Columbia Basin Partnership
Workshop #2

On the Science of Salmon and Steelhead Hatcheries in the Columbia Basin

June 7, 2016

Paul Kline – Idaho Department of Fish and Game

Talk Outline

- The changing role of hatcheries
- The hatchery/wild interaction debate
- The development of scientific tools to better manage hatcheries
- Review some of the “new” tools

Hatcheries Re-focus

Harvest augmentation

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Mitigation

↓

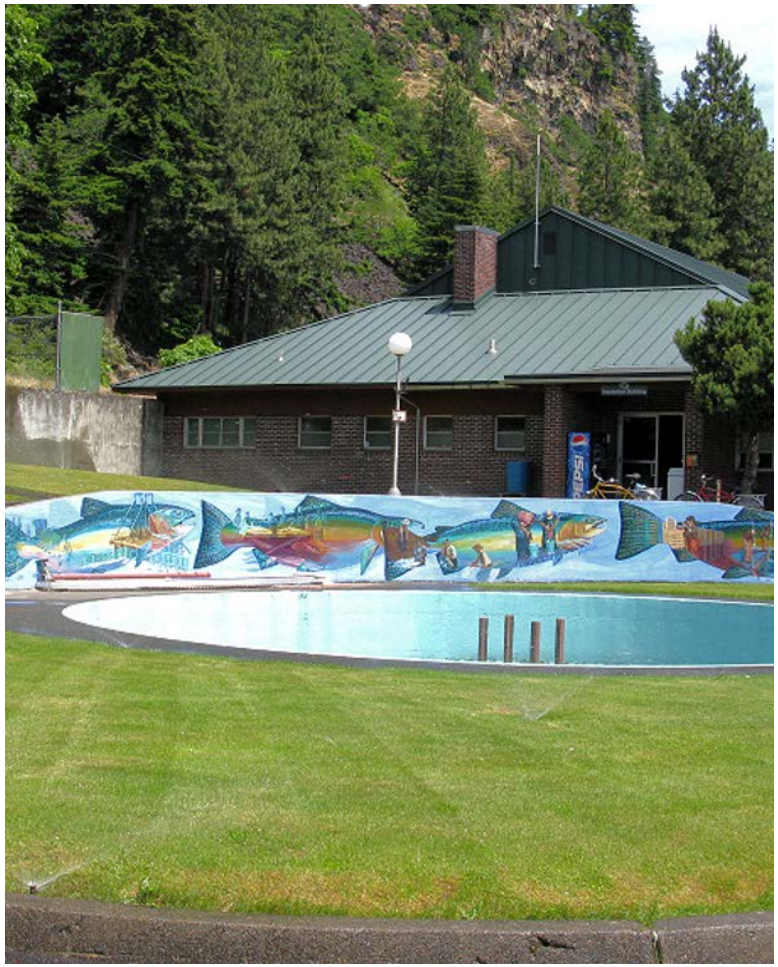
Reintroductions

↓

Supplementation

↓

Conservation



- Supplementation –
- Conservation –
  - Captive Rearing –
  - Captive Broodstocking –

First supplementation/conservation programs:

- Late 1970s: White River spring Chinook Salmon program (CB)
- 1982: Imnaha River spring Chinook Salmon program (Sup.)
- Mid 1980s: Umatilla salmon and steelhead programs (Sup.)
- 1991: Snake River sockeye salmon program (CB)
- I991: Idaho Supplementation Study, spring/summer Chinook (Sup).
- 1992: Dungeness River spring Chinook salmon program (CB)
- Early 1990s: Atlantic salmon programs (CB)
- 1992: Sacramento River winter Chinook salmon program (CB)

The Hatchery/Wild Debate

Risks included:

Genetic risks – reduced fitness from interbreeding

Ecological risks – from competition for food and space

Genetic Effects of Captive Breeding Cause a Rapid, Cumulative Fitness Decline in the Wild

Hitoshi Araki,* Becky Cooper, Michael S. Blouin

Reduced recruitment performance in natural populations of anadromous salmonids associated with hatchery-reared fish

M.W. Chilcote, K.W. Goodson, and M.R. Falcy

Fitness Decline under Relaxed Selection in Captive Populations

EDWIN H. BRYANT* AND DAVID H. REED

Department of Biology, University of Houston, Houston, TX 77204-5513, U.S.A.

