The Economic Value of Rogue River Salmon

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EXECUTIVE SUMMARY

In 2008, the ***Save the Wild Rogue Campaign*** engaged ECONorthwest to analyze the economic value of salmon and steelhead in the Wild & Scenic Rogue River. In this report, we summarize the results of our analysis, which is based on peer-reviewed, published research, results from the Oregon Population survey, and fish-count data published by the Oregon Department Fish and Wildlife.

Salmon are the quintessential icon of the Pacific Northwest with significant cultural and economic value. Based on the results of more than ten years of household surveys, Oregonians overwhelmingly and consistently state that protecting and enhancing salmon habitat is important.

West Coast residents alone enjoy more than $1.5 billion in economic benefit each year from the entirety of all Rogue River salmon and steelhead runs. Maintaining the current level of protection on the Rogue may not be sufficient to ensure that current and future residents will be able to enjoy this level of economic benefit.

In this analysis, we develop estimates for only three of the economic values associate with Rogue River salmon: commercial fishing, sport fishing, and non-use value. Non-use values represent the vast majority of the economic value of Rogue River salmon.

- $1.4 million annually associated with commercial fishing
- $16 million annually associated with sport fishing
- $1.5 billion annually associated with non-use values

For more than a decade, Oregonians have consistently stated that improving salmon habitat is important and have expressed a willingness to pay more than $70 million dollars per year to enhance salmon habitat in Oregon.

Oregon and Washington residents state a willingness to pay more than $800 per fish to increase Northwest salmon populations

The Wild & Scenic Rogue River is a national treasure. Each year, tens of thousands of rafters, anglers, hikers, and other sightseers visit the river, and recreate in or along it. Its cultural importance to many Americans is comparable to our most majestic National Parks and National Monuments.

Healthy salmon habitat is a necessary condition underlying the Wild & Scenic Rogue River's rich ecological abundance as well as the values derived from it. Today, while many salmon runs in the Northwest are either endangered or threatened, the majority of the Rogue's salmon runs remain relatively strong. Over the past decade, salmon and steelhead counts at Gold Ray Dam average nearly 87,000 fish annually. As residential and commercial development continues to degrade Northwest rivers, it becomes increasingly important to protect the scarce, healthy rivers such as the Wild & Scenic Rogue and its tributaries.

As global warming threatens to bring drastic weather changes to the Rogue Valley, the importance of streams flowing into the Rogue will only increase. They provide critical spawning grounds and cold water refugia for salmon and steelhead. Increasing protection for these streams may serve to offset some of the

adverse impacts on the Rogue River anticipated as the region experiences changes in climate in the coming years. The cold water provided by these streams will help mitigate increasingly warm summer water temperatures in the Rogue.

Enhanced protection of the critical streams that flow into the Wild & Scenic Rogue River is a virtually costless action that will lead to significant economic benefits for both the present and future generations. In light of the economic downturn currently facing the nation, the need for both immediate and long-term economic payoffs has never been greater. Investments in the protection of salmon habitat in the Wild & Scenic Rogue will continue to provide economic benefits to society for many generations. The results presented in this report demonstrate that Rogue River salmon and steelhead provide large net benefits to society. Policy-makers should take steps now to protect the Wild & Scenic Rogue River habitat so that society may begin reaping the benefits of these actions today.

INTRODUCTION

The Save the Wild Rogue Campaign engaged ECONorthwest[1] to analyze the economic value of salmon and steelhead in the Wild & Scenic Rogue River. In assessing this value, ECONorthwest considered the benefits of salmon to the commercial fishing industry, to sport anglers, and for their intrinsic value to residents of Oregon and the West Coast. It is important to recognize the limitations of this analysis. Salmon have significant cultural value to Northwest Tribes, they provide benefits to the entire ecosystem of the Rogue Valley, and they are a valuable source of food for marine mammals. ECONorthwest did not attempt to evaluate the economic value of these important cultural and biological benefits. Thus, the values in this report should be viewed as lower bound estimates of the true economic value of salmon.

The Rogue River is extraordinary, both as a river and as salmon and steelhead habitat. Located in the southwestern corner of Oregon, the Rogue River flows approximately 215 miles from its headwaters in the Cascade Range, near Crater Lake, reaching the Pacific Ocean at the city of Gold Beach. In 1968 Congress designated an 84-mile stretch of the Rogue River from the confluence of the Applegate River (seven miles downstream of the City of Grants Pass) to the Lobster Creek Bridge (11 miles upstream of Gold Beach) as a National Wild and Scenic River. The Rogue River was one of the original eight rivers included in the Wild and Scenic Act, which protects from development or degradation certain rivers or river segments that have national significance.

The Wild and Scenic section of the Rogue River provides important habitat for a variety of wildlife including spring and fall Chinook, summer and winter steelhead, and coho salmon. This section of the river and its tributaries serve both as spawning grounds for certain anadromous fish and as an important migratory path for other anadromous species as they travel upstream to spawn or from spawning grounds to the ocean. The water quality in this section of the river and its tributaries affects the health of salmon and steelhead. Normal fish growth and productivity increases depend on cold stream temperatures, which helps regulate salmonid metabolic function. As stream temperatures rise, abnormal fish behaviors and mortality increase.[2]

According to the National Marine Fisheries Service, the survival of Pacific Northwest salmon and steelhead—and the commercial harvests they support—depend on protecting and restoring habitat diversity and migratory connections among habitats.[3] The Rogue River is the spawning, rearing, and migration site for nearly 100,000 anadromous fish returning from the ocean each year. Only the

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[1] Throughout this report, the terms "we," "our" and "us" refer to the authors of this report at ECONorthwest.

[2] Heyn, K. 2008. White Paper on the Biological Contributions of Tributary Streams to the Wild Rogue River, Oregon. American Rivers.

[3] NOAA's National Marine Fisheries Service. 2006. *Salmon Habitat*. Retrieved December 1, 2008, from http://www.nwr.noaa.gov/Salmon-Habitat/index.cfm.

Columbia River produces more Pacific Salmon in the state of Oregon.[4] As salmon populations in other rivers in the Pacific Northwest decline, healthy habitats such as the Rogue River become even more important and valuable.

Conserving healthy salmon populations also reinforces recreational, aesthetic, and other economically significant amenities in the Pacific Northwest. Workers benefit from healthy salmon habitats by living amid high-quality natural-resources amenities. In effect, workers receive a second paycheck—denominated in access to scenic vistas, outdoor recreation opportunities, etc.—that augments the first paycheck earned through work and investments. In fact, evidence suggests that the second paycheck is great enough to offset the potential benefits that would accrue from attracting more businesses to the region through environmental deregulation. In a 1993 survey, the Oregon Business Council asked Oregonians, "Which is more important to economic growth in Oregon? Relax environmental regulations to make it easier for companies to do business or maintain a quality environment to attract people and companies to Oregon?" Of the 90 percent of the respondents who had an opinion, over four times as many wanted Oregon to "maintain a quality environment" than to "relax environmental quality.[5]

High environmental quality standards do not indicate that businesses have fewer incentives to locate in the Pacific Northwest region. The quality of life in the Pacific Northwest, characterized largely by its natural resources, also attracts new residents who often have higher levels of education than current residents and they often are willing to accept reduced earnings to live in the Pacific Northwest.[6] Attracting high-quality workers at lower costs relative to other regions of the country, helps businesses in the Pacific Northwest compete with firms elsewhere, thus strengthening this region's economy.

