

DAVID H. BECKER (OSB # 081507)
Law Office of David H. Becker, LLC
917 SW Oak Street, Suite 409
Portland, OR 97205
(503) 388-9160
davebeckerlaw@gmail.com

Attorney for Plaintiff Native Fish Society

PETER M.K. FROST (OSB # 91184)
Western Environmental Law Center
1216 Lincoln Street
Eugene, OR 97401
Tel: (541) 359-3238
Fax: (541) 485-2457
frost@westernlaw.org

Attorney for Plaintiff McKenzie Flyfishers

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF OREGON
PORTLAND DIVISION

NATIVE FISH SOCIETY,
MCKENZIE FLYFISHERS,

Plaintiffs,

v.

Case No.: 3:12-cv-431-HA

DECLARATION OF
CHRISTOPHER A. FRISSELL, Ph.D.

NATIONAL MARINE FISHERIES
SERVICE, REBECCA BLANK, Acting
Secretary of Commerce, **WILLIAM STELLE,**
Regional Administrator, NMFS, **OREGON**
DEPARTMENT OF FISH & WILDLIFE,
ROY ELICKER, Director, ODFW,
BRUCE McINTOSH, Acting Fish
Division Administrator, ODFW, **CHRIS**
WHEATON, Northwest Region Manager,
ODFW,

Defendants.

I, Christopher A. Frissell, declare the following matters are personally known to me and to which I am competent to testify under penalty of perjury of the laws of the United States:

1. My current address is 39625 Highland Drive, Polson, MT. I have been retained by Plaintiffs to provide expert opinion testimony on salmon management, hatchery effects and recovery in this matter. This declaration supports the Plaintiffs' Motion for Preliminary Injunction.

PROFESSIONAL QUALIFICATIONS

2. I have 31 years of professional experience of field research and review of conservation planning and management with trout, salmon and steelhead in western North America. I held research faculty appointments at Oregon State University and the University of Montana Flathead Lake Biological Station for 14 years, for 12 years held the position of Senior Staff Scientist and later Director of Science and Conservation for a non profit conservation organization, the Pacific Rivers Council, and presently work as a fishery and watershed science consultant.

3. I received Bachelor of Arts (B.A.) degree in Zoology with High Honors at the University of Montana in 1982, and Master of Science (M.S) and doctoral (Ph.D.) degrees in Fishery Science from Oregon State University in 1986 and 1992, respectively.

4. In the course of my work, I have conducted and directed numerous observational field studies of salmon, steelhead and trout behavior in response to habitat features, both natural and man-made or man-influenced. I am familiar with the scientific literature on wild fish response to habitat, and the literature on how hatchery fish and hatchery operations, particularly

by way of behavioral and genetic alterations, but also by way of simple overwhelming numbers and artificially selected locations of release, can adversely affect naturally occurring fish and overall population dynamics. I have also spent considerable effort reviewing in detail ESA listing determinations and recovery plans for salmon and trout species, and in review of fishery management and conservation and species recovery programs by state and federal agencies. For example, in 1998-2000, I served as a member of the Northwest Power Planning Council Ecological Work Group, which developed the Multi-Species Framework as a template and for fishery and wildlife planning, including assessment of hatchery management options, in subbasins of the Columbia River Basin.

5. From about 2004 until 2010 as Senior Staff Scientist for the Pacific Rivers Council, I was deeply involved in scientific support for successful litigation of California's hatchery programs state-wide under the California Environmental Quality Act. This work required me to engage in comprehensive and ongoing review of the literature pertaining to all aspects of salmon and trout hatchery operations and their environmental impacts on naturally occurring fishes and other species, and it necessitated my review of numerous specific hatchery operations in California and how their impact on wild fish and other biota might be minimized or avoided.

6. I have published more than 30 articles in scientific journals and symposia proceedings, served as primary or co-author on twelve books or book chapters, and written more than 25 research reports concerning how salmon, trout, and other native species survive and prosper in freshwater ecosystems, and how management can be successfully shaped to protect and restore threatened and endangered trout and salmon species.

