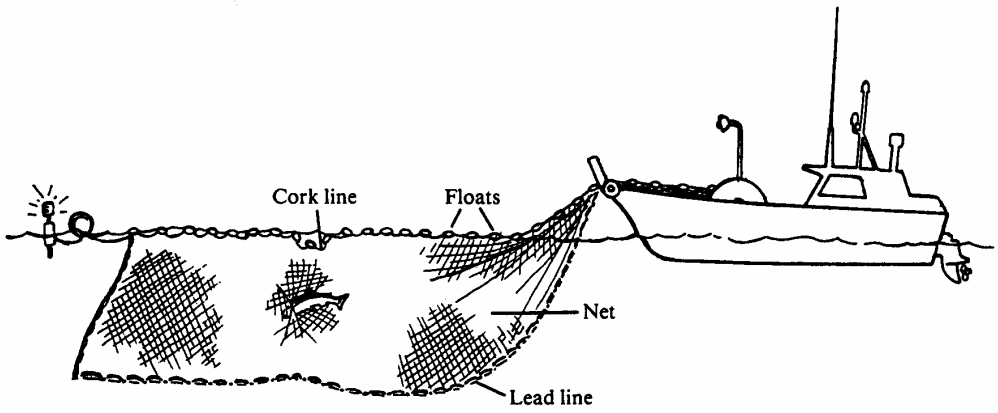
FINAL DRAFT
Revision 4: November 10, 2006

Select Area Fishery Evaluation Project
Economic Analysis Study

Final Report



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Select Area Fishery Evaluation Project
Economic Analysis Study

Final Report

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Oregon Department of Fish and Wildlife
through
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November 2006

PREFACE AND ACKNOWLEDGEMENTS

The Bonneville Power Administration (BPA) and Oregon Department of Fish and Wildlife (ODFW) provided funding to hire a consultant to develop an economic review of the Select Area Fishery Evaluation Project (SAFE or Project). The BPA funding was from reserve budget allocations for the Washington Department of Fish and Wildlife (WDFW) Project management. The ODFW funding was from State general funds granted to Clatsop County to be used specifically for contracting with a consultant.

The workscope came about from the review of the SAFE Final Project Completion Report dated October 2004 by the Joint Independent Scientific Review Panel (ISRP) and Independent Economic Analysis Board (IEAB) of the Northwest Power and Conservation Council (NPCC). The review dated March 16, 2005 raised concerns about the methods and adequacy for the accounting of costs, benefits, and economic value in the context of project alternatives.

The economic analysis occurs as the Project is in transition from explorative to implementing stages. The NPCC must make decisions about recommending continued BPA funding of the Project. The economic analysis results will assist in determining priorities among other NPCC Fish and Wildlife Program (FWP) proposals. The Project must fit into actions to further FWP's vision to promote diverse salmon life histories.

Many agency contacts need to be mentioned for their helpful input to the Study. The BPA contact was Ben Zelinsky, the WDFW contact was Marc Miller, and the ODFW contact was John North. The Clatsop County contact was Tod Jones. Other agency people that were very helpful in guiding the Study to completion were Geoffrey Whisler and Chris Rodriguez at ODFW and Toni Miethe at Clatsop County. Toni has worked on the Project since 1983 and was a great source for historical knowledge. Harry Upton (current economist at ODFW) provided early guidance on analysis directions.

Contributing hatchery production information was provided by individual hatchery managers. They should be recognized for their patience and understanding in deciphering information available to them in ways it could be used in this Study. The following staff members of WDFW and ODFW hatcheries provided useful operational and budget information.

Hatcheries		
WDFW	ODFW	Staff
Grays River		Shane McEnney, Mike Queener, Karl Mahlum, Matt Fisher
	Big Creek	Alan Meyer
	Oxbow	Duane Banks
	Sandy	Ken Bourne
	Willamette	Gary Yeager
	Cascade	Mark Trayner, Brett Requa
	Gnat Creek	Roger Warren

Alan Dietrichs, Field Supervisor, who operates the Clatsop Economic Development Council Fisheries Project (CEDC) hatchery, was equally helpful. Other CEDC hatchery and net pen operation staff are Rod Litton, Biologist; Chris Ketcham, Biological Aide; Dan Dunn, Biological Aide; and Keith Warren, Biological Aide.

SAFE produced fish are caught both by recreational anglers and the lower Columbia River gillnet commercial fishing fleet. Representatives from the local fishing user groups were helpful (and sometimes quite vocal) about their support of the Project. A notable group is Salmon For All (SFA), which is an association of commercial fishing interests who advocate policy for both fishing opportunities and salmon stocks recoveries.

A commercial fisherman and seafood processor survey was used to update information about their family and business activities. Many of the SFA board members were participants or acted as liaisons and their interest was critical in getting sufficient and accurate results. The authors thank all the survey participants for their time and effort in providing the information.

Fish landing data and licensing information was mostly garnered from the Pacific Coast Fisheries Information Network (PacFIN) database maintained by the Pacific States Marine Fisheries Commission (PSMFC) and the fish ticket and permit databases maintained by the states. Will Daspit at the PSMFC, Lee Hoines at WDFW, John Seabourne at ODFW, and Gerry Kobylinski at the California Department of Fish and Game (CDFG) assisted in providing the data. Alaska landing and permitting information was received from the Commercial Fisheries Entry Commission (CFEC). Kurt Schelle, Research and Planning Project Leader, and other staff members at CFEC were helpful interpreting the information.

The Study consultant was The Research Group (TRG), Corvallis, Oregon. Hans Radtke, Shannon Davis, and Chris Carter were the principal authors. Dr. Carter was the former economist at ODFW. The authors were greatly assisted by Kari Olsen at TRG. TRG team has over 75 years of research and analysis experience in the economics of marine resources and has undertaken prior studies of the Columbia River recreational and commercial fisheries. These studies include the original feasibility study to ramp-up the SAFE, titled "Lower Columbia River/Youngs Bay Terminal Fisheries Expansion Project," prepared for SFA in January 1996. The authors' more recent Columbia River studies have included the John Day Dam Drawdown Phase 1 Study prepared for the U.S. Army Corps of Engineers (USACE) in August 2000, Economic Evaluation of the Northern Pikeminnow Management Program prepared for the PSMFC in June 2004, and the Lower Snake River Juvenile Salmon Migration Feasibility Study, Anadromous Fish Economic Analysis prepared for Foster Wheeler Environmental Corporation and U.S. Army Corps of Engineers in 1999.

This report was reviewed in draft form to provide candid and critical comments. This feedback helped make the findings of this report as sound as possible and ensures the report meets standards for objectivity, evidence, and responsiveness to the Study charges. Although reviewers provided many useful comments and suggestions, they were not asked to endorse Study findings and recommendations. This independent examination task was done in accordance with accustomed procedures and review comments were carefully considered.

The authors' interpretations and conclusions should prove valuable for this Study's purpose. However, no absolute assurances can be given that the described results will be realized. Government legislation and policies, market circumstances, and other situations will affect the basis of assumptions in unpredictable ways and will lead to unanticipated changes. The information should not be used for investment or operational decision making. The authors do not assume any liability for the information and shall not be responsible for any direct, indirect, special, incidental, or consequential damages in connection with the use of the information.

Authorization is granted for the Study report's contents to be quoted either orally or in written form without prior consent of the authors. Customary reference to authorship, however, is requested.

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LIST OF ACRONYMS AND ABBREVIATIONS

APAC	Artificial Production Advisory Committee
APRE	Artificial Production Review and Evaluation
BEA	U.S. Bureau of Economic Analysis
BPA	Bonneville Power Administration
CBFWA	Columbia Basin Fish and Wildlife Authority
CDFG	California Department of Fish and Game
CEA	cost-effectiveness analysis
CEDC	Clatsop Economic Development Council Fisheries Project
CFEC	Commercial Fisheries Entry Commission
CHA	cost-per-harvestable adult
CHF	fall Chinook
CHS	spring Chinook
COH	coho
CWT	coded wire tag
ESA	Endangered Species Act
FEAM	Fisheries Economic Assessment Model
FMP	Fishery Management Plan
FTE	full time equivalent
FWP	Fish and Wildlife Program
GAO	Government Accountability Office
HGMP	hatchery and genetic management plan
HRP	Hatchery Reform Project
I/O	input/output
IEAB	Independent Economic Analysis Board
IHOT	Integrated Hatchery Operations Team
IMPLAN	IMpact Analysis for PLANning
ISAB	Independent Scientific Advisory Board
ISRP	Independent Scientific Review Panel
M&E	monitoring and evaluation
MA	Mitchell Act
MFCMA	Magnuson-Stevens Fishery Conservation and Management Act
NEV	net economic value
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPCC	Northwest Power and Conservation Council
ODFW	Oregon Department of Fish and Wildlife
OMB	Office of Management and Budget
PacFIN	Pacific Coast Fisheries Information Network
PDO	Pacific Decadal Oscillation
PFMC	Pacific Fishery Management Council
PGE	Portland General Electric
PSMFC	Pacific States Marine Fisheries Commission
RecFIN	Recreational Fisheries Information Network

REI	regional economic impact
SAB	select area bright fall Chinook
SAFE or Project	Select Area Fishery Evaluation Project
SAR	smolt-to-adult return rate
SFA	Salmon For All
TRG	The Research Group
USACE	U.S. Army Corps of Engineers
URB	upriver bright fall Chinook
USFWS	U.S. Fish and Wildlife Service
WDFW	Washington Department of Fish and Wildlife
West Coast	West Coast of contiguous U.S., including Washington, Oregon, and California
WTP	willingness-to-pay

EXECUTIVE SUMMARY

INTRODUCTION

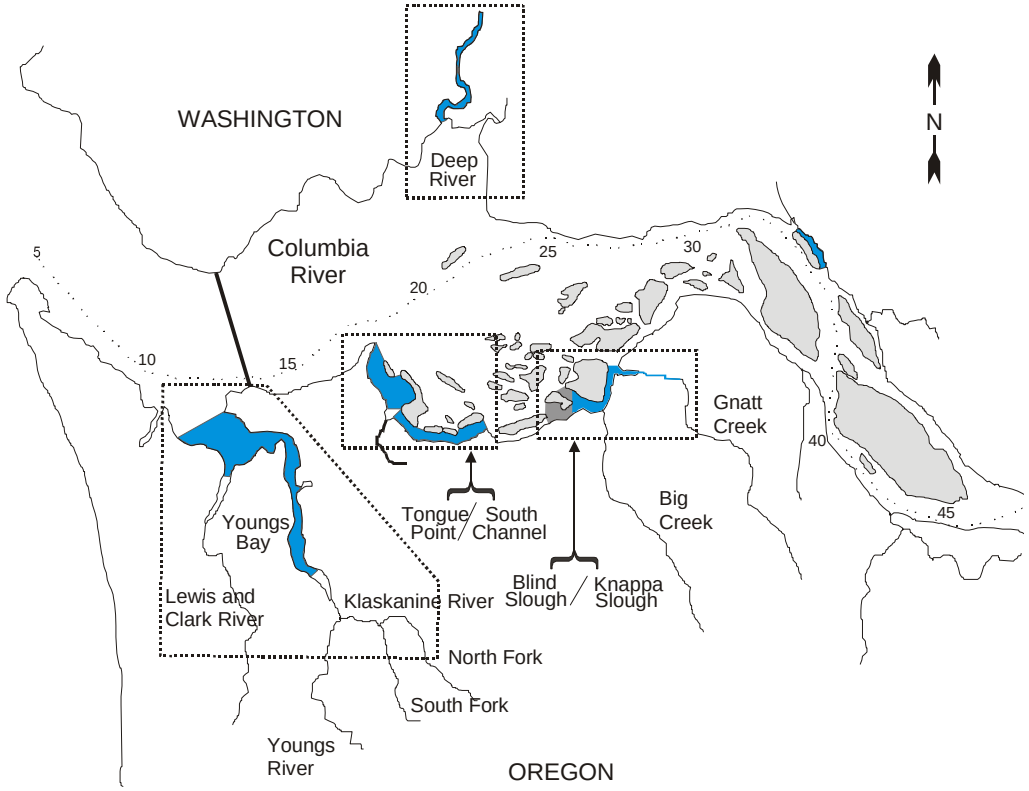
This Study provides an economic analysis of the Select Area Fishery Evaluation Project (SAFE or Project). The SAFE is an expansion of a hatchery project (locally called the Clatsop Economic Development Council Fisheries Project or CEDC) started in 1977 that released an early run coho (COH) stock into the Youngs River. The Youngs River entrance to the Columbia River at River Mile 12 is called Youngs Bay, which is located near Astoria, Oregon (Map ES.1). The purpose of the local hatchery project was to provide increased fishing opportunities for the inriver commercial fishing gillnet fleet. Instead of just releasing fish at the hatchery, a small scale net pen acclimation project in Youngs Bay was tried in 1987. Research found higher smolt-to-adult return rates (SAR's) and the returns to the off-channel net pen location would allow higher harvest rates than could be used on the mainstem Columbia River.

The Bonneville Power Administration (BPA), who had been providing funds to the Project since 1982, greatly increased their financial participation for the experimental expansion of the net pen operations in 1993. Instead of just being a funding partner in CEDC operations, the BPA became a major financing source for other hatchery production operations. BPA's minor share (less than 10 percent) of CEDC funding in 1982 grew to about 55 percent in 1993. The annual estimated operation and management costs for SAFE except for the value of volunteer time and donated materials is in the $2.4 million range in recent years. Of this amount, BPA annual funding has been in the $1.6 million or two thirds range in recent years. Depreciation on capital assets (or an equivalent amount for annual contributions to a capital improvement fund) would be in addition to these operation and management costs.

The Study workscope included the following economic analysis.

- A brief recounting of SAFE operations and administration is made. The amount and mix of recent smolt releases, and the number of adult returns are described. A review of the gillnet fishery and participants is provided to show who benefits from the program.
- A cost analysis was completed for CEDC operations and all current contributing hatchery operations. This was needed at a detailed species and rearing level to provide inputs to the economic analysis models.
- Economic measurements are provided for net economic value (NEV), regional economic impacts (REI), and cost-effectiveness analysis (CEA). A change in SAFE production NEV and REI is calculated between status quo conditions and a hypothetical alternative for no BPA funding. The CEA is a method by which internal cost analysis ratios can be used to show whether least cost operations are being attained and how least cost planning can be used in future decision making. The CEA also provides a basis for comparing the SAFE to other Columbia River salmon recovery programs. The comparison may be useful to funding agencies who must choose a suite of projects to implement among many proposed in order to accomplish regional goals.
- REI is calculated for all gillnet permittee fisheries participation to show the importance to the local economy. The REI is also calculated for Columbia River recreational fishing.

Map ES.1
SAFE Existing Net Pen Acclimation Sites



Current funding for net pen operations and hatchery production (both from CEDC hatchery operations and other hatcheries contributing smolts) has allowed for about five million releases for spring Chinook (CHS) (24 percent of total), COH (45 percent of total), and a fall Chinook (30 percent of total) called select area bright (SAB). There are four net pen sites: Youngs Bay, Blind Slough/Knappa Slough, Tongue Point/South Channel, Oregon; and Deep River, Washington.

There have been multiple hatcheries contributing smolts to SAFE other than the CEDC Hatchery over the years. There are currently four Oregon Department of Fish and Wildlife (ODFW) run hatchery complexes contributing smolts for release at the Oregon side net pens. (1) The Gnat Creek Hatchery provides CHS. (2) The Cascade and Oxbow hatcheries provide COH. These hatcheries are located within a few miles of each other near Bonneville Dam. (3) The Sandy River Hatchery provides COH. (4) The Big Creek and Klaskanine hatcheries will be providing COH. The Washington Department of Fish and Wildlife (WDFW) Grays River Hatchery raises and releases smolts at the Washington side Deep River net pen site. Several other ODFW and WDFW hatcheries participate by contributing broodstock or are involved in rearing.

Operation strategies in recent years have been to increase CHS production to take advantage of higher prices for this species and provide year-around fisheries. The SAFE system's bread and butter stock is an early run COH. SAFE operation strategies are being re-programmed to make up for the recent loss (releases in 2004 using 2002 broods) of one million COH smolts from the U.S. Fish and Wildlife Service Eagle Creek Hatchery. Another important re-programming change is the complete transfer of SAB stocks to the responsibility of SAFE. The SAB is an egg transfer Rogue River fall Chinook originally brought into Columbia River production for the purpose of furthering SAFE goals. It has been raised and released at the ODFW Big Creek Hatchery before 1995 when the broodstock program was moved to the ODFW Klaskanine Hatchery. But starting in 2006 the broodstock will be totally assigned to the CEDC South Fork Klaskanine River Hatchery. SAB's have a better flesh quality and have a higher SAR than other stocks that might be used, such as an indigenous tule fall Chinook.

Measures were developed for the following economic indicators.

- A ratio was developed for cost per "harvestable" adult for the SAFE system and comparable hatcheries to show whether there is a recruitment-to-spawner cost advantage. "Harvestable" adults includes hatchery escapement returns in the ratio's denominator.

- Trend ratios were developed for harvest revenue and smolt releases divided by operating costs for the SAFE system and comparable hatcheries to show whether business efficiencies were changing over time.

- Incremental NEV and REI measurements were shown for a hypothetical alternative where the SAFE system did not have BPA funding.

- CEA ratios for cost per "harvested" adult were developed to show how least cost planning was being used for SAFE system operations and to show any advantages over traditional hatchery operations.

- A ratio for cost per impacted fish was developed to show comparisons based on a common measurement (cost per one percent saved juvenile) to other Columbia River salmon recovery projects.

- Other economic contribution calculations at a local and regional economy level were developed for the lower Columbia River commercial and recreational fishing user groups to show relative share of SAFE system economic contributions.

- A sensitivity analysis was completed to show how variability in SAR's affects economic measurements.

A digest of the analysis results is shown in Table ES.1.

Table ES.1
Analysis Results Digest

Measure	Analysis Purpose	Result Synopsis
Cost per smolt produced by CEDC and contributing hatcheries	Determine overall production costs	CHS $0.64 COH $0.49 SAB $0.32
Cost per "harvestable" adult for SAFE and comparable hatcheries	Comparative fish recruitment cost and provide tool for least cost planning among options	CHS $76 compared to $75 COH $20 compared to $23 SAB $31 compared to $56
SAFE production estimated value in 2004 for all river and ocean harvest locations	Achieve maximum fishery access to hatchery production	Commercial harvest revenue $1.53 million and recreational fishing expenditures $1.47 million
Commercial harvest revenue divided by operating costs	Least cost for maximum commercial gillnet fisheries and recreational angler access	<1 ratio for commercial harvest revenue >1 ratio for commercial harvest revenue plus recreational expenditures
Smolt releases divided by operating costs	Efficiency trends	≈ 2 smolt per dollar cost
Incremental NEV and REI for w/o BPA funding alternative	Incremental effects to the nation and region from alternative	NEV decrease $49 thousand REI decrease $2.2 million
Cost per "harvested" adult for SAFE and comparable hatcheries	Evaluate objective for fishery access	$31 compared to $82
Cost per impacted fish saved using translation to one percent saved juveniles	Rating among other projects with similar objectives using common outcome indicator	Spill $600 million Passage improve $95 CHF and CHS Pikeminnow $2.9 CHF and CHS SAFE $0.84 CHF and $0.51 CHS
Gillnet permittee REI	Determine importance of gillnet fisheries' participation to local economy	Gillnet salmon $3.0 Other West Coast $5.3 Alaska $3.7 Total local $12.0 million personal income Jobs 441
	Determine importance of gillnet fisheries' participation to regional economy	Gillnet salmon $5.1 Other West Coast $7.8 Alaska $7.8 Total regional $20.6 million personal income
Ocean, estuary, and mainstem (below Bonneville Dam) recreational salmon fishing REI	Show user group regional economic effects for all lower Columbia River recreational fishing	Total regional $21.0 million personal income
Astoria/Ilwaco area overall fishing industry	Determine gillnet sector relationship to local fishing industry	Gillnet salmon 7% of harvest revenues in 2004 of which SAFE production 33%

STUDY FINDINGS

Telling results are explained in a findings format below.

SAFE Administration

1. BPA funding is about two thirds of the annual $2.4 million overall SAFE operation costs in recent years. The overall cost includes net pen operation costs, contributing hatchery smolt production and hauling costs, and states' program management costs. In regards to smolt production costs only, the BPA financed shares represent about half of the smolts used in the Project.

2. The SAFE is transitioning to a new phase for less release strategy experimenting and more to production at proven sites with proven stocks. Operation efficiency indicators (such as releases per cost) should increase in future years as the program heads towards implementation rather than being exploratory.

3. Planned full-scale production has never been reached during the project's development phase. Cost modeling from this Study would allow for more accurate operational budgeting to be completed to show expansion feasibility. The feasibility would also have to be accompanied with investigations about ecological impacts, contributing hatchery production plans, and state/federal management approvals.

4. The administration of SAFE is being handled by knowledgeable and experienced staff at CEDC and state agencies. However, there is no local, state, or federal technical or oversight board convening during public meetings focused to the SAFE operations. Periodic presentations and approvals to such an independent board would add analysis information availability, public witness and input, and production oriented justifications for the operations. There is heightened public awareness about hatchery ecological interactions and there are more water resource coordination bodies now than when SAFE started. A governing board with overlapping interests would help define and shape SAFE purpose among all water uses.

SAFE Production Costs

5. The economic analysis provides information to discuss effects from shifts (release strategies and numbers) in production and any gained efficiencies. Such a discussion was not possible without the contributing hatchery production cost estimates. Cost accounting practices melded together common operations and assumptions had to be made on how they applied to individual stocks. Hatchery site visits were made to each contributing hatchery to interview senior personnel on how annual and summary budgets might be disaggregated to represent costs for the SAFE production. Significant review and modeling was necessary to itemize costs necessary to show the economic value for all SAFE operations. It is recommended data systems be developed to track production costs across salmon life-cycles for the purpose of accomplishing economic evaluations in the future.

6. In addition to operation costs, facility costs need to be reflected in total production costs. For day to day operation decision making, they will likely be considered "sunk costs." However, in an evaluation of expanding programs or decision making over long terms that will include heavy maintenance and replacement costs, facility costs need to be included. Information from other studies were used as proxies to determine probable replacement costs for the type and size of hatcheries that are providing SAFE smolts. The resulting amortized fixed costs, which include an annual depreciation allowance plus average annual financing interest costs, were translated to a per-smolt cost basis. The calculated per-smolt costs are $0.24. Recently constructed and planned hatcheries to be used for research and supplementation were much greater than this calculation for a typical existing augmentation hatchery.

7. Using cost-per-harvestable adult fish ratio, the slightly higher SAFE costs combined with slightly higher SAR's mean the overall ratio is about the same for comparable hatchery releases. The ratios can be useful for determining species release strategies. For example, the use of SAB stock ($31 ratio) over the indigenous tule fall Chinook stock ($56 ratio) appears to be a cost-effective choice.

8. The SAFE system provides for harvest access that traditional hatchery releases do not. SAFE system harvest rates can be nearly 100 percent of the adult returns not needed for broodstock programs, while constraints on harvesting traditional hatchery releases in mixed stock mainstem areas means adult returns will become hatchery surpluses. The mentioned "harvestable" adult fish ratio includes escapement to hatcheries. A "harvested" adult is a better cost-effectiveness ratio given Project objectives to provide for harvest access. The overall SAFE production cost-per-harvested adult ratio for the snapshot conditions used in this report's economic analysis is $31 compared to similar hatchery production of $82.

9. Production shifts towards the highly valued CHS have occurred. While this provides for higher harvest revenues, operation financial planning needs to consider that CHS has 30 percent higher production costs than COH and more than double the costs of rearing and acclimating SAB.

SAFE Economic Analysis

10. The production alternatives chosen for the NEV analysis are for what might be considered status quo (also used as the baseline alternative), and secondly, a hypothetical situation for no BPA or equivalent replacement funding. The estimated NEV for the status quo alternative is negative $170 thousand and the alternative for lost BPA funding is a negative $219 thousand. The incremental NEV for this alternative moves the baseline effects to a more negative $49 thousand. Or in other words, this means the status quo alternative is a more positive $49 thousand. If the same CHS production was continued at comparable hatcheries with traditional releases and included in the funding alternative, the incremental NEV moves the baseline effects to a more negative $271 thousand.

11. NEV estimates utilized in this report should be viewed as general indicators for comparing alternatives. It is a method for showing whether a proposed alternative has greater net benefits than the baseline. Specific application of the models for certain program effects or in selective geographic areas may not be appropriate. The equation to determine NEV may not include all the effects from proposed alternatives. Some would argue that because augmentation hatcheries are to offset dam construction impacts that hydropower values should be in the NEV equation. Similarly, it could be argued that forgone power to assist fish survival and other opportunity costs for land and water use should be used in the NEV equation.

12. The REI from SAFE production for all river and ocean commercial and recreational fishing is $3.4 million in total personal income. The alternative for without BPA funding decreases this amount by $2.2 million to $1.2 million.

13. Environmental variables such as ocean conditions and estuary smolt predation greatly affect the realized economic returns from SAFE investments. If the lowest and highest SAR's during the selected 1990's broodstock years are used in a sensitivity analysis, the economic effects vary by a factor of 100. Operation research is continuing to minimize smolt mortality during net pen acclimation custody. A current experiment is to tow the net pens downstream into the lower estuary for liberation to determine whether aviary predation can be reduced.

14. The CEA provided a cost comparison to several external (non-SAFE related) programs. The cost comparison measure used the SAFE objective to maximize harvest access to hatchery production while minimizing impacts to depressed stocks. The comparison basis was cost per one percent saved juveniles associated with impacted returns of upriver CHS and upriver bright fall Chinook. The external program example programs included forgone hydropower benefits from spilling ($600 million for fall Chinook), smolt passage improvements ($9.5 million from installing a corner collector at Bonneville Dam for both species), and the effects from the Northern Pikeminnow Sport Fishing Reward Program ($2.91 million for both species). The SAFE calculated to be $0.84 million for fall Chinook and $0.51 million for CHS. The selected objective used to generate the CEA statistic shows SAFE to have a very favorable comparison to the other programs.

15. Because some of the present smolt production costs are shifted toward SAFE operations funded by states and stakeholder interests, net costs for hatchery production sponsors decrease. Smolt production levels to meet augmentation hatchery goals are maintained and the number of adults reaching accessible fisheries is increased. Depending on the policy choice of program sponsors to maintain hatchery production levels, the SAFE would appear to be consistent with the Northwest Power and Conservation Council (NPCC) Independent Economic Analysis Board (IEAB) definition for cost-effective.

<u>Other Economic Analysis</u>

16. SAFE released fish have contributed about a third of the lower Columbia River gillnet fleet's harvest revenues in recent years. The gillnet fleet's average annual salmon harvest

revenue from off-channel and mainstem areas was $2.1 million in the five years ending in 2004. There has been an increasing trend in the harvest revenue in recent years. Year 2005 annual salmon harvest revenue was $2.4 million and the off-channel harvest revenues were $0.9 million. This trend is partially due to higher prices being received from a SAFE production shift to CHS.

17. Gillnet permittee residency was analyzed so economic impact modeling for fishing related revenue could be traced to local households. Fishing industry operating costs are usually incurred near the fishery's access locations, but labor payments and business net income goes to permit residence locations for respending. For WDFW and ODFW issued gillnet permits, 51 percent are registered to Clatsop and Pacific county addresses. About 98 percent are issued to addresses in Washington and Oregon. WDFW Columbia River gillnet licensees can also fish Grays Harbor or Willapa Bay locations. About 30 percent of gillnet permittees were found to have Alaska fishing permits of which 58 percent were registered to Washington, 39 percent to Oregon, and the rest to other states. Many gillnet permittees also hold other West Coast fishing permits, including Washington or Oregon Dungeness crab permits.

18. Gillnet permittees are typically from families with long histories in many different fisheries. Their other fishery earnings in 2004 were estimated to be $3.9 million from other Columbia River and West Coast fisheries and $5.5 million from Alaska fisheries. These earnings are placed in risk if the significant share of SAFE related earnings were to go away. This is especially so because they are received during the course of seasonal non-participation in other fisheries.

19. Total estimated local (Clatsop and Pacific counties) economic contribution made by gillnet permittees is $12.0 million in personal income, which represents about 441 jobs. Total estimated regional (Oregon and Washington states) economic contribution is $20.6 million.

20. The average number of vessels in the years 2000 to 2004 that participated in the gillnet fishery was 258. Not all permitted vessels harvest every year in the gillnet fishery. Only 41 percent of vessels earning more than $500 in annual gillnet revenues participated every year during the last five years. The average number that fished at off-channel locations was 143 or 55 percent of the total. Most (71 percent) of those that fish at off-channel locations fish in Youngs Bay. The least fished site is Deep River (seven percent). Of the total WDFW and ODFW permitted vessels that were fished in 2004, the WDFW permitted share that fish in off-channel locations is 14 percent and the ODFW permitted share is 83 percent. This compares to the mainstem where WDFW is 36 percent and ODFW is 60 percent. (These vessel count percents do not total to 100 percent, mainly because some vessels are associated with both states' permits.)

21. The gillnet salmon fishery is a small, but important, contributor to the Astoria/Ilwaco area fishing industry. The gillnet salmon fishery represents about seven percent of all harvest revenues delivered in this area. Businesses that support the gillnet fleet also outfit and supply ocean fisheries. Seafood processors that purchase the Columbia River salmon catches also receive deliveries from ocean catches. In some cases, plant facilities

are owned by a major processing company and landings at other ports are hauled to the Astoria/Ilwaco area for processing.

22. Recreational fishing is allowed at SAFE net pen fishing areas, but there are only comparatively minor harvests. The commercial fishery average harvest for 2001 to 2005 was 83.8 thousand fish and the recreational fishery average was 1.3 thousand fish. SAFE production recreational harvests are mostly in the mixed stock ocean and river fisheries. Using average SAR's and proposed Year 2006 releases would project 13.9 thousand to be caught in all recreational fisheries.

23. The late summer and fall lower Columbia River commercial salmon harvests enter worldwide market conditions with many substitutes. This river fishery provided only seven percent of the West Coast catch and the West Coast catch was only 18 percent of all West Coast plus Alaska wild caught harvest revenue in 2004. The bulk of the river harvests are shipped to either custom processing facilities in the case where fillet markets exist or to wholesalers in the case of whole fresh/frozen product markets. Very little local labor is committed to processing. A few active gillnet permittees are experimenting with vessel direct public and restaurant sales for spring salmon harvests in fresh product forms. There are market advantages for river fisheries which can be enhanced with SAFE production shifts and cooperative arrangements for quality assurance and marketing programs. Marketing programs will need to distinguish the harvests from the other market substitutes.

STUDY CONCLUSIONS

The report discussed economic analysis results in terms of cost-effectiveness because business feasibility ratios are not always applicable when applied to public investments. For example, government intervention was necessary to build the Columbia River Basin hydropower system that led to development of habitat and fish mitigation programs. This federal intervention is a transfer of wealth through subsidies to the private sector accomplished in ways that complicate accounting of benefits and costs. The result for the narrow case of reviewing the SAFE is that a $2.4 million project helps inject $12.0 million personal income into local area households.

It depends on perspective for whether the project is judged economically feasible. For harvesters that pay 10 percent of their ex-vessel value for the privilege of harvesting SAFE production, the five year average annual return has been about $680 thousand harvest revenue. From the perspective of the electric rate payer, it is costing them $1.6 million out of a $2.4 million project to provide the $680 thousand harvest revenue. The harvesters' perspective is that dams were built for society and society needs to mitigate for their adverse effects. Society's perspectives are not so clearly defined, but there are many studies that show continued support for salmon recovery. How much of the recovery benefits should accrue to commercial or other user groups is a matter of policy concern.

The SAFE appears to be a winning solution to several problems. The SAFE system adult salmon return rates are at least similar and sometimes higher due to lower estuary predation and other factors affecting out-going smolt migration mortality. Adult returns to the off-channel net pen

locations means commercial and recreational fishing at the release sites will have lower harvest impacts on upriver destined depressed stocks than when fishing at mainstem locations. Fishing on these hatchery origin stocks allows significantly higher harvest rates, since adult returns not needed for broodstock can be 100 percent harvested rather than subject to harvest curtailments due to impacts on depressed stocks in mainstem fishing locations. The higher harvest rates on the returning adults also solves some problems that accompany the usual practice of releasing smolts at upriver hatchery location sites. Too many hatchery produced fish return to these release sites and surpluses (those in excess of what is needed for future generation broods) must be handled and disposed. The value of the hatchery fish caught at the net pen sites is higher because of better fish condition and ready markets compared to public hatchery surpluses. Moreover, a higher value accrues to the fishing industry rather than a lower value to the hatchery sponsors. If there must be augmentation hatchery production, then Study results suggest the SAFE process is a cost-effective method for allowing greater fishery access to the production.

I. INTRODUCTION

A. Study Purpose

The purpose of this Study is to provide an economic review of current and proposed changes to the Select Area Fishery Evaluation Project (SAFE or Project).[1] The Study results are the information requested in comments made on the Project by a joint review dated March 2005 by the Northwest Power and Conservation Council (NPCC) Independent Scientific Review Panel (ISRP) and Independent Economic Analysis Board (IEAB). North et al. (2006) addressed technical questions about operations and plans, and this report contains the response information for comments concerning Project economics. This report can be considered an economic feasibility review meeting guidelines for cost-effective analysis developed by the IEAB (2003). It also contains other economic measurement descriptions to illustrate the economic effects of SAFE.

The SAFE is an expansion of a hatchery project (locally called the Clatsop Economic Development Council Fisheries Project or CEDC) started in 1977 that released an early run coho (COH) stock into the Youngs River.[2] The Youngs River entrance to the Columbia River at River Mile 12 is called Youngs Bay, which is located near Astoria, Oregon. The purpose of the hatchery project was to provide increased fishing opportunities for the inriver commercial fishing gillnet fleet. Instead of just releasing fish at the hatchery, a small scale net pen acclimation project in Youngs Bay was tried in 1987. Hirose et al. (1998) found that 1991-1992 COH broodstock over-wintered at the net pens had double the smolt-to-adult return rate (SAR) of traditional hatchery release, less than one percent stray rates, and 99 percent fishery harvests. It was surmised that smolts from other Columbia River hatcheries could be hauled to the net pens for acclimation and release to take advantage of the SAR's and fishing rates. Proposals were tendered to Bonneville Power Administration (BPA) and other agencies to fund the expansion for using other hatcheries' smolts and other off-channel release sites.

The BPA, who had been providing funds to the Project since 1982, greatly increased their financial participation for the experimental expansion of the net pen operations in 1993. Instead of just being a funding partner in CEDC operations, the BPA became a major financing source for other hatchery production operations. The BPA has viewed the 10 plus years of funding since then as an explorative project with two phases: a "research" phase ending in 1993, and a "development" phase ending in 2006. The next phase is referred to in proposals to BPA for continued funding as an "establishment" phase to be started in 2007.

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1. The name of the Project has changed over the years to be more consistent with the phased approach to its development and maybe for public relations purposes too: early years - CEDC Fisheries Project; 1993 - Columbia River Terminal Fisheries Project; 1997 - Select Area Fishery Evaluation Project; and, 2006 - Select Area Fisheries Enhancement Project.
2. The Clatsop Economic Development Council Fisheries Project (CEDC) is the name still associated with the hatchery project. The CEDC was an advisory body within County government for a variety of economic development projects. The CEDC has since been disbanded. Staff working on the hatchery project are employed in positions within Clatsop County's Community Development Department.

There are three components of SAFE:

1. The CEDC owns and operates the net pens in the Columbia River estuary on the Oregon side. The CEDC also owns and operates a hatchery on the South Fork Klaskanine River.[1]
2. There are many other hatcheries contributing smolts to the net pen operations. The present suite of hatcheries are operated by the Washington Department of Fish and Wildlife (WDFW) and Oregon Department of Fish and Wildlife (ODFW). The WDFW owns and operates the net pens at Deep River on the Washington side of the Columbia River.
3. The monitoring and evaluation (M&E) responsibilities are performed by employees of WDFW and ODFW.

BPA provides funding for all three components as part of NPCC Project No. 199306000. The CEDC and other contributing hatcheries have other sources of funds that also support the SAFE.

BPA's minor share (less than 10 percent) of CEDC funding in 1982 grew to about 55 percent in 1993 with the beginning of the development phase of the Project. The balance of the CEDC budget over the years has been from other federal, state, and local government programs. It has also included a 10 percent fee assessment (five percent of ex-vessel value received by harvesters plus five percent of purchase value made by processors) on harvests that take place in off-channel locations near the release sites. The CEDC total annual budget in the last several years has been in the $600 to $700 thousand range. The Project over the years also has relied on heavy volunteer participation and other agency inkind support.

The CEDC budget is exclusive of WDFW and ODFW M&E costs, and all non-CEDC hatchery smolt production costs. The annual estimated operation and management costs for SAFE except for the value of volunteer time and donated materials is in the $2.4 million range. Of this amount, BPA annual funding has been in the $1.6 million or two thirds range in recent years. Depreciation on capital assets (or an equivalent amount for annual contributions to a capital improvement fund) would be in addition to these operation and management costs.

North et al. (2006) documented results through the second of three phases and described potential capacities. Full capacity as defined in early planning for the project (TRG 1996) was not reached by the time the second phase ended. Current funding for net pen operations and hatchery production (both from CEDC hatchery operations and other hatcheries contributing smolts) has allowed for about five million spring Chinook (CHS), COH, and fall Chinook (CHF) releases.[2] There are four net pen sites: Youngs Bay, Blind Slough/Knappa Slough, Tongue Point/South Channel, Oregon; and, Deep River, Washington (see Map I.1).

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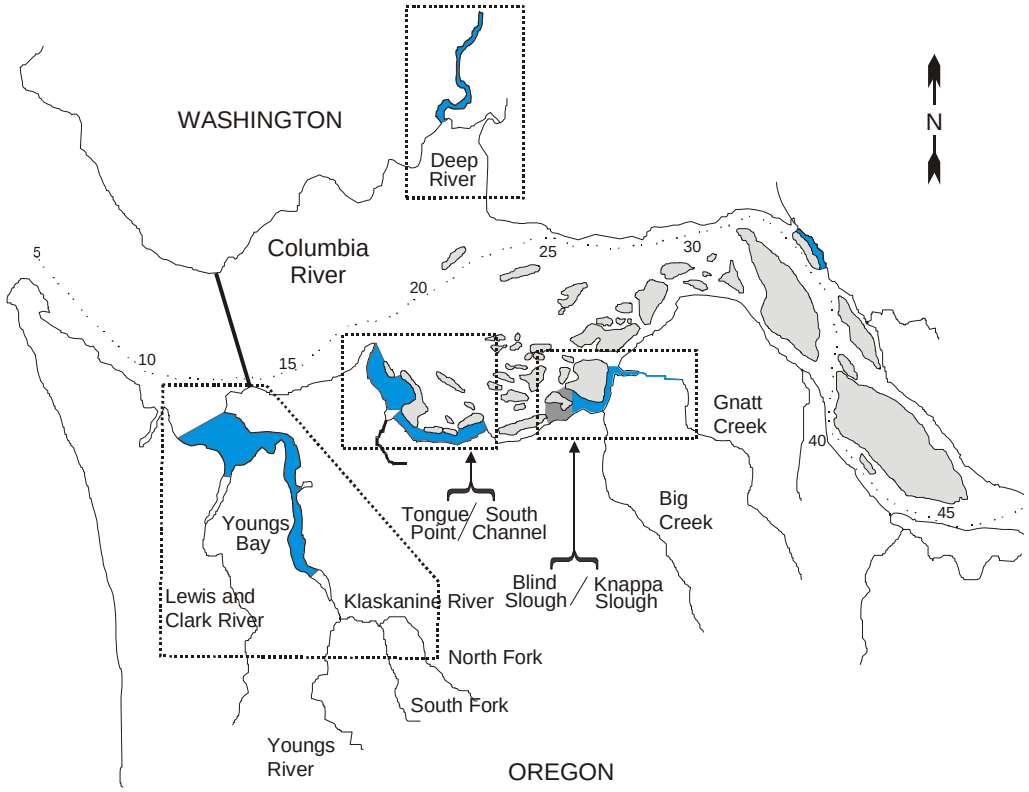
1. There is another hatchery owned and operated by the Oregon Department of Fish and Wildlife (ODFW) on the North Fork Klaskanine River. It is referred to in this report as the Klaskanine Hatchery.
2. Many different indigenous and Columbia River out-of-basin stocks have been used during the course of Select Area Fishery Evaluation Project (SAFE). For example, spring Chinook (CHS) stocks contributed by ODFW are from Willamette River tributaries. Out-of-basin stocks include a Rogue River genetic fall Chinook (CHF) called select area bright (SAB). This had been a seed stock at the ODFW Big Creek Hatchery for many years. This stock was selected for mitigation production because of its high flesh quality, improved ocean survival, and ocean migration pattern that benefits Oregon ocean fishing. There were experimental releases of a Trask River stock late fall/winter Chinook in 1975 that apparently have colonized the South Fork Klaskanine, Youngs River, and Lewis and Clark River.

Map I.1
SAFE Existing Net Pen Acclimation Sites



Source: North et al. (2006).

B. Economic Analysis Context

To fully understand the breadth of the Project requires close reading of its history as recounted in North et al. (2006). This economic Study only uses a snapshot of the most recent operations for economic analysis purposes and does not evaluate cost considerations of past operations or policy considerations for future operations. One contingency alternative for the loss of BPA funding is evaluated for the purpose of characterizing the current approach to operations. Also, the Study was for policy level economic analysis and not a business level efficiency examination. Internal management had to be investigated in order to determine cost structures, but were not evaluated for best practices.

Tracking down total SAFE related costs for the snapshot conditions became a major task for this Study. The cost analysis was to include details about operations and M&E for all smolt production. Currently, smolt production takes place at a CEDC owned and operated hatchery and several other WDFW and ODFW operated hatcheries. Smolts at various stages in their life cycle are hauled to the CEDC owned and operated net pens for final rearing and acclimation. Smolt production is partially funded by the BPA at the WDFW and ODFW hatcheries. Since

cost accounting at CEDC and at the contributing hatcheries does not itemize for the small lots of smolts hauled to the net pens, it was necessary to estimate what these production costs might be. The cost analysis also is to include facility and other fixed costs associated with hatchery production.

The settling of what operational levels to evaluate in this economic analysis was troublesome. There are annual changes to SAFE sponsored smolt releases depending on CEDC hatchery and other hatchery smolt availability. The mix of species counts one year will not be the same the following year. It was decided to use calendar year 2006 intended release counts for the cost analysis and a range of SAR's associated with 1990's broodstocks for the economic feasibility analysis. Since the "salt" years vary among species to be between one and five years, there is a disconnect between adopted years of broods and the adopted year used for costs to produce and release the broods. The years selected were in order to use current personnel understanding about costs and to have synthesized information available about the survival of broodstock. This snapshot approach with disconnected fish lineage becomes a major assumption for the cost analysis. Any selection of different release programs or brood years for the cost analysis will produce different results. The disconnected approach is meant to be the best approximation of the level of program costs and "benefits" for an on-going program at current production levels.

There are changes to costs and benefits when the SAFE operations become part of hatchery release strategies. For example, besides the SAFE operational and administrative costs, smolts have to be hauled to the net pen sites in trucks, fed, and monitored. There are savings at hatcheries from not having to deal with surplus returns. The commercial price for harvests at net pens is greater than selling the surpluses. Depending on the objectives for hatchery production, there might be more or lesser cost solutions than what the SAFE operation strategies currently afford. Economic indicators to show strategy measurements are addressed in the economic evaluation tasks.

The sponsor's feasibility declaration in moving from the development phase to the establishment phase only addressed whether the Project successfully attained at least partial fulfillment of stated goals. It did not recommend or evaluate whether there were other alternatives to do the same. The Study attempts to provide a cost analysis to increase understanding about Project feasibility.

To assess whether there might be other alternatives to accomplish Project purposes, NPCC Fish and Wildlife Program managers and other Columbia River Basin fish management experts were interviewed. The interviews were to discuss whether the following alternatives might be possibilities.

- Radical alternative approaches, such as using fish wheels and distributing harvest revenues to gillnet permittees, or mitigating through gillnet permit buyouts, might be possibilities, but their assessments were not within the Study scope.[1,1]

1. Fish wheels, weirs, and traps are a fishing technique known for being highly successful for their catch rates and their potential for low indirect mortality rates in selective fisheries. Fish wheels appeared on the Columbia River in the 1870's, catching as many as 6,000 fish a day. Canneries and fish markets built fish wheels to take advantage of large fish runs and deliver a fresh product to their customers. These techniques were statutorily

- Substitute salmon production approaches, such as improving habitat in tributaries that would bolster natural runs and also allow off-channel fishing did not have readily available information.

- Another possible alternative would be techniques to lower impacts in mainstem fisheries through fishing regulations. There might be other selective fishing approaches using, for example, gear types or management procedures to lower impacts and allow increased harvest rates. Research for live capture selective harvesting using tangle nets and live fish release boxes has been promising and is incorporated into current regulations (Vander Haegen et al. 2002 and Whisler 2003). Adaptive management procedures for setting regulations to reduce mortality on the depressed stocks have tightened mainstem fishery access down to very low levels. It was beyond the Study workscope to determine whether other management procedures might be as significant to even come close to equaling what is accomplished through off-channel harvests that the SAFE provides.

- SAFE goals are to increase access to fish for a certain user group. It would seem that another alternative would just be to produce more fish at existing hatcheries, i.e. more fish in the river would provide for more harvests. However, recovery plans developed for Endangered Species Act (ESA) listed fish limits certain levels of harvest mortality no matter how many hatchery fish are in the river. Hydropower mitigation agreements provide funds to replace lost fish production, however there is a delicate balance in trying to catch the hatchery produced fish due to collateral impacts on depressed natural production stocks. Consequently, returning adults to hatcheries can have large surpluses over what is needed for broodstock.

- To avoid the extra hauling, acclimation, and management costs for SAFE, an alternative might be to move (close or reprogram existing fishery augmentation hatcheries and build new ones) hatchery production to areas near the off-channel fishing sites.[2] Again, such an alternative investigation was beyond the scope of the Study. The investigation would

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banned in Oregon in 1926 and Washington in 1939. One criticism is that it is a cooperative rather than an individual fishing technique (Donaldson and Cramer 1971). Whether these methods are even workable under current river conditions has not been researched.

1. There have been past gillnet permit voluntary participation buyout programs. Prior to 1990, there were four programs for Washington and Oregon salmon gillnet permits. Another one occurred in 1995 for Washington held permits when 83 were retired. The average cost per retired permit was about $22 thousand (WDFW 1995). There were two additional Washington permit buyout programs between 1995 and 1998 (Muse 1999). The first of these retired 52 permits for an average cost of $45 thousand. In the first phase of the second program, 61 permits were retired at $10 thousand each. The second phase retired nine permits for an average $27 thousand each. The permits that have been privately sold in recent years have been in the $10,000 to $15,000 range, depending on whether there were river drift rights attached to them (Martin 2006). The reduction in fleet capacity and fishing power due to buyout programs is questionable because of the sizeable latent capacity in remaining permits. There are 258 Washington permits remaining today and 318 Oregon permits. These permits are assigned to 481 vessels, of which only 260 landed fish in 2004. Of these vessels, 54 caught 50 percent of the harvest by revenue and 155 caught 90 percent of the harvest by revenue.
2. Site selection for existing hatcheries was done before the full consequences of their production were known, and they are generally located near the offending dams where water supply and quality is sufficient. Traditional smolt releases occur at the hatcheries so that sufficient broodstock returns for future generations.

be very complicated given sometimes international agreements that reference existing fish production, complicated dual state management of river fishing seasons, biological concerns about integrated hatchery practices and ecosystem approaches to fish production. It could be expected that such investigations and planning would have minimum 10 year horizons.

The interviews resulted in a determination that the SAFE is unique in its purpose and operations. There is not sufficient Study resources to undertake a more comprehensive cost-benefit and least cost analysis using some or all of the above mentioned alternatives.

Cost-benefit analysis would be an appropriate method for judging the economic efficiency of the SAFE and other proposed Columbia River salmon recovery projects; however, this approach has not been adopted by the NPCC for project analysis and/or ranking. A cost-effectiveness analysis (CEA) that reduced SAFE results to a ratio of cost-to-objective was used in order to have comparisons with other existing salmon recovery projects. The comparison was for illustrative purposes.

This Study also is to provide recommendations about how commercial fisheries can maximize the economic value derived by the SAFE project if it is to continue. Unit costs of production are derived to show how release strategies might be shifted to maximize value. For example, what would it mean to shift production to higher harvest price CHS over COH? Suggestions are made about better marketing techniques that could be used to increase demand and attendant prices for the harvests. Background information about the area's overall fishing industry is offered to show the relative share of Project economic contribution estimates.

C. Sources of Information

In addition to secondary sources of information, there were two tasks for primary data collection. The first was to determine comprehensive smolt production costs that included CEDC operations and contributing hatchery operations. The CEDC financing is aptly handled through Clatsop County's accounting system. Project costs were readily available for labor, materials and services, and capital costs. However, costs for production and release by stocks had to be estimated. Cost accounting practices melded together common operations and assumptions had to be made on how they applied to individual stocks. This was also endemic to the ODFW and WDFW hatchery programs. Hatchery site visits were made to each contributing hatchery to interview senior personnel on how annual and summary budgets might be disaggregated to represent costs for the SAFE production. Significant review and modeling was necessary to itemize costs necessary to show the economic value for all SAFE operations. A separate chapter in this report describes the cost analysis approach and results.

The second data collection task was to acquire harvest and processor level cost and earning information. The existing information was for fishery prosecution in 1994 acquired by the same consultants (TRG 1994). A key informant survey was used to make adjustments to those survey results. The survey administration methods and results are described in Appendix B.

The compilation of gillnet fishery commercial landing and licensing information used databases operated by the WDFW, ODFW, and Pacific States Marine Fisheries Commission (PSMFC). The information sources for the databases are fish tickets that are submitted when a harvester delivers a catch to a processor or sells catch to the public. The WDFW and ODFW compile this information and then upload it to the PSMFC Pacific Coast Fisheries Information Network (PacFIN) system. Landing information includes harvests made in the Pacific Ocean and Columbia River, as well as from non-Indian and treaty fisheries. Recreational fishing activity is from several databases that again originate with WDFW and ODFW. For consistency reasons, the recreational fishing data whenever possible is from annual reports issued by the WDFW and ODFW Joint Columbia River Management Staff. Alaska fisheries' earnings are from databases maintained by the Alaska Commercial Fisheries Entry Commission (CFEC). Year 2004 was chosen for the data benchmark period because it was the most recent calendar year that data was complete when the Study started.

There were 260 harvesters in 2004 that participated in the lower Columbia River gillnet fishery. Of the 260 vessels making landings in the 2004 gillnet fishery, 242 harvested from mainstem catch areas and 141 from off-channel catch areas. Five different vessel categories were used to pattern the harvesters. There were 52 businesses that purchased salmon from the harvesters. Most of the purchases were directed towards the usual market channels for whole and fillet fresh product forms. There was a small amount sold directly by the harvesters to restaurants and the public. Four processor and buyer types were assigned. A go-to-market model for the different frozen and fresh product forms was developed to show value changes in the distribution chain. The compiled data is discussed in a separate report chapter and detailed information is included in appendices.

The other data, such as SAFE production and SAR's, was available in raw or synthesized form by either CEDC or WDFW/ODFW staff. Other secondary data or comparisons to other Study results are fully documented in the report.

D. Definitions

Revenue generated when harvesters receive money for delivering their catch to processors, restaurants, direct sales to the public, and other types of buyers is referenced in this report as harvest revenue, landing value, or ex-vessel value. When processors sell their products to wholesalers, it is called ex-processor value. Ex-vessel prices are reported per "round" pound equivalents. Round pounds are either the actual weight of fish when purchased by the buyer or processor, or the weight corrected by an adjustment factor in the case that the fish was dressed (gutted, gilled, and headed) when sold to the buyer or processor. All ex-vessel revenues and prices have been adjusted to real dollars using the GDP implicit price deflator developed by the U.S. Bureau of Economic Analysis (BEA).

There are many other economic method and measurement terms used in this report. Appendix D provides the background and definitions for the terms.

The geographical extent of economies is for two areas. The local economy is the economic activity in Clatsop County, Oregon and Pacific County, Washington. The regional economy is the economic activity in the states of Washington and Oregon. West Coast means west contiguous U.S. coastal states, including Washington, Oregon, and California.

