Supporting Salmon, Supporting Communities

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A degree project in partial fulfillment of the requirements for the degree of

Master of Public Administration

University of Washington

Daniel J. Evans School of Public Affairs

2014

Approved by:

Dr. C. Leigh Anderson

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A report prepared for the Upper Columbia Salmon Recovery Board

Public Service Clinic: Degree Project for UCSRB
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June 2014

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Executive Summary

This paper analyzes the benefits of salmon restoration projects in the Upper Columbia River Basin. Salmon restoration has been a priority in Washington State since the species was listed under the Endangered Species Act in the late 1990's. In response to the species' listing, the Upper Columbia Salmon Recovery Board was founded in order to engage local communities in salmon restoration efforts. Our paper attempts to measure the economic, ecological and cultural values that salmon restoration projects bring to the communities in the Chelan, Douglas and Okanogan counties.

Photo from: http://www.biology-blog.com/blogs/archives/Biology-blog/187195566-Sep-23-2010.html

To analyze the economic benefits of salmon recovery, we assessed the potential for job creation from salmon restoration efforts. More specifically, we researched the direct and indirect employment opportunities created from these projects. Direct jobs are the employment opportunities created for planning and implementation of restoration projects (Nielsen-Pincus et al, 2013). Examples include manual labor jobs to specialized experts, like a monitoring scientist. Indirect job opportunities are a result from the direct jobs created by the restoration. When more people in the area are employed and spend more money within the community on services, the economy produces indirect job opportunities, such as tourism and retail, to meet the needs of the employed residents.

To estimate direct job statistics, we used two different studies that assessed direct job creation in restoration projects. In Nielson et al, 13.1 labor-related, direct jobs were created with each $1 million in funding (2013). In the Washington Department of Fish and Wildlife and the Edwards et al study, 17 restoration jobs were created for each $1 million in restoration financing (Lyons, 2012, Edwards et al 2013). To calculate the direct job statistics for Chelan, Douglas and Okanogan counties, we

combined the job creation estimates with the salmon recovery grant funding data sets from the Washington State Recreation and Conservation Office (RCO). In this case, we used an aggregate of funding from RCO and sponsor-matching funds since 1999.

Table 1: Restoration grants by RCO by County since 1999.

County	RCO and sponsor-matching funds received since 1999 in millions
Chelan	$ 38
Douglas	$ 3
Okanogan	$ 47

To estimate the number of direct jobs created we multiplied the RCO and sponsor-matching funding with the estimated number of jobs that the two different studies found; 13.1 labor-related jobs for every $1 million in funding and 17 direct jobs for every $1 million.

Table 2: Calculations for Direct Jobs Created by County since 1999.

County	Employment Estimates for 13.1 labor-jobs per$1 Million	Employment Estimates for 17 restoration jobs per $1 Million
Chelan	499.3	648.00
Douglas	38.6	50.1
Okanogan	625.1	811.2

The data we used for direct job estimates is limited to the RCO records. As such, our estimates do not consider funding from other entities, either public or private. However, it is likely that restoration funding has entered the communities from other sources. This suggests that our direct jobs estimates are fairly conservative.

We also found that indirect job creation occurs as a result of the increased community wage earnings and spending cycles. To estimate indirect job effects, we calculated an employment multiplier based on the Economic Base Model for each county in 2005, 2011 and 2012. In 2012, the employment

multiplier for Chelan County was 4.02, meaning that 3.02 jobs were indirectly created as a result of 1 direct job. In Douglas and Okanogan, the employment multiplier in 2012 were 3.36 and 2.63, respectively. Our multipliers correspond with other job-creation studies in similar regions, reinforcing the theory that direct job creation spurs employment growth in local communities.

Table 3: Employment Multipliers by County

Multiplier	2005	2011	2012
Chelan	4.26	4.23	4.02
Douglas	3.30	3.37	3.36
Okanogan	2.55	2.64	2.63

To further assess the economic value of restoration, we looked at state residents' perceived value of salmon presence through willingness-to-pay (WTP) and travel cost studies. Each study found a positive willingness-to-pay for salmon enhancement projects. Travel-cost studies have also observed positive values for salmon fishing, estimating that an angler spends $2,000 in harvesting a salmon (USDI, 2003). These studies show that public support is positive for restoration activities that lead to increased salmon populations.

Our research also found that salmon and restoration projects have positive ecological and cultural values. Salmon are a keystone species to the environment, meaning that they play a pivotal role in supporting the ecosystem and the other species. Research has shown that salmon presence attracts other species to the environment, serve as a major food source and provides salt-water nutrients to riparian vegetation. Culturally, salmon have immense value to the Native American tribes of the region, in this study specifically, the Colville Confederated Tribes and the Yakama Nation have been living in the region and harvesting salmon for over 10,000 years. This paper does not quantify the ecological and cultural benefits, our research portrays salmon restoration projects as beneficial to local communities and the natural environment.

Background Information

About the Upper Columbia Salmon Recovery Board

> Mission statement of the UCSRB: "To restore viable and sustainable populations of salmon, steelhead, and other at-risk species through collaborative, economically sensitive efforts, combined resources, and wise resource management of the Upper Columbia region.

The Upper Columbia Salmon Recovery Board (UCSRB) began operations in 1999 in response to declining salmon populations and the impending listing of the species on the Endangered Species Act. UCSRB engages with many stakeholders and interest groups to assist in understanding regional recovery plans, and to increase education and awareness about salmon recovery issues. UCSRB places a heavy emphasis on collaboration with other organizations and local governments. Over the last two decades, UCSRB has partnered with other agencies to complete over 270 projects and protect thousands of acres of habitat (UCSRB website, 2014).

Figure 1: Walla Walla River near Stone Creek. Photo by Glenn Scofield-Williams, "Snake River Fall Chinook Recovery: A Tribal Success Story"

UCSRB is also a designated 'lead entity' by the Salmon Recovery Funding Board (SRFB). SRFB grants federal and state funding to restoration projects to help meet salmon recovery goals. As a lead entity, the UCSRB highlights priority actions for funding, and helps develop regional recovery plans (RCO, 2010). UCSRB, in partnership with NOAA, created the *Upper Columbia Spring Chinook Salmon and Steelhead Recovery Plan*, which was adopted by the National Marine Fisheries Service as a viable recovery plan for Endangered Species Act requirements.

History of Columbia River Basin

Prior to western settlement, it was estimated that 10 to 16 million salmon returned annually to the river to spawn and die (Williams, 2006). When explorers Lewis and Clark arrived at the Columbia Basin, they found that the native cultures were centered on salmon for subsistence and economic prosperity (Williams, 2006). As settlers began to populate the area in the early 1900's, commercial fishing quickly became an economic industry.

Figure 2 Upper Columbia River Basin Map.: Photo from http://en.wikipedia.org/wiki/File:Columbiariver

In 1883, commercial fisheries extracted an estimated 40 million pounds of salmon from the Columbia Basin (Williams, 2006). Harvest yields continued to remain high throughout the 20th century with an average of 1-2 million pounds annually since the 1940's (Williams, 2006). Additionally, logging, agriculture and urbanization created "profound changes in the natural character" of the area, which put further stress on salmon populations (Williams, 2006). The high salmon yields and the loss of habitats due to increased development and hydroelectric dams, depleted the salmon population to a point that the stocks were listed on the Endangered Species Act in the late 1990's. (Williams, 2006).

Community Overviews

Figure 3: Map of Washington State by County. Photo from: http//geology.com/state-map/maps/washington-county-map.gif

This paper focuses on the counties of Chelan, Douglas and Okanogan located in Central Washington State. These three counties are the primary regions involved in the *Upper Columbia Spring Chinook Salmon and Steelhead Recovery Plan.* According to the Washington State Office of Financial Management, all three counties are large in size and have low population densities signifying that the area is mostly rural. Okanogan County has the lowest population density but the largest size, comprising of 7.93% of land area in Washington State. Together, the counties make up approximately 15% of the land area in the state.

