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Task Number 139

Integrated Hatchery Operations: Fish and Wildlife Program Costs and Other Economic Effects Phase 1

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Executive Summary

This report documents a preliminary investigation of the economic effects of implementing the Hatchery Scientific Review Group (HSRG) draft recommendations on Fish and Wildlife Program (FWP) projects. Phase I study focuses on incremental hatchery costs. A potential Phase II would broaden the context to include changes in harvest and habitat that would accompany implementation of the HSRG recommendations.

The HSRG recommendations could significantly increase the costs of the FWP. The report 1) analyzes direct effects of the recommendations on hatchery projects currently funded by BPA in the FWP (FWP projects), 2) considers the potential FWP cost impacts of HSRG recommendations for non-FWP hatchery projects, and 3) discusses some potential interactions involving habitat, harvest, and mainstem bypass operations. At the time of this writing, the HSRG report was still considered draft and subject to revision.

FWP projects. Based on Pisces data, the direct cost of FWP hatchery projects has recently averaged $20 million annually of which $18 million was paid by the FWP.[1] Indirect costs, primarily a share of research, monitoring and evaluation (RM&E), should be added to obtain the total FWP hatchery cost that might be affected. BPA estimates total FY 2008 FWP hatchery costs of $46.2 million including RM&E.[2] About 15 to 20 percent of recent FWP direct hatchery costs involved resident and sport fisheries that would probably be unaffected by HSRG recommendations.

Appendix 1 identifies important HSRG recommendations and considers potential costs for FWP hatchery projects. Important new investments were recommended for these FWP projects:

- New adult trapping facilities and rearing facilities at the Hood River Production Program;
- New acclimation facilities for the Umatilla Hatchery;
- For Coho Restoration Mid-Columbia, additional rearing locations in the upper Columbia River;
- Development, testing and deployment of live capture gear at the Nez Perce and Umatilla projects;
- Improvements to the fish weir on the Lostine River to benefit captive breeding under Northeast Oregon Hatchery project (NEOH) as well as conventional hatchery fish.

Additional costs may be required for planning, to allow separation of integrated and segregated populations, and for facilities and equipment.

Cost estimation is complicated by several issues. First, the cost to attribute to the HSRG recommendations depends on the cost baseline. Some HSRG recommendations were already required or planned through the Federal Columbia River Power System 2008 Biological Opinion (BiOp) or through hatchery Master Plans. Some have been planned even longer; the Lostine

[1] Pisces is BPA's Fish and Wildlife Program cost tracking system. See Table 1.
[2] FY 2008 Action Agency Columbia Basin Hatchery Costs. Pie diagram from Jeff Stier, 3/24/2009

weir, for example, since 2006. Some HSRG recommendations may be funded through the 2008 Columbia Basin Fish Accords Memoranda of Agreements (Fish Accords). The Fish Accords confirm the commitment of certain tribes, States and federal agencies to many hatchery projects potentially affected by HSRG recommendations.[3] The Fish Accords will provide funding for some HSRG recommendations at existing FWP hatcheries. However, new projects are proposed that are not covered by the HSRG recommendations.

Second, it is sometimes not clear what method or technology would be selected to implement a recommendation. Some projects are still in planning stages. In other cases there are no representative cost data or cost allocation among potential funding sources is not clear. Incremental costs might be less if recommended changes are accomplished using existing infrastructure, or more if facilities require unusual amenities or configurations.

Still, we estimate that, as a result of HSRG recommendations, the additional one-time investment costs (above and beyond BiOp costs) requested of BPA for existing FWP hatchery projects could be, as an order of magnitude estimate, about $10 to $20 million. By "order of magnitude" we mean that incremental capital costs would likely be in this range, but could be more or less. A large share of this cost might be covered under the Fish Accords. However, some of the projects in the Fish Accords are not yet planned or described in much detail.

In addition, HRSG recommendations would increase long-term annual operations costs through increased marking requirements, operation of live capture gear, adoption of selective harvest methods, and some additional transportation of fish. The additional costs for FWP hatchery projects, after considering some cost savings, might be, as an order of magnitude estimate, $1 to $2 million annually.[4] Again, it is not clear what share of this cost might be covered under the existing Fish Accords, and the estimated cost increase does not include some actions that were also required by the 2008 BiOp Reasonable and Prudent Alternatives.

The HSRG recommendations could also result in additional research, monitoring and evaluation (RM&E) costs. The potential RM&E costs have not been scoped, but some of these costs were also required or paid by other initiatives.

HSRG recommendations could reduce some operations costs at FWP hatcheries relative to planned operations. For example, production levels would be reduced at some hatcheries and some transportation of fish from outside of local river basins would be eliminated. An important share of FWP hatchery costs are related to the conservation, recovery and re-introduction objectives. Successful integrated hatchery operations should allow these projects to scale back operations and reduce costs. In the long run, hatchery operating cost savings from HSRG recommendations could be similar in size to operating cost increases.

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[3] 2008 Columbia Basin Fish Accords Memorandum of Agreement between the Three Treaty Tribes and FCRPS Action Agencies, between the Colville Tribes and FCRPS Action Agencies, between the State of Idaho and FCRPS Action Agencies, and between the Shoshone-Bannock Tribes and FCRPS Action Agencies.

[4] The make these annual costs comparable to the one-time investment costs, the annual costs should be expressed in net present value terms; the annual costs are discounted over an extended period using an accepted discount rate. The net present value of $1 to $2 million annually for 25 years is on the order of $14 to $35 million in net present value terms ($1 million at 5 percent, $2 million at 3 percent).

In summary, for FWP hatchery projects

1. The HSRG recommendations generally would not require major changes in planned operations at FWP hatchery projects, partly because many of the changes were already planned;
2. Therefore, the recommendations should not result in large incremental cost increases at these hatchery projects.

Incremental costs could be more if major re-engineering of existing hatcheries is required; no such changes have been identified.

Other Hatchery Projects. The FWP might be asked to fund HSRG recommendations at hatchery projects that are not currently within the FWP. BPA currently provides about $30 million annually for other federal hatchery projects. The potential for HSRG recommendations to increase costs at these federal hatcheries has not been analyzed on a project-by-project basis.

Other funding sources, especially Mitchell Act and State funds, are facing cutbacks related to changing federal priorities and reduced State revenues. BPA could be asked to fund HSRG recommendations outside of currently-funded hatchery projects simply because of a lack of funds from the other sources. In general, the types of changes suggested for hatcheries in the lower Basin, which tend to be funded by sources other than the FWP, are more significant than for hatcheries elsewhere. The provisions of Section 4(h)(10)(A) of the Northwest Power Act may limit BPA's responsibility at hatcheries where funding is currently provided by States or other agencies.

Hatchery operations costs at non-FWP hatcheries might be decreased by changing the species composition as well as total level of production. Hatchery production of all species except sockeye salmon would be reduced, so some cost savings at the other hatcheries might be expected, all else equal. Total operations cost savings system-wide from HSRG-recommended production reductions are estimated to be about $1.8 million annually.

Harvest and Habitat Interactions. FWP costs could be affected by changes in harvest patterns. HSRG recommendations often note that more selective harvest practices are needed to obtain population objectives. Common harvest-related problems include excessive straying of hatchery fish into the wild, insufficient escapement of natural-origin fish, or insufficient numbers of natural-origin fish for broodstock. The HSRG recommendations often include more marking of fish and changes in harvest practices to remedy these problems. Our order-of-magnitude estimate of increased FWP costs includes increased marking costs, costs for live capture gear, and new weirs and weir improvements. Additional operations costs associated with selective fisheries may involve enforcement and monitoring. Some of these costs are covered by the Fish Accords.

HSRG costs should be somewhat offset by benefits from larger harvests. The HSRG estimates that total harvest will be increased. For some populations, harvest would shift from ocean to mainstem and terminal fisheries.[5] A variety of interactions with international treaties and Native American treaties, as well as harvest management agreements, will affect the cost of HSRG

[5] HSRG 2008b.

recommendations and the value of fish harvested. More analysis of effects on total harvest and subsequent economic outcomes is suggested when a harvest BiOp is completed.

The HSRG recommendations interact with habitat projects in several ways. In most cases, the HSRG notes that population objectives depend on habitat conditions. In some cases, HSRG population objectives recognize the inadequacy of existing habitat. HSRG recommendations are part of an overall push to establish naturally self-reproducing populations. This initiative includes habitat projects as part of the overall package. Hatchery improvements will not, by themselves, increase habitat costs. However, the HSRG recommendations generally acknowledge the important synergies between integrated production and improved habitat. In the short run (the next ten years) existing commitments and legal pressures will probably not allow for changes in habitat costs in response to HSRG recommendations or their results. In the long run, if HSRG recommendations are successful in establishing naturally self-reproducing populations then legal pressures to increase habitat spending could diminish.

HSRG recommendations often note situations where data collection or reporting is inadequate. Research, monitoring and evaluation (RM&E) costs are currently almost 40 percent of FWP costs depending on the definition used. HSRG recommendations could have important effects on RM&E costs. Given the relatively large role the FWP has assumed in RM&E, this potential should be investigated further. We also recommend some cost engineering studies to estimate and compare costs of alternative selective harvest strategies and live capture, including weirs, modifications at existing facilities, and live capture gear.

Background

The Northwest Power Act Section 839b(h)(10)(D)(vi) requires that cost effectiveness be considered for projects brought before the Northwest Power and Conservation Council (Council) for funding.[6] The Independent Economic Analysis Board (IEAB) was established to advise the Council on appropriate economic methods for evaluating Fish and Wildlife Program (FWP) projects.

Hatcheries are an important part of the FWP. Hatchery policies and practices are changing in response to new knowledge about the interaction between hatchery and natural stocks. Most hatcheries practice segregated production whereby fish raised in hatcheries are separated from naturally produced fish. In segregated operations, hatchery fish should "not influence or alter the wild population."[7] Broodstock are taken from hatchery fish. In integrated operations, the hatchery is managed as part of the wild population. Natural broodstock are used to produce hatchery fish that have natural genetic characteristics and can contribute to the wild population.

The Hatchery Scientific Review Group (HSRG) was established and funded by Congress to provide independent and credible recommendations for hatchery reform. The HSRG's work ranges from general investigations about using hatcheries to help recover naturally spawning populations, to specific, science-based recommendations for individual populations.[8] The HSRG is recommending changes at Columbia Basin hatcheries to transform operations from segregated to integrated, where appropriate, or to ensure that segregated hatcheries are operated in a manner that best protects natural origin stocks. These changes will require capital investments and changes to operations and maintenance (O&M) and monitoring costs.

Ideally, HSRG recommendations would affect hatchery master plans in the earliest stages. The Council uses a three-step review process for hatchery project requests.[9] In Step 1 conceptual design plans are used to establish intent and scope. Step 2 is a preliminary progress review. After Step 2 a hatchery proposal should provide the specifics needed to ensure that the project can accomplish its intent and scope, and that financial plans and environmental review have been completed. After Step 3, the project goes out for bid.[10]

For hatchery plans still in early part of the step review it would be useful to address the HSRG recommendations at a conceptual level. For projects in later review, it would be helpful for decision-makers to address the HSRG recommendations at a more specific level. For existing projects, HSRG recommendations should become part of the "best available science" that NOAA must consider when issuing biological opinions in future ESA section 7 consultations. It is not clear how HSRG recommendations should affect decisions about existing projects, but it is

[6] The Act states that "In making its recommendations to BPA, the Council. . . shall determine whether the projects employ cost-effective measures to achieve program objectives."
[7] HSRG. Undated.
[8] See HSRG Undated and HSRG 2008a.
[9] A hatchery review is triggered when a project proposes any one of the following: (a) construct significant new productions facilities; (b) begin planting fish in waters they have not been planted in before; (c) increase significantly the number of fish being introduced; (d) change stocks or the number of stocks, and/or (e) change the location of the production facilities."
[10] NPCC. 2006.

expected that BPA and the Council will review the HSRG recommendations and implement them as deemed appropriate.

