NATIVE FISH SOCIETY

NATIVE BROOD STOCK HATCHERIES ARE NOT A SOLUTION FOR THE RECOVERY AND PROTECTION OF WILD SALMON AND STEELHEAD

By Bill Bakke

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Hatchery reform is gaining momentum in the Northwest following several decades of scientific review of hatchery programs and their effect on native, wild salmonids. The emphasis on hatchery reform has been pushed along by the Endangered Species Act and the listing of most wild salmon and steelhead along the west coast. Before the ESA-listing of salmonids, conservation of wild fish populations was not a major concern among the fish agencies and tribes. Now that wild fish are a factor, saving the hatchery programs and creating a framework that justifies their continued operation has become a necessity.

It is no longer acceptable to limit hatchery evaluation to the number of juveniles released, but must include their survival, contribution to fisheries and their impact on natural populations. The ESA requires evaluation on the effect of hatchery fish on wild fish and the ecosystems that support them. This has lead to looking "beyond the hatchery fence" and has created the idea that hatcheries can be used to recover wild salmon and steelhead populations. Native broodstock hatcheries have become the new fad in the Northwest along with claims that the best way to operate a hatchery program is to integrate wild and hatchery fish populations using native, wild fish as the source for artificial propagation. But the fad is over-reaching the science. These native broodstock hatcheries have not been tested to see if in fact they can actually be used to rebuild wild salmonid populations and protect their biological integrity. In fact, the most recent scientific assessments indicate that these so-called conservation hatcheries create problems. However, that has not deterred the political enthusiasm for using hatcheries to rebuild wild salmonid populations.

I have compiled some of the assessments of conservation/native broodstock hatcheries. These assessments do not indicate that these hatcheries are risk free and in fact they expose this technology as harmful to the region's declining wild salmon and steelhead populations.

However, the state agencies like the Oregon and Washington departments of fish and wildlife are converting their hatcheries to serve, in part, a conservation function along with production of fish to serve harvesters; the N.W. Power Planning and Conservation Council is presently advocating the integration of wild and hatchery fish in the region's hatcheries; Washington's Hatchery Scientific Review Group has developed a plan for hatchery integration, and NOAA Fisheries has drafted a new hatchery policy that promotes hatchery and wild fish integration. This is all being done in the name of conservation, but so far the technology is experimental and there is no scientific verification that it works as it is being sold.

The purpose of this type of hatchery is to reduce the risk to native, wild salmonids from genetic and ecological changes that reduce reproductive success, but does it?

The following scientific assessments review conservation hatcheries using native broodstock to rebuild wild populations.

Little Sheep Creek, Oregon:

This hatchery project is jointly operated by the tribes and ODFW and began in 1986. The purpose is to provide summer steelhead for fisheries and to supplement a natural population using hatchery produced fish to increase abundance. The wild summer steelhead in this stream are described as a depleted population.

"The natural origin summer-run steelhead population…has not recovered following nearly two decades of (hatchery) supplementation." (ISAB 2003)

"Supplementing…summer-run steelhead since the early 1980s using endemic population for broodstock, has not achieved Lower Snake River Compensation Program or US v Oregon program goals nor increased naturally produced steelhead abundance. The low SAR (smolt to adult survival) for hatchery-produced smolts has prevented the program from achieving the 2,000 adult return performance standard." (ISAB 2003)

This hatchery program releases 230,000 hatchery summer steelhead smolts per year into Little Sheep Creek and 100,000 smolts into Big Sheep Creek.

Clackamas River Wild Coho Broodstock Program:

In 1996 the Oregon Department of Fish and Wildlife initiated a "rescue/recovery" hatchery program for wild coho in the Clackamas River in an effort to increase the number of wild coho. *"This rescue program was initiated in response to the extremely depressed returns observed during the late 1990s"* (Mark Chilcote, ODFW).

In his analysis of this native broodstock rescue program Chilcote made the following key points:

"The smolt to adult survival of "wild-type" hatchery fish was nearly 1/10 of the survival rate for wild smolts (97 and 98 brood year production)."

"Averaging the results of 5 brood years, the total return to the basin was not increased by using wild fish for hatchery broodstock. Just as many total fish would have been produced if there had been no hatchery program at all."

"All the hard effort involved in collecting and raising these fish didn't pay off. These results have very serious implications for the use of hatchery programs to help restore lower Columbia River coho."

"We need to find out why this occurred (if we can). If there is no corrective solution, then our tools to help restore lower Columbia River (LCR) coho have been significantly reduced. We need to respond accordingly."

"Removing wild fish and running them through the hatchery system yielded no more adult offspring than if they had been left in the river."

"When spawner density begins to fall into the range that we might be concerned about the persistence of the population, we should expect egg to smolt survival to be at its highest. Under such conditions, there will be little benefit to bringing some of the wild fish into the hatchery environment if the resulting hatchery smolts will have ocean survival rates that are 1/10 of those for wild smolts."

"…all indications are that hatchery fish, even from wild broodstocks, are not as successful as wild fish in producing viable offspring under natural conditions…"

"The survival rates for the hatchery "rescue" smolts were low; 0.7% for 1999 smolts and 2.2% for 2000 smolts. In contrast, survival rates for wild smolts in the same years were 6.6% and 15.3%. Although, hatchery smolts normally do not survive quite as well as do wild smolts, the difference is generally much less."