E. Relevant Literature

There was limited hatchery production cost analysis information available to compare the SAFE system. Carter (1999) modeled harvest benefits and production costs, but the analysis was for Oregon coastal hatcheries. Caudill (2002) discussed benefits and production costs for four U.S. Fish and Wildlife Service (USFWS) mid-Columbia River hatcheries, but did not itemize cost results for stocks. The IEAB (2004) did itemize for costs at the stock level for several Columbia River hatcheries, but did not use an example early run COH hatchery release or comparable CHS hatchery releases. There were several good Alaska hatchery fishery benefit studies (Heard 2003) and studies by Hartman (1986) and Reifenstuhl and Blair (2003) did look at Alaska enhancement hatchery benefits and production costs. The IEAB is considering a project in the near future to extend the 2004 cost analysis to additional Columbia River hatcheries. The future analysis will be an important research addition to assist in policy deliberations for the best use of scarce salmon recovery funds.

F. Report Content

This report is organized to first discuss SAFE administration in Chapter II. An understanding of SAFE purpose and history will be useful to the reader when reviewing the economic analysis. A more complete description of Project history is in North et al. (2006) and parts are only recounted in this report for reader convenience. Because SAR's are such an important variable in calculating the costs and benefits from hatchery production, Chapter III is singularly devoted to this topic. Chapter IV describes the lower Columbia River gillnet and recreational fisheries. Much detail is given to the earnings sources for the commercial fishery participation so that the SAFE production share is understood. Included in this chapter is a discussion about the gillnet fishery in context with the lower Columbia River commercial fishing industry. An appendix in the report explains market opportunities for realizing the highest value possible from the commercially harvested SAFE production salmon resources. The SAFE cost analysis results for showing total costs to produce and release the smolts is described in Chapter V. The economic analysis results are described in Chapter VI. Economic analysis methods and factors are contained in an appendix. Chapter VII discusses what was learned in the Study investigations. Several appendices are included that contain detailed production cost data, gillnet fishery participant survey results, salmon market opportunity descriptions, economic analysis method explanations and factors, and detailed lower Columbia River commercial fish landing tables.

II. SAFE OPERATION AND ADMINISTRATION

A. SAFE Purpose

The completion reports required as BPA grant conditions have not always been clear about Project goal and objective definitions. Probably the best description of goals, objectives, and metrics is contained in the narrative supporting the BPA FY 2007-2009 funding application. The introduction statements from the supporting narrative section are paraphrased here. Note that while the statements are described as "criteria" in the supporting narrative, the statements can also be interpreted as objective statements. The details about how the criteria are measured can be found in the supporting narrative.

Earlier Project goals were to determine feasibility through research. The next phase goal will be to provide commercial and recreational harvest opportunity from hatchery stocks while minimizing impacts to listed salmonids. Specifically, the biological goals of the project include:

1. Maximize SAFE production and fisheries
2. Minimize the impact of SAFE fisheries on listed species
3. Minimize the impact of SAFE hatchery production on listed species

Evaluation criteria that can be used to measure progress toward project objectives include:

- Progress toward project release goals
- Progress toward increasing harvest in SAFE fisheries
- Progress toward improving SAR's
- Maintaining low impact rates on adult ESA-listed salmonids from incidental harvest in SAFE fisheries
- Minimizing straying of adult fish produced by the SAFE Project
- Monitoring the contribution of SAFE commercial harvest to total non-Indian commercial harvest in the Columbia River Basin
- Minimizing the potential for competitive interaction of SAFE juveniles with wild salmonids migrating through the Columbia River Estuary
- Minimize negative effects of SAFE production on the environment

The above cited narrative as well as North et al. (2006) have shown the consistency with the many overlapping plans and programs, statements, and court decisions that govern Columbia River hatchery production and fisheries. Since BPA funding must be found consistent with the NPCC Fish and Wildlife Program (FWP), strong justification is made with that plan's vision and action statements. For example, the tie between the SAFE system and FWP Vision 4 and 5 concerning hatchery production and harvest is made (NPCC 2000).

SAFE planning does not address management allocation between fishery user groups, however statistics are offered on the user group share of harvests in these documents. The Project objectives have never been to exclude recreational fisheries from benefiting from the Project; indeed, fishery management has allowed for both user groups' access.

B. SAFE Production

1. Existing Production

The Project is discussed in annual completion reports as being phased. Each of the first two phases (called research and development) had its own research oriented objectives. The development phase has included many studies besides evaluating sites, such as rearing densities, release timing, broodstock holding, avian predation avoidance, and winter dormancy feeding regimes.

Local efforts to promote fishery augmentation through hatchery operations started with a CEDC sponsored project in 1977 using Tucker Creek ponds for final rearing and releases. Grassroot volunteer efforts and donated materials plus labor from the Astoria Job Corps were used to build the South Fork Klaskanine River Hatchery in 1981. An early run COH was raised and released at the Hatchery. The BPA greatly increased funding in 1993 following a feasibility review of the research phase.

The feasibility review was based on the initial success of the Youngs Bay net pen project that released the early returning COH stock starting in 1987. The funding allowed for the development phase to experiment with new stocks and evaluate 25 potential release sites on both sides of the Columbia River. Over the years, stray problems for some experimental releases exceeded maximum thresholds.[1] Other considerations for disease, and water quality and quantity issues, were investigated. Towing net pens out of the off-channel acclimation sites to the lower estuary for release to facilitate a rapid out-migration for reduced predation is currently being tried. Funding limitations have reduced the release sites to four net pen sites (Deep River [36 net pens], Youngs Bay [76 net pens], Tongue Point/South Channel [37 net pens], Blind Slough/Knappa Slough [15 net pens]) and the South Fork Klaskanine River Hatchery. The release site at Steamboat Slough (16 net pens) has been discontinued and the pens have been relocated to Deep River. The current stocks are CHS (24 percent of total), COH (45 percent of total), and select area bright fall Chinook (SAB) (30 percent of total).

Smolt sources have recently been from five state operated hatchery complexes and the CEDC operated hatchery.[2] (1) ODFW operated Gnat Creek Hatchery provides CHS. (2) ODFW operated Cascade and Oxbow Hatcheries provide COH. These hatcheries are located within a few miles of each other near Bonneville Dam. (3) ODFW operated Sandy River Hatchery provides COH. (4) WDFW Grays River Hatchery provides CHS and COH. (5) ODFW operated Big Creek Hatchery with a broodstock program maintained at the ODFW Klaskanine Hatchery was providing SAB, and will continue to provide COH. (6) The CEDC Hatchery located on the

1. Straying of SAB's has been an issue in the past for jeopardizing compliance with ODFW's Wild Fish Policy and federal Endangered Species Act (ESA) listed fish recovery plans. There was significant escapement of SAB Big Creek Hatchery releases to natural CHF spawning areas in lower Columbia River Washington tributaries. This prompted relocation of the broodstock program to Klaskanine Hatchery which decreased stray rates considerably.
2. The U.S. Fish and Wildlife Service (USFWS) operated Eagle Creek Hatchery located on a tributary to the Clackamas River was a large supplier of coho (COH). The SAFE received up to one million full-term COH smolts for acclimation funded by the Mitchell Act (MA). This was discontinued in 2004 (2002 brood) due to federal budget shortfalls.

South Fork Klaskanine River has shifted between broodstock programs and species rearing in years past.[1] This hatchery will assume the SAB broodstock program. The hatchery will also be used for COH final rearing and release.

The state and CEDC hatcheries are referred to as complexes in this report because while the mentioned hatcheries may be the final departure point for smolts hauled to net pen release sites, broodstock programs for the species and intermediate smolt rearings are not always located at the hatcheries. For example, the CHS reared at WDFW operated Grays River Hatchery are broodstock from the WDFW Lewis River and Cowlitz River hatcheries. The other ODFW operated hatcheries raising CHS use Willamette River broodstock captured at Dexter Dam on the South Santiam River. Broodstock for COH is varied and includes capture facilities at Bonneville Hatchery, Sandy River Hatchery, and Grays River Hatchery. The hatchery complexes will transfer smolts between hatcheries for different smolt life cycles to take advantage of facility capacities. Smolts from one hatchery complex may be delivered to several different net pen release sites for final life cycle rearing and acclimation or for just a short period to accomplish acclimation.

An important planned change to the 2006 schedule is the complete transfer of SAB stocks to the responsibility of SAFE in 2007. The SAB is an egg transfer Rogue River CHF originally brought into Columbia River production for the purpose of furthering SAFE goals. The stock was raised and released at the ODFW's Big Creek Hatchery and released from Youngs Bay net pens. The broodstock collection program in recent years was moved from the Big Creek Hatchery to the ODFW Klaskanine Hatchery in order to decrease straying. It also has been raised and released from the South Fork Klaskanine River Hatchery, but starting in 2006 the broodstock will be totally assigned to this hatchery. The ODFW has responded to new directives for only production and enhancement of indigenous stocks (ODFW 2005). This will result in ODFW reprogramming the Klaskanine Hatchery to operate the facility for other than just collection and final rearing of SAB's. If BPA funds can be secured, the Klaskanine Hatchery will also return to rearing COH.

Such operational changes are not new to SAFE. As smolt availability and facility/equipment funding has waned and waxed, and test fishery results gathered, the operations have entered into new phases. The initial phase called "research" was when the Youngs River early run COH broodstock was found to have improved smolt and adult survivals when final rearing was at net pens in Youngs Bay. The terminal fishery near the net pen site was off-channel to the mainstem passage of upriver destined stocks. This lowered harvest mortality to the upriver stocks and looked attractive enough to the NPCC to recommend BPA to fund a "development" phase for expanding the Project to other sites with other stocks. The Project sponsors have concluded that their research and testing has shown the Project feasible and the final phase called "establish" is to continue the Project at successful sites with proper species stocking. The final phase does not assume a self-sufficient funding mechanism nor complete attainment of the goal for thorough evaluation of all potential sites and stocks.

1. An example was a shift from COH to CHS at the South Fork Klaskanine Hatchery. CHS production was initiated in 2004 (2002 brood), however the program had to be terminated following discovery of chronic bacterial kidney disease. Enforcement of junior water rights deprived the Hatchery of sufficient water at correct water temperatures for the continued production of CHS.

2. Near-term Planned Production

The intended smolt source, release site, and funding support in 2006 are shown in Table II.1. The application proposal submitted to the NPCC for continued BPA funding and North et al. (2006) describe future planned production structures. The following production descriptions are paraphrased from that proposal:

- Effective FY 2007, the full-time WDFW environmental specialist position was eliminated with responsibilities shifting to existing SAFE staff; duties for the existing ODFW staff technician were adjusted to provide three months of hatchery assistance at Klaskanine Hatchery; and ODFW's Gnat Creek Hatchery staff will assume feeding duties at CEDC's Blind Slough net-pen site, making it possible for CEDC staff to assist at Klaskanine Hatchery.
- Beginning in 2005, and continuing though 2007, WDFW field duties are being combined into fewer positions, resulting in the elimination of four part-time positions into one position located at Grays River Hatchery, with duties divided between rearing and local SAFE fishery sampling.
- An oxygen supplementation system will be installed at Gnat Creek Hatchery to fully utilize incubation capacity at 1.2 million eggs.
- SAB improved broodstock collection methods and broodstock program relocated to South Fork Klaskanine Hatchery.

Table II.1
Proposed SAFE Production for BPA Fiscal Year 2006-2007

Species	Brood Year	Release Site	Number	CWT Groups	Smolt Source	CEDC Rearing Strategy	Funding Source
CHS	2005	Deep River	350,000	2	Lewis or Cowlitz	over-winter	BPA
CHS	2005	Youngs Bay	450,000	1	Gnat Creek	over-winter	BPA
CHS	2005	Blind Slough	300,000	1	Gnat Creek	over-winter	BPA
CHS	2005	Tongue Point	100,000	1	Gnat Creek	Acclimation	BPA
COH	2005	Deep River	550,000	2	Grays River	over-winter	BPA
COH	2005	Youngs Bay	400,000	1	Cascade	over-winter	Mitchell Act
COH	2005	Youngs Bay	800,000	1	Oxbow	over-winter	Mitchell Act
COH	2005	Tongue Point	200,000	1	Cascade	over-winter	Mitchell Act
COH	2005	Blind Slough	300,000	1	Sandy	Acclimation	Mitchell Act and PGE
COH	2005	SF Klaskanine	200,000	1	Big Cr./Salmon R	over-winter	ODFW
SAB CHF	2006	Youngs Bay	500,000	1	SF Klaskanine	Full-term	BPA
SAB CHF	2006	SF Klaskanine	700,000	1	SF Klaskanine	Full-term	ODFW
		Total	4,850,000				

Notes: 1. The table shows intended smolt origin and release locations and actual numbers may be different as the fiscal year progresses. A similar but slightly different production schedule is used in this report's economic analysis. The different schedule was thought to be more representative of future near-term production.
2. Identified funding sources are for smolt production only. Other funds, including BPA and ODFW, are used by the CEDC for final rearing and acclimation.

Source: CEDC.

- Steamboat Slough releases discontinued and net pens moved to Deep River site to increase COH and CHS production.
- Effective FY 2008, two full-time project manager positions at CEDC and WDFW will be reduced to half-time.

These steps will enable the following production increases:

- 250,000 CHS at Gnat Creek Hatchery
- 50,000 COH and 100,000 CHS at Deep River
- 200,000 COH at South Fork Klaskanine Hatchery from Salmon River Hatchery and 750,000 COH new broodstock program at Klaskanine Hatchery. These SAFE COH production increases are an attempt to make up for the lost Eagle Creek Hatchery production.
- Potential for attaining 1.5 million production goals for SAB

Along with this documented description of planned production increases, it was necessary to put forward a production contingency to be used in the economic analysis for what might be production levels without BPA funding. Operational contingencies associated with BPA funding levels have not been developed. Some budgets like Gnat Creek and Grays River hatcheries are 100 percent BPA supported. Other hatcheries like the Cascade and Oxbow complex and Big Creek budgets are Mitchell Act (MA) supported. The Sandy Creek Hatchery is supported by MA and Portland General Electric (PGE) funding. For the contingency, it is assumed that all hatchery production with BPA support would go away and hatchery production with non-BPA support would continue. This may or may not happen as states would scramble to adjust budgets and plans for new revenue structures. The contingency is shown Table II.2 and a later chapter uses the information to model expected harvest benefits from the lowered production levels.

The contingency shows that overall production goes from 4.95 million to 2.40 million. The elimination of BPA funding at CEDC would terminate net pen site operations. It is assumed operations for COH releases and the continuance of the SAB broodstock program would occur at the South Fork Klaskanine Hatchery. The Cascade and Oxbow hatchery complex , and Sandy Creek Hatchery production would continue, but CEDC would not have the means for acclimation. The COH production would be traditional hatchery releases which would not add to SAFE Area harvests. Columbia River fishing on adult returns would be subject to depressed stock impact allocations which would probably prevent much access in mainstem fishery. Adult returns would therefore largely become escapements to hatcheries. The SAFE agency participants have reviewed this conjectured production contingency, but have not approved the envisioned changes in SAFE. Its usefulness is for economic analysis where it can be helpful for showing economic effects for moving from one alternative operation to another.

3. Long-term Planned Production

CEDC personnel believe that the existing facilities could handle double the present releases if smolts could be reared at the CEDC hatchery or provided through other hatchery production (Jones 2006). North et al. (2006) documents the long-term potential expansion at an 11 million

Table II.2
Hatchery Production Contingency Related to Funding Support

Production Agency	Species	Hatchery Complex	Funding Source	Smolt Production	Release Site
With BPA Funding					
ODFW	CHS	Gnat Creek	BPA	850,000	Net pens
WDFW	CHS	Grays River	BPA	350,000	Net pens
ODFW	COH	Cascade/Oxbow	MA	1,400,000	Net pens
	COH	Sandy	MA/PGE	300,000	Net pens
WDFW	COH	Grays River	BPA	550,000	Grays River (broodstock) and net pens
CEDC	SAB	S.F. Klaskanine	ODFW	1,500,000	S.F. Klaskanine (broodstock) and net pens
Total Smolt Production				4,950,000	
Without BPA Funding					
ODFW	CHS	Gnat Creek		0	
WDFW	CHS	Grays River		0	
ODFW	COH	Cascade/Oxbow	MA	1,400,000	Bonneville
	COH	Sandy	MA/PGE	300,000	Cedar Creek
WDFW	COH	Grays River		0	
CEDC	COH	S.F. Klaskanine	Other	200,000	S.F. Klaskanine
CEDC	SAB	S.F. Klaskanine	ODFW	700,000	S.F. Klaskanine
Total Smolt Production				2,600,000	

Notes: 1. There are slight differences in Table II.1 and II.2 with BPA funding due to the differences in actual release plans and adopted snapshot descriptions used in this report.
2. Funding sources are BPA, NOAA Mitchell Act (MA), and Portland General Electric (PGE). Volunteer and inkind support is not included as a revenue source.

release level, although additional equipment, net pens, and operational funding would be needed to increase the release levels to these potentials. CEDC is pursuing congressional appropriations to provide for capital cost expansions.

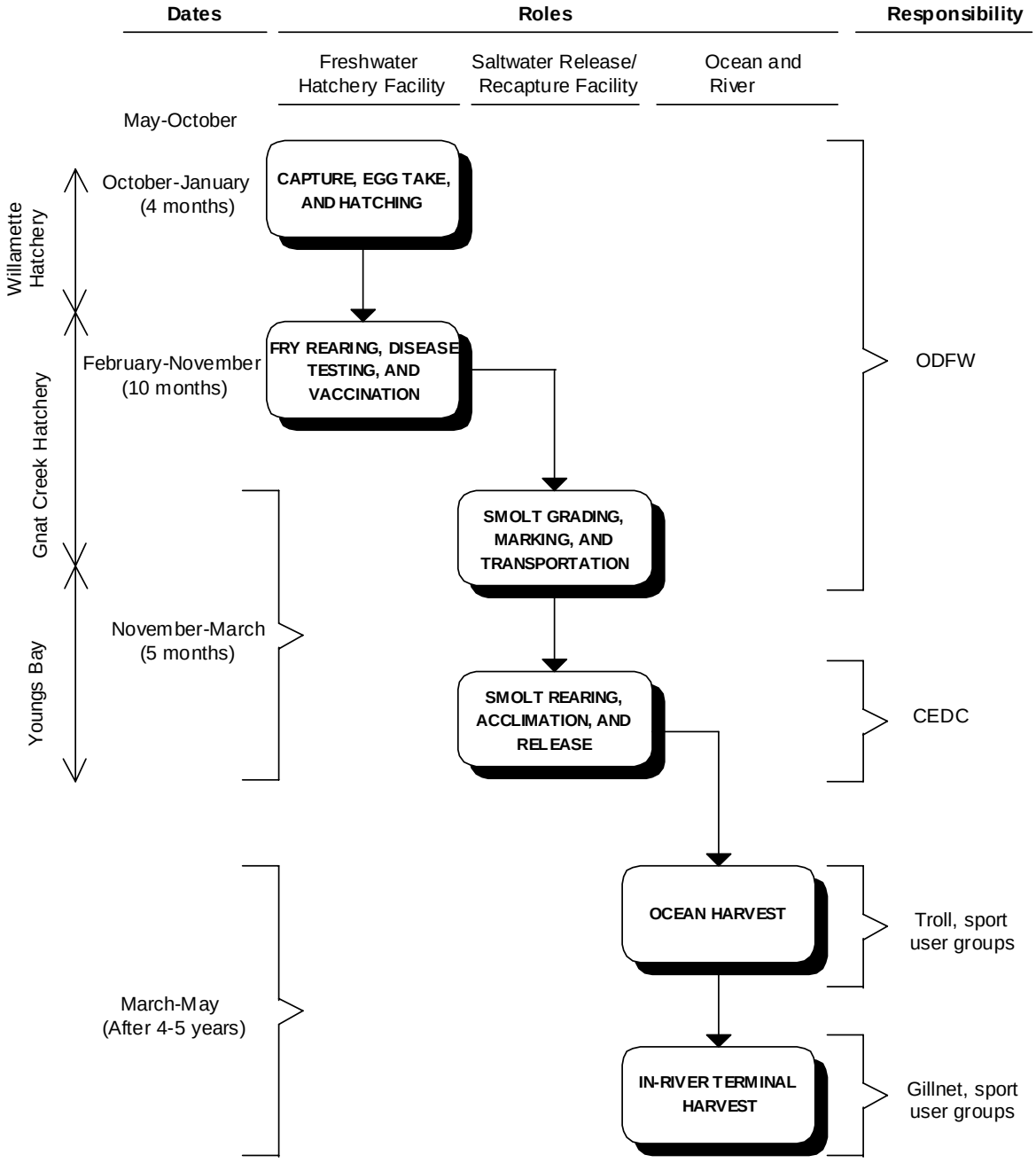
The capacity at the existing potential or even higher release levels has not yet been accompanied with research on ecological impacts, contributing hatchery production plans have not been developed, and state M&E approvals have not been concluded. High harvest rates are a concern because 17 percent (composition weighted average across all stocks and net pen sites 1996 to 2004) of SAFE area harvests are non-SAFE, local and upriver origin stocks (North et al. 2006). The higher harvest rates desired for SAFE stocks may exceed what is needed to maintain local wild stocks. Hatchery fish residualism, juvenile competition with other local fish species, and attraction of predators are concerns that would have to be addressed with higher levels of broodstock programs and net pen release strategies (Anderson and Wilen 1985).

C. SAFE Components

A description of the administration for SAFE's three components (CEDC operations, hatchery production, and state management) is summarized below. Figure II.1 is a graphical

Figure II.1
SAFE Production Roles and Responsibilities for Selected Contributing Hatchery

Hatchery Rearing: Gnat Creek
Species: CHS, 450,000 smolts
Brood and Life Cycle: Willamette
Release Site: Youngs Bay



representation of the roles and responsibilities of SAFE system production related to these components. The figure shows the salmon life cycle stages where agencies are involved. A chapter later in this report discusses budget details for these components. The SAFE supports a total of 14.5 full time equivalent (FTE) jobs for hatchery and net pen operations and management.

1. CEDC Operations

The BPA grant for SAFE going to the CEDC is managed as a separate fund in the Clatsop County budget. Clatsop County is ultimately responsible for grant and other funding mechanism conditions and the liability for operations. There are seven County employee positions, not all of which are FTE. The CEDC budget also includes 15 percent contribution to the community development department head's salary and fringe benefits. The CEDC director position is envisioned to be 0.5 FTE starting in 2008. Assets include the net pens and docks located on lands leased from the Oregon Department of State Lands. Assets also include facilities and equipment located on County owned lands on the South Fork Klaskanine River. The estimated asset value of facility and equipment is about $600,000. There is no local advisory board for the SAFE, although a local association comprised of fishing interest members, called Salmon For All (SFA), regularly provides input and feedback on SAFE operations. CEDC management has been SFA board members. The SFA could be considered as having stakeholder interest in SAFE, rather than providing oversight duties on benefits and risks.

2. Hatchery Production

BPA funds to reimburse SAFE related hatchery production go to the CEDC and respective state agencies. WDFW operates the Deep River net pen site that is populated using Grays River Hatchery production. ODFW hatcheries provide the bulk of released smolts for SAFE. The state agencies apply an indirect rate to the operational cost requirements to administer and manage the SAFE. There are seven employment positions at the hatcheries associated with SAFE smolt production. Hatchery managers rely on state M&E management personnel to provide annual production forecasts that they can build into the hatcheries' operational plans. Hatchery managers coordinate with CEDC personnel for available dates and locations for hauling reared smolts.

3. State Management

The BPA funds for SAFE that are used for technical guidance, monitoring, and evaluation are managed by the WDFW and ODFW. Monitoring has included fishery and stream sampling. The WDFW has been responsible for monitoring water quality associated with the net pens. Many years of monitoring results found localized degradation not to be an issue. Since no adverse environmental effects have been associated with SAFE net pen rearing, future plans include simplification of the water quality program. WDFW and ODFW management responsibilities are to be 1.5 FTE positions total at the respective agencies. (Not all assigned employees will be at FTE levels.) Other employee hours or contract personnel are claimed against the Project as needed to complete the monitoring responsibilities.

The states have developed hatchery and genetic management plans (HGMP's) for the SAFE hatchery operations. Representatives of the states meet as summoned with Columbia River Basin technical committees, like the Willamette and Lower Columbia River Region Technical Recovery Team and the plethora of other planning and regulating agencies overseeing Columbia River governance. (Appendix C contains a short description of the legal framework related to duties of some of these agencies.) They also meet regularly with the Columbia River Compact fish managers to specify current year SAFE area fishing regulations. State budgets reflect M&E responsibilities, however they include costs more generally associated with hatchery production like marking/coded wire tag (CWT) costs.

There is no federal or bi-state oversight committee for SAFE that meets on a regular basis. Production decisions are at the staffing level. There are public meetings to review SAFE area fishing regulations and ad hoc public meetings have been called to announce SAFE production changes. While SAFE production plans clearly have been cognizant of benefits and risks, they are not subject to prior technical committee public meeting review. Committee staffing duties and holding public meetings are not without costs, however there are also benefits for education and outreach. Controversial staff level decisions can receive heightened scrutiny and awareness when defended at committee meetings. Policy directions can be set to assist staff in day-to-day operational decisions. There is heightened public awareness about hatchery ecological interactions and there are more water resource coordination bodies now than when SAFE started. A governing board with overlapping interests would help define and shape SAFE purpose among all water uses.

III. SAFE PRODUCTION SMOLT SURVIVAL RATES

The indicator for the share of hatchery reared smolts that escape natural mortality and show-up either as harvested or are returns to hatcheries is called SAR in this report. SAR's are tracked by recovery of CWT's inserted in a sample of released smolts. The compilation of the CWT information is expanded to represent the universe sampled. This allows estimates of fish harvested in the different ocean and river locations by commercial and recreational anglers to be made.[1]

Survival rates vary a great deal. For example, Oregon coastal COH SAR's of three to six percent were common in the late 1960's through the mid 1970's. Since then, survival has only been 1.5 percent or less. In the Columbia River production, the COH SAR's were above four percent during the 1980's and dropped to less than one half percent during 1995 and 1996. This increased somewhat in the early 2000's, but seems to be on a decreasing trend since return Year 2004. Table III.1 shows 30 year averages for up to late 1990's broodstock by species over the entire Columbia River Basin (IEAB 2005).

Table III.1
Smolt-to-Adult Survival Rates 30 Year Average for
Columbia River Basin Hatchery Origin Fish by Areas of Releases

	Snake River	Upper Columbia	Middle Columbia	Lower Columbia	Willamette
Coho	NA	1.20%	1.20%	2.50%	1.20%
Spring/Summer Chinook	0.37%	0.37%	0.37%	0.97%	0.97%
Fall Chinook	0.60%	0.60%	0.60%	0.32%	NA
Steelhead	0.70%	0.70%	0.70%	0.40%	0.40%

Notes: 1. Rates expressed as representative percents of adults contributing to fisheries plus adults returning to hatcheries divided by released hatchery reared smolts. Survival rates are best estimates based on information provided by the "Annual Coded Wire Program - Missing Production Groups" annual reports (Fuss et al. 1994 and Garrison et al. 1995) and compiled from Pastor (1995, 1996) and Smith (1998); more recent broodstock rates compiled from databases at http://www.rmpc.org/.

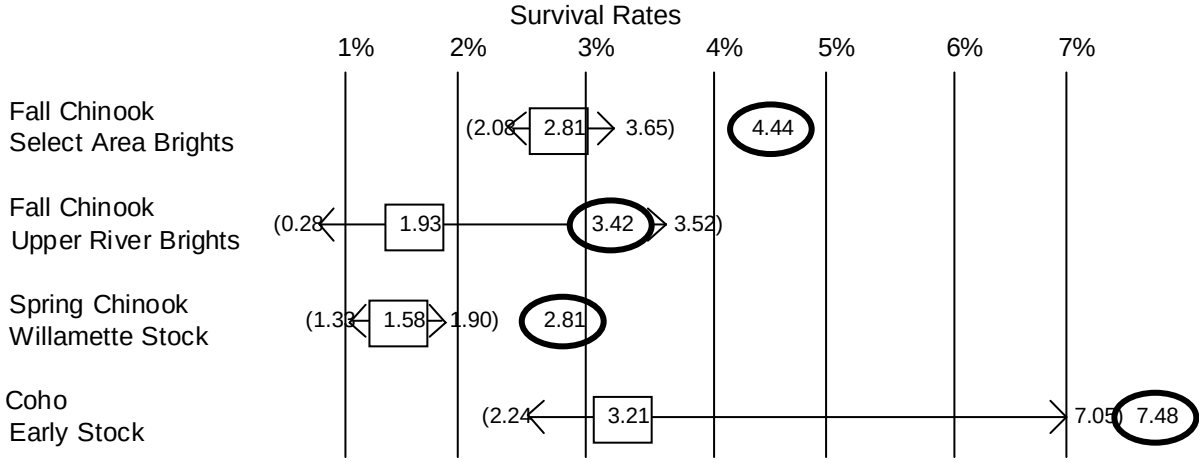
Source: IEAB (2005).

1. The source data for all smolt-to-adult return rates (SAR's) is gleaned from the coded wire tag (CWT) database maintained by Pacific States Marine Fisheries Commission (PSMFC) and accessed online at www.rmpc.org. The database includes, by tag code, the total smolt releases, CWT counts, tag loss rate, and recoveries by year and site (includes fisheries and hatchery/stream escapement and expanded for sample rates). SAR's are calculated from the number of CWT's recovered from all locations, applied this ratio to total release to estimate total return, and then apportioned this total return to each recovery location in proportion to CWT recovery. The major assumption is that all possible return locations are adequately sampled. High homing rates have been documented for SAFE releases, so there is confidence that a significant number of CWT's are not being inappropriately assigned to natural mortality. Harvest rates on SAFE released fish are calculated by examining the proportion of CWT recoveries that came from fisheries (harvests) as opposed to hatcheries or streams (escapement). CWT recovery data shows that the majority (over 90 percent) are recovered in fisheries (harvest) which is presumably much different from other propagation programs.

TRG (1996) referenced existing survival rates and biologists' estimates for the previous SAFE economics review (Figure III.1). The estimated SAR's used in determining feasibility did not pan out. This demonstrates the importance for more research on expected survival rates for any proposed changes to SAFE production schedules.

Whether or not there is a survival improvement advantage in using net pen acclimation can be shown by comparing rates to traditional hatchery releases. North et al. (2006) describes SAR's for the Project released smolts compared to similar production hatchery release rates (Table III.2). The SAB releases are for the ODFW Big Creek Hatchery production model, so no comparable hatchery broodstock results are available.[1] The Big Creek Hatchery tule CHF five year average SAR's are shown for interest.[2]

Figure III.1
Smolt-to-Adult Survival Rates Used for Determining Project Feasibility for the Columbia River Terminal Fisheries Project



Notes:
1. Figure was published in a report by TRG (1996).
2. The notes for the published figure are:
   a. ( ) Indicates range of survival rates.
   b. ☐ Indicates average survival rates without acclimation.
   c. ⬭ Indicates estimated survival rates with acclimation.
   d. For CHS survival rate estimates without acclimation, the brood years 1984 to 1987 were used. For CHF, 1983 to 1987 broods were used. For early stock COH, 1988 to 1989 broods were used to represent the average, while 1985 to 1989 broods were used to show the range.
   e. The range of survival rates do not include the most recent El Niño event rates. For COH, the rates were as low as 0.25%.

1. The ODFW Big Creek Hatchery model is for Youngs Bay net pen acclimation and Klaskanine Hatchery broodstock collection. Big Creek Hatchery did have traditional releases ending in 1995, but there is no overlap in years that can provide for comparable SAFE system results.
2. Comparing SAR's from two differing production methods requires two stocks with similar life histories, migration patterns, exposure to fisheries, etc. One way to evaluate the SAB program would be to compare it to an alternate production strategy (i.e. different stock). If SAB's were not being produced, the most likely stock would be tule CHF.

Table III.2
SAFE Production and Comparable Hatchery Smolt-to-Adult Survival Rates

Stock	Broods	SAR	
		SAFE Production	Comparable Hatchery
CHS	1994-2000	0.85% (0.02% - 1.84%)	0.76% (0.02% - 3.59%)
COH	1993-2000	2.44% (<0.01% - 5.99%)	1.97% (<0.01% - 5.73%)
SAB	1991-2000	1.05% (0.09% - 2.31%)	--
Tule CHF	1991-2000	--	0.44% (0.07% - 1.11%)

Notes: 1. The range during brood year periods is shown in parentheses.
2. The SAR's for SAB use the Big Creek Hatchery model which includes Youngs Bay net pen acclimation and Klaskanine Hatchery broodstock program.
3. The tule CHF is a Big Creek Hatchery traditional smolt release stock.

Source: ODFW.

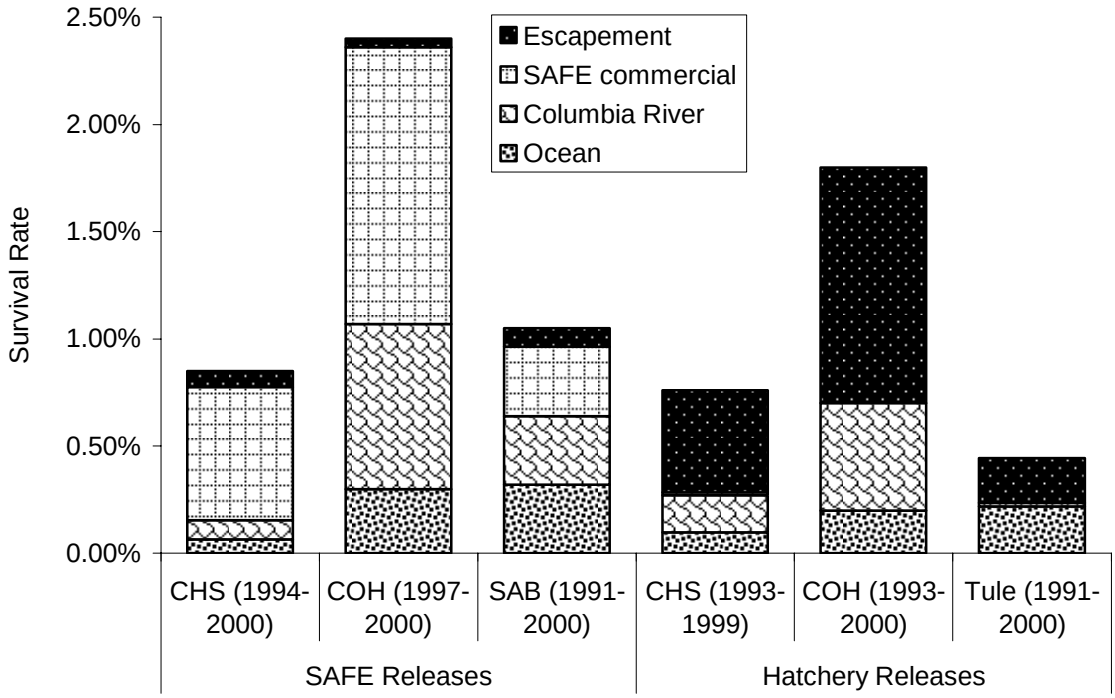
Figure III.2 depicts SAFE production and comparable hatchery CHS and COH contributions to fisheries. The itemization of fishing and escapement for all the SAFE production stocks is shown in Figure III.3 to Figure III.5.

It is difficult to adopt a SAR to use for a particular brood year in the Study as reflective to what might happen as a result of ocean conditions, harvest management regimes, and other smolt mortality influences. Different periods used in calculating averages will have quite different results. Ocean and in-stream harvest management regimes are set by many overlapping jurisdictions that are responding to international and national treaties, as well as biological conservation concerns. Harvest levels will vary dramatically from year to year. Predicting how harvest management may change geographic fisheries is problematic and only point averages are used for this Study to encompass how adult returns benefit economies through commercial and recreational fisheries.

Stock composition of SAFE area harvests is accomplished through sampling before the fish are transported from the fishing area (North et al. 2006). Since 2001 for example, the sampling rate in fall fisheries averaged 28 percent of the landed catch with a range of 16 to 38 percent. The results of the 1996 to 2004 sampling for COH show the fishing areas harvests of net-pen origin averaging 87 percent at Youngs Bay, 80 percent at Tongue Point, 80 percent at Blind Slough, and 88 percent at Deep River. All of the sites had an average of less than one percent contribution from above Bonneville Dam. The stock composition of CHF harvested in SAFE sites from 1996 through 2005 varied considerably. During this period on average, composition of SAFE stocks was 82 percent Youngs Bay, 74 percent at Tongue Point, 92 percent at Blind Slough, and 69 percent at Deep River. Overall, winter-summer commercial fisheries consisted of 83 percent SAFE stocks, 13 percent lower Columbia River stocks, three percent upriver stocks, 0.3 percent Oregon coastal Chinook stocks, and 0.4 percent summer Chinook stocks.

The basis for calculating SAFE production SAR's is using the number of smolts released and the projected number that show up in harvests or hatchery returns. The SAFE production release

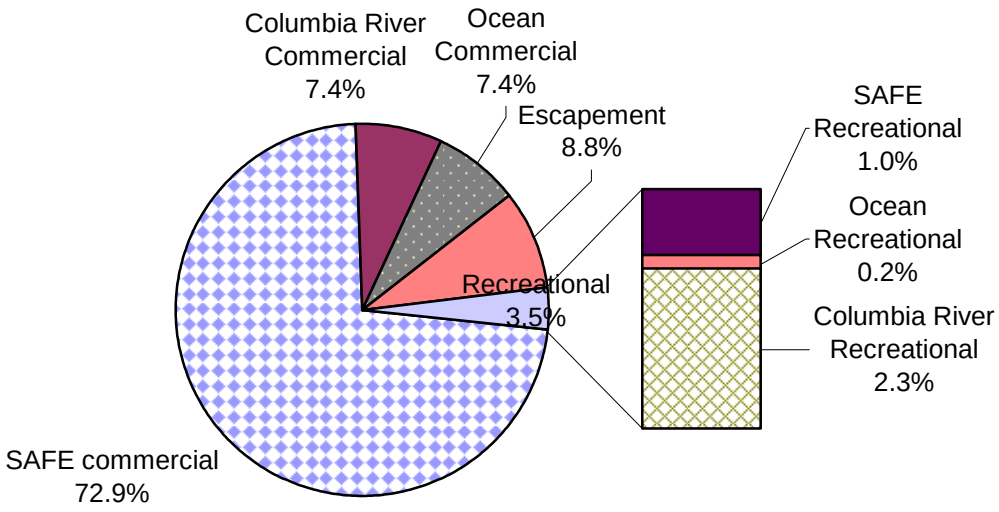
Figure III.2
Survival Rates of SAFE Production by Contribution to
Fisheries Compared to Traditional Hatchery Releases



Notes: 1. Tule total SAR is for 1991-2000 brood years, but fishery contribution share is based on 1987-1991 brood years.
2. Comparable hatcheries for CHS are those raising Willamette River Basin stock. COH are several lower Columbia River hatcheries, including Elochoman River, Fallert Creek, North Toutle, Bonneville, etc. The tule CHF is singularly Big Creek Hatchery stock.

Source: ODFW.

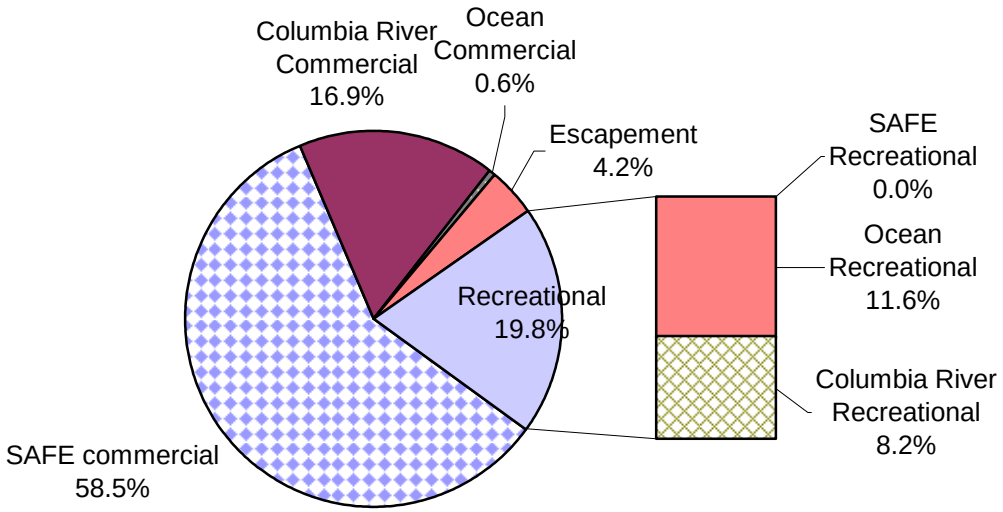
Figure III.3
Contribution Share of SAFE Spring Chinook to Regional Fisheries



Notes: 1. Based on recoveries of 69 coded-wire tag groups for 1994-2000 brood years.

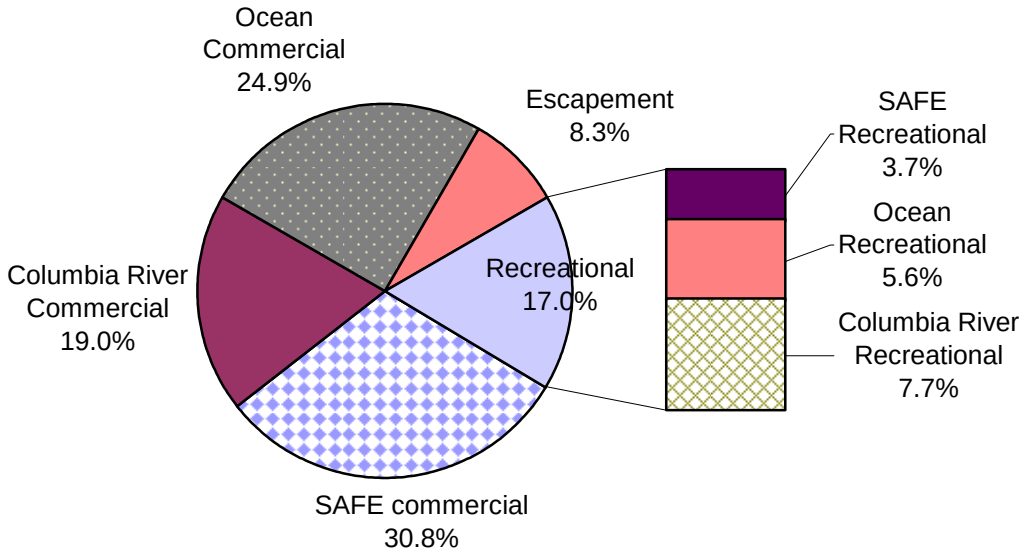
Source: ODFW.

Figure III.4
Contribution Share of SAFE Coho to Regional Fisheries



Notes: 1. Based on recoveries of coded-wire tag groups for 1993-2000 brood years.
Source: ODFW.

Figure III.5
Contribution Share of Select Area Bright Fall Chinook to Regional Fisheries



Notes: 1. Based on recoveries of 64 coded-wire tag groups released from SAFE Youngs Bay net pens and Klaskanine Hatchery for 1991-2000 broods.
Source: ODFW.

number is an estimate for both broodstock program liberation and net pen acclimation release. The release number estimating does not have the benefit of equipment counters, but ponding numbers are adjusted daily throughout the rearing cycle based on known mortalities. Errors in these counts will propagate through the projected return expansion methodology resulting in higher SAR uncertainty. If there are underestimated releases, then Project SAR's will be better than reported. Net pens especially are subject to catastrophic predation and disease events that can drastically effect release counts. Non-evasive counting equipment advancement has been made in recent years. Using fish counting equipment to either validate mortality estimates or be universally used for 100 percent enumerations would lower SAR uncertainties. Because SAFE area fishing is at concentrated locations, there are also opportunities to supplement return estimates with acoustic and sonar counting equipment (Botkin et al. 2000).

The comparison between off-channel and mainstem fisheries impacts to two wild stocks is shown on Table III.3. Impacts are calculated as the percentage of the population that represents mortalities as the result of fishing.

Table III.3
Comparable Commercial Fishing Wild Stock Impacts

	Off-Channel	Mainstem
Upriver CHS (2002-2005)	0.19% (0.05% - 0.32%)	2.27% (1.14% - 2.86%)
Upriver Bright CHF (2002-2005)	0.19% (0.01% - 0.28%)	3.12% (1.97% - 5.17%)

Source: ODFW and WDFW (January 2006 and July 2006).

Current user group allocations for upriver spring Chinook and upriver bright fall Chinook are specified in the 2005-2007 *U.S. v. Oregon* Interim Management Agreement (Agreement). For upriver Chinook, sockeye, steelhead, coho, and white sturgeon, the allocation of impacts is based on a 2001 agreement on treaty Indian/non-Indian allocation that provides for a sliding scale harvest rate on total run size and ESA listed run size. The non-Indian allocation of impacts on upriver spring Chinook ranges from a low of 0.5 percent (for upriver runs less than 33,000) to a high of two percent (for upriver runs greater than 82,000) (ODFW and WDFW, January 2006). The impact limit is shared between the lower Columbia non-Indian commercial fishery and the mainstem recreational fishery with a small number of impacts to fisheries above McNary Dam. The non-Indian portion of the upriver catch was not formally allocated among commercial and recreational fisheries until 2002. State commissions determine allocations preseason which then guide the specification of preseason management regulations as well as in-season transfers of impact allocations to reflect changing conditions in the fisheries. The non-Indian allocation was 40 percent commercial and 60 percent recreational in 2002 to 2005, except 35 percent and 65 percent in 2003. In 2006, it was 43 percent commercial and 57 percent recreational. Sport fisheries have a lower mortality-per-released fish rate than do commercial fisheries, so total retained catch can be higher in sport fisheries.

The upriver bright fall Chinook is subject to involved treaty Indian and non-Indian allocations. Most of these fish are destined for spawning in the Hanford Reach. A small component is the

Snake River wild fall Chinook. The new Agreement specifies a freshwater impact rate of 31.29 percent allocated 23.04 percent for treaty Indian fisheries and 8.25 percent for non-Indian fisheries (ODFW and WDFW, July 2006). The upriver bright fall Chinook non-Indian impacts downstream of the Snake River are allocated preseason 50 percent (4.125 percent impact) to the sport fishery and 50 percent (4.125 percent) to the commercial fishery. Upriver bright fall Chinook sport fishery Buoy 10 impacts are about 0.84 percent or 20 percent of the allocation and sport fishery mainstem impacts below Bonneville Dam are 3.11 percent or 76 percent of the allocation. The upstream areas above Bonneville Dam have the balance of impacts. All of the commercial fisheries allocated impacts occur in SAFE area and mainstem fisheries below Bonneville Dam. Fall commercial fisheries are non-selective, so there is no differential to compare to sport fishery mortality-per-retained fish.

IV. FISHERY CONTRIBUTIONS

A. SAFE Production Related Harvest

Fishery management objectives for the returning SAFE stocks are to maximize harvests. This is an involved process requiring the approval of the NOAA Fisheries concerning impacts to species listed under the ESA. Commercial and recreational seasons for areas near SAFE release sites are set by the Columbia River Compact and by the respective state agencies. Regulations have been developed and refined based on results of test fishing and CWT analyses to determine time, area, and gear parameters to maximize harvest of target stocks, and minimize impacts to non-local stocks. An extensive CWT recovery program exists to ensure adequate recoveries from the fisheries and escapement areas to evaluate rearing/release strategies, straying, survival, harvest efficiency, and fishery contributions.

The SAFE contribution to the gillnet fishery has varied widely over the years, depending on whether mainstem fishery access was allowed. For example, the SAFE contributed 80 percent to 99 percent of the COH landings from 1994 through 1998 when mainstem harvest opportunities were severely constrained (North et al. 2006). Recent years average ex-vessel value for all river fisheries has been about one third in off-channel locations (Table IV.1, Figure IV.1, and Map IV.1).[1]

There are 576 gillnet fishery permits in Washington (258) and Oregon (318). After accounting for permittee double permit holders and other factors, there are 481 vessels associated with the

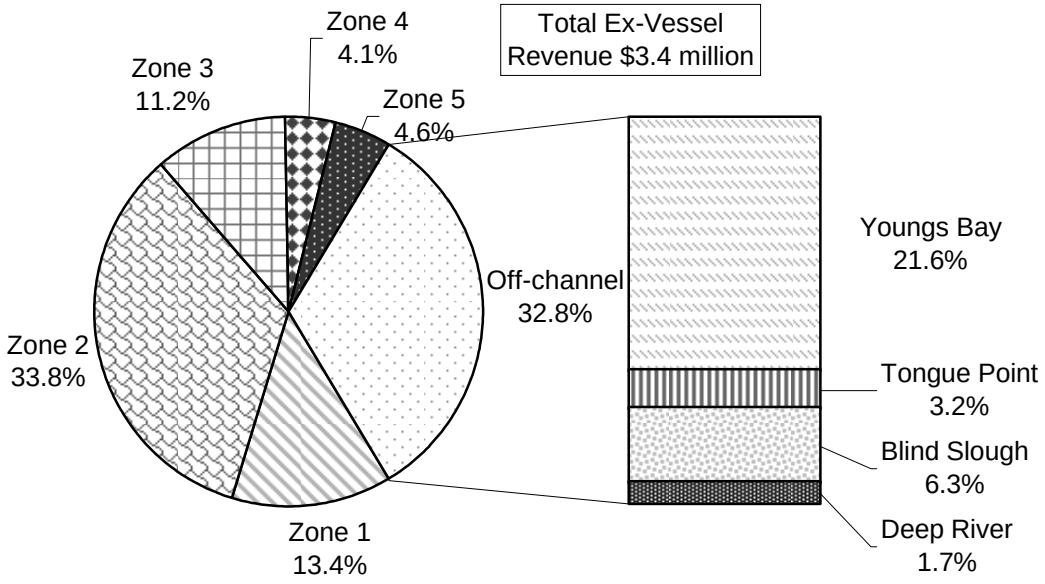
Table IV.1
Lower Columbia River Salmon Harvest Ex-Vessel Value and Price by Area of Catch in 1996 to 2004

	Mainstem			Off-channel			
Harvest	Value		Composite	Value		Composite	Sum
Year	Amount	Share	Price	Amount	Share	Price	Value
1996	110,376	41%	0.39	155,739	59%	0.69	266,115
1997	93,480	34%	0.58	181,060	66%	0.95	274,540
1998	47,565	17%	0.81	227,177	83%	0.91	274,742
1999	494,634	64%	0.87	281,301	36%	1.08	775,935
2000	751,875	58%	0.61	545,293	42%	0.82	1,297,168
2001	1,133,017	74%	0.47	400,514	26%	0.82	1,533,531
2002	1,524,915	73%	0.82	559,964	27%	0.55	2,084,879
2003	1,593,543	67%	0.67	790,323	33%	0.60	2,383,866
2004	2,266,507	67%	1.44	1,107,919	33%	1.28	3,374,426
5 Yr Avg	1,453,971	68%		680,803	32%		2,134,774

Notes: 1. Value and price are nominal.
2. A harvester strike occurred in 2001 that resulted in reduced off-channel deliveries.
Source: PacFIN annual vessel summary November 2004, February 2005, and May 2006 extractions.

