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ECOLOGICAL RISKS OF SALMON AND STEELHEAD HATCHERY PROGRAMS

Ecological risk of hatchery fish on wild salmonids is an emerging interest in the scientific community concerned with conservation of wild salmonids and their recovery. More attention has been directed toward understanding the genetic effects of interbreeding of wild and hatchery salmonids. While this work is important for it has an impact on the fitness and productivity of wild salmonids, it does not address the ecological effects of hatchery fish on wild fish. These ecological effects include competition for food and rearing territory, predator attraction, and disease transfer. Another aspect that can be included are harvest impacts on wild fish as fisheries target hatchery salmonids that can withstand a higher harvest rate than wild fish resulting in the over harvest and depletion of wild spawners.

The following scientific observations are focused on the ecological effects of hatchery fish on wild salmonids.

"A conservative interpretation of these findings would indicate that when hatchery fish comprise more than 50% of the natural spawning population there is an unacceptable risk of reproductive failure and, therefore, possible extirpation."

Chilcote, Mark. 1998. Oregon Steelhead Status. Oregon Department of Fish and Wildlife. Progress Report 98-3.

"For ecological purposes, the number of hatchery adults in a natural production area needs to be low enough that they cause little or no increase in density-dependent mortality of wild fish. The minimum hatchery proportion probably varies depending on the wild population, but Kostow and Zhou (2006) detected higher wild fish productivities when hatchery proportions were below 10% or 12% compared to when they were above 30%. They also noted progressively increased depression of wild fish productivity as hatchery proportions increased further."

Kostow. 2008. Factors that contribute to the ecological risks of salmon and steelhead hatchery programs and some mitigating strategies. Fish Biol. Fisheries. Springer Scicence+Business Media

"…relative population survival rates (recruits produced per spawner) were found to decrease at a rate equal to or greater than the proportion of hatchery fish in the natural spawning population. In other words, a spawning population with 20% hatchery strays had the net survival rate (recruits per spawner) that was 20% less than a population comprised entirely of wild fish (0% hatchery strays). Likewise, a population with 40% hatchery strays had a population survival rate that was 40% lower than a population comprised entirely of wild fish" (ODFW 2008).

ODFW. 2008. Recovery Strategies to close the conservation cap, methods and assumptions. Lower Columbia River Recovery Plan Stakeholder Team for Oregon.

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

"However, it is possible that this study's primary finding was the product of adverse ecological interactions between hatchery and wild fish and not differential reproductive success."

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

"The results of the current study provide further evidence that large hatchery programs present risks to the recovery of populations of wild salmon through ecological interactions. This evidence suggest that the presence of large numbers of hatchery smolts during migration to the ocean (typical of smolt release programs for salmon and steelhead in the Pacific Northwest) results in increased mortality to wild smolts by attracting predators.

"To aid recovery of depressed wild salmon, the operation of hatcheries must be changed to reduce interactions of hatchery smolts with wild smolts.

"Hatchery programs designed for harvest augmentation should be removed from basins with habitat that has high potential to produce wild salmonids.

"A program that reduces harvest, restores habitat, and reduces hatchery effects is necessary."

Nickelson, Thomas. 2003. The influence of hatchery coho salmon on the productivity of wild coho salmon populations in Oregon coastal basins. Can. J. Fish. Aquat. Sci. 60: 1050-1056.

"The combined effect of poor hatchery fish fitness and depressed wild fish production due to competition with the hatchery fish poses a double jeopardy that could quickly erode natural production in any system."

Kosktow, Kathryn, E., and Shijie Zhou. 2006. The effect of an introduced summer steelhead hatchery stock on the productivity of a wild winter steelhead population. Trans. Am. Fish. Soc. 135: 825-841.

HEARING THE TRUTH FROM THE MARGINS: Occasionally, an angler or fish biologist will flash his membership card in the Flat Earth Society and their love of the media and public meetings ensures us that we will hear their conventional wisdom often. They attract attention for their ideas for they are simple and are often conveyed in a convincing way. Those responsible for making policy decisions are often enamored by their insights, the media loves to gather quotes from real folks, and fish agencies have been known to put them on advisory panels. These champions of misinformation are attracted to harvest and hatchery issues and the following statement was recently reported as if it were news.

