Lauren M. Rule (OSB # 015174)
Elizabeth H. Potter (OSB #105482)
ADVOCATES FOR THE WEST
3701 SE Milwaukie Ave. Suite B
Portland, Oregon 97202
lrule@advocateswest.org
epotter@advocateswest.org

Attorneys for Plaintiffs

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 Fourth 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 three previous declarations in support of Plaintiffs' Motion for Preliminary Injunction. *See* ECF Nos. 37, 76, and 97.

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.

Background on the Decline of Upper Willamette River Chinook Salmon and Steelhead

5. My previous declaration describes the life history needs and status of Upper Willamette River ("UWR") Chinook salmon and steelhead, which are the only two native runs of salmon and steelhead within the UWR basin above Willamette Falls and are both listed as threatened under the ESA. ECF No. 37 ¶¶ 9–14. The following paragraphs include a brief summary of the key points about the species.

6. Peak passage of adult spring Chinook salmon at Willamette Falls generally is late April through May with part of the run extending into late August and early September. Adult salmon historically migrated to the upper portion of watersheds to hold in pools and

sections of river that have low water temperatures through summer. Adult salmon must now hold in the lower reaches of three subbasins—North and South Santiam and Middle Fork Willamette—because access to these upper watersheds is blocked by dams. Spawning generally begins in late August and continues into early October, with peak spawning in September. Natural incubation of Chinook eggs is timed to allow fry to emerge in the spring when food in the river is sufficient for survival and growth.

7. UWR Chinook now most commonly return from the ocean as age 4 or age 5 adults, although some return as age 3 and age 6. Fish from the same brood year migrate to the ocean and return from the ocean at different ages, which imparts diversity to the population. Diversity in a population spreads risks to individuals because they occupy different habitats at different times, a concept known as the 'portfolio effect' (i.e., not all eggs are in one basket). Consequently, the population is buffered from environmental effects that may be detrimental to a particular group of fish within the population, which allows populations to respond to changing environmental conditions.

8. Juvenile Chinook salmon have a broad range of migratory life histories and two primary smolt life histories: those that migrate to the ocean in their first year of life (subyearling smolts) and those that migrate in their second year (yearling smolts). Based on research of UWR Chinook salmon[1], juvenile salmon may migrate long distances as newly emerged fry and rear downstream in lower sections of tributaries and in the Willamette River. Other peak migrations from spawning areas are juvenile fish moving in fall and winter in their second year of life and yearling smolts in the spring of their second year of life. Therefore, juvenile Chinook from the same year class occupy a variety of habitats at different times of years and this spreads risks to the population.

[1] R.K. Schroeder, L.D. Whitman, B. Cannon, & P. Olmsted. 2016. Juvenile life-history diversity and population stability of spring Chinook salmon in the Willamette River basin, Oregon. Canadian Journal of Fisheries and Aquatic Sciences 73:921–924.

9. Peak migration of UWR native steelhead is in late March–April, with some fish moving from mid-February to mid-May. They spawn in March through June in mainstem rivers and smaller tributaries, with peak spawning in late April and early May. Similar to spring Chinook, UWR steelhead have diverse life histories as juveniles and adults. Juvenile steelhead rear in mainstem habitats and the upper portions of the subbasins for 1–4 years, most frequently for 2 years before migrating to the ocean as smolts in April and May. Most UWR steelhead spend two years in the ocean but may spend 1–4 years before returning to freshwater.

10. Currently, less than 10,000 wild Chinook salmon return each year to the UWR basin, which is a fraction of the historic estimates of about 300,000–450,000 based on harvest and egg takes.[2] Seven independent populations of spring Chinook have been identified in the UWR Chinook ESU: Clackamas, Molalla, North Santiam, South Santiam, Calapooia, McKenzie, and the Middle Fork Willamette. Most UWR Chinook salmon populations were considered to be at a very high risk of extinction in the 2011 recovery plan,[3] except for the Clackamas (moderate) and the McKenzie (low) populations, the two populations with significant numbers of naturally produced fish. The other Chinook populations are heavily supplemented by hatchery fish, with the exception of Molalla and Calapooia subbasins, which presently have very low numbers of Chinook salmon. Although the 2015 NMFS 5-year status review determined that the risk category should remain unchanged, the document acknowledged an overall decrease, and stated that "the inability of many populations to access historical headwater spawning and rearing areas may put this ESU at greater risk in

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[2] *Historical population structure of Willamette and lower Columbia River Basin Pacific salmonids.* 2003. NMFS Report *by* J. Myers, C. Busack, D. Rawling, and A. Marshall.
[3] *Upper Willamette River Conservation and Recovery Plan for Chinook Salmon and Steelhead.* 2011. Prepared by ODFW and NMFS.

the near future". UWR spring Chinook was the only ESU among the six Chinook salmon ESUs in the Pacific Northwest with a recent risk trend of "declining".

11. About 70% of the Chinook salmon that return to UWR basin are hatchery fish. 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.

12. Abundance of winter steelhead by run type is not available prior to 1971, so historic abundance is unknown. However, over 10,000 late run winter steelhead—those returning after February 15 (late run) are considered to be the native run—returned on average in 1971–1988 compared to an average of about 3,200 in 2008–2020, a decrease of almost 70% (Figure 1).

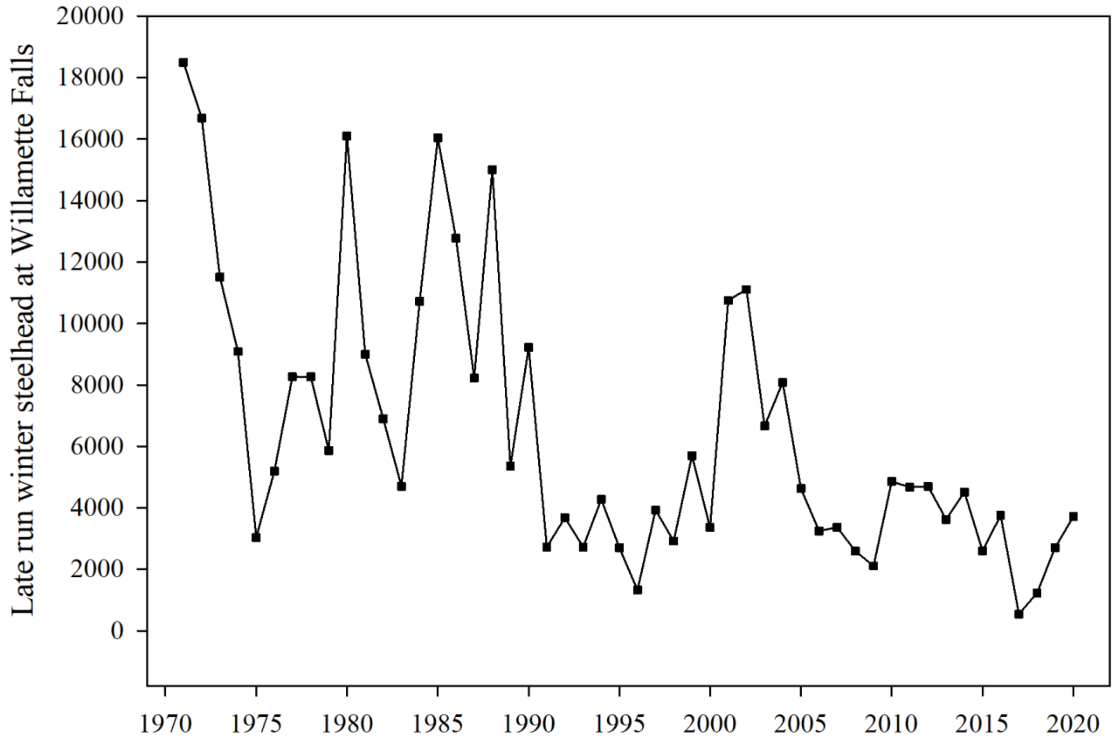

Figure 1. Number of late winter steelhead at Willamette Falls, 1971–2020.

13. Of the four independent populations of winter steelhead identified in the UWR (Molalla, North Santiam, South Santiam, and Calapooia), the North and South Santiam rivers are thought to have been major production areas. The 2015 NMFS 5-year status review found the Calapooia population was considered to be at a moderate risk of extinction and the other three were considered to be at a low risk of extinction, but all four populations showed decreases in abundance trends. 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.[4]

14. 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.

15. The 2011 recovery plan for UWR Chinook salmon and steelhead included two recovery goals: 1) achieve delisting from the federal ESA threatened and endangered species list, and 2) achieve 'broad sense recovery' defined by Oregon as having populations of naturally produced salmon and steelhead that maintain self-sustaining populations while providing for significant ecological, cultural, and economic benefits. The plan further adopted four biological attributes that contribute to the viability of salmon and steelhead populations: abundance, productivity, spatial distribution, and diversity. Viability is based on an assessment of biological or physical criteria that when met would indicate the target population or group of populations is unlikely to go extinct.

[4] 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.

Recent Population Declines

16. When NMFS issued the Biological Opinion for the Willamette Project in 2008, UWR Chinook salmon and steelhead were highly imperiled. Numbers of wild spring Chinook have been available since 2002 when all returning hatchery fish could be identified with an adipose fin clip and unclipped hatchery fish could be further estimated from the presence of an induced thermal mark[5] in the otoliths of carcasses recovered on spawning grounds. Since the Biological Opinion was issued, the species has continued to decline. The following numbers of wild spring Chinook salmon and winter steelhead have been updated from my third declaration to encompass more recent data where available.

17. Population numbers may fluctuate annually for many reasons including factors affecting either freshwater or ocean survival. To assess the long-term stability of populations, it is important to look at trends such as the pattern of peak counts, which shows responses of the population to favorable conditions, and running average of counts, which smooths the effect of fluctuations.

