

# RECLAMATION

*Managing Water in the West*

Technical Memorandum Number EC-2008-02

## Estimating Fishery Economic Use Values



U.S. Department of the Interior  
Bureau of Reclamation  
Technical Service Center  
Denver, Colorado

January 2008

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*by*

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## Acronyms and Abbreviations

ADFG	Alaska Department of Fish and Game
BCAs	benefit-cost analyses
CVM	contingent valuation method
GDP	Gross Domestic Price
IPD	Implicit Price Deflator
NED	National Economic Development
ODFW	Oregon Department of Fish and Wildlife
P&Gs	<i>Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies</i>
PFMC	Pacific Fishery Management Council
PSMFC	Pacific States Marine Fisheries Commission
Reclamation	Bureau of Reclamation
SAFE	Salmon Stock Assessment and Fishery Evaluation
TCM	travel cost method
WDFW	Washington Department of Fish and Wildlife
WTP	willingness-to-pay

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## **1.0 Introduction**

Federal water management agencies, such as the Bureau of Reclamation (Reclamation), often impact fish populations through the construction and operation of their projects. As a result, estimating the fishery economic effects of a proposed project or of a change in operations at an already existing project is often required to evaluate the proposed action.

This technical memorandum provides analytical information on applying existing information to estimate fishery economic use value benefits applicable to Reclamation benefit-cost analyses (BCAs). Fishery use values refer to the economic benefits that fishery resource users (e.g., fishermen) experience when “using” the fishery resource. Typically, fishery use value stems from the harvest and consumption of fish. This form of fishery use value is therefore often referred to as consumptive use value. Commercial, recreational, and Tribal subsistence harvests reflect the most common forms of fishery consumptive use value. A less commonly measured form of fishery use value is referred to as nonconsumptive use value and includes non-harvest oriented fishery activities such as recreational catch and release fishing and fish viewing. These consumptive and non-consumptive use values differ from nonuse values which can be held by both resource users and nonusers related to the existence or preservation of a resource even if the individual never intends to make use of the resource.

The methods and values presented in this document focus on commercial, recreational or sport, and Tribal subsistence consumptive use values. The example used throughout the report strives to measure consumptive use values associated with Yakima River salmon populations. The Yakima River Basin is in south-central Washington State. The primary salmon species harvested within the Yakima River are Chinook and Coho. Salmon are an anadromous species, meaning they migrate to the ocean before ultimately returning to their river of origin to spawn. As a result, Yakima River salmon stocks are harvested not only in the Yakima River, but also in the Columbia River into which it flows as well as the Pacific Ocean. While the information presented in this paper focuses on fishery consumptive use values related to Yakima River salmon populations, the approaches can be generalized to many other fish species.

### **1.1 National Economic Development Benefit-Cost Analysis**

To provide some perspective on the need for fishery use values related to the Yakima River Basin, National Economic Development (NED) oriented BCAs are being developed for the various Yakima River planning and environmental studies currently underway. To be consistent with Federal water management

agency economic guidelines,<sup>1</sup> these BCAs will attempt to quantify not only the benefits to fisheries (ocean and in-river commercial, recreational, and Tribal) but also any relevant benefits to agriculture, municipal and industrial water supply, recreation (reservoir and river), hydropower, etc. Cost categories covered include construction costs, interest during construction, and annual operation, maintenance, replacement, and energy costs. The annual stream of benefits projected over the period of analysis for each study are discounted to a present value before being aggregated and compared to the aggregated present value of the costs to calculate net benefits for each study alternative. If an alternative's benefits exceed its costs, a positive net benefit results, and the alternative is considered economically justified. This document focuses only on the estimation of fishery economic use values necessary for the BCA fishery benefit analysis. While fisheries benefits are only one piece of the overall BCA puzzle, they tend to be a very important component in many Reclamation studies. This is because many Reclamation studies, especially within the last 20 to 30 years, have been initiated with the objective of improving habitat conditions to aid in the recovery of diminished fish populations.

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<sup>1</sup> *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies*, also referred to as the "P&Gs" (U.S. Water Resources Council, 1983).

## **2.0 Fisheries Use Value Estimation**

The fisheries use value benefit estimation process discussed below focuses on harvest oriented consumptive use values measured on a per fish basis. Given the migratory range of Yakima River salmon, these harvest oriented fishery use values include commercial, sport, and Tribal fisheries in the ocean, lower Columbia River (Zones 1-5), Columbia River (Zone 6), and Yakima River. The values per fish developed in this report are to be subsequently applied to annual estimates of fish harvest developed by project alternative, harvest area, and species to calculate annual fishery economic benefits. The annual fishery benefits are then discounted to a present value as of the start of the benefits period and aggregated into an estimate of total fishery consumptive use value benefits. This report focuses on one component of the fishery use value benefit estimation process—the critical estimate of economic values per fish.

### **2.1 Ocean Commercial**

The basic objective of a Reclamation ocean commercial fishing economic benefit analysis, as described in the P&Gs, is to estimate the change in commercial fishing profitability stemming from changes in ocean commercial harvest associated with each of the proposed “action” alternatives as compared to the baseline No Action Alternative. This section describes how estimates of ocean commercial profitability per fish by species were developed for subsequent application to projections of the species-specific incremental harvest for each of the action alternatives being considered in the Yakima River planning studies.

The ocean commercial benefit estimation procedure makes use of the most recent annual data on commercial ex-vessel (harvest level) prices per pound by State (California, Oregon, Washington, and Alaska) and species (Chinook and Coho salmon) in conjunction with average weights per fish by species to calculate values per fish by State and species. Table 1—Ocean Commercial Fishing #1 presents data obtained from the Pacific Fishery Management Council’s (PFMC) “Review of Ocean Salmon Fisheries” and the Alaska Department of Fish and Game (ADFG). The Review of Ocean Salmon Fisheries is put out annually by PFMC and includes a comprehensive discussion of salmon ocean commercial and sport fishing activity off the coasts of California, Oregon, and Washington over the past year. This report also includes a substantial amount of historical

**TABLE 1.—OCEAN COMMERCIAL FISHING #1: Ocean Commercial Values per Fish by Species and State**

Sources: (1) CA, OR, WA Data: PFMC, Review of 2006 Ocean Salmon Fisheries (2006 Salmon SAFE Document, published 2/2007), Socioeconomic Chapter, Tables IV-2, 3, 4, 5, 6, 7, 8 (<<http://www.pcouncil.org/salmon/salsafe.html>>).  
 (2) Alaska Data: Department of Fish and Game, Division of Commercial Fisheries, Commercial Salmon Harvests and Exvessel Values (<<http://www.cf.adfg.state.ak.us/geninfo/finfish/salmon/salmcatch.php>>).  
 (3) Implicit Price Deflator (IPD) Annual and Quarterly Values: U.S. Bureau of Economics Analysis Web site (<<http://www.bea.gov/national/nipaweb/index.asp>>).

		Insert Target Quarter: 1st Quarter 2007		Insert IPD Value: 118.041		Chinook					Insert Profit %: 0.8	
Annual IPD	IPD Annual Index Value	State/Year	Nominal Value <sup>1</sup> (K\$)	1 <sup>st</sup> Quarter 2007 Real Value (K\$)	Dressed Pounds Landed (Thousands)	# Fish Harvested (Thousands)	Nominal Price per Pound (Dressed)	1 <sup>st</sup> Quarter 2007 Real Price per Pound (Dressed)	Pounds per Fish	Nominal Revenue/Profit per Fish	Real 1st Quarter 2007 Revenue/Profit per Fish	
<b>I. CALIFORNIA:</b>												
			Table IV-2	Table IV-2 (Calculated)	Table IV-6	A-3	Table IV-2 (Calculated)	Table IV-2 (Calculated)				
95.414	0.808	1997	7,288	9,016	5,248	487	1.39	1.72	10.77			
96.472	0.817	1998	3,060	3,744	1,847	227	1.66	2.03	8.14			
97.868	0.829	1999	7,429	8,960	3,846	264	1.93	2.33	14.54			
100	0.847	2000	10,304	12,163	5,131	480	2.01	2.37	10.68			
102.399	0.867	2001	4,773	5,502	2,409	193	1.98	2.28	12.48			
104.187	0.883	2002	7,776	8,810	5,008	392	1.55	1.76	12.79			
106.404	0.901	2003	12,181	13,513	6,392	492	1.91	2.11	12.99			
109.426	0.927	2004	17,895	19,304	6,230	502	2.87	3.10	12.41			
112.737	0.955	2005	12,913	13,521	4,347	341	2.97	3.11	12.75			
116.043	0.983	2006 <sup>2</sup>	5,261	5,352	1,030	69	5.11	5.20	14.97			
		5-Year Sum:	56,026	60,499	23,007	1,795						
		10-Year Sum:	88,880	99,885	41,488	3,448						
		1) REVENUE:										
		5-Year Straight Avg:	11,205	12,100			2.88	3.06	13.18	37.99	40.28	
		5-Year Weighted Avg:					2.44	2.63	12.81	31.21	33.70	
		10-Year Straight Avg:	8,888	9,988			2.34	2.60	12.25	28.64	31.86	
		10-Year Weighted Avg:					2.14	2.41	12.03	25.78	28.97	
		2) PROFIT:										
		5-Year Straight Avg:								30.39	32.22	
		5-Year Weighted Avg:								24.97	26.96	
		10-Year Straight Avg:								22.91	25.49	
		10-Year Weighted Avg:								20.62	23.18	

TABLE 1.—OCEAN COMMERCIAL FISHING #1 (continued): Ocean Commercial Values per Fish by Species and State (Chinook)

Annual IPD	IPD Annual Index Value	State/Year	Chinook						Pounds per Fish	Nominal Revenue/Profit per Fish	Real 1st Quarter 2007 Revenue/Profit per Fish
			Nominal Value <sup>1</sup> (K\$)	1st Quarter 2007 Real Value (K\$)	Dressed Pounds Landed (Thousands)	# Fish Harvested (Thousands)	Nominal Price per Pound (Dressed)	1st Quarter 2007 Real Price per Pound (Dressed)			
(See IPD data under California Chinook)											
<b>II. OREGON:</b>											
			Table IV-3	Table IV-3	Table IV-7	A-8	Table IV-3	Table IV-3			
			(Calculated)	(Calculated)			(Calculated)	(Calculated)			
		1997	2,469	3,055	1,542	150	1.60	1.98	10.30		
		1998	2,297	2,811	1,398	124	1.64	2.01	11.26		
		1999	1,400	1,689	721	63	1.94	2.34	11.53		
		2000	2,988	3,527	1,481	136	2.02	2.38	10.90		
		2001	4,680	5,395	2,897	275	1.62	1.86	10.54		
		2002	5,383	6,099	3,488	304	1.54	1.75	11.47		
		2003	7,186	7,972	3,639	330	1.97	2.19	11.04		
		2004	9,832	10,606	2,850	253	3.45	3.72	11.28		
		2005	8,466	8,864	2,671	251	3.17	3.32	10.63		
		2006 <sup>2</sup>	2,663	2,709	486	35	5.48	5.57	13.90		
		5-Year Sum:	33,530	36,250	13,134	1,173					
		10-Year Sum:	47,364	52,726	21,173	1,920					
1) REVENUE:											
		5-Year Straight Avg:	6,706	7,250	2,627		3.12	3.31	11.66	36.43	38.61
		5-Year Weighted Avg:					2.55	2.76	11.20	28.59	30.91
		10-Year Straight Avg:	4,736	5,273	2,117		2.44	2.71	11.28	27.57	30.61
		10-Year Weighted Avg:					2.24	2.49	11.03	24.67	27.46
2) PROFIT:											
		5-Year Straight Avg:								29.14	30.89
		5-Year Weighted Avg:								22.87	24.73
		10-Year Straight Avg:								22.06	24.49
		10-Year Weighted Avg:								19.73	21.97

TABLE 1.—OCEAN COMMERCIAL FISHING #1 (continued): Ocean Commercial Values per Fish by Species and State (Chinook)

Annual IPD	IPD Annual Index Value	State/Year	Chinook							
			Nominal Value <sup>1</sup> (K\$)	1st Quarter 2007 Real Value (K\$)	Dressed Pounds Landed (Thousands)	# Fish Harvested (Thousands)	Nominal Price per Pound (Dressed)	1st Quarter 2007 Real Price per Pound (Dressed)	Pounds per Fish	Nominal Revenue/Profit per Fish

(See IPD data under California Chinook)

**III. WASHINGTON:**

**A. Non-Indian:**

State/Year	Table IV-4 Table IV-4	Table IV-4 (Calculated)	Table IV-8	A-13	Table IV-4 (Calculated)	Table IV-4 (Calculated)	Pounds per Fish	Nominal Revenue/Profit per Fish	Real 1st Quarter 2007 Revenue/Profit per Fish
1997	125	155	80	6	1.56	1.93	12.46		
1998	123	151	82	6	1.50	1.84	13.83		
1999	377	455	198	17	1.90	2.30	11.34		
2000	224	264	131	10	1.71	2.02	12.76		
2001	349	402	241	21	1.45	1.67	11.35		
2002	756	857	678	54	1.12	1.26	12.60		
2003	951	1,055	821	56	1.16	1.29	14.61		
2004	1,079	1,164	504	35	2.14	2.31	14.25		
2005	1,273	1,333	471	35	2.70	2.83	13.43		
2006 <sup>2</sup>	1,029	1,047	222	17	4.64	4.71	13.24		
5-Year Sum:	5,088	5,455	2,696	197					
10-Year Sum:	6,286	6,882	3,428	259					

1) REVENUE:

5-Year Straight Avg:	1,018	1,091	539	2.35	2.48	13.62	32.02	33.80
5-Year Weighted Avg:				1.89	2.02	13.67	25.80	27.66
10-Year Straight Avg:	629	688	343	1.99	2.22	12.99	25.81	28.77
10-Year Weighted Avg:				1.83	2.01	13.26	24.31	26.62

2) PROFIT:

5-Year Straight Avg:							25.62	27.04
5-Year Weighted Avg:							20.64	22.13
10-Year Straight Avg:							20.65	23.02
10-Year Weighted Avg:							19.45	21.29

TABLE 1.—OCEAN COMMERCIAL FISHING #1 (continued): Ocean Commercial Values per Fish by Species and State (Chinook)

Annual IPD	IPD Annual Index Value	State/Year	Chinook							
			Nominal Value <sup>1</sup> (K\$)	Real Value (K\$)	Dressed Pounds Landed (Thousands)	# Fish Harvested (Thousands)	Nominal Price per Pound (Dressed)	Real Price per Pound (Dressed)	Pounds per Fish	Nominal Revenue/Profit per Fish

(See IPD data under California Chinook)

**B. Indian:**

1) REVENUE:

5-Year Straight Avg:	Due to lack of data, used the non-Indian values per fish times	11.53	27.11	28.61
5-Year Weighted Avg:	Treaty Indian pounds per fish.	11.53	21.76	23.33
10-Year Straight Avg:		10.27	20.41	22.74
10-Year Weighted Avg:		10.27	18.82	20.61

2) PROFIT:

5-Year Straight Avg:			21.68	22.88
5-Year Weighted Avg:			17.41	18.67
10-Year Straight Avg:			16.32	18.20
10-Year Weighted Avg:			15.06	16.49

TABLE 1.—OCEAN COMMERCIAL FISHING #1 (continued): Ocean Commercial Values per Fish by Species and State (Chinook)