The change to integrated operations will affect other parts of the Fish and Wildlife Program. The HSRG stated in its "Preview of Key Findings for Lower Columbia River Hatchery Programs:"

> "The foundation of the HSRG's evaluation is that conservation goals need to be met for key natural populations while at the same time maximizing harvest. In order for hatchery actions to effectively address conservation goals, harvest reforms are also necessary."[11]

The HSRG concluded that managers must implement harvest reforms to achieve conservation and harvest goals, and they noted that "benefits of habitat quality improvements would double if combined with hatchery reforms."

Three important questions for the NPCC are raised by the HSRG's recommendations:

- What cost changes can be expected for hatcheries within the FWP?
- What other changes to Fish and Wildlife Program costs, including costs at other hatcheries, may be expected, and
- What other economic impacts such as changes in harvest practices and income can be expected?

What cost changes can be expected for FWP hatcheries?

The main purpose of this work was to estimate changes in costs at hatcheries funded by the FWP caused by HSRG recommendations. The HSRG process did not provide the needed cost information.

The IEAB has approached this question by these steps:

1. What share of FWP costs may be directly affected?

2. How will costs at FWP hatcheries be affected?

3. What is the amount of cost change that might be expected?

BPA (2008) reported on types of work funded by contracts signed on or after October 1 2004 and through December 14, 2008.[12] During this period, $668 million in contracts were let, or about $167 million per year. Most FWP program costs paid for research, monitoring and evaluation (RM&E) and data management (39%) and habitat (25%). Of the $668 million, $79 million or 12 percent was for hatchery construction, operation or maintenance (Table 1, tables follow text). The annual FWP cost of hatchery projects was about $20 million ($79/4).

[11] HSRG 2007.
[12] Bonneville Power Administration. 2008a.

Categories of contract expenditure can be ambiguous. In this case, some of the RM&E was surely hatchery-related. In FY 2008, BPA estimates that expenditures for FWP hatchery projects, including RM&E, were $46.2 million.[13]

Some hatchery costs involve species that would be unaffected by HSRG recommendations. The IEAB used BPA's PISCES database of Fiscal Year (FY) 2005 through 2008 hatchery costs to consider this distinction. About 18 percent of the 4-year hatchery costs involved sturgeon, bull trout, kokanee salmon, Pacific lamprey, other resident species and local sport fisheries.

Table 1 (table follows text) provides data on BPA hatchery projects for anadromous salmonids that could be directly affected by HSRG recommendations. The largest reported cost shares during the FY 2005 to 2008 period paid for Redfish Lake and Snake River Sockeye programs (13.6%), Yakima-Klikitat (13%), Umatilla Hatchery and related passage (10.6%), and Nez Perce Tribal Hatchery (10.2%). Other large shares were reported for SAFE (7.2%), Grand Ronde programs (5.5%) and subsequent Oregon and Idaho spring and upriver fall Chinook programs.

The 2008 Columbia Basin Fish Accords Memoranda of Agreements (Fish Accords) confirm the commitment of certain tribes, States and federal agencies to pursue salmon and steelhead hatchery projects during the 2008 to 2017 period. The cost of FWP hatchery projects is expected to increase relative to the recent past because of proposed expansion of existing projects as well as new projects. These expansions and new projects are informed by independent science review. The IEAB estimates that, if all Fish Accord projects are approved as envisioned, these annual average cost increases can be expected relative to 2004 to 2008 averages:

- Existing and expanded hatchery planning and O&M (Primarily Hood River, Yakima-Klikitat Fisheries Project (YKFP), reconditioning steelhead Kelts, Mid-Columbia Coho Restoration): $5.8 million;
- New hatchery planning and O&M (primarily Wenatchee, Yakima, Upper Columbia, Snake R. and administration but not sturgeon): $3.6 million;
- Commitments for new hatchery investments, including Chief Joseph, YKFP, Walla Walla and Hood River: $13.4 million. (Cost sharing may be obtained for some costs)

These data suggest that the Fish Accords will increase the amount of FWP direct hatchery costs relative to the recent past. Detailed information about most Fish Accord project costs was not available in time to inform this report. However, some Fish Accord funding will likely be used to help existing projects meet HSRG recommendations even though this funding is not explicitly mentioned in the Accords. It is also important to note that some new Fish Accord projects were not covered by the HSRG recommendations, and many existing FWP hatchery projects are not covered by the Fish Accords.

The IEAB worked with NPCC staff to develop a list of projects that are potentially most affected by HSRG recommendations. The list of projects, along with information about their status in other hatchery-related processes, is provided in Figure 1.

[13] Jeff Stier, personal communication, 2009.

Figure 1. FWP Hatchery Projects that Could be Substantially Affected by HSRG Recommendations

	Project	HSRG Did Not Cover	HSRG Suggested Release Already Required by BiOp	Covered by a Recent Master Plan	HSRG Costs may be Covered by Fish Accords
1	Nez Perce Tribal Hatchery				
2	Pittsburg Landing Fall Chinook Acclimation Project				
3	Umatilla Hatchery and related operations				X
4	Yakima (Cle Elum - spring Chinook)				X
5	Klikitat River			X	X
6	Hood River Production Program			X	X
7	Select Area Fisheries Enhancement				
8	Coho Restoration Mid-Columbia				X
9	Johnson Creek Artificial Propagation Enhancement Project				
10	Reintroduce Chum Salmon/ Duncan Creek				
11	Chief Joseph Dam Hatchery	X		X	X
12	Manchester Spring Ch. Captive Breeding				X
13	Northeast Oregon Hatchery Master Plan (NEOH)				X
14	Oregon Spring Chinook Captive Breeding				X
15	Idaho Spring Chinook Captive Breeding				X
16	Snake River Sockeye Captive Breeding		X		X
17	Walla Walla Spring Chinook Master Plan	X			X

Table 2 provides information about the purposes, operations and target species of these hatchery projects. These projects are not mutually exclusive. In particular, projects 12 through 16 are interrelated. Projects 3 through 6, 8 and 11 through 17 are slated for funding and development under the Fish Accords. This list, however, does not include all projects to be funded by the Fish Accords.

We next reviewed HSRG (2008a) recommendations. The recommendations are provided by population, so some interpretation was necessary involving which hatcheries affect which populations. Our summary of potentially important recommendations with some preliminary cost investigations is provided in Appendix 1. Appendix 2 provides the entire group of HSRG recommendations used to evaluate cost changes at FWP hatcheries.

Two projects, 11 and 17, are in early stages. The Chief Joseph Dam Hatchery project is currently in Step 2 review and has not been recommended for implementation. The Walla Walla Spring Chinook Master Plan has not been approved and has not had environmental and design reviews. Neither of these projects was reviewed by the HSRG. The HSRG recommendations in these

subbasins only apply to the existing programs.[14] Since the HSRG recommendations do not apply to these projects no incremental costs can be evaluated.

Three projects, 5. 6, and 11, have recent approved Master Plans. For these, the IEAB identifies some differences between HSRG recommendations and the Master Plans and documents how some Master Plan costs are related to HSRG recommendations.

To estimate costs associated with the HSRG recommendations, the IEAB reviewed data from available sources to obtain comparable cost information. Some sources were:

- Hood River and Klikitat master plans (Confederated Tribes and Bands of the Yakama Nation and WDFW 2008; HDR|FishPro, 2008);
- The IEAB study of hatchery costs (IEAB 2002);
- Information about marking costs was obtained from Pacific Streamkeepers Federation (2007);
- Historical costs paid by BPA for similar improvements.

Several issues complicated the cost estimation exercise. It is difficult to attribute particular costs to HSRG recommendations. Some improvements were already planned or were part of Biological Opinions prior to HSRG recommendations. We have assumed that most Bacterial Kidney Disease (BKD) control actions recommended by the HSRG would be required even without HSRG recommendations. For some recommendations, options are still being considered. For example, live capture gear may substitute for fish weirs in some places. On the Hood River, the HSRG suggested a fish weir at the Powerdale site but the Council recently approved the Master Plan which includes two weirs upstream instead. In some locations, proposed improvements are unique so that no representative cost data are available. Cost engineering studies will be required. In still others, appropriate cost sharing among BPA, other federal agencies, states and tribes is not clear.

Appendix 1 shows the HSRG (2008a) recommendations with our rough cost estimates for each recommendation. Our best "order of magnitude" estimates of the important investment costs are:

- $2.5 million for new adult trapping facilities and rearing facilities on the Hood River, also included in the Master Plan. A rearing facility at Moving Falls is expected to cost $1.85 million and two weirs upstream instead are expected to cost $750,000;
- For Coho Restoration Mid-Columbia, additional rearing locations in the upper Columbia River, we assume 2 sites at $1.5 million apiece, or $3 million overall;
- $2 million for new acclimation facilities for the Umatilla project;
- $1 million for development, testing and deployment of live capture gear at the Nez Perce and Umatilla projects;
- $1 million for the Grande Ronde/spring Chinook captive breeding project to improve the fish weir on the Lostine River; a similar cost may be required on the Imnaha.

[14] In the case of Chief Joseph, the proponents are planning using HSRG recommended methods. A preliminary review indicates that this project is likely to meet the criteria and standards recommended by the HSRG. Paquette, 2009.

Roughly, these increased investment costs amount to $10 to $20 million. Some of these costs will be funded within the existing Fish Accords. However, there is not enough information about projects to be funded under the Fish Accord MOA with the three treaty tribes to determine if these costs are covered or not.

Incremental costs could be more if important structural changes at existing hatcheries are required. For example, at the Umatilla hatchery, the existing integrated operation for Spring Chinook would change to segregated and integrated. Therefore, the hatchery would need to maintain two separate populations of Spring Chinook. We have not identified any investment costs associated with such structural changes; these should be investigated.

Important annual operating cost increases could be expected. Most estimated costs are for additional marking of fish. Operations costs for the new Hood River facilities in the Master Plan are expected to be about $150,000 annually. It is assumed that the FWP would pay for additional costs of acclimating 2.1 million fish at Select Area Fisheries Enhancement (SAFE) at a cost of $480,000 annually. Costs of increased production of Snake River sockeye are not counted because this action was included in the 2008 FCRPS BiOp RPA Action 42. Roughly, the increase in O&M cost at FWP hatcheries caused by the HSRG recommendations appears to be $1 to $2 million annually. Again, some of these costs will be funded within the existing Fish Accords.

Since production levels would be reduced at some hatcheries, cost savings might be associated with reduced transportation costs and more successful re-introductions from integrated operations. These cost savings are not counted in the $1 to $2 million of annual costs.

What other changes to Fish and Wildlife Program costs may be expected?

The HSRG recommendations might affect FWP costs in many other ways. The Scope of our work did not allow us to identify how the BiOp or the Accords might interact with HSRG recommendations to affect FWP costs. In general,

- The FWP might contribute funds at hatcheries or for populations not currently funded by the FWP;
- The FWP might contribute more funds for M&E needed to support integrated operations;
- Changes in fish populations in natal streams might lead to changes in habitat expenses;
- Changes in fish populations might lead to changes in mainstem operations.