Chinook salmon

18. Estimated numbers of wild spring Chinook at Willamette Falls have declined from 13,241 (2002–2007) to 7,364 (2008–2019), a decline of 44% (Figure 2). In addition, peaks in the number of wild Chinook have declined from 17,700 in 2003 to about 12,000 in 2011 to 8,600 in 2015. The number of wild spring Chinook increased in 2019 and is also likely to increase in 2020 based on the number of unclipped fish counted (final estimates of the wild fish component will not be available until biological data collected in Fall 2020 are analyzed). Although the recent increase in abundance is encouraging, the 5-year running

[5] Beginning with the 1996 brood year, hatchery Chinook released in the Willamette and Sandy basins were marked by raising and lowering water temperatures on a set schedule during incubation, which increased or decreased development resulting in distinct patterns in the growth rings of the ear bones (otoliths). Otoliths recovered from unclipped spawned adults are analyzed to identify fish with thermal marks (hatchery) vs those without (wild).

average of wild fish abundance indicates the long-term trend remains at a low level (Figure 3).

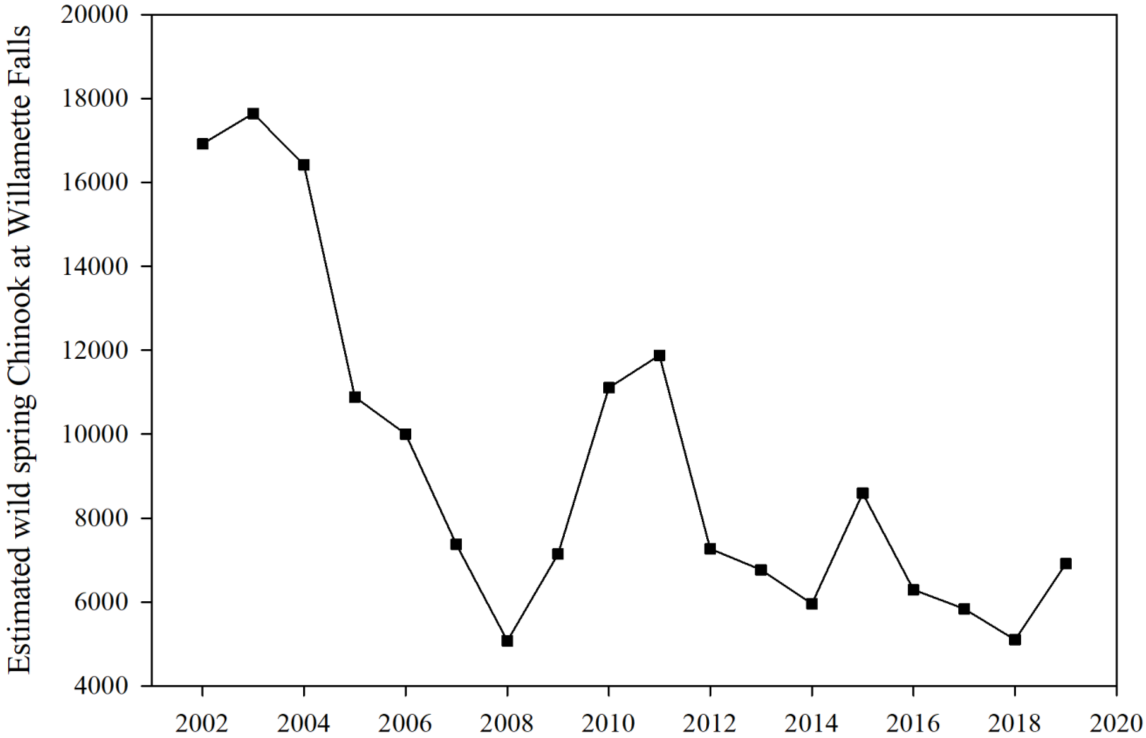

Figure 2. Estimated number of wild spring Chinook salmon at Willamette Falls, 2002–2019.

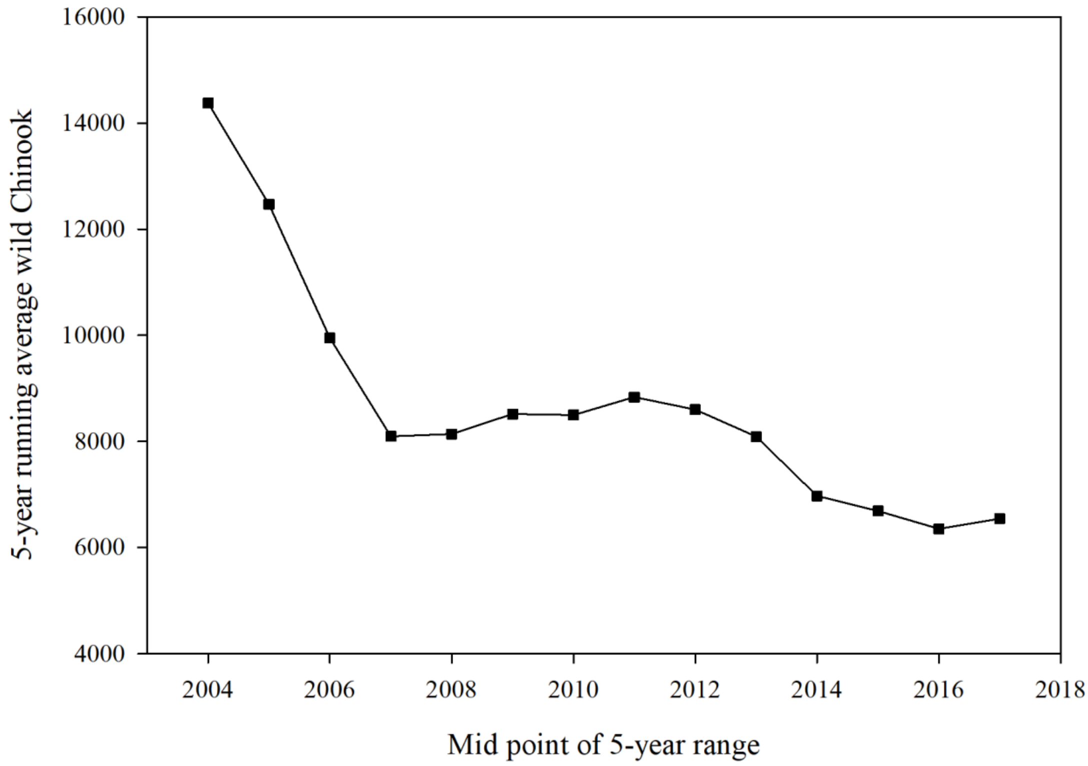

Figure 3. Trend in abundance of wild spring Chinook salmon at Willamette Falls.

19. Although the number of wild spring Chinook in the McKenzie River increased in 2019 (similar to the increase noted at Willamette Falls), the mean number of wild fish has declined significantly by about 50% from 2001–2007 to 2008–2019, to a mean of about 1,700 adults[6] (Figure 4). The trend for wild Chinook in the McKenzie shows a steep decline followed by a decreasing to stable trend at a relatively low abundance level, with an increase in the last 5-year period due to a relatively large run size in 2019 (Figure 5).

[6] The number of wild adult Chinook in subbasins was estimated from a combination of dam counts (where available, e.g., Leaburg Dam on McKenzie), redd counts, and pre-spawning mortality.

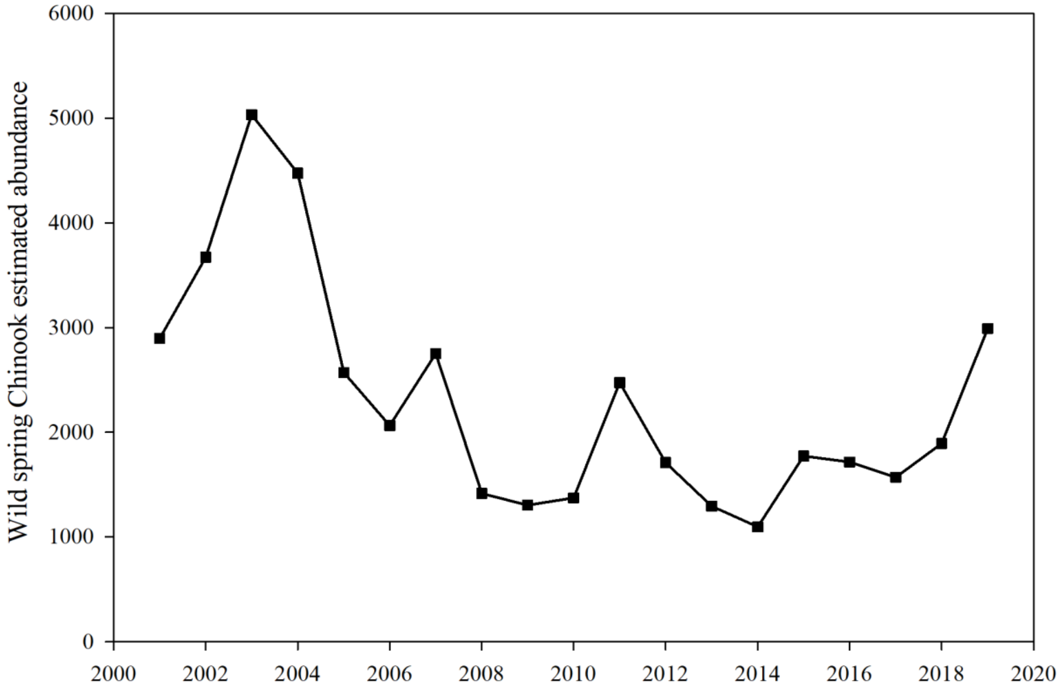

Figure 4. Estimated abundance of wild spring Chinook salmon in the McKenzie River subbasin.

