Analysis of the Economic Benefits of Salmon Restoration Efforts on the Lower Coquille River and Associated Economic Impacts

Report to the Nature Conservancy

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DRAFT – NOT FOR CIRCULATION

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EXECUTIVE SUMMARY

The Nature Conservancy and local partners are working together to restore 300 acres of floodplain wetlands in the Coquille River estuary at the mouth of China Camp Creek. This report analyzes some of the economic benefits resulting from this restoration project.

Healthy watersheds provide abundant natural resources and economic opportunities: clean drinking water, clean air, robust fish populations, and enhanced recreational opportunities, to name a few. Healthy watersheds also mean healthy economies. Investing in watershed restoration can create jobs and stimulate economic activity in local communities, today and in the future.

Watershed restoration in Oregon can help restore wild salmon populations for the benefit of ecosystems and fisheries. One of the largest remaining aggregates of wild Coho salmon in the United States outside of Alaska is a distinct population of salmon called Oregon Coastal Natural Coho. Most of this population originates in waters from the Coquille River north to the Nehalem River (ODFW, 2011a). Over the last few decades, achieving desired spawning goals for this distinct population has proven difficult, and these Coho salmon have been under close scientific inspection and strict harvest management for years.

The lower Coquille River Watershed in Southwest Oregon provides important habitat for juvenile and adult forms of many anadromous fish species, including Oregon Coastal Natural Coho. The value of floodplain channels and ponds as over-wintering habitat for juvenile Coho salmon is well documented, and the loss of over-wintering habitat in the lower Coquille has been identified as the primary limiting factor to adult Coho populations (Nickelson, 2011; Coquille Indian Tribe, 2007). Restoration of overwintering habitat near the mouth of China Camp Creek by the Nature Conservancy and its partners may contribute towards rebuilding Coho populations in the Coquille River.

A recent analysis by Nickelson (2011) projects the potential Coho salmon response to The Nature Conservancy's restoration efforts at China Camp Creek. Nickelson (2011) estimates that the project can produce, on average, 11–14 adult Coho salmon per acre of restored wetland annually, or as many as 18–23 per acre in years with good ocean conditions and high marine survival rates (Nickelson, 2011). This means that the 300 acre China Camp Creek project can produce as many as 3,300–4,200 adult Coho salmon annually.

To support the proposed restoration efforts, the Nature Conservancy asked Ecotrust to examine the potential economic impacts of the planned restoration activities. We began by reviewing restoration projects of similar size and scope in Oregon to determine the short-term economic benefits from expenditures related to restoration activities at China Camp Creek. We found that projects of similar size and scope required restoration expenditures averaging $3,181–$4,784 per acre, or $1.1–$1.7 million over 300 acres. Expenditures on restoration create demand for local labor and supplies, thereby stimulating short-term economic activity directly and indirectly through the multiplier effect. Using output and employment multipliers from the literature, Ecotrust estimates that restoration activities in the lower Coquille River could generate $2.6-$3.4 million dollars in economic output in the near term and 18-25 direct, indirect, and induced jobs in the regional economy. These jobs may be full-time, part-time, temporary, seasonal, or non-seasonal in nature.

One of the main goals for wetlands restoration in the lower Coquille River is to restore wild Coho populations to abundance and create economic opportunities through expanded recreational and (perhaps someday) commercial Coho fisheries. We approached the economic contributions of the proposed wetland restoration to the Coquille in-river recreational fishery in two ways. First, we used data on recreational angler expenditures from the literature to determine the value of economic output attributed directly and indirectly to recreational salmon fishing opportunities. Using expenditure estimates and multipliers from the literature, we found each additional adult salmon added to the in-river recreational fishery in the Coquille may contribute $483 in regional economic activity. Over a 20 year time period, the contributions to the in-river recreational fishery from the China Camp Creek restoration project may be as high as $2.5–$3.2 million dollars.

Alternatively, we report the value of sport caught recreational salmon at $165.16 per fish, based on a review of non-market valuation studies in the literature. This is a different approach to estimating the value of salmon and the results cannot be compared, or added, to those derived using the expenditure-based approach. At $165.16 per fish, Ecotrust found the China Camp Creek restoration project may contribute $.86–$1.1 million dollars in value to the recreational fishery over 20 years.

Our findings only capture a portion of the value of the China Camp Creek restoration project. Other economic benefits would include biodiversity, clean water, habitat, and other ecosystem services. This analysis also does not capture the value of salmon for all Oregonians. Studies have shown that wild salmon and wild salmon habitats are important to many Oregonians, not only those who participate in recreational fisheries (Helvoight and Charlton 2009).

Watershed restoration is about more than restoring abundant wild salmon populations. It is about restoring ecosystem function today and in the future. The dollars spent on restoration projects represent an investment in natural capital and communities that can pay out over many years. Restoration costs will be incurred in the short run, but the benefits of restoring abundant salmon runs and improving ecosystem function will accrue over time. For these reasons and more, we conclude that the proposed restoration project at China Camp Creek can deliver significant benefits to the regional economy and the population at large.

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1. INTRODUCTION

Healthy watersheds provide abundant natural resources and economic opportunities: clean drinking water, clean air, robust fish populations, and enhanced recreational opportunities, to name a few. Healthy watersheds also mean healthy economies and investing in watershed restoration can create jobs and stimulate economic activity for local communities, today and into the future.

The Nature Conservancy and local partners are working together to restore floodplain wetlands in the Coquille River estuary in Southwest Oregon. The lower Coquille watershed provides important habitat for juvenile and adult Coho, and other anadromous fish species, including Chinook salmon, steelhead, and cutthroat trout. Coho salmon have ecological, cultural, and economic value and can serve as an indicator of the health of the ecosystem and the effectiveness of management actions.

The value of floodplain channels and ponds in the lower Coquille as over-wintering habitat for juvenile Coho salmon is well documented (Nickelson, 2011; Coquille Indian Tribe, 2007). In 2007, the Coquille Indian Tribe prepared a large scale assessment of the Coquille watershed for the National Oceanic and Atmospheric Administration (NOAA) Fisheries Service. Their study documented the limiting factors for Coho salmon populations in the Coquille watershed and suggested management options for conserving native fish populations and improving water quality throughout. This effort found that the lack of overwintering habitat is the single most important limiting factor to the survival success of Coho salmon populations.

On the basis of these and other recommendations, the Nature Conservancy and its partners are planning to restore roughly 300 acres of wetlands at the mouth of China Camp Creek in the Coquille Valley. Those activities include:

- Reconnecting river and stream channels (e.g. reconnecting sloughs, removing and/or replacing tidegates)
- Restoring slow-water refugia
- Restoring wetland and riparian vegetation
- Removing invasive species

A key goal of the restoration effort at China Camp Creek is to increase Coho abundance by improving overwintering habitat. Throughout this report, we refer to these planned activities as the China Camp Creek Restoration Project (CCCRP). To support the efforts of the CCCRP, this study examines the potential economic benefits of the planned restoration activities.

We begin by examining economic benefits related to expenditures on the restoration activities. We estimate project expenditures by reviewing projects of similar size and scope to the CCCRP. Restoration expenditures create jobs and stimulate economic activity in the region. To estimate the potential economic output and employment resulting from the CCCRP, we apply the relevant multipliers developed by the Ecosystem Workforce Program at the University of Oregon (Nielsen-Pincus and Moseley, 2010) to our estimates of per acre restoration expenditures.

In addition, we review the literature on the economic value of salmon to determine a range of values of the economic benefits from the CCCRP over the long term. More specifically we explore the economic benefits from an expanded in-river recreational salmon fishery.

Our analysis only captures a portion of the potential economic benefits of the CCCRP. The economic benefits of the CCCRP are much broader and would include biodiversity, watershed services, and other ecosystem services.

2. RESTORATION WORK

Watersheds are areas or regions of land that drain into a lake, wetland, stream, or river. The purpose of watershed restoration is to restore ecosystem health and function after a specific incident or period of deterioration. The approach and intensity of restoration work varies greatly depending on each site and intention. The Oregon Watershed Enhancement Board (OWEB) provides data and funding to support watershed education, assessments, monitoring, and restoration across the state. Table 1 describes the categories of watershed restoration projects that OWEB uses.

Table 1. Common restoration activities (OWEB)

Restoration Activity	**Description**
Fish Passage	Removal of barriers to fish passage such as culverts and dams
In-stream	Enhancement of stream habitat and function
Riparian	Enhancement and restoration of native riparian vegetation
Road	Inventory, construction, reparation, or decommission of roads
Upland	Agricultural water management, juniper management, & noxious weed treatments
Urban	Urban centered actions removing sources of watershed pollution
Wetland	Restoration of wetland and estuarine habitat
Combined	A diverse combination of some of the above project types together

Source: OWEB (2011), and Nielsen-Pincus and Moseley (2010)

This section of the report summarizes the work scope of the CCCRP, examines similar restoration projects completed in Oregon, estimates the potential cost of the CCCRP, and finally, estimates the potential associated economic benefits of the CCCRP restoration activities.

2.1. The Coquille Watershed

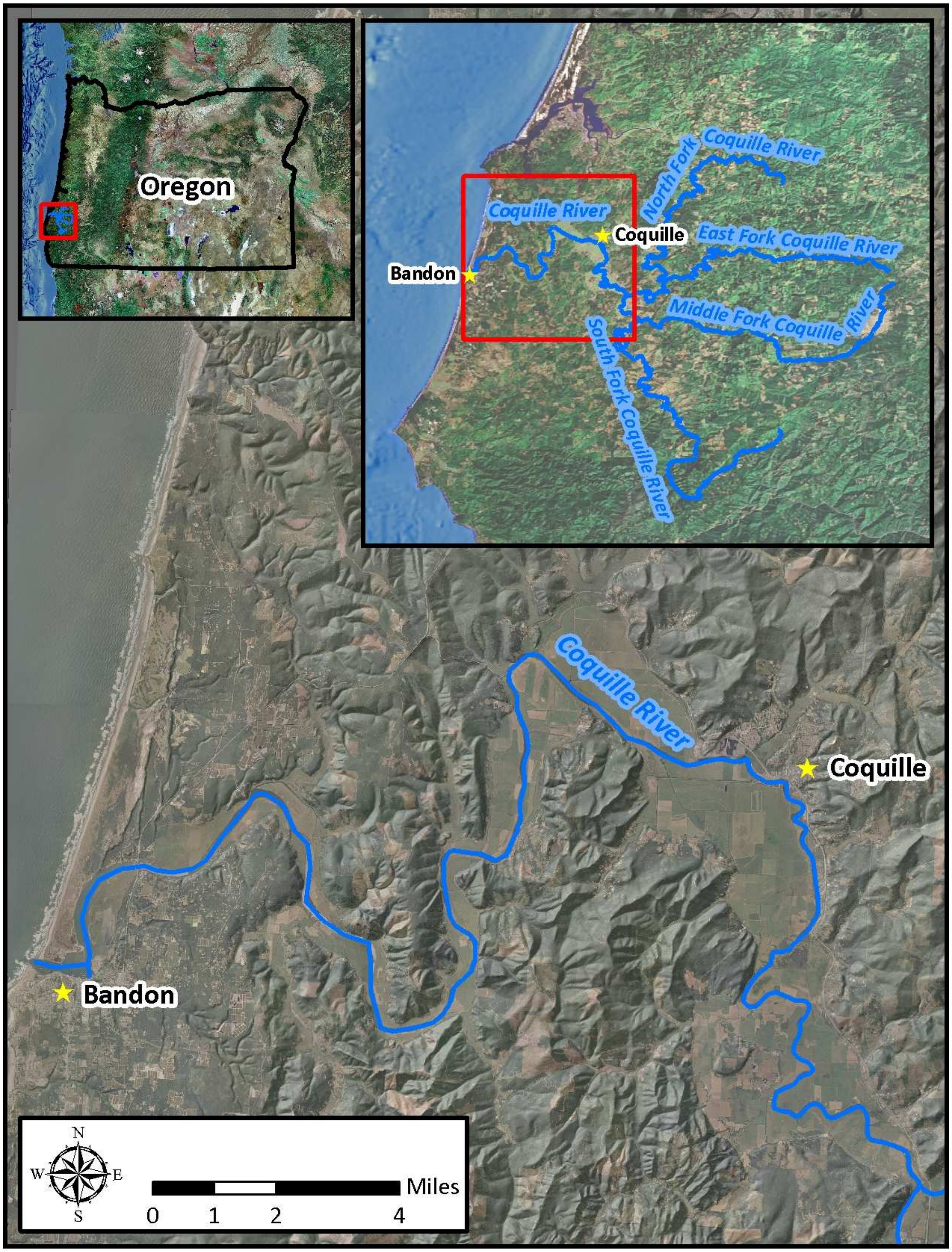
Coquille Watershed is part of the South Coast Basin in the southwest corner of the state of Oregon, (Figure 1). The 1,032 square mile Coquille Watershed is comprised of five recognized subdivisions based on the primary tributaries of the Coquille River — the North Fork; East Fork; Middle Fork; and South Fork — and the main-stem of the Coquille below the confluence of the North and South Forks. There are 3,280 miles of stream within the Coquille subbasin; 3.8 stream miles per square mile of land area in the subbasin on average. Average drainage density by subdivision ranges from a high of 4.5 mi./sq. mi. in the Coquille subdivision to a low of 3.5 mi./sq. mi. in the South Fork of the Coquille.[1]

In their comprehensive assessment of the Coquille watershed, the Coquille Indian Tribe (2007) identified the restoration of 'slow-water refugia for winter parr' as the most vital strategy to conserve the Coho salmon population in the Coquille River. Refugia are areas where organisms such as parr (juvenile fish) can survive and develop through unfavorable conditions, such as winter.

