DRAFT

The Effect of Fish Traps and Hatchery Supplementation on Salmon Recovery in the Methow Basin

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Introduction

Douglas County PUD has recently put a major fish dam ("weir") and fish trap across the Twisp River. They have also undertaken many of the steps to put a similar fish dam and trap across the Chewuch River. Smolt (juvenile fish) traps have been placed at various locations across the watershed. The fish traps are part of a hatchery-based "supplementation" program for spring Chinook salmon (*Oncorhynchus tshawytscha,* a federally endangered species).

The fish traps block the river to passage for all fish. Options for up river movement of fish are restricted by the operators of the fish traps. These "weir watchers" must open the trap to allow for individual fish movement. Beaver, otter and mink which inhabit the rivers will also have their movement impeded by the fish traps. This will be a total barrier from shore to shore and from riverbed to above river surface. An illustration of the proposed Douglas County PUD Chewuch River Fish Trap is shown in Figures 1-3 below.

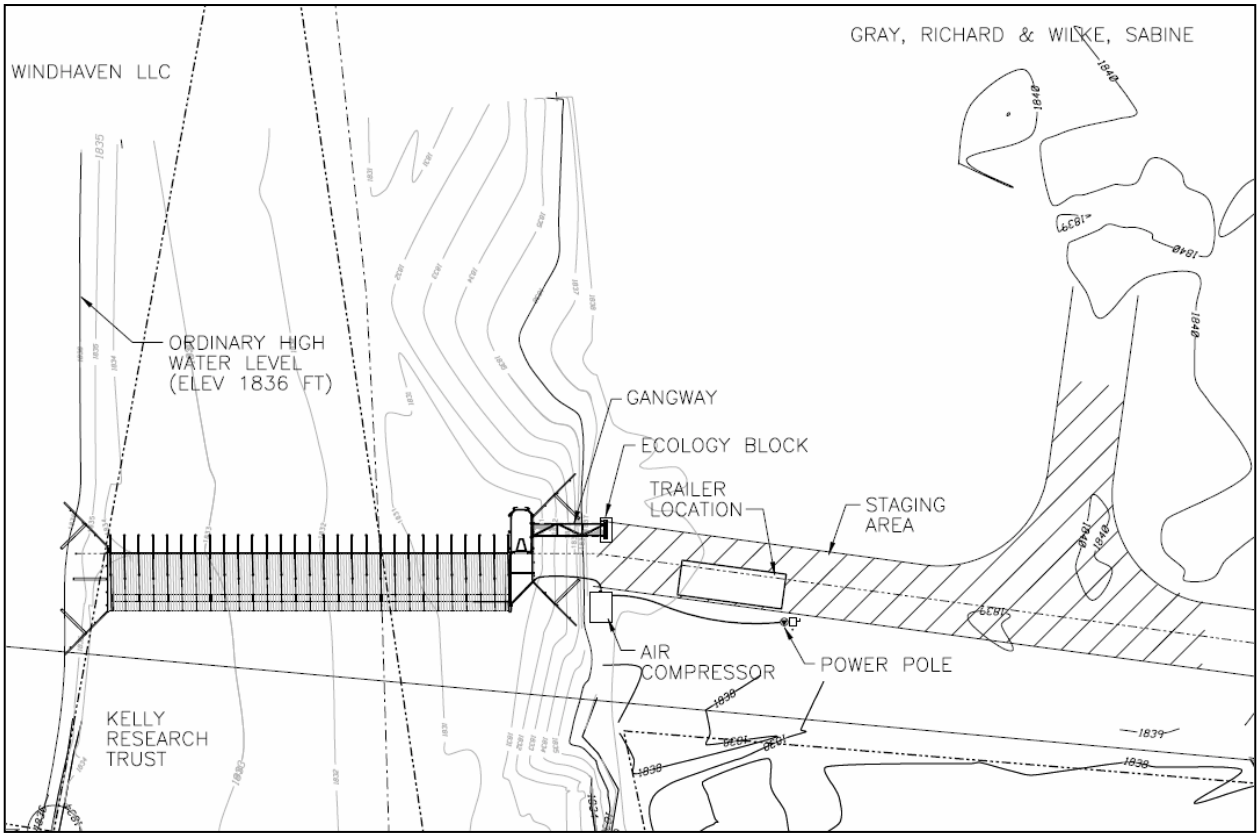

Figure 1. Proposed Chewuch Fish Trap – Plan View (Source: Douglas County PUD)