Source: Mark Chilcote memo to Bob Hooton and others, February 1, 2002. ODFW

Hood River Native Broodstock Program:

In 1994 the Oregon Department of Fish and Wildlife and tribes began to evaluate the reproductive success of native broodstock and compared them to the wild fish they were derived from. Kathryn Kostow evaluated the data collected on wild, native broodstock, and old hatchery stock to determine whether there is a life history and behavior difference between them. The following is taken from the abstract in a paper published by Kostow in 2004.

Juvenile phenotypes and fitness as indicated by survival were compared for naturally produced steelhead (Oncorhynchus mykiss), a new local hatchery stock, and an old nonlocal hatchery stock on the Hood River, Oregon, U.S.A. Although the new hatchery stock and the naturally produced fish came from the same parent gene pool, they differed significantly at every phenotype measured except saltwater age. The characteristics of the new hatchery stock were similar to those of the old hatchery stock. Most of the phenotypic differences were probably environmentally caused. Although such character changes would not be inherited, they may influence the relative fitness of the hatchery and natural fish when they are in the same environment, as selection responds to phenotypic distributions. A difference in fitness between the new hatchery stock and naturally produced fish was indicated by significant survival differences. Acclimation of the new hatchery stock in a "seminatural" pond before release was associated with a further decrease in relative smolt-to-adult survival with little increase in phenotypic similarity between the natural and hatchery fish. These results suggest that modified selection begins immediately in the first generation of a new hatchery stock and may provide a mechanism for genetic change.

Kostow notes in her study *that 'new hatchery fish' derived from the wild population and called 'native brood stock' had poor survival."* She said*, "Average smolt to adult survival for the naturally produced winter and summer steelhead were five to six times higher than for the new hatchery stock. "*

"…large phenotypic responses by fish from the same parent gene pool to the differences between the captive and natural environments are consistent with the process of domestication."

"This study demonstrates large average phenotype and survival differences between hatchery-produced and naturally produced fish from the same parent gene pool. These results indicate that a different selection regime was affecting each of the groups. The processes indicated by these results can be expected to lead to eventual genetic divergence between the new hatchery stock and its wild source population, thus limiting the usefulness of the stock for conservation purposes to only the first few generations."

Source: Can. J. Fish. Aquat. Sci. 61: 577-589, 2004

Deschutes River Native Broodstock Evaluation:

In 1977, Reg Reisenbichler published a paper comparing the growth and survival differences between hatchery and wild steelhead. In this study Reisenbichler compared crosses between wild and hatchery fish to hatchery and wild fish in both the stream and hatchery environments. He found that *"there were genetic differences in growth rate and survival between the offspring of hatchery and wild steelhead."* The hatchery steelhead were derived from the wild fish in the river and at the time of this work, they were two generations removed from the wild gene pool.

He found that *"The observed differences in survival suggested that the short-term effect of hatchery adults spawning in the wild is the production of fewer smolts and ultimately, fewer returning adults than are produced from the same number of only wild spawners."*

Even though the hatchery fish were only two generations removed from the wild population, the hatchery fish survived better in the hatchery ponds and their run timing had changed compared to the wild fish. In contrast the wild fish survival was higher than hatchery fish in the natural streams.

Source: J. Fish. Res. Board Can., Vol 34, 1977

Contribution of Hatchery Fish to the Natural Productivity of Wild Fish:

Ian Fleming and Erik Peterson evaluated the reproductive success of hatchery and wild salmon in nature and found that the hatchery fish productivity was less than that for wild salmon. The reasons for this reduced productivity were stated as:

"Hatchery adults appear to show reduced expressions of morphological characters important during breeding, such as secondary sexual characters (color, kype). Such reduced expressions of secondary sexual characters can have negative consequences for natural breeding success."

"*For hatchery females in competition with wild females, indicators of inferior competitive ability include delays in the onset of breeding, fewer nests, and greater retention of eggs. Ultimately, the breeding success of hatchery fish is frequently inferior to that of wild females."*

"*The breeding behavior of males appears more strongly affected by hatchery rearing than that of females, reflecting the greater intensity of selection on male competitive ability during this period. Hatchery males tend to be less aggressive and less active courting females and ultimately achieve fewer spawnings than wild males. Hatchery males suffer more from inferior breeding performance than hatchery females. This pattern also appears to carry over into the wild, where gene flow between cultured and wild salmonids is sex based…"*

"The most common form of release program is aimed at the supplementation of wild populations, i.e. the intentional integration of hatchery and natural production, with the goal of improving the status of an existing natural population. Such integration, however, entails significant ecological and genetic risks to the wild population."

"…Despite large-scale releases…the supplementation programs must be deemed failures. In none of the studies reporting significant introgression, is there information on whether the release program resulted in improved natural production of the population."

Source: 2001. Nordic J. Freshw. Res. 75: 71-98.

Mixed Spawners Means Lower Natural Productivity:

In 2003, Mark Chilcote of ODFW published a paper that evaluated the effect on reproductive success by mixing wild and hatchery steelhead on the spawning grounds. He concluded the following:

"…a spawning population comprised of equal numbers of hatchery and wild fish would produce 63% fewer recruits per spawner than one comprised entirely of wild fish. For natural populations, removal rather then addition of hatchery fish may be the most effective strategy to improve productivity and resilience."