Potential to share in other costs

BPA may be asked to share in increased costs in hatchery operations that are not currently part of the FWP. To gauge the potential size of non-FWP contributions, the IEAB investigated the amount of contribution by non-FWP sources. BPA estimates total FY 2008 FWP hatchery costs of $46.2 million including RM&E.[15] BPA also provides direct funding for hatchery programs

[15] FY 2008 Action Agency Columbia Basin Hatchery Costs. Pie diagram from Jeff Stier, 3/24/2009

managed by other agencies, such as the USFWS Lower Snake River Compensation Plan (LSRCP) hatcheries. In FY 2008 BPA provided LSRCP funding of $19.4 million, plus $11 million for other federal agency hatchery projects.

Other federal contributions for Columbia basin hatcheries include Mitchell Act funds, reported to be about $11 million in 2004 and 2006.[16] Oregon reported a non-federal contribution of $6.7 million in 2003.[17] In 2007, the Oregon 2007-09 Legislatively Adopted Budget for fish propagation was $47.45 million of which $5.7 and $9.5 million were provided from State general funds and other non-federal sources, respectively. In 2001, Washington reported a 1999-01 biennium hatcheries division budget of $56.26 million which included $17.3 million of State general funds, or about $8.6 million annually.[18] The remaining non-federal share of the Washington State costs was not reported. Some of the reported State costs are not Columbia basin or anadromous fish costs.

NOAA (2008) reports that BPA provided $50.1 million of total $87.5 million in hatchery O&M costs in the basin in FY 2006. Most of the non-BPA share was provided by utilities ($14 million), Mitchell Act ($11 million) and other federal agencies ($9.7 million)

From these data it appears that BPA recently funded well more than half of hatchery O&M and RM&E costs in the region.[19] Outside of the FWP, there is potential for BPA costs to be increased because of the other hatcheries that BPA funds. The potential for HSRG recommendations to result in increased costs at these hatcheries has not been analyzed.

At other hatcheries, the provisions of Section 4(h)(10)(A) of the Northwest Power Act may limit BPA's potential role. The Act provides that

> Expenditures of the Administrator pursuant to this paragraph shall be in addition to, not in lieu of, other expenditures authorized or required from other entities under other agreements or provisions of law.

Council staff note that "The in-lieu provision is not a matter of policy. It is a matter of law that prohibits Bonneville from funding an action in lieu of funds authorized or required from others."[20] However, funding of HSRG recommendations at other hatcheries may not be authorized or required from others, so BPA might still be asked to contribute. The IEAB is not qualified to review the extent to which funding of HSRG recommendations in this situation may be allowed or required.

Operations costs at non-FWP hatcheries may be increased by changing species composition. Table 3 shows preliminary current and HSRG recommended production levels by ESU. These data suggest that coho and fall run Chinook production are expected to decrease by about 3.5 and 1.9 million smolts, respectively. [21] Coho and fall Chinook operations costs are about $0.35 and

[16] NOAA 2008; BPA 2004
[17] ODFW 2008.
[18] WDFW 2008.
[19] (46.2+19.4+11)/(46.2+19.4+11+5.7+9.5+17.3/2)
[20] Fritch and Shurts, 2009.
[21] Deschutes fall Chinook production is not counted in these estimates.

$0.10 per smolt released.[22] Therefore, potential operations cost savings system-wide are about $1.4 ($1.2 + $0.19) million annually. The reduced coho production is about 20 percent of current levels. The reduced fall run production is only about 2.8 percent of current levels or about 70 million smolts;

The HSRG also recommends reduced production of spring and summer Chinook, chum salmon and steelhead, but these changes are small relative to current levels. Spring/summer chinook, chum salmon and steelhead releases would decrease by 341,000, 111,000 and 158,000 respectively. At an operations cost per fish of $0.60, $0.10 and $1.30, additional cost savings would be $421,000 annually. With the savings from coho and fall Chinook, total annual operations cost savings basin-wide could reach $1.8 million annually.

Sockeye production would increase by 599,000 fish. The increased sockeye production could be expensive but this plan is also required by FCRPS BiOP RPA Action 42.. Otherwise, and all else equal, these data suggest that total operations costs could be decreased by HSRG recommendations. These cost savings could help compensate for other cost increases required by the recommendations.

The next steps to judge total cost increases should be additional scoping of potential cost responsibilities at non-FWP hatcheries, and if warranted, analysis of the HSRG recommendations at these hatcheries.

Harvest

Documentation of the HSRG process frequently notes the close relationship between natural population objectives and harvest strategies. Common problems include excessive straying of hatchery fish into the wild, insufficient escapement of natural-origin fish, or insufficient numbers of natural-origin fish for broodstock. HSRG recommendations often note that more selective harvest practices are needed to remedy these problems. For the Upper Columbia River summer/fall Chinook, for example, “Selective fisheries are essential to ensure survival of sufficient natural fish while allowing fisheries to continue at such high rates. The HSRG recommends that all freshwater sport fisheries immediately be managed selectively. The Colville Tribes’ growing ceremonial and subsistence fishery should continue to develop its selective capacity. Research on selective fishing gears for commercial fishing should commence immediately.”[23]The Colville Fish Accord provides for new harvest gear research and testing. In the lower Columbia, straying of hatchery stocks from projects such as SAFE should be reduced through better selective harvest in commercial fisheries.

The HSRG recommendations often include more marking of fish; specifically, marking by adipose fin clips allows for easy identification of hatchery adults. Our FWP cost analysis included increased marking costs at BPA-funded hatcheries, costs for live capture gear, and new weirs and weir improvements. Some of these costs were also required by BiOp RPAs. Additional operations costs associated with selective fisheries may involve harvest operations, enforcement and monitoring. Many of the costs of selective fisheries would be borne by the State and tribal agencies that have jurisdiction over recreational and tribal fisheries.

[22] The Research Group. Undated.
[23] HSRG. 2008b.

Other costs and benefits will be paid by fishers who must release wild fish but who benefit by an expanded local fishery. The HSRG estimates that total harvest will be increased. In some cases, increased daily bag limits on hatchery fish can be expected. In general, the increased annual costs of selective harvest operations should be somewhat offset by larger harvest volumes. For some populations, harvest would shift from ocean to mainstem and terminal fisheries.[24] For these populations, ocean harvesters may lose revenue while sport and tribal fishers benefit.

There are a host of international salmon treaties and agreements that affect protection and harvests of Columbia River salmon. These include the 1992 International North Pacific Fisheries Commission (INPFC) Convention and the Pacific Salmon Treaty (PST) between the United States and Canada. These normally state that the country from which the stocks originate has the right to harvest these stocks and an obligation to protect the same.

Harvest management agreements and rebuilding obligations between the United States and Canada are updated periodically. The latest agreement under the PST took effect on January 1, 2009, and will remain in place through 2018. A key provision for the (US) SE Alaska ocean fishery is that the current Chinook maximum catch levels would be reduced by 15 percent, and by 30 percent in the case of the west coast of Vancouver Island Canadian fishery.

Funds would be provided to mitigate for harvest reductions and to support selective harvest programs.

"A fund will be created, endowed by both the US and Canada, to support implementation of the Chinook chapter. Key elements would include:

- $30M which Canada can access to help mitigate the impacts of harvest reductions in Canada;
- $15M ($7.5M from each country) to support the coastwide coded-wire tag (CWT) program;
- $10M from the Northern and Southern Endowments Funds for a "Sentinel Stocks Program";
- up to $3M which Canada can access to support pilot projects and the evaluation of mass-marking and mark-selective fisheries in Canada; and
- $1M to improve the analytical models to implement the Chinook agreement."

A variety of agreements, laws and court decisions set guidelines and hard limits to the totals and shares of salmon that may be taken by any entity. These include the Pacific Fishery Management Council (PFMC) salmon harvest management process, agreements to rebuild salmon stocks as codified in the Northwest Power Act, court decisions that have defined obligations to Northwest Indian Tribes, and most recently, court mandates to protect listed salmon stocks

Relationships between the HSRG recommendations and the above treaties and agreements, as they relate to harvests, need to be analyzed in more detail. For example, about six percent of fall Chinook originating from the Columbia River system will be harvested off Alaska and 25 percent in Canadian waters. About 13 percent will be harvested off the Washington coast.

[24] Ibid.

Questions such as the following should be addressed. How will the HSRG recommendations address the changes in the 2009 Pacific Salmon Treaty? There is currently no scientific agreement about the efficacy of ocean selective harvest programs. Can the PFMC be induced to reduce overall Chinook harvest off the Washington coast while Canada is not asked to make additional reductions in their harvest? Until there is a harvest BiOp it will be difficult to fully evaluate the implications of the HSRG recommendations. This topic could be investigated in a Phase II study.

This HSRG Phase I report does not include harvest costs or benefits in this report. However, these costs and benefits should be analyzed, especially as a total HSRG review is completed and production and harvest changes take place in treaties and management agreements. Analysis of economic impacts, overall expected smolt production, expected adult survivals, and distribution of harvest can only be completed when a harvest review is completed.

Naish et al. (2008) review the history and consequences of hatchery programs and find that

> Economic issues have rarely been included in decision making on hatchery programmes. . . Hatcheries have played an important role in sustaining some highly endangered populations, and it is possible that reform of practices will lead to an increase in the number of successful programmes. However, a serious appraisal of the role of hatcheries in meeting broader needs is urgently warranted and should take place at the scientific, but more effectively, at the societal level.

Habitat

For most of the populations affected by FWP hatcheries, the HSRG concluded that

> "(a) hatchery and harvest reforms alone will not achieve recovery of listed populations (habitat improvements are also necessary), and (b) effectiveness of habitat actions will be greatly increased if they are combined with hatchery and harvest reforms."[25]

The HSRG often notes that, even with hatchery improvements, habitat limits production. For fall run Chinook produced by the Nez Perce, the HSRG "could not increase natural-origin spawning under current habitat conditions. Because the HSRG was unable to craft a scenario that increased natural origin spawning our recommendations focused on near term improvements to the current programs." In the Upper Grand Ronde River, "because of low habitat productivity, the HSRG was unable to craft a solution to improve the population designation from Stabilizing."[26]

HSRG recommendations are part of an overall effort to establish naturally self-reproducing populations. This initiative includes habitat projects as part of the overall recovery package. Hatchery improvements will not, by themselves, increase habitat costs. However, the HSRG recommendations generally acknowledge the important synergies between integrated production and improved habitat. HSRG recommendations could increase the measured productivity of habitat. In some cases, successful integrated production programs could increase incentives to accelerate habitat restoration. On the other hand, if HSRG recommendations are successful in

[25].Ibid. Spring run Chinook produced by the Nez Perce appear to be one exception.
[26] Ibid

establishing naturally self-reproducing populations, legal pressures to increase habitat spending could diminish.

Mainstem Operations and Transportation

The potential effects on mainstem operations are somewhat similar to those for habitat. Increased numbers of juveniles could result in increased demand for spill or transportation. Currently, juvenile transportation and spill standards sometimes allow transportation to cease when no juveniles are present. Therefore, larger up-river populations could increase transportation costs. On the other hand, recovered populations would be likely to enable more flexibility in selecting cost-effective methods of maintaining the healthy populations, and this could result in substantial cost savings.

Conclusions

The preceding discussion suggests that a Phase II study might provide useful information, but only after additional information has been provided in the form of a harvest BiOp.

Overall Conclusions

In summary, for FWP hatchery projects

1. The HSRG recommendations generally would not require major changes in planned operations at FWP hatchery projects, partly because many of the changes were already planned;
2. Therefore, the recommendations should not result in large incremental cost increases at these hatchery projects.