Annual IPD	IPD Annual Index Value	State/Year	Chinook						Pounds per Fish	Nominal Revenue/Profit per Fish	Real 1st Quarter 2007 Revenue/Profit per Fish
			Nominal Value <sup>1</sup> (K\$)	1st Quarter 2007 Real Value (K\$)	Dressed Pounds Landed (Thousands)	# Fish Harvested (Thousands)	Nominal Price per Pound (Dressed)	1st Quarter 2007 Real Price per Pound (Dressed)			
(See IPD data under California Chinook)											
<b>IV. ALASKA: Southeast Only</b>											
		1997	8,420	10,417	5,170	300	1.63	2.01	17.23		
		1998	4,130	5,053	4,050	240	1.02	1.25	16.88		
		1999	4,910	5,922	2,950	190	1.66	2.01	15.53		
		2000	5,750	6,787	3,780	230	1.52	1.80	16.43		
		2001	7,030	8,104	4,160	244	1.69	1.95	17.05		
		2002	7,527	8,528	6,661	417	1.13	1.28	15.97		
		2003	7,939	8,807	6,616	431	1.20	1.33	15.35		
		2004	15,359	16,568	7,413	497	2.07	2.24	14.92		
		2005	16,491	17,267	6,518	462	2.53	2.65	14.11		
		2006 <sup>2</sup>	18,121	18,433	5,377	355	3.37	3.43	15.15		
		5-Year Sum:	65,437	69,603	32,585	2,162					
		10-Year Sum:	95,677	105,887	52,695	3,366					
1) REVENUE:											
		5-Year Straight Avg:	13,087	13,921	6,517		2.06	2.18	15.10	31.11	32.99
		5-Year Weighted Avg:					2.01	2.14	15.07	30.27	32.19
		10-Year Straight Avg:	9,568	10,589	5,270		1.78	1.99	15.86	28.27	31.62
		10-Year Weighted Avg:					1.82	2.01	15.66	28.42	31.46
2) PROFIT:											
		5-Year Straight Avg:								24.89	26.39
		5-Year Weighted Avg:								24.21	25.76
		10-Year Straight Avg:								22.62	25.30
		10-Year Weighted Avg:								22.74	25.17

TABLE 1.—OCEAN COMMERCIAL FISHING #1 (continued): Ocean Commercial Values per Fish by Species and State (Coho)

State/Year	Coho						Profit %:	Pounds per Fish	Nominal Revenue/Profit per Fish	Real 1st Quarter 2007 Revenue/Profit per Fish
	Nominal Value <sup>1</sup> (K\$)	1st Quarter 2007 Real Value (K\$)	Dressed Pounds Landed (Thousands)	# Fish Harvested (Thousands)	Nominal Price per Pound (Dressed)	1st Quarter 2007 Real Price per Pound (Dressed)				
							0.8			

(See IPD data under California Chinook)

I. CALIFORNIA: No ocean commercial Coho fishery in California from 1997-2006.

II. OREGON:

	Table IV-3	Table IV-3 (Calculated)	Table IV-7	A-8	Table IV-3 (Calculated)	Table IV-3 (Calculated)			
1997	0	0	0	0					
1998	0	0	0	0					
1999	1	1	1	0	1.00	1.21			
2000	75	89	71	12	1.06	1.25	5.79		
2001	41	47	52	9	0.79	0.91	5.57		
2002	8	9	11	2	0.73	0.82	7.26		
2003	36	40	43	6	0.84	0.93	6.68		
2004	86	93	70	9	1.23	1.33	7.92		
2005	37	39	20	3	1.85	1.94	7.64		
2006 <sup>2</sup>	38	39	13	1	2.92	2.97	9.19		
5-Year Sum:	205	219	157	21					
10-Year Sum:	322	356	281	42					

1) REVENUE:

5-Year Straight Avg:	41	44	31	1.51	1.60	7.74	11.71	12.36
5-Year Weighted Avg:				1.31	1.40	7.54	9.84	10.52
10-Year Straight Avg:	32	36	28	1.30	1.42	7.15	9.31	10.15
10-Year Weighted Avg:				1.15	1.27	6.62	7.59	8.40

2) PROFIT:

5-Year Straight Avg:							9.37	9.89
5-Year Weighted Avg:							7.87	8.42
10-Year Straight Avg:							7.44	8.12
10-Year Weighted Avg:							6.07	6.72

**TABLE 1.—OCEAN COMMERCIAL FISHING #1 (continued): Ocean Commercial Values per Fish by Species and State (Coho)**

State/Year	Coho						Pounds per Fish	Nominal Revenue/Profit per Fish	Real 1st Quarter 2007 Revenue/Profit per Fish	
	Nominal Value <sup>1</sup> (K\$)	1st Quarter 2007 Real Value (K\$)	Dressed Pounds Landed (Thousands)	# Fish Harvested (Thousands)	Nominal Price per Pound (Dressed)	1st Quarter 2007 Real Price per Pound (Dressed)				
(See IPD data under California Chinook)										
<b>III. WASHINGTON:</b>										
<b>A. Non-Indian:</b>										
	Table IV-4	Table IV-4 (Calculated)	Table IV-8	A-13	Table IV-4 (Calculated)	Table IV-4 (Calculated)				
1997		0								
1998		0								
1999	19	23	21	4	0.90	1.09	5.45			
2000	34	40	31	5	1.10	1.29	5.89			
2001	34	39	49	8	0.69	0.80	6.04			
2002	2	2	1	0	1.58	1.76	5.56			
2003	40	44	54	9	0.74	0.82	6.03			
2004	106	114	91	13	1.16	1.26	6.85			
2005	16	17	10	1	1.60	1.68	6.93			
2006 <sup>2</sup>	16	16	10	1	1.60	1.63	7.91			
5-Year Sum:	180	194	166	25						
10-Year Sum:	267	296	267	42						
1) REVENUE:										
5-Year Straight Avg:	36	39	33		1.34	1.43	6.65	8.90	9.50	
5-Year Weighted Avg:					1.08	1.17	6.60	7.16	7.72	
10-Year Straight Avg:	33	30	33		1.17	1.29	6.33	7.42	8.17	
10-Year Weighted Avg:					1.00	1.11	6.30	6.30	6.99	
2) PROFIT:										
5-Year Straight Avg:								7.12	7.60	
5-Year Weighted Avg:								5.73	6.17	
10-Year Straight Avg:								5.94	6.54	
10-Year Weighted Avg:								5.04	5.59	
<b>B. Indian:</b>										
1) REVENUE:										
5-Year Straight Avg:	- Due to lack of data, used the non-Indian values per fish times Treaty Indian pounds per fish.							6.01	8.04	8.59
5-Year Weighted Avg:								6.01	6.52	7.03
10-Year Straight Avg:								5.47	6.41	7.06
10-Year Weighted Avg:								5.47	5.47	6.06
2) PROFIT:										
5-Year Straight Avg:								6.43		6.87
5-Year Weighted Avg:								5.22		5.62
10-Year Straight Avg:								5.13		5.64
10-Year Weighted Avg:								4.37		4.85

**TABLE 1.—OCEAN COMMERCIAL FISHING #1 (continued): Ocean Commercial Values per Fish by Species and State (Coho)**

State/Year	Coho						Pounds per Fish	Nominal Revenue/Profit per Fish	Real 1st Quarter 2007 Revenue/Profit per Fish
	Nominal Value <sup>1</sup> (K\$)	1st Quarter 2007 Real Value (K\$)	Dressed Pounds Landed (Thousands)	# Fish Harvested (Thousands)	Nominal Price per Pound (Dressed)	1st Quarter 2007 Real Price per Pound (Dressed)			
(See IPD data under California Chinook)									
<b>V. ALASKA:</b>									
<b>Southeast Only</b>									
1997	14,270	17,654	14,410	1,970	0.99	1.23	7.31		
1998	13,990	17,118	23,310	2,990	0.60	0.73	7.80		
1999	21,080	25,425	21,510	3,580	0.98	1.18	6.01		
2000	9,690	11,438	13,800	1,950	0.70	0.83	7.08		
2001	13,950	16,081	22,140	3,300	0.63	0.73	6.71		
2002	10,255	11,619	24,417	3,242	0.42	0.48	7.53		
2003	11,417	12,666	17,564	2,498	0.65	0.72	7.03		
2004	20,089	21,671	21,743	3,085	0.92	1.00	7.05		
2005	17,451	18,272	18,369	3,003	0.95	0.99	6.12		
2006 <sup>2</sup>	19,765	20,105	14,018	2,054	1.41	1.43	6.82		
5-Year Sum:	78,977	84,332	96,111	13,882					
10-Year Sum:	151,957	172,048	191,281	27,672					
1) REVENUE:									
5-Year Straight Avg:	15,795	16,866	19,222		0.87	0.92	6.91	6.02	6.39
5-Year Weighted Avg:					0.82	0.88	6.92	5.69	6.07
10-Year Straight Avg:	15,196	17,205	19,128		0.83	0.93	6.95	5.73	6.47
10-Year Weighted Avg:					0.79	0.90	6.91	5.49	6.22
2) PROFIT:									
5-Year Straight Avg:								4.81	5.11
5-Year Weighted Avg:								4.55	4.86
10-Year Straight Avg:								4.59	5.18
10-Year Weighted Avg:								4.39	4.97

<sup>1</sup> Value refers to revenue.

<sup>2</sup> Preliminary data.

data. ADFG also maintains databases with both current and historical data. All of this revenue and landings (harvest) information can be found on the PFMC and ADFG Web sites.<sup>2</sup>

The most recent 10 years (1997-2006) worth of annual data on revenue, dressed pounds landed (i.e., partially processed harvest which may include the removal of internal organs, gills, fins, and head), and number of fish harvested were gathered by species and State. To be consistent with PFMC procedures, original year (nominal) revenue data were converted to “current” (real) dollars using the U.S. Bureau of Economic Analysis Annual Gross Domestic Product (GDP) Implicit Price Deflator (IPD).<sup>3</sup> The intent was to present fishing values measured in current (1<sup>st</sup> quarter 2007) dollars to be consistent with the cost estimates used in the Yakima River planning studies.

Total nominal and real revenues were divided by total dressed pounds landed on an annual basis to calculate annual nominal and real prices per pound by State and species. Five and 10-year straight and weighted averages of both nominal and real prices per pound were calculated. The weighted averages were developed by summing the total revenue over the 5- or 10-year period and dividing it by the total dressed pounds landed over the same time period. Five and 10-year straight and weighted average estimates of dressed weight per fish by State were also calculated and applied to the estimates of price per pound to estimate 5- and 10-year straight and weighted average nominal and real commercial revenues per fish by State. Note that the assumption was made that the additional harvest generated by the alternatives under consideration in the Yakima River studies is not expected to be large enough to generate a change in salmon prices, as a result, the plan was to make use of relatively recent salmon prices within the commercial fishing analysis.

Estimates of 5- and 10-year straight and weighted average nominal and real profitability per fish by species and State were developed and then estimated by applying a marginal or incremental profitability percentage of 80 percent (0.8) to the estimated revenue per fish. A literature review of a series of salmon ocean commercial fishing studies (National Marine Fisheries Service, and ADFG, 2003) indicated a range of profitability percentages from 0.43 to 0.99. As discussed in Platt (2008), excess harvest capacity within the ocean salmon commercial fishing

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<sup>2</sup> PFMC Salmon Stock Assessment and Fishery Evaluation (SAFE) Report Web site: Historic Data and Annual Reviews of Ocean Salmon Fisheries <<http://www.pcouncil.org/salmon/salsafe.html>>.

ADFG Division of Commercial Fisheries—Salmon Catch, Effort, and Value: Annual Data by Species and area at <<http://www.cf.adfg.state.ak.us/geninfo/finfish/salmon/salmcatch.php>> (go to ADFG home page: <<http://www.adfg.state.ak.us>>, click on “Commercial Fishing,” click on “Salmon,” click on “Catch, Effort, and Value.”)

<sup>3</sup> U.S. Bureau of Economic Analysis Annual and Quarterly Gross Domestic Product Implicit Price Deflator data at: <<http://www.bea.gov/national/nipaweb/index.asp>> (click on “List of Selected NIPA Tables,” click “Table 1.1.9 Implicit Price Deflators for Gross Domestic Product.”)

industry leads to the potential of harvesting additional fish with relatively little additional cost. As a result, the additional profitability associated with the incremental harvest revenue is likely to be high implying the use of a high profitability percentage. Ultimately, the 5-year weighted average of real profitability per fish by State and species was applied in the Yakima River ocean commercial fishing economic benefit analyses since this estimate is based on the most recent data (years 2002-2006), accounts for landings differences between years (weighting), and converts dollars to a common year (real dollars).

Since the ocean commercial profitability values per Chinook and Coho salmon vary by State, to apply them to estimate changes in commercial fishing benefits would require estimates of ocean commercial harvest by State stemming from the increases in Yakima River fish stocks. The biological population and harvest modeling effort provided estimates of total ocean commercial harvest, but not ocean harvest broken down by State. To estimate the portion of Chinook and Coho commercial ocean harvest by State stemming from the Yakima River, data were gathered from hatchery fish coded wire tag recoveries as obtained from the Pacific States Marine Fisheries Commission (PSMFC) Regional Mark Processing Center (RMPC).<sup>4</sup> With the assistance of RMPC personnel, the database of wire tag recoveries was searched for Chinook and Coho ocean commercial recoveries stemming from the Yakima River. Table 2—Ocean Commercial Fishing #2 presents the results of the coded wire tag database queries. The data from the database were used to calculate the percentage of Yakima River ocean commercial recoveries by species and State. Note that while the information within the database only reflects a small portion of the total ocean commercial harvest by State and species, it does provide an indication of the potential percentage allocation of harvest by species and State.

Since Alaskan ocean commercial fishing economic data are broken down into four subregions, a further query of the PSMFC coded wire tag recovery database was needed to separate the Alaskan harvest stemming from the Yakima River by subregion (see Table 3—Ocean Commercial Fishing #3). This additional database query was only conducted for Chinook since no coded wire tag recoveries in Alaska stemming from the Yakima River were reported for Coho. Given that 95 percent of the Alaskan Chinook ocean commercial tag recoveries stemming from the Yakima River occurred in Alaska's Southeast Region, the Alaskan ocean commercial economic data used in the Yakima River analysis focused exclusively on Southeast Region data. So while the percentage of ocean commercial harvest by species and State (including Alaska) was obtained from Table 2—Ocean Commercial Fishing #2, the data from Table 3—Ocean Commercial Fishing #3 were needed to make the decision to use southeast Alaska economic data to reflect Alaskan Chinook harvest for the benefit estimation process.

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<sup>4</sup> PSMFC Regional Mark Processing Center (RMPC) Web site: <<http://www.rmpc.org>>.

**TABLE 2.—OCEAN COMMERCIAL FISHING #2: Percentage of Yakima River Ocean Commercial Harvest by Species and State (hatchery coded wire tag data)**

Source: PSMFC Regional Mark Processing Center's Coded Wire Tag Recovery Database (Web site: <<http://www.rmpc.org>>).

