Annual Costs of Wild Salmon Restoration Efforts in the Columbia River Basin

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Abstract

The goal of this project was to estimate the total annual cost of salmon recovery efforts throughout the Columbia River Basin from all stakeholders, including direct and indirect costs. How much is spent on salmon recovery efforts each year in the Columbia River Basin? Depending on who you ask, you will likely get a different number. There is no clearly defined cost for how much is spent on salmon recovery efforts each year in the Columbia River Basin. There are multiple federal, state, private, and tribal agencies throughout the Columbia River Basin that work with salmon restoration. Besides, there are numerous stakeholders indirectly involved with salmon restoration efforts. While many stakeholders work together to restore wild salmon populations, their costs are not easily identifiable and often not reported or distinguished from each other. Multiple state and federal agencies work with similar sources of federal funding that is often reported as a single value that also includes funding that supports other fish and wildlife activities. Various industries, including dam operation, transportation, agriculture, and tourism, all participate in salmon restoration but infrequently report the costs associated with those efforts. Even more important is how someone defines "cost." More specifically, how one defines an indirect cost is vital to calculating total salmon recovery efforts. One specific example of debate is forgone revenues of stakeholders. These forgone economic opportunities – lost electricity, transportation, farming, and Tribal over-the-bank salmon sales must be included to capture an overall restoration cost. There can also be lost intangibles that cannot easily be converted to economic measures (e.g., tribal ceremonial value). *I conclude that a minimum of $1.25 billion is spent annually throughout the Columbia River Basin by direct and indirect methods to recover salmon runs.*

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Introduction

The Columbia River Basin is the fourth largest river basin in the United States and produces more hydroelectric power than any other North American river system (GAO, 2018). The Basin covers parts of seven states and one province while impacting roughly eight million people who inhabit and work in the Basin (GAO, 2018). Hydroelectric projects and reservoirs in the Basin, including more than 35 major federal and non-federal dams (Figure 1), provide flood control and irrigation to more than six million acres of agricultural land (GAO, 2018).

Pacific salmon have played a significant role in the cultural, social, and economic development of communities around the North Pacific for many generations (Glavin, 2001). The importance of salmon in the Columbia River basin dates back thousands of years when the rivers of the Pacific Northwest produced abundant runs of salmon relative to the population. Native American use of Chinook salmon and other salmonids, has been documented in the region for over 9000 years (Butler and O'Connor, 2004; Johnson et al., 2018). Salmon once occupied nearly 13,000 miles of Columbia River Basin streams and rivers (CRITFC, 2018). Several sources have estimated that reaches of the Columbia River, above and below Bonneville Dam, once produced between 10 and 16 million salmon annually (NPPC, 1987; Mcconnaha et al., 2006; CRITFC, 2018). Other more conservative estimates projected run at 6.2 million fish (PFMC 1979; Mcconnaha et al., 2006).

Shortly after the arrival of white settlers in the Pacific Northwest, wholesale exploitation of salmon stocks began (Twitchell, 1989; Johnson et al., 2018). By the 1880s the Columbia salmon runs were diminishing at an alarming rate. This prompted federal, state, and provincial governments to begin management practices aimed at preventing future declines. Salmon in the Basin experienced broad declines linked to overfishing, water diversion projects, habitat destruction, connectivity reduction, introgression with hatchery-origin fish, hydropower development, and pollution (Twitchell, 1989; Johnson et al., 2018). The Columbia River Basin river system is now one of the most hydroelectrically-developed in the world (Johnson et al., 2018).

Hydroelectric power generation, agricultural practices, and other human activities have impaired water quality in some areas of the Basin to the point where historic salmon and steelhead stocks and human health are at risk (GAO, 2018). Today there are nine dams between the furthest inland salmon spawning tributaries in the mid-Columbia Basin and the ocean, and eight dams between the furthest inland salmon spawning Snake River tributaries and the ocean (Johnson et al., 2018). In total, more than 55% of the historically available spawning habitat in the Columbia River Basin is now blocked by dams (Harrison, 2008; Johnson et al., 2018).

Today, of the possibly 16 million wild salmon that once inhabited the Columbia Basin, only about 1% remain (Levin, 2016). The Columbia River Basin is now "the most endangered river system in the country" (Lacey, 2008). Twenty-eight salmon species face extinction on the West Coast and are protected under the Endangered Species Act (ESA), while others have been significantly reduced in their populations (NOAA, 2018).

As harvest and returns decline significantly, hatcheries production of salmon ramped up dramatically to mitigate salmon losses. The 20th century saw several salmon recovery programs, mostly mitigation through hatchery programs, for fishery impacts from the development of the river's hydroelectric potential (Mcconnaha et al., 2006). By 1905, 62 million eggs and fry were released by hatcheries in the Pacific Northwest (Cobb, 1921; Johnson et al., 2018). Hatchery mitigation intensified in the Columbia River in the 1960s, and by 1995 as much as 80% of the Columbia River Chinook salmon were hatchery-origin fish (Lichatowich and Mobrand, 1995; Johnson et al., 2018). In the early 2000s, hatcheries in the Columbia released some 235 million juvenile salmon and steelhead each year (NPCC, 2003; Mcconnaha et al., 2006). Today, around 143 million salmon and steelhead are released each year in the Columbia Basin from mouth to headwaters (Johnson, 2016).