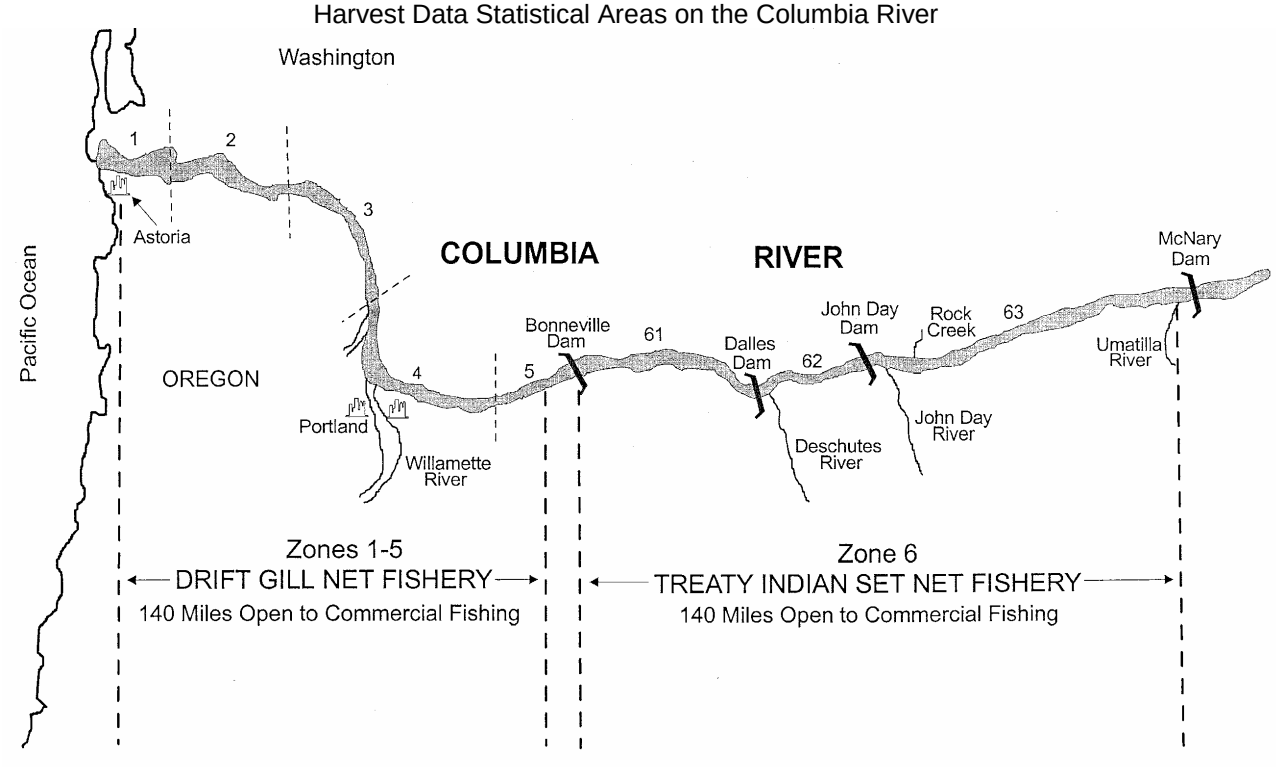
1. Off-channel fisheries can mostly be attributed to SAFE production, however there is some natural spawner and other non-SAFE hatchery production that contributes to these fisheries. For example, some Big Creek Hatchery reared tule CHF are caught in the off-channel fisheries.

Figure IV.1
Lower Columbia River Gillnet Fishery Off-channel and Mainstem Harvest Revenue in 2004



Source: PacFIN annual vessel summary November 2004, February 2005, and May 2006 extractions.

Map IV.1
Harvest Data Statistical Areas on the Columbia River



Source: WDFW and ODFW (2002).

permits. There have been many gillnet licenses retired through buyout programs and there has been attrition for other reasons since a license moratorium went into effect in 1980. When attrition of permits for whatever reason falls below 200 in Oregon, a lottery may be held to offer permits to bring the number back up to 200. Washington does not have a permit floor. Washington licensed vessels can also harvest in Grays Harbor or Willapa Bay.

The average number of vessels in the years 2000 to 2004 that participated in the gillnet fishery was 258 (Table IV.2). The average number that fished at off-channel locations was 143 or 55 percent of the total. Of those that fished at off-channel locations, an average 33 of them did not also fish in the mainstem. Of those that fished in the mainstem, an average 115 of them did not also fish at off-channel locations. Most (71 percent) of those that fish at off-channel locations fish in Youngs Bay. The least fished site is Deep River (seven percent).

Of the total WDFW and ODFW permitted vessels, only 55 percent of them were fished in 2004 (Table IV.3). The WDFW permitted share that fish in off-channel locations is 14 percent and the ODFW permitted share is 83 percent. The rest of the vessels held permits for both WDFW and ODFW, or could not be found in state license files. This compares to the mainstem where WDFW is 36 percent, ODFW is 60 percent, and the rest either held dual state permits or can't be associated with a permit. Reciprocity agreements between the two states allow vessels with

Table IV.2
Vessel Participation in Off-channel Fishing Locations in 2000 to 2004

		Off-channel Fishing Area										
		Youngs	Tongue	Blind	Deep	Total			Mainstem			
Year	Season	Bay	Point	Slough	River	Only	No.	Share	Only	No.	Share	Total
2000	Spring	71	41	40	0	51	90	78%	25	64	56%	115
	Summer/Fall	83	53	22	26	56	140	51%	132	216	79%	272
	Annual	102	68	44	26	58	154	55%	125	221	79%	279
2001	Spring	92	66	51	0	32	121	63%	70	159	83%	191
	Summer/Fall	72	16	13	6	28	94	41%	138	204	88%	232
	Annual	106	69	52	6	33	141	54%	118	226	87%	259
2002	Spring	78	53	27	0	34	112	62%	70	148	81%	182
	Summer/Fall	73	34	19	4	22	103	49%	106	187	89%	209
	Annual	90	63	33	4	26	128	55%	106	208	89%	234
2003	Spring	89	30	37	5	41	123	65%	67	149	78%	190
	Summer/Fall	80	47	19	6	26	124	52%	114	212	89%	238
	Annual	104	55	40	6	25	145	58%	106	226	90%	251
2004	Spring	82	0	41	5	40	108	54%	91	159	80%	199
	Summer/Fall	87	55	38	8	22	130	51%	123	231	91%	253
	Annual	101	55	53	8	23	146	55%	119	242	91%	265
5-yr Avg	Spring	82	38	39	2	40	111	63%	65	136	77%	175
	Summer/Fall	79	41	22	10	31	118	49%	123	210	87%	241
	Annual	101	62	44	10	33	143	55%	115	225	87%	258

Notes: 1. Deep River includes Steamboat Slough. Blind Slough includes Knappa Slough and other nearby clean-up fishery areas in some years. Youngs Bay includes Youngs River.
2. Spring season tallies are whether a vessel made a delivery between January 1 and May 31.

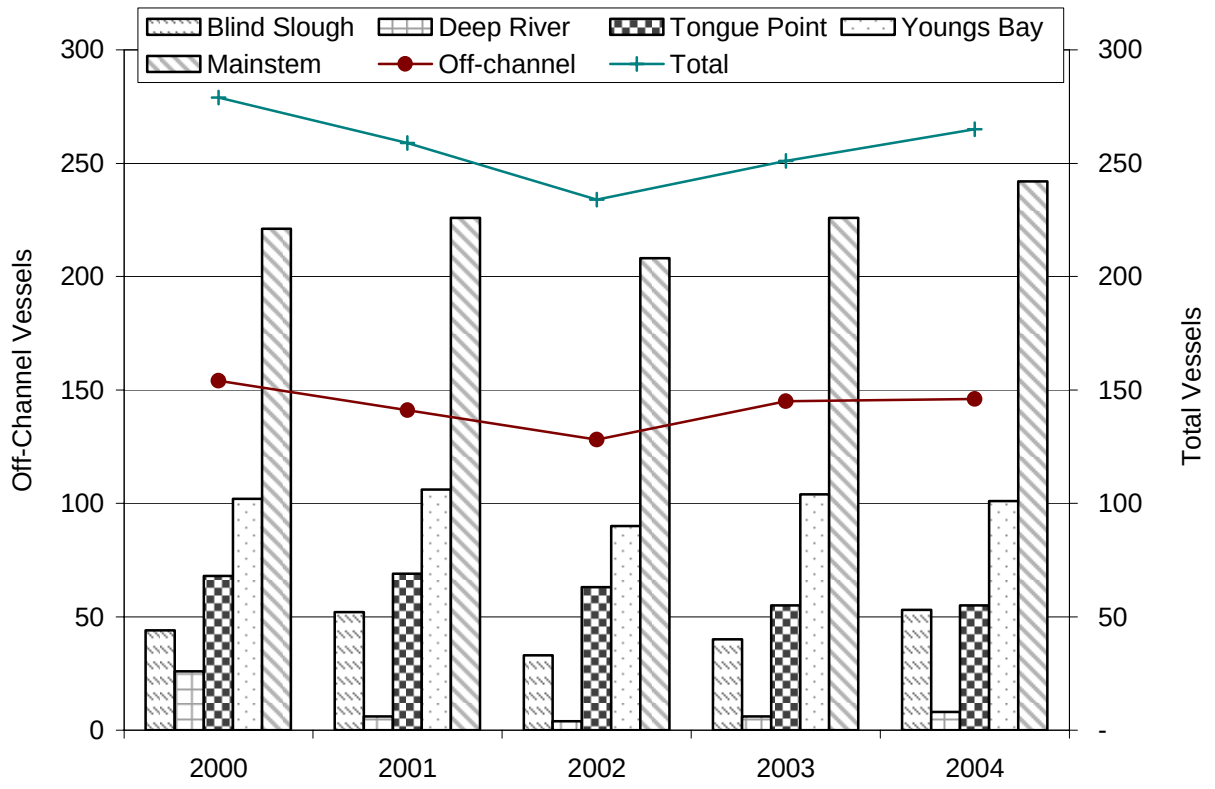
Source: Study.

Table IV.3
Vessel Participation by State Licensed in Off-channel Fishing Locations in 2004

State	Off-channel Fishing Area													
	Youngs Bay		Tongue Point		Blind Slough		Deep River		Total		Mainstem		Total	
Permitted	No.	Share	No.	Share	No.	Share	No.	Share	No.	Share	No.	Share	No.	Share
WDFW	14		10		4		6		21		88		88	
WDFW only	9	9%	8	15%	1	2%	6	75%	16	11%	80	33%	80	30%
ODFW	88		46		51		2		121		154		172	
ODFW only	83	82%	44	80%	48	91%	2	25%	116	79%	146	60%	164	62%
Both	5	5%	2	4%	3	6%	0	0%	5	3%	8	3%	8	3%
Neither	4	4%	1	2%	1	2%	0	0%	9	6%	8	3%	13	5%
Total	101	100%	55	100%	53	100%	8	100%	146	100%	242	100%	265	100%

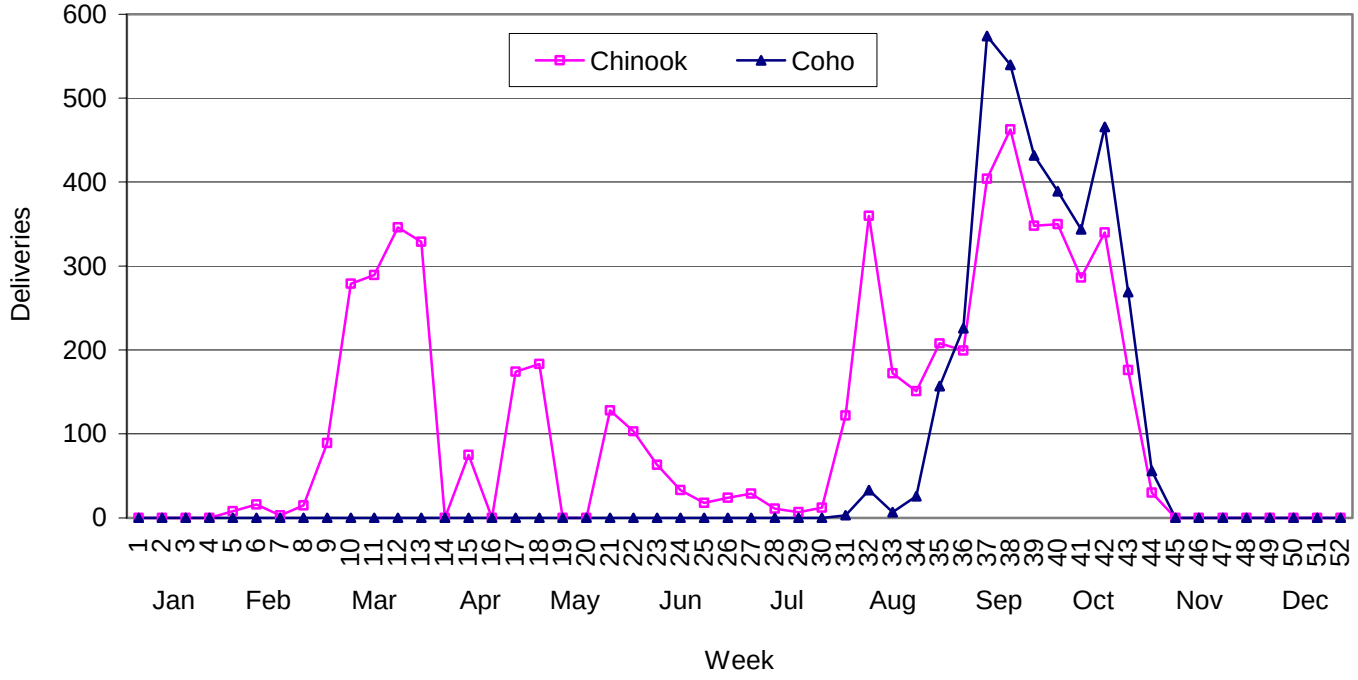
Notes: 1. Total row is for all identifiable vessels in PacFIN (excludes vessels with ID of "NONE" or "ZZ...") making salmon landings from lower Columbia River catch areas. Some vessels had state gillnet permits from both states. Not all identifiable vessels in PacFIN could be matched to a vessel ID in either of the state permit files.
Source: Study.

Figure IV.2
Vessel Participation by Fishing Locations in 2000 to 2004



Notes: Bars and lines are not additive because vessels may participate in more than one fishery.
Source: Study.

Figure IV.3
Weekly Deliveries of Salmon Caught in Lower Columbia River in 2004



gillnet permits to fish at any of the locations, but they must purchase a state vessel license for the state where deliveries are made.

B. Gillnet Fishery Setting

1. Commercial Fisheries

The lower Columbia River gillnet salmon fishery occurs amid a backdrop of a large commercial fishing industry. The same infrastructure (moorage, processing facilities, gear suppliers, etc.) serves the different fleets that participate in the ocean and river fisheries. In sum, the Astoria and Ilwaco area commercial fishing industry is a big contributor to the regional economy. Commercial fishing contributed 10 percent of all personal income to the Astoria area's economy alone in 2003 (TRG March 2006). Distant water fisheries made up about 15 percent of this personal income source.[1]

The combined landings at Astoria and Ilwaco were $50.3 million in 2004 (Table IV.4), making them the highest ranked along the U.S. West Coast and sixth nationally (NMFS 2005). Salmon fisheries (caught with ocean troll gear and lower Columbia River net gear) represented about

1. Revenue returned in the form of wages and salaries or profits from deliveries to non-West Coast locations and revenue derived from expenditures made in West Coast locations for repairs, provisioning, or moorage is referenced in this report as distant water fishery revenue. An example non-West Coast location is Alaska. The revenue generated from the at-sea deliveries for the Pacific whiting fishery is categorized as distant water fishery revenue.

nine percent of onshore landed revenue. (Appendix E shows landing trends by species groups for the combined ports.) Salmon fisheries landed revenue was up in 2004. It was about double what was seen during the five year 1999 to 2003 average.

The salmon fisheries landed revenue increase in 2004 was partly due to higher landing volume from river fisheries and partly due to an ex-vessel price increase. Troll Chinook prices adjusted for round pound weight over all size categories increased about $1.25 per pound over the previous year to $3.00 (Figure IV.4). Lower Columbia River net gear caught CHS averaged $3.77 and CHF averaged $1.33 per round pound. COH troll caught was $1.08 and net gear caught was $0.91. The same species prices for Columbia River treaty fisheries were about half those received in the gillnet fisheries.

Columbia River harvests have shifted away from being upper river CHS to lower river hatchery produced CHF and COH. The CHS destined for upriver spawning areas during March to July contained fat reserves and were marketed fresh or frozen as prime fish or destined for specialty markets for canning or smoking. Presently, the bulk of the CHF return in September. These returning adults are mostly lower river stocks that have been naturally programmed not to contain large body fat reserves. The lower fat content, the natural aging process, and the competing West Coast salmon markets combine to produce fish that do not bring very high harvest prices. The "bunching up" of the runs in a short period also requires harvest, processing, and marketing capabilities that are unused for most of the year. The result is seasonal "boom or bust" fluctuations for communities that rely on the income from these fisheries.

There were 358 vessels that delivered troll caught or gillnet caught salmon to the Astoria or Ilwaco port groups (Table IV.5). One of the vessels harvested in both fisheries. Of the 99 total vessels that delivered troll caught salmon to lower Columbia River ports in 2004, 84 vessels received more than $500 in fishery revenue. Their average salmon revenue was $7,258, which was about nine percent of their total fisheries revenue. The average salmon revenue for the top 10 vessels was $20,564 and their dependency on salmon revenue was 19 percent. The top 17 (17 percent) vessels harvested 50 percent of this fishery's total value. The bottom 67 vessels (i.e. 84 minus 17 vessels or 80 percent of all vessels delivering more than $500) harvested 10 percent of the total value.

There were 260 vessels that delivered gillnet caught salmon from the lower Columbia River non-tribal fishery to Washington and Oregon ports in 2004, and of those vessels, 242 received more than $500 in fishery revenue. The vessels receiving more than $500 represented 93 percent of all vessels making deliveries and 50 percent of those with active permits. Their average gillnet caught salmon revenue was $12,346, which was about 83 percent of their total fisheries revenue. The top 10 vessels average gillnet caught salmon revenue was $41,351.

A scattergram (Figure IV.5) shows gillnet salmon revenue by total vessel revenue in 2004. This figure shows the fleet has a very high dependency in the gillnet fishery. For those vessels that specialize in this fishery, 93 percent of vessel total revenue is from the gillnet fishery. There is a fairly continuous distribution along the y-axis for gillnet revenue (the median gillnet revenue is $8,879 and the 90th percentile is $26,693). Vessels with less specialization in gillnet salmon revenues tend to have higher total revenues. This makes sense, since the higher revenue vessels

Table IV.4
Harvest Revenue Delivered Within Study Region and Delivered
From Columbia River Area-of-Catch to Other Ports in 2004

Landing Location	Area-of-Catch ($000)				
		Columbia River		Other Harvest	
Gear and Species	Ocean	Lower	Upper	Locations	Total
Salmon Net					
Astoria	0	2,318	0	0	2,318
Ilwaco	0	1,027	4	341	1,372
Other ports		29	1,365		1,394
Salmon Troll					
Astoria	537	0	0	0	537
Ilwaco	100	0	0	0	100
Groundfish					
Astoria	6,660	0	0	0	6,660
Ilwaco	135	0	0	0	135
Pacific Whiting					
Astoria	1,277	0	0	0	1,277
Ilwaco	249	0	0	0	249
Dungeness Crab					
Astoria	2,454	0	0	0	2,454
Ilwaco	2,457	0	0	3	2,460
Pacific Sardine					
Astoria	4,843	0	0	0	4,843
Ilwaco	837	0	0	0	837
Pink Shrimp					
Astoria	1,722	0	0	0	1,722
Ilwaco	558	0	0	0	558
Albacore Tuna					
Astoria	2,071	0	0	0	2,071
Ilwaco	8,300	0	0	0	8,300
White Sturgeon					
Astoria	0	310	0	0	310
Ilwaco	0	116	0	34	150
Other ports		2	92		94
Halibut					
Astoria	239	0	0	0	239
Ilwaco	54	0	0	0	54
Shellfish					
Astoria	115	0	0	0	115
Ilwaco	13,773	0	0	0	13,773
Other Species River					
Astoria		27	0	0	27
Ilwaco		55	0	1	56
Other ports		1	4		5
Other Species Ocean					
Astoria	90				90
Ilwaco	18				18
Total					
Astoria	20,008	2,656	0	0	22,664
Ilwaco	26,483	1,198	4	379	28,064
Total Astoria/Ilwaco	46,492	3,854	4	379	50,728
Total other ports		32	1,461		1,493

Table IV.4 (cont.)

Notes:
1. Fish ticket information for Columbia River salmon area-of-catch is assigned to two general river landing codes. One code is for Washington side landings and one code is for Oregon side landings. It is assumed the lower Columbia River area-of-catch landings on the Washington side are delivered to Ilwaco purchasers and landings on the Oregon side are delivered to Astoria. Fish ticket information for area-of-catch when not made at a river location (i.e. deliveries to a Seattle area purchaser) does not have this limitation and is assigned to "other ports." The same assumption for upper river treaty harvests is not valid. About a quarter of the upper river harvests are purchased by the same processors and buying stations that purchase from lower river harvests. This means there will be a slight undercounting of business activity for Astoria and Ilwaco processing businesses.
2. For ocean area-of-catch, Astoria includes Cannon Beach and Seaside landing locations. Ilwaco includes Willapa Bay and Chinook locations. Other ports include other Columbia River points of landing as well as out-of-region locations such as the Seattle area. Other areas-of-catch include Willapa Bay, Grays Harbor, and Puget Sound.
3. Salmon net gear includes gillnet in the lower Columbia River and set net and dip net with a very minor amount of gillnet in the upper Columbia River.
4. Salmon troll includes a very minor amount harvested in the ocean with other non-net type gear.
5. There is a minor amount of groundfish showing on fish tickets for being caught in the upper Columbia River and landed at Ilwaco and Oregon side Columbia River ports. No attempt was made to resolve inconsistencies in fish ticket information.
6. Shellfish includes Washington aquaculture shellfish.
7. "Other species river" includes eulachon ($49 thousand) and shad ($31 thousand). "Other species ocean" includes hagfish ($38 thousand) and mackerels ($16 thousand). Other species in other catch areas includes green sturgeon ($1 thousand).

Source: PacFIN annual vessel summary and fish ticket data, May 2006 extraction.

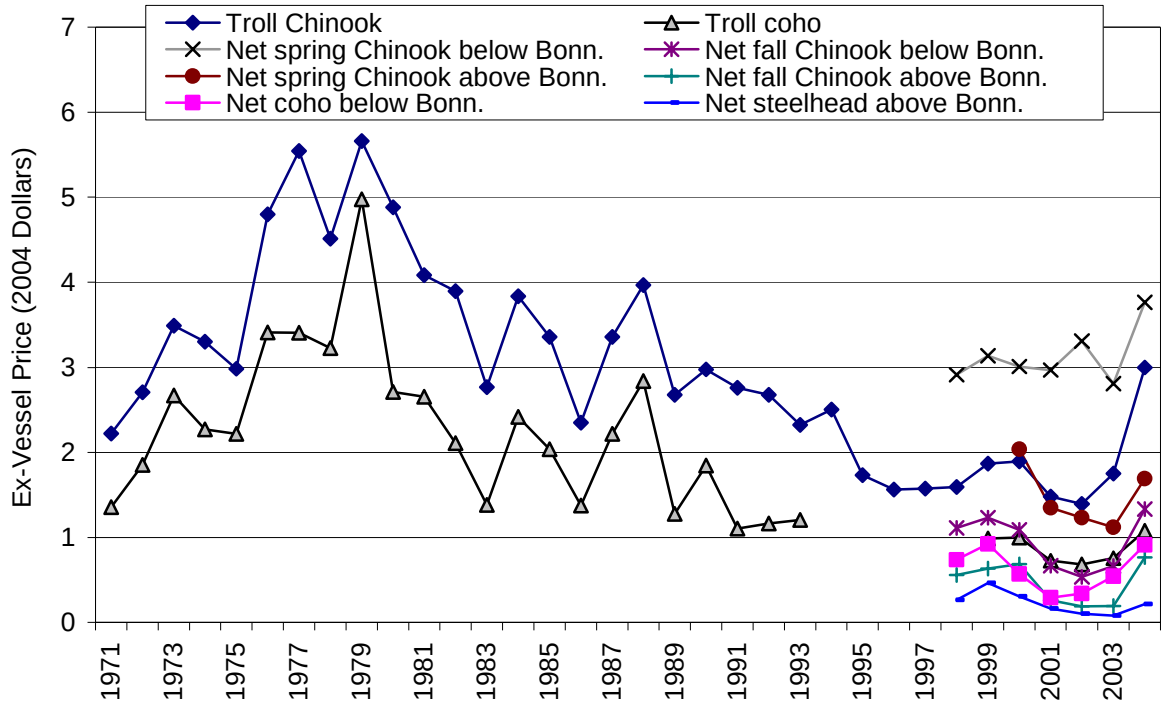
tend to participate in a variety of fisheries and only pursue gillnet salmon opportunistically. Since average total revenue per vessel varies widely and there is high specialization in the gillnet fishery, the fleet is particularly vulnerable to business failure with salmon season downturns. The same vulnerability could be said for buyers and processors that specialize in gillnet salmon products.

Not all permitted vessels harvest every year in the gillnet fishery. Figure IV.6 shows the number of unique vessels participating over the last five years. Only 41 percent of vessels earning more than $500 in annual gillnet revenues participated every year during this period (44 percent including vessels with less than $500).

Vessels harvesting in the ocean return to port at trip end and sell their catch to buyers and processors or directly to the public.[1] The majority of processors that handle salmon tend to have smaller overall annual purchases (Table IV.6). Of the processors and buyers whose annual purchases are less than $500,000, 46 percent are for salmon purchases. Of those whose annual purchases are greater than $500,000, 11 percent are salmon purchases. The average processor salmon purchase (filtered for vessels that have a limited sellers license) is $168,000.

1. Much of the gillnet fishery landings are handled by tenders in order to keep the harvesters at their fishing locations. Seasons sometimes are only days and hours within days. The extra cost of the second handling is necessary to take advantage of the fishing openings.

Figure IV.4
Oregon Salmon Species Annual Ex-Vessel Price Trends in 1971 to 2004



Notes: 1. Prices adjusted to real 2004 dollars using the GDP implicit price deflator developed by the U.S. Bureau of Economic Analysis.
2. Ex-vessel price is the amount paid to fishers at the time of fish delivery.
3. Inriver salmon prices include Oregon and Washington side landings.
4. Prices are annual and species averaged expressed in round weight, except for troll Chinook prior to 1981 which are based on dressed weight, and are for onshore landings only. Average prices for salmon include seasonal and size considerations.

Source: Oregon Department of Fish and Wildlife for years prior to 1981. PacFIN January 2003, July 2003, January 2004, and February 2005 extractions for 1981 onward. PFMC "Review of Ocean Salmon Fisheries" for inriver Chinook and COH.

In addition to the harvesting vessel or tender delivering to a large processor, salmon is also purchased by independent buyers or purchased at outposts owned by larger companies. Independent buyers sometimes have local distribution to restaurants, but the larger companies haul the product to central locations for further processing and packaging. There is a growing use of custom cutting facilities located near cold storage centers in Washington for the additional processing and packaging. This decreases labor costs for the processor, but also decreases local job opportunities. A very small amount of landings is being used by vessels or small groups of vessels selling directly to the public. For example, there were five vessels from Oregon that have a limited commercial fish dealer license that sold $7,021 of lower Columbia River gillnet salmon directly. An appendix in this report discusses the market opportunities for adding value through this market channel.

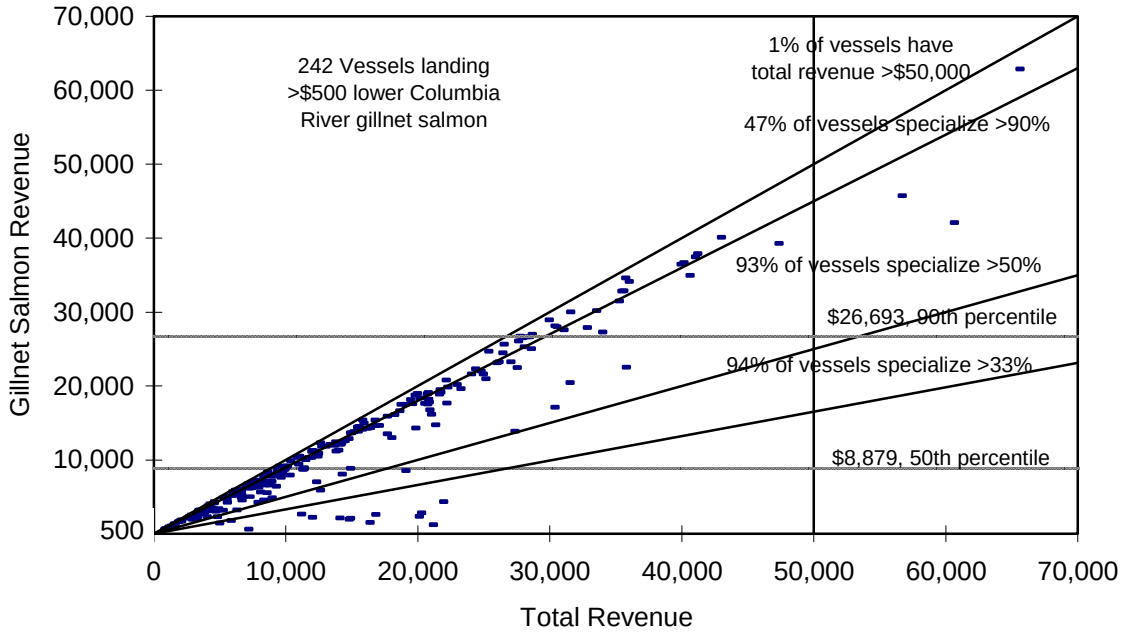
Table IV.5
Lower Columbia River Port Group Troll and Gillnet Salmon Fishery Vessel Participation in 2004

	Gillnet		Troll	
Volume (thousands pounds)	2,443		261	
Oregon landings	1,666		208	
Washington landings	777		52	
Ex-vessel value (thousands)	$3,374		$613	
Change from 2003	42%		10%	
3 year average	69%		43%	
10 year average	252%		268%	
	Count	Share	Count	Share
Vessels	260		99	
Vessels >$500 revenue	242	93%	84	85%
Average fishery revenue	$12,346		$7,258	
Fishery share		83%		9%
Vessels 50% value	54	21%	17	17%
Vessels 90% value	155	60%	47	47%
Top 10 vessels	10	4%	10	10%
Average fishery revenue	$41,351		$20,564	
Fishery share		87%		19%
Gillnet permits		576		
Oregon		318		
Washington		258		
Vessels with gillnet permits		481		
Oregon		318		
Washington		172		
Both		9		

Notes: 1. Gillnet refers to characteristics of participants harvesting salmon in the lower Columbia River area-of-catch using gillnet gear. Troll refers to participants making landings to Astoria and Ilwaco with salmon caught with troll gear.
2. Troll gear harvest revenue is for landings at Astoria or Ilwaco port groups only. Vessels may have made troll gear harvest landings at other port groups.
3. Astoria includes Cannon Beach and Seaside landing locations. Ilwaco includes Willapa Bay and Chinook locations.
4. Excludes vessels with identification codes reported as "NONE" or "ZZ..." (DRVID only). Gillnet total landings include all vessel identification codes.

Source: PacFIN November 2004, February 2005, March 2005, and May 2006 extractions.

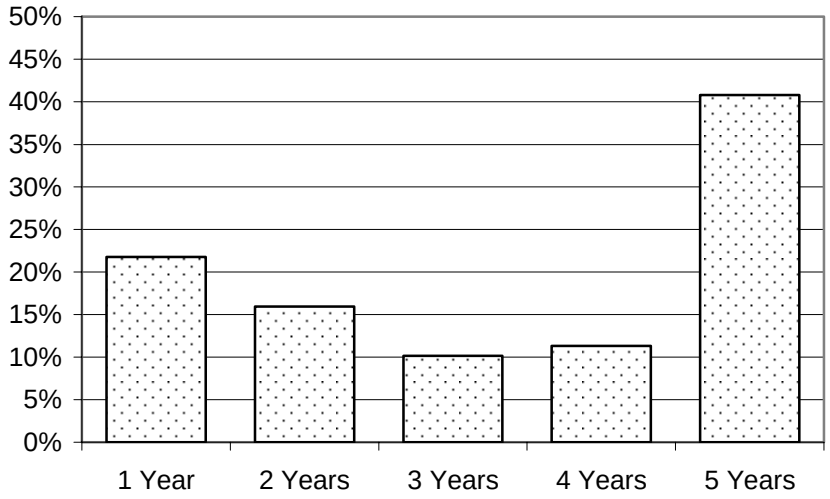
Figure IV.5
Scattergram Showing Lower Columbia River Gillnet Salmon
Revenue as Compared to Total Vessel Revenue in 2004



Notes: 1. Each dot represents a unique vessel.
2. Excludes vessels with lower Columbia River gillnet salmon revenue less than $500 and vessels with identification codes reported as "NONE" or "ZZ..." (DRVID only).
3. Vessel revenue is from landings at any U.S. West Cost port.

Source: PacFIN annual vessel summary, May 2006 extraction.

Figure IV.6
Lower Columbia River Gillnet Salmon Vessel Participation During Period 2000 to 2004



Notes: 1. Includes U.S. West Coast vessels landing at least $500 of gillnet salmon from the lower Columbia River in a year; excludes vessels with identifier "NONE" or "ZZ..."
2. Vessels are tracked over years by their plate numbers. If a vessel is re-documented and continues participation in the same fishery, then its previous experience is omitted. Only vessels that make deliveries in each year are included in the analysis.

Source: PacFIN November 2004, February 2005, and May 2006 extractions.

Table IV.6
Counts and Purchases by Processor Categories for Ilwaco and Astoria Port Groups

Processor Port Group Purchase Amount	Ownership Count	Port Group	Salmon Subtotal	Salmon Net	Salmon Other	Salmon Troll
>$500K	12	34,905,737	3,886,055	3,322,612	25,794	537,649
$50K-$500K	17	3,364,877	1,505,796	1,480,625	18	25,153
$10K-$50K	25	523,461	262,099	218,845	0	43,254
<$10K	59	121,491	41,584	27,781	0	13,803
Subtotal	113	38,915,566	5,695,534	5,049,863	25,812	619,859

Notes:
1. Processor category bins were determined using purchases at the port group level.
2. Some of the processors made purchases in both Oregon and Washington, so some of the Ilwaco and Astoria counts will overestimate businesses.
3. The port groups are defined to include ocean and Columbia River purchases. Ilwaco is assigned all river deliveries to the Washington side and Astoria is assigned all river deliveries on the Oregon side. This assignment is useful for showing processor characteristics, but overestimates business activity within the Astoria and Ilwaco region. Astoria includes minor deliveries at Seaside and Ilwaco includes deliveries made to Long Beach and Chinook.
4. Salmon purchases include troll and net caught fish from non-Indian and treaty fisheries.
5. Aquaculture purchases are not included.
6. For Ilwaco and Astoria combined, the combined port group purchases for processors with licenses on both sides of the Columbia River are combined before assignment to bins, so they may not be in the same bin as they were with Ilwaco and Astoria grouped separately.

Source: TRG (May 2006).

2. Additional Fisheries Income for Gillnet Fishery Participants

Gillnet fishery permittees are usually from families with long traditions in the fishing industry. There is family income from other fishery participation than just the revenue received from the lower Columbia River fishery. This includes vessel revenue in West Coast ocean fisheries, Willapa Bay and Grays Harbor gillnet fisheries, Puget Sound fisheries, and Alaska fisheries. It may be from using the same vessel that fishes in the lower Columbia River fishery or a different vessel. It also can be from family members that are crewmen, skippers, and processing workers for these different fisheries. Families will participate in the regional fishing industry in other ways, like making or repairing gear or offering other specialty products and services in order to raise revenues.

The dependence of total family income on the fishing industry varies widely. The 1994 survey (TRG 1994) found 27 percent was non-fishing industry related for vessel owner families. This Study's update survey did not result in adjustments to that level. Family members will have other occupations to even out the irregular flow of fishing income and to secure health insurance and other benefits associated with wage and salary occupations. Seafood processing and other supplier and provisioning businesses associated with the gillnet fishery also have other income sources. Accounting of the total economic contribution the gillnet fishery makes to the regional economy needs to acknowledge not only the direct income received from the gillnet salmon fishery, but also the above mentioned related and associated income for the families and businesses.

The important portion of the gillnet salmon fishery income among all permittee income sources places these families and businesses at risk from any downturns in the fishery. When that portion is lost, total permittee income can be subtracted from the economy when there are no local substituting income generation activities. To show the portion size, an attempt was made for this Study to account for gillnet permittee family income from West Coast (including Willapa Bay, Grays Harbor, and Puget Sound) and Alaska fisheries. Table IV.7 shows the fishery itemizations for revenues earned in the West Coast fisheries and Table IV.8 shows the fishery itemization for revenues earned in the Alaska fisheries. The share of gillnet salmon fishery income is 23 percent and nearly half the gillnet permittees' revenue from the itemized fisheries is from Alaska (Figure IV.7).

When calculating the local economic contribution for all permittee revenue, the place of permittee residence must be a modeling input. Operating costs are usually incurred near the fishery's access locations, but labor payments and business net income is exported to residence locations. Table IV.9 shows 2004 addresses for gillnet permittees. A later chapter in this report includes these residency shares when calculating the economic contribution to the local economy.

C. Recreational Fishing

Spending associated with recreational salmon fishing can generate a substantial amount of economic activity in local and regional economies. Anglers spend money on a wide variety of goods and services. Trip-related expenditures may include expenses for food, lodging and transportation. Most anglers also buy equipment and angling-related goods and services such as rods, reels, lures, hooks, lines, bait, boats, boat fuel, guide and outfitter services, camping equipment, and memberships in fishing clubs and organizations. Because this spending directly affects towns and communities where these purchases are made, angling can have a significant impact on local economies, especially in small towns and rural areas where fishing occurs.[1]

There is a significant lower Columbia River boat and bank recreational fishery.[2] In 2004, there were a total of 421.7 thousand angler trips made in the mainstem with kept catches of 54.9 thousand salmon and steelhead, 25.6 thousand sturgeon, and 123.0 thousand shad. Of these trips, 156.1 thousand were for CHS with 23.9 thousand caught. The Buoy 10 (Columbia River navigation aid No. 10 to Tongue Point and Rocky Point management line above the Astoria-Megler Bridge) generated an additional 68.8 thousand angler trips with catches of 16.0 thousand Chinook and 15.2 thousand COH. Ocean fishing trips originating in the Astoria and Ilwaco area ports were 59.2 thousand when 73.5 thousand COH and 8.4 thousand Chinook were harvested.

1. Trip expenditures used in this economic analysis do not include equipment or other fixed cost angling related expenditures. These type of expenditures can exceed what an angler spends on an annual basis for the fishing experience. However, the economic analysis in this report is related to changing conditions that might affect trip generations. In this case, it is assumed spending for equipment would continue whether or not trips occurred.
2. Mainstem fisheries do not include the area's river and stream fisheries, such as the popular Willamette River CHS fishery. The sources for recreational trip data are WDFW and ODFW (2002), PFMC (2005), and ODFW (December 2005).

Table IV.7
Gillnet Fishery Permittee Other Fishery Revenue in 2004

Species Group	Revenue ($000's) Lower Col. R. Gillnet Salmon Fishery Vessels	Other Fisheries Vessels
Cod/rockfish		1.6
Sole/flounder	0.7	
Sablefish		116.2
Chinook	2,388.3	172.6
Gillnet	2,388.1	18.5
Troll	0.3	154.2
Chum	43.1	17.6
Coho	1,125.7	66.9
Gillnet	1,125.6	46.2
Troll	0.2	20.6
Sockeye	3.0	2.1
Dungeness crab	4.5	2,641.0
Other pelagic	6.5	
Albacore tuna	1.1	267.0
Halibut (PFMC)		24.1
Sea urchins	3.7	
Other	9.5	
Sturgeon	390.0	
Shad, unspecified	19.9	5.3
Total	3,996.1	3,314.4

Catch area breakdown for gillnet gear

Catch Area	Species		
Columbia River below Bonneville	Chinook	2,081.9	
Columbia River below Bonneville	Chum	0.1	
Columbia River below Bonneville	Coho	906.5	
Columbia River below Bonneville	Sockeye	3.0	
Columbia River below Bonneville	Sturgeon	370.6	0.2
Columbia River below Bonneville	Shad, unspecified	19.9	
Columbia River above Bonneville	Other	2.1	
Willapa Bay	Chinook	42.3	17.7
Willapa Bay	Chum	38.6	13.0
Willapa Bay	Coho	67.7	38.8
Willapa Bay	Sturgeon	18.6	5.1
Grays Harbor	Chinook	1.6	0.3
Grays Harbor	Chum	3.7	4.7
Grays Harbor	Coho	30.5	7.5
Grays Harbor	Sturgeon	0.5	
Puget Sound	Chinook		0.5
Puget Sound	Sockeye		2.1
Puget Sound	Chum	0.7	
Other	Chinook	0.2	
Other	Other pelagic	6.5	
Other	Sturgeon	0.2	
Total		3,595.2	89.7

Table IV.7 (cont.)

Notes: 1. Revenue is in thousands.
2. Lower Columbia River gillnet salmon fishery includes 260 identified vessels and additional lower Columbia River gillnet salmon revenue from unspecified vessels. Other fisheries includes 57 identified vessels not in the lower Columbia River gillnet salmon fishery.
3. This table includes vessels other than lower Columbia River salmon gillnet vessels that have owner names common to state gillnet and crab permit files. There was review and verification by gillnet industry spokespersons for the matching representation.
4. The "other vessel" revenue may overstate earnings received by gillnet permit owners because there may be a few situations where a gillnet permit owner is leasing a crab permit to another vessel. The gillnet permit owner will receive lease fees for a crab permit, but the table includes revenues from all fisheries for that vessel that is using the leased crab permit.
5. State crab permit files used as a pathway to determining the other vessels. This table may undercount revenue received by gillnet permittees if the "other vessels" did not have a crab permit associated with it.

Source: PacFIN annual vessel summary data, May 2006 extraction; and gillnet and crab permit files from WDFW and ODFW.

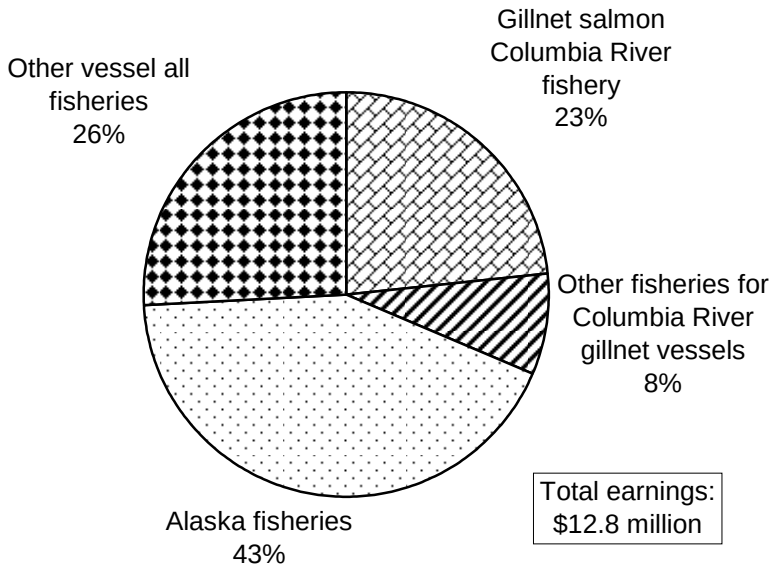
Table IV.8
Gillnet Fishery Permittee Alaska Fishery Revenue in 2004

	Revenue	Permit Count
Alaska		
Crab	1,127	5
Halibut	706	7
Herring	125	15
Groundfish	27	
Shellfish	8	
Sablefish	474	3
Salmon	2,988	133
Subtotal	5,455	166

Notes: 1. Revenue is in thousands.
2. Some permit counts not shown for confidentiality.

Source: Commercial Fish Entry Commission (CFEC) permit registration files and annual reports for earnings per permit fished by permit owner state.

Figure IV.7
Share of Gillnet Permittee Fisheries Earnings in 2004



Notes: 1. Notes from Tables IV.7 and IV.8 apply.
Source: Study.

Success rates have varied widely over the years due to management restrictions (bag limits, season openings like weekend closures, etc.) and angler motivations (weather, perceived abundances, etc.). Generally, estuary success rates are about two trips per fish and ocean are between 0.5 and one trip per fish (Figure IV.8). The Columbia River mainstem salmon fishery in 2004 had 291.3 thousand salmon trips, so the success rate was about 5.3 trips per fish.

The ocean and inriver fishing trips were mostly in mixed stock fisheries where SAFE production stocks are only a part of abundances. Recreational fishing is allowed at SAFE net pen areas, but only comparatively minor harvests have been recorded. The commercial fishery average harvest for 2001 to 2005 was 83.8 thousand fish and the recreational fishery average was 1.3 thousand fish (North et al. 2006). There may have to be additional recreational fishing restrictions in Youngs River in the future to ensure adequate COH and SAB broodstock returns.

The SAFE production generated harvests in the mixed stock recreational fisheries can be calculated using average SAR from Table III.2. If the SAR brood year averages were applied to the smolt release profiles used in the economic analysis, then 0.4 thousand CHS, 10.9 thousand COH, and 2.7 thousand SAB would be caught in recreational fisheries.

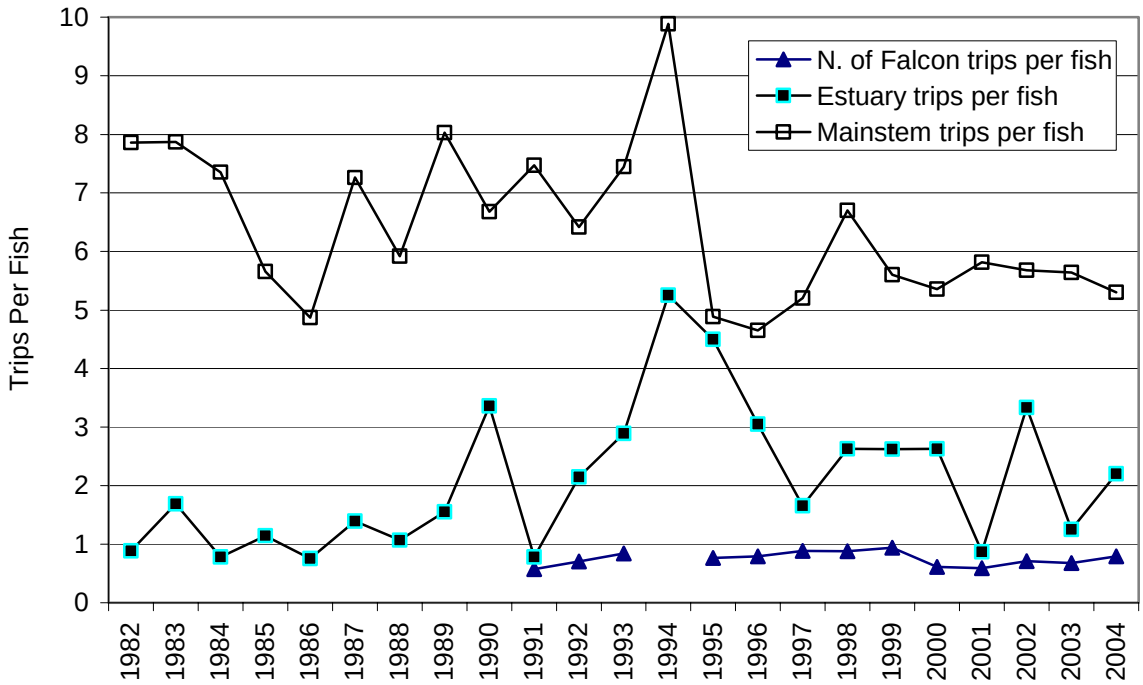
Table IV.9
Gillnet Permittee Addresses

	ODFW Gillnet		WDFW Gillnet		Combined	
Gillnet permits	318		258			
Unique owner full names	298	100%	216	100%		
OR address	242	81%	18	8%		
Astoria area zip code	167	56%	11	5%		
WA address	48	16%	196	91%		
Ilwaco area zip code	6	2%	78	36%		
AK address	7	2%	2	1%		
MN address	1	0%	0	0%		
CA address	0	0%	0	0%		
Other states and bad data	0	0%	0	0%		
Local						51%
Regional						98%
Count of gillnet permittee also owning an Alaska permit					166	100%
OR address					64	39%
WA address					96	58%
AK address					6	4%
Local						51%
Regional						96%
Count of gillnet permittee also owning a Dungeness crab permit						
Unique owner full names	23	100%	25	100%	48	100%
OR address	18	78%	1	4%	19	40%
Astoria area zip code	16	70%	1	4%	17	35%
WA address	5	22%	24	96%	29	60%
Ilwaco area zip code	1	4%	13	52%	14	29%
Local					31	65%
Regional					48	100%

Notes:
1. Astoria and Ilwaco zip codes are for Clatsop and Pacific counties, respectively.
2. There may be some cross-state ownership of gillnet permits. So while the count of permits is correct, the number of permittees may be less. An analysis of crab vessel permit cross-state ownership was completed, so the column titled combined reflects crab permittee counts.
3. Local and regional residency shares assume permits associated with active vessels (harvested in the gillnet salmon fishery in 2004) and inactive vessels are about the same. This assumption is probably reasonable given that Oregon gillnet permittee names associated with active vessels are 62% names with Astoria/Ilwaco zip codes, and Oregon gillnet permittee names associated with non-active vessels are 53% names with Astoria/Ilwaco zip codes. Washington gillnet permittee names associated with active vessels are 42% names with Astoria/Ilwaco zip codes, and Washington gillnet permittee names associated with non-active vessels are 40% names with Astoria/Ilwaco zip codes.
4. Alaska local share is assumed the same as for all gillnet permittees.

Source: WDFW permit files, ODFW permit files, and CFEC permit registration files and annual reports.

Figure IV.8
Recreational Fishing Success Rate in North of Falcon Ocean Fishery,
Columbia River Estuary Fishery, and Mainstem Salmon Fishery in 1982 to 2004



Note: 1. One trip equals one angler day.
2. Estuary success rates are for the Buoy 10 fishery.
3. Mainstem salmon fisheries include steelhead catch.

Source: WDFW and ODFW (2002), PFMC (2005), and ODFW (December 2005).

Table IV.10
Ocean, Estuary, and Mainstem Recreational Fishing Effort and Catch in 2002 to 2005

	2002	2003	2004	2005
Ocean				
Effort	48,000	66,400	59,200	45,400
Catch				
Coho	59,408	106,444	73,535	38,693
Chinook	10,786	8,114	8,405	13,203
Success rate	0.7	0.6	0.7	0.9
Estuary				
Effort	84,457	88,827	68,818	55,182
Catch				
Coho	6,233	54,440	15,169	6,878
Chinook	19,441	16,316	16,046	9,286
Salmon success rate	3.3	1.3	2.2	3.4
Mainstem				
Spring Chinook				
Effort	175,052	160,765	156,101	
Catch	20,711	17,384	23,877	
Success rate	8.5	9.2	6.5	
Other (summer Chinook, fall Chinook, steelhead, coho, etc.)				
Effort	344,348	326,904	265,585	
Other salmon effort	170,710	166,148	135,155	
Other effort	173,651	160,756	130,430	
Sturgeon	155,782	142,864	114,908	
Shad	17,869	17,892	15,522	
Catch				
Other salmon, steelhead	40,384	40,553	31,039	
Sturgeon	38,279	31,932	25,569	
Shad	148,164	115,867	123,047	
Other salmon success	4.2	4.1	4.4	

Note: 1. Year 2005 mainstem effort and catch not available.
Source: WDFW and ODFW (2002), PFMC (2005), and ODFW (December 2005).

V. COST ANALYSIS

A. Background

Harvesting and canning salmon played a key role in the economic development of the Pacific Northwest. As salmon stocks began to decline due to a variety of factors, salmon hatcheries were built to replace and/or increase natural production.

Oregon and Washington have funded hatchery salmon production for more than 100 years. This activity has been continually viewed as a relatively simple solution to persistent problems of habitat loss and overfishing. From the earliest efforts well into the 1960's, most production relied primarily on release of salmon fry with a gradual shift toward holding fish to fingerling size for stocking. Since then, hatchery programs began holding fish for release as full term smolts. As release sizes became larger, costs per smolt became a crucial part in hatchery production decisions.

The region's hatchery operations are receiving close study because of their potential impacts to wild salmon stocks. 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 (National Research Council 1996).

Several hatchery review projects have been completed or are underway in the Pacific Northwest.[1] Recommendations and guidelines for technical and policy reform of hatcheries were made by Integrated Hatchery Operations Team (IHOT 1995). The National Marine Fisheries Service (NMFS) completed consultations covering all hatchery production in the Columbia Basin. As a result, hatchery management practices have been substantially revised (NMFS 2000). NPCC established the Artificial Production Review and Evaluation (APRE) process guided by the Artificial Production Advisory Committee (APAC) and the Council's Independent Scientific Advisory Board (ISAB) in 1999. A series of reports have since been issued that have included the review of individual basins' hatcheries (APRE 1999 and 2004). The database described in APRE (2004) provides a wealth of information on purpose, general funding, overall smolt production, and estimated survival rates (when available) of all artificial propagation programs (sites) in the Columbia Basin. However, the information contained in the APRE database is not sufficient to complete a cost-effectiveness review. The successful approach used in the State of Washington Hatchery Reform Project started in 1999 has been extended in 2006 to include the entire Columbia River Basin. This review is called the Columbia River Basin Hatchery Reform Project (HRP). The HRP is working in collaboration with a separate review process ongoing for the USFWS National Fish Hatcheries in the Basin. An MA Hatchery Environmental Impact Statement Project was started in 2004. Each successive review has recommended integrated hatchery operations so as to lower impacts to wild stocks while still fulfilling their objectives.