Species	Harvest Type	Recovery Year	Hatchery Salmon Coded Wire Tag Recovery Data by Species and Area Stemming From Yakima River										Total			
			Alaska Recoveries	Alaska Percent	Canada Recoveries	Canada Percent	Washington Recoveries	Washington Percent	Oregon Recoveries	Oregon Percent	California Recoveries	California Percent		Percent North	Percent South	
Chinook	Commercial	1984		0.000	2	1.000		0.000		0.000		0.000		2		
		1985	2	0.250	6	0.750		0.000		0.000		0.000		8		
		1986	5	0.250	14	0.700		0.000	1	0.050		0.000		20		
		1987	18	0.367	25	0.510	3	0.061	3	0.061		0.000		49		
		1988	18	0.514	15	0.429	1	0.029		0.000	1	0.029		35		
		1989	11	0.297	22	0.595	2	0.054	1	0.027	1	0.027		37		
		1990	51	0.560	39	0.429		0.000	1	0.011		0.000		91		
		1991	23	0.418	30	0.545	1	0.018	1	0.018		0.000		55		
		1992	9	0.474	7	0.368	3	0.158		0.000		0.000		19		
		1993	28	0.571	18	0.367		0.000	3	0.061		0.000		49		
		1994	32	0.640	18	0.360		0.000		0.000		0.000		50		
		1995	3	0.231	7	0.538	1	0.077	2	0.154		0.000		13		
		1996	18	0.947	1	0.053		0.000		0.000		0.000		19		
		1997	41	0.612	24	0.358	1	0.015	1	0.015		0.000		67		
		1998	68	0.701	25	0.258	1	0.010	3	0.031		0.000		97		
		1999	133	0.619	68	0.316	13	0.060		0.000		0.005	1	215		
		2000	114	0.891	9	0.070	4	0.031	1	0.008		0.000		128		
		2001	39	0.780	5	0.100	2	0.040	4	0.080		0.000		50		
		2002	87	0.837	12	0.115	3	0.029	2	0.019		0.000		104		
		2003	80	0.909	6	0.068	2	0.023		0.000		0.000		88		
2004	20	0.645	8	0.258	3	0.097		0.000		0.000		31				
2005	17	0.500	16	0.471	1	0.029		0.000		0.000		34				
2006	6	0.750	2	0.250		0.000		0.000		0.000		8				
1984-2006 Totals:			823	0.649	379	0.299	41	0.032	23	0.018	3	0.002	1269	0.980	0.020	

Direction of migration from the mouth of the Columbia River

TABLE 2.—OCEAN COMMERCIAL FISHING #2 (continued): Percentage of Yakima River Ocean Commercial Harvest by Species and State (hatchery coded wire tag data)

Species	Harvest Type	Recovery Year	Hatchery Salmon Coded Wire Tag Recovery Data by Species and Area Stemming From Yakima River										Total	Percent North	Percent South
			Alaska Recoveries	Alaska Percent	Canada Recoveries	Canada Percent	Washington Recoveries	Washington Percent	Oregon Recoveries	Oregon Percent	California Recoveries	California Percent			
Coho	Commercial	1981		0.000		0.000	1	0.071	12	0.857	1	0.071	14		
		1982		-		-		-		-		-	0		
		1983		-		-		-		-		-	0		
		1984		-		-		-		-		-	0		
		1985		-		-		-		-		-	0		
		1986		-		-		-		-		-	0		
		1987		-		-		-		-		-	0		
		1988		0.000	1	1.000		0.000		0.000		0.000	1		
		1989		0.000	10	0.123	5	0.062	64	0.790	2	0.025	81		
		1990		0.000	2	0.040	9	0.180	26	0.520	13	0.260	50		
		1991		0.000	2	0.024	3	0.036	63	0.750	16	0.190	84		
		1992		0.000	1	0.143	1	0.143	5	0.714		0.000	7		
		1993		0.000		0.000	1	1.000		0.000		0.000	1		
		1994		-		-		-		-		-	0		
		1995		0.000	1	0.500	1	0.500		0.000		0.000	2		
		1996		-		-		-		-		-	0		
		1997		-		-		-		-		-	0		
		1998		-		-		-		-		-	0		
		1999		0.000		0.000	2	1.000		0.000		0.000	2		
		2000		0.000		0.000	1	0.500	1	0.500		0.000	2		
		2001		0.000		0.000	3	0.750	1	0.250		0.000	4		
		2002		0.000		0.000	1	1.000		0.000		0.000	1		
		2003		0.000		0.000	1	1.000		0.000		0.000	1		
		2004		0.000		0.000	3	1.000		0.000		0.000	3		
		2005		-		-		-		-		-	0		
		2006		-		-		-		-		-	0		
		1981-2006 Totals:	0	0.000	17	0.067	32	0.126	172	0.680	32	0.126	253	0.194	0.806

Direction of migration from the mouth of the Columbia River

**TABLE 3.—OCEAN COMMERCIAL FISHING #3: Alaskan Ocean Chinook Coded Wire Tag Recoveries by Area Stemming from Yakima River**

Source: PSMFC Regional Mark Processing Center's Code Wire Tag Recovery Database (Web site: <<http://www.rmhc.org>>).

Species Type	RC State	RC RMPC Region *	Fishery Type	Recovery Date Year	Sum (RC Total)	Percent by Area
Chinook	Alaska	CNAK	Commercial	1986	1	0.122
Chinook	Alaska	SEAK	Commercial	2006	6	
Chinook	Alaska	SEAK	Commercial	2005	15	
Chinook	Alaska	SEAK	Commercial	2004	20	
Chinook	Alaska	SEAK	Commercial	2003	80	
Chinook	Alaska	SEAK	Commercial	2002	87	
Chinook	Alaska	SEAK	Commercial	2001	38	
Chinook	Alaska	SEAK	Commercial	2000	112	
Chinook	Alaska	SEAK	Commercial	1999	129	
Chinook	Alaska	SEAK	Commercial	1998	62	
Chinook	Alaska	SEAK	Commercial	1997	38	
Chinook	Alaska	SEAK	Commercial	1996	17	
Chinook	Alaska	SEAK	Commercial	1995	3	
Chinook	Alaska	SEAK	Commercial	1994	31	
Chinook	Alaska	SEAK	Commercial	1993	26	
Chinook	Alaska	SEAK	Commercial	1992	9	
Chinook	Alaska	SEAK	Commercial	1991	21	
Chinook	Alaska	SEAK	Commercial	1990	43	
Chinook	Alaska	SEAK	Commercial	1989	8	
Chinook	Alaska	SEAK	Commercial	1988	17	
Chinook	Alaska	SEAK	Commercial	1987	15	
Chinook	Alaska	SEAK	Commercial	1986	4	
Chinook	Alaska	SEAK	Commercial	1985	2	
				Total:	783	95.140
Chinook	Alaska	WEAK	Commercial	2005	2	
Chinook	Alaska	WEAK	Commercial	2001	1	
Chinook	Alaska	WEAK	Commercial	2000	2	
Chinook	Alaska	WEAK	Commercial	1999	4	
Chinook	Alaska	WEAK	Commercial	1998	6	
Chinook	Alaska	WEAK	Commercial	1997	3	
Chinook	Alaska	WEAK	Commercial	1996	1	
Chinook	Alaska	WEAK	Commercial	1994	1	
Chinook	Alaska	WEAK	Commercial	1993	2	
Chinook	Alaska	WEAK	Commercial	1991	2	
Chinook	Alaska	WEAK	Commercial	1990	8	
Chinook	Alaska	WEAK	Commercial	1989	3	
Chinook	Alaska	WEAK	Commercial	1988	1	
Chinook	Alaska	WEAK	Commercial	1987	3	
				Total:	39	4.739
				Overall Total:	823	100

Note: \* Alaskan ocean commercial data is broken down into 4 subregions: (1) southeast (SEAK), (2) central (CNAK), (3) Artic-Yukon-Kuskokwim (AYK), and (4) westward (WEAK). Note that no recoveries of Yakima Chinook in the AYK region have been recorded in the database.

Given that BCAs focus on NED, harvest and associated benefits occurring in Canada would be irrelevant for this analysis. The 29.9 percent and 6.7 percent of ocean commercial Chinook and Coho harvest respectively stemming from the Yakima River which was expected to be caught in Canada should therefore be excluded from the ocean commercial fishery benefit analysis.

The coded wire tag based percentages of ocean commercial harvest by species and State stemming from Yakima River stocks were applied to the State-by-State ocean commercial profitability estimates to calculate a weighted average ocean commercial profitability estimate per fish by species.<sup>5</sup> Since the coded wire tag data included Canada, the State-by-State percentages by species needed to be recalculated without Canada to total 100 percent. There has not been an ocean commercial fishery for Coho in California over the past 10 years. As a result, both the California and Canada harvest percentages were eliminated and the value per fish was based on only Oregon and Washington data (notice that the Alaskan percentage was zero for Coho). If the percentages hadn't been recalculated, the U.S. only weighted average profitability per fish would have been understated since the unadjusted State percentages total only to 70.1 percent (100% – 29.9% Canadian) for Chinook and 93.3 percent (100% – 6.7% Canadian) for Coho. To calculate nationally oriented ocean commercial fishing benefits, either the ocean commercial harvest estimates provided by the biologists will need to focus exclusively on U.S. harvest or the Canadian harvest percentages will need to be applied to the total (U.S. and Canada) ocean harvest by species so that the Canadian harvest could be deducted from total harvest to estimate U.S.-only harvest. Table 4—Ocean Commercial Fishing #4 presents the weighted average U.S. ocean commercial revenue and profitability estimates per fish by species. In the Yakima River BCAs, the 5-year weighted average profitability values per fish by species (\$25.57 for Chinook and \$8.07 for Coho in 1<sup>st</sup> quarter 2007 dollars) were applied to the annual estimates of U.S. ocean commercial harvest by species for each alternative. The annual profitability estimates were discounted to the present and aggregated to provide an ocean commercial fishing benefit estimate.

## 2.2 Ocean Sport

Unlike commercial fishing, recreational or sport fishing activities typically do not take place within a market setting (with the exception of for-hire sector trips—

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<sup>5</sup> Another option would have been to apply the percentages by state from the coded wire tag data to the overall ocean commercial harvest estimates developed by study team biologists and then apply the profitability values per fish from each State to the State-specific harvest estimates. However, this approach would require the analyst to track many more value estimates—one for each species, State, harvest type, and harvest area.

**TABLE 4.—OCEAN COMMERCIAL FISHING #4: Weighted Average Revenue and Profitability per Fish by Species**

	Chinook					Coho						
	California	Oregon	Washington	Alaska	Canada <sup>1</sup>	TOTAL	California	Oregon	Washington	Alaska	Canada <sup>1</sup>	TOTAL
% Harvest by State/Country:	0.0024	0.0181	0.0323	0.6485	<b>0.2987</b>	1.0000	0.1265	0.6798	0.1265	0.0000	<b>0.0672</b>	1.0000
% Harvest by States Only:	0.0034	0.0258	0.0461	0.9247		1.0000	n/a <sup>2</sup>	0.8431	0.1569	0.0000		1.0000
1) REVENUE:												
5-Year Straight Avg:	0.14	1.00	1.56	30.50		33.19	n/a	10.42	1.49	0.00		11.91
5-Year Weighted Avg:	0.11	0.80	1.27	29.77		31.96	n/a	8.87	1.21	0.00		10.08
10-Year Straight Avg:	0.11	0.79	1.33	29.24		31.47	n/a	8.55	1.28	0.00		9.84
10-Year Weighted Avg:	0.10	0.71	1.23	29.09		31.12	n/a	7.08	1.10	0.00		8.18
2) PROFIT:												
5-Year Straight Avg:	0.11	0.80	1.25	24.40		26.56	n/a	8.34	1.19	0.00		9.53
5-Year Weighted Avg:	0.09	0.64	1.02	23.82		25.57	n/a	7.10	0.97	0.00		8.07
10-Year Straight Avg:	0.09	0.63	1.06	23.39		25.17	n/a	6.84	1.03	0.00		7.87
10-Year Weighted Avg:	0.08	0.57	0.98	23.27		24.90	n/a	5.66	0.88	0.00		6.54

<sup>1</sup> Will need to reduce ocean harvest by Canada harvest percentage (29.87% for Chinook and 6.72% for Coho) to account for U.S.-only harvest.

<sup>2</sup> Despite the historical data on coded wire tag recoveries (early 1990s), there was not an ocean commercial Coho fishery in California during the 1997-2006 period.

charterboat, partyboat, guideboat activities). As a result, market price information is generally unavailable and nonmarket valuation techniques are typically employed.

The most common nonmarket valuation techniques used in valuing sport fishing and other outdoor recreation activities are the travel cost method (TCM) and contingent valuation method (CVM). Both of these approaches have been recommended for use in valuing outdoor recreation activities within the P&Gs. The TCM makes use of data on observed recreator behavior to develop a sport fishing statistical demand model where visitation is estimated as a function of travel costs to the site, site quality (e.g., fish harvest), and other socioeconomic/demographic factors. The area under the demand curve provides a measure of recreator willingness-to-pay (WTP). Subtracting from WTP the cost of accessing the site (e.g., travel cost) provides a measure of the net WTP or economic value attributable to the associated level of recreation visitation, a standard recreation valuation measure otherwise referred to as consumer surplus. Contingent valuation uses surveys to directly ask recreators about their WTP for different recreationally oriented scenarios. As with TCM, CVM also provides a measure of consumer surplus. One of the advantages as well as difficulties with CVM is that it involves posing hypothetical questions within the survey. As a result, the CVM technique can be used to estimate values for previously unseen scenarios, beyond the range of historical experience, prior to their implementation. Due to the hypothetical nature of some of the CVM questions, some economists prefer using TCM since it is based on actual observed behavior. Unlike CVM, a disadvantage of a standard TCM is that it cannot estimate values for scenarios beyond the range of historical observation.

To estimate values per recreationally caught fish for use in the Yakima River sport fishing benefit estimation analyses, a detailed literature search of salmon and steelhead economic sport fishing studies was conducted. The use of valuation results from existing studies, a procedure referred to as benefits transfer, is a common practice for recreational economic analyses. Virtually all of the reviewed studies providing original value estimates used either the TCM or CVM approach. Over 80 studies were gathered and reviewed for their applicability to the Yakima River sport fisheries economic analyses. An annotated bibliography was developed of the various reviewed studies. Those studies which provided value estimates were included in an Excel spreadsheet for further data analysis. Since various runs of salmon are recreationally caught both in rivers and in the ocean, with different values associated with river versus ocean sport fishing, the Excel worksheet was separated into salmon ocean versus salmon in-river sections. Note that there were not enough salmon studies differentiated by species (e.g., Fall Chinook, Spring Chinook, Coho, etc.) to allow for separate value estimates by salmon species, therefore all salmon sport fishing trips/days were assigned the same value within the same general geographic area (i.e., ocean versus river). However, a separate section was developed for steelhead as a number of steelhead studies were available (note that steelhead are recreationally

caught only within Pacific Northwest rivers and not in the ocean). Of the over 80 salmon and steelhead studies reviewed, only 59 provided original value estimates (17 for ocean salmon, 18 for river salmon, and 24 for river steelhead). The other studies either did not provide value estimates or made use of estimates from another existing study.

