The Scientific Basis for Artificial Propagation in the Recovery of Wild Anadromous Salmonids in Oregon

Executive Summary

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EXECUTIVE SUMMARY

Artificial propagation has been a prominent part of the management of salmonids in Oregon since the late 1800s, and we expect this will continue to be true because hatcheries can have an important role to play in the recovery of wild stocks of anadromous salmonids in Oregon. Today, the state of Oregon operates 34 hatcheries plus satellite facilities, which released 74 million salmon and trout in 1995 (ODFW 1998). ODFW also works with the Clatsop Economic Development Commission in the operation of the Youngs Bay facility and with the Port of Newport in the operation of the Yaquina Hatchery, which releases 150,000 fall chinook annually. ODFW oversees fish cultural activities at 25 sites for the Salmon Trout Enhancement Program (STEP) (ODFW 1998). In addition there are two federal hatcheries that operate in the state: Eagle Creek in the Clackamas watershed and Warm Springs in the Deschutes watershed.

The Oregon Plan for Salmon and Watersheds (Oregon Plan) identified hatcheries as a factor limiting the recovery of wild salmonids (Oregon Plan 1997). While the factors for decline are specific to Oregon coast natural (OCN) coho salmon, they are believed to be broadly applicable to other anadromous salmonids as well.

Oregon uses artificial propagation to achieve several different management purposes: Mitigation, Harvest Augmentation, Supplementation, Restoration, Conservation, and the STEP Hatchbox Program. Hatcheries are also seen as one element of a broad strategy for the recovery of depressed stocks in the Oregon Plan. We describe here the scientific basis on which artificial propagation can be a positive force in the Oregon Plan. Our approach to this topic is broad and strategic, and our findings and conclusions are at this same level of resolution. There is a lot of variation in hatchery programs and the circumstances within which they operate; therefore, there are likely to be some exceptions to our findings and conclusions. These should be viewed simply as exceptions to findings and conclusions that have broad applicability.

The IMST study of artificial propagation began in 1998, and was divided into three phases.

- Phase I addressed the consistency of hatchery measures in the Oregon Plan with the findings on salmon hatcheries reported in three scientific review panels. The results of Phase I are in a Technical Report released in 1998 (IMST 1998).

- Phase II of the IMST study of artificial propagation was a scientific evaluation of the audit of Oregon's coastal and Willamette hatchery programs conducted in 1999 (ODFW 1999a). The results of the scientific evaluation are in an October 25, 2000, letter report to ODFW[1].

- Phase III focuses on the scientific basis for the artificial propagation of anadromous salmonids, and how the artificial propagation programs of the State can be scientifically consistent with the recovery of wild salmonids in Oregon. This document is the Technical Report on Phase III of the IMST study of artificial propagation. The conclusions we reach in this report are based on information in this report and on what we learned in three other IMST reports dealing with various aspects of artificial propagation (IMST 1998; IMST 2000; letter report to ODFW[2]).

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[1] October 25, 2000 letter to Kay Brown, ODFW
[2] October 25, 2000 letter to Kay Brown, ODFW

Science Questions - There are a great many science questions that could be part of this project. The two broad questions we selected for study are critical to accomplishing the mission of the Oregon Plan. Each question contains sub-elements in which more specific issues are addressed.

1. **What is the scientific basis for the artificial propagation of anadromous salmonids?**
   To answer the first science question, we evaluate the scientific basis for the key management assumptions associated with artificial propagation. Following are the five assumptions we tested and our findings for each of them:

   Assumption 1. Higher survival in the egg to smolt life stage in the hatchery results in a net increase in adult ocean recruits. Ocean recruits are the total of hatchery and wild fish.

   This assumption was subdivided to consider egg to smolt survival separately from smolt to adult survival.

   The IMST finds that the hatchery environment does give a survival advantage from the egg to smolt stage compared to survival for the same life stages for naturally produced fish, and the monitoring of egg to smolt survival in hatcheries appears to be adequate.