7. Attached hereto as Exhibit 1 are my curriculum vitae, which includes a list of all my peer reviewed publications.

8. I have not provided expert testimony at trial or deposition during the last four years.

9. My normal hourly rate is \$120 per hour and I worked 48 hours preparing this declaration.

MATERIAL REVIEWED IN PREPARING THIS STATEMENT

10. For the purpose of preparing this declaration, I reviewed the following documents: 1) NMFS, 28 September 2012, *ESA Section 7 Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat (EFH) Consultation* (hereafter referred to as BiOp); 2) NMFS 28 September 2012, Memorandum for Barry Thom from Robert Turner, *Hatchery and Genetic Management Plans submitted by Oregon Department of Fish and Wildlife for the artificial propagation of salmon and steelhead in the Sandy River, Oregon*; 3) Oregon Department of Fish and Wildlife's (ODFW) 31 May 2011 updated *Hatchery and Genetic Management Plans* for Spring Chinook, coho salmon, winter steelhead, and summer steelhead, as submitted to NMFS (hereafter referred to as HGMPs); 4) Zweifel, J.C., 2012, ODFW Sandy River Spring Chinook Stray Reduction Program report; 5) ODFW 31 December 2012 letter to Rich Turner (NMFS), Re Hatchery Genetic Management Plan Compliance Report 2012 – Sandy Fish Hatchery; 6) ODFW *Sandy Hatchery Operations Plan, 2013*; 7) Spring Chinook Surveys by USFS (undated memo); 8) Schroeder, K. (ODFW), *Sandy Basin Spring Chinook Spawning Surveys – 2010*; 9) Schroeder, K. and three others, 2011, *Sandy Basin Spring Chinook Spawning Surveys – 2011*; 10) Schroeder, K. and three others, Draft 31 December 2012, *Sandy Basin Spring Chinook Spawning Surveys – 2012*; 11) U.S. Forest Service (USFS) 2012

spring Chinook spawning survey data; 12) Oregon Department of Fish & Wildlife and NMFS, Lower Columbia River Conservation and Recovery Plan for Oregon Populations of Salmon and Steelhead – 2010; 13) Email from Todd Alsbury (ODFW) to Rich Turner (NMFS) dated June 25, 2012 regarding winter steelhead in Cedar Creek. I also consulted available published scientific literature for pertinent information on selected topics, some of the more directly important scientific sources are cited below. I am familiar with the Sandy River basin through several field trips since about 2005 to visit streams, rivers, and watershed restoration projects around the basin. In 2010-12 I worked as scientific contributor to the report “Protecting Freshwater Resources on Mt. Hood: Recommendations for Policy Changes,” prepared by the Pacific River Council.

CONSERVATION CONTEXT OF THE SANDY HATCHERY OPERATIONS

11. Because most directly affected species (three “ESUs” and a “DPS”) by the Sandy River Hatchery program--the Lower Columbia River Spring Chinook salmon, Lower Columbia River Coho salmon, Lower Columbia River Steelhead, and Columbia River Chum salmon--are all listed as threatened species under the U.S. Endangered Species Act, actions such as hatchery operations involving these species within their range should not “jeopardize the continued existence” of the species nor “adversely modify or destroy designated critical habitat” (BiOp p.17). To meet this standard, ODFW has implemented a range of measures to modify the way fish are taken reared, and released in Sandy River hatchery operations.

12. However, as nicely discussed in the BiOp (p. 42-50), our present scientific understanding underscores that even the optimum hatchery practices inherently result in some level of adverse effect to wild or naturally-occurring salmon and steelhead, spelling out that these effects span several categories (genetic alteration through destruction of mate selection

behavior and subsequent domestication selection, behavioral alteration, predation on or competition with wild fish, ancillary harm to wild fish from brood stock capture and other interventions, structures, or discharges, and other deleterious effects). These negative effects of hatchery fish on wild populations are well-documented in the scientific literature, including several studies cited in the BiOp.

13. Hatchery operations harm wild fish and their ability to recover natural populations. Within the first generation of their removal from the wild, hatchery fish have been reported to have a reproductive success rate that is only 60% to 80% of the reproductive success of wild fish (Araki et. al. 2008) and display characteristics of adaptation to captivity that make them significantly less suited for survival in the wild (Christie et. al. 2011). Accordingly, hatchery operations pose genetic threats to wild salmon and steelhead. When hatchery fish spawn with wild fish, the resulting offspring are less fit to survive and reproduce in the wild than fish which are wholly wild. Genetic threats include those caused by introgression of genetic material from hatchery fish into the native population through interbreeding, which leads to loss of reproductive fitness and loss of the genetic diversity in the wild fish population. Deleterious genetic changes can occur within the first generation (Christie et al. 2011) or over several generations of hatchery breeding and rearing (Reisenbichler and McIntyre 1977; Chandler and Bjornn 1988; Reisenbichler and Rubin 1999, Araki et al. 2007, Araki et al. 2008). Emlen's (1991) modeling of a hypothetical salmon population scenario and showed that with 5% interbreeding of hatchery salmon in a natural population, deleterious genetic changes can reduce fitness in the resulting offspring, and recovery from even a single episode of interbreeding may take many generations.

14. The presence of hatchery fish also poses ecological risks to wild fish, including competition with wild juvenile fish for local food resources and rearing space, competition with

wild adults for spawning territory, predation of hatchery fish on wild fish, and delaying the migration of returning wild adults and causing them to spawn prematurely downstream of artificial barriers. The release of hatchery raised fish and operation of artificial barriers to migration cause significant disruptions to the rearing, feeding, sheltering, and spawning behavioral patterns of wild fish and create the likelihood of injury or death to wild fish. The release of hatchery fish also poses a risk of introducing disease and parasites into the wild fish population. The combined effects of this slate of adverse ecological, behavioral physiological and genetic effects of exposure of wild to hatchery fish can be major observed declines in fitness and survival in the wild (e.g., Christie et al. 2012, Kostow and Zhou 2006, Chilcote 2003).