We know what has caused the decline of salmons runs in the Columbia Basin, but how much will it cost to fix it? All of today's recovery and restoration efforts come at a cost. The question is, what is the accurate cost of these programs and projects? The answer is complicated, and even with the most accurate estimations, is based on a large number of assumptions. Depending on what you consider a cost, the estimations may vary greatly among agencies and stakeholders. This work will provide my best estimation of Annual Salmon Recovery Costs in the Columbia River Basin.

Federal Costs

The most extensive review to date within the Columbia River Basin on Salmon Recovery Costs was done in 2002 by the United States General Accounting Office (GAO) to the Ranking Minority Member of the Subcommittee on Fisheries, Wildlife, and Water, Committee on Environment and Public Works of the U.S. Senate. In a report titled "COLUMBIA RIVER BASIN SALMON AND STEELHEAD: Federal Agencies' Recovery Responsibilities, Expenditures and Actions" the GAO estimated that from 1982 through 2001, federal agencies expended about $6.4 billion dollars on salmon restoration in the Columbia Basin (GAO, 2002; Mcconnaha et al., 2006). On average, over the course of 20 years at least $320 million per year was spent on direct salmon restoration actions just through these federal sources, mostly through Bonneville Power's Fish and Wildlife programs that we will examine further in the paper. Over the last five years of the study ending in 2001, these annual costs averaged ~$360 million/year.

The 2002 GAO report found that 11 federal agencies, described below, are involved with salmon and steelhead recovery efforts in the Columbia River Basin. These 11 federal agencies are commonly referred to as the "Federal Caucus" and spend the majority of salmon recovery funding in the Columbia River Basin each year. The National Marine Fisheries Service, NMFS, is responsible for preparing recovery plans and consulting with other federal agencies to determine whether the agencies' planned actions will jeopardize listed salmon and steelhead populations. In addition to NMFS, the federal agencies involved in the recovery effort include the following: The U.S. Army Corps of Engineers (USACE) and the Bureau of Reclamation (BoR), which operate the Columbia River Basin dams that salmon and steelhead must pass, and the Bonneville Power Administration (BPA), which markets the electric power created by water flowing through the dams' turbines. The U.S. Forest Service (USFS), Bureau of Land Management (BLM), and U.S. Fish and Wildlife Service (USFWS) manage natural resources, which include habitat for salmon and steelhead, for multiple purposes, such as timber, grazing, fish, wildlife, and recreation. The Environmental Protection Agency (EPA), U.S. Geological Survey (USGS), Natural Resources Conservation Service (NRCS), and Bureau of Indian Affairs (BIA), which carry out various actions, such as setting water quality standards, performing research, working with landowners, and protecting tribal fishing rights, all of which, directly affect salmon and steelhead populations (GAO, 2002).

The Federal Caucus estimate they expended almost $1.8 billion (unadjusted for inflation) from fiscal year 1982 through fiscal year 1996 and about $1.5 billion (in 2001 dollars) from fiscal year 1997 through fiscal year 2001 on efforts specifically designed to recover Columbia River Basin salmon and steelhead (GAO, 2002). The $1.5 billion expended in the last

five fiscal years consists of $968 million that federal agencies spent directly (Table 1) and $537 million that the federal agencies received and then provided to non-federal entities, such as states and Indian tribes (Table 2). The four largest federal agencies accounted for about 88 percent of the $968 million that the federal agencies expended in the last five fiscal years (GAO, 2002). The non-federal entities that receive federal funds include multiple states, tribes, government consortium groups, such as the Columbia Basin Fish and Wildlife Authority and the Northwest Power Planning Council (NWPPC), and fish conservation organizations. About $353.7 million of the $537.2 million was provided to states and tribes, (Table 3) (GAO, 2002). Highlighted in the 2002 GAO report were the following expenditures and projects associated from the various agencies. The USACE, expended about $590 million primarily on projects such as improving the passage of juvenile salmon and steelhead at the dams. The USFS expended about $106 million primarily on ESA consultations and projects, such as habitat improvement, land acquisition, watershed restoration, in-stream habitat improvement, and improving passage at culverts and small dams that block salmon and steelhead passage. The USFWS expended about $97 million primarily on salmon and steelhead hatcheries. The U.S. BoR expended about $62 million primarily on recovery projects such as water acquisition, augmenting existing water sources, and habitat acquisition.

In addition to the $1.5 billion described above, the 11 federal agencies estimated that they expended $302 million (in 2001 dollars) in the last five years on modifications to projects that benefited, but were not specifically directed at, salmon and steelhead, such as erosion control to improve crop productivity and wildlife habitat, which also improves stream flows and reduces sedimentation in spawning habitat (GAO, 2002). These additional indirect expenditures included technical assistance and funding for private land conservation and research that evaluates the effect of diet, growth regime, and environment on the development of salmon. It must be noted that some of these costs are for all salmon species, not just Columbia River Basin fish and some agency values are estimated (Table 4) (GAO, 2002). Including these additional costs, the average federal spending on salmon recovery efforts in the Columbia River Basin is approximately $360 million/year.