   In mitigation and augmentation hatchery programs, the IMST finds that post-release survival rates for hatchery fish are often lower than the survival rates of wild fish. However, we also find that under most conditions, smolt to adult survival of artificially propagated fish is sufficient to provide an increase in adults for the fishery. We caution however that current monitoring is not adequate to verify that the combination of artificial propagation and production by wild fish is greater than would occur from natural production alone.

   In supplementation and conservation hatchery programs, the IMST finds that under some conditions, smolt to adult survival of artificially propagated fish is sufficient to provide a net increase in the number of naturally spawning adults, but this may not be resulting in increased natural production in subsequent generations.

   With respect to the STEP Hatchbox program, the IMST finds that there is no basis on which to judge whether the program provides a net increase in ocean recruits. Monitoring and evaluation of the hatchbox program is inadequate. However, the hatchbox program does appear to have value as an educational tool.

   Assumption 2. Hatchery production can mitigate for wild fish production lost due to human activities in a watershed.

   The IMST finds that Oregon's hatchery mitigation programs have met with some success; however, many mitigation goals only specify the numbers of juveniles to be released. This does not allow assessment of whether hatchery programs are maintaining the premitigation, naturally-produced supply of adult fish to the fishery. Most mitigation goals do not take into consideration the productive capacity of the system or fluctuations in climate and ocean conditions.

Assumption 3. Hatchery operations retain behavioral, physiological, and genetic characteristics that facilitate hatchery adult returns. This assumption was subdivided to consider domestication separately from genetic management.

The IMST finds that domestication does occur, and it is not necessarily inconsequential, resulting in decreased survival of hatchery fish after they are released from the hatchery. The IMST also finds that mate selection in the hatchery can have major detrimental consequences on the characteristics of the hatchery population, post-release performance of hatchery fish, and the performance of the wild fish if the two interact.

Assumption 4. Interactions between hatchery and wild fish do not negatively impact the survival of wild fish.

The IMST finds that this is not a uniformly valid assumption. Interactions between hatchery and wild fish at the adult and juvenile stages may pose real risks of detrimental impacts to wild populations. The occurrence and magnitude of the risks depend on the circumstances. Unfortunately, due to insufficient monitoring, we do not know enough about effects outside the hatchery to determine the impact of interactions on the fitness of wild fish.

Assumption 5. Augmentation and supplementation hatcheries add to existing natural production without replacing it.

The IMST finds that supplementation can increase the level of natural spawners over the numbers that would have been present without supplementation. It remains to be documented that an increased level of spawning activity translates into sustainable higher levels of natural production, especially in those cases where the factor(s) limiting natural production has not been corrected. Unless supplementation programs are carefully implemented, there is a risk that artificial production could replace natural production.

The IMST also finds that augmentation hatcheries have contributed to the catch of salmon and steelhead in Oregon. In general, however, the natural and artificial production in watersheds that employ augmentation hatcheries have been so poorly monitored that we cannot tell whether they replaced natural production or added to it. There are cases where the evidence suggests that replacement of natural production with hatchery production has occurred (Hilborn and Eggers 2000).

2. Scientifically, how could Oregon's artificial propagation program be consistent with the recovery of wild salmonids in Oregon?

The IMST finds that Oregon's artificial propagation program could be consistent with the recovery of wild salmonids if it has an overarching and strategic plan and policy that incorporated recommendations from recent scientific panels and a landscape perspective. The landscape perspective means a management perspective that includes a larger spatial scale, a longer time horizon and that integrates information about the condition of freshwater and marine systems, predation and other aspects of fish management such as harvest and hatchery management.

Conclusions and Recommendations

Based on these findings, the IMST reaches the following conclusions and makes the following recommendations:

Conclusion 1: ODFW lacks an overarching policy/framework for hatchery management.

Recommendation 1. ODFW should develop a comprehensive plan/cohesive policy for hatchery management.

Artificial propagation, the largest single program devoted to fish management in ODFW, needs a single coherent set of goals, policies, and Administrative Rules. This policy should provide:

- Specific management objectives.
- Strategic guidelines for the entire hatchery program and for the management of individual hatcheries.
- A link between hatchery objectives and management objectives.
- A link between hatchery management and the Oregon Plan.
- Strategies for mitigation of fish lost to the fisheries that include a combination of artificial propagation, habitat improvements, harvest management, and other appropriate strategies.