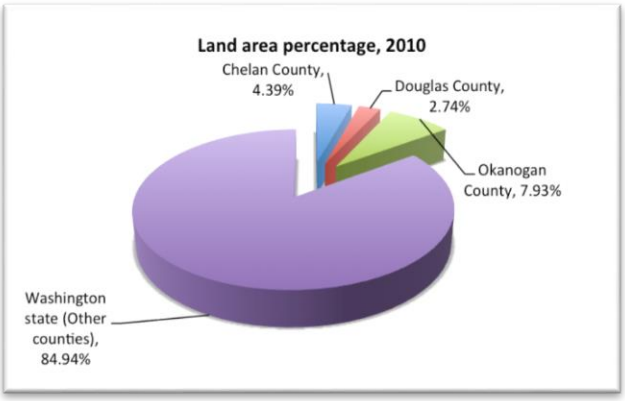

Figure 4: Land Area Pie Chart. Data from the U.S. Census Bureau Quick Facts

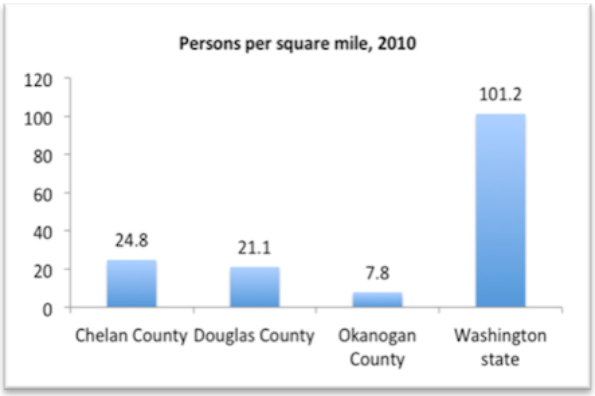

Figure 5: Population Density Bar Chart. Data from U.S. Census Bureau Quick Facts

Chelan and Douglas Counties

Chelan and Douglas counties are located on the eastern side of the Cascade Mountains and are divided by the Columbia River. Both counties have a diversified topography that includes mountains and river plains that allows for a wide variety of industries in the area, including their primary sectors of agriculture, retail and seasonal tourism. (Meseck, 2013).

Douglas County averaged 10,776 jobs in 2012 (Appendix III). The agricultural sector is significant with approximately a third of the workforce in that industry. While Chelan has an agricultural industry as well, the county also serves as an industrial hub and has a substantial manufacturing and the transportation industry. Chelan also has a larger employed population with an average of 39,583 jobs in 2012 (Appendix III).

Okanogan County

Okanogan county borders Canada on the north; the Columbia River Basin and Lake Roosevelt form its southern and eastern borders, and the North Cascade Mountains form its western border. Okanogan is one of the largest counties in the state at 5,268 square miles and has the fifth fewest residents per square mile. This county generally experiences 300+ days of sunshine and has a large agricultural and tourism industry, with approximately 10% of the non-farm workforce in the leisure and hospitality industry. (Office of Financial Management, 2012). Logging and wood manufacturing industry is also an important aspect of Okanogan's history, with the Colville tribe owning and running one of the largest mills in the area today (Meseck, 2013). Currently logging and manufacturing provide an aggregate 1,080 jobs in the area. In 2012, there were 17,269 jobs in Okanogan County (Washington State Office of Financial Management, 2014).

Rural Communities and Restoration Economies

Chelan, Douglas and Okanogan Counties

Rural communities depend on the same things that all other macro-economies depend on: good jobs, access to critical services, and healthy environments (USDA 2014). However, rural economies have distinct characteristics because of their distance from urban centers and low populations. For one, the low density of people makes it hard to provide all of the necessary services and jobs in a cost-efficient manner (USDA, 2014). Secondly, professional and high-education level jobs are typically centered in urban areas; so the potential for people to relocate for better wages is a

particular threat to rural communities. Lastly, rural areas typically have one or two concentrated industries, while urban cities have incorporated a lot more options and diversified their economic base. Keeping these characteristics of rural economies in mind, we can assess the value that salmon restoration projects have had economically in the Douglas, Chelan and Okanogan counties.

Restoration Economy

In many rural communities, traditional resource-use activities have declined substantially as resources have become depleted or as legislative policies have been enacted to protect the existing resources (Haynes 2002). As increased ecological protection continues, rural economies may be harmed as the traditional employment opportunities decrease. For instance, the primary traditional economy for the Washington peninsula was logging until the Endangered Species Act halted the majority of timber production because of the Spotted Owl's endangered status (Farber, 2012). However, rural communities may be able to replace their traditional industries with a restoration economy and benefit from an industry that enhances and restores the natural environment.

Sustainable economic development refers to the practices that simultaneously create economic vitality, environmental stewardship, and social equity (Weinberg, 2000). The idea behind sustainable development is that rural communities can develop a sense of autonomy and create an economic system independent from local resource extraction. Ecological restoration is a form of sustainable economic development that allows communities to invest in 'themselves', both in tangible resources and economic benefits (Nielsen-Pincus, 2013). Indeed, restoration efforts in the United States have been steadily rising. Between 1990 and 2005, average investment into restoration-related projects was estimated to be greater than $1 billion a year (Bernhardt et al, 2005). Essentially, sustainable development and restoration efforts empower the local community to realize their local assets, and replenish and manage them responsibly while still tapping into the global economy (Weinberg, 2000). Additionally, restoration activities spur employment and economic development and increase industries independent from resource management, such as tourism or hospitality.

Methodology

Our project uses both qualitative and quantitative tools to analyze the value of salmon restoration projects in Chelan, Douglas and Okanogan counties. In the economic analysis section, we conducted a literature review and built an employment multiplier using the Economic Base Model. In the cultural and ecological section, we researched scientific articles to help illustrate the benefits of salmon presence.

- **Direct Job Creation:** We researched a number of studies that estimated direct job increases for salmon restoration projects. To derive direct job estimates, we chose two studies that were similar in study purpose and scope, as well as geographic region. The direct job estimates for Chelan, Douglas and Okanogan counties came from Nielsen-Pincus et al (2013) and the Washington Department of Fish and Wildlife/Edwards et al (2012, 2013). We then applied the Washington State Recreation and Conservation Office's (RCO) statistics on federal and state funding to estimate how many direct jobs have been created by the injection of salmon recovery and restoration grants.

- **Indirect Job Estimation:** We built an employment multiplier using the Economic Base Model to estimate indirect job effects in Chelan, Douglas and Okanogan counties based on the data from the Employment Security Department. To estimate the economic base for each county we used a Location Quotient technique. The Location Quotient technique is a method to compare the local economy to another reference economy. (For more information, see Appendix II).

- **Willingness to Pay (WTP):** To assess public support for salmon presence and enhancement, we analyzed previous contingent valuation and travel cost studies. Contingent valuation is an economic tool for estimating services that do not have an ascribed price in the marketplace. Likewise, travel cost studies create a surrogate price for the value by analyzing the amount of money people spent to participate in the activity.

- **Ecological and Cultural Benefits:** To evaluate the ecological and cultural benefits of salmon presence, we conducted a literature review as well as anecdotal quotes.

Restoration Projects Increase Job Opportunities

In the United States, studies have shown that restoration projects increase job opportunities both directly and indirectly (Nielsen-Pincus, 2010 and 2013, Stamper, 2012). Direct jobs are employment opportunities created for the planning and implementation of restoration projects (Nielsen-Pincus et al, 2010). Direct jobs represent people that are paid to perform tasks specific to the project. The positions may range from specialized professions, like a biologist, to laborers that plant vegetation for riparian habitat. The presence of direct jobs and the increase of wages spent in the community, may lead to indirect job creation. Indirect jobs are those that are created to meet the additional demand of goods and services when direct jobs are created. Indirect jobs are typically estimated with a multiplier; a ratio that attempts to quantify extra employment from a monetary injection.

There are number of studies that drill deeper into the results of direct and indirect job creation to determine a quantifiable result. The Washington State Recreation and Conservation Office (RCO) "found that a $1 million dollar investment in watershed restoration directly results in 15-33 new or sustained jobs and has been shown to create $2.2-2.5 million in total economic activity." Regional studies support RCO's statistic. A Nielsen-Pincus et al study estimated that $1 million dollars of project funds created 31.5 new jobs. Additionally, a study by Ecotrust in southwest Oregon found that an average of 19 jobs were created for each $1 million of restoration project funds (Kellon). The large range for the employment effects can be explained by the diverse projects and payroll needs of each restoration program.

Restoration projects create low-skill labor jobs as well as opportunities for professional skillsets. The increase of labor jobs is important to the community, as these jobs are easier to fill with local applicants (Nielsen-Pincus et al, 2010). However, the presence of professional jobs also contributes significantly to the community and range of services. When specialized practitioners move into communities for restoration jobs, they bring their experience and training to the region. A restoration project in Humboldt County, CA illustrates the diversity of jobs created. From 1995 to 2002, 300 jobs were created as a result of one restoration project in the area. The employment

opportunities ranged from labor-related to specialized positions requiring advanced degrees (Nielsen-Pincus et al, 2010).

A study by Nielsen-Pincus et al found that indirect jobs are created by the implementation of restoration projects in the state of Oregon. Nielsen-Pincus cited an employment multiplier of 2.4 to 4.0 (2010). This means that for every job created by restoration funding, 2.4 to 4.0 total employment opportunities occur in the region. Additionally, ecological restoration may increase the number of tourism jobs as opportunities to visit the area for recreational activities increases. For example, fishing permits for salmon and steelhead in the Columbia River Basin generated $2.3 million in revenue between April 2010 and June 2011 (WDFW). Overall, the Columbia River Basin fisheries' economic value is estimated to be over $27 million dollars in 2004 (UCSRB).