For that reason, the CCCRP will focus specifically on restoring wetland habitat near the mouth of China Camp Creek in the Coquille Valley (see Figure 1). Current plans for the CCCRP involve wetlands of 300 acres or more and likely include fish passage, in-stream, riparian, and general wetland restoration activities.

[1] Data taken from Inforain Coquille subbasin atlas http://www.inforain.org/coquille_atlas/subbasin.html

Figure 1. Project area



2.2. Review of Restoration Projects and Expenditures

To estimate potential project expenditures Ecotrust reviewed restoration projects of similar scope and size to the CCCRP. The Oregon Watershed Enhancement Board (OWEB) keeps an accessible and extensive inventory of watershed restoration projects occurring across the state called the Oregon Watershed Restoration Inventory (OWRI). At the time of this study in 2012, OWEB's OWRI database documented nearly 13,000 watershed projects throughout all of Oregon between the years 1995–2009. The OWRI data coordinator states, "It is the goal of OWRI to be the central repository of restoration project data in Oregon" (B. Riggers, personal communication, July 19, 2010). Given these reasons and the extensive project monitoring methodology used by OWRI, we used the OWRI database to identify and analyze restoration projects resembling the CCCRP.

The CCCRP aims to restore a large area (roughly 300 acres) of low-lying wetlands with an emphasis on Coho salmon support and recovery. Similar projects were determined by screening the OWRI database for projects matching the following criteria:

- Those with direct 'cash' project expenditure information; and
- Those that did not contain restoration activities classified as road, upland, or urban (leaving only projects with fish passage, instream, riparian, wetland, or combined activities); and
- Those that reported restoration results in terms of 'total acres treated' for wetland activities (vs. number of stream miles treated, number of road/stream crossings improved for fish passage, etc.); and
- Those that occurred on at least one or more acres.

Filtering the database thus, a total of 169 similar watershed restoration projects remained; they occurred over the years 1997–2009 in 29 counties across the state Oregon. Project cost data for each project included 'Total Cash' and 'Total In-kind' expenditures. 'Total In-kind' expenditures are defined by OWEB as, "the value of donated or in-kind services, materials, labor, etc." (OWEB, 2011). Although in-kind expenditures may include direct in-kind funding matches, i.e. cash, and many watershed restoration projects depend on in-kind funding to succeed, we included only direct cash expenditures in this analysis because estimating the economic impact of in-kind contributions is very uncertain. Because only direct expenditures are considered in this analysis, project expenditures and the resulting economic impact estimates are likely to be conservative. All project expenditure data was adjusted to 2010 dollars using the Bureau of Labor Statistic's (2011) Consumer Price Index. All values and estimates below are given in 2010 dollars unless otherwise noted.

To attain expenditure per acre figures, we divided total project expenditures by total acres treated. These figures were averaged, and three outlier projects - projects with expenditure/acre amounts that deviated significantly - from other projects, were eliminated.[2] Thus, a total of 166 comparable projects remained, classified as "All Projects" within our analysis. Within the "All Projects" group, it was possible to differentiate even further, determining three subset project groups, for a total of four groups (Figure 2).

Figure 2. Project groups

Group 1	All Projects	The complete set of 166 comparable wetland restoration projects initially determined.
Group 2	Coho Salmon	Projects which specifically indicated that species benefits would result to Coho Salmon.
Group 3	Ocean & Estuary	Projects defined as having a wetland connection type of 'ocean or estuary'.
Group 4	Coho Salmon + Ocean & Estuary	Projects that were classified as both Coho Salmon and Ocean & Estuary projects.

[2] Three standard deviations away from the average.

Table 2 details some summary statistics for each of the project subset groups. Group 4, Coho Salmon + Ocean & Estuary, likely contains the projects that are most similar to the CCCRP. Due to its more extensive exclusion criteria, this group contains the least amount of projects, fourteen. Group 4 projects averaged $4,784 per acre; treated an average of 37 acres per project; targeted three species benefits; and usually included only one restoration activity, 'wetland'.

Table 2. Project statistics

Project types	# of projects	Average $/acre	Average # of acres	Average # of species	Average # of activities
Group 1: All Projects	166	$8,585	222	3	1
Group 2: Coho Salmon	46	$6,594	88	4	2
Group 3: Ocean & Estuary	24	$7,852	28	2	1
Group 4: Coho Salmon + Ocean & Estuary	14	$4,784	37	3	1

Source: OWEB (2011) data

Figure 3 (below) compares the four project groups in terms of the number of projects, average total acres per project, and average expenditure per acre. While there were fewer Group 3 projects, these projects tended to require higher expenditures than Group 2 projects, even though Group 2 projects were larger on average in terms of acreage. Group 4 projects involving Ocean & Estuary wetlands and a Coho Salmon species benefit, required fewer expenditures per acre overall.

Figure 3. Project statistics

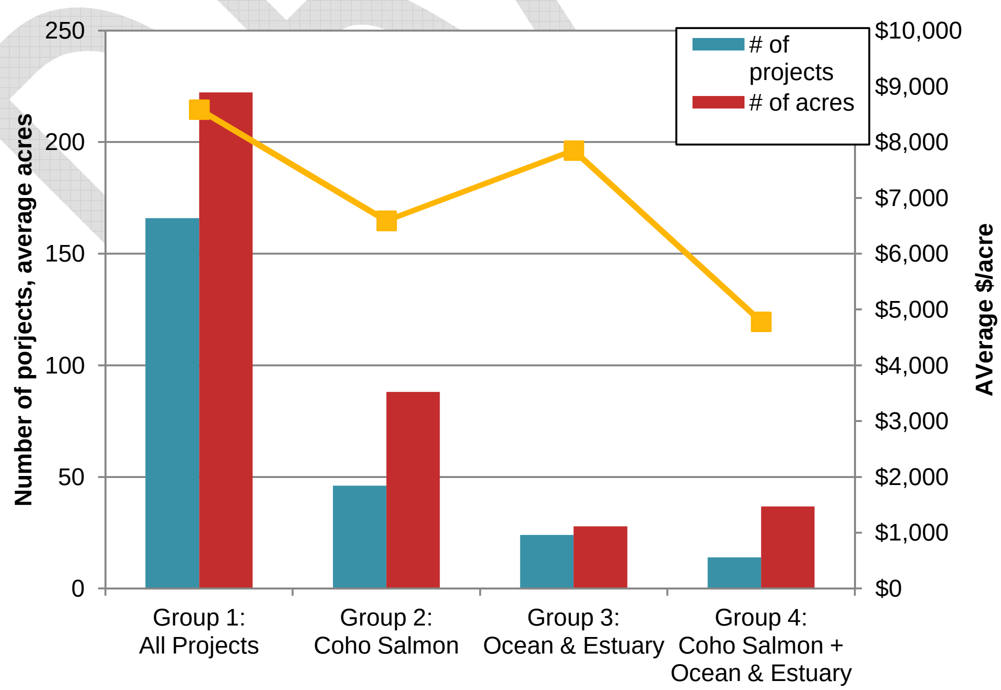


Figure 4 examines Group 4 projects in greater detail, detailing the acreage and expenditure per acre of each of the fourteen restoration projects in that group.[3] Expenditures per acre varied greatly among the smaller projects. For projects in excess of ten acres, expenditures per acre averaged $3,181.

Figure 4. Acreage and associated expenditure per acre for Group 4 projects

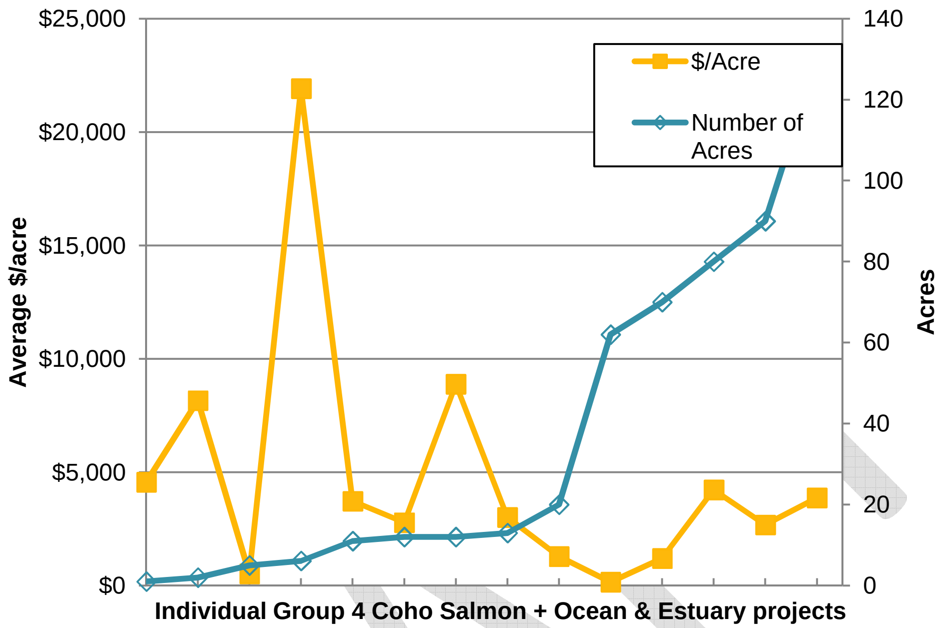
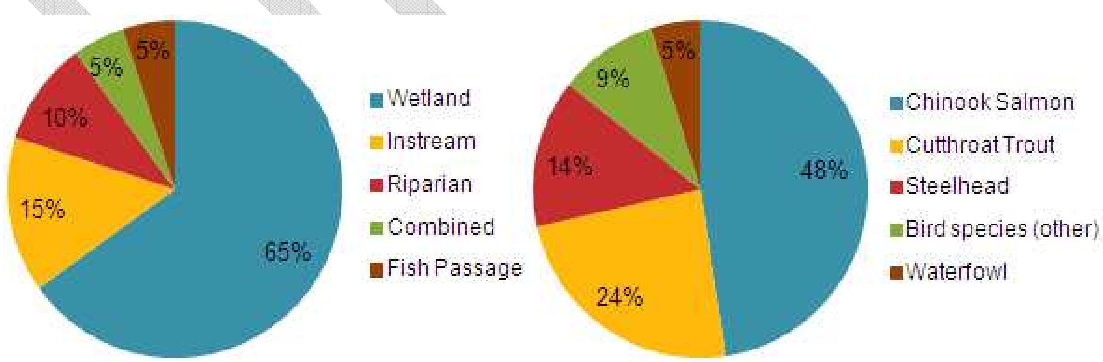


Figure 5 displays additional details about Group 4 projects including the other recorded restoration activities and other included species benefits. Beyond Coho Salmon, many projects also resulted in species benefits to cutthroat trout, steelhead, and some bird species.

