# March 2012 Errata

## Page 17 – Corrections indicated in red

**Table 7. Recreational shellfish catch (pounds) in Washington in 2006, by species group and catch region**

| SPECIES GROUP | NORTH PUGET SOUND | SOUTH PUGET SOUND | STRAIT | COAST | COLUMBIA RIVER | TOTAL |
|---|---|---|---|---|---|---|
| **Dungeness Crab** | **798,104** | **381,692** | **39,755** | **--** | **--** | **1,219,551** |
| **Shrimp** | **21,388** | **82,683** | **1,850** | -- | -- | **105,921** |
| **Razor clams** | -- | -- | -- | 3,601,000 | -- | 3,601,000 |
| **Other clams** | **92,704** | **252,964** | -- | -- | -- | **345,668** |
| **Oysters** | **19,106** | **632,988** | -- | -- | -- | **652,094** |

Notes:

All values are in pounds except for oysters, which are in number of oysters.

Columbia River region includes the Columbia River and all tributaries, including the Snake River.

Source: Preliminary data for the Sport Catch Report provided by WDFW (Kraig pers. Comm.)


FINAL REPORT

# Economic Analysis of the Non-Treaty Commercial and Recreational Fisheries in Washington State

December 2008

# Economic Analysis of the Non-Treaty Commercial and Recreational Fisheries in Washington State


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# Final Report: Economic Analysis of the Non-Treaty Commercial and Recreational Fisheries in Washington State

## Governor Christine Gregoire's Request

"To allow us to fully educate the public on the importance of fishing, I would like the Commission to summarize the economic benefit that our commercial and recreational fisheries provide the state. While sustainable fishing practices must be consistent with conservation needs of the fish, both fisheries have an important economic role, particularly in our rural communities."

## Executive Summary


This study was conducted with the express purpose of addressing the request from Governor Gregoire to explore the economic importance of the non-treaty commercial and recreational fisheries in the State of Washington. The study is designed to summarize the overall economic benefits of Washington's non-treaty commercial and recreational fisheries for 2006. Although the study estimates net economic values and economic impacts of both commercial and recreational fisheries, it is not sufficiently comprehensive and the values are not estimated with adequate precision to warrant a comparative analysis of the two fisheries. Some components of net economic values were not quantified and, in the case of economic impacts, the effects associated with the spending by state resident anglers are fundamentally different from the effects generated by non-resident recreational anglers and by commercial fishers.

### Study Conclusions

Ultimately, our findings indicate that commercial and recreational fisheries not only contribute employment and personal income, but also contribute in several other significant ways to Washington's economy, as well as to its residents' quality of life.

In terms of economic impacts, commercial and recreational fishing conducted in Washington fisheries directly and indirectly supported an estimated 16,374 jobs and $540 million in personal income in 2006. When viewed in the context of the Washington state economy, these levels of employment and earnings account for about 0.4 percent of total statewide employment and about 0.2 percent of total statewide personal income in 2006.

Recreational fishing generates the larger share of economic impacts, supporting 12,850 jobs or more than three-quarters of the fishing-related jobs in 2006. Of the jobs supported by recreational anglers, state residents accounted for more than 90 percent of the spending that supports these jobs.

While the spending by non-resident anglers contributes to the tourism economy in Washington State, spending by resident anglers serves to direct discretionary consumer spending toward fishing-related goods and services. As a consequence, spending by non-resident anglers plays a more pivotal role in supporting the state economy than does the spending by resident anglers.

The non-treaty commercial fishery in Washington waters also contributes an estimated $38 million in net economic values (net income or profits), allowing commercial fishers to participate in a livelihood that has been passed down from generation to generation. And, recreational fisheries generate an estimated $424 million in net economic values (over and above expenditures) to the estimated 725,000 residents who live and fish in Washington, suggesting that sport fishing substantially contributes to anglers' quality of life.

## Detailed Summary of Finding

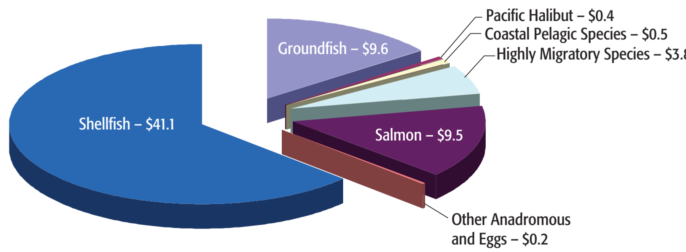
Our study focuses specifically on fishing activity in state waters in 2006, and considers two widely used but distinctly different economic measures:

- Net economic values and
- Economic impacts

Net economic values measure the net (or surplus) value to commercial and sport anglers who participate in the fisheries. For sport anglers, net economic values measure an angler's willingness to pay over and above actual out-of-pocket costs to fish. For commercial fishers, net economic values represent the profit (or net income) from fishing. Economic impacts, on the other hand, measure the jobs and personal income that are directly and indirectly supported statewide by sport and commercial fishing activity.

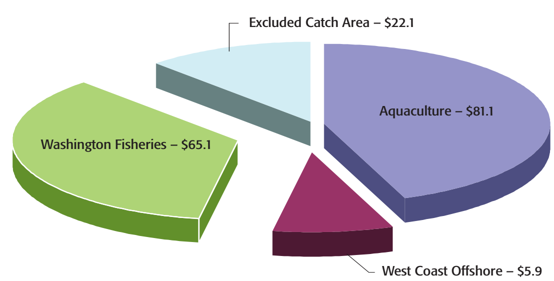
### Commercial Fishery

Washington State's commercial fishing industry is structured around a multi-species fishery. Groundfish, halibut, albacore, salmon, and shellfish are all major species groups important to the industry. In 2006, non-tribal commercial fish landings from Washington fisheries totaled nearly 109.4 million pounds, generating $65.1 million in ex-vessel value (i.e. the price received by commercial fishers for fish landed at the dock) for fish harvesters. Although groundfish produced the greatest share of landings (about 54%), shellfish generated the greatest share of ex-vessel value (63%).




Harvest value from Washington fisheries in 2006 by species group (in millions of dollars)

As indicated above, this study focuses on the fisheries in Washington waters only, which represent only one part of a much larger commercial fishing industry in Washington State. But the commercial fishing industry in Washington has other vital components, including harvesting by western Washington tribes; harvesting in distant waters including Alaska, Oregon and Canada; and aquaculture operations.




Harvest value from Washington fisheries and other commercial landings in 2006 (in millions of dollars)

In terms of regional catch, the Coastal area is by far the largest contributor to commercial fish harvesting in Washington, accounting for 85 percent of total pounds landed and 63 percent of total ex-vessel value. Grays Harbor County—producing

King Salmon

$19.3 million in landings from Washington fisheries—is the state's largest commercial port area, and accounted for nearly 30 percent of the total value of landings from Washington fisheries in 2006. Other port counties with significant shares of commercial harvest values include Whatcom County (21%), King County (9%), Skagit County (7%), and Clallam County (5%).

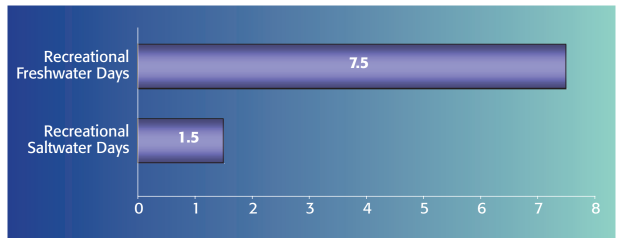
Seafood processing also contributes significantly to the value of Washington's commercial fisheries. Including in-state processing, the wholesale value of fishery products caught in Washington waters was an estimated $101 million in 2006. Groundfish accounted for about 61 percent of this value, and shellfish accounted for about 21 percent.

**Recreational Fishery**

An estimated 824,000 anglers fished (finfishing and shellfishing) in Washington State in 2006. About 88 percent of these anglers were state residents, and 12 percent were nonresidents. State residents fished about 8.5 million days (about 93% of all fishing days in Washington) and nonresidents fished 615,000 days (about 7% of all fishing days).

In addition to finfishing, shellfishing is a popular activity in Washington State, primarily along the Pacific Coast and the shoreline of Puget Sound. Both Dungeness crab harvesting in North Puget Sound waters and clamming for razor clams along the Pacific Coast shoreline are very popular with state residents.

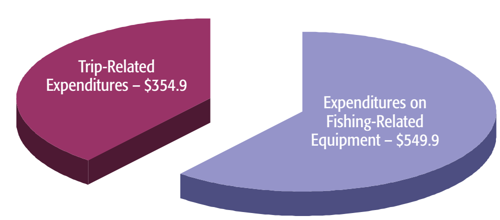
In 2006, an estimated 286,000 anglers sport fished in marine waters in Washington, accounting for 1.5 million saltwater angler days. Salmon was the most popular target species, comprising 52 percent of the saltwater angler days. On about 35 percent of angler days shellfish was the target, and on the remaining 12 percent of days other saltwater species were the major focus.




Recreational fishing days in Washington State in 2006 (millions of days)

Fishing for trout was the most popular freshwater fishing activity (48% of all angler days in Washington State), followed by fishing for salmon (23%), steelhead (12%), and black bass (12%). An estimated 538,000 anglers participated in freshwater fishing in Washington State in 2006, accounting for 7.5 million angler days.

Recreational anglers in Washington State spent an estimated $904.8 million in 2006 on fishing-related equipment and trip-related items. Trip-related expenditures, including food, lodging, transportation, and other trip expenses, totaled $354.9 million, and expenditures on fishing-related equipment totaled about $549.9 million.




Recreational fishing expenditures in Washington State in 2006 (millions of dollars)

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# Final Report: Economic Analysis of the Non-Treaty Commercial and Recreational Fisheries in Washington State

## Table of Contents



## Appendices

# Final Report: Economic Analysis of the Non-Treaty Commercial and Recreational Fisheries in Washington State

## List of Tables



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# *INTRODUCTION*

This economic study of the non-treaty commercial and recreational fisheries in the state of Washington was commissioned by the Washington State Department of Fish and Wildlife (WDFW). The impetus for the study was provided by Governor Chris Gregoire in a request to the Washington Fish and Wildlife Commission, as stated in the following:

***"Economic Benefits: To allow us to fully educate the public on the importance of fishing, I would like the Commission to summarize the economic benefit that our commercial and recreational fisheries provide the state. While sustainable fishing practices must be consistent with conservation needs of the fish, both fisheries have an important economic role, particularly in our rural communities."***

**This report addresses the Govenor's study guidance. More specifically, the report addresses the following objectives:**

- identify affected fisheries and their beneficiaries
- establish the conceptual foundation (net economic values and economic impacts) for assigning value to the beneficiaries
- characterize sport fishing activity in terms of catch and effort by species groups for the 2006 base year
- establish statewide economic values (net economic values) and impacts (jobs, earnings) associated with sport fisheries for the 2006 base year
- characterize commercial fishing activity in terms of harvest by species groups and by port
- establish statewide economic values (net economic values) and impacts (jobs, earnings) associated with commercial fisheries for 2006 base year

As stated in the study objectives, both net economic values and economic impacts are addressed in the report. Net economic values and economic impacts are two widely used but distinctly different economic measures. Net economic values measure the net (or surplus) value to commercial and sport anglers associated with participating in the fisheries. For sport anglers, net economic values measure an angler's additional willingness to pay to fish over and above actual out-of-pocket costs. For commercial fishers, net economic

## *Section 1* *(cont.)*

values mostly represent the profit (or net income) from fishing. Economic impacts, on the other hand, measure the jobs and personal income that are supported by sport and commercial fishing activity. Both commercial and sport fishing are widely recognized as important industries to the state of Washington, making significant contributions that support local, regional, and the state economy.

Although this study focuses on the values that fisheries provide to users (commercial fishers and sport anglers) of the resources, it should be acknowledged that protecting fishery resources, particularly those resources that may be threatened or endangered, has value to persons who don't directly use (or even consume) fishery resources. These values are often referred to as non-use or passive use values. Although non-use values are not included for evaluation in this study, it is important to acknowledge them and to understand that a more comprehensive accounting of all of the social and economic values of Washington fisheries would attempt to address them more thoroughly. Because there is considerable debate within the economics profession concerning the theory and legitimacy of measuring these values, further examination of them here is considered beyond the study scope.