What Constitutes a Job

When assessing direct job numbers, a 'job' is considered to be any task or work performed for a wage. There is no distinction between full-time, part-time or temporary positions. Thus, a 'job' can be a task where someone is on payroll temporarily or as a permanent employee. This is important to recognize because it fails to illustrate how sustainable and stable employment opportunities are from restoration activities. While there has been anecdotal evidence of job trends, we cannot know the breakdown between full-time or part-time without more data collection.

Direct Job Creation from Salmon Restoration Projects

To estimate the direct effects of job creation on restoration projects, we needed to estimate the amount of funding that has entered the community. To do this, we used the data from the RCO, which manages grant programs and provides technical assistance to local government agencies and non-profits. There is the distinct possibility that private funding has also been granted to agencies for salmon restoration, our analysis only focuses on federal and state funds. Because of RCO's comprehensive data set and their partnership with different salmon grants, their data provides a good indication of how much federal and state funding has entered the counties for salmon restoration.

Within the RCO, there are different funding opportunities for salmon restoration projects. A primary funder for salmon recovery is the Salmon Recovery Funding Board (SRFB). Since the SRFB's

inception, the program has helped 2,300 projects statewide and administered around $615 million of state and federal funds (2013). In addition to SRFB's funding, agencies can also apply for RCO grants that are financed by other agencies. Examples of these include Washington Department of Natural Resources' Family Fish and Forest Passage Program (FFFPP) and Washington Department of Fish and Wildlife's Estuary and Salmon Restoration Program. Lastly, most of the RCO grants require a matching of resources, up to 50%, increasing the total financial investment in the area.

Since 1999, Okanogan and Chelan counties have each had over 100 salmon projects funded by the Washington Recreation and Conservation Office (See Table 4). Douglas County, however, has only secured funding for six salmon projects.

Table 4: The Number of Salmon Restoration Projects by County

County	Chelan	Douglas	Okanogan
Number of Projects Funded (1999-2014)	**111**	**6**	**115**

Table 5: Amount of Monies for Restoration Projects by County

County	Chelan	Douglas	Okanogan
RCO Money	**$23,433,229.96**	**$2,843,713.33**	**$22,738,579.45**
Sponsor Matching Total	**$14,679,355**	**$100,500**	**$24,976,755**
Total Money	**$38,112,584.96**	**$2,944,213.33**	**$47,715,334.45**

For yearly breakdown, see Appendix III.

To assess the direct job impact on the communities in the Upper Columbia River Basin, we looked at two different studies that attempted to assess employment opportunities per $1 million of funding. First, Nielsen-Pincus et al looked at direct job creation for manual, equipment contracts, and technical services (2013). For labor jobs, Nielsen-Pincus et al estimated that 13.1 jobs would be added per $1 million of project funds. In comparison, the equipment and technical-contracting direct jobs are significantly lower at 4.8 and 8.7 jobs per $1 million dollars (2013). Nielsen-Pincus et al gives several explanations for this discrepancy. One reason is that labor jobs typically make up the vast majority of payroll for restoration projects (2013). Additionally, labor-jobs tend to be fairly low-paid. The coupling of a larger payroll budget and a smaller salary allows for more labor-intensive positions to be offered (2013).

The second study on direct job effects looked at the American Recovery and Reinvestment Act funding in 2009 and estimated the direct jobs that resulted from federal stimulus funding. The study concluded that habitat restoration projects were the highest-value projects, adding an average of 17 direct jobs per $1 million investment (Edwards et al, 2013). The Washington Department of Fish and Wildlife (WDFW) used this number for their own program analysis, but cited a more moderate estimate of a fixed 17 jobs per $1 million in funding (Lyons, 2013). In order to provide conservative estimates, we use the WDFW interpretation for our own analysis.

To estimate the direct job effects in Chelan, Douglas and Okanogan counties, we multiplied the RCO and sponsor-matching funds with the direct-job estimates from the Nielsen et al and WDFW/Edwards et al studies. Table 6 below estimates that 13.1 indirect jobs are created per $1 million in funding. Table 7, uses the number from WDFW/Edwards et al, which extends the number to include any restoration-related, direct jobs. Using both of these estimates, we can get an idea of how many direct jobs have been created in local economies since 1999.

Table 6: Calculations for Direct Jobs Created by County from Nielsen-Pincus et al Estimates

County	Number of jobs created for every $1 million in restoration dollars (rounded to the nearest tenth)
Chelan	**13.1 *(38,112,584.96)=499.3**
Douglas	**13.1 *(2,944,213.33)=38.6**
Okanogan	**13.1 *(47,715,334.45)=625.1**

Table 7: Calculations for jobs created by County from the Washington Department of Fish and Wildlife/Edwards et al estimates.

County	Number of jobs created for every $1 million in restoration dollars (rounded to the nearest tenth)
Chelan	**17 * (38,112,584.96)=648.0**
Douglas	**17 *(2,944,213.33)=50.1**
Okanogan	**17 *(47,715,334.45)=811.2**

Salmon restoration projects add positive value to local communities because they provide jobs to local residents. The restoration jobs act as an economic driver, increasing community spending cycles and economic growth.

The Employment Multiplier and Indirect Effects

The economic gains from salmon restoration projects produce spillover effects in the economy, which can create additional employment opportunities. The direct job to indirect job creation ratio can be estimated through the use of a multiplier, calculated using the Economic Base Model.

What is a Multiplier?

Multipliers are used to predict the "ripple effect" of a new, expanding, or declining industry (Miller, 2010). The multiplier is a ratio of total changes divided by initial changes, summarizing the economic impact resulting from a change in the local economy. When restoration projects bring money and jobs into a community, positive indirect and spillover effects occur in the local area as well. For example, the wages earned from construction jobs might be spent in local restaurants and shops. These service businesses will then hire more people to meet the increased demand, leading to indirect job creation. Four types of multipliers are commonly used to assess economic changes: output, employment, income and value-added multipliers (Miller, 2010). In this paper, we use an employment multiplier to assess the indirect job creation.

Constructing an Employment Multiplier

Employment multipliers have been used to understand the effects of injecting funding into communities for the last several decades. For one, multipliers are an important indicator for regional

planners to study the employment impacts of outside financing or influences in rural towns (Garrison, 1972). Secondly, the multiplier can be used to estimate the potential job growth when engaging in public projects. Due to the limited time and resources of community leaders, a multiplier works as a quick proxy to evaluate the economic impact generated by public projects (Miller, 2010). Among the economic multiplier models, input-output models are given most attention (Richardson, 1985). However, the input-output model requires substantial data collection. Thus, due to data limitations the multiplier was calculated using an alternative method: the Economic Base model.

Economic Base Model

This theory allows us to identify the spillover from external factors on employment in the community. To understand the economic interrelations within communities, the Economic Base Model divides the local economy into two segments: firms and individuals serving markets outside the community named 'basic', and firms and individuals serving markets within the community, 'non-basic'. Thus, 'basic' employment is dependent on external factors while 'non-basic' employment is dependent on local needs. The 'basic' sector is considered the prime mover of the local economy, meaning that if 'basic' employment increases or declines, then 'non-basic' employment is expected to move in the same direction (Tiebout, 1962). For example, when federal or state funding enters the community, direct employment opportunities tend to increase. These jobs are considered 'basic' employment because they are based on the externally injected funds. Subsequently, the new project also increases the demand for restaurants and retail shops in the community, thereby increasing indirect job opportunities.

The methodology and data sets are further explained in Appendix II. To create our multiplier, we used the data set 'Quarterly Census of Employment and Wages'[1] from the Employment Security Department, which contains employment data for each county from 2005 to 2012.

[1] The employment data of Quarterly Census of Employment and Wages dataset is derived from the current population survey. It is indicates the number of persons of 16 years and over in the civilian noninstitutional population who, during the reference week, (a) did any work at all (at least 1 hour) as paid employees; and (b) all those who were not working but had jobs or businesses from which they were temporarily absent.

Findings on Economic Multiplier effect

Table 8: Employment Multipliers by County

	2005	2011	2012
Chelan	**4.26**	**4.23**	**4.02**
Douglas	**3.30**	**3.37**	**3.36**
Okanogan	**2.55**	**2.64**	**2.63**

Appendix III shows the calculations of these multiplier numbers.