Conservation and Evolution in Salmonids, Perspectives Over Six Decades:

In 2004, Fred Utter published a paper tracking his thoughts about fish culture over six decades. As a graduate student at the University of Washington he studied under Dr. Lauren Donaldson where he learned that salmonids were interchangeable and could be translocated to serve supply and demand for fish. However, other faculty held that each local population was genetically adapted to its own environment, but this insight did not become apparent to him until later. He makes a distinction between fish culture and conservation, concluding that:

"…efforts to reduce domestication by regular inclusion of wild fish in hatchery brood stocks homogenize wild and hatchery stocks and prevent formation of adaptive substructures in the wild."

"…the loss of overall productivity through reduced fitness is associated with the mixed hatchery-wild breeding program. A system that prevents the occurrence of microadaptations impedes the full maturation of an ecosystem to the detriment of its stability and productivity."

"Where the goal is interbreeding between cultured and wild fish (to reduce domestication), breeding and rearing goals include minimizing the phenotypic and genetic divergence of cultured and natural fish. An alternative strategy is to rear and release hatchery fish in a manner intended to minimize their interbreeding with natural fish and to permit separate harvests of the two groups. The comparisons of these two strategies indicates that the separate approach favors a goal for conservation of wild populations."

Source: 2004 Reviews in Fish Biology and Fisheries 14: 125-144.

Hatchery Fish Impede Protection and Recovery of Wild Salmonids:

Independent scientific review of initiatives by fish managers is critical for evaluating the course of action in salmon and steelhead management and recovery. The NMFS appointed an independent science panel to review its salmonid recovery policy. The Salmon Recovery Science Review Panel (RSRP) published a paper addressing the NMFS draft hatchery policy that calls for including hatchery fish to be counted in listing and delisting decisions. The RSRP (2004) disagreed and NMFS management tried to suppress the message, forcing the RSRP to publish their findings in *Science.* However, that paper is now available on the Internet http://www.nwfsc.noaa.gov/trt/rsrp.htm Go to the September 2004 report. The following are a few statements from this report:

"…even though genetic and fitness differences between wild and hatchery fish may not be statistically significant, it is possible, or even likely, that adaptation to the hatchery environment has reduced the fitness of fish spawning in the wild, and if hatchery influences continue unabated, evolution of the ESU will be substantially impeded or altered in direction, to the detriment of its long-term viability. For this

reason, the RSRP suggests that in such situations hatchery fish, either should not be included as part of the ESU, or if included in the ESU should not be used to justify delisting from the ESA.

"Myers suggested that hatchery fish should never be included in an ESU. The main justification for this point of view is that hatchery fish experience a different environment than wild fish during their early life and inevitably undergo natural selection in a different direction than wild fish. Adaptation to the hatchery environment is similar to the well-understood process of domestication, which in the presence of gene flow from hatchery to the wild, generally reduces the fitness of the wild population and their ability to adapt to future changes in the natural environment. Except for extreme cases when a temporary conservation hatchery is necessary to prevent extinction of a small (possibly inbred) and declining wild population, hatchery fish should be regarded as impeding the future evolution of an ESU. For this reason Myers recommended that NMFS scientists should revisit the definition and application of the ESU concept. In the context of restoring wild self-sustaining populations of salmon, placing increased emphasis on the future adaptation and continued persistence of an ESU in a changing environment would justify the categorical exclusion of hatchery fish from most ESUs."

"The criteria for similarity of hatchery fish are summarized in the Hatchery Broodstock Summaries and Assessments. These are (i) the degree of genetic divergence, based on molecular genetic markers as well as morphology, behavior and fitness, (ii) the origin of the hatchery stock, and (iii) status of the wild population(s). For the great majority of ESUs there is no information on potentially adaptive trait differences between hatchery and wild fish in morphology, behavior or life history (including fitness), and in many cases information on molecular genetic markers is also lacking, so that similarity must be judged solely on the origin of the broodstock and status of the wild population(s). This is a scant basis for a clear assessment of similarity. Even when substantial data exist to support similarity with respect to quasi-neutral molecular genetic markers, in the absence of information on morphology, behavior and life history, it is not valid to conclude that there are no adaptive differences between hatchery and wild fish."

"In the absence of substantial information on potentially adaptive differences between specific hatchery fish and the wild fish in an ESU, a highly precautionary approach to the assessment of their similarity ought to be taken."

"Final determination of the degree of similarity for including hatchery fish in a listed ESU was made by the fisheries management branch of NMFS rather than by the science branch. To the panel it appears that the proposed hatchery policy directly violates the thinking of leading NMFS scientists."

The NMFS has included hatchery fish along with wild salmonids when listing wild salmonids under the ESA. The NMFS hatchery policy would perpetuate the claim that hatchery and wild fish are similar in their reproductive success in the natural environment. This claim paves the way for the development of native broodstock hatcheries as the tool to recover wild salmon and steelhead, even though the weight of scientific research does not support this claim. The NMFS position is indifferent to the science and serves as a clear example of politics driven by management over science.