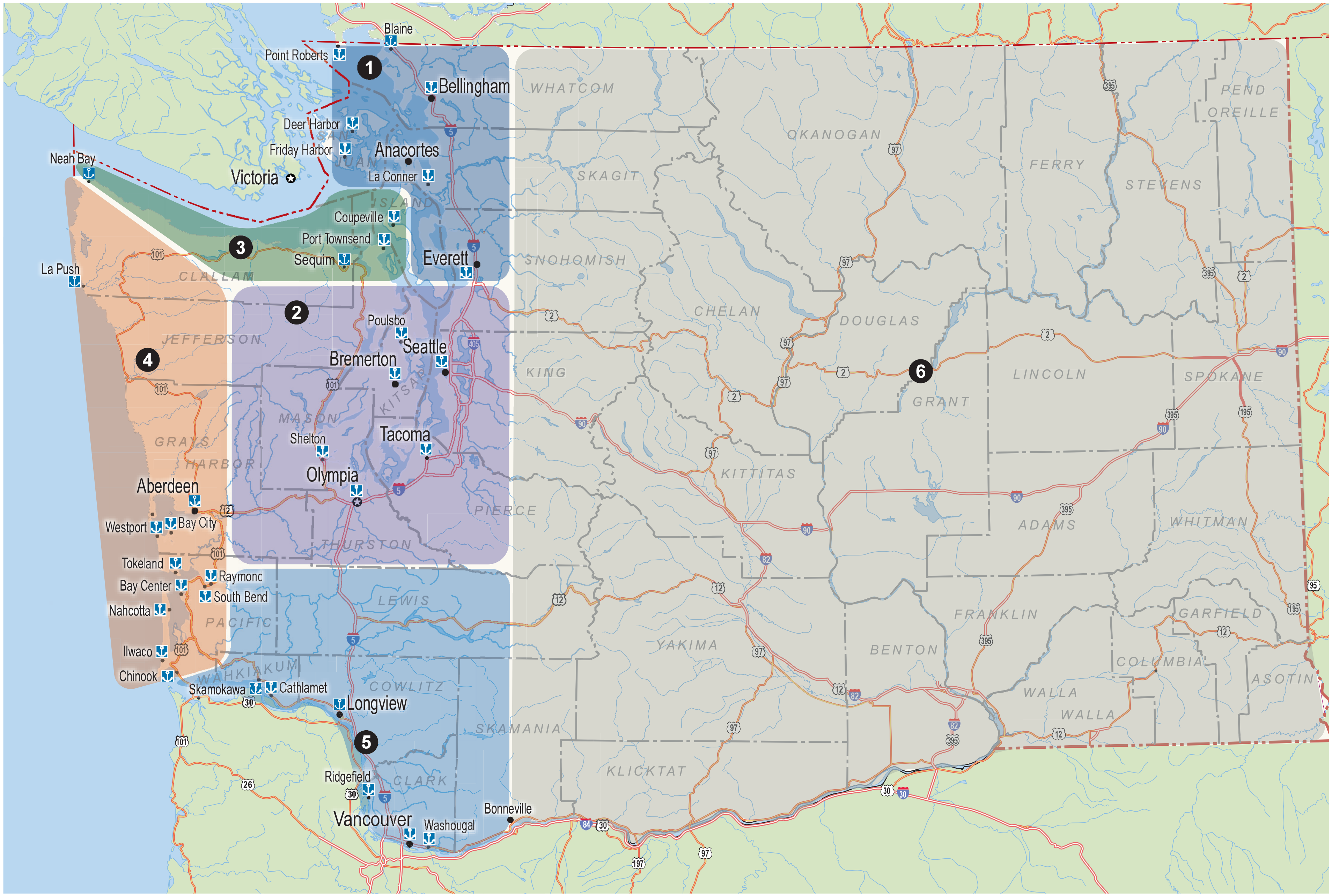
The focus of this study is on statewide economic values and impacts. Although the study focus is statewide, the approach used to develop these values and impacts is based on regional building blocks of information that also shed light on the regional importance of fisheries throughout the state. The study regions include Puget Sound (including North Puget Sound, South Puget Sound, and the Strait of Juan de Fuca), the coast (from Cape Flattery to the mouth of the Columbia River), and the Columbia River (including the river and its tributaries below Bonneville Dam and the vast inland watershed above the dam). These regions are highlighted in ***Figure 1***.

This study is limited to estimating economic values and impacts associated with non-tribal fisheries in Washington waters only. Fisheries that are excluded from assessment include the fisheries of the western Washington treaty tribes; distant water fisheries, including the Alaskan and Canadian fisheries; catch landed in Washington from harvest areas south of the seaward extension of the Washington-Oregon land border; fisheries where Washington home-port vessels deliver to other states; and fish products from aquaculture operations in Washington State. As described in more detail in Section 4, these additional commerical fishery components contribute substantially to the overall value of the commercial fishing industry in Washington as well as to the state economy. Therefore, it is important to recognize that the economic values and impacts of the commercial fisheries described in Section 2 of this report represent only a piece of a much larger industry in the state of Washington.

Lastly, a note about those who were instrumental in assembling the information that serves as the report foundation. We wish to thank Lee Hoines and Eric Kraig of the WDFW whose tireless efforts to assemble data from the commercial fishing license and catch database, and from WDFW's Sport Catch Report made pulling this report together in short order possible. Also, a special thanks to Craig Burley for keeping all the parts moving at all times that allowed us to meet a tight schedule.

*Net economic values (NEVs) and economic impacts provide information that helps decisionmakers answer different questions. Because NEVs are monetary measures of economic welfare, they are used to evaluate the economic efficiency of policy or program changes. Benefit-cost analysis is a widely used analytical tool for evaluating the economic efficiency of policy actions, such as changing hatchery production or reallocating fish harvest among user groups. Decisions are reached on whether the benefits of proposed changes in existing policy would exceed the costs of the proposed action. Economic impacts, on the other hand, provide decision makers with information on how policy changes affect economic activity, as measured in terms of jobs and personal income, in communities, regions, or even at the state or national level. Because economic impacts are measures of economic activity, the information is important in the context of local and regional economic development goals. For example, a major increase in hatchery capacity and operations could result in increasing the number of jobs and personal income in areas targeted for economic development, thereby contributing to achieving local economic development objectives.*

Figure 1. Study area and generalized catch regions




LEGEND

- U.S. Canadian and Washington State Border
- Counties
- Major Cities/Towns
- Ports

Catch Regions

1 North Puget Sound
2 South Puget Sound
3 Strait
4 Coast
5 Lower Columbia River
6 Upper Columbia River (and eastern Washington)

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*Dungeness crab*

# *COMMERCIAL FISHERIES*

**This section presents an overview of the commercial fishing industry and fishing activity, followed by descriptions of pounds landed and ex-vessel value of fish commercially harvested in 2006, which are characterized by species group, by catch region, and by port county of origin. The economic impacts generated by the commercial fishery also are described at the state level.**

## Industry and Activity Overview

The Washington commercial fishing industry is structured around a multi-species fishery. Major species groups important to the state's fishing industry are groundfish, halibut, salmon, albacore, and shellfish. Important species within the groundfish category include whiting, flatfish, rockfish, lingcod, and sablefish. Washington fishers must rely on a number of different fisheries that are seasonal and fluctuate from year to year for their livelihoods. Additionally, many Washington-based commercial fishing enterprises, including harvesters, processors and support businesses, rely to a great extent on the catch of Alaskan and other distant water fish that is delivered to Washington ports for processing and distribution to world markets. All of these fisheries contribute to a wide range of commercial activities that have economic and social significance to those engaged in commercial fishing, including fish buyers and processors, suppliers of commercial fishing equipment and services, and fishing communities that depend on these fisheries. Seafood harvesters use a variety of fishing gear that falls under the broad categories of net gear, dredge gear, pot gear, gear that uses hooks and lines, and other gear.

In the Puget Sound area ***(see Figure 1)***, major commercial fishing ports are located in Seattle, Bellingham Bay, and Blaine. Ports are also located in Friday Harbor, Anacortes, La Conner, Everett, Tacoma, Olympia, and Shelton. Seattle has traditionally served as an important entry port for Alaska, and many of the large seafood catcher-processors participating in Alaskan fisheries are based there. Blaine and Bellingham, both north of Seattle, are important ports for groundfish vessels, with about one-third of the Puget Sound

port group's fishing vessels home ported in Bellingham in 2001. In terms of the distribution of different sized vessels, Puget Sound is consistent with the West Coast as a whole, with about two-thirds of the vessels under 40 feet; however, one of the two vessels over 150 feet participating in West Coast fisheries is based in Seattle. (NMFS 2005)

Along the Strait of Juan de Fuca, ports are located in Port Townsend, Sequim, Port Angeles, and Neah Bay. Port Angeles is the delivery port for the bulk of limited entry fixed gear and open access groundfish vessels in the Strait of Juan de Fuca region. Ports along Washington's coast include La Push, Copalis Beach, Grays Harbor, Westport, Willapa Bay, and Ilwaco.

The seafood distribution chain begins with deliveries by the harvesters (ex-vessel landings) to the shoreside networks of buyers and processors, and includes the linkage between buyers and processors and seafood markets. Most Washington commercial landings are delivered to shore-based processors and are processed within the state, although a portion of the catch is handled by at-sea processors on factory ships. On-shore processing capacity has been consolidating in recent years.

Several companies have left the market or have chosen to quit the business entirely. This has led to trucking fish from certain landing ports communities for processing. Therefore, landings do not necessarily indicate processing activity in those communities. Some proces-

Table 1. Pounds of commercial fish landings from Washington non-treaty fisheries in 2006, by species group

| SPECIES GROUP AND MAJOR SPECIES | POUNDS LANDED | PERCENT OF TOTAL |
|---|---|---|
| **Groundfish (excluding Pacific Halibut)** | | |
| Pacific whiting | 51,066,719 | 86.2 |
| Sablefish | 2,119,563 | 3.6 |
| Sole (Dover and petrale) | 1,646,374 | 2.8 |
| Spiny dogfish | 1,079,207 | 1.8 |
| Other groundfish | 3,306,061 | 5.6 |
| ***Total Groundfish*** | ***59,217,924*** | ***100.0*** |
| **Pacific Halibut** | | |
| ***Total Pacific Halibut*** | ***135,868*** | ***100.0*** |
| **Coastal Pelagic Species** | | |
| Sardines | 7,354,425 | 89.3 |
| Herring (bait) | 445,437 | 5.4 |
| Other pelagic species | 433,216 | 5.3 |
| ***Total Coastal Pelagic Species*** | ***8,233,078*** | ***100.0*** |
| **Highly Migratory Species** | | |
| Albacore tuna | 4,799,705 | 99.9 |
| Other highly migratory species | 2,961 | <0.1 |
| ***Total Highly Migratory Species*** | ***4,802,666*** | ***100.0*** |
| **Salmon** | | |
| Chum | 8,273,081 | 75.1 |
| Sockeye | 1,251,656 | 11.4 |
| Chinook | 972,851 | 8.8 |
| Coho | 522,640 | 4.7 |
| Pink* | – | – |
| ***Total Salmon*** | ***11,020,228*** | ***100.0*** |
| **Other Anadromous and Eggs** | | |
| Sturgeon | 92,226 | 58.1 |
| Mixed shad | 60,366 | 38.1 |
| Columbia River smelt | 5,866 | 3.7 |
| Eggs – chum | 163 | 0.1 |
| ***Total Other Anadromous and Eggs*** | ***158,621*** | ***100.0*** |
| **Shellfish** | | |
| Dungeness crab | 17,106,237 | 66.3 |
| Pink shrimp | 4,986,709 | 19.3 |
| Geoduck clams | 2,472,598 | 9.6 |
| Other shellfish | 1,224,598 | 4.7 |
| ***Total Shellfish*** | ***25,789,641*** | ***99.9*** |
| ***GRAND TOTAL*** | ***109,358,026*** | |

* The pink salmon fishery occurs during odd-numbered years only. The average annual catch (pounds landed) of pink salmon caught in Washington waters in 2001, 2003, and 2005 was 5,238,586 pounds.