15. In some instances, fishery managers deem hatchery populations to be necessary to support or recover a dwindling listed population or ESU. Therefore the necessary rational context for consideration of a hatchery program for recovery of a listed species is to carefully account for and weigh the relative expected benefits against its known or likely adverse genetic, behavioral, and ecological effects.

16. Thus, the question naturally arises whether the Sandy Hatchery operations themselves contribute in any way to the recovery of threatened and endangered fishes in the Sandy River system. ODFW does not explicitly claim benefit to listed Sandy River salmon and steelhead from its hatchery stocks. Recovery goals are described in the BiOp for Sandy River spring Chinook salmon, Coho, and winter steelhead. In each case, the Sandy Hatchery program is not affirmed as necessary or contributory to recovery, and, except for coho, hatchery practices were identified as threats or “limiting factors” to recovery (BiOp, p. 25-26, and 33). The BiOp (see Table 8, p. 51, and following) identifies the potential “safety net” benefit of broodstock collection, and the potential benefit of supplementing spawning numbers for severely depleted natural

populations as the sole beneficial uses of hatchery programs. While the BiOp speculates there could be a potential future need to supplement wild winter steelhead in the Sandy, nowhere is this identified as an imminent conservation need. To the contrary, recovery planning has identified the potential for each of these listed populations to recovery if hatchery programs and other threats are removed or alleviated.

17. Therefore, while the Sandy hatchery program overall is being modified in ways that the ODF claims will supposedly “minimize” harmful effects—but in fact only reduces them relative to past levels that were deemed more threatening—and NMFS in the BiOp has projected that harmful effects should likely be small, it remains inescapable *there is no offsetting benefit identified that justifies the ongoing hatchery program as a conservation need*. Instead of considering whether the hatchery program is justified at all in the context of recovery needs of the species, the HGMPs and BiOp simply focus on reducing harmful actions. The Sandy hatchery program, therefore, benefits not Sandy River salmon, but two other groups: 1) those legally responsible for numerically mitigating for fish lost from historically blocked habitat in Bull Run watershed (and other effective, non-hatchery options would be available for this purpose, such as watershed restoration actions), and 2) those who participate in sport fishing opportunity for anglers (for whom fishing opportunities would also be available on wild fish if they were successfully restored).

18. The Sandy Hatchery programs continue to operate at the expense of risk or threat to naturally occurring salmon and steelhead populations in the Sandy River and its tributaries. In my opinion, a more informative, rational, and likely effective analysis and BiOp would consider a baseline recovery scenario as one without a hatchery program in the Sandy River Basin, and would then consider incremental introduction of the proposed hatchery actions against the increment of

harm (or risk of harm) to listed fish and their habitat that they introduce. I believe this form of analysis and disclosure would likely lead to a differently configured and scaled hatchery program—and a somewhat different and more effective set of reforms and practices to protect wild fish—than those now proposed.

19. The Sandy River and its tributaries offer an important opportunity for the recovery of wild fish populations that will contribute to the recovery of the ESUs and DPS to which they belong. The basin contains a significant amount of accessible habitat for all stages of salmonid life cycles including significant areas of high quality habitat, has had two dams that limited access to spawning habitat removed in the last five years, has a major habitat conservation plan in place to mitigate for blocked habitat in the Bull Run watershed, has newly-opened passage to steelhead and coho spawning habitat in Cedar Creek upstream of the Hatchery, and has access to the ocean that is not impeded by a dam on the Columbia River. Yet the wild fish populations in the basin do not yet show clear and consistent signs of recovery. In my opinion, the evidence suggests that operation of the Sandy Hatchery is at present a major limiting factor preventing the recovery of these wild fish populations.

STRAY RATES OF HATCHERY FISH

20. With actions taken to somewhat reduce the total numbers (to 200,000 spring chinook and 300,000 coho), increase the rearing to maturity, implement acclimation ponds, and alter the locations of spring Chinook smolts stocked by the hatchery program, ODFW hopes to reduce future stray rates of hatchery-origin returning adults into wild-spawning populations below the target of 10 percent hatchery fish. Despite these actions, the large number of smolts stocked in the Sandy River (relative to naturally occurring spring Chinook smolt populations) are likely to still result in large numbers of stray hatchery fish throughout the river system in the future. The

BiOp (p. 44-45) presents an excellent overview of the scientific literature on the factors known to influence the incidence straying of hatchery-origin salmon, stating that “One goal for hatchery programs should be to ensure that hatchery practices do not lead to higher rates of genetic exchange with fish from natural populations that would occur naturally.” Rearing and release practices, and ancestral origin are identified as playing a role in straying, and in reduced homing tendency by hatchery fish, based on past studies.

