Appendix D
DESCRIPTION OF THE INPUT-OUTPUT MODEL FOR PACIFIC COAST FISHERIES (IOPAC)

2011-2012 GROUNDFISH HARVEST SPECIFICATIONS
DRAFT ENVIRONMENTAL IMPACT STATEMENT

Document Version III (Draft)

October, 2009

Prepared by

Jerry Leonard
NOAA Fisheries
Northwest Fisheries Science Center
Seattle, WA
jerry.leonard@noaa.gov

and

Phil Watson
Dept. of Agricultural Economics and Rural Sociology
University of Idaho
Moscow, ID
pwatson@uidaho.edu

Table of Contents

Tables

Figures

Acknowledgements

There are numerous individuals to thank for their contributions to this effort. We would like to thank the following.

Brad Stenberg, PacFIN, who supplied fish ticket landings data and consultations about PacFIN related data issues.

Dave Colpo, Pacific States Marine Fisheries Commission, who provided guidance on PacFIN data and landings taxes.

Doreen Hansen, Natural Resources Economist, who provided information about the proportion of groundfish landings made directly to the public in CA.

Greg Konkel, Washington Department of Fish and Wildlife, who provided insight into tribal landings WA.

Lee Hoines, Washington Department of Fish and Wildlife, who provided knowledge of commercial fishing in WA.

Marlene Bellman, Pacific States Marine Fisheries Commission, who provided guidance with PacFIN data and constructed maps.

Michelle Grooms, Oregon Department of Fish and Wildlife, who provided insight and data regarding landing fees and knowledge of commercial fishing in OR.

Natalia Smagina, Jason Sayer, Julie Hoke, and Beth Leech of the Washington Department of Revenue for insight and data regarding the Enhanced Food Fish Tax.

Scott Steinback, NMFS, Northeast Fisheries Science Center, who provided invaluable advice on how to construct a fisheries specific IO model using IMPLAN.

Steve Freese, NMFS, who provided project insight into federal excise taxes.

Terry Tillman and Gerry Kobylinski, California Department of Fish and Game, who provided insight into landings taxes and knowledge of commercial fishing in CA.

Personnel at numerous harbors who supplied moorage rates: Kevin Rockwell (Oxnard CA), Anita Yao (San Francisco CA), Don Ashley (Long Beach, CA), Lori Strong (Los Angeles, CA), Jere Kleinbach (Ft. Bragg, CA), Bridget Kurz (Sonoma County, CA), Mick Kronman (Santa Barbara, CA), Harry Jones (San Diego, CA), and Cheryl Charitar (Coos Bay, OR)

Executive Summary

(July 13, 2010)

The Input-Output model for Pacific Coast Fisheries (IO-PAC) is designed to estimate the gross changes in economic contributions and net economic impacts resulting from policy, environmental, or other changes that affect fishery harvest. This is a brief description of the data used, assumptions made, and construction of the IO-PAC model. Complete details about the model are contained in the report "*Description of the Input-Output Model for Pacific Coast Fisheries"* that was presented at the Scientific and Statistical Committee of the Pacific Fishery Management Council on November 4, 2009.

IO-PAC was built by customizing the IMPLAN regional input-output software to enable its use for commercial fishing. The methodology employed in this model is similar to that used in the Northeast Region Commercial Fishing Input-Output Model developed by Steinback and Thunberg (2006). IO-PAC is designed to estimate the economic effects of changes in fishing harvest for various types of vessels and fish species, over multiple geographic areas along the Pacific Coast. The economic effects can be exhibited as a change in total economic output, income, or employment. Estimates can be calculated for the entire West Coast, the states of Washington, Oregon, and California, and 19 port area regions along the coast.

Data used to develop the fishing sectors were obtained from the Pacific Fisheries Information Network (PacFIN) fish ticket data maintained by the Pacific States Marine Fisheries Commission; the Northwest Fisheries Science Center's (NWFSC's) limited entry fixed gear, limited entry trawl and open access cost earnings survey; moorage rates from 19 ports along the West Coast; and collection statistics for the Washington Enhanced Food Fish Tax. Data included in PacFIN includes fish ticket and vessel registration data that is supplied by California Department of Fish and Game (CDFG), Oregon Department of Fish and Wildlife (ODFW), and Washington Department Fish and Wildlife (WDFW). The 2006 PacFIN fish ticket data, when aggregated into vessel classifications and commodity types, comprise the sales estimates that are included in the model. The default IMPLAN 2006 data is used in IO-PAC for the non-fishing economy of the regions such as the agricultural, manufacturing, trade, and service sectors as well as the various institutions in the region such as households and governments. The NWFSC's cost-earning surveys provide the majority of data necessary to construct the production functions in IO-PAC. The cost-earnings surveys were conducted for the limited-entry trawl, limited-entry fixed gear, and open access fleets. Data for 2004 were used from the limited entry surveys, and data for 2005 were used from the open access survey. Because the cost earnings surveys did not collect data on vessel moorage expenditures, moorage expenditures were estimated using 2009 data on moorage rates from 19 ports along the West Coast. Data on Washington Enhanced Food Fish Tax collections in 2006 were obtained from the Washington Department of Revenue and are used to estimate the flow of fish landings received by seafood wholesalers.

IO-PAC covers the groundfish, salmon, crab, HMS, CPS, lobster, and shrimper commercial fisheries on the West Coast. Commercial fishing vessels are classified by type using the 19 sector scheme developed by Radtke and Davis (2000). Vessels produce 32 unique species/gear outputs in the model. Since vessels that harvest groundfish are captured in all three NWFSC cost-earning surveys, the production functions for these vessels are likely more accurate than those in other fisheries. For this reason, IO-PAC is currently only used to estimate the impacts for the commercial groundfish sector.

There are several planned improvements to IO-PAC. The production functions for the non-groundfish fisheries will be improved through expanded cost earnings surveys. The production functions for the groundfish fisheries will be updated with newer cost earnings data. Recreational fisheries will be added. The product flow assumptions in the model will be updated as better data become available. In addition a

new version of IMPLAN was very recently released and IO-PAC will be updated to use the new IMPLAN.

I. Introduction

When making decisions, federal fishery managers are required to consider the importance of fishery resources to fishing communities. National Standard 8 of the Magnuson-Stevens Fishery Conservation and Management Act (as amended through January 12, 2007) specifies that such considerations utilize economic and social data based upon the best scientific information available to provide for the sustained participation, and to the extent practicable, minimize adverse economic impacts on fishing communities. Policy changes involving fishery harvest affect individuals and businesses directly involved in the fishing industry. These decisions also affect gas stations that supply fuel to fishing vessels, grocery stores that supply provisions to vessel crew members, heath care providers that service communities in which crew families reside, and even teachers whose salary depends partially on sales and property taxes generated by fishing activity. This paper describes a new model developed by the Northwest Fisheries Science Center (NWFSC) to estimate these effects, and therefore provide information about the effects of fishing on regional economies.

The NWFSC's Input-Output model for Pacific Coast Fisheries (IO-PAC) is designed to estimate the gross changes in economic contributions and net economic impacts resulting from policy, environmental, or other changes that affect fishery harvest. The IO-PAC was built by customizing the IMPLAN regional input-output software to enable its use for commercial fishing. The methodology employed in developing this model is similar to that used in the Northeast Fisheries Science Center's Northeast Region Commercial Fishing Input-Output Model (Steinback and Thunberg, 2006).

The IO-PAC model is designed to estimate the economic effects of changes in fishing harvest for many types of vessels and fish species over multiple geographic areas along the Pacific Coast. Commercial fishing vessels are classified by type using the 19 sector scheme developed by Radtke and Davis (2000). Vessels produce 32 unique species/gear outputs in the model. Estimates can be calculated for the entire West Coast, the states of Washington, Oregon, and California, and the ports displayed in Figure D-1.C.

Data used to customize IMPLAN were derived from the Pacific Fisheries Information Network (PacFIN) fish ticket data maintained by the Pacific States Marine Fisheries Commission; the NWFSC's limited entry fixed gear, limited entry trawl and open access surveys; and information obtained from the California Department of Fish and Game, the Oregon Department of Fish and Wildlife, and the Washington Department of Fish and Wildlife. A critical component of IO-PAC is the estimation of unique production functions for each of the 19 vessel classifications included in the model. The NWFSC's cost-earnings surveys were the primary source of information used to estimate these production functions. Because the surveys primarily targeted vessels that had a minimum threshold of groundfish or troll caught salmon landings, the model is likely most accurate for the groundfish-related contribution and impact estimates. However, the surveys provided enough cost-earnings data to build unique production functions for some vessel classification sectors that are not designated as groundfish related. Other vessel classification sectors included in the model did not have sufficient data to estimate unique production functions. For these sectors, a weighted average production function was used. The NWFSC plans to survey these vessel categories in the near future, and the data will be incorporated into the model as it becomes available. In addition, the NWFSC plans to add additional sector (e.g., private recreational and charter recreational) in future versions of the model.

This paper provides an overview of the IO-PAC model's design, explains its operation, and displays the outputs generated by its use. The paper proceeds as follows. Section II, Elements of Input-Output Analysis, summarizes both the procedures used in input-output modeling and the required considerations

for its use in a fishery management setting. Section III, Background Data, presents the data used in building the customized sectors contained in the model. Section IV, IO-PAC Model, describes the model in detail. Section V, Model Construction, discusses the model's incorporation into the default IMPLAN system. Section VI, Impact Estimation, explains the application of the model to generate impact assessments and offers two hypothetical examples. The last section, Discussion, reviews the IO-PAC model, discusses its limitations, and makes suggestions for further improvement.

II. Elements of Input-Output Analysis

When a business or firm expands or contracts, there is a ripple effect through the economy. For example, when fishing vessels increase their landings, they purchase more fuel and increase payments to labor. This new economic activity also generates activity in related businesses that sell to the fishing fleet. The related businesses then buy more inputs and hire more labor. Some of the additional labor income is subsequently spent on goods and services in the community. The change in one industry, therefore, is multiplied throughout the economy following its linkages to other businesses and payments to workers. To capture these effects, it is necessary to use an economic model that contains these linkages. Input-output analysis is a method of modeling relationships among businesses, and between businesses and consumers.

The short discussion of Input-Output (IO) models that follows is by no means exhaustive. More detailed descriptions of Input-Output analysis can be found in Miller and Blair (1985) and Hewings (1985). A survey of IO studies is found in Richardson (1985).

II.A Input-Output Fundamentals

The underpinning of input-output analysis is a double-entry accounting framework that tracks the flow of dollars in the economy. Expenditures and receipts of businesses and households are tracked. The sum of all expenditures made by businesses and households in the economy must equal the sum of all income received. These transactions are expressed in matrix form, and input-output multipliers are derived through the manipulation of this matrix as shown below.

The multipliers in input-output models describe the "backward" linkages among industries. As some exogenous economic event affects an industry under investigation, economic activity is then affected in input supply industries and from changes in personal income. Any economic changes found downstream, "stemming from" effects, must be exogenously incorporated into the model (Watson et. al, 2008).