A complication with the use of these studies involves the type of value estimate(s) provided in each study. Many of the studies provided value estimates for a specific change in fishery conditions (e.g., a certain percentage change in fish populations/harvest or for the marginal/next fish harvested). The specific changes in fishery conditions therefore varied widely across the “change in conditions” studies, suggesting that the valuation results also reflected a wide range of different scenarios. Unfortunately, such studies would likely have little relevance to the Yakima studies since the change in fishery conditions evaluated in each reviewed study would be significantly different from that being evaluated in the Yakima studies. Given this situation, the decision was made to focus only on those studies which provided value estimates for “current” conditions at the time of the study. While conditions at the time of the study may vary from those seen today, fishery conditions tend to change rather slowly, implying those current condition value estimates would likely be more relevant to the Yakima studies.

In addition, this analysis grouped the studies and averaged the values within the spreadsheets across the following time intervals: since 2005, since 2000, since 1995, since 1990, since 1985, with the intent on focusing on the more recently completed studies. With more recent studies, it is more likely that advanced forms of the TCM and CVM approaches would have been used and fishery conditions would be less likely to have changed significantly from current conditions. Unfortunately, it appears the majority of salmon and steelhead studies were conducted from the late 1970s to the late 1980s, so many (but not all) of the studies may be getting somewhat dated. Also note that the values from the various studies were indexed up to current (April 2007) dollars based on the consumer price index to be consistent with the Yakima River studies cost estimates. To the extent possible, this analysis also tried to make use of the more recent studies to minimize the duration of the indexing period. In addition, despite the fact that the studies reflect a range of different river and ocean locations, most of these studies were conducted in the Pacific Northwest States of California, Oregon, Washington, and Idaho (with several from Alaska). Furthermore, by grouping the studies by species (salmon versus steelhead) and geographic setting (ocean versus river), this analysis lumped similar studies together. The intent was to obtain the most relevant values possible by averaging valuation results over similar species, geographic areas, and time periods.

Another issue pertains to the units of measure of the sport fishing effort estimates. Sport fishing effort is typically measured in terms of recreation days by Federal and State fisheries agencies (see Table 5—Ocean Sport Fishing #1). One needs to be careful in using fishery agency effort data because in some cases the estimates

**TABLE 5.—OCEAN SPORT FISHING #1: Days per Chinook and Salmon Harvested**

Source: PFMC, Salmon SAFE Report Web site: <<http://www.pcouncil.org/salmon/salsafe.html>>, 2006 SAFE Report Socioeconomic Chapter, Table IV-10.

Year/Area	Charterboat Ocean Sport Salmon Days (thousands)	Private Boat Ocean Sport Salmon Days (thousands)	Total Ocean Sport Salmon Days (thousands)	Charterboat Chinook Ocean Landings (thousands of fish)	Private Boat Chinook Ocean Landings (thousands of fish)	Total Chinook Ocean Landings (thousands of fish)	Charterboat Coho Ocean Landings (thousands of fish)	Private Boat Coho Ocean Landings (thousands of fish)	Total Coho Ocean Landings (thousands of fish)	Total Chinook & Coho Ocean Landings (thousands of fish)	Total Chinook and Coho Harvest Rate per Day	Total Chinook and Coho Days per Fish Harvested
<b>CALIFORNIA:</b>												
1997	102.6	131.7	234.3	122.3	106.6	228.9	0.0	0.5	0.5	229.4	0.979	1.021
1998	67.0	85.0	152.0	59.7	62.3	122.0	0.0	0.1	0.1	122.1	0.803	1.245
1999	62.6	84.4	147.0	40.5	47.4	87.9	0.0	0.6	0.6	88.5	0.602	1.661
2000	94.0	120.4	214.4	91.9	94.0	185.9	0.0	0.4	0.4	186.3	0.869	1.151
2001	69.9	95.2	165.1	43.2	55.6	98.8	0.1	1.2	1.3	100.1	0.606	1.649
2002	86.6	123.4	210.0	85.1	96.9	182.0	0.0	0.8	0.8	182.8	0.870	1.149
2003	59.4	75.3	134.7	48.3	46.4	94.7	0.1	0.6	0.7	95.4	0.708	1.412
2004	97.7	121.0	218.7	124.7	96.5	221.2	0.0	1.4	1.4	222.6	1.018	0.982
2005	69.1	103.9	173.0	61.3	81.9	143.2	0.0	0.7	0.7	143.9	0.832	1.202
2006	43.3	77.0	120.3	34.7	54.8	89.5	0.0	1.4	1.4	90.9	0.756	1.323
5-Year Straight Avg:	71.2	100.1	171.3	70.8	75.3	146.1	0.0	1.0	1.0	147.1	0.837	1.214
5-Year Weighted Avg:											0.859	1.165
10-Year Straight Avg:	75.2	101.7	177.0	71.2	74.2	145.4	0.0	0.8	0.8	146.2	0.804	1.280
10-Year Weighted Avg:											0.826	1.210

**TABLE 5.—OCEAN SPORT FISHING #1 (continued): Days per Chinook and Salmon Harvested**

Year/Area	Charterboat Ocean Sport Salmon Days (thousands)	Private Boat Ocean Sport Salmon Days (thousands)	Total Ocean Sport Salmon Days (thousands)	Charterboat Chinook Ocean Landings (thousands of fish)	Private Boat Chinook Ocean Landings (thousands of fish)	Total Chinook Ocean Landings (thousands of fish)	Charterboat Coho Ocean Landings (thousands of fish)	Private Boat Coho Ocean Landings (thousands of fish)	Total Coho Ocean Landings (thousands of fish)	Total Chinook & Coho Ocean Landings (thousands of fish)	Total Chinook and Coho Harvest Rate per Day	Total Chinook and Coho Days per Fish Harvested
<b>OREGON:</b>												
1997	3.9	26.4	30.3	1.5	6.2	7.7	2.4	3.6	6.0	13.7	0.452	2.212
1998	1.8	24.2	26.0	0.5	3.6	4.1	0.5	1.8	2.3	6.4	0.246	4.063
1999	5.5	43.9	49.4	0.9	6.9	7.8	3.4	10.3	13.7	21.5	0.435	2.298
2000	9.8	68.7	78.5	3.6	21.8	25.4	7.5	25.7	33.2	58.6	0.746	1.340
2001	18.2	102.3	120.5	6.4	20.8	27.2	19.3	75	94.3	121.5	1.008	0.992
2002	15.7	91.9	107.6	7.9	39.5	47.4	9	27.5	36.5	83.9	0.780	1.282
2003	23.4	121.1	144.5	8.8	31.8	40.6	23.7	90	113.7	154.3	1.068	0.936
2004	21.1	124.6	145.7	14.6	41.8	56.4	13.1	58.8	71.9	128.3	0.881	1.136
2005	9.9	66.1	76.0	4.5	23.4	27.9	3.1	10.6	13.7	41.6	0.547	1.827
2006	8.0	54.3	62.3	1.5	11.6	13.1	3.6	12	15.6	28.7	0.461	2.171
5-Year Straight Avg:	15.6	91.6	107.2	7.5	29.6	37.1	10.5	39.8	50.3	87.4	0.747	1.470
5-Year Weighted Avg:											0.815	1.227
10-Year Straight Avg:	11.7	72.4	84.1	5.0	20.7	25.8	8.6	31.5	40.1	65.9	0.662	1.826
10-Year Weighted Avg:											0.783	1.277
<b>WASHINGTON:</b>												
1997	12.5	15.1	27.6	1.7	2.3	4.0	12.5	12.8	25.3	29.3	1.062	0.942
1998	5.5	6.8	12.3	1.1	0.9	2.0	5.6	7.1	12.7	14.7	1.195	0.837
1999	17.5	29.9	47.4	5.7	4.1	9.8	16.3	23.7	40.0	49.8	1.051	0.952
2000	17.1	27.9	45.0	5.1	3.4	8.5	27.9	35.8	63.7	72.2	1.604	0.623
2001	41.2	72.4	113.6	11.9	10.8	22.7	66.2	98.2	164.4	187.1	1.647	0.607
2002	37	57.4	94.4	30.9	27	57.9	30.4	43.7	74.1	132.0	1.398	0.715
2003	44.5	75.5	120.0	16	18.1	34.1	53.4	84.9	138.3	172.4	1.437	0.696
2004	36.5	73.1	109.6	10.3	14.6	24.9	37.6	75.1	112.7	137.6	1.255	0.797
2005	31.7	58.9	90.6	15.9	20.4	36.3	19.2	32.6	51.8	88.1	0.972	1.028
2006	24.5	39.1	63.6	4	6.7	10.7	16.2	19.9	36.1	46.8	0.736	1.359
5-Year Straight Avg:	34.8	60.8	95.6	15.4	17.4	32.8	31.4	51.2	82.6	115.4	1.160	0.919
5-Year Weighted Avg:											1.206	0.829
10-Year Straight Avg:	26.8	45.6	72.4	10.3	10.8	21.1	28.5	43.4	71.9	93.0	1.236	0.856
10-Year Weighted Avg:											1.284	0.779

referred to as “trips” actually reflect “days” from an economics perspective (e.g., PFMC data). From an economist’s point of view, a recreation trip reflects a single visit to a recreation site from one’s primary residence even if the visit involves multiple days. Conversely, estimates of recreation days reflect the actual number of days spent on-site where a recreation day can involve recreating for any portion of a calendar day. As a result, a recreation trip can be comprised of more than one recreation day. Economists tend to focus on trips as the preferred visitation and valuation measure since many of the travel cost components are incurred on a per trip basis as opposed to a per day basis (e.g., costs of traveling to the region). For local residents, recreation trips tend to equal the number of recreation days (i.e., locals typically take single day trips). On the other hand, nonlocals tend to stay overnight in the region, implying multiple day trips. If a site experiences a significant amount of visitation from nonlocals, the number of days could significantly exceed the number of trips. Given that the Federal and State agency fishing effort estimates are generally measured in days, the valuation estimates would also need to be measured in days. Unfortunately, the majority of the reviewed studies measured values on a per trip basis and did not provide estimates of the average number of days per trip to allow for conversion of per trip to per day values. To the extent that per trip values exceed per day values, the use of per trip estimates would overstate sport fishing benefits.

The need to develop a value per day estimate eliminated the available studies which only provided estimates of values on a per trip basis. For ocean benefit estimation, only two studies conducted since 1985 were located which provided current condition value estimates on a per day basis: (1) Olsen et al. (1991) and (2) Jones and Stokes (1987). Olsen et al. (1991) conducted a contingent valuation survey in 1989 to estimate use and nonuse values associated with current ocean and Columbia River conditions as well as a doubling of the size of the salmon and steelhead runs on the Columbia River. This is perhaps the most frequently referenced study of Columbia River salmon values found in the literature. Jones and Stokes (1987) conducted a survey in 1986-7 of Juneau Alaska area anglers (with analysis conducted by Michael Hanemann [UC-Berkeley] and Richard Carson [UC-San Diego]) using sophisticated random utility travel cost models. The average across the four values per day estimates (two from each study), indexed to April 2007 dollars, was \$115.28.

A final aspect of the ocean sport fishing analysis has to do with the conversion of value estimates from a per day basis to a per fish basis. The biological models used in the Yakima River studies estimated changes in fish populations for each alternative from which harvest estimates were developed. Since the sport fishing economic studies employed report values on a per day basis, those values have to be converted to a per fish basis before being applied to the harvest estimates. A standard procedure for conversion is to multiply the values per day by the number of ocean sport fishing days per fish harvested. Federal and State fisheries agencies generally collect data on ocean sport harvest and effort from which harvest per day estimates can be derived. While harvest is estimated by species,

the number of days fished may not be species-specific since many anglers do not target specific species. In others words, ocean sport trips may target certain general types of fish (e.g., salmon), but those trips may not be species-specific (e.g., Fall Chinook trips). PFMC visitation data are available by species group (e.g., salmon), but not by individual species. As a result, it is often necessary to combine individual species (e.g., Fall Chinook, Spring Chinook, Coho) into similar species groups (e.g., salmon) based on the level of detail available for the effort (trips/days) data. Harvest per day estimates can be calculated for general species types using the Federal/State agency catch and effort data. The inverse of harvest per day is the days per fish harvested factor needed to convert value per day to value per fish.

Similar to the ocean commercial analysis, ocean sport data on days per fish harvested varied by State. To estimate a weighted average days per Chinook and Coho salmon harvested across the various States, coded wire tag data (as obtained from the PSMFC Regional Mark Processing Center) was again used, this time to estimate the percentage of ocean sport harvest by State stemming from the Yakima River (see Table 6—Ocean Sport Fishing #2). Note that while the days per fish harvested had to be combined for Chinook and Coho due to lack of detail on fishing effort (i.e., salmon trips rather than Chinook salmon trips), the coded wire tag data were salmon species specific. Multiplying the generic salmon days per harvested fish by State by the species specific (Chinook and Coho) percentages by State stemming from the Yakima River allows for the estimation of weighted average species specific estimates of days per ocean sport harvested Chinook and Coho salmon. While this estimate would be more accurate if species-specific visitation estimates could be developed and therefore species-specific days per harvested fish estimates were available, nevertheless this estimate does make it possible to differentiate between fish species.

A complication with the estimation of the weighted average days per Chinook and Coho stemmed from the lack of certain data from the State of Alaska. While Alaska gathers data on ocean sport Chinook and Coho harvest, their effort (days fished) data are not species or species group specific. The estimates of ocean sport fishing days in Alaska include all species. Therefore, it would not be reasonable to develop a “days per Chinook or Coho harvested” estimate since the fishing day estimate includes days where salmon are not being targeted. Since salmon days per fish harvested could not be estimated for Alaska, another option would be to see if the available Alaskan ocean sport salmon valuation studies provided estimates of values on a per fish basis. If so, no conversion would need to be made between values per day and values per fish. Unfortunately, none of the Alaskan studies reported values on a per fish basis or provided harvest per day information to make such a conversion possible. As a result, a weighted average day per Chinook and Coho harvested were estimated based only on data from the States of California, Oregon, and Washington. The percentages by State for California, Oregon, and Washington were re-weighted to sum to 100 percent (see Table 7—Ocean Sport Fishing #3). For Coho, this data shortage was not a problem

**TABLE 6.—OCEAN SPORT FISHING #2: Percentage of Yakima River Ocean Sport Harvest by Species and State (hatchery coded wire tag data)**

Source: PSMFC Regional Mark Processing Center's Coded Wire Tag Recovery Database (Web site: <<http://www.rmhc.org>>).