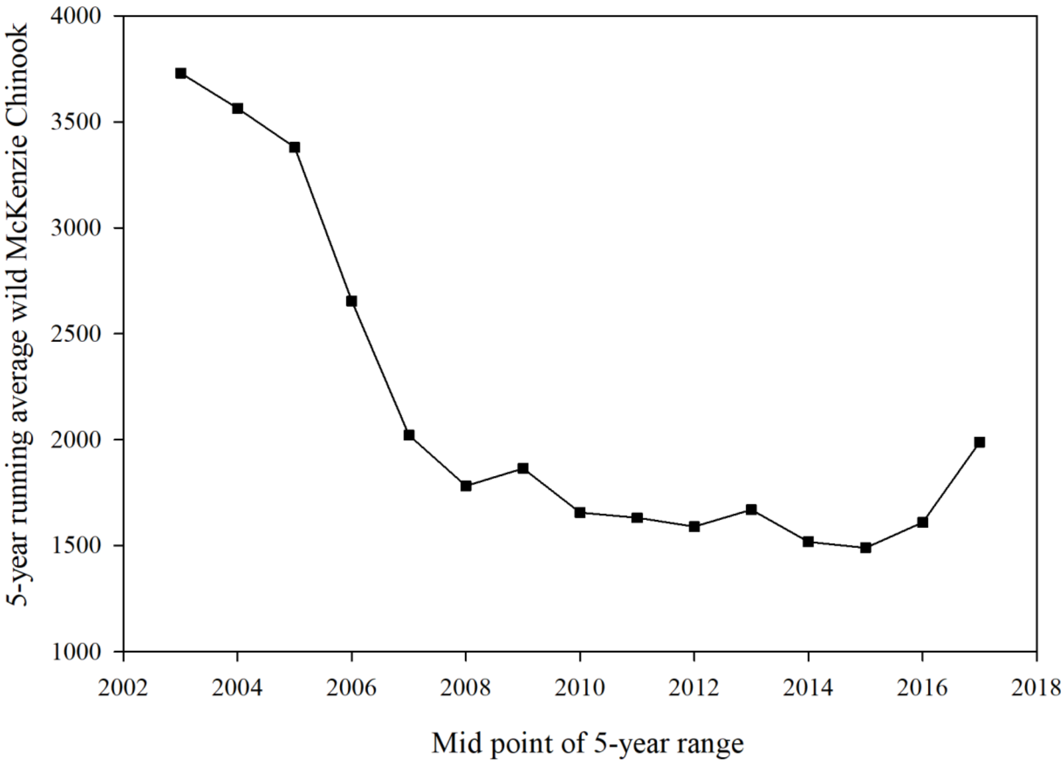

Figure 5. Trend in abundance of wild Chinook salmon in the McKenzie River subbasin.

20. Populations of wild Chinook in the other subbasins have generally fluctuated at low levels of abundance with recent multi-year declines followed by an increase in 2019, most notably in the North Santiam (Figure 6), although these numbers may include first generation progeny of hatchery fish that spawn in relatively high numbers in these subbasins. The mean abundance in 2008–2019 was below 800 fish in the North and South Santiam subbasins and was about 400 fish in the Middle Fork Willamette subbasin, with 79% of these occurring in Fall Creek. Of particular concern is the recent decline of wild Chinook in the South Santiam from a mean of 1,034 in 2009–2015 to a mean of 287 in 2016–2019 (Figure 6).

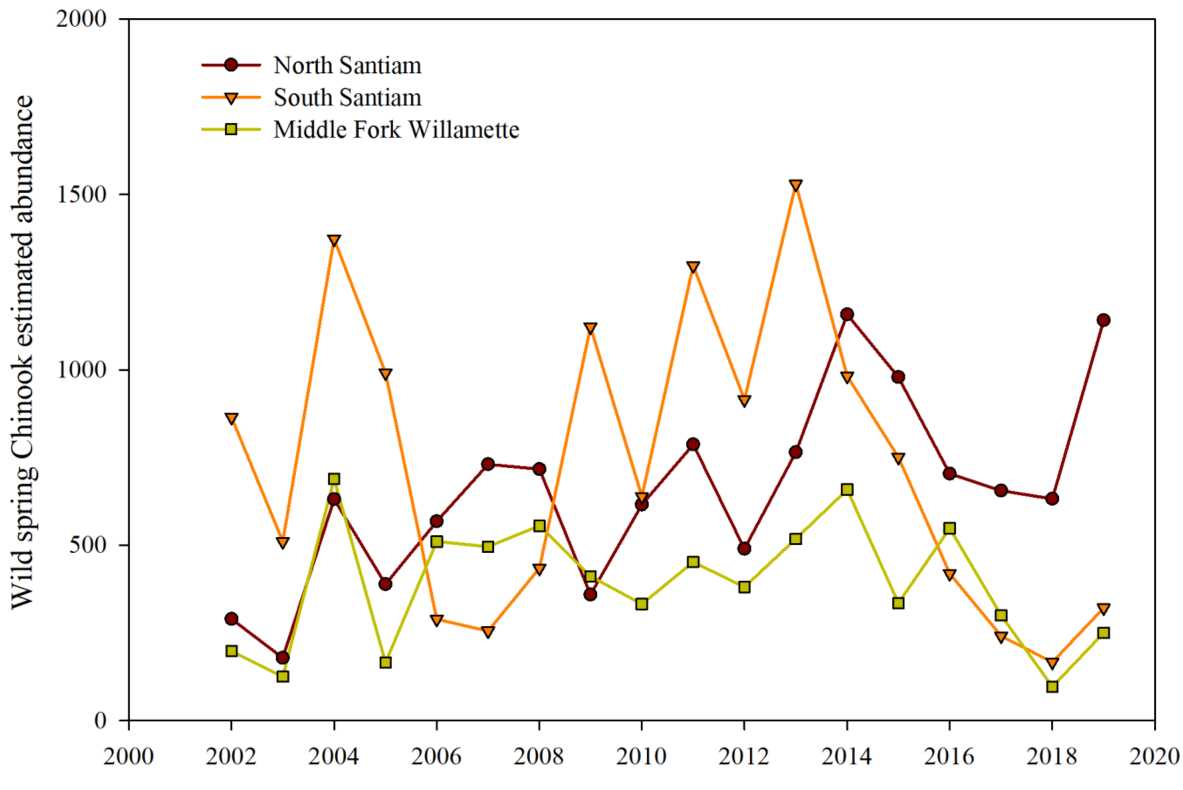

Figure 6. Estimated abundance of wild spring Chinook salmon in the North and South Santiam and Middle Fork Willamette subbasins.

Steelhead

21. Winter steelhead are enumerated at Willamette Falls and those that pass after February 15 (late run) are considered native to the basin, whereas the early run of winter steelhead are considered to be progeny of naturalized winter steelhead from hatchery programs that have been discontinued. The 2008–2020 average abundance of late run steelhead was about 3,200 compared to about 7,600 in 1971–2007, a decrease of almost 60% (Figure 1). Within recent years, the average abundance in 2017–2020 was about 2,050 compared to about 3,700 in 2008–2016 (-45%). Peaks in abundance have decreased over time from over 15,000 in 1970s and 1980s to about 11,000 in 2001 and 2002 to less than 5,000 after 2010 (Figure 1). The overall trend in the abundance of late run winter steelhead as measured by the 5-year running average indicates a general decline in recent years (Figure 7).

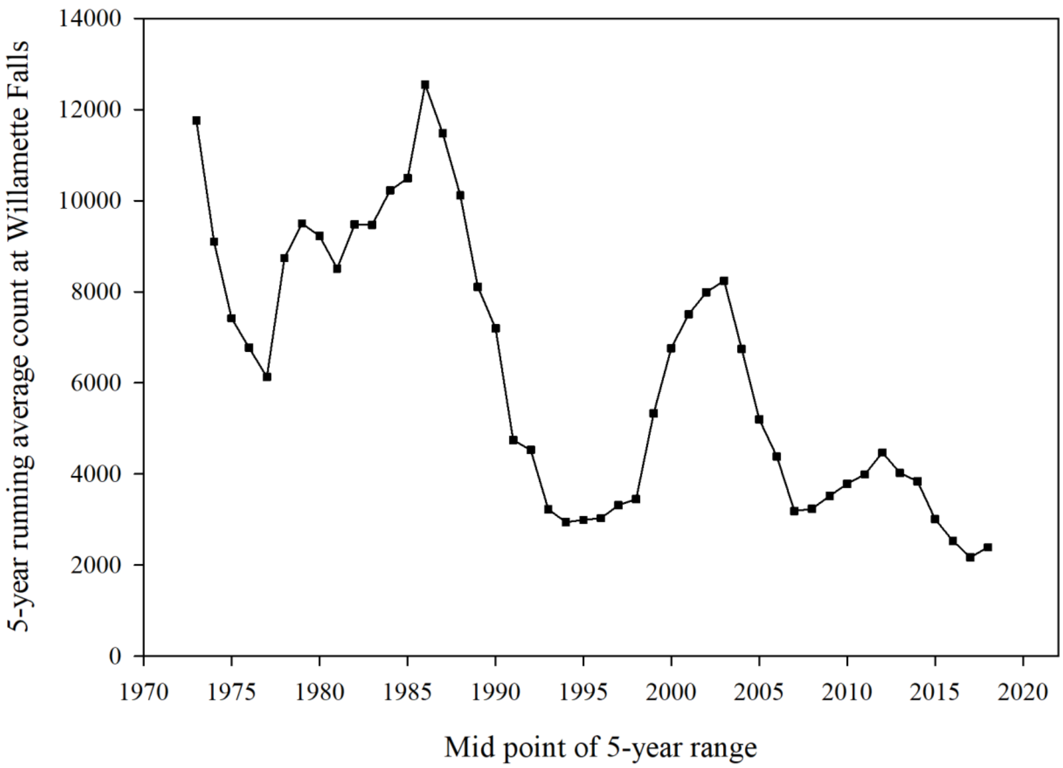

Figure 7. Trend in abundance of late run winter steelhead at Willamette Falls.

22. Abundance of winter steelhead in subbasins has been estimated by partitioning the Willamette Falls count based on the proportion of redds in each subbasin. Although there is much uncertainty in these data (available through 2016), they provide a general index of trends. In the North Santiam the 1985–2007 average was 1,263 compared to 790 in 2008–2016 (-38%). Estimated abundance in the South Santiam decreased from 1,847 in 1985–2007 to 821 in 2008–2016 (-56%). The Molalla population decreased from 1,801 in 1985–2007 to 1,313 in 2008–2016 (-27%) and the Calapooia decreased from 412 to 360 (-43%) during the same periods.