Selection in Captivity during Supportive Breeding May Reduce Fitness in the Wild

MICHAEL J. FORD

National Marine Fisheries Service, Northwest Fisheries Science Center, Conservation Biology Division, 2725 Montlake Boulevard E., Seattle, WA 98112, U.S.A., email mike.ford@noaa.gov

Effects of Supportive Breeding on the Genetically Effective Population Size

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Fisheries, 2004, 29:9, 12-31

fisheries management **perspective**

The Controversy about Salmon Hatcheries

ABSTRACT

The use of hatcheries has been a subject of lengthy debate in the management of salmon and trout resources in the Pacific Northwest. The problem has resulted in part from the wide distribution of hatchery fish in circumstances where natural populations were disadvantaged by management policy involving hatchery fish and the confusion of the effects of management with the effects of artificial propagation. Recently, the controversy has been epitomized by the recommendations to fisheries management agencies that excess hatchery fish should not be allowed to spawn in the wild, and hatchery fish should be excluded from salmon populations listed under the Endangered Species Act. The authors of the present article disagree with those recommendations and conclude that hatchery fish have an important role in recovery and supplementation of wild stocks. The present article is an attempt to help give balance to the discussion by providing a different perspective on hatchery fish and the literature pertaining to artificial propagation.

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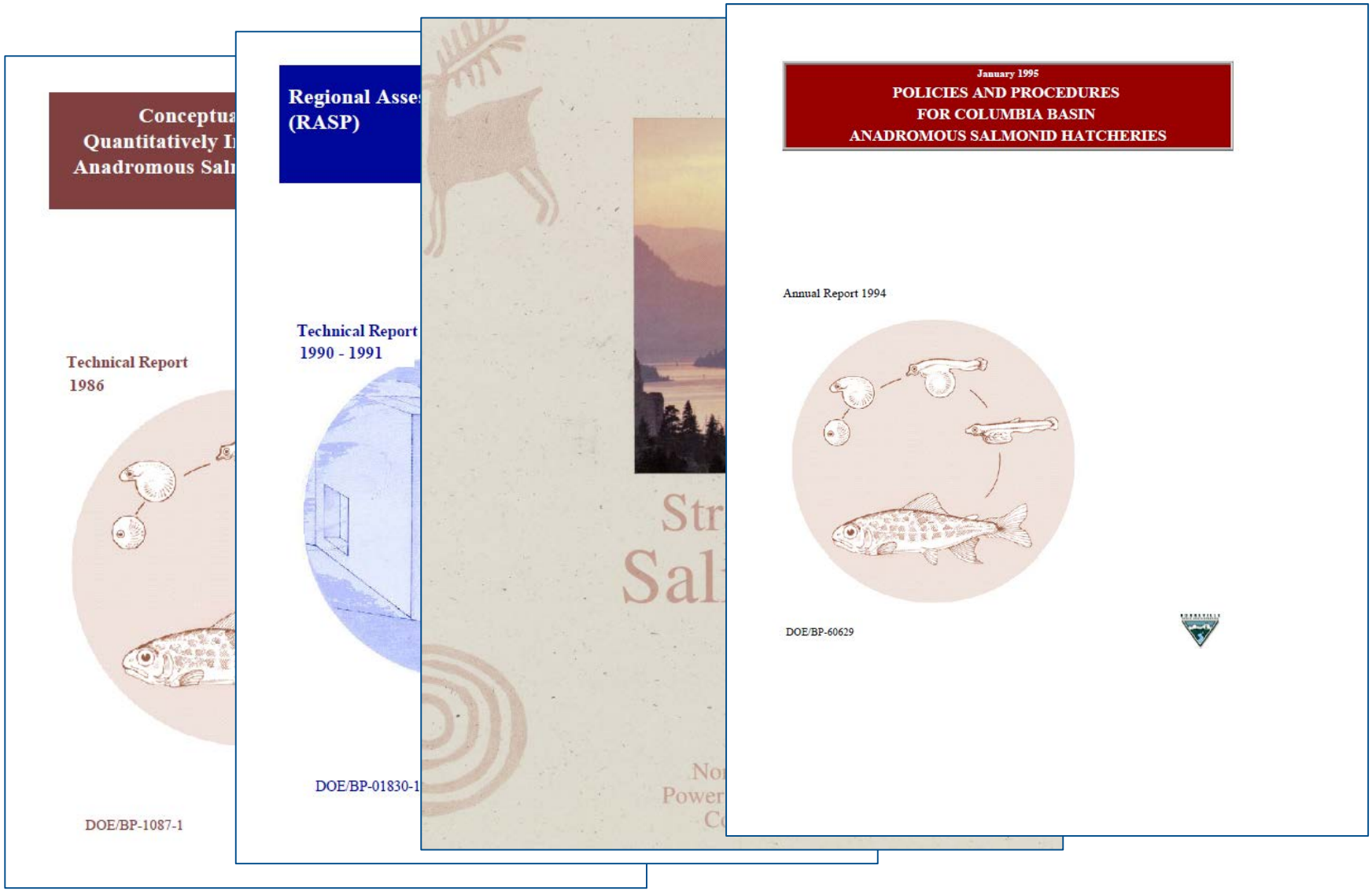
Introduction