Using the Economic Base Model above, we calculated an employment multiplier for Chelan, Douglas and Okanogan counties in 2005, 2011 and 2012. The employment multiplier for the three counties ranges from 2.55 to 4.26, with Chelan having the highest multiplier effect and Okanogan having the lowest. The multiplier is generally stable, with the largest change over time being .24 in Chelan County. The multiplier represents a ratio of proportionality, for example in Chelan County in 2005 1 direct job created 4.26 total jobs, and 2 direct jobs created (2*4.26) 8.52 total jobs. The effect of the multiplier, in Chelan in 2012, was one direct job from salmon restoration created 4.02 total jobs. One direct job in Douglas County produces 2.36 indirect jobs, and 1.63 indirect jobs are generated in result from one direct job creation in Okanogan. It is important to recognize that this multiplier is not specific to restoration jobs, but rather represents the whole local economy.

Willingness-to-Pay for Salmon Enhancement

Table 9: Summary Table of Willingness-to-Pay Studies

Study Name	Amount per Year
Wallmo and Lew, 2012	**$40 per household**
Bell et al, 1999	**$25 to $125 per household**
Layton et al, 1999	**$119.04 per household**
Olsen et al, 1991	**$26.51 to $74.16 per household**
Loomis et al, 1996	**$26.50 to $60 per household**
Travel Cost: USDI, 2003	**An average of $2,000 to harvest a salmon**

Our analysis has found that people have a positive Willingness-to-Pay (WTP) for salmon restoration projects both nationally and in the Pacific Northwest (Montgomery, 2000). Indeed, a study by Wallmo and Lew surveyed 4,000 people nationally and found that households would be willing to pay $40 per year for increased runs of the Puget Sound Chinook salmon and the Upper Willamette Chinook salmon (2012). In order to estimate the WTP, we analyzed previous contingent valuation studies that have been completed on salmon restoration projects in the region.

Bell et al used a survey to assess willingness-to-pay for local salmon enhancement projects that would allow the allowable catch of Coho salmon to increase to 80,000 fish per year in Washington and Oregon state coastal communities (1999). They found that willingness-to-pay was positively correlated with income, but that all communities had willingness-to-pay values that ranged from approximately $25 to $125 annually. These numbers are similar to other studies (Bell et al, 1999). One issue with this particular study is that the scope was focused on people who live near the Pacific Ocean estuaries or the coast. The focus on this particular population brings up external validity issues as their sampled population may have different values than those of Columbia Basin residents. A study by Layton et al also found that households located in the western side of the state were willing to pay, on average, $119.04 to increase Eastern Washington salmon runs by 50% (1999). These studies suggest that Western Washington residents place a higher value on salmon, and are willing to pay for salmon increases even in non-local communities.

Another study, conducted by Olsen et al asked households how much they would add onto their electric bill in order to double the number of salmon and steelhead in the Columbia River (1991). The researchers found that all households were willing to pay a positive amount but that the willingness-to-pay number differed depending on their interest in fishing. For households that had no interest, they were willing to pay $26.51 per year, while households that currently fish would pay $74.16 annually (Olsen, 1991). This study points out that fishing enthusiasts tend to value salmon species more, increasing the perceived benefits for restoration projects.

Lastly, a paper by Loomis et al found that people's willingness-to-pay for salmon enhancement was between $26.50 and $60 per household per year (1996). However, a later paper by Huppert showed that Loomis' aggregate willingness-to-pay across the state was not high enough to cover the costs of the restoration. Thus, although the willingness-to-pay was positive, completing the project would

have resulted in net economic loss. However, there are other non-monetary values to consider in salmon restoration projects.

Photo from http://www.corbisimages.com/stock-photo/royalty-free/42.18629819/middleaged-man-fishing?popup=1

Looking at a travel cost study, The U.S. Department of the Interior (USDI) estimated a Sport fisher's valuation of the salmon species'. To do this, the USDI monetized how much money an angler spends, on average, to harvest salmon. USDI found that in Washington State, 367,000 out of 938,000 anglers reported fishing for salmon and/or steelhead (USDI, 2003). On average, these anglers spent $2000 in harvesting a salmon (2013). Using a travel-cost method, this number can be used to estimate a Sport fisher's collective value for salmon and how much they would be willing to pay for population increases via restoration projects.

The next sections of the report will address these two non-economic values: ecological benefits and cultural relevance.

Ecological Benefits of Salmon Presence and Restoration

Salmon have an important ecological value, particularly because of their status as a 'keystone species'. A 'keystone species' means that the salmon's viability in an ecosystem is a clear indicator that the system is in a healthy and stable state. When salmon are present in an environment, other species are attracted to the ecosystem because of the fish. For instance, an increase in salmon positively correlates with the increase of many other stream-resident fish species (Bilby et al, 1998). Insects and scavengers also migrate towards salmon, specifically at the spawning grounds where the salmon quickly die. Vertebrate densities also increase, typically migrating from outside the ecosystem to feed on the salmon. Lastly, birds also increase in density in response to the salmons' effect on the invertebrate species (Gende et al, 2002)

Salmon also affect the land outside of the water system. When salmon die after spawning, their carcasses provide nutrients to the ecosystem (Gende et al, 2002). The nutrients derived from salmon are special to the riparian and river ecosystems because the fish acquire the nutrients while in the ocean. When they die, the nutrients are left behind in the freshwater systems. The nutrients can then be transmitted to plants in a few different ways. First, vertebrates can eat the salmon and dispose of the nutrients nearby (via feces or leaving 'leftovers') (Gende et al, 2002). Second, invertebrates can remove nutrients by eating small pieces of the carcasses, which would then pass onto higher trophic levels through the chain of consumption (Gende et al, 2002). Lastly, the transmission of nutrients can naturally occur by depositing in gravel beds and being carried by water flows (Gende et al, 2002).

Salmon need complex water systems and a plethora of vegetation in or near the river to increase chances of survival. The waterways and floodplains can provide side channels and areas to spawn away from the currents and high-river flows. Floodplains provide beds of sediment that salmon can use in spawning and rearing activities (NOAA, 2014). As for vegetation, trees and shrubs by the river provide shade for the species, but also provide places to hide from larger predators (NOAA, 2014). Indeed, studies have shown that salmon presence is correlated with large woody debris that has fallen into streams (Suttle, 2004, Hartman, 1996).

Salmon are also sensitive to water temperatures and need shade from nearby trees for protection (Williams, 2006). This makes riparian buffers a necessary part of restoration. Thus, salmon restoration strives to rebuild an ecosystem that contains stream integrity and high levels of foliage over the lake.

Restoration projects attempt to return the ecosystem back to a state where salmon are able to live. Restoration of an area does not necessarily mean that the habitat is returned to how it was before humans entered the system. Rather, it is a process that considers both humans and wildlife needs. Humans currently use rivers for hydropower, irrigation, and floodplains for residential development and agriculture. Thus, restoration plans need to consider both human activities and salmon needs when designing a specific project. The Society of Ecological Restoration echoes this statement by saying that restoration is returning the land back to a state of 'ecological integrity' (Harris, 2001). Ecological integrity includes the amount of biodiversity in the area and the presence of ecological processes, while looking at the historical trajectory of the land and any cultural presence (Harris, 2001).

The next section of the report discusses the historical and cultural relevance of salmon for the Pacific Northwest tribes, as well as the economic value for the Colville Confederated Tribes and the Yakama Nation.

Cultural Benefits of Salmon Presence

Photo from www.kgbds.ord/domain/691

In the counties of Chelan, Douglas and Okanogan, salmon have provided a plethora of cultural benefits to local native tribes. Indeed, the Colville Confederated Tribes and the Yakama Nation have many connections to salmon: social, spiritual, subsistence and economic ties that require understanding to better manage this natural resource (Montag and Swan, et al, 2014). For example, the Yakama Nation sees salmon as a "First Food", part of a sacred diet that is fundamental to tribal culture (Montag and Swan, et al, 2014). The tribal connection to the salmon are often passed down generationally through traditional knowledge transmission, using ceremonies and celebrations (Lal et al. 2011; Tsosie 2007). Tribes are also natural stakeholders in salmon restoration projects because of their ethos about natural involvement in hatcheries (Appendix IV). This report does not attempt to quantify the value of salmon on tribal culture or well-being. Instead, this paper aims to portray the cultural roles that the salmon has for these societies and the benefits that salmon restoration projects have had on the tribal community.

Social Traditions Center around the Salmon: Celebrations and Ceremonies

Salmon have been a prominent part of the Natives' diet, but the species also influences the tribes' traditions, and shared knowledge and language. Many of the First People's of the Northwest have annually held ceremonies, festival and community gatherings that honors and illustrates the importance of the salmon species in the tribal culture. By protecting the salmon, the species continues to give strength to the sovereignty and uniqueness of the Native tribes and social traditions dedicated to the species (Ladue, 2014).

Tribal communities also have strong spiritual connections to Mother Earth and native species like the Pacific Salmon. Native Americans seek religious and spiritual inspiration with their waters and lands. Geographic locations, mountains and waters, are held sacred and sometimes used for ceremonial purposes. In addition, many tribes respect and hold sacred how different species impact Mother Earth; therefore detrimental effects on these species are of great concern (Cozzetto et al, 2013). Spiritually, many of the tribe's chosen members perform rites, songs, and dances to honor the salmon as the species is revered in their culture.