21. However, one of the likely contributing causes to increased straying is the transfer of young fish across geographical locations during their hatchery lives, where they are exposed to different water supplies and other environments than their hatchery of origin. Experimental studies show the developing physiological and behavioral imprinting that affects later homing behavior of salmon and trout could be markedly influenced by such transfers. Because of rearing capacity limitations at Sandy Hatchery, spring Chinook are trucked from that location to hatcheries in two other basins for extended rearing before they are returned to the Sandy for final acclimation and release. In my opinion, unless this transport of hatchery fish from hatchery to hatchery and across drainage basins is curtailed, then ODFW has not taken all necessary and prudent measures to reduce harm from straying of hatchery Chinook salmon into natural populations. The problem, of course, is that ODFW would presumably have to greatly reduce the total number of hatchery smolts it rears and releases in the Sandy if it could not exploit these out-of-basin rearing facilities. However, since both reducing the number reducing the transport of hatchery salmon should reduce straying, this would seem to be a prudent choice, if the goal is truly to “minimize” impact to wild salmon. In the quest to maintain large numbers of released smolts, ODFW has chosen to ignore reasonable and prudent measures that would further mitigate the impact of the hatchery program on wild fish. I could find no discussion of the implications of

Sandy hatchery fish transport to out-of-basin rearing facilities in the BiOp, despite the recognized importance attached to reduced stray rates.

22. ODFW's own staff recommended at least twice (Schroeder 2010, 2011) that numbers of spring Chinook smolts stocked be reduced in order to bring down future hatchery fish stray rates on the spawning grounds. The Schroeder 2010 report (p.1), ODFW's primary internal report on the numbers and incidence of hatchery fish in Sandy Basin spring Chinook populations for that year, states that previous attempts to reduce hatchery Chinook migration into the Upper Sandy system by releasing hatchery smolts into the lower Sandy River "...appear to have been ineffective in reducing numbers of hatchery fish migrating into the upper basin." Schroeder (2010, p. 1) further concluded that "Immediate actions should be taken to reduce the number and proportion of hatchery Chinook in the upper Sandy Basin...Finally, reductions in the hatchery program should be seriously considered (at least in the short-term) until other measures have proven effective in reducing the number and percentage of hatchery-origin Chinook in the spawning population." After a additional year of data showing that stray hatchery Chinook greatly out-numbered wild spawners in the upper basin, Schroeder and his colleagues (2011, p. 3) reiterated, "Because the effectiveness of alternative release will not be known until the adults return 4-5 years later, reductions in the hatchery program should be seriously considered (at least in the short-term) until other measures have proven effective in reducing the number and percentage of hatchery-origin Chinook in the spawning population."

23. ODFW has agreed to implement additional rearing and release measures that the agency hopes might reduce straying further, but I understand that ODFW has also decided to voluntarily to reduce the number of hatchery spring chinook (from the NMFS-authorized level of 300,000 to 200,000) and coho (from 500,000 to 300,000) released into the Sandy River in 2013.

What I do not understand is this: If reduction of smolt releases is a necessary and prudent measure to protect wild fish—as the data seem to confirm—why was this not considered and recommended, indeed required, by NMFS as a condition of permitting the hatchery program?

24. A simple analysis is enough to suggest that even with ODFW's planned "voluntary" 25% reduction in releases of hatchery spring Chinook smolts, it is likely that it will not be possible to attain ODFW's (and NMFS's sanctioned) goal of 10% or less hatchery stray incidence in spawning areas. If we assume that modified rearing measures might reduce the pre-trap incidence of straying hatchery Chinook into the Upper Sandy from the present 60-70% to nearer 50% of the prevailing average total return, a 33% reduction in the total number of Chinook smolts released is most likely to produce a roughly proportional one-third reduction in those strays, producing a total stray rate in the neighborhood of 30-40% into the Upper Sandy. If we very generously assume that perfected weirs and traps can reduce that figure by another 50%, that could result in an incidence of hatchery strays of roughly 14-20 percent of total Chinook returns to the upper Sandy Basin. A few further simple trial-and-error calculations suggest that on average, cutting Chinook smolt releases from their authorized 300,000 to the range of 75,000 to 100,000 (25-30% of recent releases) or less—in tandem with significant reductions from altered rearing strategies, and greatly improved trapping efficiency—is probably necessary to achieve a stray rate of 10% or less. This assumes no major increase in the total population of wild fish or decrease in the survival rate to return of hatchery fish, as well as the generous assumptions stated about rearing strategy and weir effectiveness.

25. I note that shortly after I made the rough calculations and drew the conclusions reported in the preceding paragraph, I received the draft report by Schroeder et al. (2012) which estimated (p. 5) that with weirs running for several months in 2012 as planned, 25-30% of the

spawning spring Chinook salmon in the upper Sandy basin spawning population were of hatchery origin. This is a bit higher than I estimated above, but the potential effects of altered rearing and release regimes have not yet kicked in. However, of more consequence is that 2012 was a year of substantially increased wild returns compared to 2011, while the return of hatchery fish declined (Schroeder et al 2012, p. 5, Fig. 3); because hatchery and wild runs within the same basin commonly have disparate survival rates like this in the a given brood year, these vagaries can considerably affect the percentage of wild fish in the run. Had hatchery and wild returns been nearer the average levels of recent years (returns always vary and seldom fall on the average), the observed incidence of hatchery strays in spawning areas would likely have been dramatically higher than the observed percentage—and much higher than my generous estimates above.