Source: WDFW license and fish ticket database (Hoines pers. comm.)

sors in Washington receive landings from both Washington and Alaska fisheries. (NMFS 2005)

## Fish Harvesting and Ex-Vessel Value

Non-tribal commercial fish landings from Washington fisheries totaled nearly 109.4 million pounds in 2006, generating $65.1 million in ex-vessel value (i.e., the price received by commercial fishers for fish landed at the dock) for fish harvesters. As ***Table 1*** shows, landings are grouped into seven major species groups, including groundfish, Pacific halibut, coastal pelagic species, highly migratory species, salmon, other anadromous species and eggs, and shellfish.

In term of pounds landed, the groundfish group, with 59.2 million pounds in landings, is Washington's largest fishery, accounting for 54 percent of the commercial catch from Washington waters. Within this species group, Pacific whiting accounts for more than 85 percent of total groundfish landings. Landings of groundfish generated $9.6 million in ex-vessel value for harvesters in 2006, with landings of sablefish and Pacific whiting contributing substantially to this total ***(Table 2)***.

Although the groundfish species group produces the greatest share of landings, the shellfish species group, with 25.8 million pounds in landings, generates the greatest share of ex-vessel value. The $41.1 million in shellfish landings accounted for 63 percent of total ex-vessel value, compared to 15 percent for the groundfish group,

Table 2. Value (ex-vessel) of commercial fish landings from Washington fisheries in 2006, by species group

| SPECIES GROUP AND MAJOR SPECIES | EX-VESSEL VALUE | PERCENT OF TOTAL |
|---|---|---|
| **Groundfish (excluding Pacific Halibut)** | | |
| Sablefish | $4,307,235 | 44.8 |
| Pacific whiting | $3,025,858 | 31.5 |
| Sole (Dover and petrale) | $990,652 | 10.3 |
| Other groundfish | $1,295,122 | 13.5 |
| ***Total Groundfish*** | ***$9,618,867*** | ***100.0*** |
| **Pacific Halibut** | | |
| ***Total Pacific Halibut*** | ***$407,382*** | ***100.0*** |
| **Coastal Pelagic Species** | | |
| Sardines | $311,575 | 61.7 |
| Herring (bait) | $148,007 | 29.3 |
| Other pelagic species | $45,082 | 8.9 |
| ***Total Coastal Pelagic Species*** | ***$504,664*** | ***99.9*** |
| **Highly Migratory Species** | | |
| Albacore tuna | $3,777,024 | 100.0 |
| Other highly migratory species | – | – |
| ***Total Highly Migratory Species*** | ***$3,777,024*** | ***100.0*** |
| **Salmon** | | |
| Chum | $4,739,201 | 49.9 |
| Chinook | $2,552,615 | 26.9 |
| Sockeye | $1,492,285 | 15.7 |
| Coho | $711,455 | 7.5 |
| Pink* | – | – |
| ***Total Salmon*** | ***$9,495,556*** | ***100.0*** |
| **Other Anadromous and Eggs** | | |
| Sturgeon | $182,957 | 94.8 |
| Columbia River smelt | $9,557 | 4.9 |
| Eggs – chum | $652 | 0.3 |
| Mixed shad | $2 | – |
| ***Total Other Anadromous and Eggs*** | ***$193,168*** | ***100.0*** |
| **Shellfish** | | |
| Dungeness crab | $29,567,235 | 71.9 |
| Geoduck clams | $7,957,798 | 19.4 |
| Pink shrimp | $1,589,534 | 3.9 |
| Other shellfish | $1,987,995 | 4.8 |
| ***Total Shellfish*** | ***$41,102,562*** | ***100.0*** |
| ***GRAND TOTAL*** | ***$65,099,232*** | |

* The pink salmon fishery occurs during odd-numbered years only. The average annual value of pink salmon caught in Washington waters in 2001, 2003, and 2005 was $547,525.

Source: WDFW license and fish ticket database (Hoines pers. comm.)

attributable to total landings from Washington waters in 2006. Within the shellfish group, Dungeness crab accounts for more than two-thirds of landings and ex-vessel value, as shown in ***Tables 1 and 2.***

Albacore is the most important highly migratory species. In 2006, albacore landings from Washington waters totaled 4.8 million pounds and about $3.8 million in ex-vessel values. Of the coastal pelagic species, sardines are the most important.

Salmon is a major contributor to the Washington commercial fishing industry. In 2006, salmon landings from Washington waters totaled 11.0 million pounds and $9.5 million in ex-vessel value, accounting for 10.1 percent of the total landings and 14.6 percent of the total ex-vessel value generated by landings across all species groups. Within the salmon species group, chum salmon accounted for three-quarters of salmon landings and about half the ex-vessel value. Despite accounting for only 8.8 percent of pounds landed within this group, Chinook contributed more than a quarter of the total value of salmon landings from Washington waters.

Smaller contributions to Washington's overall commercial fishery are made by the "other anadromous species and eggs group" and Pacific halibut. As ***Tables 1 and 2*** show, the "other anadromous species and eggs group" produced about 159,000 pounds of landings, valued at $193,200, in 2006. Within this group, sturgeon and shad landings accounted for the vast majority of landings and value. Pacific halibut landings from Washington waters totaled 135,900 pounds, generating $407,400 in ex-vessel value in 2006.

Landings and the associated value of those landings from Washington fisheries in 2006 are shown by catch region in ***Table 3***. The Coastal catch area is by far the largest contributor to the overall Washington fishery, accounting for 85 percent of pounds landed and 63 percent of ex-vessel value. Within the Coastal catch region, landings of groundfish (including Pacific halibut, highly migratory species, and coastal pelagic species) and shellfish species are the biggest contributors. Combined, these two species groups accounted for nearly 99 percent of the pounds landed in the catch region and 95 percent of the ex-vessel value. Most of the remaining value of the catch in the coastal catch area is generated by landings of salmon.

Outside of the coastal catch region, the North and South Puget Sound catch regions were the largest contributors to the overall Washington commercial fishery in 2006. The North Puget Sound catch area contributed nearly 7 percent of the pounds landed within the overall fishery and 14 percent of its ex-vessel value ***(Table 3)***. The South Puget Sound catch contributed a larger share to the overall Washington fishery, producing 9 percent of landed pounds and 19 percent of ex-vessel value. Within both catch regions, the salmon species group is a much bigger contributor to landings and ex-vessel values than it is in the other catch regions. The value of salmon landings totaled $3.8 million in the South Puget Sound area and $2.9 million in the North Puget Sound area, accounting for 40 percent and 27 percent, respectively, of the value of all salmon landings within the overall Washington commercial fishery. Within both the North and South Puget Sound catch regions, salmon landings accounted for nearly one-third of the value of all landings. Shellfish, however, was the larger contributor to ex-vessel value in both areas, accounting for about two-thirds of total ex-vessel value within both the North and South Puget Sound catch regions.

Within the Strait of Juan de Fuca catch region, which accounted for 0.8 percent of pounds landed and 1.7 percent of ex-vessel value within the overall Washington fishery, shellfish and groundfish are the major contributors. Shellfish produced 83 percent of the catch area's total pounds landed and 94 percent of its ex-vessel value. Groundfish accounted for most of the remaining landings and value within the catch area ***(Table 3)***.

The Lower Columbia River catch region, which accounted for 0.6 percent of the landings and 1.8 percent of the ex-vessel value within the overall Washington fishery, is dominated by the catch of salmon species ***(Table 3)***. Harvests of salmon produced 84 percent of both the pounds landed and ex-vessel value of the total catch in the Lower Columbia River catch region. The Upper Columbia River, which is primarily a recreational and tribal fishery, produced 8,400 pounds of non-

Table 3. Pounds landed and value (ex-vessel) of commercial fish landings from Washington non-treaty fisheries in 2006, by catch region (in thousands of pounds and dollars)

| SPECIES GROUP | CATCH REGION | | | | | | | | | | | | STATE TOTAL | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NORTH PUGET SOUND | | SOUTH PUGET SOUND | | STRAIT OF JUAN DE FUCA | | COAST | | LOWER COLUMBIA RIVER[1] | | UPPER COLUMBIA RIVER | | | |
| | Pounds Landed | Value | Pounds Landed | Value | Pounds Landed | Value | Pounds Landed | Value | Pounds Landed | Value | Pounds Landed | Value | Pounds Landed | Value |
| Groundfish[2] | 647.3 | $203.3 | 643.4 | $198.9 | 135.8 | $60.3 | 70,642.0 | $13,400.6 | 3.7 | –[3] | 8.4[4] | –[3] | 72,080.6 | $13,863.1 |
| Pacific Halibut | – | – | – | – | – | – | 135.9 | $407.4 | – | – | – | – | 135.9 | $407.4 |
| Salmon | 3,255.9 | $2,909.4 | 6,468.8 | $3,777.2 | 4.5 | $4.9 | 773.9 | $1,789.6 | 517.0 | $1,014.5 | – | – | 11,020.2 | $9,495.6 |
| Other Anadramous and Eggs | – | – | 0.2 | $0.7 | – | – | 64.6 | $8.3 | 93.9 | $184.2 | – | – | 158.5 | $193.2 |
| Shellfish | 3,374.2 | $6,207.4 | 2,666.3 | $8274.1 | 704.8 | $1,068.5 | 19,044.0 | $25,552.1 | 0.2 | $0.3 | – | – | 25,789.6 | $41,102.6 |
| ***TOTAL*** | ***7277.4*** | ***$9,320.1*** | ***9778.7*** | ***$12,250.9*** | ***845.1*** | ***$1,133.7*** | ***90,660.4*** | ***$41,158.0*** | ***614.8*** | ***$1,199.0*** | ***8.4*** | ***–*** | ***109,184.8*** | ***$65,061.7*** |

Notes:
[1] The Lower Columbia River includes the river and tributaries below Bonneville Dam.
[2] Includes highly migratory and coastal pelagic species in the Coastal region.
[3] Notes: No value is estimated because the catch is a by-catch for which the harvester is not paid for the product.
[4] This catch is mostly carp caught by commercial fisheries from Oregon who do not sell their catch.

Source: WDFW license and fish ticket database (Hoines pers. comm.)

Table 4. Value (ex-vessel) of commercial fish landings from Washington fisheries in 2006, by port county of origin (in thousands of dollars)

| SPECIES GROUP | PORT COUNTY OF ORIGIN | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | CLALLAM | CLARK | COWLITZ | GRAYS HARBOR | ISLAND | JEFFER-SON | KING | KITSAP | MASON | PACIFIC |
| Groundfish[1] | $1,456.7 | – | – | $5,270.0 | $0.5 | $54.0 | $104.4 | – | $35.0 | $2,480.5 |
| Salmon | $603.5 | $43.4 | $325.5 | $513.5 | $16.9 | $117.3 | $1,391.9 | – | $1.3 | $1,068.5 |
| Other Anadramous and Eggs | $0.002 | – | $50.7 | $8.0 | – | – | $1.0 | – | – | $56.9 |
| Shellfish | $1,036.1 | – | $3.8 | $13,470.6 | $64.9 | $1,197.0 | $4,481.7 | $190.7 | $54.6 | $7,384.1 |
| ***TOTAL*** | ***$3,096.3*** | ***$43.4*** | ***$380.0*** | ***$19,262.1*** | ***$82.3*** | ***$1368.3*** | ***$5,979.0*** | ***$190.7*** | ***$90.0*** | ***$1,099.0*** |

| SPECIES GROUP | PORT COUNTY OF ORIGIN | | | | | | | | STATE TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| | PIERCE | SAN JUAN | SKAGIT | SNO-HOMISH | THUR-STON | WAHKIA-KUM | WHAT-COM | OTHER | |
| Groundfish[1] | $122.7 | – | $27.7 | $77.9 | $4.4 | – | $4,674.1 | – | $14,307.9 |
| Salmon | $106.8 | $28.4 | $593.0 | $679.1 | $158.5 | $380.4 | $3,404.5 | $63.1 | $9,495.6 |
| Other Anadramous and Eggs | $0.5 | – | – | – | – | $75.6 | – | $0.4 | $193.1 |
| Shellfish | $1,920.4 | $107.2 | $3,730.4 | $619.2 | $1,309.0 | $104.9 | $5,427.9 | $0.01 | $41,102.5 |
| ***TOTAL*** | ***$2,150.4*** | ***$135.6*** | ***$4,353.1*** | ***$1,376.2*** | ***$1,471.9*** | ***$560.9*** | ***$13,506.5*** | ***$63.5*** | ***$65,099.1*** |

Notes:
[1] Includes Pacific halibut, highly migratory species, and coastal pelagic species.