Figure 5. Group 4 projects: Restoration activities and targeted species



One completed project that fits the criteria for Group 4 projects but was not reflected in the OWEB database because it has only recently been completed is the Ni-les'tun Tidal Marsh Restoration in nearby Bandon Marsh. This project – a collaborative effort by government, private, and community organizations – was the largest tidal marsh wetland restoration in the state of Oregon at the time of its completion in

[3] See Appendix A for table describing these fourteen projects in greater detail.

2011. Covering approximately 418 acres of refuge property, the project was designed to restore tidal marsh to lands that had been ditched, diked, and drained for use as pastureland/dairy a century ago.

Because the project is not yet reflected in the OWEB database, exact project expenditure data could not be obtained. Total project costs, however, have been cited as near $9.5 million dollars, or approximately $23,000 per acre, funded by a combination of federal stimulus money, OWEB grants, funds from the New Carissa oil-spill settlement, and awards from many smaller grants (Muldoon, 2010).

Although the size and location of the Ni-les'tun restoration project is similar to the proposed CCCRP, the scopes of the projects differ significantly. In the Ni-les'tun project, high voltage power lines were rerouted underground and beneath the Coquille River; utility poles and lines along North Bank Lane were placed underground; nearby roadways and highways were considerably raised, widened, and repaved; and many accompanying fish culverts were installed. The nature of these activities explains the comparatively high price tag of this restoration project. Due to the unique attributes of this project, the Ni-les'tun Tidal Marsh Restoration Project is not a good proxy for the costs of the CCCRP.[4]

2.3. Estimated Expenditures on CCCRP

To estimate the potential expenditures related to the CCCRP, we averaged the expenditures per acre of the fourteen projects in project Group 4, Coho salmon + Ocean & Estuary. The average expenditure per acre over the fourteen projects is $4,784. If we exclude the smaller projects of less than ten acres, the average expenditure per project is $3,181. We note the largest of these fourteen projects included only 130 acres, significantly less than the projected 300 acres of the CCCRP. Because expenses per acre tend to decrease with total acreage treated in this project category, it is likely that the actual expenditure per acre for the CCCRP will be less than $4,784. Therefore, we estimate CCCRP project expenditures conservatively to be $3,181–$4,784 per acre.

We then multiply the average expenditure per acre to the total acreage targeted by the CCCRP. We therefore estimate the total expenditures related to the CCCRP to be $1.0–$1.4 million.[5]

Table 3. Estimated expenditures for the CCCRP

	300	**Estimated # of acres: CCCRP**
x	$3,181–$4,784	**Range of average $/acre: Group 4 projects**
	$954,325–$1,435,058	**Estimated Total Expenditure of CCCRP**

2.4. Economic Impacts of CCCRP Restoration Activities

The dollars spent on restoration projects represent a type of investment, an investment in natural capital and communities that pays out over time. Studies have shown that restoration projects create demand for local labor and supplies (Nielsen-Pincus and Moseley, 2010; Sheeran and Hesselgrave, 2011). Unlike other sectors, the jobs created through restoration projects typically cannot be outsourced to far-off places. Restoration also stimulates demand for the products and services of local businesses (e.g. plant nurseries, heavy equipment companies, and rock and gravel companies). These dollars tend to stay in the local economy. A recent University of Oregon study found that approximately 80% of OWEB's restoration expenditures remain in the county where the project is located. Over 90% of restoration expenditures stay within the state (Hibbard and Lurie, 2006).

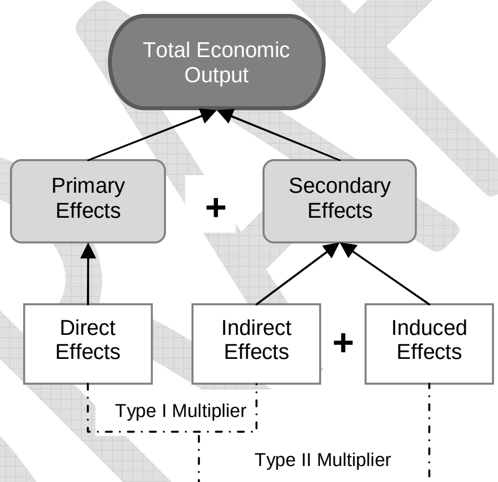
[4] At the time of this study, US Fish and Wildlife Service refuge manager Dave Ledig informed us that a detailed economic analysis of the Ni-les'tun Tidal Marsh Restoration Project is currently being undertaken and is expected to be released late March 2012 (personal communication, February 7, 2012). For more information on the marsh and the restoration project, please see http://www.fws.gov/oregoncoast/bandonmarsh/index.htm.

[5] The Oregon Coast Coho Conservation Plan (ODFW, 2007) identified the potential to restore 213 miles of high quality habitat in the Coquille subbasin for a total cost of $5.3 million over a period of many years.

Every dollar spent on salaries or supplies for a restoration project is re-circulated throughout the local economy. Economists can estimate this 'multiplier effect' to determine the total economic output that can be generated from a given expenditure on restoration. Economic multipliers measure the changes in economic activity or output resulting from an initial expenditure.[6] For example, a multiplier of 1.5 implies that $1.00 of direct expenditure on restoration generates an additional $0.50 in economic activity, resulting in a total economic impact of $1.50.

Multipliers capture the ripple effects of economic activity; simply, a direct change in one sector affects others. The multiplier effect (Figure 6) includes direct, indirect, and induced economic activity. Direct effects are the most straightforward; they include the economic activities associated most directly with the restoration activity. Indirect effects account for the demands for services, supplies, equipment and other inputs produced by related industries to support the restoration work. Finally, induced effects capture the increased spending and economic activity that result when those employed in sectors linked directly and indirectly to restoration activities spend their income on goods and services. Employment multipliers measure the number of additional jobs created from each job created to do restoration work. For example, a project to restore native plants along a stream will purchase supplies from a local nursery; the nursery, in turn, will hire workers and supplies from other businesses. A person hired to remove invasive plants along a stream may spend money at a local restaurant; the restaurant, in turn, will hire cooks and waiters and order supplies from other businesses.

Figure 6. Multiplier effects



The multipliers used in this analysis come from a recent study by the Ecosystem Workforce Program (EWP) at the University of Oregon (Nielsen-Pincus and Moseley, 2010). The purpose of their study was, "to examine the employment and economic impacts of public investment in forest and watershed restoration in Oregon" (Nielsen-Pincus and Moseley, 2010, p. 4). To derive the multipliers, the EWP study used the economic impact modeling software IMPLAN, which contains county and federal economic statistics specialized by region, U.S. Census Bureau payroll statistics, and OWRI data from completed Oregon forest and watershed restoration projects. The resulting multipliers, therefore, are appropriate for our analysis. Table 5 details the multipliers and EWP's estimates of the number of jobs supported per $1 million invested in specific restoration activities.[7]

[6] Economic multipliers, invaluable tools in economic analyses, are derived from input-output (I-O) models that describe the structure of an economy in terms of the inputs to its various industry sectors and the distribution of the outputs from those sectors. I-O models are the most comprehensive economic accounts at the level of the whole economy. In the United States, it is common to use multipliers derived through IMPLAN

[7] The job creation potential of restoration activities compares favorably to investments in other sectors of the economy. Studies by Heintz et al. (2009a) and Heintz et al (2009b) estimate the job creation potential of investments in transportation infrastructure, renewable energy, building retrofits, coal, oil and natural gas. The comparison with restoration activities shows that restoration can

Table 4. EWP economic multipliers and employment effects

Restoration Activity	Economic Multipliers[8] Type I	Type II	Employment per $1 million invested Direct+ Indirect	Direct+ Indirect+Induced
In-stream	1.7	2.2	10.5	14.7
Riparian	1.7	2.4	17.5	23.1
Wetland	1.8	2.4	12.5	17.6
Fish passage	1.8	2.3	10.6	15.2
Upland	2	2.6	10.8	15
Other	1.8	2.3	10.4	14.7
All (aggregate)	1.9	2.4	11.7	16.3

Source: Based on Nielsen-Pincus and Moseley (2010)

The EWP study estimates the direct, indirect, and induced employment impacts of restoration investments. Employment impacts are measured by the number of jobs created directly or indirectly through restoration activities. A job could include paid work that is part-time, full-time, permanent, temporary, seasonal, or non-seasonal in nature. An example of direct job creation would be a heavy equipment operator hired for site preparation. An example of indirect job creation would be a salesperson at a local wholesaler of building materials or landscaping supplies (Nielsen-Pincus and Moseley, 2010). An example of induced job creation would be waiter at a local restaurant where those employed in restoration activities dine.

The EWP study also estimated the employment impacts of restoration investments by contractor type including, labor-intensive, equipment-intensive (watershed), equipment-intensive (forestry), and technical contracting (see Table 5). Labor-intensive restoration activities, such as site preparation, tree and shrub planting, and cutting small trees and brush by hand, demonstrate the greatest employment potential. These labor-intensive restoration activities have the potential to create 23.8 jobs for every $1 million invested. Across all contracting types, restoration activities on average have the potential to create 19 jobs for every $1 million invested.[9]

Table 5. EWP employment restoration employment effects by contractor type

Type of restoration contracting	Employment per $1 million invested Direct+ Indirect	Direct+ Indirect+ Induced
Labor-intensive	17.5	23.8
Technical	12.6	19.1
Equipment-intensive (watershed)	10.5	15.7
Equipment-intensive (forestry)	12	17.2
Average	**13.2**	**19.0**

Source: Nielsen-Pincus and Moseley (2010)

Applying the EWP multipliers derived for the watershed restoration category to our previous estimate of the potential expenditures on the CCCRP ($1.4 million), we are able to estimate the total potential economic output and number of jobs created.

create more jobs than comparable green investments in renewable energy, building retrofits, and transportation infrastructure. Restoration investments can create more than twice the number of jobs as comparable investments in coal, and more than three times the number of jobs as comparable investments in oil or natural gas.

[8] Type 1 multipliers include only direct and indirect effects. Type 2 multipliers include direct, indirect, and induced effects.

[9] These are estimates of jobs, not full-time equivalents.

Table 6 details those results. Assuming project expenditures of $1.4 million, the total estimated economic output associated with the CCCRP is $2.6–$3.4 million; total estimated employment is 18–25 jobs.

Table 6. Estimated CCCRP associated output and employment

	Economic Multipliers		**Employment per $1 million invested**	
	Type I	**Type II**	**Direct+ Indirect**	**Direct+Indirect +Induced**
Wetland	1.8	2.4	12.5	17.6
Estimated output and employment	**$2.6–$3.4 million**		**18–25 jobs**	

Source: Authors' estimates using multipliers from Nielsen-Pincus and Moseley (2010)

A range of benefits is given to allow for greater approximation. The lower values in the range are calculated by using Type I multipliers, which measure only the direct and indirect effects of the investment. The higher values in the range are calculated by using Type II multipliers, which measure the direct, indirect, and induced effects of the investment. Type I multipliers generate more conservative values while Type II multipliers portray the macro-scale effects of an investment.

The economic impacts estimated above stem from the restoration activities themselves. A restored watershed capable of supporting abundant wild salmon populations will provide additional benefits to the economy. Outdoor recreational activities are big businesses in Oregon. Fishing for salmon and steelhead are especially important to the state, but recreational tourism also includes hunting, wildlife viewing, hiking, camping, and rafting, kayaking, mountain biking, among other activities. All of these pursuits are dependent upon the existence of healthy watersheds. Investing in watershed restoration, therefore, can lead to increased expenditures on recreation and tourism in Oregon.

Dean Runyan Associates (2009) estimated hunting, fishing, wildlife viewing, and shellfish harvest participation and related expenditures throughout Oregon in 2008. The study surveyed participants selected at random from license sales records; samples were stratified by certain regions of the state and by quarterly collection period. Overall, nearly 12,000 individuals provided information about their fishing, hunting, shellfishing, and wildlife viewing trips. Their results show that in 2008, nearly 2.8 million Oregon residents and nonresidents participated in the following recreational activities: 631 thousand fished, 282 thousand hunted, 175 thousand harvested shellfish, and 1.7 million participated in outdoor recreation where wildlife viewing was a planned activity (Dean Runyan Associates, 2009). And the concomitant expenditures by participants (state residents and nonresidents) in fish and wildlife recreation in 2008 were estimated at $2.5 billion for spending on travel, local recreation, and equipment purchases (Dean Runyan Associates, 2009).