26. Because reported stray rates have ranged up to the extraordinarily high levels over the last several years (45-77% in 2008-2011, reported in Schroeder et al. 2012), because of the likely ineffectiveness of slate of mitigation measures in preventing adverse interaction between hatchery fish and wild fish, and also because in my opinion the scientific literature indicates harm to wild fish could occur at stray rates well less than ODFW's stated goal of 10 percent, continued and potential long-lasting harm to wild fish and is likely to continue unless the release of hatchery fish is halted until ODFW can demonstrate that its mitigation can be successful. The only other options for attaining the ten percent goal rely on gains from rearing and trapping measures. (In my opinion, the expectation of such extraordinary gains from "tweaking" salmon rearing and trapping regimes are likely not reasonable, based on literature values from controlled experiments, geography of the river and past migration patterns of returning hatchery salmon in the Sandy system, and other considerations.) While it is always possible to ignore an opportunity for logical

analysis by presuming that everything is too complicated for any analysis to suffice, it is not at all clear from the record why NMFS did not choose to conduct—or if it did, did not choose to disclose—some kind of simple and reasoned calculus informed with directly relevant, existing basin-specific data (data which were collected by ODFW for just this purpose) to inform its decision. Halting large-scale hatchery releases appears to be a biologically prudent and justified measure for protecting Sandy River salmon and steelhead, and fostering their recovery in the wild.

WEIRS AND THEIR EFFECTIVENESS

27. To reduce hatchery spring Chinook straying into certain tributaries, ODFW has installed seasonal weirs, or constructed barriers that at least partially block upstream migration of adult salmon during the June through September migratory period. Blocked salmon that try to pass the weir are funneled into a trapping device. Hatchery-origin salmon, recognized by fin clips, are removed from the trap, while wild salmon are released above the weir to spawn upstream. While weirs were invoked in part because adult salmon returning for the next few years were not reared under the modified conditions of the new HGMPs, they also may be needed into the future because ODFW has chosen not to invoke the measures identified above to further reduce the propensity of hatchery fish to stray—namely reducing numbers of released smolts and curtailing out-of-basin transportation and rearing.

28. While some of the unintended adverse effects of weirs on fish were discussed in the BiOp (discussed in the next section of this declaration), the effectiveness of weirs for the purpose of screening fish was not given more than cursory mention. NMFS simply stated that weirs are known to be useful and effective when appropriately applied, with the caveat there can be a “steep learning curve” associated with their maintenance and design. My students and I

have built several weirs and fish traps in research projects, and in my career I have visited and spoken with field and supervisory at many other weirs similar to those prescribed for the Sandy (most recently in 2012 to view a state-of-art fish weir constructed to trap Chinook and other salmon in the Hoh River, Washington). It is well-recognized that even the most expensive and elaborate weirs are variably effective at stopping fish, depending on the nature of the location where they are installed, appropriateness of design to the site, behavior of the fish in the locality of the weir, and variability of weather and water conditions, and other unexpected natural events or man-caused accidents. Equally important in this application, weirs must not only effectively act as barriers to hatchery fish, but they must effectively trap and retain them for removal, while also safely trapping wild fish to allow their release upstream.

29. While I will discuss some of the potential adverse effects of weirs on fish in the wild below, I first want to turn to the question of their effectiveness. Namely, few weirs are anywhere near 100 percent effective at stopping and trapping fish; some are more effective at stopping fish, but less effective at trapping them (because fish may behaviorally shy away from the weir altogether or avoid entering the trap location itself). Maintaining a single weir and trap on a salmon stream is a costly and time-intensive proposition; maintaining a flotilla of them is decidedly daunting. Even in the best circumstances, most weirs are only partially effective at stopping fish. Conditions occur when the weir partially fails and fish are able to find and pass through gaps. For example, a slight increase in stream flow during a storm can, at certain locations, result in a large increase in flow velocity, and the mesh size of the weir screens may be insufficient to pass the flow; the barrier is then overtopped (or, per some designs, automatically retracts upward) and fish are able to pass. Variations in streamflow can also cause traps to malfunction (Zweifel 2012 points out the sensitivity of the traps, or *fykes*, to variations in current

velocity, with fish able to easily escape at lower flow rates). Floating debris is an omnipresent problem. In the fall, screen mesh may be compromised by infilling with autumn leaves; unless cleaned, sometimes several times daily, flow stress on the structure greatly increases, and a breach can easily form, allowing fish to pass. In other cases, trees or large branches falling during windstorms—surprisingly common in forest settings—can damage and breach a weir. Bears and other mammals often tamper with traps, which can sometimes result in either injury to, or inadvertent release and passage of trapped fish. Even at remote locations vandals are a constant threat, unless structures are attended 24 hours a day. Finally, the digging activity of salmon themselves can undermine the barrier, as ODFW reported happened to its Cedar Creek trap near Sandy hatchery in 2012, resulting in passage of numerous hatchery salmon above the weir (Zweifel 2012). While there are design and maintenance measures that can reduce the risks of each of these problems, over the course of a season, to my knowledge, few weirs will not experience one or more episodes resulting in at least a partial breach. Fish that hold below a weir for days or weeks, avoiding the structure and its trap, will often seize such an opportunity to pass.

