Independent Scientific Advisory Board
for the Northwest Power and Conservation Council,
Columbia River Basin Indian Tribes,
and NOAA Fisheries
851 SW 6th Avenue, Suite 1100
Portland, Oregon 97204
ISAB@nwcouncil.org

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To: Judi Danielson, Chair, Northwest Power and Conservation Council
Olney Patt, Jr., Executive Director, Columbia River Inter-Tribal Fish Commission
Usha Varanasi, Director, NOAA-Fisheries Northwest Fisheries Science Center
D. Robert Lohn, Regional Administrator, NOAA Fisheries

From: Eric J. Loudenslager, Chair, Independent Scientific Advisory Board

Subject: ISAB Supplementation Report Follow-up

The ISAB thanks the Northwest Power and Conservation Council for the opportunity to report on the findings and conclusions of our supplementation report at the Council's June 2003 meeting in Boise. We also thank the Northwest Fisheries Science Center and the Columbia River Inter-Tribal Fish Commission for their review comments.

Supplementation is a complicated topic. There is an ongoing debate among managers and scientists as to whether this strategy increases the abundance of natural origin adults and what effect it has on the natural spawning replacement rates—both quantities are critical to the recovery of *self-sustaining* salmon and steelhead populations. For these reasons the ISAB supplementation report was lengthy and detailed.

Council members had many questions for the ISAB during our presentation. Based on these questions, the ISAB concluded that a brief summary of our conclusions and recommendations could assist the Council, NOAA Fisheries, and CRITFC in identifying the priority issues in our report. That summary follows. If Council, NOAA Fisheries, or CRITFC executives or staff scientists request, the ISAB would be pleased to provide further elaboration of the summary points.

Hatchery fish are not the same as wild fish. Fish adapt genetically (evolve) to the conditions of hatchery rearing, a process termed domestication. They also will evolve new life history strategies as they adapt to completing their life cycle in the wild after their release from the hatchery. When compared against wild stocks, production hatchery stocks usually have lower adult-to-adult reproductive success when breeding in the wild. Because many of the traits associated with domestication are determined genetically, allowing domesticated salmon to interbreed with wild salmon will reduce the fitness of the integrated (mixed hatchery/wild) population spawning in the wild.

The degree of domestication for any given population depends on the number of generations that the population has spent in hatchery breeding and the strength of domestication selection. In a hatchery population maintained by deliberately isolated (closed) breeding, the level of domestication is generally high. For this reason it is to be expected that a supplementation program that simply allows large numbers of individuals from a closed hatchery line to interbreed with a self-sustaining wild stock of the same species will have considerable negative effects on the natural spawning productivity and

viability of that wild stock. This conclusion formed the basis for the ISAB recommendations in the hatchery surplus report (ISAB 2001-3).

Some supplementation programs propose to maintain their lines by an integrated breeding protocol that uses some wild-spawned fish for broodstock in each generation and that limits the numbers of hatchery-spawned fish that are allowed to breed in the wild in each generation. Such a protocol results in a pedigree in which some of the recent ancestry is from hatchery breeding and some is from natural breeding. These types of protocols will cause less domestication than long-term exclusive (closed) hatchery breeding, but they do not eliminate domestication. For that reason these programs still pose a risk to the viability of wild stocks.

There has not yet been enough experience with supplementation programs that are based on defined integrated breeding protocols to quantify how much domestication will occur in such programs or how much damage they will cause to the natural spawning life cycle performance of wild stocks, as measured by adult-to-adult replacement rates of the wild spawning fish. It also is not yet clear how effective such programs will be at increasing the number of naturally spawning fish of naturally spawned origin, if they comply with the defined broodstock and outplanting constraints.

It is for these reasons that the ISAB and ISRP have recommended that supplementation of an existing wild stock should be implemented only on an experimental basis, in settings where some probability of damage to the wild stock can be tolerated, and where the progress of the experiment can be monitored. Effective monitoring is critical to ensure that we will learn from the experiment how much domestication really occurs, what is the effectiveness of such a program for increasing recruitment from natural spawning, and what is the cost to natural spawning fitness. To be effective for this purpose, monitoring in each such experiment must measure, over time: 1) the actual rates of drawing naturally spawned and hatchery spawned fish for broodstock, 2) the actual proportions of naturally spawned and hatchery spawned fish on the spawning grounds, 3) the natural spawning replacement rates in the supplemented population and in an unsupplemented control, and 4) the number of naturally spawning fish of naturally spawned origin in the supplemented population and an unsupplemented control. Because of natural variation in salmon productivity from one year to the next, and imperfect matching of treatment and control stocks and environments, reliable conclusions will require results from a number of implementations of this design. At present the experimental design(s) of the supplementation projects in the Columbia River Basin, based on the projects reviewed in our report, will not resolve these uncertainties.

These concerns about scale, experimental design, experimental control, and monitoring needs have been at the heart of the issues raised by the ISRP in their reviews of specific supplementation programs. These same concerns were explained in detail in the ISAB general review of supplementation.

Public enthusiasm over the record returns of salmon of the last few years further challenges us as scientists and managers to adequately communicate why these large current returns of mostly hatchery fish are not a sufficient measure of success at restoring wild populations. The critical evidence will be determining whether natural spawning by these returning adults is more or less productive than unsupplemented wild stocks, under equivalent conditions. We must bear in mind that even though present ocean conditions are good, they are expected to continue to cycle. As a result, it is important to determine not whether hatchery-based production has supplemented the natural returns in these recent years (it generally has), but whether these natural spawners (hatchery and wild) produce increased numbers of adult progeny in future years.