The multipliers in input-output models are separated into three types of effects.

Direct effects refer to the production changes associated with a variation in final demand for the good itself. It is the initial activity that occurs in the economy, which is exogenous to the model.

Indirect effects refer to secondary activity caused by changing input needs of directly affected industries (e.g., additional input purchases to produce additional output).

Induced effects are caused by changes in household spending due to additional employment generated by direct and indirect effects.

The fundamental equation of input-output analysis is central to understanding multipliers:

$$X = (I-A)^{-1}Y$$

where X is a J x 1 vector of industry outputs, or sales, for each of J sectors, $(I-A)^{-1}$ is collectively referred to as the "Leontief inverse", with I being an JxJ identity matrix, while Y is a J x 1 vector of final demands for all J sectors' production. A is the matrix of technical coefficients, which describes the flow of inputs from sector i to sector j. For a simple two sector economy, the A matrix of inter-industry linkages would look as follows:

$$A = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}$$

with a_{11} showing purchases by Industry 1 from firms in the same sector, while a_{21} represents inputs that Industry 1 buys from Industry 2. The other elements are defined accordingly. (These values are usually reported per dollar of sales. Thus, a_{21}= 0.15 means that for each dollar of sales by Sector 1, Sector 1 would purchase $0.15 worth of inputs from Sector 2). The Leontief inverse of the A matrix is represented as:

$$(I-A)^{-1} = \begin{bmatrix} \alpha_{11} & \alpha_{12} \\ \alpha_{21} & \alpha_{22} \end{bmatrix}$$

The elements in the Leontief inverse matrix represent the total direct and indirect changes in output (measured in dollars) within the row industry resulting from an additional dollar's worth of final demand initiated in the column industry. To calculate an output multiplier for a region, a change in final demand for a given sector is hypothesized, which can come from added spending by consumers, exporters, investors or government. (For simplicity, we calculate the total effect of a one-dollar change in final demand for a given industry.) This is calculated as follows:

$$\Delta X_1 = (I-A)^{-1}\Delta Y_{1j} = \begin{bmatrix} \alpha_{11} \\ \alpha_{21} \end{bmatrix}$$

where ΔX_1 is a vector of changes in total industry output from a one-dollar change in final demand for sector 1, $(I-A)^{-1}$ is the Leontief inverse, and ΔY_{1j} is a column vector that contains a 1 in the first row to show the dollar change in final demand for sector 1, and 0 in all other positions. The result is equal to the first column of the Leontief inverse. The direct effect is α_{11}, while indirect effects relate to the off-diagonal elements, which is α_{21} in this case. The total output multiplier then is the sum of all changes in output that result from the increase in final demand for industry j, and is calculated as follows:

$$O_j = \sum_{i=1}^{n} \alpha_{ij}$$

for all j, where O_j is the output multiplier for industry j, which comes from the column sum of the α_{ij} values in the Leontief inverse.

The are two types of multipliers, Type I and Type II, that differ in what parts of the economy are endogenous in the A matrix. For a Type I multiplier, only inter-industry linkages are included, so, as in the example above, only *direct* effects of the change in final demand for industry j and the *indirect* effects on other sectors are included. The effects that arise as employees receive increased income and spend it

are not included in the Type I multiplier. Thus, the Type I multiplier is defined as: Type I = (Direct effects + Indirect effects) / Direct effects.

Type II multipliers make household spending and wages endogenous. In this case, the modified A matrix is:

$$\overline{A} = \left[\begin{array}{cc:c} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ \hdashline a_{31} & a_{32} & a_{33} \end{array}\right]$$

The new third column adds households as an endogenous sector that purchases products and services from other sectors based on their increased wages that are found in the added third row. (a_{33} shows the hiring of laborers directly by households, which might be a variety of personal services).

The additional spending that occurs in the economy due to new household income is called an induced effect. The direct, indirect, and induced effects together yield a "Type II" multiplier. The Type II multiplier is defined as follows: Type II = (Direct effects + Indirect effects + Induced effects) / Direct effects[1].

II.B IO Model Assumptions

There are several key assumptions of IO models. First, IO models are demand driven and assume that the supply of outputs is unlimited. As a result, an increase in demand is always met by an increase in supply. Second, IO models assume that commodity and factor prices are fixed regardless of any change in demand. Due to these assumptions, IO models tend to overestimate the effects of policy changes (Miller and Blair, 1985). Third, IO models assume zero substitution elasticities in production and consumption. For producers, the technical coefficients (a_{ij}) are fixed. For consumers, the proportion of their total expenditures made on different commodities is fixed. As a result of the fixed factor ratios, IO models are less appropriate for studying economies that are facing factor constraints or changes in production technology (Seung and Waters, 2005).

II.C Study Area Considerations

Selection of the appropriate study area is an important dimension in IO analysis. Generally, larger geographic areas have larger multipliers in an IO model. The level of economic interdependence among entities in lager geographic areas is greater than that in smaller geographic areas. Smaller geographic areas tend to have lower economic diversity and must import a larger portion of goods and services (Miller and Blair, 1985). Consequently, businesses in larger geographic areas likely derive a higher proportion of their inputs from within the area than businesses in smaller geographic areas. Likewise, households in larger geographic areas likely source a higher share of consumed goods and services from within the area than households in smaller geographic areas. Thus, in IO models, the greater the interdependence among entities, the larger the resulting multipliers will be.

While choosing a larger study area will likely produce larger multipliers, it also may reduce the relative importance of a particular industry. The larger the study area the more likely the effects of a change in

[1] Other multipliers, such as SAM multipliers, endogenize additional sectors, such as government expenditure or other institutions.

economic activity will be masked by other activity that is occurring within the area. The relative importance of a particular industry will be diluted (Watson et. al, 2007).

The appropriate size of the analysis region depends heavily on the purpose of the analysis and the particular policy issue that is being addressed. For example, if the question being addressed is how the output from the fishing industry in a small port in Oregon ripples through the Oregon economy, then a state-wide study area is appropriate. However, if the question is how a change in fishing regulations will affect the income of inhabitants of the same small port, then a smaller port-level study area is more appropriate.

II.D Trade Flow Considerations

Location quotients, supply-demand pooling and regional purchase coefficients (RPCs) are the varieties of methods used to estimate trade flows into and out of a study region. The IO-PAC model uses an RPC approach to estimate regional trade flows. Using RPCs is the approach generally suggested by makers of IMPLAN[2]. The RPCs used in the model are generated by IMPLAN software through a series of econometric equations. An RPC for a given commodity indicates the proportion of local demand for the commodity that is met by local production.

II.E Input Output Models in a Fishery Context

There are numerous studies that examine the economic contribution and impacts of recreational and commercial fisheries. Seung and Waters (2006) provided a detailed overview of the use of input output models in a fisheries context.

Steinback (2004) points out an important consideration that input-output models must address before they are appropriate for use in a fishery management context. Input-output models are designed to estimate the backward linked effects of an exogenous change in final demand. However, fishery managers do not control the sale of fishery resources in final markets such as grocery stores, restaurants, etc. Rather, fishery managers control harvest of fishery resources. Management is imposed at the point of production. If the standard input-output framework is not modified to account for this, and changes in production are entered as if they were changes in final demand, the estimates of economic impacts will be overstated.

There are several approaches to handling production changes rather than final demand changes in an input-output framework. The approach in the IO-PAC model is the same as that used by Steinback and Thunberg (2006). The regional purchase coefficients (RPCs) of the directly impacted sectors are set to zero, and then production changes are modeled as if they originated from final demand. This approach permits the utilization of the ready-made input output system IMPLAN. The directly impacted sectors that are added to IMPLAN are all given an RPC of 0 except for the bait supplying sector. The bait sector supplies the commodity of bait to the fish harvesters that are added to the model. No other sector purchases bait in the model. As a result, not setting the RPC to 0 for the bait supplying sector avoids the feedback effect that necessitates the RPCs be set to 0 as discussed in Steinback (2004). By setting the RPCs to 1 for the bait sector, we are assuming that harvesters will purchase 100% of bait from suppliers within the study area. The wholesale seafood trade sector that is added to the model is also assigned an RPC of 0. The default fish processing sector (IMPLAN sector 71) is also assigned an RPC of 0 because it will be modeled as a directly impacted sector in the same manner as the harvesting sectors. The default

[2] See the *IMPLAN Professional Software, Analysis, and Data Guide* available at www.implan.com.

fishing sector in IMPLAN (Sector 16) is also assigned an RPC of 0 to avoid double counting of harvester level impacts when impacts on the seafood processing sector are entered.

II.F IMPLAN

IMPLAN (Impact Analysis for PLANning) is a commercially available data collection and regional modeling system that was developed by the USDA Forest Service with cooperation of the Federal Emergency Management Agency and the USDI Bureau of Land Management for use in land and resource management planning. It has been in use since 1979. The IMPLAN system has appeal due to its widespread use and availability of support literature. Integrating gear and species specific commercial fishing data into the IMPLAN framework permits anyone with knowledge of how to use IMPLAN to assess the impact of fishery specific management actions. Additionally, by using IMPLAN, the interrelationships among the newly created fishing related sectors and other industrial sectors are explicitly detailed.

III. Data

Data for the model come from three primary sources: 1) IMPLAN, 2) PacFIN, and 3) the NWFSC's cost-earnings surveys. In addition to these primary data sources, data on landing tax rates and moorage rates are described at the end of the section.

III.A IMPLAN Data

IMPLAN collects, organizes, and econometrically estimates the data that is necessary to construct regional economic impact models.[3] These data are collectively referred to as the region's "social accounts" and consist of purchases of inputs, labor, and capital by the respective sectors of the economy, the output production of each sector, household demands in the region, sources of income of households in the region, taxes paid and government spending in the region, and the regions imports and exports.

IMPLAN constructs county level social accounts based on a variety of data sources including the U.S. Census Bureau, U.S. Bureau of Economic Analysis (BEA), and ES-202 employment data. The procedure that IMPLAN uses to generate the social accounts consists of two main components. The first is the national make and use transaction tables, and the second is the county specific data on industry output, employment, value added, and final demands. Final demands, in turn, consist of household, government, and export purchases. The national make and use transaction tables are based on the 1997 Benchmark Input-Output study conducted by the BEA.

An absorption table is then created by dividing each of the elements of the use matrix by the respective industry's total output. This yields the percent of each dollar of output spent on intermediate inputs from other sectors. A column, then, represents the industry's production function or the proportion of intermediate inputs used to produce one dollar of output.

The actual industry mix, or the size of each industry in a region, is specific to the study area. IMPLAN uses county specific ES-202 data, county business patterns data from the U.S. Census Bureau, Bureau of Labor Statistics, and BEA's Regional Economic Information System (REIS) data to estimate employment for every sector in the region. Value-added components such as employee compensation, proprietor's income, and other property income are derived from National Income and Product Accounts data from the

[3] See the *IMPLAN Professional Software, Analysis, and Data Guide* available at www.implan.com.

BEA. Estimates of total industry output primarily come from the BEA's output series and from their Annual Survey of Manufactures.

