Economic Implications of the Coastal Multi-Species Conservation and Management Plan

Wild Salmon Center
Portland, Oregon

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Economic Implications of the Coastal Multi-Species Conservation and Management Plan

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prepared by

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Abstract

The Wild Salmon Center (WSC) sponsored an economic analysis project to review the effects of the Oregon Department of Fish and Wildlife (ODFW) Coastal Multi-Species Conservation and Management Plan (CMP). The CMP is required under Oregon's Native Fish Conservation Policy (NFCP) to identify and implement appropriate strategies and actions necessary to restore and maintain native fish. The CMP is the last in a series of anadromous fish management plans developed by the ODFW. Its geographical coverage is the central Oregon Coast and addresses Species Management Units (SMU's) for Chinook salmon and steelhead. The CMP was being developed without economic analysis indicators. The WSC project issued its report while the CMP was in a draft stage so that public and policy decision makers could be informed on the economic effects.

The WSC project objectives are to show CMP regional economic contribution effects that would come from the management plan being in place. The main features of the CMP are actions to change hatchery practices and harvest management. Economic analysis results are itemized for hatchery and wild origin fish, and for hatchery operations including Salmon and Trout Enhancement Program (STEP) facility operations. The resolution level for the economic effect estimates is four stratums: North Coast (northern boundary Necanicum River), Mid-Coast, Umpqua, and Mid-South Coast (southern boundary Elk River). The economic analysis measurement (includes multiplier effect) was for changes in regional economic contributions measured by personal income to households within the strata. Net economic value concepts, including non-use valuations, were discussed, but the economic analysis of CMP changes using this measurement were not undertaken.

Key results are:

1. The estimated economic contribution from the analyzed freshwater fisheries angler activity for status quo conditions is $32 million in total personal income. The economic contributions from status quo hatchery/STEP operations are an additional $4.5 million personal income.
2. The overall economic contributions from the CMP actions to freshwater fisheries angler activity will be about 15 percent greater than CMP current conditions or an increase of $5.5 million in total personal income. Hatchery/STEP operations economic contributions from the CMP actions will be about three percent greater or $0.2 million in total personal income.
3. Wild fish contribute roughly 40 percent of angler activity economic contributions in status quo conditions. This includes the value of selective (catch and release) fisheries. The CMP actions economic effects are 64 percent from wild origin fish. This includes the management change for wild origin winter steelhead fishery to retention in some locations. While the CMP actions identify several changes to management for selective fisheries, an action objective is to allow for an adaptive response for takings when there are wild origin fish status improvements. This management change would likely attract additional angler activity causing increased economic contributions.

4. The hatchery/STEP costs per freshwater retained fish are $128. The summary cost indicator varied widely by the necessary trapping, rearing, and releasing operations for the different species; and, the proportion of adults escaping ocean mortalities (environmental and harvesting). For example, fall Chinook is subject to significant ocean fisheries while steelhead is not.
5. While hatchery/STEP operation costs were analyzed, the economic analysis project was not a cost- benefit analysis study. Additional investigation is necessary to determine all costs, including opportunity and externality costs, and benefits for such an analysis.
6. The economic analysis project did not include assessments for other CMP recommended actions, such as habitat improvements and predation resolutions. The CMP discusses strengthened ODFW involvement in such programs, but did not explore how such programs may increase fishing opportunities. An economic analysis of such explorations could provide cost effectiveness information for the tradeoffs with hatchery production.
7. Only some CMP implementing costs are suggested, and the CMP does not identify alternative funding sources for carrying out CMP actions. For example, one element of the hatchery facility actions calls for an unidentified sponsor to inaugurate out-of-basin spring Chinook stock acclimation projects on the Yaquina River and Coos River. If the funding is from existing state/local tax supported programs, there would be opportunity costs for the present use of those funds.
8. Under existing State and federal statutes that address natural resource management, access to mixed stock (hatchery and wild origin) fisheries can be limited by unintended bycatch and harm done to the wild origin fish. The economic analysis results from this project reveal the recreational angling and hatchery operation economic contributions at risk if access to mixed stock fisheries is eliminated.
9. Vibrant wild fish populations provide a range of economic benefits that are not included in the quantitative analysis, for example: indication of healthy watersheds can promote economic development, and there is reduced need for State and federal interventions in land uses in order to protect fish habitat.

The approved CMP actions by the Oregon Fish and Wildlife Commission (OFWC) to be included in the final version CMP may be different than what has been analyzed, therefore the described results would not be entirely applicable.

Preface

This report was prepared for the Wild Salmon Center (WSC), Portland, Oregon by The Research Group, LLC (TRG), Corvallis, Oregon. The primary author at TRG was Shannon Davis, who was greatly assisted by Kari Olsen. The contract coordinator for the WSC was Mark Trenholm, Salmon Stronghold Program Manager. The report contents were expertly guided by a project advisory committee whose members are Hans Radtke, Ph.D. Natural Resource Consultant, Chris Carter, Ph.D., retired Oregon Department of Fish and Wildlife (ODFW) staff economist, and Aaron Jenkins, current ODFW staff economist. Tom Stahl, Assistant Conservation and Recovery Program Manager and Kevin Goodson, Conservation Planning Coordinator from ODFW attended most advisory committee meetings. Matt Falcy, Fish Conservation Biologist from ODFW attended meetings when agenda items were specific to anadromous fish stock conditions.

The economic analysis design draws substantially on economic modeling methods, data, and results described in (TRG 2013). Recounting and paraphrasing from the publication is used in this report. While this report had a primary author, there were many contributors. Dr. Radtke was an instrumental contributor to the analysis of hatchery operation and capital costs. Dr. Carter was the principal investigator for the original Oregon coastal hatchery economic model that was subsequently updated and used twice more in the last 10 years to evaluate the hatcheries' net economic benefits. The present study borrows methods from Dr. Carter's model design. Dr. Carter also provided instructions for showing how hatchery production adult survival sensitivities affect economic benefits. The sensitivity analysis application using Columbia River anadromous fish hatcheries as examples is described in a forthcoming publication he authored. ODFW staff needs to be complimented for their generous time and helpful spirit in providing information necessary to translate fish biological information into frameworks necessary for this study's economic analysis.

The report was prepared to inform decision making about the Coastal Multi-Species Conservation and Management Plan (CMP) being prepared by the ODFW. The CMP was developed using stakeholder teams for review of draft plans. The ODFW sought public review of CMP drafts prior to presentation to the Oregon Fish and Wildlife Commission (OFWC). The OFWC will include additional opportunity in their usual two meeting adoption process. The economic analysis information contained in this report provides economic analysis information about proposed plan actions not elsewhere found in ODFW prepared documents.

The report contains methodologies recommended with the understanding that technically sound and defensible approaches would be used. Where judgment became necessary, conservative interpretation was to be employed. Because this philosophy was strictly adhered to in all aspects of the report, the materials developed are useful descriptions of economic implications and contain reasonable estimates of economic effects from proposed draft CMP conservation and management actions.

The report is prepared to assist in decision making. The authors' interpretations and recommendations should prove valuable for that purpose, but no assurance can be given that decisions based on this plan will fulfill expectations of market demands nor achieve financial projections. Government legislation and policies, market circumstances and other situations can affect the basis of assumptions in unpredictable ways and lead to changes in study conclusions. Neither the study sponsor, nor author, nor any person acting on their behalf makes any warranty of representation, expressed or implied, with respect to the accuracy, completeness or usefulness of the information contained in this document, or that the use of any information, apparatus, method, or process disclosed in this document may not infringe on privately owned rights.

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Appendix

Glossary

Angler day	Sometimes the word "trip" is used in this report's narrative, but the unit of measurement for effort is an angler day. Trip expenditures for overnight lodging is factored into the average angler day spending. The hours actually spent fishing in a calendar day are not a consideration. The amount of money spent for the fishing experience is not appreciably different whether fishing was for a few or many hours. Literature use of the word trip is usually associated with a fishing experience duration that may be more or less than a calendar day. Trip counts in this study have been adjusted to account for multiple days when fishing occurred during a single trip.
Catch	The term catch used in this study is retained fish. Catch is expanded to include non-retained fish counts using angler preference survey factors in order to calculate total effort using success rates. Success rates are angler days per retained and non-retained catch.
CEA	Cost effectiveness analysis is a method to assess how to get the biggest "bang for the buck." CEA can be used to compare two or more alternatives when the projects have the same type of output. For example, what alternative salmon production technique might achieve the least cost long term for fisheries. The measurement unit in this case would be harvesting cost per produced or saved fish that contributes to fisheries. In the case of comparisons for projects that will have ongoing (such as artificial propagation) costs versus one-off (such as habitat improvement) costs, equivalency annualized costing procedures are first applied.
CMP	Coastal Multi-Species Conservation and Management Plan
CPUE	Catch per unit effort is the multiplicative inverse of success rates.
Economic consequences	An economic contribution metric that relates to a short-term perspective for how an industry is represented in the local economy. If there is a change in the economy's industry activity, there may very well be adjustments in the longer term that may cause increased economic contributions. For example, a tourism business start-up may replace a fishing industry business closure.
Economic metric	The economic contribution measurement selected for this study is personal income. It could just as well been other metrics that would describe the same economic direct and secondary effects, but in a different dimension. Other example metrics are business output (analogous but different than sales), value added, generated government taxes, and jobs.
EEZ	exclusive economic zone
ESA	Endangered Species Act
FEAM	Fishery Economic Assessment Model was used to calculate fishing industry economic contributions. The FEAM is a derivation of the IMPLAN input-output model.

I/O	economic input/output model
M&E	monitoring and evaluation
MSA	Magnuson Stevens Act
Multiplier effect	The economic effects from subsequent rounds of spending (indirect and induced effects) that occur before money has leaked from the economy. For example when personal income is the economic metric, it includes the net earnings from jobs and business owner income where commercial fishing vessels purchase goods and services. It also includes the net earnings gained from businesses receiving the share of household spending that can be attributed to income from the fishing industry.
Net economic value	The sum of positive and negative net economic values (NEV) typically used in benefit-cost analysis (BCA) framework. NEV is measured by the most someone is willing to give up in other goods and services less the actual costs in order to obtain a good, service, or state of the environment. The accounting of benefits in a BCA would include valuations for not only extracting or disturbing natural resources like fish, but also appreciating their non-use. The accounting for costs in a BCA would include opportunity costs, such as for the next best use of the investment being studied. One summary statistic for the BCA is net present value (NPV) which is the sum of discounted net between benefits and costs over the period being analyzed. A BCA has the advantage for including economic effects from decisions made in a current year that are staged over future years. It is important to declare an accounting stance when applying a BCA to understand which user and non-user groups are being included. A national economy accounting stance is generally declared for an analysis when decision actions affect non-users.
NFCP	Native Fish Conservation Policy
NMFS	National Marine Fisheries Service
O&M	operations and maintenance
ODFW	Oregon Department of Fish and Wildlife
OFWC	Oregon Fish and Wildlife Commission
PacFIN	Pacific Fisheries Information Network
Personal income	Income accruing to households in the form of net earnings from wages, salaries, proprietorship income, etc.
PFMC	Pacific Fishery Management Council, headquartered in Portland, Oregon. A U.S. federal board which oversees management of marine fisheries in federal waters off Washington, Oregon and California. With halibut, the PFMC's role is to decide on allocations between user groups and development of programs to manage and reduce halibut bycatch.

Regional economic impact (REI)	Economic contribution and REI are different concepts, but in this report the two terms are used interchangeably. A stricter use of the term "contribution" would be for an economic activity that exists. The use of the term "impact" would be when an economic activity is to be subtracted or added. It is the share of the regional economy supported by the expenditures made by the industry being analyzed. It can be expressed in terms of a variety of economic metrics.
Resource rent	The term resource rent (or just the one word rent) introduces opportunity and expectation costs to a commercial fisheries profit equation. There would be subtractions from the fishery earnings from not only the prosecution costs, but also from using the capital investment and labor investment in a next best substitute manner, and the subtraction for the perceived amount of profit to be made in the fishery. Resource rent calculations typically do not include external effects outside the fishery, such as ecosystem effects.
SAR	Smolt-to-adult survival ratio. The SAR is a common and comparative index of how well hatchery production is faring in prevailing environmental conditions and contributing to fisheries. Total SAR is the multiplicative inverse of the ratio for smolts released divided by harvestable adults. Harvestable adults are catch in all ocean and freshwater fisheries plus hatchery returns plus straying to spawning beds. Sometimes SAR is a reference to a particular component of mortality source such as freshwater fishery SAR. In such cases, the total smolt-to-adult survival ratio will use the acronym SAS.
SMU	Species management unit. MSA's National Standard 3 (NS 3) guidelines specify 'species management units' for fishery management plans to be practical divisions based on a variety of ecological and socioeconomic factors. A single SMU may be comprised of more than one species population defined by genetic integrity and variability. SMU's are realistic planning species population combinations. There is NMFS guidance for carrying out NS 3 when defining SMU's for ESA listings, critical habitat designation, and recovery plan development. However, none of the species being addressed in the CMP are ESA listed. The CMP addresses six SMU's: Chinook salmon (spring and fall), chum salmon, steelhead trout (winter and summer), and cutthroat trout. Both hatchery and wild origin fish are included in the SMU's.
STAC	Salmon and Trout Advisory Committee
Status quo	The status quo scenario used Year 2012 hatchery and STEP facility production to estimate contribution to fisheries. The contribution to fisheries from wild production used the CMP current observed conditions.
STEP	The Salmon and Trout Enhancement Program (STEP) was created by the Oregon Legislature in 1981. The legislation allows volunteers to participate in fish culture programs and other activities to promote restoration of wild fish stocks. One coordinator and 11 ODFW staff biologists work with STEP volunteers to ensure activities further objectives for management and conservation. A STEP advisory committee appointed by the governor

	oversees activities and recommends implementation projects. Activities have included stream habitat restoration work, spawning surveys, education projects, and hatched and reared several million anadromous species per year.
TAC	Total allowable catch. The term is used synonymously with the term catch limit.
USFWS	U.S. Fish and Wildlife Service
Wild origin	For this economic analysis study, the term wild fish is for any salmon or steelhead reproduced exclusively outside of a hatchery operation. This definition means a salmon or steelhead could be the progeny of wild parents or hatchery parents that strayed and spawned in the natural environment.
WSC	Wild Salmon Center, Portland, Oregon
WTP	willingness-to-pay

Executive Summary

Introduction

The Oregon Department of Fish and Wildlife (ODFW) is developing the Coastal Multi-Species Conservation and Management Plan (CMP) for anadromous fish species originating from the central Oregon Coast. The CMP was developed without economic analysis indicators being provided for the effects from the proposed conservation and management actions. The Wild Salmon Center (WSC), recognizing the importance for such indicators being available for technical and policy decision making, retained professional economists to develop an economic analysis that shows the CMP regional economic contribution effects.

The CMP is required by Oregon's Native Fish Conservation Policy (NFCP). The NFCP was adopted by the Oregon Fish and Wildlife Commission (OFWC) in 2002 to support and increase the effectiveness of the 1997 Oregon Plan for Salmon and Watersheds. The NFCP employs conservation plans to identify and implement appropriate strategies and actions necessary to restore and maintain native fish in Oregon to levels that provide benefits to the citizens of the state. The CMP addresses Species Management Units (SMU's) for Chinook salmon and steelhead.[1]

Economic Analysis Methods and Assumptions

The economic analysis is for CMP actions to change hatchery production or alter harvest management for four SMU's: Chinook salmon (spring and fall) and steelhead trout (winter and summer) from both wild and hatchery origin. An economic analysis is also completed for ODFW hatchery and Salmon and Trout Enhancement Program (STEP) facility operations. An analysis is not completed for other CMP actions for additional monitoring, research, or other conservation actions (including habitat improvement and predation resolutions).

The CMP geographic coverage is for SMU's contained in an area bordered on the north by Necanicum River and on the south by the Elk River. Species populations were grouped into four geographic strata: North Coast stratum, Mid-Coast stratum, Umpqua stratum, and Mid-South Coast stratum. These strata are very similar to those identified in the Oregon Coast Coho Conservation Plan. The assumed finite economic analysis local region is the strata. This is because affected business market area and the business labor residency is most likely aligned with the strata boundaries. There may be distributional economic impacts within a stratum that would not be patterned with this assumed economic region resolution.

The CMP defines current conditions and explains a set of actions to accomplish desired conditions for fisheries opportunities and conservation standards. The CMP indicators for

1. Information in the CMP describes the status of chum salmon and cutthroat trout, but does not propose conservation and management guidance. The ODFW has already developed a conservation plan for Oregon Coast coho salmon. Oregon Coast coho were listed in 2008 as an ESA threatened species. Critical habitats have been federally designated and "takings" biological opinions have been issued for fisheries and hatchery operations.

conditions are hatchery production levels defined by releases and wild fish spawner counts. A timeline for imposing actions and the time horizon for attaining the desired conditions is absent from the plan. Given the ambiguity for when the goals might be reached, this study's prospective analysis shows possible economic contribution effects that would occur if all of the actions were in-place today. However, such calculations do not give a time appreciation for such a situation as many anadromous fish generations may be needed to realize the desired conditions.

The economic analysis results are estimates for changed freshwater fisheries economic contribution and changed ODFW hatchery facility and STEP operation economic contribution. The economic analysis metric is the transactional economic activity stirred up in an economy using the measurement unit for personal income accruing to local households.[2] The provided economic analysis results start with adopting estimates of angler spending for a freshwater fisheries fishing trip's variable cost. This means the economic model's results do not include effects from capital purchase items like boats, since they can't be exclusively associated with implementation of the CMP. The economic contribution calculations include not only the direct spending effects from fishing trips and hatchery operations, but also the indirect and induced effects that follow. Economic input/output (I/O) models are used to estimate the downstream economic contributions which are sometimes called the multiplier effect or ripple effect.

An economic analysis measurement value for angler satisfaction is not a modeled outcome. If it was modeled, there would be consequential impacts in the value when harvest management and/or fish availability changed the fishing experience (such as for certain bag limits, sizes, wild origin retention, locations, etc.) preferred by anglers. The economic analysis measurement that is used simply assumes that an angler will pursue a fishing opportunity and spend about the same for another trip experience. A related consideration for using an economic analysis measurement for angler satisfaction value is whether there is difference in value for a purely wild fish fishery or mixed stock (where there are encounters with both wild and hatchery origin fish) fishery. Research shows that anglers do place a different value on fish origin.

Catch of hatchery and wild origin fish used in this study are calculated economic analysis modeling inputs. It was necessary to connect hatchery origin catch with its brood year hatchery production so that the ratio of catch and production could be applied to CMP called for changes in hatchery production. The freshwater fisheries catch calculations rely on angler harvest card tabulations after correcting for submittal compliance and other biases. The estimated proportion of hatchery origin catch is determined after subtracting the estimated proportion of wild origin catch. (Because there are fish origin selectivity regulations, it was assumed all reported winter and summer steelhead catch was hatchery origin fish.) The catch calculations for wild origin fish rely on historical catch regression analysis of terminal run size.

The harvest card tabulations for the analyzed fisheries during the period 2008 to 2012 showed catch increased in each succeeding year with 2012 being the highest catch in the last

2. No differentiation is made between anglers that are resident and non-residents. This is important to point out because non-resident spending in regional economies generates new income through their trip expenditures. An equivalent resident fishing spending for fishing trips may occur anyway in the region for different services and goods when fishing opportunities change. In this case, the net effects to the economy may not be much depending on multiplier effects from the different purchases.

approximately two decades. However, there is large variation in the last two decades with freshwater fisheries catch varying by more than a factor of two depending on species. Since the economic contribution calculation methods rely on linear relationships of catch and effort, the selection of particular brood years to use for determining survival-to-fisheries is important to showing absolute effort and hence economic contribution levels. The average 2010-2011 adult return years were used to show annual catch of hatchery origin fish. The same period was used by ODFW to describe wild origin fish terminal run size in "current" conditions.

The provided economic analysis for ODFW hatchery and STEP facility operations starts with assessing production costs. Replacement capital costs are treated as an included apportioned expense in the assessment. (When capital costs are included, the analysis reflects economic cash flow rather than financial cash flow.) ODFW hatchery facility operation costs generally depend on the size of releases. Spring Chinook are usually released at 10 to 15 per pound which cost about $1.06 per smolt when facility annualized replacement capital costs are included. Steelhead require longer hatchery culturing and are released at larger sizes -- about six per pound. They cost about $1.77 per smolt to produce. Fall Chinook are sometimes released at earlier life cycle stages including sizes of 50 per pound which cost considerably less to produce. Tracking production costs is difficult because hatchery operation accounting is usually pooled across populations. Also, specific populations can be raised to one life stage at one facility, transferred to another for final rearing, and transferred again for acclimation and release. There are cost savings to the State for releases by the STEP program since those organizations use volunteer labor and less capital intensive facilities.

The estimated annual cost of operating study area hatcheries, including amortized capital costs, for production of the anadromous fish species contributing to the analyzed fisheries for status quo conditions is about $5.7 million. Summary indicators to add clarity for these costs, which additionally could be used as production effectiveness indicators, are the cost per harvested adult and angler spending per harvested adult. It costs about $128 per harvested adult when catch in freshwater fisheries are the accounting basis. The cost indicator varied widely by the necessary trapping, rearing, and releasing operations for the different species; and, the proportion of adults escaping ocean mortalities (environmental and harvesting). For example, fall Chinook is subject to significant ocean fisheries while steelhead is not. There is utility in such summary indicators when using a return on investment measure for evaluating hatchery facility programs. For these indicators, the objectives being analyzed would be minimizing the cost per harvested fish and optimizing the spending per harvested fish.

<u>Freshwater Fisheries and Hatchery Production Economic Contribution Modeling Results</u>

The estimated economic contribution from the analyzed freshwater fisheries for status quo conditions is $32 million total personal income. Wild fish contribute roughly 40 percent of angler activity economic contributions in status quo conditions. The overall economic contributions from the CMP actions to freshwater fisheries angler activity will be about 15 percent greater or an increase of $5.5 million in total personal income. Hatchery/STEP operations economic contributions from the CMP actions will be about three percent greater or $0.2 million in total personal income (Table ES.1). The Mid South Coast stratum contributes the most to the CMP actions effects at 31 percent.

An interesting economic statistic usually overlooked when providing economic assessments of recreational fishing is the associated economic contribution that come from the hatchery operations. Despite having to use imputed data and simplifying assumptions, best estimate economic effects are offered. The hatchery production, including STEP facility spending, generates about $4.5 million to the CMP study area and the state economy. The hatchery operation contributions are about 12 percent of the status quo sum that includes freshwater fisheries angler activity economic contributions. It is estimated the CMP called for actions to change hatchery production will increase the economic contribution by $0.2 million (Table ES.1).

Economic Benefits From Healthy Wild Fish Populations

The described economic contribution from CMP study area freshwater fisheries and hatchery operations is considerable. The economic contributions are especially important to rural economies dependent on the fisheries and hatchery operations. Angling is one form of outdoor recreation that is tied to the more general tourism industry. The attraction of just the opportunity to fish may have been one motivation to make a trip amongst other planned general tourism activities. Moreover, vibrant and year around fisheries access is an indicator of healthy natural resources and can be considered an economic development asset.

The basis for maintaining and improving the CMP study area freshwater fisheries is the wild production contributions. This is for two broad reasons. The first is the ominous government intervention power that follows findings that wild stocks are depleted. The Oregon Conservation Strategy and more specifically the Oregon Sensitive Species Rule call for proactive actions to recover depleted species. The federal Endangered Species Act (ESA) allows for sweeping powers to prevent further takings of listed species that can shut down fisheries. A conclusion from this economic analysis study would be the magnitude of regional economic activity from freshwater fisheries at risk from not having healthy wild stocks. But it would be a small component of total economic activity at risk due to effects from other curtailed land and water use.