Studies of federal lands in the Pacific Northwest found that, on a per-acre basis, the economic value of fishing exceeds the values of all other recreational activities.[7] Protecting salmon habitats helps improve the quality of other recreational activities, such as fishing and boating, which enhance the economic value of the region's natural resources.

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[4] Heyn, K. 2008. *White Paper on the Biological Contributions of Tributary Streams to the Wild Rogue River, Oregon*. American Rivers.

[5] Oregon Business Council. 1993. *Oregon Values and Beliefs: Summary.* May.

[6] Judson, D.H., S. Reynolds-Scanion, and C.L. Popoff. 1999. "Migrants to Oregon in the 1990's: Working Age, Near-Retirees, and Retirees Make Different Destination Choices." *Rural Development Perspectives* 14 (2): 24-31.

[7] Forest Ecosystem Management Assessment Team. 1993. *Forest Ecosystem Management: An Ecological, Economic, and Social Assessment.* Forest Service, Fish and Wildlife Service, National Marine Fisheries Service, National Park Service, Bureau of Land Management, and Environmental Protection Agency. 794-478. July.

SALMON AND THE ENDANGERED SPECIES ACT

Twenty-nine species of West Coast salmon and steelhead are listed as either endangered or threatened under the Endangered Species Act (ESA) and two species are listed as a species of concern.[8] Table 1 summarizes the 2008 ESA listings for West Coast salmon and steelhead. Coho salmon, which use the Wild & Scenic section of the Rogue River as a migratory path to spawning grounds on the Upper Rogue River, are a threatened species. Coho salmon occupy approximately fifty percent of their historic range and scientists are concerned about further population loss in larger river basins such as the Rogue, Klamath, and Trinity Rivers.[9]

Overfishing used to be the major cause of salmon decline, but in recent years, loss of freshwater habitat has become the largest threat to salmon populations. Habitat degradation occurs through mining, logging, cattle grazing and agricultural practices, and blockage of river systems by dams for electricity generation, flood control, and irrigation.[10]

NOAA's National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service share responsibility for the listing of species under the Endangered Species Act.[11] NMFS manages marine and anadromous species, including all species of west coast salmon and steelhead. Economic factors are not to be considered by NMFS when determining if a species is sufficiently at risk of extinction that it warrants listing as a threatened or an endangered species under the provisions of the ESA. The agency also is not to consider economic issues when it determines whether or not to provide legal protection to a listed species. Instead, these determinations are to be based solely on biological factors. Economics comes into play only when, for each listed salmon species, the Secretary of Commerce designates critical habitat, an action that restricts federal agencies from taking actions that would destroy or adversely modify habitat essential to conserving the species. Before making this determination, the Secretary must consider all the economic impacts, plus national-security and other impacts. Following this accounting, the Secretary may exclude an individual area from the designation only if the benefits of exclusion for that area outweigh the benefits of designation.

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[8] NOAA's National Marine Fisheries Service. 2008. *Snapshot of Salmon & Steelhead ESA Status*. http://www.nwr.noaa.gov/ESA-Salmon-Listings/Salmon-Populations/Index.cfm.

[9] NOAA's National Marine Fisheries Service Southwest Regional Office. *Southern Oregon/Northern California Coast Coho ESU*. Retrieved Nov. 20, 2008 from, http://swr.nmfs.noaa.gov/recovery/Coho_SONCCC.htm.

[10] Montgomery, C.A. and T.L. Helvoigt. 2008. *Trends in Oregonians' Willingness to Pay for Salmon*.

[11] NOAA is the National Oceanic and Atmospheric Administration.

Table 1: Endangered Species Act Status of West Coast Salmon & Steelhead

	Species	Endangered Species Act Listing Status	ESA Listing Actions Under Review
Sockeye Salmon (Oncorhynchus nerka)	Snake River	Endangered	
	Ozette Lake	Threatened	
Chinook Salmon (O. tshawytscha)	Sacramento River Winter-run	Endangered	
	Upper Columbia River Spring-run	Endangered	
	Snake River Spring/Summer-run	Threatened	
	Snake River Fall-run	Threatened	
	Puget Sound	Threatened	
	Lower Columbia River	Threatened	
	Upper Willamette River	Threatened	
	Central Valley Spring-run	Threatened	
	California Coastal	Threatened	
	Central Valley Fall and Late Fall-run	Species of Concern	
Coho Salmon (O. kisutch)	Central California Coast	Endangered	
	Southern OR/Northern CA	Threatened	
	Lower Columbia River	Threatened	Critical Habitat
	Oregon Coast	Threatened	
	Puget Sound/Strait of Georgia	Species of Concern	
Chum Salmon (O. keta)	Hood Canal Summer-run	Threatened	
	Columbia River	Threatened	
Steelhead (O. mykiss)	Southern California	Endangered	
	Upper Columbia River	Endangered	
	Central California Coast	Threatened	
	South Central California Coast	Threatened	
	Snake River Basin	Threatened	
	Lower Columbia River	Threatened	
	California Central Valley	Threatened	
	Upper Willamette River	Threatened	
	Middle Columbia River	Threatened	
	Northern California	Threatened	
	Puget Sound	Threatened	Critical Habitat
	Oregon Coast	Species of Concern	

Source: ECONorthwest with data from NOAA's National Marine Fisheries Service. 2008. *Snapshot of Salmon & Steelhead ESA Status*. http://www.nwr.noaa.gov/ESA-Salmon-Listings/Salmon-Populations/Index.cfm.

Many benefits accrue from designating critical salmon habitat, which could also be realized through improved ecosystem management practices in areas *not* designated as critical habitat. Improving water quality and aquatic habitat creates many benefits that are not directly related to salmon. In fact, many businesses and farms reduce their impacts on streams because they find it profitable to do so.[12] Benefits may be realized through reductions in flood damages, improvements in bird habitat, water quality, recreational opportunities, and increased property values near the stream. The area and extent of the impacts of the improved habitat can be vast. Benefits may be seen downstream from the site or in other watersheds. It is not necessary to wait for a stream or watershed to be designated as a critical habitat to obtain these benefits. The costs of improving water quality and aquatic habitat are often less than the benefits gained by doing so and when the risk of salmon extinction depends on the given habitat the benefits are even greater.

