Salmon Hatcheries: Past, Present and Future

Prepared for

Oregon Business Council

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Introduction

A recent video showing staff from the Fall Creek Hatchery (Alsea River, Oregon) clubbing salmon to death has stirred controversy about that practice and has raised broader questions regarding the role of hatcheries in salmon management. As a result of that incident, hatcheries, which have a long history of public support, but surprisingly little evaluation and accountability, are coming under increasing scrutiny. The controversy has also raised several questions and concerns about hatchery practices in general and the role of hatcheries in the recovery of depleted salmon populations. The purpose of this report is to provide background information on hatcheries in a non-technical format that will clarify some of the concerns and answer some of the questions.

The massive use of hatcheries, a growing concern for the fate of wild fish, and listings of salmon under the Endangered Species Act (ESA) have combined to produce a bewildering array of terms. Where once there were wild and hatchery salmon now there is wild salmon, natural salmon and hatchery salmon. Salmon and trout whether natural or hatchery can be native or introduced. A group of salmon that is somewhat reproductively isolated is referred to as stock. In addition, a single stock or a group of related stocks may be an Evolutionary Significant Unit (ESU), a gene conservation unit or a metapopulation. A glossary located in Appendix A defines these terms.

Critical statements about hatcheries in this report generally apply to the older programs. The separation between older and newer programs is about 1980. The large number of hatcheries, built prior to 1980, are in greatest need of reform. The newer state and tribal programs are generally based on current science, although that science is still woefully inadequate. The newer and older programs do share one attribute in common—an unverified optimism that hatcheries can overcome the consequences of poor habitat stewardship.

Historical Background

The artificial propagation of fish has been around a very long time, but the use of hatcheries to increase the abundance of salmon on a large scale is relatively new, within the last 160 years. Modern hatchery programs for salmon have their roots in a discovery made by two French fishermen in 1841. The fishermen, Messieurs Gehin and Remy, observed salmon spawning for several nights, then developed a procedure for stripping eggs from female salmon and fertilizing them. They also devised apparatus for incubating and hatching the eggs. In the late 19th century, the belief that humans should control the reproduction of economically important fishes and, that in doing so they would increase the abundance of salmon had strong intuitive appeal. The basis for that belief was found in agriculture.

Early proponents of artificial propagation of fishes compared hatcheries to farms. The comparison with farms gave hatcheries instant success by analogy. Agriculture had increased the production of important human foods so it was natural to conclude that fish farms (hatcheries) would increase the production of fishes. This success through association with agriculture was unfortunate because it removed the incentive to actually determine the performance of hatcheries. Thirty-five years after the two French fishermen made their discovery, hatcheries were propagating Pacific salmon and the U. S. Fish Commission was proclaiming that artificial propagation would make salmon so abundant that there would be no need to regulate harvest or protect habitat. Such hyperbole had no basis in science, but those who wanted to maintain high harvest rates or alter the habitat in salmon rivers accepted it as fact.

As a consequence, hatcheries were constructed and used as a substitute for habitat protection and harvest regulation. It is now generally recognized that accepting hatcheries in lieu of habitat and rational harvest was not an effective tradeoff. Artificial propagation was not able to maintain the abundance of salmon. However, as wild populations declined with the loss of habitat and under the pressure of excessive harvest, the small number of adults that hatcheries were able to produce became a larger and larger part of the total run. Salmon of hatchery origin are now the dominant type of fish in many watersheds. In the Columbia Basin hatchery fish make up 95 percent of the coho, 70 to 80 percent of the spring and summer chinook, 50 percent of the fall chinook, and 70 percent of the steelhead (NMFS 2000). In Oregon's coastal basins, the percentage of hatchery coho salmon in the natural spawning areas ranges from none (Miami River) to over 90 percent (Salmon River) (Figure 1). Nicholas and Hankin (1989) estimated that 21 of 36 coastal stocks of spring and fall chinook salmon were almost entirely comprised of wild fish. In the remaining stocks, the percentage of hatchery fish in the runs ranged from 10 to 75 percent.

Oregon's hatchery program annually releases 74 million salmonids: 60.4 million salmon, 6.4 million steelhead and 7.6 million trout (ODFW 1998).