"The Yakama people have depended on the salmon since time immemorial. The Creator asked the salmon to sacrifice themselves so that the Yakamas would have food. Without salmon, the traditional Yakama culture and economy cease to exist."- Lee Carlson of Yakama Nation Fisheries, 2014

The photograph above is a fish drying rack, a traditional tool used for drying fish for later use. *Photo from the U.S. National Park Service's Photo Gallery, http://www.nps.gov/media/photo/gallery.htm?id=859A44FD-1DD8-B71C-078752A578C05791*

Traditional Knowledge Systems

Salmon-centered gatherings are vital to communicating the social and spiritual traditions that the community finds culturally valuable. These are the types of knowledge and values that tribes hold and desire to be passed down from generation to generation. For example, Elders want to pass on information to the younger generations about the land and waters in which they reside and hold in high esteem. Academics have termed this as traditional ecological knowledge (TEK). "Traditional ecological knowledge (TEK) [is] learned and shared through tribal members' close connections to and understanding of the functions and processes of the physical landscape." (Montag and Swan et al, 2014). It has also been defined as "the collection of knowledge, practice and belief that has evolved through the adoption of adaptive processes and passed on through generations via cultural transmissions" (Williams, 2009). An example is teaching young tribal members traditional fishing techniques brings together education and cultural preservation.

A fairly recent development in environmental, land and resource, and wildlife management is the combination of TEK and western science and management, which has the capacity to improve decision-making and validity of those conclusions (Butler, 2012). Studies have shown that TEK based models can realistically advise recovery planning (Polfus et al, 2014). However, this type of collaboration between tribes and government can be hard to manage for a variety of reasons, including the difference in the knowledge bases and the power differences in society (Briggs, 2005).

Salmon restoration projects in the Upper Columbia region of Washington State, in particular the

counties of Chelan, Okanogan, and Douglas, have been impacted by the combination of TEK and western science management practices. The example here is the collaboration between the Colville Confederated Tribes and the Yakama Nation and the Upper Columbia Salmon Recovery Board. The tribes have ongoing influence on the salmon restoration projects in the region. Both tribes hold seats on the UCSRB and both of the tribes own and maintain hatcheries that produce hatchery fish that bolster the wild salmon population. The Colville Confederated Tribes operate the Chief Joseph Hatchery and have taken a lead in the combination of TKE and western science management theories. Keith Wolf, the Chief Joseph Hatchery Science program manager said:

> *"The Tribes have embraced hatchery reform efforts that seek to find a balance between artificial and natural production and address the often conflicting goals of increased harvest and conservation."*

Economic Benefits of Salmon to First People's Communities

The tribal societies in the Pacific Northwest found salmon so plentiful, that the tribes' economy, rituals, and culture were built around this resource and are still known today as the "Salmon Cultures" (Moss, 2012). In the past, salmon has been estimated to account for up to 40% of the tribes' daily caloric intake (Montag and Swan et al, 2014). The majority of the Pacific Northwest tribes engaged in subsistence living, meaning that they only produced enough food and resources for basic necessities. The idea is not restricted to traditional tribal members, but it is also the basis for an alternative worldview (Thornton, 1998). Therefore, understanding the implications of subsistence living for Native cultures is important when realizing the impact of salmon depletion and its potential economic value to tribes.

In the Pacific Northwest's Alaska waters, the value of subsistence harvests have been estimated at $134-$268 million dollars annually (ADFG, 2010). Subsistence provides an important economic base for rural economies but it is also represents a complex social economy as well (Wolfe, 1987). Thornton identifies, "It is not only about how much you take from the land, but where you take it from, whom you take it with, whom you share it with and in what context."

Economic Development and Settlers

As a result of western settlement, communications and trading increased between the settlers and Native populations. Additionally, the tribes' current subsistence lifestyle was degraded as the United

States Government took away lands and native hunting and fishing grounds (Suquamish tribal website). Thus, as the current political economy in the region moved to a more capitalist nature, the Native community had to specialize, diversify and invest in their natural resources. The tribes began to specialize in salmon fishing (Moss, 2012). For example, fishing weirs traps as investments in fisheries management were tied to the importance of salmon as a viable economic commodity (Moss et al. 1990).

Legal and Treaty Rights in the Context of Stewardship

Photo by http://www.portlandartmuseum.us/mwebcgi/mweb.exe?request=record;id=29904;type=101

This photograph is taken of Native fishers at the Celilio Falls on the Columbia River. The fishers are Native peoples who had lived in the area for at least 15,000 years before the region was destroyed in 1957 with the construction of the Dalles Dam. Before implementation of the dam, this community was the oldest remaining in North America. The damming of areas along the Columbia River have disrupted native people, wildlife and ecology of the Pacific Northwest. As such, the United States court system has had to step in to deliberate dilemmas and tribal laws.

Historically, Native Americans signed treaties with the United States government in which they agreed to cede lands. During those treaty signings, tribes were recognized as sovereign entities by the federal government beginning in the 18th century (Schmidt, 2009). A very important provision in many of the treaties was the right entitling the Native peoples to their "usual and accustomed grounds" to live, fish and hunt (WDFW). This gives the federal government and Native American tribes a unique legal responsibility in dictating areas to be set aside as tribal lands, as well as decisions pertaining to traditional fishing and hunting grounds[2].

[2] In the Supreme Court case of Cherokee Nation vs. Georgia in 1831 Justice Marshall ruled that tribal lands are "domestic, dependent states" held in trust by the U.S. government with the responsibility to manage and oversee such lands and their natural resources (Schmidt, 2009).

The Colville and Yakama, along with others tribes, maintain an inherent connection to the lands and waters and the resources of their jurisdiction. However, salmon as an endangered species affects those rights and interests. For example, when treaties were signed salmon runs were at harvestable levels. Since then the population has been devastated to the point that they became covered under the ESA, which negates tribal rights to take fish by federal law and reduces their harvest by natural law. "Currently, it is estimated that the runs are seven to ten times below harvestable levels. The federal government may be liable if the runs are not restored, leaving the taxpayers with a bill of somewhere between six and twelve billion dollars" (Zerbe, 2011). This stems from the U.S. court's Boldt Decisions which states that the tribes are entitled to take 50% of the salmon run harvest.

Table 9: Comparison of Estimated Tribal Harvests from Pre-Contact to Current Time

With harvest measured in 1000's of pounds

Time periods	Nez Perce	Shoshone/Bannock	Yakama Nation	Umatilla	Warm Springs
Pre-contact harvest	2,800	2,500	5,600	3,500	3,400
Harvest in mid-1800's	1,600	1,300	2,400	1,600	1,000
Current tribal harvest	160	1	1,100	0	77

Table source: "Tribal Circumstances & Impacts from the Lower Snake River Project on the Nez Perce, Yakima, Umatilla, Warm Springs, and Shoshone Bannock Tribes" (Meyer, 1999)

In the case of Eastern Washington, tribal lands and its management by the Colville Confederated tribes and the Yakama tribe have taken on a prominent role in conducting salmon restoration projects and using hatcheries to supplement salmon population levels. The tribes have invested in multiple projects that work to further salmon presence. For example, the tribes are working as stewards of the land and maintaining values important to the communities by building, maintaining, and running hatcheries. The Colville Confederated Tribes is currently building the Chief Joseph fish hatchery at the cost of $51 million dollars (Colville Confederated Tribes, 2014).

The array of different benefits that the salmon provide to Pacific Northwest tribes illustrates the positive value that the species' have on the native culture (Appendix V).

Conclusion

The benefits of salmon presence and restoration in the Columbia Basin have been valued both quantitatively and qualitatively in prior studies. Our analysis on direct and indirect job estimates, coupled with the literature we have reviewed, shows that salmon restoration projects have a positive effect in improving ecosystems and communities in the Columbia River Basin.

Since the salmon's listing on the Endangered Species Act, restoring salmon populations has been a priority for Washington State agencies and non-profit organizations. With the creation of the Salmon Recovery Funding Board and the designation of lead entities such as UCSRB, recovery plans have been implemented and thousands of acres of habitat have been restored. Projects include both small-scale projects, such as planting riparian habitat and adding large woody debris into the stream to large-scale efforts, like the removal of the Elwha Dam and building fish ladders. All of these projects have used innovative solutions to create more salmon-friendly habitat amidst the varying needs of humans.

Our paper suggests that restoration benefits are not only exclusive to salmon; but that restoration projects also provide economic benefits to communities as well. The RCO has said that 80% of salmon recovery funding is spent in the county where the grant was given (2013). Essentially, salmon enhancement projects create jobs and increase spending-cycles in local communities. Rural counties, in particular, should recognize the potential benefits that restoration projects may bring to their community and consider switching to an economic system that enhances the natural resources.