"A wild fish is any fish that comes up through the gravel even though both parents were hatchery fish. So how do we get more wild fish? Simple, we plant more hatchery fish."

Bob Heirman, Author and conservationist, The Herald, August 31, 2008. Everett, Washington

Even though this point of view is frequently encountered there are facts that dispute it and both agencies and anglers could do a better job of getting the word out. I have provided a few observations on the effect hatchery fish have on the productivity of wild fish. There are certainly more, but these should be enough to build conviction for conservation of wild salmonids

"Those populations with a high percentage of naturally spawning hatchery fish had low productivity, demonstrated by low values for recruitment." (recruitment means survival to the adult stage or returning adults from natural spawning.)

"This indicates that in terms of possible adverse impacts on the productivity of wild populations, the percentage of hatchery fish in a natural spawning population is more important than the origin of the hatchery stock involved."

Chilcote, Mark. 1998. Oregon Steelhead Status. Oregon Department of Fish and Wildlife. Progress Report 98-3.

"Artificial propagation does not contribute to increased natural productivity needed for viability, and appears in most cases, to erode productivity of wild populations.

McClure et al. 2008. Evolutionary affects of alternative propagation programs: implications for viability of endangered anadromous salmonids. Evolutionary Applications. Blackwell Publishing Ltd. 1:356-375

"We measured lifetime reproductive success of the first two generations of steelhead trout that were reared in captivity and bred in the wild after they were released. By reconstructing a three-generation pedigree with microsatellite markers, we show that genetic effects of domestication reduce subsequent reproductive capabilities by ~40% per captive-reared generation when fish are moved to natural environments. These results suggest that even a few generations of domestication may have negative effects on natural reproduction in the wild and that the repeated use of captive-reared parents to supplement wild populations should be carefully reconsidered.

Hitoshi Araki, Becky Cooper, Michael S. Blouin. 2007. Genetic Effects of Captive Breeding Cause a Rapid, *Cumulative Fitness Decline in the Wild. Science. Vol. 318. no. 5847, pp. 100 - 103*

"Perhaps the most important conclusion of our study is that even a hatchery program designed to minimize differences between hatchery and wild fish did not produce fish that were identical to wild fish."

Curtis Knudson et al. 2006. Comparision of life history traits between first-generation hatchery and wild upper Yakima River spring chinook salmon. Trans. Am. Fish. Soc. 135: 1130-1144.

HOH RIVER WILD STEELHEAD ISSUE PAPER: STOCK AND FISHERY INFORMATION: The following analysis of the Hoh River wild steelhead status and fishery management problems is provided by the Wild Steelhead Coalition in Washington.

Background on the Public Interest to Save Wild Steelhead

2002. Sport Fishers recognized that wild steelhead, statewide, were in serious decline and initiated a movement to save wild fish. During a hearing in Vancouver on wild steelhead, about 90% of a large audience of fishers asked for a moratorium on harvest. The Commission responded with a 5 fish limit.

2003. Members of the Wild Steelhead Coalition met individually with WA Fish and Wildlife Commissioners throughout the state to discuss the declining wild steelhead stocks. We suggested ending the state harvest of wild steelhead and allow our share to spawn, helping to prevent further declines and to rebuild depleted populations. The Commission, in February of 2003, voted to establish a moratorium for two years on state wild steelhead harvest. However, later that year the Commission responded to political and legal concerns by holding a second hearing in Bremerton. Approximately 65% of the sport fishers attending testified against further harvest. The Commission followed by establishing a limit of one wild fish annually. The intent of the regulatory decision by the Commission was stated as "an intent to act in a very conservative manner".

Later that year the WDFW policy branch ignored the Commission decision and its conservation intent and signed a three year agreement with the Hoh Tribe giving them up to 68% of the wild fish and allowing harvest far below the 2,400 escapement goal. Escapements as low as 1600 fish could be negotiated in annual plans during low run years.

2004. A WDFW sport fisher survey found about 64% of the states fishers supported no harvest.

History of the Hoh River Wild Steelhead Run Abundance

The historical estimate by McMillan and Gayeski (2006) indicates a run size in 1920 of 35,000 to 59,000 wild fish based on a watershed size and abundance comparison to the Queets River.