However, once the ESA designates critical habitat, more costs will be imposed on the residents, businesses, and local governments impacted by the habitat area. The laws pertaining to critical habitat impose several costs on federal agencies and private parties with an interest in the critical habitat region. The consultation costs of obtaining an assessment from the federal government of a project's impact on the species' habitat, the costs of modifying a given project to comply with ESA, and the costs of delaying the implementation of the project while assessments and modifications are made are a few of the costs associated with critical habitat.[13] Many of these costs can be avoided by improving salmon habitats before critical habitat is designated.

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[12] Goodstein, E., B. Doppelt, and K. Sable. 2000. *Saving Salmon, Saving Money: Innovative Business Leadership in the Pacific Northwest*. Center for Watershed and Community Health, Portland State University; Sullivan, P., D. Hellerstein, L. Hansen et al. 2002. *The Conservation Reserve Program: The Implications for Rural America. United States Department of Agriculture, Economic Research Service.* Agriculture, Economic Report 834. September.

[13] Sunding, D. *The Economic Impacts of Critical Habitat Designation*. Giannini Foundation of Agricultural Economics.

ANADROMOUS FISH ON THE ROGUE RIVER

Table 2 shows the fish counts for different species of anadromous fish at Gold Ray Dam for years 1997 through 2006. Gold Ray Dam is located approximately thirty river miles upstream of the start of the Wild & Scenic Section of the Rogue River so the numbers reported represent only the fish that pass through the Wild & Scenic Section to spawn above the dam. Table 3 shows the estimated fish escapements for different species at Huntley Park located downriver from the Wild & Scenic Section. Based on conversations with the Oregon Department of Fish and Wildlife there are no known data of the number of anadromous fish that spawn and rear in the Wild & Scenic Rogue River and its tributary streams.

Table 2: Fish Counts at Gold Ray Dam

Year	Summer Steelhead	Winter Steelhead	Spring Chinook	Fall Chinook	Coho	Total Steelhead, Chinook, and Coho
1997	7,538	14,957	41,794	4,857	15,750	84,896
1998	6,056	5,029	15,957	5,332	6,044	38,418
1999	4,785	9,497	20,981	3,540	7,722	46,525
2000	6,734	6,807	30,265	9,892	28,791	82,489
2001	16,114	8,944	33,273	13,606	32,962	104,899
2002	29,296	22,287	47,781	19,823	34,154	153,341
2003	20,297	24,850	41,841	24,857	17,179	129,024
2004	13,658	21,889	39,243	15,007	21,702	111,499
2005	10,414	11,908	18,090	8,615	14,632	63,659
2006	14,579	9,560	11,718	6,908	11,368	54,133

Source: ECONorthwest with data from Oregon Department of Fish and Wildlife, Roseburg. 2003. Letter to Ted Helvoigt. and Oregon Department of Fish and Wildlife, Fish Division. 2008. *Fish Counts*. Retrieved October 29, 2008, from http://www.dfw.state.or.us/fish/fish_counts/goldray/2006/gold_ray_dam._2006.asp.

Figure 1: Fish Counts at Gold Ray Dam (1943-2006)

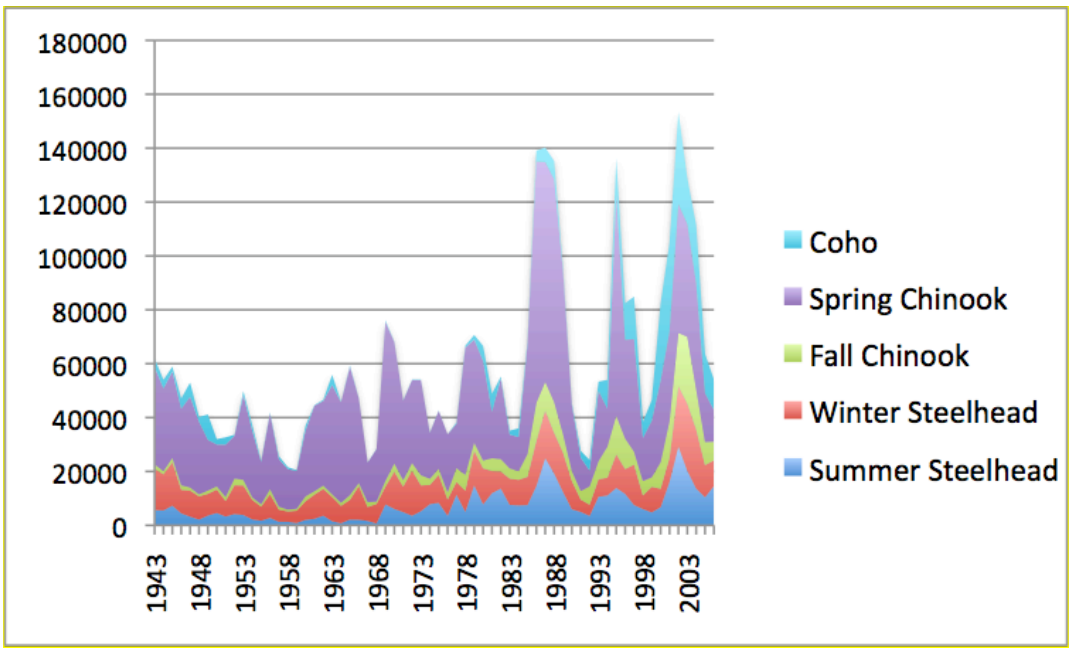

Table 3: Huntley Park Estimated Adult Fish Escapements

Year	Summer Steelhead	Fall Chinook	Coho
1997	15,325	17,186	40,647
1998	9,222	16,867	6,817
1999	15,882	19,456	6,155
2000	21,856	34,562	18,572
2001	17,397	35,447	37,243
2002	35,813	62,576	27,103
2003	21,005	86,551	16,071
2004	14,209	55,170	46,546
2005	10,466	23,733	8,271
2006	18,142	14,738	16,397

Source: ECONorthwest with data from Mazur, Steven. 2008. *Huntley Park Trend Data*. Email to T. Helvoigt October 22.

The Wild & Scenic section of the Rogue River and its tributaries provide important cold water refugia for salmon and steelhead. Anadromous fish are present in at least 100 stream miles across 14 tributary streams of the Rogue River.[14] The streams play an important role in salmon habitat as they bring colder water temperatures to the larger main Rogue, and they provide refuge from the warm water temperatures of the main stem during summer months. These cold temperatures also permit higher concentrations of oxygen to dissolve in the water. With the projected climate changes predicted for the coming years, these cold water streams will become even more valuable to salmon and steelhead survival. A report which utilized aerial thermal surveys indicated that there already is a trend of downstream warming on the Rogue. The cold water refugia is necessary for migrating salmon and steelhead so that they remain healthy and able to fight disease. Each species of anadromous fish uses the Rogue River habitat in a different manner, but the health of the river and its streams is important to the health of each species.

