardize salmon upstream of Foster Dam, and uses this as the basis to preclude any immediate reintroduction efforts. ECF No. 134 ¶¶ 60, 62, 67.

70. Because unclipped hatchery fish have been recently outplanted upstream of Foster Dam, the group of Chinook salmon that are passed upstream of the dam would not be classified as exclusively natural origin. As noted above, unclipped hatchery fish have been recently outplanted (*see* footnote 23) and as Mr. Piaskowski notes, the proportion of hatchery spawners has been as high as 33% in recent years. ECF No. 134 ¶ 61.

71. It is probably premature to call the group of salmon outplanted upstream of Foster Dam "locally adapted" or even "self-sustaining". Self-sustaining would imply that this group of fish could be self-sufficient without direct and ongoing human interference of individuals or the environment.[30] Strict interpretation would mean that as long as fish have to be trapped and transported they could not be technically self-sustaining. However, if we accept this level of

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[28] K.G.O'Malley, A.N. Black, M.A. Johnson, and D. Jacobsen. 2017. Population productivity of spring Chinook salmon reintroduced above Foster Dam on the South Santiam River. July 2017 Report, Prepared for U.S. Army Corps of Engineers. (**noting failure of 2010 brood year**). *See also* J.D. Romer, F.R. Monzyk, R. Emig, and T.A. Friesen. 2016. Juvenile salmonid outmigration monitoring at Willamette Valley project reservoirs. ODFW report, Task Order No. W9127N-10-2-0008-0035, page 18.
[29] Evans et al. 2016, noting most of the 2014 ouptlants were of unknown origin and about 35% of 2012–2013 outplants were from not above the dam; see also Table 1 with proportion of unclipped hatchery fish from spawning ground recoveries above Foster of 19%, 33%, 10%, 10% in 2011–2014, respectively.
[30] D.J. Rohlf, C. Carroll, and B. Hartl. 2014. Conservation-reliant species: toward a biology-based definition. BioScience 64:601–611.

ongoing intervention, then a population above Foster might be considered self-sustaining if they met or exceeded replacement for multiple generations without supplementation of additional adults. These fish do not meet that standard.

72. Local adaptation is a process in which individuals of a population have higher fitness in their local environments than individuals from a different population and environment, and in salmon this is partly a function of homing.[31] Conditions that lead to local adaptation include low gene flow (e.g. low dispersal from other populations or high homing rates) and other selection factors. Rapid evolution can occur in salmonids but this requires several generations and some degree of isolation, either spatial, reproductive behavior, or other isolating behaviors. Occurrence of rapid evolution in salmonids has been reported in 6–30 generations, with specific examples of 13 generations (about 56 years) in sockeye salmon and <15 generations (83 years) in Atlantic salmon.[32] Therefore, local adaptation in salmon that were outplanted upstream of Foster Dam is unlikely because of the short time-frame in which Chinook salmon have been outplanted upstream of Foster Dam and the lack of isolation due to mixing between progeny of outplanted adults, progeny of naturally-produced adults from downstream of the dam, and unclipped hatchery fish outplanted upstream of the dam.

73. As stated in my Fourth Declaration, the reintroduction of salmon and steelhead upstream of Green Peter Dam was identified in several RPAs in the 2008 BiOp and research to evaluate reintroduction was ranked as high to medium priority by members of the WATER committee in 2017, but ranked as "do not fund – low priority" by the Corps and BPA. ECF No.

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[31] D.J. Fraser, L.K. Weir, L. Bernatchez, M.M. Hansen, and E.B. Taylor. 2011. Extent and scale of local adaptation in salmonid fishes: review and meta-analysis. Heredity 106:404–420. (6–30 generations for rapid local adaptation)
[32] A.P. Hendry, J.K. Wenburg, P. Bentzen, E.C. Volk, and T.P. Quinn. 2000. Rapid evolution of reproductive isolation in the wild: evidence from introduced salmon. Science 290:516–518. A.J. Jensen, L.P. Hansen, B.O. Johnsen, and S. Karlsson. 2017. Rapid evolution of genetic and phenotypic divergence in Atlantic salmon following colonization of two new branches of a watercourse. Genetics Selection Evolution 49:22 pages.