Questions about the success of hatchery fish and their contribution to wild and native Pacific salmon and steelhead (*Oncorhynchus* ssp.) populations have garnered substantial controversy during the last century. Early in the history of hatchery production the issue was over-exploitation of wild fish mixed with hatchery fish that could sustain higher rates of harvest. The controversy shifted to objections about using hatcheries to mitigate for loss of habitat resulting from river development, such as hydropower production, and finally to concerns about the effect of hatchery fish on wild populations as reviewed by the National Research Council (1996). The general exclusion of hatchery fish from populations listed under the Endangered Species Act (ESA) (Waples 1991) intensified the debate, especially when hatchery programs, also sponsored under federal legislation, accounted for the majority of the salmon runs along the Pacific Coast. The present emphasis is now on supplementation programs designed to strengthen or to help recover native populations. However, two articles against hatchery fish coming from advisory committees (ISAB 2002; Myers et al. 2004) added notable uncertainty about the use of hatchery fish for supplementation of wild populations. The

Hatcheries Practices Modernize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FOR COLUMBIA BASIN
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Annual Report 1994
DOE/BP-60629

Review of Artific
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Part I
A Scientific
for Columbia River Pro

April 19

Scientific Revi
Independent Scientific

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Program Evaluation an
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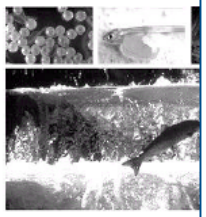
Artificial Productio



Report and Recommenda
Northwest Power Planni

Council document

October 13, 199

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APRE

Artificial Production Review and Evaluation

DRAFT
Basin-Level Report

Northwest Power and Conservation Council

Document 2003-17

October 7, 2003

Recommendations for Broad Scale Monitoring to Evaluate the Effects of Hatchery Supplementation on the Fitness of Natural Salmon and Steelhead Populations

Final Report of the Ad Hoc Supplementation Monitoring and Evaluation Workgroup*

Peter F. Galbreath[1], Chris A. Beasley[2], Barry A. Berejikian[3], Richard W. Carmichael[4], David E. Fast[5], Michael J. Ford[3], Jay A. Hesse[6], Lyman L. McDonald[7], Andrew R. Murdoch[8], Charles M. Peven[9], David A. Venditti[10]

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[2] Quantitative Consultants, Inc.
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[6] Nez Perce Tribe, Department of Fisheries Resources Management
[7] Western EcoSystems Technology, Inc.
[8] Washington Department of Fish and Wildlife
[9] Peven Consulting, Inc.
[10] Idaho Depart of Fish and Game

October 9, 2008

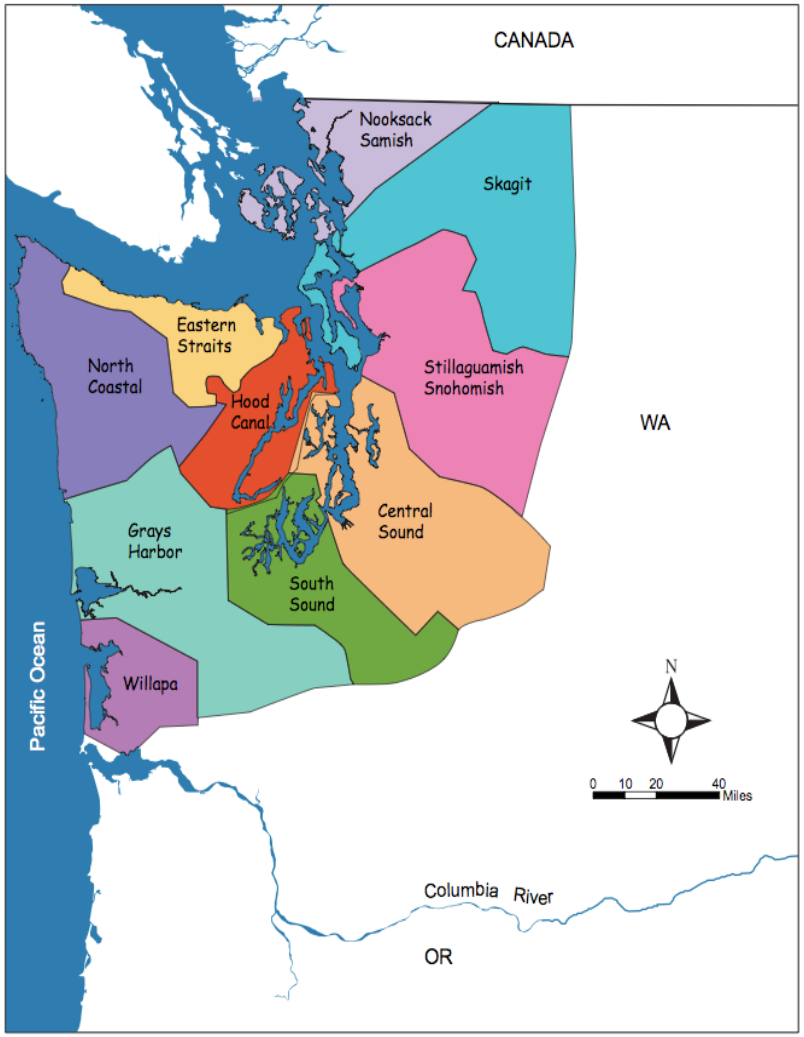
* Workgroup members participated as individuals, not as agency representatives. The report's content, conclusions and recommendations are solely those of the workgroup.