**Counties include the following ports:**

| | |
|---|---|
| **CLALLAM** | La Push, Neah Bay, Port Angeles, Sequim |
| **CLARK** | Ridgefield, Vancouver, Washougal |
| **COWLITZ** | Longview |
| **GRAYS HARBOR** | Aberdeen, Bay City, Westport |
| **ISLAND** | Coupeville, Deer Harbor, Whidbey Island |
| **JEFFERSON** | Port Townsend |
| **KING** | Seattle |
| **KITSAP** | Poulsbo, Bremerton |
| **MASON** | Shelton |
| **PACIFIC** | Bay Center, Chinook, Ilwaco, Nahcotta, Raymond, South Bend, Tokeland |
| **PIERCE** | Tacoma |
| **SAN JUAN** | Friday Harbor |
| **SKAGIT** | La Conner |
| **SNOHOMISH** | Everett |
| **THURSTON** | Olympia |
| **WAHKIAKUM** | Cathlamet, Skamokawa |
| **WHATCOM** | Bellingham Bay, Blaine, Point Roberts |

tribal commercial landings in 2006, primarily carp caught by commercial fishers who do not sell their catch.

The value of commercial fish landings from Washington fisheries for counties with commercial ports is shown in ***Table 4***. Grays Harbor County, with $19.3 million in landings from Washington fisheries, is the state's largest commercial port area, accounting for nearly 30 percent of the total value of landings from Washington fisheries in 2006. Other port counties with significant shares of statewide commercial harvest values include Whatcom County (21%), King County (9%), Skagit County (7%), and Clallam County (5%). From a species perspective, groundfish harvest values are largest in Grays Harbor County, Whatcom County, and Pacific County. Shellfish is also a large contributor to the commercial catch landed in Grays Harbor County, as it also is in Whatcom County and Pacific County. Salmon landings from Washington's fishery are largest in Whatcom, King, and Pacific counties.

## Economic Values and Impacts

The economic benefits of Washington's commercial fishery are measured in terms of the net economic values and economic impacts of commercial fishing and seafood processing.

Net economic value (NEV) is a gauge of the amount of wealth generated for participants in the commercial fisheries. For this study, NEV for the commerical fishery is characterized by the gross revenue generated by commercial fishing and processing minus the costs to harvest and process seafood. In other words, NEV represents the profits to commercial harvesters and processors.

The economic impacts of Washington's commercial fishery are characterized by the economic output (revenues) of the commercial fishing harvesting and processing sectors and by the employment and personal income directly and indirectly generated by those activities. The methods used to assess net economic values and economic impacts are described in ***Appendix B***.

### Net Economic Values

As discussed previously, the commercial harvest of fish and shellfish from Washington waters generated about $65.1 million in ex-vessel value for harvesters in 2006. Processing the seafood produced by this harvest generated an estimated $101.0 million in wholesale value for companies located in Washington ***(Table 5)***. About 61 percent of this value was attributable to the harvest of groundfish species; 21 percent was generated by processing of shellfish species.

The NEV (or profit) for harvesters and processors generated by the 2006 harvest from Washington waters was estimated to total $38.0 million ***(Table 5)***. Shellfish harvesting and processing was the greatest contributor to these benefits, accounting for 46 percent of total NEV. NEV generated by the harvesting and processing of groundfish and salmon species contributed 32 percent and 19 percent, respectively, to total NEV. While NEV is positive in the aggregate, it may mask what is happening at an individual fishery level or business level. For example, some local harvesters or processors likely were operating at a loss in 2006, but, in the aggregate, these

Table 5. Net economic values and economic effects generated by the Washington commercial fishery in 2006

| FISHERY[1] | REVENUE[2] | | PERSONAL INCOME[3] | | | EMPLOYMENT[4] | | NET ECONOMIC VALUE[5] |
|---|---|---|---|---|---|---|---|---|
| | HARVESTER | PROCESSOR | HARVESTER | PROCESSOR | TOTAL | JOBS | PERCENT OF TOTAL | |
| Groundfish | $13,901 | $31,437 | $18,775 | $22,970 | $41,745 | 993 | 28% | $12,116 |
| Pacific halibut | $407 | $486 | $587 | $76 | $663 | 16 | 0.4% | $196 |
| Salmon | $9,496 | $16,624 | $12,370 | $8,935 | $21,305 | 507 | 14% | $7,091 |
| Other anadromous and eggs | $193 | $2,838 | $2,901 | $1,492 | $4,393 | 105 | 3% | $1,138 |
| Shellfish | $41,103 | $49,636 | $53,935 | $25,981 | $79,916 | 1,903 | 54% | $17,484 |
| ***Total*** | ***$65,100*** | ***$101,021*** | ***$88,567*** | ***$59,456*** | ***$148,022*** | ***3,524*** | ***100%*** | ***$38,024*** |

Notes: All dollars are in thousands.

[1] Fisheries are for Pacific Ocean harvests within the EEZ, excluding Dungeness crab harvested off the Oregon coast and all other commercial inland fisheries that are landed onshore. Aquaculture and tribal harvests also are excluded.

[2] Harvester revenue (ex-vessel revenue) are what harvesters receive when selling their retained catch. Processor revenue is the wholesale value of seafood products.

[3] Personal income consists of total personal income generated by harvester and processor activities, including the indirect and induced multiplier effects.

[4] Jobs are the number of full- and part-time jobs using Bureau of Economic Analysis estimates for wage and salary earnings and proprietorship earnings in Washington in 2006.

[5] Net economic value is the prorated profitability of vessels and processors active in the Washington fishery.

Source: TRG 2008.

losses were being offset by the profits of other harvesters or processors.

## Economic Impacts

Fishing vessels, processors, and industry-support businesses generate economic activity throughout Washington State. The estimated economic impacts, including the personal income and jobs, generated by the harvesting and processing of seafood from Washington waters in 2006 are shown in ***Table 5.*** The personal income generated by this activity is estimated to total $148.0 million, including $88.6 million in personal income from harvesting activities and $59.4 million from processing activities. These income estimates include personal income earned in other sectors of the Washington economy generated by purchases of inputs by seafood harvesters and processors and by the spending of their employees on goods and services.

Employment generated by seafood harvesting and processing attributable to catch from Washington waters is estimated to total 3,524 full- and part-time jobs in 2006 ***(Table 5).*** Most of these jobs are generated by the catch and harvest of shellfish, groundfish, and salmon. It should be noted that many seafood harvesting and processing jobs are seasonal and part time, and that the total number of jobs in the commercial fishing and processing industries likely exceeds the estimated jobs shown in ***Table 5.*** The economic effects generated by harvests from Washington waters represent a small part of Washington's economy, but are important at the community level along the Washington Coast, the Strait of Juan de Fuca, and the Puget Sound areas.

Of the species groups shown in ***Table 5***, the shellfish fishery accounted for the highest share (54%) and the halibut fishery the smallest share (0.4%) of the total personal income and jobs directly and indirectly generated by harvests from Washington waters. Salmon species accounted for about 14 percent of total income and jobs.

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King Salmon

# *RECREATIONAL FISHERIES*

**This section presents an overview of recreational fishing in Washington State, followed by a description of recreational catch and effort by species group and catch area. Angler expenditures, net economic values and economic impacts of recreational fishing at the state level also are described.**

## Activity Overview

According to the U.S. Fish and Wildlife Service, 824,000 state resident and non-residents (16 years old and older) fished in Washington State in 2006. Of this total, 725,000 anglers (88 percent) were state residents, and 98,000 anglers (12 percent) were non-residents. Anglers fished a total of 9.1 million days in Washington, an average of 12 days per angler. State residents fished about 8.5 million days, or about 93 percent of all fishing days in Washington. Non-residents fished 615,000 days in Washington, or about 7 percent of all fishing days in the state. (USFWS 2008)

Marine fishing and shellfishing in Washington State occurs along more than 500 miles of Pacific coast shoreline and more than 2,000 combined miles of Puget Sound, San Juan Islands, Strait of Juan de Fuca and Hood Canal shoreline (see ***Figure 1***). Sport fishing opportunities also are available in more than 4,000 rivers and streams (stretching over 50,000 miles), 7,000 lakes (over 2,500 at alpine elevations) and 200 reservoirs. (WDFW 2008)

Many lakes in the state are open year around, but the spring lake fishing "opener" on the last Saturday in April signals the traditional start of freshwater fishing activity. WDFW estimates that as many as 500,000 anglers fish on that weekend alone. Other waters are managed with different seasons, often to protect nesting waterfowl or for other biological reasons. To meet fishing demand, WDFW hatcheries stock about 22 million trout and kokanee fry annually. Trout (and kokanee) fishing highlights include:

- Trout fishing, especially for rainbows in lowland lakes, is usually best in spring and fall when the water is cool (but not frigid). Larger, deeper lakes can be good for trout all year.

- June and July are usually best for kokanee (a landlocked or non-anadromous sockeye salmon)
- Many alpine or high elevation lakes are stocked with cutthroat, rainbow and golden trout between June and October. Eastern brook trout, lake trout and brown trout have been introduced to add diversity to the stocking program.

Rivers and streams generally open June 1, after trout have had a chance to spawn and most anadromous salmonid smolts (juvenile salmon, steelhead, sea-run cutthroat, and char) migrate to saltwater. Most rivers and streams are managed to produce wild trout, salmon and steelhead. Consequently, few rivers and streams are stocked with hatchery reared trout.

Mountain whitefish are popular stream catches in winter when they gather in schools to spawn. Some streams have special "whitefish-only" winter seasons.  Walleye fishing in Columbia River reservoirs is a year around opportunity, with most trophy class fish caught in late winter and early spring months.  As temperatures rise, warmwater species such as bass, crappie, sunfish, and catfish provide other angling prospects.

Angling opportunities for anadromous fish such as steelhead and salmon vary widely according to area, time of year, and status of the particular run or species. Open seasons for marine fish, anadromous fish and shellfish sometimes are set or adjusted during the year. Highlights of fishing for anadromous species and shellfishing include:

Steelhead

- Fishing opportunities for smelt (eulachon) on the Columbia River and its tributaries depend on annual smelt abundance. North Coast and Puget Sound fisheries for other smelts, such as surf and longfin, also vary with the run size.
- Shad runs in the lower Columbia River peak in late May through early July, with several million shad passing Bonneville Dam annually.
- Sturgeon fishing on the Columbia River has been growing in popularity, thereby requiring more restrictive measures. Harvest quotas are often reached and published regulations are changed during the season.
- Open seasons for lingcod, halibut and rockfish vary among the 13 marine areas to protect the populations of these species. Other marine bottomfish are generally available year around.
- Oysters, clams, shrimp and crab are in their prime in the spring during daytime low tides on Puget Sound and Hood Canal beaches.

In addition to its more publicized fish planting programs, WDFW also manages stocking programs designed to enhance shellfishing opportunities for species such as clams and oysters.

## Catch and Effort

Anglers in Washington State catch finfish in marine and fresh waters and harvest shellfish along marine shorelines.  About two-thirds of the catch of bottomfish are caught in coastal waters and the remaining third caught in the marine waters of Puget Sound (***Table 6***).  Salmon are caught in both fresh waters and marine waters, with about 60 percent of the salmon catch occurring in marine waters.  Puget Sound salmon account for about 60 percent of all salmon caught in marine waters. In fresh waters, 57 percent of the salmon was caught in Puget Sound streams and 38 percent was caught in the Columbia River and its tributaries.  Most of the steelhead (74%) and almost all of the sturgeon (95%) caught in Washington waters in 2006 were caught in the Columbia River and its tributaries.  Although catch numbers are not available for trout and other inland species, about 22 million trout and kokanee (land-locked salmon) are stocked annually in inland streams and lakes.