Restoration benefits are also important to the people of the Pacific Northwest. Many tribes not only have long-standing traditions associated with the salmon, but also use the salmon as an economic resource through the use of hatcheries. Furthermore, the positive willingness-to-pay for salmon increases by Washington residents signifies the public support for restoration activities, and the value of keeping the salmon in our local communities. Lastly, our congressional and legal framework has dictated salmon restoration as an important public value. The Endangered Species Act has made salmon populations a key consideration when developing habitat areas, while judicial rulings such as the Boldt decision has given native tribes the power to demand viable salmon populations for their cultural value.

In continuing studies, we would like to further analyze how restoration projects contribute to stable employment throughout a community. Currently, we can only guess what types of jobs are created in the community, and whether they are day-to-day positions or are full-time, stable employment opportunities. Knowing the stability of the jobs that restoration creates is instrumental to determining the effects that restoration projects have on the Columbia Basin communities. Overall, restoration projects bring positive benefits to local residents in economic, ecological and cultural ways. We hope that future studies will continue to support our findings and add to measuring and quantifying restoration benefits.

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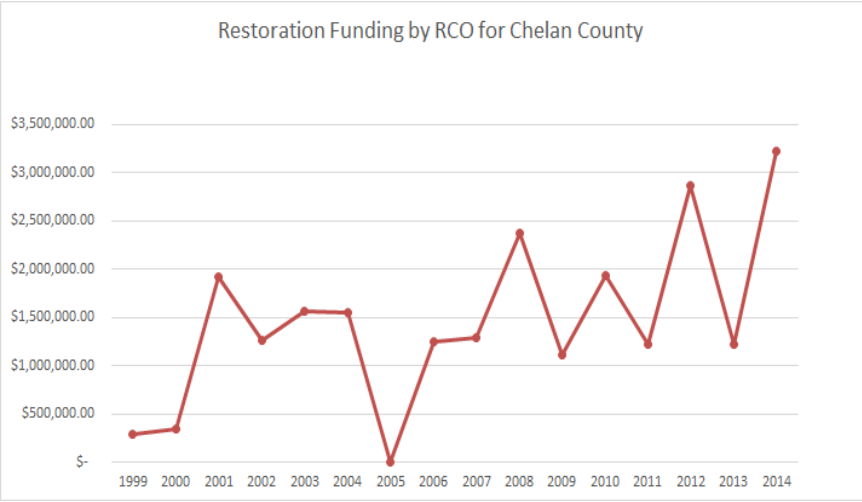
Appendix I

Chelan County:

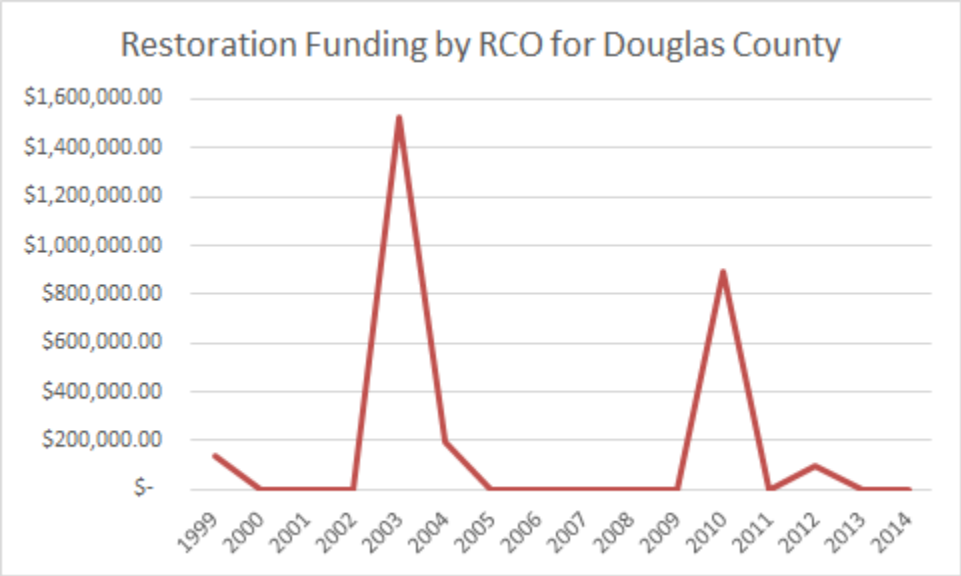


Graph visually showing the flow of restoration dollars by RCO yearly for projects in Chelan County

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Agency contribution (over 15 years)	Total Amount Given
Projects																		
Money	$ 290,098.29	$344,160.44	$ 1,922,095.99	$ 1,269,016.59	$ 1,564,097.71	$ 1,546,862.38	no data	$ 1,248,363.41	$ 1,294,335.44	$ 2,371,926.20	$ 1,118,405.02	$ 1,931,137.40	$ 1,225,859.23	$ 2,868,891.86	$ 1,215,675.00	$ 3,222,305.00	$ 14,679,355.00	$ 38,112,584.96

Yearly breakdown for Federal Funds given by the Washington State Recreation and Conservation Office in Chelan County

Douglas County:

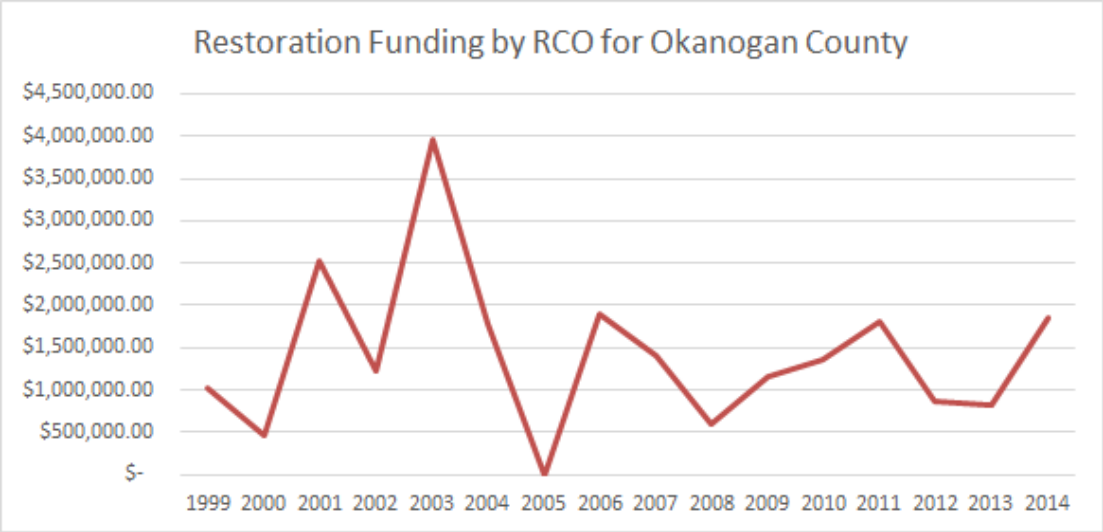


Graph visually showing the input of restoration dollars by Washington RCO yearly for projects in Douglas County

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Agency contribution (over 15 years)	Total Amount Given
Projects																		
Money	$ 140,000.00	no data	no data	no data	$ 1,523,723.07	$ 194,500.00	no data	no data	no data	no data	no data	$ 892,648.26	no data	$ 92,842.00	no data	no data	$ 100,500.00	$ 2,944,213.33

Yearly breakdown for Federal Funds given by the Washington State Recreation and Conservation Office in Douglas County

Okanogan County:



Graph visually depicting the input of restoration dollars by Washington RCO yearly for projects in Okanogan County

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Agency contribution (over 15 years)	Total Amount Given
Projects																		
Money	$ 1,022,130.08	$ 466,500.11	$ 2,519,908.72	$ 1,231,075.62	$ 3,949,434.44	$ 1,781,545.68	no data	$ 1,888,920.30	$ 1,409,570.87	$ 597,557.41	$ 1,151,551.02	$ 1,361,328.45	$ 1,809,797.77	$ 872,808.98	$ 824,825.00	$ 1,851,625.00	$ 24,976,755.00	$ 47,715,334.45

Yearly breakdown of Federal Funds given by the Washington State Recreation and Conservation Office in Okanogan County.

Appendix II

This appendix provides the theoretical foundation of the Economic Base Model that was used to calculate the employment multiplier.

Economic Base Model: Method and Data

To prepare better information for policy makers or businesses to make decisions in the local economy, the Economic Base Model gathers information on current sources of income, employment and prospects for economic growth or decline. Essentially, economic base studies aim to understand the sources and level of income and employment in a community (Tiebout, 1962).