The default IMPLAN 2006 data is used to represent the non-fishing economy of the regions such as the agricultural, manufacturing, trade, and service sectors as well as the various institutions in the region such as household and governments.

III.B PacFIN Data

IO-PAC utilizes 2006 fish ticket data from the Pacific Fisheries Information Network (PacFIN).[4] Data included in PacFIN includes fish ticket and vessel registration data that is supplied by California Department of Fish and Game (CDFG), Oregon Department of Fish and Wildlife (ODFW), and Washington Department Fish and Wildlife (WDFW). Each time a commercial fishing vessel lands fish along the West Coast, it is documented on a fish ticket. For all commercial landings sold to wholesale fish dealers or processors, the fish buyers are required to fill out a fish ticket that describes the species, weight, and total price paid for the fish purchased. It also contains information on the vessel ID of the seller, the gear type used to catch the fish, the date of the transaction, and the port where the fish is landed. If a commercial fishing harvester sells directly to consumers, the harvester is responsible for recording the receipts, filling out fish tickets and remitting the information to the appropriate state agency. Vessel registration information supplied by the states includes some physical characteristics such as length and engine horsepower. For this project, personnel at PacFIN supplied data on pounds landed and revenue received by species, gear type, and port for each vessel that landed more than $1,000 in 2006.

These data, when aggregated into vessel classifications and commodity types, comprise the sales estimates that are included in the model. The vessel classification scheme and commodity types will be discussed further in Section IV. PacFIN contains shoreside landings along the West Coast. There are no landings data for two of the vessel classifications: Alaska Fisheries Vessels and Mothership/Catcher Processors. As a result, the current version of IO-PAC cannot be used for estimating impacts resulting from harvest changes in these sectors.

In addition to landings data, PacFIN data contains vessel physical characteristics and permit information. The physical characteristics that come from vessel registrations include length and engine horsepower. Special endorsements and permit information such as federal limited entry trawl and limited entry fixed gear are also included. The length of the vessel information will be used in the calculation of moorage rates.

There is a PacFIN vessel identification issue that affects some estimates in IO-PAC. Fish ticket data are linked to individual vessels through an identification variable called Derived ID in PacFIN. Derived ID is generated primarily through the use of coast guard and state agency registration numbers. There are some instances when a fish ticket contains a vessel identifier that does not have a valid coast guard or state registration ID. These records are assigned a Derived ID that begins with "ZZZ." In 2006, nine percent of landings by value on the West Coast were attributable to fish tickets with a ZZZ identifier. This percentage is substantially higher when narrowing the scope to WA alone. Fish tickets with a Derived ID beginning with ZZZ are almost entirely tribal fishing vessels in WA. In 2006 91% of fish tickets with ZZZ IDs were from Indian tribal vessels in WA[5].

In a given year the ZZZ identifiers are intended to be unique to an individual vessel. Every fish ticket with the same vessel identification number that is not a valid Coast Guard or state registration number is

[4] See http://pacfin.psmfc.org/index.php.
[5] Based on PacFIN data query.

given a single consistent ZZZ ID. However, uniquely identifying an individual vessel is problematic for the tribal vessels. Each fish ticket from a tribal vessel in WA has a unique tribe identifier in the first two digits of the tribal ID that is remitted to PacFIN. Following the first two digits, some tribal IDs have a number for an individual member of the tribe. Some tribe IDs do not include a number for an individual tribe member. When tribe IDs do not include a number for individual tribe member following the first two digits, a single ZZZ value within PacFIN can represent more than one vessel. Even in cases when the tribe IDs do include a number for individual tribe members, a single ZZZ ID in PacFIN is sometimes attributable to more than one vessel because an individual fisherman within a tribe will sometimes operate more than one vessel[6].

IO-PAC does not exclude the fish ticket data from vessels with ZZZ IDs. Vessels with ZZZ IDs are important for estimates of commercial fishing revenue, especially in WA. In instances where a unique ZZZ identifier represents more than one vessel, vessel classification as displayed in Table D-1 is affected, however, in IO-PAC it is assumed that misclassifying revenue by type of vessel is less problematic than excluding the revenue altogether. Additionally, failure to uniquely identify vessels results in a different approach to employment estimate in WA, which will be discussed in greater detail in the Section IV.H.

III.C NWFSC Cost-Earnings Survey Data

The NWFSC's cost-earning surveys provide the data necessary to construct the production functions in IO-PAC. There are three cost-earning surveys that were used in developing the production functions: the limited entry trawl survey, the limited entry fixed gear survey, and the open access survey. The costs categories from the surveys that were used in the model include fuel and oil, food and provisions, ice, bait, repairs/maintenance/improvements, insurance, leased permits, purchased permits, interest, crew expense, captain expense, length of vessel, and market value of vessel. The responses to the cost-earnings surveys can be easily matched to vessel landings by species, gear type, physical characteristics, and permit information contained in PacFIN. A short description of the surveys follows. For a more detailed description of the survey programs and summary statistics used in constructing the production functions see Lian (2009)[7].

The survey population for the limited entry trawl survey consisted of all vessels with a limited entry trawl permit and at least $5,000 in landings in 2004. The survey collected information for 2003 and 2004 through in-person interviews. There were 91 completed responses out of a total of 143 vessels for a response rate of 64%. Using the vessel classification scheme Radtke and Davis (2000) that is shown in Table D-1, Large Groundfish Trawler was the principle classification of respondents, but there were also a sizeable number of responses among vessels classified as Whiting and Crabber. There were five responses from vessels classified as Small Groundfish Trawler and a few responses classified as Alaska Fisheries Vessel, Shrimper, and Other.

The survey population for the limited entry fixed-gear survey consisted of all vessels with a limited entry fixed gear permit and at least $5,000 in landings in 2004. This survey also collected information for 2003 and 2004, and used in-person interviews. There were 61 completed responses out of a total of 121 vessels for a response rate of 51%. Sablefish fixed gear was the principle classification of respondents, but there were also a sizeable number of responses from vessels classified as Crabber, and Other Groundfish Fixed Gear.

[6] Personal correspondence with Greg Konkel of WDFW July 14, 2009.
[7] See Tables 4, 5, 6, 10, 11 and 12 in *West Coast Limited Entry Earnings Survey Protocol and Results for 2004* and Tables 3, 4, 5, 6 in *West Coast Open Access Groundfish and Salmon Troller Survey Protocol and Result for 2005*.

The survey population for the open access survey consisted of all active commercial fishing vessels that (1) landed at least $2,500 of salmon and groundfish at West Coast ports during 2005 and 2006, (2) had at least one trip on which groundfish and salmon accounted for a majority of revenue from landings, and (3) did not hold a limited entry permit. All survey data was collected by either using in-person or telephone interviews. There were 532 vessels that met the above three requirements for which a telephone number was obtainable. The survey collected information for years 2005 and 2006. There were 168 completed responses out of a total of 532 vessels for an overall response rate of 32%. There were responses from vessels classified as Crabber, Other < $15,000, Other > $15,000, Other Groundfish Fixed Gear, and Salmon Trollers.

The production functions in IO-PAC rely on only the 2004 data from the limited entry trawl and fixed gear surveys and only on the 2005 data from the open access survey. The survey results differ considerably depending on which year is chosen for a couple of reasons.

In the limited entry trawl sector, differences between 2003 and 2004 reflect the implementation of the groundfish fishing capacity reduction program Congress enacted in 2003. The National Marine Fisheries Service (NMFS) invited program bids in July 2003. Bids were accepted during August 2003. One hundred eight groundfish permit owners submitted bids and the NMFS accepted bids involving 92 vessels. On December 4, 2003, accepted bidders were required to permanently stop all further fishing with the reduction vessels and permits (Federal Register, 2003).

The reduction in capacity had a sizeable impact on average vessel costs and revenue. For the purposes of IO-PAC it is assumed that the survey results from 2004 are more representative of current operations and are therefore used to construct the production functions.

Differences in open access survey results between 2005 and 2006 reflect the fishery failure for Pacific salmon. In August,2006 Secretary of Commerce declared a Commercial Fishery Failure for the California and Oregon salmon fisheries, pursuant to section 312 (a) of the Magnuson–Stevens Fishery Conservation and Management Act (Upton, 2008). The Pacific salmon fisheries failure had a sizeable impact on average vessel revenue for some vessel classifications. The change in revenue is relatively the greatest for vessels classified as Sablefish Fixed Gear, Other <$15,000, and Other >$15,000. Because of the salmon failure, 2006 is a major transitional year for open access fishing vessels. A high percentage of vessels classified as Salmon Trollers in 2005 shift into other vessel categories in 2006. It is unknown whether the transitional changes experienced in 2006 will become the new standard. For the purposes of IO-PAC it is assumed that the non-failure year provides better representation of the status quo for average costs and revenues of the open access fleet. Hence, the 2005 results are used to develop the production functions.[8]

III.D Landings Taxes and Moorage Rates

The voluntary cost-earnings surveys listed above were not designed to capture all possible cost sources that commercial fishing vessels encounter. Attempting to capture all potential costs would have resulted in more lengthy questionnaires and possibly lower response rates. To improve response rates and data accuracy, some cost categories were not captured. Two such categories are moorage and landings taxes. As a result, these cost categories were estimated with data obtained from other sources.

Commercial fishing moorage rates for various length vessels were obtained from numerous ports along the West Coast. Annual moorage rates for 2009 are displayed in Table D-2. Ports often handle moorage

[8] The cost-earnings survey for the open access fleet will be fielded again in 2010 and collected data for years 2008 and 2009. This assumption will be analyzed when 2008 and 2009 data become available.

costs differently. Some charge a straight cost per foot, while others charge an increasing cost per foot as the vessel surpasses specified thresholds. Some ports charge by the length of slip, regardless of the length of the vessel. If available information indicated that the maximum slip length in a port is smaller than a given vessel size, no rate is reported in the table. An average for each vessel size in each state is developed by calculating the mean for all non-blank ports in the table. The West Coast average is the mean of the CA, OR, and WA averages. Because CA has noticeably more harbors listed, taking the mean of all the harbors would increase the influence of the CA harbors on the overall total. By using the mean of the CA, OR, and WA averages, each has the same weight in the West Coast average.

Commercial fishing vessels also incur federal and state taxes. The federal and state tax rates are presented in Table D-3. There are landings taxes at the federal level to partially fund the groundfish fishing capacity reduction program. The tax programs in the three states differ in how they are administered and the rates that are levied by species. These taxes are referred to as landings taxes in California and landing fees in Oregon. The tax program in Washington is referred to as the enhanced food fish tax. Technically, the levy in Washington is on the first commercial possession by an owner of fish within the state. For the purposes of this discussion all of these levies are referred to as "landings taxes". Information on landings taxes was obtained from the ODGW, CDFG, and the Washington Department of Revenue (WDOR). In Washington, the taxes are administered by the WDOR with some assistance by the WDFW.