Shellfishing is a popular activity along the Pacific Coast and the shoreline of Puget Sound.  As shown in ***Table 7***, harvesting Dungeness crab is very popular in North Puget Sound waters, accounting for more than 85 percent of the statewide catch.  Most (78%) of the spot shrimp harvested by recreational shellfishers is caught in South Puget Sound waters.  Razor clams are only harvested on coastal beaches but is a highly popular activity, with tens of thousands of clammers heading to the coast on weekends when razor clamming is open (Kraig pers. comm). Other clamming and oyster harvesting occurs mostly on shoreline beaches in the South Puget Sound area.

According to the U.S. Fish and Wildlife Service (2008), 286,000 anglers participated in sport fishing in marine waters in Washington State in 2006, and accounted for 1.5 million saltwater angler days (***Table 8***). Trout was the most popular freshwater target species, followed by salmon, steelhead, and black bass. Of the saltwater species, salmon accounted for 52 percent of all saltwater angler days, followed by shellfish (35% of saltwater angler days) and other saltwater species (13%).

## Economic Values and Impacts

This section describes the economic values and impacts associated with sport fishing activity in Washington State. First, the expenditures that anglers make to participate in recreational fishing in Washington State are described. Second, the net economic values associated with sport fishing, which represent the value that anglers place on sport fishing over and above their expenditures, are identified. Lastly, economic impacts, as measured by statewide jobs and earnings, associated with sport fishing activity and angler spending are presented.

Expenditures and net economic values are two widely used but distinctly different economic measures of sport fishing. Whereas angler expenditures represent out-of-pocket costs that

Table 6. Recreational finfish catch (numbers of fish) in Washington in 2006, by species group and catch region

| SPECIES GROUP | CATCH REGION | | | | |
|---|---|---|---|---|---|
| | PUGET SOUND | COAST | COLUMBIA RIVER | UNKNOWN AREA | TOTAL |
| **Bottomfish** | 112,457 | 295,151 | — | — | 407,608 |
| **Pacific Halibut** | 2,727 | 6,977 | 692 | — | 10,400 |
| **Albacore** | — | 18,941 | — | — | 18,941 |
| **Salmon** | | | | | |
| Marine | 65,423 | 43,027 | — | — | 108,450 |
| Freshwater | 98,576 | 7,186 | 65,817 | 1,227 | 172,806 |
| **Steelhead** | 12,709 | 15,415 | 80,294 | 477 | 108,895 |
| **Sturgeon** | 203 | 456 | 15,695 | 182 | 16,536 |
| ***Total*** | ***292,095*** | ***387,153*** | ***162,498*** | ***1,886*** | ***843,636*** |

Notes:
Columbia River region includes the Columbia River and all tributaries, including the Snake River.

Bottomfish catch in area 4b is included in the coastal region.

Albacore landings in Washington include fish caught in marine waters off the southern coast of Washington and northern coast of Oregon. All trips originated from ports in Ilwaco and Westport. Includes albacore caught by charter fleet only.

Source: Preliminary data for the Sport Catch Report and other catch data provided by WDFW (Kraig pers. comm).

Table 7. Recreational shellfish catch (pounds) in Washington in 2006, by species group and catch region

| SPECIES GROUP | NORTH PUGET SOUND | SOUTH PUGET SOUND | STRAIT | COAST | COLUMBIA RIVER | TOTAL |
|---|---|---|---|---|---|---|
| **Dungeness crab** | 3,330,004 | 271,167 | 261,540 | — | — | 3,862,711 |
| **Shrimp** | 23,520 | 87,996 | 1,950 | — | — | 113,466 |
| **Razer clams** | — | — | — | 3,601,000 | — | 3,601,000 |
| **Other clams** | 93,038 | 252,628 | — | — | — | 345,666 |
| **Oysters** | 19,129 | 632,966 | — | — | — | 652,095 |

Notes:
All values are in pounds except for oysters, which are in number of oysters.

Columbia River region includes the Columbia River and all tributaries, including the Snake River.

Source: Preliminary data for the Sport Catch Report provided by WDFW (Kraig pers. comm)

Table 8. Anglers, fishing days, and net economic values in Washington State in 2006, by type of fish

| SPECIES GROUP | Freshwater | | | Saltwater | | | Total | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | NUMBER OF ANGLERS[1] | ANGLER DAYS[1] | NET ECONOMIC VALUES | NUMBER OF ANGLERS[1] | ANGLER DAYS | NET ECONOMIC VALUES | NUMBER OF ANGLERS[1] | ANGLER DAYS[1] | NET ECONOMIC VALUES | PERCENT OF TOTAL NET ECONOMIC VALUES |
| **Crappie** | 15,000 | 114,000 | $4,133,000 | – | – | – | 15,000 | 114,000 | $4,133,000 | 0.9% |
| **Panfish** | 46,000 | 574,000 | $20,810,000 | – | – | – | 46,000 | 574,000 | $20,810,000 | 4.5% |
| **White bass/ striped bass hybrids[2]** | 30,000 | 292,000 | $10,586,300 | – | – | – | 30,000 | 292,000 | $10,586,300 | 2.3% |
| **Black bass** | 75,000 | 1,087,000 | $39,408,600 | – | – | – | 75,000 | 1,087,000 | $39,408,600 | 8.5% |
| **Catfish, bullheads** | 23,000 | 244,000 | $5,897,400 | – | – | – | 23,000 | 244,000 | $5,897,400 | 1.3% |
| **Walleye, sauger** | 23,000 | 78,000 | $2,827,800 | – | – | – | 23,000 | 78,000 | $2,827,800 | 0.6% |
| **Steelhead** | 113,000 | 1,097,000 | $51,260,500 | – | – | – | 113,000 | 1,097,000 | $51,260,500 | 11.1% |
| **Trout** | 337,000 | 3,622,000 | $145,903,900 | – | – | – | 337,000 | 3,622,000 | $145,903,900 | 31.6% |
| **Salmon** | 142,000 | 1,763,000 | $82,381,300 | 152,000 | 811,000 | $47,038,000 | 294,000 | 2,574,000 | $129,419,300 | 28.0% |
| **No target** | 29,000 | 203,000 | $7,359,600 | – | – | – | 29,000 | 203,000 | $7,359,600 | 1.6% |
| **Other freshwater fish** | 47,000 | 265,000 | $9,607,400 | – | – | – | 47,000 | 265,000 | $9,607,400 | 2.1% |
| **Other saltwater fish** | – | – | – | 44,000 | 187,000 | $11,220,000 | 44,000 | 187,000 | $11,220,000 | 2.4% |
| **Shellfish** | – | – | – | 129,000 | 547,000 | $23,521,000 | 129,000 | 547,000 | $23,521,000 | 5.1% |
| ***TOTAL*** | ***538,000*** | ***7,524,000*** | ***$380,175,800*** | ***286,000*** | ***1,545,000*** | ***$81,779,000*** | ***824,000*** | ***9,069,000*** | ***$461,954,800*** | ***100.0%*** |

Notes:
[1] Values do not add to the total because some anglers targeted multiple species.
[2] Although these values were reported by the USFWS (2008), WDFW has indicated that these species do not occur in Washington State and is likely a misidentification.

Sources:
Number of anglers and angler days are as reported by USFWS (2008).
Net economic values were derived from angler days and per day values identified in Appendix A and summarized in this section.

anglers incur to participate in sport fishing, net economic values (often referred to as "consumer surplus") represent the net or surplus amount that anglers would (theoretically) be willing to spend to participate in sport fishing. Economic impacts measure the importance of the "sport fishing economy."

**Angler Expenditures**

According to the U.S. Fish and Wildlife Service (2008), all fishing-related expenditures in Washington State totaled about $905 million in 2006 (***Table 9***). Trip-related expenditures, which include food, lodging, transportation, and other trip expenses, totaled $355 million, or about 39 percent of all fishing expenditures. Expenditures for food and lodging were $118 million and transportation expenditures were $120 million. Other trip expenses, such as equipment rental, bait, and cooking fuel, totaled $117 million. Each angler spent an average of $482 on trip-related costs during 2006.

Anglers spent about $550 million on equipment in Washington in 2006, 60 percent of all fishing expenditures. Fishing equipment (rods, reels, line, etc.) spending totaled $139 million, 29 percent of the equipment total. Auxiliary equipment expenditures (tents, special fishing clothes, etc.) and special equipment expenditures (boats, vans, etc.) amounted to $347 million, or about 71 percent of the equipment total. Special and auxiliary equipment are items that were purchased for fishing but could be used in activities other than fishing. The purchase of other items, such as magazines, membership dues, licenses, permits, stamps, and land leasing and ownership, amounted to $64 million—7 percent of all fishing expenditures.

Table 9. Trip and equipment expenditures for sport fishing in Washington in 2006 by resident and nonresident anglers (in thousands of dollars)

| TYPE OF EXPENDITURE | RESIDENT ANGLERS | NON-RESIDENT ANGLERS | ALL ANGLERS IN WASHINTON[2] |
|---|---|---|---|
| **Trip-related expenditures** | | | |
| Food and lodging | $104,600 | $13,278 | $117,878 |
| Transportation | $97,508 | $22,623 | $120,130 |
| Boating costs[1] | $71,482 | $2,136 | $73,619 |
| Other trip costs | $36,686 | $6,567 | $43,253 |
| ***Total trip-related expenditures*** | ***$310,276*** | ***$44,604*** | ***$354,880*** |
| **Equipment expenditures** | $467,469 | $18,477 | $549,915 |
| ***Total expenditures*** | ***$777,745*** | ***$63,081*** | ***$904,795*** |

Notes:
[1] Boating costs for non-residents were estimated based on available data.
[2] Expenditures for equipment and total expenditures by all anglers in Washington do not equal the sum of values from resident and non-resident anglers because these values were derived from different samples.
Source: USFWS 2008

**Net Economic Values**

Net economic values measure the monetary value that anglers place on sport fishing over and above what they actually spend to participate in the fisheries. These values are the appropriate measure of economic value for a wide range of analyses (including benefit-cost analysis) that quantify and compare benefits and costs. Total user benefits from sport fisheries are calculated as the summation of anglers' willingness to pay across all individuals who participate in sport fishing.

Net economic values associated with sport fishing typically are determined based on the value of an angler day (or trip). Angler surveys often are used to estimate these values. Values differ by type of activity, including species sought, mode of fishing (e.g., shore fishing or fishing from a boat), and angler success. As described in ***Appendix A***, net economic values for recreational fisheries focus on sport anglers only, and are estimated based on a review of previous studies of anglers' net willingness to pay for fishing opportunities. For this study, the following per day values are used to estimate the net economic value of sport fishing:

- Salmon fishing in marine waters, $58/day
- Other fishing in marine waters, $60/day
- Shellfish harvesting, $43/day
- Trout fishing, $50/day

- Salmon/steelhead fishing in freshwaters, $58/day
- Other coldwater fishing in freshwaters, $45/day
- Warmwater fishing, $30/day

Based on these per day values and on the number of angler days reported in ***Table 8***, net economic values for sport fishing in Washington State are estimated at $462.0 million in 2006, including $380.2 million for freshwater fishing and $81.8 million for saltwater fishing. At $145.9 million, fishing for trout generates the greatest amount of net economic values, followed by salmon (both saltwater and freshwater) at $129.4 million, steelhead at $51.3 million, and black bass at $39.4 million.

**Economic Impacts**

The economic impacts generated by sport fishing activity can be traced from anglers who purchase goods and services, to the creation of statewide jobs and earnings that are supported by these purchases. Anglers purchase gasoline and food, stay at motels and campgrounds, and purchase other goods and services in communities throughout the state. This spending directly supports jobs and generates earnings in fishing-related sectors, and indirectly generates jobs and earnings in many other sectors of the economy as the directly-affected businesses and their employees spend in the local economy. In effect, angler purchases result in three types of economic impacts on regional and the state economy:

- Direct impacts: the first round effect of angler-related spending (e.g., increase in food sales, income to food store owners, wages paid to store employees).
- Indirect impacts: the ripple effect of additional rounds of re-spending of the initial angler-related expenditures (i.e., the effects of purchases of additional goods and services by other firms in sectors supplying goods and services to food stores, such as food wholesalers and transporters).
- Induced impacts: further ripple effects generated by employees in directly and indirectly affected businesses spending some of their wages in other businesses (i.e., food store employees spend part of their wages in local businesses whose owners and employees also spend in the local area).