Species	Harvest Type	Recovery Year	Hatchery Salmon Coded Wire Tag Recovery Data by Species and Area Stemming From Yakima River:										Total	Of Columbia River	
			Alaska	Alaska Percent	Canada	Canada Percent	Washington	Washington Percent	Oregon	Oregon Percent	California	California Percent			
Chinook	Sport	1983		0.000		0.000		0.000	1	1.000		0.000	1		
		1984		-		-		-		-		-	0		
		1985		0.000	1	1.000		0.000		0.000		0.000	1		
		1986		0.000	2	1.000		0.000		0.000		0.000	2		
		1987		0.000	2	0.500	2	0.500		0.000		0.000	4		
		1988		0.000	1	1.000		0.000		0.000		0.000	1		
		1989		0.000	2	0.250	5	0.625		0.000	1	0.125	8		
		1990	3	0.600	1	0.200	1	0.200		0.000		0.000	5		
		1991		0.000		0.000	2	1.000		0.000		0.000	2		
		1992		-		-		-		-		-	0		
		1993		0.000		0.000	3	1.000		0.000		0.000	3		
		1994	1	1.000		0.000		0.000		0.000		0.000	1		
		1995		0.000		0.000		0.000		0.000	1	1.000	1		
		1996	1	1.000		0.000		0.000		0.000		0.000	1		
		1997	3	0.500		0.000	3	0.500		0.000		0.000	6		
		1998	1	0.091	3	0.273	7	0.636		0.000		0.000	11		
		1999	10	0.303	13	0.394	9	0.273	1	0.030		0.000	33		
		2000	21	0.700	8	0.267	1	0.033		0.000		0.000	30		
		2001		0.000	2	0.500	1	0.250	1	0.250		0.000	4		
		2002	6	0.400	6	0.400	3	0.200		0.000		0.000	15		
2003	6	1.000		0.000		0.000		0.000		0.000	6				
2004		0.000	3	0.600	1	0.200	1	0.200		0.000	5				
2005	1	0.500	1	0.500		0.000		0.000		0.000	2				
2006	1	1.000		0.000		0.000		0.000		0.000	1				
1983-2006 Totals:			54	0.378	45	0.315	38	0.266	4	0.028	2	0.014	143	0.958	0.042



**TABLE 7.—OCEAN SPORT FISHING #3: Values per Fish**

State	5 & 10-Year Weighted Average Chinook & Coho Days/Fish Harvested	Percent Chinook Harvest by State	Re-Weighted Percent Chinook Harvest by State	Percent Coho Harvest by State	Re-Weighted Percent Coho Harvest by State
California:	1.165	0.014	0.045	0.090	0.091
Oregon:	1.227	0.028	0.091	0.423	0.424
Washington:	0.829	0.266	0.864	0.484	0.485
Alaska:	not available	0.378	—	0.000	—
Canada:	not applicable	0.315	—	0.003	—
			1.000		1.000
5-Year CA/OR/WA Weighted Average Days/Fish Harvested:			0.880		1.028
Value per Day (April 2007 \$):			\$115.28		\$115.28
Value per Fish (April 2007 \$):			\$101.49		\$118.54
California:	1.210	0.014	0.045	0.090	0.091
Oregon:	1.277	0.028	0.091	0.423	0.424
Washington:	0.779	0.266	0.864	0.484	0.485
Alaska:	not available	0.378	—	0.000	—
Canada:	not applicable	0.315	—	0.003	—
			1.000		1.000
10-Year CA/OR/WA Weighted Average Days/Fish Harvested:			0.844		1.029
Value per Day (April 2007 \$):			\$115.28		\$115.28
Value per Fish (April 2007 \$):			\$97.24		\$118.62

since no coded wire tags were recovered in Alaska, but for Chinook this exclusion proved problematic since nearly 38 percent of the coded wire tags were recovered in Alaska. The decision was made to exclude Alaska and to assume that the ocean sport fishing values per fish in Alaska is analogous to the weighted average across California, Oregon, and Washington.

Table 7—Ocean Sport Fishing #3 presents the results of applying the re-weighted percentages by State to the 5-year weighted average days per fish harvested by State to estimate an overall weighted average days per ocean sport fish harvested for Chinook (.880) and Coho (1.028). Multiplying these estimates of overall ocean sport days per harvested fish by the \$115.28 value per day provides the necessary estimates of values per fish for Chinook (\$101.49) and Coho (\$118.54). While both species used the same estimates of value per day and days per fish harvested by State, the difference in value per fish is driven by the harvest percentages by State obtained from the coded wire tag data. As with the ocean commercial analysis, the percentage of ocean sport Chinook harvest stemming from the Yakima River expected to be taken in Canada (31.5%) would need to be excluded from the analysis (note the percentage of Coho harvested in Canada was essentially zero (0.3 %)). To calculate nationally oriented ocean sport fishing benefits, either the ocean sport harvest estimates provided by the biologists will need to focus exclusively on U.S. harvest or the Canadian harvest percentages will need to be applied to the total (U.S. and Canada) ocean harvest by species so that Canadian harvest could be deducted from total harvest to estimate U.S. harvest.

### **2.3 Lower Columbia River (Zones 1-5) Non-Indian Commercial**

The Lower Columbia River non-Indian commercial fishing analysis applies a similar methodology as the ocean commercial fishing analysis (section 2.1). Zones 1-5 basically extend from the mouth of the Columbia River 140 miles upriver to Bonneville Dam. Zones 1-5 are open to non-Indian commercial fishermen and sport fishermen.

Ten years worth of revenue and round pounds<sup>6</sup> landed data were obtained from the PFMC annual Review of Ocean Salmon Fisheries. Data from both Oregon and Washington were combined to estimate total Lower Columbia River values. As with the ocean commercial fishing analysis, nominal revenues were obtained from the report and real revenues were estimated using the GDP Implicit Price Deflator. Five and 10-year straight and weighted averages of nominal and real prices per pound by species were multiplied by average round pounds per fish to estimate revenues per fish by species as presented in Table 8—Lower Columbia River Non-Indian Commercial Fishing #1.

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<sup>6</sup> Entire fish as opposed to a partially processed dressed fish.

**TABLE 8.—LOWER COLUMBIA RIVER NON-INDIAN COMMERCIAL FISHING #1: Non-Indian Commercial Values per Fish by Species and State**

Sources: OR, WA Data: PFMC, Review of 2006 Ocean Salmon Fisheries (2006 Salmon SAFE Document, published 2/2007), Socioeconomic Chapter, Table IV-9 (<<http://www.pcouncil.org/salmon/salsafe.html>>).

					Non-Indian Spring Chinook							Insert Profit %: 0.8		
					1st Quarter 2007				1st Quarter 2007					
Year	Annual IPD	IPD Annual Index Value	Nominal Value Data Year	Applied IPD Index	State/Year	Nominal Value <sup>1</sup> (K\$)	Real Value <sup>2</sup> (K\$)	Round Pounds Landed (thousands)	# Fish Harvested (thousands)	Nominal Price per Pound (round)	Real Price per Pound (round)	Round Pounds per Fish	Nominal Revenue/Profit per Fish	Real 1st Quarter 2007 Revenue/Profit per Fish
					<b>I. OREGON:</b>	Table IV-9	Table IV-9 Calculated)	Table IV-9	n/a <sup>4</sup>	Table IV-9 (Calculated)	Table IV-9 (Calculated)			
1997	95.414	0.808	2000	0.847	1997	69	81	26	n/a	2.65	3.13			
1998	96.472	0.817	2000	0.847	1998	94	111	35	n/a	2.69	3.17			
1999	97.868	0.829	2000	0.847	1999	81	96	28	n/a	2.89	3.41			
2000	100	0.847	2000	0.847	2000	229	270	85	n/a	2.69	3.18			
2001	102.399	0.867	2001	0.867	2001	586	676	222	n/a	2.64	3.04			
2002	104.187	0.883	2002	0.883	2002	932	1,056	316	n/a	2.95	3.34			
2003	106.404	0.901	2003	0.901	2003	378	419	147	n/a	2.57	2.85			
2004	109.426	0.927	2004	0.927	2004 <sup>3</sup>	1,027	1,108	276	n/a	3.72	4.01			
2005	112.737	0.955	2005	0.955	2005 <sup>3</sup>	314	329	92	n/a	3.41	3.57			
2006	116.043	0.983	2006	0.983	2006 <sup>3</sup>	614	625	131	n/a	4.69	4.77			
					5-Year Sum:	3,265	3,536	962						
					10-Year Sum:	4,324	4,770	1,358						
					1) REVENUE:									
					5-Year Straight Avg:	653	707			3.47	3.71	15.21	52.74	56.41
					5-Year Weighted Avg:					3.39	3.68	15.03	51.02	55.26
					10-Year Straight Avg:	432	477			3.09	3.45	14.86	45.93	51.25
					10-Year Weighted Avg:					3.18	3.51	15.00	47.77	52.70
					2) PROFIT:									
					5-Year Straight Avg:								42.19	45.13
					5-Year Weighted Avg:								40.82	44.21
					10-Year Straight Avg:								36.74	41.00
					10-Year Weighted Avg:								38.22	42.16

TABLE 8.—LOWER COLUMBIA RIVER NON-INDIAN COMMERCIAL FISHING #1 (continued): Non-Indian Commercial Values per Fish by Species and State (Spring Chinook)

Year	Annual IPD	IPD Annual Index Value	Nominal Value Data Year	Applied IPD Index Value	State/Year	1st Quarter 2007		Non-Indian Spring Chinook		1st Quarter 2007		Round Pounds per Fish	Nominal Revenue/Profit per Fish	Real 1st Quarter 2007 Revenue/Profit per Fish
						Nominal Value <sup>1</sup> (K\$)	Real Value <sup>2</sup> (K\$)	Round Pounds Landed (thousands)	# Fish Harvested (thousands)	Nominal Price per Pound (round)	Real Price per Pound (round)			
<b>II. WASHINGTON:</b>														
(See IDP data under Oregon Spring Chinook)														
					1997									
					1998									
					1999									
					2000	15	18	3	n/a <sup>4</sup>	5.00	5.90			
					2001	134	154	35	n/a	3.83	4.41			
					2002	295	334	70	n/a	4.21	4.77			
					2003	80	89	20	n/a	4.00	4.44			
					2004 <sup>3</sup>	272	293	69	n/a	3.94	4.25			
					2005 <sup>3</sup>	220	230	62	n/a	3.55	3.72			
					2006 <sup>3</sup>	320	326	87	n/a	3.68	3.74			
					5-Year Sum:	1,187	1,272	308						
					10-Year Sum:	1,336	1,444	346						
					1) REVENUE:									
					5-Year Straight Avg:	237	254			3.88	4.18	15.21	58.95	63.63
					5-Year Weighted Avg:					3.85	4.13	15.03	57.93	62.09
					10-Year Straight Avg:	191	206			4.03	4.46	14.86	59.89	66.31
					10-Year Weighted Avg:					3.86	4.17	15.00	57.93	62.63
					2) PROFIT:									
					5-Year Straight Avg:								47.16	50.90
					5-Year Weighted Avg:								46.35	49.68
					10-Year Straight Avg:								47.91	53.05
					10-Year Weighted Avg:								46.34	50.11

TABLE 8.—LOWER COLUMBIA RIVER NON-INDIAN COMMERCIAL FISHING #1 (continued): Non-Indian Commercial Values per Fish by Species and State (Spring Chinook)

Year	Annual IPD	IPD Annual Index Value	Nominal Value Data Year	Applied IPD Index Value	State/Year	1st Quarter 2007		Non-Indian Spring Chinook		1st Quarter 2007		Round Pounds per Fish	Nominal Revenue/Profit per Fish	Real 1st Quarter 2007 Revenue/Profit per Fish	
						Nominal Value <sup>1</sup> (K\$)	Real Value <sup>2</sup> (K\$)	Nominal Price per Pound (round)	Real Price per Pound (round)						
<b>III. OR &amp; WA COMBINED:</b>															
(See IDP data under Oregon Spring Chinook)						1997	69	81	26	n/a <sup>4</sup>	2.65	3.13			
						1998	94	111	35	n/a	2.69	3.17			
						1999	81	96	28	n/a	2.89	3.41			
						2000	244	288	88	n/a	2.77	3.27			
						2001	720	830	257	n/a	2.80	3.23			
						2002	1,227	1,390	386	n/a	3.18	3.60			
						2003	458	508	167	n/a	2.74	3.04			
						2004 <sup>3</sup>	1,299	1,401	345	n/a	3.77	4.06			
						2005 <sup>3</sup>	534	559	154	n/a	3.47	3.63			
						2006 <sup>3</sup>	934	950	218	n/a	4.28	4.36			
						5-Year Sum:	4,452	4,809	1,270						
						10-Year Sum:	5,660	6,215	1,704						
						1) REVENUE:									
						5-Year Straight Avg:	890	962			3.49	3.74	15.21	53.03	56.85
						5-Year Weighted Avg:					3.51	3.79	15.03	52.70	56.92
						10-Year Straight Avg:	566	621			3.12	3.49	14.86	46.43	51.88
						10-Year Weighted Avg:					3.32	3.65	15.00	49.83	54.72
						2) PROFIT:									
						5-Year Straight Avg:							42.43	45.48	
						5-Year Weighted Avg:							42.16	45.53	
						10-Year Straight Avg:							37.14	41.51	
						10-Year Weighted Avg:							39.87	43.77	

**TABLE 8.—LOWER COLUMBIA RIVER NON-INDIAN COMMERCIAL FISHING #1 (continued): Non-Indian Commercial Values per Fish by Species and State (Fall Chinook)**

State/Year	Non-Indian Fall Chinook - Brights & Tules (*)						Insert Profit %: 0.8		
	Nominal Value <sup>1</sup> (K\$)	Real Value <sup>2</sup> (K\$)	Round Pounds Landed (thousands)	# Fish Harvested (thousands)	Nominal Price per Pound (round)	Real Price per Pound (round)	Round Pounds per Fish	Nominal Revenue/Profit per Fish	Real 1st Quarter 2007 Revenue/Profit per Fish
(See IDP data under Oregon Spring Chinook)									
<b>I. OREGON:</b>	Table IV-9	Table IV-9 (Calculated)	Table IV-9	n/a <sup>4</sup>	Table IV-9 (Calculated)	Table IV-9 (Calculated)			
1997	73	86	143	n/a	0.51	0.60			
1998	36	42	53	n/a	0.68	0.80			
1999	92	109	89	n/a	1.03	1.22			
2000	111	131	116	n/a	0.96	1.13			
2001	130	150	273	n/a	0.48	0.55			
2002	217	246	604	n/a	0.36	0.41			
2003	419	465	748	n/a	0.56	0.62			
2004 <sup>3</sup>	610	658	633	n/a	0.96	1.04			
2005 <sup>3</sup>	476	498	405	n/a	1.18	1.23			
2006 <sup>3</sup>	655	666	363	n/a	1.80	1.84			
5-Year Sum:	2,377	2,533	2,753						
10-Year Sum:	2,819	3,052	3,427						
<b>1) REVENUE:</b>									
5-Year Straight Avg:	475	507			0.97	1.03	18.44	17.93	18.93
5-Year Weighted Avg:					0.86	0.92	18.38	15.87	16.91
10-Year Straight Avg:	282	305			0.85	0.94	17.70	15.08	16.71
10-Year Weighted Avg:					0.82	0.89	18.06	14.85	16.08
<b>2) PROFIT:</b>									
5-Year Straight Avg:								14.34	15.14
5-Year Weighted Avg:								12.70	13.53
10-Year Straight Avg:								12.07	13.37
10-Year Weighted Avg:								11.88	12.86

\* "Tules" (to-lee) are fall Chinook that are ready to spawn and are therefore less commercially valuable than fall "brights." Fall brights spawn later and further upstream (Hanford Reach or Snake River). These values include both tules and fall brights.