Another key federal funding source for salmon recovery in the Columbia Basin is the Pacific Coastal Salmon Recovery Fund (PCSRF). NOAA Fisheries, the agency charged with administering PCSRF's competitive grants process, has awarded states and tribes an average total of $77 million annually since 2000 (NOAA, 2018). The recovery fund was allocated $65 million for fiscal year 2017 (NOAA, 2018). Since 2000, the PCSRF received $1.35 billion in Congressionally appropriated funds, and leveraged over $1.69 billion in non-PCSRF contributions (NOAA, 2018). The GAO report from 2002 is a good resource for a snapshot of federal spending on salmon recovery efforts in the Columbia River Basin, but it does have

limitations. One of the clear limitations is understanding all of BPA's costs. While the costs of BPA's direct-actions are noted, BPA makes reference to the underestimation of costs in a letter to the GAO regarding the first draft of the report. BPA stated to the GAO that direct costs, capital costs, reimbursed costs, replacement power, and lost revenues should be included in BPA's actual expenditures for salmon and steelhead recovery. BPA states that their actual costs from fiscal years 1997-2001 were over $3 billion as compared to $378 million in the original draft report (GAO, 2002). This is a critical disagreement when looking at both direct and indirect costs associated with salmon recovery in the Columbia River Basin.

This paper will account for the indirect costs BPA mentions, but this is a hot topic among various stakeholders. There are a number of stakeholders on both sides of the debate that will argue for or against counting these costs. In this paper, I will consider these costs associated with salmon recovery, but it should be noted that expenses like forgone revenue never involve the exchange of real money.

If we include BPA's additional cost requests, the actual costs of federal agency spending from 1997-2001 were slightly over $3.3 billion (BPA Cost Table, 2018). However, the same BPA cost table shows that while expenses were just over $3.3 billion, BPA received credits of $744.9 million. If you only include these additional expenses from BPA, the total federal salmon recovery expense would equal just over $4.7 billion for years 1997-2001. This would bring the average federal salmon recovery expenses to $940 million per year. This costs estimation per year is much larger than the previous $360 million year when not including BPA's additional indirect costs.

Not everyone agrees on how these costs should be calculated. Landry (2003) estimated that the federal government, conservatively, spends $400 per fish in its efforts to keep salmon swimming through the tributaries of the Columbia and Snake River basins in Oregon, Washington, and Idaho. Landry (2003) stated that "The General Accounting Office's 2002 study was one of the first studies to describe federal salmon and steelhead recovery projects and to quantify the amounts of money spent on preserving salmon. He noted that the study found "little conclusive evidence to quantify the extent of the projects' effects on returning fish populations" (GAO, 2002). Landry stated that some of the GAO-reported activities do not really qualify as recovery projects, including research studies, monitoring actions, surveying spawning grounds, and ESA required consultations. Few activities are on-the-ground experiments in recovery management (Landry, 2003). Here lies a key difference in how recovery costs are calculated.

Landry's (2003) efforts to quantify the costs of salmon recovery suggest that the costs are much higher-approximately $2.9 billion over five years or $575.7 million per year. Landry summarized expenditures from 1998-2002 through direct communication with departments and agencies heavily involved in salmon recovery (Landry, 2003). Landry states that "it avoids or at least minimizes double counting by considering various cost reimbursement agreements between agencies". Unlike the GAO report, this study includes the cost of reduced power generation (the amount of hydropower forgone) due to salmon recovery efforts (Landry, 2003).

Landry states that "Most agencies do a poor job of accounting for salmon recovery expenditures". There is an argument to be made that calculating expenditures is more challenging as many agencies do not do a very good job of highlighting funding sources in public records. As Landry noted, BPA records expenditures as a salmon recovery-related project when it allocates money to the USACE for cost reimbursement and the USACE records the same money as a salmon related expenditure when funds are allocated. The end result would be an overstatement of expenditures unless the funds are tracked properly (Landry, 2003). It is very possible that many of the reported values from the GAO report and other agency reports include double-counting of total expenditures.

This same perspective on costs was also shared by Dr. William Jaeger, an Applied Economics Professor at Oregon State University. Dr. Jaeger shared the difficulties "in trying to reconcile the various figures from the different programs. Some of these are 'double counting' and some are not. Others (BPA Power Purchases and BPA Foregone Revenue) are the result of creative accounting, and not real dollars being spent to restore salmon". I agree with Dr. Jaeger that forgone revenue is suspect because there is not actually money gained/lost or even exchanged. Deciding how to account for these costs or expenses can lead to large discrepancies among counting costs.