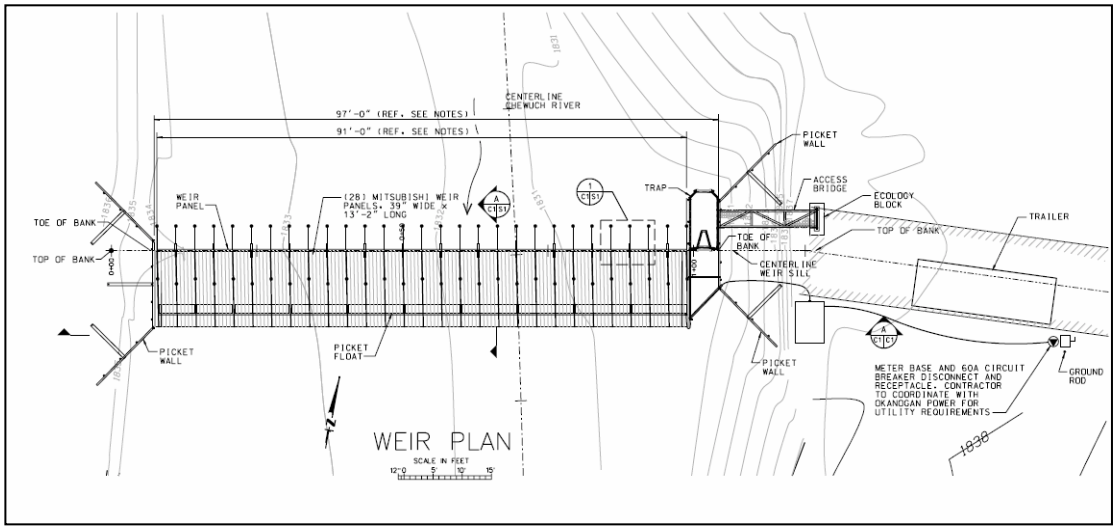

Figure 2. Proposed Chewuch Fish Trap – Detail Plan, (Source: Douglas County PUD)

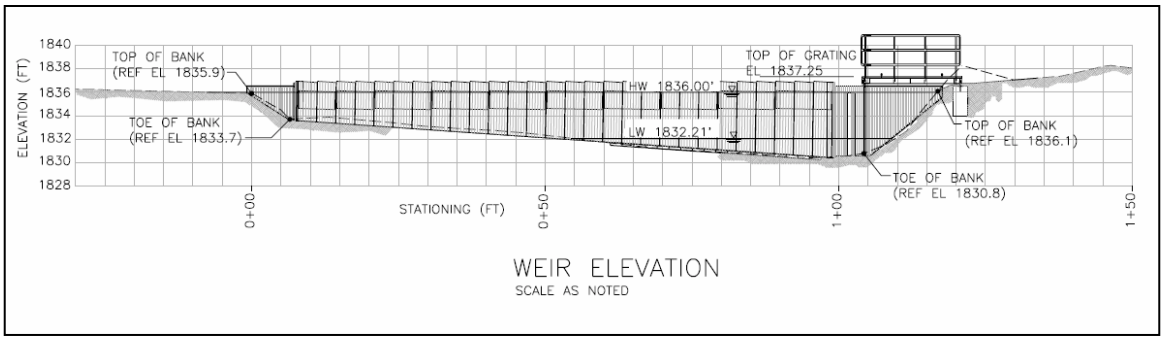

Figure 3. Proposed Chewuch Fish Trap – Elevation View, (Source: Douglas County PUD)

The fish traps will be used to catch and collect mature adult spring Chinook salmon. These fish are later killed and their eggs taken to stock Douglas County PUD sponsored hatcheries.

The traps will operate from April through August. It is necessary for the PUD to maintain "weir watchers" 24 hours a day 7 days a week for a 4 to 5 month interval. The Twisp River fish trap and surrounding river are illuminated with high intensity lighting at night. The workers periodically remove the salmon, put them in a water/formaldehyde solution and later kill them at the hatchery where their eggs and milt (semen) are removed. Everything else (other fish, etc.) that is caught in the trap is supposedly released. The fish trap staff live in a mobile home next to the fish trap on the bank of the river while they work their 12-hour shifts.

The Chewuch River and Salmon Habitat

The map below (Figure 4) shows that there are over 100 healthy, active, natural, Chinook spawning redds in the Chewuch above the proposed fish trap. Local and regional fish biologists acknowledge that this is one of the best spawning areas left in the Upper Columbia River system.