30. Not surprisingly, therefore, Schroeder and colleagues (2011, p. 3) reported that weir-trap arrays placed for a month in the lower Salmon River and lower Zigzag River in the upper Sandy during the 2011 season, coupled with removal of all fin clipped fish trapped, only marginally reduced the incidence of hatchery-origin spawners in Salmon river (from an estimated 73% hatchery fish without trapping to 62% with trapping) and ZigZag River (from an estimated 71% without trapping to 53% with trapping). In other words, in its first year, trapping reduced hatchery fish entry in to the upper reaches of Salmon River and ZigZag River by 15% and 25%, respectively. I've seen no evidence these ODFW estimates of trapping effectiveness

were considered by NMFS in its analysis and decision, even though that decision rests largely on weirs and traps to reduce hatchery fish straying, and these are among the few direct data available. Extending the season of weir and trapping to 3 or 4 months will certainly improve their effectiveness for hatchery fish removal, but by how much is not discussed by ODFW or NMFS. The need to pull weirs because of increased streamflows and returning wild coho salmon (see below) in the fall results in an annual opportunity for hatchery Chinook holding downstream of the weirs to freely migrate into upper areas.

ADVERSE EFFECT OF WEIRS ON WILD FISH

31. While they have beneficial uses, fish weirs and traps pose a wide variety of risks to both target species and other species that may be inadvertently affected. Weirs are a temporary but significant alteration of habitat; their known adverse effects on salmon and steelhead are listed in the BiOp (p. 50). They include: 1) delayed upstream migration (and inhibited downstream migration); 2) behavioral aversion to the weir resulting in “forced” or premature spawning downstream of the structure where egg-laying conditions may be unfavorable (such accumulations of fish are also visible and vulnerable to predators and human poachers); 3) “fallback,” or the known but poorly understood behavioral tendency of some fish, once they do pass a weir or trap, to return back downstream through it and be captured and handled multiple times; 4) direct injury or mortality of fish that attempt to jump or otherwise pass through the barrier; 5) injury and stress to fish held in the close confines of the trap itself; 6) injury or stress that occurs when fish are held for extended periods of hours or days; 7) injury and stress to fish retrieved or netted within the trap and handled for identification and release, tissue sampling, or other biological sampling; 8) post-handling, stress-induced disorientation or exhaustion after release that makes the fish vulnerable to downstream displacement (hence

passive “fallback“ or possible injury if pinned against the weir) and predation or poaching. The BiOp (p.50) also briefly mentions a list of possible actions to remediate these effects, including personnel training, debris removal, guards posted against poaching, and frequent sampling to reduce the holding time of trapped fish. A wide range of other measures are commonly necessary too, before weirs become functional and “tuned” to reduce their most acute side effects. For example, Zweifel (2012) mentioned the need to altering the Sandy weir designs in 2011 to increase velocity of flow through traps and prevent fish from escaping traps (an abortive form of fallback), and also mentions the need to relocate a weir when the initial site selection proved unworkable.

32. After identifying these several sources of injury that are endemic to weirs and traps, and recognizing that the operation of multiple weirs simultaneously affecting a large proportion of the naturally spawning populations of listed salmon and steelhead in the Sandy Basin, NMFS the BiOp (p. 57) summarily dismisses these concerns with the statements that “BMPs will be used to operate the weirs and handle fish,” and that “weir technology has improved greatly over the previous couple of decades” and is now “widely applied.” Moreover, the BiOp (p.57) further mentions that surveying spring Chinook salmon above and below the weirs by ODFW will allow them to monitor weir effects. No mention is made of how monitoring will establish that juvenile and adult coho and juvenile winter steelhead are not impacted by the weirs (with the exception that weirs will be removed when the first returning coho are caught in the traps; because this date typically overlaps with the spring Chinook migration in the fall, this measure is a critical factor that limits the possible effectiveness of weirs in removal of hatchery spring Chinook—see above discussion of potential weir effectiveness).

33. Any single weir and trap intrinsically poses a range of possible side effects, and

these adverse effects—as well as the feasibility of mitigating them—must be carefully weighed against the benefit gained by weir and trap operation. Through manpower-intensive and constant effort, adverse effects can be reduced, but seldom or never to a level that can be arbitrarily deemed insignificant or negligible. Tradeoffs between desired and possible undesired effects should be very carefully evaluated. The risk that adverse effects outweigh beneficial effects grows as the number of weirs and traps increases, the habitat area and number of fish affected by them increases, and the duration of time they spend in the stream increases. The Sandy basin weir and trap array is one of the most extensive examples of I have heard of; the duration of trapping not only extends over many months within a year, but presumably will extend for many years—permanently or indefinitely. Because hatchery fish stray in large numbers to all quarters of the basin, numerous weir sites are needed.