The NPCC also requested the IEAB provide a CEA of hatcheries in 2001. Only the first phase of that study has been completed (IEAB 2002). The study concluded that "[the] cost analysis has given us a basis for optimism that more extensive cost-effectiveness study of specific project

1. See Chapter VII, Section E for sources of information about these projects.

proposals for the Council cost will provide useful information." The study also noted some data gaps and needs and recommended "that the Council consider funding a Phase II Economics Analysis of Artificial Production to more fully investigate a wide range of hatchery objectives and cost configurations. This would involve developing a larger data base of cost and production information, to support evaluation of separable costs for rearing individual stocks and species at hatcheries having multiple stocks and purposes. The study could be broadened to involve some collaboration between the economists and biological analysts in order to broaden the assessment of costs associated with augmentation, mitigation, restoration, and other ESA-related objectives." The findings and recommendations from the IEAB (2002) report were useful in determining an approach to compile total production costs for the SAFE.

The SAFE, among all the categorizing definitions that might be found in hatchery review documents, is an extension of an augmentation hatchery project whose purpose is fishery enhancement. Its operation is unique in how smolt releases are accomplished. Releases are at harvest sites tested to have low intercepts of upriver destined depressed stocks. Released stocks have been tested to have low stray rates. Many species, stocks, and release sites have been reviewed before settling on current operations. There are extra costs associated with transporting and acclimating the smolt so they return to the sites. Taken alone, the extra costs for the SAFE process are a small amount of total hatchery production costs. Most of the smolts come from other hatcheries and it is necessary to account for those costs. The management and evaluation costs also need to be included in order to calculate Project feasibility as might be characterized in a CEA.

B. Cost Categories

Five production categories were selected for the cost analysis:

1. Hatchery operation costs. This category includes the primary hatchery plus other hatcheries where the fish might be taken for rearing. The CEDC South Fork Klaskanine River Hatchery costs are part of this category. Future SAB species releases are to be a CEDC responsibility; SAB production costs use the previous ODFW Big Creek Hatchery model.
2. SAFE acclimation costs. This category includes over-wintering production (for some species) and acclimation costs as well as CEDC management costs. Acclimation at the WDFW operated Deep River net pen site is included in the Grays River Hatchery budget, so it is not itemized.
3. State agency headquarters costs. These costs are calculated as an indirect accounting rate on some hatchery costs.
4. State agency management costs. The M&E management budgets were adjusted for some hatchery production costs.
5. Capital or fixed costs. These costs were not typically included in annual budgets showing hatchery operation costs. It was necessary to use other studies to estimate construction and upgrade costs.

C. Hatchery Fixed Costs

In any economic analysis, facility costs present a special problem. In day to day operations, they will likely be considered "sunk costs." However, in an evaluation of expanding programs or decision making over long terms that will include heavy maintenance and replacement costs, facility costs need to be included.[1]

There are several studies available that can be referenced for making fixed cost estimates. A study by Rich Berry provided such estimates (Radtke and Davis 1997).[2] The estimates do not reflect the considerable pre-project and design costs in today's findings about the effects of hatchery production on native stocks. Carter (ODFW 1999) accumulated 10 years (1989-1999) of hatchery capital cost data for Oregon state-funded hatcheries and annualized the costs to determine a ratio of capital costs to operation costs. He assumed no new funds would be available for capital improvement of state-funded hatcheries in the 10 years following 1989-1999. The ratio was used as an average for the set of studied hatcheries. A recent update to his calculation shows per-smolt cost estimates are about $0.04 (personal communication October 2006).

Carter concluded his estimates are conservative because ODFW funded only essential construction projects during the study's 10 year time frame, and therefore, should be considered maintenance and upgrade capital costs. An engineering approach such as Berry's estimates most likely provides better estimates of capital costs when new construction or expansion is being considered. It may be appropriate to use Carter (1999) estimates in the short term, assuming only the minimum level of capital improvement expenditures will be made to keep the production hatcheries operating. For a longer term or expansionary period, the estimates quoted by Berry should be used. For any special application such as research, neither of these mentioned studies would apply.

It is necessary to reduce Berry's estimate to an annual cost. Capitalization policies for the states or other federal agencies contributing smolts for the project were not consulted in determining a method to use for amortizing the adopted fixed costs. It was simply assumed that the Berry estimate for capital costs would require debt financing (20 year borrowing term and current discount rate) and the useful life for computing straight-line depreciation would be 30 years (no salvage value after 30 years). The Office of Management and Budget (OMB) mandates using a discount rate set in January of each year for federal economic analysis, which is 5.2 percent in 2006.[3] Using a 30 year life cycle period includes longer lasting structures as well as shorter life

1. Facility costs are referred to as fixed costs in this study to differentiate them from hatchery operation variable costs. Fixed costs in this context would include pre-project, design, construction, and financing costs. Capital costs is a term used interchangeably with fixed costs.
2. Radtke and Davis (1997) reiterated personal communication with Rich Berry at ODFW (March 1995). Mr. Berry was responding to the question "If you were asked to construct a hatchery that produces salmon smolts for commercial and recreational harvests, what is your estimate of the total construction costs?" His estimate for a state operated hatchery's construction costs would be about $50 per pound of smolt produced.
3. The Office of Management and Budget (OMB) released OMB Circular A-94 "Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs," dated October 29, 1992. This Circular no longer prescribes a discount rate, but instead advises that an appropriate discount rate should be used to discount costs and benefits. The discount rate mandated for cost-effectiveness analyses (CEA) is the treasury borrowing rate taken from the

cycle items (like concrete raceways). This period would be considered an economic life rather than a structural life.

The resulting amortized fixed costs include the annual depreciation allowance plus average annual financing interest costs. This is translated to a per-smolt cost simply by dividing by the smolt production. The calculated per-smolt costs are $0.24.

The adopted fixed costs are influenced for being on the high end of a range because not all of a hatchery's fixed cost would necessarily have to use debt financing. Also, the useful life could be longer than 30 years or there would be an end-of-life salvage value. The adopted costs are tempered to being on the lower end of a range by the costs not including today's pre-project and design costs.

There have been no hatcheries built in the last decade comparable to those that are currently providing stocks to SAFE. One new research facility has been built in the Oregon Coast Range. The cost was $7.8 million for reconstructing an existing augmentation hatchery (ODFW October 2005). There are no plans to use this facility for augmentation or supplementation purposes. A new Yakama Nation supplementation and research facility was constructed during the late 1990's at Cle Elum, Washington. Production capacity is 810,000 CHS or 54,000 pounds at 15 smolts per pound. Construction costs were $35.1 million that included a $15.9 million central hatchery, $6.1 million for three acclimation sites, $3.4 million water cooling facility, and $1.6 million capture trap. The costs are $650 per pound. The planning and permitting costs were $3.3 million. A hatchery complex is being improved for the purpose of "supplementation" in the Grande Ronde River watershed (tributary to the Snake River) at a cost of $19 million (Kirkman 2005). Improvements to two existing hatcheries and the construction of a new Lostine River Hatchery will allow production for about 1.39 million juvenile CHS. This is about $14 per smolt released, or about $165 per pound produced - about three times higher than the Berry method estimate for a "standard" hatchery capital cost. Permit costs may be a significant part of the expense of developing new sites. Construction in environmentally sensitive areas, difficult site conditions, expensive land, complex water supply development, long piping distances, and distant utilities are other factors that can drive up capital costs. The Berry method estimates may be appropriate for the original costs of the existing augmentation hatcheries, but do not reflect current hatchery pre-project and construction costs.

D. SAFE Production Costs

The CEDC and each contributed stock hatchery costs are generally well-documented on an aggregated and annual basis. However, cost accounting procedures did not allow separation into stock-specific components. Cost information was made available to investigators on a piecemeal basis. For example, one hatchery had hand written notes of the SAFE costs, while another hatchery based the SAFE costs on a formula of 33 percent of all budget items. Even other

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Presidential Administration's economic assumptions, published at the beginning of each year, with maturity comparable to the period of analysis. This provides a more stable discount rate to reduce the need for revisions to the economic analysis. The current discount rates (released every January/February) are at http://www.whitehouse.gov/omb/circulars/a094/a94_appx-c.html.

hatcheries admitted most of their budgets are funded as part of the SAFE project, but then produce other fish for recreational harvests also (usually COH or steelhead). These considerations had to be combined into a puzzle that somehow reflected the estimated costs of the SAFE production. Appendix A contains a description of each hatchery's cost structure and the assumptions used to make these estimates. A summary of the estimates on a cost per released smolt basis for the above mentioned cost categories is shown on Table V.1. Example costs per smolt for selected species, hatchery, and release sites are shown on Figure V.1.

The following are some general observations about smolt size, time in hatchery, and production costs.

- Most of the smolts released range from 10 to 15 per pound for CHS and COH and 20 to 25 for SAB.
- The CHS and COH will spend about 18 months in the system, and the SAB about nine months. Costs will reflect that time.
- Feed costs will range from $0.40 to $0.80 per pound of feed, depending on size and quality. Feed conversion rates range from 0.8 to 1.2, therefore a smolt that is 10 to the pound will cost about from $0.06 to $0.12 per smolt.
- Labor costs are the largest component of total variable costs, usually over 50 percent.
- Project M&E costs were $0.03 per smolt for ODFW and $0.16 for WDFW.
- Another significant cost is central office overhead and indirect costs (referred to herein as Olympia and Salem headquarter costs). They are from about $0.04 to $0.10 per smolt.
- The capitalized construction and upgrade costs are estimated to be $0.24 per smolt. This assumes the fixed costs required debt financing. Annual debt servicing costs plus straight-line depreciation over the assumed useful life are included in these per-smolt costs.

Overall, the costs of hatchery operations do not vary significantly when all segments of the operation from collecting adults for capturing, eyeing, ponding, release, etc. are included.

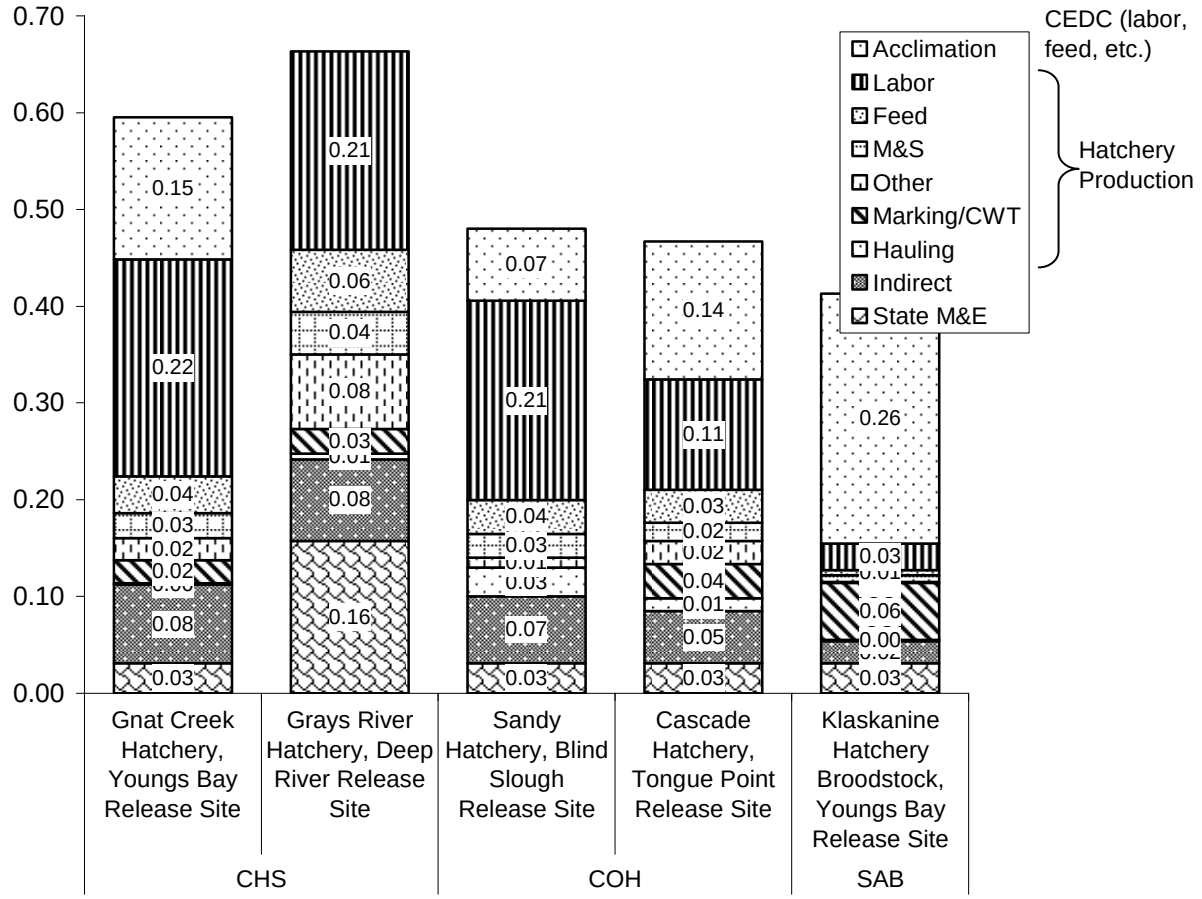
At private salmon aquaculture as a comparison, the cost of a smolt may average $1.60 to $2.00 for a 100 gram (3.5 oz or 4.5 smolts per pound) fish (Radtke and Davis 1997, and Forster 1995). Salmon aquaculture's objective is to produce desired protein at least cost. As salmon ranching hatcheries released larger sized smolts, they realized that the costs of returns were getting larger, especially as the percentage of adults harvested do not increase proportionally enough to cover the extra costs. At $2.00 per smolt with a 10 percent return, the cost is $20 per fish; at two percent (most likely) the cost is $100. This is about five to seven times the actual selling price of the harvested fish. Salmon ranchers quickly realized their returns could be increased by building fences (net pens for full term aquaculture) and thereby increasing the survival rates to about 90 percent.

Table V.1
Summary Cost Per Released Smolt for Hatchery Production, Net Pen Acclimation, Monitoring and Evaluation, and Management

Table	Hatchery Agency	Species	Hatchery	Smolts /2	Release Site	Hatchery and Release Operational Costs /1			Hatchery Indirect /3	State M&E /4	Total Operational and Indirect	Capital or Fixed Costs /5	Total Costs /8
						Other Hatchery	SAFE Acclimation	Total					
A	ODFW	CHS	Gnat Creek	450,000	Youngs Bay	0.361	0.147	0.508	0.081	0.031	0.620	0.238	0.858
B		CHS	Gnat Creek	300,000	Blind Slough	0.361	0.147	0.508	0.081	0.031	0.620	0.238	0.858
C		CHS	Gnat Creek	100,000	Tongue Point /7	0.444	0.074	0.518	0.100	0.031	0.649	0.238	0.886
D	WDFW	CHS	Grays River	350,000	Deep River	0.447	--	0.447	0.084	0.158	0.688	0.238	0.926
E	ODFW	COH	Cascade	400,000	Youngs Bay	0.239	0.143	0.382	0.054	0.031	0.467	0.238	0.705
F		COH	Cascade/Oxbow	800,000	Youngs Bay	0.179	0.143	0.322	0.040	0.031	0.393	0.238	0.631
G		COH	Cascade	200,000	Tongue Point	0.239	0.143	0.382	0.054	0.031	0.467	0.238	0.705
H		COH	Sandy	300,000	Blind Slough	0.306	0.074	0.380	0.069	0.031	0.480	0.238	0.718
I	WDFW	COH	Grays River	550,000	Deep River and Grays River	0.418	--	0.418	0.079	0.158	0.654	0.238	0.892
J	CEDC	SAB /6	S.F. Klaskanine	700,000	S.F. Klaskanine	0.185	--	0.185	--	0.031	0.216	0.238	0.454
K	CEDC	SAB /6	S.F. Klaskanine	800,000	Youngs Bay	0.101	0.258	0.359	0.023	0.031	0.413	0.238	0.651
		Total Smolt Production		4,950,000									

Notes:
1. Includes labor, feed, and other costs for hatchery and net pen operations for a particular budget year. That particular year may have had a different release strategy than the current year or a planned future years. The costs per smolt are assumed to apply to the new release strategy. SAFE acclimation may include 2nd grow-out for some species. Deep River net pen 2nd stage grow-out and acclimation costs are included in Grays River Hatchery budgets. Hatchery costs are estimated to be 66%, while net pen operations are 34% of total costs.
2. Smolt release strategy is intended for Year 2006 and 2007.
3. Hatchery production cost overhead charged by states' central management (i.e. Olympia and Salem headquarters' costs) is 28.8% for WDFW and 34.2% for ODFW, but does not include contract and feed costs. The effective rates are 18.8% and 22.5%. The rate does not apply to CEDC hatchery production costs. CEDC will be involved in Klaskanine Hatchery operations through services sharing understandings, so the rate would apply to that hatchery's production.
4. Onsite state monitoring and evaluation (M&E) costs include headquarters' costs.
5. Fixed costs are estimated using Berry formula for $50 per smolt production weight. The estimates are capitalized for showing the annual per-smolt cost.
6. For the SAB program, the 700,000 release is a replacement broodstock program at S.F. Klaskanine for what was previously maintained at the Klaskanine Hatchery. The 800,000 release will involve transferring fry (1,000 per pound) to the Youngs Bay net pens. Estimates for SAB are based on past Big Creek Hatchery model costs.
7. Information used in the cost analysis included a 2nd grow-out stage at Tongue Point, with a 1st grow-out stage at Gnat Creek. The costs in this table are adjusted by time to represent over-wintering occurring at Gnat Creek and only acclimation at Tongue Point.
8. Total costs are calculated as follows, e.g. row for Table A: 0.361 + 0.147 + 0.081 + 0.031 + 0.238 = $0.858.

Figure V.1
Hatchery Production and Acclimation Costs Per Released Smolt
for Selected Species, Contributing Hatcheries, and Release Site



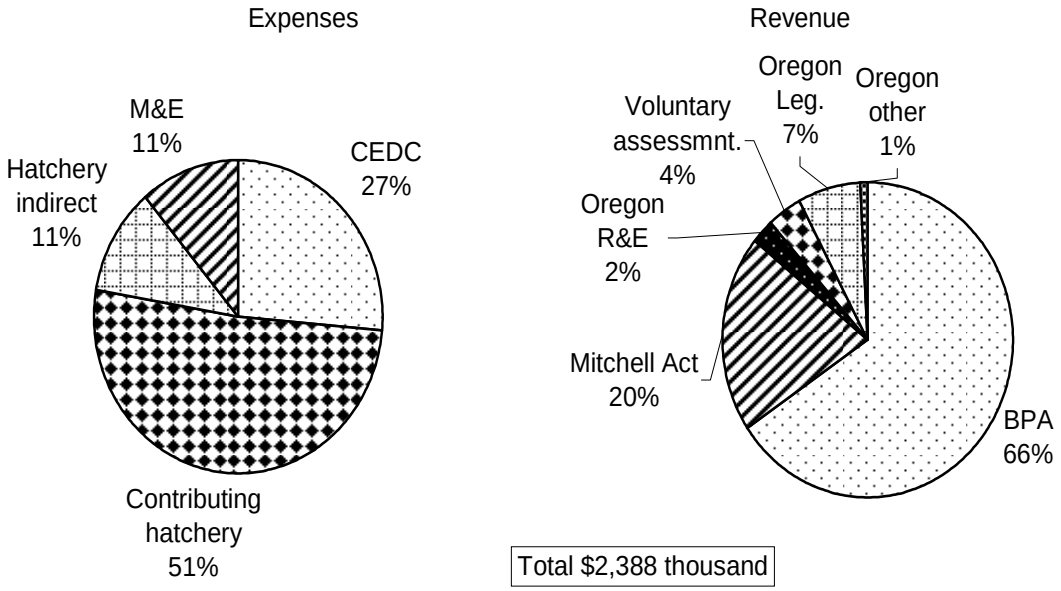
Notes: 1. Fixed costs are not included.
2. Costs for SAB are based on Big Creek Hatchery past rearing and release costs.
3. Acclimation costs for Deep River net pens included in the hatchery budget.

E. Cost Analysis

Estimated total SAFE operating, management, and fixed costs for producing and releasing smolts is shown on Table V.2. This includes the CEDC hatchery as well as the other supporting hatcheries cost and management budgets. Operation costs are estimated using costs per smolt garnered from reviewing the contributing hatchery budgets and then applied to the table's shown releases.

Tabulating the contributing hatcheries' cost per smolt required an estimating procedure. Hatchery budget information was only available on an overall operation basis. But the smolts contributed to the SAFE project were usually only certain species reared to a certain age. Sometimes their handling for marking was at different rates, and of course, they required hauling

Figure V.2
SAFE Related Operation Cost Budget Shares for Near-Term Proposed Release Strategy



Notes: 1. Expenses and revenues in thousands of dollars.
2. Annualized fixed costs are not shown in budget shares.

to the net pen sites. The major assumptions for the cost estimating are in notes for the itemized hatchery budget tables shown in Appendix A.

Fixed costs are estimated by using the Berry formula based on smolt production weight. Including fixed costs (such as ponds, roads, buildings, etc.) in an economic analysis is an important component of any long term public infrastructure decision making process. If initial construction costs can be considered sunk costs, then at least the fixed costs should account for heavy maintenance and replacement type construction. Sometimes sunk costs are resurrected into current costs to show past sponsor participation in projects. A typical example is utilities who want power generating facilities included in customer rate determining calculations. In the case of SAFE, WDFW and ODFW might argue their hatcheries' initial construction costs should be shown for SAFE cost sharing.

The BPA funded share of the project is estimated based on previous years hatchery funding programs. There are some small cost-sharing arrangements at the contributing hatcheries, such as for capturing at Bonneville Hatchery and other handling/rearing activities that are not accounted for in the BPA share estimates. Some costs are incurred at the Bonneville Hatchery for COH capture which receives MA funds and U.S. Army Corps of Engineers (USACE) funds. The Sandy Hatchery receives partial funding from PGE, but SAFE production is associated with MA funding. The USFWS operates the Eagle Creek National Fish Hatchery, but COH production from this hatchery has not been used after 2004 releases and it is unlikely it will be reinstated at this facility in the near future. Volunteer efforts at the CEDC operations are also not costed for the purpose of showing this item as a cost and revenue source.

Table V.2
Total Estimated SAFE Related Budget for Near-Term Release Strategy

Agency and Hatchery	Species	Smolts	Expenses: Average Per Smolt Cost	Expenses: Smolt Cost ($000's)	Expenses: Adj. M&E Budgets ($000's)	Expenses: Total ($000's)	Revenue: Source	Revenue: BPA Share
A. ODFW Hatcheries Smolt Production					126			
1. Gnat Creek	CHS	850,000	0.37	315			BPA	100%
2. Cascade (plus Oxbow)	COH	600,000	0.24	144			MA	0%
3. Oxbow (from Cascade)	COH	800,000	0.18	144			MA	0%
4. Sandy	COH	300,000	0.31	92			MA/PGE	0%
5. Klaskanine (rearing and Youngs Bay release)	SAB	800,000	0.19	148			BPA	100%
B. WDFW Hatcheries Smolt Production and Acclimation					142			
1. Grays River	CHS	350,000	0.45	156			BPA	100%
2. Grays River	COH	550,000	0.42	230			BPA	100%
C. CEDC Hatchery and Acclimation Budget								
1. BPA (approximately)				370			--	100%
2. Oregon R&E (for SAB)				45			--	
3. Voluntary assessment fee				70			--	
4. Oregon Legislature (for S.F. Klaskanine Hatchery)				130			--	
5. Oregon other (marking)				15			--	
Total budget				630				
6. Smolt production	SAB	700,000	broodstock					
D. Total SAFE Related Operation Budgets								
Hatchery and acclimation related costs								
Contributing hatcheries						1,229		
SAFE						630		
Subtotal						1,859		
Hatchery indirect								
Mitchell Act						85	MA	0%
BPA						177	BPA	100%
Subtotal						262		
Subtotal hatchery operations						2,121		
M&E						268	BPA	100%
Total operations						2,388		67%
E. Total Annual Fixed Cost						1,177		
F. Total Annual Cost						3,565		
G. Smolt Production								
Production		4,950,000						
Per smolt operational cost			0.48					
Per smolt total cost			0.72					
CHS			0.88					
COH			0.73					
SAB			0.56					

Table V.2 (cont.)

Notes:
1. Expenses and revenues can be considered recent years' average and release strategy is proposed for near-term operations.
2. Hatchery costs for SAFE fish, except for the CEDC hatchery, are calculated on a per smolt basis. CEDC budget is assumed adequate to cover new production costs for the 700 thousand SAB broodstock program.
3. Monitoring and evaluation (M&E) includes WDFW and ODFW headquarters costs. M&E is adjusted for WDFW and ODFW hatchery production costs. The headquarters' cost effective indirect rate is 18.8% for WDFW hatcheries and 22.5% for ODFW hatcheries after accounting for certain capital items which the indirect rate cannot be applied.
4. Fixed costs are estimated using Berry formula for $50 per smolt production weight. The estimates are capitalized for showing the annual per-smolt cost.
5. Funding sources are BPA, NOAA Mitchell Act (MA), and Portland General Electric (PGE). Volunteer and inkind support is not included as a cost nor revenue source.

Average total costs over recent years when about five million smolts have been released is shown in Table V.2. Total operational costs are estimated to be $2.4 million. Contributing hatchery costs, including their indirect costs, is 62 percent of the total operational cost. The CEDC share is 27 percent and the M&E share is 11 percent. The operational and management cost is calculated to be about $0.48 per released smolt. The fixed costs using the Berry formula at release weight would add another $1.2 million to the operation and management budget. This would mean the entire program annual cost is approximately $3.6 million. It is estimated the BPA funded share for the SAFE is 67 percent.

Costs have been disaggregated so that all SAFE component costs are visible. Important cost components to the SAFE operations may only include individual entities' budgeted items, e.g. their rearing and acclimation operation costs. States may want to know their research and M&E costs. Also, indirect costs of maintaining headquarter oversight of these programs need to be identified. Funding agencies (e.g. BPA) may be interested in the cost categories of the SAFE program, but they may also want to know what other funds from their agency are included (e.g. MA funds). For public policy decisions, all costs including fixed costs should be considered, even as each entity may only be focused on their actual cash outlay for specific programs.

F. Cost Ratios

SAFE smolt production costs are only one component of the unit cost of a returning adult. The smolt unit cost of production allows an evaluation of a hatchery to control costs and reflect one part of the efficiency of an operation. However, smolts are not sold or caught. The cost to produce a returning harvestable adult gives a better evaluation of individual hatcheries and of the hatchery program in general. Table V.3 provides the cost-per-harvestable adult (CHA) by using SAR's as described in a previous chapter.

The CHA can be a useful indicator for making SAFE operational decisions based on internal program considerations. (A later chapter will discuss cost considerations for comparison to external programs.) For example, because SAB's are released at smaller sizes, production costs-

Table V.3
SAFE Production Cost Per Harvestable Adult

Species	Average Operation Cost Per Smolt	Average SAR	SAFE Area Share	CR Fishery Share	Basis for Cost Per Harvestable Adult: Per SAFE Harvest	Per CR Harvest	Per Total Adult Return
CHS	0.64	0.85%	73.8%	83.5%	102	91	76
COH	0.49	2.44%	58.5%	83.6%	34	24	20
SAB	0.32	1.05%	34.5%	61.2%	89	50	31

Notes: 1. Average production costs are weighted average based on releases using snapshot conditions from Table V.1.
2. Average SAR's are across the brood years shown in Table III.2, then segmented to fisheries using results in Figures III.3 to III.5.
3. SAFE area and Columbia River harvest shares include commercial and recreational fisheries. Columbia River harvest includes SAFE area and mainstem harvests, but not ocean harvests. Total adult return includes all inriver and ocean harvests as well as escapement to hatcheries.

Source: Study.

per-smolt are half CHS costs. However, the CHA indicator for SAFE harvest shows they are about equal, while Columbia River harvest and total adult return CHA is much lower. This is because SAB is a heavily harvested species in ocean and mainstem fisheries. The same mathematical procedures using weighted average production costs and representative SAR's can be applied to a more detailed individual contributing hatchery stocks for internal least cost planning.

CHA indicators for SAFE production (Table V.3) can be related to comparable hatchery production (Table V.4) as a test of cost-effectiveness.[1] This generates SAFE production total cost per Columbia River harvest and per total adult return of $91 and $76 for CHS (compared to $327 and $75) and $24 and $20 for COH (compared to $83 and $23). Assuming tule CHF cost the same to produce as SAB, the CHA is $50 and $31 (compared to $1,416 and $56).[2] The results show the higher costs for the SAFE release process do not outweigh the lower SAR's for hatchery release processes, except for the SAB production when considering total adult returns. If the SAFE objectives are for least cost to enhance Columbia River harvests, then the SAFE process is much less. The use of SAB's ($31) over the indigenous tule CHF stock ($56) appears from this simplifying comparison to be a cost-effective choice. This conclusion ignores other

1. A study by IEAB (2002) provided selected hatchery ratios, however methodologies and cost accounting do not make the results comparable. The IEAB study includes some capital costs and some of the selected hatcheries' objectives were for supplementation. In addition, brood years were different, meaning the smolts were subjected to different ocean condition influences. With all these caveats, the Leavenworth Hatchery ratio was $192 for CHS and the Spring Creek Hatchery CHF was $46.
2. Tule CHF production costs should actually be less than SAB production costs. This is because feeding and rearing costs are less since they are typically released at 80 per pound rather than 20 per pound.

Table V.4
Comparable Hatchery Production Cost Per Harvestable Adult

	Cost Per Smolt			Average SAR		Basis for Cost Per Harvestable Adult	
Species	Operation Cost	Accli-mation	Adjusted	SAR	CR Share	Per CR Harvest	Per Total Adult Return
CHS	0.64	0.074	0.568	0.76%	22.9%	327	75
COH	0.49	0.074	0.414	1.80%	27.8%	83	23
Tule CHF	0.32	0.074	0.247	0.44%	3.9%	1,416	56

Notes: 1. Comparable hatchery production cost assumed to be same as contributing hatchery SAFE production costs less CEDC acclimation costs. There are some SAFE system extra costs not accounted for in the acclimation costs, such as hauling, and extra marking/CWT for SAFE production groups.
2. CR harvest is contributions to commercial and recreational mainstem fisheries. Total adult return includes all inriver fisheries and escapement to hatcheries.

considerations about the use of out-of-basin stocks, such as genetic mixing interactions with wild stocks, harvest regulations causing disproportionate harvest impacts to local wild stocks, and other factors.

The comparison to traditional hatchery release processes is interesting in that the SAFE process generates about the same total adult return cost ratios for similar stocks. However, SAFE is a process to increase fishery access to augmentation hatchery production. Harvest regulations tailored to recovery plans for depressed stocks would prevent that access and the fish would return to hatcheries as surpluses.

Another cost indicator given hatchery augmentation objectives might be a ratio for harvest value. Table V.5 shows estimates of harvest value from SAFE production measured by commercial harvest revenue and recreational fishing expenditures. These measures show dollar flows arising from fishing activity, but these values are not particularly good indicators for effects to the local economy. A following chapter uses modeling procedures to estimate how these dollar flows lead to personal income contributions. The ratios of harvest values to SAFE costs are shown in Figure V.3.[1] Downturns in the trend line for 2001 and 2002 were influenced by a harvester strike concerning price issues. The downturn in 2004 to 2005 was due to lost COH Eagle Creek Hatchery production for the return's brood years.

The cost ratios are comparable among themselves, but the commercial harvest revenue ratio should not be judged for being less than one. The ratio is a simple relationship between one realized value and production costs. It is not a benefit-cost ratio, because not all benefits nor costs are included in the equation. For example, when recreational fishing expenditures are included, the ratio is greater than one.

1. Comparable hatchery ratios obviously are much less because the escapement share of SAR is much greater. Surplus sales could be included in the ratio's numerator, since hatcheries do receive some revenue from edible surplus fish sales. However, hatcheries typically have to pay for a majority of the surplus fish to be hauled to rendering plants.

Table V.5
SAFE Production Potential Harvest Value by Harvest Location in 2004

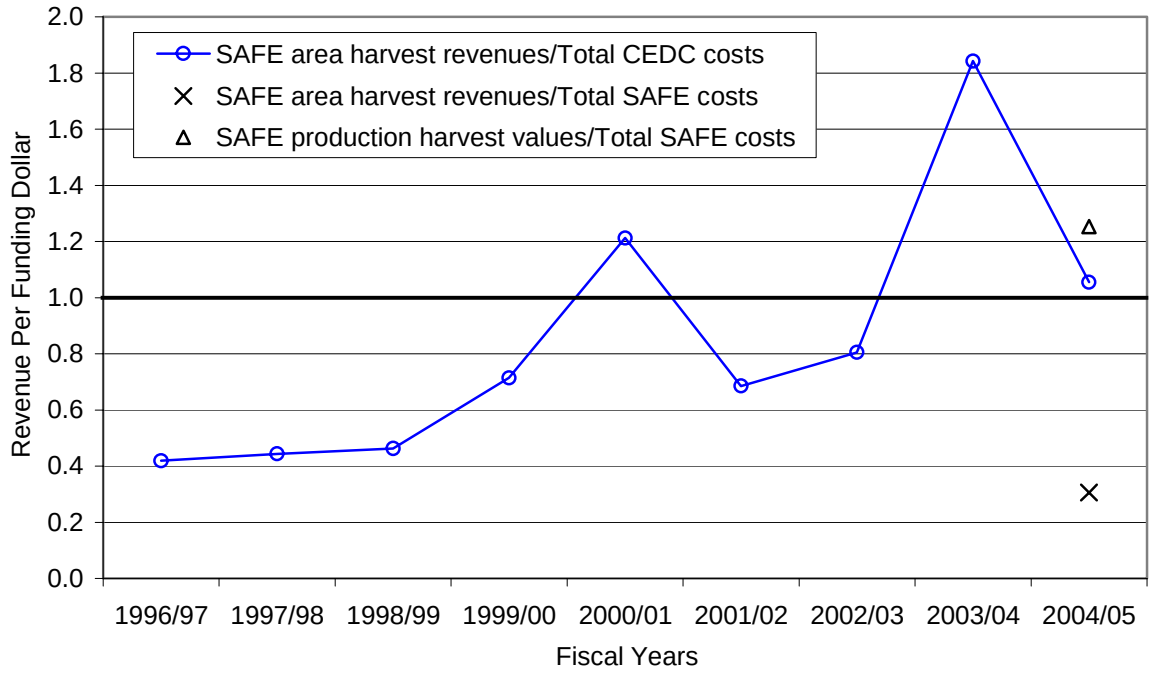
		Fishery Share			Value ($000)			
Species	SAR	Off-channel	Mainstem	Ocean	Off-channel	Mainstem	Ocean	Total
Commercial								
CHS	0.85%	72.8%	7.4%	7.4%	493	50	50	594
COH	2.44%	58.5%	16.9%	0.6%	375	108	4	487
SAB	1.05%	30.8%	19.0%	24.9%	185	114	149	448
Subtotal					1,053	272	203	1,528
Recreational								
CHS	0.85%	1.0%	2.3%	0.2%	45	103	1	149
COH	2.44%	0.0%	8.2%	11.6%	0	665	338	1,003
SAB	1.05%	3.7%	7.7%	5.6%	86	179	47	312
Subtotal					131	948	386	1,465
Commercial and recreational total					1,184	1,220	589	2,993

Notes:
1. Value is the potential estimate for commercial harvest revenue or recreational fishing expenditures generated from SAFE production at the different fishing locations. Value is characterized as potential because actual brood year SAR's and SAFE releases contributing to 2004 fisheries are not used. Instead, value is estimated using average SAR 's times economic analysis snapshot condition releases and Year 2004 prices.
2. Total SAFE production commercial harvest revenue estimated using ratio of average SAR for SAFE area to commercial harvest revenue for the off-channel fishing locations. This assumption is reasonable because ocean prices are typically higher, but this is offset by per-fish weight being lower.
3. Off-channel revenue includes some non-SAFE stocks. About 17% of SAFE area fish are from other local or upriver stocks.
4. Success rates are trips per fish. It is assumed that lower estuary success rates apply to SAFE area angling locations.
5. Recreational fishing trip expenditures are different for ocean and inriver fishing locations.

Source: In-river (off-channel and mainstem) harvest revenue is from PacFIN fish ticket data, May 2006 extraction. Trip expenditures are from Gentner et al. (2001).

A cost ratio related to efficiencies might be smolt releases per production costs. Figure V.4 shows the ratio over the past nine years has remained about the same. This is despite the many experiments in sites, stocks, release strategies, and other research. It would be expected that the recent years' downturn in the ratio would reverse during the future implementation of the project. Taking advantage of project capacities at known feasible sites given similar production costs would raise the ratio.

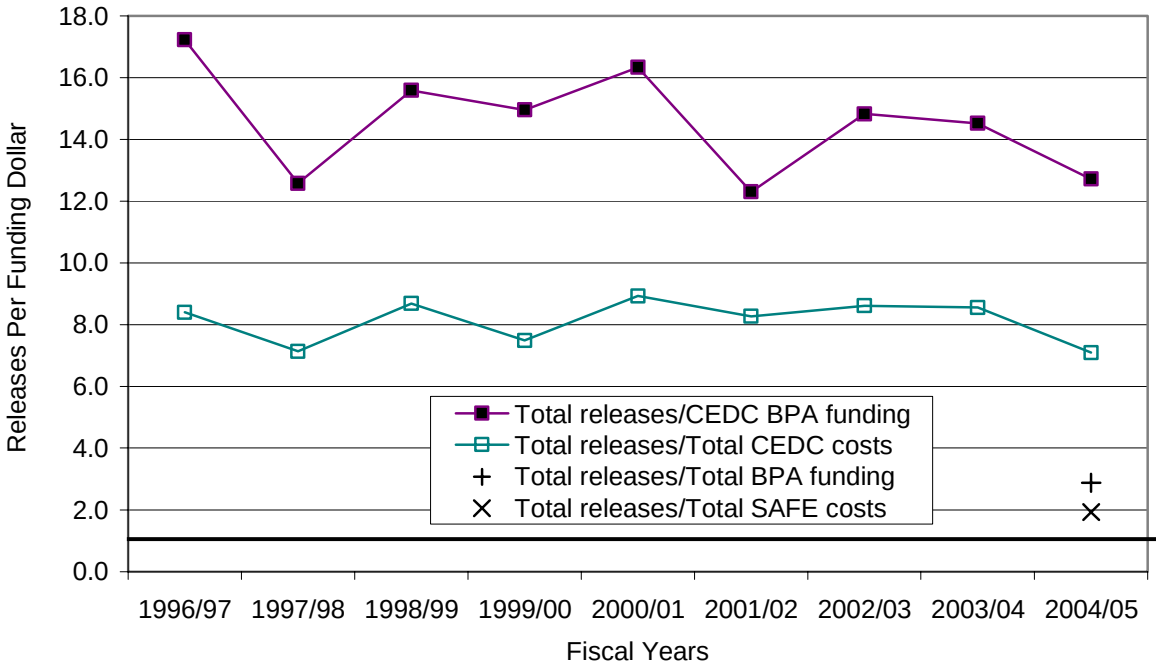
Figure V.3
Harvest Revenue Per Funding Dollar Cost Ratios



Notes: 1. Harvest values include commercial harvest revenue plus recreational fishing expenditures wherever SAFE production is caught. Fishing activity is based on average SAR's and current release strategies.
2. SAFE area harvest revenue is actual in 2004.

Source: Study for harvest value estimates and PacFIN fish ticket data May 2006 extraction for SAFE area harvest revenues.

Figure V.4
Smolt Releases Per Funding Dollar Cost Ratios



Notes: 1. Dollars adjusted to real 2004 using the GDP implicit price deflator developed by the U.S. Bureau of Economic Analysis.

Source: Study.

VI. ECONOMIC ANALYSIS

A. Introduction

This chapter provides analysis results for determining net economic value (NEV), regional economic impact (REI), and results from CEA. Methods and factors used for the analysis are more fully presented in Appendix D. Chapter I discussed the economic analysis context for the Study and explained the boundaries to be used in the analysis.

NEV is calculated for what might be considered status quo (also used as the baseline alternative), and secondly, a hypothetical situation for no BPA or equivalent funding. Status quo would mean the approximately two thirds BPA share would continue, smolt release levels would be about five million, and average SAR's for 1990's brood years would apply. The releases would be the same mix of species previously described as the near-term plan which was used to show snapshot condition results for the production cost analysis. The alternative for no BPA funding was described as an administrative contingency in Table II.2. For the contingency, it is assumed that all hatchery production with BPA support would go away and hatchery production with non-BPA support would continue as traditional hatchery releases.

Commercial and recreational fishing NEV's are based on updated per fish unit values from the author's previous Columbia River study (Radtke et al. 1999). Subtracted from these benefits are the costs for the SAFE system production which includes CEDC operations, contributing hatchery costs for providing smolts, and state management. Estimated capital costs for hatchery production are also subtracted.

It is acknowledged there could be other benefits and costs brought into the equation. Hatchery production is to replace lost habitat due to hydropower development, so hydropower benefits and dam construction costs could be included. Dams have multiple benefits like transportation, but they also have multiple and cumulative costs. Benefits promote industrial and urban development which in-turn can have adverse consequences. Opportunity costs for land and water could be brought into the equation. There are also non-market benefits that could be considered, like the benefits from non-consumptive fish resource recreational experiences. Despite the simplifying assumptions of only using harvest values and production cost elements, results should be revealing for showing the incremental effect of the funding contingency alternative.

This basic approach for determining NEV also sets the stage for conducting further research for effects from changed economic and environmental conditions or sensitivity to policy considerations. For example, how would harvest price increases or decreases change benefit-cost results? What would be the effect of salmon recovery successes which now severely limit below Bonneville inriver fisheries? What are the effects from changed SAR's? Are there distributional changes to fishery user groups (commercial, recreational, and tribal)? What are the long-term, indirect ecological effects from the concentrated SAFE area fishing? These research questions were beyond the scope of this Study and such questions must be left to future analysis.

REI's are calculated two different ways. The first uses per fish unit values from the author's previous Columbia River study (IEAB 2005) to determine economic activity generated from SAFE production. The activity is measured by total personal income from commercial harvesting and processing, and recreational fishing for the adult returns to off-channel, mainstem, and ocean fisheries. The second REI modeling calculates total economic activity generated by gillnet permittees whereby harvesting SAFE production at off-channel locations is but one component of their overall fishing industry business. Gillnet permittees participate in other West Coast and Alaska fisheries. The second modeling method uses gillnet fleet cost-earning budgets acquired through Study tasks. This economic modeling factors for the model were described in a previous report chapter. The accounting stance is for the local (Astoria/Ilwaco area) and regional (Washington/Oregon states) economies. Gillnet permittee non-fishing income is mentioned to show the breadth of family and business participation in the local economy.

REI's for recreational fishing are also calculated for trips when salmon is targeted at inriver (below Bonneville) locations and in the ocean when trips originate from Astoria/Ilwaco. The recreational REI's are itemized for the CHS fishery and for summer/fall fisheries. Because angler residency information was not known, the accounting stance is only for regional economies.

A side calculation is made for REI's from hatchery production and SAFE administration. These REI's are an itemization of the overall SAFE production REI's and are not additive to it. There was an interest by Study sponsors for this information.

The CEA in this chapter is a cost comparison to several external (non-SAFE related) programs. A previous report chapter on cost analysis described how internal program cost comparisons might be helpful in decision making for least cost approaches to accomplishing Project goals. The SAFE has multiple objectives which makes the external comparisons difficult. The external program cost comparison used the objective to maximize harvest access to hatchery production while minimizing impacts to depressed stocks. The comparison basis was cost per one percent saved juveniles associated with impacted returns of upriver CHS and upriver bright CHF. The external program examples included forgone hydropower benefits from spilling, smolt passage improvements, and the smolt predation reductions from the Northern Pikeminnow Sport Fishing Reward Program.

B. SAFE Production Net Economic Value

The modeling uses a status quo alternative and an alternative for without BPA funding of SAFE operations. For the latter alternative, contributing hatchery production dependent on 100 percent BPA funding is lost and hatchery production using MA or other funding would continue as traditional hatchery releases. Modest levels of production at the CEDC hatchery facilities using state and local funds would continue.

The analysis does not attempt to measure the program's total benefits over time in relation to its costs. It only provides simple one-time estimates of NEV from commercial and recreational

harvests and hatchery surplus sales from the SAFE production. The estimated NEV for the status quo alternative is negative $170 thousand and the alternative for lost BPA funding is negative $219 thousand (Table VI.1). Therefore, the incremental NEV is algebraically positive $49 thousand (Table VI.3).

The negative NEV calculation for augmentation 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 NEV. The Salmon River Hatchery located on the northern Oregon Coast has not attained this SAR level in any of the brood years 1995 to 2000. The Bandon Hatchery located along the southern Oregon Coast has fallen below the level in three out of six years for the same brood years.[1]

NEV analysis can also be useful for showing operation efficiencies. For example, the NEV analysis shows the influence of CHS production. Harvesters receive a high price per pound for this species, however its production costs are also high. If its production was continued for the alternative to status quo, the incremental NEV would algebraically be a positive $271 thousand. The CEA discussion later in this chapter shows how only harvest numbers and the cost side of production can similarly be useful for showing operation efficiencies.

Table VI.1
Benefits and Costs for SAFE Alternatives

		SAFE	Harvest Benefits ($000's)									
		Cost	Commercial			Recreational			Hatchery Surplus			NEV
Species	Releases	($000's)	SAFE	Mainstem	Ocean	SAFE	Mainstem	Ocean	Market	Carcass	Total	($000's)
With BPA Funding (Baseline)												
CHS	1,200,000	$771	$431	$44	$21	$12	$28	$1	$11	$1	$549	-$222
COH	2,250,000	$1,099	$336	$97	$2	$0	$269	$380	$8	$2	$1,094	-$5
SAB	1,500,000	$482	$133	$82	$99	$52	$109	$53	$11	$1	$539	$57
Total	4,950,000	$2,352	$899	$222	$122	$65	$406	$434	$30	$4	$2,182	-$170
Without BPA Funding (Alternative)												
CHS	0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
COH	1,900,000	$824	$30	$74	$2	$0	$164	$227	$65	$16	$578	-$246
Cascade	1,400,000	$580	$0	$53	$1	$0	$113	$156	$52	$13	$390	-$190
Sandy	300,000	$147	$0	$12	$0	$0	$27	$37	$12	$3	$91	-$55
CEDC	200,000	$98	$30	$9	$0	$0	$24	$34	$1	$0	$97	-$1
SAB	700,000	$225	$62	$38	$46	$24	$51	$25	$5	$1	$252	$27
Total	2,600,000	$1,049	$92	$113	$48	$24	$215	$251	$70	$17	$830	-$219

Notes:
1. Broodstock fish assume 20% escapement and carcass sales include broodstock fish. Hatchery surplus fish assume 80% escapement fish of which half enter edible market. Egg sales are not included as a hatchery surplus revenue source.
2. Commercial and recreational ocean fisheries assume Washington ocean NEV unit values for CHS and COH and Oregon ocean unit values for SAB.
3. Commercial inriver fisheries assume same NEV unit values for SAFE area and mainstem harvest locations.

1. SAR estimates for CWT production groups can be found at: http://www.cqs.washington.edu/cwtSAR/.

The same NEV analysis approach could be used for other alternative production strategies. For example, lost BPA-funded production might have replacement with tendered agreements with other federally funded augmentation hatcheries. The NEV results would be quite different when other than BPA funded production is directed through the SAFE system. The cost analysis from Chapter VI revealed that only 40 percent of the CEDC budget was used for net pen, hauling, extra marking/CWT, and management costs. Most of these costs would have to be incurred anyway for traditional hatchery releases. So the NEV benefit side of the equation would account for higher harvest values and the cost side of the equation would account for the minor difference in SAFE system costs.

C. SAFE Production Regional Economic Impacts

The REI from SAFE production for status quo alternative is estimated to be $3.4 million personal income of which about one third is from ocean and inriver recreational fishing (Table VI.2). The incremental change is $2.2 million (Table VI.3). These measurements are to regional economies wherever SAFE production is harvested. The estimates do not include effects from substitution fisheries that may offset downturns in what SAFE production contributes to the fisheries.

REI's for program administration and hatchery production are shown in Table VI.4. Representative rather than annual actual budgets are used for the analysis. Actual program administration expenditures vary from year-to-year, so the choice for using the shown budgets should be viewed as providing a representative REI for these types of expenditures. The

Table VI.2
Regional Economic Impacts for SAFE Alternatives

		Regional Economic Impacts ($000's)								
		Commercial			Recreational			Hatchery Surplus		
Species	Releases	SAFE	Mainstem	Ocean	SAFE	Mainstem	Ocean	Market	Carcass	Total
With BPA Funding (Baseline)										
CHS	1,200,000	$851	$86	$42	$14	$33	$1	$20	$1	$1,050
COH	2,250,000	$566	$163	$5	$0	$314	$444	$13	$3	$1,507
SAB	1,500,000	$232	$143	$192	$61	$127	$61	$18	$2	$837
Total	4,950,000	$1,649	$393	$239	$75	$473	$507	$51	$6	$3,393
Without BPA Funding (Alternative)										
CHS	0	$0	$0	$0	$0	$0	$0	$0	$0	$0
COH	1,900,000	$50	$125	$4	$0	$191	$264	$107	$27	$769
Cascade	1,400,000	$0	$90	$3	$0	$132	$182	$85	$21	$514
Sandy	300,000	$0	$21	$1	$0	$31	$43	$20	$5	$121
CEDC	200,000	$50	$15	$0	$0	$28	$39	$1	$0	$134
SAB	700,000	$108	$67	$89	$28	$59	$29	$8	$1	$390
Total	2,600,000	$159	$192	$93	$28	$250	$293	$115	$28	$1,159

Notes: 1. Notes from Table VI.1 also apply for REI unit values.

Table VI.3
SAFE Alternatives Net Economic Value and Regional Economic Impact Comparisons

Alternative	NEV ($000)	REI ($000)
Baseline	-170	3,393
Alternative Change	49	2,234

Notes: 1. Change is the incremental difference between baseline less alternative. It is a one-time effect applicable to snapshot conditions and is not accumulative over future years.

Table VI.4
Regional Economic Impacts From SAFE Program Administration and Hatchery Production

Agency	Current Budget ($)	% Labor	REI ($000)
CEDC	$630,000	66%	$1,031
WDFW (M&E)	$141,885	100%	$279
ODFW (M&E)	$125,712	100%	$247
Headquarters Program Management	$262,132	100%	$515
Hatcheries (WDFW and ODFW)	$1,228,537	56%	$1,890

Notes: 1. Itemization for labor and non-labor expenditures are shown in Appendix A for the respective agencies. Separate IMPLAN derived response coefficients were used for the expenditure itemization.
Source: Study.

expenditures are made at hatchery and state management headquarter locations, so the effects are regional. These calculations are already included in the previous REI tallies and are not additive to it.

D. Gillnet Permittee Regional Economic Impacts

The modeling features are:

- Gillnet permittees impacts for two regions: local (Astoria/Ilwaco area) and regional (Oregon/Washington states).
- Categorizations of likely replacement economic activity without gillnet permittee participation (sometimes called substitution effects).

The economic impact analysis is to calculate the generated personal income received by households in two regions (Astoria /Ilwaco area and Washington/Oregon states) from economic

activities connected in some way to the lower Columbia River gillnet fishery permittees. The activities are for:

- Direct revenue received by vessels from lower Columbia River gillnet fishery harvests
- Processor/buyer sales of products using gillnet fishery harvests
- Processors also purchase SAFE production edible hatchery surplus fish. Processors in-turn provide product wastes and carcasses for conversion to fish meal. Some hatchery surplus sales are carcasses for rendering.
- Gillnet fishery permit owner income from other fisheries, including West Coast and Alaska landing earnings

There are other activities related to or associated with the gillnet fishery that can only be acknowledged as also being a personal income generator. This includes permittee family income when members work as crewmen or as processor workers in other fisheries. It also includes activities where families augment harvest related income with other business or wage and salary employment. An indicator of these activities' effects is from the 1994 gillnetter survey that found that 27 percent of family income was not related to gillnet or other fishery sources. There may be other gillnet fishery associated economic impacts, such as tourists drawn to working waterfronts, that also are not calculated.