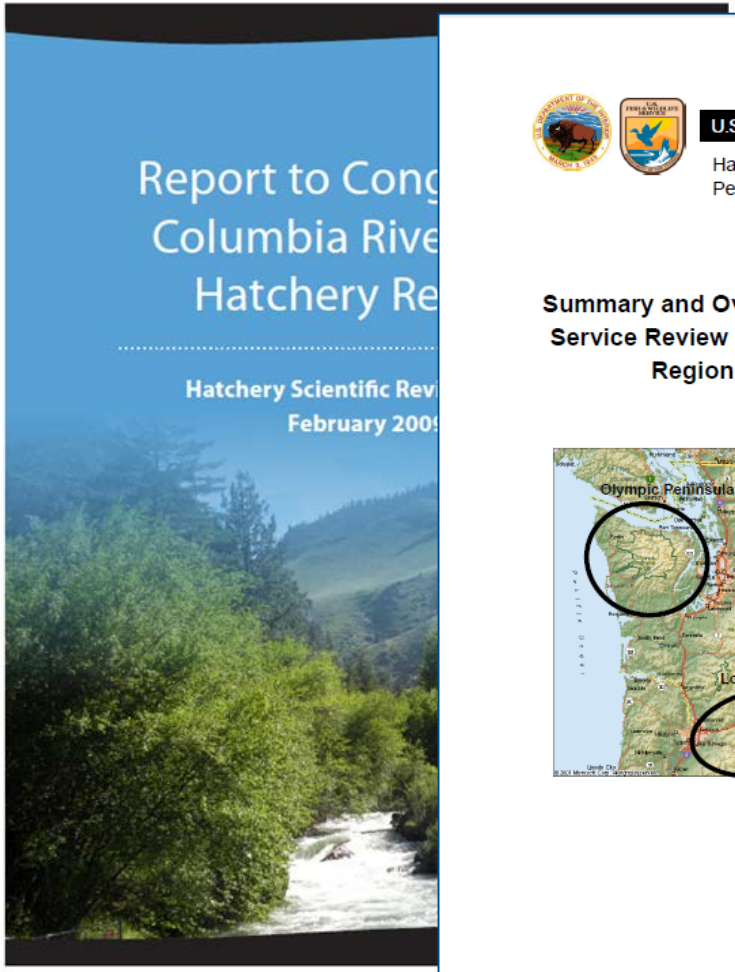
HATCHERY SCIENTIFIC REVIEW GROUP
Puget Sound and Coastal Washington Hatchery Reform Project