The second broad reason is society's interest in healthy wild stocks. There are many U.S. West Coast depleted or extirpated salmon and steelhead population examples where research has found public support for government participation in rebuilding wild stocks other than just for fisheries. There are economic analysis methods that can establish valuations for society's interest, and the valuations can be useful in tradeoff analysis for determining regulations and spending priorities. While economic analysis valuation based results can be informative, the descriptions can also be abstract and difficult to understand. Properly designed and representative results from simple opinion surveys are also illustrative of society's interests. For example, an Oregon angler and resident preference survey undertaken in early 2013 (fishery participation questions referenced annual 2012 angler activity) shows an overwhelming support for considering wild fish in developing the CMP. The support for management that aims for healthy population was supported by both anglers (91 percent) and the general population (94 percent). More than half of both respondents (65 percent of anglers and 56 percent of the general population) agreed that the plan should be developed to avoid ESA listings.

Discussion and Recommendations for Additional Analysis

The CMP economic analysis shows there are few gains and minimal shifts in geographic (defined by stratums) fishing opportunity. There are some ODFW hatchery facility and STEP production and practice changes that contribute to different fishing opportunities. Some of the changes require significant new funding, such as for new hatchery trapping and rearing capacity. One element of the hatchery production actions calls for an unidentified sponsor to inaugurate out-of-basin spring Chinook stock acclimation projects on the Yaquina River and Coos River. The CMP emphasis is on finding a balance between wild fish conservation and maintained angling opportunity. ODFW is put into a supporting role for habitat protection and improvements to be accomplished by others.

The study provides interpretive discussion about one of the key value inferences of wild origin fish production. For fisheries with mixed (wild and hatchery) stocks, healthy wild origin fish stocks ensure access to harvesting the hatchery produced fish. Under present laws of species protection only a certain amount of wild fish are allowed to be taken if there is a concern about the viability of that species. If the total harvest pool is flooded with hatchery origin fish, higher exploitation than can be tolerated by the wild origin will have adverse impacts (certain amount of wild fish suffer mortality even in selective fisheries). There is also the contended concern that hatchery origin fish affect the reproductive fitness of future generations due to stray interbreeding, hatcheries introducing disease, and other deleterious impacts to wild origin fish. Hatchery operation strategies and fish management exploitation rates would have to be reviewed (including conceivably situations for zero fisheries) for consistency with depleted wild stocks recovery.

Hatcheries were built and operate in an involved economic, environmental, and social context. Economic analysis can provide insight into the existing economic effects and relative magnitude and direction of economic changes associated with plans. However, there may be different hatchery production or operation alternatives, or alternative means for accomplishing the same objectives to sustain fisheries. (It could be that hatchery funding sources are encumbered for dedicated use and not available for alternative use such as habitat improvements.) The economic analyses should prove useful in understanding the effects of hatcheries whose purpose is fishery augmentation. While not addressed in this study, a valuable application of the information would be to assess the tradeoffs between changing hatchery production and practices, and the recovery and improvement in natural stocks through habitat enhancements, passage improvements, etc.

Relying on unit economic values from other economic studies brings additional uncertainty into an economic analysis. The other studies may have been performed for different purposes and situations. It is recommended that a more thorough study design be employed for an improved economic analysis. The design should include an angler economic survey that solicits comprehensive trip expenditure and marginal benefit valuation responses. The angler information needs to be accurate for the important trip characteristic variables to be affected in management plans. Research has shown that angler trip behavior is dynamic, and a static model such as employed in this economic analysis study does not account for trip motivation elasticities.

It is also recommended that there be new and more thorough investigation of artificial propagation costs. This is an accounting function that will need ODFW and STEP sponsors commitments. If existing accounting information cannot be untangled to derive costs by species populations and expenditure types, then at least a couple of annual cycles prior to the new study will be needed to generate the detailed actual costs. STEP production has a high presence on the Oregon Coast and there has been no comprehensive benefit and cost evaluation of the program. Development of inclusive smolt-to-adult survival ratio (SAR) datasets for the STEP is an especially lacking monitoring measurement.

Table ES.1
CMP Effects From Freshwater Fisheries and Hatchery Operations by Strata

		CMP Effects				
			Stratum Shares			
Analyzed Fisheries	Status Quo	Total	North Coast	Mid Coast	Umpqua	Mid S. Coast
Catch						
Hatchery	44,305	+4,271	47%	15%	7%	30%
Wild	36,976	+9,192	17%	28%	26%	29%
Total	81,282	+13,463	26%	24%	20%	30%
Angler Days						
Total	717,011	+123,689	26%	25%	18%	31%
Economic Contributions (thousands)						
Analyzed fisheries	32,011	+5,522	26%	25%	18%	31%
Hatchery operations	4,493	+184				
Total	36,504	+5,706				

Notes: 1. Economic contributions are expressed as personal income adjusted to Year 2012 dollars using the GDP implicit price deflator developed by the U.S. Bureau of Economic Analysis.
2. Status quo is a patterned contribution to fisheries using Year 2012 hatchery releases and wild production in CMP current conditions.
3. CMP effects are the change resulting from plan actions. A negative sign would indicate a decrease and a positive sign would indicate an increase. The plan effect shares describe each stratum's proportion of the overall effects.
4. CMP effects assumes current ocean harvest management regimes.
5. Catch and angler days are for mixed stock fisheries. This is a reference to fisheries that occur where there are encounters with both hatchery and wild fish. Some of these fisheries are selective for retention of only hatchery origin fish.

I. INTRODUCTION

A. Purpose

The Oregon Department of Fish and Wildlife (ODFW) is developing the Coastal Multi-Species Conservation and Management Plan (CMP) for anadromous fish species originating from the central Oregon Coast. The CMP was developed without economic analysis indicators being provided for the effects from the proposed conservation and management actions. The Wild Salmon Center (WSC), recognizing the importance for such indicators being available for technical and policy decision making, retained professional economists to develop the economic analysis. The purpose of this report is to explain methods and results that show the economic implications from implementing the plan. The economic analysis is for actions contained in a draft CMP.[1] Consequently, the final adopted actions by the Oregon Fish and Wildlife Commission (OFWC) may be different and the economic analysis described in this report would not be entirely applicable.

B. Background

The CMP is required by Oregon's Native Fish Conservation Policy (NFCP).[2] The NFCP was adopted by the OFWC in 2002 to support and increase the effectiveness of the 1997 Oregon Plan for Salmon and Watersheds. The NFCP employs conservation plans to identify and implement appropriate strategies and actions necessary to restore and maintain native fish in Oregon to levels that provide benefits to the citizens of the state. The CMP addresses Species Management Units (SMU's) for Chinook salmon and steelhead.[3] The CMP is the last plan in Oregon to be developed under the NFCP. The plan is different than the others because none of the SMU's for which conservation and management guidance is outlined are listed under the state or federal Endangered Species Act (ESA). The CMP focuses not only on conserving wild salmon and steelhead, but also on hatchery and wild fish harvest management to provide Oregon ocean and freshwater fishing opportunities.

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1. This report makes reference to the CMP without the modifier "draft." However, in all cases of the reference to the plan it needs to be understood that the proposed actions being analyzed are from the April 2014 version. Appendix A contains tables for hatchery production changes and the desired status of natural production contained in the version being analyzed.
2. This paragraph is paraphrased from content in the CMP (ODFW 2014).
3. Information in the CMP describes the status of chum salmon and cutthroat trout, but does not propose conservation and management guidance. The ODFW has already developed a conservation plan for Oregon Coast coho salmon (ODFW 2007). Oregon Coast coho were listed in 2008 as an ESA threatened species. Critical habitats have been federally designated and "takings" biological opinions have been issued for fisheries and hatchery operations.

C. Scope

1. Tasks

The economic consultant work scope had the following tasks.

1) Inaugurate a project advisory committee who will be brought together at several meetings to review economic analysis methods and progress.

2) Define economic activity measurements in order to understand what metrics will be used for the economic analysis; and, develop datasets and assumptions to be used in calculating and discussing fish use and non-use values.

3) Integrate results from the CMP with the economic analysis methods (Task 2). Include meeting(s) with ODFW assigned staff and plan stakeholders, as needed to procure ODFW generated CMP outcome measures that will become economic analysis model inputs.

4) Develop a regional economic impact (REI) model with features for showing economic contribution generated from recreational fishing within the study area and the economic effects for changing fishing opportunities as a consequence of carrying out the CMP.

5) Utilize economic model (Task 4) for showing status quo and CMP induced changed economic contributions. The economic analysis will be limited by existing available status quo and CMP information.

6) Describe results of the economic analysis of CMP actions. Descriptions will acknowledge there are other forces that affect angler demand and resulting economic activity, such as ocean and freshwater conditions due to climate-driven and land use changes that impact fish availability. Discussions will also include a summary of hatchery production costs. Foregone economic activity benefits from ESA listings are to be mentioned.

2. Dimensions

a. Fisheries

The economic analysis is for CMP actions to change hatchery production or alter harvest management for four SMU's: Chinook salmon (spring and fall) and steelhead trout (winter and summer) from both wild and hatchery origin. The CMP discusses status and conjoint biological effects for actions on chum and cutthroat trout species. There are also discussions about the overlapping effects on coho populations. The fisheries for chum, cutthroat trout, and coho take place in the fall and are somewhat coincident with the popular fall Chinook fishery. It is unknown how much of the effort in the fall fisheries would be increased with the inclusion of the additional species. The CMP discussions about effects on the other species are apropos because there may be vulnerable bycatch species whose mortalities are a limiting factor for actions pertaining to the other fisheries.

An economic analysis is also completed for ODFW hatchery and Salmon and Trout Enhancement Program (STEP) facility production operations. An analysis is not completed for other CMP actions for additional harvest management, research, or other conservation actions (including habitat improvement and predation resolutions).

b. Spatial

The CMP geographic coverage is for SMU's contained in an area bordered on the north by Necanicum River and on the south by Elk River. Species populations were grouped into four geographic strata: North Coast stratum, Mid-Coast stratum, Umpqua stratum, and Mid-South Coast stratum. These strata are very similar to those identified in the Oregon Coast Coho Conservation Plan (ODFW 2007).

The economic analysis shows angler participation and economic contributions itemized for the strata. Each stratum's port groups, cities, and major rivers and streams, are identified in Table 1. The coastal basins and hatcheries within the strata coverage area are shown in Figure 1a and 1b respectively.

c. Temporal

The CMP defines current conditions and explains a set of actions to accomplish desired conditions. The CMP indicators for conditions are hatchery production levels defined by releases and wild fish spawner counts. A timeline for imposing actions and the time horizon for attaining the desired conditions is absent from the plan. This omission in plan specificity is attributed to certain called-for actions (such as habitat preservations and improvements) not being in the control of ODFW.[4]

Given the ambiguity for when the goals might be reached, this study's prospective analysis shows possible economic contribution effects that would occur if all of the actions were in-place today. However, such calculations do not give a time appreciation for such a situation as many anadromous fish generations may be needed to realize the desired conditions. The model assumes that all other biological and economic influences remain the same. Without dynamic feedback loops for predicting future effects, especially for testing the effects of worsening or improved environmental conditions, there will be unexplained uncertainty in the modeling results.

D. <u>Report Contents</u>

Economic information can be useful in developing fish resource conservation and management plans. With the information, there can be additional strategies for optimizing, holding neutral, or

4. There are annual monitoring and evaluation requirements that will be matched with minimum performance thresholds and a 12 year check-in action to determine plan progress.

minimizing economic valuation changes. Sometimes assuming changed fish availability is equated to economic impacts is not sufficient. Additional summary indicators that inform on economic dimensions are needed. Developing the economic information requires systematic investigations about the interactions of changed fish resources (such as more or less hatchery origin fish) and altered angler access (such as angler fishing regulations) to the fish resources with the regional economy. The altered access may change angler demand for fishing opportunities which in turn will modify angler spending and angler satisfaction for fishing experiences. If there is changed angler activity, then there will be economic consequences in regional economies. The explanations for the investigative process as well as modeling outcome summary measurements are useful information for plan developers and policy decision makers who must use multiple criteria in their plan policy decisions.

This report describes a candid attempt to apply economic analysis to the CMP actions in order to show economic consequences information. The report is written for a non-technical audience, but has sufficient detail to instruct readers about economic measurements, methods to derive the measurements, and the utility of measurements for evaluating plan actions. There should be sufficient detail in the report's procedural and data descriptions that any researcher can replicate the modeling approach, compute the same results, and apply the analysis to different sets of plan actions.

The report contents for Chapter I are a brief background description to characterize the CMP goals and scope and describes the economic analysis tasks. Chapter II contains economic analysis method descriptions. There are focused explanations on economic modeling assumptions and data sources in this chapter. The modeling results are summarized in Chapter III. The interpretations and inferences of modeling results are presented in Chapter IV. There are many appendices included in the report that either are for reader convenience in not having to track down cited reports, such as the information about CMP actions, or provide relevant fisheries information from other studies.

II. ECONOMIC ANALYSIS METHODS AND ASSUMPTIONS

A. Economic Valuation Definitions

This report is about the incremental change in economic activity for certain anadromous fish freshwater fisheries due to proposed actions described in the CMP. These fisheries occur in the midst of other recreational fishing opportunities, such as anadromous fish freshwater fisheries outside the study area and ocean recreational fisheries. Moreover, the recreational fishing activity runs coincident with a large commercial fishing industry.[5] To help characterize the analyzed fisheries, this report also provides some comparative statistics for the other recreational

5. Mostly the commercial fishing is relegated to ocean waters, but there are some bay commercial fisheries too. Bay commercial fisheries using boats include Dungeness crab and herring in non-Columbia River bays. The Columbia River also has very active other commercial fisheries, such as for salmon, sturgeon, and shad. In regards to particular commercial fisheries, Figure D.3 shows an itemization for the Oregon salmon commercial fishery. The commercial troll salmon fishery generated $6.2 million and the Columbia River non-Indian and commercial tribal fisheries generated another $4.1 million personal income in 2012.

and commercial fishing activities (Appendix D). From a direct economic impact perspective, the same businesses are selling goods and services to participants in any of these fisheries.

The analyzed fisheries economic valuation estimates for the CMP actions are the transactional economic activity stirred up in an economy and are measured by personal income accruing to local households. There are other ways to measure the value of recreational fishing. The other valuation measures for recreational fishing include:

- Anglers' marginal benefit beyond what was spent on the fishing trip (sometimes called consumer surplus).[6] The problem in estimating this value is that the angler's revealed or stated preference that provides a measurement may be related to more than just one factor (e.g. the quantity of fish available).
- Commercial benefits from angler expenditures (sometimes called producer surplus). Recreational fishing is intimately connected to businesses (e.g. guide services) selling goods and services to an angler in order that the fishing experience can be consummated. Obtaining a measurement of this benefit change across all businesses using cost functions is formidable. Not the least is figuring out the loss or gain in their goods and services being associated with changes in study fisheries.

The two added together are called net economic value from recreational fishing and are a different metric from the economic contributions measured by personal income used in this study. The two represent one type of a use value of fish resources. Another type of use value associated with fish resources that is a non-extractive is, for example, taking a trip to visit a hatchery or view wild fish spawning sites.

There also are non-use values associated with fish resources. For example, society will place a value on just the existence of healthy fish resources so that there is an option for fishing. Total net economic value is the sum of the marginal benefits from use and non-use values.[7]

Acquiring pertinent data, applying correct methods, and interpreting results for total net economic valuations is laborious and problematic. If there is not the time and budget justification to generate quantitative information, value change movements and magnitudes can be discussed in a qualitative manner to assist in policy decision making. While net economic values were not estimated for this study, a concluding section in this report discusses their application in conservation and management policy decision making.

6. Studies have shown that people are willing to pay extra for the opportunity to use fish resources. Haab et al. (2006) used a nested random utility model and the 1998 Pacific Region economic add-on survey results for such calculations. Anglers in Oregon would pay between $13 and $28 for site access.
7. When using recreational fishing net economic value to provide information for fishery management decision making, there will undoubtedly be consequential impacts to commercial fisheries when fish quantity is added or subtracted in recreational fisheries. There are methods to generate commercial fisheries net economic value that can be validly compared to the recreational fisheries net economic value. Calculating the commercial fishing net economic value metric is an equally formidable exercise as for recreational fishing. Commercial fishing producer surplus is related to harvester and processor business profits. Consumer surplus is related to willingness to pay a different price for the produced seafood.

The above discussion on different types of economic values dwells on the need and usefulness to offer quantitative measurements for economic benefits. These measurements are sometimes statutorily required and are usually of genuine interest to decision makers. However, there is another economic analysis method called cost effectiveness analysis (CEA) that does not require calculation of economic value. CEA shows how to get the biggest "bang for the buck." CEA is appropriate for alternative actions that 1) produce the same or similar type of output, 2) have costs and output that can be measured or reasonably estimated, and 3) have costs large enough to justify the additional analysis. CEA can be used to compare two or more alternatives when the projects have the same type of output. For example, what alternative salmon production technique (artificial propagation or habitat improvements) might achieve the least cost long term for fisheries. The measurement unit in this case would be harvesting cost per saved fish that contributes to fisheries. The advantage of CEA is that only costs and objectives need to be quantified rather than economic value measurements.

The economic analysis starts with adopting an estimate for angler spending for a fishing trip's variable cost. This means the economic contributions do not include effects from capital purchase items like boats, since they cannot be exclusively associated with adoption of the CMP. There are other studies that do include fishing capital costs which might be of interest to readers of this report: Gentner and Steinback (2008) and USFWS (2013).[8] In addition to angler trip spending, the expenditures made by hatcheries for production levels are estimated. Knowing angler and hatchery spending will allow for calculating the direct or first round transactions that occur in a regional economy.

The economic contribution calculations include not only the direct spending effects of the fishing industry and hatchery operations, but also the indirect and induced effects that follow. Economic input/output (I/O) models are used to estimate the downstream economic contributions which are sometimes called the multiplier effect or ripple effect. The estimates are based on the simplifying assumptions that all angler expenditures and hatchery costs are paid from household revenue and federal funds originating from outside the regions, and that there are no active use substitution activities within the region.

The reason for using total personal income as a metric is that it represents the amount which accrues to households through spending and respending for the purchases of goods and services used in recreational fishing activities. Sometimes studies will quote results in terms of other economic performance indicators, such as full-time equivalent jobs whose compensation would equate to generated personal income's net earnings, the region's business output associated with the trip spending, added value the trip spending makes in the region, and even local and state

8. There are modeling issues associated with determining the economic effects from capital purchases in a regional economic study such as the Oregon Coast. One issue is where the spending for capital items has occurred. Was the spending in the angler's resident economy, en route to the fishing location, or at the fishing location? Another is how much of the capital item is actually associated with fishing. A pickup truck used to pull a boat may be used for other transportation purposes too. Estimates of the economic effects from equipment and other capital items vary widely in studies. For example, Gentner and Steinback (2008) found 63.6 percent in survey year 2006 of total economic contributions were from durable goods used for saltwater fishing in Oregon. The U.S. Fish and Wildlife Service (USFWS) National Surveys found total spending for saltwater fishing nationwide was 40.4 percent in data year 2006 and 29.1 percent in data year 2011 for non-trip related items.

level taxes produced from the economic activity. This basket of indicators differently describes the same long term economic effects arising from recreational fishing spending. Using any of the indicators is certainly acceptable as long as one measurement is not compared to another. This report adopts the singular indicator for personal income because it tends to be the most comprehensible of all the mentioned indicators.

The following are underlying assumptions and modeling interpretations for the economic analysis.

- A trip made for recreation purposes may be for multiple reasons, such as fishing and visiting a museum. It could be the spending and consequently the economic contribution estimates in this study overlap with other studies of non-fishing recreational activities.

- There is not sufficient data to distinguish whether fishing trips were guided or unguided, so average trip spending and economic contribution estimates across modes were used. This is unfortunate because the proposed conservation and management actions in the CMP can have differential demand for the two modes. These two modes can have quite different economic consequences.

- No differentiation is made between anglers that are resident and non-residents. This is important to point out because non-resident spending in regional economies generates new income through their trip expenditures. Local resident fishing trip spending may or may not have been spent anyway in the regional economy, so the economic contribution estimates cannot be considered calculations of basic industry economic contribution.[9]

- The location where angler expenditures and hatchery production expenditures occur is important for showing economic impacts on the State or regional economies as well as the local economy. For example, a portion of angler trip expenditures can be near the angler's home, enroute, or at the destination. Hatchery operations labor and utilities costs are expenditures that are made in the local area, but there are usually major costs for outside the local area for such items as feed. Because it was assumed the spending by anglers and by hatchery operations was in the local economy, the resulting economic contribution direct impact estimates that are supposed to only show new money injected in local economies are probably a liberal estimate. The I/O model factors used for calculating indirect and induced impacts would account for trade leakages.

- The assumed finite economic analysis local regions are the strata. This is because affected businesses' market area and the businesses labor residency is most likely aligned

9. Basic economic impact analysis attempts to sort out the driving economic activities in regional economies (Scott 1984). Local industries with markets outside of the region bring new money into the region and are called basic industries. Industries with markets within the region are called secondary or support industries. Thus, when there is an increase in spending in basic industries, there is a resultant increase in secondary industries. Trade leakage occurs when spending and respending for labor, supplies, and services occurs outside the region. The relationship between an activity's total impact on the region's economy that includes the effect from the secondary industries, and the basic industry, is known as the multiplier or ripple effect. In the vernacular of input-output modeling terminology, the total impact on an economy included the direct, indirect, and induced effects of the activity.

with the strata boundaries. There may be distributional economic impacts within a stratum that would not be patterned with this assumed economic region resolution. For example, an outdoor recreation retail supply business that is convenient for anglers fishing at one location may be benefited and a business at another location within the stratum may be adversely affected by CMP actions. The net result would be zero in our modeling as long as angler effort for the transferred fishing opportunities is the same.

- An economic analysis measurement value for angler satisfaction is not a modeled outcome. If it was modeled, there would be consequential impacts in the value when harvest management and/or fish availability changed the fishing experience (such as for certain bag limits, sizes, locations, etc.). The economic analysis measurement that is used simply assumes that an angler will pursue a fishing opportunity and spend about the same for another trip experience.

- A related consideration for using an economic analysis measurement value for angler satisfaction is whether there is difference in value for a purely wild fish fishery or mixed stock (where there are encounters with both wild and hatchery origin fish) fishery. Research shows that anglers do place a different value on the two fisheries.[10]

- The CMP proposed action timeline for implementation and derived results is assumed to be immediate. In reality, the biological and economic consequences will probably take many anadromous fish generations. The assumption for immediacy is an analysis convenience that does not take in consideration the discounted future value of economic effects for the currently made harvest management and hatchery production decisions. Again, there are economic analysis measurement techniques to account for time staged economic effects, but they are not included in this study's methods.

- There may be some over-counting where an angler has combined more than one target species or fished in more than one location during one trip. This is an endemic problem in economic modeling when several different data sources are used to account for recreational fishing.

- The other economic methods and angler demand assumptions include: no change in per unit angling trip expenditures nor changed catch per unit effort (CPUE) due to liberalizing some fisheries selective fisheries management, such as retention of wild steelhead in a few locations; no change in angler motivations affecting demand other than related to fish availability; and, no change to ocean fisheries harvest management regimes. A static model not correctly specified for elasticities toward trip behavior may systematically introduce biases for predicted angler day calculations (Provencher and Bishop 2001).

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10. Anderson and Lee (2013) using 2006 and 2007 survey based discrete choice experiments determined willingness-to-pay (WTP) differences in catching and releasing Chinook and coho salmon of hatchery and wild origin in an ocean mixed stock fishery setting. For example, anglers value higher the "catch" of a hatchery origin Chinook rather than a wild origin Chinook ($150 vs. $102 for medium size fish). However, anglers value higher the "release" of a wild origin Chinook ($64 vs. $22 for medium size fish). The values for coho are smaller with wild origin release value having a $15 positive difference.

