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The Native Fish Society is a forward-thinking organization guided by the best available science to advocate for historically abundant wild, native fish and promote the stewardship of habitats that sustain them

HATCHERY STRAYS DEplete WILD SALMONIDS

By Bill Bakke
8.19.10

INTRODUCTION:

For 150 years it has been assumed that hatchery fish can rebuild declining runs of wild salmonids and replace their habitat. Little thought is given to wild fish conservation and hatchery fish spawning naturally in the same streams with wild fish is considered a plus.

There are two kinds of strays. The first is when hatcheries release juvenile salmonids and the adults go into other watersheds and spawn. The second is when hatchery fish are released into other streams and there is no effort to separate hatchery adult spawners from wild fish spawning naturally in the stream.

There are two recognized impacts from hatchery fish on wild fish when they spawn naturally in streams. A major concern is the genetic impact from naturally spawning hatchery fish with wild fish in streams. Scientific research has shown that this results in a reduction of fitness and reproductive success of the wild spawners. Genetic introgression can change the wild fish so that they are poorly adapted to their spawning and rearing streams. Another impact that is emerging is related to the ecological effect of hatchery fish spawning naturally in streams. The hatchery fish compete with wild fish for finite food supply. They also compete with wild fish for rearing space. In addition, hatchery fish are predators on wild fish and attract predators and can introduce diseases.

It is also recognized that non-selective fisheries targeted on hatchery fish have an impact on wild fish that are mixed in with hatchery fish, a typical situation. Even when there is a selective fishery and wild fish are released, there is a poorly quantified mortality impact on wild fish.

Taken together, these impacts affect the number of wild spawners that reach their home streams and when hatchery fish spawn naturally with wild fish the reproductive success of the wild fish is reduced. Consequently, the hatchery programs are a constraint on wild salmonid abundance and spawning success. Wild salmonids are declining along the west coast of North America and many populations are now protected species under the Endangered Species Act, so impact from hatchery fish is contributing to the further decline of wild salmonids and impeding recovery of ESA-listed populations. These impacts are not effectively regulated and for that reason there is inadequate protection for wild populations of fish.

In 1978 researchers tested the survival of hatchery and wild steelhead in the Deschutes River, Oregon to determine if there is a difference between them in the natural stream and hatchery environments. The results clearly pointed to wild fish surviving better than hatchery fish in streams than hatchery fish. The reverse was true in the hatchery. When wild and hatchery fish were crossed their progeny survival was better in streams than pure hatchery fish but inferior to wild fish. Naturally spawning wild fish produced more adult spawners than hatchery fish under the same conditions, but a naturally spawning population of wild and hatchery fish produce fewer adults.

During the 1980s and 1990s further research confirmed this initial research in other rivers. During this time concerns about mixing hatchery and wild fish in streams became the subject of concern, leading to scientific recommendations for how many naturally spawning hatchery fish could safely spawn with wild fish.

Even though a problem was recognized in scientific circles, agency fish managers embraced the concept of using hatchery fish to supplement wild fish in order to rebuild wild fish populations. A strong institutional interest developed to save wild fish with hatchery fish. Testing this theory became the purpose for expanding hatchery production in the name of conservation hatcheries.

But scientific information and expert panels continued to question the purposeful use of hatcheries for recovery of wild salmonids. Their recommendations were resisted by the fish agencies. This research remains ignored. Scientific evaluation is not being incorporated into fish management decisions and today there has been little change.

Following the Deschutes experiment, thirty-one years later research on using native brood stock in a hatchery program was tested on the Hood River steelhead and Yakima River spring chinook to measure the difference in survival between the hatchery fish and the wild fish in these rivers. The results are striking for they confirmed the initial study done on the Deschutes River and on other streams such as the Kalama River.

When hatchery fish spawn naturally with wild fish they are considered strays. Below I present some recommendations made by scientists in chronological order showing the increasing concern about how many strays should be allowed to spawn with wild fish. The concern is primarily directed at non-native strays. The research completed in 2007 to 2009 indicate that it does not matter what kind of hatchery fish are used (native broodstock or domesticated hatchery fish), for each reduces the reproductive fitness and survival of wild fish in streams.

- NMFS: GENETIC EFFECTS OF STRAYING OF NON-NATIVE FISH 1997

NMFS Makes a distinction for non-native stocks and recommends a stray rate that does not exceed 5%.