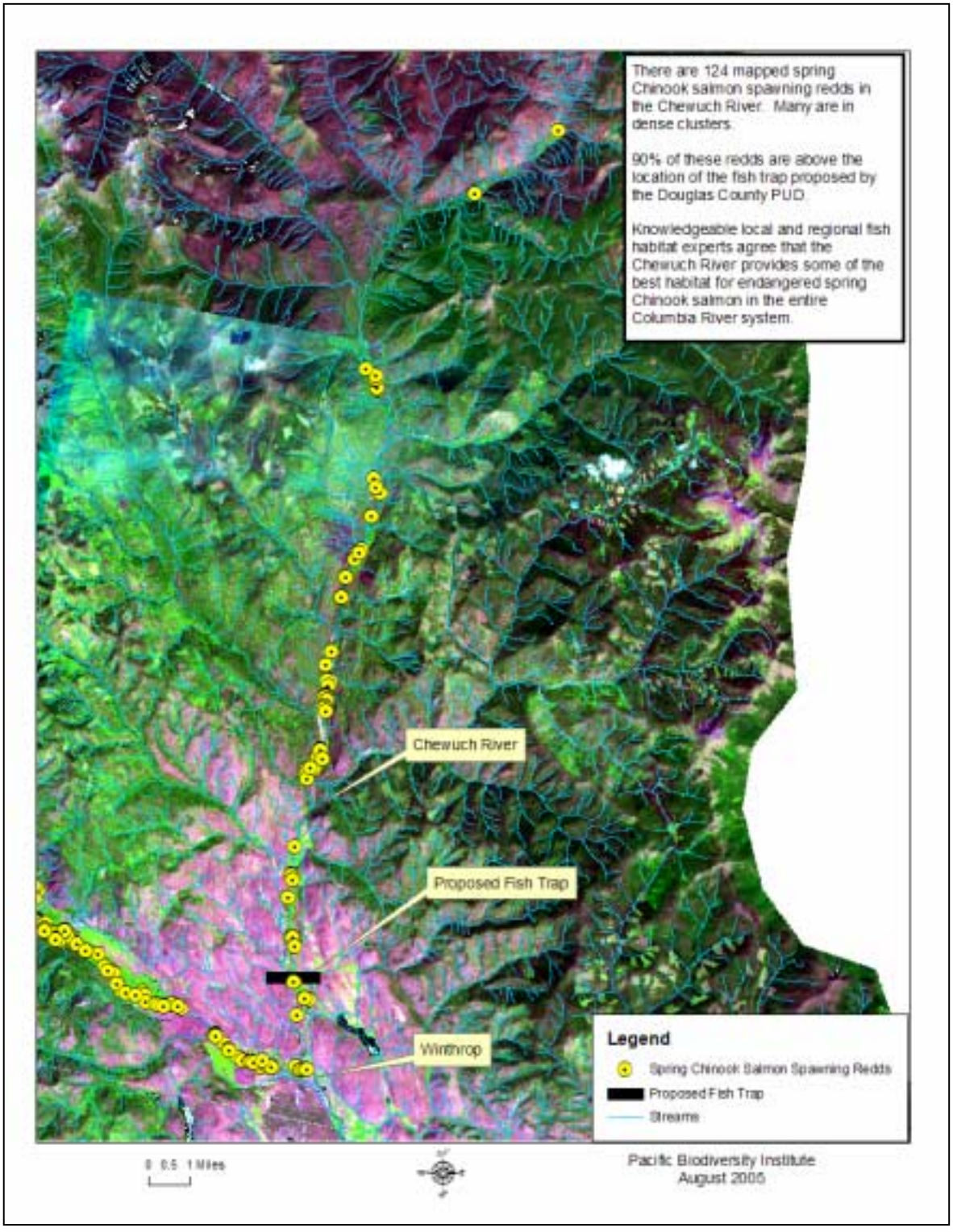

Figure 4. Fish Trap location and Chinook redds in Chewuch River.

The Chewuch River also has excellent riparian habitat and contains some of the best riparian forests in the Columbia Basin. It is free flowing and has very little rip-rapping or other channel modifications that have degraded fish habitat along other rivers. There are many side channels and pools for juvenile rearing.

The photograph on the left illustrates riparian habitat at the site of the proposed Douglas County PUD Fish Trap. The center of the fish trap would be located at the yellow notice sign shown in this photo. This riparian habitat would be extensively altered by the fish trap facility and associated mobile home located on this bank.

The photograph on the right is looking upstream from right below the proposed location of the Chewuch Fish Trap. Once the fish trap is installed, it would be the most prominent feature visible in this scene.

There is excellent habitat for salmon spawning and rearing in the Chewuch River. The salmon do not need a hatchery – they just need to be allowed to return to their ancestral spawning and rearing areas here.

The Twisp River and Salmon Habitat

The map below (Figure 5) shows that there were 153 active Chinook salmon spawning redds in past years in the Twisp River. Like the Chewuch River, local and regional fish biologists acknowledge that the upper Twisp River is one of the best spawning areas left in the Upper Columbia River system.