Travel-generated expenditures for freshwater fishing alone totaled an estimated $195.6 million in 2008, see (Table 7). Nearly 60% of total expenditures were not 'local' or associated with trips less than 50 miles. This is important to point out because non-resident spending in regional economies generates new income for residents. It is also interesting to note that the $195.6 million in total travel-generated expenditures was fairly distributed across the state of Oregon, ranging from 5-18% per travel region. On the other hand, the portion of local expenditures varied greatly across travel regions at 17% in the North Coast region to 92% in the Portland Metro/Columbia region.

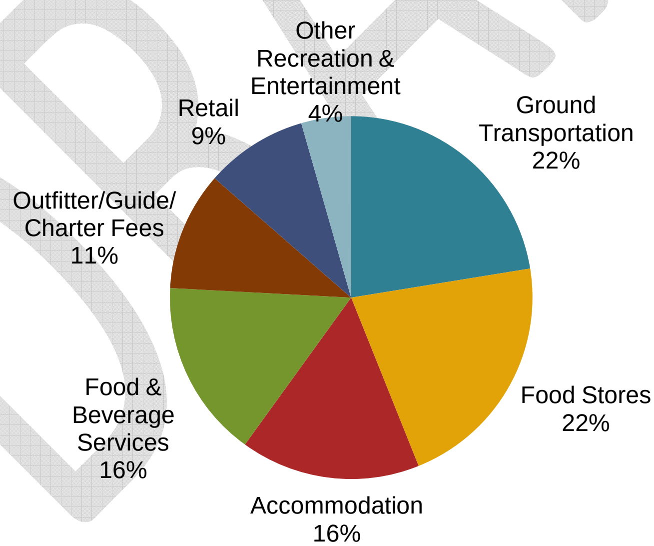
Table 7. Expenditures for freshwater fishing by trip type for Oregon travel regions, 2008

Travel region	Travel-generated expenditures* (millions $) Overnight	Day	Total	% by travel region	Local expenditures** (millions $)	% of expenditures local
Willamette Valley	$14.4	$12.3	$26.7	14%	$17.6	66%
North Coast	$9.1	$8.9	$18.0	9%	$3.0	17%
Central Coast	$12.0	$8.1	$20.1	10%	$3.9	19%
South Coast	$6.3	$2.7	$9.0	5%	$2.6	29%
Portland Metro/Columbia	$8.9	$9.2	$18.1	9%	$16.6	92%
Southern	$16.8	$11.5	$28.3	14%	$11.3	40%
Central	$25.8	$9.6	$35.4	18%	$7.3	21%
Eastern	$20.6	$7.0	$27.6	14%	$6.1	22%
Mt. Hood/Gorge	$6.9	$5.4	$12.3	6%	$6.0	49%
State	**$120.8**	**$74.8**	**$195.6**	**100%**	**$74.3**	**38%**

Note: Resident and nonresident expenditures associated with freshwater fishing in Oregon.
* Travel-generated expenditures associated with overnight and day trips 50+ miles (one-way).
** Local recreation expenditures associated with trips under 50 miles.
Source: Dean Runyan Associates (2009)

These travel-generated expenditures were spread throughout the regional state economy and occurred in many different sectors, see Figure 7. However, recreationists not only spend money in the categories displayed below, they also make expenditures on durable goods, such as boats. Expenditures on durable goods are not included in these travel-generated expenditures.

Figure 7. Travel-generated freshwater fishing expenditures, 2008



Source: Based on Dean Runyan Associates, 2009

The Dean Runyan Associates (2009) study also details recreational expenditures at the county level, see Table 8. In Coos County, wildlife viewing generated the largest amount of total travel-generated expenditures (42%) followed by fishing (37%). Fishing, however, brought in more local recreation expenditures, 41% and 27% of total county recreation expenditures respectively. In total, recreationists in Coos County spent a total of $33.5 million in 2008, $6.2 million of which was local recreation.

Table 8. Expenditures by activity for Coos County, 2008 (thousands $)

Expenditures	Shellfishing	Fishing	Hunting	Wildlife Viewing	Combined Activities
Travel-Generated	**$4,552**	**$12,253**	**$2,535**	**$14,111**	**$33,452**
Local Recreation	**$1,081**	**$2,551**	**$905**	**$1,637**	**$6,175**

Source: Dean Runyan Associates (2009)

Table 9 details overnight, day, local, and total travel-generated expenditures made in Coos County in 2008 specifically for freshwater fishing. In total, freshwater fishing travel-generated expenditures were estimated at $4.5 million in 2008, 41% of which was associated with trips less than 50 miles in duration.

Table 9. Expenditures for freshwater fishing in Coos county, 2008 (thousands $)

Travel-generated expenditures*			Local recreation expenditures** (millions $)**
Overnight	**Day**	**Total**	
$2,714	**$1,842**	**$4,555**	**$1,885**

Source: Dean Runyan Associates (2009

* Travel-generated expenditures associated with overnight and day trips 50+ miles (one-way). ** Local recreation expenditures associated with trips under 50 miles.

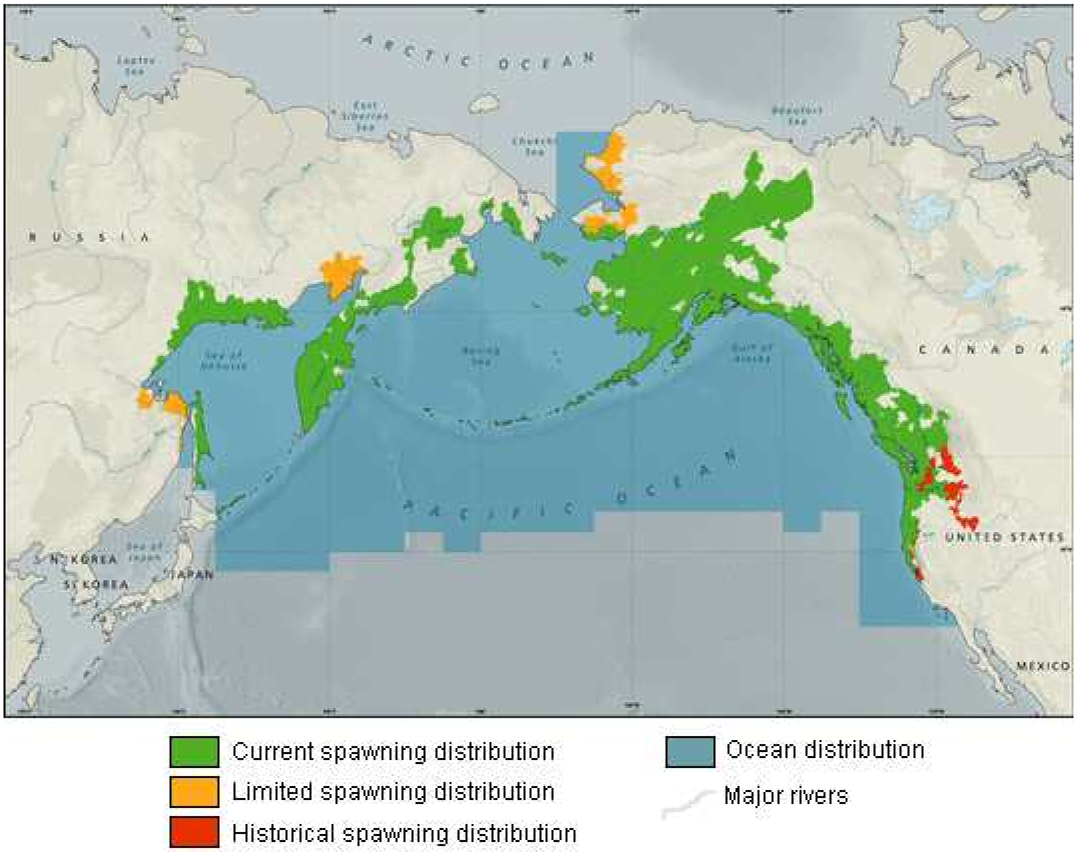
3. RESTORATION BENEFITS RELATED TO SALMON FISHERIES

In the previous section, we examined the potential economic impacts from expenditures on the CCCRP activities. However, there are other foreseeable benefits to this restoration. As the wetlands are restored, fisheries will be enhanced, likely resulting in larger recreational and, perhaps someday, commercial fisheries from which local communities can benefit. In this section, we examine the potential economic benefits of an enhanced Coho salmon fishery on the Coquille River.

3.1. Coquille Coho Fishery

Coho salmon (Oncorhynchus kisutch) is a species of anadromous fish in the salmon family. Coho salmon are native to the North Pacific Ocean, and throughout their lives range from eastern Russian and northern Japan to western Canada and the western United States, see Figure 8.

Figure 8. Coho salmon distribution



Source: Augerot and Foley (2005)

Oregon is on the southern range of current Coho spawning distribution. Scientists have identified wild Coho populations in Oregon coastal rivers, comprising a group of fish known as Oregon Coastal Natural Coho (OCNs), most of which originate in waters from the Coquille River north to the Nehalem River (ODFW, 2011a). Oregon Coastal Natural Coho are distributed between 21 independent populations. The Coquille Coho population is one of these sub-groups.

Even though OCNs are one of the largest remaining aggregates of wild Coho populations in the United States outside of Alaska, achieving desired spawning goals has been a problem in the last decade. Coho salmon have been under close scientific inspection and strict harvest management for years. Efforts to protect these wild populations have been the driver affecting ocean fishing seasons the last three years, and bay and river sport fisheries since 1993.

Scientists have identified habitat loss, poor ocean conditions, low summer water flows, blocked upstream passage, harvest, hatchery release, and changed ocean conditions as the major limiting population factors. One complicating factor is that much of Coho habitat (90%) is located on private lands (ODFW, 2007). Coho are highly specialized, and occupy habitat somewhat distinct from other salmon species. According to the Oregon Department of Fish and Wildlife (OFDW), Coho prefer:

- Small, low-gradient tributary streams for spawning and juvenile rearing
- Pea to orange-size spawning gravel
- Over-winter primarily in off-channel alcoves and beaver ponds, where available.
- Prefer complex instream structure (primarily large and small woody debris) and shaded streams with tree-lined banks for rearing.

In 1997, the Oregon Department of Fish and Wildlife (ODFW) adopted a comprehensive harvest management plan called the Oregon Coast Coho Management Plan (OCSRI, 1997), which reduced cumulative harvests in ocean and fresh water fisheries. The Pacific Fisheries Management Council (PFMC) then adopted the Oregon plan to guide ocean Coho management.[10] The original management plan allowed for the eventual creation of terminal fisheries on known, healthy runs of Coho salmon.

In 2005, the state of Oregon conducted a viability analysis of the entire Coho Evolutionary Significant Unit (ESU) and determined the ESU to be viable. Viable means that the population is likely to persist into the foreseeable future. Viable, however, does not imply that adult populations are sufficient to generate economic, social, and cultural values. The state also found the Coquille Coho population to be viable, but with adult populations insufficiently abundant to meet the goals of the Oregon Plan. What has followed has been years of contentious debate over the appropriateness of listing the Oregon Coast Coho ESU as endangered under the federal Endangered Species Act (ESA) (ODFW, 2007). As of June 2011, NOAA announced that Oregon Coast Coho would retain its current listed status under the ESA.