Today, the U.S. Army Corps of Engineers (USACE), the Bureau of Reclamation (BoR) and the Bonneville Power Administration (BPA), called "Action Agencies," currently fund more than $500 million in actions each year to benefit fish and wildlife (BPA, 2016). Funding is provided by the electric ratepayers who purchase the power produced by federally operated dams on the Columbia and Snake rivers, as well as by federal taxpayers who fund activities for nonpower project purposes such as flood risk management and navigation (BPA, 2016). The largest funding agency in the Upper Columbia salmon recovery funding mix is the Portland-based Bonneville Power Administration (BPA).

According to John Tyler, Public Affairs Specialist at BPA, approximately $700 million/year is spent by BPA on their Fish and Wildlife Program. Of that $700 million/year, roughly $250

million is spent annually on implementing on the ground projects with a majority focused on salmon recovery (Tyler, 2019). The remaining ~$450 million per year is spent on operational costs, capital improvements, debt payback, and foregone revenues. The total amount spent from the three action agencies alone represents about $950 million/year spent on salmon recovery efforts, including direct and indirect expenses. Including the remaining seven federal agencies, I can estimate that at a minimum $1 billion/year is spent on salmon recovery efforts in the Columbia River Basin by federal agencies alone. Including all indirect expenses and funding provided to non-federal agencies and organizations, I estimate the actual federal salmon recovery efforts could be as high as $1.25-1.3 billion annually. Again, this estimate is based on my interpretation of indirect costs which could be inflated due to the potential of double-counting costs.

Looking closer at the Annual Fish and Wildlife Spending of BPA you can see where the distinction between direct and indirect costs can become complicated. For 2018, BPA reported total fish and wildlife costs of approximately $480.9 million (NPCC, 2019). The 2018 Columbia River Basin Fish and Wildlife Program Costs Report states the following expenditures:

- $258.7 million in direct (expense) costs which pays for projects such as habitat improvements, research, and some fish hatchery costs.
- $89.9 million in reimbursements to the federal Treasury for expenditures by the USACE, BoR, and USFWS for investments in fish passage and fish production, including expenses of federal fish hatcheries.
- $105.1 million for debt service (interest, amortization, and depreciation) of capital investments for facilities.
- $2.9 million in forgone hydropower sales revenue.
- $24.3 million in power purchases.

What is not included in these costs is the $83.2 million borrowed from the U.S. Treasury in 2018 for capital projects, software development costs, and federal projects as part of the Columbia River Fish Mitigation Program (NPCC, 2019). The borrowed Treasury money was not included because these costs, in addition to debt service on capital investments, would double count some costs. What is more interesting is that the BPA total does not count a credit of $70.1 million from the federal Treasury. If counted, then BPA's annual cost would be $410.8 million. Additional 2018 costs found in the annual report were the estimated cost for court ordered spill of $38.6 million, $10.1 million spill surcharge to customers, and a reduction in the fish and wildlife budget of $20 million (NPCC, 2019).

The most controversial annual BPA costs relate to the estimation of forgone revenue when calculating charges for ratepayers. According to BPA, they expect annual total foregone

revenue and power purchases to roughly amount to $200 million per year, but the variation can be extremely large (Tyler, 2019 and NPCC, 2019). The results from the 80 years of water modeling have found an annual total range of approximately $21 million to $314 million in costs to BPA (NPCC, 2019). The counting of this large variation in total costs divides many stakeholders when calculating BPA's total costs. According to Mr. Tyler at BPA, annual Fish and Wildlife Costs are ~$700 million, but in 2018 the actual number was below $500 million, according to BPA's annual Report (NPCC, 2019).

Another topic of debate relating to salmon recovery costs from BPA money is the direct fish and wildlife spending. While $176 million is spent on anadromous fish, other funds are directed towards resident fish, wildlife, and program support (Figure 2). For my calculations, I consider all of these relevant costs to salmon recovery. Direct costs relate to the anadromous portion while indirect costs would include other fish species, wildlife, and program support. These indirect costs are important because much of the work surrounding resident fish species involves water quality and habitat, both of which are important to and benefit salmon recovery even though salmon recovery is not the primary goal. Wildlife money can also be considered when evaluating water quality and habitat as well, especially erosion control which is important to spawning salmon. Program support is another often overlooked expenditure as programs must be managed and evaluated to understand what is needed and what actions are taken to support salmon recovery in the Basin.

While BPA's funding and cost calculation can be complex and controversial at times, many other federal programs and agencies can also be as challenging to analyze. In 2018, the GAO released a study titled '*Columbia River Basin: Additional Federal Actions Would Benefit Restoration Efforts*.' The purpose of the study was to review restoration efforts in the Columbia River Basin, especially water quality improvement efforts, while also tracking the sources of funding and federal funding expenditures for the Columbia River Basin (GAO, 2018). While this study did not directly address salmon recovery, these efforts and expenditures can be seen as indirect costs associated with salmon recovery as improvements to water quality benefit salmon recovery. GAO found that most agencies and their restoration efforts were funded through a mix of federal and non-federal sources. The report also stated that "total federal expenditures for restoring the Columbia Basin could not be determined." Instead, they provided sample data from five agencies gathered through surveys (see below for survey results).