**TABLE 8.—LOWER COLUMBIA RIVER NON-INDIAN COMMERCIAL FISHING #1 (continued): Non-Indian Commercial Values per Fish by Species and State (Fall Chinook)**

State/Year	Non-Indian Fall Chinook – Brights & Tules								
	1st Quarter 2007			1st Quarter 2007			Real 1st Quarter 2007		
	Nominal Value <sup>1</sup> (K\$)	Real Value <sup>2</sup> (K\$)	Round Pounds Landed (thousands)	# Fish Harvested (thousands)	Nominal Price per Pound (round)	Real Price per Pound (round)	Round Pounds per Fish	Nominal Revenue/Profit per Fish	Real 1st Quarter 2007 Revenue/Profit per Fish
(See IDP data under Oregon Spring Chinook)									
<b>II. WASHINGTON:</b>									
1997	9	11	9	n/a <sup>4</sup>	1.00	1.18			
1998	29	34	27	n/a	1.07	1.27			
1999	86	102	82	n/a	1.05	1.24			
2000	131	155	138	n/a	0.95	1.12			
2001	67	77	122	n/a	0.55	0.63			
2002	99	112	215	n/a	0.46	0.52			
2003	258	286	448	n/a	0.58	0.64			
2004 <sup>3</sup>	431	465	338	n/a	1.28	1.38			
2005 <sup>3</sup>	327	342	235	n/a	1.39	1.46			
2006 <sup>3</sup>	420	427	218	n/a	1.93	1.96			
5-Year Sum:	1,535	1,633	1,454						
10-Year Sum:	1,857	2,011	1,832						
<b>1) REVENUE:</b>									
5-Year Straight Avg:	307	327			1.13	1.19	18.44	20.76	21.95
5-Year Weighted Avg:					1.06	1.12	18.38	19.40	20.64
10-Year Straight Avg:	186	201			1.03	1.14	17.70	18.15	20.17
10-Year Weighted Avg:					1.01	1.10	18.06	18.30	19.82
<b>2) PROFIT:</b>									
5-Year Straight Avg:								16.61	17.56
5-Year Weighted Avg:								15.52	16.51
10-Year Straight Avg:								14.52	16.14
10-Year Weighted Avg:								14.64	15.86

**TABLE 8.—LOWER COLUMBIA RIVER NON-INDIAN COMMERCIAL FISHING #1 (continued): Non-Indian Commercial Values per Fish by Species and State (Fall Chinook)**

State/Year	1st Quarter 2007		Non-Indian Fall Chinook – Brights & Tules		1st Quarter 2007		Round Pounds per Fish	Nominal Revenue/Profit per Fish	Real 1st Quarter 2007 Revenue/Profit per Fish
	Nominal Value <sup>1</sup> (K\$)	Real Value <sup>2</sup> (K\$)	Round Pounds Landed (thousands)	# Fish Harvested (thousands)	Nominal Price per Pound (round)	Real Price per Pound (round)			
(See IDP data under Oregon Spring Chinook)									
<b>III. OR &amp; WA COMBINED:</b>									
1997	82	97	152	n/a <sup>4</sup>	0.54	0.64			
1998	65	77	80	n/a	0.81	0.96			
1999	178	210	171	n/a	1.04	1.23			
2000	242	286	254	n/a	0.95	1.12			
2001	197	227	395	n/a	0.50	0.57			
2002	316	358	819	n/a	0.39	0.44			
2003	677	751	1,196	n/a	0.57	0.63			
2004 <sup>3</sup>	1,041	1,123	971	n/a	1.07	1.16			
2005 <sup>3</sup>	803	841	640	n/a	1.25	1.31			
2006 <sup>3</sup>	1,075	1,094	581	n/a	1.85	1.88			
5-Year Sum:	3,912	4,166	4,207						
10-Year Sum:	4,676	5,063	5,259						
1) REVENUE:									
5-Year Straight Avg:	782	833			1.03	1.08	18.44	18.91	19.98
5-Year Weighted Avg:					0.93	0.99	18.38	17.09	18.20
10-Year Straight Avg:	468	506			0.90	0.99	17.70	15.89	17.60
10-Year Weighted Avg:					0.89	0.96	18.06	16.06	17.38
2) PROFIT:									
5-Year Straight Avg:								15.13	15.98
5-Year Weighted Avg:								13.67	14.56
10-Year Straight Avg:								12.71	14.08
10-Year Weighted Avg:								12.84	13.91

**TABLE 8.—LOWER COLUMBIA RIVER NON-INDIAN COMMERCIAL FISHING #1 (continued): Non-Indian Commercial Values per Fish by Species and State (Coho)**

State/Year	Non-Indian Coho						Round Pounds per Fish	Nominal Revenue/Profit per Fish	Real 1st Quarter 2007 Revenue/Profit per Fish
	Nominal Value <sup>1</sup> (K\$)	Real Value <sup>2</sup> (K\$)	Round Pounds Landed (thousands)	# Fish Harvested (thousands)	Nominal Price per Pound (round)	Real Price per Pound (round)			

Insert Profit %: 0.8

(See IDP data under Oregon Spring Chinook)

**I. OREGON:**

State/Year	Table IV-9	Table IV-9 (Calculated)	Table IV-9	n/a <sup>4</sup>	Table IV-9 (Calculated)	Table IV-9 (Calculated)
1997	115	136	149	n/a	0.77	0.91
1998	131	155	193	n/a	0.68	0.80
1999	400	472	469	n/a	0.85	1.01
2000	506	597	949	n/a	0.53	0.63
2001	374	431	1323	n/a	0.28	0.33
2002	373	423	1148	n/a	0.32	0.37
2003	776	861	1522	n/a	0.51	0.57
2004 <sup>3</sup>	679	732	755	n/a	0.90	0.97
2005 <sup>3</sup>	845	885	789	n/a	1.07	1.12
2006 <sup>3</sup>	627	638	478	n/a	1.31	1.33
5-Year Sum:	3,300	3,538	4,692			
10-Year Sum:	4,826	5,329	7,775			

**1) REVENUE:**

5-Year Straight Avg:	660	708		0.82	0.87	9.98	8.21	8.70
5-Year Weighted Avg:				0.70	0.75	9.77	6.87	7.37
10-Year Straight Avg:	483	533		0.72	0.80	9.22	6.67	7.41
10-Year Weighted Avg:				0.62	0.69	9.34	5.80	6.40

**2) PROFIT:**

5-Year Straight Avg:							6.57	6.96
5-Year Weighted Avg:							5.50	5.90
10-Year Straight Avg:							5.34	5.92
10-Year Weighted Avg:							4.64	5.12





Round pounds (full fish) per fish by species data, shown in Table 9—Lower Columbia River Non-Indian Commercial Fishing #2, were obtained from the Oregon Department of Fish and Wildlife (ODFW) Web site<sup>7</sup> and from Doug Case, ODFW staff. Again, an estimated profitability percentage of 80 percent was used to calculate profitability per fish by species. Since the biological harvest model estimated non-Indian commercial in-river harvest for this stretch of the Columbia River (Zones 1-5), there is no need to use hatchery coded wire tag recovery data to allocate harvest within the Columbia River Basin. For the Yakima River Basin economic analysis, the 5-year weighted average profitability value per fish by species (\$45.53 for Spring Chinook, \$14.56 for Fall Chinook, and \$5.82 for Coho in 1<sup>st</sup> quarter 2007 dollars presented in Table 8—Lower Columbia River Non-Indian Commercial Fishing #1) was applied directly to the annual estimates of Lower Columbia River commercial harvest. The annual profitability estimates were discounted to the present and aggregated into a total Lower Columbia River commercial fishing benefit estimate.

## **2.4 Lower Columbia River (Zones 1-5) Sport**

The Lower Columbia River sport fishing benefits analysis follows the same general procedure as outlined under the ocean sport fishery (section 2.2). Zones 1-5 basically extend from the mouth of the Columbia River (including the Buoy 10 sport fishery) 140 miles upriver to Bonneville Dam.

The value per day was pulled from the river oriented salmon literature search described under the ocean sport fishing section. Four value estimates obtained from three river oriented salmon studies conducted with data gathered since 1985 averaged \$68.72 per day in April 2007 dollars. In addition to the Olsen et al. (1991) study discussed in the ocean sport fishing section, another Olsen study was included (Olsen and Richards, 1992) as well as a study by Gallo (2003). The Olsen and Richards (1992) study reported current condition and doubling of salmon population results from a contingent valuation survey conducted on the Rogue River in Oregon in 1992. The Gallo (2003) study used a zonal travel cost model to estimate values associated with current and salmon doubling scenarios on the Sacramento River in California based on a 1999 survey.

As described under the ocean sport fishing section, value per salmon sport fishing day needs to be converted to a value per fish before being applied to the Lower Columbia River sport fish harvest estimates. Ten years worth of Lower Columbia River sport salmon and steelhead harvest and effort (days fished) data, as obtained from an ODFW report “The 2005 Lower Columbia River and Buoy 10 Recreational Fisheries” (Watts and Takata, 2006) with 2006 data provided by James Watts (ODFW staff), is presented in Table 10—Lower Columbia River Sport Fishing #1. The data were used to calculate the conversion factor of Lower Columbia River salmon sport fishing days per fish harvested. Using the 5-year

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<sup>7</sup> ODFW Web site: <[http://www.dfw.state.or.us/fish/OSCRP/CRM/comm\\_fishery\\_updates.asp](http://www.dfw.state.or.us/fish/OSCRP/CRM/comm_fishery_updates.asp)>.

**TABLE 9.—LOWER COLUMBIA RIVER NON-INDIAN COMMERCIAL FISHING #2: Average Weights per Fish by Species for Non-Indian Commercial Harvest**

Source: ODFW Web site (<[http://www.dfw.state.or.us/fish/OSCRP/CRM/comm\\_fishery\\_updates.asp](http://www.dfw.state.or.us/fish/OSCRP/CRM/comm_fishery_updates.asp)>. Fish Division, Ocean Salmon & Columbia River Program, Columbia River Fisheries & Management, Commercial Fishing Landings and Doug Case, ODFW staff.

Year	Season	Location	Non-Indian			Non-Indian			Non-Indian		
			Winter/Spring/Summer Chinook			Fall Chinook			Coho		
			# Fish	# Pounds	Pounds per Fish	# Fish	# Pounds	Pounds per Fish	# Fish	# Pounds	Pounds per Fish
1997	Combined	Mainstem & Nonmainstem	1,913	26,211	13.7	8,609	151,696	17.6	19,477	152,855	7.8
1998	Combined	Mainstem & Nonmainstem	2,231	35,476	15.9	4,339	78,143	18.0	23,801	194,226	8.2
1999	Combined	Mainstem & Nonmainstem	1,971	28,310	14.4	8,055	116,994	14.5	80,533	683,934	8.5
2000	Combined	Mainstem & Nonmainstem	6,988	88,077	12.6	13,196	246,583	18.7	173,888	1,548,562	8.9
2001	Combined	Mainstem & Nonmainstem	15,955	255,295	16.0	24,636	394,516	16.0	253,495	2,257,359	8.9
2002	Combined	Mainstem & Nonmainstem	26,083	388,461	14.9	43,523	816,528	18.8	164,152	1,687,089	10.3
2003	Combined	Mainstem & Nonmainstem	10,962	172,739	15.8	67,601	1,222,859	18.1	262,450	2,402,880	9.2
2004	Combined	Mainstem & Nonmainstem	24,329	351,589	14.5	53,706	987,165	18.4	118,466	1,138,396	9.6
2005	Combined	Mainstem & Nonmainstem	10,557	166,560	15.8	36,232	646,856	17.9	98,175	1,001,927	10.2
2006	Combined	Mainstem & Nonmainstem	16,453	249,269	15.2	30,568	583,787	19.1	66,025	701,722	10.6
		5-Year Sum:	88,384	1,328,618		231,630	4,257,195		709,268	6,932,014	
		10-Year Sum:	117,442	1,761,987		290,465	5,245,127		1,260,462	11,768,950	
		5-Year Straight Average:			15.2			18.4			10.0
		5-Year Weighted Average:			15.0			18.4			9.8
		10-Year Straight Average:			14.9			17.7			9.2
		10-Year Weighted Average:			15.0			18.1			9.3

Note: Years 2003-2006 from ODFW Web site; Years 1997-2002 from Doug Case (ODFW staff).

**TABLE 10.—LOWER COLUMBIA RIVER SPORT FISHING #1: Days per Fish Harvested**

Source: Watts and Takata, 2006.

Year	Salmon and Steelhead Effort (days)	Salmon and Steelhead Harvest	Harvest per Day	Days per Fish Harvested
1997	146,734	50,808	0.346	2.888
1998	132,164	29,265	0.221	4.516
1999	149,838	36,738	0.245	4.079
2000	197,354	51,105	0.259	3.862
2001	433,036	197,547	0.456	2.192
2002	430,196	86,738	0.202	4.960
2003	415,740	28,693	0.310	3.230
2004	360,074	86,101	0.239	4.182
2005	304,977	55,916	0.183	5.454
2006	260,532	42,946	0.165	6.067
5-Year Sum:	1,771,519	400,394		
10-Year Sum:	2,830,645	765,857		
5-Year Straight Average:			0.220	4.779
5-Year Weighted Average:			0.226	4.424
10-Year Straight Average:			0.263	4.143
10-Year Weighted Average:			0.271	3.696

weighted average estimate of salmon sport fishing days per salmon harvested for the Lower Columbia River (4.424), the \$68.72 per day value converts to \$304.02 per fish. This value would apply to all species of salmon.

## 2.5 Columbia River (Zone 6) Indian Commercial

The Columbia River Indian commercial fishing analysis applies basically the same methodology as the ocean and non-Indian Lower Columbia River commercial fishing analyses (sections 2.1 and 2.3). Zone 6 of the Columbia River extends from Bonneville Dam, approximately 140 miles upriver to McNary Dam. While Zones 1-5 are assigned to non-Indian fisheries, Zone 6 is purely a Tribal fishery.

Ten years worth of revenue and round (full fish) pounds landed data were obtained from the PFMC annual Review of Ocean Salmon Fisheries. Data from

both Oregon and Washington were combined to estimate total Zone 6 Columbia River values. Nominal revenues were obtained from the report and real revenues were estimated using the GDP Implicit Price Deflator. Five and 10-year straight and weighted averages of nominal and real prices per pound by species were multiplied by average pounds per fish to estimate revenues per fish by species as presented in Table 11—Columbia River Indian Commercial Fishing #1. Round pounds per fish by species data, shown in Table 12—Columbia River Indian Commercial Fishing #2, were obtained from the ODFW Web site and from Doug Case, ODFW staff. Again, an estimated profitability percentage of 80 percent was used to calculate profitability per fish by species. Since the biological harvest model estimated Indian commercial in-river harvest for this stretch of the Columbia River (Zone 6), there is no need to use hatchery coded wire tag recovery data to allocate harvest within the Columbia River. The 5-year weighted average profitability per fish by species (\$22.56 for Spring Chinook, \$8.78 for Fall Chinook, and \$3.11 for Coho in 1<sup>st</sup> quarter 2007 dollars as presented in Table 11—Columbia River Indian Commercial Fishing #1) was applied directly to the annual estimates of Zone 6 Columbia River commercial harvest. The annual profitability estimates were discounted to the present and aggregated into a total Zone 6 Columbia River commercial fishing benefit estimate.