General trends

23. In contrast to the population declines in the upper Willamette Basin, the populations of wild Chinook salmon and winter steelhead in the near-by Clackamas and Sandy basins generally have increased in recent years after adult and juvenile fish passage at the dams in the Clackamas was improved, and Marmot Dam in the Sandy River was removed (Figure 8). Although populations may fluctuate independently from year to year, the absence of substantial improvement in UWR Chinook compared to the recent increasing trends in the Clackamas and Sandy basins provides at least circumstantial evidence that UWR dams are a primary factor in the continued decline of UWR salmon and steelhead due to the lack of adult and juvenile passage at UWR dams and associated deleterious effects of dam operations.

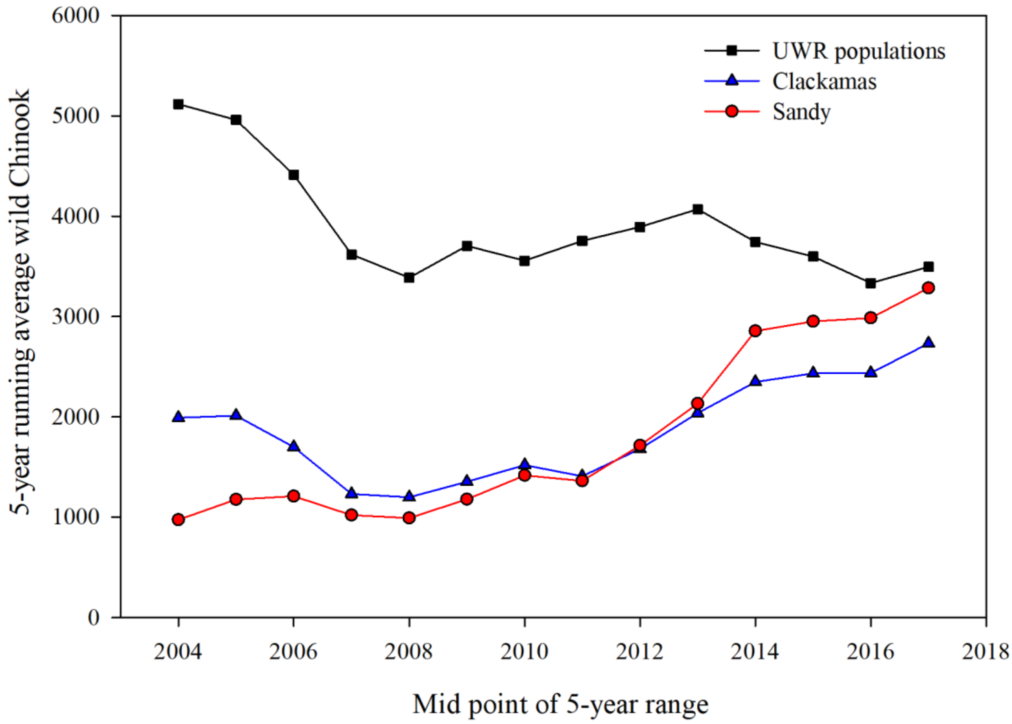

Figure 8. Trend in abundance of wild spring Chinook salmon populations in UWR and in the Clackamas and Sandy subbasins (2002–2019).

24. Risks of extinction for salmon and steelhead populations increase when they experience rapid or prolonged declines that result in spawner abundance of <500 fish.[7] The 2011 recovery plan identified "conservation gaps" as the magnitude of improvement needed for recovery. Population declines of Chinook salmon and winter steelhead have occurred since 2008, with some recent declining trends, which increases the conservation gaps, thus jeopardizing recovery. Populations that remain at low levels of abundance can face a high risk of extinction if they experience a rapid decline from additional stress such as predation or unexpected events such as poor ocean conditions or fires.[8] Run size data for wild UWR salmon and steelhead indicate that populations have experienced relatively rapid declines in

[7] Spence, B.C. and 9 co-authors. 2008. A framework for assessing the viability of threatened and endangered salmon and steelhead in the north-central California coast recovery domain. NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC-423.
[8] Viability of UWR winter steelhead was lower in populations with low abundance and viability decreased with predation from sea lions, especially in populations with low abundance (M. Falcy 2017, *see* footnote 4).

past years, illustrating that the risk of decreased viability is high for populations at low levels of abundance if further rapid declines occur. These low levels of abundance can increase the risk of extinction through loss of diversity and resilience. For example, populations with an effective population size of less than 500 can lead to a loss of genetic diversity that may result in the inability of a population to cope with environmental changes.[9]

25. The recent wildfires of 2020 should be a warning about the potential impact of stochastic events on habitats, fish, and infrastructure. Fires burned through critical habitat for spring Chinook and steelhead in parts of the Molalla, North Santiam, Calapooia, and McKenzie watersheds, in addition to the Clackamas. Effects on listed species are unknown at this time, but there is a potential that short-term effects (e.g., landslides and debris flows) could reduce survival. As such, the benefits of a relatively large run of Chinook salmon and steelhead at Willamette Falls in 2020 may not be realized. Fires disrupted operations at dams, fish collection facilities, and hatcheries, although results could have been much worse.

Recent and Ongoing Harm from the Willamette Project

26. 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. The operation and maintenance of the Corps' dams have altered the habitat, flows, and water temperatures throughout the Willamette Basin. Despite some recent changes in operations, continued effects include high pre-spawning mortality of adult fish, premature incubation of eggs and emergence of fry, lack of access to historic spawning and rearing habitat, lack of effective

[9] Effective population size is the number of individuals in a population who contribute offspring to the next generation and is generally less than the total number of individuals in a population because of unequal sex ratios and variation in the reproductive success of individuals (e.g., pre-spawning mortality is high in several UWR populations reducing reproductive success and the number of fish who contribute offspring). In salmon the effective population size can be substantially lower than the total number in a population (RS. Waples, 2002. *Effective size of fluctuating salmon populations.* Genetics vol 161: pp 783–791).

and safe passage for juvenile fish through reservoirs and dams, and disruption of rearing and growth of juvenile fish.

27. 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.

28. The ongoing operation and maintenance of the dams and reservoirs continues to disrupt the life history of UWR Chinook salmon and winter steelhead. Our research has shown that life history diversity at both the adult and juvenile stages provides stability and resilience to populations. Under projected effects of climate change in the Willamette Basin, protection of life history diversity will likely be critical for maintaining spring Chinook and winter steelhead populations. Life history diversity of populations has been reduced under current conditions and operations of the dams, and populations have continued to decline throughout the Upper Willamette Basin.

Continued contribution of WVP operations to the decline of the species

29. In my professional opinion, the Corps' ongoing operation of its dams have contributed to the continual decline of spring Chinook salmon and winter steelhead and prevented their recovery. This substantial harm to the species is ongoing and likely to continue into the foreseeable future without immediate and more aggressive action than has occurred in the past. Using the criteria for assessing viability of populations—abundance/productivity, spatial structure, and diversity[10]—factors that have led to the decline

[10] P. McElhany and 11 co-authors. 2006. Revised viability criteria for salmon and steelhead in the Willamette and Lower Columbia River Basins. Draft Report, NMFS, Seattle. *See also* Upper Willamette River Conservation and Recovery Plan for Chinook Salmon and Steelhead. 2011. ODFW and NMFS.

of populations have not been adequately addressed by measures taken by the Corps since the issuance of the 2008 BiOp. Even if one accounts for the time needed to plan and implement the various RPAs in the 2008 BiOp, data on the populations indicates little improvement in the status of UWR Chinook salmon and steelhead populations in the last 7–8 years, and many populations have declined. Little progress has been made in insuring the viability of UWR salmon and steelhead. Abundance and productivity of the species are inadequate to meet conservation and recovery goals, which can be largely attributed to loss of historic habitat upstream of dams. Access to historic spawning and rearing areas along with necessary passage for juvenile fish is critical for restoring abundance, productivity, spatial structure, and diversity of populations.

30. Life history diversity has been reduced because juvenile fish passage at dams is inadequate for full expression of migratory life histories. Likewise, lack of access to historical habitats has constrained life history diversity in most populations because habitat downstream of dams has been degraded by dam operations, specifically water quality such as flow, temperature, and dissolved gases. Habitat downstream of dams is considered critical habitat because wild fish populations have been largely confined to these areas. Without access to historic spawning and rearing areas in the North and South Santiam and the Middle Fork Willamette subbasins, it is highly doubtful that conservation goals will be achieved for the species, much less delisting or broad sense recovery. This is particularly the case under probable future effects of climate change which will make the areas downstream of dams less hospitable for adults to hold and spawn, and for juvenile fish to rear.

31. In my professional opinion, progress toward recovering these species will not be possible as long as adult salmon and steelhead are restricted to a fraction of their historic range downstream of the dams. Measures to provide dam passage have failed to meet both the spatial structuring and diversity criteria for viability. Measures implemented to date have

failed to meaningfully improve juvenile fish passage much less allowed fish to express their full range of life histories. Our research and others have shown the diversity of life histories in both juvenile and adult fish is important for providing stability and resilience to populations and allowing them to adapt to changing environmental conditions such as climate change. For juvenile salmon and steelhead, passage should be provided at different times of the year depending on the migratory behavior exhibited by progeny of adult fish transported upstream of dams. For example, in the upper reaches of the McKenzie subbasin where adult salmon can access some historic spawning areas, the primary periods of migration are winter to early spring for newly emerged fry migrating to mainstem habitats, October through December for fall migrants, and March through mid-June for yearling smolts.

32. 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. Measures taken to date have shown little progress in addressing these factors and their effects on the species. 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. Recently, predation by sea lions at Willamette Falls has affected populations, especially winter steelhead. However, the effects of predation are more pronounced when populations have already been reduced than if the populations were at recovery levels. In my professional opinion, the dams are the primary reason that the species were listed as threatened under the ESA and recovery will not be possible without immediate operational changes and major alterations to the dams and dam operations.