1. Gillnet Fishery

Fishery prosecuting expenditures for five harvesting business strategies were compiled for the Year 2004 landings. Return-to-labor for the vessels was calculated to show out-of-area permittees revenue flows. Product forms for the proportions purchased by four processor/buyers were assigned. The product forms are whole (head-on) fresh, head-off fresh and frozen, fillets fresh and frozen, and other. Other includes a small amount of canned, smoked, and jerky. Processing expenditures for product preparation and cold storage were reduced for assumed share of haul-outs to custom cutting and storage operations in the Bellingham/Seattle area. The modeling factors across the vessel and processor types and product flows were described in the appendix.

An attempt was made in the Study's survey update to gather information about any differentiation in harvester and processor expenditures associated with the SAFE and other contributing stock fisheries. Survey participants did not consider harvest prosecuting costs to be different. Any differential price between the two contributing stock segments would show up in the database used to determine landing value.

Total landed revenue of the lower Columbia River gillnet salmon fishery was $3.4 million in 2004. Local area economic contributions from the fishery are estimated to be $3.0 million. Gillnet vessel other harvests such as sturgeon generated another $1.0 million personal income in 2004 (Table VI.5). The economic effects from the gillnet salmon fishery would be categorized as dependent on gillnet permittee participation. As such, there would be no likely economic analysis substitution effects.

2. Gillnet Permittee Other Fisheries Income

The $3.3 million additional West Coast harvest revenue earned in other fisheries by gillnet fishery permittees would generate approximately $4.3 million personal income in the area's economy (Table VI.5). The calculation of the economic impact from a permittee's other fishing income uses West Coast landings and distant water fisheries earnings. It is suggested that these fisheries are fully utilized and other local harvesters would make the same deliveries to processors. In this case, the harvester economic effects would simply be accounted in another harvester class and the processor share of the economic effects would be the same. Therefore the degree of substitution effects could be considered likely.

3. Gillnet Permittee's Distant Water Fisheries Income

The distant water fisheries economic effect is a somewhat more complex calculation. It is assumed that Alaska revenue is derived mostly from vessels already located at the fishing grounds. This means some vessel services and provisioning occurs in Alaska. Other purchases such as bait or capital purchases for gear or repairs are made locally and shipped to Alaska. The purchases made in Alaska would lessen the economic effects that would traditionally be made to the local area when prosecuting a local fishery.

It is also assumed only a portion of fisheries earnings' returns-to-labor or permittee's lease rents are returned to local and regional economies. Modeling for distant water fisheries impacts has shown about half the returns-to-labor from harvesting or permitting payments would return to the area economy of an owner's residence (Radtke and Davis 1999). The portion varies across fisheries, depending on the season length and other factors. Most gillnet permittee Alaska fishery permits are for salmon (Table IV.8). It is assumed a higher portion would be returned because of the short durations for these fisheries. Given $5.5 million was Alaska earnings, it is estimated the amount of personal income generated in the Astoria and Ilwaco area would be about $3.7 million after considering the multiplier effect and permittee residency (Table VI.5).

E. Recreational Fishing Regional Economic Impacts

Calculations are made for economic impacts from recreational salmon fishing on the lower Columbia River (mainstem and estuary), or from salmon ocean recreational fishing when trips originate in the Ilwaco and Astoria area. There is other recreational fishing for ocean bottomfish, river sturgeon, and other species that is not included in the analysis. The calculation is not itemized for resident or non-resident anglers, so the impact accounting is at the regional level. Consequently, recreational angling is not categorized for having local substitution effects.

Recreational fishing economic effects on local area economies is calculated using assumptions about expenditures per angler day (Table D.3). This distinguishes trip expenditures from other equipment and annual costs paid to maintain readiness for participating in recreational fishing activities. Fairly recent survey information for per day saltwater fishing expenditures is available (Gentner et al. 2001) and recreational user effort estimates are reported by ODFW (2005).

Table VI.5
Local and Regional Economic Impacts Estimates for Gillnet Permittees in 2004

	Gillnet Vessel		Gillnet Permittees Other Vessel Fisheries			West Coast		All
	Gillnet Fishery	Other Fisheries	Astoria/ Ilwaco	Other Ports	Subtotal	Fisheries	Alaska	Fisheries
Landings (round 000)	2,443	734	1,722	325	2,047	5,224		
Ex-vessel value ($000)	3,374	622	2,712	602	3,314	7,310		
Ex-processor value ($000)	6,285	1,623	6,319	1,259	7,578	15,485		
Economic impacts ($000)								
Regional Area Impacts From West Coast Fisheries								
Harvester	2,943	998	3,569	738	4,308	8,249		
Processor	2,145	664	1,547	289	1,836	4,644		
Subtotal	5,088	1,662	5,116	1,027	6,143	12,893		
Local Area Impacts From West Coast Fisheries								
Harvester	2,137	725	2,633	395	3,029	5,890		
Processor	865	268	1,248	0	1,248	2,381		
Subtotal	3,002	993	3,882	395	4,277	8,271		
Regional and Local Area Impacts From Alaska Fisheries								
Earnings							5,455	
Regional							7,755	
Local							3,712	
Total Economic Impacts								
Regional								20,648
Local								11,983

Notes: 1. Pounds are round pound equivalents in thousands, ex-vessel revenue and ex-processor sales are in thousands of 2004 dollars, and economic impacts are expressed as personal income in thousands of 2004 dollars.
2. Local area economy is Clatsop and Pacific counties. Regional area economy is Oregon and Washington states.

The reported effort estimates are not differentiated for angler residency. The differentiation is important to assess the proportion of economic effects that might be otherwise generated from angler spending in other sectors of the economy. An assumption was made to use the same mix of charter/guided, private boat, and bank modes as well as the same share of resident and non-resident participants in Oregon found by Gentner et al. (2001) for calculating the economic effects of mainstem recreational fishing. Summing the recreational economic impacts from ocean trips originating in Astoria or Ilwaco, plus the trips whose purpose is to fish the Buoy 10 fishery, plus other mainstem fisheries below Bonneville Dam shows recreational fishing contributed $21.0 million in personal income to the regional economy in 2004 (Table VI.6).

F. Cost-Effectiveness Analysis

As previously explained, CEA differs from NEV and REI economic analysis approaches. CEA instead asks the question: given a particular objective, which is the least cost way of achieving

Table VI.6
Regional Economic Impact Modeling Estimates for Columbia River Recreational Fishing in 2004

			River		
	Ocean	Estuary	Spring Chinook	Fall Chinook/ Coho	All Fisheries
Effort	59,200	68,818	156,101	135,155	
Expenditure ($000's)	3,972	4,618	10,474	9,069	
Economic impact ($000's)	2,966	3,447	7,820	6,770	21,003

Notes:
1. Effort is trips and success rate is trips per retained fish.
2. Expenditures are for angler day trip costs and do not include annual equipment costs.
3. Oregon share of charter, private boat, and bank trips; and, share of resident and non-resident participants is assumed to apply to Astoria and Ilwaco trip origin as well as river fishing.
4. Trip costs and economic impacts per trip adjusted to Year 2004 using the IPD developed by the U.S. Bureau of Economic Analysis.
5. Economic impacts are expressed as personal income in thousands of 2004 dollars.

Sources: Trip expenditures and participants from Gentner et al. (2001). Response coefficients are from 2000 Fisheries Economic Assessment Model (FEAM). The 2000 FEAM is based on IMPLAN 1998 base data. Subregions using county level total personal income for a weighting factor. Trip counts ocean and estuary from PFMC (2005). Mainstem trips and catch from ODFW (2005).

it? Thus, it facilitates choice among options, but cannot answer whether or not any or all of the options are worth doing. CEA is used instead of NEV and REI analysis when there are difficulties in associating monetary values with outcomes, but where the outcomes can be defined or quantified in non-monetary fashion (Pearce 1992).

The Northwest Power Act requires CEA for projects and approaches considered by the NPCC for funding.[1] For example, some interests in the region are considering if it is possible to achieve targeted levels of juvenile salmonid survival with reduced spill offset by other techniques for reducing mortality (IEAB 2004).

Cost-effectiveness can be used for judging internal program decisions about how to operate in a least cost manner. A previous chapter provided prescriptive descriptions about how costs per harvestable adults for species and release strategies could be used in operational decision making. Table VI.7 shows a similar measure by SAFE production species compared to traditional hatchery releases. This table uses harvested adults to show movements in the statistic caused by differing rates of escapement for the two operation types. CHS production provides a high price fish and assists in providing year around fishing opportunities to the gillnet fleet. However, it is the highest cost per harvested adult of the species mix. The use of SAB species is justified over tule CHF based on this measurement ($33 vs. $105) if the traditional hatchery release costs for tule CHF are anywhere close to SAFE production costs. This is because tule CHF provide very little contribution to Columbia River fisheries. Overall, moving from SAFE

1. The Northwest Power Act is an alias for the Pacific Northwest Electric Power Planning and Conservation Act passed by Congress in 1980. It is the authorizing legislation for the NPCC.

production to the traditional hatchery production using the species mix assumptions from Table VI.7 causes the composite cost per fish to go from $31 to $82.

The SAFE can also be compared to external programs based on its objectives. The trick is to find a comparable statistic. This is made even more difficult because SAFE has multiple objectives. If the objective to be used is providing lower costs for harvest access at lower Columbia River fisheries, then Equation 1 will apply and tend towards negative values as SAFE costs go down. If the objective to be used is showing lower costs per impacted depressed stocks, then Equation 2 will apply. It will tend toward positive values as impact rates improve.

Equation 1:

$$\sum \left[\text{Smolt Releases} * \text{SAR} * \text{Cost Per Smolt}\right]_{s,SAFE} - \left[\text{Smolt Releases} * \text{SAR} * \text{Cost Per Smolt}\right]_{s,OTHER}$$

Equation 2:

$$\sum \left[\frac{\text{Smolt Releases} * \text{SAR} * \text{Cost Per Smolt}}{\text{Harvest} * \text{Impact Rate}}\right]_{s,i,SAFE} - \left[\frac{\text{Smolt Releases} * \text{SAR} * \text{Cost Per Smolt}}{\text{Harvest} * \text{Impact Rate}}\right]_{s,i,OTHER}$$

where *s = species released*
i = species protected
SAFE = smolts raised/acclimated at SAFE facilities
OTHER = smolts raised and released at hatcheries

The IEAB (2004) has chosen annual costs per one percent juvenile "savings" as a measure for salmon recovery CEA. Since SAFE is a harvesting program, the comparison required translation to outmigrating juveniles associated with the harvest brood years. SAR's from Table III.1 are used to approximate brood year conditions for return years impacts. Snapshot conditions costs from this report's cost analysis were assumed to apply to those juveniles. The selected impacted stocks were upriver CHS and upriver bright CHF (URB). Table VI.8 shows the costs per one percent juveniles saved for upriver CHS to be $0.51 million and for URB to be $0.84 million. The annual costs of a one percent savings of juvenile salmonids compared to other programs are shown in Table VI.9. The selected objective used to generate a statistic shows SAFE to have a very favorable comparison to the other programs. However, there is some interpretation of the provided statistic necessary to judge the project cost-effective according to IEAB (2004) definitions.

The IEAB (2004) defined a project as representing a cost-effective scenario when it reduces net costs and increases the objective relative to the status quo scenario. It is a "win-win" situation that should be acceptable to the program sponsors as well as fisheries interests. In the case of SAFE, some of the present smolt production costs are shifted toward SAFE operations funded by states and stakeholder interests. Smolt production levels to meet augmentation hatchery goals are maintained and the number of adults reaching accessible fisheries is increased. If BPA suggests that replacement hatchery production is not required (as is shown in the NEV analysis alternative), then (sticking with the same metaphor) the case might be considered a "tie-win"

Table VI.7
Cost-Effectiveness Analysis for SAFE Cost Compared to
Traditional Hatchery Production Cost Per Harvested Adult

	Species	Releases (000,000)	SAR	Harvested Share	Harvested Adults	SAFE Cost Per Smolt	SAFE Cost ($000's)	SAFE Cost Per Adult
SAFE Production								
	CHS	1.20	0.85%	91.1%	9,292	0.64	771	83
	COH	2.25	2.44%	95.8%	52,597	0.49	1,099	21
	SAB	1.50	1.05%	91.7%	14,443	0.32	482	33
Total		4.95			76,331		2,352	31
Comparable Hatchery Production								
	CHS	1.20	0.76%	37.5%	3,422	0.57	682	199
	COH	2.25	1.97%	38.9%	17,238	0.41	932	54
	Tule CHF	1.50	0.44%	53.2%	3,540	0.25	370	105
Total		4.95			24,199		1,984	82

Notes:
1. Cost per "harvested" adult used in this table is distinguished from the indicator for cost per "harvestable" adult used in previous chapters. The indicator for harvestable includes escapement to hatcheries.
2. Comparable hatchery per smolt costs are assumed to be the same as SAFE production less acclimation costs.
3. Hatcheries and stocks selected for comparison are described in Table III.2.
4. SAFE production harvest includes commercial and recreation SAFE area, other Columbia River, and ocean harvest locations.

Table VI.8
Cost-Effectiveness Analysis for SAFE Cost Per Impacted Fish

	Year 2002-2005 Avg.			Saved Impact					Cost Per
Species	Run Size	SAR	Outmigrating Juveniles (000,000)	Rate	Harvest	Juveniles (000,000)	SAFE Cost ($000's)	Cost Per Saved Juvenile	1% Saved Juvenile $000,000
Upriver CHS	225,619	0.37%	61.0	2.08%	4,686	1.3	1,056	$ 0.834	$ 0.509
URB	320,675	0.60%	53.4	2.93%	9,391	2	2,472	$ 1.580	$ 0.844

Notes:
1. SAR used in this table are adult survival to run size. SAR's from Table III.1 are used to approximate brood year conditions for return years impacts.
2. Saved rate is the mainstem fishing impact rate less the SAFE area fishing impact rate for return years in Table III.3.
3. Saved juveniles represent number of outmigrating juveniles associated with saved harvests. This assumes zero adult passage mortality.
4. Total SAFE costs are segmented for CHS and for COH and SAB costs. SAFE CHS costs apply to upriver CHS impacts and SAFE summer and fall fishing costs apply to URB impacts.
5. SAFE costs include fixed costs.

Table VI.9
Cost-Effectiveness Analysis Using Comparative Programs

	Species		
Selected Programs	CHF	CHS	Steelhead
August spill at Ice Harbor	$600	No effect	No effect
Extended length screens at Lower Granite	$12	$3	$6
Extended length screens at Little Goose	$23	$7	$14
Corner collector at Bonneville	$95	$95	$158
Sport Fishing Reward Program		$2.91 (all stocks combined)	
SAFE	$0.84	$0.51	na

Notes: 1. Table values are annual costs (millions of dollars) per one percent increase in salmonid downstream migration survival. The Ice Harbor Spill Program is the forgone hydropower benefits per one percent increase in smolt survival.
2. SAFE costs include operation, management, and annualized fixed costs.

Source: IEAB (2004) and Radtke et al. (2003) for other actions and Study for SAFE.

scenario.[1] Net costs stay the same, but harvest benefits are increased. Depending on which policy choice is made by program sponsors to maintain hatchery production levels, the SAFE would appear to be consistent with the IEAB definition for cost-effective for either definition.

1. The BPA suggests that there is no separate or related requirement to replace hatchery production if SAFE is not funded (Skidmore 2006). This suggestion would have to be interpreted in light of the NPCC's policy for "Doubling the Runs." This policy is a commitment to support community benefits from access to fisheries. BPA operates the power system and provides off-site mitigation for effects caused by the federal hydroelectric power system. Other factors that are deleterious to fish and wildlife are not the responsibility of BPA. The Doubling the Runs goal was addressed to all interests that affect adult returns to the river. BPA has funding responsibility for hatchery construction and operations, but it is limited to specific requirements as directed through NOAA biological opinions and other agreements. There are 126 dams in the Columbia River Basin and only 29 are operated under the federal hydroelectric power system.

VII. STUDY RESULTS DISCUSSION

A. Introduction

The development phase of the Project starting in the early 1990's was accompanied with an economic analysis (TRG 1996). The expanded project was to have released 57 million smolts that could generate an additional $11 million of revenues for gillnet harvesters. A financial support program of around $15 million was required to pay for annual operating and capital costs. The TRG (1996) study concluded that: "The advantage of this program is in the expected increase in marine survival rates of smolts to harvested adults. These marine survival rates are estimated to be 1.77 greater for [fall] Chinook and 2.33 greater for COH. This [selective fishing] project, working in concert with existing Columbia River hatcheries that operate because of mitigation agreements, will be able to finish raising and releasing smolts at comparable existing hatcheries." The SAR projections did not pan out and an expansion of the envisioned production levels did not take place. This wide gap between expectations and reality has led to concerns about the Project's economic feasibility.

A review of the SAFE project by advisory bodies of the NPCC (ISRP and IEAB March 2005) identified a number of economic issues that need consideration:

- The North et al. (2004) report does not provide information on costs of achieving project goals. This is a major omission in terms of evaluating either the likely cost-effectiveness of continuing investments or the appropriate level of such investments.

- Because cost considerations are absent, the report presents only a partial picture of project benefits (gross, rather than net incremental benefits). Maximizing the value of harvest, as well as the project overall, requires a consideration of both costs and benefits and how they change under different conditions.

- The report does not thoroughly explain how decisions about project modifications are made, and how costs and benefits inform those decisions.

- Expectations about how long BPA mitigation funding of this fishery should continue are not discussed, nor are possibilities for cost sharing between the region and local interests according to the distribution of project benefits and responsibilities for power system mitigation.

- Economic components (costs and benefits) are not part of ongoing M&E, but should be.

Previous chapters have provided much detailed information about Project economics to address these issues. Measures were developed for the following indicators.

- A ratio was developed for cost per "harvestable" adult for the SAFE system and comparable hatcheries to show whether there is a recruitment-to-spawner cost advantage. "Harvestable" adults includes hatchery escapement returns in the ratio's denominator.

- Trend ratios were developed for harvest revenue and smolt releases divided by operating costs for the SAFE system and comparable hatcheries to show whether business efficiencies were changing over time.

- Incremental NEV and REI measurements were shown for a hypothetical alternative where the SAFE system did not have BPA funding.

- CEA ratios for cost per "harvested" adult were developed to show how least cost planning was being used for SAFE system operations and to show any advantages over traditional hatchery operations.

- A ratio for cost per impacted fish was developed to show comparisons based on a common measurement (cost per one percent saved juvenile) to other Columbia River salmon recovery projects.

- Other economic contribution calculations at a local and regional economy level were developed for the lower Columbia River commercial and recreational fishing user groups to show relative share of SAFE system economic contributions.

A digest of the analysis results is shown in Table VII.1. Telling results are explained in a findings format (see executive summary). This chapter is to better characterize the economic effects from SAFE production in particular and the gillnet fishery in general to make the economic analysis information more useful for technicians and policy makers.

B. Economic Result Sensitivity Analysis

SAFE system outcomes are derived from production conditions for which sponsors have no control. A factor affecting salmon is the concentration of predators in the estuary and ocean. Seals and sea lions have been targeted for over a century for preying on Columbia River salmon (Reed 1890). More recently bird populations in the lower Columbia River have been identified as effective predators of salmon smolts. The world's largest colony of Caspian terns and the two largest colonies of double-crested cormorants on the West Coast have recently become established in the Columbia estuary (NMFS 2000).

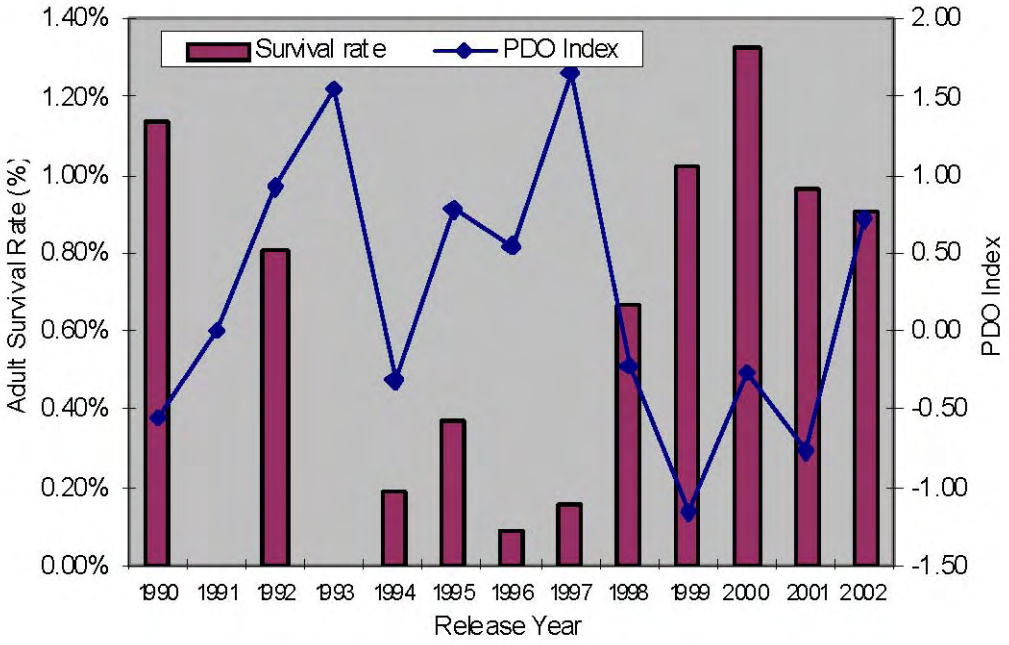
While not yet fully understood on an ecosystem basis, ocean conditions appear to strongly influence smolt survival. Correlations with numbers of adult salmon returning to spawning streams and hatchery release sites have received considerable study (Mantua 1997). Important changes in Northeast Pacific marine ecosystems have been correlated with the Pacific Decadal Oscillation (PDO) index (Anderson 1997 and Francis et al. 1998). Warm PDO phases have favored high salmon production in Alaska and low salmon production off the west coast of California, Oregon, and Washington states. Conversely, cool PDO eras have favored low salmon production in Alaska and relatively high salmon production for California, Oregon, and Washington (Hare 1996, Hare et al. 1999, Peterson et al. 2006). North et al. (2006) shows CHS SAFE production related to the 12 month PDO index for recent brood years (Figure VII.1).

Table VII.1
Analysis Results Digest

Measure	Analysis Purpose	Report Location	Result Synopsis
Cost per smolt produced by CEDC and contributing hatcheries	Determine overall production costs	Table V.1 and Table V.3	CHS $0.64 COH $0.49 SAB $0.32
Cost per "harvestable" adult for SAFE and comparable hatcheries	Comparative fish recruitment cost and provide tool for least cost planning among options	Table V.3 and Table V.4	CHS $76 compared to $75 COH $20 compared to $23 SAB $31 compared to $56
SAFE production estimated value in 2004 for all river and ocean harvest locations	Achieve maximum fishery access to hatchery production	Table V.5	Commercial harvest revenue $1.53 million and recreational fishing expenditures $1.47 million
Commercial harvest revenue divided by operating costs	Least cost for maximum commercial gillnet fisheries and recreational angler access	Table V.5 and Figure V.3	<1 ratio for commercial harvest revenue >1 ratio for commercial harvest revenue plus recreational expenditures
Smolt releases divided by operating costs	Efficiency trends	Figure V.4	≈ 2 smolt per dollar cost
Incremental NEV and REI for w/o BPA funding alternative	Incremental effects to the nation and region from alternative	Table VI.3	NEV decrease $49 thousand REI decrease $2.2 million
Cost per "harvested" adult for SAFE and comparable hatcheries	Evaluate objective for fishery access	Table VI.7	$31 compared to $82
Cost per impacted fish saved using translation to one percent saved juveniles	Rating among other projects with similar objectives using common outcome indicator	Table VI.9	Spill $600 million Passage improve $95 CHF and CHS Pikeminnow $2.9 CHF and CHS SAFE $0.84 CHF and $0.51 CHS
Gillnet permittee REI	Determine importance of gillnet fisheries' participation to local economy	Table VI.5	Gillnet salmon $3.0 Other West Coast $5.3 Alaska $3.7 Total local $12.0 million personal income Jobs 441
	Determine importance of gillnet fisheries' participation to regional economy	Table VI.5	Gillnet salmon $5.1 Other West Coast $7.8 Alaska $7.8 Total regional $20.6 million personal income
Ocean, estuary, and mainstem (below Bonneville Dam) recreational salmon fishing REI	Show user group regional economic effects for all lower Columbia River recreational fishing	Table VI.6	Total regional $21.0 million personal income
Astoria/Ilwaco area overall fishing industry	Determine gillnet sector relationship to local fishing industry	Table IV.4	Gillnet salmon 7% of harvest revenues in 2004 of which SAFE production 33%

Source: Study.

Figure VII.1
Relationship Between SAR and Pacific Decadal
Oscillation Index SAFE System Spring Chinook Releases



Notes: 1. CHS brood years are 1988-2000. PDO is 12 month index.
Source: North et al. (2006) and Mantua (1997).

It is of interest to show the sensitivity of SAFE system economic measurements related to a range of SAR's. Such information can be useful for judging the Project feasibility in a longer planning horizon than what might be shown in the snapshot conditions used in the economic analysis. Sponsors can decide if economic outcomes during high risk years (positive PDO index years) are sufficient to justify waiting for the benefits during low risk years (negative PDO index years). While sufficient and reliable information is not yet available, future operational planning could even ramp-up or ramp-down production in anticipation of ocean survival.

The economic results sensitivity analysis is shown in Table VII.2. The SAR extremes during the brood years selected to develop the average SAR used in the economic analysis are shown as low and high in the table. For example, the SAFE production commercial harvest revenue varies by a factor of 10 for the SAR range.

Risk in a production system is the probability of an undesirable outcome. SAFE sponsors have investigated and experimented with a number of remedies to improve smolt survival during rearing and acclimation and provide best conditions for out-migration. However, this sensitivity analysis shows a very high variability for production factors related to environmental conditions.

Table VII.2
Economic Result Sensitivity to SAR Range

Measure	Indicator	SAR Range Average	Low	High
SAFE production estimated value in 2004 for all river and ocean locations	Commercial harvest revenue ($000)	$1,528	$35	$3,624
	Recreational fishing expenditures ($000)	$1,465	$34	$3,473
Incremental NEV and REI for w/o BPA funding alternative	NEV change ($000)	$49	-$1,651	$2,309
	REI change ($000)	$2,234	-$446	$5,760
Cost per “harvested" adult across all stocks	Total production	$31	$1,406	$13

Notes: 1. SAR range from Table III.2. It is assumed for the sensitivity analysis that SAR lows and highs occur in the same year for all stocks.
Source: Study.

C. Economic and Fiscal Effects Summary

1. Relationship to Local Economy

The gillnet salmon fishery represents a small but significant component of the area's overall fishing industry. Previous chapters have described its harvest revenue compared to the total fishing industry harvest revenue for the Astoria/Ilwaco area to be seven percent (Table IV.4). Its relative contribution to the total local economy can also be determined.[1] A common measurement for personal income generated can be used to show the relative contribution. A following section in this report shows the share of gillnet salmon fishery generated personal income at the local level is 0.3 percent of net earnings, and net earnings is 58 percent of total personal income in Clatsop and Pacific counties (Table VII.4). As previously mentioned, it can be argued that the gillnet fishery share does not account for other economic activity related and associated with it. This totals to $12.0 million personal income in the local area for the gillnet salmon fishery, other gillnet vessel fisheries, other gillnet permittee vessel West Coast landings, and Alaska fishery participation. This raises the share to about one percent of the two counties' net earnings. The Study didn't estimate the impacts of other activity, such as those by visitors drawn to fishing industry attractions, special fishery management and enforcement centers, fish resource education and research institutions, etc. These economic activity generators bring new money into communities and their impact can be considerable.

2. Economic Substitution Effects

The modeling for the gillnet fishery economic contributions has sorted out whether new money is being brought into the local area. Modeling results were itemized for being at the regional level (Washington and Oregon state economy) or at the local level (Astoria/Ilwaco area). There

1. The REI for the total fishing industry in Clatsop County is $101.2 million which is 18.0 percent of the County's net earnings and 10.9 percent of total personal income in 2003 (TRG March 2006). There are no recent studies available to show similar statistics for Pacific County.

Table VII.3
Regional Economic Impact Summary by Economic Contribution Dependency in 2004

Economic Activity	Dependency Categories			
	Allied	Related	Associated	Other
Gillnet fishery	5.1			
Other gillnet permittee fisheries				
Gillnet vessel		1.7		
Gillnet permittee other vessel		6.1		
Other permittee family income				
Fisheries		7.8	NC	
Non-fisheries			NC	
SAFE Program				
Commercial	2.3			
Recreational	1.1			
Other			NC	
Recreational angling				
Ocean				3.0
Estuary				3.4
River				14.6

Notes: 1. Amounts are personal income in millions of 2004 dollars. "NC" means not calculated.
2. Economic contribution dependency are categories for degrees of substitution effects. The category for "allied" is directly the result of gillnet permittee economic activity and would go away without their participation. The category for "related" may have some likelihood for being generated anyway. The category for "associated" is even more likely to be substituted.
3. An example of "other economic activity" would be visitors drawn to the local area because of the fishing industry.
4. Angler residency information was not available, therefore recreational economic contribution is not categorized for having local substitution effects.

Source: Study.

is another economic effect to consider when judging the real dependency of the economic activity on gillnet fishery permittees. In the current Study we call this the "substitution effect." This effect can be classified into three categories: "allied" (solely attributable to gillnet permit holder participation), "related" (highly likely not to have substitution), and "associated" (having lower connection to permit holder participation). Gillnet fishery economic impacts are allied in Table VII.3 when they are inclusive of harvesting and processing gillnet caught fish. The economic effects from other fisheries income are categorized as related. This includes West Coast and Alaska fisheries. The associated economic activity would include other family members working in fisheries or non-fisheries occupations. More levels of economic effects can be attributed to the gillnet fishery, but they have not been quantitatively analyzed and are only shown as "NC" on the table. For example, visitors to the Astoria and Ilwaco area might be attracted to working waterfronts and other fishing industry related attractions such as museums.

Recreational angling economic activity is not categorized in Table VII.3 because trip expenditure estimates were not available for resident/non-resident participants. Economists generally assume that resident anglers would spend an equal amount on another recreational experience if a fishing trip did not occur.

Table VII.4
Gillnet Fishery Other Economic and Fiscal Impact Measures in 2004

Item	Measure	Amount	Amount ($000)	Share
A.	Astoria/Ilwaco harvest revenue and share			
	Gillnet salmon fishery		3,374	6.7%
	Other ocean and river fisheries		47,354	93.3%
	Total		50,728	100.0%
	Share of gillnet salmon fishery attributable to SAFE production	33%		
B.	Economic impacts and share			
	Gillnet salmon fishery local personal income		3,002	
	Gillnet permittee all fisheries local personal income		11,983	
C.	Size of local economy		3,393	
	Clatsop and Pacific net earnings		874,897	
	Clatsop and Pacific total personal income		1,511,541	
D.	Employment effects			
	Clatsop and Pacific employment (includes wage/salary and proprietorship, full and part time)	32,209		
	Clatsop and Pacific net earnings per employment	27,163		
	Gillnet permittee all fisheries contributed employment	441		
E.	Fiscal impacts			
	Clatsop and Pacific assessed value ($000,000)	5,348		
	County district property taxes in Clatsop and Pacific counties		8,595	
	Weighted county district tax rate (per $000)	1.6072		
	Ratio of assessed value to personal income	3.54		
	Gillnet salmon fishery asset valuation /1		17,278	
	Gillnet salmon fishery asset value subject to property valuation		8,639	
	County district property taxes attributed to gillnet industry asset valuations	13,885		
	Assessed value attributable to gillnet salmon fishery personal income		10,620	
	County district property taxes attributed to gillnet salmon fishery economic contributions	17,068		
	County district property taxes attributed to gillnet salmon fishery asset value plus gillnet salmon fishery economic contributions	30,953		
	SAFE production related to gillnet industry's valuation and county district taxes	10,163		

Notes: 1. Gillnet salmon fishery asset value calculated using present value method for 50% of 2004 harvest revenues annualized over 15 years with 5.2% discount rate. Tangible asset value subject to property valuation is probably half of the total asset value.

Source: Assessed property value and district tax rates provided by Clatsop County Assessor's Office and Pacific County Assessor's Office. Personal income is from U.S. Bureau of Economic Analysis (BEA). Gillnet salmon fishery asset valuation methods described in TRG (1994).

3. Other Economic Activity Measurement Units

This Study used total personal income to measure economic activity. While personal income is a useful unit for comparisons to other fishing user group impacts that affect the economy through different dollar flows, there are other measurement units, such as employment numbers, that can be used. Personal income is added to households as a derivation of the net earnings. This component of personal income includes wages, salaries, and proprietorship income. To measure economic effects, the simple ratio of employment to net earnings can be used. (If employment position counts are to be calculated using an average annual wage and salary levels, then the proprietorship income must first be accounted for in the generated net earnings estimate.) Using BEA county level data, the estimated personal income translates to 441 full and part time employment positions in the local economy (Table VII.4).[1] Even other economic activity measurements derived from this Study's modeling can be made. Gross business output and gross value added (gross output less intermediate goods used up in production) for the gillnet fishery can be translated from modeling results. It is left to future research prompted by analyst interest to make these economic calculations.

4. Fiscal Impact Measurement Units

Fiscal impact measurement units can be approximated with the assumption that there are causal relationships to the level of personal income. It might be argued that current levels of countywide total property assessed value are being maintained by economic activity.[2] Then district tax rates based on property value can be used to show the proportion of taxes being contributed by the fishing industry sector. The gillnet fishing industry's general property and personal property valuation subject to taxation would be related to its estimated business asset value plus a share of downstream supporting business and household property valuation. There are many property valuation exemptions that make such an estimate difficult (Washington State Department of Revenue 2000). The harvest participant asset value has been estimated to be between 36 percent and 100 percent of expected future harvest revenues reduced to present value using a discount rate and 15 year term (TRG 2004). Tangible asset value subject to property valuation is probably half of the total asset value. The downstream estimates would include valuation of other fishing industry participants (processors and ancillary businesses such as moorage providers, fishing gear businesses, etc.) and the share of valuation attributed to the general economy measured by the multiplier effect. The downstream fiscal impacts will be assumed to be the share of total assessed value related to economic activity measured by personal income. Table VII.4 factors were used to itemize an approximation of county property taxes associated with the gillnet fishery. Using the harvest revenue share in recent years, $10,163 of the taxes could be attributable to the SAFE program in Clatsop and Pacific counties.

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1. Annual employment data by industry and occupation is readily available at the county level. However, industry sector definitions and the nature of payments-to-labor preclude its use for defining the fishing industry. Crewman and skippers are paid as contractors and usually receive shares of harvest revenues for payments. Owners operate vessels as businesses, and receive payments as net income after revenues and fishing expenditures are accounted. Seafood processor workers are sometimes contract labor rather than holding employment positions. The Oregon Employment Department (October 2005) describes other factors and suggest other ways to estimate fishing industry employment.
2. This will probably generate a higher local ratio of assessed value to economic activity than would a national ratio because of higher proportion for industrial land and buildings in Clatsop and Pacific counties.

A caution is that the above estimates are the average fiscal impacts. A much more thorough analysis would be necessary to show marginal fiscal impacts for the purpose of evaluating changes. A change from industrial development can include costs (like roads, schools, and other public services) as well as adding to local property tax bases (University of Nevada Economic Development Center 1996).

D. Other Gillnet Fishery Economic Analysis Studies

This Study provided an opportunity to investigate gillnet fishery participant economics. New cost-earning information was acquired or confirmed for harvesters and primary processors. Modeling refinements were developed to show the participants' impacts to the local as well as regional economies. It is of interest to show how investigation results compare to other economic modeling efforts.

There are two other commercial and recreational fishing REI estimates made for the lower Columbia River salmon fishery on a regular basis. Previous SAFE annual completion reports contained estimates and a special briefing report was completed by Carter (2002). The segment attributable to SAFE production is included in those descriptions. In addition, the Pacific Fishery Management Council (PFMC) annually provides REI modeling results for the Columbia River non-Indian salmon allocations (PFMC 2006). The comparison of these two estimates to Study results is shown in Table VII.5. The other estimates have their own unique methodological approaches, modeling assumptions, and baseline data. Carter (2002) uses static REI per fish weight values. Recent influences of price increases on harvest values would not be reflected in the methods. PFMC (2006) similarly uses weight based factors. Both estimates

Table VII.5
Comparison of Other Regional Economic Modeling Results

			SAFE Production			Salmon Fishery		
							Recreational	
Author	Year	Dollars	Commercial	Recreational	Total	Commercial	Estuary	River
Study	2004	2004	$2.3	$1.1	$3.4	$5.1	$3.4	$14.6
Carter	2002	2001	$1.7	$0.8	$2.5	--	--	--
PFMC	2002	2005	--	--	--	$6.4	$3.2	--
PFMC	2004	2005	--	--	--	$7.4	$2.5	--

Notes:
1. REI estimates are personal income in millions generated to the regional economy.
2. Economic contribution from SAFE production includes off-channel and mainstem river, and ocean fisheries as shown on Table VI.2. SAFE production total does not include hatchery surplus or egg sale economic impacts for SAFE broodstock programs.
3. Gillnet salmon fishery is river fisheries. Study commercial REI estimates are from Table VI.5 and Study recreational estimates are from Table VI.6. Study and PFMC estuary is fall fisheries sometimes called the Buoy 10 fishery. Study river is all salmon fisheries upriver from Tongue Point.

Source: Carter (2002) and PFMC (2006).

were derived from the 1998 version of FEAM. The Carter and PFMC factors are not influenced by recent changes in salmon processing for being located at centralized operations. Neither the Carter nor PFMC approaches are refined for local versus regional economies.

The Study model accounts for the different geographic boundaries in two ways. Labor and fish prosecuting expenditure dollar flows are specific to gillnet permittee residency. About 51 percent of permittees do not live in the Astoria/Ilwaco area. Secondly, economy response coefficients that account for the multiplier effects are specific to the two economies. Trade leakages from Clatsop and Pacific counties to the respective state economies mean the response to generated income at the regional level will be larger than at the local level. A Study survey of fishing industry participants was used to develop new vessel and processor budgets. Seafood processor and buyer purchase-to-distribution arrangements were tracked to show where expenditures were being made for the different product forms. The other two studies are done annually, so there are benefits for showing same-assumption trends. It is suggested that the more refined approach used in this one-time Study modeling effort might be useful to the other agencies for reviewing their model's methods and assumptions.

E. Acquiring Production Cost Data

During the interviews of hatchery staff, one hatchery technician remarked, "We all know how to produce smolts ... we also know how to make improvements ... we should be judged on how well we do compared to other similar operations." No hatchery system surveyed had cost accounting for stock level releases allowing such comparisons. The provided budgets had too many joint products. Also, the budgets generally contained only variable costs and expensed capital items. Hatchery operators thought that if major costs were to occur, they would be contained in other headquarter budgets.

A major problem for production cost accounting is that it takes three to five years from the time of smolt release to when an adult Chinook returns. It will take another two years to gather and evaluate the survival rate and catch history of the brood year. It would be important to establish a tracking cost data system linked to the life cycle of the hatchery production.

Hatchery data systems have emerged in recent years as a result of hatchery reform initiatives. An online database is maintained for artificial production information in the Columbia River Basin created during the APRE process.[1] The information was originally collected from agency managers and is available for on-going review and modification. Only total hatchery production cost is a data element. The website hosting the hatchery database also has access to each HGMP. Another hatchery review project is the Puget Sound and Coastal Washington Hatchery Reform

1. APRE hatchery and genetic management plans are available at: http://www.apre.info/APRE/home.jsp. Data and information from the APRE will soon be moved to a new website, http://www.managingforsuccess.us. This new site has updated information taken from recently developed HGMP's, CWT analysis, facilities and operations reports, NPCC subbasin plans, BiOp's, and other sources of information.

Project.[1] The project provides both template and operational tools (e.g. software spreadsheets, population dynamic models) for reviewing hatcheries. The Columbia River Basin Hatchery Reform Project was started in 2006.[2] The USFWS has begun a hatchery review process.[3] The proposed process, among other goals, is to acquire cost information for the purpose of improving cost-effectiveness of hatchery programs (USFWS June 2005).

The IEAB (2002) and CBFWA (2003) have strongly recommended that cost tracking data systems be instituted. A cost tracking data system would include, among other data elements, consistent cost information for:

- Operating costs listed separately for labor, overhead, utilities, fish feed, and other itemizations applicable to production groups. Normal maintenance and upkeep directly associated with each specific location; and joint costs shared across a number of operating locations (e.g. head office and hatchery facility) and planning expenses, research and tag recapture/analysis applicable to production groups.
- Capital costs listed separately to include construction expenses, design and planning, and land acquisition. These costs are to be sub-divided into buildings, equipment, raceways, water supply facilities, and land. Useful life expectancy should be estimated.

It should include survival rates that approximate returns to fisheries, hatcheries, and spawning grounds for any specific production. Table templates in this report's appendix may be useful for beginning discussions about such a cost accounting system.

A robust data system would provide the parameters for making comparisons among hatcheries with the same objectives for fish production. For example, hatchery production for the purpose of fishery augmentation should not be compared to hatchery production with the purpose of research or supplementation. At a policy level, the information can be important for ranking and allocating salmon recovery and habitat mitigation funds.

1. Information about the Puget Sound and Coastal Washington Hatchery Reform Project is at: http://www.lltk.org/HRP.html.
2. The Columbia River Basin Hatchery Reform Project (HRP) is a Congressional 2005 directive to NOAA to replicate the Puget Sound and coastal Washington hatchery reform project in the Columbia River Basin. It is an independent and collaborative review of how harvest and hatcheries - particularly federally-funded hatcheries - are affecting the recovery of salmon and steelhead fisheries listed under the Endangered Species Act. The Project uses an independent scientific panel called the Hatchery Scientific Review Group and an independent third-party facilitator. The Hatchery Reform Coordinating Committee (called The Steering Committee) is the vehicle for cooperative management of the Project. The Committee will help coordinate with the other on-going initiatives in the Basin. Steering Committee members are managers of hatchery programs in the Basin. The Steering Committee ensures that the Columbia River HRP is an effective, collaborative process. More information and project progress statements can be found at http://www.hatcheryreform.us/.
3. The USFWS initiated a series of hatchery reviews in May 2005. It is also patterned on the principals, goals, and procedures from the Puget Sound and Coastal Washington Hatchery Reform Project. See Columbia River Basin Hatchery Review at: http://www.fws.gov/pacific/Fisheries/Hatcheryreview/index.html.

F. Study Conclusions

The report discussed economic analysis results in terms of cost-effectiveness because business feasibility ratios are not always applicable when applied to public investments. For example, government intervention was necessary to build the Columbia River Basin hydropower system that led to development of habitat and fish mitigation programs.[1] This federal intervention is a transfer of wealth through subsidies to the private sector accomplished in ways that complicate accounting of benefits and costs.[2] The result for the narrow case of reviewing the SAFE is that a $2.4 million project helps inject $12.0 million personal income into local area households.

It depends on perspective for whether the project is judged economically feasible. For harvesters that pay 10 percent of their ex-vessel value for the privilege of harvesting SAFE production, the five year average annual return has been about $680 thousand harvest revenue. From the perspective of the electric rate payer, it is costing them $1.6 million out of a $2.4 million project to provide the $680 thousand harvest revenue. The harvesters' perspective is that dams were built for society and society needs to compensate them. Society's perspectives are not so clearly defined, but there are many studies that show continued support for salmon recovery. How much of the recovery benefits should accrue to commercial or other user groups is a matter of policy concern.[3]

The SAFE appears to be a winning solution to several problems. The SAFE system adult salmon return rates are at least similar and sometimes higher due to lower estuary predation and other factors affecting out-going smolt migration mortality. Adult returns to the off-channel net pen locations means commercial and recreational fishing at the release sites will have lower harvest impacts on upriver destined depressed stocks than when fishing at mainstem locations. Fishing on these hatchery origin stocks allows significantly higher harvest rates, since adult returns not needed for broodstock can be 100 percent harvested rather than subject to harvest curtailments due to impacts on depressed stocks in mainstem fishing locations. The higher harvest rates on the returning adults also solves some problems that accompany the usual practice of releasing smolts at upriver hatchery location sites. Too many hatchery produced fish return to these

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1. The MA has historically been the federal funding vehicle to provide for lost fish production through hatchery propagation. The MA annual budget has been in the $15 million to $18 million range. A more recent federal funding program that overlaps the Columbia River Basin is the Pacific Coastal Salmon Recovery Fund established by Congress in 2000. It has provided in the range of $90 million annually to the West Coast states and tribes. BPA funding for the NPCC recommended fish and wildlife programs is from hydropower sales and not federal appropriations. Moreover, BPA responsibilities for mitigation programs are limited by the Northwest Power Act (authorizing legislation for the NPCC), ESA agreements, NOAA biological opinions, and other requirements for the projects it can provide funding (GAO 2004). BPA annual funding for fish and wildlife programs has been in the $140 million range. BPA sales are partially to regions outside the Columbia River Basin, so it is not only Pacific Northwest rate payers that are reimbursing fish and wildlife funded programs.
2. See Appendix D for discussion of externalities usually not included in a benefit and cost analysis.
3. The previously described Columbia River Basin Hatchery Reform Project (see Page VII-9, Footnote 2) is to review all aspects of hatchery operations, including their purpose for fishery augmentation. One of the objectives of the Project is to review whether current harvest levels could be sustained in light of ESA mandates for salmon recovery and the effects of hatchery ecological impacts. See the January 25, 2006 press announcement at: http://www.salmonrecovery/ for more website links to statements about the Reform Project's purpose.

release sites and surpluses (those in excess of what is needed for future generation broods) must be handled and disposed. The value of the hatchery fish caught at the net pen sites is higher because of better fish condition and ready markets compared to public hatchery surpluses. Moreover, a higher value accrues to the fishing industry rather than a lower value to the hatchery sponsors. If there must be augmentation hatchery production, then Study results suggest the SAFE process is a cost-effective method for allowing greater fishery access to the production.

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Appendix A

Contributing Hatchery Production Costs

Contents

Glossary

CHF - Fall Chinook
CHS - Spring Chinook
COH - Coho
SAB - Select Area Bright Fall Chinook (Rogue River egg transfer)
M&E - Monitoring and evaluation performed by WDFW and ODFW personnel
MA - Mitchell Act
CWT - Coded wire tag
R&E - Oregon Watershed Restoration and Enhancement Program
M&S - Materials and supplies
P/S - Personal services
S/S - Supplies and services

I. Detailed Costs Per Released Smolt

						Hatchery Production Costs								
Table	Production Agency	Species	Hatchery	Smolts	Release Site	Capturing and Eying Costs	Labor	Feed	M&S	Other	Marking/ Marking	CWT	Hauling	Subtotal
A	ODFW	CHS	Gnat Creek	450,000	Youngs Bay	0.0250	0.2240	0.0380	0.0260	0.0230	0.0202	0.0035	0.0014	0.3611
B	ODFW	CHS	Gnat Creek	300,000	Blind Slough	0.0250	0.2240	0.0380	0.0260	0.0230	0.0202	0.0035	0.0014	0.3611
C	ODFW	CHS	Gnat Creek	100,000	Tongue Point	0.0250	0.2800	0.0475	0.0325	0.0288	0.0202	0.0083	0.0014	0.4436
D	WDFW	CHS	Grays River	350,000	Deep River	0.0250	0.2050	0.0640	0.0440	0.0770	0.0170	0.0086	0.0060	0.4466
E	ODFW	COH	Cascade	400,000	Youngs Bay	--	0.1140	0.0340	0.0190	0.0240	0.0271	0.0083	0.0130	0.2395
F	ODFW	COH	Cascade/Oxbow	800,000	Youngs Bay	--	0.0790	0.0200	0.0230	0.0090	0.0271	0.0083	0.0130	0.1795
G	ODFW	COH	Cascade	200,000	Tongue Point	--	0.1140	0.0340	0.0190	0.0240	0.0271	0.0083	0.0130	0.2395
H	ODFW	COH	Sandy	300,000	Blind Slough	--	0.2060	0.0350	0.0250	0.0100	--	--	0.0300	0.3060
I	WDFW	COH	Grays River	550,000	Deep River and Grays River	--	0.2050	0.0640	0.0440	0.0770	0.0197	0.0023	0.0060	0.4180
J	ODFW	SAB	S.F. Klaskanine	700,000	S.F. Klaskanine	--	0.0840	0.0150	0.0210	0.0050	0.0310	0.0277	0.0015	0.1852
K	CEDC	SAB	Klaskanine	800,000	Youngs Bay	--	0.0280	0.0050	0.0070	0.0010	0.0310	0.0277	0.0015	0.1012

I. Detailed Costs Per Released Smolt (cont.)

Table	Acclimation Agency	Species	Smolts	Release Site	SAFE Function	SAFE Grow-Out and Acclimation
A	CEDC	CHS	450,000	Youngs Bay	Grow-out and acclimation costs	0.1470
B	CEDC	CHS	300,000	Blind Slough	Grow-out and acclimation costs	0.1470
C	CEDC	CHS	100,000	Tongue Point	Acclimation costs	0.0742
D	WDFW	CHS	350,000	Deep River	Grays River Hatchery budget includes Deep River acclimation, and broodstock costs	--
E	CEDC	COH	400,000	Youngs Bay	Youngs Bay rearing and acclimation	0.1426
F	CEDC	COH	800,000	Youngs Bay	Youngs Bay rearing and acclimation	0.1426
G	CEDC	COH	200,000	Tongue Point	Tongue Point rearing and acclimation	0.1426
H	CEDC	COH	300,000	Blind Slough	Blind Slough acclimation	0.0742
I	WDFW	COH	550,000	Deep River and Grays River	Grays River Hatchery budget includes Deep River acclimation, and broodstock costs	--
J	CEDC	SAB	700,000	S.F. Klaskanine	Broodstock	--
K	CEDC	SAB	800,000	Youngs Bay	Grow-out and acclimation costs	0.2580

II. Itemized Hatchery Cost Estimates

Table: A and B
Hatchery Rearing: Gnat Creek
Species: CHS, 750,000 smolts
Brood and Life Cycle: Captured at Dexter Dam and eyed at Willamette Hatchery; 1st grow-out at Gnat Creek to 25 per pound transferred in October; and, 2nd grow-out and acclima at net pens released at 12 per pound in April
Release Site: 450,000 at Youngs Bay (over-winter and acclimation) and 300,000 at Blind Slough (over-winter and acclimation)
Marking/CWT Rate: 19.2%

		Operation Cost			
		Willamette Hatchery (eyed eggs)		Gnat Creek Hatchery (1st grow-out)	
Cost Category	Released Smolts	Amount	Per Smolt	Amount	Per Smolt
Table A. Gnat Creek - Youngs Bay	450,000				
Propagating					
Labor				$100,800	0.2240
Feed				$17,100	0.0380
M&S				$11,700	0.0260
Other				$10,350	0.0230
Subtotal				$139,950	0.3110
Handling					
Marking				$9,090	0.0250
Marking/CWT				$1,555	0.0180
Hauling smolts				$630	0.0014
Subtotal				$11,275	0.0251
Total		$11,250	0.0250	$151,225	0.3361
Table B. Gnat Creek - Blind Slough	300,000				
Propagating					
Labor				$67,200	0.2240
Feed				$11,400	0.0380
M&S				$7,800	0.0260
Other				$6,900	0.0230
Subtotal				$93,300	0.3110
Handling					
Marking				$6,060	0.0250
Marking/CWT				$1,037	0.0180
Hauling smolts				$420	0.0014
Subtotal				$7,517	0.0251
Total		$7,500	0.0250	$100,817	0.3361

II. Itemized Hatchery Cost Estimates (cont.)

Table: C
Hatchery Rearing: Gnat Creek
Species: CHS, 100,000 smolts
Brood and Life Cycle: In Year 2005, adults captured at Dexter Dam, spawn and eyed at Willamette, grow-out 1st stage Gnat Creek, Nov.-April grow-out 2nd stage 75,000 at Tongue Point and release 25,000 to John Day River. New strategy is to keep at Hatchery through 2nd stage and transfer to Tongue Point for acclimation.
Release Site: 100,000 at Tongue Point (acclimation)
Marking/CWT Rate: 19.2%

		Operation Cost					
		Willamette Hatchery (eyed eggs)		Gnat Creek (1st grow-out)		Gnat Creek (2nd grow-out)	
Cost Category	Released Smolts	Amount	Per Smolt	Amount	Per Smolt	Amount	Per Smolt
Table C. Gnat Creek - Tongue Point	75,000					100,000	
Propagating							
Labor				$16,800	0.2240	$28,000	0.2800
Feed				$2,850	0.0380	$4,750	0.0475
M&S				$1,950	0.0260	$3,250	0.0325
Other				$1,725	0.0230	$2,875	0.0288
Subtotal				$23,325	0.3110	$38,875	0.3888
Handling							
Marking				$1,515	0.0250	$2,020	0.0250
Marking/CWT				$619	0.0430	$826	0.0430
Hauling smolts				$105	0.0014	$140	0.0014
Subtotal				$2,239	0.0299	$2,986	0.0299
Total		$1,875	0.0250	$25,564	0.3409	$41,861	0.4186
Gnat Creek - John Day River	25,000						
Propagating							
Labor				$7,448	0.2979		
Feed				$1,264	0.0505		
M&S				$865	0.0346		
Other				$765	0.0306		
Subtotal				$10,341	0.4136		
Handling							
Marking				$505	0.0250		
Marking/CWT				$206	0.0430		
Hauling smolts				$35	0.0014		
Subtotal				$746	0.0299		
Total		$625	0.0250	$11,087	0.4435		

Notes: 1. Hatchery propagating costs for John Day River releases are estimated based on time to be 33% greater because they are kept at the hatchery until release.
2. Hatchery propagating costs for 2nd grow-out fish are estimated based on time to be 25% greater because they are kept at the hatchery until ready for the acclimation transfer.