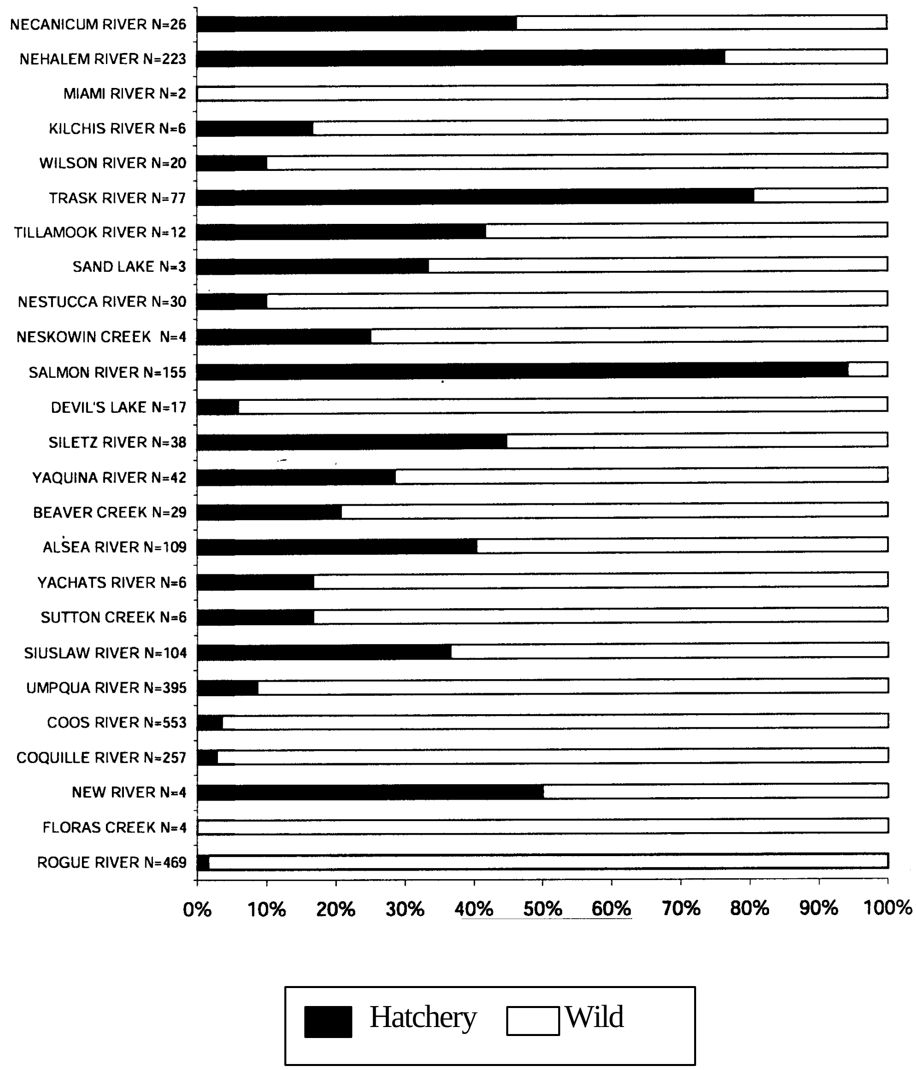

Figure 1. Rearing origin of naturally spawning adult coho salmon in major coastal river basins over the 6-year period of 1992-98. Estimates derived from analysis of scales collected on random spawning surveys. Samples from the Rogue Basin are only from the most recent 3-year period (1996-98). Solid bars represent hatchery fish and open bars represent naturally produced fish. (Source: Jacobs, et al. 2000)

Hatchery Evaluations

The analogy with farms was only half-correct. Humans could control the reproduction of salmon and increase the survival of juveniles while they were in the hatchery, but at some point the young salmon are released back to the river and ocean where they are on their own, beyond the protection of humans. This is an important and often overlooked dilemma. The artificial propagation of salmon has a dual mission, and the two goals seem to have contradictory elements. Hatcheries must produce fishes that are adapted to and capable of surviving in the hatchery with its highly controlled and protected environment and at the same time, those fish must also survive in the river and ocean environments that contain predators and competitors, are subjected to natural fluctuations in climate and habitat that has been degraded due to human activities. For about 100 years research focused on one half of the mission—how to raise healthy fish in the hatchery. Recently, studies addressing the fate and effects of salmon once they are released from the hatchery have shown that domesticated stocks do not do well in the natural environment. However, the research effort in this area has been minimal.