Incremental costs could be more if major re-engineering of existing hatcheries is required; no such changes have been identified.

There is potential for the FWP to be asked to fund HSRG recommendations at hatchery projects not currently funded by the FWP. Exposure may be limited by the “in-lieu” provisions of the Northwest Power Act. Habitat costs could also be affected, but current commitments limit short-run potential. In the long run, there are factors that could decrease or increase costs so the net effect is not clear.

The HSRG recognizes that, for many populations, hatchery reforms alone are not sufficient to achieve population goals; harvest reforms are also needed. The FWP has had little involvement in harvest programs in the past so it is not clear how FWP costs may be affected by harvest reforms. In the long run, if hatchery and harvest reforms are successful then FWP costs could be decreased.

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Tables

Table 1. Nominal Costs of BPA Hatchery Program by Project, FY 2005 through FY 2008, from Pisces Data, Hatchery Projects Likely to be Affected by HSRG Recommendations

BPA Number	Project Name	BPA Cost	Other Cost	Total Cost	Share of Total BPA Hatchery Cost
198335000	Nez Perce Tribal Hatchery M&E	$7,342,451	0	$7,342,451	10.2%
198343500	Umatilla Hatchery O&M Ctuir	$3,647,092	0	$3,647,092	5.1%
198343600	Umatilla Passage	$113,121	$0	$113,121	0.2%
198802200	Umatilla Fish Passage Ops	$244,000	$0	$244,000	0.3%
198903500	Umatilla Hatchery O&M ODFW	$3,273,505	$130,000	$3,403,505	4.6%
199000500	Umatilla Hatchery M&E	$355,760	$93,000	$448,760	0.5%
198805303	Hood R Production M&E	$221,672	$29,000	$250,672	0.3%
198805304	Hood R Production M&E ODFW	$2,706	$54,682	$57,388	0.0%
198805306	Hood R Production O&M Pge	$171,736	$0	$171,736	0.2%
198805307	Hood R Production O&M Ws/ODFW	$865,874	$0	$865,874	1.2%
198805308	Hood R. Powerdale Oak Springs	$1,206,697	$22,538	$1,229,235	1.7%
199107200	Redfish Lake Sockeye	$462,000	$0	$462,000	0.6%
199204000	Redfish Lake Sockeye Broodstock	$1,536,010	$0	$1,536,010	2.1%
199305600	Demonstration of Captive Salmon	$221,433	$171,276	$392,709	0.3%
199306000	SAFE	$5,174,807	$1,678,471	$6,853,278	7.2%
199506325	Klikitat Fishery YKFP M&E	$148,999	$0	$148,999	0.2%
199604000	Coho Restoration Mid-Columbia	$3,864,372	$1,069,500	$4,933,872	5.4%
199604300	Johnson Creek Artificial Propagation	$1,016,992	$0	$1,016,992	1.4%
199606700	Manchester S. Chinook Captive Broodstock	$1,102,000	$0	$1,102,000	1.5%
199700100	IDFG Salmon River Spring Chinook	$399,657	$0	$399,657	0.6%
199701325	Yakima Klikitat	$9,222,709	$0	$9,222,709	12.8%
199800702	Grand Ronde Sup. Lostine	$1,094,437	$5,520	$1,099,957	1.5%
199800703	Grand Ronde O&M	$1,544,000	$0	$1,544,000	2.2%
199800704	Grand Ronde Spring Chinook ODFW	$541,164	$120,000	$661,164	0.8%
199801001	Grand Ronde Captive Brood O&M	$737,556	$0	$737,556	1.0%
199801005	Pittsburg Landing Fall Chinook	$1,766,916	$0	$1,766,916	2.5%
199801006	Captive Broodstock	$20,000	$0	$20,000	0.0%
199801007	Capt John Rapids Fall Chinook	$173,000	$0	$173,000	0.2%
199801008	Big Canyon Fall Chinook	$196,893	$0	$196,893	0.3%
199801800	John Day Watershed Restoration	$15,737	$0	$15,737	0.0%
200001700	Recondition Wild Steelhead Kelts	$177,000	$0	$177,000	0.2%
200001900	Tucannon R Spring Chinook	$459,920	$0	$459,920	0.6%
200003300	Walla Walla Fish Passage	$4,680	$0	$4,680	0.0%
200105300	Re-introduction of Chum in Duncan Creek	$374,400	$66,389	$440,789	0.5%
200203100	Chinook Growth Rate Modulation	$326,000	$281,722	$607,722	0.5%
200302300	Chief Joseph Dam Hatchery	$24,430	$30,000	$54,430	0.0%
200306200	Eval. Repro. Success Kelt Steelhead	$243,269	$0	$243,269	0.3%
200306300	Repro Success Abernathy Cr	$280,095	$0	$280,095	0.4%
200500200	Lower Granite Dam Trap Improvement	$435,000	$0	$435,000	0.6%
200740100	Kelt Reconditioning/repro Success	$352,000	$395,000	$747,000	0.5%
200740200	Snake R Sockeye Captive Program	$6,194,163	$441,864	$6,636,027	8.6%
200740300	Idaho Spring Chinook Captive Program	$660,166	$134,446	$794,612	0.9%
200740400	OR Spring Chinook Captive Program	$2,709,992	$137,186	$2,847,178	3.8%
	TOTAL for Projects Potentially Affected	**$58,924,406**	**$4,860,594**	**$63,785,000**	**82.1%**

Table 1. Continued. Total Costs of Hatchery Program by Project, FY 2005 through FY 2008, Hatchery Projects with Little Potential to be Affected by HSRG Recommendations

BPA Number	Project Name	BPA Cost	Other Cost	Total Cost
198503800	Colville Hatchery	$1,542,022	$0	$1,542,022
198806400	Kootenai White Sturgeon	$5,246,349	$213,250	$5,459,599
199004400	Cour d'Alene Res. Habitat	$36,500	$549,989	$586,489
199101903	Hungry Horse Mitigation Habitat	$66,000	$195,000	$261,000
199101904	Hungry Horse Mitigation Kokanee	$385,687	$0	$385,687
199104600	Spokane Tribal Hatchery	$1,724,830	$45,000	$1,769,830
199104700	Sherman Cr. Hatchery O&M	$782,247	$0	$782,247
199402600	Pacific Lamprey	$329,050	$0	$329,050
199404900	Kootenai R Resident Fish	$6,000	$860,000	$866,000
199500100	Kalispel Tribe Resident Fish	$528,047	$95,282	$623,329
199500900	Lake Roosevelt Rainbow Trout	$335,275	$122,040	$457,315
199501100	Chief Joseph Konakee Enhancement	$145,255	$0	$145,255
199501300	Nez Perce Trout Ponds	$231,861	$0	$231,861
199501500	Lake Billy Shaw O&M and M&E	$900,866	$0	$900,866
199502700	Lake Roosevelt Sturgeon	$182,539	$68,396	$250,935
200702400	Cour d'Alene Trout Ponds	$43,500	$9,000	$52,500
200200600	Bull Trout Movement Tucannon	$5,100	$0	$5,100
200203700	Freshwater Mussels in River	$23,500	$0	$23,500
200102900	Ford Hatchery Improvement O&M	$361,683	$48,000	$409,683
	TOTAL for Projects Not Likely Affected	$12,876,308	$2,205,957	$15,082,265
	BPA All Hatchery Projects Total	**$71,800,714**	**$7,066,551**	**$78,867,265**

Source: BPA 2008b

Table 2. Important BPA-Funded Hatchery Projects that May be Affected by HSRG Recommendations			
Project Name	**Target Populations**	**Subbasin**	**Existing Purposes and Operations**
Nez Perce Tribal Hatchery	Spring, Fall Chinook	Clearwater	Designed for incubation and rearing of 1.4 million (M) fall Chinook and 0.625 M spring Chinook salmon. Spring Chinook broodstock are trapped at Lolo and Newsome Creek weirs and at the NPTH-Site 1705 adult ladder and some are obtained from the IDFG Powell satellite (Lochsa River). Fall Chinook broodstock are from Site 1705 and Lower Granite Dam. Spring Chinook are released at the Yoosa (Lolo Creek), Newsome Creek and Meadow Creek, Selway River. Fall Chinook smolts are released at Site 1705 and upstream.
Pittsburg Landing Fall Chinook Acclimation Project	Fall Chinook	Snake Hells Canyon	Fall run smolt produced at Lyons Ferry Hatchery are acclimated, transported and released at Pittsburg Landing, Big Canyon, and Capt John Rapids
Umatilla Hatchery and related operations	Spring, Fall Chinook, S. Steelhead, Coho	Umatilla, Walla Walla	Incubation, rearing and transportation of spring Chinook, fall Chinook and summer steelhead. In 2008, objective was to produce 0.6 fall Chinook for release into the Umatilla River and 0.8 M for release into the Snake River below Hells Canyon Dam. Also, 0.8 M spring Chinook and 0.15 M summer steelhead produced for the Umatilla River. All adults collected at Three Mile Dam except for Snake R. stock is from Ice Harbor.
Yakima/ Klikitat		Yakima	The purposes of the YKFP are to enhance existing stocks of anadromous fish in the Yakima and Klickitat river basins while maintaining genetic resources, to reintroduce stocks formerly present in the basins; and to apply knowledge gained about supplementation throughout the Columbia River Basin.
Cle Elum	Spring Chinook		YKFP produces spring Chinook at Cle Elum that are acclimated in the upper Yakima basin.
Prosser/ Marion	Fall Chinook, Coho		Coho and fall Chinook are reared (inbasin brood) and acclimated (in-basin and out-of-basin smolts) at Prosser and Marion Drain hatcheries. Willard NFH and Eagle Creek NFH are source for out-of-basin coho. Little White Salmon NFH is source for fall Chinook.
Hood River Production Program	Spring Chinook	Hood	In addition to production at BPA-funded Parkdale facility, BPA pays project-related incubation and rearing at Oak Spring and Round Butte/Pelton Ladder
Select Area Fisheries Enhancement	Fall and Spring Chinook	Columbia Estuary	Hatchery juveniles are reared and released from net pens in the lower Columbia R. BPA funds production at Gnat Creek and Grays River. Big Creek and S. Fork Klaskanine hatcheries are source for falls, Willamette hatchery for spring run.
Reintroduce Chum Salmon/ Duncan Cr	Chum	Lower Columbia	Monitor and evaluate the reintroduction of chum salmon to Duncan Creek. Three different reintroduction strategies are being evaluated: recolonization via straying, direct adult supplementation to spawning channels and hatchery reared fed-fry releases.
Coho Restoration Mid-Columbia:	Coho	Wenatchee	Restore naturally spawning coho in the Wenatchee and Methow River basins by transferring adult and/or juvenile coho from lower river hatcheries (Willard, Winthrop, Entiat, Leavenworth) to selected habitats or acclimation ponds.