Same Shed Different Tool:

The integration of hatchery and wild salmonid populations has been going on for 150 years and the Northwest salmon and steelhead runs have continued to decline and go extinct. In order to preserve hatcheries and the millions of public dollars that flow to the agencies and tribes to operate them, a new tool had to be found in the same old shed. It is called, surprisingly, hatchery integration. This is a re-tooling of the term *supplementation* that withered under scientific review. The stated purpose of both concepts is to save wild fish, but the unstated reason behind hatchery integration is to improve the survival of hatchery fish. And it does. The Hood River experimental results point out that the "new hatchery fish" derived from wild parents, do survive better than the "old hatchery fish" using fish cultivated for 48 years, but their survival and reproductive success is still not equal to wild fish. However, this carefully crafted hatchery reform subterfuge is working and has its public advocates, some of which champion the conservation of wild steelhead and salmon. The so-called hatchery reform group, Long Live the Kings in Washington has this to say about integrated hatchery programs:

"Integrated programs are most appropriate where conservation is a primary goal…A properly integrated program maintains fish that are adapted to the natural environment…therefore these fish may be appropriate for helping to rebuild declining wild populations and the functional habitats that sustain them. In this context a hatchery should not be seen as a substitute for habitat, but rather as an extension of it – a productive tributary of the watershed in which it resides."

Source: Long Live the Kings: Puget Sound and Coastal Washington Hatchery Reform Project, May 2005 Update.

Integration Of Hatchery And Wild Fish Will Certainly Not Increase The Wild Population:

Using hatcheries to rebuild wild salmon and steelhead populations is on everybody's priority list. The Independent Scientific Advisory Board (ISAB) was asked by NOAA Fisheries, the federal agency with the authority to recover ESA-listed salmon and steelhead, to provide a scientific assessment of using hatchery fish to rebuild wild populations. An important question is whether the wild population is sustainable once the hatchery boost is removed.

The ISAB evaluated 97 integrated hatchery programs in the Columbia River Basin and in Puget Sound. They found that "*Only 2 of 97 natural populations appear to be self-sustaining at this time,* and *…there is little evidence of self-sustaining natural populations in integrated hatchery/natural systems."* The ISAB said, *"The first step toward improving these programs is to improve the carrying capacity of the environment and the productivity of the natural-origin salmon and steelhead."* They also note that these programs fell short on maintaining criteria to help maintain the reproductive success of the natural populations: having 10% or more of the broodstock be of natural-origin and having less than 5% of the natural spawning adults of hatchery origin. These criteria were recommended by a science review panel for Washington hatcheries, but state compliance with those recommendations remains a problem.

Another concern that has been elevated by scientific evaluation is the loss of fitness or reproductive success of hatchery fish. There is evidence that hatchery fish fitness declines regularly with the number of generations in the hatchery and data indicates fitness is lost in excess of 20% per generation.

A summary of some consequences of an integrated hatchery-natural production system are listed by the ISAB. 1) Integration certainly will not increase the natural spawning fitness of the supplemented stock; 2) Integration will increase harvest, but once hatchery releases are reduced or terminated, the population will decline; 3) Integration will increase the number of natural spawners, but once hatchery releases are reduced or terminated the natural spawners will decline. 4) Integration "*may"* depress the natural spawning fitness and will continue for generations after integration is terminated.

The ISAB concludes by saying, *" …reestablishing self-sustaining populations is likely to be the exception, rather than the rule unless ecological/habitat/overharvest/ problems are solved and augmentation (hatchery) programs have been implemented in a manner that minimizes genetic/adaptive impacts on natural populations."*

In the ISAB review of Columbia River hatchery supplementation projects they commented on integrated hatchery-wild breeding programs. They say that even though these new hatcheries are an improvement over the old hatchery programs, *"they do not eliminate domestication,"* and *"for that reason these programs still pose a risk to the viability of wild stocks."* (ISAB 2003)

The ISAB response is available at: http://www.nwppc.org/fw/isab/Default.htm
Go to the study 2005-2.

Source: Independent Scientific Advisory Board. 2005

NMFS Advances Politically Designed Hatchery Policy:

The scientific studies referenced here are but a few of many that have been published, but they have a remarkable agreement; that is, hatcheries select for traits that do well in the hatchery environment but performance in the natural environment is poor and they contribute to the risk portfolio of wild salmonids. This information is available to decision makers and can be used to develop policies on hatcheries. However, by reading the following quotes of top administrators for NOAA Fisheries in response to news accounts on the draft federal hatchery policy, it is clear that scientific literature has been ignored. Bob Lohn, the Regional Administrator of NOAA Fisheries in Seattle, attended a scientific conference and was surprised to find out the number of times hatcheries do not increase wild salmonids. What is surprising is that he was surprised.

"In a surprising number of instances, hatcheries are being operated in a way that does not assist the natural spawning component of the run."

-Bob Lohn, NOAA Fisheries Regional Administrator
The Statesman Journal, Salem, Oregon May 26, 2004

Three days later Lohn amended his earlier statement saying that hatcheries can "bolster" rather than "assist" naturally spawning salmon. The obvious difference is significant for hatcheries can increase the numbers of adult fish returning but they cannot increase the productivity of the wild runs. This retreat by Lohn came from his exposure to science and research, and in truth he could no longer say with conviction that hatcheries "assist" naturally spawning salmon.

"…used in appropriate cases, typically in the short term…(hatcheries) can bolster the naturally spawning runs. We know because it's been done, and it appears to work."

- - Bob Lohn, Seattle Post-Intelligencer, May 29, 2004.

Lohn is correct in his statement. Since improvements in nutrition and disease control hatchery salmon survival has improved and fish are produced for harvest. Hatcheries have been used for this purpose for over 100 years. What has not been proven and appears to not work is the use of hatcheries to increase natural production of wild populations.

Even though Bob Lohn seems to have moderated, the hatchery policy he is advocating is not changed and continues the unsupported conviction that hatcheries can be used to save wild salmon.

