

## **Native Fish Society introduction to Mitchell Act Hatchery Economic Study**

The following summary of the Mitchell Act Hatchery Economic Study was requested by the Native Fish Society in order to provide our members and the public with understanding and insight on hatchery funding and the cost to provide a fish that is harvested. Since Mitchell Act Hatcheries are paid for with public funds it may be a good idea to know what's going on.

The reader should know that the report you are about to read has been officially banned by NMFS. That's right; NMFS rejected this economic evaluation because it did not give them the answer they wanted. When professional studies are suppressed, the public never sees them, but NFS won't let this one be swept under the NMFS office rug.

This summary is based on the full economic evaluation of Mitchell Act Hatcheries which NFS has also provided on its web page. This economic study is part of a larger Environmental Impact Statement being developed by NMFS on Mitchell Act Hatcheries.

NMFS is rather sensitive, for they not only have a mandate to recover ESA-listed salmon and steelhead in the Columbia River; they also fund Mitchell Act hatcheries that are contributing to the extinction of endangered fish. At the very least, NMFS would like to show that their hatchery program is not a deficit spending program to justify its negative effect on salmon recovery.

The summary will point out that the Mitchell Act Hatchery programs are deficit spending and that the primary beneficiaries of hatchery program funding are the fish management institutions. It is little wonder that NMFS leadership rejected this economic evaluation of its hatchery program and hired another party with the hope there would be a better answer.



Bill Bakke,  
Executive Director

## **Summary Paper**

# **Economic Effects and Social Implications From Federal Mitchell Act Funded Hatcheries**

prepared by:

Hans D. Radtke and Chris N. Carter  
Natural Resource Economists

prepared for:

Native Fish Society

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## **Introduction**

An economic effects and social implication discussion was developed for Columbia River Basin federal Mitchell Act (MA) funded fish hatcheries by The Research Group, Corvallis, Oregon (TRG).<sup>1</sup> Bill Bakke, Executive Director for the Native Fish Society, asked Hans Radtke and Chris Carter, who were technical advisors on TRG study, to summarize TRG's findings. This summary paper is written to minimize economic terminology and methodological descriptions so as to make it understandable to a wide audience of reader backgrounds.

TRG collected baseline condition data from hatchery program managers that detailed hatchery operations, administration, and facility capital costs. Relationships between the cost data for raising smolts and harvestable adults were developed.<sup>2</sup> Economic returns were calculated to show benefits from fisheries and benefits to communities where hatchery operations and administration are located. The economic returns calculations included three economic measurements: direct financial value,<sup>3</sup> net economic value (NEV), and regional economic impacts (REI). The NEV was then used in a benefit-cost analysis (BCA) framework. In addition to the hatchery production and resulting economic effect descriptions, TRG also discussed some social implications of the MA funded hatchery operations.<sup>4</sup>

While TRG report has a wealth of other descriptions, this summary paper will center on descriptions for production cost per released smolt or harvestable adult, REI measurements for fisheries and hatchery operations, and the BCA results. The estimated NEV used in the BCA are for commercial harvest and recreational fishing activities. Budgets for various vessel categories involved in harvesting and budgets for processing firms involved in manufacturing primary salmon products are used to develop the commercial active use NEV estimates. The NEV for recreational fisheries relies on recent literature findings. Other benefits not measured by harvesting, such as passive use NEV, were not included in the BCA equations.<sup>5</sup> The costs used in the BCA were solely hatchery production costs.

BCA can provide useful information. BCA results may be added to the usual political and social considerations to examine the alternatives' economic efficiency standing. In contrast, REI provides estimates of the effects on the regional financial economy of projects with regard to such aggregate measures as jobs and total personal income.<sup>6</sup> The REI information is usually very important to people in the region because funding for the projects is viewed as new money coming from outside the area. This regional point of view is in contrast to the BCA which is from a national accounting stance.