II. Itemized Hatchery Cost Estimates (cont.)

Table: D
Hatchery Rearing: Grays River, Lewis/Cowlitz
Species: CHS, 350,000 smolts
Brood and Life Cycle: Lewis and Cowlitz broodstock (about half from each) delivered to Grays River as eyed eggs; 1st stage rearing at Grays River, and 2nd stage rearing/acclimation at Deep River net pens
Release Site: Deep River
Marking/CWT Rate: 19.2%

		Operation Cost			
		Lewis/Cowlitz River Hatchery (eyed eggs)		Grays River Hatchery	
Cost Category	Released Smolts	Amount	Per Smolt	Amount	Per Smolt
Table D. Grays River - Deep River	350,000				
Propagating					
Labor				$71,750	0.2050
Feed				$22,400	0.0640
M&S				$15,400	0.0440
Other				$26,950	0.0770
Subtotal				$136,500	0.3900
Handling					
Marking				$5,939	0.0210
Marking/CWT				$3,024	0.0450
Hauling smolts				$2,100	0.0060
Subtotal				$11,063	0.0316
Total		$8,750	0.0250	$147,563	0.4216

Notes: 1. Eyed egg costs use Willamette Hatchery estimate. Eyed eggs are received in the December/January period. The Grays River Hatchery raises them to October 1 and transfers the production to the net pens at Deep River at 21 per pound. They are held at the net pens until May and released at 10 to 12 per pound.
2. Net pen rearing and acclimation costs for Deep River are included in the hatchery budget. Hatchery costs are estimated to be 66%, while net pen costs are estimated to be 34%.

II. Itemized Hatchery Cost Estimates (cont.)

Table: E, F, and G
Hatchery Rearing: Cascade and Oxbow
Species: COH, 1,425,000 smolts
Brood and Life Cycle: Capture at Bonneville Hatchery, haul to CEDC at 25 to 30 per pound to be held until 10 to 12 per pound
Release Site: 400,000 Cascade plus 825,000 Oxbow at Youngs Bay (over-winter and acclimation), 200,000 at Tongue Point (over-winter and acclimation)
Marking/CWT Rate: 6.4%

		Operation Cost					
		Cascade to CEDC		Cascade to Oxbow		Oxbow to CEDC	
Cost Category	Released Smolts	Amount	Per Smolt	Amount	Per Smolt	Amount	Per Smolt
Table E, F, G. Cascade and Oxbow - 1,425,000 Youngs Bay, Tongue Point							
Propagating							
Labor		$68,400	0.1140	$22,400	0.0280	$40,800	0.0510
Feed		$20,400	0.0340	$6,400	0.0080	$9,600	0.0120
M&S		$11,400	0.0190	$4,000	0.0050	$14,400	0.0180
Other		$14,400	0.0240	$4,800	0.0060	$2,400	0.0030
Subtotal		$114,600	0.1910	$37,600	0.0470	$67,200	0.0840
Handling							
Marking		$16,286	0.0290	$21,715	0.0290		
Marking/CWT		$4,992	0.1300	$6,656	0.1300		
Hauling smolts		$7,800	0.0130			$10,400	0.0130
Subtotal		$29,078	0.0485	$28,371	0.0355	$10,400	0.0130
Total		$143,678	0.2395	$65,971	0.0825	$77,600	0.0970

Notes:
1. Capture and egg costs at Bonneville Hatchery assumed inkind or are included in Cascade Hatchery budget.
2. In the revised budgets of 2006, ODFW has allocated $18,612 from their M&E budget to cover marking, marking/CWT, and trucking at the Cascade/Oxbow hatcheries for SAFE programs. This adds $0.013 per smolt for trucking (before indirect costs). For marking/CWT, this adds $0.130 per smolt and fin-clipped only at $0.029 per smolt.
3. Table F (400,000 to Youngs Bay) and H (200,000 to Tongue Point) is "Cascade to CEDC" column, and Table G (825,000 to Youngs Bay) is the sum of "Cascade to Oxbow" and "Oxbow" columns.

II. Itemized Hatchery Cost Estimates (cont.)

Table: H
Hatchery Rearing: Sandy
Species: COH, 300,000 smolts
Brood and Life Cycle: Post-acclimation release weight is 12 to 15 per pound
Release Site: 300,000 at Blind Slough (acclimation)
Marking/CWT Rate: 6.4%

Cost Category	Released Smolts	Operation Cost Sandy River Hatchery Amount	Per Smolt
Table H. Sandy - Blind Slough	300,000		
Propagating			
Labor		$61,800	0.2060
Feed		$10,500	0.0350
M&S		$7,500	0.0250
Other		$3,000	0.0100
Subtotal		$82,800	0.2760
Handling			
Marking			
Marking/CWT			
Hauling smolts		$9,000	0.0300
Subtotal		$9,000	0.0300
Total		$91,800	0.3060

Notes: 1. Marking and CWT costs are not itemized because they are either included in the states' M&E budgets or are incorporated into the hatchery budget's other cost items.

II. Itemized Hatchery Cost Estimates (cont.)

Table: I
Hatchery Rearing: Grays River
Species: COH, 550,000 smolts
Brood and Life Cycle: Broodstock maintained at hatchery; 2nd stage grow-out at net pens for those releases
Release Site: 400,000 at Deep River (net pens) and 150,000 broodstock release at hatchery
Marking/CWT Rate: 6.4%

Cost Category	Released Smolts	Operation Cost Grays River Hatchery Amount	Per Smolt
Table I. Grays River - Deep River	550,000		
Propagating			
Labor and technical services		$112,750	0.2050
Feed		$35,200	0.0640
M&S		$24,200	0.0440
Other		$42,350	0.0770
Subtotal		$214,500	0.3900
Handling			
Marking		$10,811	0.0210
Marking/CWT		$1,267	0.0360
Hauling smolts		$3,300	0.0060
Subtotal		$15,378	0.0280
Total		$229,878	0.4180

Notes: 1. Pen rearing and acclimation costs for Deep River net pens are included in the hatchery budget. Hatchery costs are estimated to be 66%, while net pen costs are estimated to be 34%.

II. Itemized Hatchery Cost Estimates (cont.)

Table: J and K
Hatchery Rearing: New strategy is for rearing at Klaskanine and S.F. Klaskanine
Species: SAB, 1,500,000 smolts
Brood and Life Cycle: In Year 2005, 700,000 raised at Big Creek and released at S.F. Klaskanine (20 per pound) for broodstock; 800,000 reared at Big Creek and over-wintered and acclimated at Youngs Bay. New strategy is to rear 1,500,000 at S.F. Klaskanine and release 700,000 for broodstock, and take 800,000 at 1,000 per pound in February to Youngs Bay net pen for release in July at 20 per pound
Release Site: New strategy 700,000 broodstock release at S.F. Klaskanine and 800,000 at Youngs Bay
Marking/CWT Rate: 14%

		Operation Cost			
		South Fork Klaskanine Hatchery (broodstock)		Klaskanine Hatchery (1st grow-out)	
Cost Category	Released Smolts	Amount	Per Smolt	Amount	Per Smolt
Table J, K. Klaskanine, S.F.					
Klaskanine - Youngs Bay	1,500,000				
Propagating					
Labor		$58,800	0.0840	$22,400	0.0280
Feed		$10,500	0.0150	$4,000	0.0050
M&S		$14,700	0.0210	$5,600	0.0070
Other		$3,500	0.0050	$800	0.0010
Subtotal		$87,500	0.1250	$32,800	0.0410
Handling					
Marking		$21,672	0.0360	$24,768	0.0360
Marking/CWT		$19,404	0.1980	$22,176	0.1980
Hauling smolts		$1,050	0.0015	$1,200	0.0015
Subtotal		$42,126	0.0602	$48,144	0.0602
Total		$129,626	0.1852	$80,944	0.1012

Notes: 1. Table shows new smolt release strategy, but costs per smolt based on Big Creek Hatchery model in 2005.

III. Hatchery Cost Estimate Notes

A. Spring Chinook Costs Notes

1. Gnat Creek Hatchery

The Gnat Creek Hatchery budget was allocated for SAFE fish based on the following model:

- The ODFW Gnat Creek Hatchery produces 850,000 smolts to distribute to the SAFE Project. The fish rearing annual budget is $382,354.

- Because they keep the fish longer for John Day River releases, the Gnat Creek Hatchery costs were increased by 33% to include the added time at the hatchery for SAFE fish.

- CHS adults are captured at Dexter Dam in the Willamette Basin. The adults are spawned and eyed by the Willamette Hatchery. According to the hatchery manager, the eyeing costs are about $0.025 per eyed egg (50% labor, 25% chemicals/feed, 12.5% indirect, and 12.5% other costs).

2. Grays River, Washington Hatchery

The Grays River Hatchery budget was allocated to SAFE fish as follows:

- Eyed eggs came from Cowlitz/Lewis hatcheries. Cost estimates are based on similar Willamette Hatchery estimates.

III. Hatchery Cost Estimate Notes (cont.)

B. Coho Costs Notes

1. Grays River Hatchery

a. The Grays River Hatchery budget was allocated for SAFE fish as follows.

Total CHS and COH budget is $361,392 (after correction for steelhead production). On a per smolt basis (total production is 350,000 CHS and 550,000 COH for a total of 900,000 smolts), this is $0.402 per smolt. CHS are released at 10 per pound while COH at approximately 12 per pound. In total, CHS are held for one year in the hatchery and about 4 to 5 months in net pens. COH are held for 11 to 12 months in the hatchery and about 6 months in net pens. Costs are therefore evenly distributed between COH and CHS (based on weight and time considerations). Hatchery costs are estimated to be 66%, while net pen costs are 34% (based on time in each facility). The net pen operation is covered by Grays River Hatchery staff, so is included in the hatchery budget.

Per smolt CHS and COH costs are based on percentages of total costs.

		$0.402
Labor	51.0%	0.205
Feed and additives	15.9%	0.064
Maintenance and supplies	10.9%	0.044
Other	1.7%	0.007
Transportation	1.5%	0.006
Total hatchery and net pen variable costs		0.326
Indirect costs	18.9%	0.076

Marking and CWT (Included in state M&E budgets: mark per smolt cost is $0.021, and CWT cost is $0.024 for CHS and $0.015 for COH.)

b. Hauling smolts is estimated $600 per 1,500 pounds. Hauling costs are only included when there was a budget for that item. When hatchery budgets did not include hauling costs, they are assumed to be inkind from state's general hatchery budget.

2. Cascade Hatchery

Cascade Hatchery budget for SAFE fish breakdown was allocated by poundage:

- SAFE direct transfers 600,000 smolts ÷ 25 to 30 smolts per pound ≈ 24,000 pounds.
- Cascade/Oxbow/CEDC transfers 825,000 ÷ 100 per pound = 8,250 pounds.
- Therefore ¾ costs = CEDC transfers and ¼ costs = Cascade/Oxbow/SAFE transfers.
- Mass marking attributed ($41,505) all to Cascade and CWT is contract services at Cascade.

3. Sandy Hatchery

Sandy Hatchery SAFE budget breakdown is as follows:

- The Sandy SAFE is part of a total of 1,000,000 smolts and some steelhead production.
- Removed 10% of the budget for steelhead projection and allocated a total of $373,485 to COH smolt production.
- The Sandy Hatchery production was then estimated on a per smolt cost.
- No marking or CWT costs were allocated.

III. Hatchery Cost Estimate Notes (cont.)

C. Fall Chinook Costs Notes

CHF release strategy using SAB broodstock (transported Rogue River CHF) are in transition. For about 10 years, Big Creek has been the supplier of SAB smolts for the SAFE program. In this program, Big Creek supplied up to 1.5 million smolts. A portion of these (700,000) were collected at Klaskanine Hatchery in the fall (August to December), eyed and raised to 60 to the pound at the Big Creek Hatchery until May. They were then transferred back to the Klaskanine Hatchery and reared there until July-August. They were then released at 20 to 25 per pound in weekly stages (200,000; 250,000; 250,000). At the same time, the Big Creek Hatchery spawned, eyed, and raised 700,000 to 800,000 pre-smolts (1,000 per pound) until February. These were then placed in CEDC net pens in Youngs Bay to be fed and released in mid July (at 20 per pound).

ODFW is planning to reprogram the Klaskanine Hatchery and transfer the SAB program to the CEDC. In 2005-2006 the broodstock of 700,000 pre-smolts from Big Creek Hatchery were transferred in May to the CEDC S.F. Klaskanine Hatchery. They were raised to 25 per pound, and released at the Hatchery as future broodstock. The CEDC will initiate another 800,000 SAB smolt production for release at Youngs Bay net pens (ponded at pre-smolts 1,000 per pound) and released in mid July (at 20 per pound). The planned program is to replace the 1.5 million smolts annually released in the past using Big Creek Hatchery involvement.

The reprogrammed Klaskanine Hatchery will also produce COH in the future. Plans are to use Big Creek broodstock eyed eggs to be reared to 60 per pound at Klaskanine, then transferred and reared to 20 per pound at Clackamas Hatchery, then transferred to the Klaskanine Hatchery and reared to 12 per pound, and then released at Klaskanine Hatchery. The COH program is a future plan, so is not included in these cost tabulations.

There are no actual budgets available for the proposed program, therefore the existing SAB Big Creek Hatchery budget is used as a model to estimate actual costs per smolt.

	Release or		Weight		Time	
Total Annual Production at Big Creek Hatchery	Transfer at	Rear	Pounds	Share	Months	Share
Tule CHF 5,700,000 smolts	80/pound	6 months	71,250	36%	34,200,000	59%
COH 535,000 smolts	12/pound	18 months	44,383	23%	9,630,000	17%
Winter Steelhead 160,000	7/pound	18 months	22,857	12%	2,880,000	5%
CEDC SAB 700,000 broodstock	20/pound	12 months	58,333	30%	8,400,000	14%
CEDC SAB pre-smolts for Youngs Bay 800,000	1,600/pound	4 months	500	0%	3,200,000	5%
Total			197,323			

Total Budget is $758,740 and the SAB program is 30% by weight and 19% by time. By time, this is equal to $144,161; this is close to the actual budget of $141,480 which was allocated to Big Creek. Using 14% and 5% as a time base, the costs would be apportioned as listed below.

	Amount	Share		Cost Per Smolt	
				20/pound (14% time)	1600/pound (5% time)
P/S	426,268	56%	Labor	0.084 /1	0.028
S/S	102,580	14%	M&S	0.021	0.007
Contracts	8,000	1%	Other	0.002	0.001
Non Exp	12,000	2%	Other	0.003	0.001
Fish Food	79,266	10%	Feed	0.015	0.005
Indirect	130,626	17%	Indirect	0.025	0.008
Total Big Creek Budget	758,740	100%		0.150	0.050
			Marking and CWT costs	0.041	0.041
			Hauling	0.0015	0.0015

Notes: 1. SAB at 5% e.g. $758,740 x 0.14 / 700,000 = 0.152 x 0.56 = 0.084.

2. The marking costs have been added to reflect the standard costs of $36 per 1,000 for finclipping (or $0.036 per smolt) and $162 per 1,000 for CWT ($0.162 per smolt). Only about 5% receive CWT. Total marking and CWT cost is estimated to be $0.041. Hauling is also charged at 0.0015.

III. Hatchery Cost Estimate Notes (cont.)

D. CEDC Hatchery Cost Notes

The CEDC Project is both a hatchery and net pen acclimation operation. The hatchery is located on the South Fork Klaskanine River which is a tributary to Youngs River. The hatchery operation was started in 1977 as a fishery enhancement program for the mainstem Columbia River gillnet fishery. Clatsop County owns and operates the hatchery that annually had released up to eight million smolts. The hatchery is managed and maintained by a combination of County staff and industry volunteers. In the past, a majority of stocks released at the hatchery were CHF. With the encouraging returns of net pen reared COH, the release mix has changed over the years. In 1993, there were no Chinook and 4.2 million COH smolts released, of which 82 percent were acclimated and released from net pens. CHS has also been reared and released at the hatchery (1992-1995 and 2002-2004 brood years). It is planned that the hatchery will continue final rearing and release of the early run COH. The CEDC hatchery has capture facilities for returning spawners, but most years' eggs or fingerlings are hauled from other ODFW hatcheries.

The ODFW also operated the Klaskanine Hatchery on the North Fork Klaskanine River. This hatchery typically has released about one million COH smolts. COH escapement past the terminal fishery on Youngs Bay and River had been adequate to supply COH spawners to the ODFW hatchery.

The ODFW using the Big Creek Hatchery complex, prior to 1990, released four to seven million chum and tule CHF. These releases have been terminated in favor of the more promising net pen acclimation program using early COH and select area bright (Rogue River egg transfer) CHF (SAB). The Big Creek Hatchery is divorcing itself from SAB production and transferring the broodstock to the CEDC Hatchery. It is envisioned the CEDC Hatchery will maintain releases in the 700,000 range at the Hatchery. The Klaskanine Hatchery will be reprogrammed to raise an additional 800,000 SAB at Youngs Bay net pens. It is planned in future years the Klaskanine Hatchery will also return to releasing in the range of 750,000 COH using rearing combinations with other ODFW hatcheries. The CEDC is seeking Oregon Legislature recognition for the reprogramming and continued funding support.

The representative annual CEDC budget is as follows:

BPA (approximately)	370,000
Oregon R&E (for SAB)	45,000
Voluntary assessment fee	70,000
Oregon Legislature (for S.F. Klaskanine Hatchery)	130,000
Oregon other (marking)	15,000
	$630,000

About 40% of this budget is for the net pen operation, while 60% is allocated to the hatchery operations. CEDC cost categories can be considered as follows:

Labor	66.0%
Feed	15.0%
M&S	12.0%
Other	0.0%
Marking	1.0%
CWT	0.0%
Hauling	2.0%
County indirect	4.0%

III. Hatchery Cost Estimate Notes (cont.)

D. CEDC Hatchery Cost Notes (cont.)

1. Smolts released at the Oregon side are:

	Tongue Point	Blind Slough	Youngs Bay	
CHS	100,000	300,000	450,000	
COH	200,000	300,000	1,200,000	
SAB			800,000	
	300,000	600,000	2,450,000	
Acclimated				3,350,000
Broodstock				700,000

2. Grow-out and acclimation costs per smolt are:

CHS	Grow-out and acclimation	0.1470
CHS	Acclimation	0.0742
COH	Grow-out and acclimation	0.1426
COH	Acclimation	0.0742
SAB	Grow-out and acclimation	0.2580

E. State Management Costs

The monitoring and evaluation (M&E) costs for ODFW in 2005-2006 was budgeted $209,255 and the WDFW costs were $308,149. Each state's responsibilities contribute to the total SAFE management and one state's budget may contain an item that provides information for both states' programs. For example, the WDFW hired an environmental specialist and incurred expenses for water quality monitoring at all release sites. The ODFW M&E budget was reduced in mid-year to $207,166. Of this amount, $81,454 is to be related to fish production, of which $62,843 is for SAB's (6 month hatchery tech and salary + fringe + standby, and SAB CWT and marking and overhead), and $18,611 is for COH production (Cascade Hatchery CWT and trucking and overhead). The WDFW current budget has also been decreased to $177,585 due in part to elimination of the water quality monitoring. A portion of this budget ($35,700) covers marking and CWT costs at Grays River Hatchery. The two states' hatchery production costs are moved to the itemized hatchery cost accounting.

The decision was made to use the current budgets as an indicator of future requirements with revisions when they were explained. The two states' past budgets totaled $517,404 for a program that produced about 5 million smolts at four release sites. The new management budgets for both states total about $267,000 after adjusting for hatchery production costs. The WDFW manages the Grays River Hatchery complex that produces about 900,000 smolts at one release site, and the ODFW manages four hatchery complexes contributing 4.1 million smolts to three release sites. The budgets total about 55% for labor, 23% for service and supplies, and 23% overhead (indirect charge from central office of Olympia or Salem).

The following are the per state and per smolt M&E costs:

ODFW: ($207,166 - $81,454) / (4,050,000) =	$0.031
WDFW: ($177,585 - $35,700) / (900,000) =	$0.158

The following are the per state adjusted M&E budgets:

ODFW: ($207,166 - $81,454) =	$125,712
WDFW: ($177,585 - $35,700) =	$141,885

III. Hatchery Cost Estimate Notes (cont.)

F. Hatchery Indirect Costs

The indirect charge from central office at Olympia or Salem for federal grants in 2006 is 28.79% for WDFW and 34.16% for ODFW. In regards to the rate being applied to funds supporting hatchery production, the budget for feed, contract services (such as for marking), and capital equipment is excepted from the rate. This means across the contributing hatcheries, the rate becomes 18.8% of the WDFW hatchery complex costs and 22.5% of the ODFW hatchery complex costs.

Appendix B

Gillnet Fleet and Processor Characteristics

GILLNET FLEET AND PROCESSOR CHARACTERISTICS

A. Participant Survey

Ex-vessel revenues received from participating in a fishery are not the best indicator for determining a fishery's value. A better measure is the return received to labor (crewman, skippers, and owners in the case of the harvesting sector) for the revenue received from the fishery. However, data on fishery prosecuting costs and owner earnings are not generally tabulated. Ex-vessel value represents the cost of obtaining fish for processors. It does not include considerations for a fish dealer's handling, preparation, packaging, storing, and marketing product forms. Information on revenues earned from processing/marketing these landings is also not generally available. In addition, some processors may market fish imported from other states or countries; the revenues and costs associated with these imported products are also not serially compiled in a database.

There have been special studies from time-to-time to survey participants for this information. For example, the Pacific Fishery Management Council (PFMC) economic impact modeling used in fishery management plan (FMP) development for species under their jurisdiction uses vessel budgets for several salmon vessel types to determine participant operating costs (Davis 2003). The vessel types include one category for salmon netter. To provide better resolution of vessel types and processors participating in the gillnet fishery, a special survey was undertaken for this Study. The special survey was designed to build on a previous more thorough survey completed in 1994 and described in The Research Group (1994).

The previous survey used a sampling approach of the universe for processor or buying stations and vessel permittees. The surveys were administered as self-directed, mail-out questionnaires to businesses purchasing gillnet fishery harvests and vessel owners. Information from businesses was requested about:

1. Plant management (name, owner).
2. Plant capacity and utilization from 1986 through 1993 and what was expected in 1994 (overall through-put capacity, salmon through-put capacity, actual total salmon deliveries, actual Columbia River salmon deliveries).
3. Plant typical income statement (sales, variable and fixed operating expenses, and net income).
4. Yield by Columbia River gillnet caught species.
5. Labor and other variable costs by Columbia River gillnet caught species.
6. Asset value using replacement cost of equipment and intangible investments used to process salmon.
7. Attitudes towards potential federal government buyout and owner support programs.
8. General comments.

A list of businesses holding valid state permits for processing and reselling fish was procured from Washington and Oregon. This list was augmented by comparing to past and current members of the organization. For the previous survey, a total of 39 business names were identified and 24 of the businesses known to be active out of the 39 were mailed a questionnaire.

The survey of vessel owners was for all licensees holding valid gillnet permits with Oregon or Washington. Information requested included:

1. Demographic information about the vessel owner (residence zip code, owner age, owner experience in fishing industry, number of generations family has been in the fishing industry, and source of household income).
2. Vessel characteristics (documented name, USCG identification number, length, power).
3. Delivery ports between 1986 and 1990 study time period.
4. Amounts of Columbia River gillnet deliveries during the study time period (high, low, average).
5. Management of vessel (crew number, hired skipper).
6. Vessel income statement (operating expenses, return to owner, etc.).
7. Asset value using replacement cost and purchase price /date (vessel, trailer, permit, drift rights, gear, moorage docks, and other equipment/buildings/trucks).
8. Attitudes towards potential federal government buyout and owner support programs.
9. General comments.

For the previous survey, the list of 867 permittees was procured from the two states and all received a questionnaire. It was necessary to do follow-up personal interviews with the most active processing businesses to get responses. For vessels, there was a 34 percent response rate based on permit counts. Summing the average annual receipts received by vessel responders and comparing the sum to the average total ex-vessel revenue received by the industry showed the responders landed 49 percent of the deliveries. The higher response based on landings is consistent with survey theory that those active and interested in the survey purpose will make the effort to respond. This means that survey characteristics expressed as owner or permit averages will over-estimate the characteristic. It also meant that attitudes and comments may over-report the needs and desires of all industry participants.

The special survey for this Study used a key informant approach. Twenty five vessel owners and 12 processor and buying station representatives were asked to participate. They were provided an updated questionnaire that included survey results from the previous study as an attachment. (The questionnaires are shown at the end of this appendix.) The vessel participants were selected to be a mix of mainstem and Select Area Fishing Evaluation Project (SAFE) fishers and to be more or less active harvesters. The processors were selected to represent major buyers as well as independent buying stations and vessel owners who sell directly to the public. The survey package was mailed to the key informants with a written request for a personal interview. Follow-up phone calls were made to schedule the interviews. Nine of the vessel owners and 11 of the processing businesses completed the interviews.

The updated information to the original survey results was used to determine a more refined vessel and processor business categorization than found in the PFMC modeling. Summary results explained below are for the five harvester business strategies and four processor categories that were selected using expert judgment to represent the fishery participants.

B. Harvester Business Strategy Profiles

Consideration for determining business strategy categories was based on gillnet vessel landing amounts. Table B.1 is an explanation of how survey results apply to each business strategy. Table B.2 shows the vessel counts and share of fishery revenues for the five business strategy assignments. Table B.3 shows representative budgets for the business strategies and a weighted average composite budget.

Table B.1
Survey Results for Harvester Business Strategies

Business Strategy	Explanation
1. Part-time gillnetter and receives another $50 thousand or more from a variety of fisheries and fishery related income	Owner has developed diversified strategy to sustain revenues. Different combinations include the following: • Gillnet fishery including SAFE locations • Tender/buyer on Columbia River • Buyer and marketer to niche markets in Seattle or Portland • Small time value added producer/marketer of gillnet and other fish products • Gillnetter in Alaska • Crabbing in Pacific Northwest or Alaska • Tendering in Alaska
2. Gillnet revenue greater than $20 thousand with additional revenue from Alaska fisheries	Full time Pacific Northwest and Alaska fishermen. Besides gillnetting in the Pacific Northwest, he will also fish the Bristol Bay area or other areas of Alaska. They will have a boat in the Pacific Northwest and a boat in Alaska.
3. Gillnet revenue $10 to $20 thousand and total fishing income $50 thousand	Full time Pacific Northwest fishermen. Besides gillnetting in the Columbia River, he may also gillnet in Grays Harbor. He may also crab fish in the winter and crew on other boats in times when not preparing for, or taking part in, gillnetting.
4. Gillnet revenue is $5 to $10 thousand	Part time gillnetters. They take part in the fishery when possible. The gillnetter will hold a job other than fishing and/or another member of the household will have a job that provides a basic income with benefits. A subgroup of these may be retirees that use this as supplemental income.
5. Less than $5 thousand gillnet revenue	Permit holders that do not actively take part in the fishery. They hold the permits either for their cultural/historical value or speculative value.

Notes: 1. Harvester business strategies are used to classify how the gillnet vessel might fit into the gillnet permit owner's overall fishing industry participation. Other sections in this report address revenue generation from non-gillnet vessels.

Table B.2
Harvester Business Strategies by Gillnet and Other Fishery Revenue in 2004

		Vessel Count		Sum Gillnet Revenue		Sum Other Fishery Revenue		
Type	Gillnet Revenue	Amount	Percent	Amount	Percent	Amount	Percent	Share
1.	Minority revenue	26	10%	46,239	2%	202,763	33%	81%
Majority revenue		234	90%	2,945,240	98%	418,877	67%	12%
2.	> $20,000	47	18%	1,376,480	46%	166,285	27%	11%
3.	> $10,000	67	26%	982,344	33%	141,964	23%	13%
4.	> $5,000	60	23%	443,997	15%	71,285	11%	14%
5.	< $5,000	60	23%	142,419	5%	39,343	6%	22%
	Total	260	100%	2,991,479	100%	621,640	100%	17%

Notes: 1. Other fishery revenue shown in this table is from U.S. West Coast landings only. Table does not include revenue from other vessel or permits owned or operated by gillnet permit owners.
Source: PacFIN annual vessel summary, May 2006 extraction.

C. Processor Profiles

There were 52 different processor businesses that purchased lower Columbia River gillnet caught salmon in 2004. Table B.4 shows processor counts by purchase categories. The survey results indicated that the purchase categories are not the best indicator of business types. Instead of basing business types strictly on the amount of gillnet or other fishery purchases, expert judgment was used to assign types aligned with their operational characteristics. The four types of fish receiver/processors assigned are:

1. Fish receiver that buys for their own marketing purposes. These may be a retail market in Seattle or Portland, or a farmer's market in the Portland or Seattle area.

2. Buyer that purchases mainly for their own value added purposes. Product forms may include smoking and/or canning.

3. Tender and buyer that purchases mostly for resale to other larger processors.

4. Medium and large processor. Receives fish and sells them to distributors or hauls them to Seattle for further processing and marketing. The tender/receiver weighs them, ices the fish, and grades them out. He also makes out the fish tickets (either in his name or the processor that he delivers to). The fish tickets are made out in the fish processor name or in their name. The fish processor supplies ice, the transportation, and pays the harvester. They receive from $0.15 to $0.25 per pound, depending on the species.

The following are representative operational information for the types.

Type 1. Fish Receiver

These receivers buy directly from fishermen, and set up markets in advance. This is mostly in the metropolitan area of Seattle or Portland. They set quality standards and many times will pay

Table B.3
Gillnet Vessel Composite Budget by Harvester Business Strategies in 2004

	Business Strategies					
Vessel Fishery Participation	1. Minority Revenue	2. > $20,000	3. > $10,000	4. > $5,000	5. < $5,000	Composite
Revenue	10%	18%	26%	23%	23%	22%
Vessel counts	26	47	67	60	60	260
Fishery Revenue						
Troll Chinook	$1,155	$135	$24	$77	$29	$171
Troll coho	$3,210	$85	$8	$99	$74	$378
Gillnet spring Chinook	$481	$11,612	$5,341	$3,001	$855	$4,413
Gillnet fall Chinook	$1,050	$8,529	$5,059	$2,024	$764	$3,594
Gillnet coho	$245	$9,105	$4,250	$2,373	$751	$3,486
Other salmon (other gillnet caught pink, sockeye, etc.)	$1,067	$183	$35	$71	$53	$177
Sturgeon	$1,977	$2,985	$1,775	$913	$410	$1,500
SSMACK (shad, herring)	$249	$95	$215	$0	$17	$101
Other (tuna, groundfish, etc.)	$144	$95	$73	$31	$76	$75
Totals	$9,577	$32,824	$16,780	$8,588	$3,029	$13,896
Variable Expenses						
Vessel/Engine Repair	$570	$2,771	$999	$511	$514	$1,052
Gear Repair/Replace	$570	$3,464	$999	$511	$514	$1,177
Fuel & Lubricants	$499	$693	$874	$447	$771	$681
Food & Supplies	$71	$346	$125	$64	$0	$117
Ice & Bait	$0	$69	$0	$0	$0	$13
Dues & Fees	$713	$1,386	$1,249	$639	$514	$910
Transportation	$356	$693	$624	$319	$257	$455
Miscellaneous	$713	$693	$1,249	$639	$514	$784
Crew Shares	$1,425	$5,542	$2,497	$1,278	$0	$2,083
Total Variable Expenses	$4,917	$15,657	$8,615	$4,409	$3,083	$7,271
Fixed Expenses						
Insurance	$300	$500	$300	$300	$200	$313
Moorage	$500	$800	$500	$500	$400	$531
Interest Expense	$100	$300	$100	$100	$0	$113
Depreciation	$0	$0	$0	$0	$0	$0
Licenses	$500	$1,000	$500	$500	$300	$544
Miscellaneous	$500	$1,000	$500	$500	$500	$590
Total Fixed Expenses	$1,900	$3,600	$1,900	$1,900	$1,400	$2,092
Total Expenses	$6,817	$19,257	$10,515	$6,309	$4,483	$9,363
Net Income	$2,760	$13,567	$6,265	$2,279	-$1,454	$4,533
Pro-forma Indicators						
Operating cost including labor	51%	48%	51%	51%	102%	52%
Fixed cost	20%	11%	11%	22%	46%	15%
Net income	29%	41%	37%	27%	-48%	33%
Return to labor (crew, skipper, owner)	44%	58%	52%	41%	-48%	48%
Operating cost not incl. labor	36%	31%	36%	36%	102%	37%

Notes: 1. Vessel budgets are adapted using survey results from the Fisheries Economic Assessment Model (FEAM) originally developed by Hans Radtke and William Jensen for the West Coast Fisheries Development Foundation in 1988. The FEAM was most recently updated to 2000 representations (Davis 2003). Fishery revenue has been updated to 2004 ex-vessel value and variable expenses have been updated using original budget proportions.
2. The composite vessel budget is a weighted average of the vessel types participating in the fishery.

Source: Study.

Table B.4
Processor Types by Lower Columbia River Gillnet Salmon and Other Fishery Purchases in 2004

		Business Count		Sum Gillnet Purchases		Sum Other Fishery Purchases		
Type	Gillnet Purchases	Amount	Percent	Amount	Percent	Amount	Percent	Share
1	> $250,000	5	10%	2,333,415	69%	32,667,123	96%	93%
2	> $100,000	4	8%	701,688	21%	608,235	2%	46%
3	> $10,000	10	19%	251,568	7%	688,706	2%	73%
4	< $10,000	33	63%	87,755	3%	26,379	0%	23%
	Total	52	100%	3,374,426	100%	33,990,443	100%	91%

Notes: 1. Processor licenses were assigned to one business when used on both Washington and Oregon sides.
Source: PacFIN annual vessel summary, May 2006 extraction.

about $0.25 per pound extra for these fish. They may gross a total of $50,000 to $100,000 each year and net about 50 percent.

Their activities involve buying, making out tickets in their name, paying the fishermen, gutting and cleaning the fish (separating eggs), packing in ice, and transporting to market. This income will be additional income to other family occupations. Overall, such a small receiver/marketer may supplement his household income by $7,000 to $12,000 per year. Their investments are about $50,000 in ice machine, pickup, tractor, and totes. A small receiver/marketer that sells in farmers market expects to receive the usual 40 percent retail markup. The marketing advantage is the quality and the cultural sell.

Type 2. Buyer and Marketer

This type may involve marketing whole, filleting fish, or taking the product to retail markets like farmers markets in the Portland or Seattle area. Their products include albacore and salmon (smoked). Overall, their sales approach $500,000 annually. Of this, perhaps 10 percent is fresh, 45 percent smoked, and 45 percent canned. Eggs are sold to Franko's in Washington.

The equipment is usually old and antiquated. The market value for the existing equipment may be the real estate, no value for the machinery. The replacement value would be close to $1 million.

Typical Sales

Fresh market	$50,000	
Whole, H&G	80%	
Fillets	20%	
- Coho		50%
- Spring Chinook		10%
- Chinook brights		30%
- Other		10%
Smoked, canned	$225,000	
Canned	$225,000	

Type 3. Tender/Buyer

These receivers buy mostly for other, larger processors. The tender/buyer owns a dedicated dock space. He will provide unloading facilities and usually provide space for boats. As he receives the fish, he grades them, ices them in totes, and fills out state fish tickets (either in his name or in the processor's name). The processor will usually provide ice and will also pick up the fish from the buyer. The processor will also pay the fishermen directly. Margin is from $0.15 for lower priced fish (coho and tules) to $0.25 for spring Chinook. The price difference is due to the volume and also to the additional care that higher priced fish receive.

Many of the tender/buyers also have other jobs throughout the year, such as:

- Part time work in retail
- Gillnetter on the Columbia River
- Gillnetter and tender in Alaska
- Small added value processing
- Marketing Alaska fish along with Columbia fish in Oregon, Washington, and throughout the West
- Crabbing off Washington or Oregon

The Columbia receiver component may make up 25 to 75 percent of the household income.

Type 4. Medium to Large Processor

There are four larger processors in the Astoria area that receive, process, and market fish harvested from the lower Columbia River. The larger processors will have total sales over $5 million. Their operation generally receives the fish from the tender. The processor guts the fish, and in some cases removes the head, re-ices, and sells the fish to a distributor or sends the fish to be put into cold storage. Very little is processed into fillets etc. in the Astoria area. Purchases are hauled to cold storage and processing facilities in the Seattle/Bellingham area. The cost to put fish into cold storage is about $0.20 to $0.25 per pound and about $0.01 per pound per month in storage.

Typical Sales

	Spring Chinook	Coho	Fall Chinook Tule	Fall Chinook Bright
Destination market				
U.S.	Fresh	Fresh	West Coast	Fresh, Frozen
Europe		Frozen		
Product Form				
Head-on fresh	100%			
Head-off fresh		45%		75%
Head-off frozen		45%		25%
Fillets fresh		5%		
Fillets frozen		5%		
Canned				
Smoked				
Jerky			100%	
Eggs				

A processor in the Astoria area that has salmon product sales over $1 million may have the following salmon purchases.

Typical Salmon Purchases

- $750,000 troll and gillnet
    - 20% troll Chinook
    - 80% gillnet
        - 50% SAFE
        - 50% mainstem
- $250,000 hatchery surplus
    - 100,000 coho @ $0.50
    - 100,000 fall @ $0.25
    - 50,000 spring and summer @ $1.50

Hatchery surplus fish (over and above needed for propagation) that are not harvested by troll gear in the ocean, by gillnets in the Columbia River, or by recreational anglers may be sold to processor on a bid basis. The spread and margins between wild capture ocean and river, and hatchery salmon, are basically the same; it all depends on the purchase price.

D. Additional Processing Characteristics

Much of the salmon harvested and processed to a product for freezing (graded, headed/gutted, boxed) is sent to the Seattle/Bellingham area. This is an area that handles fish from Alaska, as well as from the Pacific Northwest. The area is also a central place from which to market fish throughout the world. Fish may be cut fresh there or put into cold storage. Fish are stored in the name of the Astoria area processor until they are sold, either in their frozen whole form or further processed for sale to the buyer's specifications. The processing in the Seattle/Bellingham area of Columbia River fish is part of a larger base. Labor is experienced, and the storage and marketing

infrastructure is adequate. These plants also process farmed fish. There is not enough volume on the Columbia River to compete with the Bellingham area processing.

Local processors utilizing Columbia River Basin salmon harvests supply seafood salmon products to a growing market demand for wild caught fish. A carcass byproduct from the processing also serves as an additional added-value manufacturing input. A local business uses the carcasses for the manufacture of fish meal and oil. This analog salmon product has been used at Columbia River hatcheries to rear a new generation of salmon smolts. There is also a worldwide poultry and cattle livestock market for this protein form.

November 6, 2005

Re: Commercial Fishing Vessel Owner and Lessee Survey
Gillnet Fishery Economic Study

Dear Vessel Owner or Lessee:

Attached is a questionnaire for commercial fishing vessel owners and lessees. Responses will help us better understand and describe the commercial gillnet fishing industry. The survey is similar to one we conducted about 10 years ago. That survey was a complete survey of all participants in the Columbia River gillnet fishery. So that changes in the gillnet industry are adequately described, we are asking about 12 key industry members to help us update economic information about the industry. For your interest, I am enclosing the results from that old survey.

You can fill-out the questionnaire and mail it directly to Dr. Hans Radtke using the enclosed stamped envelope or have Dr. Radtke call you to help interpret the questions. Dr. Radtke will also be in the Astoria area the next couple of weeks if you want to set up a personal visit. If you would rather have Dr. Radtke call upon you by phone or in-person, please contact him at (541) 547-3087 or (541) 758-1432 to make arrangements.

The information from survey results will only reflect general conditions and trends. Individual vessel owner or lessee data will remain with Dr. Radtke and be destroyed when the study is complete.

Please complete all questions as accurately as possible. It is more important, however, to use an estimate for an answer than to not complete it. If you wish to make additional comments, please feel free to use the space provided on the back page of the questionnaire.

Time is of the essence in being able to use the survey derived information. Please return the completed survey as soon as possible or call Dr. Radtke for a phone or personal interview.

Thank you for your help.

Irene Martin, Chair
Social and Economic Committee

IM:kco
Encl.

Columbia River Commercial Gillnet Fishery
Vessel Owner or Lessee Questionnaire

Owner(s) or Lessee(s) Contact Information

1. Name(s): _____
   Address: _____ City: _____, State: __, Zip: _____
   Telephone: _____ Email: _____
   Vessel documented name: _____ and ID: _____

Vessel Information

2. What are the characteristics of the vessel identified above?

Length	Horsepower	Fuel Capacity	Home Port
_____	_____	_____	_____

3. Is the vessel usually operated by the owner or is it leased to someone else for the gillnet fishery? (Answer owner operated if the arrangement is to pay a skipper a share of revenues.)
   ____ Yes - owner operated. ____ No - leased to another party. ____ other arrangement. specify. _____
   _____

Owner or Lessee Information

We understand there may be more than one owner per vessel, but we just need to know information about one owner. Therefore, we will refer to this person as the principal owner.

3. How many years has the principal owner been in the commercial fishing industry? _____
   (This would include years both as a vessel owner plus any other years of industry involvement, such as being a crew member.)

4. How many generations has the principal owner's family been in the fishing industry? _____

5. What is the age of the principal owner? _____

Fishing Operation Revenue Information

6. a. What percentage of the owner's typical total household income (profit and crew/skipper share, gillnet fishery chartering or tendering, leasing out gillnet permits, etc.) during the years 2000-2004 is from Columbia River gillnet fishing? _____%
   b. What percentage is from Alaska salmon gillnet fishing? _____%
   c. What percentage is from Alaska other fishing? _____%
      Identify major other fishery _____
   d. What percentage is from other fishing? _____%
      Identify major other fishery _____
   e. What percentage is from non-fishing? _____%
   (The percentages from Question 6 should total to 100%.)

7. a. During the 2000-2004 time period, please provide the annual highest total Columbia River gillnet fishing revenue received. _____ year; _____ total revenues
   b. During the 2000-2004 time period, please provide the average Columbia River gillnet fishing revenue received. _____ revenues
   c. During the 2000-2004 time period, what was your lowest total fishing revenue from Columbia River gillnet fishing? _____ year; _____ revenues

Fishing Operation Cost Information

8. a. Average annual number of crew hired during 2000-2004 for this vessel (other than yourself)? ___ number; _____ percentage of revenue or other basis for crew payments.
   b. Was a skipper, other than the owner, typically used to operate the vessel during the gillnet fishery? _____ (yes/no); _____ percentage of revenue or other basis for skipper payments.
   c. Which of the following average 2000-2004 expenses were deducted from total revenue after calculating the crew and skipper share when this vessel participated in the gillnet fishery. A blank will mean that nothing is deducted.

	Crew Payments % or $	Skipper Payments % or $
i. Fuel and lubricants		
ii. Food and other supplies		
iii. Ice and bait		
iv. Landing taxes or unloading expenses		
v. Other. Specify _____		

9. Please provide the average annual operating expenses and profit during the period 2000-2004, either as dollars or as a percent of your total fishing earnings in the Columbia River gillnet fishery. (See attached for a "typical" revenue and cost budget that we have used for our past assessment work. You may use that as a reference to describe your own situation.)

	%	or	$
Vessel and engine repair and replacement			
Gear and back-up gear repair and replacement			
Support gear (snag nets, net banging racks, etc.)			
Fuel and lubricants			
Ice and bait			
Food on vessel and other supplies			
Landing taxes or unloading expenses			
Dues and association fees			
Crew shares			
Skipper shares (skipper other than yourself)			
Insurance			
Moorage			

	%	or	$
Payments on loan			
Interest			
Principal			
Payments on lease			
Licenses			
Bookkeeping, legal, or other services			
Miscellaneous other expenses			
Fishing asset depreciation claimed			
Profit (owner share)			
Total Annual Expenses and Profit	100%		$_____

10. Please explain any estimated cost differences between fishing for gillnet salmon in SAFE areas and mainstem. (Costs would exclude payments to crew and skippers. Assume the fishery is for fall Chinook.)

    a. Estimate your expected daily costs of the two areas: mainstem $_____ SAFE area $_____
    b. Difference because of _____

11. What would it cost if you had to replace your Columbia River fishing business investment?

	Percent of Use Devoted to Fishing	Today's Replacement Cost	Purchase Price	Year Acquired
Vessel	100%			
Permit	100%			
Drift rights	100%			
Fishing gear	100%		NA	NA
Back-up fishing gear	100%		NA	NA
Support gear (snag nets and barges, tools, net hanging racks, etc.)	100%		NA	NA
Trailer	100%			
Specially equipped truck to haul trailer				
Dock				
Shop building				
Net and boat shed				
Other (specify) _____				
_____				
_____				

Total Replacement Value $_____

November 6, 2005

Re: Survey of Columbia River Gillnet Caught (Non-Indian) Salmon Buying Stations and Processing Businesses

Enclosed is a questionnaire for businesses that use Columbia River gillnet (non-Indian) caught salmon. Responses will help us better understand and describe the commercial gillnet processing industry. The survey is similar to one we conducted about 10 years ago. That survey was a complete survey of all participants in the Columbia River gillnet fishery. So that changes in the gillnet industry are adequately described, we are asking key industry members to help us update economic information about the industry.

For your interest, I am enclosing examples of buying station and processor business budgets that were put together using the old survey. They might guide you in filling out the questionnaire.

You can fill-out the questionnaire and mail it directly to Dr. Hans Radtke using the enclosed stamped envelope or have Dr. Radtke call you to help interpret the questions. Dr. Radtke will also be in the Astoria area the next couple of weeks if you want to set up a personal visit. If you would rather have Dr. Radtke call upon you by phone or in-person, please contact him at (541) 547-3087 or (541) 758-1432 to make arrangements.

The information from survey results will only reflect general conditions and trends. Individual business owner data will remain with Dr. Radtke and be destroyed when the study is complete.

Please complete all questions as accurately as possible. It is more important, however, to use an estimate for an answer than to not complete it. If you wish to make additional comments, please feel free to use the space provided on the back page of the questionnaire.

Time is of the essence in being able to use the survey derived information. Please return the completed survey as soon as possible or call Dr. Radtke for a phone or personal interview.

Thank you for your help.

Irene Martin, Chair
Social and Economic Committee

IM:kco
Encl.

Survey of Columbia River Salmon
Buying Stations and Salmon Processing Businesses

1. Name of Plant _____

2. Owner of Plant _____

3. What is the estimated current and past use of your plant capacity (in percent of daily through-put pounds), what were total salmon (round pounds) deliveries, and what were Columbia River gillnet (non-Indian) caught salmon (round pounds) deliveries?

Year	Salmon Share of Plant Capacity (percentage)	Total (Troll and Gillnet Caught) Salmon Deliveries (round pounds)	Columbia River Gillnet (Non-Indian) Caught Salmon		
			Salmon Deliveries (round pounds)	SAFE Areas (percentage)	Mainstem Areas (percentage)
2000	_____ %	_____ lbs.	_____ lbs.	_____ %	_____ %
2001	_____ %	_____ lbs.	_____ lbs.	_____ %	_____ %
2002	_____ %	_____ lbs.	_____ lbs.	_____ %	_____ %
2003	_____ %	_____ lbs.	_____ lbs.	_____ %	_____ %
2004	_____ %	_____ lbs.	_____ lbs.	_____ %	_____ %

5. Attached are some general pro forma statements for several size buyers and processors, as well as individual specie processing cost estimates. Please review these and provide similar information that generally fits your situation for processing all (salmon and non-salmon) species. Use the 2000 to 2004 time period and just make your estimates for a typical average year. Use percentage of total annual sales or dollar estimates in these estimates.

	Percent	or	Dollars
Income			
Total Annual Sales	100%		$_____
Variable Expenses			
Cost of product purchased	_____ %		$_____
Processing labor	_____ %		$_____
Direct materials cost	_____ %		$_____
Manufacturing overhead	_____ %		$_____
Fish taxes	_____ %		$_____
Bad debt expense	_____ %		$_____
Other (specify) _____	_____ %		$_____
Total Variable Expenses	_____ %		$_____

	Percent	or	Dollars
Fixed Expenses			
Administrative salaries	%		$
Maintenance and repairs	%		$
Utilities	%		$
Telephone	%		$
Insurance	%		$
Business/property taxes	%		$
Administrative supplies	%		$
Miscellaneous administration	%		$
Interest expense	%		$
Depreciation	%		$
Other (specify) _____	%		$
Total Fixed Expenses	%		$
Total Variable and Fixed Expenses	%		$
Net Income	%		$

6. Please provide the following Columbia River gillnet caught (non-Indian) salmon yield information by the indicated species for a typical, average year during the 2000 to 2004 time period. An industry standard yield percentage is attached. If your yield differs, please provide that information.

	Coho	Spring Chinook	Fall Chinook Tule	Fall Chinook Bright
Initial quantity (total round pounds)				
Initial price per round pound				
Does this include tendering cost? If yes, what is the tendering cost?				
Tax or fees per pound				
Yield from raw product to sold product in percentage of raw product weight	75% head-off 90% head-on	75% head-off 90% head-on	75% head-off 90% head-on	75% head-off 90% head-on
Sales price of manufactured salmon product per processed pound				

	Coho	Spring Chinook	Fall Chinook Tule	Fall Chinook Bright
Salmon egg price per pound of eggs				
Additional total sales of eggs per processed pound				
Labor cost per processed pound				
All other variable costs per processed pound				

7. This question is to determine the plant's equipment and intangible investments for processing Columbia River gillnet caught salmon. For assets used for any salmon processing, please estimate the replacement value at today's cost, a salvage value at the end of depreciation, and a useful life in years. We will assign a Columbia River gillnet caught share of the investment based on other survey answers.

Replacement Cost	$
Salvage Value	$
Useful Life (years)	
Intangible Assets	$

8. Market information.

   a. Please provide general information on the main product from Columbia River gillnet caught salmon and destination of the product.

	Coho	Spring Chinook	Fall Chinook Tule	Fall Chinook Bright
Destination market				
Head on fresh				
Head on frozen				
Head off fresh				
Head off frozen				
Fillets fresh				
Fillets frozen				
Canned				
Smoked				
Eggs				

b. What are the key impediments to increased markets for SAFE harvested fish?

i. In general, please describe: _____

_____

ii. Specific to species, please describe:

Coho: _____

_____

Spring Chinook: _____

_____

Fall Chinook Tule: _____

_____

Fall Chinook Bright: _____

_____

Comments Taken From Interviews and Questionnaires

Timing of Harvest

1. Earlier time of the year leads to better prices. If you can beat "Copper River" in time, you have an advantage.
2. Timing of openings should be aimed at market "niches;" when other production areas are not producing great quantities.
3. The terminal fish come at good times because some of it is out of regular season and it provides consistency of supply for fish distributors.
4. Fishing times need to be coordinated so as not to compete with Alaska troll fish harvests.
5. The industry needs to emphasize frozen fish sales to be able to market fish throughout the season.
6. They can get the best price if they are in front of the "Copper River salmon."
7. Consistency in season is the key to marketing fish.