Hatchery research has successfully developed facilities, procedures and methods that ensure the production of healthy fish in the hatchery environment. Part of that success was realized because hatchery practices often produced a population of domesticated salmon. Domestication is selection for those traits that are beneficial in the hatchery environment. Such selection increases fitness in the hatchery, but it often decreases fitness in the natural environment (Campton 1995). Because domestication often reduces the fitness of the hatchery fish in the natural environment, hatchery practices should be designed so the artificially propagated salmon and steelhead mimic the attributes of wild fish (IMST 2000). For that reason, it is not possible to use hatcheries to completely replace wild salmon. Our knowledge of the critical attributes of wild salmon is still too incomplete. It is important to maintain the wild populations as models to study to determine what attributes must be preserved in the hatchery fish.

A heavy reliance on hatchery production carries with it additional risks:

- *Catastrophic Loss*. Because hatcheries raise fish in large numbers that are restricted to relatively small space they are vulnerable to catastrophic losses of biological (e.g. disease) or mechanical (e.g. pump failure) origin.
- *Loss of Diversity.* To reduce cost hatcheries, like factories, employ economies of scale. This leads to reliance on a few large stocks instead of a diversity of stocks of various sizes. This is equivalent to "placing all our eggs in one basket" and increases the risk of major disruptions in production during adverse environmental conditions.

- *Cost.* The economic cost of replacing most or all natural salmon production with hatcheries would be prohibitive.
- *Loss of Genetic Diversity.* In agriculture, where we do have a reliance on artificial production of crops, we maintain at great expense seed banks that attempt to collect and preserve the genetic diversity of important food crops. Those seed banks have proven to be absolutely necessary to maintain production. There is no equivalent seed banks for salmon genetic diversity except in the thousands of populations that still inhabit rivers across the landscape. Heavy reliance on hatcheries could erode the genetic diversity of salmon and threaten their long term productivity.

Our understanding of the fate of hatchery fish after release from the hatchery and the consequences of hatchery management on wild populations is still very incomplete. After 128 years of experience with salmon hatcheries, why is it that we know so little about the fate and effects of hatchery salmon in the natural environment? Why is it that we know so little about the performance of artificially propagated salmon outside the hatchery fence?

Part of the answer to that question comes from the way we evaluate hatcheries. Historically, hatchery managers assumed that the number of fish released from the hatchery was an adequate surrogate for the number of adults that return. Consequently performance was measured in terms of juvenile salmon released not the actual adult returns. This is largely still the case. For example, 41 out of 51 hatchery programs reviewed in a recent audit by Oregon Department of Fish and Wildlife (ODFW) still measure success by the number of juveniles released. Only nine of those 51 programs used adult returns as a measure of performance (ODFW 1999). Success of half of the hatchery mission—the production of healthy juveniles—is evaluated, success of the other half of the hatchery mission—the increase of adult returns is not measured. Evaluation of the effects of hatchery fish on wild salmon is not being done, except in a few of the newer programs. The older programs are still locked in the myth of success by analogy.

The failure to pay adequate attention to the second half of the hatchery mission has impeded the effective use of hatcheries and has inadvertently caused them to contribute to the depletion of wild salmon stocks. Recently three scientific panels reviewed hatchery programs and among the panels' conclusions there were ten common to all three (Flagg and Nash 1999).

1. Hatcheries have generally failed to meet their objectives.
2. Hatcheries have imparted adverse effects on natural populations.
3. Managers have failed to evaluate hatchery programs.
4. Hatchery production was based on untested assumptions.
5. Supplementation should be linked with habitat improvements.
6. Genetic considerations have to be included in hatchery programs.
7. More research on experimental approaches are required.
8. Stock transfers and introduction of non-native species should be discounted.
9. Artificial production should have a new role in fisheries management.
10. Hatcheries should be used as temporary refuges, rather than for long-term production.