119 ¶ 55. After 12 years, the Corps' only proposed measure related to reintroduction of salmon and steelhead upstream of Green Peter is to develop a RM&E plan in conjunction with the WATER team. ECF No. 134 ¶ 62; ECF No. 133 ¶ 34. However, this is nothing more than what should have been accomplished years ago under the 2008 BiOp, and given the recent history in which the Corps ranked reintroduction as low priority, skepticism would not be unwarranted about the Corps' commitment to initiating any measures related to reintroduction upstream of Green Peter.

74. It is because of these past delays and the Corps' obfuscation of using the outplanted salmon population upstream of Foster to further delay any direct actions on reintroductions upstream of Green Peter Dam that I recommended the oversight of an independent scientific team to develop an accelerated plan with firm commitments from parties. ECF No. 119 ¶ 56. I also supported the experimental release of fish upstream of Green Peter (hatchery Chinook salmon) with associated RM&E such as tagging and genetic sampling to assess the movement, distribution, and spawning success of outplanted adults. ECF No. 119 ¶ 56. Further, progeny of outplanted adults would provide the opportunity to study migration timing into the reservoir and reservoir behavior, and to assess potential passage opportunities such as the spill operation proposed by Plaintiffs.

75. The objective of initially outplanting hatchery Chinook salmon upstream of Green Peter Dam is to gain knowledge about spawning distribution, spawning success, and early behavior of progeny. The focus is not to quickly rebuild the South Santiam Chinook population but to actively take steps to advance a full reintroduction program, which is critical for recovery of the salmon and steelhead populations in the South Santiam Basin.

McKenzie

76. In general, the measures proposed by the Plaintiffs are similar to those the Corps proposes or has proposed in the past with some differences in timing and duration. In addition, the Plaintiffs proposed a deep drawdown in fall which the Corps acknowledges could provide better passage conditions for juvenile salmon. ECF No. 134 ¶ 76; ECF No. 133 ¶ 43.

77. As with the other reservoirs and dams, measures may have trade-offs and this would apply to both the Corps' and Plaintiffs' proposals. Some of the trade-offs could be managed once annual environmental conditions are known and results of hydrologic modeling for temperature and flow are available to the TAT.

78. One of the Corps' arguments against maintaining Cougar Reservoir at a lower level is the effect on growth of entrapped juvenile Chinook salmon based on results of a reservoir growth model. ECF No. 133 ¶ 39. The model was developed from data on fish growth and prey abundance in reservoirs of the Middle Fork Willamette watershed (Fall Creek, Lookout Point, Hills Creek). It is uncertain if results would carry over directly to the South Fork McKenzie watershed. For example, the growth rate (mm/d) of juvenile salmon in Cougar Reservoir averaged 0.55 in 2011–2014 compared to 0.79 and 0.78 in Lookout Point and Fall Creek reservoirs, respectively (Fall Creek was for 2013–2014).[33] Weekly mean fork length was also much lower in Cougar Reservoir than Lookout Point Reservoir in spring through fall. Thus, the growth model used by the Corps to argue against the drawdown may not be fully applicable to fish in Cougar Reservoir.

79. Regardless, growth of fish in the reservoir should be a low priority and secondary concern when evaluating benefits for juvenile fish passage at the dams—the primary concern.

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[33] Summarized in A.C. Hansen, T.J. Kock, and G.S. Hansen. Synthesis of downstream fish passage information at projects owned by the U.S. Army Corps of Engineers in the Willamette Basin, Oregon. U.S. Geological Survey Open File Report 2017-1101.

Studies have shown that dam passage mortality is higher in larger fish than in smaller fish; therefore, even if fewer fish are able to rear in the reservoir if it is held at a low level or their growth is slower, the smaller fish might have higher survival through the dam. As mentioned earlier, any comparison of survival between different strategies (fish passed downstream vs. fish entrapped in reservoirs) should be for full life-cycles (e.g., fry-to-smolt, smolt-to-adult).

80. As with the other reservoirs, the Corps makes assumptions about the distribution of fish in the reservoir based largely on status quo management, and even then the data show some fish near the dam in spring. Plaintiffs' operations are aimed at facilitating movement of fish toward the dam in spring. The Corps does acknowledge benefits from a deep drawdown in fall including a "significant increase" in numbers with potential for "future increase in population abundance." EFC No. 134 ¶ 76; ECF No. 133 ¶ 43. In my professional opinion, the Plaintiffs' proposed interim measures have the potential for immediate benefits to reduce harm to spring Chinook salmon. Trade-offs could be adaptively managed to minimize biological effects at the dam and downstream.