33. In the face of declining trends for UWR salmon and steelhead populations, the ongoing dam operations are inadequate for the protection and recovery of these listed species. Corps dams have blocked passage to historic spawning areas in the North and South Santiam, McKenzie, and Middle Fork Willamette subbasins, resulting in a loss of about 20–90% of historic habitats. Reintroductions of adult salmon and steelhead upstream of dams must be implemented to provide successful adult spawning and juvenile fish passage at the dams. To date, efforts to reintroduce adult salmon and steelhead above the dams have had limited success or have not been implemented (e.g., above Green Peter Dam). Where fish have been transported upstream of dams, mortality has often been high and lack of passage for juvenile fish means that reintroduction efforts have had little effect in preventing further decline in wild fish populations, with the possible exception of Fall Creek where deep drawdowns have been implemented. Plans to provide for permanent juvenile fish passage at dams in the upper Willamette basin (e.g., Cougar, Detroit, Lookout Point) are years away from finalization, much less implementation.

34. Operations of Corps dams in the upper Willamette Basin that would benefit fish have often been a lower priority than other uses (e.g., recreation, power generation), even when flood control can be achieved. As a result, salmon and steelhead are negatively affected by unnatural flows, water temperatures, and total dissolved gases. Unnatural flow and temperature conditions downstream of dams result in environmental conditions that can lead to high pre-spawning mortality of adults and premature development of eggs and emergence of fry. Altered flows and temperatures can affect the growth of juvenile fish and interfere with cues for migration. Controlled flows in the winter reduce access to refuge habitat in floodplains for juvenile fish and expose them to high water velocities during extended periods when flows are unnaturally kept at bankful levels. The presence of unneeded revetments results in loss of habitat complexity for rearing and exacerbates the

effects of controlled winter floods by preventing access to floodplains and other habitats off the main channel of the rivers.

35. Substantial harm to federally listed Chinook salmon and steelhead will continue without meaningful changes to dam operations, particularly related to providing effective juvenile fish passage and protecting critical habitat downstream of dams. Because populations have continued to decline since 2008, a lack of effective measures while the Corps and NMFS complete consultation would further jeopardize UWR Chinook salmon and winter steelhead over the next several years. Populations of UWR salmon and steelhead have been depressed for an extended period of time, which has increased their vulnerability to extinction and jeopardized their recovery. Populations that remain at low levels of abundance for extended periods of time are at increased risks from environmental changes such as drought and poor ocean conditions, and from stochastic events such as floods and fires. These concerns were communicated by NMFS in a 2019 letter to the Corps: "Any additional delay in implementing critical fish passage and habitat actions associated with WVS [Willamette Valley System] would only prolong this period of elevated extinction risk and potentially make recovery of these species more difficult in the future".[11]

36. Given the declining trends in abundance and the low levels of abundance, immediate and substantial changes to dam operations are needed to reduce the risks of extinction for populations of UWR salmon and steelhead and to increase the probability of recovery. The loss of one or two populations would increase the risk of extinction for UWR salmon and steelhead and would lower the probability of recovery. The desired status for the UWR ESU is to have at least two viable populations with a low risk of extinction, with an average risk score for all populations of 2.25 (score ranges from 0 at very high risk of

[11] Letter from K.W. Krantz, Assistant Regional Administrator, NMFS to S. Hill, District Engineer, Army Corps of Engineers, dated June 28, 2019.

extinction to 4 at very low risk).[12] Additionally, the historically most productive populations would be restored to a low risk of extinction to achieve the desired status for the ESU. For Chinook salmon, 3 of the 4 core populations would need to be restored (Clackamas, North Santiam, McKenzie, and Middle Fork Willamette) and both the North and South Santiam populations of winter steelhead would need to be at low risk. These objectives will not be achieved without significant changes to WVP operations that provides access to upstream habitat with effective downstream passage and that improves downstream habitat.

Need for interim measures to remedy ongoing harm

37. In my professional opinion, it is imperative to take immediate action to address passage at the dam, particularly for juvenile fish, and to minimize harm to fish spawning and rearing downstream of dams. Because adoption of the new operations BiOp and implementation of permanent passage measures are years away, and because much time has already been lost—resulting in the continued decline of the species—meaningful interim measures are important to prevent further harm to the species and to provide the necessary foundation so that permanent solutions can be more quickly implemented.

38. The general approach of interim measures should be to implement operational changes to provide more favorable conditions for juvenile fish passage. Measures such as deep drawdowns in fall would make it easier for juvenile fish to migrate to the dams by reducing the length of the reservoirs and providing current to attract fish downstream. Deep drawdowns would also make it easier for fish to access RO passage routes rather than going through turbines by reducing the depth to which fish would have to sound to find the opening and would increase survival by reducing hydraulic head and associated pressure. Spring spills that coincide with peak migration times would provide an effective passage route for juvenile

[12] Upper Willamette River Conservation and Recovery Plan for Chinook Salmon and Steelhead. 2011. ODFW and NMFS.

fish. Because of uncertainty about fish passage measures, RM&E should be planned to collect 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. Years have been spent already with little to show for conservation or recovery of the species, or implementation of effective recovery measures.

39. Successful reintroduction of salmon and steelhead upstream of dams and establishment of sustainable populations obviously will require effective passage for juvenile fish at the dams. Permanent solutions for juvenile fish passage are years away, therefore interim measures are needed to reduce harm. Interim measures should draw on results of previous studies[13] that conclude the following: a) passage efficiency and survival are generally higher for fish using spillways or ROs as passage routes rather than powerhouse routes, b) deep drawdowns of reservoirs improve migration through reservoirs by shortening the length of reservoirs and providing current to attract fish to forebays, c) drawdowns also 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.

40. Because of uncertainties about effects of operations on juvenile fish passage, interim measures and studies are needed and should be designed to provide information to speed progress on long-delayed permanent solutions. Depending on the specific measures, studies should be designed as controlled experiments such as with releases of tagged fish upstream and downstream of dams to evaluate immediate and long-term survival. Interim measures are merely a stopgap that should be designed to improve juvenile fish passage and reduce harm to populations while permanent solutions are developed and should not be

[13] Summarized by Hansen, A.C., Kock, T. J, and Hansen, G.S. 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.

viewed as a substitute for substantive measures to achieve passage levels effective enough to meet conservation and recovery goals.

41. Successful spawning of Chinook salmon and steelhead outplanted upstream of dams is a critical first step to increase natural production and reduce ongoing harm. However, benefits from outplanting will only be realized if the adults spawn successfully. Although this is a relatively easy measure to implement, a high degree of uncertainty remains about outplanting because of inconsistencies in how it has been implemented or evaluated in the past. Therefore, interim measures associated with outplanting should be implemented with enough scientific rigor and RM&E to answer specific questions about outplanting methods and spawning success. This will require measures that have a scientific framework and secure funding to provide consistency for evaluating which factors affect successful transport, release, and spawning, and to provide a basis to adapt management as needed to improve spawning success.

42. In addition to measures needed to ensure progress on reintroducing salmon and steelhead upstream of dams, measures are needed to minimize harm from dam operations to salmon and steelhead that currently spawn and rear downstream of dams. These populations must be secured to meet conservation goals and prevent further decline of the species. In particular, measures are needed for modifying operations at Cougar, Detroit, Big Cliff, Foster, and Green Peter dams to meet flow and temperature standards for spawning and rearing. In addition, measures are needed to minimize TDG downstream of Big Cliff and Foster dams.

43. Measures should not be constrained by assumptions about continuing current dam operations (e.g., power generation) or the configuration of dams. For adult passage, measures should be implemented to assess the feasibility of modifying dams to allow run-of-river operations and provide passive adult fish passage.

General shortcomings of the Corps' interim measures

44. I have reviewed the Corps' document entitled Willamette Valley Project Interim Measures, Implementation Plan (Revised June 2020). In my professional opinion, the Corps' interim measures generally lack bold or timely approaches to swiftly reduce ongoing harm to the species. Some measures are merely the minimum that were previously required in the 2008 BiOp but never implemented—like the outplanting above Green Peter. Other Corps measures represent relatively minor modifications to current operations that will not meaningfully reduce harm, and others lack firm commitments for timely development or funding to provide much assurance of implementation.

45. Because most of the Corps' measures do not represent definitive progress toward viable juvenile fish passage solutions, it is unclear and unlikely that even if all the interim measures were implemented it would reduce ongoing harm to the species, much less achieve progress toward recovery. In addition, many of the measures lack scientific rigor for evaluating the individual measures or for providing needed information to develop and implement adaptive management decisions. It should be acknowledged that measures may not result in significant benefits to the fish; therefore, adequate RM&E plans are critical for evaluating the effectiveness of measures in order to improve them or to identify future paths forward.

46. Success of measures to increase natural production (which in turn would reduce harm) requires information at each phase: trapping and handling adults, transporting and releasing adults, assessing spawning and incubation success, evaluating life history of juvenile fish entering and migrating through the reservoir, evaluating passage of juvenile fish at dams, and evaluating outmigration of juvenile fish to Willamette Falls (assessment of delayed mortality and long-term survival). The Corps' proposed measures fall short of

providing relief for the listed species or providing the necessary information to develop and initiate permanent passage solutions.

47. The Corps' proposed measures continue the pattern of taking a piecemeal approach to implementing operational changes needed for progress in providing juvenile fish passage at dams. The Corps largely proposes narrow, site-specific measures that fail to recognize and provide for diverse migratory life histories and behavior of juvenile salmon and steelhead. The Corps' measures also fail to adequately address the large-scale effects of dams and dam operations on salmon and steelhead in the Willamette watershed, and therefore would provide limited benefit in increasing natural production, spatial structure, and diversity necessary to ensure the viability of the listed species. Finally, the Corps' measures do not provide adequate RM&E needed to collect the information necessary for implementing comprehensive or adaptive management decisions about passage.

Assessment of Proposed Interim Measures by Subbasin

48. In the paragraphs below, I describe the types of measures that are needed to remedy ongoing harm and then assess the Corps' interim measures along with the Plaintiffs' proposed measures. In my professional opinion, the Plaintiffs' proposed measures would have a greater chance of increasing juvenile fish passage at dams in fall and spring than that proposed by the Corps. Increasing the effectiveness of juvenile fish passage would subsequently contribute to increased natural production and diversity, which would reduce harm to the listed species. In addition, the Plaintiffs' measures include RM&E to monitor population viability, assess interim measures, and study alternative operations or structural changes.