The landings taxes are typically paid by individuals or companies licensed as commercial fish receivers. These licensed fish receivers include wholesale fish dealers, seafood processors, and in the case of Oregon, licensed bait dealers. However, in all three states, in the event that a commercial fisherman sells fish directly to the ultimate consumer, thereby bypassing the transfer of fish to a licensed receiver, the commercial fisherman becomes liable for the tax[9].

In addition to landings tax liabilities for selling directly to the final consumer, it is common in WA for fish receivers to shift some of the tax liability they face back to commercial fishermen. In WA it is written in the tax code[10] that fish receivers can shift half of the landings tax back to fish sellers. As a result, fishermen and receivers typically negotiate a price that appears on the fish ticket that is the basis of the revenue in PacFIN. However, when receivers pay fishermen, one half of the receivers' tax liabilities are deducted from the amount paid. This does not happen in every transaction, but it is reported to occur in a substantial majority of cases[11].

In both OR and CA the tax code does not include the provision to shift some of the tax back to harvesters. It may occur in some cases, but according to personnel at the ODFW and CDFG, the price paid to the fish harvester by receivers that appears on the fish ticket is net of any tax agreement.[12] As a result, the revenue received by harvesters that is reflected in fish tickets is considered net of tax in CA and OR. For CA and OR, the only occurrence of state-level landings taxes paid by fish harvesters is when sales are made to the final consumer.

The federal government also places fees on certain fish landings to partially fund the groundfish fishing capacity reduction program. The fees are legally placed on the fish harvesters who sell the fish (50 C.F.R.

[9] California fish and game code Section 8040-8070; Revised Code of Washington Chapter 82.27; 2006 Synopsis Oregon Commercial Fishing Regulations.
[10] Revised Code of Washington Chapter 82.27
[11] Personal correspondence with Lee Hoines of Washington Department of Fish and Wildlife on July 8, 2009.
[12] Personal correspondence with Terry Tillman CDFG on July 14, 2009 and Michelle Grooms of ODFW on July 14, 2009. Both Terry Tillman and Michelle Grooms indicated that this is not fully understood, but their understanding combined with that of the authors supported this assumption.

§ 600.1102), but fish buyers are directed to collect the fee and deduct it from the net trip proceeds that fish buyers pay to the fish sellers. The letter sent out to fish buyers (NMFS, 2009) clearly indicates that the full amount of the tax should be paid by fish sellers. We therefore assume that fish harvesters pay the full amount of the federal landings fee, and harvester proceeds on fish tickets are not net of these fees.

IV. The IO-PAC Model

The IO-PAC model is a fisheries specific input-output model, where 19 unique vessel classification sectors, one wholesale seafood dealer sector, and one bait supplying sector are incorporated into IMPLAN regional input-output software. The 19 fishing vessel classifications (Table D-1) are based on the rules developed by Radtke and Davis (2000). The vessel sectors produce 32 unique species/gear commodity outputs. The bait sector produces a single commodity, bait. The methodology employed to develop IO-PAC is modified from the Northeast Fisheries Science Center's Northeast Region Commercial Fishing Input-Output Model (NERIOM) developed by Steinback and Thunberg (2006). The approach differs from that of the Fisheries Economic Assessment Model (FEAM) that is currently being used in fisheries management along the West Coast.

The FEAM model is also based on an underlying IMPLAN input-output model and begins by extracting the regional economic multipliers from a pre-generated IMPLAN model. The IMPLAN multipliers are then applied to the estimates of the expenditures made by the respective fishing sectors to determine the total economic impact of the fishing sectors. In this way, the ripple effects of the expenditures made by the fishing vessel sectors are accounted for by externally multiplying the expenditures by their regional and industry specific multipliers. A similar process is used in FEAM to determine the economic impacts of the seafood processing sectors. This method is similar to the method used by Kirkley (2004) in the Mid-Atlantic regional impact model. When the multipliers are calculated through the regional absorption table inversion, the fishing sectors are not present in the model. This method requires relatively less effort to construct than the NERIOM approach. However, because this approach does not internalize the fishery sectors into the input-output model framework, it does not explicitly detail the relationships between the fishery-related sectors and other industrial sectors (Seung and Waters 2006).

The method employed by NERIOM and IO-PAC is to directly modify the sectors contained within the IMPLAN system. The regional linkages between the customized fishery sectors are established before the regional absorption table is inverted and the input-output model is calculated. This method fully takes into account the effects of the personal income generated by the fishing industry and the feedback interactions in the regional economy. Additionally, the approach of building the model in IMPLAN will also aid in the construction of a computable general equilibrium model (CGE) in the future. Information contained in the underlying social accounting matrix in IMPLAN can be used as the starting point for building a CGE model.

The IO-PAC model is constructed by first generating a default IMPLAN model based on the geographical area to be analyzed. New data for the 21 new industry sectors, 32 species/gear commodity outputs, and a single bait commodity are entered into the model. The model is then re-run with the new data to generate the fully customized regional input-output model. The model is then ready to complete economic impact estimates.

IV.A Industry Additions

The industrial sectors that are added to IMPLAN include 19 vessel sectors, a single bait sector, and a wholesale seafood dealers sector. The 19 vessel sectors entered in the model follow the vessel

classification scheme of Radtke and Davis (2000). Each vessel was assigned to one of the 19 vessel sectors based on the criteria presented in Table D-1. The classifications are rank dependent so that a vessel is classified into the highest ranking sector in which it meets the classification rule. For example, if a vessel meets the rule to be classified as Sector 1 (Mothership/Cather Processor), then it is classified as Mothership/Catcher Processor regardless of whether it meets any additional classifications. Likewise, if a vessel satisfies the classification rule for Sectors 4, 12, and 18, then the vessel would be classified as Sector 4 because that is the highest ranking vessel sector to which it belongs. Classification of vessels was performed by personnel at PacFIN and appended to the fish ticket data that was supplied for the purposes of this project.

Alternative categorization schemes were considered, but this scheme has some historical precedence, so there is general familiarity with it by fishery managers on the West Coast. Additionally, it is a classification scheme that data from of a variety of different sources can be grouped with relative ease.

A wholesale seafood dealers sector is included in the model to account for economic effects of changes in the flow of fish to wholesale seafood dealers. Some fish flows from fish harvesters to parties other than seafood processors. This is necessary because some fish flows to wholesale seafood dealers, where it subsequently flows to restaurants, retailers, seafood processors, or is exported. In the default IMPLAN, wholesale seafood dealers are included in the default wholesale trade sector (Sector 390). Wholesale seafood dealers comprise a small portion of all wholesale dealers that are included in this IMPLAN sector. Consequently, the production functions, trade flows, and value added estimates in the default wholesale trade sector, which includes everything from electronics to lumber could differ from those of wholesales seafood dealers (Steinback and Thunberg, 2006). Hence, a wholesale seafood dealer sector was developed. The amount of fish that is expected to flow from harvesters to wholesale seafood dealers is detailed in Section IV.D.

A bait supplying sector is included in the model to provide a sector to allocate bait purchases made by fish harvesters. Recall that the RPCs of all directly impacted sectors are set to 0 in IO-PAC, so directing bait purchases to any of these sectors would have effectively forced bait purchases to be sourced from outside the study area. The bait supplying sector that is included is a stand-alone sector that only supplies bait to fish harvesters. No other sector purchases bait. As a result, the sector avoids the feedback problems that necessitate setting the RPC be set to 0 (see discussion in Steinback 2004). The inclusion of a stand-alone bait supplying sector enables bait purchases to be sourced from within the study area while avoiding the feedback effects.

The vessel classifications along with the bait sector and wholesale seafood dealer sector represent the industries added to IMPLAN. The IMPLAN codes for these classifications are displayed in Table D-4.

IV.B Commodity Additions

The commodities added to IMPLAN include 32 different species/gear combinations and one bait commodity. The commodities are displayed in Table D-5. The gear type portion of the commodity classification was made by grouping PacFIN (fish ticket) data along the gear categories presented in Table D-6. The species classifications portion of the commodity classification was made by grouping the PacFIN data into the categories displayed in Table D-7.

The total landings by vessel type and species/gear combinations are displayed in Table D-8. Landings are classified in the species/gear classifications even if species for particular gear types are considered bycatch.

Use of species/gear combinations increases the flexibility of IO-PAC. They permit impact estimates to be made for harvest changes on a commodity basis. In practice most impact estimates will likely be desired for particular gear classifications because regulations are often made based on vessels with particular permit authorization or gear type. However, there may be instances when impacts on a commodity basis will be preferable.

Impacts on a commodity basis will, unlike impact estimates on vessel classification basis, affect all vessels with landings of a particular species, regardless of vessel classifications. For example, suppose there is an area closure or some other regulation change that is expected to reduce fixed-gear sablefish landings. Vessels classified in several categories have appreciable fixed-gear sablefish landings. In 2006, these included Sablefish Fixed Gear (51%), Crabbers (36%), Other Groundfish Fixed Gear (4%), Other Less than 15k (3%), and Salmon Trollers (2%). The remaining 4% of fixed-gear sablefish landings was spread across the remaining vessel classifications. In this example, entering an exogenous reduction in the fixed-gear sablefish harvest would result in a negative impact on all of these vessel classifications. The size of the impact in each vessel classification is determined by the specifics of its production function and its respective share of total sablefish fixed-gear landings.

The overall impact would be different for a scenario in which the same exogenous reduction in harvest affects only vessels classified as Sablefish Fixed Gear. The greater the differences between the production functions of all the other vessel classifications with fixed-gear sablefish landings from those categorized as Sablefish Fixed Gear, the greater the difference in the results. Assuming the production functions differ considerably, similar results using the vessel classification approach would require separate exogenous harvest estimates for each vessel classification. Prior to entering the downturn in fixed-gear sablefish landings into model, the total downturn would require apportionment among the different vessel classifications and each expected change would be entered separately. For example, the total downturn in fixed-gear sablefish landings would first require apportionment among Sablefish Fixed Gear, Crabbers, Other Groundfish Fixed Gear, etc. Then, each of those expected changes would be entered in the model separately and the impacts estimated simultaneously.

IV.C Study Area

The IO-PAC model is a collection of region specific models. There are models for Washington, Oregon, California, and the whole West Coast. Additionally, there are models for the ports and port aggregates. Because each of the state, port, and port-aggregate models are sub-regions of the West Coast region, they will all be referred to as sub-regions in the following discussion. This follows the terminology used by Steinback and Thunberg (2006) in the NERIOM.

The collection of regional models is displayed in Figure D-1. A detailed list of how the ports aggregates were constructed using PacFIN data is presented in Appendix A. The port and port aggregates were designed to correspond to the location and composition of port groups present in the 2005-2006 Pacific Coast groundfish environmental impact statement (Pacific Fishery Management Council, 2004).[13]

The IO-PAC approach of region specific models is intended to be flexible enough to provide impact estimates for a wide variety of policy situations and analysis goals. It can provide coast wide, state wide, and port level impacts. The appropriate study area is dependent on the nature of the policy change, the goals of the analysis, and the resolution of the exogenous change in fish harvest that is expected.