### **Background**

There were 18 MA supported hatchery complexes existing at the time of the investigation. The basis for the funding support is to mitigate for lost salmon and steelhead natural production that came about from Columbia River dam construction and other water and land developments. The production objectives for all of the hatcheries are to augment remaining natural production for the benefit of fisheries. About \$11.5 million out of the \$16 million of MA appropriations are provided annually to state (Oregon and Washington) fisheries agencies, the U.S. Fish and Wildlife Service (USFWS), and treaty tribes for hatchery operations.<sup>7</sup>

Total smolt production by all Columbia River Basin hatcheries in the early 2000's was about 136 million, which is about half of all hatchery and wild production (IEAB 2005). The estimated production of hatcheries wholly or partially funded by the MA in recent years is about 65 million smolts. Harvest contributions from all Columbia River Basin production is more than three-quarters hatchery production in recent years. This is due to fishery management attempts using fish mark selective fisheries, avoidance, and other techniques to reduce impacts on adults from natural production origins.

Columbia River commercial, tribal, and recreational fisheries are of major economic importance in Pacific Northwest states. Due to the migratory behavior of Pacific salmon

and steelhead, fish originating in the Columbia River also contribute to distant water fisheries. For example, a significant proportion of the Chinook catch in southeast Alaska and British Columbia salmon fisheries are from the Columbia River. The U.S.-Canada Pacific Salmon Treaty adjusts allocations between countries, depending on production origin abundances.

Hatchery operations are receiving close study because of their potential impacts to wild runs. Once thought to be straightforward, using hatchery production for mitigating lost habitat due to dam construction has given way to scientific findings about their adverse impacts (NRC 1996). There is even evidence that salmon enhancement programs on their own, i.e. having objectives not associated with mitigation, provide no net gain to harvests through displacement of productivity in wild-spawners (ISG 1996).

Hatcheries have been referred to as a foolish bargain (Walters 1996). Naish et al. (2008) discusses hatchery production in context with the political response to societal demands for salmon and steelhead harvest and conservation. They found that economic analysis rarely plays a role in decision making for that response. They conclude that knowledge gaps may have prevented that information being generated in the past, but suggest that future political responses need not be made in ignorance of economic implications.

Several hatchery review projects have been completed or are underway in the Pacific Northwest to determine ways hatcheries can operate to reduce impacts to wild spawners. The approach used in the State of Washington started in 1999 was directed by Congress in 2005 for application to the entire Columbia River Basin. This review is called the Columbia River Basin Hatchery Reform Project and \$3 million was appropriated by Congress for NOAA Fisheries to undertake the review. The process has been completed and final recommendations can be found at: <http://www.hatcheryreform.us>. Economics was not explicitly used as criteria to decide on the final recommendations.

## **Inputs Into the Economic Analysis**

It is essential to determine the costs of producing salmon and steelhead for economic analysis modeling. Typically, costs can be separated into the following categories:

- Operations and maintenance (O&M) costs.
- Indirect costs.
- Capital costs (facility construction and new equipment purchases necessary to change operation practices and or expand production).

O&M costs typically refer to those variable costs that pertain directly to the day to day operations of hatcheries and often includes annual maintenance costs to keep the hatchery operable. Indirect costs typically refer to overhead costs, administrative costs, headquarters costs and the like. The treatment of capital costs deserves some special attention when a BCA is conducted on hatchery development. Original facility construction costs may sometimes be considered "sunk costs," particularly if the hatchery was built 20 or 30 years ago, or last had major modifications that long ago. However, decisions made today that have long term cost implications for the future should consider all relevant costs, including capital construction costs. Because Columbia River Basin hatcheries are being reviewed for long term policy changes in terms of their contribution to harvest and their impact on salmon recovery, the consideration for including all relevant costs is meaningful.

MA funded hatchery system outcomes, such as harvest benefits, depend on production and ecosystem conditions over which agencies may have no control. These conditions affect the smolt survival rate (SAR).<sup>8</sup> While not yet fully understood on an ecosystem basis, ocean conditions appear to strongly influence SAR.