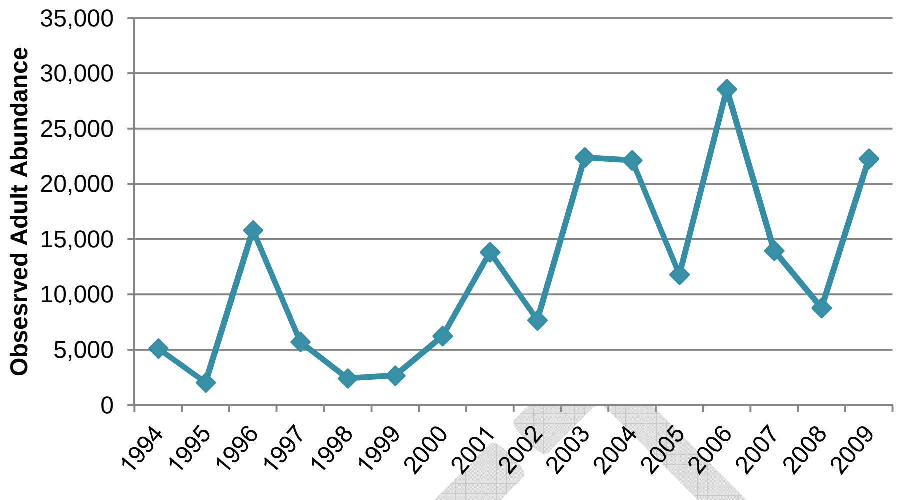
In 2007, Oregon created the Oregon Coast Coho Conservation Plan (Conservation Plan). It outlines a mixture of private and public initiatives to protect and restore habitat for the benefit of the Oregon Coast Coho ESU. Its goal is to achieve an average spawner return to the ESU of at least 100,000, in years of extremely low marine survival, and as many as 800,000 or more, during years of high marine survival. A return of 100,000 spawners would be more than twice the amount observed over the period 1993–1996. A return of 800,000 would be 3–4 times more than those that returned over the period 2002–2003. The Conservation Plan recognizes that these are ambitious goals, "unlikely to be achieved in the near term" (ODFW, 2007, p. 7). It cites a 50-year timeframe as more realistic for achieving the desired goals.

In 2009, Oregon ODFW created a Fisheries Management and Evaluation Plan to allow for limited recreational terminal fisheries of wild Coho in coastal rivers, including the Coquille. It specified a maximum harvest impact (freshwater and ocean) of 35%; actual harvest levels would be determined by population-specific and basin-specific details and vary from year to year based on conditions. As of 2011, the PFMC Review 10 (2011) states no more than a 15% exploitation rate for fresh and ocean waters combined.

Coho salmon have been fished along the Coquille River as far back as the Coquille Indians have lived there. By some estimates, the Coquille River may have supported a population as large as 400,000 adult Coho before 1908 (Coquille Indian Tribe, 2007). By the 1990s, however, population numbers dropped so significantly that the fisheries had to be closed (Figure 9). Figure 9 details observed adult abundance of Coquille Coho from 1995-2009. The average estimated population over that period is 11,969, roughly 3% of the theoretical pre-1908 estimated population.

[10] Amendment 13 to the Pacific Salmon Plan (PFMC, 1999).

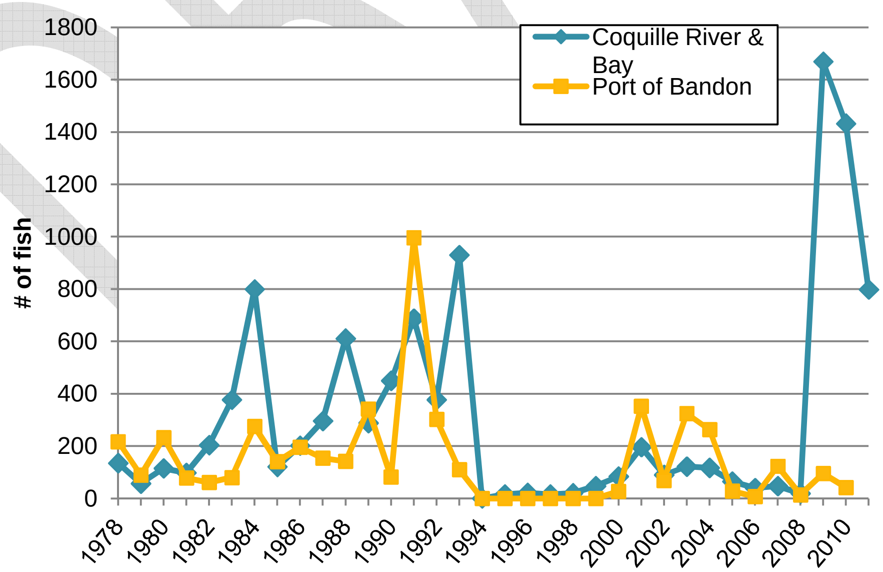
Figure 9. Coquille Coho Adult Abundance 1994-2009



Source: ODFW[11]

Figure 10 (below) details the sport catch of Coho on the Coquille river and bay and in Bandon from 1978-2011. The closure of the fisheries in the mid-1990s led to a drop in the total sport catch of Coho salmon in the Coquille River and in the ocean sport catch in nearby Bandon where the mouth of the river meets the sea (Figure 10). While the years 1995–2008 did record Coho catches, these catches likely involved stray fish from another basin or a wild Coho that was caught incidentally as an angler was targeting other species. While hatchery fish did likely comprise the majority of Coho caught during the wild fishery's closure, hatchery releases were stopped in the mid 2000s as returns were not enough to cover program costs (M. Gray, personal communication, January 13, 2012).[12] Currently, there are no Coho hatchery programs within the Coquille.

Figure 10. Sport catch of Coho salmon in the Coquille River and in Bandon, 1978–2010



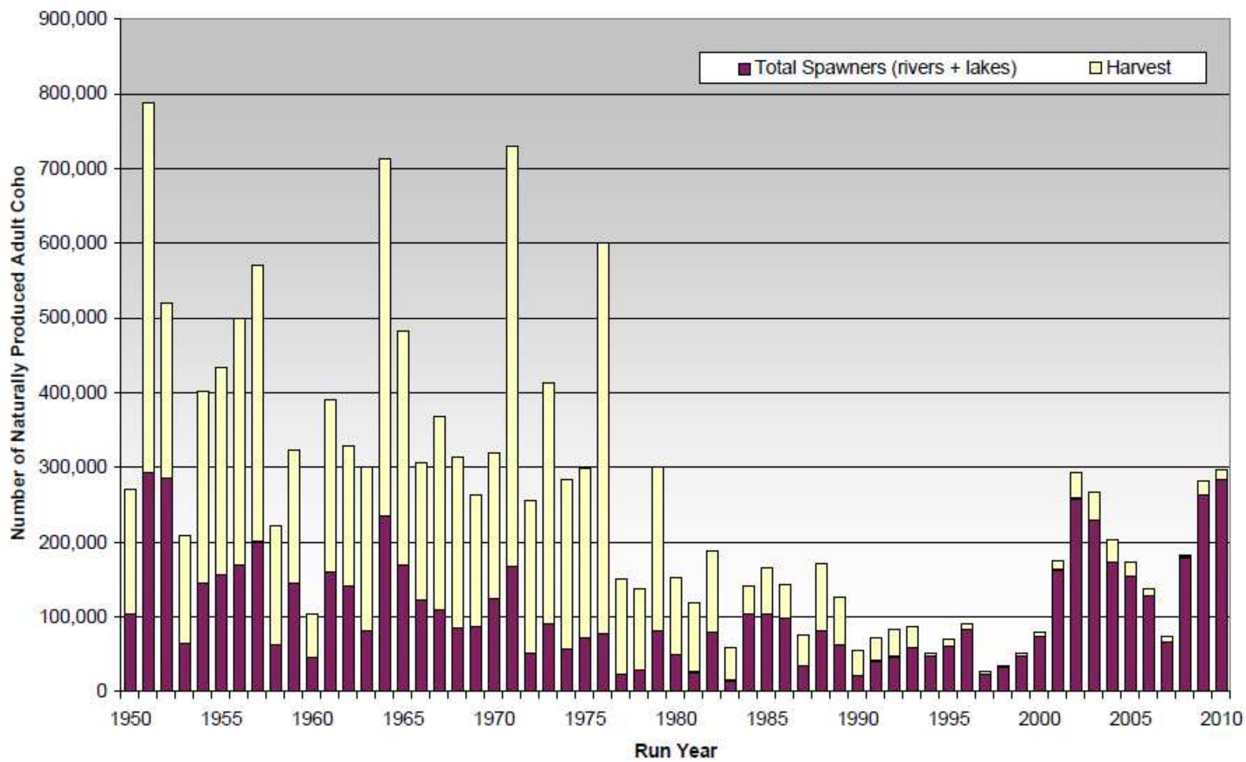
Source: ODFW (2011b)

[11] Source: Abundance data download for Coho ESU at http://odfwrecoverytracker.org/. Accessed March 2012.
[12] Personal communication with Michael Gray, ODFW, January 13, 2012.

In 2009, a wild Coho terminal fishery was opened on the Coquille. As a result, an estimated 1,669 and 1,432 Coho were harvested in 2009 and 2010 respectively (Figure 10). A preliminary estimate of 798 sport-caught Coho on the Coquille River is available for the 2011 harvest.[13] Although the 2009 and 2010 harvests exceeded historic Coho sport catches in the Coquille, the estimated harvest in 2011 is actually slightly lower than that recorded in 1993 (Figure 10).

Figure 11 (below) displays the estimated spawner population and harvested amount for Oregon Coast Coho ESU for the years 1950–2010. Again, the precipitous decline in total numbers is evident until the 1990s, when the population stabilized, in part due to harvest restrictions. Most notable about Figure 11 is the harvest rate – usually more than 50% of the total spawning population until the mid 1990s. More recently, the actual fishery harvest rate has been closer to 5–6% of the total population.[14]

Figure 11. Number of adult Oregon Coast Coho ESU spawning in the wild, and harvest impacts, 1950–2010



Source: ODFW, 2010

At the time of this study, the Coho fishery on the Coquille is predicted to be open for 2012, though fishery managers have the ability to close it at any time. As of January 2012, ODFW regulations in the Southwest Zone, under which the Coquille river is managed, in an open season allow for: two adult salmon or steelhead per day, 20 per year; five jack salmon per day, two daily jack limits in possession. However, at this time the salmon and steelhead fishery is listed as closed in all waters unless noted by special regulations. Currently, there is an exception that allows harvest of adipose-finclipped (hatchery) Coho salmon in water bodies with a currently open Chinook or steelhead season. In other words, anglers are able to harvest a hatchery Coho if they are participating in a special open Chinook or steelhead season and happen to catch a marked Coho. In the case of the Coquille, such a Coho would like be a stray from another basin since managers no longer release marked Coho smolts in that river.

Wild, unmarked Coho may only be harvested if the regional fishery is approved by NOAA Fisheries and the Oregon Fish and Wildlife Commission for the upcoming season. Following research, quota

[13] Personal communication with Michael Gray, ODFW, January 13, 2012.
[14] Personal communication with Michael Gray, ODFW, January 13, 2012.

development, and proposal submittal, an open season is typically approved by the end of summer just before the season opening in September. The season will run until December or until the established quota is met. Because this process is time sensitive, wild Coho regulations are usually established as Temporary Rules.

3.2. Salmon Production Potential of Restored Wetlands in the Coquille Valley

The Nature Conservancy commissioned a study to determine the Coho population response to CCCRP activities. The study by Nickelson (2011) estimates that the CCCRP can produce, on average, 11-14 adult Coho salmon per acre of restored wetland annually, or possibly as many as 18- 23 in years with good ocean conditions and high marine survival rates (Nickelson, 2011). These estimates were derived using two approaches: 1) a literature review; and 2) a close examination of historical abundance.

Nickelson's literature review covered fifteen papers with data on densities of Coho salmon smolts in floodplain habitats (see Table 1, Nickelson, 2011). Smolts are young salmon, silvery in color, which will migrate to the sea for the first time to develop into mature salmon. The literature generally reported that larger areas yield more fish, but the density of fish declines. For his actual analysis, Nickelson (2011) utilized data from four papers that covered areas of comparable size to the proposed CCCRP plans. The results of his analysis found an average smolt density of 230 smolts/acres.

In the historical abundance approach, Nickelson (2011) reviewed historical land survey notes estimating number of wetland acres in the 1850s and in 2006. Pairing this data with population estimates of Coho salmon population from studies based on cannery records, Nickelson (2011) produced trends in estimated abundance of adult Coho salmon from the Coquille River. His analysis assumed that the decrease in available wetlands was slow over the first half century, then increased with improved technology; 50% of the historical wetland acreage was available in late 1880s and only 25% after 1908. Based on this assumption, he projected a smolt production rate of 180–230 smolts/acre.