Catch is defined in this report to be retained fish. A recent trend in fishery management is to use "catch and release" or "selective fish" regulations. This means that average effort based on fish retained per unit of time fished may not adequately determine the total fishing pressure for certain fisheries where catch and release fish regulations are used. Because angler day estimates are based on creel surveys that occur in areas where management regulations allow full and selective fish retention, the estimates probably are reflective of effort in these fisheries. However, some angling occurs in areas in wild fish management areas where available species and regulations are only non-retention fishing. Effort in areas and seasons with these regulations would not be included, causing a conservative influence on economic contribution estimates.

B. Economic Contribution Modeling

Angler activity economic modeling has five general inputs from which linear application of ratios determines the economic effects. The five inputs are:

a) Smolt-to-adult survival ratios (SAR) that provide the hatchery production contribution to fisheries measured by retained catch counts.
b) Wild fish production contribution to fisheries using statistical modeling of the difference between river escapement and terminal run size.
c) Success rates that translate the hatchery and wild production catch to angler days. This means the angler demand will have a mix of linearity associated with a predictor of hatchery and wild fish availability.
d) Average angler trip expenditures made to pursue the angler opportunity.
e) Regional economy multiplier factors that account for the ripple effect of the expenditures.

The model drivers for these inputs are shown on Table 3a.

The economic contribution from fisheries model in algebraic notation for one stratum is as follows:

$$U_s = \sum_{i,j}^{hs} \quad = \; SAR_{i,s} \cdot R_{i,j} \cdot D_i \cdot E \cdot M$$

where:

i = analyzed fishery
j = hatchery
hs = all the hatchery and STEP facilities in a stratum
s = stratum
U = economic contributions of hatchery and STEP production's contribution to freshwater fisheries
SAR = the reciprocal of pre-smolt and smolt releases divided by freshwater fisheries catch

R = pre-smolt and smolt releases
D = angler day success rates
E = angler day spending, i.e. variable cost of a trip reduced to per day spending averaged over Oregon Coast freshwater anadromous fish fisheries and mode (bank, boat, guided, unguided)
M = angler spending multiplier derived from Oregon Coast I/O model

The hatchery operation economic modeling has five general inputs:

a) Production amounts in units of fish raised to a certain life-cycle size.
b) Per-produced-fish labor and materials cost.
c) Headquarter and monitoring and evaluation (M&E) overhead rates.
d) Hatchery facility replacement capital costs determined by fish production capacity.
e) Regional economy multiplier factors that account for the ripple effect of the expenditures.

The model drivers to calculate hatchery production costs and economic contributions are shown on Table 3b.

The economic contribution from hatchery production model in algebraic notation for one stratum is as follows:

$$V_s = \sum_{i,j}^{hs} R_{i,j} \cdot [(L_i \cdot K \cdot M_l) + (N_j \cdot M_n)] + [(L_i + N_i) \cdot (1 + I + ME) \cdot M_l]$$

where:

i, j, s and *R* = (see fisheries model equation)
V_s = economic contributions of hatchery operations
L = operating cost per analyzed fishery release for labor
N = operating cost per analyzed fishery release for non-labor
M = labor (*l*) and non-labor (*n*) multiplier from Oregon Coast I/O model
K = share of labor before indirect, i.e. the indirect portion is assumed to be exported
I = effective rate of headquarter costs
MR = effective rate of M&E costs

The economic modeling provides a simulation analysis for cross-sectional data. The modeling can be used for assessing changed economic contributions due to modified hatchery operations or testing the effects of harvest management that alters angler opportunities. This is accomplished by exogenously changing the model's input values. The model inputs for status quo and CMP wild and hatchery production are shown on Table 3c. The Table 3c data source is the CMP and the pertinent pages from the CMP that show the data are included in Appendix A.

There are other economic contributions that can come from CMP implementation that have not been included in this study's economic analysis. These are the ongoing and additional costs for fisheries management, changed hatchery practices to avoid domestication and encourage homing, new M&E duties, enforcement, predator solutions, and the called for one-off costs for habitat improvements.[11] The short-term construction and long-term maintenance costs for habitat improvements can be sizeable (Nielsen-Pincus and Moseley 2010).

C. Catch Modeling

Catch of hatchery origin and wild origin fish used in this study are calculated economic analysis modeling inputs. The CMP proposes making changes to hatchery production and release sites. The hatchery production status quo and CMP proposed changes in production are shown in Table 2. It was necessary to connect hatchery origin catch with its brood year hatchery production so that the ratio of catch and production or SAR could be applied to CMP called for changes in hatchery production. The SAR can then be applied to CMP actions for hatchery releases to calculate catch of hatchery produced fish. The freshwater fisheries catch calculations for wild origin fish rely on a relationship between catch and terminal run size. Appendix C has explanations for the catch calculation methods used for the two different origin fish.

Freshwater fisheries catch (combined hatchery origin and wild origin) in the study area has varied considerably over the last two decades (Figure 2). The recent five year trend since a low catch in 2008 has had increases in each succeeding year. The catch in 2012 was the second highest in the last 18 years. The recent high was partly due to large increases in winter steelhead catch.

There have been different levels of hatchery production and practices, different ocean/freshwater harvest management rules, varied environmental conditions, and changed general economy status during the 18 year shown catch period.[12] Each would be contributing and overlapping factor for the catch variation. However, the period from 2010 forward has had approximately the same study area brood year hatchery production; adults were facing about the same ocean and freshwater harvest management regimes; and, angler motivation factors (such as disposable income levels, fuel prices, locational access, etc.) had stable trajectories.[13] This consistency addresses some of the mentioned factors, and given assumptions about constant fishing pressures, reveals the importance of environmental conditions on ultimate catch levels.

Catch has varied by more than a factor of two depending on species (Figure 2). Since the economic contribution calculation methods rely on linear relationships of catch and effort, the selection of particular brood years to use for determining survival-to-fisheries is important to showing absolute economic contribution levels. The average 2010-2011 adult return years were used to show annual catch of hatchery and wild origin fish. The same period was used by

11. Appendix A contains the list of implementation items and costs for the CMP actions in two categories of priority. Neither category includes estimated habitat improvements costs.
12. See Peterson et al. (2013) for detailed descriptions of physical and biological ocean conditions that may affect the growth and survival of juvenile salmon.
13. See Abbott et al. (2013) for a discussion about angler behavior linked to fishery management policy.

ODFW to describe wild origin fish terminal run size in "current" conditions. The ODFW estimated the proportion of fall Chinook catch comprised of wild origin fish (personal communication March 2014). There also is approximately 500 spring Chinook catch on the Umpqua River. The functions for predicting wild fish catch based on terminal run size using spawner count indicators that is explained in Appendix C were used to determine the percentage change in the wild origin fish base conditions.

D. <u>Hatchery Production Costs</u>

Hatchery operations in the study area are constantly changing as sponsors react to available funding, regulations, and overall hatchery program requirements. Further, once pre-smolts or smolts are released they face varying environmental conditions and changed fishery management schemes and that make estimating mortalities difficult. So the choice for a particular cost accounting year, hatchery operation details, and the fishery management regimes to show economic effects is an important determinate of the results. The choice of another set of modeling inputs even with same production levels will generate dissimilar results. For the economic analysis in this report, we are using per pre-smolt and smolt cost accounting information from previous studies and what happened to average brood year releases (i.e. downstream migration mortality, ocean survival, fishery exploitation rates, returns to hatcheries, and straying to wild spawning grounds). The releases for which the per-fish economic effects are applied are for planned 2012 operations. A more involved analysis would report on the uncertainty of economic effects estimates given modeling input probabilities for varying production unit cost estimates and for higher or lower SAR.

The modeling outputs are sometimes provided as ratios using harvested adults. Harvested adults include ocean and freshwater fisheries catch. The ocean and freshwater catch is determined from data on the recovery of coded wire tags. The analysis of recoveries shows that study area hatchery stocks are caught in the ocean along Alaska, British Columbia, Oregon, and other West Coast states coastline. Recovery data also shows there is some straying of hatchery stocks to outside study area coastal basins. The economic analysis modeling assumes all of the freshwater fisheries effects are within the stratum where the releases occurred.

The hatchery production costs used for the economic analysis modeling were a combination of actual and estimated costs for different life cycle stages (i.e. egg, fry, smolt, etc.). The species specific costs are in the following summary categories:

- Operations and maintenance (O&M) costs. O&M costs can include some capital costs for new equipment purchases necessary to change operation practices and or expand production. These capital costs would be expensed during the accounting year.
- Indirect costs. Examples are headquarter costs for administration and management.
- Capital costs. Capital costs are annualized pro-rated past facility construction costs and annualized financial costs).

O&M costs typically refer to those variable and fixed costs that pertain directly to the day to day operations of hatcheries and often include annual maintenance costs to keep the hatchery operable. They also can include minor upgrades to facilities that accounting practices would allow to be expensed in an annual budget. Indirect costs typically refer to overhead costs, administrative costs, headquarters costs and the like. The treatment of capital costs deserves some special attention when the cost analysis is to be used in public policy decision making. While year-to-year budget analysis may only need to consider financial cash flow related to O&M and indirect costs, public policy decision making needs additional information about capital costs in order to assess tradeoffs for using public funds. Capital costs include both depreciation and annualized interest costs.[14] When capital costs are included, the analysis reflects economic cash flow rather than financial cash flow.

Original facility construction costs may sometimes be considered "sunk costs," particularly if the hatchery was built 30 or 40 years ago, or last had major modifications that long ago. However, decisions made today that have long term cost implications for the future should consider all relevant costs, including capital costs. Because hatcheries are being reviewed for long term policy changes in terms of their contribution to harvest and their impact on salmon recovery, the consideration of all relevant costs is meaningful. Public policy decision making needs to balance the economic cash flow and economic effects information with other environmental and social criteria concerning the use of public funds for hatchery production.

Hatchery costs generally depend on the size of release. Spring Chinook and coho are usually released at 10 to 15 per pound which cost about $0.71 to $1.06 per smolt (Table 3c). Steelhead require longer hatchery culturing and are released at larger sizes -- about six per pound. They cost about $1.77 per smolt to produce. Fall Chinook are sometimes released at a subyearling life cycle stage including sizes of 50 per pound which cost considerably less to produce. Tracking actual production costs is difficult because hatchery operation accounting is usually pooled across populations. Also, specific populations can be raised to one life stage at one facility, transferred to another for final rearing, and transferred again for acclimation and release. There are cost savings to the State for releases by the STEP program since those organizations use volunteer labor and less capital intensive facilities.[15]

The estimated annual cost of operating study area hatcheries, including amortized capital costs, for production of the anadromous fish species contributing to the analyzed fisheries for status quo conditions is about $5.7 million (Table 4). Summary indicators to add clarity for these costs, which additionally could be used as production effectiveness indicators, are the cost per harvested adult and angler spending per harvested adult. It costs about $128 per harvested adult

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14. The method and interest rates used by the Bonneville Power Administration for evaluating their funded fish and wildlife projects is adopted for this study.
15. STEP facilities provide a mix of life-stage rearing. In some cases ODFW facilities provide fish to STEP facilities for final rearing and acclimation. In other cases, STEP facility operations include trapping parents and hatching eggs in trays. Some fish are released in early life-stages and others have final rearing and are released as smolts. In the absence of a STEP program level cost analysis, the average costs were assumed to be ODFW facility non-labor portion plus half of labor portion of operating costs. The assumed labor costs, although greatly reduced due to volunteer labor participation, would account for the prorated costs of STEP statewide staffing for one coordinator and 11 biologists. The ODFW headquarter costs for STEP are assumed to be the same rate as ODFW hatchery facility cost structure, and are applied to the assumed reduced operation costs. There was no comprehensive assessment of STEP facility replacement costs available, therefore it was assumed that facility costs were half of the average similar production ODFW facility costs.

when catch in freshwater fisheries are the accounting basis. The cost indicator varied widely by the necessary trapping, rearing, and releasing operations for the different species; and, the proportion of adults escaping ocean mortalities (environmental and harvesting). For example, fall Chinook is subject to significant ocean fisheries while steelhead is not. There is utility in such summary indicators when using a return on investment measure for evaluating hatchery facility programs. For these indicators, the objectives being analyzed would be minimizing the cost per harvested fish and optimizing the spending per harvested fish.

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 spring Chinook (CHS) and coho (COH) and 20 to 25 per pound for fall Chinook (CHF). The CHS and COH will spend about 18 months in the hatchery system, and the CHF about nine months. Costs will reflect that hatchery system 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.
- Marking (adipose fin clip) and CWT insert costs are a federal directive and have partial federal funding from other programs, such as the Pacific Coastal Salmon Recovery Fund (PCSRF). Tribal hatcheries do not use marking except for research purposes. Marking costs are about $0.05 per smolt, depending on the share of smolts to receive a CWT insert. CWT insert costs are about $0.20 per smolt.
- Labor costs are the largest component of total variable costs, usually around 50 percent, not including labor overhead for fringe benefits, insurance, etc.
- Central office overhead, management and evaluation, and other indirect costs (sometimes referred to as headquarter costs) are significant. They are from about $0.03 to $0.40 per smolt.
- Capitalized facility construction costs were estimated, assuming the facility costs required debt financing. Annual debt servicing costs plus straight-line depreciation over the assumed useful life are included in the accounting of per-smolt costs. They were calculated to be about $0.14 per smolt across all hatcheries' operations.

III. FRESHWATER FISHERIES AND HATCHERY PRODUCTION ECONOMIC CONTRIBUTION MODELING RESULTS

The estimated economic contribution from the analyzed freshwater fisheries for status quo conditions is $32 million total personal income (Table 6 and Figure 3). Wild fish contribute roughly 40 percent of angler activity economic contributions in status quo conditions. The overall economic contributions from the CMP actions to freshwater fisheries angler activity will be about 15 percent greater or an increase of $5.5 million in total personal income.[16]

16. A "status quo" situation was defined for this study in order to develop an economic contribution simulation model. The status quo conditions were analyzed fisheries hatchery releases in 2012 and annual freshwater catch averaged over 2010-2011. There were many other observed data (such as historical catch per unit effort) and assumptions (such as static ocean environmental and harvest regimes) used to develop the simulation model,

Hatchery/STEP operations economic contributions from the CMP actions will be about three percent greater or $0.2 million in total personal income (Table 7). The Mid South Coast stratum contributes the most to the CMP actions effects at 31 percent, however the overall share of economic contribution effects by stratum will not change much between CMP current and desired conditions (Figure 4).

An interesting economic statistic usually overlooked when providing economic assessments of recreational fishing is the associated economic contribution that come from the hatchery operations. Despite having to use imputed data and simplifying assumptions, best estimate economic effects are offered. The hatchery production, including STEP facility spending, generates about $4.5 million to the CMP study area and the state economy (Table 5). The hatchery operation contributions are about 12 percent of the status quo sum that includes freshwater fisheries angler activity economic contributions. It is estimated the CMP called for actions to change hatchery production will increase the economic contribution by $0.2 million (Table 7).

Hatcheries were built and operate in an involved economic, environmental, and social context (Naish et al. 2008). Economic analysis can provide insight into the existing economic effects and relative magnitude and direction of economic changes associated with plans. However, there may be different hatchery production or operation alternatives, or alternative means for accomplishing the same objectives to sustain fisheries. (It could be that hatchery funding sources are encumbered for dedicated use and not available for alternative use such as habitat improvements.) The economic analyses should prove useful in understanding the effects of hatcheries whose purpose is fishery augmentation. While not addressed in this study, a valuable application of the information would be to assess the tradeoffs between changing hatchery production and practices, and the recovery and improvement in natural stocks through habitat enhancements, passage improvements, etc.

IV. ECONOMIC BENEFITS FROM HEALTHY WILD FISH POPULATIONS

The described economic contribution from CMP study area freshwater fisheries is considerable. The economic contributions are especially important to rural economies dependent on the fisheries. Angling is one form of outdoor recreation that is tied to the more general tourism industry. The attraction of just the opportunity to fish may have been one motivation to make a trip amongst other planned general tourism activities. Vibrant stocks of wild origin fish are an indicator of healthy natural resources and can be considered an economic development asset. Living in such an environment is attractive to entrepreneurs and employees. The attraction is an important decision variable alongside more straightforward business location considerations such as market and suppliers logistics, and labor costs.

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and the degree of their validity will determine model application representativeness. The status quo situation is like the CMP "current" situation, but dissimilar in hatchery release numbers. The modeling for status quo conditions uses 2012 actual releases and the CMP current conditions use release goals. The CMP economic effects are the difference between the current and desired conditions.

The basis for maintaining and improving the CMP study area freshwater fisheries is the wild production contributions. This is for two broad reasons. The first is the burdensome government intervention that usually follows findings that wild stocks are depleted. The Oregon Conservation Strategy and more specifically the Oregon Sensitive Species Rule call for proactive actions to recover depleted species. The federal ESA allows for sweeping powers to prevent further takings of listed species that can shut down fisheries. A conclusion from this economic analysis study is the magnitude of regional economic activity from freshwater fisheries at risk from not having healthy wild stocks. Freshwater fisheries would be a small component of total economic activity at risk due to effects from other curtailed land and water use. The State and federal government can redirect funding that might otherwise be used in other government programs; and, restrict private sector land uses, limit water withdrawals, timber harvesting, and other activities. The ODFW (2007) reports that $107 million was spent alone for coho salmon from 1997 to 2003 in restoration work by private landowners and state and federal agencies. The restoration work can have short-term economic benefits, but does not offset diminished long-term uses of land for productive uses when listing occurs and critical habitat or recovery planning restricts uses (Nielsen-Pincus and Moseley 2010).

The second broad reason is society's interest in healthy wild stocks. There is substantial literature describing experiments that equate the healthy status of wild fish stocks to a non-use economic value (Wallmo and Lew 2011). Huppert (1999) acknowledged that an economic value can probably be estimated, but discussed the utility of a value with what is largely a social function. He cautioned that an economic value may not appropriately reflect the future option value of the resource. Brauman et al. (2007) discusses that trying to establish an economic value for a single species ignores the complimentary values where restored or conserved natural systems will support many ecosystem services values. There are many U.S. West Coast depleted or extirpated salmon and steelhead population examples where research has found support for government participation in rebuilding wild stocks other than just for fisheries (Helvoigt and Charlton 2009).

While economic analysis based results can inform decision makers about non-use valuations, properly designed and representative reported results for simple opinion surveys are also be illustrative of society's interests. The Oregon angler and resident preference survey results (OSU Survey Research Center 2013) show an overwhelming support for considering wild fish in developing the CMP. The support for management that aims for healthy population was supported by both anglers (91 percent) and the general population (94 percent). More than half of both respondents (65 percent of anglers and 56 percent of the general population) agreed that the plan should be developed to avoid ESA listings.[17]

17. The survey administration did not instruct respondents on tradeoff costs for specific plan actions so the interpretation of support responses and priority determinations is clouded by knowledge bias. For example, anglers responded 58 percent to increase hatchery production for their most fished species on Question 24 without being briefed on hatchery production and other tradeoff costs to attain same production such as habitat improvements.

V. DISCUSSION AND RECOMMENDATIONS FOR ADDITIONAL ANALYSIS

This economic analysis shows there are few gains and minimal shifts in geographic (defined by stratums) fishing opportunity. There are some ODFW hatchery facility and STEP production and practice changes that contribute to different fishing opportunities. Some of the changes require significant new funding, such as for new hatchery trapping and rearing capacity. One element of the hatchery production actions calls for an unidentified sponsor to inaugurate out-of-basin spring Chinook stock acclimation projects on the Yaquina River and Coos River. The CMP emphasis is on finding a balance between wild fish conservation and maintained angling opportunity. ODFW is put into a supporting role for habitat protection and improvements to be accomplished by others.

The study provides interpretive discussion about one of the key value inferences of wild origin fish production. For fisheries with mixed (wild and hatchery) stocks, healthy wild origin fish stocks ensure access to harvesting the hatchery produced fish. Under present laws of species protection only a certain amount of wild fish are allowed to be taken if there is a concern about the viability of that species. If the total harvest pool is flooded with hatchery origin fish, higher exploitation than can be tolerated by the wild origin will have adverse impacts (certain amount of wild fish suffer mortality even in selective fisheries). There is also the contended concern that hatchery origin fish affect the reproductive fitness of future generations due to stray interbreeding, hatcheries introducing disease, and other deleterious impacts to wild origin fish. Hatchery operation strategies and fish management exploitation rates would have to be reviewed (including conceivably situations for zero fisheries) for consistency with depleted wild stocks recovery.

The economic analysis of hatchery production drew upon data and results from an internal ODFW staff evaluation of coastal hatcheries as directed by House Bill 3489 which passed in the 75th Oregon Legislative Session (ODFW 2010). The ODFW evaluation was the third in the last 15 years that included economic criteria. The economic analysis in these three evaluation studies used a measure for net economic value, but was limited since they did not include opportunity and externality costs that can arise from hatchery production. Such evaluations should list the positive as well as the negative attributes of each facility. Economic metrics can then be assigned to each of these facilities as an overall comparison of coastal hatchery production and wild fish conservation programs. Further, the more in-depth evaluations could be used in a CEA to judge best use of funds for the programs. It would be important that the expanded analysis met tests for independent and expert scientist review. Perhaps the analysis could be a project for the Alsea Hatchery Research Center with review and oversight by the Independent Multidisciplinary Science Team (IMST) (with additional independent economists added to their panel).

Relying on unit economic values from other economic studies brings additional uncertainty into an economic analysis. The other studies may have been performed for different purposes and situations. It is recommended that a more thorough study design be employed for a new economic analysis. The design should include an angler economic survey that solicits comprehensive trip expenditure and marginal benefit valuation responses. The angler information needs to be accurate for the important trip characteristic variables to be affected in management plans, such as spending location (home, enroute, destination) and angling mode (boat, bank, guided, unguided, etc.). The survey should include trip decision variables for more than just catch rates afforded by fish availability so that demand prediction can be sensitive to management specifications such as daily and seasonal bag limits, area and time closures, fish size, and wild/hatchery origin preferences.

Research has shown that angler trip behavior is dynamic, and a static model such as employed in this economic analysis study does not account for trip motivation elasticities. It would be important to know specifics about next best use of angler behavior, whether it was for different fishing opportunities or another activity. The CMP action for a mandatory return and additional information (including counting released fish) harvest card will assist in expanding survey results to represent the universe of anglers. The CMP action for guide service mandatory logbook submittals will also provide critical catch and participation data as well as allowing justification findings for allocation management decisions.

Another recommendation is prompted because of the reliance on other studies for unit economic values. A new and more thorough investigation of artificial propagation costs needs to be completed. This is an accounting function that will need ODFW and STEP sponsors commitments to provide accurate cost information. If existing accounting information cannot be untangled to derive costs by species populations and expenditure types, then at least a couple of annual cycles prior to the new study will be needed to generate the detailed actual costs. STEP production has a high presence on the Oregon Coast and there has been no comprehensive cost and benefit evaluation of the program. Development of inclusive SAR datasets for the STEP is an especially lacking monitoring measurement. Proper benefit and cost evaluations require that opportunity and externality costs are included when efficiency calculations are a metric. Without such information, there may be an erroneous conclusion from the economic analysis described in this report that the STEP production is more economically efficient than any of the ODFW hatchery facility production.

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Table 1
Counties, Port Groups, Cities, and Rivers by Study Area Strata

Stratum	County	Port Group	Cities and Areas	Major Rivers and Streams
None	Clatsop	Astoria	Astoria, Hammond/Warrenton, Gearhart, Seaside and Cannon Beach	Columbia, Klaskanine, Lewis and Clark, and Youngs Rivers; Big Creek, Gnat Creek, and Bear Creek
North coast	Tillamook	Tillamook	Tillamook, Garibaldi, Netarts, and Pacific City	Tillamook River and Bay, Kilchis, Miami, Necanicum, Nehalem, Nestucca, Trask, and Wilson Rivers
Mid coast	Lincoln, Lane	Newport	Newport, Depoe Bay, and Florence	Yaquina, Siletz, Alsea, and Salmon Rivers; Big Elk Creek, Drift Creek, and Siuslaw River
Umpqua	Douglas		Winchester Bay	Umpqua River
Mid south coast	Coos, north Curry	Coos Bay	Coos Bay, Charleston, Bandon, and Port Orford	Coos, Coquille, Elk, and Sixes Rivers
None	South Curry	Brookings	Brookings and Gold Beach	Chetco River, Rogue River and Bay

Notes: 1. This table shows a different port group assignment of Winchester Bay and Florence than is traditional for economic analysis of ocean fisheries.