Clearly, this list of conclusions strongly suggests the need for hatchery reform, which ODFW was trying to implement at the Alsea Hatchery. Unfortunately, a poorly chosen approach (clubbing) and a seemingly uncaring implementation has been confused with the legitimate need to reform hatchery programs.

At this point it is appropriate to visit the subject of hatchery broodstocks, since it was the broodstock that was being killed in the Alsea Hatchery incident. Historically, little attention was paid to broodstocks, beyond the need to obtain the number of eggs required to fill the hatchery. Where those eggs came from was of little concern. Salmon eggs were freely moved between rivers and hatcheries. Until the 1940s, it was common practice to place a barrier across the stream below the hatchery and block the run of salmon. All of the fish were captured and the eggs taken (Wallis 1963).

The original attributes of salmon populations used as hatchery broodstocks were often altered to make them conform to the hatchery environment. For example, one common change was a shift to an earlier time of spawning. To ensure the hatchery filled its quota of eggs, all the eggs from the earliest maturing fish were collected. This selection for early maturation, eventually led to hatchery broodstocks that reached peak spawning several weeks before their wild counterparts.

Then when those early maturing fish strayed onto natural spawning grounds they were out of synch with the natural flow patterns and suffered high mortality.

In recent years, genetic guidelines for maintaining broodstocks and hatchery management in general have been published (e. g., Kapuscinski and Jacobson 1987). However, many broodstocks have been in use since long before those guidelines came into effect. Correcting the effects of past practices on hatchery broodstocks should be a high priority. That is part of what was happening at the Alsea Hatchery.

Hatcheries consume a significant part of the salmon management and restoration budget. Given the status of the state's salmon populations and the hatchery program's track record, it's foolish to be satisfied with the status quo operation and evaluation of artificial propagation programs. Hatchery programs should be required to operate at peak performance and that performance must be measured both inside and outside the hatchery fence.

Current Roles

Five general purposes for hatchery programs have been identified: Mitigation, harvest augmentation, supplementation, restoration, and conservation.

Mitigation

Mitigation hatcheries attempt to replace natural production lost because of habitat degradation. In this century, most salmon hatcheries were built to mitigate for habitat that has been blocked or degraded (National Research Council 1996). Mitigation hatcheries are usually the product of formal, legal agreements tied to specific development activities such as dams. On the Oregon coast, Cole Rivers Hatchery (Rogue River) mitigates for Lost Creek Dam which blocks access to salmon habitat in the upper river. Most of the hatcheries in the Columbia River Basin mitigate for the construction and operation of the hydroelectric system.

Harvest Augmentation

The goal of augmentation hatcheries is to increase sport and/or commercial harvest opportunities. This is probably the oldest use of artificial propagation. In some cases augmentation hatcheries target a specific fishery in a specific location to minimize interaction with wild populations. The Young's Bay program in the lower Columbia River is an example of this kind of targeted augmentation.

Supplementation

The generally accepted definition of supplementation was developed by the Regional Assessment of Supplementation Project (RASP): *"Supplementation is the use of artificial propagation in the attempt to maintain or increase natural production while maintaining the long-term fitness of the target population, and keeping the ecological and genetic impacts on non-target populations within specified biological limits"* (RASP 1992). Supplementation hatcheries attempt to increase natural production. The use of supplementation assumes that the problem that caused reduced production in the target stock has been corrected and that the natural habitat is capable of producing more fish. Supplementation projects should be temporary, terminating after natural production has increased.

Restoration

Restoration hatcheries attempt to reestablish salmon or steelhead populations in habitat from which they were previously extirpated. In Oregon, the hatchery program in the Umatilla River is an example of restoration.

Conservation

The conservation hatchery is the newest purpose for artificial propagation. Its goal is to prevent extinction of threatened or endangered stocks. The concept of a conservation hatchery is new and its scope and constraints are still being developed. Hatchery programs with conservation objectives often employ captive broodstock technology. Captive broodstock programs circumvent natural mortality in the ocean and estuary by keeping the salmon in the hatchery throughout their entire life cycle from hatching until they mature. Conservation hatcheries may play an important role in preventing extinction, however they are still experimental.

The primary purposes of most of Oregon's hatcheries are mitigation (17 hatcheries) and augmentation (13 hatcheries) (ODFW 1999). Two hatcheries have research as their primary purpose. Conservation and supplementation are often included as a secondary purpose of mitigation or augmentation hatcheries. In Oregon, restoration is considered part of mitigation.