Table 2. Continued.			
Johnson Creek Artificial Propagation Enhancement Project	Summer Chinook	Salmon	Increase survival of a weak population of summer Chinook salmon in Johnson Creek, a tributary of the South Fork Salmon River in Valley County, Idaho. About 100,000 summer Chinook are released into Johnson Creek. Adults are collected at the weir. Eggs are incubated and reared at McCall Hatchery
Chief Joseph Hatchery Program	Summer and Fall Chinook	Okanogan	The NPCC recommended that BPA fund a program sponsored by the Confederated Tribes of the Colville Reservation to assist in the conservation and recovery of summer/fall Chinook salmon in the Okanogan subbasin and the Columbia River between the Okanogan River and Chief Joseph Dam. The CJHP includes construction, operation and maintenance of a hatchery for egg incubation and early rearing near Chief Joseph Dam and acclimation ponds. Adult fish broodstock collection would occur throughout the project area. Final rearing and release of juvenile fish would occur at new and existing acclimation ponds. The Chief Joseph Hatchery is currently in Step 2 review and has not been recommended for implementation.
Manchester Spring Chinook Captive Breeding	Spring Chinook	Basinwide	Captive broodstock program for Snake R. spring Chinook (Grand Ronde and Salmon R.) at Manchester, Puget Sound. Parr (Grand Ronde) or eggs (Salmon) from rivers to hatcheries to Manchester to Bonneville (GR) or Eagle (Salmon).
Northeast Oregon Hatchery Master Plan (NEOH)	Spring Chinook	Grande Ronde	Supplement spring Chinook in Lostine, Catherine Cr, Upper Grande Ronde. Acclimate smolts, trap and spawn adults. M&E provides abundance and life history performance measures. Broodstock reared at Bonneville, Wallowa, and Lookingglass. Juveniles released in Upper Grande Ronde, Catherine CR and Lostine. 2006 plans included new hatchery facility and adult collection facility for Lostine River stock, modifications to Lookingglass Hatchery, and expansion of Imnaha satellite facility. BPA funds marine culture and rearing at Bonneville and Wallowa
Oregon Spring Chinook Captive Breeding	Spring Chinook	Grande Ronde	Purpose is to aid recovery of endangered spring/summer Chinook salmon by providing safety nets for Salmon and Grande Ronde River Basins stocks and research basis for captive rearing and captive breeding programs. In Idaho, juveniles or eyed eggs are taken from Lemhi, East Fork Salmon, West Fork Yankee; in Oregon, from the Grande Ronde. After collection, the fish or eggs are transported to the Eagle Fish Hatchery or the Lookinglass Hatchery for freshwater rearing to smolts. Salmon are raised at Manchester WA during the marine phase of their life cycle. When fish begin to mature, they are transferred to freshwater facilities in Oregon and Idaho for final maturation and are released back to Snake River tributary waters to spawn.
Idaho Spring Chinook Captive Breeding	Spring Chinook	Salmon	
Snake River Sockeye Captive Breeding	Sockeye	Salmon	Conserve and rebuild the Redfish Lake sockeye salmon stock, focused on Alturas, Pettit, and Redfish lakes. The program includes the captive broodstock program, production supplementation, habitat evaluations, genetics monitoring and monitoring and evaluation of fish supplemented back to the system. Fish are trapped at the Redfish Lake Creek and at the Sawtooth Hatchery. The Eagle Fish Hatchery is the primary culture facility for broodstock rearing and spawning. Fertilized eggs are transferred to Sawtooth Fish Hatchery for continued culture through release. Eggs and fish are released into the habitat. Eyed eggs are planted in egg boxes in lakes in the fall. Pre-smolts are released directly to the lakes. Smolts are released to outlet streams in the spring, and prespawn adults are released to lakes in the fall. The eggs, smolts and fish are monitored to document the success of each strategy.
Walla Walla Spring Chinook Master Plan	Spring Chinook	Walla Walla	CTUIR has developed a reintroduction plan for spring Chinook. This plan includes the release of hatchery adults from nearby hatchery programs and recently the release of Carson or Walla Walla stock hatchery smolts into the South Fork Walla Walla. This project does not have an approved Master Plan and has not had environmental and design reviews.

Source: Primarily project sponsors

Table 3. DRAFT Existing and HSRG Proposed Columbia Basin Hatchery Production, 1000 Fish Released.

				Change by Species						
	Production Target			Chinook			Others			
Population	Current	HSRG Solu-tion	Change	Fall	Spring	Sum-mer	Coho	Chum	Steel-head	Sock-eye
Lower Columbia River Chinook ESU	53,874	52,057	-1,817	-1,933	117					
Upper Willamette River Chinook ESU	5,574	5,474	-100		-100					
Middle Co. River Spring - Run Chinook	4,371	4,204	-167		-167					
Deschutes R. Summer / Fall Chinook	Not provided									
Upper Co. River Spring - Run Chinook	3,211	3,295	84		84					
Upper Co. R. Summer / Fall Chinook	20,906	19,968	-938		-599	-341				
Snake River Fall - Run Chinook ESU	5,803	5,803	0							
Snake River Spring / Summer Chinook	Not provided									
Upper Salmon River Chinook MPG	2,034	2,751	717		385	331				
Middle Fork Salmon River Chinook MPG	None									
South Fork Salmon River Chinook MPG	3,899	3,485	-414			-54				
Grande Ronde - Imnaha Chinook MPG	1,239	1,261	22		22					
Tucannon - Asotin Chinook MPG	133	163	30		30					
Clearwater Chinook MPG	4,832	4,783	-49		-49					
Lower Columbia River Coho ESU	16,985	13,471	-3,514				-3,514			
Upper Columbia River Coho ESU	834	830	-4				-4			
Columbia River Chum ESU	300	189	-111					-111		
Southwest Washington Steelhead DPS	322	322	0							
Lower Columbia River Steelhead DPS	3,044	3,019	-25						-25	
Upper Willamette River Steelhead DPS	594	594	0						0	
Middle Columbia River Steelhead DPS	686	603	-83						-83	
Upper Columbia River Steelhead DPS	1,151	1,192	41						41	
Snake River Steelhead DPS	Not provided								0	
Salmon River Steelhead MPG	4,317	4,437	120						120	
Clearwater River Steelhead MPG	2,942	2,830	-112						-112	
Grande Ronde Steelhead MPG	959	959	0						0	
Imnaha Steelhead MPG	212	214	2						2	
Tucannon - Asotin Steelhead MPG	152	51	-101						-101	
Upper Columbia Sockeye ESU	212	212	0							0
Snake River Sockeye ESU	152	751	599							599
TOTAL				-1,933	-277	-64	-3,518	-111	-158	599

Source: HSRG 2009

Appendix 1. Summary of HSRG Recommendations for FWP Hatcheries and IEAB Cost Estimates [27]

For Nez Perce, all fall run releases (1.4 million smolts) would be adipose fin clipped. From BPAs 2003 annual report, looks like all are code-wire tagged (cwt) already. Assume they would be both. Cost $0.05 per adipose clip. $70,000 annually. If cwt can be eliminated, cost savings.

Deploy live capture selective fishing gears to collect broodstock. Not clear what might be needed; weirs are already in place at Lolo and Newsome Creeks, but tribal members may want to catch fish at usual and accustomed places. Capture gear could have important operations costs.

For Lolo Creek, convert 150,000 pre-smolt to 100,000 smolts, and for Newsome Creek, convert 75,000 pre-smolts to 75,000 smolt. Cost/smolt is high here already (IEAB 2006). At $2.60 per smolt the annual cost savings with 50,000 fewer fish would be $130,000. However, a significant cost per smolt increase can be expected, mostly because of additional mortality from pre-smolt to smolt.

For Pittsburg Landing, all fall run releases (2.1 million smolts) should be adipose fin clipped. Assuming no Lyons Ferry fish are adipose clipped, the cost at $0.05 per smolt would be $105,000 annually.

For Umatilla, for spring Chinook, shift from 925.2 integrated to 277.6 integrated and 562.2 segregated. Some costs for separating the two populations may be needed. Eighty percent of the unharvested adults from the harvest component would be removed. This might be done at 3 Mile Dam, or at usual and accustomed fishing places. For fall Chinook, shift from 399.2 integrated and 648 segregated to 479 and 411.5, respectively. Deploy live capture selective fishing gears to collect fall run broodstock. This might be done at 3 Mile Dam broodstock collection facility. Fifty percent of the unharvested fall-run adults from the conservation component would be removed. This could be done at 3 Mile Dam, but would probably be accomplished at usual and accustomed fishing places.

For both runs, juveniles from the conservation program would be coded-wire tagged only, while the harvest program fish would be adipose-marked and coded-wire tagged. Currently, all juveniles released to the Umatilla are adipose clipped. All Umatilla falls, half of Snake R falls, 40% of steelhead and 6% of springs are cwt. CWT and adipose costs are assumed to be $0.20 and $0.05 per fish, respectively. The additional cost is calculated to be about $100,000 annually. The additional cost of cwt for spring run fish is somewhat offset by reduced costs for adipose clips for fall run fish.

[27] HSRG. 2008. Review and Recommendations. Population and Related Hatchery Programs. http://69.30.63.183/mfs/report/download/report_download_form_show.action. Dated October 8.

A new acclimation site further up in the watershed may be required. The IEAB (2002) reported that three acclimation sites at the Yakima hatchery cost an average of $2 million apiece.

Managers should consider trucking spring-run adults returning to Three Mile Dam from the conservation program and natural-origin adults to the spawning grounds. Additional trucking capital and operations costs may be required. Coho broodstock would be collected from adults returning to Three Mile Dam.

At Cle Elum, opportunities to increase harvest of hatchery fish or remove additional hatchery fish at Roza would be pursued. At Marion/Prosser, for fall Chinook, shift from 367,100 integrated and 1,701,000 segregated to 2,030,600 integrated. Develop the capability to collect local broodstock. Mark all juveniles. A conservation and recovery plan for the Marion Drain population would be developed. For coho, develop local broodstock. Naches fish should be coded-wire tagged but not adipose fin-clipped. Lower river fish should have external marks and a portion code-wire tagged.

For Klikitat River spring Chinook, the HSRG proposes a reduction in production from 831,200 to 800,800. The Klikitat Subbasin Anadromous Fisheries Master Plan also proposes releases of about 800,000 spring Chinook smolts. This plan "would increase production of steelhead at the Klickitat Hatchery and eventually eliminate in-basin artificial production of coho. In-basin fall Chinook production levels would remain the same, but half the production would be transferred from Klickitat Hatchery to a proposed new facility at Wahkiacus."[28] The HSRG shows recommended fall Chinook production levels decreased from almost 3.9 million to 3.5 million. The Klikitat Master Plan suggests 4 million at the Wahkaicus and Klikitat facilities. The HSRG and the Master Plan would both replace the existing steelhead releases from the Skamania hatchery with an integrated program at the Klikitat hatchery. The HSRG and the Master Plan would both reduce coho releases in the basin from about 3.5 million currently to about 1 million. In general, HSRG recommendations are similar to Master Plan plans except that the Master Plan includes the new Wahkaikus facility. This difference might be counted as a cost savings attributable to the HSRG recommendations.

At Hood River, HSRG recommendations are supplemented with information from the Master Plan. Increase spring Chinook production from 125,900 to 147,000. At $0.60 per fish, the annual cost increase would be about $13,000. New incubation and rearing facilities would be built. A rearing facility at Moving Falls is expected to cost $1.85 million. HSRG recommendations found that "A fish weir at the Powerdale site would provide a unique opportunity and certainty for meeting research and management goals" but the Hood River Master Plan found that "greater flexibility, lower environmental impact, and a lower cost approach was desired."[29] The Council recently approved a plan

[28] NPCC. 2005. Issue Paper. Klickitat Subbasin Anadromous Fishery Master Plan. Page 6.
[29] HDR|FishPro. Oregon Department of Fish and Wildlife and Confederated Tribes of the Warm Springs Reservation. 2008. Revised Master Plan for the Hood River Production Program. Project 1988-053-15, Contract 23380-1.

that includes two weirs upstream instead. These are expected to cost $750,000. $0.5 million of cost for the West Fork might not be counted since this was already intended. NPCC staff has noted that the existing Powerdale Dam might be used as the fish weir. Modification costs would be much more than the two planned sites.