The 1950's run size was estimated by McMillan and Gayeski (2006) from landing records to be between 8,000 and 13,000 wild fish. The authors used the same estimation procedure employed by NOAA Fisheries for their estimate of the historical Puget Sound population.

The run abundance peaked at approximately 5,800 wild fish during the early 1980's and has since fallen to abundances of 2,500 to 4,000 in recent years.

MSH Management

MSH estimates a maximum perpetual harvest level based on long term stability in habitat capacity and stock productivity. However, MSH models were not designed to address other conservation or recovery needs. MSH models do not provide the necessary tools to manage for (1) the long term highs and lows in productivity due to weather and ocean cycles, (2)

maintaining life history and genetic diversity and distribution, (3) mixed stock fisheries, (4) hatchery impacts on genetics and productivity, and (5) habitat changes. The models only provide harvest parameters based on current abundance information fed into the model. The model error (such as the intervals around predicted run sizes) and management error (the inability to accurately estimate annual parameters such as the impending run and the total harvest) for wild steelhead are very high. The recent history of depletion of many Western Washington River's is a sad testimony to the status of wild steelhead stocks, and is in part due to MSH management.

MSH models are based on the theory of compensation; that runs will be more productive at low abundance levels. That is not unreasonable as fewer parr present less competition with each other and should have higher survival rates. Depensation, the biological phenomenon that occurs when reduced stock size results in reduced recruitment (due to a low critical mass, predation and disease problems) runs contrary to the model theory of compensation. History has shown that many wild steelhead stocks have become extinct or unable to rebuild on their own when reduced to moderately low populations.

Neither Ricker or Beverton/Holdt, in their major work on MSH published in the 1950's indicated a familiarity with ocean productivity cycles, such as the Pacific Decadal Oscillation (PDO) and Anthropogenic Global Warming (AGW). However, they did discuss the effects of observed random variation, including annual weather variation, on their models.

Many fisheries managers now recognize the limitations and problems of managing at MSH. There is recognition amongst many managers that the stocks need to be managed for spawner and total stock abundances significantly greater than the estimates of MSH.

MSH Escapement for the Hoh River

A 2,900 wild fish escapement was calculated by Gibbons, et al., in their paper of 1985.

In 1988 the Hoh Tribe convinced the Fisheries Advisory Board (FAB) in what was probably a compromise, to lower the escapement goal to 2,400 wild fish.

The 2003 to 2007 three year management agreement allowed for annual plans to utilize an escapement as low as 1600 wild fish if the predicted run was low.

Gayeski (2006) conducted a current stock recruitment analysis and found that maximum recruitment would occur at an escapement level of 3,780 wild steelhead. Managing at this level would encourage the population to recover lost diversity, productivity and capacity.

Hoh River Watershed Condition

About 56% of the Hoh River watershed is in the Olympic National Park and additional lands adjoining the South Fork of the Hoh River are under consideration for either Wild and Scenic River or Wilderness Area designation.

The Hoh River Trust has purchased important habitat along main stem and tributaries of the Hoh River and has 13 new acquisitions planned. There are several other organizations working to preserve additional Hoh River habitat.

Little habitat change has occurred since the 1950's: there are no dams, no significant changes in agriculture or logging, no mines, etc.

This scenario implies that there has probably been little or limited changes in the Hoh River productivity, that most of the rivers habitat will be well secured for the future, and that the river should support higher abundances in the future similar to those of the 1950's (8,000 to 13,000 wild fish per year).

Recent Fishery Impacts

Due to MSH harvest, management error and a very aggressive commercial harvest attitude, the Hoh Wild steelhead run has been under escaped in 9 of the last 20 years. As recent as the 2002/03 and 2005/06 seasons the escapement has been below 2,400 wild fish by 784 and 920 fish, respectively.

Last years (2007/08) run was predicted to be low and the Hoh Tribe demanded more than 69% of the harvest. The tribe refused to agree to or sign an annual management plan and went fishing. The wild steelhead run made its minimal required escapement (2,417 wild fish) last year only because WDFW demanded the tribe close their fishery by March 30 (their normal time for closing). The tribe refused to close unless the state closed; hence the sport fishery closed early on April 2 (30 days earlier than planned). The tribe continued to fish Ceremonial and Subsistence during April. The final landings were: Hoh Tribe, 940 wild fish, or 77% of the harvest; Sport Fishery, 275, or 23% of the harvest of wild fish (includes Catch and Release estimated mortality); escapement, 2419 wild fish. Had the sport fishery continued to it's normal closing date of April 16, the run would have been significantly under escaped.