Nickelson then examined marine survival rates over the period 2001–2010. Survival rates ranged from 1.9%–10.0%. The average survival rate over the period was 6.1%. Nickelson estimated an average production rate of 11–14 adults per acre per year based on the average survival rate, or as many as 18–23 adults per acre per year based on the highest survival rate, 10%. Based on Nickelson's projections, a restored wetland area of 300 acres can produce as many as 3,300–4,200 adults annually (average survival rate), or 5,400–6,900 adults annually (10% harvest rate) (Table 10).

Table 10. Projected annual adult salmon response from CCCRP

	Smolts per acre		**Adults per acre (6.1% survival rate)**		**Adults per acre (10% survival rate)**	
	Low	**High**	**Low**	**High**	**Low**	**High**
	180	230	11	14	18	23
Total @ 300 acres	**54,000**	**41,400**	**3,300**	**4,200**	**5,400**	**6,900**

The contribution of CCCRP wetlands restoration to in-river or ocean fisheries depends on allowable harvest rates. Nickelson assumes a 10% freshwater harvest rate and determines that an acre of restored wetland can contribute 1.2–1.4 adult Coho salmon to the recreational in-river sport fishery each year. Assuming a cumulative (marine and freshwater) harvest rate of 20–35%, and 10% freshwater harvest rate, he estimates an acre of restored wetlands can contribute 1.1–3.5 Coho salmon for ocean harvest each year. A 300 acre wetland restoration project, therefore, could return 330–420 adult salmon to the in-river fishery and 330–1,050 to the ocean fishery yearly (Table 11).

Table 11. Yearly restoration contributions to fisheries

		Harvest rate	# fish contributed to fishery (300 acre restoration area): Low adult response (3300)	High adult response (4200)
Nickelson	In-river	10%	330	420
	Ocean	10–25%	330–825	420–1,050
PFMC	In-river	5%	165	210
	Ocean	10%	330	420
Historic	Cumulative	50%	1,650	2,100

Nickelson's (2011) assumptions regarding harvest rates, however, may be too optimistic, at least in the near term. Nickelson assumes a 20–35% cumulative harvest rate for freshwater and marine fisheries; however the PFMC Review 10 (2011) states no more than a 15% exploitation rate for fresh and ocean waters combined. Personal communication with district fish biologist Michael Gray at ODFW finds that in-river harvest rates have been closer to 5–6% in recent years, below the 10% in-river harvest rate that is allowable. For comparison purposes, we estimate the likely contribution to in-river and ocean fisheries using a 15% cumulative harvest rate in Table 11**.**

Successful restoration efforts targeted for any one of the 21 independent populations of Oregon Coast Coho, such as the Coquille Coho, likely cannot change conditions sufficiently for the entire ESU to warrant delisting under the ESA, or to change harvest rates significantly in the near term. But efforts such as those planned for the Coquille watershed are now being encouraged and supported throughout the wild Coho coastal range. Should they be successful and levels approximating historical abundance eventually return, higher harvest rates could be sustained in the future. Historically, the ESU supported harvest rates of 50% of more (Figure 10). For comparison purposes, we include the estimated contribution of restoration to cumulative fisheries if harvest rates equaled 50%. Recent proposed changes to the management matrix and NOAA's recent decision to list Pacific Coast Coho under the ESA, complicate matters sufficiently to preclude a more definitive assessment of changes to in-river and ocean harvest rates resulting from successful restoration efforts.

3.3. Economic Value of Salmon

Restored salmon populations generate value in multiple ways; commercial and recreational fishing opportunities are amongst some of the most commonly cited in the literature. Increased commercial fishing opportunities create income for fishermen and those who work in related industries. Similarly, increased recreational fishing opportunities support local businesses and industries. When recreational or commercial anglers spend money on fishing supplies, food, and lodging, those dollars circulate throughout the local and regional economy through the multiplier effect.[15] Those expenditures create jobs and income for local residents, who in turn spend their income at other local businesses. In this way, an increase in commercial or recreational fishing opportunities can support jobs and income growth in local and regional economies.

Table 12 presents some of the more widely cited estimates of regional economic impact of *commercially* caught salmon in Oregon per fish, adjusted to 2010 dollars. Radtke & Davis (1995) and Independent Economic Analysis Board (EAB) (2005) derived these estimates by applying appropriate economic multipliers to ex-vessel prices per pound of salmon. Helvoigt and Charlton (2009) base their estimate on their review of the literature, which included studies based on other locations in the Northwest beyond Oregon, as well as Chinook and Steelhead.[16]

[15] The multiplier effect is described in Section 2 of this report.
[16] It is interesting to note that studies that estimate the dollar impact per Chinook caught off the Oregon Coast tend to be much higher. The larger the fishery, the more individuals and

Table 12. Economic impact per commercial-caught salmon

Study	Location	Species	Per Fish Economic Impact ($2010)
Radtke & Davis, 1995	Oregon Coast	Coho	$14.35
IEAB, 2005	Oregon Coast	Coho	$22.45
Helvoigt and Charlton, 2009	Rogue River	Coho	$19.99

Recreational fishing also impacts local and regional economies through the multiplier effect (Helvoigt and Charlton, 2009). An economic impact analysis of an improved salmon run due to restoration efforts begins with a projection of the increase in regional angling activity and expenditures resulting from restoration initiatives.[17] The economic impact is then determined by multiplying the expenditures by the appropriate economic multipliers. Reading (2005) estimated the total economic impact of restored salmon and steelhead fisheries in Idaho to be $544 million annually using this approach.

In this study, economic impact from restored fisheries measures the total output produced in the region that can be attributed directly or indirectly to the increase in demand for goods and services and the resultant rise in income. Reading (2005) has been criticized for over-estimating the regional economic impacts from restored salmon fisheries.[18] In contrast, IEAB (2005) estimates the total economic contribution of salmon and steelhead originating in the Columbia River basin to the entire Northwest and Canada to be $140 million in personal income annually.

Personal income and economic output are two distinct measures of economic impact and are not generally comparable. Personal income is typically only a fraction of the total economic output produced, as the revenues, salaries, wages, and dividends associated with that economic output may accrue to entities outside of the region. For example, expenditures on gasoline to power boats or to drive to recreational fishing sites benefit oil companies and oil exporting countries well beyond the region. The multipliers used to generate personal income are different than those used to estimate total economic output, though both methods are trying to capture the ripple effects of angler expenditures on local and regional economies. These two approaches to capturing economic impact are validated by the literature, but are not comparable and should not be confused.

A recent study by Thomson and Speir (2011) estimates economic output from increased abundance of salmon in the Klamath subbasin following proposed dam removal. Their analysis estimated average expenditures per recreational angler day by non-residents for lodging, fuel, gasoline and transport to and from fishing site, gear, boat fuel, and outfitter fees to be $101 ($2010) per angler day.[19] This is a reasonable approximation for in-river recreational salmon angling expenditures by non-residents elsewhere in Oregon, including the Coquille.[20]

To estimate the resulting economic impact, we apply multipliers found in the literature. Thomson and Speir (2011) use a regional economic impact multiplier of 1.21, which means that every $1.00 in recreational angling expenditures generates $1.21 in total regional economic output. Reading (2005) uses larger multipliers in his analysis: $2.71 for in-river fishing communities and $2.78 for the whole state.[21] If we apply these multipliers to an average expenditure of $101 per angler day, we find that each additional angler day has the potential to contribute $122.21–$273.71 in economic output.

[17] Unlike commercial fishing, where price per pound serves as a good proxy for value to the fishermen, the value of fish in recreational fisheries is more difficult to measure. Expenditures are one approach.
[18] IEAB (2005) finds Reading's (2005) estimates of angler trips from restored populations to be over-stated.
[19] Their estimate is based on a 2004 economic survey of recreational angler expenditures conducted by the National Marine Fisheries Service. We converted the estimate to 2010 dollars.
[20] An angler day is typically one fisherman fishing at one site for any amount of time on a given day. In this analysis, they convert harvest to angler days by a conversion factor of 3.95, defined as the ratio of angler days to salmon harvest over the period 2001–2004.
[21] The multiplier effect increases with the scale of the economy considered. Local multiplier effects are smaller than state level multiplier effect and so forth.

Table 13. Potential economic output per recreational salmon angler day

Study	Direct expenditure per angler day	Economic multiplier	Total output per angler day
Thomson and Speir, 2011	$101	1.21	$122
Reading, 2005	$101	2.71	$274

Table 14. Potential economic output per recreational salmon

Study	Direct expenditure per fish	Economic multiplier	Total output per fish
Thomson and Speir, 2011	$399	1.21	$483
Reading, 2005	$399	2.71	$1081

Similarly, we can convert Thomson and Speir's estimate of expenditures per angler day to expenditure per salmon, assuming that it takes 3.95 angler days to catch a salmon. This generates an estimate of potential economic output from each salmon available to the in-river fishery of $483–$1081 per fish.[22]

Economic output is only one way, and not necessarily the best way, to capture the value of restoring robust Coho populations to the Coquille River. The amount of money recreational anglers actually spend to participate in their activity is only one component of the value of recreational fishing. Recreational anglers derive value from their activities above and beyond what is captured by their expenditures. Unlike commercial anglers who fish to sustain an income and livelihood, recreational anglers primarily fish because they derive pleasure and benefit from it. Measuring these benefits is difficult, as there are no markets to directly observe how much these anglers are willing to pay to obtain these benefits. Expenditures capture how much they have to pay; not how much they might be willing to pay. Economists call the difference between what an angler actually pays and what he/she is willing to pay 'consumer surplus'. It is a measure of the benefit to the angler of participating in the activity above and beyond what he/she must pay for it. An increase in consumer surplus, therefore, increases the angler's well-being. It is, perhaps. the truest indicator of actual economic value from recreational fishing, though it is difficult to estimate.

Economists use non-market valuation techniques to estimate the economic value of non-market goods, such as recreational fishing. Stated preference approaches, such as contingent valuation, directly ask individuals who benefit from ecosystem services how much they might be willing to pay for a change in site quality or a unit increase in the availability of fish to be caught. It is called 'contingent valuation' because responses are contingent on the hypothetical scenarios constructed by the survey. The literature on contingent valuation methods (CVM) is expansive. The methods are widely accepted, though commonly known to be subject to framing, income, and other biases introduced through the survey design.

Alternatively, economists can elicit non-market values indirectly, through revealed preference approaches such as the travel cost method (TCM). In the travel cost method, distances traveled and associated costs are assumed to be indicative of the value of the ecosystem amenity to the user. Costs incurred to travel to recreational fishing sites are then used as surrogates for market prices. This provides theoretical points along a demand curve for recreational fishing, from which an economist can then estimate consumer surplus. The TCM works best in instances where users travel long distances, such as to national parks. This method will understate the value of recreational fisheries if anglers travel short distances to their preferred fishing sites.

[22] Converting expenditures per angler day to expenditures per fish likely results in an over-estimate as it assumes that all trip expenditures can be attributed to the amount of salmon caught.

Estimating non-market values requires primary data – data which is often difficult and costly to obtain. In instances when primary data is not available, benefits transfer can be used. A benefits transfer adapts research on non-market values to a different context (Thomson and Speir, 2011). Brouwer (2000) outlines the factors which determine the validity of benefits transfer to fisheries research. First, the primary studies must be based on sound empirical techniques and data. Second, the population of anglers must be similar. Third, fishery conditions should be similar (Thomson and Speir, 2011).

Thomson and Speir (2011) conduct a benefits transfer to estimate the value of recreational angling for salmon in the Klamath Basin. They review 8 studies (1 literature review, 3 travel cost studies, 1 random utility model, and 3 contingent valuation models) from 1984–1996 based on regions across Washington, Oregon, and Alaska (Appendix B). They report an average value in angler days of $66.74 per day. Using their conversion factor of 3.95 angler days per fish, and adjusting for 2010 dollars, we convert their estimate from angler days to fish and report the average value of a salmon as $255.56.