Table XX. Federal Expenditures Captured through a 2018 GAO Report (18-561) on Water Restoration Efforts as described above. (GAO, 2018.)

Federal agency	Restoration effort	Federal expenditures by fiscal year (in millions of dollars)			Total
		2014	2015	2016	
U.S. Army Corps of Engineers	Ecosystem Restoration Programs[a]	6.59	3.55	5.52	**15.66**
Bonneville Power Administration	Columbia River Fish & Wildlife Program[b]	85.53	94.42	96.67	**276.62**
Environmental Protection Agency	Lower Columbia Estuary Partnership[c]	9.49	5.94	21.74	**37.17**
U.S. Forest Service	Pacific Northwest Region Watershed and Aquatic Restoration	17.58	36.15	37.89	**91.62**
U.S. Geological Survey	National Water Quality Programs[d]	12.11	14.70	12.93	**39.74**

The complexity of calculating federal salmon recovery costs is complicated and compounded by the simple argument that the federal government doesn't know where the real and accurate costs of salmon recovery stand within its budgets. Any cost is an estimation gathered through funding sources often never organized or in agreement with other agencies and stakeholders. Often expenses are simply lumped into large programs that are not solely dedicated to salmon recovery or are simply not tracked due to a lack of funding requirements. I believe it is safe to estimate a minimum of $1 billion is spent on salmon recovery efforts in the Columbia River Basin through both direct and indirect federal sources.

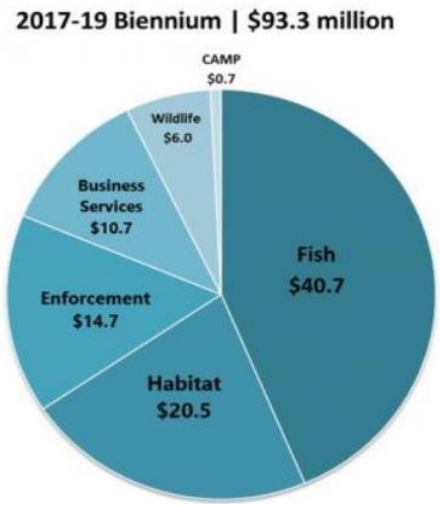
State Costs

Calculating the total cost of salmon recovery efforts in the Columbia River Basin also required an analysis of state costs and expenditures. At least 11 federal agencies spend a majority of the salmon recovery expenses in the Basin. However, each state has around 12 agencies that one could argue fund direct or indirect salmon recovery programs. The states of Washington, Oregon, Idaho, and British Columbia spend the bulk of salmon recovery dollars in the Basin, but other states with boundaries within the Columbia River Basin like Wyoming, play an indirect role in recovery expenditures. The Basin stretches across seven states total (Appendix #1). Each of these states plays a role in the Basin's management therefore, it can be said have an indirect role in salmon recovery.

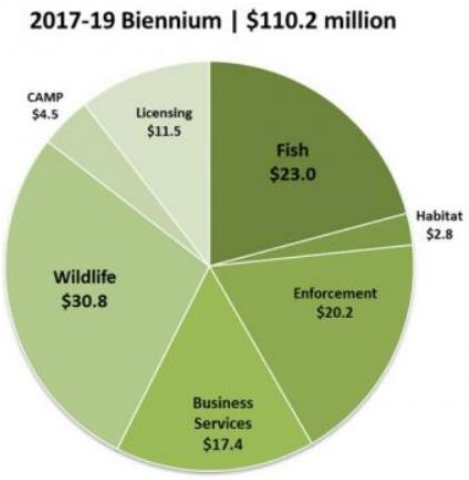
Salmon are anadromous fish spending a majority of their lives in the ocean. Considering this aspect, efforts taken in Alaska and ocean management can be counted towards indirect recovery costs. Oregon and Washington both have ocean salmon programs dedicated to protecting salmon before they enter river bodies to spawn. The complexity of calculating salmon recovery costs grows with each state and stakeholder involved. To further complicate

state spending, a majority of state funding throughout the Basin is from federal sources and is not easily identifiable through the multitude of agencies and programs within each state. Based on my estimations, at least $200 million annually is spent from state sources, excluding federal costs already stated above, on salmon recovery efforts. The most difficult challenge with calculating state spending is not double-counting funds provided through federal sources.

Washington State is the largest funder of salmon recovery in the Columbia Basin followed by Oregon and Idaho. Two of the largest funders of salmon recovery dollars in WA are the Washington Department of Fish and Wildlife (WDFW) and the Washington State Recreation and Conservation Office (RCO). WDFW's operating budget for Fiscal Years 2017-2019 was $437.6 million or $218.8 million per year (WDFW, 2017). Of this operating budget, 27% or $118.8 million was from federal funding. The remaining funds consisted of local, state general, wildlife, and other funds other than federal sources. State spending on average over the two-year cycle was $159.4 million per year on all WDFW programs. Looking at the state's general fund breakdown, below, just over $20 million annually is spent on fish related programs.



WDFW State General Funds 2017-19.



WDFW Wildlife Funds 2017-19.