Source: Study.

Table 2
CMP Area Hatchery Propagation Releases

Hatchery Facility	Stock	Harvest Goal	Release Number Goal	3-Year Average	Release Location	Status Quo Release Number	2012 Release Size (fpp)	Stratum	Operator	Plan Current	Proposed Release Changes
Winter Steelhead											
Alsea	Siletz	1,500	50,000	52,203	Palmer Creek	52,573	26	Mid coast	ODFW	50,000	0
Alsea	*Alsea hatchery/wild	2,400	120,000	150,547	Hatchery, Alsea River	126,570	6	Mid coast	ODFW	120,000	20,000
Alsea	*Alsea wild	na	20,000	20,533	Yaquina (Big Elk Cr.)	21,619	6	Mid coast	ODFW	20,000	-20,000
Bandon	**Coos River	2,000	125,000	132,260	Millicoma (E/W Forks) & S. Fk. Coos River	75,095	na	Mid south	ODFW	125,000	0
Bandon	Coquille R. & S. Fk. Coquille	3,000	118,000	114,891	Coquille Tributaries (Ferry Cr.) S. Fk. Coquille R.	115,371	6	Mid south	ODFW	115,000	0
Bandon	Ten Mile Lakes	2,000	21,000	20,468	Eel, Saunders, and Tenmile creeks	10,800	na	Mid south	ODFW	21,000	4,000
Millicoma Pond	Coos River					0	7	Mid south	ODFW		
Cedar Creek	Nestucca hatchery/wild	1,900	195,000	210,633	Nestucca, Three Rivers, Wilson***, Kilchis***	116,615	8	North coast	ODFW	150,000	-10,000
Elk River	Chetco	800	50,000	47,908	Chetco River	0	6	Mid south	ODFW		
North Nehalem	N. Fk. Nehalem	1,300	130,000	135,296	N. Fk. Nehalem & Necanicum	134,720	10	North coast	ODFW	130,000	0
Rock Creek	S. Umpqua	2,340	77,000	77,582	S. Fk. Umpqua & Deer Creek	0	na	Umpqua	ODFW	120,000	30,000
Trask	Wilson River	1,000	100,000	144,991	Wilson	183,410	11	North coast	ODFW	140,000	10,000
Letz Creek					Letz Creek (Siuslaw Basin)	9,122	6	Mid coast	STEP		
Palmer Creek					Palmer Creek (Siletz Basin)	0	8	Mid coast	STEP		
Munsel Creek	Green Cr. and Whittaker Cr.				Siuslaw Basin	65,140	***6***	Mid coast	STEP		
Umpqua	Cow Creek				Eastwood Elementary, Canyon Cr., and Seven Feather	108,968	***6***	Umpqua	STEP		
Elk River	Chetco River Hatchery					0	***6***	Mid south	STEP		
STEP	Siuslaw R. - wild					0	na	Mid coast	STEP		
none assigned - Siuslaw mgmt area								Mid coast	ODFW	100,000	0
Summary		18,240	1,006,000	1,107,312		1,020,003				1,091,000	34,000

Notes: *Alsea hatchery stock is used as back-up source for the wild Alsea program.
**Shipped to Cole Rivers Hatchery for incubation and rearing.
***Released from Tuffy Creek facility.

Hatchery Facility	Stock	Harvest Goal	Release Number Goal	3-Year Average	Release Location	Status Quo Release Number	2012 Release Size (fpp)	Stratum	Operator	Plan Current	Proposed Release Changes
Summer Steelhead											
*Cedar Cr. & Salm	Siletz	2,400	80,000	67,343	Siletz River	52,500	6	Mid coast	ODFW	80,000	-30,000
Cedar Creek	Nestucca	1,000	100,000	150,547	Nestucca, Three Rivers, S. Fk. Wilson River	104,401	6	North coast	ODFW	100,000	0
Rock Creek	N. Umpqua	5,000	110,000	123,762	N. Fk. Umpqua Galesville Reservoir	93,774	8	Umpqua	ODFW	165,000	0
Summary		8,400	290,000	341,652		250,675	7			345,000	-30,000

Notes: *Adults are collected and spawned by Cedar Creek hatchery, eggs shipped to Salmon River for incubation and rearing.

Table 2 (Cont.)

Hatchery Facility	Stock	Harvest Goal	Release Number Goal	3-Year Average	Release Location	Status Quo Release Number	2012 Release Size (fpp)	Stratum	Operator	Plan Current	Proposed Release Changes
Spring Chinook Coastal											
Cedar Creek	Nestucca	825	110,000	116,402	Nestucca River, Three Rivers	111,026	14	North coast	ODFW	110,000	120,000
Rock Creek	N. Umpqua River	10,260	342,000	316,232	N. Fk. Umpqua Galesville Reservoir	383,940	8	Umpqua	ODFW	342,000	0
Trask	Trask River	1,800	253,000	247,045	Wilson River, Trask River	72,340	24	North coast	ODFW	345,000	55,000
Trask Pond	Trask River (Trask Hatchery)					118,438	14	North coast	ODFW		
Whiskey Creek	Trask River (Trask Hatchery)					35,379	11	North coast	STEP		
Whiskey Creek Volunteer					Wilson River, Trask River	101,191	12	North coast	STEP		
none assigned - Yaquina management area (net pens)					(net pens)	0	***8***	Mid coast	ODFW	0	100,000
none assigned - Coos Bay Frontal mgmt area (net pen			____	____	(net pens)	0	***8***	Mid south	ODFW	0	100,000
Summary		12,885	705,000	679,679		822,314				797,000	375,000
Fall Chinook Coastal											
Bandon	Coos River	4,000	205,000	760,767	Blossom Gulch, South Slough	2,033,172	na	Mid south	ODFW	1,993,000	100,000
Bandon	Coos River		800,000		Noble Creek, Millicoma River, Fourth Cr. Reservoir	99,760	na	Mid south	both	100,000	-100,000
Bandon	Coquille	2,500	174,600	76,972	Cunningham Cr., Ferry Cr., Sevenmile Cr., Hall Cr.	144,610	51	Mid south	both	175,000	0
Coquille HS	Coquille R. (Bandon Hatchery)					0	22	Mid south	STEP		
Millicoma Pond	Coos River					0	58	Mid south	ODFW		
Elk River	Elk River	2,500	325,000	325,508	Elk River	335,182	13	Mid south	ODFW	325,000	-50,000
Elk River	Chetco	600	150,000	172,927	Chetco River, Ferry Creek	0	11	Mid south	ODFW		
*North Nehalem/T	Trask	1,035	139,000	105,386	Necanicum River, Trask River	143,313	30	North coast	ODFW	138,000	37,000
Salmon River	Salmon River	1,000	200,000	202,592	Salmon River	206,602	13	Mid coast	ODFW	200,000	0
Coos					Coos Basin	0	75	Mid south	STEP		
South Coos River Trap						0	75	Mid south	STEP		
Umpqua Fishermen Association						237,000	***75***	Umpqua	STEP		
Gardiner-Reedsport-Winchester Bay					Winchester Bay	80,000	***75***	Umpqua	STEP		
none assigned - Winchester Bay (net pens)					Winchester Bay (net pens)	100,000	***75***	Mid south	STEP		
Elk River	Chetco River Hatchery					0	***11***	Mid south	STEP		
Rhoades Pond					Three Rivers and Nestucca River	67,306	17	North coast	STEP		
Whiskey Creek Volunteer					Wilson River, Trask River	0	***30***	North coast	STEP		
none assigned - Nestucca R mgmt area								North coast	ODFW	100,000	0
none assigned - Umpqua mgmt areas		____	____	____		____		Umpqua	ODFW	470,000	0
Summary		11,635	1,993,600	1,644,152		3,446,945				3,501,000	-13,000

Notes: *Adults are collected and spawned at Trask hatchery and 25,000 fish are produced at North Nehalem.

Notes:
1. For STEP operations, the hatchery facility is the STEP organization name.
2. Release sizes that are estimated by the size of the stock of the same species in the nearest basin are shown in ***bold italics.*** Release sizes shown as "na" indicate stocks with zero releases, or with no data available. Release stages shown as "fng" are fingerlings.
3. Plan current release numbers exclude unfed fry releases. STEP releases for Plan current are assumed to be the same as status quo STEP releases.
4. Elk River Hatchery releases of Chetco River stock to the Chetco River are excluded. Elk River is in the CMP Area, but Chetco River is not.
5. Status quo releases are for Year 2012.
6. At some hatcheries for some populations, fish have only been raised to life-cycle stage of fingerling and fry before being released. The releases include landlocked locations where they contribute to resident fish fisheries. The costs for the handling and raising are not included in the hatchery production cost economic analysis.

Sources: ODFW (2010); ODFW (2013); ODFW (undated); Coquille River STEP, www.coquilleriverstep.org; Coos River STEP - Noble Creek Fish Hatchery, http://noblecreekfish.net/index.html; Florence STEP, http://florencestep.com/; City of Depoe Bay, http://www.cityofdepoebay.org/; Gardiner-Reedsport-Winchester Bay STEP Inc., of Douglas County; Tillamook Anglers Corporation. Net pen releases of ODFW spring Chinook are estimated from CMP Plan document (January 2013 draft) proposed releases, and net pen STEP fall Chinook releases are estimated from April 2012 Minutes of the STEP Advisory Committee (STAC). Release size is from ODFW (2013). Plan current release and proposed release change numbers are from CMP Plan document (ODFW 2014). Status quo releases are from personal communication with Kevin Goodson, ODFW, December 3, 2013.

Table 3a

Model Drivers for Wild and Hatchery Production Catch and Economic Contribution Calculations

FALL CHINOOK WILD ORIGIN FISH CATCH PROPORTION

North Coast		Mid Coast		Umpqua		Mid South Coast	
Necanicum	40%	Salmon	40%	Umpqua	80%	Coos	40%
Nehalem	99%	Siletz	99%			Coquille	90%
Tillamook	90%	Yaquina	99%			Sixes	90%
Nestucca	80%	Alsea	99%			Elk	23%
		Siuslaw	99%				

	Fall Chinook	Spring/Sum Chinook	Winter Steelhead	Summer Steelhead	Analyzed Fisheries
WILD PRODUCTION CATCH FUNCTION					
Point					
α =	0.332040	0.195370	0.135550	2.137100	
β =	7,067.7	2,116.0	2,540.0	924.2	
Lower confidence					
α =	0.240030	0.121820	0.037089	0.529350	
β =	4,542.8	322.8	-2,487.8	733.2	
Upper confidence					
α =	0.424060	0.268920	0.234010	3.744900	
β =	9,592.5	3,909.3	7,567.7	1,115.2	
HATCHERY PRODUCTION SMOLT-TO-ADULT SURVIVAL					
SAR (harvest only)	1.06%	2.24%	1.97%	1.17%	1.41%
Freshwater	0.34%	1.16%	1.97%	1.17%	0.80%
Ocean	0.72%	1.08%	0.00%	0.00%	0.61%

Notes: 1. SAR determination was completed at the stratum level. The shown SARS are a production weighted average across strata.

	Fall Chinook	Spring/Sum Chinook	Winter Steelhead	Summer Steelhead	Analyzed Fisheries
SUCCESS RATES					
Freshwater	6.00	7.50	4.00	4.00	

Notes: 1. Success rates are expressed as number of days per fish caught.
Source: TRG (2013).

	Fall Chinook	Spring/Sum Chinook	Winter Steelhead	Summer Steelhead	Analyzed Fisheries
NON-RETAINED CATCH RATES					
Status quo	23%	27%	62%	57%	
Current status	23%	27%	62%	57%	
Desired status	23%	27%	62%	57%	

Notes: 1. Rates apply to sum of wild and hatchery retained catch.
Source: Non-retained catch rates were derived using Question 19a and 20a preference survey results as described in OSU (2013).

	Analyzed Fisheries
FRESHWATER FISHING	
Economic contributions per angler day	44.64

Notes: 1. Economic contributions are expressed as personal income, adjusted to Year 2012 dollars using the GDP implicit price deflator developed by the U.S. Bureau of Economic Analysis.
Source: TRG (2013).

Table 3b
Model Drivers for Wild and Hatchery Production

	Fall Chinook	Spring/Sum Chinook	Winter Steelhead	Summer Steelhead	Analyzed Fisheries
WILD SPAWNERS					
Observed	89,200	3,500	69,300	3,500	165,500
Desired	123,700	5,200	85,600	4,800	219,300

Notes: 1. Desired status assumes current status fishery management regimes.
Source: ODFW (2014).

	Fall Chinook	Spring/Sum Chinook	Winter Steelhead	Summer Steelhead	Analyzed Fisheries
HATCHERY PRODUCTION					
Status quo releases					
Smolt production	3,346,945	822,314	1,020,003	250,675	5,439,937
ODFW	2,962,639	685,744	836,773	250,675	4,735,831
STEP	384,306	136,570	183,230	0	704,106
Smolt production, net pens					
Unidentified	0	0	0	0	0
STEP	100,000	0	0	0	100,000
Plan current releases					
Smolt production	3,885,306	933,570	1,274,230	345,000	6,438,106
ODFW	2,931,000	797,000	991,000	345,000	5,064,000
STEP	954,306	136,570	283,230	0	1,374,106
Smolt production, net pens					
Unidentified	0	0	0	0	0
STEP	100,000	0	0	0	100,000
Proposed change in releases					
Smolt production	-13,000	175,000	34,000	-30,000	166,000
ODFW	-13,000	175,000	34,000	-30,000	166,000
STEP	0	0	0	0	0
Smolt production, net pens					
Unidentified	0	200,000	0	0	200,000
STEP	0	0	0	0	0

Notes: 1. STEP releases for Plan current are assumed to be the same as status quo STEP releases.
2. Hatchery production status quo is for pre-smolt and smolt releases in 2012.
Source: ODFW (2014).

Table 3c
Model Drivers for Hatchery Production Costs

	Fall Chinook	Spring/Sum Chinook	Winter Steelhead	Summer Steelhead	Analyzed Fisheries
COST PER SMOLT (mixed smolt and pre-smolt sizes)					
ODFW					
Operation	0.3300	0.4300	0.7200	0.7200	
Labor	39%	42%	42%	42%	
Non-labor	61%	58%	58%	58%	
Headquarters	0.1238	0.1613	0.2700	0.2700	
Capital/fixed	0.3785	0.4921	0.8201	0.8201	
Unidentified					
Operation, net pen		0.1470			
Capital/fixed, net pen		0.1044			
STEP					
Operation	0.2664	0.3395	0.5685	0.5685	
Headquarters	0.0999	0.1273	0.2132	0.2132	
Capital/fixed	0.0328	0.2050	0.3076		
Operation, net pen	0.2580				
Capital/fixed, net pen	0.2088				

Notes:
1. Operation cost per smolt is from Coastal Hatchery Evaluation HB 3489 report (ODFW 2010).
2. In the absence of a STEP program level cost analysis, the average costs were assumed to be ODFW facility non-labor portion plus half of labor portion of operating costs. The assumed labor costs, although greatly reduced due to volunteer labor participation, would account for the prorated costs of STEP statewide staffing for one coordinator and 11 biologists. The ODFW headquarter costs for STEP are assumed to be the same rate as ODFW hatchery facility cost structure, and are applied to the assumed reduced operation costs. There was no comprehensive assessment of STEP facility replacement costs available, therefore it was assumed that facility costs were half of the average similar production ODFW facility costs.
3. Net pen program operation costs per smolt are from the BPA SAFE report (TRG November 2006).
4. The ODFW operations can include costs for propagating fish to a life-cycle stage when they are transferred to another organization for acclimation and release as well as raising fish to a out-migrating smolt life-cycle stage.
5. Headquarter costs are calculated using a rate whose basis is hatchery operation costs. Headquarter costs can include central services for M&E, hauling smolts between hatcheries, marking and tagging, laboratory services, etc. and overhead costs for administration and management, etc.

	Analyzed Fisheries
HATCHERY PRODUCTION ECONOMIC IMPACT FACTORS	
I/O model response coefficient	
Labor	1.97
Non-labor	0.99
Hatchery operation and headquarter cost labor share	
ODFW labor share (before indirect)	65%
Assumed wage and salary benefit exports	35%

Table 3c (Cont.)

	Fall Chinook	Spring/Sum Chinook	Winter Steelhead	Summer Steelhead	Total
HATCHERY COST SHARES					
Operating (per fish)					
Propagating					
Labor	39%	42%	42%	42%	
Feed	7%	13%	13%	13%	
M&S	10%	9%	9%	9%	
Other	2%	16%	16%	16%	
Handling					
Marking	22%	4%	4%	4%	
Marking/CWT	20%	9%	9%	9%	
Other costs	1%	1%	1%	1%	
Spawning and eyeing	-	5%	5%	5%	
Administrative (percent of operating)					Total
Hatchery indirect					22.5%
Local M&E					5%
Central M&E					10%
Capital or fixed					
$ per pound					$86
Year					2012
Capital or fixed total costs for net pens					
Fixed height deck and gangway, hand hoist, floating docks, and piers					$250,000
Net pen material purchase					$15,000
Backland improvement for access parking, feed storage building, equipment					$100,000

Notes: 1. Hatchery production cost overhead charged by states' central management (i.e. Salem headquarters' costs) is 34.2% for ODFW, but does not include contract and feed costs. The effective rate is 22.5%. STEP and unidentified net pen overhead cost rate is assumed to be included in ODFW hatchery accounting.

2. Onsite central monitoring and evaluation (M&E) costs are shown as an itemized headquarters' costs.

3. Fixed costs are estimated using Berry formula for per smolt production weight. The estimates are then adjusted to a current year using a construction cost index and amortized for the calculation of an annual per-smolt capital cost. The amortizing terms are 30 years and the interest rate is from USDA Natural Resources Conservation Service. Fixed costs for STEP programs are estimated using half the Berry formula, and fixed costs for net pens are based on net pen costs from TRG (November 2006) instead of the Berry formula.

Source: Hatchery cost shares are from (TRG November 2006), where fall Chinook used 20 smolt per pound for select area bright fall Chinook for South Fork Klaskanine and Klaskanine hatcheries; spring Chinook used nine smolt per pound; and winter and summer steelhead used six smolt per pound.

FINANCIAL	Total
Useful life	30
Salvage value	$0
Interest rate	4.000%
Loan term	20

Source: Interest rate from Water Resources Council discount rates, released January of each year, http://www.economics.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/econ/prices.

Table 4
Hatchery Production Cost, Catch, and Cost Per
Harvested Adult for Status Quo Conditions by Facility Type

	Fall Chinook	Spring/Sum Chinook	Winter Steelhead	Summer Steelhead	Analyzed Fisheries
Cost (thousands)	2,666	835	1,714	454	5,668
ODFW facilities	2,466	743	1,515	454	5,177
Operation	978	295	602	180	2,056
Headquarters	367	111	226	68	771
Capital/fixed	1,121	337	686	206	2,351
Unidentified facilities	0	0	0	0	0
Operation, net pen	0	0	0	0	0
Capital/fixed, net pen	0	0	0	0	0
STEP facilities	200	92	200	0	491
Operation	102	46	104	0	253
Headquarters	38	17	39	0	95
Capital/fixed	13	28	56	0	97
Operation, net pen	26	0	0	0	26
Capital/fixed, net pen	21	0	0	0	21
Harvested adults (thousands)	37	18	20	3	78
Freshwater	12	10	20	3	44
Ocean	25	9	0	0	34
Cost per harvested adult					
Freshwater and ocean basis	73	45	85	155	73
ODFW facilities	67	40	75	155	66
Unidentified facilities	0	0	0	0	0
STEP facilities	5	5	10	0	6
Freshwater basis	227	87	85	155	128
ODFW facilities	210	78	75	155	117
Unidentified facilities	0	0	0	0	0
STEP facilities	17	10	10	0	11

Notes:
1. Harvested adults are retained catch.
2. Costs are for annual ODFW hatchery and STEP facilities and include amortized capital costs.
3. Using only freshwater fisheries catch as a basis for the cost-per-harvested-adult statistic would be interpreted to mean that the ODFW hatchery and STEP facility production have singular fisheries objectives.

Table 5
Hatchery Operation Economic Contribution by Facility Type for
Status Quo Conditions and CMP Current and Desired Conditions

	Fall Chinook	Spring/Sum Chinook	Winter Steelhead	Summer Steelhead	Analyzed Fisheries
Economic contributions hatchery operations (thousands)					
ODFW facilities					
Status quo	1,888	569	1,163	348	3,969
Plan current	1,867	662	1,378	480	4,386
Plan desired	1,859	807	1,425	438	4,529
Unidentified facilities					
Status quo	0	0	0	0	0
Plan current	0	0	0	0	0
Plan desired	0	41	0	0	41
STEP facilities					
Status quo	234	90	201	0	525
Plan current	527	90	311	0	927
Plan desired	527	90	311	0	927
All facilities					
Status quo	2,122	659	1,364	348	4,493
Plan current	2,395	751	1,689	480	5,314
Plan desired	2,386	938	1,736	438	5,498

Notes: 1. Economic contributions are expressed as personal income adjusted to Year 2012 dollars using the GDP implicit price deflator developed by the U.S. Bureau of Economic Analysis.

Table 6
Hatchery and Wild Production Freshwater Catch, Angler Days, and Economic Contribution
for Status Quo Conditions and CMP Current and Desired Conditions

	Fall Chinook	Spring/Sum Chinook	Winter Steelhead	Summer Steelhead	Analyzed Fisheries
HATCHERY PRODUCTION					
Catch (thousands)					
SQ	12	10	20	3	44
Plan current	14	11	25	4	53
Plan desired	14	15	25	3	58
Angler days (thousands)					
SQ	91	99	210	27	428
Plan current	111	109	258	36	515
Plan desired	112	155	262	30	559
Economic contributions fishing (thousands)					
SQ	4,075	4,416	9,391	1,210	19,092
Plan current	4,970	4,880	11,512	1,622	22,984
Plan desired	4,998	6,929	11,707	1,344	24,979
Plan effects	1%	42%	2%	-17%	9%
WILD PRODUCTION					
Catch (thousands)					
Observed	36	1	0	0	37
Desired	43	1	3	0	46
Angler days (thousands)					
Observed	284	5	0	0	289
Desired	334	7	27	0	368
Economic contribution (thousands)					
Observed	12,680	238	0	0	12,918
Desired	14,916	316	1,214	0	16,446
Plan effects	18%	33%			27%
TOTAL ANALYZED FISHERIES					
Catch (thousands)					
SQ (incl. hatch., wild obs.)	48	10	20	3	81
Plan current	51	11	25	4	90
Plan desired	57	16	28	3	104
Angler days (thousands)					
SQ (incl. hatch., wild obs.)	375	104	210	27	717
Plan current	395	115	258	36	804
Plan desired	446	162	289	30	928
Economic contributions fishing (thousands)					
SQ (incl. hatch., wild obs.)	16,756	4,654	9,391	1,210	32,011
Plan current	17,650	5,118	11,512	1,622	35,902
Plan desired	19,914	7,245	12,921	1,344	41,424
Plan effects	13%	42%	12%	-17%	15%

Notes: 1. Economic contributions are expressed as personal income adjusted to Year 2012 dollars using the GDP implicit price deflator developed by the U.S. Bureau of Economic Analysis.
2. SQ is status quo conditions.