The upper Twisp River also has excellent riparian habitat and contains some excellent riparian forests. It is free flowing and has very little rip-rapping or other channel modifications that have degraded fish habitat along other rivers. There are many side channels and pools for juvenile rearing.

Like the Chewuch River, there is prime and abundant habitat for salmon spawning and rearing in the Twisp River. The salmon do not need a hatchery – they just need to be allowed to return to their ancestral spawning and rearing areas.

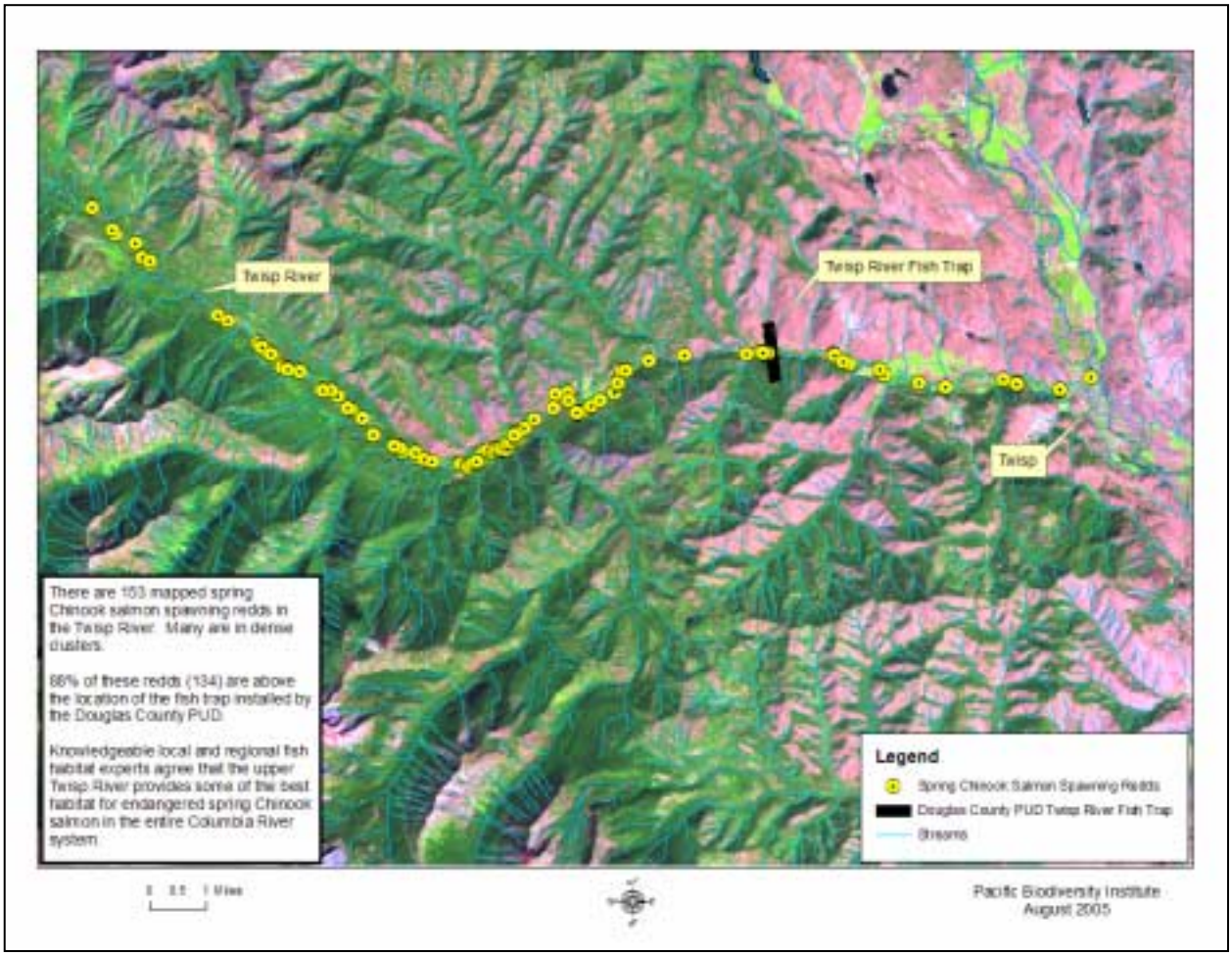

Figure 5. Fish Trap location and Chinook redds in Twisp River.