A hatchery consequence model was used for determining estimates of harvests and hatchery returns.<sup>9</sup> The hatchery model uses early 2000's broodstock SAR and recent years' ocean and river harvest exploitation rates. The hatchery consequence model's

output was adapted to reflect actual 2006-2007 agency hatchery production. The marine fisheries harvests were assigned to economic regions corresponding to available economic models for use in the economic analysis.<sup>10</sup>

### **Analysis Results**

The economic analysis results are provided for production costs and three measurements of economic returns. One economic return measurement is direct financial value, the value that a commercial harvester receives (usually called ex-vessel value) or that a recreational angler spends per fish. Another is a benefit-cost comparison of a measurement for generated net economic value to the costs of hatchery production. The third is a measurement of income and resulting employment that may be created from harvesting and producing salmonids at the MA funded hatcheries.

Hatchery costs generally depend on the size of smolts at release. Fall Chinook, which are usually reared at a size of 30 and up per pound depending on whether they are up-river bright or tule stocks, average \$0.176 per smolt, spring Chinook and coho are usually released at 10 to 15 per pound which cost about \$1.09 per smolt, and steelhead which are released at larger sizes at six to the pound cost about \$2.55 per smolt to produce (Table 1). The total hatchery cost per harvestable adult ranged from \$56 for coho to \$229 for winter steelhead with an overall average cost per harvestable adult for all species of \$73. For all species, total hatchery costs exceeded the economic returns using measurements for direct financial value by a ratio of 1.2. That means that overall it costs \$73 to produce a salmon for which \$60 is received by a commercial fisherman and what a recreational angler spends. The only species production that is less than one is spring Chinook at 0.9, which is a reflection of its higher commercial harvest price and its recreational angling attraction.

The production costs of the 65 million MA hatchery releases is estimated to be \$30.4 million (including MA funding, other funding resources, and annualized capital costs).

The benefits as measured in this paper are estimated to be \$18.9 million annually. The BCA analysis resulted in a minus \$11.5 million calculation under baseline SAR's with annualized capital construction costs included (Table 2).

When the assumption is made that hatchery costs are paid from money originating outside the study region, then resulting income and employment in the Pacific Northwest Region is considerable as measured by REI. The contributions are in those economies where the hatchery produced adults are caught, including Alaska, British Columbia, and ocean and river regions in Washington and Oregon; and, where hatcheries and administration services are located. The annual MA funding for hatchery operations and administration generate about \$50.3 million in regional personal income which translates to 1,400 full and part-time jobs (Figure 1). About 46 percent is from fishery related effects and business use of marketable surplus hatchery returns. The other 54 percent are contributions made in local economies from hatchery operations and administration. The fisheries and operations contributions are especially important to rural economies dependent on fisheries and/or where hatchery operations occur.

### **Discussion of Analysis Results**

The negative BCA calculation of a minus \$11.5 million for hatchery production is not unusual. Carter (1999) found, for example, that coastal Oregon COH hatchery production SAR's of at least 1.7 percent coupled with selective retention management would be needed to generate positive BCA. Oregon Coast hatcheries rarely attain this SAR level. For example, the Bandon Hatchery located along the southern Oregon Coast had fallen below the level in three out of six years for the 1995-2000 brood years and the Salmon River Hatchery on the northern Oregon Coast did not attain that level in any of those same brood years. Caudill (2002) reported the economic contributions and hatchery costs for four mid-Columbia River USFWS hatcheries. An extension of that information can be interpreted to show a negative BCA for the USFWS hatcheries. Pearse (1994) studied the British Columbia hatchery system. The BCA results varied

widely at the individual hatchery level, but overall generated a 0.6 benefit to cost ratio. The author provided additional investment strategy information by dropping past capital cost expenditures. The benefit to cost ratio rose to 1.6. Similar BCA questions have arisen concerning the Alaska Salmon Enhancement Program (Boyce et al. 1993).