For instance, coho salmon use the Wild & Scenic Section of the Rogue River as a migratory path. Coho can mostly be found in Lobster, Quosatana, Silver, Foster, Shasta Costa, Lawson, Mule and Billings Creeks, which feed into the Rogue River. In the summer, coho prefer to swim to pools in small streams. In the winter, they prefer off-channel alcoves. Complexity, such as mixtures of small and large wood, is important for productive coho streams. The health of the Rogue River, as a migratory passage, and its tributaries, as spawning and rearing grounds, are key factors for the health of coho salmon.

Wild spring Chinook also use the main stem of the Rogue River as a migratory passage and spawn above Gold Ray Dam. Fall Chinook usually spawn in the lower regions of the river. Only about 10% of fall Chinook spawn above Gold Ray Dam. The early entry adults spawn between Grave Creek and Gold Ray Dam and in the lower 25 miles of the Applegate River. The late entry adults typically spawn below Watson Creek on the Rogue River and in the Illinois basin. The Wild & Scenic section of the Rogue River is an important spawning ground for the fall Chinook. In 1979, pre-spawn mortalities of fall Chinook from low flows and high temperatures on the Rogue River were as high as 85%. Although there is not enough data available to draw any conclusions about the health of late entry fall Chinook, it appears that their population is declining. Table 4 shows the redd (salmon nest) counts on the main stem of the lower Rogue River from surveys conducted by the Oregon Fish and Wildlife Department every twenty years.

[14] Heyn, K. 2008. *Save the Wild Rogue*. American Rivers.

Table 4: Redd Counts on the Lower Rogue River

Survey Year	Method	Redds/mile
1953	Boat	5.1
1954	Boat	5.7
1974	Plane	4.0
1976	Plane	4.3
1993	Helicopter	0.2

Source: Weinhold, M. Lower Rogue River Basin Watershed Condition Assessment. 1995. Lower Rogue Watershed Council for State of Oregon Watershed Health Program and Strategic Water Management Group.

Winter steelhead also spawn in the Wild & Scenic section. They most often spawn in the tributary streams to the Rogue, only spawning in the main stem if objects obstruct their passage or when water levels are too low to permit them to spawn in the smaller streams. Summer Steelhead usually spawn above the Wild & Scenic Section but half-pounders usually overwinter within the lower fifty miles of the Rogue's main stem and over 95% of the summer steelhead have a half-pounder lifestyle.

The health of the Wild & Scenic Rogue River as a salmon spawning, rearing, and migratory habitat is necessary for the protection of healthy anadromous fish. Maintaining cold water temperatures in the main stream of the Rogue River with limited debris and protected watersheds will help to maintain a healthy habitat for salmon and steelhead.

VALUE OF ROGUE RIVER SALMON

By protecting salmon and steelhead populations in the Rogue River, Oregon is protecting an asset important to residents of the Pacific Northwest. For example, studies indicate that households in Washington and Oregon are willing to pay $30-$130 per year to finance salmon recovery efforts.[15] Salmon populations also help sustain jobs in the Pacific Northwest. If salmon populations were restored sufficiently to allow increases in commercial harvest, fishers and those in related industries would enjoy new business and job opportunities in Oregon, Washington, and elsewhere along the salmon's migration routes. Further benefits accrue to recreational anglers and all residents of the Pacific Northwest who benefit from the clean water, flood control and open spaces associated with salmon habitat. Since the values of many of these benefits accruing from salmon habitat are not captured by market prices, economists must employ different methods to measure the aggregate benefits that salmon and steelhead provide to the Northwest. Hence, the household surveys provide a means to estimate the extent to which Northwest residents value salmon and enhancements to salmon habitat.

Economists describe economic benefits of ecosystem goods and services, such as the benefits of protecting salmon and steelhead habitat, using various methods. Established markets exist for some benefits, such as increases in the supply of goods, e.g., commercial harvests of fish. In these cases, we can interpret market prices as a measure of the economic benefit of actions that protect or increase the supply of the good. We note, however, that factors such as externalities (e.g., when prices do not include pollution impacts) or government intervention (e.g., when subsidies artificially elevate prices) can distort market prices.

Measuring the economic significance of benefits for which markets do not exist, such as cultural values, amenity values, and the recreational value of sport fishing, is more challenging. Economists have developed techniques that can approximate the economic values of some of these benefits. These techniques have been tested and improved over the decades, with results and methods vetted through publication in academic journals and presentations at scholarly conferences.[16] We describe some of the more commonly used techniques in more detail in our discussion of the sport fishing and existence values of salmon and steelhead.

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[15] Goodstein, E. and L. Matson. 2007. "Climate Change in the Pacific Northwest: Valuing Snowpack Loss for Agriculture and Salmon." In J.D. Erickson and J.M. Gowdy, eds., *Frontiers in Ecological Economic Theory and Applications*. Northampton, MA: Edward Elgar.

[16] For more information on the methods of measuring economic benefits that are not traded in markets, see The National Research Council. 2004. *Valuing Ecosystem Services: Toward Better Environmental Decision-Making*. Committee on Assessing and Valuing the Services of Aquatic and Related Terrestrial Ecosystems, National research Council; Millennium Ecosystem Assessment. 2005. *Ecosystems and Human Well-Being*; and Barbier, E.B., et al. 1997. *Economic Valuation of Wetlands*. Ramsar Convention Bureau, Department of Environmental Economics and Environmental Management, University of York, Institute of Hydrology, IUCN-The World Conservation Union.

1. Commercial Fishing Value of Rogue River Salmon

Although the market price for wild salmon provides a reasonable starting point for calculating the commercial fishing value of a Pacific Northwest salmon or steelhead, many factors complicate the calculation. Salmon are often caught far from the streams in which they were spawned. Since many Pacific Northwest salmon are caught in the ocean near Alaska and Canada, estimates of the contribution of Northwest-spawned salmon to the total Pacific catch must be made.

Table 5 shows the results of studies conducted by the Independent Economic Analysis Board (IEAB) (2005) [17] and Radtke and Davis (1995 a), In each of these studies, the authors estimate the economic impact that commercial-caught salmon and steelhead has on the Northwest economy.[18] Both studies focus on Columbia River Basin fisheries.

Table 5: Economic Value of Commercial-Caught Salmon and Steelhead, Estimates from the Academic Literature

Study	Species	Location	Average weight	Ex-vessel price per lb	Per Fish Economic Value ($2007)*
Radtke & Davis, 1995 a	Chinook	WA. Coast	11.51	$2.56	$64.95
Radtke & Davis, 1995 a	Chinook	WA. Coast	23.53	$1.09	$78.14
Radtke & Davis, 1995 a	Chinook	OR. Coast	11.4	$2.53	$68.14
Radtke & Davis, 1995 a	Coho	OR. Coast	4.56	$1.18	$13.64
IEAB, 2005	Coho	WA. Ocean	3.8	$1.84	$15.29
IEAB, 2005	Coho	OR. Ocean	5.8	$1.89	$21.34
IEAB, 2005	Coho	CA. Ocean	5.9	$1.89	$25.28
IEAB, 2005	Chinook	WA. Ocean	12.2	$2.17	$59.14
IEAB, 2005	Chinook	OR. Ocean	11.2	$2.17	$51.48
IEAB, 2005	Chinook	OR. Ocean	11.2	$2.17	$51.48
IEAB, 2005	Chinook	CA. Ocean	11.6	$2.51	$65.86
IEAB, 2005	Steelhead	B.C. Ocean	7.00	$1.67	$27.28

ECONorthwest compilation of various studies

Table 6 shows the estimated economic impact to the Northwest of salmon and steelhead caught commercially in coastal areas of the Northwest (excludes British

[17] Independent Economic Analysis Board. 2005. *Economic Effects from Columbia River Basin Anadromous Salmonid Fish Production*. Document IEAB 2005-1.