One must consider that fish programs in Washington and Oregon have Marine/Ocean programs that account for costs, as seen in both ODFW and WDFW budgets. Here I will consider that the total fish expenditures in both state general and wildlife funds will have a direct or indirect impact on salmon recovery in the Columbia River Basin. There is also a habitat improvement, enforcement, and program support element that is extremely difficult to breakdown and capture for this study. WDFW alone contributes at least $30 million annually in salmon recovery programs within the Columbia River Basin.

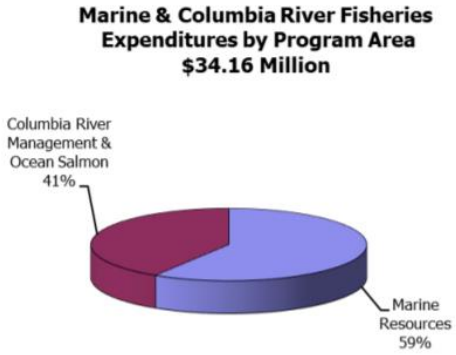
Another major funding agency in the State of Washington is the Recreation and Conservation Office. Since 1999, this agency has invested $1,002,570,328 in salmon recovery statewide (with an estimated 25.05%) with $251,140,348 going into the Columbia Basin, according to Director Kaleen Cottingham. Of the ~$83 million invested annually throughout the state, approximately 48% or ~$40 million goes to support programs in the Columbia River Basin (Cottingham, 2019). In addition, the RCO is also involved in the following projects during this time period: Review Panel $406,537, Monitoring Panel $224,720, Lead Entities $3,300,000, Regions $6,509,062, Monitoring contracts $3,232,095, and Hatchery reform contracts $230,314 at ~$6.9 million per year.

Statewide numbers for 2017-2019 biennium	
PCSRF awards expected or received year 1	18,800,000
PCSRF Year 2	18,800,000
SRFB appropriation	16,500,000
PSAR appropriation	40,000,000
FFFPP appropriation	5,000,000
ESRP appropriation	8,000,000
Chehalis Basin	47,616,483
WCRI	12,500,000
TOTAL	167,216,483

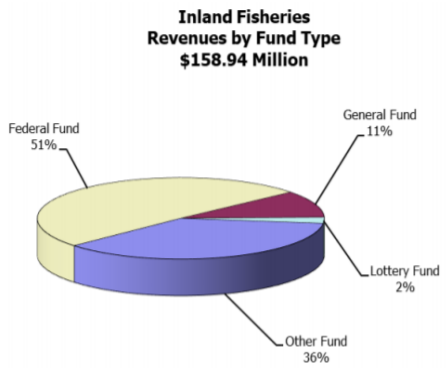
PCSRF = Pacific Coastal Salmon Recovery Fund (Federal)
SRFB = Salmon Recovery Funding Board appropriation (state bond funds)
PSAR = Puget Sound Acquisition and Restoration appropriation (state bond funds)
FFFPP = Family Forest Fish Passage Program appropriation (state bond funds)
ESRP = Estuary and Salmon Restoration Program appropriation (state bond funds)
Chehalis Basin appropriation (state bond funds)
WCRI = WA Coastal Restoration Initiative (state bond funds)

During the same fiscal period, the State of Oregon operated with $358,115,884 total funds with $133,139,592 being from federal funds over the two-year cycle (ODFW, 2017). The Fisheries Division expended $34.1 million to the Marine and Columbia River Section with $13.3 million from federal sources. State funds accounted for $10.4 million per year with 41% of all marine funds directed towards to Columbia River Management and Ocean Salmon, see below

(ODFW, 2017). Inland fisheries over the same period received just over $158 million or $79 million annually with $40.2 million from federal sources each year, see below (ODFW, 2017).



ODFW Approved Marine and Columbia River Budget 2017-19



ODFW Approved Inland Fisheries Budget 2017-19

It is tough to determine the exact percentage breakdown of each state's annual commitment to salmon recovery. Other departments and sections within WDFW and ODFW contribute to salmon recovery such as program support and enforcement. Based on the data above from the 2017-2019 Legislative Approved ODFW Budget and programs, I can estimate that at least $70 million annually is spent on direct and indirect salmon recovery efforts in the Columbia River Basin from ODFW and WDFW and another ~$40+ million from the Washington RCO.

Other State agencies like the Oregon Water Enhancement Board (OWEB) play an important role in salmon recovery across the Basin. OWEB is funded primarily with Measure 76 Lottery Funds and federal funds from the Pacific Coastal Salmon Recovery Fund (PCSRF) and also receives revenues from the sales of salmon license plates (OWEB, 2018). OWEB's 2017-19 budget was $34.3 million with $25.9 million from federal sources. Overall, OWEB contributes just over $4 million to statewide water projects. State Department of Transportation Offices also contributes to salmon recovery efforts. In the 2017-19 biennium, approximately $97.5 million will be spent on stand-alone projects that correct fish passage barriers in the State of Washington (WADOT, 2019).