Recommendation 2. ODFW should adopt and incorporate the recommendations of the independent science panels into statewide comprehensive policy.

This would:

- Minimize the adverse affects of hatcheries on natural populations.
- Adequately evaluate hatchery programs.
- Link supplementation programs with habitat improvements.
- Include genetic considerations in hatchery programs.
- Eliminate stock transfers and introductions of non-native species.
- Incorporate more experimental approaches into their artificial propagation program.

Recommendation 3. ODFW should tie the operation of hatcheries to explicit, measurable management objectives.

The performance measures that track the achievement of these objectives should include a quantitative measure that relates directly to management purposes. This will provide a technically sound basis for policy and management decisions.

Recommendation 4. ODFW should implement the recommendations made in IMST's Workshop on Conservation Hatcheries and Supplementation in the assessment and revision of supplementation programs.

Conclusion 2: Many of Oregon's hatchery programs fall closer to the hatchery-specific approach than to the landscape approach. Current management strategies do not provide a cohesive approach to manage hatcheries from a landscape perspective.

Recommendation 5. ODFW should incorporate the landscape perspective into hatchery management.

The shift towards a landscape perspective for hatchery management should include consideration of the following:

- The stream and ocean environment into which the hatchery fish are released, the effects of hatchery fish on other species, and the effects of hatchery fish on wild populations of the same and other species.
- Natural fluctuations in climate and habitat conditions in freshwater and the ocean.
- Metapopulation structure and dynamics and the role of a specific hatchery to emulate a core or a satellite population within the metapopulation.
- System wide measures of performance that include a hatchery(s) as part of the watershed need to be utilized.

Recommendation 6. ODFW should initially give priority for change from the hatchery-specific to the landscape perspective consistent with the direction of this report to coastal and Lower Columbia system hatchery programs.

Recommendation 7. ODFW should support and participate in collaborative research efforts to determine the consequences of interactions between hatchery and wild fish.

Few studies have tracked the effects of interactions between hatchery and wild fish on the long-term survival of wild populations. Studies to resolve the consequences of differences between hatchery and wild fish are long and difficult to accomplish. There are many potentially valuable collaborators in this effort.

Recommendation 8. The IMST should convene a workshop to clarify the state of knowledge on the differences between hatchery and wild fish and the implications to supplementation programs and the fitness of naturally spawning populations.

Conclusion 3. Current monitoring and evaluation of hatchery programs is inadequate.

Recommendation 9. ODFW should strengthen the monitoring and evaluation of hatchery programs.

All artificial propagation programs need to monitor what occurs after fish are released from the hatchery, including smolt to adult survival, effects on wild fish of the target species, and effects on non-target species. Monitoring needs to be done at the watershed and individual hatchery levels to produce different types of information to accomplish hatchery-specific and landscape management goals.

Specifically this recommendation includes but is not limited to:

- **Monitoring smolt to adult survival for hatchery and wild fish on a watershed basis.**
- **Monitoring smolt to adult survival at each individual hatchery program.**
- **Monitoring fry to adult survival in the STEP hatchbox program.**
- **Determining the effects of interactions between hatchery and wild fish outside the hatchery.**
- **Placing monitoring data in an accessible, user-friendly database**.

Recommendation 10. ODFW should establish an explicit process for adaptive management that makes effective use of the results from monitoring programs.

Monitoring and evaluation are essential to adaptive management. However, determining the extent of monitoring and evaluation programs is a dilemma because, while they are very valuable, they require the allocation of scarce financial and human resources. The following approach helps determine what needs to be done, given that there is a limit to the amount of monitoring and evaluation that can be done:

a. Describe artificial propagation programs at the hatchery and at the landscape level in measurable management objectives that are meaningful within the context of the Oregon Plan.
b. Establish the variables that can be measured and will be used to represent the management objectives.
c. Measure and evaluate the variables with an intensity that will allow evaluation of the degree to which the management objectives are being attained, within some established level of certainty.