The claims made in the quotes below about the benefits of hatcheries, of course, do not provide any specific supporting information. These statements and the new federal hatchery policy indicate that NMFS has changed from using the best available science to the best available politics.

"Run right, hatcheries can be of considerable value to rebuilding wild fish runs."

-Bob Lohn, The Washington Post, April 28, 2004

"…use hatchery fish more aggressively to restore salmon runs would benefit timber-dependent communities and industries… Experts think this will bring the runs back sooner and in greater numbers."

-Mark Rutzic, Legal Advisor to NOAA Fisheries and
Past timber industry lawyer. The New York Times, May 9, 2004

"NOAA is encouraged by improvements in hatchery management, and is seeing their increasing contribution to speeding up the recovery of salmon."

-Conrad C. Lautenbacher, Jr.
Vice Admiral, U.S. Navy (Ret.)
Under Secretary of Commerce for Oceans and Atmosphere. NOAA News Release on the Hatchery Policy. May 13, 2004

According to the ISAB (2005) the NOAA Fisheries Hatchery Listing Policy says that it is important to conserve natural populations, but it does not require that all natural populations be recovered under all circumstances in order to call the ESU recovered. This policy is not consistent with the latest science. *"This concept of ESU viability does not accommodate the loss of populations or the anadromous or resident life history from any given ESU, because that loss would represent a loss in diversity for the ESU that would put its long-term viability at risk."* Also, an ESU should not be considered viable if the natural component of the population is unlikely to persist when hatchery stocking is terminated.

Re-Constructing The Salmon to Fit Social and Political Trends:

Our view of salmon is shaped by experience, observation, society's values and political initiatives. This social construction of salmon has little to do with the salmon itself, its behavior, natural history, or adaptive evolution. We act on the salmon's behalf through our own social viewpoints and those view points constantly change.

Prior to the listing of wild, native salmon populations under the ESA, there was little regard given to wild salmon, but once they were listed, wild salmon recovery became an industry. Our approach to pre-ESA salmon was to construct hatcheries to "mitigate" the loss of salmon habitat with hatcheries as the dams were built, but little evaluation was done to determine whether mitigation was successful in replacing what was lost. Mitigation for lost and degraded salmonid habitat with hatcheries has been a major failure given the fact that hatchery and wild salmon and steelhead abundance is now 2%-5% of historical levels.

After the salmon were listed as ESA protected species the primary response has been to develop a rationalization that would support using hatcheries to recover wild salmon.

In Oregon's Grande Ronde River, non-native chinook salmon were imported and released prior to the native chinook being listed as a threatened species. After the wild salmon were listed, the biologists began an inventory and discovered there were six distinct breeding populations of wild chinook. The non-native hatchery fish were removed and the wild fish were moved into the hatchery to replace them.

The mainstem dams that kill the wild and hatchery salmon have been redefined by NMFS, the federal agency responsible for wild salmon recovery. The dams are now defined as a natural feature of the salmon ecosystem rather than a major impediment to salmon survival and recovery.

In his book *Fishy Business, Salmon, Biology, and the Social Construction of Nature,* Rik Scarce interviewed Pacific salmon biologists and gave them pseudonyms to protect them. The book is based on those interviews and it provides an insight into how we socially construct salmon.

Historically biologists constructed salmon to be seen as *"interchangeable with one another…. Salmon become part of an undifferentiated, homogenized Nature…. The result is an oddly common place salmon – a mechanical, schematic, engineered fish – to many of those who know the most about them. The outcome is a highly engineered fish. The historical goal of hatcheries has been to create a homogenized salmon. Such fish are supreme examples of rationalization. They are the products of a predictable, calculable, efficient, productive process – fast food with fins."* (Scarce)

Conservation biologist at the University of Toronto, Mart Gross, adds to this, saying: *"They have created an entirely new animal that lives for an entirely new purpose. The farmed salmon should be considered a new species – Salmo domesticus."*

Today some biologists see themselves differently, and their research has lead to viewing salmon in the context of its variable habitats and evolutionary history. Yet they argue that their research is not being included in management decisions.

"Owing to managers' economically and politically powerful positions, biologists have effectively been kept out of the decision making process where, they assert, they and their studies belong, and they have a hard time getting their studies to be considered as integral to management decisions…(Scarce)

While powerful social and management forces have a strong influence over our definition of salmon, there is the accumulating evidence that "*Raising salmon in hatcheries is fundamentally a waste of time. Biologists argue that hatchery salmon are inferior to wild ones because they lack the skills necessary to survive in the wild. Interbreeding between hatchery and wild salmon creates a third class of salmon, one of ambiguous parentage: fish neither of hatchery or wild origin. This is the natural salmon. Hatcheries need periodic infusions of genes from wild fish in order to avoid genetic problems…and may inadvertently doom themselves."* (Scarce)

Rik Scarce. *Fishy Business*. Temple University Press. 2000

Conclusion: What Is Not Stated, The True Value Of Native Broodstock Hatcheries:

A shift is taking place in our view of salmon. The view that salmon are interchangeable is being replaced with a view that salmon are locally adapted, a long standing debate in the Northwest, going back to the research of Willis Rich in 1939.