The almost exclusive emphasis on the number of juveniles released and the research focus on problems "within the hatchery fence" has had important consequences. Hatcheries were and in many cases continue to be operated as though they were independent of the ecosystems their fish are released into. Carrying capacities of the river and estuary, natural fluctuations in climate and productivity (fluctuating carrying capacities), interactions with wild fish of the same or different species, and the effects of domestication on the ability of the hatchery fish to survive in the wild are generally ignored. Today our knowledge of these areas is rudimentary at best. As mentioned earlier, throughout the history of hatcheries, the primary focus of attention has been on the hatchery environment. What happened to the salmon beyond the hatchery fence received little attention.

What are some of the consequences of the failure to integrate natural and hatchery production? Has the failure to consider the ecological attributes of the watershed when planning hatchery operations caused real problems? Since evaluations rarely went beyond the hatchery fence, we do not know all the successes and failures, however, here are some examples of unintended consequences:

- The transfer of hatchery fish among watersheds was historically a pervasive hatchery practice that persists today, but to a lesser extent. Such transfers are a direct result of the failure to consider the ecosystem attributes and integrate the hatchery into the watershed. The presence of disease or parasites in a watershed is an important ecosystem attribute that illustrates the kind of problems created by the "within the fence" focus of hatchery programs. Fish native to a watershed where a parasite is present may have developed resistance to the organism whereas fish native to a stream where the same parasite is absent may be very vulnerable to it. Here is an example: Between 1966 and 1975, the State of Oregon released over one million juvenile steelhead from coastal rivers into the Willamette River Basin. During this period, only one release of juvenile steelhead was marked and evaluated for adult returns—no adults were ever observed from that group. It wasn't until 1982 that published research gave a reason for the lack of adult returns. The Willamette watershed contains a parasite, *Ceratomyxa shasta*, which is absent in most coastal watersheds. Research showed that steelhead from a coastal river were highly susceptible to the parasite whereas stocks from the Columbia Basin, of which the Willamette is a part, were resistant to the parasite. Stocking of steelhead from coastal streams was a futile exercise because the attributes of the ecosystem were not considered.

- Poor survival of hatchery fish that are highly susceptible to a disease or parasite in the watershed they are released into is a major problem as described above. However, it is not the only problem that can result from a lack of an ecosystem perspective. Some of the hatchery fish may survive even though they are highly susceptible to a parasite or disease. If they survive to the adult stage and return to the river and spawn with the native population, the result can be a lowering of the resistance of the native fish to the pathogen (Hemmingsen, et al. 1986). This appears to be what happened to coho salmon in Fishhawk Creek in the Nehalem River. The Trask River hatchery stock of coho salmon, which is susceptible to *Ceratomyxa shasta* were planted into Fishhawk Creek for 12 years (1965 to 1976). *Ceratomyxa shasta* is found in the Nehalem River and the native stock is resistent to it. Apparently some of the Task River stock of coho survived and returned to Fishhawk Creek where they spawned with wild fish. Research conducted in 1980 showed that the Fishhawk Creek coho salmon had reduced resistance to *Ceratomyxa shasta* compared to native coho in other parts of the Nehalem River where Trask River coho were not stocked (Wade 1986).

- Domestication of the hatchery stock often includes a shift to an earlier time of spawning compared to the wild stock in the same river (Waples 1991a). The earlier time of spawning is apparently beneficial in the hatchery environment. However, the shift in time of spawning can be lethal to the hatchery fish that spawn in the natural river, because the earlier spawning is out of synch with the natural attributes of the watershed. Earlier spawning exposes incubating eggs to fall freshets, bed movement and high mortality. In fact, streams planted with the early spawning, hatchery coho in an attempt to supplement natural production actually showed reduced natural production (Nickelson et al. 1986). This is another example where failure to consider ecological attributes of the ecosystem led to unintended results. It was this kind of maladapted hatchery broodstock, that is at the center of the Fall Creek Hatchery (Alsea) controversy.