One difficulty with agencies like OWEB is breaking down salmon recovery costs as funds are generally approved by project and work areas rather than species-based improvements or vice-versa. Based on previous grant funds administered about half improve areas within the

Columbia River Basin according to Andrew Dutterer, Partnerships Coordinator at OWEB (Personal Communications with Dutterer, 2019).

Washington and Oregon spend a majority of the state resources on salmon recovery within the Columbia River Basin, but they also receive the most federal funding. Idaho spent just over $38.8 million in 2017 on its state fishery programs (Kline, 2019). Of these expenditures, just over $15.7 million was from state funds and the remaining from federal sources. Speaking with Paul Kline, Deputy Director of Programs and Policy with the Idaho Fish and Game (IDFG), he mentioned that capturing accurate salmon recovery costs is extremely difficult even for an agency in itself. One specific challenge is found with matching funds. There are some recovery program funds from NMFS that can be matched with BPA funds the state already receives. Based on IDFG spending and programs and the other state agencies involved in direct or indirect salmon recovery efforts, I estimate that Idaho spends $25 million a year on salmon recovery within the Columbia River Basin. Looking at all states and provinces involved and the multitude of agencies, I estimate that $200-250 million is spent annually in the Columbia River Basin from state-only funding.

Additional Costs

Salmon recovery measures such as modified timings of dam releases, reservoir drawdown, and flow augmentation of the Columbia River Basin can have impacts on power rates, grain transportation costs, irrigation water costs, and reductions of supply to irrigators in agricultural sectors throughout the Columbia River Basin. Studies on the effects of ESA-related salmon recovery measures have found that these impacts could reduce agricultural producer's profits by more than $35 million per annum (Aillery et al., 1999). This study is quite outdated but focused on the upper Snake River Basin and only represents a small portion of the overall Columbia River Basin. It is important to recognize the scope of agriculture and shipping throughout the Columbia River Basin and its costs related to salmon recovery. I estimate that transportation and agriculture industries spend $25-50 million a year in expenses associated with salmon recovery. These items include shipping, irrigation methods, water use, and water quality related programs.

Non-governmental organizations play an important role in salmon recovery efforts throughout the Columbia River Basin. Save Our wild Salmon, an NGO advocacy organization, has an annual budget is about $250K. Their primary sources of income are non-government grants and individuals per director, Joseph Bogaard. According to Mr. Bogaard,

"The big spenders are not the members of the NGO community, but the federal agencies (using energy consumer and taxpayer dollars) planning and executing salmon programs – they spend many hundreds of millions of dollars annually on often ineffective programs. Estimated spending over the past 25 years by federal agencies on Columbia Basin salmon recovery programs is $16B based on 5 consecutive illegal plans dating back to the 1990s. Despite much time and spending, no listed salmon/steelhead populations recovered".

Save Our Wild Salmon is one of many NGO's in the Columbia River Basin that either spend directly or indirectly on salmon recovery efforts. I can estimate that at least 50 NGO's operate within the Columbia River Basin that have costs directly or indirectly related to the recovery of salmon. These NGO groups range from fishing clubs like the Northwest Steelheaders, conservation groups like Save Our Wild Salmon, and water advocates like WaterWatch to large environmental NGO's like Sierra Club. Based on an estimation of $250,000 costs per group, at least $12.5 million is spent annually within the Columbia River Basin, impacting salmon recovery.

Salmon Recovery and Restoration efforts are complex and expensive. Even more problematic is the task of trying to decipher multiple stakeholder budgets and accounting ledgers when there is no standardized format. One of the biggest challenges facing estimating salmon recovery costs is tracking down expenses without double-counting. There is a reason why no one I met with or talked to had the slightest idea of what salmon recovery efforts in the Columbia River Basin cost. My estimations are my best attempt to sift through the clutter and discrepancies and provide an unbiased account of real spending. ***I conclude that a minimum of $1.25 billion is spent annually throughout the Columbia River Basin by direct and indirect methods to recover salmon runs.***

Appendix and Tables

Appendix #1: Map of the Columbia River Basin. Source: U.S. Army Corps of Engineers from GAO Report 18-561, 2018.

Figure 1: Major Dams on the Columbia River. Source: Source U.S. Army Corps of Engineers from GAO Report 18-561, 2018.