[13] See Table 8-1 Appendix A. *2005-2006 Pacific Coast Groundfish Fishery FINAL Environmental Impact Statement.*

If a policy change will only affect a few ports along the West Coast, then, depending on the intent of the analysis, it may be preferable to use study areas for only those sub-regions. For example, assume that a given policy will reduce fish harvest in only Astoria and Westport, and estimating changes in income in these communities is the objective of the analysis. If exogenous estimates of the changes in harvest are known for Astoria and Westport, it will likely be preferable to estimate the impacts of the changes by using only Astoria and South Washington study areas. The multipliers from the Astoria and South Washington study areas will likely result in better estimates of income effects than using the entire West Coast as the study area. Additionally, performing an analysis on these smaller study areas will likely do a better job of depicting the relative importance of the fishing industry.

However, estimated impacts are often desired that follow political or administrative boundaries. For example, estimated impacts may be needed for states or for the entire West Coast. In these cases, the state level and West Coast models will likely be more appropriate. In the example of a downturn in fish harvest in Astoria, the effects of the reduction will have a greater total income impact on the state of Oregon as a whole than in Astoria alone. The economy of Oregon is more diversified than the economy of Astoria, so the multiplier will be larger.

While the impact of using the Oregon study area will be greater, the relative importance of the fishing industry will be less. Obtaining results at the state level or for the entire West Coast will come at the expense of obtaining a clear picture of the effects at a particular port. An advantageous feature of the IO-PAC model is that it is flexible enough to estimate the effects of changes in fishing regulations at many different levels of geographic resolution.

An underlying assumption in the downturn of fish sales in Astoria and Westport example is that the exogenous effects are known for a relatively small geographic area. For some policy or other effect on harvest, this may not be the case. However, the IO-PAC approach is also flexible enough to handle scenarios in which exogenous impacts are not known for individual ports. If a given policy is expected to result in a loss in fish sales across the entire West Coast, but no port level exogenous estimates are known, then the West Coast study area could be used to estimate the impacts of such a change. These West Coast impacts could then be apportioned to the state and port level of detail based on some metric of relative importance of the different regions to the whole. One such metric might be the proportion of landings of a particular species in the different geographic areas. Another approach used in the NERIOM is to apportion the indirect effects based on the relative importance of sub-regional economies to the total regional economy.

The IO-PAC approach to study area is intended to be flexible enough to handle numerous different types of analyses. For policies that only affect a few ports and the exogenous effects are known at that level, then models for port specific study areas can be used. For policies that will affect all ports along the West Coast, the model for the West Coast is available. Additionally, the state level study areas are available to develop state level impact estimates for cases in which exogenous impacts are state or port specific.

IV.D Product Flow

Product flow considerations are important for fishing industry impact and contribution models. Generally, as long as fish harvester sales are not to final consumers or exported from the study area, it continues to affect economic activity within the study area. Each firm that purchases the seafood may add value in the production of its own goods or services. Hence, a fish processor may add value to raw fish by filleting, packaging, cooking, canning, or icing. Wholesalers may add value by freezing, warehousing, providing an auction market, or shipping services. Retailers may add value by storing, icing, and displaying the product for purchase by final consumers. Restaurants may add value by cooking and

preparing the seafood for patrons. At any of these stages, there is the potential that a change in fishery regulations will have an economic impact.

The product flow of fishery resources is complex and there are few sources of data that can be used to accurately account for these transactions in an economic model. Like other fishery IO models (Steinback and Thunberg, 2006 and Kirkley et. al, 2004), the IO-PAC model relies on simplifying assumptions. There are some data available to help guide these assumptions, and while by no means extensive, the data represents the best available at this time. The assumption about the flow of fish in IO-PAC were derived by utilizing data from the Washington Department of Revenue (WA DOR) and the absorption of fish made by the IMPLAN default seafood product preparation and manufacturing sector (Sector 71).

The WA form of a landing tax, the Enhanced Food Fish Tax, is administered by the WA DOR. Because the tax is levied on the individual or entity that first retains possession of the fish in WA, the tax records are useful in understanding the flow of fish between different types of buyers. When a commercial vessel sells fish directly to the public, the vessel pays the tax. Every business entity in the state of WA must file a master business application with the Licensing Division of WA DOR. On this application, the business explains the type of commercial activity in which it will be involved. The business is then analyzed and classified by North American Industry Classification System (NAICS) code based on its principle source of revenue. Revisions to the classifications of businesses are made through time based on reported activity contained in tax returns.[14] The proportion of the tax paid by businesses thus classified provides insight into the flow of harvested fish.

Table D-9 presents the proportion of Enhanced Food Fish Tax paid by type of business by six digit NAICS code in 2006. It indicates that Fish and Seafood Merchant Wholesalers paid 30.2% of the tax. Based on this proportion, IO-PAC assumes that 30% of all fish landed in each study area along the West Coast will pass through fish and seafood merchant wholesalers. The fish purchased by wholesale seafood dealers will subsequently be purchased by final consumers, exported out of the region, intermediate demand other than processing, and fish processors.

The proportion of fish landings in each study area that will flow to fish processors is determined by constructing a default IMPLAN model for each study area and then viewing the commodity balance sheet for the commercial fishing sector. For the West Coast Region as whole, approximately 45% of all the default commercial fishing sector sales are purchased by the seafood product preparation and manufacturing sector. This is similar to the 42.3% that flows to the seafood canning and fresh and frozen seafood processing sectors according to enhanced food fish tax records in WA.

The flow of fish in IO-PAC is displayed in Figure D-2. Each solid line between the different entities in the harvesting and product distribution schematic is included as a calculated impact in IO-PAC. Those represented with a dashed line are not incorporated in IO-PAC. Similar to the approach by Steinback and Thunberg (2006), there are expected to be a number of seafood substitutes available beyond fish and seafood merchant wholesalers and seafood processors. Hence, the impacts of most fishery management actions on final consumers and other intermediate demand industries are likely to be negligible.

IV.E Vessel Production Functions

The production functions in the IO-PAC were developed by weighting the results of the three different NWFSC cost-earnings surveys and incorporating information on landings taxes and moorage rates. The survey results provided the majority of the information used to construct the production functions. The results from the cost-earnings surveys were weighted to produce a single production function that

[14] Personal correspondence with Beth Leech of WA DOR, July 10, 2009.

represents the vessels contained in each of the vessel classifications. Moorage and landings taxes were estimated using external sources and added to the production functions. There are some vessel classifications that have not yet been included in the cost-earnings surveys. The assignment of production functions for these sectors are addressed in two ways. All of these sectors, with the exception of Small Groundfish Trawlers, were assigned a weighted average production function. Small Groundfish Trawlers were assigned the production function of large groundfish trawlers.

Cost-Earnings Surveys

The following steps describe how the results from the three cost-earnings surveys were used to generate the cost estimates for the production functions. First, the average expenditures by cost category from the three cost-earnings surveys were converted to a proportion of average revenue for each of the vessel classifications. If C_{ik} equals the average cost of each expenditure category (i) for vessel classification (k) and R_k is equal to the average revenue for vessel classification (k), then the proportion in each expenditure category from each survey (s) can be represented as $P_{iks} = \frac{C_{iks}}{R_{ks}}$.

Second, three of the vessel classifications shown in Table D-1, Crabber, Sablefish Fixed Gear, and Other Groundfish Fixed Gear, have survey results from more than one cost-earnings survey. For these categories a weighting mechanism was used to combine the results from the surveys.

Total West Coast landings for each of the vessel classifications were converted to constant 2006 dollars using the PPI for unprocessed and packaged fish. West Coast landings by vessel classification (k) from each survey (s) is represented by WC_{ks}. The weights to combine the results of the three different surveys are given by $\frac{WC_{ks}}{\sum_{s} WC_{ks}}$.

Altogether, the survey portion of the production function for all vessel classifications (k) and all expenditure categories (i) is given by $P_{iks} \frac{WC_{ks}}{\sum_{s} WC_{ks}}$.

There are some vessel classifications that have no data from any of the NWFSC's cost-earnings surveys. These include Mothership Catcher/Processors, Alaska Fishery Vessels, Small Groundfish Trawlers, Pelagic Netters, Migratory Netters, Migratory Liners, Shrimpers, Salmon Netters, Other Netters, Lobster Vessels, and Diver Vessels. For all but Small Groundfish Trawlers, these categories incorporate the survey data in the form of a weighted average production function. The production functions for all of the covered classifications were weighted based on their respective West Coast landings and included in this weighted average production function. Small Groundfish Trawlers are assumed to have the same production function as Large Groundfish Trawlers. As additional data becomes available, specific production functions for these categories will be developed and incorporated into IO-PAC.

Moorage

Moorage was calculated by converting the moorage cost data presented in Table D-2 to dollars per foot, multiplying dollars per foot by the average length of vessel by classification and survey population, and

weighting the moorage expenditures of the different survey populations in the same manner described above. Dollars per foot from Table D-2 for the West Coast range from $40.40 to $47.30 with an overall average of $44.90 in 2009 dollars. This per-foot amount was converted to 2006 dollars by using the CPI and equals $41.80.

Landings Taxes

Average federal taxes by vessel classification were estimated by multiplying average value of landings by species by state within each vessel classification by the federal tax rates displayed in Table D-3. The federal tax rates are applied by species by state to all of the average landings made in each of the vessel classifications. The tax rate multiplied by the average landings by species is borne 100% by harvesters.

Average Washington taxes were estimated in two parts. First, Table D-9 indicates that WA commercial fishermen were responsible for 12.6% of landings taxes collections in 2006. Hence, it is assumed that for all vessel classifications 12.6% of average landings by species is sold directly to the public. On 12.6% of average landings by vessel classification by species, the full tax rate is assumed to be paid by harvesters. Second, because of the tax shifting arrangement in WA, harvesters are estimated to pay half of the tax rate displayed in Table 3 on the remaining 87.4% of average landings by species. Total average taxes by vessel classification are created by summing the direct to consumer and tax shifted components.

Average Oregon taxes were estimated by applying the tax rates by species in Table D-3 to 12.6% of the vessel landings for each classification. Oregon is assumed to have the same proportion of fish sold directly to consumers as Washington. It is possible to segment sales by species for commercial fishing harvesters holding "Limited Fish Seller Licenses" in Oregon. These licenses permit harvesters to sell directly to the public off their vessels. Sales by harvesters with these licenses are a much smaller proportion of all landings than 12.6%. It is reported to be closer to 1%.[15] However, some harvesters have "Wholesale Dealer Licenses," as they are required for harvesters who wish to sell landings directly to consumers and retail businesses from a location other than their vessel. The amount of landings sold in this manner is unknown, which necessitated an assumption that the flow of fish in Oregon is similar to Washington.

For each vessel classification, average California taxes were estimated by applying the tax rates by species in Table D-3 to 2% of trawl gear landings and 21% of fixed gear landings. Approximately 2% of trawl caught groundfish and 21% of fixed-gear groundfish bypassed wholesalers and processors and were purchased by final consumers in 2006.[16] These percentages are applied to all commodities in the model. The groundfish focus of the model at this time supports this assumption. As improved data for other species groups are added, these proportions will be adjusted.