Together, these three effects constitute the total impact on sales, employment and income resulting from angler spending. The magnitude and location of the impacts are affected by the number of anglers, amount of spending, and where anglers make their purchases.

In 2006, anglers accounted for more than 9 million angler days in the state and generated an estimated $355 million in trip-related spending and $549 million in equipment expenditures. Direct impacts of this spending on the state economy include supporting an estimated 7,950 jobs and $165.7 million in personal income (***Table 10***). Accounting for the multiplier effect (indirect and induced impacts) increases the total statewide number of jobs to 12,850 and $392.9 million in personal income. Business sectors substantially affected by angler spending include food and lodging (1,383 direct jobs supported), transportation (304 direct jobs supported), sporting goods (4,961 direct jobs supported), recreation equipment rental (92 direct jobs supported), and recreation services (1,149 direct jobs supported).

Because spending by non-resident anglers is part of the tourism industry in Washington State, it is important to highlight the impact that angler spending by non-resident visitors have on the state economy. As shown in ***Table 10***, spending by non-resident anglers directly support 509 jobs statewide and indirectly support an additional 374 jobs through the multiplier effect. Spending by non-resident anglers also directly generates $13.1 million and indirectly generates an additional $17.4 million in personal income for persons working in recreation-related sectors.

Table 10. Estimated economic impacts of sport fishing in Washington waters in 2006

| ANGLER CATEGORY/ SECTOR | JOBS[1] | | | PERSONAL INCOME[2] | | |
|---|---|---|---|---|---|---|
| | DIRECT JOBS[3] | TOTAL JOBS[3] | PERCENT OF TOTAL | DIRECT INCOME[3] | TOTAL INCOME[3] | PERCENT OF TOTAL |
| **Resident Anglers** | | | | | | |
| Food & Lodging[4] | 1,227 | 1,600 | 14% | $28,838 | $37,183 | 11% |
| Transportation[5] | 247 | 284 | 2% | $9,707 | $11,335 | 3% |
| Sporting goods[6] | 4,217 | 4,241 | 38% | $75,641 | $76,079 | 22% |
| Recreation equipment rental[7] | 79 | 84 | 1% | $2,464 | $2,620 | 1% |
| Recreation services[8] | 1,152 | 1,178 | 10% | $28,224 | $28,846 | 8% |
| Other sectors[9] | 38 | 3,896 | 35% | $830 | $190,019 | 55% |
| ***Total*** | ***6,960*** | ***11,283*** | ***100%*** | ***$145,704*** | ***$346,082*** | ***100%*** |
| **Non-Resident Anglers:** | | | | | | |
| Food & Lodging[4] | 159 | 193 | 22% | $3,960 | $4,713 | 15% |
| Transportation[5] | 75 | 79 | 9% | $3,473 | $3,621 | 12% |
| Sporting goods[6] | 178 | 180 | 20% | $3,189 | $3,227 | 11% |
| Recreation equipment rental[7] | 18 | 18 | 2% | $551 | $365 | 1% |
| Recreation services[8] | 77 | 80 | 9% | $1,894 | $1,948 | 6% |
| Other sectors[9] | 2 | 333 | 38% | $49 | $16,670 | 55% |
| ***Total*** | ***509*** | ***883*** | ***100%*** | ***$13,116*** | ***$30,544*** | ***100%*** |
| **All Anglers:** | | | | | | |
| Food & Lodging[4] | 1,383 | 1,807 | 14% | $32,499 | $41,968 | 11% |
| Transportation[5] | 304 | 346 | 3% | $11,959 | $13,806 | 4% |
| Sporting goods[6] | 4,961 | 4,989 | 39% | $88,989 | $89,486 | 23% |
| Recreation equipment rental[7] | 92 | 98 | 1% | $2,861 | $3,036 | 1% |
| Recreation services[8] | 1,149 | 1,178 | 9% | $28,156 | $28,862 | 7% |
| Other sectors[9] | 61 | 4,432 | 34% | $1,237 | $215,738 | 54% |
| ***Total*** | ***7,950*** | ***12,850*** | ***100%*** | ***$165,701*** | ***$392,896*** | ***100%*** |

Notes:

[1] Represents the number of full- and part-time jobs.

[2] Represents employee compensation and proprietors income in thousands of 2006 dollars.

[3] Values for All Anglers do not equal the sum of values from Resident Anglers and Non-Resident Anglers because these values were derived from different samples.

[4] Represents employment and income generated by visitor trip spending in food stores, eating and drinking places, and hotels, motels, and other businesses providing accommodations.

[5] Represents employment and income generated by visitor trip spending on airfare, public transportation, and private transportation.

[6] Represents employment and income generated by visitor spending during and apart from fishing trips on fishing equipment (e.g., bait, tackle, rods and reels) in sporting goods stores.

[7] Represents employment and income generated by visitor trip spending on rental of recreation equipment.

[8] Represents employment and income generated by visitor trip spending on recreation services (e.g., boat launching and mooring, guides).

[9] Represents employment and income directly and indirectly generated in all other sectors of the Washington state economy.

Source: IMPLAN model runs using trip and equipment expenditures estimates for fishing in Washington in 2006 by resident and non-resident anglers as inputs.

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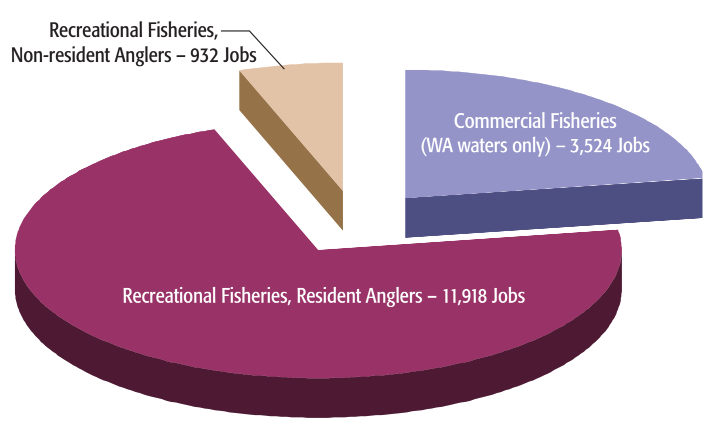
# *ECONOMIC IMPORTANCE OF COMMERCIAL AND RECREATIONAL FISHERIES IN WASHINGTON*

This study evaluated the economic values and impacts of commercial and recreational fisheries in Washington State. Although the estimates of these measures are conceptually consistent for the two fisheries, comparing the results between the fisheries is not appropriate for several reasons. In the case of net economic values, some components were not quantified, such as surplus values to consumers associated with the commercial harvest or non-use values. In the case of economic impacts, the impacts associated with the spending by state resident anglers, which comprise more than 90 percent of the total recreational effects, are fundamentally different in terms of contribution to the state economy from the effects generated by non-resident recreational anglers and by commercial fishers. Overall, the study is not sufficiently comprehensive and the values are not estimated with adequate precision to warrant a comparative analysis of the two fisheries.

As described in Sections 2 and 3, commercial and recreational fishing activity in Washington waters directly and secondarily supported an estimated 16,374 jobs and $540.0 million in personal income in 2006. As shown in ***Figure 2***, recreational fishing generated an estimated 12,850 jobs of which spending by resident anglers supported 11,918 jobs and non-resident spending supported 932 jobs. Commercial fishing and processing

Figure 2. Statewide jobs supported by commercial and recreational fisheries in 2006



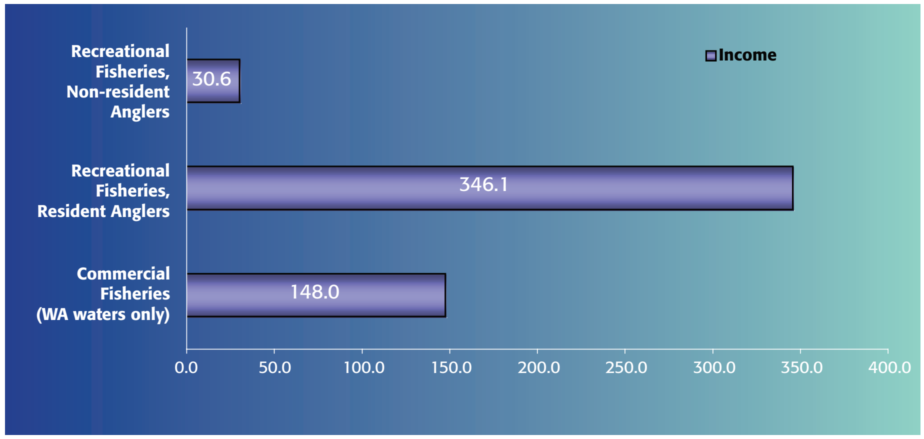
in Washington waters generated an estimated 3,524 jobs in 2006.

When viewed in the context of the Washington State economy, the total levels of employment and earnings accounted for about 0.4 percent of total statewide employment and about 0.2 percent of total statewide personal income in 2006. Unlike spending by non-resident anglers that contributes to the tourism economy, spending by resident anglers serves to direct discretionary consumer spending towards fishing-related goods and services. When the spending and associated economic effects generated by resident angler spending are excluded, commercial and non-resident recreational fishing accounts for about 0.1 percent of statewide employment and less than 0.1 percent of statewide personal income.

Although the contribution of Washington's commercial and recreational fisheries to the overall state economy is relatively small, the contributions to individual sectors of the state's economy are more important. Spending by recreational anglers generates important economic contributions to several key sectors of the state's economy, including an estimated 0.6 percent of statewide jobs in the food and lodging sector, 0.9 percent of the jobs in the transportation sector, 21.7 percent of the jobs in the sporting goods retailing sector, and 4.7 percent of the jobs in the amusement and recreation services sector.

In terms of the contribution that Washington commercial fisheries made to the state economy, it should be emphasized that this study focuses on the commercial fisheries in Washington waters. Other components of the commercial fishing industry in Washington include harvesting by western Washington tribes; fish harvesting in distant waters including Alaska, Oregon and Canada; and aquaculture operations.

Figure 3. Statewide income generated by commercial and recreational fisheries in 2006 (in millions of dollars)




The value of commercial landings from Washington waters only totaled $65.1 million, which accounts for about 22 percent of the total jobs and 15 percent of the total personal income in the state's overall commercial fishing and seafood processing sector. As reported by TRG (2008), the 2006 harvest value for three prominent commercial fisheries not included in this study are:

- ***West Coast offshore Pacific whiting fishery.*** This fishery is prosecuted by motherships, catcher vessels, and catcher-processor vessels that home-port in Puget Sound localities. The offshore catch areas for this fishery extends from the U.S.–Canada border to north of San Francisco. The estimated harvest value by the 11 catcher vessels that hail from Washington ports was $2.9 million in 2006. The estimated harvest value by the nine catcher-processors that hail from Washington ports was $8.9 million.
- ***Oregon Coast catch area.*** Species harvested south of the Washington-Oregon land boundary but delivered to Washington ports include albacore tuna ($11.4 million), Dungeness crab ($2.5 million), sablefish ($1.2 million) Pacific whiting ($1.0 million), and pink shrimp ($0.5 million).
- ***Alaska and other non-West Coast mainland waters.*** These fisheries include a predominant Pacific halibut fishery, in which the landing value of harvests in 2006 was $6.2 million, representing 74 percent of

all Pacific halibut delivered in Washington in 2006.