Rationale of the Economic Base Model

Charles Tiebout claims that in order to analyze the economic interrelations within communities, economic activities must be defined as either "exports" or "local" sources of demand (1962). These two bins are created because it is too costly and infeasible to consider the details of each and every economic unit. Within the two bins, there are further subdivisions of economic sources of demand such as private exports, government exports and local consumption, but the two bins allows for the economic model to be analyzed.

For example, Boeing sells its commercial jets to national and international firms. At the same time, it also produces defense products for the Federal government. Therefore, both the production of commercial jets and the defense products are export goods, this allows the bin to be further broken down into private exports and government exports.

To identify the sector as an "export", we need to specify how other industries are tied to that market. For example, in Seattle, a number of firms pack salmon and distribute to national markets. So the employment and income from the salmon packing company are dependent on exports in the Seattle economy. While packing salmon, the bags are purchased and sold from manufacturers locally. Yet, the employment of producing bags is classified as indirect exports, because the bags ultimately end up as an exported product. Similarly, these demands can be aggregated into industries. Industry aggregates usually follow the classification of Standard Industrial Classification Manual. Combining the sectors and industries, we create a number of export and local sectors for each regional economy.

Once you separate the export and local industries, you can then consider all export industries as basic and all others are as non-basic. (Tiebout, 1962)

Location Quotient Technique

To measure the base of the local economy, we could either conduct surveys to collect data or measure the economy indirectly. To indirectly measure, you can either use the assumption approach, the location quotient technique or the minimum requirement technique. In our study, we chose the location quotient technique. The underlying argument of the location quotient technique is that if a given community is highly specialized in the production of particular commodity compared to a reference economy (e.g. national, state), the product is presumed to be an export item. An example of this is automobiles manufactured in Detroit (Tiebout, 1962). An important assumption for the location quotient technique is that the local economy has the same demands as the reference economy (Tiebout, 1962). For example, if the local community were self-sufficient in construction material, the proportion of local employment in the community would be the same as the reference economy.

Based on the Tiebout's Economic Base Model, we assumed that the demand patterns of each county are the same as the state level (1962). According to this assumption, we have the equation (1) below. X equals the amount of people that would be employed in industry *i* in the county if it just provides enough supply for local needs. These employees are assigned to the non-basic (local) sector. If the employment in industry in the county is larger than X, this means that the extra jobs come from the export market and are considered as 'basic employment' as shown in equation (2). For example, suppose that the state employment in producing automobiles is 1000, the total state employment is 100,000, and the total employment of Detroit is 20,000 then X equals to 200.

$$\frac{X}{20{,}000} = \frac{1{,}000}{100{,}000} \; then \; X \; (local \; sector) = 200$$

Since Detroit is highly specialized the producing automobiles, the actual employees in the industry are 300. That is to say the extra 100 employees are serving the exports market, while the 200 employees owe their jobs to local sector. If we repeat the process of assigning employment either to basic or non-basic, we could aggregate the total basic employment and total non-basic employment. As the third equation shows how to calculate the base multiplier, which indicates the total

employment generated per 'basic' employee. As the multiplier grows bigger, the total employment generated per basic employee will become larger. The size of the multiplier is affected by several factors, including the size of the region, geographic isolation, specialization and so forth (UW).

$$\frac{X}{total\ local\ employment} = \frac{state\ employment\ in\ industry\ i}{total\ state\ employment} \quad (1)$$

$$basic\ employment\ in\ industry\ i = local\ employment\ in\ industry\ i - X \quad (2)$$

$$Base\ multiplier = \frac{total\ local\ employment}{basic\ employment} \quad (3)$$

About the Data Set Used to Create the Multiplier

To measure the multiplier effect, we looked at two data sets: the County Business Patterns from the United States Census Bureau[3] and the Quarterly Census of Employment and Wages from the Employment Security Department[4]. Both of these data sets are categorized and coded according to the North American Industry Classification System (NAICS).

The timeline for the data set of the U.S. Census County Business Patterns was 1998 to 2011, which overlaps mostly with the years of direct job creation since the data for salmon restoration projects started in 1999. The range of these years allow us to see the multiplier effect in the community before and after grant money was given by Washington RCO. However, some employment data was represented by ranges and was coded as letters instead of numerical values, therefore we did not have the exact number of employment for those industries. Thus, in order to fully assess the indirect job effects from restoration projects, we needed to calculate a multiplier that looked at all industries in the local economy. In light of that, we used the data set of the Quarterly Census of Employment and Wages because it had the most complete set of industrial employment data we found. One issue to note is that the earliest data is from 2005, so we were unable to calculate the multiplier effects prior to that year. Instead, we compare the multiplier for 2005, 2011 and 2012 to understand any trends over time.

[3] The employment data is collected differently across the two data sets. The County Business Patterns data set is collected from administrative records for single-unit companies and a combination of administrative records and survey collected data for multi-unit companies. The employment data refers to the number of paid employees, consisted of full and part-time employees, including salaried officers and executives of corporations, who are on the payroll in the pay period including March 12.

[4] The employment data of Quarterly Census of Employment and Wages dataset is derived from the current population survey. It is indicates the number of persons of 16 years and over in the civilian noninstitutional population who, during the reference week, (a) did any work at all (at least 1 hour) as paid employees; and (b) all those who were not working but had jobs or businesses from which they were temporarily absent.

Appendix III

Multiplier calculation for all industries: Year 2012

2012		Chelan	Douglas	Okanogan	Washington State	Chelan as percent of total	Douglas as percent of total	Okanogan as percent of total	WA state as percent of total	Location quotient for Chelan	Location quotient for Douglas	Location quotient for Okanogan
NAICS Code	Total	39,583	10,776	17,269	2,894,394							
11	Agriculture, forestry, fishing and hunting	9,702	2,993	5,626	95,442	0.25	0.28	0.33	0.03	7.43	8.42	9.88
21	Mining	18	0	0	2,083	0.00	0.00	0.00	0.00	0.63	0.00	0.00
22	Utilities	24	0	43	4,864	0.00	0.00	0.00	0.00	0.36	0.00	1.48
23	Construction	1,133	372	399	129,791	0.03	0.03	0.02	0.04	0.64	0.77	0.52
31-33	Manufacturing	1,967	394	351	277,361	0.05	0.04	0.02	0.10	0.52	0.38	0.21
42	Wholesale trade	2,291	400	197	121,764	0.06	0.04	0.01	0.04	1.38	0.88	0.27
44-45	Retail trade	4,276	1,346	1,808	314,383	0.11	0.12	0.10	0.11	0.99	1.15	0.96
48-49	Transportation and warehousing	763	257	96	82,657	0.02	0.02	0.01	0.03	0.67	0.84	0.19
51	Information	404	123	128	104,480	0.01	0.01	0.01	0.04	0.28	0.32	0.21
52	Finance and insurance	664	127	204	87,636	0.02	0.01	0.01	0.03	0.55	0.39	0.39
53	Real estate and rental and leasing	446	114	128	43,545	0.01	0.01	0.01	0.02	0.75	0.70	0.49
54	Professional and technical services	726	247	236	166,643	0.02	0.02	0.01	0.06	0.32	0.40	0.24
55	Management of companies and enterprises	35	22	39	36,293	0.00	0.00	0.00	0.01	0.07	0.16	0.18
56	Administrative and waste services	573	224	209	139,007	0.01	0.02	0.01	0.05	0.30	0.43	0.25
61	Educational services	101	0	0	35,868	0.00	0.00	0.00	0.01	0.21	0.00	0.00
62	Health care and social assistance	4,781	648	1,137	330,531	0.12	0.06	0.07	0.11	1.06	0.53	0.58
71	Arts, entertainment, and recreation	500	360	103	45,329	0.01	0.03	0.01	0.02	0.81	2.13	0.38
72	Accommodation and food services	3,676	670	1,133	228,392	0.09	0.06	0.07	0.08	1.18	0.79	0.83
81	Other services, except public administration	1,163	328	624	132,126	0.03	0.03	0.04	0.05	0.64	0.67	0.79
GOV	GOVERNMENT	6,341	2,129	4,578	516,199	0.16	0.20	0.27	0.18	0.90	1.11	1.49
NEC	NOT ELSEWHERE CLASSIFIED	0	24	231	0	0.00	0.00	0.01	0.00	0.00	0.00	0.00
	Multiplier	4.02	3.36	2.63								