For summer steelhead, a single location in the lower river would be used for broodstock management rather than multiple sites higher in the watershed. This could result in immediate cost savings. Use other marking methods (body tags, elastomer tags, etc.) that may have less of an effect on survival. Costs are unknown.

At SAFE, increase fall-run production to 3.3 million with the addition of 2.1 million fish from Washougal tule production. The IEAB (2002) estimated an average net pen acclimation cost at the Clatsop Economic Development Council (CEDC) Terminal Fisheries Project (TFP) of $0.23 per fish. At this rate the increase in annual cost would be $480,000. This does not include production cost of the Washougal 0-age smolts. The IEAB noted that, if production costs were similar to the Spring Creek hatchery then total average cost would be $0.37 to 0.42 per fish so total cost increase would be $777,000 to $882,000. However, the increase in SAFE production might be offset by reduced production at another Washington hatchery. Improve estimate of stray rate and develop a rigorous monitoring program to assess impacts to native stocks.

For Coho Restoration Mid-Columbia, managers should identify additional rearing locations in the upper Columbia River. The IEAB (2002) reported that three acclimation sites at the Yakima hatchery cost an average of $2 million apiece. Assume 2 sites would cost $4 million.

At Johnson Creek (JCAPE) Summer Chinook, no cost increases due to HSRG recommendations were noted.

For Reintroduce Chum Salmon/Duncan Cr, fed fry should be adipose fin-clipped. About 100,000 are produced so cost would be about $5,000 annually. Collection of 100% natural origin return (NOR) broodstock. Monitor strays in spawning escapement and natural production. Include a "sunset" clause. This could result in cost savings.

Chief Joseph Dam Hatchery (CJDH) is not built yet. This project is currently in Step 2 review. The HSRG did not provide recommendations related to this population. Current plans are believed to be consistent with HSRG methods.

Under HSRG recommendations, Okanogen-Similkameen summer-fall production would be increased from 574,100 to 911,200. The Master Plan proposes increasing production to 1,100,000. [30] The HSRG proposes that Upper Middle Columbia Mainstem summer would be increased from 0 to 803,000. The Master Plan proposes 900,000 to support an

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[30] Ibid. Page 4.

integrated harvest objective. Therefore, HSRG recommendations would reduce production relative to this plan. Almost 300,000 fewer fish would be produced which, at $0.10 per fish, would save $30,000 annually.

For all Spring Chinook Captive Breeding Programs, for the Grand Ronde Lostine Spring run, the weir would need to be improved to remove 90% of the unharvested hatchery-origin fish. Not clear what cost might be, assume $1 million. For Grand Ronde Catherine Spring, 70% of returning hatchery-origin adults would be removed at the weir or through selective fisheries. For Upper Grand Ronde Spring Run, all returning natural-origin adults would be used as hatchery broodstock when returns are less than 50. Implement other means to improve the success of the conventional program and reduce the reliance on the captive brood program. For Idaho Spring Chinook, for Yankee Fork, managers should consider adopting a sliding scale broodstock/escapement management strategy.

For Snake R. Sockeye Captive Breeding, increase production by 599,000. This action was included in the 2008 FCRPS Biological Opinion. Implement other actions to increase anadromous adults. Capture adult Snake River sockeye salmon at Lower Granite Dam for transport to Idaho. This action was in the 2008 FCRPS Biological Opinion so it should not be attributed to HSRG recommendations. It seems like current programs are expensive relative to a successful integrated operation; for example, current programs require transportation and rearing of captive broodstock.

The Walla Walla Spring Chinook Master Plan has not been approved and has not had environmental and design reviews. The HSRG did not provide recommendations related to this population.

Appendix 2. Text from HSRG Recommendations Used to Develop Summaries in Appendix 1. [31]

Nez Perce

For all species, coordinate with Clearwater, Dworshak, Kooskia.

For fall run, the HSRG looked at various hatchery scenarios that could improve productivity while meeting the standards for a Primary or Contributing population, but could not increase natural-origin spawning under current habitat conditions and each would result in loss of significant harvest. Because the HSRG was unable to craft a scenario that increased natural origin spawning our recommendations focused on near term improvements to the current programs.

To promote spatial structure and local adaptation to improve productivity, the HSRG recommends that managers develop broodstock collection capabilities for releases into the Clearwater and Snake rivers. Due to the lack of adult capture facilities, the HSRG recommends that managers develop, test and deploy live capture selective fishing gears to collect broodstock from the Clearwater and the Snake River upstream of the confluence of the Clearwater River (e.g., Captain John's, Pittsburg Landing, and Hells Canyon Dam).

The HSRG identified terminal selective harvest opportunities on hatchery fish (20% on HORs and 3% incidental on NORs). This fishery will require 100% adipose fin-clipping of hatchery fish. This will provide additional harvest benefits while having minimal effects on natural-origin returns.

For coho, this is a reintroduction program to develop self-sustaining populations. The HSRG recommends that managers establish locally adapted adult returns to meet all broodstock needs for this program. This could best be accomplished by (a) emphasizing adult returns for broodstock from all adult capture facilities; and (b) releasing any additional Eagle Creek smolts exclusively at facilities where broodstock subsequently could be collected (e.g., Nez Perce Tribal Hatchery, Dworshak National Fish Hatchery, Kooskia National Fish Hatchery). Initially the primary focus of this program should be to establish a locally adapted hatchery population. As managers build returns of locally adapted hatchery-origin adults, phase out the importation of out-of-basin coho. Once adults return in excess of broodstock needs, adults could be outplanted or some of the smolt production could be allocated to tributary releases. The final step would be to transition from locally adapted segregated hatchery broodstock to a well integrated program. A PNI greater than 0.5 is necessary for the natural environment to drive

[31] HSRG. 2008. Review and Recommendations. Population and Related Hatchery Programs. http://69.30.63.183/mfs/report/download/report_download_form_show.action. Dated October 8.

adaptation and increase fitness. To be most successful, managers should reestablish their monitoring and evaluation program.

For Lolo Creek spring Chinook, the HSRG recommends converting the current pre-smolt program to a smolt program of approximately 100,000 fish with a pNOB of 100% and a PNI of 0.67. All hatchery adults would be allowed to spawn naturally. This is expected to result in an average pHOS of 50%. This approach will increase the total spawners as well as natural-origin spawners via reproduction by hatchery-origin recruits in Lolo Creek. In the long term, this approach will provide additional fish for harvest.

For Lower Selway spring Chinook, Goals for this program need to be clarified. As stated, managers have identified conservation as well as harvest goals. Operation of the current hatchery program in the lower river is inconsistent with achieving the conservation goal unless returns from the hatchery program can be managed on spawning grounds. If managers place emphasis in the harvest objective, continuing current operations would be consistent with the HSRG-defined standards of a Stabilizing population.

For Upper Selway spring Chinook, at the current level of juvenile production and with no capability in place to collect returning adults for broodstock or to control the composition of adults on spawning grounds, managers will not meet HSRG-defined standards for Contributing or Primary populations. While not presented, the HSRG identified that managers could meet the HSRG-defined standards for a Contributing population. One way to accomplish this would be to source 100% natural-origin adults for broodstock, reduce juvenile releases to 100,000 fish, and transition to a smolt release from a parr release. Transitioning to a release program that plants 100,000 smolts instead of 300,000 parr will increase survival back to the habitat and may reduce potential competitive concerns with naturally produced Chinook salmon juveniles in the upper Selway River system. Use of selective fishing or trapping gear could provide the means to collect natural-origin broodstock and provide additional harvest benefit as well.

For South Fork Clearwater, Newsome Creek: The HSRG recommends converting the current pre-smolt program to a smolt program of the same size (approximately 75,000 smolts, pNOB=100%, PNI=0.6) and allowing all other returning adults to spawn (excluding strays from the segregated programs). This would allow the program to operate consistent with the standards of a Contributing population and reduce the ecological impacts of parr releases on naturally rearing spring Chinook. This approach is expected to increase the total spawners as well as natural-origin spawners via reproduction by hatchery-origin recruits in Newsome Creek.

Steelhead information needed.

Umatilla

Develop a two-stage stepping stone program to support the fall run natural population and to provide harvest, and second similar program for spring run. For fall run, an integrated conservation component producing approximately 480,000 yearling smolts

would be produced and maintained by collecting 100% of its broodstock from natural-origin returns. For spring run, the integrated conservation component would produce approximately 250,000 smolts. This component would initially be produced from 100% natural- origin broodstock, but subsequent generations would be maintained by collecting 60% natural-origin broodstock and 40% hatchery-origin returns from this component. For both runs, excess hatchery-origin returns from the conservation component would provide all broodstock to maintain an additional second stage harvest component of approximately 411,000 zero-age fall run smolts and 560,000 spring run smolts. Unharvested hatchery returns from the harvest component would not be used for broodstock. This would require differential marking of juveniles from the two programs. For example, the juveniles from the conservation program would be coded-wire tagged only, while the harvest program fish would be adipose-marked and coded-wire tagged.

This solution would require that 50% of the unharvested fall-run adults from the conservation component be removed (50% would be allowed to spawn), and that 80% of the unharvested adults from the harvest component would be removed. For the spring run, juveniles from the conservation program should be acclimated and released in the upper watershed nearer primary spawning habitat. This may require development of a new site further up in the watershed. Managers should also consider trucking spring-run adults returning to Three Mile Dam from the conservation program and natural-origin adults to the spawning grounds.

For coho: Collect broodstock from adults returning to Three Mile Dam. Adipose-mark all released juveniles in order to evaluate composition on the spawning grounds, reproductive success in the natural environment, and to increase harvest opportunities. Shift the program to local hatchery broodstock and allow returning fish to spawn naturally. Initially allow all hatchery fish not needed for broodstock to spawn naturally. Once naturally produced fish can be identified, develop a plan to evaluate habitat productivity and develop a locally adapted stock. If sufficient natural-origin fish return, initiate an integrated conservation program with a targeted PNI greater than 0.5. Retain a segregated harvest program using local brood and Three Mile Dam to effectively segregate and remove hatchery adults. If the habitat cannot support natural production, the managers should focus on habitat improvements and continue to operate a locally adapted hatchery program for harvest.

Yakima/Klikitat: Klikitat

For fall run, developing the capability to collect local broodstock should be the first priority. This would increase survival and the likelihood of meeting harvest and conservation goals. Mark all juveniles from this program to make it possible to identify and manage the origin of broodstock, monitor the natural-origin population and achieve desired harvest rates for hatchery and natural-origin population components. Implement the most effective means for capturing broodstock.

Develop a conservation and recovery plan for the marion drain population. In the near term, collect as many natural-origin fish for broodstock as possible. Additional methods to collect broodstock should be developed. Monitor natural escapement and make every effort to restrict it to fish from the Marion Drain population.. The HSRG recommends that managers implement a BKD control strategy for their spring and summer/fall Chinook hatchery programs where BKD has proved a recurring problem.

For coho, the reintroduction programs should continue to move aggressively toward developing local broodstocks within the basin. Broodstock for fish released in the upper Yakima should be collected at Roza. Broodstock for fish released in the Naches should be collected from the Naches. We recommend that these fish should be coded-wire tagged but not adipose fin-clipped.

The segregated harvest program in the lower river should also be based on a local broodstock from hatchery returns. These fish should have external marks and a portion coded-wired tagged to maximize harvest so that broodstock separation can be achieved and straying into the natural population can be evaluated.