34. I examined preliminary numbers from spawning surveys above and below Sandy Basin weirs in 2011 and 2012 and related information from ODFW (Zweifel 2012, Schroeder and colleagues 2011, Schroeder and colleagues 2012) and the Forest Service (USFS 2012). These sources provided some empirical evidence that adverse effects have been occurring; these include behavioral avoidance resulting in concentrations of hatchery and wild Chinook salmon below weirs, corresponding evident depletion of wild fish numbers above weirs, and likely forced spawning and probably increased interbreeding of wild and hatchery fish in the artificial aggregations of fish below the weir sites. For example, Schroeder and colleagues (2011, p.3), evaluating two weirs placed for one month in 2011, stated “Possible effects of traps on Chinook were suggested by distribution of redds,” and concluded that “Altered distribution of spawning Chinook could be caused by delay in upstream migration or reluctance of fish to enter traps resulting in displacement of fish to areas downstream of the traps or to other tributaries.” The

USFS (2012) data strongly suggest that similar behavioral avoidance and displacement effects occurred in the more prolonged and extensive deployment of weirs and traps during the 2012 season, and preliminary ODFW data reported in Schroeder et al. (2012) show a similar (but somewhat less pronounced) pattern. ODFW's preliminary data (Schroeder et al. 2012) do not allow direct quantitative assessment of changes in associated with weirs because pre-2011 survey sections did not correspond to present weir locations. In my opinion, harmful effects of the nature reported above are endemic to weir and trap operations, and while they might be marginally reduced, they are likely to continue to occur into the foreseeable future.

35. For the reasons stated above, in my opinion NMFS' rather summary dismissal of side effects of an extensive, long-duration weir-and-trapping program is shoddy and not defensible. The trade off in the Sandy case is potential genetic integrity benefit from reduced numbers of hatchery fish spawning with wild fish above the weir locations, weighed against the potential impact of genetic integrity of increased numbers and interbreeding of wild and hatchery fish below the weir locations, as well as potential behavioral alteration and injury to wild fish that encounter and must pass through the weirs and traps to return to natal spawning areas. With such a balance of potential benefits and harms at stake, measurable performance criteria should be established to determine when undesired side effects are acceptable, and when they may exceed the potential benefits. Ensuring these adverse effects don't approach or exceed "acceptable" levels is equally critical to the well-being and recovery of wild salmon and steelhead in the Sandy Basin as is ensuring the desired beneficial effect is actually attained.

36. In the case of the Sandy, only a single formal criterion was established by ODFW and NMFS to determine "success" of the weirs—the reduction of hatchery spring Chinook to less than 10 percent of spring Chinook in spawning areas above the weirs. In the Incidental Take

Statement, (BiOp page 67) NMFS imposed a single criterion for acceptable harm, that being "any change greater than 20 percent in spawning distribution above and below the weir and in pre-spawning mortality from what was measured during previous spawning ground surveys prior to the installation and operation of the weirs in 2011" NMFS's choice of this criterion for "take" associated with weirs and traps is not explained or reasoned relative to presumed biological benefit or net benefits to wild fish. In fact no rationale is provided. Moreover, it is unclear how the numerical standard is to be applied. Is it violated by a single date showing distortion of spawning distribution of this magnitude at one weir? Or does it need to be shown as an average across all weirs? Or does it apply to all observations aggregated over the entire migration period? Further, Schroeder et al. (2012) pointed out that pre-2011 observations of fish and redds were compiled at stream section break that do not correspond to present weir locations, complicating any comparison across years (especially given that much of the observed distortion will likely occur in close proximity to the weirs). Moreover, does the language mean that *both* distortion of spawning distributions and an increase in pre-spawning mortality of the stated magnitude are necessary, or is one or the other sufficient to trigger a violation? Pre-spawning mortality is normally a highly variable factor, with observations dependent on vagaries of weather, streamflow, predators, scavengers, human egg poachers, and particular day of the survey. While a 20 percent increase in pre-spawning mortality is certainly a biologically significant harm, it may be very difficult to measure consistently in the field. In my view, the lack of precision and rigor in stating the terms of evaluation and their biological basis means that it could be very difficult for ODFW or NMFS to assess and substantiate whether the actions are in compliance.

37. In my opinion, in view of the intrinsic tradeoffs and limitations recognized above,

even an extraordinarily well-funded and ideally executed system of weirs and traps could probably not reduce the occurrence of hatchery fish to less than 10 percent basin wide without risking undue and offsetting harm to wild fish in the Sandy Basin. Even if such were achieved above weir locations, only that limited part of the river system above the weirs would receive the benefits of reduced hatchery fish occurrence. In my opinion a weir and trap program, therefore, is little more than a partially successful remedial measure that fails to compensate for the causal threat: that is, the release of inordinately large numbers of hatchery fish in ODFW's Sandy River management program. And, in my opinion considering the data reported (cited above) on weir-associated fish distributions which indicate distortions in the distribution of wild and un-trapped hatchery fish, it is highly likely that the 2012 operations of the weir have caused harm to wild fish. As stated above, because many of the effects are intrinsic to weirs and traps and difficult or impossible to do away with even with an extremely well-executed large-scale program, it appears most likely that these effects will continue at some level that causes harm to wild fish in future years.