Hatcheries and Wild Fish

David Montgomery, a professor at the University of Washington, discusses the role of hatcheries, *"What hatchery boosters didn't understand was that after leaving home and hitting the real world, hatchery-raised fish survive at much lower rates than their wild cousins. Raising fish in a hatchery and releasing them to the wild may not increase the number of adult fish. Instead, it simply rearranges when in their life cycle most of the fish die"* (Montgomery 2003).

Montgomery goes on to describe in layman's terms the situation facing young salmon, *"In the wild, most die very young. Those few that survive are, on the average, better suited for whatever life the local stream has to offer salmon. The dreadful culling of wild salmon in their early life stages equips the survivors for success on the rest of their epic journey out to the sea and back home again. Charles Darwin called this natural selection."*

"Protected from day one, hatchery fish are not subject to this selective pressure. So when they are released into the wild, more of them are killed by predators or other natural hazards. Releasing hatchery fish into a stream is like dropping suburban teenagers into the middle of the Congo and asking them to walk out of the jungle to the coast. Few will make it. The hatchery fish that do make it back may be well suited for life in the marine environment, but the hidden price of reliance on hatchery fish is that resilience to disturbances, environmental change, and natural hazards in the equally crucial river environment may be bred out of a population."

Gayeski and Brulle (2004) summarize the science of hatcheries on salmon recovery and conservation in comments to NOAA Fisheries. *"NOAA Fisheries has no foundation for any claim that the genetic resources available in hatchery populations offer any potential value to the recovery, conservation, or sustainability of naturally spawning wild salmonid populations and the ecosystems they depend on, particularly in the face of overwhelming scientific evidence of the ecological and genetic risks hatchery salmonids pose to wild populations. This conclusion is supported by the preponderance of current scientific literature, and the guidance provided by NOAA Fisheries' own independent scientific-advisory panels."*

Michael Ford, of NOAA Fisheries Northwest Fisheries Science Center concludes that substantial reduction in natural spawning fitness can easily result from hatchery supplementation programs (Ford 2002). Even the best hatchery practices and modern supplementation programs can quickly result in genetic changes in salmon populations which decrease their ability to spawn naturally and reduce the chances for maintenance of self-sustaining salmon runs. Long-term supplementation (as Douglas County PUD is gearing up for) can effectively drive natural spawning fitness to near zero.

A recent study demonstrates that hatchery fish have smaller brains than their wild counterparts. M. P Marchetti and G. A. Nevitt (2003) discovered the mechanistic basis for the observed vulnerability of hatchery fish to predation and their general low survival upon release into the wild. The brains of hatchery fish do not develop like they would in the wild. This is of critical importance as Marchetti and Nevitt discuss, *"These issues are particularly important when endangered fishes are taken out of the wild to be maintained in captive rearing programs (Philippart 1995, Snyder et al. 1996). The environmental landscape of a typical fish hatchery is deprived of many of the natural sensory inputs a wild fish would encounter. Standard captive*

rearing environments lack temporally and spatially changing olfactory and visual cues; fish experience little or no contact with living organisms other than conspecifics or hatchery workers. There are no predators to avoid or live prey to pursue. Such programs tend to be designed to preserve genetic strains of fish without regard to the critical role phenotypic plasticity may play in the life history of the species (Shumway 1999), or the potential impact of domestication when animals must be maintained for several generations (Philippart 1995). By illustrating phenotypic differences between hatchery and wild reared fish in an organ as fundamental to behavior as the brain, the present study adds to a growing body of literature in providing a dramatic illustration for why such practices need to be revisited in conservation efforts to preserve wild salmon. Understanding how environmental enrichment or captive rearing practices influences neural proliferation and development may well be a topic of concern for hatchery managers and conservation biologists of the future."

The body of scientific knowledge pointing to problems with hatchery fish compared to their wild counterparts is vast. Although hatchery managers and the biologists that work for hatcheries have been quick to defend hatcheries and slow to acknowledge their problems, numerous prestigious scientific studies and panels have indicated that hatcheries are one of the problems that wild salmon face, not part of the solution. We will now examine some highlights from this scientific literature.

The National Academy of Science's National Research Council on Hatchery Supplementation

A report from the National Academy of Science's National Research Council (NRC) Committee on the Protection and Management of Pacific Northwest Anadromous Salmon is highly critical of the role that hatcheries have played in the salmon crisis (NRC 1996). This committee was charged by the NRC to analyze the causes of decline and options for intervention (as well as other related questions). This report is one of the most objective and scientifically credible reports on the salmon crisis. The committee membership was comprised of some of the most highly respected scientists in the nation.