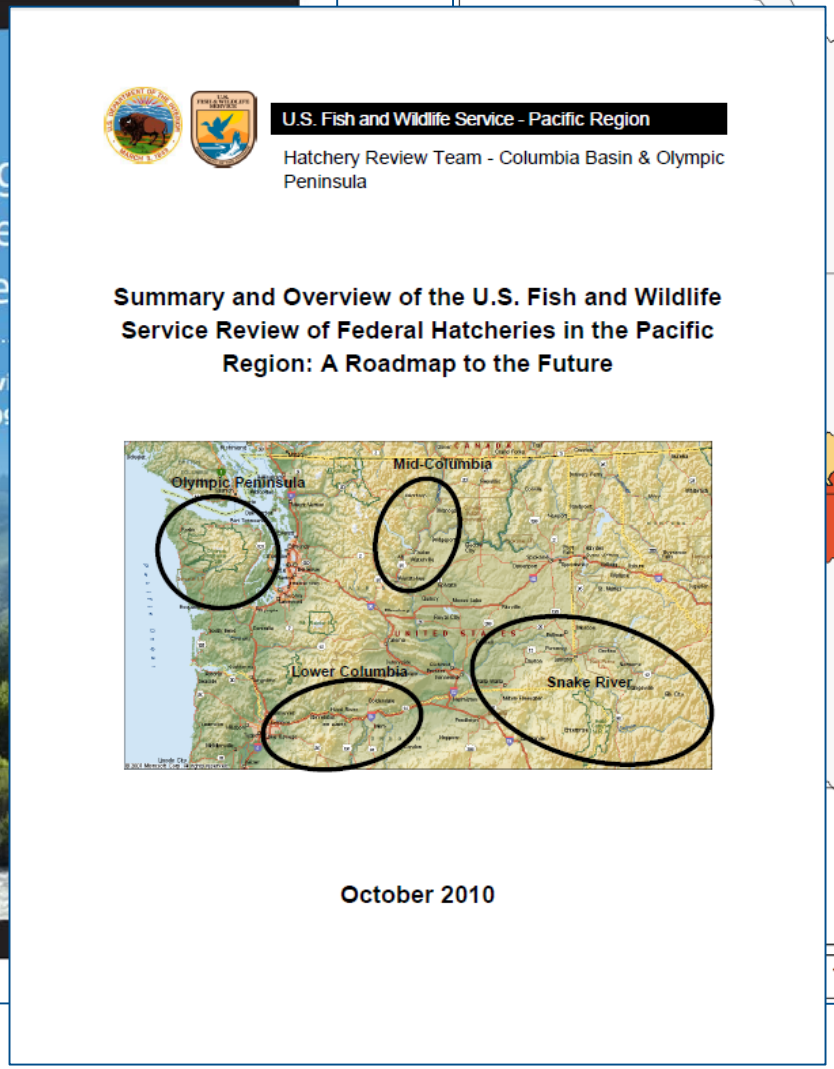
HATCHERY REFORM

Principles and Recommendations of the Hatchery Scientific Review Group

April 2004





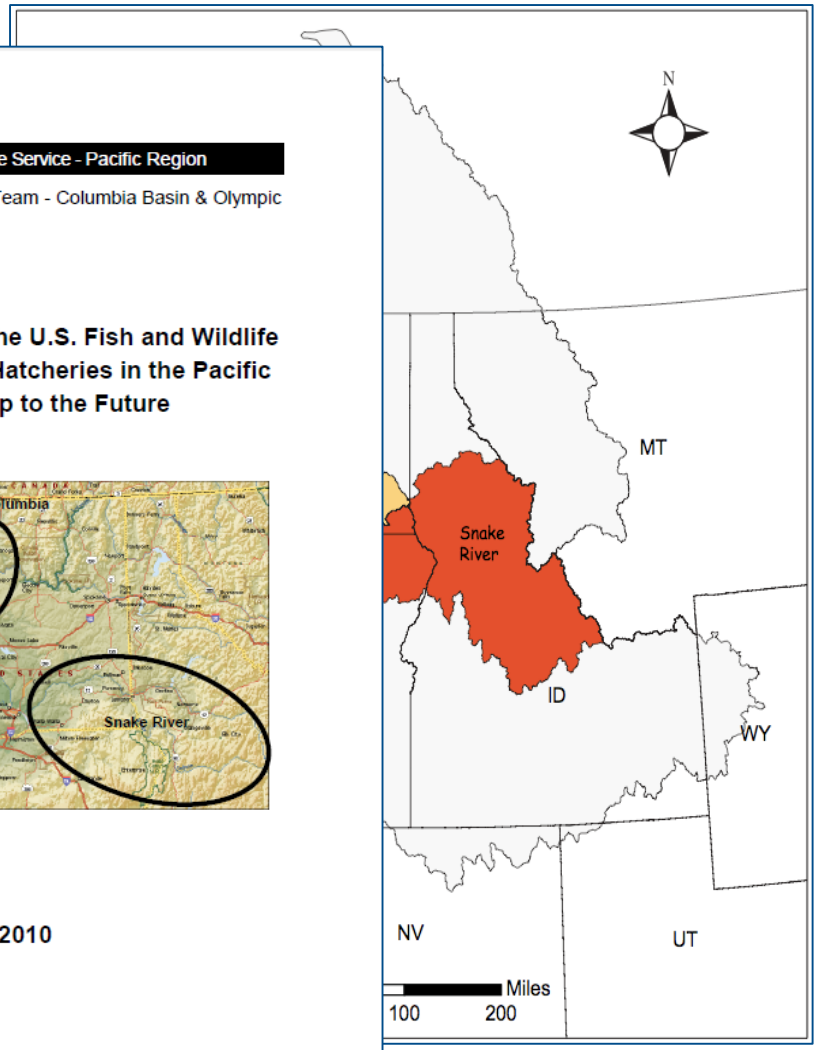


U.S. Fish and Wildlife Service - Pacific Region

Hatchery Review Team - Columbia Basin & Olympic Peninsula

Summary and Overview of the U.S. Fish and Wildlife Service Review of Federal Hatcheries in the Pacific Region: A Roadmap to the Future

October 2010