## **2.6 Columbia River (Zone 6) Indian Ceremonial and Subsistence**

Economic analyses do not attempt to place a value on Tribal ceremonial or spiritually oriented harvest since that would be akin to placing a value on Tribal culture. However, subsistence harvest in some cases has been valued purely from a food-based perspective. Tribal subsistence harvest provides more than simply a food-based value since such harvests are also inextricably linked to Tribal culture. As a result, any attempt to use a food-based value to measure Tribal subsistence values would significantly understate the true Tribal value of the subsistence fishery resource. Nevertheless, to avoid the situation of not placing any value on the ceremonial and subsistence harvest, the Yakima River study economic analyses used a food-based value as a defensible lower bound. Crutchfield et al., 1982 suggest two possible approaches for estimating food-based subsistence values—opportunity cost and cost of substitute foods. Assuming the opportunity to sell the fish exists, the opportunity cost approach involves using commercial ex-vessel price as the forgone market value when one harvests a fish for subsistence purposes. The cost of substitute foods approach uses the retail price of the closest substitute food item as an indicator of the value of the subsistence harvest. Given the difficulty in selecting a substitute food item, the analysis uses the opportunity cost concept based on the Columbia River (Zone 6) Indian 5-year weighted average *revenue* per fish from the commercial fishing analysis as a lower bound subsistence and ceremonial value (\$28.20 for Spring Chinook,

**TABLE 11.—COLUMBIA RIVER INDIAN COMMERCIAL FISHING #1: Columbia River Zone 6 Indian Commercial Values per Fish by Species and State**

Sources: OR, WA Data: PFMC, Review of 2006 Ocean Salmon Fisheries (2006 Salmon SAFE Document, published 2/2007), Socioeconomic Chapter, Table IV-9 (<<http://www.pcouncil.org/salmon/salsafe.html>>).

		Insert Target Quarter:										Insert Profit %:		
		1st Quarter 2007				Indian						0.8		
		Insert IPD Value:				Spring Chinook								
		118.041				1st Quarter 2007				1st Quarter 2007				
Year	Annual IPD	IPD Annual Index Value	Nominal Value Data Year	Applied IPD Index Value	State/Year	Nominal Value <sup>1</sup> (K\$)	Real Value <sup>2</sup> (K\$)	Round Pounds Landed (thousands)	# Fish Harvested (thousands)	Nominal Price per Pound (round)	Real Price per Pound (round)	Round Pounds per Fish	Nominal Revenue/Profit per Fish	Real 1st Quarter 2007 Revenue/Profit per Fish
<b>I. OREGON:</b>						Table IV-9	Table IV-9 (Calculated)	Table IV-9	n/a <sup>4</sup>	Table IV-9 (Calculated)	Table IV-9 (Calculated)			
1997	95.414	0.808	2000	0.847	1997				n/a					
1998	96.472	0.817	2000	0.847	1998				n/a					
1999	97.868	0.829	2000	0.847	1999				n/a					
2000	100	0.847	2000	0.847	2000	2	2	1	n/a	2.00	2.36			
2001	102.399	0.867	2001	0.867	2001	33	38	25	n/a	1.32	1.52			
2002	104.187	0.883	2002	0.883	2002	17	19	14	n/a	1.21	1.38			
2003	106.404	0.901	2003	0.901	2003	5	6	1	n/a	5.00	5.55			
2004	109.426	0.927	2004	0.927	2004 <sup>3</sup>	148	160	80	n/a	1.85	2.00			
2005	112.737	0.955	2005	0.955	2005 <sup>3</sup>				n/a					
2006	116.043	0.983	2006	0.983	2006 <sup>3</sup>				n/a					
						5-Year Sum:	170	184	95					
						10-Year Sum:	205	225	121					
						<b>1) REVENUE:</b>								
						5-Year Straight Avg:	57	61		2.69	2.97	16.61	44.64	49.37
						5-Year Weighted Avg:				1.79	1.94	16.38	29.30	31.80
						10-Year Straight Avg:	41	45		2.28	2.56	17.65	40.20	45.20
						10-Year Weighted Avg:				1.69	1.86	15.63	26.49	29.05
						<b>2) PROFIT:</b>								
						5-Year Straight Avg:							35.72	39.50
						5-Year Weighted Avg:							23.44	25.44
						10-Year Straight Avg:							32.16	36.16
						10-Year Weighted Avg:							21.19	23.24

TABLE 11.—COLUMBIA RIVER INDIAN COMMERCIAL FISHING #1 (continued): Columbia River Zone 6 Indian Commercial Values per Fish by Species and State (Spring Chinook)

Year	Annual IPD	IPD Annual Index Value	Nominal Value Data Year	Applied IPD Index Value	State/Year	Indian Spring Chinook		Round Pounds Landed (thousands)	# Fish Harvested (thousands)	Nominal Price per Pound (round)	Real Price per Pound (round)	Round Pounds per Fish	Nominal Revenue/Profit per Fish	Real 1st Quarter 2007 Revenue/Profit per Fish
						1st Quarter 2007	1st Quarter 2007							
						Nominal Value <sup>1</sup> (K\$)	Real Value <sup>2</sup> (K\$)							
<b>II. WASHINGTON:</b>														
(See IPD data under Oregon Spring Chinook)					1997				n/a <sup>4</sup>					
					1998				n/a					
					1999				n/a					
					2000	51	60	27	n/a	1.89	2.23			
					2001	280	323	221	n/a	1.27	1.46			
					2002	218	247	185	n/a	1.18	1.34			
					2003	142	158	133	n/a	1.07	1.18			
					2004 <sup>3</sup>	165	178	105	n/a	1.57	1.70			
					2005 <sup>3</sup>	113	118	67	n/a	1.69	1.77			
					2006 <sup>3</sup>	425	432	180	n/a	2.36	2.40			
					5-Year Sum:	1,063	1,133	670						
					10-Year Sum:	1,394	1,516	918						
					1) REVENUE:									
					5-Year Straight Avg:	213	227			1.57	1.68	16.61	26.12	27.84
					5-Year Weighted Avg:					1.59	1.69	16.38	25.98	27.70
					10-Year Straight Avg:	199	217			1.57	1.72	17.65	27.80	30.45
					10-Year Weighted Avg:					1.52	1.65	15.63	23.74	25.82
					2) PROFIT:									
					5-Year Straight Avg:								20.90	22.27
					5-Year Weighted Avg:								20.78	22.16
					10-Year Straight Avg:								22.24	24.36
					10-Year Weighted Avg:								18.99	20.66

TABLE 11.—COLUMBIA RIVER INDIAN COMMERCIAL FISHING #1 (continued): Columbia River Zone 6 Indian Commercial Values per Fish by Species and State (Spring Chinook)

Year	Annual IPD	IPD Annual Index Value	Nominal Value Data Year	Applied IPD Index Value	State/Year	Indian Spring Chinook		Round Pounds Landed (thousands)	# Fish Harvested (thousands)	Nominal Price per Pound (round)	Real Price per Pound (round)	Round Pounds per Fish	Nominal Revenue/Profit per Fish	Real 1st Quarter 2007 Revenue/Profit per Fish
						1st Quarter 2007	1st Quarter 2007							
						Nominal Value <sup>1</sup> (K\$)	Real Value <sup>2</sup> (K\$)							
<b>III. OR &amp; WA COMBINED:</b>														
(See IPD data under Oregon Spring Chinook)														
					1997				n/a <sup>4</sup>					
					1998				n/a					
					1999				n/a					
					2000	53	63	28	n/a	1.89	2.23			
					2001	313	361	246	n/a	1.27	1.47			
					2002	235	266	199	n/a	1.18	1.34			
					2003	147	163	134	n/a	1.10	1.22			
					2004 <sup>3</sup>	313	338	185	n/a	1.69	1.83			
					2005 <sup>3</sup>	113	118	67	n/a	1.69	1.77			
					2006 <sup>3</sup>	425	432	180	n/a	2.36	2.40			
					5-Year Sum:	1,233	1,318	765						
					10-Year Sum:	1,599	1,741	1,039						
					1) REVENUE:									
					5-Year Straight Avg:	247	264			1.60	1.71	16.61	26.63	28.39
					5-Year Weighted Avg:					1.61	1.72	16.38	26.39	28.20
					10-Year Straight Avg:	228	249			1.60	1.75	17.65	28.20	30.89
					10-Year Weighted Avg:					1.54	1.68	15.63	24.06	26.20
					2) PROFIT:									
					5-Year Straight Avg:								21.30	22.71
					5-Year Weighted Avg:								21.11	22.56
					10-Year Straight Avg:								22.56	24.71
					10-Year Weighted Avg:								19.25	20.96

**TABLE 11.—COLUMBIA RIVER INDIAN COMMERCIAL FISHING #1 (continued): Columbia River Zone 6 Indian Commercial Values per Fish by Species and State (Fall Chinook)**

		Indian					Insert Profit %:		
		Fall Chinook - Brights & Tules*					0.8		
		1st Quarter 2007		1st Quarter 2007					
State/Year	Nominal Value <sup>1</sup> (K\$)	Real Value <sup>2</sup> (K\$)	Round Pounds Landed (thousands)	# Fish Harvested (thousands)	Nominal Price per Pound (round)	Real Price per Pound (round)	Round Pounds per Fish	Nominal Revenue/Profit per Fish	Real 1st Quarter 2007 Revenue/Profit per Fish
(See IPD data under Oregon Spring Chinook)									
<b>I. OREGON:</b>	Table IV-9	Table IV-9 (Calculated)	Table IV-9	n/a <sup>4</sup>	Table IV-9 (Calculated)	Table IV-9 (Calculated)			
1997	57	67	136	n/a	0.42	0.49			
1998	44	52	73	n/a	0.60	0.71			
1999	70	83	127	n/a	0.55	0.65			
2000	102	120	166	n/a	0.61	0.73			
2001	8	9	8	n/a	1.00	1.15			
2002	4	5	6	n/a	0.67	0.76			
2003	13	14	19	n/a	0.68	0.76			
2004 <sup>3</sup>	568	613	775	n/a	0.73	0.79			
2005 <sup>3</sup>	219	229	267	n/a	0.82	0.86			
2006 <sup>3</sup>	319	324	217	n/a	1.47	1.50			
5-Year Sum:	1,123	1,185	1,284						
10-Year Sum:	1,404	1,517	1,794						
<b>1) REVENUE:</b>									
5-Year Straight Avg:	225	237			0.87	0.93	19.22	16.81	17.91
5-Year Weighted Avg:					0.87	0.92	19.16	16.76	17.69
10-Year Straight Avg:	140	152			0.76	0.84	18.65	14.10	15.65
10-Year Weighted Avg:					0.78	0.85	18.77	14.69	15.87
<b>2) PROFIT:</b>									
5-Year Straight Avg:								13.45	14.33
5-Year Weighted Avg:								13.41	14.15
10-Year Straight Avg:								11.28	12.52
10-Year Weighted Avg:								11.75	12.69

\* "Tules" (to-lee) are fall Chinook that are ready to spawn and are therefore less commercially valuable than fall "brights." Fall brights spawn later and further upstream (Hanford Reach or Snake River). These values include both tules and fall brights.

**TABLE 11.—COLUMBIA RIVER INDIAN COMMERCIAL FISHING #1 (continued): Columbia River Zone 6 Indian Commercial Values per Fish by Species and State (Fall Chinook)**

State/Year	Indian								
	Fall Chinook – Brights & Tules								
	1st Quarter 2007			1st Quarter 2007					
	Nominal Value <sup>1</sup> (K\$)	Real Value <sup>2</sup> (K\$)	Round Pounds Landed (thousands)	# Fish Harvested (thousands)	Nominal Price per Pound (round)	Real Price per Pound (round)	Round Pounds per Fish	Nominal Revenue/Profit per Fish	Real 1st Quarter 2007 Revenue/Profit per Fish

(See IPD data under Oregon Spring Chinook)

**II. WASHINGTON:**

1997	278	328	633	n/a <sup>4</sup>	0.44	0.52			
1998	246	290	508	n/a	0.48	0.57			
1999	336	397	613	n/a	0.55	0.65			
2000	297	351	509	n/a	0.58	0.69			
2001	315	363	1306	n/a	0.24	0.28			
2002	282	319	1587	n/a	0.18	0.20			
2003	292	324	1607	n/a	0.18	0.20			
2004 <sup>3</sup>	443	478	806	n/a	0.55	0.59			
2005 <sup>3</sup>	716	750	1404	n/a	0.51	0.53			
2006 <sup>3</sup>	1269	1,291	905	n/a	1.40	1.43			
5-Year Sum:	3,002	3,162	6,309						
10-Year Sum:	4,474	4,891	9,878						

**1) REVENUE:**

5-Year Straight Avg:	600	632			0.56	0.59	19.22	10.84	11.36
5-Year Weighted Avg:					0.48	0.50	19.16	9.12	9.60
10-Year Straight Avg:	447	489			0.51	0.57	18.65	9.54	10.56
10-Year Weighted Avg:					0.45	0.50	18.77	8.50	9.29

**2) PROFIT:**

5-Year Straight Avg:								8.68	9.09
5-Year Weighted Avg:								7.29	7.68
10-Year Straight Avg:								7.64	8.44
10-Year Weighted Avg:								6.80	7.43

**TABLE 11.—COLUMBIA RIVER INDIAN COMMERCIAL FISHING #1 (continued): Columbia River Zone 6 Indian Commercial Values per Fish by Species and State (Fall Chinook)**

State/Year	Indian								
	Fall Chinook – Brights & Tules								
	1st Quarter 2007			1st Quarter 2007					
	Nominal Value <sup>1</sup> (K\$)	Real Value <sup>2</sup> (K\$)	Round Pounds Landed (thousands)	# Fish Harvested (thousands)	Nominal Price per Pound (round)	Real Price per Pound (round)	Round Pounds per Fish	Nominal Revenue/Profit per Fish	Real 1st Quarter 2007 Revenue/Profit per Fish

(See IPD data under Oregon Spring Chinook)

**III. OR & WA COMBINED:**

1997	335	395	769	n/a <sup>4</sup>	0.44	0.51			
1998	290	342	581	n/a	0.50	0.59			
1999	406	479	740	n/a	0.55	0.65			
2000	399	471	675	n/a	0.59	0.70			
2001	323	372	1,314	n/a	0.25	0.28			
2002	286	324	1,593	n/a	0.18	0.20			
2003	305	338	1,626	n/a	0.19	0.21			
2004 <sup>3</sup>	1,011	1,091	1,581	n/a	0.64	0.69			
2005 <sup>3</sup>	935	979	1,671	n/a	0.56	0.59			
2006 <sup>3</sup>	1,588	1,615	1,122	n/a	1.42	1.44			
5-Year Sum:	4,125	4,347	7,593						
10-Year Sum:	5,878	6,408	11,672						

**1) REVENUE:**

5-Year Straight Avg:	825	869			0.60	0.63	19.22	11.46	12.02
5-Year Weighted Avg:					0.54	0.57	19.16	10.41	10.97
10-Year Straight Avg:	588	641			0.53	0.59	18.65	9.89	10.93
10-Year Weighted Avg:					0.50	0.55	18.77	9.45	10.30

**2) PROFIT:**

5-Year Straight Avg:								9.17	9.62
5-Year Weighted Avg:								8.33	8.78
10-Year Straight Avg:								7.91	8.74
10-Year Weighted Avg:								7.56	8.24

TABLE 11.—COLUMBIA RIVER INDIAN COMMERCIAL FISHING #1 (continued): Columbia River Zone 6 Indian Commercial Values per Fish by Species and State (Coho)