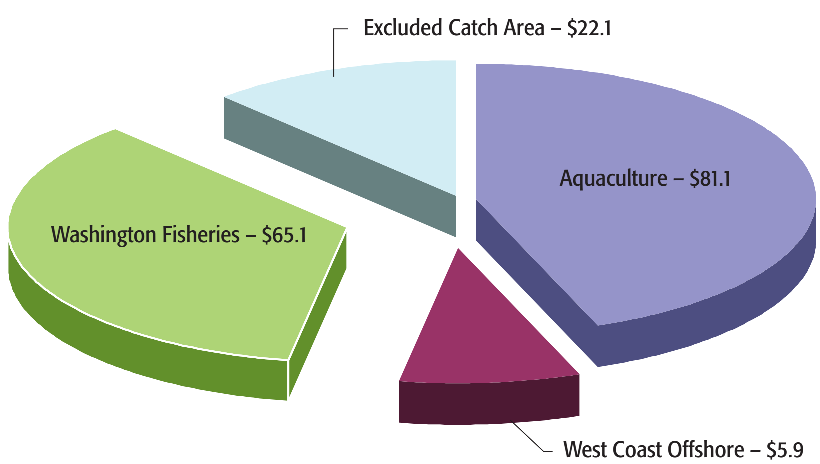
Additionally, aquaculture accounted for $81.1 million of commercial harvest value.

Spending by resident and non-resident anglers in Washington is part of a billion dollar sport fishing industry in Washington State that supports a network of retail and wholesale businesses. In 2006, anglers spent an estimated $550 million on fishing equipment and made about $355 million in trip-related costs. Spending by non-resident anglers (estimated at $63.1 million in 2006) is part of an important tourism industry in Washington that has been valued at nearly $14 billion in 2006 (Dean Runyan Associates).

In addition to commercial and recreational angler spending, fishing-related expenditures also are made annually by governmental and non-governmental agencies for education, research, management, and enforcement of the fishing industries.

Lastly, it must be recognized that, in addition to the employment and personal income contributions to the regional and state economy, these fisheries contribute in other important ways to Washington's economy and the quality of life of its residents. The commercial fishery in Washington waters contributes an estimated $38 million in net economic values (net income) to commercial fishers, allowing them to participate in a livelihood that has been passed down from generation to generation. Additionally, sport fishing opportunities generate an estimated $424 million in net economic values (surplus value over and above expenditures) to the estimated 725,000 resident anglers in Washington. And finally, the working waterfronts that serve both Washington and distant water fisheries are an integral part of many communities. These waterfronts attract visitors wanting to experience and see lively commerce activities in a backdrop of expansive harbor views. Although this economic study is more narrowly focused on the economic values to commercial fishers and sport anglers, the broader social and economic values supported by the commercial and recreational fisheries must be acknowledged.

Figure 4. Harvest value from Washington fisheries and other commercial landings in 2006 (in millions of dollars)



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# *NET ECONOMIC VALUES FOR RECREATIONAL FISHING*

[Note: Much of the material in this appendix is drawn from a report prepared by the U.S. FWS (2003) that describes results from a special contingent valuation study as part of the 2001 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation.]

In 2006, an estimated 824,000 anglers fished in Washington State. These anglers spent $349.9 million on trips to participate in sport fishing. Expenditures are a useful indicator of the importance of sport fishing activities to local, regional, and national economies. However, they do not measure the economic benefit to either the individual participant or, when aggregated, to society.

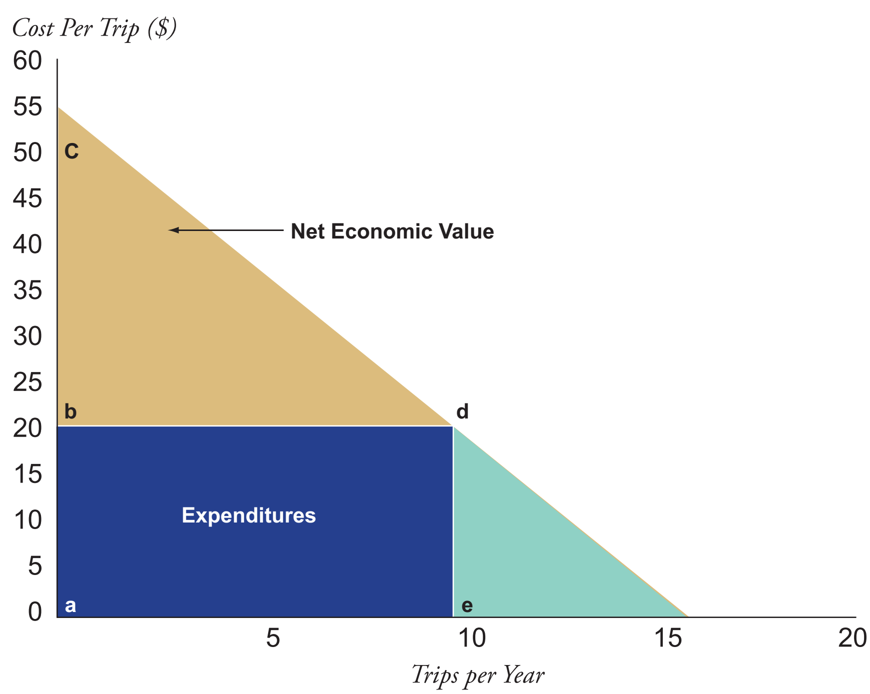
Net economic values associated with sport fishing include values that recreational fisheries generate for both consumers (anglers) and producers of goods and services that sell to anglers. Net economic value to consumers is measured by the dollar amount that anglers would be willing to pay over and above what they actually pay to participate in sport fishing. Net economic value to producers (e.g., charter boat operators, guides, and other sport fishing-related businesses) is measured by the net income (or profit) generated by sales to recreational anglers.

For this study, only net economic values to consumers (sport anglers) are evaluated. It is assumed that the net income to producers would occur elsewhere in the economy if anglers changed their spending behavior. For example, if sport anglers no longer have opportunities to sport fish for salmon in Puget Sound, the net income to sport fishery-related producers associated with the reduction in angler spending would shift to producers of other goods and services as anglers shift their spending patterns. Consequently, there would be no net change in net income from a state perspective.

Expenditures and net economic values are two widely used but distinctly different measures of the economic value of recreational fisheries. Net willingness to pay, or "consumer surplus," is the accepted measure of economic value for a wide range of analyses that seek to quantify benefits and costs. The total benefit to anglers is the summation of willingness to pay across all fishing participants.

There is a direct relationship between expenditures and net economic value, as shown in ***Figure A-1***. A demand curve for a representative angler is shown in the figure. An individual angler's demand curve provides the number of trips that the angler would take per year at different trip costs. The downward sloping demand curve represents the angler's marginal willingness to pay per trip and indicates that each additional trip is valued less by the angler than the preceding trip. All other factors

Figure A-1. Individual angler's demand curve for fishing Trips



being equal, the lower the cost per trip (vertical axis) the more trips the angler will take (horizontal axis). The cost of an angling trip serves as an implicit price for fishing because a market price generally does not exist for this activity. At $60 per trip, the angler would choose not to fish, but if fishing trips were free, the angler would take 16 fishing trips. At a cost per trip of $20, the angler takes 10 trips, with a total willingness to pay $375 ***(area acde in Figure A-1)***.

Total willingness to pay is the total value that the angler places on participation. The angler will not take more than 10 trips because the cost per trip ($20) exceeds what he would pay for an additional trip. For each trip between zero and 10, however, the angler would actually have been willing to pay more than $20 (the demand curve, showing marginal willingness to pay, lies above $20). The difference between what the angler is willing to pay and what is actually paid is the net economic value.

In this simple example, therefore, net economic value is $175 [($55 – $20) × 10 ÷ 2)] (triangle *bcd* in ***Figure A-1***) and angler expenditures are $200 ($20 × 10) (rectangle *abde* in ***Figure A-1***). Thus, the angler's total willingness to pay is composed of net economic value and total expenditures. Net economic value is simply total willingness to pay minus expenditures. The relationship between net economic value and expenditures is the basis for asserting that net economic value is an appropriate measure of the benefit an individual derives from participation in an activity and that expenditures are not the appropriate benefit measure. Expenditures are out-of-pocket expenses on items an angler purchases in order to fish. The remaining value, net willingness to pay (net economic value), is the economic measure of an individual's satisfaction after all costs of participation have been paid.

For this study, net economic values to sport anglers is estimated based on the findings of previous studies focused on estimating net economic values for different sport fishing activities. These values are summarized in ***Table A-1***, with specific values used to estimate the value of freshwater and saltwater fishing for different species highlighted. All values in ***Table A-1*** are presented in 2006 values. In addition to the values reported in ***Table A-1***, net economic values for trout fishing ($50/angler day) were derived from the U.S. FWS's special report (2003) cited at the beginning of this appendix. The per-day values used to estimate the net economic values for sport fishing were as follows:

- Salmon fishing in marine waters, $58/day
- Other fishing in marine waters, $60/day
- Shellfish harvesting, $43/day
- Trout fishing, $50/day
- Salmon/steelhead fishing in freshwaters, $58/day
- Other coldwater fishing in freshwaters, $45/day
- Warmwater fishing, $30/day

These per day values were applied to the number of angler days to derive estimates of total net economic values for all anglers in Washington State.

Table A-1. Net economic values for sport fishing, by type of fishing and region

| Species Category | N | NORTHEAST | N | SOUTHEAST | N | INTERMOUNTAIN | N | PACIFIC | N | ALASKA | N | NATIONAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | |
| **Cold Water** | 58 | | 20 | | 116 | | 13 | | 4 | | 3 | |
| Min | | $3.75 | | $19.48 | | $6.62 | | $2.56 | | $2.56 | | $30.28 |
| Max | | $149.57 | | $117.05 | | $420.57 | | $194.41 | | $96.28 | | $53.85 |
| Average | | $39.54 | | $51.25 | | $62.54 | | $54.10 | | $53.90 | | $38.53 |
| Median | | $27.04 | | $51.19 | | $47.22 | | $45.31 | | $58.37 | | $31.47 |
| | | | | | | | | | | | | |
| **Warm Water** | 119 | | 63 | | 38 | | 3 | | | | 7 | |
| Min | | $0.48 | | $3.84 | | $13.05 | | $14.91 | | | | $19.34 |
| Max | | $176.10 | | $254.30 | | $129.56 | | $41.01 | | | | $115.59 |
| Average | | $42.87 | | $54.37 | | $45.55 | | $28.59 | | | | $55.59 |
| Median | | $27.18 | | $47.13 | | $32.84 | | $29.83 | | | | $55.93 |
| | | | | | | | | | | | | |
| **Coastal** | 11 | | 34 | | | | 24 | | | | 9 | |
| Min | | $2.41 | | $3.36 | | | | $5.80 | | | | $9.14 |
| Max | | $215.16 | | $990.22 | | | | $533.72 | | | | $272.19 |
| Average | | $68.47 | | $144.74 | | | | $140.09 | | | | $73.70 |
| Median | | $7.34 | | $73.32 | | | | $102.10 | | | | $59.66 |
| | | | | | | | | | | | | |
| **Anadromous** | 33 | | 1 | | 16 | | 27 | | 18 | | 3 | |
| Min | | $0.35 | | $138.22 | | $15.11 | | $19.31 | | $20.73 | | $41.62 |
| Max | | $149.61 | | $138.22 | | $85.00 | | $287.33 | | $84.40 | | $190.16 |
| Average | | $39.41 | | $138.22 | | $51.20 | | $65.61 | | $40.76 | | $103.36 |
| Median | | $4.69 | | $138.22 | | $49.21 | | $57.92 | | $38.90 | | $78.30 |
| | | | | | | | | | | | | |
| **Mixed** | 30 | | 1 | | 16 | | | | 16 | | | |
| Min | | $0.71 | | $134.24 | | $26.77 | | | | $55.96 | | |
| Max | | $61.91 | | $134.24 | | $217.71 | | | | $328.96 | | |
| Average | | $20.08 | | $134.24 | | $59.28 | | | | $213.13 | | |
| Median | | $18.32 | | $134.24 | | $36.18 | | | | $206.87 | | |
| | | | | | | | | | | | | |
| **Not Specified** | 112 | | 16 | | 48 | | 14 | | 2 | | 1 | |
| Min | | $4.51 | | $3.46 | | $11.28 | | $1.74 | | $85.18 | | $67.12 |
| Max | | $390.45 | | $474.77 | | $312.71 | | $119.87 | | $105.94 | | $67.12 |
| Average | | $49.66 | | $93.47 | | $77.31 | | $39.10 | | $95.56 | | $67.12 |
| Median | | $36.01 | | $34.20 | | $62.70 | | $43.12 | | $95.56 | | $67.12 |

Note:
All values presented in the table have been converted to a 2006 base year.