Helvoigt and Charlton (2009) reviewed 22 studies conducted in the Northwest, including California and Idaho, from 1983–1992 to estimate the value of salmon to recreational anglers. Twelve of these studies, however, were based on steelhead, rather than Coho or Chinook salmon. Not surprisingly, the studies they reviewed varied in results depending on location and methods. Base on their review of the literature, Helvoigt and Charlton (2009) determine the annual willingness to pay for sport-caught Coho in the Rogue River to be $165.16 ($2010). For recreational ocean fisheries, they estimate an annual willingness to pay of $67.33 ($2010).

If we exclude from Helvoigt and Charlton's literature review the studies they had included from California and Alaska, as well as studies that targeted steelhead, the average economic value based on willingness to pay for a sport-caught salmon from the remaining 8 estimates averages $96.52 (Table 15).

Table 15. Estimates of economic value of sport-caught salmon, various studies

Study	Location	Species	Method	WTP per fish ($2010)	WTP per fish ($2007)
Olsen and Richards, 1992	Rogue River	Fall Chinook	TCM	$109.03	$103.64
Meyer et al., 1983	Rogue River	Fall Chinook	TCM	$60.01	$57.04
Meyer et al., 1983	Columbia River	Salmon	TCM	$210.64	$200.23
Olsen et al., 1990	Columbia River	Salmon	CVM	$73.46	$69.83
Olsen et al., 1990	Washington Ocean	Salmon	CVM	$66.91	$63.60
Olsen et al., 1990	Washington Freshwater	Salmon	CVM	$59.05	$56.13
			Average	**$96.52**	**$91.75**

Source: Authors' compilation from Helvoigt and Charlton 2009

We can conclude that the literature cites a range of salmon values in recreational fisheries. To reflect the inherent uncertainty in all of these estimates, we present a range of low, medium, and high values in Table 15. We will use the middle estimate, $165.16 to estimate the value of sport-caught salmon in the Coquille. We believe that this is a reasonable estimate based on the range of findings in the literature.

Table 16. Economic value of sport-caught salmon ($2010)

Low	Medium	High
$96.52 (Authors)	$165.16 (Helvoigt and Charlton, 2009)	$255.56 (Thomson and Speir, 2011)

3.4. Economic Value of Salmon Over Time

The CCCRP is an investment in wetlands restoration that can deliver a stream of benefits over time. The costs to restore wetlands near China Camp Creek will be incurred in the near-term. Once over-wintering habitat is restored, it is assumed that the Coquille can support a healthy Coho population years into the future (assuming no other changes in habitat or ocean conditions that affect Coho survival). The question remains: how quickly will the Coho population respond to restoration efforts? The timing of those benefits may influence considerations about the desirability of upfront investments in restoration today.

Reconnecting river and stream channels can be completed in a relatively short time frame; revegetation of stream beds can take years to mature to full effect. The use of the wetland will also be dependent on the ability of fish to find it, which in turn is a function of factors affecting juvenile abundance. The response rate of adult salmon populations to restoration efforts, therefore, is based on a range of assumptions. Previous studies have documented quick salmon response rates to habitat restoration (Solazzi et al., 2000; Crombie, 1995).

We assume that the restoration efforts proposed in the CCCRP in year one will produce the average adult salmon response and average annual contribution to the in-river fishery (330-420 adult salmon according to Nickelson 2011) by year two and every year thereafter over the 20 year span of the project. We then estimate the present discounted value of CCCRP contributions to the in-river recreational fishery over 20 years[23]. We do this calculation for the two distinct estimates of recreational salmon value we described above: $483 per fish (expenditure approach) $165.16 per fish (willingness to pay approach). We multiply these values by the total expected annual contribution to the in-river fishery (330–420 adult salmon) and estimate the present discounted value of those contributions over a 20 year time period using a 3% discount rate (Table 17).

Table 17. Present discounted value of CCCRP contributions to the in-river fishery

	Year 1 (thousands $)	Total over 20 years (3% discount rate) (thousands $)
WTP approach	$54.5–$69.4	$865–$1,101.3
Expenditure approach	$159.4–$202.9	$2,530.7–$3,220.9

Source: authors' calculations

4. ADDITIONAL BENEFITS OF SALMON RESTORATION

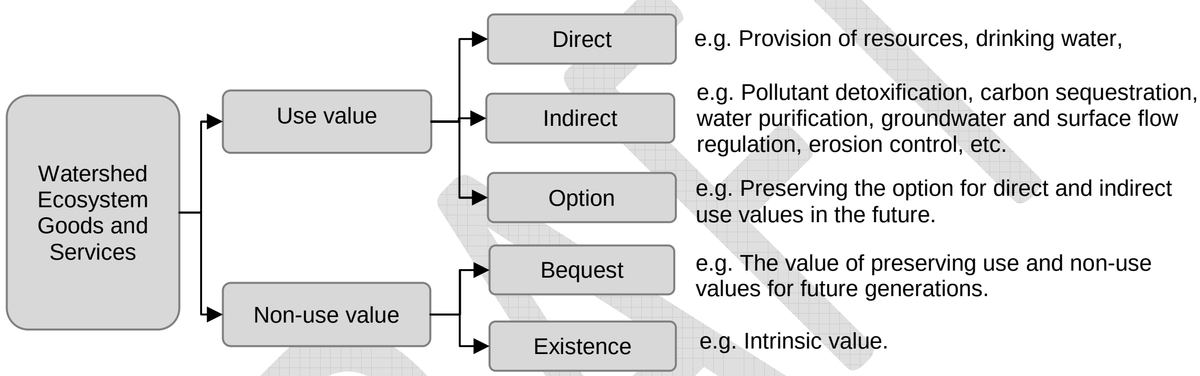
A critical assessment of the value of CCCRP restoration would not be complete without consideration of the other benefits that accompany improved ecosystem function. Habitat improvements also provide ecosystem goods and services that are fundamental to human health, economic productivity, and quality of life. In this section, we briefly discuss some of the additional benefits of restoration activities in Oregon using results from the existing literature.

As originally outlined by Daily (1997), watershed ecosystems supply a vast array of vital ecosystem goods and services which provide direct and indirect support of local economies. In economics, total economic value includes all of the values that contribute to people's utility, well-being, and satisfaction - whether or not those values are paid for or are derived through direct or indirect consumption. The total economic value of ecosystem goods and services, therefore, includes direct use, indirect use, and existence values

[23] Present discounted value is the value today of a future stream of payments or benefits. Future benefits are discounted using a discount rate based on the notion that a dollar today is worth more than a dollar in the future. We assumed a 3% discount rate in this analysis, consistent with benefit-cost analyses over a comparable time-frame.

that are either market or non-market in nature (Figure 12). Direct use values derive from the direct and deliberate consumption of ecosystem services; for example, fishing is an activity that generates direct use value to participants. Indirect use values refer to the benefits we obtain from healthy ecosystems irrespective of whether we choose to consume them or not. Water purification benefits that derive from healthy watersheds are a good example. People also value the option to maintain direct and indirect use values for future benefit. Protecting watersheds today to avoid future investments in costly infrastructure to deliver clean water services is an example of option value. Existence value captures the intrinsic value of ecosystem services and amenities to people who may never benefit from them directly or indirectly. A contribution to salmon restoration efforts by residents who live outside of salmon nation reflects their measure of salmon's existence value. Finally, bequest value reflects the value of preserving use and non-use values for future generations.

Figure 12. Total economic value of ecosystem goods and services

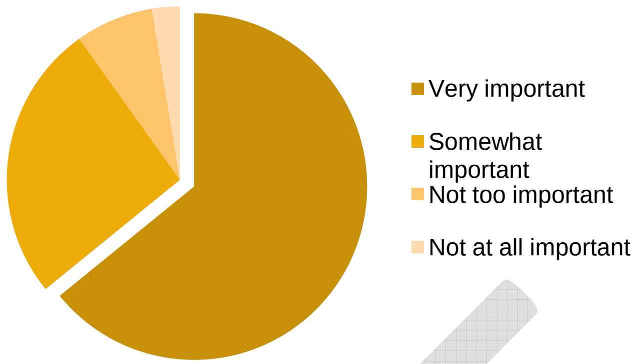


In section 3, we presented some measures of the value of restoring salmon populations to recreational users. In Oregon, however, some of the most significant values attached to salmon restoration may be social and cultural. Many Oregonians value healthy, abundant salmon populations. The Biennial Oregon Population Survey, completed for the final time in 2008, asked respondents about their willingness to pay to improve salmon runs. The survey asked Oregonians two salmon specific questions to discern the value of restoring healthy salmon populations to the region:

1. "How important do you feel it is to improve salmon runs in Oregon?"; and
2. "How much per month would you be willing to pay for water quality and habitat improvement efforts to help improve salmon runs in Oregon?" (Oregon Progress Board, 2009).

In 2008, over 90% of respondents felt improving salmon runs in Oregon was 'somewhat' to 'very important', two thirds of Oregonians responded 'very important', see Figure 13.

Figure 13. "How important do you feel it is to improve salmon runs in Oregon?"



Source: Based on Oregon Progress Board (2009) data for the year 2008

Helvoigt and Charlton (2009) analyzed the willingness to pay data collected from an earlier Oregon Population Survey in 2006. They estimated Oregonians were willing to pay $75,958,977 (2008 dollars) annually to improve salmon runs. This is just one important indicator of the economic value of restoring wetlands that provide habitat for Oregon salmon populations.

5. CONCLUSION

To the extent that most ecosystem values are not readily traded in markets with prices that can be observed and cash flows that can be counted, it is difficult to measure the total value of the myriad of ecosystem values that accrue to conservation and restoration efforts. The inability to measure all of these values complicates, and often distorts, decision making around natural resource management. The conversion of habitat to agricultural production, or the damming of rivers for electricity, generates market goods and services with attendant cash flows that can be counted. Unless some effort is made to quantify ecosystem service values, a straightforward calculus of benefits and costs most often favors development over conservation or restoration. Demonstrating the dollar value of at least some ecosystem services, however, often makes a compelling economic case for restoration.

In this analysis, we have examined different measures of the potential benefits of restoring wild salmon habitat in the lower Coquille. They are not comparable or additive; they measure different ways of conceiving of the value created through salmon restoration efforts. Nevertheless, they present a compelling case for the economic importance of restoring abundant salmon populations in the Coquille. Given the range of potential values we have measured, and those we know to exist that are not readily measured in dollar terms, the initial investment in wetlands restoration through the CCCRP makes good economic sense.

We began by estimating total project expenditures of the CCCRP based on our review of restoration projects of similar size and scope in Oregon. We estimated likely project expenditures to range from $3,181–$4,784 per acre, or $1.1–$1.7 million total for 300 acres. Expenditures on restoration create demand for local labor and supplies, thereby stimulating economic activity directly and indirectly through the multiplier effect. We estimated that restoration activities in the lower Coquille could generate $2.6–$3.4 million dollars in economic output in the near term and 18-25 direct, indirect and induced jobs in the regional economy.

A key reason for investing in wetlands restoration in the lower Coquille is to restore wild Coho populations to abundance and create economic opportunities through expanded recreational, and perhaps someday commercial, Coho fisheries. We discussed two approaches to estimating the economic benefits associated with improvements in Coho fisheries. The first approach uses data on recreational angler expenditures to determine the direct and indirect economic effects of recreational fishing opportunities. Based on our review of the literature, we found that recreational salmon anglers in Oregon may spend

$101 per angler day, or $399 per salmon , on average[24]. The literature also finds that every $1.00 in recreational salmon angling expenditure can generate $1.21 in total regional economic output. Therefore, each additional salmon added to the in-river recreational fishery in the Coquille may be worth $483 in regional economic activity. Over a 20 year time period, the present discounted value of the contributions of the CCCRP to the in-river recreational fishery may be as high as $2.5–$3.2 million dollars. This assumes that the recreational in-river fishery remains open and regulations continue to allow for fishing opportunities.

Alternatively, we report the value of sport caught recreational salmon at $165.16 per fish, based on a review of non-market valuation studies in the literature. Note, this is a fundamentally different approach to estimating the value of salmon and the results cannot be compared, or added, to those produced from an expenditure-based approach. At $165.16 per fish, the CCCRP can contribute $.86–$1.1 million dollars in present discounted value to the recreational fishery over 20years.