The West Coast model includes an additional step that is not performed on any of the models for smaller study areas. For each vessel classification it sums the federal and state taxes that were calculated separately and then divides the sum by total west coast landings. This provides the percent of total revenue for each vessel classification that is used to pay landings taxes.

Table D-10 presents the final production functions included in the West Coast Model. The state and port level models differ slightly in the moorage and tax component, but the production functions for the other

[15] Based on data of landings by license type in 2006 supplied by Michelle Grooms of ODFW.

[16] Doreen Hansen, who worked with CDFG on development of the California Ocean Fish Harvester Economic (COFHE) Model, provided information on the proportion of groundfish sales made directly to consumers. These numbers were confirmed by Terry Tillman of CDFG as direct sales to the public in 2006 in personal correspondence June 23, 2009.

categories are identical. The production function for Other > $15,000 is not shown due to confidentiality restrictions. The expenditure categories shown in Table 10 must be mapped into IMPLAN commodity codes for inclusion in the model. The mapping of the expenditure categories in Table D-10 into IMPLAN commodity codes is presented in detail in Appendix B.

IV.F Processor and Wholesale Seafood Dealer Production Functions

The processor production function is the default IMPLAN production function for the seafood product preparation and packaging (Sector 71).

Wholesale seafood dealer production functions are assumed to equal those developed by Kirkley (2004), and subsequently used by Steinback and Thunberg (2006). This production function is presented in Table D-11. The mapping of the expenditure categories included in the production function into IMPLAN commodity codes is presented in detail in Appendix B.

IV.G Sales

Baseline sales for all but two of the vessel classifications are derived from Pac FIN
fish ticket data. There are no landings data for Alaska Fisheries Vessels and Mothership Catcher Processors contained in the model.

Baseline sales for the wholesale seafood dealer sector are estimated by margining the 30% of harvested fish that is estimated to flow to wholesale seafood dealers. IO-PAC utilizes the same 40% markup margin as that used by Steinback and Thunberg (2006). Total sales are entered as the margin only, which excludes the costs of raw fish. This practice is analogous to the default IMPLAN treatment of the wholesale trade sector.

Baseline sales for the seafood processing sector are those contained in the default IMPLAN model for seafood product preparation and packaging (Sector 71).

IV.H Employment

In OR and CA, employment estimates for the vessel classifications are made by multiplying the weighted average number of crew plus captain by the number of unique vessel IDs. In WA, the ZZZ IDs necessitated an adjustment to the employment estimates. First, employment estimates for the vessel classifications are made by multiplying the weighted average number of crew plus captain by the number of unique non-ZZZ vessel IDs. The non-ZZZ employment estimates are then inflated to adjust for the ZZZ landings. It is assumed employees on vessels with ZZZ IDs are of equal productivity as those in vessels without a ZZZ ID. Thus, the number of ZZZ employees will be the same share of total employees as the value of ZZZ landings is of total landings.

The cost-earnings surveys capture the average number of crew members on each vessel not including the captain while performing five different activities: trawling, longlining, shrimping, crabbing, and trolling. IO-PAC uses the average number of crew for each vessel classification that best corresponds to the primary activity of the classification. For example, the applicable average number of crew for Large Groundfish Trawlers is assumed to be the average number of crew while the vessel is engaged in trawling.

For the three vessel classifications that are covered by more than one cost-earnings survey, a weighted average is used. The weighting scheme follows the approach used to weight the different elements of the

production function. Essentially, for each vessel classification, the weights are comprised of the share of total inflation adjusted West Coast landings attributable to vessels covered by the respective surveys.

Employment for wholesale seafood dealers is calculated by dividing the portion of total value added paid to employees by the average wage paid to fish and seafood merchant wholesalers (NAICS Code 42446) from County Business Pattern data for 2006[17]. Average earnings per employee in WA and CA were $42,300 and $36,051 respectively. Average earnings per employee was not disclosed for OR, so the average for the West Coast was created by using the weighted mean for WA and CA, where the weights are the proportion of total employment in WA and CA that exists in each respective state. The number of paid employees was 1,015 in WA and 4,429 in CA, so the weighted earnings per employee is $36,057[18].

V. Model Construction

The following discussion details the steps used to construct the model in the IMPLAN system. Much of this discussion is drawn from Steinback and Thunberg (2006). IMPLAN contains more than 60 Microsoft Access tables. Table D-12 lists the underlying data tables in the IMPLAN system and a short descriptor of the type of data contained therein. The construction of IO-PAC entailed the modification of 14 of these tables, which are noted in Table D-12.

The modification procedure consists of the following steps. First, Excel worksheets that mirror the layout of the Access tables that needed to be modified were created. Second, all of the new data necessary to modify the Access tables was entered into the Excel worksheets. Third, the data were copied from the Excel worksheets and pasted at the bottom of the relevant Access table. Lastly, the Access tables were sorted based on the necessary variables to maintain the records format.

V.A Model Construction Steps

The following steps describe the creation of the IO-PAC model. These steps are repeated for each geographic area displayed in Figure D-1.

Step 1

A default West Coast region model was created with IMPLAN software.

Step 2

The default model was then opened using Microsoft Access 2003.

Step 3

Three of the US tables and the Observed RPCs table were then deleted. This step was necessary because all IMPLAN Pro models share the following five tables:

US Absorption Table
US Absorption Totals
US Byproducts Table
Observed RPCs
Margin Codes

[17] See Census Bureau County Business Patterns: http://www.census.gov/econ/cbp/index.html.
[18] Because earnings per employee was not reported for OR, the OR models utilize the $36,057 weighted earnings.

Deletion of these tables "breaks" the link so that any subsequent changes made in Access will not affect other IMPLAN models. No changes were made to the Margin Codes table so it was not necessary to remove the link to that table.

Step 4

The deleted tables (the three US tables and the Observed RPCs table) were then replaced with the same tables contained in the 2005 IMPLAN structural matrix file 06NAT509.IMS through the import feature in Access.

Step 5

For each of the 14 tables that needed to be modified, Excel worksheets were created that mirror the layout of the tables in Access.

Step 6

Data in these 14 tables were modified to better reflect the sectoral linkages among fisheries-related industries.

Step 7

After the new data for 14 tables are created in Excel, the data are copied and pasted from the Excel worksheets and pasted at the bottom of the relevant Access table.

Step 8

The Access tables are resorted to follow the original format.

Step 9

The modified model was then opened in IMPLAN, the model was reconstructed and multipliers were re-estimated. IMPLAN will not recognize changes made to the underlying data tables unless the model is reconstructed using the updated data.

V.B IMPLAN Table Adjustments

The following provides a more detailed discussion of modifications to certain Access tables.

Industry/Commodity Codes

This table contains unique code numbers for industries and commodities. Industries and commodities share the same name and number in an IMPLAN model. Modifications included adding 21 different industry classifications: 19 different vessel categories, a bait ship category, and a wholesale seafood dealer category. Additionally, 33 different commodity sectors were added: 32 different gear/species commodity sectors and a single sector for bait. These industry sectors identify the 19 different vessel classification categories developed by Radtke and Davis (2000). The industry/commodity sectors that are added along with their IMPLAN code numbers are displayed in Tables 4 and 5.

Type Codes

The Type Codes table contains coding information on all transaction types in the data sets. For this table, we added the 54 industry/commodity code designations discussed above and the associated 54 SAM Commodity codes. Transaction codes associated with Factors, Households, Institutions, Transfers, Employment, Output, and Trade remained the same.

US Absorption

This table contains the United States absorption matrix which, in IO terminology, is the coefficient form of the use table. Essentially, the US absorption matrix contains each industry's production function. We added 1,720 rows of data that contained the production functions of each of the 19 fisheries-related vessel categories, the bait ship category, and wholesale seafood dealer category that were added to the model.

US Absorption Totals

The US Absorption Totals table contains the sum of the absorption coefficients for each industry sector. We added the appropriate absorption coefficients for the 21 new industry sectors in the model. The sum of the coefficients from each sector in the US Absorption table must match the coefficients in the US Absorption Totals table.

US Byproducts

This table contains estimates of the proportions of each commodity an industry produces. In IO terminology it is the coefficient form of the "make" table derived by dividing each element by the make table row totals. Industries often produce more than one commodity. For this table, we added the commodity proportions for the 21 industries added to the model. The commodities produced by these industries include the 32 gear/species commodities and the bait commodity.

SACommodity Sales

This table shows sales of commodities by households and institutions in the study area. We assumed that no households or institutions sold any of the 33 commodities that were added. We also assumed that were no institutional (federal and state governments) production in any of the industries or commodities added to the model and that there would be no inventory additions. The table was modified by adding rows of zeros for the institutions and inventory additions for each of the industries and commodities added.

SAEmployment

The SAEmployment table delineates average annual jobs for each industry in the study area. Jobs are measured in terms of both full-time and part-time workers combined. Employment estimates for all industry categories added to the model were included here.

SAFinal Demands

The final demand table consists of purchases of commodities for final consumption by households and institutions. The objective of modifying this table is to assign final demands for each of the commodities added to the model. This was accomplished by using information about final demand for the default fishing sector contained in IMPLAN. Final demand for the default fishing sector is apportioned among

households of different incomes, government entities, and inventory. These are referred to as "data type codes" in IMPLAN. We assume that the demand for the new species/gear commodities entered into the model will follow the same final demand distribution as default fishing sector (Sector 16). Demand totals for each of the type codes (households earning less than $10,000, $15,000-$25,000, federal Non-Defense, etc.) are generated by multiplying the proportion of default fishing sector demand (16) attributable to the different types by the total production of the new commodities entered into the model. Since the RPCs for the newly added sectors are set to 0 effectively there is no distribution of fish harvested to the final demand categories in the study area. IMPLAN will fulfill demand with imports to the study area.

SAForeign Exports

The SAForeign Exports table shows demands made for goods and services by consumers and industries outside the US. For this table, we estimated for exports of the 32 commodities added to the model by assuming the same proportion of each would be exported as appears for the default fishing sector in IMPLAN.

SAOutput

The SAOutput table is a vector of output values in millions of dollars that represents an industries total production. There is a single value for each of the 21 industrial sectors entered into the model.

SAValue Added

This table details payments made/received by each industry to employee compensation (wage and salary payments, insurance, retirement, etc.), proprietary income (all income received), other property type income (payments from interest, rents, royalties, dividends, corporate profits, etc.) and indirect business taxes (primarily excise and sales taxes). The value added transactions associated with the 21 industrial sectors were added to the table.

Observed RPCs

The Observed RPCs table contains forced regional purchase coefficient values for all states in the model. We added the 21 industrial sectors to the table and included and include and RPC value of 0 for all sectors except the bait sector, which is assigned an RPC of 1. We also added an RPC of 0 for the default IMPLAN fishing sector 16 and default seafood processing Sector 71.

RPC Methods

This table contains information for creation of the regional purchase coefficients. We added each of the newly created industry and commodities to the table, and set the Method variable of each added sector to "Observed." Additionally, we changed the default seafood processing sector and default fish harvesting sector Method from "Regress" to "Observed."