[18] The regional economic impacts include wages, proprietor's incomes, rents, interest and dividends.

Columbia and Alaska). The total estimated economic impact is not great—only $1.36 million, but represents a lower bound estimate as the estimates of the number of Rogue River fish commercially harvested off the Northwest coast is conservatively estimated.

Table 6: Per-Fish and Total Economic Impact of Commercially Caught Rogue River Salmon,* 2007 Dollars

Species	Harvest of Rogue River-Spawned Fish	Per-Fish Economic Impact	Total Economic Impact
Coho	3,299	$19	$62,307
Chinook	20,264	$63	$1,271,379
Steelhead	1,040	$27	$28,360
Total	24,603		$1,362,046

Source: ECONorthwest analysis of data from studies shown in Table 5 and data from Oregon Department of Fish and Wildlife (http://www.dfw.state.or.us/resources/fishing/sportcatch.asp)

*Does not include economic impacts associated with Rogue River-spawned salmon and steelhead commercially harvested in Pacific Ocean off the Canadian or Alaskan coast.

2. Sport Fishing Value of Rogue River Salmon

The sport fishing value of Rogue River salmon is primarily a function of the pleasure derived from the fishing experience and is significantly greater than the commercial value, as measured on a per fish or per pound basis. Based on estimates from several peer-reviewed studies of sport fishermen, the average value of a Northwest salmon or steelhead is approximately $245 expressed in 2007 dollars.

The total value of a salmon or steelhead to a recreational angler is the dollar amount that the angler is willing to pay to fish for it. Economists typically decompose the total value into two parts: the first part is the amount the angler *actually* spends to fish.[19] In most cases, however, recreational anglers are willing to spend more than they actually do to fish. The difference between what an angler is willing to pay and what he or she actually pays is referred to by economists as *consumer surplus*, and represents the second part of the total value of a sport-caught salmon. It is important to measure consumer surplus because it represents a real gain in overall economic well being above that which is observed in market transaction by those engaging in sport fishing. Consumer surplus is a means of recognizing that for many anglers, the economic value associated with the enjoyment of fishing is greater than the sum of the market-based transactions undertaken to go fishing. Thus, fishing-related expenditures alone do not account for the entire economic benefits derived from the fishing experience.

Table 7 shows the results of several studies conducted in the Pacific Northwest to estimate the value of salmon to sport anglers. The results varied depending on the location of the study and the method of evaluation employed. However, even the most conservative calculations show that the recreational value of salmon and steelhead fishing is far greater than the market (purchase) price for salmon or steelhead.

[19] Note: this amount is accounted for in the "Regional Economic Impacts of Recreation on the Wild and Scenic Rogue River."

Table 7: Estimates of the Economic Value of Sport-Caught Salmon and Steelhead from Various Studies, 2007 Dollars

Study	Location	Species	Study Method	WTP Per Fish ($2007)
Olsen et al., 1990	Washington Ocean	Salmon	CVM	$63.60
Meyer et al., 1983	Oregon Ocean	Steelhead	TCM	$154.32
Olsen et al., 1990	Oregon Coastal	Steelhead	CVM	$97.92
Olsen & Richards, 1992	Rogue River	Fall Chinook	CVM	$103.64
Meyer et al., 1983	Rogue River	Fall Chinook	TCM	$57.04
Meyer Resources, 1987	San Fran. Bay/ Sacramento & San Joaquin Rivers	Chinook	CVM	$684.65
Meyer Resources, 1987	California statewide	Chinook	CVM	$307.37
Meyer Resources, 1987	North Coast Streams	Chinook	CVM	$307.37
Olsen et al., 1990	Washington Freshwater	Salmon	CVM	$56.13
Meyer Resources, 1985	Sacramento and San Joaquin Rivers	Salmon	TCM	$302.76
Meyer et al., 1983	Columbia River	Salmon	TCM	$200.23
Olsen et al., 1990	Columbia River	Salmon	CVM	$69.83
Meyer et al., 1983	Oregon	Steelhead	TCM	$234.68
Olsen & Richards, 1992	Rogue River	Steelhead	CVM	$128.18
Meyer et al., 1983	Rogue & Illinois	Steelhead	TCM	$208.88
Meyer Resources, 1985	Sacramento and San Joaquin Rivers	Steelhead	TCM	$896.19
Meyer Resources, 1986	California, Statewide	Steelhead	TCM	$909.83
Donnelly et al., 1985	Idaho, statewide	Steelhead	CVM	$42.04
Meyer et al., 1983	Columbia River	Steelhead	TCM	$320.28
Olsen et al., 1990	Columbia River	Steelhead	CVM	$202.49
Olsen & Richards, 1992	Rogue River	Half-Pounder*	CVM	$16.73
Olsen & Richards, 1992	Rogue River	Steelhead	CVM	$33.86

ECONorthwest compilation of various studies

Although not shown here, recreational fishing also impacts the local and regional economies through the multiplier effect.[20] Dollars spent by recreational anglers on fishing supplies, food and lodging create income for local businesses and provide income and salaries for local residents. Consequently, public policy and decisions makers should take into account how decisions which impact salmon and steelhead habitat will impact sport angling and other related recreational activities that have a wider scope of influence in the economy than the market value of salmon alone.

[20] For information on the economic impact that sport fishing on the Rogue River has on the Josephine County and Oregon economies, please see "Regional Economic Impacts of Recreation on the Wild and Scenic Rogue River."

Table 8 shows the annual WTP by sport anglers for Rogue River salmon and steelhead based on information presented in Table 7. Given the unique wilderness experience offered by the Wild Rogue, the per fish and total willingness to pay (WTP) shown in Table 8 are likely low for that section of the river.