Table 7
CMP Effects From Freshwater Fisheries and Hatchery Operations by Strata

		CMP Effects				
			Stratum Shares			
Analyzed Fisheries	Status Quo	Total	North Coast	Mid Coast	Umpqua	Mid S. Coast
Catch						
Hatchery	44,305	+4,271	47%	15%	7%	30%
Wild	36,976	+9,192	17%	28%	26%	29%
Total	81,282	+13,463	26%	24%	20%	30%
Angler Days						
Total	717,011	+123,689	26%	25%	18%	31%
Economic Contributions (thousands)						
Analyzed fisheries	32,011	+5,522	26%	25%	18%	31%
Hatchery operations	4,493	+184				
Total	36,504	+5,706				

Notes:
1. Economic contributions are expressed as personal income adjusted to Year 2012 dollars using the GDP implicit price deflator developed by the U.S. Bureau of Economic Analysis.
2. Status quo is a patterned contribution to fisheries using Year 2012 hatchery releases and wild production in CMP current conditions.
3. CMP effects are the change resulting from plan actions. A negative sign would indicate a decrease and a positive sign would indicate an increase. The plan effect shares describe each stratum's proportion of the overall effects.
4. CMP effects assumes current ocean harvest management regimes.
5. Catch and angler days are for mixed stock fisheries. This is a reference to fisheries that occur where there are encounters with both hatchery and wild fish. Some of these fisheries are selective for retention of only hatchery origin fish.

Figure 1a
Oregon Coastal Basins Included in the CMP

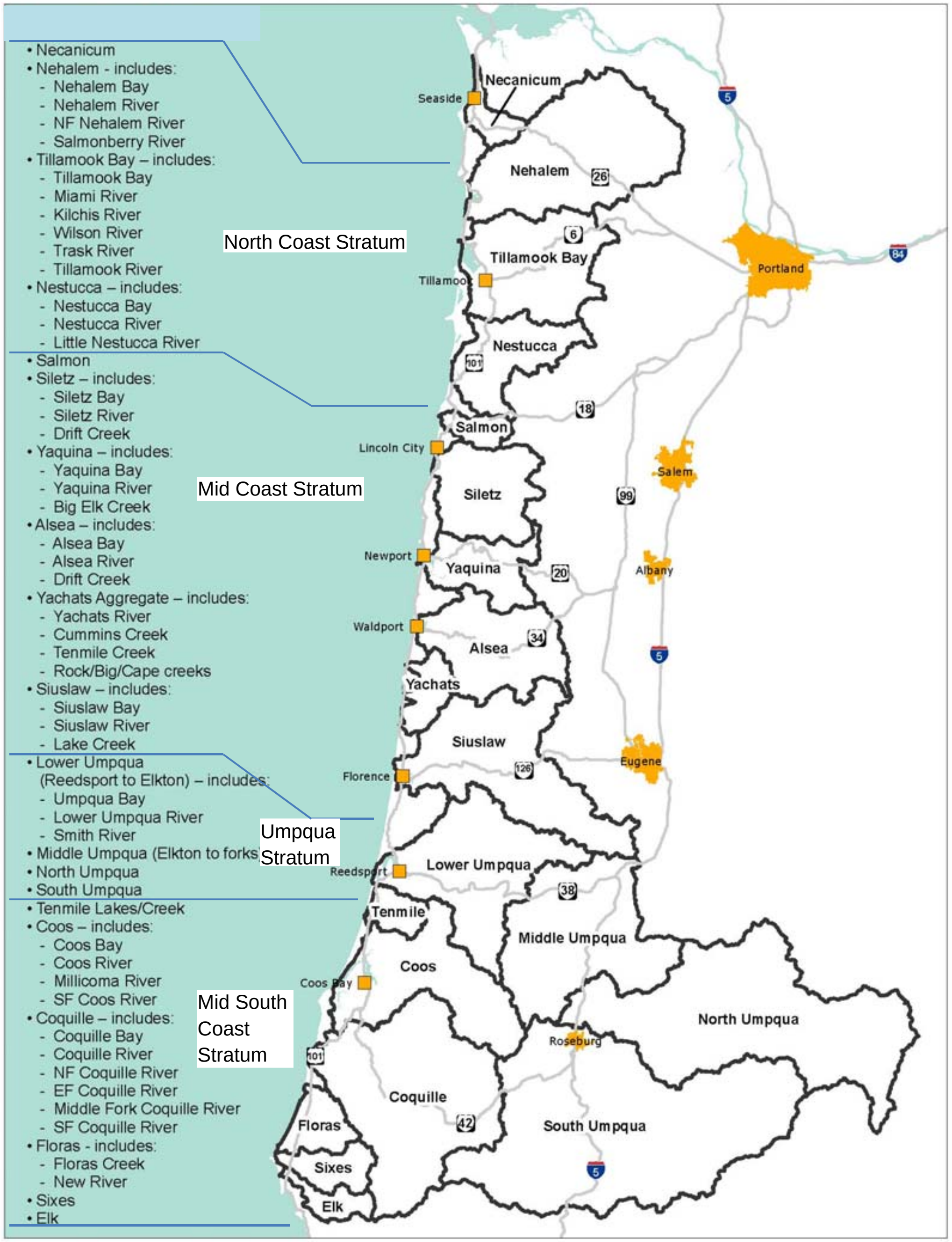

Figure 1b
Fish Propagation Facilities Included in the CMP

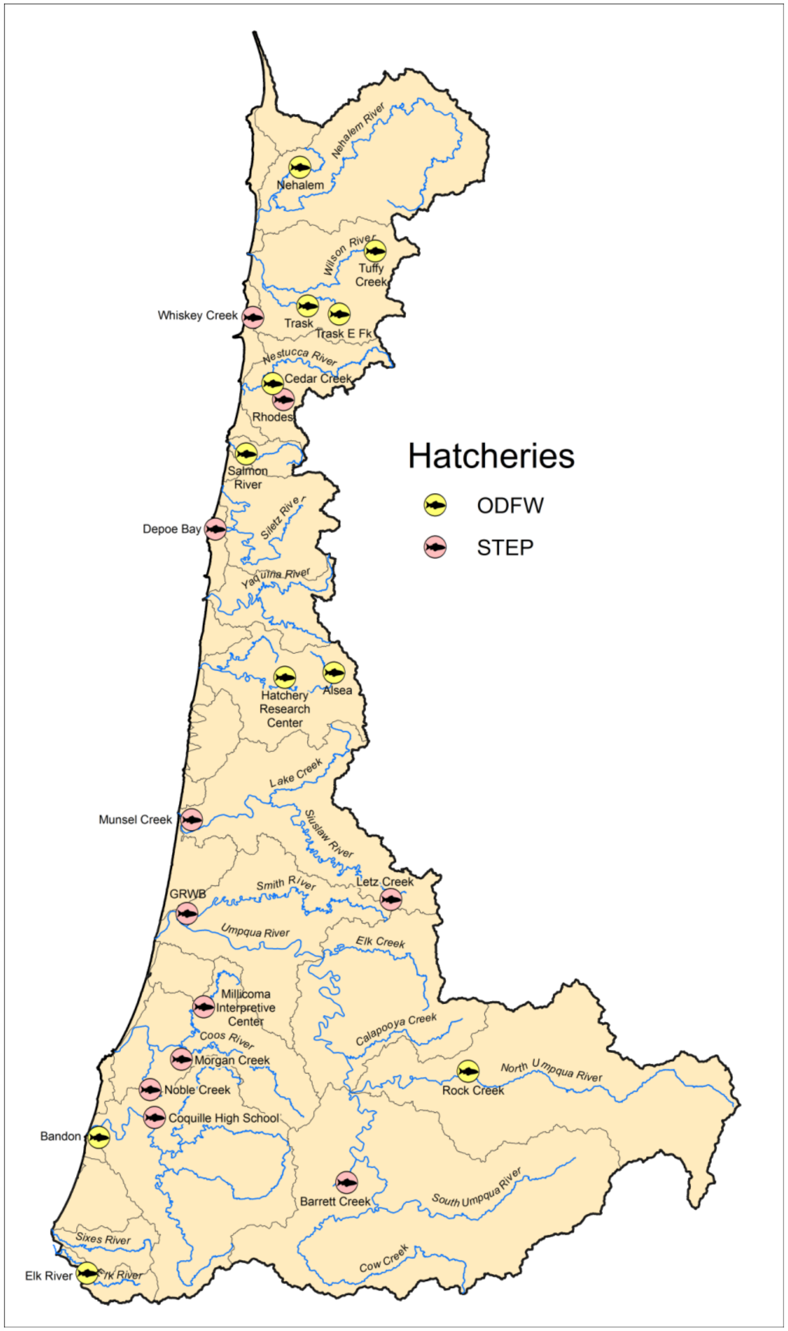

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Figure 2a
Freshwater Fisheries Catch by Species for the CMP Study Area in 1995 to 2012

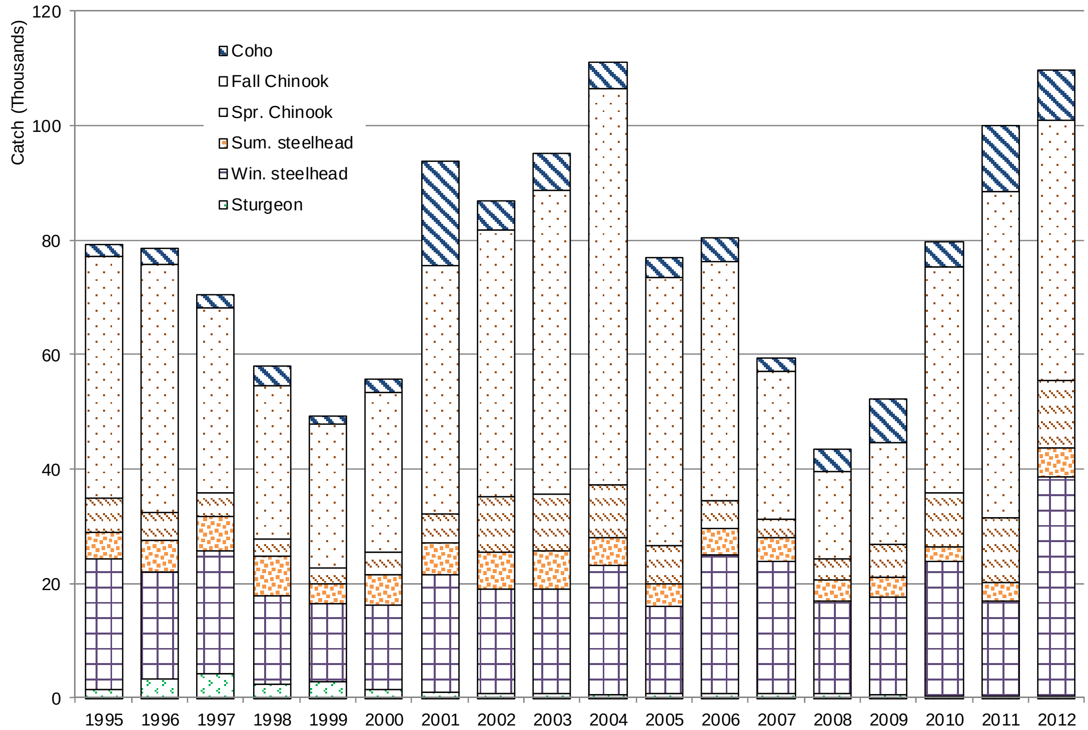
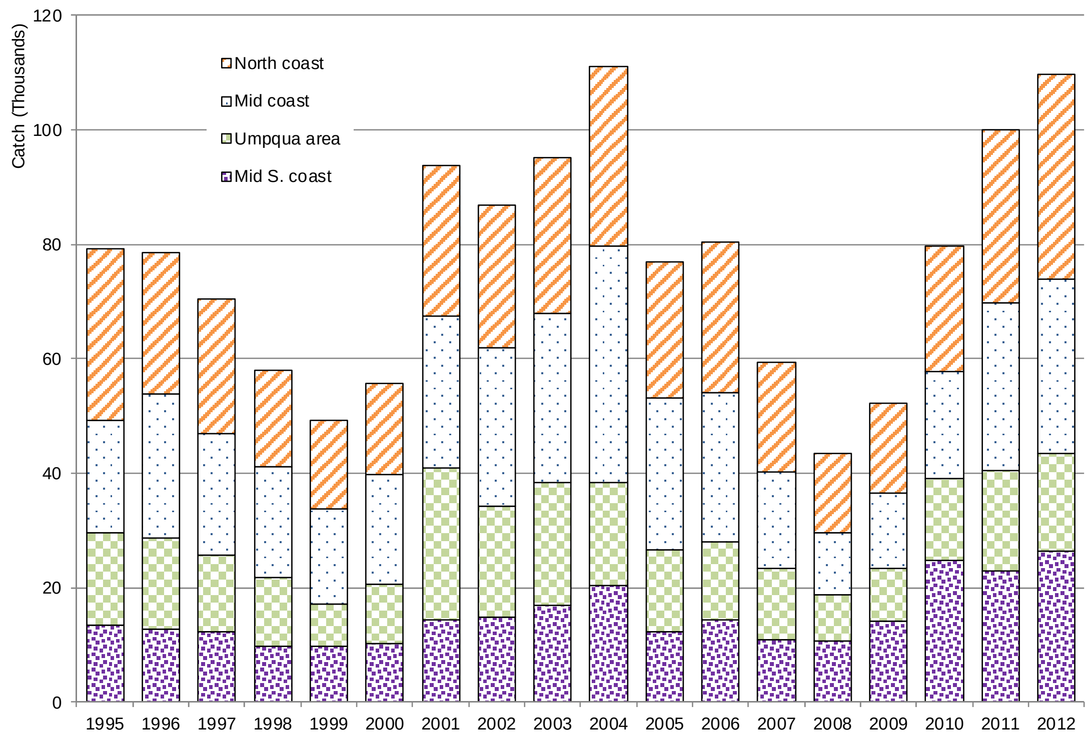


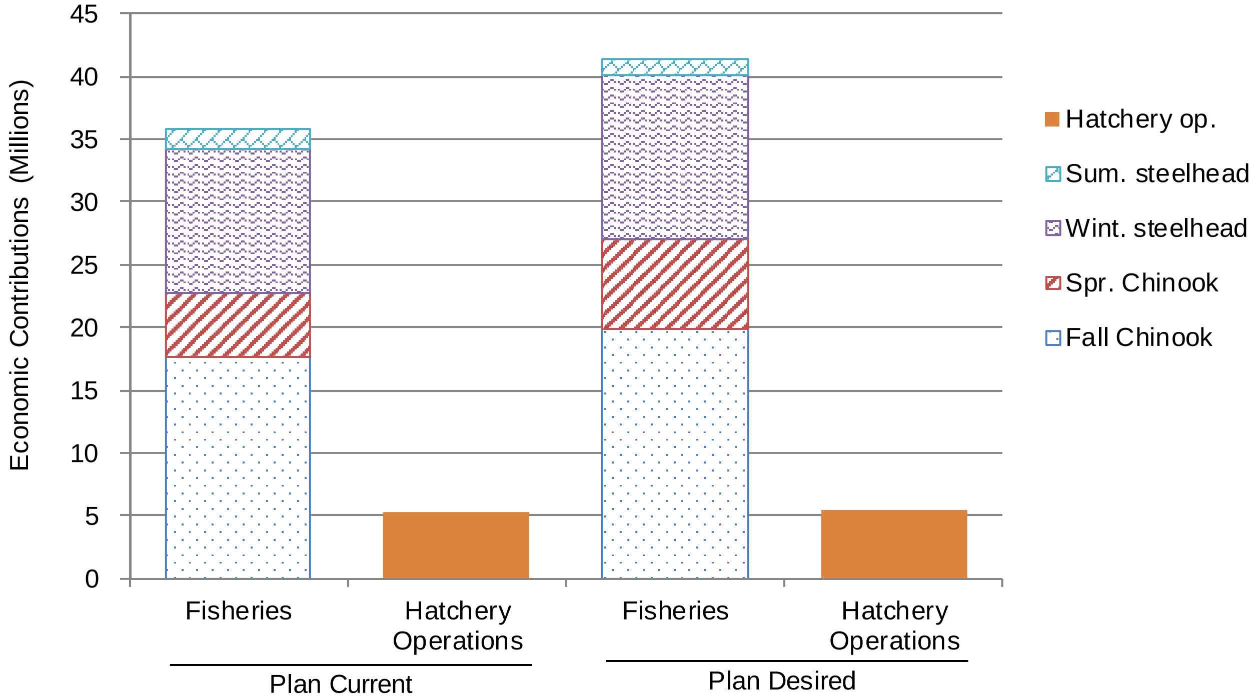
Figure 2b
Freshwater Fisheries Catch by Stratums for the CMP Study Area in 1995 to 2012



Notes:
1. Data is preliminary for Years 2008 to 2012.
2. Anadromous fish species include salmon and sturgeon.
3. Study area includes north coast (Tillamook County), mid coast (Lincoln and Lane Counties), Umpqua area (Douglas County), and mid south coast (Coos County and northern Curry County).

Source: ODFW SSHSTRP.

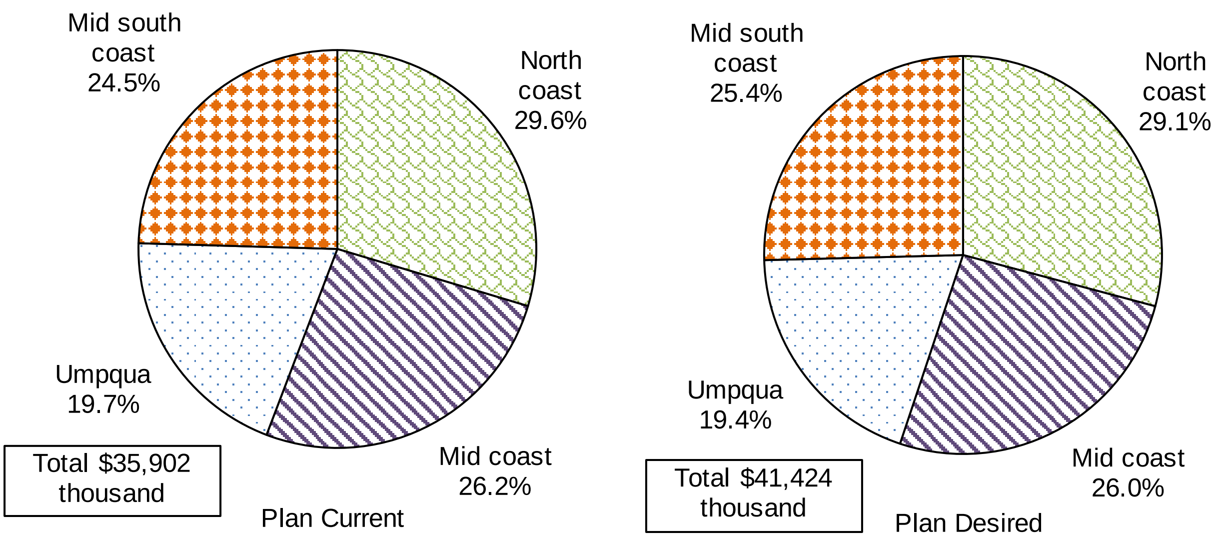
Figure 3
Economic Contributions From Freshwater Fisheries for Effects From CMP Actions



Notes: 1. Economic contribution is measured by total personal income in millions of 2012 dollars. Freshwater fisheries economic contribution is calculated for the coastwide level economy in Oregon and includes angler day expenditures for freshwater fishing. Hatchery economic contributions are calculated at the statewide level economy in Oregon and include economic effects from expenditures for hatchery operation and headquarters. Economic effects from ocean harvesting are not included.

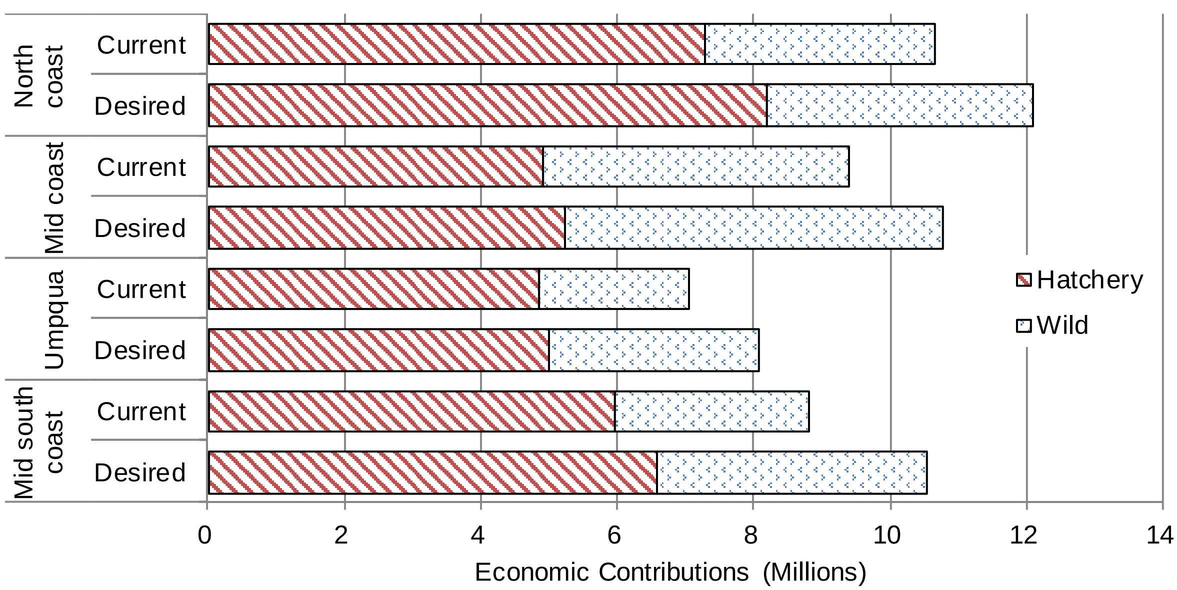
Sources: ODFW (2010). Plan current release and proposed release change numbers, and wild spawners, are from CMP Plan document (ODFW 2014). Freshwater success rate and economic contributions per angler day from TRG (2013).

Figure 4
Economic Contributions From Freshwater Fisheries by Stratum



Notes: 1. Economic contributions are expressed as personal income adjusted to Year 2012 dollars using the GDP implicit price deflator developed by the U.S. Bureau of Economic Analysis.

Figure 5
Economic Contributions From Freshwater Fisheries by Stratum and by Hatchery and Wild Origin



Notes: 1. Economic contributions are expressed as personal income adjusted to Year 2012 dollars using the GDP implicit price deflator developed by the U.S. Bureau of Economic Analysis.
2. The economic contribution estimates by fish origin are based on estimated angler catch. The same economic factors (expansion factors to account for non-retained catch, success rates, and economic contributions per angler day) are applied to both catch origins.

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Appendix A

Plan Production, Wild Abundance Goals, and Implementation Costs

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Table 13. Proposed hatchery smolt/pre-smolt program changes. Educational and short-term research programs are not documented and are assumed to have little conservation or fishing opportunity impacts. Cells that include the word "to" indicate that there is a change in the program level; there is no change if there is only a single number in a cell. Empty cells are locations which do not receive the respective run of hatchery fish. "*" indicates a modification that may require additional funding. Abbreviations are: CO = coho, ChF = fall-run Chinook, ChS = spring-run or spring Chinook, StW = winter steelhead, and StS = summer steelhead.