The calculation of BCA is dependent on the highly variable SAR parameter and assumptions about cost accounting policies. An uncertainty analysis using ranges for the economic modeling parameters shows that when smolt-to-adult survival rates are increased 60 percent over the modeling baseline conditions, then the benefit-cost analysis moves into a positive range. Also, when cost accounting definitions exclude administration and management and/or facility capital costs, measurements of economic returns also move towards a positive range. Making these accounting assumptions would not be sound policy when considering long run public investment strategies. Centralized administration and management of hatcheries is not a discretionary cost item given the management complexities and interrelationships with ecosystem conservation obligations. Annualized capital costs not only represent the costs of the past construction, but also life cycle replacement costs that will be necessary in the future.

It is not argued that the hatcheries should operate with a positive benefit-cost calculation. They were built and operate to mitigate in a much more involved economic and social context. The usefulness of such a measurement can be to show economic efficiencies in different hatchery production or operation alternatives and/or to decide on alternative means for accomplishing the same objectives to sustain fisheries. It is a comparative tool that can provide insight into the existing baseline condition effects and relative magnitude and direction of economic changes associated with hatchery operation and practices changes.

Economists have defined and occasionally measured values associated with the simple existence of natural fish populations. The value is reckoned as the amount that people (counted appropriately) would be willing to pay to assure the existence of a fish stock, or to pay for a specified increase in the fish stock. The valuations are important for bringing

into perspective market and non-market use values, such as commercial and sport fishing as compared to the non-market, non-use existence values. Policy discussions about continuing or refining artificial propagation whose purpose is to support fisheries need to consider society's comparative importance on the continued existence of natural origin salmon and steelhead stocks.

Social implications were qualitatively discussed using indicators for income distribution, quality of life, local government fiscal conditions, and cultural effects. The discussions are an interpretation for how changing hatchery operations may disproportionately affect socio-economic groups using federal environmental justice criteria. The interpretations are based on a methodological approach to answer the contentious question for fair distribution of environmental burdens and benefits. It is not a surprise that American Indian ethnicity in certain geographic areas are a socio-economic group particularly vulnerable to hatchery system changes. Given the group's thousands of years of life dependency on Columbia River fish resources, an analysis of hatchery production and practices changes may more appropriately be analyzed from a pre-hatchery system condition rather than a status quo condition. This finding is particularly apropos to current policy considerations for MA funded hatcheries because of the drastic alteration in natural origin salmon and steelhead populations caused by the initial MA funded hatchery system. The initial hatchery system development was designed to and accomplished by moving natural origin populations lost to upstream hydropower development to lower river hatchery production.

These economic analyses and social implication discussions should prove useful in understanding the effects from hatcheries whose purpose is fishery augmentation. While not addressed in this study, an analytical extension using the information would be to assess the tradeoffs between changing hatchery production and practices and the recovery and improvement in natural origin stocks through habitat enhancements, passage improvements, and harvest management decisions.

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Table 1  
Cost Per Smolt, Smolt Survival Rates, and Ratios for Cost Per Harvestable Adult and Cost per Direct Financial Value

Species	Smolt Production	Cost Per Smolt				Average SAR	Harvestable Adults	Cost Per	Direct Financial	Cost to
		Operation	Headquarters	Capital	Total			Harvestable Adult	Value Per Harvestable Adult	Harvest Value Ratio
Fall Chinook	43,043,000	\$0.096	\$0.025	\$0.055	\$0.176	0.29%	125,068	\$61	\$49	1.2
Spring Chinook	3,881,120	\$0.596	\$0.154	\$0.337	\$1.087	0.46%	17,840	\$237	\$258	0.9
Coho	16,310,000	\$0.454	\$0.093	\$0.549	\$1.095	1.57%	256,098	\$56	\$42	1.3
Summer steelhead	794,000	\$1.301	\$0.353	\$0.914	\$2.568	1.16%	9,240	\$221	\$177	1.2
Winter steelhead	895,000	\$1.350	\$0.367	\$0.808	\$2.526	1.10%	9,882	\$229	\$179	1.3
<b>Total</b>	<b>64,923,120</b>						<b>418,128</b>	<b>\$73</b>	<b>\$60</b>	<b>1.2</b>