Table 8: Estimated Annual WTP by Sport Anglers for Rogue River Salmon, 2007 Dollars

Species	Catch Location	Estimated 2007 Catch	WTP Per Fish	Estimated Total WTP	Upper Bound WTP
Coho	Ocean	6,488	$64	$412,696	$412,696
	River	1,200	$157	$188,732	$363,404
Chinook	Ocean	5,355	$64	$340,600	$340,600
	River	15,988	$232	$3,711,003	$10,946,101
Steelhead	Ocean	1,040	$126	$131,130	$160,447
	River	4,165	$299	$1,246,599	$3,789,289
Total Sport Fishing		34,236		$6,030,759	$16,012,535

Source: ECONorthwest analysis of results from studies presented in Table 7 and data from Oregon Department of Fish and Wildlife (http://www.dfw.state.or.us/resources/fishing/sportcatch.asp)

3. Non-use Value of Rogue River Salmon

Even those who do not consume salmon or steelhead may benefit from their existence. In fact, the non-use value of an environmental resource is often far greater than it's commercial or sport value. Non-use value can take several different forms: option value, which is the value of saving a good for use at another time; bequest value, the value of saving a good for future generations; altruistic value, the value of saving a good for others to use now; and existence value, the value of saving a good for the sake of its existence.[21] Surveys indicate that, in aggregate, residents of the Pacific Northwest and California place a much higher non-use value on salmon than they do use value. Only a relatively small proportion of West Coast residents participate in fishing for salmon and steelhead. Thus there are many fewer households over which to aggregate total value. For example, based on information from the *2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation: Oregon*, 455,000 Oregonians age 16 or older participated in fishing in 2006, out of a 16+ population of 2,894,050. This represents only 16% of Oregon's 16 and older population.[22] Comparatively, based on household survey results, a much larger percentage of Oregonians (and Americans in general) value Northwest salmon even though they likely will never participate in salmon fishing or even view a wild salmon (see Loomis, 1999, Pate and Loomis 1997, Loomis 1996).

Loomis (1999) estimated the marginal non-use value of salmon and steelhead on the Lower Snake River to residents of Oregon, Washington, and California.[23] The results of the analysis indicate that, as one would expect, the marginal value (i.e., the value of the next additional salmon) goes down as the total population of salmon goes up. At very low populations, (e.g. fewer than 5,000 total fish) the marginal value of an additional fish is more than $1.0 million. This immense per-fish value embodies the scarcity associated with a small fish population and society's desire to preserve the species for current and future generations.

Based on the results of the survey analysis and through the incorporation of information from other surveys, Loomis (1999) developed a *marginal WTP benefit function*, which provides estimates of the marginal value of a fish based on the size of the underlying population. He then demonstrates that as the underlying

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[21] Schuhmann, P.W. and K.A. Schwabe. 2002. "Fundamentals of Economic Principles and Wildlife Management." In L. Clark, J. Hone, J.A. Shivik, R.A. Watkins, K.C. VerCauteren, and J.K. Yoder, eds., *Human Conflicts with Wildlife: Economic Considerations. Proceedings of the Third NWRC Special Symposium*. Fort Collins, CO: National Wildlife Research Center from http://www.aphis.usda.gov/ws/nwrc/symposia/economics/.

[22] U.S. Department of Interior, Fish & Wildlife Service, and U.S. Department of Commerce, U.S. Census Bureau. *2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation: Oregon.*

[23] Loomis reviewed and augmented survey data from three other studies which asked households in the Pacific Northwest and California how much they were willing to pay for a specified increase in the number of either salmon or salmon and steelhead on a given river as a result of dam removal. None of the fish in these studies were endangered which is an important consideration when relating the results of these studies to other rivers since individuals will likely place greater existence value on an endangered species than on a non-endangered species.

population increases, the marginal value that society places on increasing the population by one fish decreases. For example, based on a salmon population of 500,000, the marginal value of one additional fish is $1,595. However, the marginal value of a second additional fish (e.g., the marginal value based on a salmon population of 500,001) is only $1,539.

Loomis (1999) developed the marginal WTP benefit function based on analysis of society's WTP to increase the salmon populations on the lower Snake River. Based on comments from one or more reviewers of his analysis, he contends that the benefit function may in fact be representative of the entire Pacific Northwest salmon population. What this means is that, though there are many distinct populations of salmon throughout the Pacific Northwest, many Northwest and California residents do not differentiate between salmon of various populations. Society's concern is for the overall welfare of salmon populations throughout the Northwest. Thus, the value that society places on the marginal fish returning to spawn in any one Northwest river is a function of the aggregate count of all salmon returning to spawn in all Northwest rivers. The result of embracing the assumption that society views all Northwest salmon as members of one Northwest-wide population, is that society's WTP for the marginal salmon of any actual (biological) population will be lower than if society viewed each biological population separately.

To estimate the society's non-use WTP for Rogue River salmon and the value society places on the entire population of Rogue River salmon we embrace the all-Northwest assumption regarding the WTP benefit function for Rogue River salmon. In doing so, we acknowledge that our estimates of the non-use or existence value represents a lower bound estimate of the actual non-use value society places on Rogue River salmon. That is, although we are unsure of society's actual non-use WTP for Rogue River salmon, we are confident that it is no lower than and may be much higher than the estimated value based on the WTP benefit function developed by Loomis (1999).

Table 9 shows the estimated marginal and average values of Rogue River salmon, as well as the total value of the Rogue River fishery based on various assumptions about the entire population of Northwest salmon. To our knowledge, "official" estimates of the aggregate population of Northwest salmon are not available.[24] However, based on escapement counts[25] for the Columbia River system from the Pacific Fishery Management Council (PFMC), we estimate the 10-year average annual salmon escapement for the Northwest to be approximately 830,000 fish.[26] Based on this estimate of the Northwest salmon population, we estimate society's annual marginal non-use WTP for a Rogue

[24] We define "aggregate population" as the 10-year average salmon escapement summed across all Northwest river systems.

[25] Escapement is the annual count of salmon and steelhead returning to their spawning ground or hatchery.

[26] The PFMC 2007 report can be found at: http://www.pcouncil.org/salmon/salsafe.html.

River salmon to be $1,008, the average WTP to be $1,824, and the total annual non-use WTP of the entire Rogue River salmon fishery to be just over $1.5 billion.

At first glance, these numbers appear to be very large. However, consider that these estimates are aggregated across the entire population of Oregon, Washington, and California—more than 46 million people in 2007. The per-person value of the entire Rogue River salmon fishery is $32.37 per year. Another perspective from which to view the annual value of the fishery is to compare it to the economic output of the 3-state region. Based on Bureau of Economic Analysis data (BEA), the combined gross state product of the three states was $2.28 trillion. The estimated annual value of the Rogue River fishery represents a mere 0.07% of the total annual output for 2007.

Table 9: Annual Non-Use Value of Rogue River Salmon, 2007 Dollars*

Assumed Northwest Salmon Population	Marginal Value of a Rogue River Salmon	Average Value of a Rogue River Salmon	Total Value of Rogue River Salmon Population
500,000	$1,595	$4,892	$2,446,138,182
750,000	$1,112	$2,217	$1,662,959,665
828,282	**$1,008**	**$1,824**	**$1,514,072,103**
1,000,000	$822	$1,266	$1,266,345,698
1,250,000	$793	$821	$1,026,859,060
1,500,000	$525	$576	$863,315,110

Source: ECONorthwest analysis of results from Loomis, J. 1999. *Recreation and Passive Use Values From Removing the Dams on the Lower Snake River to Increase Salmon.* Agricultural Enterprises, Inc. for the Department of the Army Corps of Engineers; data from the Pacific Fishery Management Council (http://www.pcouncil.org/salmon/salsafe.html) and data from Oregon Department of Fish and Wildlife (http://www.dfw.state.or.us/resources/fishing/sportcatch.asp).