		Proposed Hatchery Smolt/Pre-Smolt Program Summary and Changes				
Management Area	Stratum	CO	ChF	ChS	StW	StS
Necanicum R	North Coast Stratum		25,000		40,000	
Nehalem Bay						
NF Nehalem R		100,000			90,000	
Nehalem R						
Nehalem - Salmonberry R						
Tillamook Bay						
Tillamook - Miami R						
Tillamook - Kilchis R					40,000 to 0	
Tillamook - Wilson R				125,000 to 0	140,000 to 150,000	30,000 to 50,000
Tillamook - Trask R		100,000	113,000 to 150,000	220,000 to 400,000 *		
Tillamook R						
Nestucca Bay						
Nestucca R			100,000	110,000 to 200,000 *	110,000 to 140,000	70,000 to 50,000
Little Nestucca R				0 to 30,000 *		
Salmon R	Mid-Coast Stratum		200,000			
Siletz Bay						
Siletz R					50,000	80,000 to 50,000 [a]
Siletz - above Falls						
Siletz - Drift Crk						
Yaquina Bay				0 to 100,000 *		
Yaquina R						
Yaquina - Big Elk Crk					20,000 to 0	
Alsea Bay						
Alsea R					120,000 to 140,000	
Alsea - Drift Crk						
Yachats Aggregate						
Siuslaw Bay						
Siuslaw - Lake Crk					15,000	
Siuslaw R					85,000	
Umpqua Bay	Umpqua Stratum		170,000 [b]			
Umpqua - Smith R						
Lower Umpqua R						
Middle Umpqua R			300,000 [b]			
N Umpqua R				342,000		165,000
N Umpqua - above Rock Crk						
S Umpqua R		60,000			120,000 to 150,000 *	
S Umpqua R - above Canyonv						
Tenmile Lk/Crk	Mid-South Stratum				21,000 to 25,000	
Coos Bay Frontal			1,993,000 to 2,093,000	0 to 100,000 *		
Coos - EF Millicoma R					53,000	
Coos - WF Millicoma R			100,000 to 0		35,000	
SF Coos R					37,000	
Coquille Bay			175,000			
NF Coquille R					25,000 to 45,000	
EF Coquille R					20,000 to 0	
Middle Fork Coquille R						
SF Coquille R					70,000	
Floras/New R						
Sixes R						
Elk R			325,000 to 275,000			
NADOTs	*mixed*					
TOTAL Smolts/Pre-Smolts		260,000 to 260,000	3,501,000 to 3,488,000 [c]	797,000 to 1,172,000	1,091,000 to 1,125,000	345,000 to 315,000
		5,994,000 to 6,360,000				

[a] Effectiveness of the Siletz StS hatchery programs will be evaluated with the potential for increases (see below for details).
[b] Focused monitoring will determine if release number is appropriate or should be changed.
[c] ChF totals do not include unfed fry releases (see Table 14).

Table 14. Proposed hatchery unfed fry program changes.

		Proposed Hatchery Unfed Fry Program Changes	
Management Area	Stratum	ChF	ChS
Necanicum R	North Coast Stratum		
Nehalem Bay			
NF Nehalem R			
Nehalem R			
Nehalem - Salmonberry R			
Tillamook Bay			
Tillamook - Miami R		*50,000 to 0*	
Tillamook - Kilchis R		*50,000 to 0*	
Tillamook - Wilson R		*65,000 to 0*	
Tillamook - Trask R		80,000 to 0	*42,000 to 0*
Tillamook R		*27,500 to 0*	
Nestucca Bay			
Nestucca R		*50,000 to 0*	*65,000 to 0*
Little Nestucca R			
Salmon R	Mid-Coast Stratum		
Siletz Bay			
Siletz R			
Siletz - above Falls			
Siletz - Drift Crk			
Yaquina Bay			
Yaquina R			
Yaquina - Big Elk Crk			
Alsea Bay			
Alsea R			
Alsea - Drift Crk			
Yachats Aggregate			
Siuslaw Bay			
Siuslaw - Lake Crk			
Siuslaw R			
Umpqua Bay	Umpqua Stratum		
Umpqua - Smith R			
Lower Umpqua R			
Middle Umpqua R			
N Umpqua R			
N Umpqua - above Rock Crk			
S Umpqua R			
S Umpqua R - above Canyonv			
Tenmile Lk/Crk	Mid-South Stratum		
Coos Bay Frontal			
Coos - EF Millicoma R			
Coos - WF Millicoma R			
SF Coos R			
Coquille Bay			
NF Coquille R		*50,000*	
EF Coquille R			
Middle Fork Coquille R			
SF Coquille R		*50,000*	
Floras/New R			
Sixes R			
Elk R			
NADOTs	*mixed*		
TOTAL Unfed Fry		422,500 to 100,000	107,000 to 0

Table 17. Proposed Management Areas where wild fish may be retained (i.e., harvested). "N" indicates no retention of wild fish is allowed. "Retention" indicates that harvest is allowed (see Table 18 for details of limits and seasons). Red stippling and an asterisk indicate a change from current management regarding wild fish retention. "NADOTs" include all direct ocean tributaries not listed elsewhere in the table. Note that coho retention is only intended to be to current deadlines, without expanding further into rivers (current deadlines are mostly within tidewater, including into some rivers above bays, but a few are above tidewater).

		Proposed Wild Harvest Locations						
Management Area	Stratum	CO	Chin	Protected Ch [a]/ChS	Chum	StW	StS	CCT
Necanicum R	North Coast Stratum	N	Retention	---	N	N	---	Retention
Nehalem Bay		Retention	Retention	Retention	N	N	---	Retention
NF Nehalem R		N	Retention	---	N	N	---	Retention
Nehalem R		N	Retention	Retention	N	N	---	Retention
Nehalem - Salmonberry R		N	N	N	N	N	---	N
Tillamook Bay		Retention	Retention	N	N	N	---	Retention
Tillamook - Miami R		N	Retention	N	N	N	---	Retention
Tillamook - Kilchis R		N	Retention	N	N	N	---	Retention
Tillamook - Wilson R		N	Retention	N	N	N	---	Retention
Tillamook - Trask R		N	Retention	N	N	N	---	Retention
Tillamook R		N	Retention	N	N	N	---	Retention
Nestucca Bay		Retention	Retention	N	N	N	---	Retention
Nestucca R		N	Retention	N	N	N	---	Retention
Little Nestucca R		N	Retention	N	N	N	---	Retention
Salmon R	Mid-Coast Stratum	N	Retention	---	N	Retention*	---	Retention
Siletz Bay		Retention	Retention	Retention	N	N	N	Retention
Siletz R		Retention	Retention	Retention	N	N	N	Retention
Siletz - above Falls		N	N	N	N	N	N	N
Siletz - Drift Crk		N	Retention	N	N	N	N	Retention
Yaquina Bay		Retention	Retention	---	N	N	---	Retention
Yaquina R		N	Retention	---	N	N	---	Retention
Yaquina - Big Elk Crk		N	Retention	---	N	Retention*	---	Retention
Alsea Bay		Retention	Retention	N	N	N	---	Retention
Alsea R		Retention	Retention	N	N	N	---	Retention
Alsea - Drift Crk		N	Retention	N	N	N	---	Retention
Yachats Aggregate		N	Retention	---	N	N	---	Retention
Siuslaw Bay		Retention	Retention	---	N	N	---	Retention
Siuslaw - Lake Crk		N	Retention	---	N	N	---	Retention
Siuslaw R		Retention	Retention	---	N	N	---	Retention
Umpqua Bay	Umpqua Stratum	Retention	Retention	Retention	N	N	N	Retention
Umpqua - Smith R		N	Retention	N	N	N	N	Retention
Lower Umpqua R		N	Retention	Retention	N	N	N	Retention
Middle Umpqua R		N	Retention	Retention	N	N	N	Retention
N Umpqua R		N	N	Retention	N	N	N	N*
N Umpqua - above Rock Crk		N	N	N	N	N	N	N*
S Umpqua R		N	N	N	N	N	N	N*
S Umpqua R - above Canyonv		N	N	N	N	N	N	N*
Tenmile Lk/Crk (Silt/Tahk) [b]	Mid-South Stratum	Retention	---	---	N	N	---	Retention
Coos Bay Frontal		Retention	Retention	---	N	N	---	Retention
Coos - EF Millicoma R		N	Retention	---	N	N	---	Retention
Coos - WF Millicoma R		N	Retention	---	N	N	---	Retention
SF Coos R		N	Retention	---	N	N	---	Retention
Coquille Bay		Retention	Retention	N	N	N	---	Retention
NF Coquille R		N	Retention	N	N	N	---	Retention
EF Coquille R		N	N	N	N	Retention*	---	Retention
Middle Fork Coquille R		N	Retention	N	N	N	---	Retention
SF Coquille R		N	Retention	N	N	N	---	Retention
Floras/New R		Retention*	Retention	---	N	N	---	Retention
Sixes R		N	Retention	---	N	Retention	---	Retention
Elk R		*n/a*	Retention	---	---	*n/a*	---	*n/a*
NADOTs		N	N	---	N	N	---	Retention / N [c]

– Denotes change from current management regarding wild fish retention

[a] "Protected Ch" includes the summer-run Chinook in the Nehalem

[b] Harvest for Siltcoos and Tahkenitch is the same as Tenmile (not other NADOTs)

[c] See *Oregon Sport Fishing Regulations* for cutthroat retention regulations in NADOTs (no changes proposed)

Detailed Abundance Goals and Management Implications

Table A-III: 2. Population- and strata-specific abundances for Desired Status, sliding scale harvest decisions, observed range, and conservation decisions. Empty cells indicate that there are no data at the given scale. "*TBD*" indicates that additional data or analyses are needed to determine target abundances in the future. "---" indicates that there is no population, but angling in this area may be affected by the indicated harvest thresholds and conservation levels. "N / A" indicates that the metric is not applicable for the population or stratum. Light green shading indicates values that are for reference only (i.e., management decisions are not based directly on these).

			WILD Spawners							
SMU	Stratum	Population	Desired Abundance (75th)		High Harvest Threshold	Observed Abundance (50th)		Low Harvest Threshold	Critical Abundance	
CHINOOK	North Coast	Necanicum	34,500	*TBD*	*TBD*	24,300		*TBD*	9,100	*TBD*
		Nehalem		12,100			9,900			3,800
		Tillamook		10,500			7,800			3,700
		Nestucca		11,900			6,600			1,600
	Mid Coast	Salmon	55,000	1,800	*TBD*	40,600	1,200	*TBD*	14,700	400
		Siletz		8,100			5,800			2,300
		Yaquina		9,600			6,300			2,200
		Alsea		9,300			7,600			2,900
		Yachats **Aggregate**		*TBD*						*TBD*
		Siuslaw		26,200			19,700			6,900
	Umpqua	Lower Umpqua	6,500	*TBD*	*TBD*	4,300		*TBD*	1,500	*TBD*
		Middle Umpqua		*TBD*						*TBD*
		North Umpqua		---			---			---
		South Umpqua		6,500			4,300			1,500
	Mid-South Coast	Tenmile	27,700	---	*TBD*	20,000	---	*TBD*	7,400	---
		Coos		6,300			4,400			1,800
		Coquille		14,300			10,700			3,500
		Floras		700			400			100
		Sixes		4,400			2,800			1,200
		Elk		2,000			1,700			800
	SMU Total		123,700	123,700	*TBD*	89,200	89,200	*TBD*	32,700	32,700
SPRING CHINOOK	Umpqua	Lower Umpqua	5,200	---	*TBD*	3,500	---	*TBD*	2,000	---
		Middle Umpqua		---			---			---
		North Umpqua		4,600			3,300			2,000
		South Umpqua		600			200			*N / A*
	SMU Total		5,200	5,200	*TBD*	3,500	3,500	*TBD*	2,000	2,000
WINTER STEELHEAD	North Coast	Necanicum	21,800	5%	N / A	19,800		N / A	9,900	*TBD*
		Nehalem		20%			1,800			600
		Tillamook		50%						*TBD*
		Nestucca		25%						*TBD*
	Mid Coast	Salmon	18,500	10%	N / A	14,400		N / A	7,200	*TBD*
		Siletz		25%						*TBD*
		Yaquina		10%						*TBD*
		Alsea		25%						*TBD*
		Yachats **Aggregate**		10%						*TBD*
		Siuslaw		20%						*TBD*
	Umpqua	Lower Umpqua	24,600	10%	N / A	19,100		N / A	8,200	*TBD*
		Middle Umpqua		20%						*TBD*
		North Umpqua		40%			6,900			2,200
		South Umpqua		30%						*TBD*
	Mid-South Coast	Tenmile	20,700	5%	N / A	16,000		N / A	8,000	*TBD*
		Coos		30%						*TBD*
		Coquille		50%						*TBD*
		Floras		5%						*TBD*
		Sixes		10%						*TBD*
	SMU Total		85,600	---	---	69,300	---	---	33,300	---
SUMMER STEELHEAD	Mid Coast	Siletz	---	600	N / A	---	300	N / A	---	200
	Umpqua	North Umpqua	---	4,200	N / A	---	3,200	N / A	---	1,200
	SMU Total		---	4,800	---	---	3,500	---	---	1,400

Table 27. Costs associated with the implementation of CMP actions which may require new funding. Any actions contained in the CMP that are not included in this table are assumed to fit within current ODFW funding and staffing levels. Costs are general estimates only; detailed budgets will be developed as specific funding is sought for each action. Funding Category values indicate the following: "1" means the cost is required to implement management actions and "2" means the cost is not necessarily required for action implementation but would provide more robust, efficient, and informed implementation.

Action	Funding Category	Start-Up/One-Time		Annual	
		Description	Cost ($)	Description	Cost ($)
Hatchery Programs					
Increase ChS production (mostly at Trask Hatchery)	1	refurbish rearing pond	30,000	feed, marking	108,000
Trap Necanicum StW	2	weir and infrastructure	25,000	personnel, services/supplies	14,000
Improve Salmon R weir, trap, passage	1	re-construction/repair (additional amount needed)	200,000	n / a	0
Trap Elk R ChF (Anvil and Rock Crks)	1	weirs and infrastructure	50,000	personnel, services/supplies	28,000
Elk R Hatchery ladder outlet	1	re-construct	50,000	n / a	0
Mark all hatchery fish	2	marking trailer	1,100,000	personnel, services/supplies	28,000
Harvest					
Mandatory tag return and guide logbooks	2	n / a	0	coordinator/data entry, services/supplies	103,000
Wild StW fisheries (*see Research, Monitoring, and Evaluation costs*)	---	---	---	---	---
Predation					
Pinniped predation coordination	2	n / a	0	coordinator, services/supplies	106,000
Pinniped and cormorant research (*see Research, Monitoring, and Evaluation costs*)	---	---	---	---	---
Habitat					
increased funding for assessment, restoration, and protection of habitat is strongly supported, but specific projects and costs are not identified in the CMP					
Research, Monitoring, and Evaluation					
Research wild population impacts from pinnipeds (Coos Bay)	2	personnel, equipment, services/supplies	200,000	n / a	0
Survey and research impacts of cormorants	2	personnel, equipment, services/supplies	176,000	personnel, equipment, services/supplies	0
Monitor harvest of wild StW (creel in 2 Management Areas)	2	n / a	0	personnel, services/supplies	39,000
Monitor all species' spawner abundance at a 30% annual precision rate for populations	2	n / a	0	personnel, services/supplies	1,362,000
Programmatically conduct research and development studies for new and efficient monitoring techniques and systems	2	n / a	0	personnel, equipment, services/supplies, capital outlay	563,000
Programmatically conduct mechanistic research into critical uncertainties and management questions	2	n / a	0	personnel, equipment, services/supplies, tags	977,000
Monitor mainstem salmon spawners	1	n / a	0	personnel, services/supplies	119,000
Coordinate, compile, and maintain monitoring and management data	2	n / a	0	personnel	103,000
Maintain or expand Coded Wire Tag program for hatchery fish assessments	2	n / a	0	personnel, equipment, services/supplies	261,000
Identify chum spawning, restoration, and preservation sites	1	n / a	0	personnel, services/supplies	93,000

Action	Funding Category	Start-Up/One-Time		Annual	
		Description	Cost ($)	Description	Cost ($)
Identify chum population genetic structure	1	personnel, services/supplies, sample processing	86,000	n / a	0
TOTAL (Category 1)			**$416,000**		**$348,000**

Additional Actions *(costs to be determined [TBD] and funding source identified with implementation partners or volunteers)*					
Release hatchery ChS in Little Nestucca	1	acclimation site	TBD	personnel, services/supplies	TBD
Release hatchery ChS in Yaquina Bay	1	acclimation site	TBD	personnel, services/supplies	TBD
Monitor benefit and effects of Yaquina ChS hatchery fish	1	n / a	0	personnel, services/supplies	TBD
Release hatchery ChS in Coos Bay	1	acclimation site	TBD	personnel, services/supplies	TBD
Monitor benefit and effects of Coos ChS hatchery fish	1	n / a	0	personnel, services/supplies	TBD
Increase S Umpqua StW hatchery production	1	new rearing capacity	TBD	personnel, services/supplies	TBD
Additional support for new Oregon Hatchery Research Center studies	1	personnel, services/supplies	TBD	personnel, services/supplies	TBD

Appendix B

Recreational Fishing Data Sources

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Appendix B
Recreational Fishing Data Sources

TRG (2013) describes many data sources that have relevance to the Coastal Multi-Species Conservation and Management Plan (CMP) economic analysis. The metadata descriptions for the data sources follow. A list of acronyms and full bibliography for the abbreviations and citations are repeated from TRG (2013) at the end of this appendix.

1. Model Input Data Sources

Ocean salmon trip data is from Pacific Fishery Management Council (PFMC) annual preseason management reports. The data in these reports in recent years originate from state survey programs. The Oregon program for acquiring ocean salmon and bottomfishing catch and effort data is a service provided by the Oregon Department of Fish and Wildlife (ODFW) and is called the Ocean Recreational Boat Survey (ORBS). This ongoing program is an angler sample intercept survey (Schindler et al. 2012). In some years, the ODFW has also provided survey services for fishing in the lower estuary areas which is called the Shore and Estuary Boat (SEB) survey. ODFW discontinued the SEB survey services in 2005 due to budget restrictions. The last complete data year is 2002.

The Columbia River mainstem recreational fisheries have a separate survey program called the Columbia River Creel Program (CRCP). A sample angler intercept survey is combined with total trip counts from an aerial survey to provide the catch and effort estimates for the different mainstem fisheries. The area used in this study is downstream of the CRCP Section 9 and 10 demarcation (see Appendix A maps in TRG (2013)) and includes the popular Columbia River fall mainstem salmon fishery (sometimes referred to as the Buoy 10 fishery).[1]

The ORBS, SEB, and CRCP catch and effort estimates are compiled in a database called RecFIN. The RecFIN Program is administered by the Pacific States Marine Fisheries Commission (PSMFC).

Catch estimates for freshwater fisheries are from the ODFW Salmon-Steelhead, Halibut, and Sturgeon Tag Return Program (SSHSTRP). Program information provides annual catch data by stream segment or watershed. Anglers voluntarily return their completed tag forms to licensing agents and tabulations are expanded to also represent the proportion of anglers that do not return tags.[2] Reporting for the SSHSTRP is typically one or two years behind the current year, so the

1. Other salmon and steelhead in the Columbia River are from fisheries in the estuary tributaries on the Oregon side, such as the Youngs River, Lewis and Clark River, and Klaskanine River.
2. Estimating catch from voluntary harvest card return programs has accuracy issues. The Oregon Department of Fish and Wildlife (ODFW) requested a study by Hicks and Calvin (1964) to determine best methods to account for non-returns. Return compliance in Oregon is around 20 percent per year. The Washington Department of Fish and Wildlife (WDFW) in the past also relied on voluntary return program, but supplemented freshwater catch estimates with creel surveys and telephone surveys results. The WDFW has transitioned to a mandatory return program for crab fisheries which is enforced with a $10 penalty. A study by Conrad and Alexanders (1993) who compared harvest card and creel survey results in Puget Sound salmon fisheries found that harvest

most recent year's analysis available was used to represent this study's current year. The SSHSTRP catch is translated to angler days using example coastal stream fishery creel survey catch per unit effort (CPUE) results.

Table B.1 shows fishery specific data sources and have statements about data limitations and modeling methods and assumptions. Additional explanations about data and modeling are in TRG (2000).

The assigned success rates (days per fish, or the inverse of CPUE) used in this study (when it was necessary to calculate trips from catch) are shown in Table B.2 and Table B.3. Data sources except for the SSHSTRP did provide trip estimates so did not need the conversion to angler days. The assigned success rates are constant over all of the trend years referenced in this report. This is an important assumption because angler motivation is related to harvest rates (Larson and Lew 2013). To the degree that the assigned success rates reflect a particular year's harvest rate, it will dictate whether the assumption results in a conservative or liberal angler day estimate in a particular trend year.

The angler trip spending used in this study originates with results from other data collection and modeling studies. Gentner and Steinback (2008) survey results trip expenditure estimates are used for ocean bottomfishing and inland marine fishing. Economic response coefficients from 2007 IMPLAN were used to expand the trip expenditure estimates to represent economic contribution unit estimates. Freshwater fisheries rely on economic contribution unit estimates from the Oregon Angler Survey. The economic contribution estimates per angler day for the various fisheries are shown in Table B.4.

All economic contribution estimates referenced or developed in this study rely on factors from the IMPLAN system.[3] The spending and economic contribution estimates are adjusted to 2012 dollars using the Gross Domestic Product Implicit Price Deflator Index developed by the U.S. Bureau of Economic Analysis.

2. Other Data Sources and Studies

National Survey of Fishing, Hunting, and Wildlife-Associated Recreation

The National Survey of Fishing, Hunting, and Wildlife-Associated Recreation has been conducted since 1955. The survey is sponsored by the U.S. Fish and Wildlife Service (USFWS). The main goal of the survey is to determine the number of anglers, hunters, and wildlife watching participants and the amount spent by those individuals. The survey is undertaken every five years. The survey results used in this study are angling data year 2011. The next survey will be in 2016.

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card return rates would have to be a minimum of 70 percent to provide acceptable estimates that require no bias adjustments.

3. The multiplier effects are calculated using the Fishery Economic Assessment Model (FEAM). The FEAM is based on economic response coefficients generated from the IMPLAN input-output model. The FEAM theory and structure is described in Seung and Waters (2006). IMPLAN models are available for each county and state in the U.S. The models are distributed by MIG, Inc., 1725 Tower Drive West, Suite 140, Stillwater, MN 55082.

The survey is a two phase telephone survey. The first phase is an initial large pool of households nationwide who are contacted to determine whether they are participants in certain types of recreational activity. The second phase is to contact people from the first phase that are most likely to participate in angling, hunting, or wildlife watching. Detailed interviews are conducted in four month waves. Some non-telephone interviews do take place in situations where the individual can not be reached by phone. The survey is developed in consultation with state and federal agencies as well as several non-governmental agencies. The USFWS survey results are used by other organizations to make economic contributions, such as those completed by Southwick Associates (2013) for American Sportfishing Association (ASA) and the Congressional Sportsman's Foundation (CSF). Other fish management and government economic development agencies rely on the ASA/CSF publications when quoting recreational fishing economic contributions.[4]

Oregon Angler Survey

The Oregon Angler Survey, performed by The Research Group, Corvallis, Oregon, was a combination mail and telephone survey to persons purchasing Oregon fishing licenses (TRG 1991). Survey results provide information about angler characteristics and preferences during the survey period (1988-1989 fishing season). The sample size for the mail survey that gathered basic catch data was 12.5 thousand licensees. The sample size for the follow up telephone survey that gathered more detailed demographic and economic information from licensees that fished during the survey period was 2.0 thousand. Survey results were expanded based on known number of licenses. Economic contributions were calculated from the survey-determined fishing related expenditures for equipment and trips at the state and regional levels. The Oregon Angler Survey results for recreational economic contributions per angler day adjusted for inflation are used in this study for the freshwater fisheries.