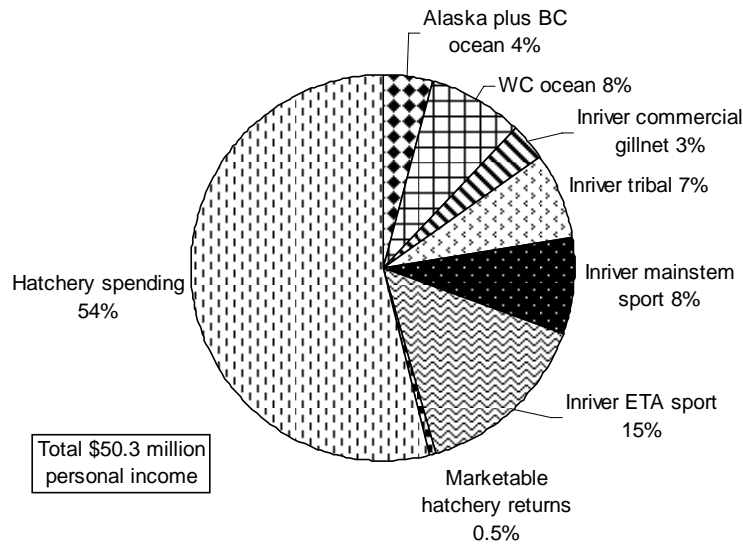
- Notes:
1. Average production costs are weighted averages based on baseline condition agency release strategies.
  2. Smolts are from MA funded hatchery production for baseline conditions.
  3. Average SAR's are across brood years representative of the early 2000's.
  4. The operation costs include maintenance costs, but do not include estimated hatchery facility construction costs. The annualized estimated construction facility costs are adjusted by the ENR Construction Cost Index to 2007 and use the Bonneville Power Administration annual amortization method.
  5. External costs are included in the operation costs. External costs for agencies not funded with MA funds that receive fish for rearing and acclimation from MA hatcheries include estimated headquarter costs. External smolt production is the internal production transferred to other hatcheries for final rearing and liberation. An example is Bonneville Hatchery complex coho transferred to the Select Area Fisheries Enhancement Project (SAFE) program for acclimation to sustain a terminal fishery.
  6. The basis for the harvestable adult cost ratio are harvests in commercial, recreational, and treaty fisheries plus escapements to hatchery returns and spawning ground straying.
  7. Direct financial value is commercial harvest value plus recreational fishing expenditures. Commercial harvest value includes tribal and non-Indian fisheries ex-vessel revenue, and hatchery surplus market sales. Recreational spending is based on catch (retained fish). Total expenditures are the calculated amount of fish catch times success rate (days per fish) times angler spending per day. The calculated amount does not include fixed costs for angling, such as boats, rods, etc.

Table 2  
Benefits From Fisheries and Marketable Hatchery Returns and  
Hatchery Production Costs by Species

Species	Smolt Releases	Production Cost (\$000's)	Harvest and Hatchery Returns NEV (\$000's)					Net Benefits (\$000's)
			Commercial	Treaty Commercial	Recreational	Hatchery Returns	Total	
Fall Chinook	43,043,000	\$7,592	\$714	\$309	\$2,694	\$48	\$3,765	-\$3,827
Spring Chinook	3,881,120	\$4,220	\$50	\$106	\$3,419	\$6	\$3,582	-\$638
Coho	16,310,000	\$14,251	\$474	\$187	\$8,001	\$28	\$8,690	-\$5,562
Summer steelhead	794,000	\$2,039	\$0	\$9	\$1,354	\$1	\$1,364	-\$675
Winter steelhead	895,000	\$2,260	\$0	\$0	\$1,478	\$1	\$1,479	-\$782
<b>Total</b>	<b>64,923,120</b>	<b>\$30,363</b>	<b>\$1,239</b>	<b>\$611</b>	<b>\$16,946</b>	<b>\$84</b>	<b>\$18,879</b>	<b>-\$11,484</b>

- Notes: 1. Production costs include MA funding, other funding sources used at hatcheries where MA funding occurs, and estimated capital costs.  
2. The net economic value (NEV) includes active use effects from all Columbia River inland, U.S. West Coast, Alaska, and British Columbia harvesting and processing regions. NEV does not include passive use valuations.