Middle Fork Willamette

81. Reintroduction of spring Chinook salmon upstream of Lookout Point reservoir is critical for the conservation and recovery of this species in the Middle Fork Willamette. Habitat is extremely limited downstream of the dams and has been degraded by dam operations. Abundance of wild Chinook salmon is extremely low (mean of 44 adults in 2008–2019, with mean of just 23 in 2015–2019, exclusive of Fall Creek).[34] Although the 2020 number of adults returning to Fall Creek was high (834), the average count was about 300 adults (94–456) in 2014–2019, when returns would be from mostly natural origin parents. In addition, as noted in

[34] Piaskowski cited the NMFS 2015 Status Review for stating that Chinook salmon in the Middle Fork Willamette (outside of Fall Creek) are functionally extinct. ECF No. 134 ¶ 39. But NMFS did not determine this. NMFS did state that the Calapooia spring Chinook population may be functionally extinct (page 214).

the NMFS 2015 Status Review, "the capacity of the Fall Creek basin alone is insufficient to achieve the recovery goals for the Middle Fork Willamette [population]."[35]

82. The Plaintiffs' proposed measures focus on improving passage at Lookout Point Dam by providing a deep drawdown in fall and maximizing opportunities for spill in the spring. The Corps acknowledges that these measures benefit fish passage at the dam. ECF No. 134 ¶¶ 84, 88. However, the Corps then chooses to focus on high pre-spawning mortality and low survival of juvenile fish in Lookout Point Reservoir, and to use these issues to basically justify inaction.

83. Mr. Piaskowski focuses on high density of hatchery fish and high pre-spawning mortality as the primary cause for low productivity of outplants. ECF No. 134 ¶ 39. He then asserts that other actions would have little benefit because of this. ECF No. 134 ¶¶ 84–85, 94. The hatchery stock in the subbasin was derived from the local population. Because of the extremely low numbers of wild fish returning to the subbasin, the hatchery fish contain the genetic legacy of this population and are needed to preserve genetic diversity in the population as well as in UWR spring Chinook salmon. In addition, these fish are necessary for reintroduction as well as meeting federal mitigation requirements. These hatchery fish were the source for the reintroduction of spring Chinook salmon upstream of Fall Creek Dam. As I pointed out earlier, the UWR hatchery program was recently assessed through the FEIS and adoption of the 2019 Hatchery BiOp and presumably the Corps had input throughout the process.

84. High density of hatchery fish can occur downstream of dams where fish are homing back to their release hatchery. Mr. Piaskowski argues that density of hatchery fish present acute problems in the Middle Fork Willamette (Dexter Dam) as well as in the South Santiam (Foster Dam). ECF No. 134 ¶¶ 61, 84, 120, 123, 125. It should be noted that these two

[35] NMFS 2015 Status Review (page 215).

populations have the lowest number of wild Chinook salmon in the UWR so hatchery fish in these subbasins (derived from local populations) are serving a conservation purpose in preserving genetic diversity and providing a source for reintroductions.

85. Nonetheless, it is fully within the Corps' purview to take actions that would reduce the density of hatchery salmon, and they do propose to provide funding for operating the Dexter trap more frequently (Interim Measure 18), which I support. ECF No. 134 ¶ 42. Oddly, Mr. Piaskowski then argues against the Plaintiffs' proposed measure to improve the Dexter collection facility unless Interim Measure 18 is implemented (as well as possible reduction of the hatchery program). ECF No. 134 ¶ 94. Plaintiffs do not oppose the additional operation of the Dexter trap (Measure 18) so the Corps can certainly provide additional funding and implement this action. As mentioned before, the issue of hatchery production should have been addressed in the development of the 2019 Hatchery BiOp and associated HGMP.

86. It should also be noted that improving the Dexter collection and holding facility was identified in the 2008 BiOp (RPA 4.6) and was to be completed by December 2014 and now that action has also been included in the 2019 Hatchery BiOp (RPA 2f), but has yet to be initiated. Therefore, at least part of the problem of high density of hatchery salmon below Dexter and Foster dams rests with the Corps. For example, after the Minto facility on the North Santiam was rebuilt the percentage of hatchery summer steelhead that were counted at Bennett dams and later collected at Minto increased from 30–50% to around 90% in 2016–2018, resulting in fewer hatchery fish remaining in the river.[36] In contrast, no measures have been implemented to increase trapping or improve the collection and handling facility at Dexter.