What will occur with straying at the 5% level?

“The genetic effects of straying at any given level cannot reliably be predicted, but some of the effects of gene flow are predictable. Based on estimates of gene flow from allozyme frequencies in natural populations, a value of 5% gene flow is much higher than that generally occurring between non-local salmon populations. Also based on what is known

about the strength of selection in other animals, this amount of gene flow would quickly lead to the replacement not only of neutral genes, but also of locally adapted ones. Most genes in natural populations probably have selection coefficients less than 5% and would thus be subject to loss if gene flow occurred at this level. The panel found no genetic justification for allowing gene flow from non-native fish at levels as high as 5%.”

“There are no "safe" levels of hatchery straying. Any level of long-term straying will change the structure of local populations.”

Are the effects of hatchery straying likely to be permanent?

“Yes. The changes in genetic structure of local populations resulting from straying are likely to be permanent. If straying stops, local populations may recover lost fitness over time through mutation, but the original genetic composition of the population will not be restored.”

“Heavily exploited populations may, at least in some years, possess fewer spawners than necessary to produce optimal numbers of juvenile fish. Current populations of salmon may not be able to maintain adequate levels of fitness, because they are smaller than they were historically, and because of rapidly changing environmental conditions. Gene flow from non-native fish is an additional challenge which will affect the ability of salmon to adapt to future changes and which can greatly decrease productivity.”

W. Stewart Grant (editor). 1997. Genetic effects of straying of non-native fish hatchery fish into natural populations: proceedings of the workshop. U.S. Dep. Commer., NOAA Tech Memo. NMFS-NWFSC-30, 130p.

- **NMFS STRAY RATE RECOMMENDATION 2001**

“Levels of gene flow from out-of-ESU hatchery stocks into natural upper Columbia steelhead populations should be less than 1% and patterns of straying and gene flow among the natural populations should be free from human-caused alterations.” (page 8)

Ford, Michael, et al. 2001. Upper Columbia River Steelhead and Spring Chinook Salmon Population Structure and Biological Requirements. National Marine Fisheries Service, Northwest Fisheries Science Center. Seattle, WA .

- **ODFW RECOMMENDS A STRAY RATE OF 10% AND MAKES NO DISTINCTION FOR ESU ORIGINS. 2002**

Native Fish Conservation Policy 2002, page 6.

“(5) Reproductive Independence – At least 90% of the spawners within a population must be naturally produced and not hatchery produced fish, unless the department determines the hatchery produced fish are being used in a short-term experimental program to help restore a population in its natural habitat or otherwise directed by a court order.”

The ODFW policy on naturally spawning hatchery fish is out-of-date, and is not consistent with research by its own staff including ecological and genetic effects of naturally spawning hatchery fish. Will ODFW listen to the research and apply it?

- **HATCHERY SCIENTIFIC REVIEW GROUP (HSRG) 2001-2009**

Hatchery Scientific Review Group (HSRG)

“...the traditional practice of replacing natural populations with hatchery fish to mitigate for habitat loss and mortality due to hydroelectric dams is not consistent with today's conservation principles and scientific knowledge. Hatchery fish cannot replace lost habitat or the natural populations that rely on that habitat.”

http://www.hatcheryreform.us/hrp/summary/welcome_show.action

HSRG recommends hatchery reform to protect wild fish, improve conservation, and change hatchery practices to benefit conservation and recovery of wild native salmonids.

The HSRG views hatchery programs being of two types: segregated and integrated. Segregated hatchery programs are isolated from wild native fish populations so that there is limited interaction. However, most segregated hatcheries are not isolated, but release hatchery fish into other rivers or they stray into other rivers where they will mix with wild fish as a composite naturally breeding population. Recognizing this the HSRG has developed guidelines to reform these hatcheries so they serve conservation principles. The integrated hatchery program uses a formula for incorporating wild fish into the hatchery breeding program and a formula for how many of these hatchery fish would be allowed to spawn naturally with wild fish. The concept of an integrated hatchery is that hatchery fish will not degrade the genetic structure of the wild population. The HSRG has developed a theoretical failsafe program for hatchery reform; however, the fish managers have converted this into a management target allowing hatchery fish to reproduce with wild fish. The HSRG integrated hatchery program is theoretical and has not been tested to determine whether the predicted benefits are real.