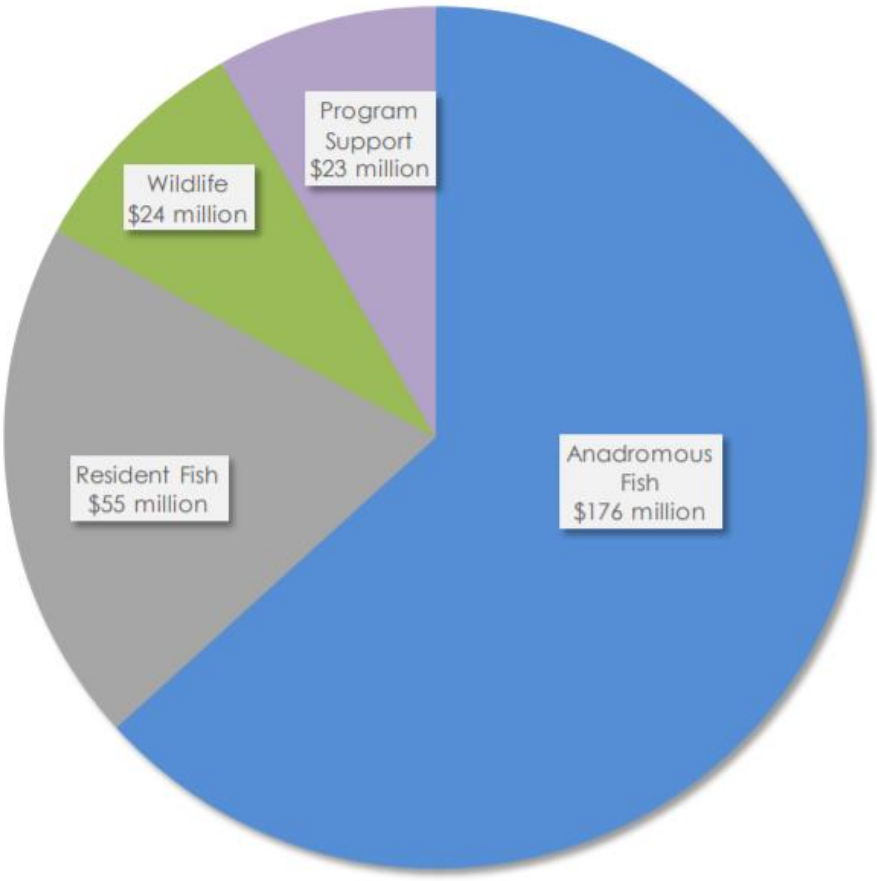


Figure 2: Cost by Species FY 2018 from BPA 2018 Annual Budget. Source: 2018 Columbia River Basin Fish and Wildlife Program Costs Report: 18TH ANNUAL REPORT TO THE NORTHWEST GOVERNORS. (NWPCC, 2019).

Exhibit 1: PCSRF Awards to States and Tribes in millions. Source: National Oceanographic and Atmospheric Administration (NOAA). 2018.
Pacific Coastal Salmon Recovery Fund FY 2017 Report to Congress.

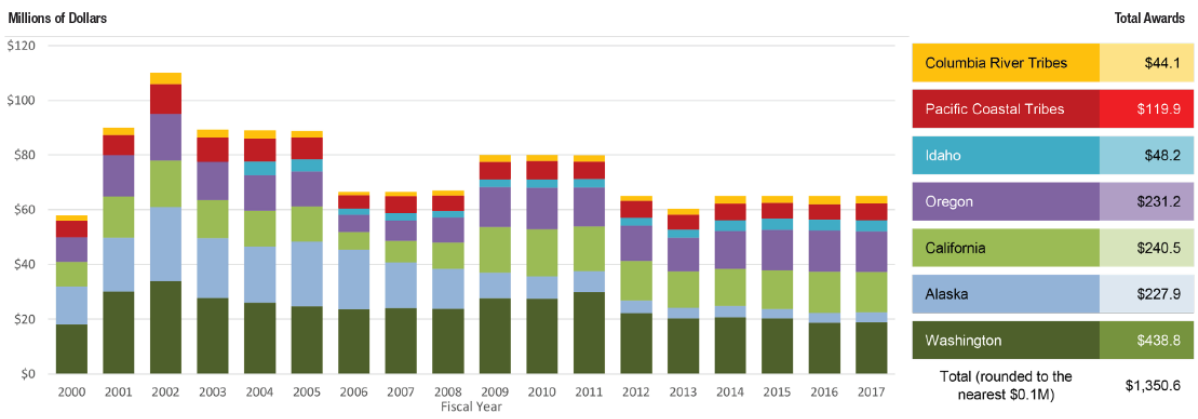


Table 1: Estimated Total Salmon and Steelhead Expenditures by Agency and Fiscal Year. Source: GAO Report 02-612, 2002.

Table 1: Estimated Total Salmon- and Steelhead-Specific Expenditures, by Agency and Fiscal Year

Dollars in thousands						
Agency[a]	**1997**	**1998**	**1999**	**2000**	**2001**	**Total**
Corps	$114,616	$131,469	$109,818	$104,370	$129,434	**$589,707**
Forest Service	25,219	20,025	18,498	19,844	22,100	**105,686**
FWS	18,525	18,058	18,481	19,074	22,593	**96,731**
BOR	15,482	12,787	10,577	14,574	8,465	**61,885**
NMFS	5,803	8,698	9,236	11,656	13,150	**48,543**
Bonneville	5,533	4,913	5,608	4,507	5,444	**26,005**
USGS	4,577	4,298	3,558	3,359	3,713	**19,505**
BLM	2,009	2,261	2,315	2,321	2,850	**11,756**
NRCS	1,912	1,119	1,359	1,653	1,697	**7,740**
BIA	59	70	68	66	99	**362**
EPA	10	15	14	14	14	**67**
Total	**$193,745**	**$203,713**	**$179,532**	**$181,438**	**$209,559**	**$967,987**

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