- In 1991 the National Marine Fisheries Service (NMFS) declared that the wild lower Columbia River coho salmon did not exist and was not eligible for listing under the federal ESA. In a later analysis of the situation, NMFS biologists concluded that hatchery operations were at least partially responsible for the loss of the wild coho salmon in the lower Columbia River. One of the factors they identified was the over stocking of the streams with hatchery fry, i.e., planting more fry than the carrying capacity of the stream (Flagg et al. 1995). This is another example of a problem created by the failure to give adequate attention to the post release fate and effects of hatchery fish and a failure to consider ecosystem attributes in implementing hatchery programs.

It could be argued that these examples all happened in the past and they do not reflect current hatchery practices. And that may be true. These specific problems may have been resolved. However, as was shown earlier, the focus of the older hatchery programs is still on the activities "within the hatchery fence" and not the larger ecosystem. As long as hatchery evaluations are based on juveniles released and as long as the attributes of the ecosystem are not fully incorporated into hatchery programs, the conditions that created the problems such as those described above still exist. In fact, more problems may exist, but are not identified because of the lack of adequate evaluation.

Hatcheries have been successful in rearing healthy juveniles in the hatchery environment. Unfortunately, this success has been extrapolated, often without adequate evaluation and verification, to the rest of the salmon's life history in the very different environment outside the hatchery. To correct this and increase the usefulness of hatcheries, their must be real reform, real changes in the way hatcheries are operated.

Future Role of Hatcheries

Hatcheries are here to stay. Whether or not the original goal of hatcheries was valid, we did trade habitat for artificial propagation and in many rivers that habitat will not be restored to even a fraction of its original productivity. In many of those systems, natural salmon production will need to be augmented with hatcheries. This is an important responsibility and it cannot be taken lightly, especially today when artificial propagation is also expected to help bring about the recovery of ESA listed ESUs. How can hatchery programs be reformed to have a better chance of meeting expectations? The following are a few suggestions. These suggestions are not intended to be a comprehensive or complete review of the future role of hatcheries.

Reform

Many of the suggestions for future roles for hatcheries (i.e., conservation hatcheries) cannot be achieved without significant reforms in the planning, implementation and administration of hatchery programs. The Northwest Power Planning Council has proposed a set of hatchery reforms in recognition of that need. Fundamental to the implementation of reform is a basic change in the way hatchery programs deal with questions and criticism. In general questions and criticisms intended to improve hatchery success are first marginalized through labels such as "hatchery bashing," then ignored. To implement effective reform, hatchery advocates will have to reduce their defensiveness and truly recognize the need for reform.

Evaluation

Hatchery operations cannot be treated as though they are independent of the ecosystem. Artificial propagation and natural production must be integrated, and this is being attempted in many of the newer programs. The first step to the integration of older hatchery programs is a change in the historical approaches to evaluation. Meaningful evaluation will be expensive, but not as expensive as maintaining ineffective programs or maintaining programs that are reducing natural production. Intensive research should be initiated on the process of domestication and its effects upon both the survival of hatchery fish that spawn in the wild and the effects on wild populations that hatchery fish interact with. One of the biggest failures of the hatchery program has been the fact that this need has been recognized for decades, but there is still woefully inadequate information on it.

Integration with the Ecosystem

To integrate natural and artificial production in a watershed, the hatchery operation must first be integrated into the ecosystem. A step in this direction would be to replace the vision of hatcheries as farms with the vision of hatcheries as artificial tributaries to a larger ecosystem. Production in the artificial tributary must be consistent with the whole system and especially the ecological attributes both upstream and downstream from the hatchery. The local metapopulation structure should be determined and hatchery operations made consistent with it. Taking this approach will probably eliminate the need for hatcheries in some streams, at least on a trial basis. It will also point to changes in some programs and identify places where new programs are appropriate.