David Montgomery in his book King of Fish, said, *"Rich noted the need to base hatchery programs on local stocks. He also said that state fisheries managers did little to protect wild runs that provided the genetic bank from which to draw robust local broodstock."*

Source: David Montgomery, *King of Fish.* Westview Press. 2003

The management of hatcheries and harvest are beginning to adjust to this change, but have not been fully converted. The native broodstock hatchery recognizes that local wild stocks can improve the performance of the hatchery fish; their survival and therefore their contribution to fisheries are enhanced. Claiming that native broodstock hatcheries are good for wild salmon recovery, and even essential, is another story that is not supported by the science.

The fish management agencies and the NMFS have sold the native broodstock hatchery as a recovery tool for wild salmon and steelhead before they have been fully tested to determine whether they work. The few on-going research projects are not promising, showing that the native broodstock hatchery fish are not equal to wild fish in survival and reproductive success. These hatchery fish diverge from the wild fish gene pool they were derived from in phenotypic traits in the first generation. The native broodstock hatchery changes the fish so that they have greater survival fitness in the hatchery than in streams. This change is due to both selective pressures in the hatchery and to relaxing selective pressures the fish would encounter in streams (Reisenbichler 1977; Goodman 2005). This domestication selection in the hatchery can be reduced but it cannot be eliminated, so the hatchery fish will always be different from wild fish in traits important for survival (Reisenbichler et al. 2004). The only result that can come from integrating wild and hatchery fish in hatchery programs is a homogenized population that does not do well in the hatchery or in streams (Goodman 2005). The fish managers have coined a term for these homogenized creatures, they call them "natural" salmon and steelhead, and they have the institutional commitment to transform the region's wild salmonids into mongrels.

Prior to the influence of hatchery releases which have largely homogenized steelhead populations in southwest Washington streams, there were only wild fish and each river had fish that could be easily recognized. Carl Gehman, owner of the Camas Sports Center in the 1950s, saw thousands of steelhead over the years brought into his store by local anglers. Carl said, *"Before the hatcheries, those of us who had fished many of the rivers could generally win a bet by telling a less experienced angler where his catch came from when he would lay it on the counter for us to examine. We seldom lost a bet."* (Bill McMillan 2005)

McMillan said, *"Although these native Washougal steelhead characteristics are now masked by hatchery returns, some segments of this diversity still exist including the very late June-July winter runs, some remaining large fall fish, but the very early winter runs, early spring fish, and particularly the small midsummer fish (the "Junies") all seem to have different timing now by weeks or months or in some cases they are entirely absent and have been so since the early to mid 1970s."*

The unstated purpose behind the native broodstock hatcheries is to improve the survival of hatchery fish for harvest, but the stated purpose is to save wild salmon and steelhead. As long as the native broodstock hatcheries are not scientifically evaluated, the fish management agencies can escape accountability and perpetuate their deception.

For the last 150 years the fish management agencies have integrated hatchery and wild salmonid populations in the Northwest; fortunately the wild populations were largely resistant to this assault, but the result has been a loss of biological diversity, declining abundance, extinctions and reduced fisheries. They now claim that the best way to save wild salmon is to integrate hatchery and wild fish. The only change has been the sales pitch.

The only way to protect and recover wild salmon is to manage hatcheries as separate from wild populations. This means hatchery fish would not interbreed with wild fish and they would not compete for food and rearing space in the rivers. It also means the fisheries would be segregated and focused on hatchery fish. One objective of harvest management should be to increase the abundance of wild fish returning to their home streams. In this way their integrity and the productive capacity of both wild and hatchery fish are maintained by segregated harvest and hatchery management. Wild salmonids will always be needed to refresh hatchery fish to improve their survival, and without them, the hatchery programs cannot be sustained. This is a different proposition than merging wild and hatchery fish into a single homogenous population. The future productivity of the hatchery program and the benefits it provides society depends upon having abundant, healthy wild populations throughout the landscape.

In order to protect and restore wild salmonids, their habitat quality and quantity has to be restored. This is a more difficult task than stocking hatchery fish in the attempt to replace damaged or lost habitat. Wild salmonid recovery depends upon having the habitat capacity each population requires to successfully complete its life cycle and maintain its reproductive success. It also means having the abundant wild populations to fully occupy the habitat and provide nutrients for stream productivity. Therefore restoration must effectively address the habitat requirements of a wild population and make sure that the fish are healthy enough to use it fully and effectively.

Wild salmonid recovery would be on a sound scientific footing if all wild populations were identified. There is presently no complete inventory of the region's wild salmonid populations. This inventory would not only identify the location of each wild population, it would describe its genetic and life history characteristics. With this baseline data, it would be possible to evaluate the various harvest, hatchery, and habitat experiments that flourish across the landscape. Until this is done, there can be no "adaptive management" and accountability, nor will we be able to describe successful management. Knowing the location and condition of the remaining natural biological diversity of native wild salmonid populations is a fundamental requirement of conservation management. Delaying this inventory is a testimony that the fish management agencies are not actually interested in serving their conservation mandate.

In the mid 1990s the Northwest Power Planning Council adopted measures that were never funded. These measures were not implemented because the fish management agencies and the Bonneville Power Administration opposed them. These measures followed the first listings of Columbia River wild chinook and sockeye under the Endangered Species Act. They included: Identify genetic and stock structure of wild populations; Collect data on wild salmon; Monitor wild salmon populations; Develop conservation policy for wild salmon; Establish a conservation program for wild salmon; and develop the means to protect depleted runs (NPPC 1994). At this time BPA funded a brief flirtation with wild salmon conservation and funded a working committee in the Columbia River Basin. After a few meetings the BPA pulled the funding. Ten years later Technical Review Teams are compiling information on ESA-listed fish for each Evolutionarily Significant Unit, but this work is not completed and does not, at this time, represent a cohesive basin-wide recovery strategy.