<u>North Santiam</u>

49. Passage for juvenile salmon and steelhead at Detroit and Big Cliff dams is imperative for increasing viability of salmon and steelhead in the North Santiam by

increasing natural production, spatial structure, and life history diversity. Operation of Detroit and Big Cliff should also be managed to reduce TDG and minimize unnatural flow and water temperature deviations in the North Santiam River to reduce harm to salmon and steelhead downstream of the dams. Under existing conditions, juvenile fish passage could be improved by using spill in the spring (when reservoirs are high) and by drawing down the reservoir in the fall to allow passage through the regulating outlets (ROs).

50. In general, the Corps' proposed measures fall short of accomplishing favorable juvenile fish passage conditions, as noted in more detail below. Measures proposed by the Plaintiffs will more adequately achieve conditions to effectively pass juvenile fish by increasing use of ROs rather than turbines in the fall and providing spring spill to increase juvenile fish passage. Passage in fall and spring is important for increasing natural production and life history diversity in the North Santiam subbasin, where dams and dam operations have constrained productivity and diversity. The Plaintiffs' measures also provide more specifics to meet standards for TDG and water temperature.

51. The Plaintiffs' measures would draw down Detroit Reservoir by November 1 to provide passage for juvenile fish through the ROs, would provide spill for spring passage, would manage Detroit and Big Cliff dams to reduce TDG and meet water temperature standards, and would prioritize passage over power generation. These measures would address the need to provide effective fish passage in fall and spring that in turn could help to increase natural production and life history diversity. The Corps proposes to stop the use of turbines between 6 to 10 AM and 6 to 10 PM, except for station service power (Measure 5). When the dam is operated for juvenile fish passage, the use of ROs should be a higher priority than turbines. Generation of power should not be part of this decision. The Corps' off-limit time periods for turbine operation should be extended to encompass normal migration times of juvenile fish including evening hours and dawn hours as is proposed by

the Plaintiffs' (4 PM to 8 AM). Although the Corps proposes spill at Big Cliff (Measure 6) and Detroit (Measure 7) dams, these measures are centered around managing TDG and water temperatures in summer and the Corps included no plan to manage spill to specifically increase juvenile fish passage in the spring. These measures appear inadequate for immediately improving conditions for fish passage, in contrast to measures proposed by the Plaintiffs, which specifically propose operations to provide spring spill. Because a permanent passage solution remains elusive, operational changes should be implemented and evaluated to provide additional information about their effectiveness as a means to help design and implement permanent passage solutions.

52. In addition to providing favorable conditions for juvenile fish passage, dam operations should be managed to meet biological needs of Chinook salmon and winter steelhead spawning and rearing downstream of the dams. The Plaintiffs' measures provide for recommendations from a technical advisory team to address flow targets that would maximize benefits to both species. Dam operations in fall (early September to late October) should be managed to adequately provide access to spawning areas downstream of the dams and to avoid dewatering completed redds, primarily upstream of Bennett dams. Changes in flow can cause adult salmon to abandon partially completed redds and depending on the timing, these fish may not have energy reserves to complete another redd. Flows that exceed ramp rates may disrupt the physical shape of redds (flatten) that can affect incubation of eggs. Flows that drop after redds are completed may dewater redds. Flow in spring should be managed for winter steelhead spawning because of the importance of the North Santiam River below dams for spawning.[14]

[14] Density in the North Santiam River was higher over 11-year data set than redd density in tributaries (6.3 vs 5.8 redds/mile), despite the fact that counting redds is more difficult in the mainstem and redds are likely undercounted.

53. Water temperatures downstream of the dams are elevated above a normal thermal regime in fall and early winter. The primary effect of high water temperature on spring Chinook salmon is accelerated incubation of eggs and subsequent early emergence of fry at a time when flow is high and food is scarce. Use of the lower RO to release cold water in early fall (prior to turnover) could lower water temperature downstream and this low elevation release would be preferable to releasing water through turbines in terms of mortality to juvenile fish. The Plantiffs' measures include use of the lower RO for temperature control.

South Santiam

54. Because of habitat limitations for spring Chinook salmon and winter steelhead in the South Santiam subbasin upstream and downstream of Foster Dam, reintroductions into the Middle Santiam River upstream of Green Peter Dam is likely necessary to successfully recover these species in the Santiam watershed. In addition, the abundance of wild spring Chinook in the South Santiam subbasin has been very low in recent years (average of <300 fish in 2016–2019). Therefore, it is imperative to take a more aggressive approach to reintroduction upstream of Green Peter Dam and to implement other operational changes to increase juvenile fish passage at Foster Dam. Immediate measures are needed to address ongoing problems with collecting and transporting adult salmon and steelhead and with passing juvenile fish at Foster Dam.

55. Reintroduction of salmon and steelhead upstream of Green Peter Dam was identified in several RPAs in the 2008 BiOp (4.1, 4.2, 4.10, 4.11, 4.12). Research to evaluate reintroduction was identified by several members of the WATER team in 2017 as high to medium priority, but ranked as "do not fund – no priority" by the Corps and BPA based on

their interpretation that work was beyond the purview of the 2008 BiOp.[15] Therefore, actions are immediately needed to initiate the long-delayed evaluation of reintroduction issues and remedies. Yet the Corps' only interim measure for Green Peter is to develop a RM&E plan by December of 2020, which is nothing more than what should have been accomplished years ago under the 2008 BiOp. The Corps still does not commit to take any concrete actions.

56. In my professional opinion, an independent scientific team should develop an accelerated plan to begin full-scale reintroduction upstream of Green Peter Dam. Parties should commit to plan and implement outplanting of adult fish upstream of Green Peter Dam no later than 2021 and to begin collecting critical data to identify changes necessary for outplanting adults and passing juvenile fish downstream. Existing information should be sufficient to develop a detailed study and evaluation plan including release locations and timing, numbers to be released, genetic sampling, and associated tagging (Floy and radio) to assess movement and spawning distribution of outplanted adults. Operations at Green Peter Dam should be managed under current conditions to provide for juvenile fish passage through spring spill and fall drawdown. Preliminary designs should be developed for modifying Green Peter Dam to provide juvenile fish passage and studies should be conducted within the next couple of years to assess juvenile passage under present conditions. The Plaintiffs' measures provide for outplanting adult fish above Green Peter within one year and designing and constructing adult release sites within two years. In addition, the Plaintiffs' measures include operational changes to achieve favorable passage conditions using spring spill and fall drawdown and to explore alternative passage operations.

[15] Issue Elevation Form dated September 29. 2017 from Steering Team to Managers Forum; and Letter from M. Liverman, Willamette Branch Chief, NMFS, to A. Gibbons, Environmental Resources Branch Chief, ACOE, dated June 28, 2019.

57. Successful outplanting of adult fish upstream of dams will require development of release sites to allow fish to recover from stress of handling and transport. Efforts to identify and develop outplant sites have been inconsistent and delayed for many years. The proposed interim measure by the Corps (Measure 11) is merely a review of options, which is something that should have been done years ago under the 2008 BiOp (RPA 4.7).[16] Development or improvement of sites should be accelerated, not only in the South Santiam upstream of Foster but also upstream of Green Peter in Quartzville Creek and the Middle Santiam River. Although the RM&E in this proposed measure states that spawning surveys will occur, the Corps needs to assure that this will actually be implemented. Measures proposed by the Plaintiffs would complete release sites in the South and Middle Santiam rivers within two years and would provide the necessary RM&E to evaluate outplanting upstream of dams.

58. Because numbers of wild spring Chinook and winter steelhead are very low in the South Santiam subbasin, measures to increase production of fish upstream of Foster Dam (trapping and outplanting adult fish and passing juvenile fish) are critical to reduce harm to the population by increasing natural production and life history diversity.

59. A fish weir designed by the Corps to facilitate juvenile fish passage at Foster Dam is not proposed for use in Measure 9 to pass juvenile fish, which I assume is because of the recent failures of the fish weir (which resulted in high mortality). Structural changes to the dam are likely needed to effectively pass juvenile fish, but there is no mention of planning or developing potential changes. Given the importance of this improvement to increase juvenile fish passage, Plaintiffs' proposed measure to assess options and begin designing a

[16] "Complete a site/concept study by February 28, 2009"; "complete construction of all selected sites by June 2012."

structural solution to facilitate juvenile passage is an important step to increase natural production and life history diversity in the South Santiam population to reduce jeopardy.

60. While work is initiated on structural improvements for long-term passage, operational measures should be implemented to improve juvenile passage by allowing for spill in fall and spring with limited use of turbines. Power generation should not be a factor in determining dam operations for fish passage. Although the downstream passage measure proposed by the Corps provides spill during fall and spring (Measure 9), the turbine shutdowns should be timed to encompass crepuscular[17] hours in the fall. Waiting to operate the spillway until 7 pm in late fall will be well after dark and juvenile fish migration generally begins before dusk with peaks often before midnight. As with other passage measures, the Corps should set juvenile fish passage and downstream water quality as the top priority and basis for decisions about dam operations, and power generation considerations should be secondary and a low priority. For this reason, the Plaintiffs' proposed measures to operate the spillway with no use of turbines for a longer time in the fall (4 PM to 8 AM) and again in the spring would create more favorable passage conditions than that proposed by the Corps. In addition, Plaintiffs' proposal to keep the reservoir level low through May 15 will provide an added benefit for spring migration because it will take less time for spring migrants to pass through the reservoir and reach Foster Dam.

61. The Corps proposes to use the fish weir for temperature control for one to two months to attract adult fish to the collection facility, along with possible use of fish pumps (Measure 10). The Foster adult collection facility has performed poorly, especially with winter steelhead, since it underwent a major and very expensive renovation. The interim measure proposed by the Corps assumes relatively minor tweaks will be sufficient to improve adult fish collection at Foster Dam. However, the Foster trap works so poorly that it may

[17] Time of day with low light levels after the sun sets or before it rises.

require a major renovation; therefore, additional data should be collected immediately to assess factors that deter fish from entering the trap. This may require a radio tracking study in the immediate vicinity to collect information on fish behavior near the entrance to the fish collection facility, especially under varying test conditions.