These estimates capture only a portion of the total potential value of the CCCRP. They do not reflect the myriad of other ecosystem benefits created through restoration investments. Nor do these estimates reflect values for the larger population. Wild salmon and wild salmon habitats are important to many Oregonians, not only those who participate in recreational fisheries.

Watershed restoration is not simply a matter of restoring abundant wild salmon populations. It is about restoring and enhancing ecosystem function today and in the future. The dollars spent on restoration projects represent an investment in natural capital and communities that can pay out over the long term. Costs to restore watersheds will be incurred in the short run; but the benefits of restoring abundant salmon runs and improving ecosystem function will accrue over time. In Oregon, recreation - especially fishing - is big business. By investing in restoration, communities in the Coquille Valley can create new opportunities for employment and income around a more sustainable and resilient natural resource economy.

[24] Assumes a ratio of angler days to harvest of 3.95.

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APPENDIX A: Group 4: Coho Salmon + Ocean & Estuary Project Details

Year	Name	County	Subbasin	# of Acres	Total Cost	$/Acre	Restoration Activities	Species Benefited	How Chosen
1999	DSL #GA 8741	Clatsop	Lower Columbia	5	$3,927	$785	Wetland	Coho Salmon	Private landowner/ member of watershed council desired to restore/enhance 5 acres of Skipanon R Floodplain.
2000	Lint Slough-Alsea Bay Estuarine Restoration	Lincoln	Alsea	70	$101,853	$1,455	Wetland	Chinook Salmon, Coho Salmon, Cutthroat Trout, Steelhead	Estuarine Restoration Oregon Salmon Plan calls for restoration of 5000 acres of estuarine habitat statewide. Project as priority for ODFW Marine Region.
2003	Winchuck Estuary Restoration	Curry	Chetco	1	$7,525	$7,525	Wetland	Chinook Salmon, Coho Salmon, Cutthroat Trout, Steelhead	n/a
2003	Sealander Wetland Restoration	Coos	Coos	11	$54,760	$4,978	Wetland	Chinook Salmon, Coho Salmon	Wetland technical advisory committee; Coos Watershed Association projects committee
2003	Perrin Wetland Restoration	Coos	Coos	2	$23,426	$11,713	Combined	Chinook Salmon, Coho Salmon	Wetland Technical Advisory Committee; Coos Watershed Association Projects Committee.
2004	South Slough Salmon Rearing Habitat Enhancement	Coos	Coos	20	$35,015	$1,751	Wetland	Coho Salmon	Wetland technical advisory committee; South Slough National Estuarine Reserve Restoration Plan.
2005	Matson Creek Wetland Restoration	Coos	Coos	80	$341,238	$4,265	Wetland	Chinook Salmon, Coho Salmon	Wetlands Technical Advisory

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Year	Name	County	Subbasin	# of Acres	Total Cost	$/Acre	Restoration Activities	Species Benefited	How Chosen
2005	Cowan Wetland Restoration	Coos	Coos	6.1	$133,681	$21,915	Wetland	Coho Salmon	NRCS-WRP overseen by the Wetlands Technical Advisory Committee
2005	Lewis and Clark Dike Breach	Clatsop	Lower Columbia	12	$106,627	$8,886	Instream, Wetland	Bird species (other), Chinook Salmon, Coho Salmon	Project was chosen based on opportunity, project benefits and landowner support.
2004	Nix Debt Cancellation Conservation Easement	Coos	Coos	62	$224,064	$3,614	Wetland	Bird species (other), Chinook Salmon, Coho Salmon	NRCS
2004	Fredrickson Wetland Reserve Program Project	Coos	Coos	12	$33,338	$2,778	Wetland	Coho Salmon	NRCS Wetland Reserve Program and Coos/Coquille Wetlands Advisory committee
2007	Lowe Creek Channel & Wetlands Restoration at Boatman Grove	Coos	Coquille	90	$266,896	$2,966	Instream, Riparian, Wetland, Fish Passage	Chinook Salmon, Coho Salmon, Cutthroat Trout, Steelhead, Waterfowl	Property was identified by USFWS staff as having high restoration/conservation potential, and property purchase by Bandon Biota facilitated project work.
2008	Brunschmid WRP	Coos	Coos	13	$39,149	$3,011	Wetland, Instream, Riparian	Chinook Salmon, Coho Salmon, Cutthroat Trout	n/a
2009	Lint Slough Restoration Project	Lincoln	Alsea	130	$517,949	$3,984	Wetland	Chinook Salmon, Coho Salmon, Cutthroat Trout	This project was a continuation of the Lint Slough restoration project started in 1998.

Source: OWEB (2011)

APPENDIX B: Thomson and Speir (2011) Benefits Transfer: Value of Salmon to Recreational Anglers

Author	Study Year	Area	Estimation Method	Calculation Method	Number of Report Estimates	Average Reported Value $/day	Year$	Value $/day 2012$
Anderson	1993	Washington (Columbia R.)	Lit Review	From text	1	$59.82	1992	$96.19
Jones & Stokes	1987	Alaska (Multiple sites)	RUM	Divide reported CD by reported angler-days (freshwater, resident only)	7	$50.93	1986	$104.84
Layman, Boyce & Criddle	1996	Alaska (Gulkana R.)	TCM	Tables 6, 7	3	$23.86	1992	$38.37
Meyer et al.	1983	Oregon (statewide)	TCM	Foster Wheeler, Table 2.II.1, Part 2, Chapter II, Page 21	1	$70.13	1998	$97.07
Olsen et al.	1990	Oregon, Washington (statewide)	CVM	Foster Wheeler, Table 2.II.1, Part 2, Chapter II, Page 22	1	$41.16	1998	$56.96
Olsen et al.	1990	Oregon, Washington (Columbia R.)	CVM	Foster Wheeler, Table 2.II.1, Part 2, Chapter II, Page 23	1	$61.99	1998	$85.80
Olsen & Richards	1992	Oregon (Rogue R.)	CVM	Foster Wheeler, Table 2.II.1, Part 2, Chapter II, Page 24	1	$29.97	1998	$41.48
Riely	1984	Oregon, Washington (statewide)	TCM	Foster Wheeler, Table 2.II.1, Part 2, Chapter II, Page 25	1	$32.44	1998	$44.89
Average								**$66.74**

Source: Thomson and Speir (2011)

APPENDIX C: Coos County

In this section of the report we utilized the National Ocean Economic Program (NOEP) coastal economy database[25] to examine the current status, changes, and trends in Coos County, where the CCCRP is planned to occur.

The NOEP data on the coastal economy were derived from the Quarterly Census of Employment and Wages (QCEW) Program from the U.S. Bureau of Labor Statistics (http://www.bls.gove/cew). Economic statistics are grouped within the QCEW by a classification system known as the North American Industrial Classification System (NAICS). Developed in the 1990's as part of the North American Free Trade Agreement (NAFTA) this classification system provides a common basis for the United States, Canada, and Mexico to better measure their economy activity. Based on the NAICS the coastal economy includes eleven sectors, see Figure 14.

Definitions of the three economic indicators presented in the NOEP coastal economy database and this report, as well as associated considerations, are as follows:

1. **Gross Domestic Product (GDP):** GDP is the value of goods and services produces or provided. GDP is a measure of value-added, or sales, minus the cost of inputs. Using this measure eliminates 'double counting' within and across sectors.
2. **Wages:** Wages are the total wages and salaries paid as reported in the QCEW by each business establishment in the various sectors/industries.
3. **Employment:** Employment is defined as the number of jobs, not individuals, and does not distinguish between part-time and full-time or year-round and part-year jobs. The data in the NOEP database are annual average employment. Employment numbers are derived from the Quarterly Census of Employment and Wages (QCEW) which only includes wage and salary employment. This definition covers approximately 90% of employment in the U.S. However, this definition of employment excludes proprietors, farm workers, military, domestic workers, unpaid family or volunteer workers, and self-employment.

All values are expressed in constant dollars with 2010 as the base year. Wages and GDP are adjusted using the U.S. Consumer Price Index (CPI). All dollar values are estimated as direct values. Direct values are those activities associated only with the designated ocean sector/industry, such as labor and capital costs.

C.1. Socioeconomic Profile

Coos County is located in southwestern Oregon, and had 1.6% of the state's population at 63,043 people in 2010. In 2010, total GDP in Coos County was $1.7 billion dollars, total wages were $665.8 million dollars, total employment was 21,302 jobs, and the total number of establishments was 1,926.

Figure 14 displays the relative percentage of each industry's contribution to total county GDP and employment. The three industries with the highest percentage of total GDP in Coos County were public administration (20%), trade, transportation, and utilities (16%), and manufacturing (15%). By employment however, the top three industries were education and health services (28%), trade, transportation and utilities (21%), and leisure and hospitality (11%).

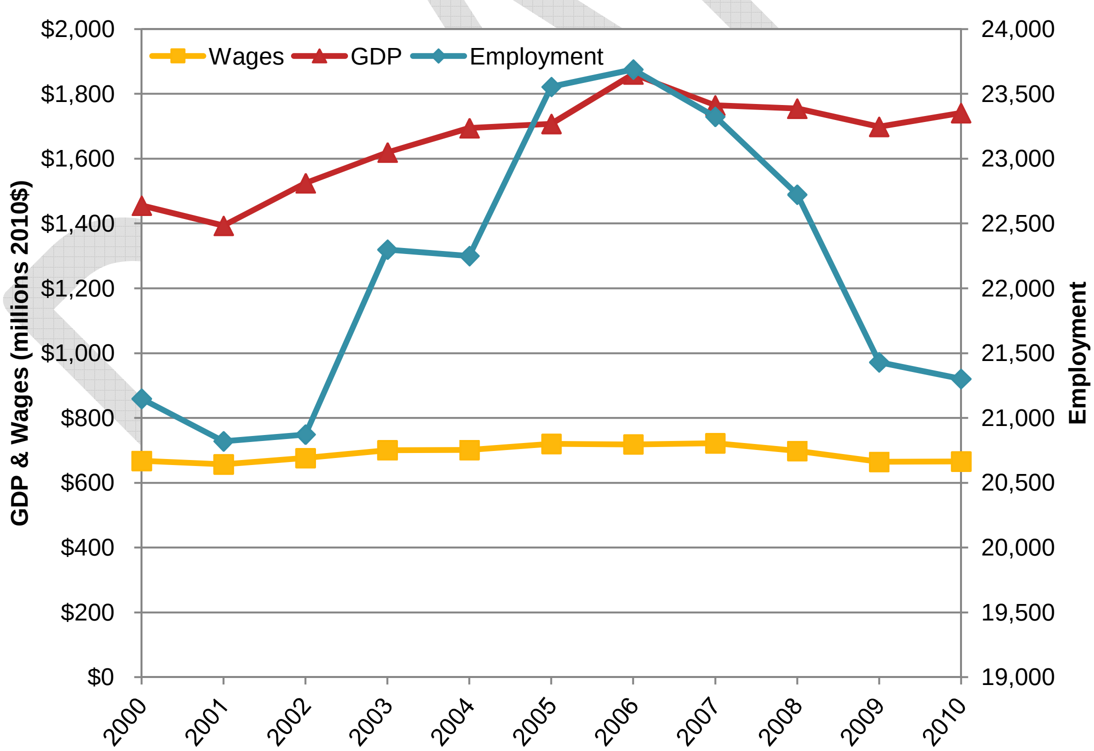
[25] Available online at http://www.oceaneconomics.org.

Figure 14. Coos County GDP and employment percentages by industry, 2010

Source: Data from the NOEP Coastal Economy Database

Figure 15 displays the trends in wages, GDP, and employment for Coos County from 2000–2010. GDP increased 19.6% while wages remained relatively stable. Employment numbers also remained relatively stable, though because they are plotted at a smaller scale in Figure 15 it does not appear so. From 2000–2010 employment grew by 0.7% overall, at a high of 23,688 in 2006 and a low of 20,821 in 2001.

Figure 15. Coos county wages, GDP, and employment, 2000–2010



Source: Data from the NOEP Coastal Economy Database