The Hoh Tribe is taking an average of 1113 wild fish or 73% of the harvest and the state 411 wild fish or 27% of the harvest each year (since 2000). Since the one fish limit was enacted in 2004, the sport fishery has harvested fewer than 200 fish per year (plus an additional estimated 120 to 160 mortality from catch and release fishing).

Incidental mortality rates were not considered in management planning prior to 2007 and are part of the reason for the often missed escapements. Incidental mortality rates includ catch and release, net drop out, predation and unrecorded (illegal) mortalities which are believed to be significant for both sides. WDFW is trying to include some of these rates in the upcoming plan/agreement but is meeting resistance.

Details of the 2003 three year Hoh River steelhead harvest agreement between the state and Hoh Tribe included a study of the Catch and Release mortality by the state and the Net Drop out mortality by the Hoh Tribe. The state invested considerable time and budget in conducting their study; the tribe did not conduct their agreed to study.

Goals for Negotiations and/or Court

1. A 50/50% allocation

2. The ability to use our fish as we desire

3. The existing 2,400 escapement goal maintained (may be decided by the FAB)

4. Aggregation not applied to steelhead management.

The above are good initial goals for future fisheries management of steelhead fisheries on the Hoh River. A AGs opinion in 2003 indicated the state should prevail on the question of allocation. Aggregation is a non issue as the tribes have taken more than 50% of the hatchery run since 1995. The state does not believe that foregone opportunity is an issue as there is no foundation established in law for this principle that has been applied to some salmon runs. Wild steelhead are not considered wastage as they may not die after spawning.

Our Goals for Conservation and Fishery Management

1. Equal (50/50%) state and tribal allocations for the wild run

2. Buffers for management error

3. Account for all fishery impacts

4. Escapement above the original 2,900 (possibly increased each generation) to challenge the rivers carrying capacity and productivity

5. Recovery of healthy and abundant populations (a good target is the population of the 1950s) to levels the river can support, through the rebuilding of the Viable Salmonid Population characteristics: diversity. distribution, productivity and abundance.

6. Assure the resilience necessary to quickly recover from environmental disruptions, cope with weather/ocean cycles and adapt to long term weather change.

The Issues that we are dealing with

1. The state will settle out of court for lower levels than their goals. They did so in 04 after taking the same steps in negotiations and preparing for court and have provided ample signs that they will do so again. The 04 settlement resulted in a bad 3 year agreement that has been detrimental to wild steelhead as well as the sport fishery. This time the state is seeking a 3 to 5 year negotiated agreement. If completed out of court, it will put off resolution to the major issues on the Olympic Peninsula coastal stocks. Director Koenings has stated that WDFW will settle out of court if their fishery management needs can be met. .

2. Dropping out of the court case leaves all of the four state goals unresolved and subject to new interpretation and change each time the state/tribe negotiate a new annual plan or long term agreement.

3. There will be no buffering for management error or opportunity for stock rebuilding.

4. The Hoh River stocks will remain subject to further declines, over harvest and loss of resiliency; and possible future listing if stocks of the Olympic Peninsula Rivers continue to decline.

5. There will be no protection against changes in stream or ocean productivity related to natural or human-caused changes in climate.

In Addition:

Presently, the Queets River stocks are managed at about a 3,000 wild fish escapement, low in comparison to the WDFW calculated escapement goal of 4,200 fish. The Quinault Tribe takes 80% of the harvest leaving only some years (when the run-sizes are especially high and/or harvests especially low) for rebuilding. The Quinault River is managed in a similar manner.

The coastal tribes have consistently argued for lower escapements of wild steelhead. As stocks decline due to excessive harvests and periods of low productivity and run sizes, the tribes argue for lower escapement goals so they can keep fishing. This is a recipe for severe and sustained depletion of wild steelhead on the Olympic Peninsula, setting the table to repeat the extremely undesirable situation that currently faces too many depleted and listed wild steelhead populations in Washington State..