Source: Derived from Boyle et. al 1997

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# Appendix B

# ANALYZING THE ECONOMIC IMPACTS OF COMMERCIAL AND RECREATIONAL FISHERIES

Input-output analysis was used to analyze the economic impacts of the commercial and recreational fisheries. This appendix describes the models, data, and underlying assumptions used in these analyses. The description of the analytical methods for commercial fisheries, including estimating net income values, is mostly based on information provided by The Research Group (2008) for this study.

Input-output analysis is a means of examining relationships within an economy, both between businesses and between businesses and final consumers. It captures all monetary market transactions for consumption in a given period. The primary input variable for input-output analysis is the dollar value of purchases of products or services for final use (i.e., final demand), which drive input-output models. Industries respond to meet demands directly by supplying goods or indirectly by supplying goods and services to industries responding directly to final demand changes. The primary output variables are predicted estimates in direct, indirect, and induced employment and income for the affected industries within a study area. (Minnesota IMPLAN Group 2000).

## Commercial Fisheries Analysis

For analyzing the economic impacts of the commercial fisheries, the Fishery Economic Assessment Model (FEAM) was used. FEAM generates measures of regional economic impacts (REI) measured by personal income and measures of commercial harvesting and primary processing business profitability[1]. The REIs are the result of the fishing industry business spending within the defined region. The spending is payments to labor and for other costs associated with prosecuting fisheries, processing a product and readying it for distribution, and the capital costs for vessels and processing plants. The defined region for this study is the state of Washington. The FEAM uses economic input-output relationships to multiply the fishing industry spending through all businesses and households that are touched by the direct (first round spending by the fishing industry), indirect (spending by suppliers to the fishing industry), and induced (re-spending by households that have received money through wages or proprietor income) effects from the fishing industry[2]. Because the FEAM results are payments to labor for all sectors of the economy, a calculation of jobs (both full-time and part-time) can be developed using the region's average wage and proprietorship income.

For this study, FEAM is useful because it provides factors for the REI and net income value (NEV) producer measures per harvest pound. NEV is a social welfare quantity that is a gauge of the amount of wealth generated to the nation from the fishing industry activity. These factors are specific to vessel and processor stratifications. For example, a vessel stratification includes the many species caught using certain gear types by a vessel that is predominantly engaged as a crabber vessel, and a processor stratification includes seafood product types (such as fresh and picked crab) produced from those harvests.

The FEAM is a matrix that marries the many vessel and processor stratifications that are found in the Washington fishing industry. The matrix is static. Changes that might occur from different market conditions, such as the price paid to harvesters or

1. The FEAM was developed by William Jensen and Hans D. Radtke for Alaska and U.S. West Coast. The model has been updated many times and is currently used by the Pacific Fishery Management Council (PFMC) for preparation of fishery management plans. An economic theory description of the FEAM can be found in Seung and Waters (2005).

2. The I/O model used in the FEAM is the IMpact Analysis for PLANning (IMPLAN) model offered by the Minnesota IMPLAN Group Inc., St. Paul, Minnesota.

prices received by processors for certain products, are not reflected in the matrix. In this study, the incremental factors are being applied to only a small portion of the commercial fishing industry in the state (i.e., harvest from Washington waters only).

The measures of business profitability (business net income) are itemized for a suite of vessel and processor types. The profitability and other variable and fixed costs from the business types can be used to estimate NEV. The total dimension of NEV includes consumer seafood value and the revenue created from the fishing and processing activity minus costs to undertake the activity and minus opportunity cost of the resources employed (i.e., what if something else were done with those resources instead of the activity?). The consumer seafood value is the difference in what a consumer would pay for seafood less what is actually paid for the seafood provided from the activity. It is a measure of net willingness-to-pay (WTP) and is sometimes called consumer surplus; as such, it is a conceptual value that can only be found through consumer surveys.

The difference between the fishing industry revenues raised and actual and opportunity costs is sometimes called producer surplus. The estimation of opportunity costs in the producer surplus equation is difficult because it also requires surveying industry participants. It is another measure that is acknowledged, but usually either is borrowed and adapted from other studies or omitted from the calculation.

In FEAM, the fishery sectors exist at a level of stratification that is appropriate for predicting the economic impacts coming from a change in landings of a particular species, changes in landings by a specific vessel type, or landings at a particular port area. FEAM is a production-oriented model which is able to estimate the impacts of changes in harvesting sectors. The FEAM consists of two submodels. The first submodel calculates revenues and expenditures of harvesting and processing industries. The second submodel is the IMPLAN model. The regional economic impacts are calculated by multiplying revenues and expenditures by the multipliers in the IMPLAN model. In FEAM, the harvesting sector is disaggregated by type of vessels, and the processing sector by type of processors. For each of the harvesting and processing subsectors, FEAM provides data on output by species, value added components, and use of intermediate inputs. Value added components include labor income (crew share, processing workers' income, and administrative salaries), capital income (operating income), and indirect business taxes (fish taxes and business/property taxes).

In FEAM, harvesters and processors purchase primary inputs (labor and capital) and intermediate inputs. The intermediate inputs include vessel/engine repair, fuel and supplies, insurance, and other goods and services. Processors also purchase fish from the harvesting sector. Revenues from both the harvesting and processing sectors are then allocated to (i) expenditures on intermediate inputs, (ii) labor income (crew shares, income to processing workers, and administrative workers), and (iii) capital income (operating income, income to owners of vessels and processing facilities). The expenditure on intermediate inputs can be divided into different variable and fixed expenditure categories such as vessel/engine repair, fuel and lubricants, supplies, insurance, and other goods and services.

The multiplier for each expenditure category is calculated as the weighted average of the IMPLAN multipliers for the corresponding sector(s). The weight is calculated as the ratio of the amount of the expenditure allocated to a given IMPLAN sector to the total expenditure in the category. The multipliers for these expenditure categories thus calculated are used to estimate changes in regional income from a change in fishery sectors' output level. Similarly, household income (expenditure), consisting of labor income and capital income, can be allocated to IMPLAN sectors. The multiplier for household income (expenditure) is calculated as the weighted average of the IMPLAN multipliers for the corresponding sector(s).

It is important to note that the REI measure for the small portion of the fishing industry activity being assessed should be considered an economic contribution within the overall effects from the fishing industry. It is an annualized estimate for conditions as they occurred in the year 2006. If the activity were for some reason taken away, it may be there would be adjustments that would ameliorate the loss one way or another and show a different impact. For these reasons, the REI estimates shown here have fairly qualified use as a comparison to the fishing industry in other points in time.

The FEAM version being used to develop the REI and NEV is described in greater detail in Davis (2003). This FEAM version was populated using the particular year 2006 harvests that are included in this study. The harvest data are from PacFIN downloads[3]. Those particular harvests represent about one-quarter of the ex-vessel revenues generated by the vessels in Washington's fishing fleet that make West Coast offshore and onshore deliveries. The spending that occurs in the Washington economy from these particular harvests is about five to six percent of the total fishing industry spending when Alaska and other distant water fisheries and private aquaculture are included. Washington's total fishing industry economic contributions from West Coast fisheries in 2004 is described in TRG (2006). The distant water fisheries effects are discussed in NRC (1986 and 1999) and more recently TRG (2007).

A summary list of assumptions used to generate the commercial REI and NEV estimates are as follows:

- Only harvesting and primary processing effects are assessed. Processed products can enter seafood distribution channels that can generate additional economic effects in Washington's economy. Management, enforcement, and research activity is not included in the economic effects measurements.
- The economic effects are a contribution measure that may have substitutes if the included fisheries are taken away. Harvesters might be able to pursue other West Coast or distant water fisheries and processors may have access to other catches. The substitutes may have different industry input-output and export-import relationships, and therefore, the effect on the economy of the substituted activities may be different.
- The economic effects are static and not necessarily linear. That is, if the included fisheries are more or less than shown, the proportional difference in REI and NEV may be different. The model does not include industry behavior dimensions, such as would undoubtedly occur if there was a shift in prices received for seafood products or prices paid to harvesters.
- The total value of seafood products associated with the included fisheries is based solely on what the seafood actually sells for. In other words, the difference in what a consumer would be willing to pay and actually pays is assumed to be zero.
- Those that work in commercial harvesting and processing businesses are motivated by the enjoyment of their careers and do not compare their participation with other employment prospects. Moreover, the harvesting and processing businesses do not necessarily have other profit making opportunities. Therefore, the opportunity costs from participating in the harvesting and processing of the included fisheries are assumed to be zero
- The economic effects from the movement of fish resources between commercial and recreational user groups cannot be assessed with the modeled estimates. Showing economic benefits from changes in allocations would require close examination of spending on a per unit basis and in aggregate before any conclusions could be reached.
- The calculation of NEV included a portion of fixed costs and labor costs that were not discounted. If other assumptions were made about

3. The Pacific Coast Fisheries Information Network (PacFIN) is a database program sponsored by the PSMFC. West Coast states, British Columbia, and Alaska fish ticket information is regularly uploaded to a central database. The database assists fish management and enforcement for federally managed fisheries. It also assists in fish resource research and investigations. Additional information is available at: http://www.psmfc.org.

alternative uses of capital and/or there were alternative employment opportunities, NEV might be significantly lower than the estimates shown.

- Only commercial REI and NEV "use" benefits are calculated. There may be other non-use and non-market benefits associated with commercial fisheries that would be additive to the use benefits. For example, there may be tourists who are drawn to working waterfronts, and their spending may generate economic contributions and add to economic wealth. There may be (positive or negative) passive use values associated with commercial harvests that should be taken into account in the NEV calculation. Passive use values are associated with people wanting the fish resource to exist but who may not actually use the resource.

## Recreational Fisheries Analysis

The analysis of economic impacts of the recreational fisheries was conducted using the IMPLAN economic input-output model and the 2006 data set for Washington State. IMPLAN (Impact Analysis for PLANning) is a computer-driven input-output model originally developed by the USDA Forest Service in cooperation with the Federal Emergency Management Agency and the USDI Bureau of Land Management to assist the Forest Service in land and resource management planning. The IMPLAN system has been in use since 1979, evolving from a mainframe, non-interactive application to a menu-driven microcomputer program that is completely interactive. (Minnesota IMPLAN Group 2000)

The IMPLAN system comprises two components: the software and the database. The software performs the necessary calculations, using study area data, to create regional and state input-output models. The databases, which are available at the county and zip code area level, and which are periodically revised using updated socioeconomic data, provide all the information needed to create the IMPLAN models. The primary input variables needed to conduct an impact analysis using IMPLAN are estimates of final demand for products or services.

For evaluating the economic impacts of recreational fisheries in Washington State, angler spending identified in ***Table 10*** was first disaggregated to appropriate expenditure categories based on spending profiles identified in Southwick Associates 2007. These results were then inputted to corresponding sectors in the IMPLAN model. The following IMPLAN sectors, with types of expenditures imputted to them, were used for the IMPLAN model runs:

- Food and beverage stores (used for food expenditures)
- Food services and drinking places (used for food expenditures)
- Hotels and motels—including casino hotels (used for lodging expenditures)
- Air transportation (used for airfare transportation expenditures)
- State and local government passenger transit (used for public transportation expenditures)
- Gasoline stations (used for private transportation expenditures)
- Sporting goods, hobby, books, and music stores (used for fishing and recreation equipment expenditures)
- General and consumer goods rental (used for equipment rental expenditures)
- Other amusement, gambling, and recreational industries (used for boat launching, mooring, guides, and land use fee expenditures)
- Other sectors: all other sectors of the Washington State economy

Recreational spending estimates were inputted into the IMPLAN model separately for expenditures made by all anglers, by resident anglers, and by non-resident anglers. The output of the modeling runs included estimates of direct, indirect, and induced levels of employment and personal income at the state level.

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