Figure 1  
Regional Economic Impacts From Ocean and Inriver Fisheries, Business Use of  
Marketable Hatchery Returns, and Hatchery Operations and Administration Spending



- Notes: 1. Regional economic impacts (REI) measurement is total personal income in thousands of 2007 dollars.  
2. Ocean fisheries include commercial, recreational, and tribal.

## Endnotes

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1. TRG was retained by NOAA Fisheries, Northwest Regional Office in 2007 to provide initial economic analysis professional services for the development of a draft economic impact statement (EIS). The EIS purpose is to provide information for policy decisions about the funding and operation of Mitchell Act supported hatcheries. Additional information about the draft EIS purpose can be found at: <http://www.nwr.noaa.gov/Salmon-Harvest-Hatcheries/Hatcheries/Mitchell-Act-EIS.cfm>. Another economic consulting business was subsequently retained to complete the EIS alternatives' economic analysis. Hans D. Radtke was an advisor to TRG. Dr. Radtke is a consulting professional natural resource economist who lives in Yachats, Oregon. Dr. Chris N. Carter (professional economist recently retired from the Oregon Department of Fish and Wildlife) was also an advisor to TRG.
2. Harvestable adults are fish catch plus hatchery returns and straying to wild spawning grounds.
3. A common harvest measurement is direct financial value. The value is sometimes called transaction value and is the addition of commercial harvest value (ex-vessel level) and recreational trip expenditures. This measurement is simply an economic activity indicator.
4. The hatchery production data and economic modeling methods are fully described in TRG report. A large number of literature references were included in that report for the convenience of the reader wishing to pursue a broader and deeper understanding of the economic analyses of fish hatcheries. A few of the more pertinent literature references are repeated in this paper.
5. In this summary paper, estimated NEV's are reported for active uses like commercial and recreational fishing activities. NEV's can also be estimated not only for active uses like fishing and even viewing fish, but also for "passive uses" like people being willing to pay to preserve natural fish runs. Economists have defined passive use values to include many different value categories, the most prominent being existence values. We did not include the passive use values in the BCA quantifications because of definition, method, and measurement challenges. However, it is important to note their applicability because conceptually they are an economic rationale for preservationist laws such as the U.S. Endangered Species Act.
6. Total personal income includes not only the direct effects of the fishing industry and hatchery operations, but also the indirect and induced effects that follow as a result. Economic input/output (I/O) models are used to estimate the REI from fish production changes and to calculate the contributions of an industry to a regional economy. The REI estimates are based on the simplifying assumptions that all hatchery costs are paid from federal funds originating from outside the regions, and that there are no active use substitution activities.
7. In addition to hatchery funding, MA appropriations are used for other fish resource protection programs, like funding the construction and maintenance of existing water diversion fish screens and fishways.
8. SAR is the ratio of smolts released divided by the number of fish harvested plus the number of fish returning to the hatchery and straying to spawning grounds.
9. The consequence model is titled the All-H-Analyzer (AHA) Model by its authors (Mobrand/Jones & Stokes). The model was used by the congressionally-established Hatchery Scientific Review Group (HSRG) to allow managers to explore potential outcomes of strategies of balancing hatcheries, harvest, habitat and hydroelectric system constraints (HSRG 2009). Harvests in the AHA Model are estimated for marine and in river fisheries. An add-on harvest model used coded wire tag (CWT) recovery information and West Coast, British Columbia, and Alaska port landings to allocate the marine catch.
10. For any particular mix of species, liberation size, and passage circumstances; and, the environmental conditions faced by the released smolts, about one-quarter to one-third that survive to adults are returns to hatcheries or strays to spawning grounds. In recent years, only about 10 to 15 percent of the returns to hatcheries are needed for broodstock. About 25 percent of the returns are sold as marketable food fish (manufactured product can be smoked fish, rendering for protein meal, etc.) and the rest of the disposition is used for stream enhancement, buried, given to food banks, or other disposal means.