87. A possible rationale for not investing in upgrades of the Dexter adult salmon trap and holding facilities might be that the best option for successful reintroduction of Chinook

[36] 2019 UWR Hatchery BiOp (NMFS Consultation No. WCR-2018-9781), Figure 61, page 156.

salmon in the Middle Fork Willamette is the removal of Dexter Dam and modification of Lookout Point Dam to provide passive upstream and downstream passage. But to my knowledge these actions have not been proposed.

88. The Corps acknowledges benefits of Plaintiffs' measures on drawdown, turbine shutoff, and spring spill but cites low survival of juvenile salmon in Lookout Point Reservoir to argue these would have no overall benefit. Further, the Corps discounts actions such as extended deep drawdown as a method to reduce predators because it cannot draw the entire reservoir to streambed. However, it proposes no measures or experimental approaches to address the issue. Experimental approaches might include manipulating reservoir levels to disrupt spawning of the predator populations. In addition, experimental approaches such as timing of deep drawdown or initiating early spring spill could alter the distribution and migration of juvenile salmon through the reservoir or reduce their exposure to predators. Overall, improving juvenile passage at Lookout Point is critically important for UWR Chinook salmon and I fully support Plaintiffs' measures to test potential operations that could result in better passage survival.

Monitoring

89. The Corps argues that the Plaintiffs' proposed monitoring is inappropriate for several reasons including no definition of measureable objectives, lack of study designs, and inability to produce assessments of viability within four years. ECF No. 134 ¶¶ 98–105. The Corps' proposed monitoring consists only of operating rotary screw traps below dams and comparing catch in the traps to previous years under "normal" operating conditions. ECF No. 134 ¶ 106. In addition, the Corps proposes to operate a trap upstream of Fall Creek Reservoir to collect and transport juvenile Chinook salmon around the reservoir and release them downstream. ECF No. 134 ¶ 46. However, these Corps proposals do not meet any of the criteria

that it claimed were necessary for valid monitoring: measureable objectives, study design, concise boundaries to assess survival, etc.

90. My fourth declaration briefly covers shortcomings of the Corps' proposed monitoring to operate screw traps as a means of evaluating the effectiveness of the Corps' interim measures. ECF No. 119 ¶ 80. In short, screw traps are difficult to calibrate, which makes it difficult to assess the catch of fish relative to the actual number of fish present; "normal" operating conditions are not defined; and variables that may affect number of juveniles present are not defined or are unaccounted.

91. Operating screw traps below dams provides limited information about survival or injury because traps are located downstream away from the immediate tailrace or the base of spillway or RO exits. Therefore, dead and severely injured fish may not be caught in traps at the same rate as live or other injured fish.[37] Trap efficiency varies with water depth, turbulence, and velocity, all of which would vary with discharge from dams and would have to be factored in for different time periods: daily, within the duration of the dam operation to be evaluated, and among years. In addition, trap efficiency is affected by size of fish, which would have to be accounted for within and among years. Finally, effectiveness of a dam operation would have to account for delayed mortality. Capturing live fish in screw traps provides little information about the ultimate survival of juvenile fish that must continue a long downstream migration, and some internal injuries that would eventually cause mortality would not be apparent.

92. The Corps' proposal to trap and transport juvenile salmon around Fall Creek Reservoir also lacks defined objectives, criteria, and measureable outcomes. It is unclear how this would be evaluated, especially for fish that would not be large enough to tag. In addition, the

[37] *See* M.L. Keefer, G.A. Taylor D.F. Gartletts, C.K. Helms, G.A. Gauthier, T.M. Pierce, and C.C. Caudill. 2013. High-head dams affect downstream fish passage timing and survival in the Middle Fork Willamette River. River Research and Applications 29:483–492.

trap would likely be inoperable during high flow events that often trigger downstream movement. Finally, the underlying assumption is that any juvenile fish caught in the trap would be an active migrant destined to continue to reaches downstream of the dam. Although this may be true for some fish, other fish might be dispersing short distances and the proportion of each would likely depend on the time of year. For example, in our study on juvenile Chinook salmon we trapped, tagged, and released fish within the Leaburg Dam bypass on the McKenzie River in the fall. Some of these fish continued to migrate downstream to Willamette Falls, some migrated to the lower McKenzie or Willamette River and reared though the winter, and some remained for several weeks to several months in the short section of the McKenzie River between Leaburg Dam and the Walterville Canal entrance. If we had transported and released these fish downstream, it is unclear how we might have affected their migratory behavior and perhaps survival.