Carrying capacities of the stream and estuary are important attributes of the ecosystem that must be considered in the design and implementation of artificial propagation programs (ISAB 2000). In terrestrial ecosystems, it is easier to recognize the importance of carrying capacity. For example, a range that has been stocked with cattle beyond its capacity and has been heavily overgrazed shows many clear, visual signs. Rivers, estuaries and oceans can also be overstocked, but because the signs of overstocking are not clearly visible, carrying capacity has been generally ignored. Carrying capacities raise several concerns in the implementation of hatchery programs. Where there is more than one hatchery in a basin (e. g. the Columbia River), production from all facilities must be coordinated and taken into account relative to the stream's capacity. This requires cooperation among states, federal and tribal organizations. Hatcheries generally are operated at fixed levels of production, but carrying capacities are not fixed they fluctuate through time. The highly publicized, fluctuation in ocean conditions is an example. Fixed levels of production could mean that at times hatchery releases exceed capacity and at other times the system could accept more juveniles with higher levels of adult production. Because hatchery fish survive in the ocean at about half that of wild salmon, the priority during periods of low ocean productivity should be to fill the limited capacity with the higher surviving wild salmon. Taking carrying capacity of the ecosystem into account in hatchery planning will require a major change in current hatchery programs.

ODFW needs to develop a plan for reform that includes: Specific, measurable objectives for each hatchery program; a monitoring and evaluation program that 1) tracks progress toward meeting objectives, 2) addresses the uncertainties regarding the fate and effects of salmon after release from the hatchery, and 3) specific steps it will take to make hatchery operations consistent with the attributes of the ecosystem.

If hatcheries are to justify their use of a large portion of the salmon management and recovery budget and if they are to achieve success consistent with that expenditure, they will have to make fundamental changes. Those changes will require a shift from a defensive attachment to the status quo. Hatchery programs will have to become more reflexive, able to openly accept and respond positively to questions and criticisms based on the latest science. In general the newer programs are making this change, although even in those cases, more fundamental research is needed. The older programs appear to be locked in the historical status quo.

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Glossary

The definitions used here come from the Oregon Administrative Rules (State of Oregon 2000), Waples (1991b), Ricker (1972) and Independent Scientific Group (1996). In some cases, I have added clarifying or explanatory text, which reflects my usage of the terms. It should be noted that many definitions do not have specific criteria, which leaves room for some judgement in the their application.

Evolutionarily Significant Units

In the federal Endangered Species Act, the definition of the term species includes these words: "any distinct population segment of any species of vertebrate fish and wildlife which interbreeds when mature." The Evolutionarily Significant Unit (ESU) was adopted by the federal agencies as a means of ensuring a consistent interpretation of a "distinct population segment." An ESU is a population or a group of populations that meet the following criteria and are therefore considered distinct under the ESA.

1. "It must be reproductively isolated from other conspecific population units, and
2. It must represent an important component in the evolutionary legacy of the species. Isolation does not have to be absolute, but it must be strong enough to permit evolutionarily important differences to accrue in different populations" (Waples 1991b).

Gene Conservation Group

This is a genetically distinct cluster of one or more populations within a taxonomic species that resulted because gene flow between the cluster and other populations or clusters has been zero or very low over sufficient geological time.

Hatchery Salmon

Any salmon incubated or reared under artificial conditions for a part of its life. This definition does not distinguish between a salmon one generation removed from the wild and a salmon whose parents were highly domesticated products of the hatchery.

Metapopulation

The simplest definition of a metapopulation is a population composed of populations. They are spatially-structured groups of local populations linked by movement of individuals between populations. The long-term persistence of metapopulations is maintained by a balance between extinction followed by dispersal and recolonization from nearby populations.

Natural Salmon

Any salmon produced in the natural environment as a result of natural reproduction. A natural salmon could be wild (see definition below) or it could be the progeny of hatchery parents that spawned in the natural environment. It is impossible to distinguish a natural and wild salmon by field observation alone.

Stock

A stock is a group of salmon spawning in a specific stream at a specific season, which do not interbreed to a substantial degree with any other group of salmon. Several stocks linked by a low level of straying may constitute a metapopulation.

Wild Salmon

Any naturally, spawned salmon belonging to an indigenous population. Indigenous means a population whose lineage can be traced back to 1800 in the same geographical area or that resulted from natural colonization from another indigenous population. As you might expect this is a difficult definition to apply since we do not have continuous records of salmon populations going back to before the Lewis and Clark expedition. Its application is more appropriate in defining what is not wild rather than what is wild. For example, the steelhead populations introduced recently by humans to some of the westside tributaries of the Willamette River would not be considered wild. Where there is doubt, a population should be considered wild unless there is clear proof that it is not.