The native broodstock hatchery does not promote conservation and recovery of wild salmon and steelhead populations, it blends them into an ambiguous vegetable soup. The actual purpose of native broodstock hatcheries is to improve the survival of hatchery fish and their contribution to fisheries. While this goal is important, it should not be done at the risk of the remaining wild populations. A more comprehensive conservation program for wild salmon and steelhead is called for, recognizing that healthy and abundant wild salmonids are not only socially and biologically important; the hatchery programs will need them to remain productive. This is brought into sharp focus by Kostow (2004) in her review of the Hood River steelhead native broodstock program. The *"old hatchery stock" has a smolt to adult survival rate that is 17% compared to the wild steelhead while the "new hatchery stock,"* derived from the wild steelhead gene pool, has a survival rate of 80% to 85% of wild steelhead. It is obvious that the wild steelhead population is needed to maintain the productivity and cost effectiveness of the hatchery program. Considering that some hatchery fish cost $891,000 per fish harvested (IEAB 2002), cost effectiveness should be a major concern. The integrated hatchery is designed to improve hatchery fish survival and contribution to fisheries, and that is their primary benefit.

What remains out of focus is the impact from integrated hatchery programs used to "supplement" wild salmonid populations. *"In the judgment of the ISRP and the ISAB (2005), the uncertainty concerning both the benefits and risks of (hatchery) supplementation is sufficiently great to put the merit of supplementation into question as a recovery strategy."*

Since the 1996 amendment to the Northwest Power Act (1980) the ISRP has been charged with providing much needed scientific review of fish and wildlife projects, including hatcheries. Resolving uncertainties related to these projects requires specific objectives and evaluation. The scientific committees recommended *"specific constraints on supplementation operations including the use of local broodstocks; limits on the fraction of wild populations that are collected for use as broodstock; limits on the proportion of hatchery-origin adults that are allowed to mix with the natural-origin adults on the spawning grounds, and limits on the use of hatchery-origin adults in hatchery spawning."*

These scientific committees complained to the council, saying that *"these recommendations have not yet been adopted as required policy…"* According to council staff, this problem will not be addressed until the adoption of the next fish and wildlife program which may not be until 2007 or later.

In the mean time, the BPA is proposing a reduction in fish and wildlife program funding for research, monitoring, and evaluation in 2007. The Oregon members of the Power Planning and Conservation Council informed BPA by letter that *"We believe, however, that you have settled on a figure that threatens to undermine our knowledge base for the overall effectiveness of the Program and will impair efforts to demonstrate the effectiveness of the program in reaching subbasin-levels goals for fish and wildlife recovery."* (Dukes and Eden 2005)

I provide this as an example of the stubborn resistance within the regional fish management and planning groups to adequately address hatchery evaluation. After eleven years of delay the scientific groups charged with evaluating hatcheries are still waiting for the policy direction to be adopted that would make evaluation possible. In the mean time new hatcheries are being built and operated even though a thorough examination of their risk to wild salmon and steelhead is stalled.

The NFS therefore concludes, based on the best available science, some of which is included here, that hatchery fish should not be listed along with wild populations. Only wild populations should be listed under the ESA. In terms of hatchery projects, integrated hatcheries will not rebuild wild populations, but they will increase the number of fish available for harvest which is their actual purpose even though much is said about their conservation value. Both conclusions are based on the fact that the hatchery environment changes the fish so that they do not have the same reproductive success as wild salmonids and this domestication selection cannot be eliminated. Consequently, integrated hatcheries will continue to mine wild stocks for an egg supply, the hatchery fish will continue to have an ecological impact on wild fish, the hatchery adults will interbreed with wild salmonids and reduce their reproductive success, and funding will continue to be diverted away from habitat protection, restoration and evaluation. All these factors can lead to only one conclusion: The integrated hatchery is detrimental to wild salmonids and should not be used in listing decisions or to rebuild wild populations. The funding for integrated hatcheries should be used to protect and monitor the health of wild salmonid populations and for habitat protection and restoration so that the productive capacity of our native wild salmonids is improved.

Additional reference on interactions between hatchery and wild salmonids can be found at the Native Fish Society web page: http://www.nativefishsociety.org/conservation/annotated.html

References:

Chilcote, Mark memo to Bob Hooton and others, February 1, 2002. ODFW

Chilcote, Mark. 2003. Relationship between natural productivity and the frequency of wild fish in mixed spawning populations of wild and hatchery steelhead (Oncorhynchus mykiss).Can. J. Fish. Aquat. Sci. 60:1057-1067

Dukes, Joan and Melinda Eden. September 7. 2005. Oregon Office of the Northwest Power Planning and Conservation Council. Letter to Greg Delwiche, Bonneville Power Administration.

Fleming, Ian and Erik Peterson. 2001. The ability of released, hatchery salmonids to breed and contribute to the natural productivity of wild populations. Nordic J. Freshw. Res. 75: 71-98.

Goodman, Daniel. 2005. Selection equilibrium for hatchery and wild spawning fitness in integrated breeding programs. Can. J. Fish. Aquat. Sci. 62: 374-389.