93. Planning is an important component for evaluating the effectiveness of measures but planning alone does not insure success, and there are many examples of planned projects that do not go as planned. Good examples are the floating fish collector that the Corps built and installed in Cougar Reservoir and has been unsuccessful, or the construction and installation of the fish weir at Foster Dam that resulted in high mortality of juvenile fish.

94. Monitoring the status of populations is critical to assess any changes in dam operations. Specific studies can be planned depending on the scope of actions or measures to be implemented. For example, short-term studies of certain actions could be conducted with juvenile hatchery fish, such as releasing PIT-tagged fish within reservoirs and downstream of reservoirs to assess successful migration to Willamette Falls or possibly through intermediate reaches (e.g., Bennett Dams in North Santiam, Leaburg Dam or Walterville Canal in McKenzie).

For other assessments, techniques such as imaging sonar detections of fish near dams[38] could be used to evaluate effects of early spill or drawdown operations on fish distribution.

95. Monitoring the status of populations and collecting data necessary for viability analysis is a critical need and was proposed by Plaintiffs not to get results in a few years, but to maintain long-term data sets and to allow for robust evaluations of the cumulative effect of operational changes. The ultimate goal of modifying dam operations is to provide adult and juvenile passage at the dams and to re-establish populations of naturally-produced fish in historic habitats. Because of the generational time of salmon and steelhead and the lag between implementation of measures and return of adults, it is important to establish a solid foundation of data to assess the effectiveness of measures.

96. In my fourth declaration I provided some monitoring specifics such as spawning ground surveys above and below dams, spawning success of outplanted adults relative to factors such as location and time, production of progeny from outplanted adults, and juvenile fish movement and distribution in reservoirs relative to dam operations. ECG No. 119 ¶¶ 74–75. I also listed monitoring needs to assess viability, status, trends, and to provide data for improving life-cycle models. ECF No. 119 ¶¶ 76–78. Life-cycle models can be used to assess the overall effectiveness of measures and can provide reach-specific survival information of juvenile salmonids if collected at the proper scale.

97. Finally, investment in PIT detection technology in the Willamette Basin would provide the infrastructure for immediate assessments of operational measures on juvenile salmon and steelhead migration and survival. If detection systems were installed or improved at various locations such as Corps dams, other dams downstream (e.g., Minto, Bennett, Lebanon, Leaburg),

[38] C.D. Smith, J.M. Plumb, N.S. Adams, and G.J. Wyatt. Predator and prey events at the entrance of a surface-oriented fish collector at North Fork Dam, Oregon. Fisheries Management and Ecology 2020 (early view).

and the system at Willamette Falls was improved then reach-specific migration and survival would be possible and immediate, thus providing a more robust feedback for adaptive management than currently exists.

Conclusion

98. The Corps contends that UWR salmon and steelhead populations are at low risk of irreparable harm because they are above the rock-bottom thresholds that would spiral the listed species into extinction. As rationale that more aggressive actions are unnecessary to increase populations, the Corps relies heavily on improved ocean conditions. ECF No. 134 ¶¶ P4, 12–13, 115, 117, 128. This reliance on ocean conditions as a surrogate remedy ignores the uncertainties in forecasting conditions or the duration of favorable conditions; e.g., the unpredicted marine heat waves (warm blobs) that have recently and repeatedly formed in the Northeast Pacific Ocean.[39] As mentioned earlier, favorable ocean conditions will only benefit populations if the freshwater phase of the life cycle can produce adequate numbers of smolts.