INADEQUATE MONITORING OF STEELHEAD AND COHO

38. I note that while the BiOp and ODFW's hatchery management and monitoring plans provide much useful information about spring Chinook salmon, they acknowledge severe limitations in data for the other listed species. In particular, numbers of winter steelhead appear to be small and they are greatly outnumbered by hatchery-origin fish, but the BiOp and ODFW identify no monitoring program or performance criteria sufficient to resolve, track, and ensure a remedy for this situation. While wild coho appear to be increasing in number in the Sandy, ODFW and NMFS identify no clear performance measures or biological criteria against which to gauge coho population status and well-being against threats from massive hatchery fish releases

and ancillary operations needed to manage hatchery fish in the Sandy system. In my opinion it is both feasible and necessary to develop such basin-specific performance measures and criteria if the promised but utterly undefined commitment to “monitoring” by ODFW is to have any assurance of protection and recovery of listed salmon and steelhead.

39. It appears the decision to permit hatchery stocking of steelhead in the Sandy was based on shockingly little information on current steelhead stray rates. This seems hard to justify considering that much of literature demonstrating harm to wild fish fitness, productivity or survival from interbreeding and otherwise interacting with hatchery fish in the wild is derived from studies of steelhead populations in nearby Columbia River tributaries (e.g., Kostow and Zhou 2006 in the Clackamas River, Araki 2007 and Christie et al. 2012 in the Hood River). I note that though recent data are scarce, the ODFW’s Recovery Plan (2010, Tables 4-8 and 6-31) reported stray rates of 52% for winter steelhead in the Sandy River (though a conflicting and unattributed statement in the same source [p.196] suggests unspecified actions have reduced the rate to less than then 10%). Secondly, in 2012 ODFW allowed wild and hatchery fish to spawn together upstream of the Hatchery in Cedar Creek, apparently with a proportion of 90% hatchery fish passing the upstream to the spawning area (Todd Alsbury ODFW 6/25/12 email to Rich Turner, ODFW). These levels of hatchery-wild fish interaction would almost certainly harm winter steelhead in the same manner as I have described previously in this declaration. Given that the Sandy Hatchery is not sorting wild and hatchery fish except at the hatchery itself and plans to continue to mix wild and hatchery steelhead in Cedar Creek, there is evidence to suggest that adverse effects from hatchery steelhead to wild winter steelhead will continue to occur.

//

//

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

DATED this 19th day of February 2013.

s/ Christopher A. Frissell

Christopher A. Frissell

LITERATURE CITED

- Araki, H., B.A. Berejikian, M.J. Ford, and M.S. Blouin. 2008. Fitness of hatchery-reared salmonids in the wild. *Evolutionary Applications* 2008 May; 1(2):342–355.
- Araki, H., B. Cooper, and M.S. Blouin. 2007. Genetic Effects of Captive Breeding Cause a Rapid, Cumulative Fitness Decline in the Wild. *Science* 318:100-103.
- Chilcote, M. W. 2003. Relationship between natural productivity and the frequency of wild fish in mixed spawning populations of wild and hatchery steelhead (*Oncorhynchus mykiss*). *Canadian Journal of Fisheries and Aquatic Sciences* 60:1057–1067.
- Chandler, G.L., Bjornn, T.C., 1988. Abundance, growth, and interactions of juvenile steelhead relative to time of emergence. *Transactions of the American Fisheries Society* 117:432–443.
- Christie M.R., M.L. Marine, R.A. French, R.S. Waples, and M.S. Blouin. 2012. Effective size of a wild salmonid population is greatly reduced by hatchery supplementation. *Heredity* 109, 254-260.
- Christie M.R., M.L. Marine, R.A. French, and M.S. Blouin (2012) Genetic adaptation to captivity can occur in a single generation. *Proceedings of the National Academy of Sciences, USA* 109:238-242.
- Emlen, R. 1991. Heterosis and outbreeding depression: a multi-locus model and an application to salmon production. *Fisheries Research* 12:187–212.
- Kostow, K.E., and S. Zhou. 2006. The Effect of an Introduced Summer Steelhead Hatchery Stock on the Productivity of a Wild Winter Steelhead Population. *Transactions of the American Fisheries Society* 135:825–841.
- Reisenbichler, R.R., Rubin, S.P. 1999. Genetic changes from artificial propagation of Pacific salmon affect the productivity and viability of supplemented populations. *ICES Journal of Marine Sciences* 56:459–466.
- Reisenbichler, R.R., McIntyre, J.D. 1977. Genetic differences in growth and survival of juvenile hatchery and wild steelhead trout, *Salmo gairdneri*. *Journal of the Fisheries Research Board of Canada* 34:123–128.