In-basin facilities for incubation and rearing should be developed. In the interim, local broodstock may need to be incubated and reared out-of-basin.

Yakima/Klikitat: Cle Elum

For upper Yakima spring Chinook, this integrated hatchery program should be continued. The managers should pursue opportunities to increase harvest of hatchery fish. This would also contribute to conservation benefits by reducing pHOS, thus improving fitness. The challenge is to achieve this increased harvest of hatchery fish with minimal impact on natural populations in the basin. In the event that additional harvest is not possible under these circumstances, the managers could consider removing additional hatchery fish at Roza Dam to achieve a conservation benefit.

Hood River

For spring run, managers should continue to use only Hood River returns for broodstock and eventually convert the program to an integrated program that meets the HSRG broodstock standards for a Primary population. The goal for the program should be to use 100% natural-origin broodstock to the extent possible. We would recommend developing incubation and rearing facilities in the Hood River for this program. In doing so, managers should apply best hatchery management practices to minimize disease problems. We support the manager's intent to install and operate a weir in the West Fork Hood River to achieve both conservation and harvest goals. Scenarios evaluated by the HSRG assumed that the proposed weir in the West Fork Hood River is sufficient to manage the spring Chinook reintroduction, harvest, and conservation.

A fish weir at the Powerdale site would provide a unique opportunity and certainty for meeting research and management goals. Continuing these studies has value in the

region, because results would aid in understanding several very important hatchery and natural population management issues.

For summer steelhead , continue the program as currently operated; however, the research objectives and evaluation program depend on the continued operation of the Powerdale facility. Managers should use other marking methods (body tags, elastomer tags, etc.) that may have less of an effect on survival. If the South Santiam stock summer steelhead program were continued, we recommend discontinuing recycling adults through the lower river. The HSRG believes that the best biological solution for broodstock management is at a single location in the lower river rather than multiple sites higher in the watershed. The HSRG recommends that managers consider the biological advantages of the location. Specific points to consider include the potential to operate a fish friendly collection facility, sample the entire returning fish population, and continue monitoring and evaluation activities at a site proven to be reliable. For winter steelhead, continue the program as currently operated; however, the research objectives and evaluation program depend on the continued operation of the Powerdale facility. The preferred solution for broodstock management and continued research would be to maintain a single weir location in the lower river rather than multiple sites higher in the watershed. Specific points to consider include the potential to operate a fish friendly collection facility, sample the entire returning fish population, and continue monitoring and evaluation activities at a site proven to be reliable.

For summer and winter steelhead, a weir structure at the Powerdale location would continue to provide value to overall stock management through the ability to: 1) collect broodstock, 2) evaluate life cycle productivity, 3) monitor hatchery fish reproductive success (maintaining the pedigree study), and 4) remove hatchery strays. The HSRG recognizes that any decision regarding the future of facilities and operations at the Powerdale location must consider potential downstream passage issues for juvenile salmonids, ecological effects of the dam and other priorities in the watershed.

SAFE

For spring Chinook, continue as is. For fall Chinook, continue the current 1.2 million Rogue Brights fall Chinook segregated harvest hatchery program. Increase production to 3.3 million with the addition of 2.1 million fish from Washougal tule production.

Develop a reliable estimate of the stray rate for this program and a rigorous monitoring program to assess impacts to native stocks.

Coho Restoration Mid-Columbia

The purpose of this program is to reestablish naturally reproducing coho salmon in the Methow River, with numbers at or near carrying capacity, that provide opportunities for significant harvest for Tribal and non-Tribal fishers. Historically, the Methow River

supported a coho population of between 23,000 and 31,000 fish, and the Wenatchee between 6,000 and 7,000 fish. The current program is part of a four phase reintroduction program that includes two broodstock development phases along with two natural production phases.

In the broodstock development phase, the program would transition from the use of lower Columbia River hatchery stocks to a Methow and Wenatchee River hatchery stock. Once the hatchery stock is established, natural production phases will outplant juveniles into key coho habitat in the Methow River, Chewuch River, Twisp River, and Wolf Creek; and in the Wenatchee, in the Chiwawa, White, and Little Wenatchee rivers, as well as Nason Creek. Juvenile releases during this phase would total approximately 1.0 million smolts in the Methow, and 1.1 million in the Wenatchee basin.

Methow: Managers should identify additional rearing locations in the upper Columbia River. The program should be phased to achieve a PNI of 0.5 as rapidly as possible.

Wenatchee: Same

Johnson Creek

Note: This project is part of the larger summer salmon program on the South Fork Salmon.

The harvest contribution of the natural and hatchery populations would go from approximately 2,990 fish to approximately 265 fish.

The HSRG recommends that managers implement a two-stage stepping stone program to support the natural population and to provide harvest. The program consists of an integrated conservation component producing approximately 250,000 smolts (PNI = 0.67, pHOS = 0.15, pNOB = .30%). Initially, this component would be produced from 100% NOB but subsequent generations would be maintained by collecting 30% natural-origin broodstock and 75% hatchery-origin returns from this integrated component. Integrated adult returns not needed to maintain the integrated broodstock would be used as broodstock for the second stage harvest component to produce approximately 750,000 smolts. This maintains some genetic continuity between the harvest component and natural fish returning to the system. Smolts produced through the integrated program could be adipose fin-clipped if sufficient numbers returned to meet escapement needs, integrated broodstock needs, as well as second stage stepping stone broodstock needs. Managers should monitor this closely and revert to code wire only if insufficient adults return to meet all needs. Smolts produced for harvest would be adipose fin-clipped. Unharvested “harvest component” fish would not be used for broodstock, released upstream of the weir, or returned to population downstream of the weir. Unharvest adults could be used for stream nutrification as appropriate.

The HSRG acknowledges that managing for the recommended PNI values may not be possible or appropriate in the near term when abundance levels are low and demographic

risks to the population increase. To address this concern, managers should develop a variable sliding scale for managing abundance so that in low abundance years, more hatchery-origin fish of the appropriate population component are allowed to reach the spawning grounds to reduce demographic risk to the respective populations.

An example of such a sliding scale would look like this:

Each year, depending on NOR run size, pNOB and pHOS are allowed to "float" or slide. The HSRG assumes managers will establish an acceptable level of removal of NORs for use in the hatchery brood. This will be a fixed percentage of the total NOR return (say 40%) and will not change, regardless of NOR return. In years of high NOR abundance, this 40% could make up 100% of the needed hatchery brood (pNOB= 100%). In that case, no HORs would be used in the hatchery brood. Hatchery fish can be allowed to reach the spawning ground (pHOS) if needed to achieve an appropriate number of fish spawning naturally (demographic benefit and use of available habitat). This however, would not be required during years of very high NOR returns as both objectives (pNOB and natural spawning) may be meet with NORs.

In years of low NOR abundance, the same 40% of the NOR return would be removed for use in the hatchery brood (pNOB). However, in these years, that 40% may make up only a small part of the needed brood (i.e. pNOB 10%). In these years, enough HORs should be used to achieve needed hatchery brood and additional HORs should be allowed to spawn naturally (pHOS) to achieve the minimum acceptable level of naturally spawning. The goal of this sliding scale is to achieve an "average" PNI over time of the desired level (0.67 or 0.5) depending on the population designation even though it may not be achieved in an one year. A good way to determine the level of NORs that should be removed each year (see above) is to review the return of NORs over a long time frame and iterate what level (30, 40, 50%) are needed, on average, to achieve the desired PNI.

Pittsburg Landing

Note: rearing at the Pittsburg Landing acclimation facility appears to be a small part of the total Lower Snake fall Chinook program.

The HSRG looked at various hatchery scenarios that could improve productivity while meeting the standards for a Primary or Contributing population, but could not increase natural-origin spawning under current habitat conditions and each would result in loss of significant harvest. Because the HSRG was unable to craft a scenario that increased natural origin spawning our recommendations focused on near term improvements to the current programs.

To promote spatial structure and local adaptation to improve productivity, the HSRG recommends that managers develop broodstock collection capabilities for releases into the Clearwater and Snake rivers. Due to the lack of adult capture facilities, the HSRG recommends that managers develop, test and deploy live capture selective fishing gears

to collect broodstock from the Clearwater and the Snake River upstream of the confluence of the Clearwater River (e.g., Captain John's, Pittsburg Landing, and Hells Canyon Dam).

The HSRG identified terminal selective harvest opportunities on hatchery fish (20% on HORs and 3% incidental on NORs). This fishery will require 100% adipose fin-clipping of hatchery fish. This will provide additional harvest benefits while having minimal effects on natural-origin returns.

The HSRG recommends that managers implement a BKD control strategy for their spring and summer/fall Chinook hatchery programs where BKD has proved a recurring problem. Ideally, the strategy should include culling (destroying) eggs/progeny from hatchery- and natural-origin brood that are found to be infected with the BKD agent. However, because brood fish with high levels of the BKD agent are more likely to transmit the agent to their progeny than brood with lesser levels of the agent, the culling of eggs/progeny from infected brood fish, should, at the very least, be applied to those with high levels of the BKD agent (e.g., ELISA OD value of 0.4 and above when broodstock are not in short supply and ELISA OD value of 0.6 and above when broodstock are in short supply). In addition, in programs using ESA-listed natural-origin brood fish, the culling of their eggs/progeny may, at the managers' discretion, be dispensed with. However, the ESA-listed broodstock should be injected, pre-spawning, with an appropriate antibiotic (preferably, azithromycin at 40 mg/kg fish), and the resulting eggs should be surface-disinfected with an iodophor. All pre-spawning brood injections may be limited to females, ESA-listed or otherwise.

Finally, eggs and hatchlings derived from broodstock found to be heavily infected with the BKD agent should be incubated/reared in isolation from those obtained from broodstock with no or lesser levels of the BKD agent. In addition, the hatchlings should be reared at the lowest possible densities (below current standards), and, at the first signs of infection with the BKD agent, they should be treated with orally administered erythromycin (100 mg/kg fish) for 28 days. The treatment should be repeated if there is evidence that the BKD agent has persisted in the hatchlings.

Reintroduce Chum Salmon/Duncan Cr

The HSRG recommends continuation of the hatchery program using local natural-origin broodstock as available and broodstock from natural origin returns from the Lewis River as necessary until the recovery goals are achieved and the population becomes self-sustaining. Fed fry should be adipose fin-clipped to distinguish HOR from NOR adults. This would allow collection of 100% NOR adults for broodstock to increase the PNI above 0.67. Monitor contribution of hatchery strays in spawning escapement and natural production. This, like all chum conservation programs in the lower Columbia, should include a "sunset" clause that would suspend the hatchery program after three generations, unless evidence suggest suspending releases earlier or extending the program beyond three generations.

Chief Joseph Dam Hatchery

To reintroduce spring Chinook into the Okanogan River, the HSRG recommends that the Okanogan population be managed using a phased transition approach, as described below. Hatchery facilities should be developed to provide within-basin full-term rearing to meet both conservation and fishery objectives. If this is not possible, long-term acclimation and adult recapture facilities should be developed within the subbasin.

Phase 1: The managers should identify appropriate stable sources of broodstock to support the reintroduction and harvest objectives. Managers should transition to local broodstock as soon as required facilities are operational and Chinook runs can support an independent local broodstock program.

Phase 2: As benefits from planned habitat improvements occur, introduce spring Chinook from the locally adapted hatchery population into these habitats.