62. In my professional opinion, the measures proposed by the Plaintiffs would more fully address the need to improve both the downstream passage at Foster Dam and the collection of adult fish to outplant upstream of the dam. The effect of Plaintiffs' measures in the Middle and South Santiam subbasins would help to reduce ongoing harm by taking immediate action to help increase natural production and diversity. These measures are particularly critical for reducing harm to the population because abundance has declined significantly in recent years, thus increasing risks to the population that may be difficult to remedy if measures are not quickly implemented. In addition, because only wild fish are outplanted upstream of Foster Dam, it is imperative to provide safe and effective passage at the dam to achieve any benefits of increasing natural production and diversity in the population.

<u>McKenzie</u>

63. Passage for juvenile Chinook salmon at Cougar Dam is necessary to increase viability of Chinook salmon and steelhead in the McKenzie subbasin by increasing natural production, spatial structure, and life history diversity in the South Fork McKenzie River, which was historically productive for salmon. Under existing conditions, juvenile fish passage could be improved by drawing down the reservoir in the fall to a lower level than presently occurs and by maintaining a low reservoir level into spring to allow passage through the ROs under conditions that increase passage and minimize mortality. During periods of juvenile fish migration, the dam should be operated to create favorable fish passage conditions and generation of power should be a low priority. Turbines should be shut

off during hours that encompass peak juvenile fish migration and include crepuscular hours. The short-term objective should be to draft the reservoir as soon as possible during the fall in order to achieve low pool elevation to improve access to RO entrance during the period when juvenile fish are most likely to be actively migrating. The long-term goal should be to increase passage efficiency and achieve high juvenile survival at all life history stages, including fry migration.

64. The interim measures proposed by the Corps do not fully achieve the short-term objective (Measures 15–17, note that only one of the proposed Measures 16 & 17 would be implemented). Specifically, it is unclear to what level the reservoir would be lowered during peak fall-early winter migration or how long it would be held at a lower level to effectively pass fish through the RO. Additionally, reservoir management to facilitate passage in spring is unclear. Finally, the Corps proposals do not specify hours when turbines would be shut off nor do they provide assurance that priority of the dam operations would be for fish passage over power generation.

65. I have reviewed the Plaintiffs' proposals for the McKenzie and in my professional opinion I find that these measures have more specificity about operations and priority for juvenile fish passage that would more adequately achieve conditions to effectively pass juvenile fish. Favorable passage conditions for juvenile fish would be created by curtailing power generation and by using a deep drawdown in fall and maintaining a low reservoir pool into spring to lower reservoir levels so juvenile Chinook do not have to sound very far to reach the RO entrance and can travel through the reservoir more quickly. These measures would result in passage conditions that have been shown to be effective and with lower mortality than at higher reservoir levels or through other routes (e.g., powerhouse).[18]

[18] Summarized by Hansen, A.C., Kock, T. J, and Hansen, G.S. 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.

The Corps' measures would be much less effective because they do not include a deep drawdown that would lower the reservoir close to the RO entrance. Because naturally produced adults are trapped and transported upstream of Cougar Dam, it is imperative to provide safe and effective downstream passage for the juvenile fish. Outplanting wild fish without ensuring safe and effective downstream passage would result in a net decline in the wild salmon population and further jeopardize conservation and recovery.

66. Because plans for permanent juvenile fish passage at Cougar Dam have yet to be developed, an independent scientific team should analyze options for a run-of-river operation at Cougar Dam. Analysis should include risks and benefits of run-of-river operations including efficiency of juvenile fish passage, infrastructure needs, and the effects of flow, water temperature, and sediment loads on restored sections of the South Fork McKenzie River downstream of Cougar Dam. The Plaintiffs' measures provide for studying alternatives including a no-power scenario and testing run-of-river operations. Run-of-river operations at Cougar Dam would create favorable conditions in late winter to early spring for passage of Chinook fry. For example, when the reservoir was drawn down before construction of the temperature control tower, passage was through a diversion tunnel very low in the dam and fry were captured downstream with some captured as early as February.[19] Fry migrate from historic spawning and rearing areas of the upper McKenzie River to rear in the lower reaches of the McKenzie River and in the Willamette River, and most migrate to the ocean as subyearling smolts in late spring and early summer. Run-of-river operation would allow full expression of life history diversity which has been shown to impart stability and resilience to populations.

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[19] Zymonas, N.D., Tranquilli, J.V., and Hogansen, M. 2011. Monitoring and evaluation of impacts to bull trout (*Salvelinus confluentus*) and spring Chinook (*Oncorhynchus tshawytscha*) in the South Fork McKenzie River from construction of water temperature control facilities at Cougar Dam, Oregon. Report of Oregon Department of Fish and Wildlife prepared for U.S. Army Corps of Engineers, Project No. W66QKZ13186766.

Middle Fork Willamette

67. Because habitat is limited for spring Chinook salmon downstream of Dexter Dam and has been degraded by dam operations, and because abundance of wild fish is extremely low (average of 44 adults in 2008–2019, with average of just 23 in 2015–2019, exclusive of Fall Creek), reintroduction upstream of Lookout Point Dam is critical to conserve and recover Chinook salmon in this subbasin. Recovery of Chinook salmon in the Middle Fork Willamette subbasin is of key importance in recovering UWR Chinook salmon because this subbasin was historically one of the largest producers of spring Chinook in the Willamette Basin and is considered a core population. Therefore, immediate and aggressive measures are necessary to address the ongoing harm to the population.

68. Passage for juvenile Chinook salmon at Lookout Point and Dexter dams is critical for increasing natural production and life history diversity to prevent extinction of the wild fish upstream of the Fall Creek confluence. Under existing conditions juvenile fish passage could be improved with a deep drawdown of Lookout Point Reservoir in the fall and by maintaining a low reservoir level through early winter to allow passage through the regulating outlets (ROs), then prioritize refill to provide spill in the spring, including possible supplemental flow from Hills Creek Dam to achieve refill targets. Concurrent with this would be to coordinate spill at Dexter Dam to increase juvenile fish passage in fall and spring. Dam operations should put a higher priority on increasing favorable passage conditions for juvenile salmon than on power generation. Power generation should be curtailed during spring spill by shutting off turbines during hours that encompass peak juvenile fish migration, including crepuscular hours, to promote passage via spill rather than through turbines. The short-term objective should be to draft the reservoir as soon as possible during the fall in order to achieve low pool elevation to provide attraction flow to the forebay, shorten travel distance, and provide easier access to RO entrance with lower hydraulic head, and then to

provide spill during spring. The long-term goal should be to increase passage efficiency and achieve high juvenile survival at all life history stages, including fry migration, such as through run-of-river operation.

69. The Corps' interim proposals are inadequate to fully address juvenile fish passage needs at Lookout Point and Dexter dams, and will likely continue harm to Chinook salmon in the subbasin. The Corps proposes just one measure to address downstream passage at Lookout Point Dam (Measure 21). Measure 21 addresses spring spill at Lookout Point Dam but does not set refilling the reservoir as the top priority to achieve levels needed to provide spill in the spring. At Dexter Dam, the Corps proposes spilling with limited turbine use during the Lookout Point spill operation, but only for the hours of 6 to 10 PM. The Corps does not propose any measures for a deep drawdown at Lookout Point (target dates or reservoir levels) to facilitate juvenile fish passage in the fall nor do they propose any measures to operate Dexter Dam to prioritize juvenile fish passage in fall. Power generation should specifically be curtailed to facilitate juvenile fish passage and encompass dusk and nighttime hours when juvenile fish passage is highest. Spill operations at Dexter Dam should be expanded to match natural migration patterns in fall and spring and coordinated with operations at Lookout Point Dam.

70. In my professional opinion, the Plaintiffs' proposals would increase the effectiveness of juvenile fish passage by drawing the reservoir to a level much lower than normal in fall that would shorten travel time, attract fish to the forebay, provide easier access to the ROs so juvenile fish do not have to sound deeply, and create favorable passage conditions by reducing head pressure. They would require spill operations at Dexter at the same time to improve passage through both dams during fall. The Plaintiffs' measures also provide for adapting operations (e.g., run-of-river) or developing structural changes (Dexter fish facility) to improve passage. The Plaintiffs' measures for fall and spring passage would

provide immediate relief from ongoing harm to Chinook salmon by increasing the opportunity for juvenile fish to pass the dams that in turn could increase natural production and life history diversity.

71. The number of piscivorous species and their abundance is higher in Lookout Point Reservoir than in Cougar or Detroit reservoirs and they consume juvenile salmon, particularly in the spring.[20] Measures such as lowering the reservoir to interrupt spawning behavior and life history of the piscivorous species could reduce their abundance. The Plaintiffs' measures include an assessment of methods to reduce predators in the reservoir to be led by a technical advisory team. These measures will further benefit UWR Chinook salmon and provide important information for the new BiOp.

Fall Creek

72. Spring Chinook produced in Fall Creek currently represent most of the wild fish in the Middle Fork Willamette subbasin (average of 72% in 2008–2016 and 98% in 2017–2019). Therefore they represent an important component in preventing the extinction of wild Chinook in this subbasin. Deep drawdowns have been used to pass fish during a relatively short window in the late fall. An extended period of deep drawdown would provide a longer window for juveniles to pass the dam. The Plaintiffs' measure to extend the deep drawdown would provide more opportunity for juvenile fish to passively migrate past the dam. The Corps proposes to trap and transport juvenile Chinook salmon (Measure 22). Provisions for passive fish passage should be a higher priority than constant human interventions such as trap-and-haul. Operating a trap through winter is unlikely to capture a significant number of fish because of low catch rates even with fish guidance measures, and high debris loads during rain events could result in high trap mortality. In Fall Creek,

[20] Summarized by Hansen, A.C., Kock, T. J, and Hansen, G.S. 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.

measures are needed to evaluate options for improving juvenile fish passage for all life histories such as a long drawdown into early winter and use of ROs in spring. Accordingly, the Plaintiffs' proposal to extend the deep drawdown and increase use of ROs in spring would provide opportunities to evaluate alternatives that allow for increased passive juvenile fish passage.