Fishing, Hunting, Wildlife Viewing, and Shellfishing in Oregon

ODFW and Travel Oregon sponsored a survey and analysis that included Oregon license holders and citizens in general to estimate the expenditures for local, day, and overnight trips to the Oregon Coast for fishing, shellfishing, hunting, and wildlife-viewing (Dean Runyan Associates 2009). The fishing, hunting, and shellfishing activities survey was mail-out for a sample of license holders. For wildlife viewing, the survey was telephone administered for a sample of the Oregon population. The survey data year was 2008. Tabulated travel regions included the North Coast, Central Coast, and South Coast.[5]

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4. An example recreational fishing economic study that relies on ASA/CSF publications for Washington State is TCW Economics and The Research Group (2008).
5. The expanded sample survey estimates are higher than observed estimates used in this report. Statewide trip days (thousands) in 2008 are freshwater angling 7,260 days (23 percent Coast), saltwater angling 1,119 (100 percent Coast), shellfish 994 (100 percent Coast), hunting 3,298 (41 percent Coast), wildlife viewing 21,756 (30 percent Coast), and total 32,313 (33 percent Coast). In regards to statewide freshwater trips (including multi-day trips), approximately 19 percent are salmon, 20 percent are steelhead, and five percent are sturgeon. In regards to statewide saltwater trips (including multi-day trips), 64 percent are for salmon and 36 percent are for other marine saltwater species. For the three coastal regions, saltwater salmon trips sum to 328.0 thousand and freshwater salmon, steelhead, and sturgeon trips sum to 612.0 thousand.

Creel Surveys

The ODFW undertakes several annual creel surveys. These include the Pacific Ocean and Columbia River lower estuary fisheries, and Salmon River/Elk River inriver fisheries. The Salmon River/Elk River inriver creel surveys undertaken as tasks in the ODFW Coastal Chinook Research and Monitoring Program (CCRMP) are an obligation for the U.S./Canada Pacific Salmon Treaty. The ODFW has undertaken other special creel surveys from time-to-time to assist in determining management plans. Creel survey information is used in this report to determine freshwater salmon, steelhead, and sturgeon fishing angler success rates. These rates are applied to other data sources that provide catch information in order to derive effort estimates.

Marine Recreational Information Program

NOAA Fisheries sponsors the Marine Recreational Information Program (MRIP) as described in NOAA Fisheries (October 2008). The MRIP encompasses the old Marine Recreational Fisheries Statistics Survey (MRFSS) which was started in 1979. The expanded duties of the MRIP include inaugurating a national saltwater angler registry program required in the 2006 Magnuson Stevens Act (MSA) amendments. The Oregon angler licensing system was reviewed by the MRIP and found to be consistent with standards so no additional licensing requirements were imposed.

Since the older MRFSS data collection procedures and economic studies that utilized the data are used in this report, a short summary of the survey approach is offered. The MRFSS was a two stage survey: a random-digit-dialing telephone survey of coastal residential households and an access-point intercept survey of anglers. The survey provided estimates of marine recreational angler fishing effort, participation, and catches of finfish and distinguishes among three different modes of fishing: bank, charter boat, and private boat at two locations in the ocean (within and outside territorial seas) and inland saltwater (estuary) areas. There have been two add-on economic surveys along the West Coast. The 1998 survey questions allowed angling demand models to be developed to determine economic valuations. The 2000 survey questions were aimed at determining angling trip and angler capital costs. Researchers have used the results to estimate saltwater fishing valuation (Hicks et al. 2000 and Haab et al. 2006) and economic contributions (Steinback et al. 2004). The MRFSS was discontinued on the West Coast in 2002 and state survey programs have substituted for acquiring recreational fishing data collection (Schindler et al. 2003). Concerns about the accuracy of MRFSS recreational angling statistics were addressed in National Research Council (2006) and McConnell (2006).

Oregon Angler Preference Surveys

The ODFW conducts angler preference surveys from time-to-time. The surveys are sometimes applicable for all State fisheries and other times are fishery and area specific. Three preference surveys applicable to this economic study were conducted for angling years 1977, 2006, and 2012. The 1977 data year survey was completed by the OSU Survey Research Center (1978) and was for a survey base of resident license holders. The 2006 data year survey was completed by Responsive Management (2006) for a survey base of resident license holders. The 2012 data year survey was completed by the OSU Survey Research Center (2013) for two survey bases: (1) sample of western Oregon resident SSHSTRP tag holders; and, (2) a sample of western Oregon residents who did not purchase a SSHSTRP tag. All preference survey results were reviewed to help make this report's interpretations and findings.

Oregon Sport Angling License Sales

The decrease in this report's fisheries overall trips in recent years is consistent with a decrease in angling license sales (Figure B.1). Total license sales in Oregon have been stagnant while the State's population has been increasing, which means per capita sales have been steadily decreasing. This trend appears to have bottomed out in 2011 because there is a slight uptick in statewide license sales and the per capita ratio in 2012.

Additional Ocean Economic Surveys

The National Marine Fisheries Service (NMFS) at a national level sponsored a marine angler expenditure survey in 2006 which was subsequently used to determine recreational angler regional economic impacts (REI) (Gentner and Steinback 2008). The MRIP does not undertake intercept and telephone surveys (i.e. the old MRFSS) on the West Coast and Alaska, so an add-on economic survey approach could not be used in these areas. In these states, license frames were utilized to contact anglers via a mail survey regarding both trip and durable good purchases. The NMFS at a regional level has recently sponsored special economic surveys of charter service businesses and anglers. The Northwest Fishery Science Center (NWFSC) sponsored a charter service business survey to collect cost-earnings data in 2006. An angler economic survey was undertaken by the NWFSC in 2006 and 2007. The angler economic survey was described by Anderson and Lee (2011). Recent survey data interpretation studies are by Anderson et al. (2013) and Anderson and Lee (2013).

Table B.1
Data Sources and Methodological Basis Used in Modeling

Fishery	User	Harvest and Effort (pounds and fish)	Recreational Trips (angler days)	Recreational Catch Per Unit Effort (retained catch per angler day)	Data Source Limitations and Methods Assumptions
Ocean salmon	Commercial	PFMC	--	--	Additional assumptions needed to disaggregate salmon management unit estimate to state boundaries and individual ports. Current year economic contributions based on previous year's market conditions.
Ocean salmon	Recreational	PFMC	PFMC	PFMC-Salmon Technical Team	PFMC information about ocean salmon abundance used to assess likelihood of angler effort. Other factors, such as w eather, general economic conditions that determine disposable income, inriver regulations, etc. are not considered. Methodological sources have a high nonresponse; available results typically for 2 to 3 years prior to current year.
Ocean other (non-salmon) and distant w ater fisheries	Commercial	TRG	--	--	Source (published in spring of each year) for current year is based on expert opinion about future market conditions; and, uses preliminary data from previous year fisheries. Ocean other (non-salmon) commercial fisheries includes estuary commercial fisheries such as Alsea Bay crab, Yaquina Bay herring, Columbia River sturgeon, Columbia River other (shad, smelt, anchovy), and Columbia River non-Indian gillnet and tribal salmon fisheries. Other commercial shellfish harvests (clams, oysters, mussels, etc.) are not included.
Ocean bottomfish and halibut	Recreational	PFMC and IPHC	ORBS	--	Bottomfish species, including halibut, sometimes have current year management quotas. This means there can be in-season management changes. Previous years stock assessment and angler participation information used to forecast current year angler participation. There may be duplicate counting w hen estimating trips for one species and comparing estimates to other fisheries.
Low er estuary salmon, steelhead, and sturgeon	Recreational	Study	SSHSTRP, ORBS, CRCP	CCRMP	Bay salmon fisheries are generally not managed by quota except for Columbia River. In recent years, there has been a native coho salmon quota fishery in some coastal streams. Catch may not adequately predict effort for fisheries regulated to be only catch and release. Creel surveys are for individual stream reaches and species and may not be applicable to other locations. There may be duplicate counting if salmon and marine species (non-salmon) are caught in the same trip. Economic contributions per day based on survey of angler trip expenditures from TRG (2000).
Low er estuary marine (non-salmon)	Recreational	Study	SSHSTRP, ORBS, and SEB	--	Marine species caught w ithin bays generally are not managed by quota, except sturgeon in Columbia River. Previous year's effort averages used to forecast current year w hen using SSHSTRP data. There are geographic boundary alignment problems w hen using data from SEB, SSHSTRP, and CRCP. The upstream SEB boundary is generally w here Highw ay 101 crosses the w aterw ay. The most recent complete year of SEB data is 2002.

Notes:
1. Current year requires forecast based on fishery management decisions or assumptions about previous year's fishing participation.
2. See Study bibliography section for report author, title, publication date, and agencies that maintain databases.

Source: TRG (2013).

Table B.2
Historical and Assigned Success Rates for Inland and Ocean Recreational Fisheries

Waterway	Source	Dates	Inland Success Rates: Chinook Fall	Chinook Spring/Summer	Coho	Winter/Summer Steelhead	Sturgeon
ESTUARY AND INLAND							
Lower Columbia River							
Sturgeon fishery							
	Devore et al. (1999)	1996-1998 average	--	--	--	--	7.32
Columbia River fall mainstem salmon fishery							
	Watts (CRCP)	2002	3.91	--	13.51	--	--
		2003	6.13	--	1.64	--	--
		2004	3.73	--	4.49	--	--
		2005	4.95	--	7.00	--	--
		2006	19.01	--	9.17	--	--
		2007	8.32	--	4.21	--	--
		2008	3.40	--	4.22	--	--
		2009	11.58	--	1.49	--	--
		2010	6.80	--	5.95	--	--
		2011	4.43	--	5.95	--	--
		2012	3.20	--	8.23	--	--
		2002-2012 average	5.10	--	3.68	--	--
Columbia River mainstem Section 10							
	Watts (CRCP)	2002	--	7.65	--	17.54	2.26
		2003	--	6.66	--	16.43	2.53
		2004	--	4.32	--	19.92	2.77
		2005	--	7.95	--	28.92	3.44
		2006	--	6.76	--	17.41	2.85
		2007	--	7.99	--	13.29	2.60
		2008	--	10.57	--	12.92	3.56
		2009	--	6.29	--	12.20	3.90
		2010	--	5.93	--	21.96	5.82
		2011	--	10.69	--	8.00	4.31
		2012	--	6.34	--	10.03	4.45
		2002-2012 average	--	6.63	--	15.23	3.12
Coast							
Nehalem River							
	ODFW AFS 65	1963-64 season	--	--	--	5.33	--
		1964-65 season	--	--	--	8.43	--
		1968-69 season	--	--	--	2.18	--
	Creel Surveys	2010	10.03	--	--	--	--
		2012	44.95	--	--	--	--
Tillamook Bay							
	Creel Surveys	1996	6.81	--	--	--	--
Wilson River							
	ODFW AFS 65	1964-65 season	--	--	--	7.88	--
		1965-66 season	--	--	--	16.91	--

Table B.2 (cont.)

Waterway	Source	Dates	Inland Success Rates: Chinook Fall	Chinook Spring/ Summer	Coho	Winter/ Summer Steelhead	Sturgeon
ESTUARY AND INLAND, Coast (cont.)							
Salmon River							
	Creel Surveys	1986-1989 average	8.80	--	--	--	--
		2002	6.91	--	42.04	--	--
		2003	6.70	--	104.29	--	--
		2005	5.28	--	--	--	--
		2006	7.07	--	--	--	--
		2007	12.61	--	--	--	--
		2008	21.75	--	--	--	--
		2009	14.49	--	--	--	--
		2010	5.89	--	--	--	--
		2011	5.20	--	--	--	--
		2012	6.18	--	--	--	--
Siletz Estuary							
	Creel Surveys	2010	14.43	--	34.55	--	--
		2011	--	--	21.14	--	--
		2012	29.86	--	52.48	--	--
Yaquina Estuary							
	Creel Surveys	2009	--	--	6.44	--	--
		2011	--	--	18.07	--	--
		2012	--	--	32.96	--	--
Alsea River							
	ODFW AFS 65	1964-65 season	--	--	--	22.79	--
		1965-66 season	--	--	--	32.25	--
Alsea Estuary							
	Creel Surveys	2011	--	--	12.05	--	--
		2012	--	--	6.12	--	--
Siuslaw River							
	ODFW AFS 65	1967-68 season	--	--	--	7.88	--
Siuslaw Estuary							
	Creel Surveys	2011	--	--	10.81	--	--
		2012	--	--	16.29	--	--
Umpqua River							
	Creel Surveys	1977-1988 average	--	11.25	--	--	--
Elk River							
	Creel Surveys	1972-1974 average	3.53	--	--	--	--
		1992-1998 average	4.01	--	--	--	--
		2007	4.47	--	--	--	--
		2008	3.20	--	--	--	--
		2009	3.71	--	--	--	--
		2010	2.54	--	--	--	--
		2011	2.19	--	--	--	--
		2012	4.21	--	--	--	--

Table B.3
Calculated CMP Analyzed Fisheries Success Rate Using Disparate Source Data

	Fall Chinook	Spring/Sum Chinook	Winter Steelhead	Summer Steelhead	Analyzed Fisheries
Catch (thousands)	63	14	53	7	136
Retained	48	10	20	3	82
Non-retained	14	4	33	4	55
Angler days (thousands)	386	79	288	64	817
Success rate	6	5	5	9	6

Sources: Catch (retained) for analyzed fisheries is annual average 2010-2011 from ODFW SSHSTRP tabulations. Non-retained catch rates were derived using Question 19a and 20a preference survey results as described in OSU (2013). Angler days are from the Oregon angler and resident preference survey results (OSU Survey Research Center 2013).

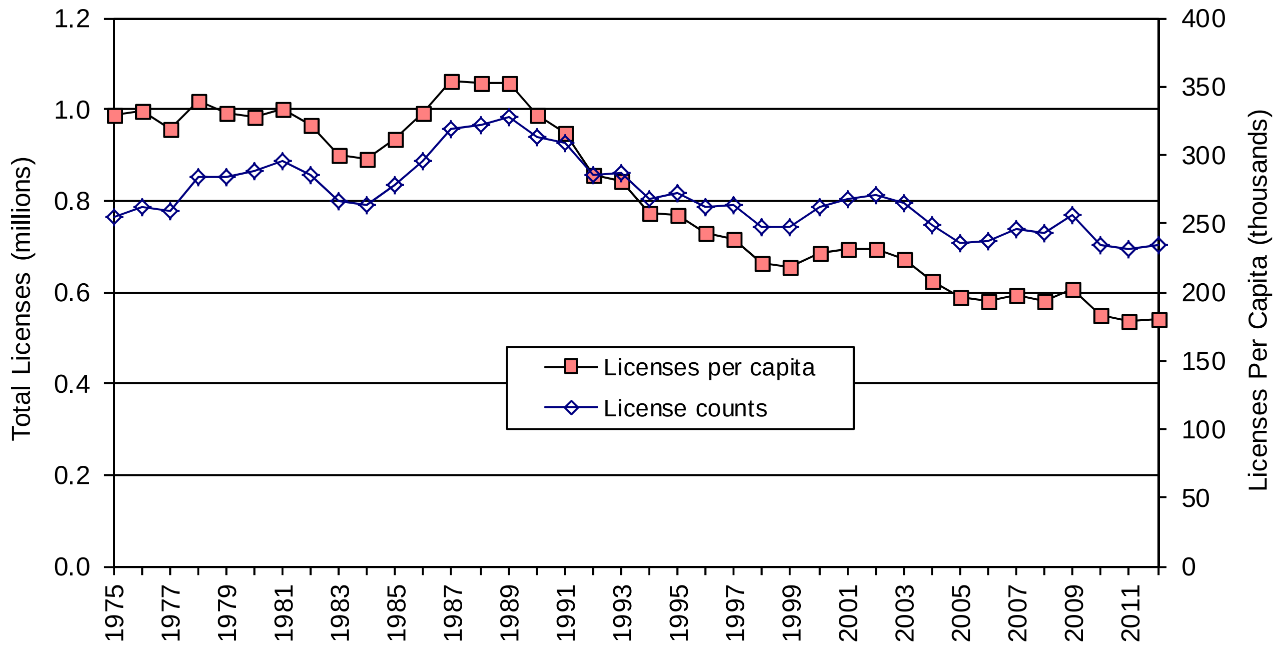
Table B.4
Economic Contributions Per Angler Day for Study Recreational Fisheries in 2012

Fishery	Fishing Mode			
Inland Marine and Freshwater Fisheries	Guided	Private Boat	Private Bank	
All areas and species	$170.85	$42.95	$20.81	
	Coast Inland	Lower Columbia River		
Salmon and steelhead (incl. coast and lower Col. R. off-channel)	$44.64	$45.94		
Salmon (incl. lower Col. R. mainstem)		$41.69		
Sturgeon	$43.43	$49.09		
Other marine	$24.75	$21.05		
Ocean Non-Salmon Fisheries	Charter	Private	Shore	Trip Weighted Average
Bottomfish	$151.78	$67.54	$42.12	$94.29
Halibut and tuna	$303.57	$67.54	$42.12	$90.25
Ocean Salmon Fisheries				
All salmon species	$145.04	$38.89		$48.37

Notes:
1. Economic contributions are expressed as personal income in 2012 dollars and are at the coastwide economic level.
2. Coastwide economic contributions for ocean salmon fisheries and the lower Columbia River mainstem fall salmon fishery are from PFMC (February 2013). The ocean non-salmon fishery uses economic contributions per angler day derived from expenditures in Gentner and Steinback (2008). Coastwide economic contributions per angler day for inland marine and freshwater fisheries are from The Research Group (1991).
3. The ocean non-salmon trip weighted average economic contributions per day are based on 2012 trips provided by ODFW (ORBS).
4. Tuna and halibut ocean bottomfishing economic contributions per day adjusted for additional spending due to charter services fishery higher costs.
5. Lower Columbia River mainstem spr./sum. salmon fishery economic contributions per angler day are assumed to be the same as the fall mainstem salmon fishery.
6. Ratio of coastwide to state economic level uses household expenditure coefficients from 2007 IMPLAN data year, except lower Columbia River mainstem salmon uses PFMC (February 2013).

Source: TRG (2013).

Figure B.1
Oregon Total and Per Capita Recreational Fishing License Sales in 1975 to 2012



Notes: 1. Fishing license counts include all types of resident and non-resident annual and daily fishing licenses, combination hunting and fishing licenses, and the Resident Sportsman License.

2. Licenses per capita are per 1,000 persons. Daily angler licenses are stated in terms of daily equivalents; e.g., a 3-day license = 3 x 1 daily equivalents. Daily licenses are sold to residents and nonresidents. Actual numbers of daily licenses are fewer than the daily equivalents because some licenses are for two, three, or four days. Some individuals may buy several daily licenses during the year. Ocean vs. inland breakdowns are not available after 1989. In 1994, the 10-day Nonresident Angler license (no tag privileges) was changed to a seven day license (tag privileges included). The Resident Sportsman's License was new in 1998 and includes deer, elk, bear, cougar, turkey, salmon-steelhead, sturgeon, and shellfish tags.

Sources: TRG (2013).

List of Acronyms

ASA	American Sportfishing Association
CCRMP	ODFW Coastal Chinook Research and Monitoring Program
CMP	Coastal Multi-Species Conservation and Management Plan
CRCP	Columbia River Creel Program
CSF	Congressional Sportsman's Foundation
CPUE	catch per unit effort
FEAM	Fishery Economic Assessment Model was used to calculate fishing industry economic contributions. The FEAM is a derivation of the IMPLAN input-output model.
MRFSS	Marine Recreational Fisheries Statistics Survey
MRIP	Marine Recreational Information Program
MSA	Magnuson Stevens Act
NMFS	National Marine Fisheries Service
NWFSC	Northwest Fishery Science Center
ODFW	Oregon Department of Fish and Wildlife
ORBS	Ocean Recreational Boat Survey
PFMC	Pacific Fishery Management Council, headquartered in Portland, Oregon. A U.S. federal board which oversees management of marine fisheries in federal waters off Washington, Oregon and California. With halibut, the PFMC's role is to decide on allocations between user groups and development of programs to manage and reduce halibut bycatch.
PSMFC	Pacific States Marine Fisheries Commission
Regional economic impact (REI)	Economic contribution and REI are different concepts, but in this report the two terms are used interchangeably. A stricter use of the term "contribution" would be for an economic activity that exists. The use of the term "impact" would be when an economic activity is to be subtracted or added. It is the share of the regional economy supported by the expenditures made by the industry being analyzed. It can be expressed in terms of a variety of economic metrics.
SEB	Shore and Estuary Boat survey
SSHSTRP	ODFW Salmon-Steelhead, Halibut, and Sturgeon Tag Return Program
USFWS	U.S. Fish and Wildlife Service
WDFW	Washington Department of Fish and Wildlife

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Appendix C

Hatchery and Wild Origin Fish Catch Modeling

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Appendix C
Hatchery and Wild Origin Fish Catch Modeling

1. Hatchery Production Catch

The proposed plan actions will cause changes in fisheries catch amounts and locations for hatchery origin fish. The statistic used to pattern the changes is smolt-to-adult survival ratio (SAR). It is only the freshwater fisheries SAR that is relevant to the economic analysis for this study.

The freshwater fisheries SAR is derived from using the SSHSTRP data source (see Appendix B) and subtracting wild fish catch (see next section in this appendix). The Coastal Multi-Species Conservation and Management Plan (CMP) used annual catch and terminal run sizes averaged for years 2010 and 2011.[1] So this economic analysis used the same years to calculate status quo SAR. Catch data was pulled from the harvest card datasets for the four species management unit (SMU) by stratums. Wild catch using Oregon Department of Fish and Wildlife (ODFW) supplied proportions to total hatchery and wild catch was calculated for fall and spring Chinook by stratum and subtracted from the harvest card data. Given selective fishery regulations, it was assumed that the harvest card catch for winter and summer steelhead was all hatchery origin fish. The Year 2012 status quo release levels were used as a divisor with the calculated hatchery origin fish to generate the needed freshwater fisheries SAR.

An ocean fisheries SAR was necessary for one model outcome summary indicator. The HB 3489 evaluation modeling results reported in ODFW (2010) were used to determine the SAR fishery component proportions. The same percentage change between this economic analysis study's determined freshwater fisheries SAR and the HB 3489 evaluation model's freshwater fisheries SAR was applied to the ocean SAR.

There was no attempt made to reconcile harvest management changes over the period represented in the chosen brood years. The environmental conditions experienced by releases may have been different than what the status quo and CMP action year releases are facing. Therefore, the calculated catch should be considered an indicator with potentially high and certainly unexplained variation.

2. Wild Fish Catch

An important draw of angler participation is afforded by wild fish production. Some wild fish fisheries are selective, such as most steelhead fisheries in recent years, and other fisheries allow retention, such as some coho fisheries. All of the major coastal rivers fisheries are mixed (hatchery and wild origin) stock fisheries which complicates determination for whether one origin (e.g. hatchery) or the other (e.g. wild) have a differential impact for attracting angling.

1. The CMP also determines hatchery and wild origin catch using a similar, but more involved methodology (see the CMP Appendix I). The method complexity was necessary to determine major salmon and steelhead population level stock status that was not need for the stratum level analysis used in this economic analysis study.

For this study's economic analysis, a calculated catch of wild fish was pooled with estimated hatchery production catch before success rates were applied in order to determine total angler effort.

The methods for the wild fish calculation require data for escapement to river entrances and estimated spawner counts.[2] The assumed difference between these two quantities is catch mortality. This means there is no consideration of freshwater prespawning mortality, which is a frequent assumption for the biological analysis CMP included coastal river basins. The escapement and catch data for fall Chinook is from data reported by the Pacific Salmon Commission (PSC 2012). The escapement and catch data for spring Chinook, winter steelhead, and summer steelhead come from the CMP.

Fall Chinook

- Four populations Oregon coastal fall Chinook escapement and terminal run abundances since 1975 are reported by the Pacific Salmon Commission (PSC 2011).

Spring Chinook

- The abundance of North Umpqua spring Chinook spawners is estimated as the census counts at Winchester Dam less fish taken in the fishery. The time period of the assessment begins in 1972 because exploitation rates prior to this time are unknown.
- The abundance of spring Chinook in the South Umpqua is computed from resting hole counts. Studies conducted in 1993 suggest that these resting pool counts represent 50 percent of the total population, but in 2009 the pools represented 95 percent of the population. For this assessment, pool counts prior to and including 1993 were assumed to represent 50 percent of the total population. Between 1994 and 1999, the pool counts were assumed to represents 65 percent of the total population size, 2000 to 2005 were assumed to represent 80 percent, and 2006 to the present are assumed to represent 95 percent.