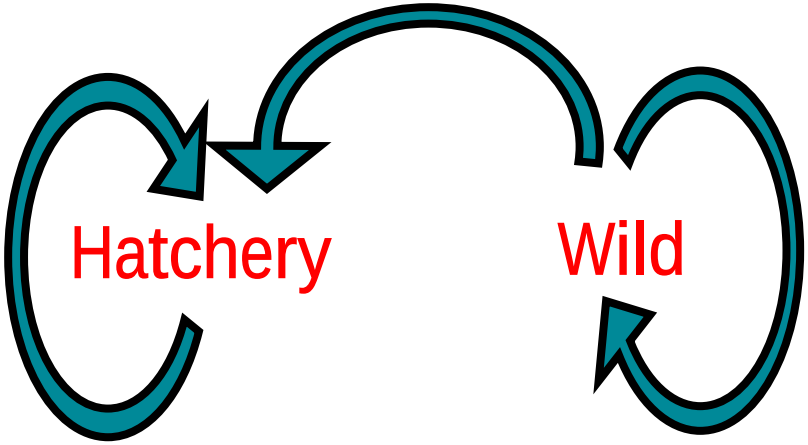
HSRG, USFWS Review Principles

- Manage hatchery broodstocks to achieve proper genetic integration with, or segregation from, natural populations
- Promote local adaptation of natural and hatchery populations
- Minimize adverse ecological interactions between hatchery- and natural-origin fish

Integrated Goal:

1 population,

2 environments

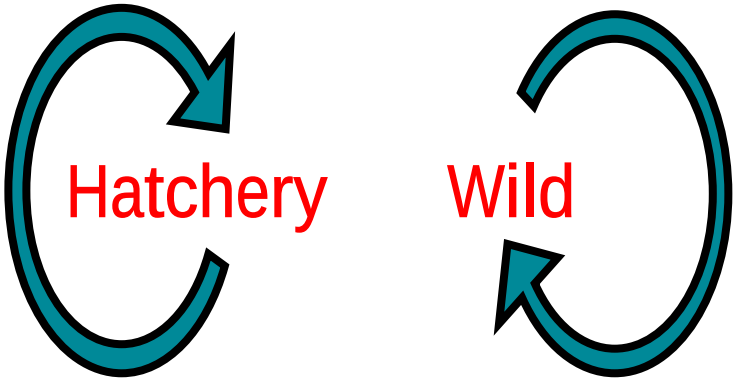


Integrated

Segregated Goal:

2 populations,

2 environments



Segregated

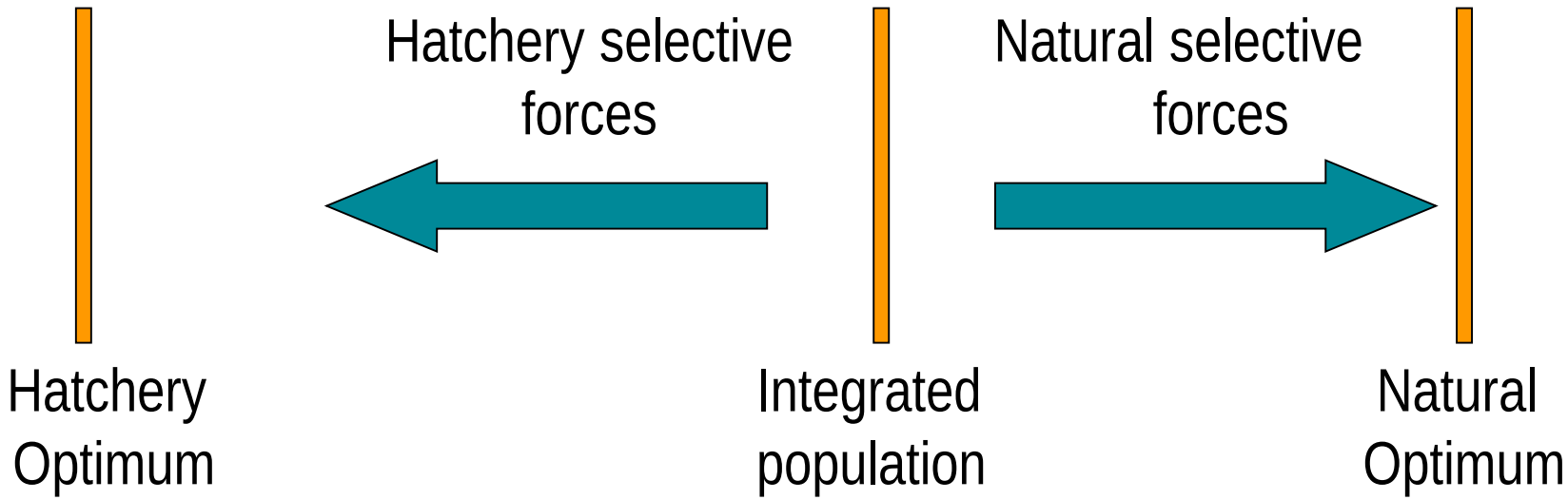
Proportionate Natural Influence –

an estimator of the selection pressure equilibrium point

$$PNI = \frac{pNOB}{pNOB + pHOS}$$

- pHOS = proportion of hatchery fish spawning
- pNOB = proportion of natural fish in broodstock
- PNI values > 0.5 indicates dominant selection pressure from the natural environment

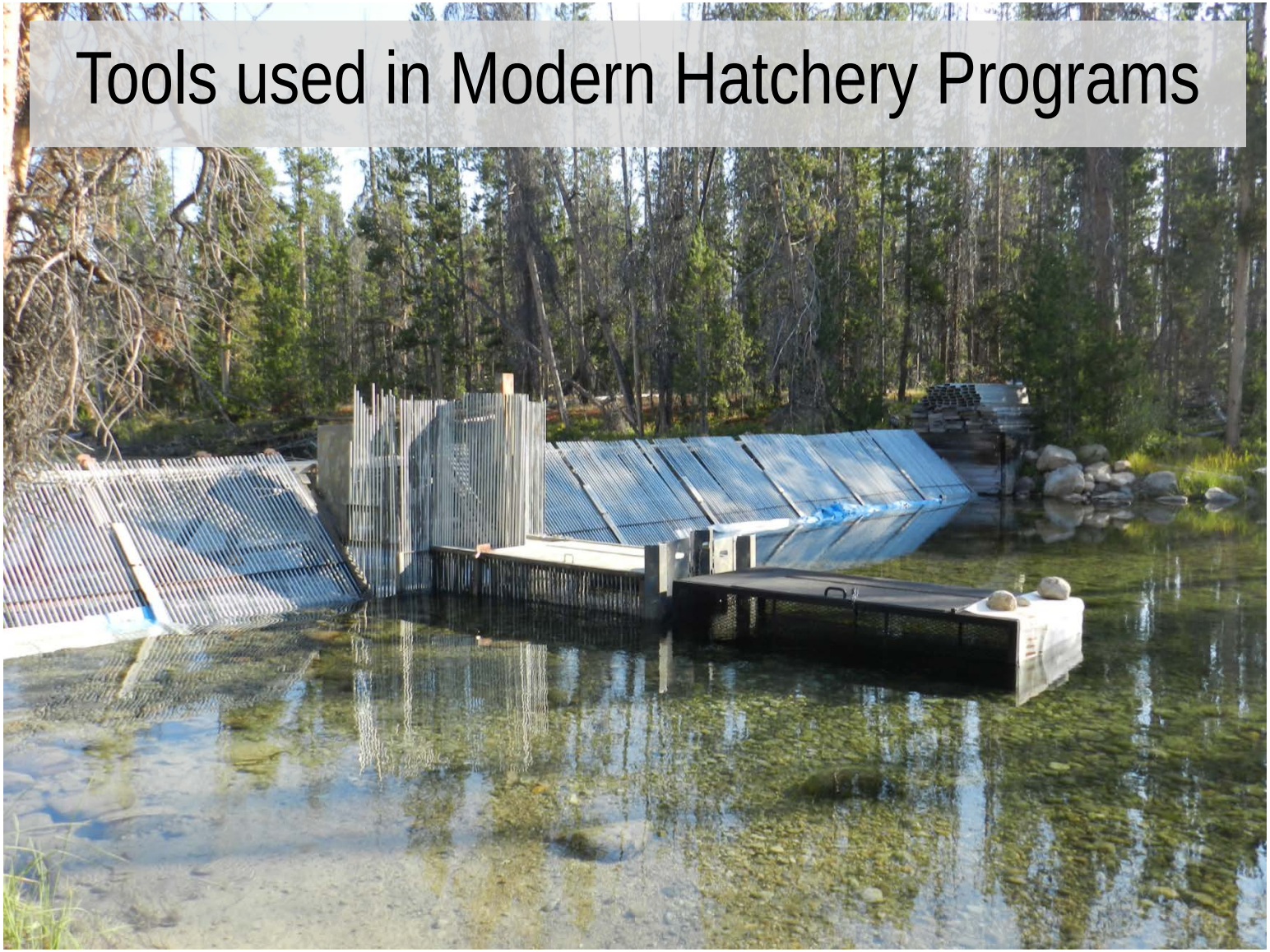
Natural selection pulls an integrated population in two directions