The NRC states in their conclusions on the effect of hatcheries,

- ***"Despite some successes, hatchery programs have been partly or entirely responsible for detrimental effects on some wild runs of salmon."***
- ***"Hatchery use has not favored conservation of biological diversity."***
- ***"The goals, specific objectives and methods of past hatchery programs were not critically reviewed for scientific validity and practical feasibility."***
- ***"Hatchery programs have lacked proper monitoring and evaluation."***

Some highlights from the NRC's recommendations,

- ***"The term 'supplementation' as a goal of hatchery programs should be abandoned."***
- ***"Hatcheries should be dismantled, revised, or reprogrammed if they interfere with a comprehensive rehabilitation strategy designed to rebuild wild populations of anadromous salmon to sustainability."***
- ***"Any hatchery that "mines" broodstock from wild (natural) spawning populations should be a candidate for immediate closure…"*** **(**This, by the way, is precisely what

Douglas County PUD's Twisp and Chewuch River fish traps are designed to do – mine broodstock from wild spawning populations.**)**

The NRC study states, *"The history of artificial propagation reveals a recurring cycle of technological optimism followed by pessimism. With the increasing reliance on artificial propagation, concerns became greatly heightened that contemporary hatchery programs are having negative effects on the genetic diversity and persistence of wild populations and that increasing releases of hatchery fish cannot override other factors contributing to an overall decline of salmon."*

The NRC study goes on: *"Disappointment has resurfaced whenever sufficient data have accumulated, to indicate that hatchery programs had failed either to improve on nature, to circumvent natural fluctuations in ocean conditions, or to make up sufficiently for large, human-induced losses of natural reproduction. Each turn of the cycle formed a larger orbit as the scale of artificial propagation has increased, naturally reproducing populations declined more precipitously, and the number of hatchery critics has increased. Prevention of another repetition of the cycle will require development of more realistic hatchery goals, overhaul of hatchery practices, and serious commitment to evaluation of hatcheries in an adaptive-management content."*

The Northwest Power Planning Council's Independent Scientific Advisory Board on Hatchery Supplementation Programs in the Columbia Basin

The Independent Scientific Advisory Board of the NW Power Planning Council (2003) reviewed salmon and steelhead supplementation programs in the Columbia Basin. Many of their findings were not supportive of continued hatchery supplementation. Three of their primary findings:

- *"**Contemporary genetic/evolutionary theory, and the literature that supports it, indicate clearly that supplementation presents substantial risks to natural populations of salmon and steelhead.** Supplementation can affect the adaptation of natural populations to their environment by altering genetic variation within and among populations, a process that can negatively affect a population's fitness through inbreeding depression, outbreeding depression, and/or domestication selection."*
- *"**Many hypotheses and conjectures concerning supplementation are largely unevaluated.** This finding is based on our review of case histories of Columbia River Basin supplementation programs."*
- *"With our current knowledge base, a technically valid risk-benefit analysis of **supplementation is dominated by the high level of scientific uncertainty** about the possible magnitudes of the potential beneficial and detrimental effects."*

The Salmon Recovery Science Review Panel on Hatchery Supplementation

The Salmon Recovery Science Review Panel (RSRP 2004) was convened by NOAA Fisheries to guide the scientific and technical aspects of recovery planning for listed salmon

and steelhead species throughout the West Coast. The panel consists of seven highly qualified and independent scientists. Panel members have all been involved in local, national, and international activities. They have served on numerous National Research Council committees and have published many papers in prestigious scientific journals.

Their report (RSRP 2004) clearly states: *"**One of the major factors affecting the status of listed Pacific salmon is the potential negative effect that hatchery fish exert on populations of wild fish. Ironically, while many hatchery programs were designed to accelerate population recovery of wild fish and stabilize their numbers, there is evidence that many supplementation programs have the opposite effect.**"*

And they go on: *"The bulk of the evidence indicates that, on the whole, hatchery fish are not equivalent to wild fish, genetically or phenotypically. Despite optimism about improvements in hatchery practices (Brannon et al. 2004), hatchery environments differ substantially from natural environments and create fish that differ from their wild counterparts in developmental trajectories that affect morphology, behavior, physiological responses, and life history. Whether these phenotypic differences are genetically based through domestication (Price 2002) or are induced by early environmental exposure (Travis et al. 1999), they represent inevitable, significant phenotypic alterations. Interbreeding between hatchery fish and wild fish can, through numerical swamping, reduce the fitness of wild fish, which can contribute to the decline of the wild population."*