Deflator1

The Deflator1 table contains deflators that account for relative price changes over time. The IMPLAN deflators are derived from the Bureau of Labor Statistics Growth Model. The 2006 IMPLAN data base contains deflators from 1977 to 2020 for each commodity in the model. We replicated the deflators IMPLAN contains for the default fish harvesting sector for all of the newly created sectors except

wholesale seafood dealers. For wholesale seafood dealers, we used the deflator for the default wholesale trade sector in IMPLAN.

VI. Impact Estimation

VI.A Estimation Procedure

IO-PAC can be used to assess the impact of a given fishery management action when an externally derived, exogenous, assessment of how the action will affect the gross output of industries or commodities that are included in the model is available. With and exogenous estimate of the effect of a management action on fish harvest, IO-PAC will estimate the backward linked impacts of the action on the economy.

Entering an exogenous impact on sales by fish harvesters is the first step in calculating an impact. However, doing so will not have any impact on the businesses that rely on the supply of fish as input in production, such as seafood processors. Since the RPC for all fishing related sectors have been set to 0, all supply of fish to these establishments will be sourced from outside the study area in the model. If the backward linked impact of the fishery management action on seafood processors and wholesale seafood dealers is included, then estimated changes in sales for these sectors must also be entered into the model. With an exogenous estimate of a change in dollar value of sales by harvesters, the estimated change in sales of wholesale seafood dealers in the study area is made by utilizing the product flow and wholesale dealer mark-up margin assumptions discussed in Sections IV.F and IV.G. It is assumed that 30% of harvested fish in the study area flow to wholesale seafood dealers and that the wholesale seafood dealer markup margin is 40%. Because the wholesale seafood dealers are treated as margin sectors, the cost of fish purchased by wholesalers is excluded from estimated sales impacts. If ΔL_k represents the change in total fish landings among vessel classification *(k)* within the study area, then the change in sales for wholesale seafood dealers in the study area *(ΔWS)* is given by

$$\Delta WS = \left[\frac{\left(\sum_{k}^{K} \Delta L_k \right)(0.3)}{0.6} \right] - \left(\sum_{k}^{K} \Delta L_k \right)(0.3) .$$

Estimated sales changes for seafood processors are made by using product flow and markup margin information contained in IMPLAN for the default seafood processing sector (71). IO-PAC assumes that landings from the fish harvesting sectors that are added to the model flows to seafood processors in the same proportion as IMPLAN indicates for sales from the default fish harvesting sector (16) to the default processing sector (71). This value can be determined by constructing a default IMPLAN model for the study area of interest and then examining the commodity balance sheet for the default commercial fishing sector. In 2006 the commodity balance sheet indicates that seafood processors purchase approximately 45% of the sales produced by the commercial fishing sector on the West Coast. In IO-PAC it is assumed that seafood processors will purchase the same share of fish landings directly from the harvesting sectors that were created.

The fish landings that are purchased by the processing sector in each study area are converted into revenue changes by applying the margins derived from the production function for processors in the area. For the West Coast, the margin for processors in 2006 was 70%. This value can be determined by constructing a default IMPLAN model for the study area and then examining the industry balance sheet for the default seafood processing sector. These producer values are then entered as the change in direct

sales for the seafood processing sector. For each study area if *(p)* represents the proportion of landings purchased by the default seafood processing sector and *(m)* represents the margin among seafood processors then the change in sales for seafood processors *(ΔPS)* is given by

$$\Delta PS = \left[\frac{\left(\sum_{k}^{K} \Delta L_k \right)(p)}{(1-m)} \right].$$

The total effect on economic activity in the study area is derived by simultaneously multiplying the estimated exogenous gross output changes for the harvesting sectors, wholesale seafood dealers, and seafood processing sectors by their corresponding model-generated multipliers. This will capture the backward-linked effects associated with a change in commercial fishing harvest within the study area. This is accomplished by entering all three values in the IMPLAN impact analysis window.

VI.B Hypothetical Examples

Two hypothetical reductions in harvest are used to illustrate the outputs produced by IO-PAC. Scenario One will be used to illustrate the impact of a reduction in sales of a particular vessel classification. Scenario Two will be used to illustrate the impact of a reduction in sales for a particular commodity (species/gear type).

For Scenario One, assume that the fishery management action will result in a $500,000 decline in total ex-vessel West Coast landings for Sablefish Fixed Gear vessels. If $500,000 is the change in total ex-vessel revenue on the West Coast, then the decline in sales of Wholesale Seafood Dealers is $100,000, and the decline in sales for seafood processors is $756,412. All three of these effects are entered on the main impact analysis window in IMPLAN, and then the impact results are analyzed. Table D-13 displays the resulting effects on total output, value added, and employment. The results are aggregated at two digit NAICS code level for all of the sectors that were not added to the default IMPLAN model. The added sectors appear individually.

For Scenario Two, assume that the fishery management action will result in a $500,000 decline in total ex-vessel West Coast landings for sablefish caught using fixed gear. This is the commodity classification, not the vessel classification. Vessels of numerous vessel classifications have sablefish landings while using fixed gear. If $500,000 is the reduction in total ex-vessel revenue of the sablefish fixed-gear commodity on the West Coast, then the decline in sales of wholesale seafood dealers and processors is the same as Scenario One. All three of these effects are entered on the main impact analysis window in IMPLAN, and then the impact results are analyzed. Table D-14 displays the resulting effects on total output, value added, and employment. The major difference in the two scenarios is that numerous vessel classifications are affected in the commodity run. The effects are still the greatest for vessels classified as Sablefish Fixed Gear because they have the largest landings of this commodity, but sizable effects are also seen for vessels classified as Crabbers in the model. Which approach one should use depends of the specifics of the issue being analyzed.

VII. Discussion

IO-PAC is designed to estimate the backward linked multiplier effects of policy changes that affect gross revenues of commercial fish harvesters, wholesale seafood dealers, and seafood processors. The IO-PAC model is a fisheries specific input-output model where 19 customized unique harvesting sectors, one

customized wholesale seafood dealer sector, and one bait producing sector that produce 34 unique commodities are incorporated into a customized IMPLAN regional input-output model.

IO-PAC is similar in many resects to the NERIOM model developed by Steinback and Thunberg (2006). The model is incorporated into the ready-made input-output IMPLAN system. Building the model directly in IMPLAN permits an analyst to trace the effects with a high level of industry detail and generate disaggregated estimates of indirect and induced multiplier effects. As pointed out by Steinback and Thunberg (2006) this approach differs from the mixed exogenous/endogenous variables models and spreadsheet-type models based on limited input-output multipliers. These approaches derive backward linked multiplier effects by aggregating or condensing the same ready-made models. The approach of building the model in IMPLAN will also aid in the construction of a computable general equilibrium model (CGE) in the future. Information contained in the underlying social accounting matrix in IMPLAN can be used as the starting point for building a CGE model.

The approach to study area in IO-PAC is intended to be flexible enough to provide impact estimates for a wide variety of policy situations and analysis goals. It can provide coast wide, state wide, and port level impacts. The appropriate study area is dependent on the nature of the policy change, the goals of the analysis, and the resolution of the exogenous changes in fish harvest that are anticipated.

The multiplier effects generated by IO-PAC are static and should be viewed as the immediate/short-term impacts of an analyzed policy change. There are several assumptions built into the model that diminish its accuracy in modeling change over an extended period of time. Underlying assumptions such as fixity of prices and zero-substitution elasticities in consumption and production are more applicable to shorter periods of time than longer. In reality, harvesters, seafood dealers, and seafood processors will all likely shift production practices to mitigate losses from changes in policy that result in reduced harvest and maximize opportunities from change in policy that will increase harvest. These longer term behavioral adjustments are not captured in IO-PAC.

IO-PAC does not include impacts beyond seafood wholesalers and processors. It is possible that restaurants and food service establishments along the West Coast could experience a reduction in local supply because of a restrictive fishery management action. This is likely to be particularly true in isolated port communities that source a high proportion of seafood demand from local producers. Following the approach of Steinback and Thunberg (2006) we have assumed that consumers would choose from among the many other close substitutes (e.g., other fish species, poultry, beef, etc.). As a result, retail level gross revenues would remain unchanged.

IO-PAC can accept input data for the years 2006 through 2020. Data contained in IMPLAN are based on economic relationships in 2006, the impacts of management actions in succeeding years are determined by converting the estimated changes in gross revenues to year 2006 dollars before the impacts are estimated. IO-PAC then converts the impact estimates back to the year of the input data (through 2020). This process accounts for the effects of inflation on the impact estimates.

IO-PAC is likely more accurate for estimating impacts resulting from changes in groundfish harvest than other species. Vessels pursuing groundfish are captured in all three NWFSC cost-earning surveys, so the production functions for these vessels are likely the more accurate. However, the cost-earnings surveys capture a sizeable number of Crab vessels and Salmon Trollers, so IO-PAC is likely reasonably accurate for these sectors as well.

There are a few areas where IO-PAC can potentially be improved. First, some simplifying assumptions were made regarding product flow, and the wholesale seafood dealer mark-up and production function. Future research efforts will attempt to obtain better information about these components. Second, IO-

PAC relies on economic relationships that existed in 2006, however, technological change and prices change at relatively slow rates, so the model can likely be used for subsequent years with minimal error. Third, IO-PAC relies on a "generic" production function for all commercial vessels on the West Coast that are currently not covered by NWFSC cost-earnings surveys. As a result, the model is likely more accurate for those sectors that have direct survey coverage. The NWFSC is currently planning data collections that will reach vessels in classifications that currently lack coverage. As cost-earnings data from these vessel classifications become available, it will be incorporated into the model.

References

50 C.F.R. § 600.1102 Pacific Coast groundfish fee.

California Codes, Fish and Game Code Section 8040-8070.

Collection Report, www.nmfs.noaa.gov/mb/financial_services/buyback.htm

Federal Register /Vol. 68, No. 213 /Tuesday, November 4, 2003

Hewings, G. 1985. Regional Input-Output Analysis. Sage Publications, Beverly Hills, CA.

Kirkley, J.E.; Ryan, W.; Duberg, J. 2004. *Assessing the economic importance of commercial fisheries in the Mid-Atlantic region: A user's guide to the Mid-Atlantic input/output model*, Virginia Institute of Marine Science, National Oceanic and Atmospheric Administration Cooperative Marine Education and Research Award.

Lian, C. 2009. West Coast Limited Entry Earnings Survey Protocol and Results for 2004.

Lian, C. 2009. West Coast Open Access Groundfish and Salmon Troller Survey Protocol and Results for 2005.

Magnuson-Stevens Fishery Conservation and Management Act (Public Law 94-265)

Miller, R.E.; Blair, P.D. 1985. Input-output Analysis: Foundations and Extensions. Prentice-Hall, London.

Minnesota IMPLAN Group, Inc., 1725 Tower Drive West, Suite 140, Stillwater, MN 55082, www.implan.com.

Minnesota IMPLAN Group, Inc., *IMPLAN System (data and software)*, 1725 Tower Drive West, Suite 140, Stillwater, MN 55082, www.implan.com.