Data source: Employment Security Department 2014

Multiplier calculation for all industries: Year 2011

2011		Chelan	Douglas	Okanogan	Washington State	Chelan as percent of total	Douglas as percent of total	Okanogan as percent of total	WA state as percent of total	Location quotient for Chelan	Location quotient for Douglas	Location quotient for Okanogan
NAICS Code	Total	38,939	10,832	17,179	2,844,391							
11	Agriculture, forestry, fishing and hunting	9,419	3,030	5,525	89,570	0.24	0.28	0.32	0.03	7.68	8.88	10.21
21	Mining	0	0	181	2,142	0.00	0.00	0.01	0.00	0.00	0.00	13.99
22	Utilities	0	0	44	4,827	0.00	0.00	0.00	0.00	0.00	0.00	1.51
23	Construction	1,348	378	451	126,993	0.03	0.03	0.03	0.04	0.78	0.78	0.59
31-33	Manufacturing	1,923	369	352	265,656	0.05	0.03	0.02	0.09	0.53	0.36	0.22
42	Wholesale trade	1,834	364	191	119,854	0.05	0.03	0.01	0.04	1.12	0.80	0.26
44-45	Retail trade	4,247	1,378	1,738	307,676	0.11	0.13	0.10	0.11	1.01	1.18	0.94
48-49	Transportation and warehousing	733	271	88	80,673	0.02	0.03	0.01	0.03	0.66	0.88	0.18
51	Information	411	161	136	103,561	0.01	0.01	0.01	0.04	0.29	0.41	0.22
52	Finance and insurance	662	136	214	87,144	0.02	0.01	0.01	0.03	0.55	0.41	0.41
53	Real estate and rental and leasing	425	114	122	43,149	0.01	0.01	0.01	0.02	0.72	0.69	0.47
54	Professional and technical services	772	244	207	162,889	0.02	0.02	0.01	0.06	0.35	0.39	0.21
55	Management of companies and enterprises	33	0	38	33,221	0.00	0.00	0.00	0.01	0.07	0.00	0.19
56	Administrative and waste services	583	202	177	136,020	0.01	0.02	0.01	0.05	0.31	0.39	0.22
61	Educational services	90	20	44	35,116	0.00	0.00	0.00	0.01	0.19	0.15	0.21
62	Health care and social assistance	4,788	661	1,176	327,373	0.12	0.06	0.07	0.12	1.07	0.53	0.59
71	Arts, entertainment, and recreation	487	343	116	45,000	0.01	0.03	0.01	0.02	0.79	2.00	0.43
72	Accommodation and food services	3,545	694	1,099	222,164	0.09	0.06	0.06	0.08	1.17	0.82	0.82
81	Other services, except public administration	1,194	317	643	132,114	0.03	0.03	0.04	0.05	0.66	0.63	0.81
GOV	GOVERNMENT	6,413	2,127	4,638	519,251	0.16	0.20	0.27	0.18	0.90	1.08	1.48
NEC	NOT ELSEWHERE CLASSIFIED	34	24	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Multiplier	4.23	3.37	2.64								

Data source: Employment Security Department 2014

Multiplier calculation for all industries: Year 2005

2005		Chelan	Douglas	Okanogan	Washington State	Chelan as percent of total	Douglas as percent of total	Okanogan as percent of total	WA state as percent of total	Location quotient for Chelan	Location quotient for Douglas	Location quotient for Okanogan
NAICS Code	Total	38,939	10,832	17,179	2,844,391							
11	Agriculture, forestry, fishing and hunting	8,657	2,881	5,035	83,155	0.23	0.28	0.29	0.03	7.69	9.41	9.74
21	Mining	0	0	53	3,301	0.00	0.00	0.00	0.00	0.00	0.00	2.58
22	Utilities	0	0	37	4,386	0.00	0.00	0.00	0.00	0.00	0.00	1.36
23	Construction	1,692	687	542	165,070	0.05	0.07	0.03	0.06	0.76	1.13	0.53
31-33	Manufacturing	2,113	219	219	267,703	0.06	0.02	0.01	0.10	0.58	0.22	0.13
42	Wholesale trade	1,392	334	315	118,698	0.04	0.03	0.02	0.04	0.87	0.76	0.43
44-45	Retail trade	4,501	1,086	1,681	310,299	0.12	0.11	0.10	0.11	1.07	0.95	0.87
48-49	Transportation and warehousing	724	349	158	80,950	0.02	0.03	0.01	0.03	0.66	1.17	0.31
51	Information	486	50	127	94,427	0.01	0.00	0.01	0.03	0.38	0.14	0.22
52	Finance and insurance	708	160	212	102,587	0.02	0.02	0.01	0.04	0.51	0.42	0.33
53	Real estate and rental and leasing	464	88	115	47,847	0.01	0.01	0.01	0.02	0.72	0.50	0.39
54	Professional and technical services	651	192	191	135,425	0.02	0.02	0.01	0.05	0.35	0.39	0.23
55	Management of companies and enterprises	51	0	0	33,313	0.00	0.00	0.00	0.01	0.11	0.00	0.00
56	Administrative and waste services	538	154	183	138,082	0.01	0.02	0.01	0.05	0.29	0.30	0.21
61	Educational services	93	0	0	29,023	0.00	0.00	0.00	0.01	0.24	0.00	0.00
62	Health care and social assistance	4,442	569	1,109	279,804	0.12	0.06	0.06	0.10	1.17	0.55	0.64
71	Arts, entertainment, and recreation	413	318	120	44,056	0.01	0.03	0.01	0.02	0.69	1.96	0.44
72	Accommodation and food services	3,216	718	1,175	215,078	0.09	0.07	0.07	0.08	1.10	0.91	0.88
81	Other services, except public administration	1,020	262	563	111,572	0.03	0.03	0.03	0.04	0.68	0.64	0.81
GOV	GOVERNMENT	6,271	2,073	5,316	501,953	0.17	0.20	0.31	0.18	0.92	1.12	1.70
NEC	NOT ELSEWHERE CLASSIFIED	45	52	64	0	0.00	0.01	0.00	0.00	0.00	0.00	0.00
	Multiplier	4.26	3.30	2.55								

Data source: Employment Security Department 2014

Appendix IV

Salmon Use in Hatcheries: An example of Direct Employment

Hatcheries have played an important role in providing jobs while attempting to supplement the wild stocks of salmon. In Washington State, the first hatchery was built on the Kalama River in 1895 and has continued to operate for more than a century (WDFW, 2014). The hatcheries industry has become an important part of the state's economy, along with an annual production of millions of fish for harvest by recreational and commercial fisheries (WDFW, 2014). Among the 83 hatchery facilities operated by the Washington Department of Fish and Wildlife, 75-80% are used to producing salmon and/or steelhead and another 20-25% rear trout and other game fish. In addition, 51 tribal hatcheries (45 NWIFC facilities, three Colville Confederated Tribes and three Yakama Nation) and 12 federal hatcheries also contribute to the statewide salmon harvest, which contributed over $1-billion to the state's economy according to estimates by the U. S. Department of Commerce (WDFW, 2014)

In recent years, state hatcheries also have taken on an equally important role in helping to recover and conserve the state's naturally spawning salmon populations. Nearly all the hatcheries in the Columbia River and a number of hatcheries in Puget Sound play a role in wild fish rebuilding programs, whether by rearing juveniles prior to release or holding fish through their lifespan to ensure the survival of depressed stocks. (WDFW, 2014) For example, in 2003, 235 million juvenile salmon were released from hatcheries in the Columbia River (NPPC, 2003). This renewed focus on wild stock recovery represents a major realignment in hatchery operations, as WDFW, the tribes, federal government and independent scientists worked to develop a comprehensive operations strategy for hatcheries in Washington.

Spring Chinook alevin or sacfry hatched from eggs
Photo from "Snake River Fall Chinook Recovery: A Tribal Success Story"

One major milestone was the mass marking of virtually all hatchery Coho and Chinook salmon released from state hatcheries. Using automatic fin-clipping machines, state hatchery crews mark

more than 100-million fish each year for release from state and tribal hatcheries, allowing for easy identification of hatchery salmon on the fishing grounds. Mass-marking laid the foundation for a new era in selective fisheries in which fishers are required to release wild, unmarked fish.

The Hatcheries Division is the largest single component of WDFW's Fish Program, with 298 FTE employees and a total operating budget of $63.9-million during the 2011-2013 Biennium, including $11.1-million from the State General Fund (WDFW, Conservation 2014).

Using hatcheries and 'artificially propagated' fish are tied with some contentious issues. When hatcheries were first introduced, the idea was that humans could exert control over the salmon life cycle and maintain a solid supply of fish for harvesting purposes (Williams, 2006). However, the salmon levels continued to fall because of overharvesting, habitat degradation and the virility of harvested salmon was not the same as the wild stocks. For instance, the wild Chinook stock continued to be the most productive in the Columbia basin, regardless of the number of artificially propagated ones (Williams, 2006). Because the wild salmon continue to outperform the hatcheries, people worry about 'hybridization'; or when wild salmon mate with farmed ones. Fears about this are well founded, as studies have shown that hybridization negatively affects fish fitness and reproductive success (Araki et al, 2010).

Appendix V

Conceptual model for First Foods with focus on salmon