The HSRG program would allow hatchery strays to reproduce naturally with wild fish based on a formula that is aimed at controlling genetic introgression and reproductive fitness in the wild stock. It does not address ecological effects of adding hatchery fish to wild fish populations for natural breeding. These ecological effects include competition for food and rearing space, predation and disease transmission, and predator attraction. These ecological impacts have been shown to reduce the reproductive success of wild salmonids. Since the time when the HSRG developed its formula for including hatchery fish in natural breeding populations, further research indicate that this does reduce the reproductive success and fitness of the wild populations. While the HSRG hatchery reform effort would improve on hatchery operations in ways that are important to wild fish conservation, it also permits natural reproduction between wild and hatchery fish. For that reason the HSRG theory may soften the impact of hatchery fish on wild fish, but would not solve the problem.

SCIENTIFIC EVALUATION: HATCHERY FISH REDUCE REPRODUCTIVE FITNESS OF WILD SALMONIDS 2007-2009

The poor reproductive fitness – the ability to survive and reproduce – of the wild-born offspring of hatchery fish means that adding hatchery fish to wild populations may ultimately be hurting efforts to sustain those wild runs, scientists have said. A study found that a fish born in the wild as the offspring of two hatchery-reared steelhead averaged only 37 percent the reproductive fitness of a fish with two wild parents, and 87 percent the fitness if one parent was wild and one was from a hatchery.

"The effect is so strong that it carries over into the first wild-born generation. Even if fish are born in the wild and survive to reproduce, those adults that had hatchery parents still

produce substantially fewer surviving offspring than those with wild parents. That's pretty remarkable."

"The implication, Blouin said, is that hatchery salmonids – many of which do survive to reproduce in the wild– could be gradually reducing the fitness of the wild populations with which they interbreed. Those hatchery fish provide one more hurdle to overcome in the goal of sustaining wild runs, along with problems caused by dams, loss or degradation of habitat, pollution, overfishing and other causes."

"The message should be clear," the researchers wrote in their report's conclusion. "Captive breeding for reintroduction or supplementation can have a serious, long-term downside in some taxa, and so should not be considered as a panacea for the recovery of all endangered populations."

"Thousands of species may require captive breeding to prevent their extinction in the next 200 years – which makes it particularly important to find out if such programs will ultimately work. This study raises doubts."

This research, which was published in *Biology Letters*, was supported by grants from the Bonneville Power Administration and the Oregon Department of Fish and Wildlife. It was based on years of genetic analysis of thousands of steelhead trout in Oregon's Hood River, in field work dating back to 1991.

CONCLUSION:

We now know that naturally spawning hatchery fish have a negative effect on the reproductive fitness and success of wild salmonids. We also know that they have an ecological impact on wild fish through competition for spawning and rearing space, disease transfer, predation, and the attraction of predators. We know that fisheries directed at hatchery fish result in the over harvest of wild fish reducing the number of spawners in our streams. Even though we know hatchery fish degrade the reproductive success of wild salmonids, allowance is still being made for mixing naturally spawning hatchery and wild fish using untested formulas.

Fish management agencies are continuing to contribute to the decline and extinction of wild salmon and steelhead, and that contribution is even more serious than that of land and water management agencies in their determined degradation of salmonid habitat. It is more serious because the fish management agencies are charged with protecting fish, recovery of wild fish, and preventing their decline.

Even though we know better the agencies resist.

By ignoring their own research on the interactions of wild and hatchery fish, the fish management agencies are failing to do their job by applying the best available scientific information. The state and federal fish management agencies have transformed salmonids into a commodity that is produced and harvested. Rather than maintain and protect the productive capacity of these fish populations and the habitats that sustain them across the landscape, they have reduced fish management to a simple industrial model of stock and kill. Consequently, stray hatchery fish are beside the point. Over harvesting wild fish is beside the point. Delivering spawners needed to fully utilize the habitat in each watershed is beside the point. These issues and many more will remain beside the point forever unless fish management institutions are accountable for the impact of hatcheries and harvest on wild salmonids. Fish managers do not consider it in

their best interest to improve management for wild salmonids when it could threaten \$123.1 million in public funding for hatcheries in the Columbia River. We have lived with this institutional commitment for 150 years and its time for change.