Quality

1. The terminal fishery has a reputation of not being as the main stem ... The terminal fish are programmed for shorter distance to spawn; therefore they are already starting to degrade when they come in to the estuary.
2. The program has to work on market acceptance of fish from the terminal fishery as being of high quality; equivalent to river fish.
3. The fish should be bled and packed with some ice.
4. There are some fishermen that believe that bleeding the fish causes a mess and therefore more work.
5. Bleeding fish may reduce weight and therefore reduction in revenues.
6. Fishermen have to believe that quality procedures like icing and bleeding make a difference in price.
7. The buyer needs to be able to verify quality practices.

8. There are not enough docks along the river to get ice to the boats.

9. Fishermen need to work with environmental groups to get the "sustainability" stamp.

10. Lower River coho has its problems with higher temperatures in that stretch of river that reduce quality.

11. Sometimes the "tribal fish" are the only fish around for buyers. Their summer fish sometimes has problems with belly burns. They need to ice their fish to produce a quality fish. Their quality has improved somewhat over time.

12. Have had quality problems with fish from Big Creek; not so much at Youngs Bay.

13. Icing still seems to be looked at as a "pain in the ass." But even though ice is sent up and down the river, it does not get to the fishermen easily enough. The river lacks infrastructure, convenient facilities to load and unload, fork lifts, and totes. But then there are not enough fish for every facility along the river.

14. Good quality is almost generic for salmon. Salmon will sell itself; just need to get it to the market.

15. Marine mammals cause a problem. The "scar" percentage is much higher for upper river tribal fish. It can be as high as 10 percent.

16. Being so close to the ocean, the fish do not water mark as easily, and the fish seem to change in that the "smell" of the fish changes as they group.

17. The tooth (or tangle net) produces a far superior product. This is especially important for spring Chinook. The tangle nets guarantee that the fish are handled carefully and individually. The result is no bruises, no net marks. But a tooth net set up would cost about $2,000 per boat (includes net, box, etc.).

18. The mainstem spring Chinook gets a little better price than spring Chinook from terminal fisheries.

19. The deepening of the Columbia River will "choke up" tributaries and access to moorage and docks.

20. Moorage and other infrastructure is an issue.

21. On the mainstem, between Astoria and Portland, they deliver after every drift every few hours so ice is not that important; although minimal icing in the boat would help.

22. Fish should be bled in the boat, especially spring Chinook. But it does take time, and the fishermen want to be compensated for the procedure. An estimate is that bleeding costs about $0.25 per pound in labor costs.

23. They insist on fish handled by hand - no picks.

24. We are losing the infrastructure for fish buyers.

25. They buy a lot of tribal fish; an education program is needed to help them provide quality fish.

26. The lower river and upper river gillnetters (tribal) to provide a good quality fish product from the Columbia River.

27. Sometimes the hatchery fish are better quality than the gillnet caught fish.

Market Notes and Other Comments

1. The fresh smoked market has been taken over by farmed fish. It offers consistency in quality and consistency in product availability.

2. Most of the smaller and medium sized buyers will take part in the RED and SAFE programs and will collect these funds as part of their service. One major processor in the Astoria area mandates this service. One other large processor is a passive participant, while the largest processor in the area does not take active part in the program. This puts the whole program at risk.

3. The smoker market is generally some high quality, small smoker/canner for "niche" markets. The smoker market for tules (and second grade hatchery fish) are the low grade (coho added) smoked salmon and salmon jerky.

4. Freight cost to Seattle area is about $0.03 per pound. It costs about $0.20 per pound to put a fish into the freezer, plus about $0.01 per month to keep it there.

5. You try to sell your fish fresh, if not then you freeze it and look for opportunities. But costs go up and price goes down so you get squeezed from both ends.

6. Markets for wild caught fish are strong. Worldwide demand is up.

Appendix C

Salmon Market and Marketing Opportunities

I. SALMON MARKET

A. Columbia River Fisheries

Columbia River inriver Indian and non-Indian commercial fishing governance includes:[1]

- The 1938 Mitchell Act was supposed to mitigate damages to salmon stocks, a result of dam construction. Congress did not fund the Act until 1949 and periodically discusses cutting off funding for hatcheries built to replace lost salmon runs.
- The Northwest Power Planning Act of 1980, which sought to assign responsibility for effects from Columbia River dams on salmon declines.
- The 1985 Pacific Salmon Treaty, which attempted to settle fishing relations between Alaska, British Columbia, and the states of Washington, Oregon, and California.
- Columbia River Fish Compact ratified by Congress in 1918 established an interstate agency to allocate inriver commercial harvests.
- The Supreme Court in 1968 held that Indian tribes with treaty rights to fish may not be limited by state regulations that infringe on those rights. Following this decision, the Federal District Court for the District of Oregon in the case United States v. Oregon became the forum for allocating the harvest of fish that enter the Columbia River system. The court retains continuing jurisdiction.
- By the late 1980s, the tribes, states and federal government reached agreement on a harvest plan for co-management of Columbia salmon and steelhead. The Columbia River Fish Management Plan (CRFMP) largely replaced annual litigation over conservation and harvest management of the shared Columbia River salmon resource. The CRFMP has expired and the parties are negotiating a new plan. The "2005-2007 Interim Management Agreement for Upriver Chinook, Sockeye, Steelhead, Coho and White Sturgeon" controls fishery management until a new plan is adopted and approved by the court.
- Outside the three-mile limit, ocean fishing is regulated by the federal government under the Fishery Conservation and Management Act of 1976 (FCMA). The FCMA establishes the Pacific Fishery Management Council (PFMC), which is composed of representatives of Washington, Oregon, California and Idaho, one representative of the Indian tribes, and the federal government.
- Starting in 1991, several evolutionarily significant units of salmon and steelhead in the Columbia Basin were listed as threatened or endangered under the ESA. The listings further complicated fishery management since the ESA prohibits "take" of listed species. The National Marine Fisheries Service became a key decision maker in harvest management because of the ESA consultation process and resulting biological opinions which authorize "incidental take." Without the biological opinions all commercial and recreational fishers would have to obtain incidental take permits. The 2005-2007 Interim Management Agreement addresses ESA requirements for Indian and non-Indian fisheries.

1. An expanded discussion of some of these governance descriptions can be found in Independent Scientific Advisory Board (ISAB) (2005).

- The Washington Fish and Wildlife Commission (WFWC) and Oregon Fish and Wildlife Commission (OFWC) are responsible for implementing the policies and programs of the states for the management of wildlife (which includes fish).
- In making harvest allocations between recreational and commercial fisheries in the Columbia River system, the WFWC and OFWC are bound by the terms of the 2005-2007 Interim Management Agreement under U.S. v. Oregon in order to meet federal statutory and treaty obligations. With that allocation as a given, the WFWC and OFWC have broad discretion to decide what allocation between recreational and commercial fisheries represents the public interest. Commissions consider economic factors along with social, recreational, aesthetic and resource management factors. Since Washington and Oregon must act jointly to determine the allocations, the commissions provide guidance to staff in how the staff should carry out negotiations for the actual management agreements.

Significant changes have occurred in peoples' attitudes toward natural resources, including growing concerns about habitat and biodiversity loss, increased emphasis on protecting wild salmon, and concerns that efforts to produce more salmon had actually caused declines in salmon runs (Gilden and Smith 1996). This has encouraged initiatives to fund salmon recovery programs as well as strengthen regulations on water development and land use to avoid deleterious impacts on fish resources.

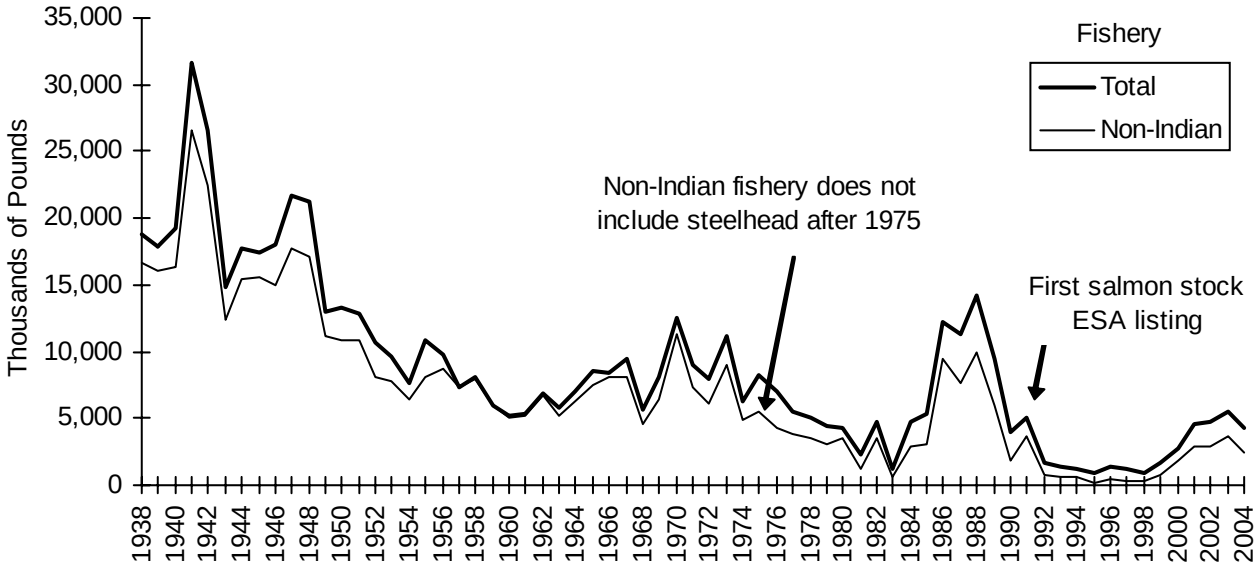
B. Lower Columbia River Gillnet Fishery

The overall trend for river salmon commercial fishery landings has been downward since 1938 (Figure C.I.1). There was a spike in the late 1980's and the bump-up during the period 2001 to 2004 was encouraging that harvest levels might have bottomed to the five million pound and ten million dollar level. While this level provides a modest fishery, it is but a fraction of historical Columbia River production landed at river locations.

Gillnet fishery salmon largely enter a global market with many substitutes. This includes readily available products from farmed salmon production and other wild capture sources. The gillnet fishery supplied about seven percent of West Coast fishery harvests and West Coast fishery harvests are about 18 percent of all Pacific Ocean landed revenue in 2004 (Table C.I.1).

The trend is for increasing shares of farmed salmon production to provide for domestic and world salmon demand. Farmed salmon production costs have allowed significantly lower prices to be passed on to consumers. However, consumers' familiarity with the differences between farmed salmon and wild capture quality is also growing, so opportunities exist to divert gillnet fishery harvests to higher value market channels. This chapter explores salmon market trends and a later chapter in this report offers organizational and marketing suggestions to target higher value niche markets. The suggestions build on laudable efforts already being made by a few harvesters and processors to realize the highest possible value of the harvests.

Figure C.I.1
Columbia River Commercial Anadromous Fish Landings, Total and Non-Indian Fisheries in 1938 to 2004



Source: Washington Department of Fish and Wildlife (WDFW) and Oregon Department of Fish and Wildlife (ODFW) (August 2004), Table 14 and Table 19; and Pacific Fishery Management Council (PFMC) (February 2005), Table IV-9.

Table C.I.1
Pacific Ocean and Lower Columbia River Wild Capture
Domestic Salmon Landings Volume and Value in 2004

	Volume		Value	
	Amount	Percent	Amount	Percent
Alaska	697.8	94.2%	225.3	82.2%
Washington (except LCR gillnet)				
Non-Indian	12.2	1.7%	5.7	2.1%
Treaty	17.0	2.3%	11.1	4.0%
Oregon (except LCR gillnet)				
Non-Indian	3.4	0.5%	10.0	3.6%
Treaty	0.9	0.1%	0.7	0.3%
California				
Ocean	7.1	1.0%	18.0	6.6%
LCR gillnet	2.4	0.3%	3.4	1.2%
Total	740.9	100.0%	274.2	100.0%

Notes. 1. Volume and value amounts are in millions.
2. There is a small California Klamath River treaty commercial fishery in some years that is not reported in this table.

Source: NMFS (November 2005) and PacFIN.

C. Changing Salmon Markets

Since the early 1980's, improved captive salmon propagation procedures and transportation systems have allowed salmon aquaculture to supply the needs of the world market with a consistent supply of salmon. Salmon aquaculture is setting standards that have to be addressed by any other producers of salmon. U.S. market consumption for seafood is up, but supplies from imports are more than filling increases in demand. Most of the supply increase is from foreign farmed salmon origin, which can be produced year around, in consumer desired size, with volumes needed by large retail and food service companies, and at a lower cost.

The "squeeze" between Alaska's production of canned and frozen salmon and aquaculture's production of fresh salmon puts Pacific Northwest salmon production into a price and market niche position. To realize improved prices, it is necessary to distinguish unique qualities of the production so customers will seek out and pay for its advantages.

D. World Salmon Supply

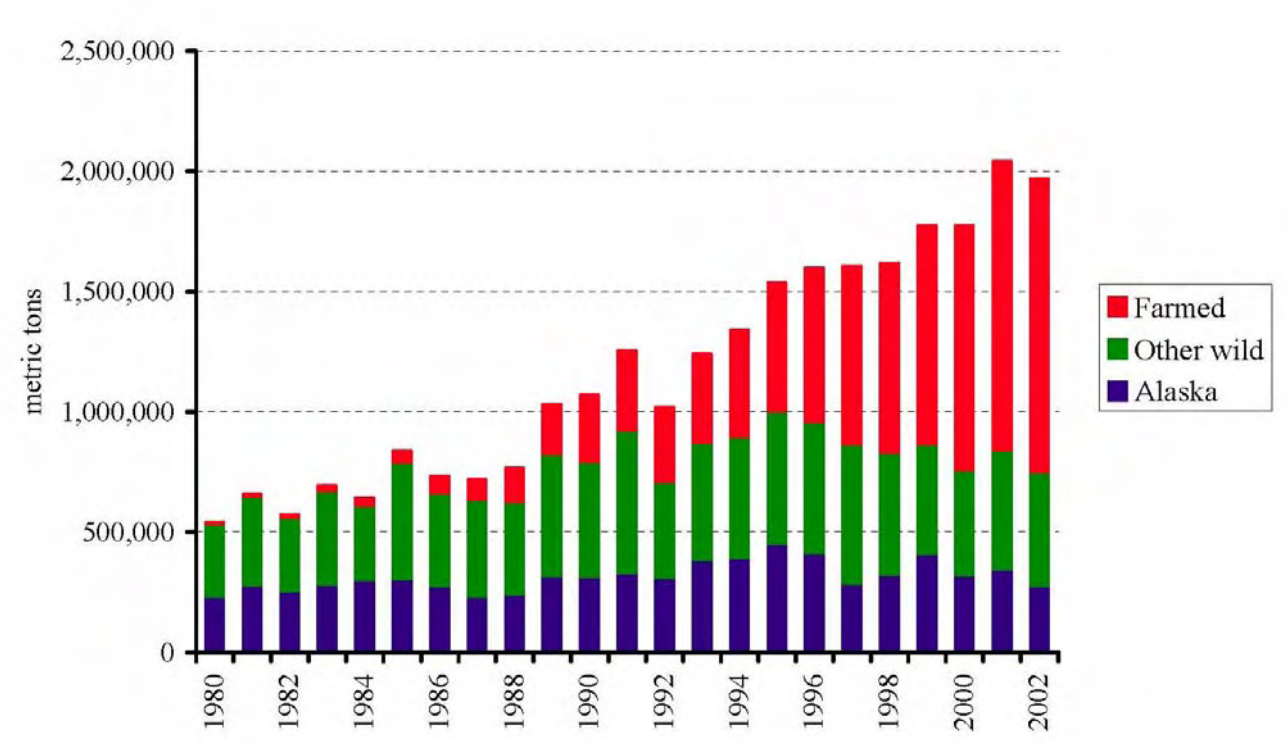
The world supply of salmon has gone through dramatic changes. Captured salmon production increased from about 520 thousand metric tons (mt) in 1980 to about 720 thousand mt in 2002 (about 40 percent of that from Alaska). At the same time that captured salmon production increased, farmed salmon increased from no production in 1980 to over 1,230 thousand mt in 2002 (Figure C.I.2). Salmon supplies that were traditionally dependent on captured harvests have changed toward farmed salmon production.

Today's global salmon markets are characterized by strong competition and rapidly growing supplies of an aquaculture product. Farmed salmon production is expected to continue to be the dominant force in product and price determination.

Farmed salmon has significant competitive advantages over wild salmon with respect to production factors (Knapp February 2005):

Production Factors	Wild Salmon	Farmed Salmon
Volume	Production volume is inconsistent from year to year and difficult to predict.	Farmers can accurately forecast production and guarantee supply commitments.
Timing	Wild harvests must occur during a short summer run.	Farmed production can occur over many months or year-round
Consistency	There is wide variation in the size and quality of individual wild fish.	Farmed fish can be produced of consistent sizes and quality.

Figure C.I.2
World Salmon Supply in 1980 to 2002



Source: Gunnar Knapp, University of Alaska at Anchorage.

Other factors affecting the marketing of captured salmon:

- Increasing consolidation of retail trade by large multinational companies (Wal-Mart, Costco, etc.) competing on price and efficiencies of scale and seeking suppliers who can offer consistent supply of high volumes at low cost.
- Changing consumer demand as incomes rise, lifestyles change, demographics change, and the range of products available to consumers change.
- Seafood reprocessing migrating to low-cost countries, such as Chinese canning of Bumblebee Russian pink salmon, and Chicken of the Sea shift of boneless/skinless salmon canning operations from U.S. to Thailand.

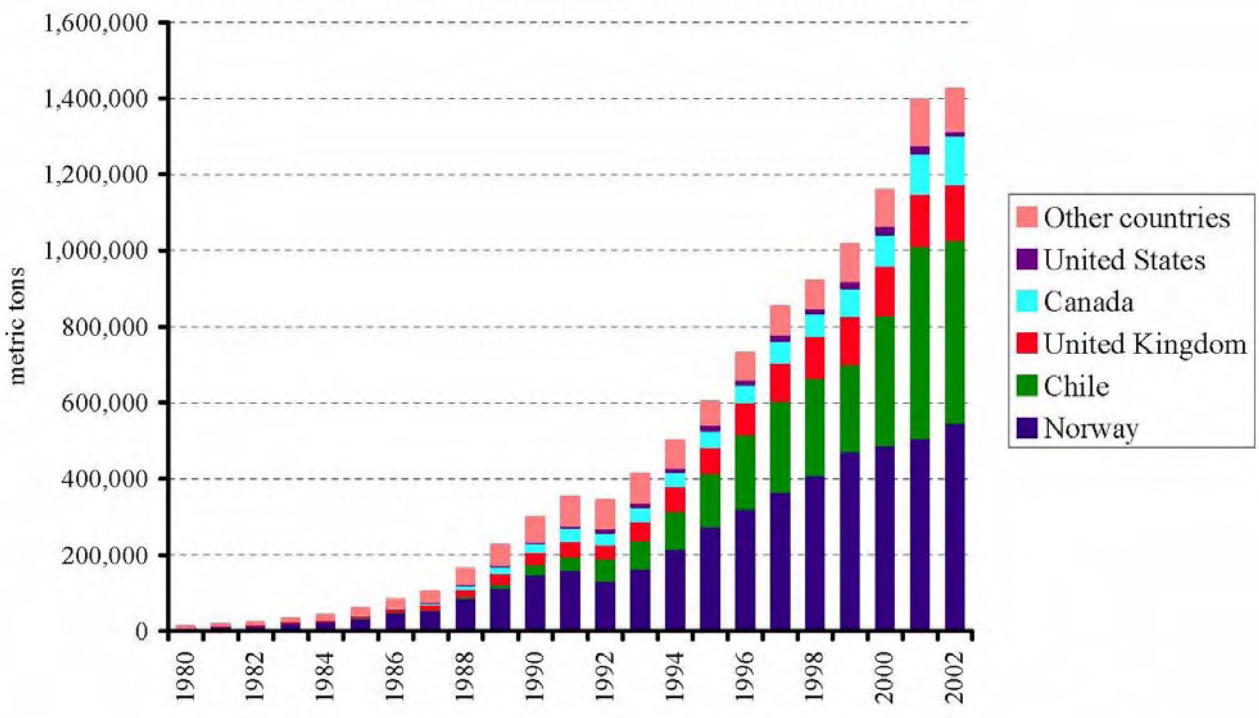
E. Farmed Salmon Origin

Salmon farming or aquaculture has been part of western civilization for some time. German biologists began hatching salmon eggs as far back as 1763. Chilean biologists began experiments with establishing non-native salmonid species in 1905. Efforts to raise salmonids as food fish began in earnest during the mid 1950's when Norwegian biologists began experimenting with Atlantic salmon smolts (Folsom et al. 1992).

Production of salmon grown in net pens began in earnest in the 1980's. In 1980, pen raised salmon accounted for one percent of the world's total salmon production; in 1991 this increased to 27 percent; the estimated 2001 percentage of farmed salmon is 65 percent.

Historically Norway has been the largest salmon farming production. But in recent years, the Norway-EU salmon agreement has slowed Norwegian growth, while Chilean production has grown very rapidly (Figure C.I.3).

Figure C.I.3
World Farmed Salmon Supply by Country



Source: Gunnar Knapp, University of Alaska at Anchorage.

One of the main reasons for Chilean farmed salmon producer competitiveness is low labor costs. An abundant supply of cheap fish meal, for use in farmed salmon feed, has also helped the Chilean producers' competitive edge. In Chile, about 1.5 to 1.8 kg of food is needed to produce one kg of mature farmed salmon. This is the equivalent of a cost of $0.68 to $0.82 per produced pound.

The farmed salmon industry is consolidating into large, vertically integrated multinational companies with operations in many countries. This results in:

- Increasing market power
- Increasing economies of scale in production, processing, distribution, and marketing
- Diversified production opportunities into other species, not just salmon

In recent years, consolidation has decreased overhead costs as well as transportation costs to the level where fillets are delivered to the West Coast at between $2.05 and $2.50 per pound. Salmon farmers are expanding production into new markets, including frozen salmon, canned salmon, and roe.

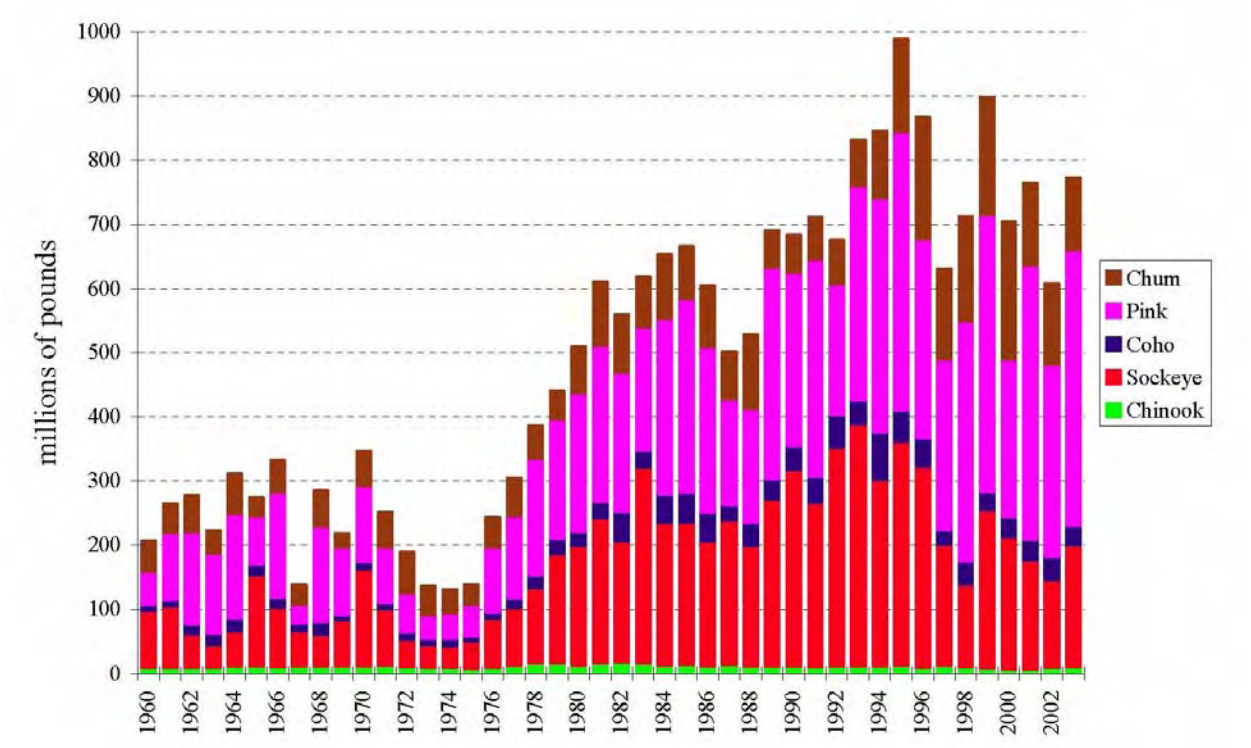
The result of the increase in world salmon supply is to decrease total revenue received by harvesters, even though total landed fish has increased. Alaska for example has increased total harvests to about 800 million pounds, from less than 400 million pounds in the 1970's (Figure C.I.4). Despite increasing harvests to record levels, total revenue from salmon fishing (adjusted for inflation) steadily decreased in the 1990's from about $500 million in the early 1990's to about $200 million in the early 2000's.

In Alaska an increasing amount of salmon is being marketed as fresh (Figure C.I.5). Specialty stores and restaurants represent a growing market for consumers whose needs are not met by the large chains (Knapp 2005). This is a relatively small share of the total market.

F. Trends in Seafood Consumption

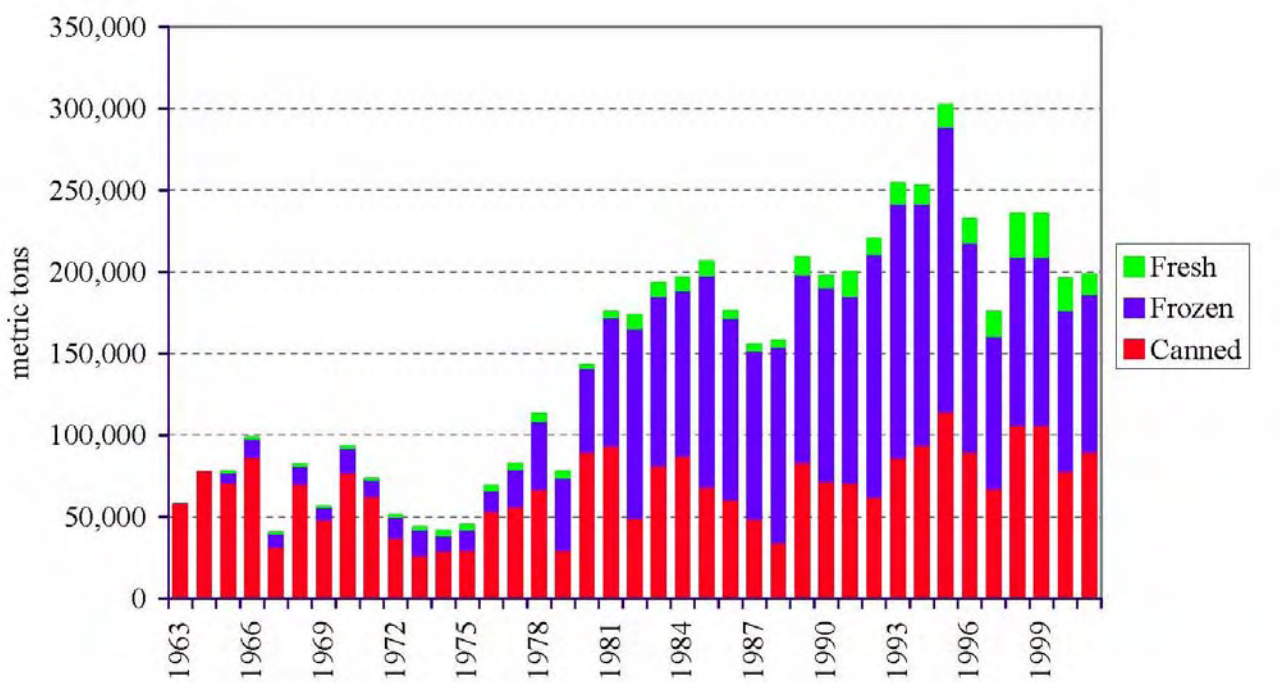
The amount and kind of food that people consume depends on many factors. The basic factors are the availability of a product and the ability of the consumer to pay for that product. As explanation of the demand for certain foods is refined, other important factors emerge. Some of

Figure C.I.4
Alaska Salmon Harvests



Source: Gunnar Knapp, University of Alaska at Anchorage.

Figure C.I.5
Alaska Salmon Production



Notes: 1. Salmon roe volume (not shown) is relatively small, but roe accounts for a significant share of total value.
Source: Gunnar Knapp, University of Alaska at Anchorage.

these are: total number and consumer level of income (total and comparison to other groups), cultural and historical influences, and price and availability of substitutes.

Seafood has had a gradual increase in per capita consumption over the years 1996 to 2004 (Table C.I.2). Much of the increase in consumption has been due to the availability of fresh and frozen seafood, and the publicity that the industry has received concerning the "healthiness" of seafood. Seafood was available more cheaply that it had been for many years, mostly due to higher national imports.

According to NOAA Fisheries (News Release November 9, 2005), Americans ate 4.8 billion pounds of seafood in 2004, which is 16.6 pounds of seafood per person. Of these, 11.8 pounds were fresh or frozen fish or shellfish (including 1.1 pound of farm-raised catfish), 4.5 pounds were canned seafood, and 0.3 pound was cured. Americans also ate a record 4.2 pounds of shrimp per person in 2004. There has been a decrease in canned tuna consumption, which is probably attributed to a decline in consumer awareness about quality and competition from fresh seafood products. The latest data from the Food and Agriculture Organization show that the U.S. ranks as the third largest consumer of seafood in the world, importing 76 percent of its seafood fare.

Table C.I.2
Annual U.S. Per Capita Consumption of Seafood Products in 1996 to 2004

	Primary Product			
Year	Fresh and Frozen	Canned	Cured	Total
1996	10.0	4.5	0.3	14.8
1997	9.9	4.4	0.3	14.6
1998	10.2	4.4	0.3	14.9
1999	10.4	4.7	0.3	15.4
2000	10.2	4.7	0.3	15.2
2001	10.3	4.2	0.3	14.8
2002	11.0	4.3	0.3	15.6
2003	11.4	4.6	0.3	16.3
2004	11.8	4.5	0.3	16.6

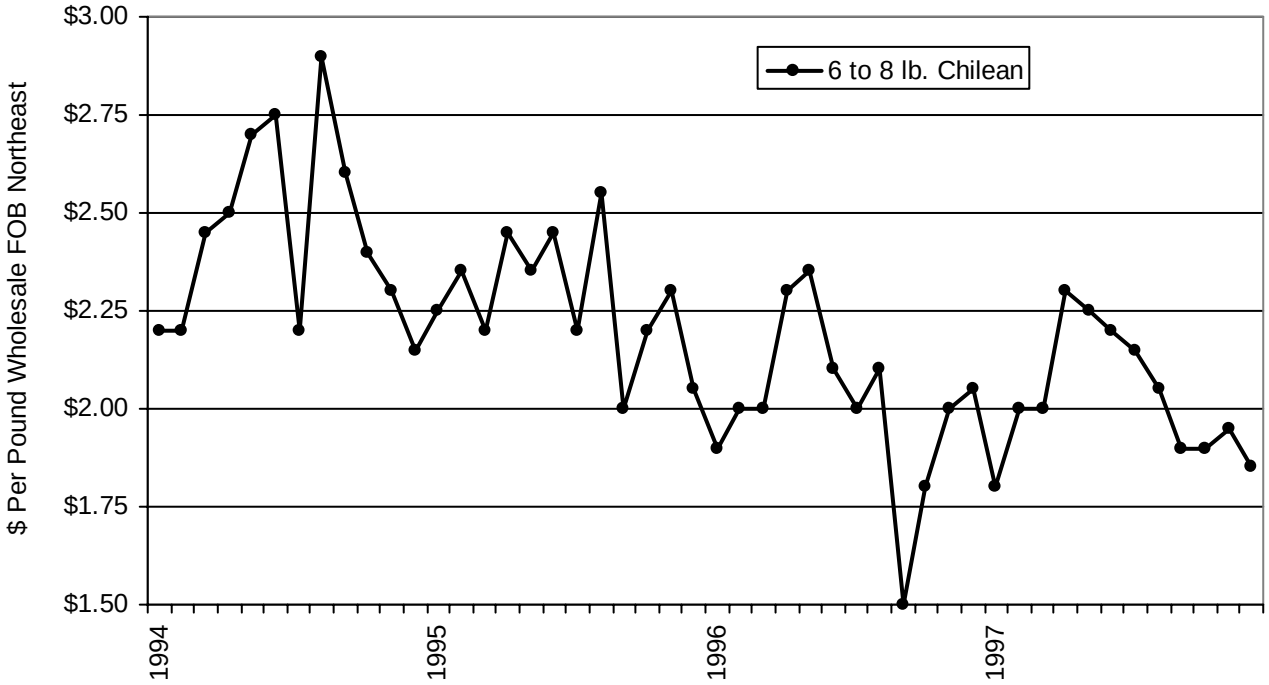
	Species					
Year	Salmon	Sardines	Tuna	Shellfish	Other	Total
1996	0.5	0.2	3.2	0.3	0.3	4.5
1997	0.4	0.2	3.1	0.3	0.4	4.4
1998	0.3	0.2	3.4	0.3	0.2	4.4
1999	0.3	0.2	3.5	0.4	0.3	4.7
2000	0.3	0.2	3.5	0.3	0.4	4.7
2001	0.4	0.2	2.9	0.3	0.4	4.2
2002	0.5	0.1	3.1	0.3	0.3	4.3
2003	0.4	0.1	3.4	0.4	0.3	4.6
2004	0.3	0.1	3.3	0.4	0.4	4.5

	Secondary Product		
Year	Fillets and Steaks	Sticks and Portions	Shrimp, including all Preparations
1996	3.0	1.0	2.5
1997	3.0	1.0	2.7
1998	3.2	0.9	2.8
1999	3.2	1.0	3.0
2000	3.6	0.9	3.2
2001	3.7	0.8	3.4
2002	4.1	0.8	3.7
2003	4.3	0.7	4.0
2004	4.6	0.7	4.2

Notes: 1. The calculation of per capita consumption is based on a disappearance model. The total U.S. supply of imports and landings is converted to edible weight and decreases in supply such as exports and inventories are subtracted out. The remaining total is divided by a population value to estimate per capita consumption. Data for the model are derived primarily from secondary sources and are subject to incomplete reporting; changes in source data or invalid model assumptions may each have a significant effect on the resulting calculation.

Source: NOAA Fisheries (November 9, 2005).

Figure C.I.6
Wholesale Prices For Fresh Atlantic Salmon in the U.S.



Source: International Salmon Farmers Association (1998).

G. U.S. Salmon Market Trends

The 1990's U.S. domestic salmon market was composed of 68 percent food service consumption and 32 percent retail consumption, but the retail market segment is increasing. Two-thirds of the retail segment is purchased through supermarkets (62 percent), followed by fish markets (23 percent) and specialty outlets (15 percent). The trend in both food service and retail sectors is toward a preference for fresh salmon over frozen salmon and a declining market share for canned salmon (Alaska Seafood Marketing Institute 1992). Fresh salmon comprised 65 percent of food service sales and comprised 35 percent of retail sales. Four out of five salmon consumers use fresh salmon. This preference was reflected by the fact that 84 percent of fresh/frozen seafood sales of salmon was in fresh form and only 16 percent frozen.

Alaska, the major producer of wild salmon in the world, is facing the same changes in salmon markets as Pacific Northwest salmon fisheries. Many in the industry agree that to compete on a global market, Alaska salmon will have to move outside the traditional forms of frozen and canned in order to receive higher revenues for their fisheries. Much food consumption has moved to eating away from home or to cooking quick, ready to eat food. This results in greater preparation at the processing sector. This involves more labor and capital input into processing.

The result is a trend for value-adding. Joe Plesha, General Counsel for Trident Seafoods, says that a production trend is definitely emerging with wild salmon (Cherry 2002). "We're like everyone else. We're working as hard as we can to do value-adding with salmon - we're spending a significant amount of resources on it."

Salmon consumption in the U.S. has tripled in the last 10 years due almost exclusively to lower prices, promotion in the retail sector, and year-round availability of fresh, farmed salmon (International Salmon Farmers Association 1998). Some salmon market characteristics are (Archibald and Anderson 1995):

- Retail salmon sales market share is increasing and food service (restaurant) market share is decreasing in the U.S. as prices have come down.
- Cheaper grades of frozen wild salmon (sockeye, pinks, and chums) are ingredient of choice in ready-to-eat meals, salmon burgers, and other mass-produced new products.
- Chile and Canada dominate as farmed salmon suppliers to the U.S. market.
- Americans clearly prefer fresh to frozen salmon in restaurants and upscale retail stores. Otherwise, fresh and frozen are seen as substitutes especially when low price is the sales incentive.
- American consumers, other than in the Pacific Northwest, don't make a distinction between farmed and wild.
- Farmed salmon supplies 80 percent of the U.S. fresh salmon market.
- Approximately 70 percent of U.S. consumers eat salmon at least once per week, however, one third of those Americans eat 90 percent of all salmon consumed.
- Generally, salmon consumption in the U.S. increases with higher income and decreases with household size. It is greatest among those aged 25 to 55 living in the East or West with household of one or two members and some college or college degree.
- While most U.S. salmon consumers list "taste" as the number one reason for eating salmon, health and nutrition aspects are usually second on the list.

Higher valued seafoods are more frequently consumed in restaurants. U.S. consumers aged 29 to 47 spend 23 percent more than the average individual on restaurant dining. This group also has a higher level of per capita seafood consumption than those in other age groups. Chain restaurants, in particular, prefer portion-controlled products which are easy to prepare. This created opportunities for seafood products which are easily standardized. It is expected that aquaculture products, and other seafood products which can be presented in an easy to prepare and highly uniform way, will gain an increased share within these chain systems.

II. SALMON MARKET OPPORTUNITIES

This section is to explain market opportunities for getting the highest possible value from gillnet fishing harvests. Suggestions are offered for product handling and preparation, as well as organizational processes needed to exploit possible markets. A pricing model is described to show how higher end consumer sale price can cover increases in harvester prices.

A. Go-to-Market Costs

The purpose of the analysis is to indicate the ex-vessel price that could be paid in order to cover processing costs, assuming there is a market at expected ex-processor price. Any lower ex-processor price would, over time, send signals to the processor to discontinue that product line. The analysis is useful in that it allows harvesters, processors, and marketers to decide the ex-vessel price that can be paid facing certain market conditions.[1]

Using this Study's survey results and communication with other Pacific Northwest salmon processors, processing costs and expected retail prices of selected product forms were modeled (Table C.II.1).[2] In the models, the ex-vessel price is a backwards calculated quantity. Example consumer retail prices are from market research. Then, ex-processor prices are estimated based on species, timing of harvest, and expected world supply market conditions. Next, processor costs and yields are used to arrive at an input purchase price. This results in a chain of calculations that translate consumer prices to harvester prices.

Fees, tendering costs if applicable, processing labor, and other variable and fixed costs add about $1.00 to the cost of producing a primary salmon product. As the amount of processing increases, the yield for the primary product decreases. Therefore, decisions on how much can be paid at the harvesting level have to be made based on the expected recovery for the product form, the cost of the added processing, and the expected wholesale price for the final product. Products requiring more intensive manufacturing do not necessarily bring in higher total gross or net revenues to a processor.

Gillnet fishery harvests have traditionally been delivered to existing processing facilities without much consideration for handling. Both harvesting and processing capabilities need to keep pace with competing production standards and be upgraded. Buying and processing capacity may not be available in places where landings are made. A more thorough review is needed to:

1. Estimate the need for upgrading harvesting capabilities (selective gear, cooling, etc.) to meet management and quality standards.
2. Inventory existing processing capabilities specific to landing areas.

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1. The results should be considered boundaries for the shown product forms useful for understanding the seafood industry. More in-depth analysis is needed for financial planning purposes.
2. The analysis is both based upon existing accounting models and on new interviews with the processors and distributors. The production margins should be considered averages. Each situation is different; however the general overview should provide information on price spread within the industry.

Table C.II.1
Salmon Fisheries Product Conversion Model

Fishery: All	Whole	Ready for Purchase Packaging										Ready to Eat Portions					Specialty Products					
Product Form: Whole, Ready to Eat Portions, Specialty Products	Spring Chinook Head On	Steaks					Fillet Steaks - Skin Off					Spring Chinook					Canned (7 1/2 oz) or Vacuum Packed			Smoked and Vacuum Packed		
		Net			Troll		Net			Troll			Net			Troll	Net			Net		
		Coho	Chinook	Sockeye	Chinook	Coho	Coho	Chinook	Sockeye	Chinook	Coho	Chinook	Coho	Chinook	Sockeye	Chinook	Coho	Chinook	Sockeye	Coho	Chinook	Sockeye
Ex-vessel price /2,3	3.77	0.91	1.33	0.80	3.00	1.08	0.91	1.33	0.80	3.00	1.08	3.77	0.91	1.33	0.80	3.00	0.91	1.33	0.80	0.91	1.33	0.80
Fish fees:																						
.0315 ad valorem management fee	0.119	0.029	0.042	0.025	0.095	0.034	0.029	0.042	0.025	0.095	0.034	0.119	0.029	0.042	0.025	0.095	0.029	0.042	0.025	0.029	0.042	0.025
.05 per lb restoration and enhancement	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
.05 per lb marketing assessment /4	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Total fees	0.219	0.129	0.142	0.125	0.195	0.134	0.129	0.142	0.125	0.195	0.134	0.219	0.129	0.142	0.125	0.195	0.129	0.142	0.125	0.129	0.142	0.125
Tendering cost or buyer /5	0.15	0.15	0.15	0.15	0.00	0.00	0.15	0.15	0.15	0.00	0.00	0.15	0.15	0.15	0.15	0.00	0.15	0.15	0.15	0.15	0.15	0.15
Total landed cost	4.14	1.19	1.62	1.08	3.19	1.21	1.19	1.62	1.08	3.19	1.21	4.14	1.19	1.62	1.08	3.19	1.19	1.62	1.08	1.19	1.62	1.08
Egg yield (percent) /6		5%	4%	4%	0%	0%	5%	4%	4%	0%	0%		5%	4%	4%	0%	5%	4%	4%	5%	4%	4%
Green egg credit @ $5.00/lb coho,		0.25			0.00		0.25		0.20				0.25			0.00	0.25		0.20	0.25		0.20
$4.50/lb Chinook and chum,			0.20	0.20		0.00		0.18		0.00	0.00			0.18	0.18			0.18			0.18	
$2.50/lb steelhead /7																						
Waste product sale @ $0.06 lb /8	0.01	0.02	0.03	0.03	0.02	0.02	0.03	0.03	0.03	0.02	0.02	0.03	0.03	0.03	0.03	0.02	0.03	0.03	0.03	0.03	0.03	0.03
Yield for primary product (percent)	88%	62%	58%	57%	68%	72%	47%	45%	44%	62%	63%	57%	46%	45%	44%	62%	45%	45%	45%	43%	43%	43%
Raw product cost of primary product	4.70	1.92	2.80	1.89	4.70	1.69	2.53	3.60	2.44	5.15	1.93	7.26	2.58	3.60	2.44	5.15	2.64	3.60	2.39	2.76	3.77	2.50
Variable costs:																						
Direct labor	0.15	0.65	0.65	0.65	0.50	0.50	0.65	0.65	0.50	0.50	0.50	1.00	1.00	1.00	0.50	0.50	1.10	1.10	1.10	1.75	1.75	2.50
Packaging and material	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.60	0.60	0.60	0.50	0.50	1.50
Other costs	0.05	0.10	0.10	0.10	0.05	0.05	0.10	0.10	0.05	0.05	0.05	0.10	0.10	0.10	0.05	0.05	0.30	0.30	0.30	0.50	0.50	0.60
Total variable costs	0.30	0.85	0.85	0.85	0.65	0.65	0.85	0.85	0.65	0.65	0.65	1.20	1.20	1.20	0.65	0.65	2.00	2.00	2.00	2.75	2.75	4.60
Raw product and variable costs	5.00	2.77	3.65	2.74	5.35	2.34	3.38	4.45	3.09	5.80	2.58	8.46	3.78	4.80	3.09	5.80	4.64	5.60	4.39	5.51	6.52	7.10
Contribution margin to fixed costs /9	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Ex-primary processor price of primary prod.	5.40	2.89	3.82	2.91	5.73	2.72	3.50	4.64	3.26	6.18	2.95	8.84	3.90	4.99	3.28	6.18	4.76	5.79	4.79	5.63	6.71	7.50
Sales of green eggs and waste /10	0.01	0.27	0.22	0.22	0.02	0.02	0.28	0.21	0.23	0.02	0.02	0.03	0.28	0.21	0.21	0.02	0.28	0.21		0.28	0.21	
Total revenues (equals total variable plus fixed costs) /11	5.40	3.17	4.05	3.14	5.75	2.74	3.78	4.85	3.49	6.20	2.98	8.86	4.18	5.20	3.49	6.20	5.04	6.00	4.79	5.91	6.92	7.50
Marketing margins																						
Brokerage (2%)	0.11	0.06	0.08	0.06	0.11	0.05	0.07	0.09	0.07	0.12	0.06	0.18	0.08	0.10	0.07	0.12	0.10	0.12	0.10	0.11	0.13	0.15
Distribution (10%)	0.54	0.29	0.38	0.29	0.57	0.27	0.35	0.46	0.33	0.62	0.30	0.88	0.39	0.50	0.33	0.62	0.48	0.58	0.48	0.56	0.67	0.75
Retailer (40%)	2.16	1.16	1.53	1.17	2.29	1.09	1.40	1.86	1.30	2.47	1.18	3.53	1.56	2.00	1.31	2.47	1.90	2.32	1.92	2.25	2.68	3.00
Customer price for primary product	8.20	4.40	5.81	4.43	8.71	4.13	5.32	7.05	4.96	9.39	4.49	13.43	5.93	7.59	4.99	9.39	7.23	8.80	7.28	8.56	10.20	11.40

Notes:
/1 Raw egg prices have declined sharply over the last two years. For example, pink and steelhead prices presently are about $1.00 per pound and in some cases were as low as $0.10 per pound.
/2 All calculations are based on a delivery weight. These are round pounds for net caught and dressed pounds for some troll caught. Net caught ex-vessel prices use example non-Indian Columbia River fishery in 2004. Troll caught uses ex-vessel annual prices for deliveries to Astoria in 2004.
/3 Ex-vessel prices are expected long-term prices based on historic prices of similar species.
/4 Assessment fee $0.05 paid by harvester is included in ex-vessel price. Another $0.05 paid by processor. These charges may not be appropriate in all cases, so reduce costs by this amount if no assessment fees.
/5 Not all inland fisheries include a tender or buyer/gatherer. If not, reduce costs by this amount.
/6 Egg yield is on average fish (male and female).
/7 Eggs are a credit which is worth $4.50 and $5.00 per lb green. Egg credit per lb ($0.25 for coho, $0.18 for fall Chinook) is adjusted for overall yield.
/8 Some processed waste products sold for $0.06 per pound. At 75% overall yield, on a round pound basis, this would generate $0.015 of revenues, at 50% yield these sales would generate $0.03, etc. This may not be appropriate in every area.
/9 Contribution margin includes financing, administrative costs, marketing and sales staff, etc. This item is sometimes called "plant overhead costs."
/10 Eggs' primary product is for the Japanese market. There are also European markets. Bait eggs may also have a market. Increased yield of 5% is used to offset the bait egg gain.
/11 In general, the processing plant sells its goods at the processor's door. If a broker is involved, this adds about 2% to the cost of the product. The distributor will add 8% to 15%, depending on the cost of transportation. The retailer margin is generally 35% to 40% of the distributor price for fresh products and specialty canned or vacuum packed products. General canned goods retail margins may be as low as 16%, but will generally be about 20%.
/12 Processing costs derived from variable and fixed costs from Fisheries Economic Assessment Model (FEAM).

3. Evaluate capital requirements of upgrading vessel and processing capabilities.
4. Review existing costs of harvesting salmon by existing means. Are there cost savings that may be introduced? Will consolidation decrease fixed and therefore overall per unit costs?

A starting point for the review would be to develop representative budgets for the upgrading costs. Improved handling techniques include immediate cooling following catch. Cooling techniques could be refrigerated sea water (RSW) systems that cost upwards of $5,000 per vessel retrofit, spray foam insulation of rehabilitated holds costing $1,500 per vessels, or using plastic bag hangers in totes at nominal costs. Any investment in cooling capability may add $1,000 per year in vessel repair and replacement budget and an estimated $800 for ice at 1,000 pounds per trip at $60 per ton for 27 trips per year. The improved handling at this production rate means adding ice capability will increase costs an additional $1,800 per year. At a per pound cost for the typical vessel, this is $0.13 per pound of salmon. Processors note that they may be willing to pay $0.10 to $0.15 per pound for cooled fish. Therefore, the harvester may question whether it is worth the extra effort and costs for better handling before such an investment takes place. Close examination of the bottom line for participating in marketing programs by individual harvesters is warranted.

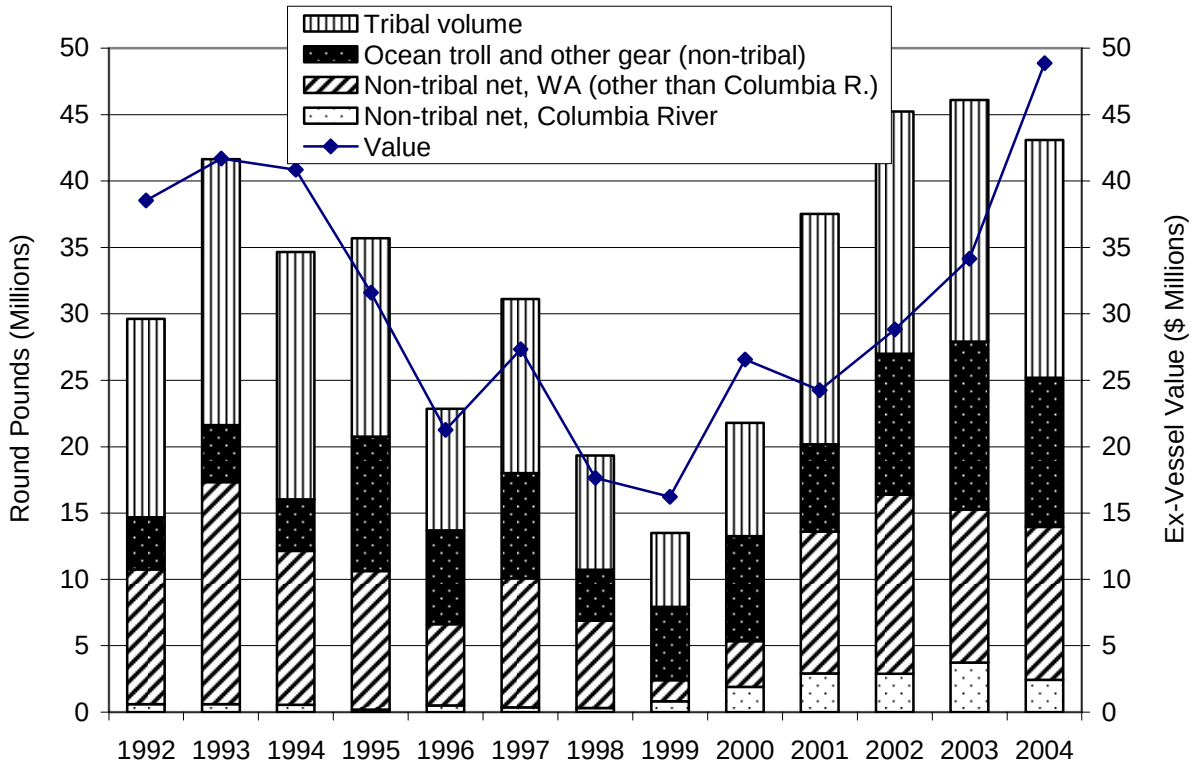
B. Marketing Opportunities

As previously mentioned, Columbia River gillnet caught salmon enter a fully developed market that has readily available salmon substitutes. Even when combined with all tribal and non-tribal West Coast wild capture salmon, it represents about two percent of salmon (Chinook, coho, sockeye) destined for the U.S. fresh/frozen market and less than one percent of the salmon (chum, pink) going to the U.S. canned market. Wild capture from all origins (Alaska, etc.) supplies only 42 percent of total (wild and farmed) salmon production. Most farmed salmon consumed in the U.S. are imports from Norway, Chile, and Canada.