Winter Steelhead

- Redds are counted in a 4.8 mile section of the Salmonberry within the Nehalem. These are then expanded to the entire Salmonberry and then expanded again assuming 2.5 redds/spawner. The time frame of analysis for this population area is 1973 to the present. There are no redd observations prior to 1973.
- North Umpqua winter steelhead are censused at Winchester Dam. The time frame of analysis for this population is 1946 to the present. Data do not exist prior to 1946.

Summer Steelhead

- Siletz River summer steelhead are counted at Siletz Falls as they are passed upstream. Uncertainty in the proportion of hatchery fish is much greater prior to 1993. Thus, the time frame of analysis of these counts begins in 1993.

---

2. The wild fish catch calculation method and data was provided through personal communication with Matt Falcy, ODFW July 2013.

- The abundance of North Umpqua summer steelhead spawners is estimated as the census counts at Winchester Dam less fish taken in the fishery. The time period of the assessment begins in 1947.

Since detailed information on catch is not available for all populations with abundance data, the relationship between catch and abundance for each SMU must be made with a subset of populations within the SMU. Data from multiple populations within a SMU were combined prior to model fitting. Plots of catch over terminal run size are color coded so that across-population heterogeneity within an SMU can be assessed visually (Figure C.1).

Although the functional form of the equation relating catch to abundance is identical to a Beverton-Holt stock recruitment function, the response variable is catch, not recruitment (Ricker 1954; Beaverton and Holt 1957). This function was nonetheless selected because its nonlinear form should match the pattern of these data: catch should go to zero when terminal run size is zero, and catch should have an upper asymptote as terminal run size becomes very large (angler saturation). These features are captured in this function:

$$C_i = [\alpha \cdot T_i] \div [1 + (\alpha \cdot T_i \div \beta)]$$

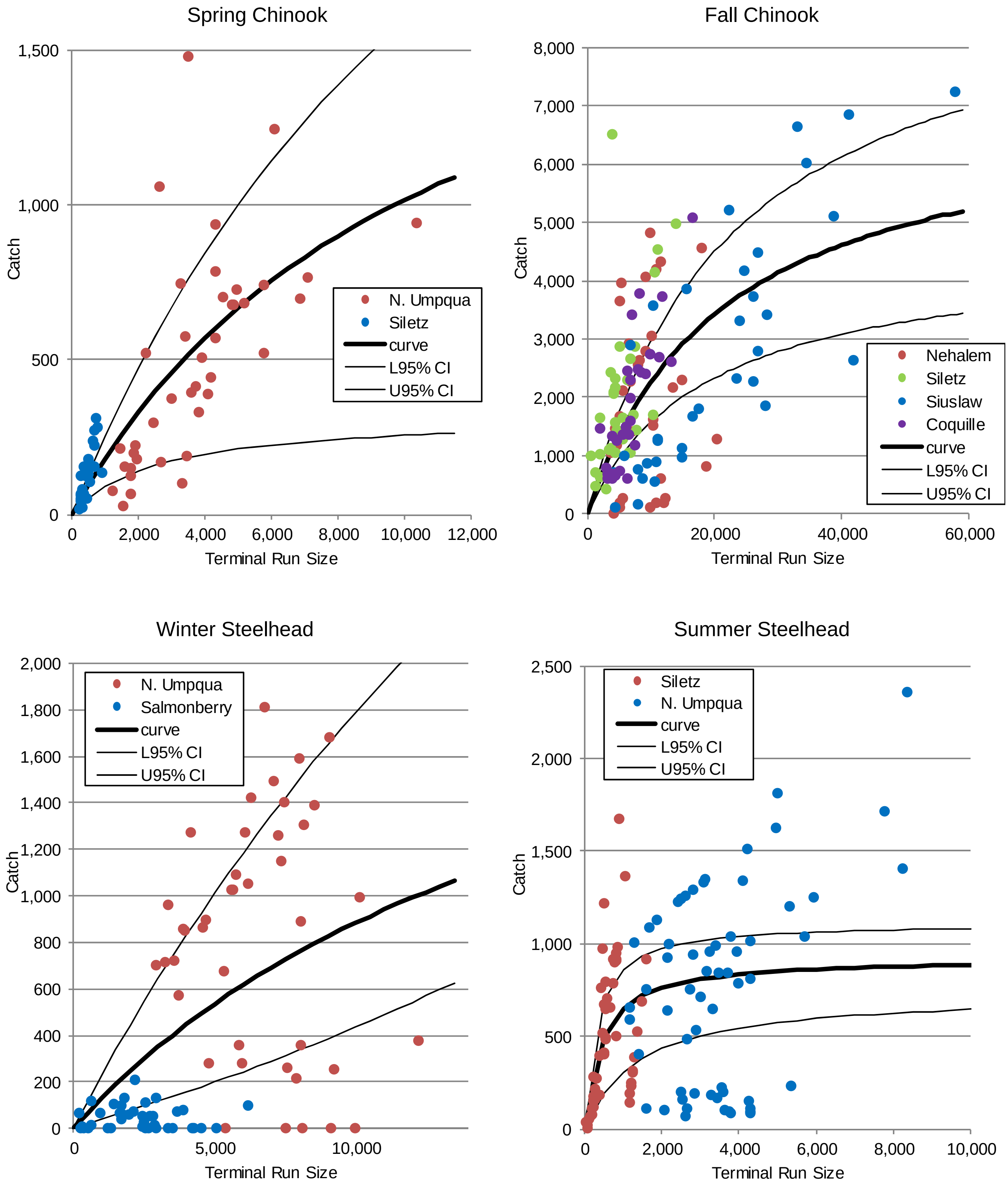
where:

i = analyzed fishery
C = catch mortality
T = terminal run size
α = slope of the catch line at the origin in a plot of catch over terminal run size
β = gives the upper asymptote of catch mortality as terminal run size becomes very large

The dimensionless function constants were estimated from catch and abundance data using an iterative least squares algorithm implemented with MATLAB software.

The foregoing simply relates catch and abundance through time. The effect of harvest regulations on catch is not explicitly modeled. Thus, the effect of different harvest regulations on catch is a source of unexplained variation. The functions for predicting wild fish catch based on terminal run size for observed and desired conditions provided the percent change in wild origin fish catch.

Figure C.1
Scattergram of Wild Production Catch by Species for Selected Basins and Years



Notes: 1. Point data includes years when freshwater fisheries management allowed wild origin winter and summer steelhead retention.

Appendix D

Oregon Marine Recreational and Commercial Fishery Economic Contribution Trends

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Appendix D
Oregon Marine Recreational and Commercial Fishery Economic Contribution Trends

The tables and figures in this appendix are from TRG (2013). The TRG (2013) title is somewhat of a misnomer in regards to the study being comprehensive for all Oregon Coast recreational fisheries. The study area and included fisheries are selective. TRG (2013) describes in detail the selected fisheries and locations so that the reader can sort out what is included in the accounting for Oregon Coast recreational fishing trips. The included fisheries are identified in notes on Figure D.1 in this appendix.

Contents

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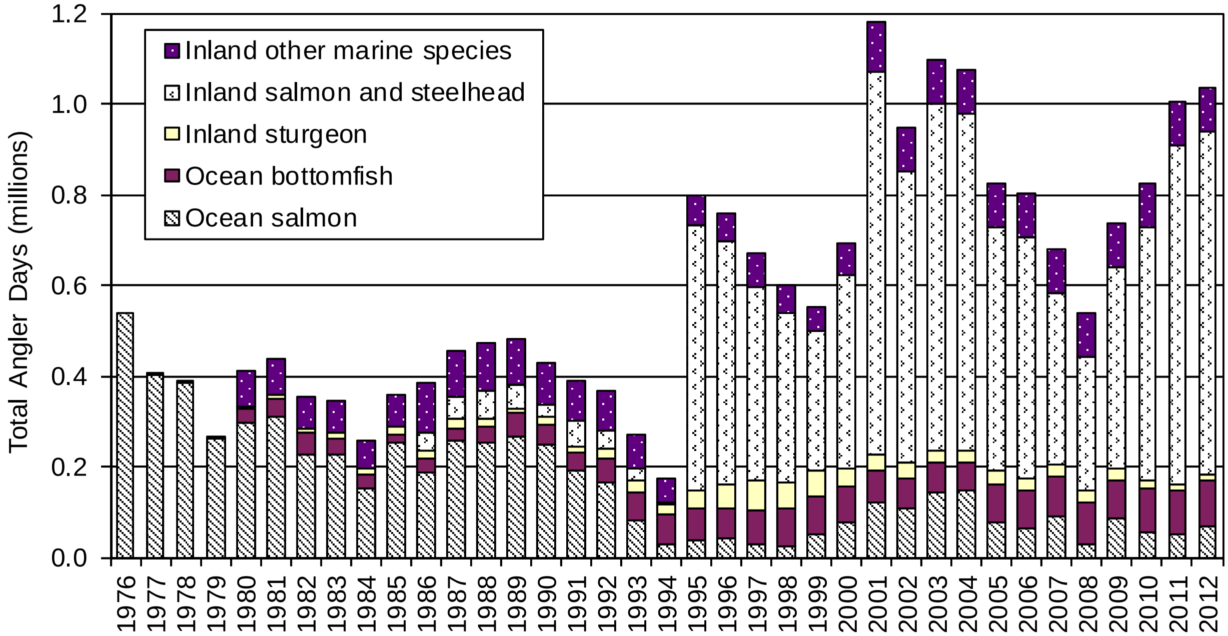
Figure D.1
Recreational Angler Days for the Study Selected Fisheries in 1976 to 2012

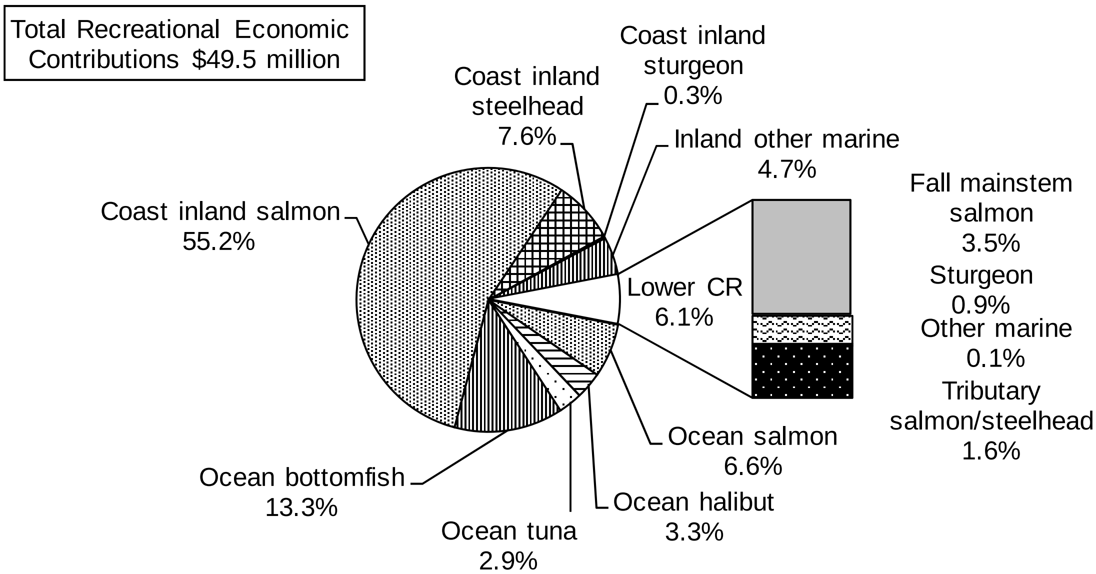


Notes: 1. Angler days are included when the fishing trip occurs in the ocean, inland marine areas (estuaries), and when the trip purpose is for certain species in coastal area freshwater locations. The ocean fisheries are separated by trip purpose being for salmon and bottomfish. If the trip purpose is for a combination of salmon and bottomfish, then it is classified as a salmon trip. The bottomfish fishery includes halibut and tuna trips. The only trips included at freshwater locations are when the trip purpose is for anadromous fish (Chinook and coho salmon, steelhead, and sturgeon). The freshwater locations are at locations approximated for being west of the Coast Range crest.

2. There are gaps in data for the included fisheries. Bottomfish angler days not available before 1980. Lower Columbia River fall salmon fishery trips are not included prior to 1982. Lower Columbia River estuary tributary and Coast estuaries are not included prior to 1995. Coast inland freshwater trips repeat 2011 for 2012. Lower Columbia River sturgeon is not available prior to 1977. Lower Columbia River mainstem salmon and steelhead trips are in the Columbia River Section 10 zone and include the popular fall Buoy 10 fishery for 1982 to 2012. Coast inland other marine species trips are only available for 1980 to 1989 and 1993 to 2002, with 1990 to 1992 estimated by 1989 and 1993, and 2003 to present estimated by 2002. Coast estuary other marine species trips most complete recent year available from RecFIN is for year 2002. The counts include trips when anadromous fish are the target species. The anadromous fish trips in 2002 based on SSHSTRP data for "bay" waterway segments are subtracted from the RecFIN derived trip data in order to avoid double counting. It is assumed that other marine species trip counts after the subtraction do not change from 2002 in subsequent years. Lower Columbia River other marine species trips are only shown for 1993 to 1999, with 2000 to present estimated by 1997-1999 average.

Sources: TRG (2013).

Figure D.2
Recreational Ocean and Inland Fisheries Economic Contribution Shares for 2012



Source: TRG (2013).

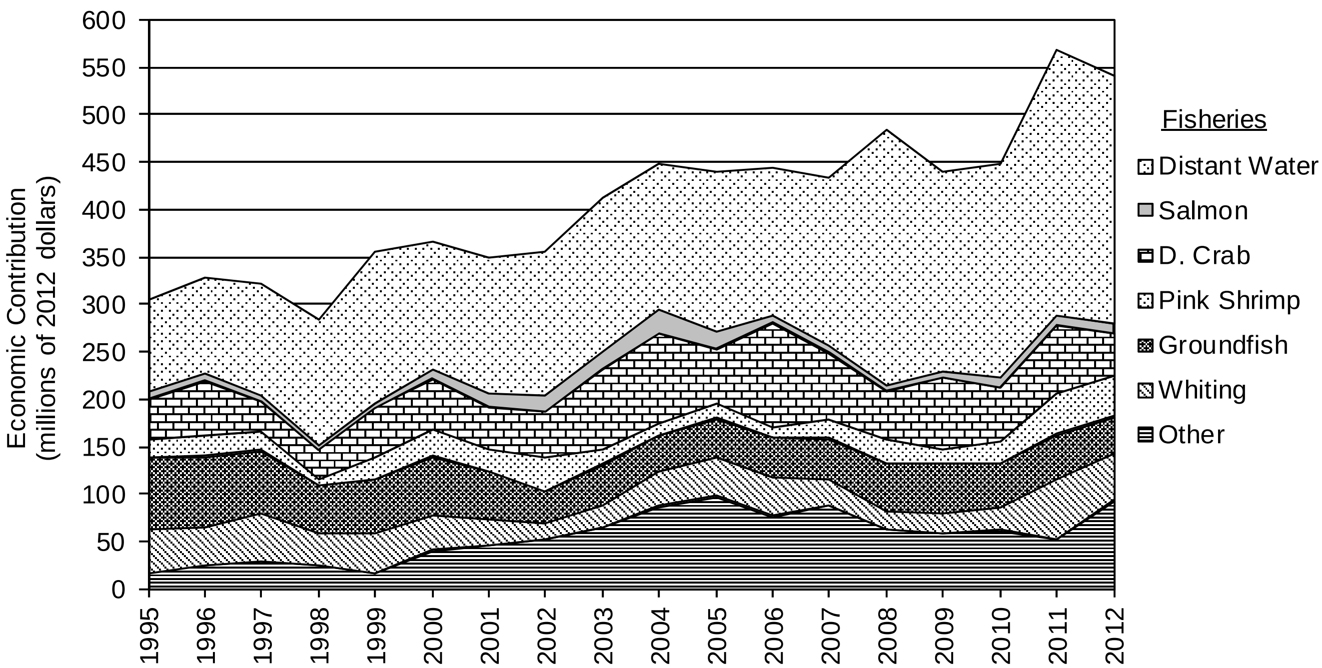
Table D.1
Ocean and Inland Recreational Fisheries Economic Contributions in 2012

Target Fishery	Commercial: Ocean Salmon	Recreational: Location: Ocean	Recreational: Location: Coast Inland: Salmon/ Steelhead	Recreational: Location: Coast Inland: Marine Species	Recreational: Location: Lower Columbia River	Recreational: Total	Recreational: Fishery Share
Ocean salmon	$5.62	$3.26				$3.26	6.6%
Inland fall salmon			$23.47		$0.33	$23.79	48.1%
Inland steelhead			$3.78		$0.10	$3.88	7.8%
Inland spr./sum. Chinook			$3.84		$0.37	$4.21	8.5%
Mainstem fall salmon					$1.73	$1.73	3.5%
Ocean halibut		$1.63				$1.63	3.3%
Ocean tuna		$1.45				$1.45	2.9%
Ocean bottomfish		$6.59				$6.59	13.3%
Other marine species				$2.33	$0.03	$2.37	4.8%
Sturgeon				$0.12	$0.44	$0.56	1.1%
Total	$5.62	$12.92	$31.09	$2.46	$3.00	$49.46	100.0%
Shares		26.1%	62.9%	5.0%	6.1%	100.0%	

Notes:
1. Economic contributions are expressed as personal income in millions of 2012 dollars and are at the coastwide economic level.
2. Fall Columbia River mainstem salmon is sometimes referred to as the Buoy 10 salmon fishery.
3. Other marine species is sometimes referred to as bottomfishing when it takes place in the ocean.
4. ODFW SSHSTRP data is 2011, June 2013 extraction.

Source: TRG (2013).

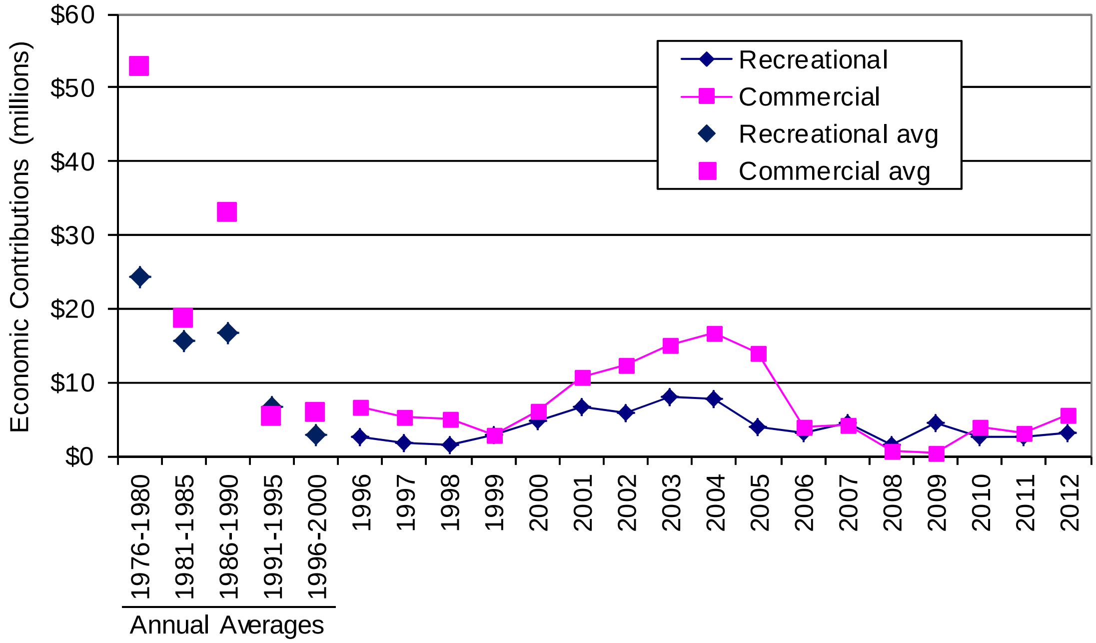
Figure D.3
Ocean Commercial and Distant Water Fisheries Economic Contributions in 1995 to 2012



Notes: 1. Economic contributions are expressed as total personal income in millions of 2012 dollars.
2. Shellfish aquaculture is not included.
3. Years 2011 to 2012 are preliminary.
4. The economic contribution from distant water fisheries includes the effects of vessel revenue returned to Oregon's economy from U.S. West Coast at-sea fisheries, Oregon home-port vessels landing in other U.S. West Coast states and Alaska, southern Pacific Ocean, and other fisheries. New fishing vessel construction, fishery management, and fishery research and training are not included.

Source: TRG (2013).

Figure D.4
Ocean Commercial and Recreational Salmon Fisheries Economic Contributions for Historical Period Averages and 1976 to 2012



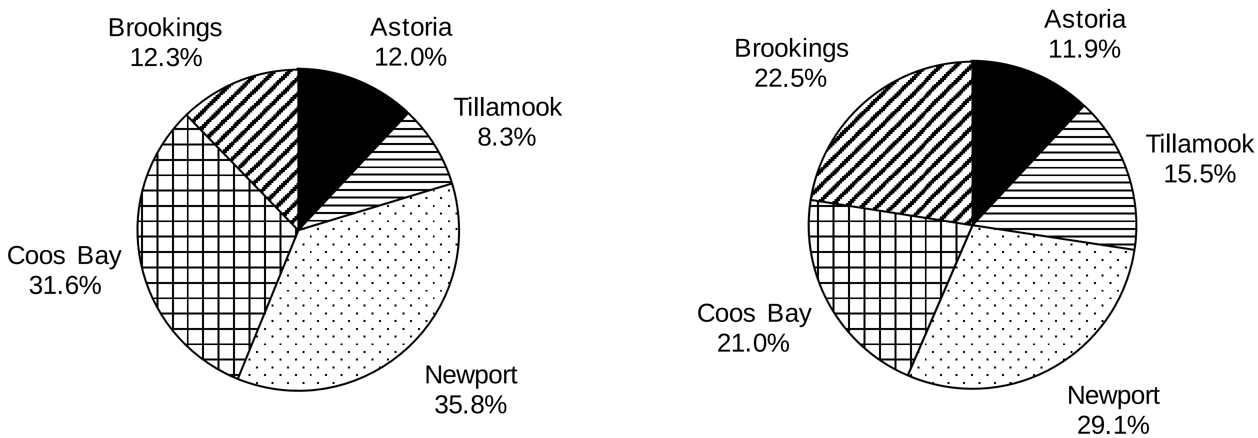
Notes:
1. Expressed as personal income in millions of 2012 dollars.
2. Contributions are at the coastwide level.
3. Contributions exclude Columbia River commercial and recreational fisheries.
4. The ocean salmon fisheries in 2006 and 2008 were declared fishery disasters by the U.S. Department of Commerce. Commercial fisheries south of Cape Falcon were closed in these years, except to some brief bubble fisheries within the Oregon Territorial Sea. There was a restricted commercial season south of Cape Falcon in 2007, but harvest rates were low and many fishermen elected not to participate. The south of Cape Falcon commercial season was closed in 2008. There was a short (September only) limited area (north of Humbug Mt. and south of Cape Falcon) commercial season in 2009. There was a return to the south of Cape Falcon commercial season in 2010 with traditional open fishing days, but Chinook harvest numbers were moderate. There were traditional day seasons for Chinook south of Cape Falcon in 2011, 2012, and 2013. These years additionally had trip limit seasons for marked coho.

Source: TRG (2013).

Figure D.5
Ocean Commercial and Recreational Salmon Fisheries
Economic Contribution Shares by Port Region in 2012

Commercial Economic Contributions: $5.6 Million

Recreational Economic Contributions: $3.3 Million



Source: TRG (2013).