* Consistent with the results of the WTP salmon question in the 1996 through 2006 Oregon Population Surveys, we assume no inflationary growth in the WTP between 1996 (the data year of the Loomis 1999 study) and 2007.

Table 9 also provides estimates of the value of Rogue River salmon based on alternative assumptions regarding the size of the entire Northwest salmon population. The declining values associated with increasing salmon populations shown in Table 9 are consistent with economic principles of diminishing marginal value. Under an assumption of relative scarcity (e.g. a total average annual escapement of 500,000 salmon across all Northwest rivers), the marginal value of Rogue River salmon is greater. And under the alternative assumption of relative abundance (e.g. 1.5 million salmon), the marginal value of Rogue River salmon is less. Stated another way, as local, regional, and oceanic conditions worsen for Northwest salmon, the value of the next Rogue River salmon increases.

While the results of Loomis' study provide insight into the values society place on salmon in general, it is important to realize that all salmon populations in the Northwest may not be valued the same. A 2005 report by Goodstein and

Matson[27] summarized and augmented research by Layton, Brown, and Plummer in 1999 on people's willingness to pay for specific salmon restoration projects. Goodstein and Matson (2007) used these data to find the perceived economic benefit of restoring salmon populations or, alternatively, of avoiding further declines in salmon populations and they extended the data collected from Washington and Oregon households to households nationwide by assuming that residents outside of Oregon and Washington, on average, placed a value on salmon restoration equal to half that of Oregon and Washington residents. This is a conservative assumption according to other studies on the value of Pacific Northwest salmon for residents outside of the Northwest region. Table 10 summarizes their findings.

Table 10: The Economic Benefits of Restoring Salmon Populations and of Preventing Further Declines in Salmon Populations

The economic benefits to residents of Oregon and Washington of restoring salmon populations:	
Columbia River Salmon	$2,890 per fish
Washington Coastal Chum Salmon	$872 per fish
Oregon Coastal Coho Salmon	$872 per fish
Rogue River Coastal Coho Salmon	$872 per fish
Puget Sound Chinook Salmon	$872 per fish
The economic benefit per year, to residents of Oregon and Washington, of preventing further declines in wild-salmon populations:	
Preventing a one-third decline in populations	$359 million - $3.6 billion
Preventing a two-thirds decline in populations	$718 million - $7.2 billion
The economic benefit per year, to residents of the U.S., of preventing further declines in wild-salmon populations:	
Preventing a one-third decline in populations	$5.4 billion - $54 billion
Preventing a two-thirds decline in populations	$10.9 billion - $109 billion

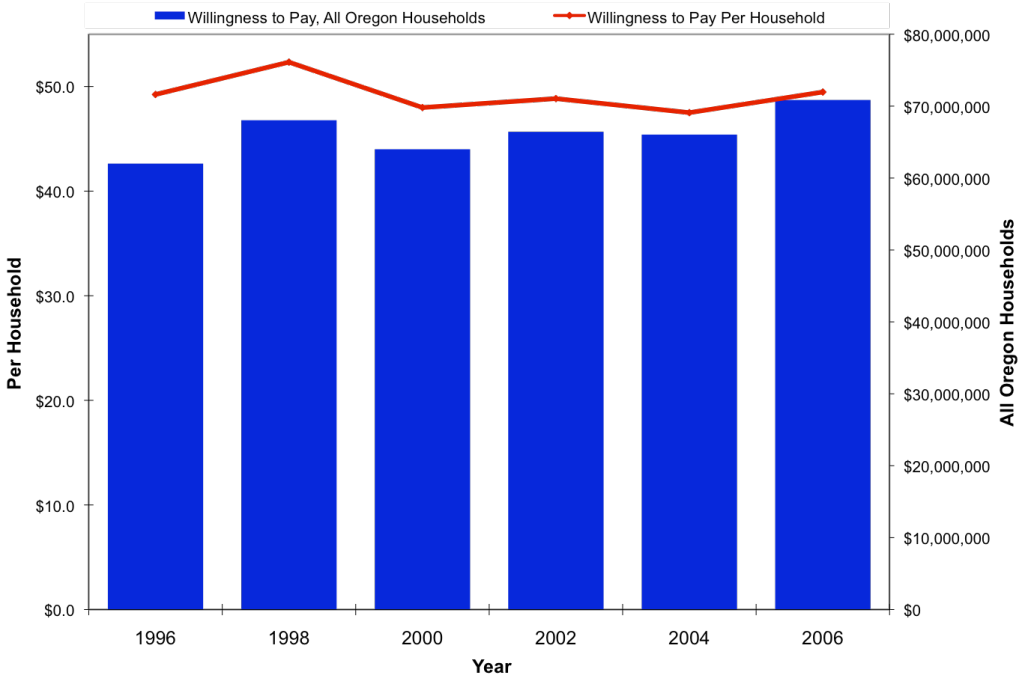
Source: ECONorthwest with data from Goodstein, E. and L. Matson. 2007. "Climate Change in the Pacific Northwest: Valuing Snowpack Loss for Agriculture and Salmon." In J.D. Erickson and J.M. Gowdy eds., *Frontiers in Ecological Economic Theory and Application*. Northampton, MA: Edward Elgar.

[27] Goodstein, E. and L. Matson. 2007. "Climate Change in the Pacific Northwest: Valuing Snowpack Loss for Agriculture and Salmon." In J.D. Erickson and J.M. Gowdy, eds., *Frontiers in Ecological Economic Theory and Applications*. Northampton, MA: Edward Elgar.

One of the disadvantages of the reports of non-use value viewed thus far is that they take data only from one point in time and do not allow us to observe how residents' willingness to pay for salmon recovery changes with changes in the economy and social structure. To observe trends in Oregonians' willingness to pay for salmon habitat restoration and improved water quality, we look at the Biennial Oregon Population Survey, conducted by the Oregon Office of Economic Analysis and the Oregon Progress Board. The survey provides data from as far back as 1996 and asks Oregon residents, how much per month they are willing to pay for water quality and habitat improvement efforts to help improve salmon runs in Oregon.