Equilibrium point is determined by balance between hatchery-to-wild and wild-to-hatchery gene flow rates

Ford, Michael J., June 2002. Conservation Biology. 16:815-825.

Tools used in Modern Hatchery Programs



In the Hatchery

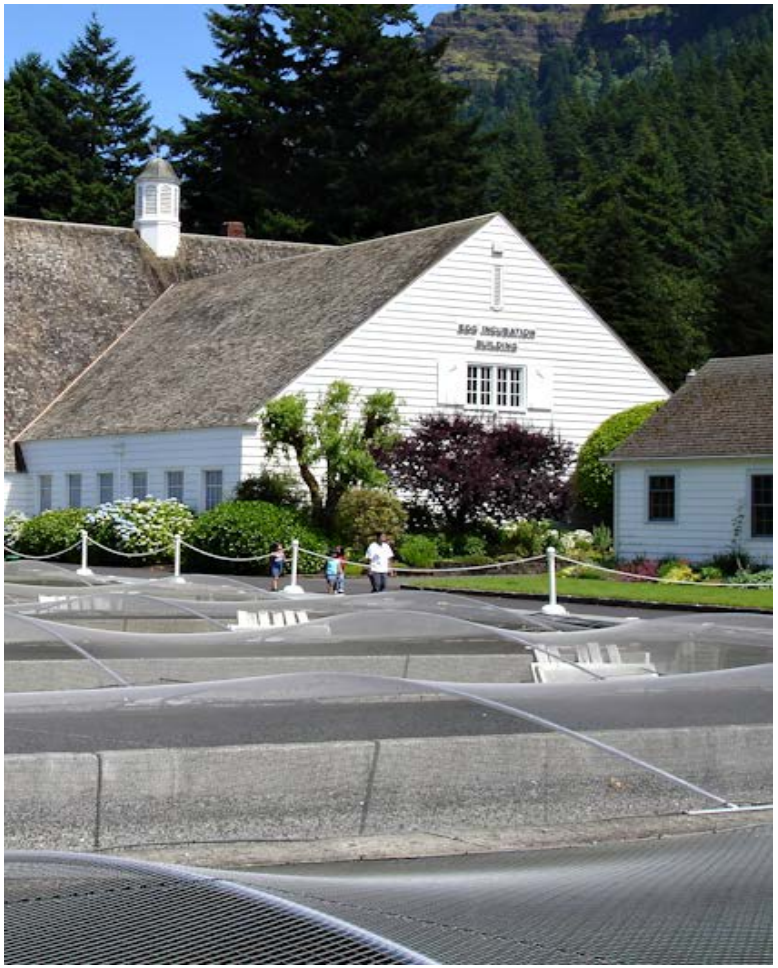
- Clearly defined goals/objectives – (segregated or integrated)
- Follow bmps for fish culture
- Stringent bio-security protocols
- Natures rearing
- Flexible facility layouts

- Mark production to enable
- identification of adult returns (cwt, PIT, fin clip, genetic marking such as pbt)

In the Hatchery

For Conservation Hatchery Programs

- Use localized broodstocks
- Factorial mating schemes and inbreeding avoidance matrices
- Sliding scale management to implement integrated broodstock management

In the Field

- Operate weirs effectively – to control unintended passage of hatchery fish
- Juvenile acclimation
- RM&E programs in place
- Adaptive Management