Farmed salmon have a vulnerable reputation for problems with color and disease. While some consumers appreciate their fitness features, the product is being characterized as dangerous by environmental organizations. Customers of farmed salmon products have to be warned at the point of sale that color is from additives.[1] The normal bright pink of wild capture comes from the fish eating krill, a tiny crustacean common in the ocean. The farm fish, because of their proximity to each other, are given antibiotics to keep them from growing ill and infecting wild fish runs.

1. The U.S. Food and Drug Administration requires retailers to place labels with notice of the color additives on the individual packaging or on cards in the freezer cases where the fish are displayed. There has been lax enforcement of this requirement (GAO 2001).

Figure C.II.1
U.S. West Coast Salmon Landing Volume and Value Trends for 1992 Through 2004



Notes:
1. Value is in 2004 dollars adjusted using the GDP implicit price deflator developed by the U.S. Bureau of Economic Analysis.
2. Landings are for Washington, Oregon, and California.
3. Ocean other gear is mainly commercial pole in California. Non-tribal net for Washington other than Columbia River includes a small amount of ocean net landed in Oregon and California.
4. Tribal landings include Pacific Ocean, Puget Sound, and river harvests. In some years, there is a small, inriver Klamath River treaty commercial fishery that is not included in this analysis.

Source: PacFIN annual vessel summary Nov. 2004, Feb. 2005, May 2006 extractions.

There are only limited opportunities to differentiate wild caught salmon in general and Columbia River gillnet harvested salmon in particular that could be used to fetch higher prices. There are:

- Niche markets using ties to historical and cultural awareness,
- Early entry into fresh markets that are sensitive to the quality and healthiness of wild capture, and
- Specialty canned and smoked products.

To produce for these markets, programs will have to be established that generate consistent and quality products in and above what is required by HACCP.[1]

Study survey results indicated that processors and buyers would be willing to work with harvesters on an organized basis. The main concerns of processors are dependable timing and proper handling. Processors would be willing to pay bonuses with a guaranteed pre-season price and agreements for delivery timing and handling standards. While there are some limited new marketing opportunities, the bulk of the harvest is not going to bypass existing markets. A broad ranged program for meeting new quality standards needs to be developed for keeping up with existing processing and distribution requirements. The program would have to include working within all segments (harvesting, processing, and marketing) of the fishing industry, including tribal interests. It would require professional staff knowledgeable in:

- Developing seafood manufacturing standards,
- Devising advertising campaigns and promotional events,
- Public relations and education,
- Advocating governmental processes for resource management, and
- Understanding processes for bringing together similar efforts with commodity commissions (such as the Puget Sound Salmon Commission and Oregon Salmon Commission) and associations (such as the Alaska Seafood Marketing Institute).

A new program will require financial support from outside sources and/or fees and assessments within the industry. Further planning work is necessary to determine policies to support new programs within the fishing industry.

C. Market Program Development

The seafood processing industry is very competitive. Processors sell within a global market with a strong foreign market share.[2,1] The nature of open ended negotiations that occur with

1. Seafood safety in the U.S. is regulated by the Food and Drug Administration. A program initiated in 1997 "requires seafood processors, repackers and warehouses--both domestic and foreign exporters to this country--to follow a modern food safety system known as Hazard Analysis and Critical Control Point, or HACCP."
2. Trade actions by the U.S. and European Communities to protect their domestic industries from "unfair" competition has had mixed results. Removing protectionist policies through the General Agreement on Tariffs and Trade (now implemented by the World Trade Organization) and the North American Free Trade Agreement is in conflict with certain industries seeking relief from product imports that are undercutting prices. Industries can petition the U.S. International Trade Commission (USITC) to begin an anti-dumping investigation for

harvesters leads to skepticism that a fair ex-vessel price is being paid. It appears from the harvester perspective that there is collusion for holding down ex-vessel prices and that processors are getting more than their fair share of margins. This perspective was brought to light in the long-running civil trial in Anchorage, Alaska Superior Court where Bristol Bay salmon fisherman sued packers for coordinated price fixing.[2] Evidence shows the processor end of the industry has suffered along with the processors. Smaller companies have gone out of business and there is consolidation to plants that have volume production using modern equipment for manufacturing and packaging.

Any program developed to produce products to compete with existing and emerging markets has to be comprehensive. Table C.II.2 is a listing of possible elements of such a comprehensive program. Each element needs more review as to its applicability, cost-effectiveness, and practicability, but it does show how extensive the involvement needs to be to make even small shifts in marketing induced price changes.

The essence of any program is to increase the harvest value and to increase the profitability for both harvesters and processors. There are several key points that need to be considered in any prospective program. These are:

- First sales marketing (consumer direct or processor delivery)
    - Develop branded marketing programs; branded marketing won't succeed unless the product is as good as it's claimed.
    - Higher quality deliveries; branded marketing of tribal salmon is hampered by inconsistent quality.

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imposing countervailing duties to counteract subsidization of foreign producers by parent countries. Subsidization can occur through capital tax incentives, bank loan guarantees, regional development grants, and the like. Maine farmed salmon producers were successful in 1990 and a 2.3 percent countervailing duty along with a 26 percent anti-dumping duty was placed on Norwegian fresh salmon entering the U.S. This did not solve the problem, because as Norway moved out of the U.S. market, Chilean and Canadian producers replaced the market share. A new petition against Chilean producers backed by State of Washington farmed salmon businesses was also recently successful in a finding by the USITC that four companies should be assessed anti-dumping duties. There were 13 other Chilean companies cleared. The proposed anti-dumping duties are low, indicating that just because they grew too much fish in the short run and sold it at a loss, is not necessarily adequate proof for imposing duties.

1. Trade embargoes on seafood products have been used in the past when production has been shown to negatively impact a marine resource. The most well known example is tuna caught with gear that kills dolphins. Trade embargoes are politically controversial and have only been used as a means to force other nations to comply with environmental views of the U.S. The goal has been to encourage other nations to enter into conservation and management agreements rather than to protect U.S. traded goods from foreign competition. There are several laws allowing the imposition of unilateral trade sanctions by the U.S. against offending nations, including the 1971 Pelly Amendment to the 1967 Fisheries Protective Act, the 1976 Magnuson Fishery Conservation and Management Act, the 1988 Marine Mammal Protection Act, and the 1990 Driftnet Act. Embargoes are sometimes threatened but seldom used when negotiating free trade act treaties or species specific resource sharing treaties, such as the 1985 U.S. - Canada Pacific Salmon Treaty and subsequent annexes most recently amended in 1999.
2. Lawyers representing a class of about 4,500 current and former Bristol Bay fishermen accuse nearly a dozen fish packers and Japanese importers of unlawfully conspiring to drive down red salmon prices to Bristol Bay gillnetters in the early 1990s. The packers and importers denied any price fixing. The lawyers were seeking more than $1 billion in damages. The jury decision on May 23, 2003 ruled against the fishermen.

Table C.II.2
Elements of a Salmon Fisheries Marketing Program

Harvesting	Processing	Marketing
Accountable standards for: - Harvesting (minimum handling standards) - Certification of time and temperature from harvest to buyer	Accountable standards for: - Processing (enforced standards) - Certification of time and temperature from fisherman purchase to market	Accountable standards for: - Marketing (money back guarantee) - Certification of time and temperature from distributor to shelf
Harvesting cooperative - Pooling of capacity with distribution of net profits by formula - Market program financial support assessments	- Draw upon existing capacity and processors strengths - Market program financial support assessments - Develop through labeling new products to differentiate treaty salmon fisheries	Establish brand and label program - Historical and cultural labels - Certification of sustainability - Pollution free
Boat equipment and human capital upgrade - Capital investment fund - Rationalization of number of boats required in specific areas ◦ expected revenues need to be compared to overall costs ◦ education and training	Develop processing capacity for full range of products	Region to be covered - Pacific Northwest tribal - Product and area specific
Handling of product - Required standards - Training on procedures - Proper procedure to cool eggs while keeping dry - Immediate catch cooling ◦ cooling with ice bags, insulated holds, RSW, etc. ◦ investigate cost of alternative methods to supply ice (local production, mobile production, deliveries from central areas)	Direct harvester sales - Educate harvesters - Provide information Product development research - Value added - Ready to eat - Specialty packs	Marketing information - Historical and cultural identification - Fishery opening dates for market anticipation

- More profitable second sale products[1]

    - More profitable processor products would be in everyone's interest, but adding value adds costs too. Adding value at the processor level doesn't necessarily add profits. Without added profits, ex-vessel prices cannot be expected to increase.
    - Operating marketing programs and developing new products cost a lot of money and there are a lot of risks for success. Just because there is investment does not necessarily mean the programs and products will succeed.

The key to any successful marketing program will be the willingness of existing harvesters to participate and work in a collective manner. Broad participation could be fostered through harvesting cooperatives.[2] The Select Area Fishery Evaluation Project (SAFE), while founded on salmon production goals, could be a basis for furthering market goals.

1. Barriers to Overcome

The following are some very general observations on the state of the Pacific Northwest salmon industry.

- Quality is not standardized. The Pacific Northwest fisheries harvest a variety of salmon species using a variety of methods from troll caught salmon to net caught pink in terminal fisheries. Salmon carcasses as well as eggs become the major product of these fisheries. Processors and ultimately customers are not now assured products are meeting certain minimum handling standards. Consistent high quality is key. Bad products can destroy years of hard work to build reputations.

- Historical/cultural awareness. The historical/cultural connection to utilization of fish resources can be an advantage in marketing of salmon products. Some consumers may

1. Secondary products are generally associated with re-manufacturing of outputs from a primary processor. Example products are frozen, breaded, individual serving packages. The value added from processing landed fish differs depending on the final seafood product form. Some salmon seafood products are sold fresh or frozen whole with a minimal amount of processing. However, most of the shipped products include a fair amount of processing, such as filleting. Intensive processing, such as smoking and canning, is also carried out by primary processors, but can also be done by re-manufacturers that receive individually quick frozen (IQF) blocks from primary processors. The more intensive the processing, the higher contributions are being made to local economies from worker wages and other processing expenditures.
2. Formation of harvesting cooperatives raises concerns about compliance with antitrust law (Sullivan 2002). The fundamental U.S. law at issue in connection with collective harvesting arrangements is the Sherman Act, Section 1 of which outlaws contracts, combinations, or conspiracies that unreasonably restrain trade (15 U.S.C. Paragraph 1). Courts have generally classified cases involving agreements among competitors into two categories, depending on the practice involved: "per se" violations and "rule of reason" violations. Collective harvesting arrangements among fishermen have commonly been considered to fall within the "market allocation" class of per se violations that are illegal unless the participants qualify for an exemption. As it happens, the Fishermen's Collective Marketing Act (FCMA) extends an antitrust exemption to "persons engaged in the fishing industry . . . collectively catching, producing, preparing for market, processing, handling, and marketing their fish." Obtaining the benefit of the FCMA exemption is conditioned upon close compliance with the Act's requirements for association membership criteria. Under circumstances present in many U.S. fisheries, harvesting cooperatives may operate legally without the FCMA exemption.

be willing to pay extra knowing the product is "wild" and harvested by people with cultural/historical connections to the resource.

- Existing processing and marketing. The Pacific Northwest has presence of some of the most aggressive fish processor and distribution companies in the U.S. Trying to reestablish new marketing avenues can be very costly and may be futile. Existing processors and marketers should be included in any program to improve products prepared and delivered to customers from fisheries. An ongoing program needs to be developed that feeds information consistent with their market requirements.

- Heterogeneity and independence of participants. Harvesters have long established fishing grounds and harvesting methods. The fishing grounds are dispersed, and little infrastructure exists, such as ice facilities, at all landing ports or buying stations. There is no organized transportation system for hauling deliveries to centrally located processing plants.

2. Critical Success Factors

Critical success factors for taking advantage of new marketing opportunities or shielding participation in existing markets are elements whose presence or satisfaction are essential to its feasibility.

- Are harvesters willing to collectively work together and pay for new programs that will have some success risk?

- Is there a willingness to pay by harvesters for the costs of a marketing program, product development, and operating a quality assurance program? How much per vessel or pound could be tolerated?

- Are harvesters willing to pay the added costs for cooling and handling at the time of catch? And will they be rewarded for these costs in the market?

- Are harvesters willing to be constrained for only selling to certain buyers who are participating in cooperative marketing programs?

- Are processors willing to develop new products and distribute within certain markets? How much would processors be willing to be assessed to participate in a cooperative marketing program?

A more thorough study is needed to get feedback on the willingness to change existing practices in order to plan for marketing program participation.

3. Recommendations

Investigations have resulted in recommendations that are separated into what can be done immediately and how to plan for future actions to take advantage of marketing opportunities.

The future actions would depend on the desired level and extent of a cooperative marketing program.

1. Provide infrastructure requirements for ice buying and transportation facilities at remote locations so there are universal services available to all harvesters.

2. Emphasize the importance of harvester handling and ice delivery systems to cool salmon immediately after harvest. Training programs on catch, handling, storage, and delivery could have immediate assignments to existing organizations like Washington and Oregon Sea Grant.

3. Establish harvesting and selling relationships preseason with buyers and processors. Buyers and processors need to know when and how much catch to expect so they can line up their own markets before seasons begin.

4. Some harvesters have already been successful in direct marketing of their catch. However, product quality varies and there is not much advertising. Training programs could be used to assist harvesters better utilize this market. Exposure to end consumers could be instructional and generate references to processors when customers need custom processing (filleting, freezing, etc.).

5. Graduating into large scale seafood product processing, inventorying, packaging, and distribution cannot be expected in the near term. There are established market channels that depend on large volumes and consistency that will take time to broach. However, there are niche markets with especially restaurants and other businesses using fresh/frozen products that could be served. This market depends on an early entry, high quality salmon, so the bulk of harvests cannot be used in this market. Negotiations with the niche market buyers would need to be concluded as much as one year in advance. It should be expected that marketing costs such as slotting fees and chef training would have to be paid. There would have to be incentives (or enforcement) for harvesters to deliver a catch graded for those markets. Certainly a price premium would be an incentive to harvesters.

6. Promotional material about historical gillnet salmon fisheries would be useful to buyers (processors, restaurants, direct purchase customers). This would include such basic information as a calendar of species availability and harvester contact information. The promotional material could be published on the Salmon For All (SFA) website.

Appendix D

Economic Analysis Methods and Factors

ECONOMIC ANALYSIS METHODS AND FACTORS

A. Introduction

The Study's overall goal is to evaluate the Select Area Fishery Evaluation Project (SAFE or Project) using economic considerations.[1] There are three analysis approaches used: determining net economic value (NEV), calculating regional economic impact (REI), and undertaking a cost-effectiveness analysis (CEA).

The NEV is the sum of benefits minus costs. Benefits minus costs for the commercial fishery varies by area and time wherever SAFE produced fish are caught. Proxy factors suggested by other studies are adopted to make these estimates. Benefits minus costs for recreational angling assume net willingness-to-pay (WTP) estimates from other studies. The NEV analysis costs include all SAFE system production and management expenditures. NEV estimates utilized in this report should be viewed as general indicators for comparing alternatives. Specific

1. Most economic analysis will be incomplete because not all changes in long range values, nonfinancial values, and external costs are addressed. Long range value changes are those that can be expected to occur after a plan's actions are absorbed. (When these future changes are included, the revenue or costs streams are reduced to annual net present values in order for them to be used in the analysis. The choice of the discount rate to use in calculating net present value is controversial [Hanley and Spash 1993].) Because of the uncertainty in knowing these adjustments, analysts generally assume the change in the short term will approximate what happens over the course of the long term. Short term value changes are the immediate gains or losses to be expected to occur if the status quo is changed.

   Economic values can also be nonfinancial (no market information exists), as well as financial (prices exist from markets where traded goods are for well-defined property rights that are exclusive, transferable, and enforceable [Panayotou 1992]). For example, some people (termed non-users) who do not actually fish for salmonids may still place a value on the existence of the resource. Deriving this value must rely on expressed preference information (either real or hypothetical) gathered through surveys that address the particular setting and policy issues needing decisions. Because of lack of budget resources to do a more comprehensive analysis, the values of the non-users are generally either not included or are imputed from other studies. Such values can play a significant role in determining future programs related to the management of a natural resource and should be a criteria in any policymaking, but should be used carefully in the decision-making because of the difficulties in measuring such values.

   Nonmarket values include livability considerations, and livability is becoming more important as Pacific Northwest economies mature. Economies are becoming more dependent upon high-technology industries, which require a highly educated, highly skilled workforce. High technology firms do not have the usual locational requirements for being near markets or near manufacturing inputs, and as such, can decide to make capital investments based on other criteria. One of the competitive advantages in the Pacific Northwest is livability relative to other areas that makes it unnecessary to pay premium compensation for a degraded environment or for overcrowding. Scenic and productive river basins will play an important role in drawing the major components of economic growth: capital and a highly skilled work force.

   External costs are also not usually evaluated. Prices of products or services sold in the open market often do not reflect all the costs of making the product or providing the service. External costs are passed on to others in society, often in the form of dirty air, polluted water, or less biodiversity. External costs are difficult to identify and hard to quantify, but they can significantly decrease the value to society of commodity production. Although it would not be easy to allocate these costs to resource management plan strategies, they could make up a significant part of the costs of producing commodity outputs and should be evaluated along with market and nonmarket values.

application of the models for certain program effects or in selective geographic areas may not be appropriate. Some would argue that because augmentation hatcheries are to offset dam construction impacts that hydropower values should also be in the NEV equation. Similarly, it could be argued that other opportunity costs for land and water use should be used in the NEV equation.

The REI analysis has four components: (1) the economic activity from commercial harvests and recreational angling attributable to SAFE production; (2) the economic activity from administering the program; (3) the economic contributions made by the gillnet fishery for which SAFE production is just a partial source of revenues; and (4) the economic contribution from recreational angling on the river and from ocean trips originating in the Astoria and Ilwaco area. The REI calculations are made for the local economy (approximated by Clatsop and Pacific counties) and for the regional economy (approximated by Oregon and Washington states) for the components that have information about where the dollar flows occur.

The CEA provides itemizations sufficient for choosing among different production strategies to achieve least cost operations. It also provides a measurement to compare the SAFE to several other Northwest Power and Conservation Council (NPCC) salmon recovery projects designed to achieve similar objectives.

A discussion of substitution effects for commercial and recreational user groups is offered. The gillnet fishery permittees participate in other fisheries whose harvests would probably occur anyway. Degrees of likelihood for substitution are used to help describe magnitude of these effects. For the recreational fisheries, it could be that a proportion of anglers would fish for other target species if salmon was not available. The Study also addressed whether the anglers were resident within the economies being analyzed. Fishing expenditures can be considered as coming from disposable income, which would be spent on other local recreational opportunities if not spent on fishing. It can also be argued that if the angling opportunity was not available, residents might travel elsewhere in recreational pursuits, thereby taking money out of the economy.

Fishery resources in the Pacific Northwest provide all types of values to society. This includes values that can be measured by those that use the resources as well as values for those that do not use the resources. Measuring values for the non-users is much more difficult because there are no traditional market exchanges. The non-users have to be asked their hypothetical WTP to maintain the resource. For the purpose of this Study, values derived from the act of fishing (by both recreational and commercial interests) are assessed quantitatively and non-user values are only qualitatively discussed.

Estimates of NEV and REI from recreational and commercial fishing are made using factors and procedures developed by management agencies, such as Oregon Department of Fish and Wildlife (ODFW) (Carter 1999), Pacific Fishery Management Council (PFMC) (2004), and NOAA Fisheries (2000). The economic analysis relies heavily on the parameters and models developed by Radtke et al. (1999). Estimates for CEA use procedures developed by the NPCC Independent Economic Analysis Board (IEAB) (2004).

B. Net Economic Value

The following sections discuss how NEV may be calculated when related to effects from the SAFE. The sections are for commercial fishing and resource user recreational fishing. A third section below discusses passive use values.

1. Commercial Fishing

To compute the NEV from commercial fishing, the costs of harvest (fuel, repairs, labor, etc.) should be subtracted from the gross revenues. Because the fishing season is of short duration, most fishing boats are not limited to salmon fishing. The investment in boat and gear is also used for other fisheries. Also, at low levels of total salmon harvest and with small incremental changes in salmon production, it is often argued that any increased harvest could be taken with almost the same amount of labor, fuel, ice, etc. as before. Since the current fisheries (both the harvesting sector and processing sector) are greatly overcapitalized, in use of fixed and operating capital as well as labor, this is a plausible assumption. This assumption implies that almost no additional costs are involved and gross benefits are close to net benefits.

Generally, any valuation of salmon species involves a geographic area and a salmon species for which there are many substitutes. In such cases, the demand curve is relatively flat. That is, if consumers are faced with a rise in the price of one type of salmon in one area, consumers may shift their consumption to an alternative salmon or some other protein product. In such cases, there are no extra benefits (or consumer surpluses) that could be counted resulting from consumers' willingness to pay different prices for a specific salmon product. Therefore, most economic valuations involving salmon will center on the benefits that a producer receives (or producer surpluses) from the harvesting and processing of salmon.

The assumption of full employment is implicit in most benefit and cost analysis. But unemployment and excess fishing capacity, both transitory and chronic, seem to prevail in many Pacific coastal communities dependent on commercial fishing. Changes in markets or fishing opportunities may make it necessary for people and capital to change occupations and/or locations. Various factors make it difficult for this to happen quickly enough to prevent a period of unemployment and idle capacity.

The Water Resources Council (1979) suggests that when "idle boats" are available, the only NEV will be the operating costs. Rettig and McCarl (1984) make recommendations that commercial fisheries NEV's range from 50 to 90 percent of ex-vessel prices.[1] Huppert and Fluharty (1996) utilized only the harvesting ex-vessel price and concluded that "All of these estimates are at or below the 50 percent net earnings rates suggested by Rettig or McCarl

1. Using ex-vessel value as a basis to estimate "net value" for tribal harvest may not apply. Chronic underemployment of human and capital resources in rural areas on tribal lands may result in very low incremental costs resulting from increased harvest opportunity. Other studies have suggested that the average cost increase with increased harvest opportunities may be two to nine percent (Barclay and Morley 1977). A two percent cost was utilized by Meyer in the Elwha Study (Meyer et al. 1995).

(1984)." Because primary processing is an integral part of producing salmon, a portion of the primary processor margins should also be used to calculate the NEV of commercial fishing.[1]

In periods of reductions, the 90 percent rule would be appropriate. However, if the total salmon harvest increases, it might not be appropriate to use the 90 percent level. A more appropriate level might be the 50 percent level [the lower level recommended by Rettig and McCarl (1984)]. In a situation where new resources (capital and labor) were needed to harvest and process a greater amount of salmon, the actual additional costs of harvesting and processing would have to be deducted from the ex-vessel price and the processors' margin in order to arrive at the NEV of additional salmon harvest.

Because it is difficult to collect data on the commercial salmon fishing industry for specific areas and specific gears and almost impossible to compare such estimates on a wide geographic and industry basis, a general guidance may be to present information on an ex-vessel basis (properly defined so as to be comparable) and on a first level primary processing basis. (This being the minimal amount of processing required to move the fish out of the region - dressing, icing, packing, etc.) The first level processor basis should be used because in many areas tendering and other costs and incentives (such as year-end bonuses) may not reflect the actual ex-vessel prices. It may also be argued that the first level processing in any area is inseparable from the harvesting component.

For this analysis, in order not to complicate the presentation, a 70 percent margin is used to represent an "average" NEV for commercial salmon harvested. The 70 percent margin is applied over a range of annual prices. The remaining 30 percent represents additional expenses of harvesting and primary processing required to produce a consumer product from Columbia River Basin anadromous fish runs. This was the same approach used by Radtke et al. (1999), so it was only necessary to update the unit values for this Study's analysis.

2. Recreational Fishing

The recreational fishing economic values are related to the act of fishing. A fishing act is generally defined as an activity carried out on a per trip or per day basis. The values adopted for this Study are from Radtke et al. (1999). Those values were from compilations of other various studies brought together to establish comparable levels for what people would be willing to pay for the fishing experience. Researchers refer to the method of relating values in one fishery and setting to another as a benefit transfer approach. Each recreational fishing experience may create its own value based on the species, geographic area fished, and other variables. The value may or may not be similar to another experience.

1. Processor margin is the difference between their purchase price, ex-vessel price, and their sales price. In many small coastal communities, there are no substitutes for the processor involved in the primary processing of salmon. Much of the salmon is partially processed on board the boat. For these reasons, the harvesting and primary processing is included. Wholesale and retail margins are not included. For retailers selling seafood, there are also a host of substitutes available.

3. Passive Use Values

Economic value represents what people would be willing to give up (pay) in exchange for a good or service. This definition describes an anthropocentric view of value, that is, value to people (Goulder and Kennedy 1997). For a fishery resource to have economic value, people must be willing to give up other valuable resources (which can be represented by money) in order to utilize the fishery resource. Clearly this makes economic value a function of people's preferences and their ability to pay.

When measuring economic value, it is not necessary to know why people value a resource (e.g., for nutritional, biological, or recreation reasons), but rather how much they value it relative to other things (Tietenberg 1996). This makes it clear that economics is an appropriate tool when the objective is to allocate scarce resources. For example, if something of value must be given up to save native fish populations, society needs to know whether the native fish are worth more than what must be given up. Information about the biological, nutritional, or recreational value of fish will certainly affect people's WTP for the resource, but the economist does not need to know the motives behind people's WTP in order to make economically efficient resource allocations. The calculation for economic efficiency requires information on the total value of resources, that value being the result of many different motives. While recognizing that total value is the goal, there are methodological issues related to the measurement of economic value that have led to distinctions among different types of economic value.

People may value a particular resource such as the fishery because they either use the resource currently, or they intend to use it at some time in the future. Current and future use value can be either direct or indirect. An example of direct use value would be the willingness of anglers to pay for access to the salmon in ocean fisheries. This may be actual price paid, which may be market price or any price that may not signal a "market clearing" price; an angler may be willing to pay more than he is being charged on the market.[1] An example of indirect use value would be the willingness of a reader to pay for a magazine account of a fishing trip to the Pacific Northwest. In both cases, someone had to actually use the site or resource in order for something of value to be produced.

There are some people who are willing to pay for a resource, even though they never intend to use it. This type of non-use value is called existence value, because people are willing to pay to ensure that a resource exists, without knowing that they will ever actually use the resource. The motive for existence value may be that people want to ensure that a resource exists for future generations to enjoy. Some economists have described these values as a kind of insurance premium, to guarantee that the resource will be available when, and if, future use is desired by them or for others.

Economists have defined and occasionally measured values associated with the simple presence of a fish population. The value is reckoned as the amount that people (defined appropriately) would be willing to pay to assure the existence of a fish stock, or to pay for a specified increase

1. Panayotou (1992) showed that for ecosystem goods and services, commercial markets fail to adequately capture the true value. Their common property nature prevents formation of efficient markets. The markets that do exist are fraught with imperfections that lead to undervaluation and/or over estimation.

in the fish stock. For example, Olsen, Richards and Scott (1991) found that people who claimed no intention to catch or eat salmon from the Columbia River were still willing to pay on average $26.52 per year per household ($37.61 in 2005 dollars) to obtain a doubling of the salmon run size. Non-use values of this sort are non-exclusive, meaning that everyone who values the fish run obtains this value simultaneously (as contrasted with consumptive user values which accrue only to those catching fish in competition with others). Hence, assuming (1) that all households enjoy this non-use value, (2) that a doubling of the fish run means 2.5 million fish per year, and (3) that there are roughly 2.0 million households in the relevant region, that value of doubling the run would be $70.24 million per year.[1]

More recently, Layton, Brown and Plummer (1999) have estimated an individual value function for a variety of fish categories (including Columbia basin migratory fish) among Washington residents. Completed for the Washington Department of Ecology, that study developed a means of estimating WTP for any given increase in fish population from an assumed current level, and for two different "without program" fish population projections. For example, for a current fish population of two million and a projected stable future population of two million in the Columbia Basin, Layton, et al. find that the typical Washington household would be WTP $119.04 per year ($135.52 in 2005 dollars) for a 50 percent increase in the migratory fish population. This represents the total (use plus non-use) value for the fish population increase. With a total of two million households holding such values, the overall value per fish is a remarkable $268.08 ($305.19 in 2005 dollars). This particular estimate pertains to a rather broad class of fish, including all the salmon and steelhead stocks in the Columbia Basin.

It is likely that the fishery resources including salmonids provide all of the above described use and non-use values to society. The decision about which ones to focus on for measurement is a function of the resource allocation question being asked. For example, if a particular fishery resource is not threatened with extinction, there is no need to measure the existence value of that resource. Since society would not be deciding whether to allocate scarce resources to save the fishery, the existence value is not relevant. If the policy decision under consideration is whether to invest resources to increase the fish populations, then the values which are measured must correspond to only the increase in fish numbers. In other words, total use value would not be the appropriate value to compare with the value of the resources necessary to increase the population by some incremental amount. Given the different types of policy decisions which might be relevant, as well as the fact that the existence of some Pacific Northwest fish populations may be in question, measurements of both total and marginal values are likely to be useful to decision makers.

C. Regional Economic Impacts

The NEV of the fishery resource has been defined as people's willingness to give up resources of value (money) to have the fishery resource. A common mistake that is often made in economic analysis is to include the costs associated with using the fishery resource (e.g. travel costs, lodging costs, equipment) as part of the NEV from the resource. These associated costs, or expenditures, are instead the source of local or REI's associated with use of the fishery.

1. Olsen, et al. take this as roughly the number of households in the Washington, Oregon, Idaho region in 1989.

The NEV must represent the value of the fishery resource itself, and not the value of the related travel and equipment items. For example, suppose the fishery was threatened by a hydropower development and policy makers wanted to know whether the anglers could "buy out" the hydropower interests. All of the money spent on travel and equipment is no longer available to be used to buy out the competing hydropower interests. However, the money that is left over, after all the costs of angling have been paid, is the net WTP (consumer surplus) for the fishery resource (or fishing at the particular site). If extracted, this surplus could, in principle, be used to buy out the hydropower interests.

Another way to view the difference between NEV and REI is to consider NEV as the net loss to society if the resource were no longer available. Suppose that a specific river fishery were no longer available to anglers, and they had to either fish somewhere else or engage in some other activity. The money spent on travel and equipment would not be lost to the financial economy - in fact it could be spent on travel and equipment or some other commodities in some other location. But the value anglers received from fishing that specific river would be lost. It must be assumed that one river's fishing was preferred over (had greater value than) those of the other rivers or activities, or the anglers wouldn't have chosen the original site in the first place. Their net WTP for the chosen fishery versus other fisheries or activities would be a loss to society. Their expenditures or associated impacts on income or jobs would be a loss to the economy in the vicinity of the preferred river, but would be a gain to some other local economy. REI, therefore, describe the local or regional effects on jobs and income associated with any specific area chosen as the point of interest.

The calculations for REI in this report are in personal income impacts. Corresponding measures for full time equivalent (FTE) jobs may be developed by assuming the personal income is a person's average wage and salary or proprietors net income. Many fishing related jobs are part-time and seasonal, as are jobs in other industries. However, to generate a comparable statistic, usually the FTE indicator is used. Even other economic activity measurements can be made. Gross business output and gross value added (gross output less intermediate goods used up in production) is an often used measure.

The above example should make it clear why local economies are often more concerned about REI than NEV, especially when the economic values are in the form of consumer surplus. If anglers are willing to pay some amount of money over and above their costs, but don't actually have to pay, the consumers get to take that surplus or value home with them in the form of "unextracted" income. It is not immediately obvious to local businesses that the consumer surplus generated from any specific fishery has any impact on the local economy. On the other hand, money spent on lodging, food, supplies, guides, etc., has a direct impact on local businesses and on personal income in the local area.

It is clear that NEV and REI are two distinct measures, and each is useful for different purposes. NEV's are important if the goal is to allocate society's resources efficiently. REI's are important in assessing the distributional impacts of the different allocation possibilities on the financial economies of areas. It may often be the case that society will want to invest in a less valuable resource because the local area or economy that holds the resource is in need of economic

development. Nevertheless, having the information on economic value will tell society how much they are giving up in order to achieve the redistribution of economic activity or development.

Some of the REI may be new to an area, some of these may be considered a transfer from one region or industry to another. For example, the expenditures on the SAFE program may be a transfer from electricity paying consumers in Portland or California to anglers and businesses in the coastal area. These are allocation and equity issues and are not addressed.

Economic input/output (I/O) models are used to estimate the REI from resource changes or to calculate the contributions of an industry to a regional economy. The basic premise of the I/O framework is that each industry sells its output to other industries and final consumers and in turn purchases goods and services from other industries and primary factors of production. Therefore, the economic performance of each industry can be determined by changes in both final demand and the specific inter-industry relationships.

The models developed for this project utilize one of the best known secondary I/O models available. The U.S. Forest Service has developed a computer system called IMpact Analysis for PLANning (IMPLAN) which can be used to construct county or multi-county I/O models for any region in the U.S.[1] The regional I/O models used by the Forest Service are derived from technical coefficients of a national I/O model and localized estimates of total gross outputs by sectors.[2] IMPLAN adjusts the national level data to fit the economic composition and estimated trade balance of a chosen region. Areas that are any combination of single counties can be constructed using IMPLAN.

Because adult salmon are harvested in ocean fisheries, any increased smolt survival will benefit economies at ocean communities from Alaska to California as well as inland communities of the Columbia Basin. All of these economies are included in the analysis. The Fisheries Economic Assessment Model (FEAM) uses the IMPLAN response coefficients to generate the REI from ocean and river commercial salmon harvests.[3] Estimates of REI from composite stocks harvested from California to Alaska are determined by the information made available on contributions of Columbia River stocks to the ocean fisheries. Unit values used to generate ocean harvest REI's are shown in IEAB (2005). Assumptions and factors used to generate REI for the lower Columbia River gillnet permittees and Columbia River recreational salmon fishing is shown in Tables D.1 to D.3.

1. The IMpact Analysis for PLANning (IMPLAN) model is now being offered for general use by the Minnesota IMPLAN Group (Olson et al. 1993).
2. The available IMPLAN models are generally three to four years behind calendar years. This is due to data availability and the time it takes to prepare the models. Unless very dramatic changes take place in a regional economy, the sector coefficients will not change dramatically from year to year.
3. The Fisheries Economic Assessment Model (FEAM) was developed for the West Coast Fisheries Development Foundation by Hans Radtke and William Jensen in 1986.

Table D.1
Regional Economic Impact Modeling Assumptions for
Harvester and Processor Economic Impact Generating Activities

Activity	Impact Source	Residency		Impact Flows	
		Local	Regional	Local	Regional
Harvester Activities					
Gillnet Fishery Vessel					
Labor	48%				
Residency		51%	98%	100%	100%
Non-residency		49%	2%	50%	100%
Fishery prosecuting costs	52%	100%	100%	100%	100%
Other West Coast Fisheries (crab vessel proxy)					
Astoria/Ilwaco landings					
Labor	58%				
Residency		65%	100%	100%	100%
Non-residency		35%	0%	50%	100%
Fishery prosecuting costs	42%	100%	100%	100%	100%
Other ports					
Labor	58%				
Residency		65%	100%	90%	100%
Non-residency		35%	0%	50%	100%
Fishery prosecuting costs	42%	100%	100%	50%	100%
Alaska fisheries					
Labor/fishery prosecuting costs	100%				
Residency/non-residency		51%	96%	75%	75%
Processor Activities					
Gillnet Fishery				50%	100%
Other West Coast Fisheries					
Astoria/Ilwaco purchases				100%	100%
Other port landings				0%	100%
Alaska fisheries				0%	0%

Notes:
1. Harvester economic impact source (labor and fishery prosecuting cost share) is from Study for gillnet fishery, FEAM for other West Coast fisheries, and from Radtke and Davis (1999) for Alaska fisheries.
2. Gillnet fishery harvester economic impacts used composite vessel budget expenditures shown in Table B.3. Gillnet fishery processor economic impacts used processor business types and product forms in Table B.4.
3. Permittee residency is from Table IV.9. Residency assumes that permittees that are active harvesters have the same residency share as non-active harvesters.
4. The local economy is combined Clatsop, Oregon and Pacific, Washington counties. The regional economy is the combined Oregon and Washington state economies.

Table D.2
Regional Economic Impact Modeling Factors for Gillnet Fishery and Other Gillnet Permittees' Fisheries

	Columbia River Gillnet Salmon Fishery				Gillnet Vessel Other Fisheries											Gillnet Permittees Other Vessel Fisheries											
					Chinook			Coho		D.	Other	A.	Sea		Stur-	Cod/	Sable-	Chinook			Coho		Sock-	D.	A.	Halibut	Stur-
	Chinook	Chum	Coho	Sock-eye	Net	Troll	Chum	Net	Troll	crab	Pelagic	tuna	Urchins	Other	geon	rockfish	fish	Net	Troll	Chum	Net	Troll	eye	crab	tuna	(PFMC)	geon
Processor contributions																											
Landed price	1.78	0.25	0.91	1.59	1.48	2.61	0.25	1.04	1.73	1.61	0.10	1.25	0.76	0.22	1.72	0.48	1.72	1.56	3.09	0.24	1.04	1.07	1.22	1.86	0.77	2.39	1.66
Taxes and fees	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tendering	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Egg credit	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Purchase cost	1.78	0.25	0.91	1.59	1.48	2.61	0.25	1.04	1.73	1.61	0.10	1.25	0.76	0.22	1.72	0.48	1.72	1.56	3.09	0.24	1.04	1.07	1.22	1.86	0.77	2.39	1.66
Yield	80%	80%	80%	80%	80%	87%	80%	80%	87%	58%	97%	85%	7%	100%	64%	29%	55%	80%	87%	80%	80%	87%	80%	58%	85%	74%	64%
Total raw product cost	2.23	0.31	1.14	1.99	1.85	3.00	0.32	1.30	1.99	2.78	0.10	1.47	10.88	0.22	2.68	1.67	3.13	1.95	3.55	0.30	1.29	1.23	1.52	3.21	0.91	3.23	2.59
Labor	0.25	0.25	0.25	0.25	0.25	0.15	0.25	0.25	0.15	0.61	0.10	0.20	0.75	0.15	0.25	0.25	0.25	0.25	0.15	0.25	0.25	0.15	0.25	0.61	0.20	0.15	0.25
Other	0.20	0.91	0.19	0.91	0.20	0.12	0.91	0.19	0.19	0.14	0.05	0.06	0.89	0.12	0.14	0.20	0.31	0.20	0.12	0.91	0.19	0.19	0.91	0.14	0.06	0.15	0.14
Contribution margin on profit	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.29	0.40	0.40	0.40	0.39	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.39
Ex-processor sales price	3.08	1.87	1.98	3.55	2.70	3.67	1.88	2.14	2.73	3.93	0.54	2.13	12.92	0.89	3.46	2.52	4.09	2.80	4.22	1.86	2.13	1.97	3.08	4.36	1.57	3.93	3.37
Marginal economic contribution per landed pound																											
Harvester	1.34	0.75	0.85	0.75	1.34	3.80	0.75	0.85	1.15	2.21	0.09	1.02	0.49	1.19	2.17	0.65	1.99	1.34	3.80	0.75	0.85	1.15	0.75	2.21	1.02	3.81	2.17
Processor	0.80	1.30	0.79	1.30	0.80	0.69	1.30	0.79	0.74	0.83	0.54	0.72	0.17	0.79	0.59	0.29	0.60	0.80	0.69	1.30	0.79	0.74	1.30	0.83	0.72	0.59	0.59

Notes:
1. Non-Columbia River gillnet gear includes harvest locations at Willapa Bay, Grays Harbor, and Puget Sound. Modeling factors assume fisheries are for fall Chinook (CHF) for these harvests.
2. Pounds are round pound equivalents in thousands, ex-vessel revenue and ex-processor sales are in thousands of 2004 dollars, and economic contributions are expressed as personal income in thousands of 2004 dollars.
3. The assumed product form for determining ex-processor sales is whole, fresh.
4. Ex-vessel price based on delivery in round weight. Ex-vessel price excludes egg credit revenues.
5. Processor price, cost, and sales are per finish pounds.
6. Not all ex-processor sales include marketing margins. Most sales occur at "the door" for troll caught salmon product forms.
7. Processor contribution includes financing, administration, marketing and sales, and other fixed costs.

Source: Study.

Table D.3
Economic Impact Modeling Factors for Recreational Fishing

	Estuary	Mainstem	Ocean	All Fisheries
Success rate	2.2		0.8	
Spring Chinook (CHS)		6.5		
Coho (COH)		4.4		
Fall Chinook (CHF)		4.4		
Expenditures per angler day				67.10
Economic impacts per angler day				50.09
Share guided				31%
Share private boat				49%
Share bank				21%

Notes:
1. Effort is trips and success rate is trips per retained fish.
2. Angler day is defined as one person fishing for at least part of a day.
3. Expenditures are for angler day trip costs and do not include annual equipment costs. Recreational fishing expenditures include trip costs incurred at residence, en route, and at destination.
4. Trip expenditures and economic impacts per trip adjusted to Year 2004 using the IPD developed by the U.S. Bureau of Economic Analysis.
5. It is assumed that all freshwater fishing experiences are similar to trip expenditures made for saltwater fishing experience. Oregon representations for trip expenditures are assumed to apply for trips originating from Washington and Oregon locations.
6. Oregon share of charter, private boat, and bank trips; and, share of resident and non-resident participants is assumed to apply to Astoria and Ilwaco trip origin as well as river fishing.

Sources: Trip expenditures and participants from Gentner et al. (2001). Response coefficients are from 2000 FEAM. The 2000 FEAM is based on IMPLAN 1998 base data. Subregions using county level total personal income for a weighting factor. Trip counts ocean and estuary from PFMC (2005). Mainstem trips and catch from ODFW (2005).

Table D.4
Total Personal Income Response Coefficients and Economic Area Adjustment Factors

Labor income response coefficient	
Local	1.78
Regional	1.97
Commercial gillnet fishing average expenditure response coefficient	
Local	0.71
Regional	0.99
Marginal to average adjustment factor	0.89
Local to state economic factor	1.16
State to regional economic factor	1.06

Source: FEAM.

Appendix E

Lower Columbia River Port Group Commercial Fisheries Landed Revenue in 1981 to 2004

Table E
Lower Columbia River Port Group Landed Revenue by Species Groups in 1981 to 2004

Astoria Port Group

Year	Price Index	Groundfish	Pacific Whiting	Salmon Net	Salmon Troll	Salmon Other	Dungeness Crab	Pink Shrimp	Pacific Sardine	Albacore Tuna	Halibut	Other	Total
1981	54.6	8,818	46	2,218	1,377	0	1,633	7,243	0	6,312	188	3,829	31,665
1982	58.0	9,103	0	4,273	1,237	0	1,789	5,393	0	839	276	633	23,543
1983	60.2	8,773	29	1,219	250	0	3,061	3,831	0	1,779	742	775	20,458
1984	62.5	7,596	4	5,574	205	0	2,716	1,086	0	620	983	1,140	19,922
1985	64.4	7,684	16	4,834	647	0	2,790	2,284	0	534	893	1,028	20,711
1986	65.8	8,990	12	10,953	390	0	1,872	10,341	0	1,145	2,164	2,187	38,054
1987	67.6	12,489	5	14,911	496	0	2,831	19,220	0	524	1,281	1,670	53,428
1988	69.9	12,386	2	24,865	220	0	4,549	6,463	0	665	637	1,282	51,068
1989	72.6	13,362	2	5,790	359	0	6,308	5,099	0	494	1,278	1,085	33,777
1990	75.4	10,277	6	3,892	248	0	6,030	5,985	0	887	1,225	870	29,420
1991	78.0	13,857	210	3,446	125	0	2,746	4,225	0	264	999	535	26,408
1992	79.8	11,927	1,415	1,010	65	0	5,153	3,658	0	1,140	758	368	25,494
1993	81.7	12,702	645	924	27	0	4,676	3,487	0	1,362	783	485	25,091
1994	83.4	12,892	1,549	924	1	0	4,675	1,699	0	599	918	349	23,604
1995	85.1	13,356	3,125	329	15	0	9,086	2,366	0	1,691	847	757	31,574
1996	86.7	12,661	2,201	326	38	0	11,978	1,464	0	2,181	538	378	31,764
1997	88.2	10,554	3,886	345	6	0	5,818	1,439	0	3,634	436	752	26,871
1998	89.1	8,403	1,804	329	1	0	3,755	811	0	4,706	122	1,099	21,029
1999	90.4	8,942	3,505	704	20	0	7,907	2,909	94	1,621	477	607	26,787
2000	92.4	10,224	3,277	1,041	287	2	6,578	3,844	1,242	3,788	460	1,076	31,819
2001	94.6	8,167	1,520	1,189	161	10	8,606	3,163	1,684	1,783	88	1,018	27,389
2002	96.2	5,321	1,256	1,605	463	1	9,252	3,502	2,931	864	476	1,151	26,823
2003	97.9	6,073	1,473	1,648	481	1	12,594	1,380	2,999	1,192	254	540	28,635
2004	100.0	6,660	1,277	3,048	523	23	2,454	1,722	4,843	2,071	239	576	23,436

Ilwaco Port Group

Year	Price Index	Groundfish	Pacific Whiting	Salmon Net	Salmon Troll	Salmon Other	Dungeness Crab	Pink Shrimp	Pacific Sardine	Albacore Tuna	Halibut	Other	Aqua-culture	Total
1981	54.6	4,433	2	3,823	1,713	0	2,396	5,754	0	978	460	4,475		24,036
1982	58.0	3,705	0	4,647	943	0	2,541	3,180	0	426	0	2,408		17,851
1983	60.2	3,174	0	1,663	282	0	4,863	2,913	0	261	0	2,142		15,299
1984	62.5	2,618	10	4,177	80	0	3,675	1,891	0	44	21	2,925		15,440
1985	64.4	2,964	3	3,460	456	0	4,481	2,549	0	118	6	3,199		17,236
1986	65.8	2,513	12	7,911	384	0	4,624	6,222	0	1,248	7	1,611		24,532
1987	67.6	3,975	27	12,894	425	0	5,512	10,163	0	967	20	1,457		35,440
1988	69.9	4,369	27	19,795	325	1	9,319	5,648	0	2,265	61	995		42,804
1989	72.6	3,719	7	6,525	217	0	11,404	4,885	0	635	5	817		28,213
1990	75.4	2,173	60	4,887	193	0	6,830	3,774	0	1,036	1	944		19,898
1991	78.0	2,346	98	4,497	104	162	2,888	2,559	0	225	1	748		13,628
1992	79.8	1,954	207	2,677	38	89	5,707	2,353	0	1,535	39	688		15,288
1993	81.7	1,297	257	1,293	8	0	5,787	2,196	0	4,201	152	700		15,892
1994	83.4	1,497	302	1,119	0	73	6,104	1,197	0	8,932	62	423	9,152	28,862
1995	85.1	1,292	391	1,016	0	60	10,105	1,484	0	3,650	88	579	9,698	28,364
1996	86.7	871	332	1,280	2	96	8,624	903	0	5,952	91	413	10,220	28,784
1997	88.2	855	181	1,118	0	163	4,929	398	0	4,604	23	351	7,645	20,267
1998	89.1	535	159	426	0	0	4,000	196	0	8,342	24	369	7,707	21,758
1999	90.4	481	219	536	10	0	5,553	272	2	2,911	45	723	8,833	19,585
2000	92.4	339	214	986	38	0	5,916	559	567	4,129	32	657	6,247	19,684
2001	94.6	359	155	1,135	59	5	6,530	630	1,147	5,641	51	685	11,992	28,389
2002	96.2	132	2	1,140	143	0	6,227	706	1,736	5,003	37	1,759	11,652	28,538
2003	97.9	624	232	1,588	120	0	9,177	433	1,114	9,689	50	1,171	11,119	35,316
2004	100.0	135	249	2,009	97	3	2,683	558	837	8,302	54	564	13,512	29,005

Table E (cont.)

Astoria and Ilwaco Port Groups

Year	Price Index	Groundfish	Pacific Whiting	Salmon Net	Salmon Troll	Salmon Other	Dungeness Crab	Pink Shrimp	Pacific Sardine	Albacore Tuna	Halibut	Other	Aqua-culture	Total
1981	54.6	13,251	49	6,041	3,091	0	4,029	12,997	0	7,291	648	8,304		55,701
1982	58.0	12,808	0	8,920	2,181	0	4,330	8,573	0	1,265	277	3,041		41,394
1983	60.2	11,947	29	2,882	532	0	7,924	6,744	0	2,040	742	2,917		35,757
1984	62.5	10,214	13	9,750	285	0	6,391	2,977	0	664	1,003	4,065		35,362
1985	64.4	10,648	18	8,294	1,103	0	7,271	4,834	0	652	899	4,227		37,947
1986	65.8	11,503	24	18,864	774	0	6,496	16,563	0	2,393	2,171	3,798		62,586
1987	67.6	16,464	32	27,805	921	0	8,343	29,384	0	1,492	1,301	3,127		88,868
1988	69.9	16,754	29	44,660	545	1	13,868	12,110	0	2,930	698	2,278		93,872
1989	72.6	17,081	8	12,315	576	0	17,712	9,983	0	1,129	1,283	1,902		61,990
1990	75.4	12,450	65	8,780	441	0	12,860	9,759	0	1,923	1,226	1,814		49,318
1991	78.0	16,203	308	7,943	229	162	5,634	6,784	0	488	1,000	1,283		40,036
1992	79.8	13,881	1,622	3,688	102	89	10,861	6,011	0	2,675	797	1,056		40,782
1993	81.7	13,999	903	2,217	35	0	10,463	5,683	0	5,564	934	1,185		40,983
1994	83.4	14,389	1,851	2,043	1	73	10,779	2,895	0	9,531	980	772	9,152	52,466
1995	85.1	14,648	3,516	1,345	15	60	19,191	3,851	0	5,341	935	1,337	9,698	59,938
1996	86.7	13,532	2,533	1,606	40	96	20,602	2,367	0	8,133	629	791	10,220	60,548
1997	88.2	11,409	4,067	1,462	6	163	10,748	1,837	0	8,239	459	1,103	7,645	47,138
1998	89.1	8,938	1,963	755	1	0	7,755	1,007	0	13,047	146	1,468	7,707	42,787
1999	90.4	9,423	3,724	1,241	30	0	13,460	3,181	96	4,532	522	1,330	8,833	46,372
2000	92.4	10,563	3,491	2,026	325	2	12,494	4,404	1,809	7,917	492	1,733	6,247	51,503
2001	94.6	8,526	1,676	2,324	220	15	15,136	3,793	2,831	7,423	139	1,703	11,992	55,778
2002	96.2	5,453	1,258	2,745	607	1	15,480	4,208	4,667	5,867	513	2,910	11,652	55,361
2003	97.9	6,696	1,706	3,236	601	1	21,771	1,812	4,113	10,881	304	1,711	11,119	63,951
2004	100.0	6,795	1,527	5,057	620	26	5,136	2,281	5,680	10,373	293	1,140	13,512	52,441

Notes:
1. Value is in thousands of 2004 dollars adjusted using the GDP implicit price deflator developed by the U.S. Bureau of Economic Analysis.
2. Astoria port group includes deliveries to lower and upper river Oregon side locations and a minor amount of landings from Cannon Beach and Seaside in some years. Ilwaco port group includes deliveries to Long Beach, Chinook, and other lower and upper river Washington side locations. The two port groups represent 99% of commercial harvests based on Columbia River area-of-catch.
3. Salmon net includes non-Indian and treaty fishery landings.
4. Washington shellfish aquaculture is included for Years 1994 to 2004.

Source: PacFIN November 2004, December 2004, February 2005, and May 2006 extractions.