The Latest Science on Conservation Hatcheries and Supplementation

Some of the latest research on the use of hatcheries to help salmon is in press at the *Canadian Journal of Fisheries and Aquatic Sciences.* The paper is titled: A Stochastic Life-cycle Model Investigation of the Potential Benefits of a Conservation Hatchery Program for Supplementing Oregon Coast Coho (Oosterhout in press). Gretchen R. Oosterhout, PhD, investigated the benefits of conservation hatchery supplementation of natural salmon runs. Her finding: *"Although optimistic assumptions were emphasized over pessimistic ones, **no set of assumptions was found that indicated clear long-term benefits from the supplementation program**. Of all the management actions modeled**, habitat restoration offered by far the largest and only permanent gains** in coho abundance while posing no genetic or ecological risk to the fish."*

In other recently published research Daniel Goodman, PhD (2005) writes: ***"**Some salmon hatchery programs intentionally integrate the wild and hatchery population by taking naturally spawned fish as some fraction of the broodstock and allowing hatchery progeny to constitute some fraction of the adults spawning in the wild. **We find a potential for substantial erosion of natural spawning fitness, compared with the original wild population, including the possibility of runaway selection driving natural spawning fitness effectively to zero."*** Goodman is the Director of Environmental Statistics at Montana State University in Bozeman and is an expert on Columbia River and Pacific Northwest salmon.

A Scientific Synopsis of the Salmon Crisis from the Smithsonian Institution's National Zoo Web Site

The Smithsonian Institution's National Zoo web site states:

- **"Another indisputable fact: Many factors are harming wild salmon.** These include dams, fishing, habitat loss and degradation, and **production of hatchery salmon that compete with their wild cousins for food**. However, interest groups downplay each of these factors and point their finger at others to take responsibility for the salmon's decline, and for their salvation." (Meadows 2005) (http://nationalzoo.si.edu/Publications/ZooGoer/2004/1/Pacific_Salmon.cfm)

You should also note that the Smithsonian Institution recognizes that the dams and their related hatcheries (e.g. Douglas County PUD, Wells Dam and associated hatcheries) are special interest groups that "downplay" their role in harming the salmon and "point their finger at others."

Meadows (2005) goes on to state:

- "Between fishing, dam construction, and other threats, salmon continued to decline. At the time, the answer to reversing this decline seemed obvious—simply supplement the wild populations with hatchery-raised fish. This approach has been so popular that there are now more than 100 salmon hatcheries in Washington and Oregon. But even though Columbia Basin hatcheries produce 100 to 200 million young salmon each year, wild Pacific salmon are still in trouble."
- **"Worse, many conservation biologists believe that hatcheries have done wild salmon more harm than good.** Today, hatchery fish comprise 90 percent of the Columbia Basin salmon run. The influx of hatchery fish has kept fishing rates artificially high; consequently, commercial fishers have continued to catch wild salmon even though their populations have been dropping."
- "Another problem is that hatchery salmon can out-compete wild salmon for territory and food, and will sometimes eat smaller wild salmon. Moreover, fish raised in hatcheries may be adapted to captivity, so they are less suited to natural conditions. For example, hatchery salmon are used to being fed and are not used to avoiding predators. If there is a genetic basis for these behaviors, interbreeding between hatchery salmon and wild stock may make the wild population less suited to natural conditions too."
- "Despite all these drawbacks, hatcheries are still releasing salmon in the Columbia Basin. Fishing interests see hatcheries as mitigation for smaller salmon runs. '[Hatcheries] were established to compensate the regional fishing industry for the permanent loss of habitat above dams,' says the Pacific Coast Federation of Fishermen's Association. 'Hatchery programs in the Columbia are extremely important to maintaining the fishing industry.'
- "Now so-called 'conservation hatcheries' have become the trend. The idea is to make hatchery salmon more like wild ones by, for example, building hatcheries that mimic natural conditions, or by using wild-spawned salmon for hatchery broodstock. **While some interests champion 'conservation hatcheries,' so far they are little more than a buzzword. Science has not yet demonstrated whether they will help or hurt wild stocks."**

Mitigation Credit

The real reason that fish traps are being built in the Methow and that hatchery supplementation programs are being widely promoted here is that Douglas County PUD needs "mitigation credit" to operate Wells Dam under their current FERC license and Habitat Conservation Plan.

Douglas County PUD kills thousands of fish while operating Wells dam. Legally, they are required to "mitigate" this fish kill. For over 100 years, hatchery "supplementation" has been promoted to mitigate for fish kill even though it has been continually discredited. Douglas County PUD needs "mitigation credit" so that they can legally operate their dams. The PUD does not get "mitigation credit" for salmon that spawn naturally in the rivers. Therefore, they are motivated to "mine" the eggs from wild salmon to stock their hatcheries and later release hatchery juveniles into the rivers to mask the very damaging effects on salmon populations of Wells Dam.