Gross, Mart. *The Oregonian*. August 31, 2003

Independent Economic Advisory Board. 2002. Artificial production review economics analysis, phase I. N.W. Power Planning and Conservation Council. IEAB 2002-5. Portland, Oregon. http://www.nwcouncil.org/library/ieab/ieab2002-1.htm

Independent Scientific Advisory Board. 2003. Review of salmon and steelhead supplementation. June 4, 2003. Northwest Power Planning and Conservation Council document ISAB 2003-3. Portland, Oregon. http://www.nwcouncil.org/library/isab/isab2003-3.htm

Independent Scientific Advisory Board. 2005. Viability of ESUs containing multiple types of populations. April 8, 2005. Northwest Power Planning and Conservation Council document ISAB 2005-2. Portland, Oregon. http://www.nwcouncil.org/library/isab/isab2005-2.htm

Independent Scientific Review Panel and Independent Scientific Advisory Board. 2005. Monitoring and evaluation of supplementation projects. N.W. Power Planning and Conservation Council. ISRP&ISAB 2005-15. Portland, Oregon.
http://www.nwcouncil.org/library/isrp/isrp2005-15.htm

Kostow, Kathryn. 2004. Differences in juvenile phenotypes and survival between hatchery stocks and a natural population provide evidence for modified selection due to captive breeding. Can. J. Fish. Aquat. Sci. 61: 577-589, 2004
http://www.nativefishsociety.org/conservation/biblio/wild_vs_hatchery/annotated_bibliography_on_salmon_hatcheries/fitness/KOSTOW2004Phenotypic.htm

Lohn, Bob. The Washington Post, April 28, 2004

Lohn, Bob. NOAA Fisheries Regional Administrator. The Statesman Journal, Salem, Oregon May 26, 2004

Lohn, Bob, Seattle Post-Intelligencer, May 29, 2004

Long Live the Kings: Puget Sound and Coastal Washington Hatchery Reform Project, May 2005 Update.

Lautenbacher, Jr., Conrad C. May 13, 2004. NOAA News Release on the Hatchery Policy.

McMillan, Bill. Personal Communication November 28, 2005.

Montgomery, David, *King of Fish.* Westview Press. 2003

N.W. Power Planning Council. 1994. Columbia River Basin Fish and Wildlife Program. Northwest Power Planning Council. Portland, Oregon. 94-55.

Reisenbichler, Reginald and J.D. McInyre. 1977. Genetic differences in growth and survival of juvenile hatchery and wild steelhead trout. Journal of the Fisheries Research Board of Canada 34:123-128.

Reisenbichler, R.R., Rubin, S.P., Wetzel, S., and Phelps, S. 2004. Natural selection after release from a hatchery leads to domestication in steelhead, *Oncorhynchus mykiss*. In Stock enhancement and sea ranching: development, pitfalls and opportunities. *Edited by* K.M. Leber, H.L. Blankenship, S. Kitada, and T. Svasand. Blackwell Science Ltd., Oxford, UK. Pp. 371-383.

RSRP 2004. Report form meeting August 30-September 2, 2004. Northwest Fisheries Science Center. National Marine Fisheries Service, Seattle, Washington. http://www.nwfsc.noaa.gov/trt/rsrp.htm
http://www.nwfsc.noaa.gov/trt/rsrpreportsept30_2004e.pdf

Rutzic, Mark, Legal Advisor to NOAA Fisheries. The New York Times, May 9, 2004

Scarce, Rik. *Fishy Business*. Temple University Press. 2000

Utter, Fred. 2004. Population genetics, conservation and evolution in salmonids and other widely cultured fishes: some perspectives over six decades. Reviews in Fish Biology and Fisheries 14: 125-144.

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Appendix:

Selected List of Integrated Hatcheries That Are Not Effective:

Steelhead

River	Hatchery Program	Date of Culture	Status	Habitat Assessment
Sandy	Late winter	2000	At Risk	Limiting
Clackamas	Winter	1991	At Risk	Limiting
Hood	Winter	1991	At Risk	Limiting
Hood	Summer	1998	Critical	Limiting
Umatilla	Summer	1992	At Risk	Limiting
Deschutes	Summer	1974	At Risk	Limiting
Yakima	Summer	2000	Critical	Inadequate
Methow	Summer	1982	Critical	Inadequate
Imnaha	Summer	1982	At Risk	Limiting

Chinook

Nooksack	Spring	1979	Critical	Inadequate
Skagit	Spring	1978	Critical	Inadequate
McKenzie	Spring	1930	At Risk	Limiting
Chiwawa	Spring	1989	Critical	Inadequate
Methow	Spring	2001	Critical	Inadequte
SF Salmon	Summer	1974	At Risk	Inadequate
Catherine Cr	Spring	1995	Critical	Inadequate
Imnaha	Spring/Sum	1982	At Risk	Limiting

Coho

Clackamas	Eagle Cr.	1957	At Risk	Limiting
Sandy			At Risk	Limiting
Washougal		1985	Critical	Inadequate

Chum

Grays	Fall	1997	At Risk	Inadequate
Washougal	Fall	2002	At Risk	Inadequate
Big Quilcene	Summer	1992	At Risk	Inadequate
SW Hood Canal	Summer	1992	At Risk	Inadequate
W Hood Canal	Summer	1998	At Risk	Inadequate

Source: ISAB 2005

For the full ISAB report follow this link
http://www.nwppc.org/library/isab/isab2005-2.htm