99. The WVP is causing ongoing and cumulative harm to Chinook salmon and winter steelhead populations and the populations remain in a precarious state despite some recent, modest improvements. An increasing trend in Clackamas and Sandy populations—where recent improvements have been made for juvenile and adult fish passage—contrasts with a decreasing trend for UWR populations (as measured at Willamette Falls) and illustrates the detrimental effects of WVP on salmon and steelhead. As noted above, a small increase in abundance in the last year or two does not constitute an overall upward trend for the population. Without access to high quality habitat upstream of the dams and associated downstream passage for juvenile fish,

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[39] *See* NOAA news release dated December 2, 2020. "String of Marine Heatwaves Continues to Dominate Northeast Pacific" https://www.fisheries.noaa.gov/feature-story/string-marine-heatwaves-continues-dominate-northeast-pacific; also N.J. Holbrook and 7 coauthors. 2020. Keeping pace with marine heatwaves. Nature Reviews Earth & Environment 1(9):482–493.

populations are likely to remain at irreparable harm, directly from ongoing mortality and indirectly from effects of chronically low abundance. Populations at low abundance are at elevated risk from unexpected events such as floods (e.g., reproductive failure of 2010 brood above Foster Dam) and fires (e.g., 2020 fires affecting large parts of Molalla, North Santiam, and McKenzie watersheds). Accordingly, I strongly disagree with the Corps' perspectives about the status of the species and the capacity of salmon and steelhead populations to withstand ongoing and cumulative harm from the WVP in the years to come.

100. The precarious state of UWR salmon and steelhead populations justifies immediate and aggressive actions to address access to historic habitat upstream of dams and to provide effective downstream passage for juvenile fish. Actions are also needed to minimize the effect of dam operations on habitat and water quality downstream of dams where populations are largely confined in the Santiam and Middle Fork Willamette watersheds.

101. UWR salmon and steelhead were listed under the Endangered Species Act in 1999 and the 2008 BiOp contained numerous actions to address passage issues and initiate reintroductions above dams. Here we are at the end of 2020; salmon and steelhead populations have further declined and are at historic low levels, many of the actions identified in the 2008 BiOp have not been implemented, and the interim measures proposed by the Corps merely start a planning phase or moderately modify operations that should have begun years ago. The Corps' measures lack any sense of urgency and represent relatively minor modifications of status quo operations that contribute to ongoing harm for salmon and steelhead populations.

102. In my professional opinion, even with its new measures, the Corps' operations will still present a dangerous and unacceptable risk to the species given their precarious states.

103. In my professional opinion, I believe the Plaintiffs' proposed measures will provide benefits to the listed species by increasing the opportunity for juvenile fish to pass downstream of dams through deep, extended drawdowns, spring spills, and increasing the hours of turbine shutdowns. In addition, the Plaintiffs' proposal to begin outplanting adult hatchery Chinook salmon upstream of Green Peter Dam is an example of taking more aggressive actions to improve access to historic habitat and is a stark contrast to the Corps' proposal to begin a study that should have occurred years ago. Measures are also proposed by the Plaintiffs to minimize the effects of water quality problems like TDG downstream of dams. The Plaintiffs' measures build on results of previous studies that found higher downstream passage and survival using spillways and RO routes, deep drawdowns to shorten the length of reservoirs and provide current through the reservoirs, drawdowns to ease access to RO entrances, and passage in fall and spring for different life histories.

104. Many of the other measures proposed by the Plaintiffs are similar to the Corps' measures, yet the Corps argues that implementing the Plaintiffs' measures will have little benefit or require biological trade-offs. Unlike the Corps' measures, the Plaintiffs' proposal includes monitoring and adaptive management provisions that can address such trade-offs.

105. The Plaintiffs' proposed measures, as with those of the Corps, will not immediately rebuild the populations or restore fish above dams. However, the Plaintiffs' proposed measures provide more opportunity to advance the objectives of providing access to historic habitat for adult fish and effective downstream passage for juvenile fish. The promising results of the deep drawdown at Fall Creek Reservoir should indicate that a more aggressive approach to providing adult and juvenile passage is warranted at the other dams. In my professional opinion, the Plaintiffs' proposed measures will do more to alleviate harm to

populations as well as to advance knowledge for planning and implementing alternative strategies needed for the recovery of the species.

Pursuant to 28 U.S.C. § 1746, I declare under penalty of perjury that the foregoing is true and correct.

Signed this 18th day of December, 2020 in Philomath, Oregon.

/s/Kirk Schroeder
Kirk Schroeder