State/Year	Indian		Coho		1st Quarter 2007		Insert Profit %:		
	Nominal Value <sup>1</sup> (K\$)	Real Value <sup>2</sup> (K\$)	Round Pounds Landed (thousands)	# Fish Harvested (thousands)	Nominal Price per Pound (round)	Real Price per Pound (round)	Round Pounds per Fish	Nominal Revenue/Profit per Fish	Real 1st Quarter 2007 Revenue/Profit per Fish
(See IPD data under Oregon Spring Chinook)									
<b>I. OREGON:</b>	Table IV-9	Table IV-9 (Calculated)	Table IV-9	n/a <sup>4</sup>	Table IV-9 (Calculated)	Table IV-9 (Calculated)			
1997				n/a					
1998				n/a					
1999	3	4	4	n/a	0.75	0.89			
2000	5	6	8	n/a	0.63	0.74			
2001				n/a					
2002				n/a					
2003				n/a					
2004 <sup>3</sup>	17	18	29	n/a	0.59	0.63			
2005 <sup>3</sup>				n/a					
2006 <sup>3</sup>	14	14	12	n/a	1.17	1.19			
5-Year Sum:	31	33	41						
10-Year Sum:	39	42	53						
<b>1) REVENUE:</b>									
5-Year Straight Avg:	16	16			0.88	0.91	9.84	8.62	8.95
5-Year Weighted Avg:					0.76	0.79	10.18	7.70	8.09
10-Year Straight Avg:	10	11			0.78	0.86	8.80	6.88	7.57
10-Year Weighted Avg:					0.74	0.79	9.38	6.90	7.44
<b>2) PROFIT:</b>									
5-Year Straight Avg:							6.90	7.16	
5-Year Weighted Avg:							6.16	6.47	
10-Year Straight Avg:							5.50	6.06	
10-Year Weighted Avg:							5.52	5.95	

**TABLE 11.—COLUMBIA RIVER INDIAN COMMERCIAL FISHING #1 (continued): Columbia River Zone 6 Indian Commercial Values per Fish by Species and State (Coho)**

State/Year	Indian								
	Coho								
		1st Quarter 2007				1st Quarter 2007			
	Nominal Value <sup>1</sup> (K\$)	Real Value <sup>2</sup> (K\$)	Round Pounds Landed (thousands)	# Fish Harvested (thousands)	Nominal Price per Pound (round)	Real Price per Pound (round)	Round Pounds per Fish	Nominal Revenue/Profit per Fish	Real 1st Quarter 2007 Revenue/Profit per Fish

(See IPD data under Oregon Spring Chinook)

**II. WASHINGTON:**

1997	1	1	2	n/a <sup>4</sup>	0.50	0.59			
1998	1	1	1	n/a	1.00	1.18			
1999	8	9	11	n/a	0.73	0.86			
2000	13	15	30	n/a	0.43	0.51			
2001	7	8	68	n/a	0.10	0.12			
2002	3	3	22	n/a	0.14	0.15			
2003	2	2	23	n/a	0.09	0.10			
2004 <sup>3</sup>	5	5	43	n/a	0.12	0.13			
2005 <sup>3</sup>	10	10	34	n/a	0.29	0.31			
2006 <sup>3</sup>	25	25	45	n/a	0.56	0.57			
5-Year Sum:	45	47	167						
10-Year Sum:	75	82	279						

**1) REVENUE:**

5-Year Straight Avg:	9	9			0.24	0.25	9.84	2.34	2.46
5-Year Weighted Avg:					0.27	0.28	10.18	2.74	2.86
10-Year Straight Avg:	8	8			0.40	0.45	8.80	3.48	3.97
10-Year Weighted Avg:					0.27	0.29	9.38	2.52	2.76

**2) PROFIT:**

5-Year Straight Avg:								1.87	1.97
5-Year Weighted Avg:								2.19	2.29
10-Year Straight Avg:								2.78	3.17
10-Year Weighted Avg:								2.02	2.21

**TABLE 11.—COLUMBIA RIVER INDIAN COMMERCIAL FISHING #1 (continued): Columbia River Zone 6 Indian Commercial Values per Fish by Species and State (Coho)**

State/Year	Indian Coho									
	1st Quarter 2007		Round Pounds Landed (thousands)	# Fish Harvested (thousands)	Nominal Price per Pound (round)	1st Quarter 2007		Round Pounds per Fish	Nominal Revenue/Profit per Fish	Real 1st Quarter 2007 Revenue/Profit per Fish
	Nominal Value <sup>1</sup> (K\$)	Real Value <sup>2</sup> (K\$)				Real Price per Pound (round)	Nominal Revenue/Profit per Fish			
(See IPD data under Oregon Spring Chinook)										
<b>III. OR &amp; WA COMBINED:</b>										
1997	1	1	2	n/a <sup>4</sup>	0.50	0.59				
1998	1	1	1	n/a	1.00	1.18				
1999	11	13	15	n/a	0.73	0.87				
2000	18	21	38	n/a	0.47	0.56				
2001	7	8	68	n/a	0.10	0.12				
2002	3	3	22	n/a	0.14	0.15				
2003	2	2	23	n/a	0.09	0.10				
2004 <sup>3</sup>	22	24	72	n/a	0.31	0.33				
2005 <sup>3</sup>	10	10	34	n/a	0.29	0.31				
2006 <sup>3</sup>	39	40	57	n/a	0.68	0.70				
5-Year Sum:	76	79	208							
10-Year Sum:	114	124	332							
1) REVENUE:										
5-Year Straight Avg:	15	16			0.30	0.32	9.84	2.97		3.12
5-Year Weighted Avg:					0.37	0.38	10.18	3.72		3.89
10-Year Straight Avg:	11	12			0.43	0.49	8.80	3.80		4.31
10-Year Weighted Avg:					0.34	0.37	9.38	3.22		3.51
2) PROFIT:										
5-Year Straight Avg:								2.37		2.49
5-Year Weighted Avg:								2.98		3.11
10-Year Straight Avg:								3.04		3.45
10-Year Weighted Avg:								2.58		2.81

<sup>1</sup> Nominal value was obtained from Table IV-9. Since real value and nominal values equate in the current year, nominal values were obtained by referring to the real values for the current year in each annual report. The annual report was not available for years 1997-1999, so those nominal values were expressed in real year 2000 \$ (obtained from the year 200 report). As a result, the 10-year nominal value estimates are incorrect, but the 10-year real values are correct.

<sup>2</sup> Real values were calculated from the nominal values using the GDP index. The calculated real values in this spreadsheet vary somewhat from those presented in Table IV-9 as this calculation used end of year GDP Implicit Price Deflator values.

<sup>3</sup> Preliminary data.

<sup>4</sup> Indicates data are not available in the PFMC report.

**TABLE 12.—COLUMBIA RIVER INDIAN COMMERCIAL FISHING #2: Average Weights per Fish by Species for Indian Commercial Harvest**

Source: Data based on personal communication with Doug Case (ODFW staff).

Year	Indian Winter/Spring/Summer Chinook			Indian Fall Chinook			Indian Coho		
	# Fish	# Pounds	Pounds per Fish	# Fish	# Pounds	Pounds per Fish	# Fish	# Pounds	Pounds per Fish
1997	14	267	19.1	39,371	733,602	18.6	223	1,635	7.3
1998	1	18	18.0	31,349	550,084	17.5	230	1,586	6.9
1999	1	31	31.0	43,780	739,633	16.9	1,650	14,294	8.7
2000	1,313	15,496	11.8	37,514	737,821	19.7	4,415	36,474	8.3
2001	16,134	219,958	13.6	73,231	1,292,967	17.7	3,757	28,679	7.6
2002	13,733	194,107	14.1	81,399	1,549,161	19.0	454	4,223	9.3
2003 <sup>1</sup>	7,936	149,197	18.8	94,822	1,926,555	20.3	3,052	25,398	8.3
2004 <sup>1</sup>	11,043	153,435	13.9	111,833	2,020,889	18.1	6,042	59,342	9.8
2005 <sup>1</sup>	3,853	66,315	17.2	92,437	1,772,975	19.2	2,169	21,810	10.1
2006 <sup>1</sup>	13,609	258,571	19.0	59,050	1,151,475	19.5	5,577	65,251	11.7
5-Year Sum:	50,174	821,625		439,541	8,421,055		17,294	176,024	
10-Year Sum:	67,637	1,057,395		664,786	12,475,162		27,569	258,692	
5-Year Straight Average:			16.6			19.2			9.8
5-Year Weighted Average:			16.4			19.2			10.2
10-Year Straight Average:			17.7			18.6			8.8
10-Year Weighted Average:			15.6			18.8			9.4

<sup>1</sup> Reflects preliminary data.

\$10.97 for Fall Chinook, and \$3.89 for Coho in 1<sup>st</sup> quarter 2007 dollars—see Table 11—Columbia River Indian Commercial Fishing #1). Since the Columbia River Zone 6 Indian fishery includes a commercial fishery there is some logic to applying this approach.

## **2.7 Yakima River Sport**

The Yakima River sport fishing benefits analysis follows the same general procedure as outlined under the ocean and Lower Columbia River sport fishery (sections 2.2 and 2.4).

It was assumed that the value per day for Yakima River sport fishing would be the same as that used in the Lower Columbia River sport fishing analysis. This value was pulled from the river oriented salmon literature search described under the ocean sport fishing section. Four salmon value estimates obtained from three river oriented studies conducted with data gathered since 1985 averaged \$68.72 per day in April 2007 dollars (see section “2.4 Lower Columbia River Zones 1-5 Sport” for details).

As also described under the ocean and Lower Columbia River sport fishing sections, value per salmon sport fishing day needs to be converted to a value per fish before being applied to the Yakima River sport fish harvest estimates provided by study team biologists. Several years worth of Yakima River sport salmon harvest and effort (days fished) data, as obtained from Jim Cummings and Paul Hoffarth of the Washington Department of Fish and Wildlife (WDFW), is presented in Table 13—Yakima River Sport Fishing #1. Note that while the Fall Chinook sport fishery has been ongoing, the Spring Chinook sport fishery has been sporadic (Yakima River Coho sport harvest is negligible). The WDFW data were used to calculate the conversion factors of Yakima River salmon sport fishing days per fish harvested by salmon species. While the river sport fishing value per day is assumed applicable to all salmon species, the different days per fish harvested for Spring versus Fall Chinook results in a different value per fish. Using the weighted average estimates of salmon sport fishing days per salmon harvested for the Yakima River (6.716 for Spring Chinook and 5.355 for Fall Chinook and Coho), the \$68.72 per day salmon value converts to \$461.52 per fish for Spring Chinook and \$368.00 per fish for Fall Chinook and Coho as measured in April 2007 dollars.

## **2.8 Yakima River Indian Ceremonial and Subsistence**

The Yakima River Indian Ceremonial and Subsistence benefit estimation methodology applies the same approaches and values as used in the Columbia River (Zone 6) ceremonial and subsistence analysis (section 2.6). Lower bound

**TABLE 13.—YAKIMA RIVER SPORT FISHING #1: Salmon Sport Fishing Days per Fish Harvested**

Species	2000	2001	2002	2003	2004	2005	2006	3-Year Straight Average	3-Year Total	3-Year Weighted Average
Spring Chinook	Source: Jim Cummings (WDFW staff), May 2007.									
Effort (hours):		55068.0	22596.8		25883.8				103548.6	
Hours/Trip: (*)		3.5	3.5		3.5					
Effort (Day Trips):		15733.7	6456.2		7395.4				29585.3	
Catch:		1908	843		1654				4405	
Catch/Trip:		0.121	0.131		0.224			0.158		0.149
Trips/Fish:		8.246	7.659		4.471			6.792		6.716
Fall Chinook & Coho (Coho minor)	Source: Years 2000-2005: Table 76, District 4 Fish Management Annual Report 2005 (P. Hoffarth, March 2006). Year 2006: Personal Communication, Paul Hoffarth (WDFW staff), May 9, 2007.									
								5-Year Straight (2002-2006) Average	5-Year (2002-2006) Total	5-Year Weighted (2002-2006) Average
Effort (hours):	12556.0	13193.0	22796.0	32225.0	23878.0	15195.0	16139.0		110233.0	
Hours/Trip: (*)	3.5	3.5	3.5	3.5	3.5	3.5	3.5			
Effort (Day Trips):	3587.4	3769.4	6513.1	9207.1	6822.3	4341.4	4611.1		31495.1	
Catch:	346	1054	2390	1463	830	733	465		5881.0	
Catch/Trip:	0.096	0.280	0.367	0.159	0.122	0.169	0.101	0.183		0.187
Trips/Fish:	10.368	3.576	2.725	6.293	8.220	5.923	9.916	6.615		5.355

food-based values per fish of \$28.20 were used for Spring Chinook, \$10.97 for Fall Chinook, and \$3.89 for Coho as measured in 1<sup>st</sup> quarter 2007 dollars were based on Columbia River Zone 6 Tribal commercial fishing revenues per fish (see section “2.6 Columbia River (Zone 6) Indian Ceremonial and Subsistence” and Table 11—Columbia River Indian Commercial Fishing #1). While it is possible that the weights per fish and therefore values per fish may differ somewhat for subsistence harvest in the Yakima River as compared to the Columbia River, the difference was assumed to be negligible given the general proximity of the upriver sections of Columbia River Zone 6 to the mouth of the Yakima River.

### 3.0 Summary and Conclusions

This paper presents information on estimating economic harvest oriented use values per fish for salmon based on existing data. References to current Yakima River projects were used to define and develop the economic value estimation methodology. Although the values were oriented toward Yakima River salmon, the approaches presented could be generalized to other river systems and fish species.

As the Yakima River is a tributary of the Columbia River, migratory anadromous salmon stemming from the Yakima River can be caught not only in the Yakima River, but also in the Columbia River and the Pacific Ocean. To estimate fishery economic harvest benefits associated with fish population improvements within the Yakima River Basin, one needs both estimates of the increase in harvest by geographic area (i.e., Yakima River, Columbia River, and Pacific Ocean) as well as economic values per fish within each geographic area. In addition, each geographic area allows different types of fish harvest—commercial, sport, and Tribal ceremonial and subsistence. This report focuses on estimating the economic values per salmon by harvest type in each geographic area.

The foundation of the commercial fishing value estimation is the existing harvest (pounds and number of fish) and market price data gathered and maintained by the PFMFC and the ADFG. This data allowed for the estimation of commercial revenue per fish by State (California, Oregon, Washington, and Alaska) from which profitability estimates were derived. To develop a weighted average value across all Pacific Coast States for the ocean commercial analysis, coded wire tag data from the PSMFC were used to calculate the percentage of Yakima River fish caught in the ocean areas of each State.

The basis for the sport fishing values was a comprehensive literature search of existing sport fishing economic studies. While the sheer number of existing studies is quite large, only a small portion of the studies could actually be used within a benefits transfer context. After selecting and averaging indexed values from the most applicable studies, an additional step was required to convert sport fishing values from a per trip/day basis to a per fish basis.

Finally, Tribal subsistence values were estimated using commercial revenues per fish (i.e., market price multiplied by average weight per fish). This food-based value assumes the subsistence harvest could have been sold within existing markets and therefore reflects the opportunity cost of the subsistence harvest. Given subsistence harvest also includes a cultural/spiritual value associated with the harvest activity, the exclusively food-based value should be considered a defensible lower bound.

In conclusion, there appears to be sufficient existing data to estimate commercial, sport, and subsistence values associated with the harvest of Yakima River salmon. While the approaches described in this report can be extended to other species and river systems, the actual value estimation will be contingent upon the existence of adequate data related to the fish species or river system in question.

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