Conclusions

The above references are enough to demonstrate that the benefit of hatchery programs has not been established. In fact, the purported benefit from hatcheries has been thoroughly refuted by objective, independent scientists. Fisheries biologists (those that do not derive their incomes from dams or hatcheries) state that significant damage to wild salmon runs results from hatchery supplementation. As we examine this, we must recognize that hatcheries have been trying to mitigate human impacts of dams, overfishing and other human impacts on salmon for 130 years (Lichatowich 1999). The history of hatcheries is one of repeated failure. Many of the problems associated with hatcheries have been public knowledge for many years. In 1941, Stanford University biology professor Willis Rich, PhD stated: "*About the only protection given to the Columbia River salmon has been that afforded by artificial propagation. Biologists in general are skeptical of the claims made for artificial propagation, and rightly so because these claims have often been extravagant and the proof is entirely inadequate. Indeed, many conservationists feel that the complacent confidence felt by fishermen, laymen, and administrators in the ability of artificial propagation to counterbalance any inroads that man may make upon the supply of a propagated species is a serious stumbling block in the way of development of a proper conservation strategy*" (Rich 1941, Montgomery 2003). This exact statement would be as relevant today as it was over 60 years ago (Montgomery 2003).

This harsh reality is reflected by the conclusions of Brulle and Gayeski (2004): "*Over 100 years of the hatchery experiment has led to the inescapable conclusion that artificial production has been a significant factor in salmon and steelhead declines, and that it is scientifically incompatible with salmon recovery.*"

The fish traps that have been installed or are proposed to be installed in the Methow Valley will ensure that many fewer fish reach their spawning beds. The leading scientific literature on salmon restoration calls this process "mining" wild fish and condemns it. The associated hatchery supplementation will result in long-term harm to the wild salmon populations in the Methow and will greatly hamper efforts to restore self-sustaining salmon populations to our rivers and streams.

Recommendations

There are much more effective ways to mitigate the impact of the Columbia River dams. The electric utilities could do much more to reduce the fish kill at their dams. The Methow's salmon must overcome nine major dams on their way back and forth to the ocean. They experience an average juvenile mortality of 15% at **each** dam/reservoir going down and 5% adult mortality at **each** dam/reservoir coming back (NRC 1996, Quinn 2005). With these odds of survival through the gauntlet of dams, it should be no surprise that the Methow's salmon are challenged with

possible extinction. If Douglas County PUD devoted a greater portion of its substantial resources to continued reduction of salmon mortality at Wells Dam, the Methow's salmon would benefit greatly. Much more benefit to self-sustaining runs of salmon will result from reduction of hydroelectric project mortality than from any other activity. Constant and intense public pressure on the electric utilities will be required to cause them to take action.

Some states and nations have made conscious decisions to greatly limit the use of hatcheries for fish propagation (Lichatowich 1999). It is time for Washington State to shed the powerful vested interests that have kept the hatchery programs alive for so many years and seriously reevaluate the role hatcheries can play in salmon recovery efforts. The effects of hatcheries still remain a significant part of the challenge that salmon face. The question remains whether hatcheries can make any contribution to a solution to the salmon crisis.

The Methow's salmon will also benefit greatly from continued efforts in the following areas:

- removal of barriers and impediments to migration in the rivers,
- ensuring adequate stream flows,
- protection of existing habitat in our rivers and streams,
- restoration of damaged habitat.

These activities will also benefit the local community and economy. Property values will be enhanced by these activities, rather than degraded by projects like the Twisp and Chewuch River Fish Traps. If Douglas County PUD really wants to help restore healthy, self-sustaining runs of salmon in the Methow, they should redirect all their resources to support of the above activities.

It is not necessary to disrupt our beautiful rivers and degrade property values to restore healthy wild salmon runs. Douglas County PUD's mitigation program is misguided and should be redirected from fish traps and hatcheries to restoration of habitat. Protecting our rivers and restoring areas of degraded habitat can provide what the fish really need to breed and rear their young. The rivers of the Methow can continue to provide critical spawning and rearing habitat for Chinook salmon, steelhead, bull trout, rainbow trout, whitefish, beaver, mink, otter, bald eagles, osprey and many other river-dependent species.

There is substantial room for optimism with regard to salmon recovery in the Methow Basin and elsewhere. Thomas Quinn (2005) concludes his landmark treatise, *The Behavior and Ecology of Pacific Salmon and Trout* with the statement *"I believe the salmon will do the rest. If we preserve habitat they will use it, and if we restore habitat and make it accessible they will find it. We must be patient, and we must ground all conservation efforts in a thorough knowledge of salmon behavior and ecology."*

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