In 2006, the survey results showed, on average, that each Oregonian household was willing to pay $4.42 per month in 2008 dollars. Extending that value over the course of a year and multiplying the result by 1,333,723 Oregon households, indicates that Oregonians alone are willing to pay a total of $75,958,977 per year to improve salmon runs. Figure 2 shows the average annual amount Oregonians stated they are willing to pay for water quality and salmon habitat improvements based on the results of the Oregon Population Survey. The willingness to pay remains fairly constant (in nominal dollars) throughout the years for which data are available indicating that Oregonians are willing to make a long-term commitment to protecting and improving salmon habitat. It also indicates that Oregonians have a continued concern for the health of salmon runs which has not diminished significantly over time.

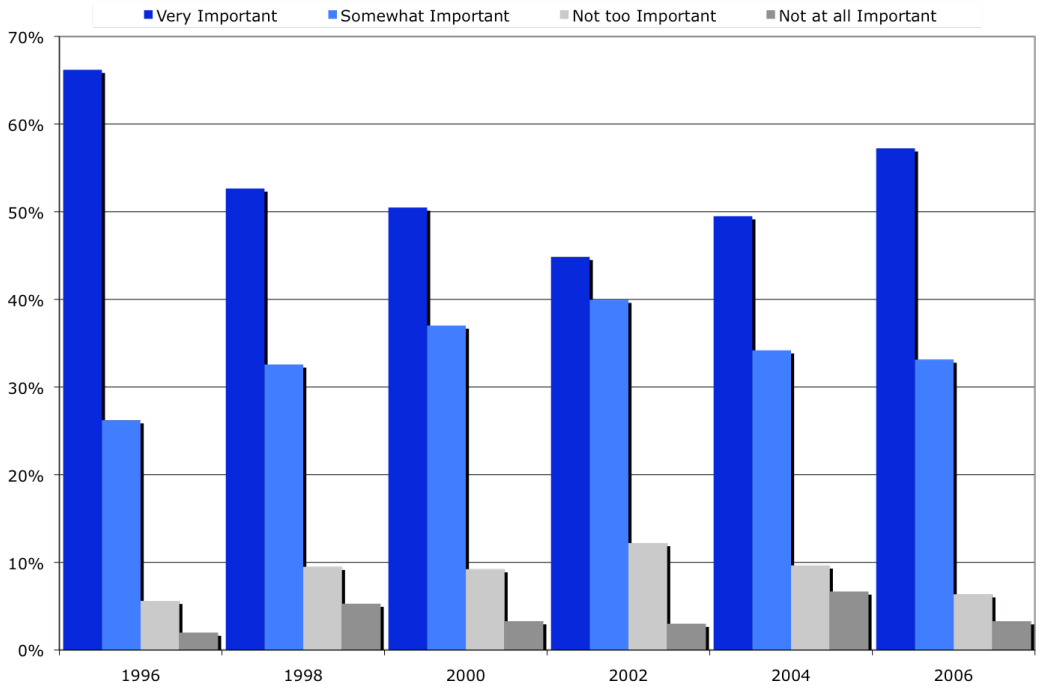
Figure 2: Oregonian's Willingness to Pay for Water Quality and Habitat Improvement Efforts to Help Improve Salmon Runs in Oregon, In Current Year Dollars



Source: ECONorthwest with data from Oregon Progress Board. *Oregon Population Survey.* http://www.oregon.gov/DAS/OPB/popsurvey.shtml

Figure 3 shows responses to another Oregon Population Survey question, "How important do you feel it is to improve salmon runs in Oregon?". It is noteworthy that in every year that the survey was conducted since 1996, over 80% of the respondents stated that improving salmon runs was very important or somewhat important and in all but two of the survey years, the majority of all respondents felt that improving salmon runs was very important.

Figure 3: How Important Do You Feel it is to Improve Salmon Runs in Oregon?



Source: ECONorthwest with data from Oregon Progress Board. *Oregon Population Survey.* http://www.oregon.gov/DAS/OPB/popsurvey.shtml

As shown by numerous surveys and studies, the continued existence of salmon and steelhead in the Pacific Northwest is very important to the local residents and is likely important to residents throughout the country. The non-use value reported in these studies has remained fairly steady over the past ten years and will likely remain so in future years. Consequently, government policies that preserve and/or enhance existing salmon and steelhead habitats have far-reaching benefits, which may not be captured by the market and these benefits will be felt by residents for many years to come.

SUMMARY

The findings of this report show that Rogue River salmon and steelhead are valuable assets to the Pacific Northwest with economic benefits that extends far beyond their market price. The commercial fishing industry for salmon and steelhead brings income into the regional economy through direct revenues and employment and is further increased by the multiplier effect. We estimate the economic value of the Rogue River to the commercial salmon fishery to be not less than $1.36 million annually.

The economic benefits society accrues from recreational fishing are even greater since the consumer surplus for each salmon and steelhead caught is typically greater than the angler's expenditures. Based on analysis of the academic literature, which includes studies of the sport value of salmon and steelhead throughout the Northwest, we estimate the annual value of all Rogue River salmon runs to be not less than $16 million.

By far, the most significant value associated with Rogue River salmon, is the non-use value to residents of Oregon, the Northwest, and the entire west coast. Based on the results of peer-reviewed, published studies and data from household surveys, we estimate the implicit value of all Rogue River salmon and steelhead runs to be approximately $1.5 *billion*—significantly greater than the total use value of Rogue River salmon. Households in the Pacific Northwest indicate they are willing to pay over eight hundred dollars per fish for salmon preservation and Oregonians consistently state a willingness to pay at least $70 million annually to enhance salmon habitat in the state.

Northwest salmon face the risk of extinction, in part, because healthy salmon habitat is scarce. As the supply of healthy salmon habitat diminishes and the risk of extinction increases, the marginal economic values associated with the remaining salmon and the cost of protecting remaining habitat will only grow. Any increase in the risk of extinction would negatively impact both the widely-recognized economic values of salmon discussed in this report, as well as the values that Congress recognizes to be "incalculable,"[28] including the spiritual, cultural, and health-related values that tribal members and others place on salmon and their habitat.[29] Protecting salmon habitat in the Wild & Scenic section of the Rogue River would reduce the risk of extinction of Northwest salmon.

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[28] House of Representatives. 1973. Report No. 93-4112. Pp.4-5.

[29] *See*, for example, Meyer Resources, Inc. 1999. *Tribal Circumstances & Impacts from the Lower Snake River Project: Executive Summary*, Columbia River Inter-Tribal Fish Commission. October.

"Despite the deprivations summarized previously, today, salmon remain connected to the core of tribal material and spiritual life. Faced with bleak present circumstances, and severely limited prospects for remedy, the tribal peoples still look first to the salmon with hope of a better future.

"Traditional activities such as fishing, hunting and gathering roots, berries and medicinal plants build self-esteem for Nez Perce peoples – and this has the capacity to reduce the level of death by accident, violence and suicide affecting our people. When you engage in cultural activities you build pride. You are helped to understand 'what it is to be a Nez Perce' – as opposed to trying to be

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someone who is not a Nez Perce. In this way, the salmon, the game, the roots, and the berries and the plants are the pillars of our world." –Leroy Seth, Nez Perce Elder

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