Phase 3: As habitat capacity and productivity increases and as the number of naturally-produced spring Chinook also increases, natural-origin adults should be incorporated into the hatchery broodstock in ever-increasing proportions to achieve a PNI initially greater than 0.5. Once the natural population abundance increases, more of the hatchery production could be used to provide harvest.

Segregated Harvest Program: To meet sport and tribal harvest objectives, a segregated program could be considered below Chief Joseph Dam. In selecting a broodstock for this program, the managers should consider using either upper Columbia spring Chinook surplus to other conservation programs (see Methow recommendations) or the Leavenworth population of Carson-stock spring Chinook (see Wenatchee recommendations).

The HSRG recommends that managers implement a BKD control strategy for their spring and summer/fall Chinook hatchery programs where BKD has proved a recurring problem. Ideally, the strategy should include culling (destroying) eggs/progeny from hatchery- and natural-origin brood that are found to be infected with the BKD agent. However, because brood fish with high levels of the BKD agent are more likely to transmit the agent to their progeny than brood with lesser levels of the agent, the culling of eggs/progeny from infected brood fish, should, at the very least, be applied to those with high levels of the BKD agent (e.g., ELISA OD value of 0.4 and above when broodstock are not in short supply and ELISA OD value of 0.6 and above when broodstock are in short supply). In addition, in programs using ESA-listed natural-origin brood fish, the culling of their eggs/progeny may, at the managers' discretion, be dispensed with. However, the ESA-listed broodstock should be injected, pre-spawning, with an appropriate antibiotic (preferably, azithromycin at 40 mg/kg fish), and the resulting eggs should be surface-disinfected with an iodophor. All pre-spawning brood injections may be limited to females, ESA-listed or otherwise.

Finally, eggs and hatchlings derived from broodstock found to be heavily infected with the BKD agent should be incubated/reared in isolation from those obtained from broodstock with no or lesser levels of the BKD agent. In addition, the hatchlings should be reared at the lowest possible densities (below current standards), and, at the first signs of infection with the BKD agent, they should be treated with orally administered erythromycin (100 mg/kg fish) for 28 days. The treatment should be repeated if there is evidence that the BKD agent has persisted in the hatchlings.

For summer/fall Chinook, A program of the current size (576,000 smolts) could be operated as an integrated program consistent with the standards of a Primary population (PNI greater than 0.67). This would require collecting broodstock throughout the full run timing from fish returning to the Okanogan system instead of at Wells Dam. There are multiple options to accomplish this. For example, one option is managing pNOB at 50%, a pHOS target of approximately 25%, which would require removing at least 50% of returning hatchery fish.

A larger integrated program, also consistent with the standards of a Primary population, is possible if pNOB could be increased or pHOS could be further reduced. In order to improve the viability and productivity of natural upper Columbia River summer Chinook populations, the HSRG recommends immediate management of all freshwater sport fisheries as selective fisheries. The Colville Tribes' growing cultural and subsistence fishery should continue to develop its selective capacity. Research on selective gear for the commercial fishery should commence immediately.

The HSRG also recommends that fishery managers immediately review the capacity of upper Columbia River summer Chinook populations to tolerate current and future high exploitation rates and adopt fisheries management and hatchery production strategies that are compatible with species conservation and survival.

The HSRG recommends that managers implement a BKD control strategy for their spring and summer/fall Chinook hatchery programs where BKD has proved a recurring problem. Ideally, the strategy should include culling (destroying) eggs/progeny from hatchery- and natural-origin brood that are found to be infected with the BKD agent. However, because brood fish with high levels of the BKD agent are more likely to transmit the agent to their progeny than brood with lesser levels of the agent, the culling of eggs/progeny from infected brood fish, should, at the very least, be applied to those with high levels of the BKD agent (e.g., ELISA OD value of 0.4 and above when broodstock are not in short supply and ELISA OD value of 0.6 and above when broodstock are in short supply). In addition, in programs using ESA-listed natural-origin brood fish, the culling of their eggs/progeny may, at the managers' discretion, be dispensed with. However, the ESA-listed broodstock should be injected, pre-spawning, with an appropriate antibiotic (preferably, azithromycin at 40 mg/kg fish), and the resulting eggs should be surface-disinfected with an iodophor. All pre-spawning brood injections may be limited to females, ESA-listed or otherwise.

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Manchester Spring Chinook Captive Breeding

This project touches on the Idaho and Oregon Spring Chinook captive breeding programs.

Grand Ronde

Fur Upper Grand Ronde spring Chinook, this program should continue to operate as a safety net until habitat is improved to a point where it can support a natural population. In years when adult escapement is low (e.g., less than 50 fish), managers should incorporate all returning natural-origin adults into the hatchery broodstock. These recommendations are meant to provide an interim conservation strategy until habitat issues are addressed. When population productivity and capacity have increased, the managers will need to develop plans to transition to a properly integrated program (e.g., PNI $\geq$ 0.50). Managers should implement other means to improve the success of the conventional program (and reduce the reliance on the captive brood program) such as (1) evaluating the potential to increase adult returns by releasing larger smolts; (2) sizing acclimation facilities to meet program needs; (3) investigating holding adults destined for natural spawning at the existing acclimation site for release into the natural environment just prior to spawning; (4) injecting adults with antibiotics; (5) using salmon carcasses or carcass analogs for nutrient enhancement; and (6) using another means of identifying the origin of adults other than adipose fin-clipping. Until the conventional program is self-supporting, fish can be released without being marked.

The HSRG recommends that the managers review the existing habitat potential (productivity and capacity) as it will influence the type of program appropriate to the conditions and the contribution the Upper Grande Ronde can make to recovery. In addition, managers should investigate options to improve survival, such as increasing smolt size at release. A plan to increased size at release would need to consider potential changes to biological factors important to natural reproduction of hatchery-origin spawners. However, the advantage of increased survival could be realized by meeting abundance goals while releasing fewer fish and removing fewer natural-origin fish for broodstock.

For Catherine spring Chinook, the HSRG identified two possible solutions for this program. If the population is designated as Contributing, the current program of 130,000 smolts could be maintained with a PNI of 0.52. This program would use 50% natural-origin broodstock (pNOB of 0.5) and would require removing 55% of hatchery fish at the

weir or through selective fisheries. If the population is designated as a Primary, a program of 75,000 smolts could be released with a PNI of 0.69. The program would use 55% natural-origin broodstock (pNOB of 0.55) and would require removing 70% of returning hatchery-origin adults at the weir or through selective fisheries. To meet mitigation goals established by the managers, the reduction of approximately 75,000 smolts from this program to meet the standards for a Primary population could be re-allocated to additional production in Lookingglass Creek without affecting current goals for that population.

The HSRG recommends that the managers review the existing habitat potential (productivity and capacity) as it will influence the type of program appropriate to the conditions and the contribution Catherine Creek can make to recovery. Managers should investigate options to improve survival, such as increasing smolt size at release. A plan to increased size at release would need to consider potential changes to biological factors important to natural reproduction of hatchery-origin spawners. However, the advantage of increased survival could be realized by meeting abundance goals while releasing fewer fish and removing fewer natural-origin fish for broodstock.

For Wallowa-Lostine spring Chinook, the HSRG recommends that genetic work be completed to determine whether fine-scale structure exists within this population. Under both scenarios described below, outplanting excess hatchery fish should be restricted to vacant or newly-opened habitat. The HSRG identified two options that would meet the standards of a Primary population. Under one option, the Lostine River component of the population would be managed consistent with a Primary population designation (PNI of 0.67). This solution manages Hurricane Creek and the Wallowa for natural reproduction and the Lostine River for hatchery and natural reproduction. This would require reducing the program to 190,000 smolt release and improving the weir to remove 90% of the unharvested hatchery-origin fish and reducing adult outplants into Hurricane Creek and the Wallowa River. This option also requires selectively harvesting 20% of the hatchery-origin fish in the terminal area.

Under another option, the Lostine River component of the population would be managed consistent with a Contributing population designation (PNI of 0.5), while the Wallowa and Hurricane creeks would be managed for natural production as a hatchery-free area, resulting in a combined PNI of approximately 0.67. This solution manages Hurricane Creek and the Wallowa for natural reproduction and the Lostine River for hatchery and natural reproduction. In developing this solution, we assumed that the Lostine River accounts for 50% of the natural production for this population. This would allow the program to be maintained at its current size (250,000 smolts; pNOB = 0.5) but would require eliminating adult outplants into Hurricane Creek and the Wallowa River and would depend upon a very low level of straying into those streams. The weir would need to be improved to remove 90% of the unharvested hatchery-origin fish. This option would not require selective harvest to remove hatchery-origin fish. In both solutions we also assumed that adults are being outplanted into vacant habitat to extend the geographic range of the population. If that is not the case, and managers intend to integrate their hatchery program with a population extending beyond the Lostine River component, we

recommend that hatchery broodstock should be representative of the expanded population.

Snake River Sockeye Captive Breeding

The HSRG concurs with the decision initiated by managers to increase smolt releases from the program. This action to increase smolt production (500,000 to 1 million fish) is identified in the 2008 FCRPS Biological Opinion. Increased smolt releases should produce increased anadromous adult returns that will be incorporated into hatchery broodstock or released to the habitat to increase natural production.

Additionally, the HSRG recommends that managers pursue other actions that have the potential to increase the availability of anadromous adults. One option is to capture adult Snake River sockeye salmon at Lower Granite Dam for transport back to Idaho. This action is also identified in the 2008 FCRPS Biological Opinion.

In addition to the above, the HSRG recommends that managers implement a downstream anadromous release and adult capture program at an appropriate lower Columbia River hatchery integrated with the expanded upriver program. This option would generate a more consistent return of anadromous sockeye salmon that could be spawned to augment the production of eggs and juveniles for incorporation into the suite of release strategies.

The overarching goal for implementing any or all of the above strategies is to return greater numbers of anadromous adults that could be used selectively in spawning designs or released to the habitat to address concerns over loss of fitness in this closed population. The HSRG also recommends that managers tag/mark all fish released by this program to facilitate subsequent collection and identification. The HSRG recommends finding alternative means of identifying fish and discontinuing the practice of ventral fin clipping.

Idaho Spring Chinook Captive Breeding

Yankee Fork: Managers should consider adopting a sliding scale broodstock/escapement management strategy. The HSRG acknowledges that managing for the recommended PNI values may not be possible or appropriate in the near term when abundance levels are low and demographic risks to the population increase. To address this concern, managers should develop a variable sliding scale for managing abundance so that in low abundance years, more hatchery-origin fish of the appropriate population component are allowed to reach the spawning grounds to reduce demographic risk to the respective populations. The goal of this sliding scale is to achieve an “average” PNI over time of the desired level (0.67 or 0.5) depending on the population designation even though it may not be achieved in any one year. A good way to determine the level of NORs that should be removed each year (see above) is to review the return of NORs over a long time frame and iterate what level (30, 40, 50%) are needed, on average, to achieve the desired PNI.

Oregon Spring Chinook Captive Breeding

Recommendations appear to have little effect on the BPA funded portion; captive breeding at Bonneville would continue?

Walla Walla Spring Chinook

Transition to local broodstock as soon as required facilities are operational. Until habitat can support an integrated population, maintain the current program until natural production appears evident. This segregated program using local broodstock would serve as a transitional phase in the reintroduction program. Returns in excess of broodstock needs should be allowed to spawn naturally. Expansion of this program should be contingent on the development of a local broodstock.

The HSRG recommends that managers implement a BKD control strategy for their spring and summer/fall Chinook hatchery programs where BKD has proved a recurring problem.