Monitoring and other measures

73. Research and monitoring should be increased to provide information that will be necessary to complete and implement the new BiOp and to assess population viability. Efforts to fill in data gaps and continue long-term monitoring of adult and juvenile fish should be conducted now instead of waiting for completion of the BiOp in order to help inform the BiOp and insure timely implementation of the new BiOp measures.

74. Spawning ground surveys for salmon and steelhead should be completed upstream and downstream of dams. In addition to redd counts, biological information should be collected to provide information relevant to each species: *Chinook salmon* – census counts of redds, pre-spawning mortality, hatchery:wild composition, and age and life history composition; *steelhead* – random and index counts of redds, genetic composition, age and life history composition.

75. Specific research and monitoring about outplanting and spawning success upstream of dams should be conducted to assess the following: a) mortality, redd distribution, overall spawning success relative to outplanting factors such as numbers released, sex ratio, timing and location of release; b) effect of outplanting factors on survival and distribution using radio tags in subset of release groups; c) spawning success of individual release groups using differently colored Floy tags for each release group; d) incubation and emergence timing using water temperature collected in spawning areas; e) fry and juvenile fish rearing using sampling techniques such as snorkeling and pole seines; f) fry and juvenile fish

movement into reservoirs (timing, length of fish, estimate numbers if possible) using rotary screw traps near head of reservoir and g) juvenile fish relative survival through reservoirs and arrival timing at dams.

76. A monitoring plan should be developed to track viability of salmon and steelhead populations using the established metrics of abundance/productivity, spatial structure, and diversity, and funding should be secured to insure long-term monitoring. These data can also be used to evaluate effectiveness of implementation measures on individual populations. A secondary plan should be developed to identify data gaps in various components of life-cycle models and establish RM&E to collect data for improving the quality of information used as inputs for the models. These models could be used to further evaluate the effectiveness of measures and to model potential outcomes of proposed measures in terms of growth, migration, survival, etc. at specific life stages.

77. Currently, data that can be used to assess viability or to improve life-cycle models are collected by individual agencies but gaps have occurred in recent years because of funding shortages. Therefore, these existing efforts should be supported and funded in the interim until a fully developed and funded long-term monitoring plan is implemented. Monitoring for tracking abundance of adult fish should be continued via video monitoring at dams in the North Santiam (Bennett dams) and McKenzie (Leaburg Dam) rivers. Implementation of video monitoring in the South Santiam (Lebanon Dam) has been delayed for several years and should be immediately completed. In addition, lack of funding or use of contractors to read and report counts has resulted in delays. Therefore, the Corps should provide adequate funding and assure immediate completion of monitoring equipment at Lebanon Dam, and provide funding for the reading and timely reporting of counts from video records. Surveys should continue upstream of these dams to provide quality assurance of

video counts (such as clipped:unclipped ratio of spring Chinook salmon and winter:summer steelhead ratios), and to collect biological data as previously noted.

78. Genetic analysis of steelhead should be conducted at Willamette Falls (adults and juveniles, if possible) and from steelhead collected on spawning grounds or in traps (e.g., Foster and Minto). Radio tracking studies should be conducted to assess migration timing, spatial distribution, and abundance of UWR winter steelhead returning to eastside and westside tributaries. Life history diversity and relative survival of juvenile Chinook salmon should be monitored. ODFW has conducted such research studies for over 15 years with established protocols to collect information on spatial distribution and in-stream movement, outmigration timing, growth, life history diversity, and relative survival, but work has been scaled back in recent years because of shortages in state and federal funds. Investment in PIT tag detection infrastructure at the PGE Sullivan Plant or other location near Willamette Falls would increase the accuracy of juvenile fish survival that could then be assessed relative to management actions affecting flow and water temperature. Similar studies should be undertaken on winter steelhead to collect data on life history diversity, spatial structure, abundance, and survival.

79. Additionally, RM&E should be designed and implemented to assess the effectiveness of the interim operational measures. Depending on the scope of the measures, controlled releases of surrogate fish should be considered upstream and downstream of the dams to fully evaluate effectiveness and long-term survival. Accordingly, in my professional opinion, Plaintiffs' measures that include RM&E and a technical advisory team to assess effectiveness of measures and to explore necessary structural changes for upstream and downstream passage are important to implement immediate actions and provide the necessary framework to develop long-term strategies.

80. One of the key shortcomings of the Corps' RM&E plan is its proposal in several measures (e.g., Measures 6-7, 15-17, 21) to compare capture of juvenile salmonids in rotary screw traps downstream of dams during these dam operations to trapping results during "normal operating conditions" in previous years. This approach is weak for several reasons: a) capture of juvenile fish in screw traps below dams is difficult to calibrate[21] because of fluctuations in flow and high velocity conditions, b) the Corps assumes data collected in the past can serve as a control against which to assess interim operational changes and neglects to account for variability in factors that affect trap catch and are unrelated to a particular dam operation (e.g., annual variability in flow and water temperature during normal operating conditions in the past), c) the proposed approach fails to account for differences in the spawning success of outplanted adults and subsequent survival and migration timing of juvenile fish (i.e., annual variability in number of juvenile fish arriving at the dam). The Plaintiffs' proposal provides for monitoring effectiveness of measures through use of a technical advisory team that would lead the design and implementation of RM&E studies and protocols. Depending on the scope of dam operations, controlled experimental releases could be implemented to assess the success or failure of flow operations in passing juvenile salmonids, and to determine site-specific and long-term survival of juvenile fish. Such experiments might include replicate groups of surrogate fish representing the general size of migrants present at the dams that would be PIT-tagged and released to assess operational changes. A control group could be released downstream of the dams (paired-release study) to assess long-term survival.

81. The Plaintiffs' measures for RM&E offer a more comprehensive approach to evaluating the effectiveness of operational changes than does that proposed by the Corps. The

[21] Trap efficiency is a metric used to estimate what proportion of the total number of fish passing the trap site are actually captured in the trap, without this information it is difficult to determine what the trap catch represents in terms of numbers of fish actually present in the river or other biases such as fish size.

Plaintiffs' measures include provisions for near-term planning of alternatives that would speed implementation of permanent passage and water quality solutions. In addition, the Plaintiffs' measures include monitoring and research to collect information on viability of the species that will be necessary for assessing the long-term effects of dam operations on the listed species and for completing and implementing the new BiOp. Finally, the inclusion of an independent technical advisory team in the Plaintiffs' measures would help to insure a scientifically-based and comprehensive approach to RM&E and development of alternative strategies needed for conservation and recovery.

Conclusion

82. Many of the interim measures proposed by the Corps represent relatively minor modifications to the current dam operations that have contributed to the ongoing harm to listed salmon and steelhead populations. Implementation of meaningful changes to achieve successful reintroduction of salmon and steelhead upstream of dams has been long-delayed and the Corps' proposed interim measures provide little assurance that progress will be made in the next few years to lower risks to the species or compensate for past harm. Most importantly, the proposed interim measures provide little assurance that progress will be achieved in providing downstream passage for juvenile salmonids at the dams or in improving water quality in critical habitat downstream of dams.

83. Although many of the measures proposed by the Corps state that they "will" take certain actions, language in the Limitations section makes it less clear that measures will be fully implemented without further delay. For instance, measures could be delayed while the Corps runs "risk and uncertainty analysis" if dam operations are not within the water control plan or the water control manual. With other measures, the Corps does not commit to fully funding RM&E or commit to action beyond minimum initial steps—"develop an initial RM&E plan" (Measure 8), "review of options" (Measure 11), "coordinate with Bonneville"

(Measure 12). The habitat Measures 1 and 2 contain perhaps the least committal language possible for an implementation plan: "create a solicitation with the goal of identifying a third-party sponsor to propose one or two projects..."

84. Given the Corps' history of delay, missed deadlines, and lack of progress with implementing RPAs of the 2008 BiOp, stronger and enforceable measures are needed immediately to remedy the ongoing harm that has occurred for years and will occur for several more years while NFMS prepares a new Biological Opinion.

85. Chinook salmon and steelhead have been at low levels of abundance for decades and have declined further since the 2008 BiOp, including recent declines to extremely low numbers of wild fish in some populations that are already considered to be at a very high risk of extinction. The condition of the populations make it imperative to implement immediate and substantial changes to dam operations to reduce the risks of extinction and to increase the probability of recovery. Without immediate and aggressive actions, populations may further decline from their already low levels of abundance jeopardizing the populations of wild fish and making recovery more difficult.

86. Wild salmon and steelhead populations have undergone periods of rapid decline in recent times, which illustrates the need to take immediate action. Although salmon and steelhead populations are inherently resilient because of factors such as their spatial distribution and diverse life histories, this capacity to persist is limited and becomes frayed when abundance is low and diversity is reduced. When populations continue at low levels of abundance for extended periods of time, unexpected events such as fires or poor ocean conditions could further reduce abundance to the point that populations may not be able to recover. Even if these populations recover, they may lose resilience because of simplified diversity or spatial distribution, making them less able to adapt to changing conditions or stochastic events.

87. Operational changes at the dams are needed to immediately provide more favorable conditions for juvenile fish passage, which could increase natural production, spatial structure, and life history diversity of populations. The Plaintiffs' measures draw on the best available information about passage effectiveness and survival at the UWR dams and can be quickly implemented under existing conditions. Measures such as deep drawdowns in fall, spring spill, and curtailment of power generation during prime migration hours would create more favorable conditions for juvenile fish passage at the dams. Immediate outplanting of adult fish above Green Peter and operations to assist juvenile passage there are critical steps to improve the perilously low populations in the South Santiam. In addition, the Plaintiffs' measures include RM&E to monitor population viability, assess interim measures, and study alternative operations or structural changes, which could be used to more quickly implement the new BiOp. Because the Corps' plan does not include these important actions, Plaintiffs' measures are much more likely to benefit UWR Chinook salmon and steelhead in the short-term and provide important information for long-term solutions.

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

Signed this 16 day of October, 2020 in Philomath, Oregon.

K. Schroeder

Kirk Schroeder

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