NMFS, Office of Management and Budget. 2009. *Pacific Coast Groundfish Fee*

Olson, D.; Lindall, S. 1999. *IMPLAN Professional Software, Analysis, and Data Guide*.

Oregon Revised Statute 508.505. 2009.

Pacific Fishery Management Council. 2004. *2005-2006 Pacific Coast Groundfish Fishery FINAL Environmental Impact Statement.*

Radtke H.D.; Davis S.W. 2000. *Description of the U.S. West Coast commercial Fishing Fleet and Seafood Processors*. Report prepared for the Pacific States Marine Fisheries Commission.

Revised Code of Washington chapter 82.27. 2009.

Richardson, H. 1985. Input-output and economic base multipliers: Looking backward and forward. *Journal of Regional Science.* 25:607-661.

Robison, M.H. 2009. *Input-Output Guidebook: A practical Guide for Regional Economic Impact Analysis*. Economic Modeling Specialists Inc., 1187 Alturas Drive, Moscow, ID 83483, www.economicmodeling.com.

Seung, C. K.; Waters, E. C. 2004. A Review of Regional Economic Models for Fisheries Management in the U.S. *Marine Resource Economics* 21(1): 101-124.

Seung, C. K.; Waters, E. C. 2005. A review of regional economic models for Alaska fisheries. Alaska Fish. Sci. Cent. Processed Rep. 2005-01.

Steinback, S.R. 2004. Using ready-made regional input-output models to estimate backward-linkage effects of exogenous output shocks. *The Review of Regional Studies* 34(1):57-71.

Steinback, S.R.; Thunberg, E.M. 2006. Northeast Region Commercial Fishing Input-Output Model. NOAA Technical Memorandum NMFS-NE-188.

Upton H. F. 2008. Commercial Fishery Disaster Assistance. *Congressional Research Service* Order Code RL34209.

Watson P.; Wilson, J; Davies S.; Thilmany D. 2008. Determining Economic Contributions in a

Recreational Industry: An Application to Colorado's Golf Industry. *Journal of Sports Economics* 9(6): 571-591.

Watson P.; Wilson, J; Thilmany D.; Winter, S. 2007. Determining Economic Contributions and Impacts: What is the difference and why do we care? *The Journal of Regional Analysis & Policy* 37(2):140-146.

Table D-1. Vessel Sectors Used in the IO-PAC (Source: Radtke and Davis, 2000)

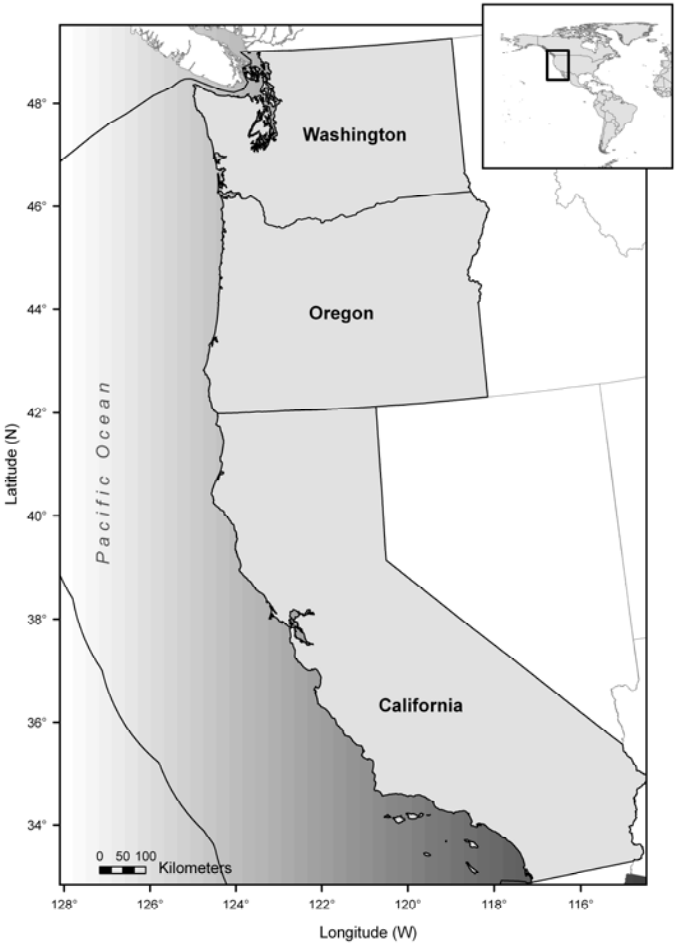
Order	Vessel Sector	Rule Description
1	Mothership/Catcher Processor	Identified by vessel documentation
2	Alaska Fisheries Vessel	Alaska revenue is greater than 50% of that vessel's total revenue
3	Pacific Whiting Onshore and Offshore Trawler	Pacific whiting PacFIN revenue plus U.S. West Coast offshore revenue is greater than 33% of that vessel's total revenue, and total revenue is greater than $100,000
4	Large Groundfish Trawler	groundfish (including sablefish, halibut, and California halibut) revenue from other than fixed gear is greater than 33% of that vessel's total revenue, and total revenue is greater than $100,000
5	Small Groundfish Trawler	groundfish (including sablefish, halibut, and California halibut) revenue from other than fixed gear is greater than 33% of that vessel's total revenue, and total revenue is greater than $15,000
6	Sablefish Fixed Gear	sablefish revenue from fixed gear is greater than 33% of that vessel's total revenue, and total revenue is greater than $15,000
7	Other Groundfish Fixed Gear	groundfish (including halibut and California halibut), other than sablefish, revenue from fixed gear is greater than 33% of that vessel's total revenue, and total revenue is greater than $15,000
8	Pelagic Netter	pelagic species revenue is greater than 33% of that vessel's total revenue, and total revenue is greater than $15,000
9	Migratory Netter	highly migratory species revenue from gear other than troll or line gear is greater than 33% of that vessel's total revenue, and total revenue is greater than $15,000
10	Migratory Liner	highly migratory species revenue from troll or line gear is greater than 33% of that vessel's total revenue, and total revenue is greater than $15,000
11	Shrimper	shrimp revenue is greater than 33% of that vessel's total revenue, and total revenue is greater than $15,000
12	Crabber	crab revenue is greater than 33% of that vessel's total revenue, and total revenue is greater than $15,000
13	Salmon Troller	salmon revenue from troll gear is greater than 33% of that vessel's total revenue, and total revenue is greater than $5,000
14	Salmon Netter	salmon revenue from gill or purse seine gear is greater than 33% of that vessel's total revenue, and total revenue is greater than $5,000
15	Other Netter	other species revenue from net gear is greater than 33% of that vessel's total revenue, and total revenue is greater than $15,000
16	Lobster Vessel	lobster revenue is greater than 33% of that vessel's total revenue, and total revenue is greater than $15,000
17	Diver Vessel	revenue from sea urchins, geoduck, or other species by diver gear is greater than 33% of that vessel's total revenue, and total revenue is greater than $5,000
18	Other > $15 Thousand	all other vessels not above who have total revenue greater than $15,000
19	Other <= $15 Thousand	all other vessels not above who have total revenue less than or equal to $15,000

Table D-2 Moorage Rates (2009)

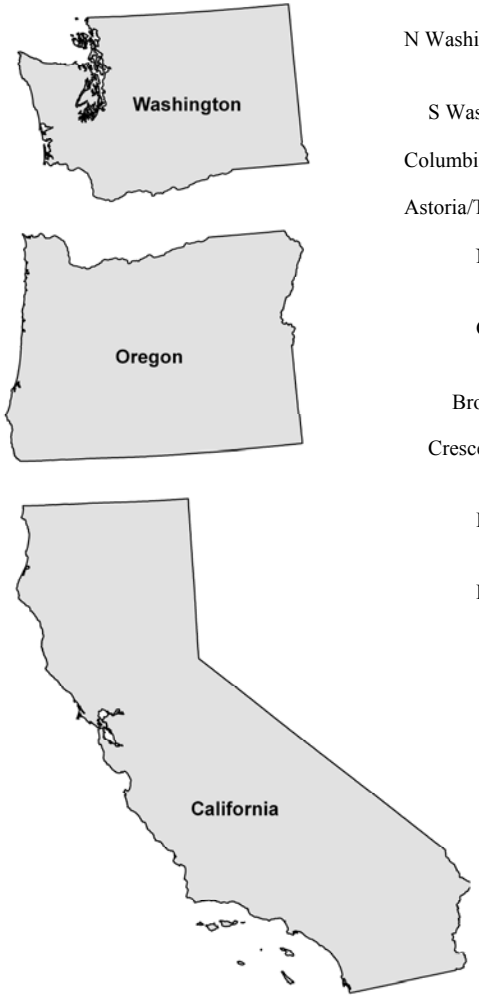
	Length of Vessel in Feet							
	85	**80**	**70**	**65**	**60**	**50**	**40**	**30**
California								
Crescent City			2381	2381	2041	1706	1450	1195
Humboldt Bay	3,315	3,120	2,730	2,535	2,340	1,950	1,560	1,170
Port of Los Angeles	4,325	4,070	3,562	3,307	3,053	2,544	2,035	1,526
San Francisco Fishermen's' Warf						1065	959	639
San Francisco Hyde Street		4,688	4,688	4,688	4,688	2,930	2,344	2,344
Half Moon Bay CA				6677	6178	5178	4178	3179
Morrow Bay			2797	2597	2398	1998	1598	1439
Moss Landing	5,523	5,198	4,549	4,224	3,899	3,249	2,599	1,949
San Diego B street pier	3,258	3,066	2,683	2,491	2,300	1,916	1,533	1,150
Bodega Bay		5,659	4,952	4,598	4,244	3,537	2,830	2,122
CA Average	4,105	4,300	3,543	3,722	3,460	2,607	2,109	1,671
Oregon								
Astoria	2,295	2,160	1,890	1,755	1,620	1,350	1,080	810
Newport	3,304	3,128	2,583	2,420	2,145	1,701	1,306	1,056
Coos Bay	2,295	2,160	1,890	1,755	1,620	1,350	1,080	827
OR Average	*2,631*	*2,483*	*2,121*	*1,977*	*1,795*	*1,467*	*1,155*	*898*
Washington								
Westport Grays Harbor	3,146	2,961	2,591	2,406	2,221	1,851	1,480	1,110
Seattle, Fisherman's Terminal	9,792	9,216	4,544	4,220	3,895	3,246	2,597	1,948
Ilwaco	1,597	1,503	1,315	1,221	1,127	635	508	381
Bellingham Squalicum Harbor						3967	3174	2380
Bellingham Blaine Harbor					4760	3967	3174	2380
WA Average	*4,845*	*4,560*	*2,817*	*2,616*	*3,001*	*2,733*	*2,186*	*1,640*
West Coast Average	**3,860**	**3,781**	**2,827**	**2,771**	**2,752**	**2,269**	**1,817**	**1,403**

Figure D-1 Study Areas in IO-PAC

A. West Cost Study Area



B. State Study Areas



C. Port Study Areas

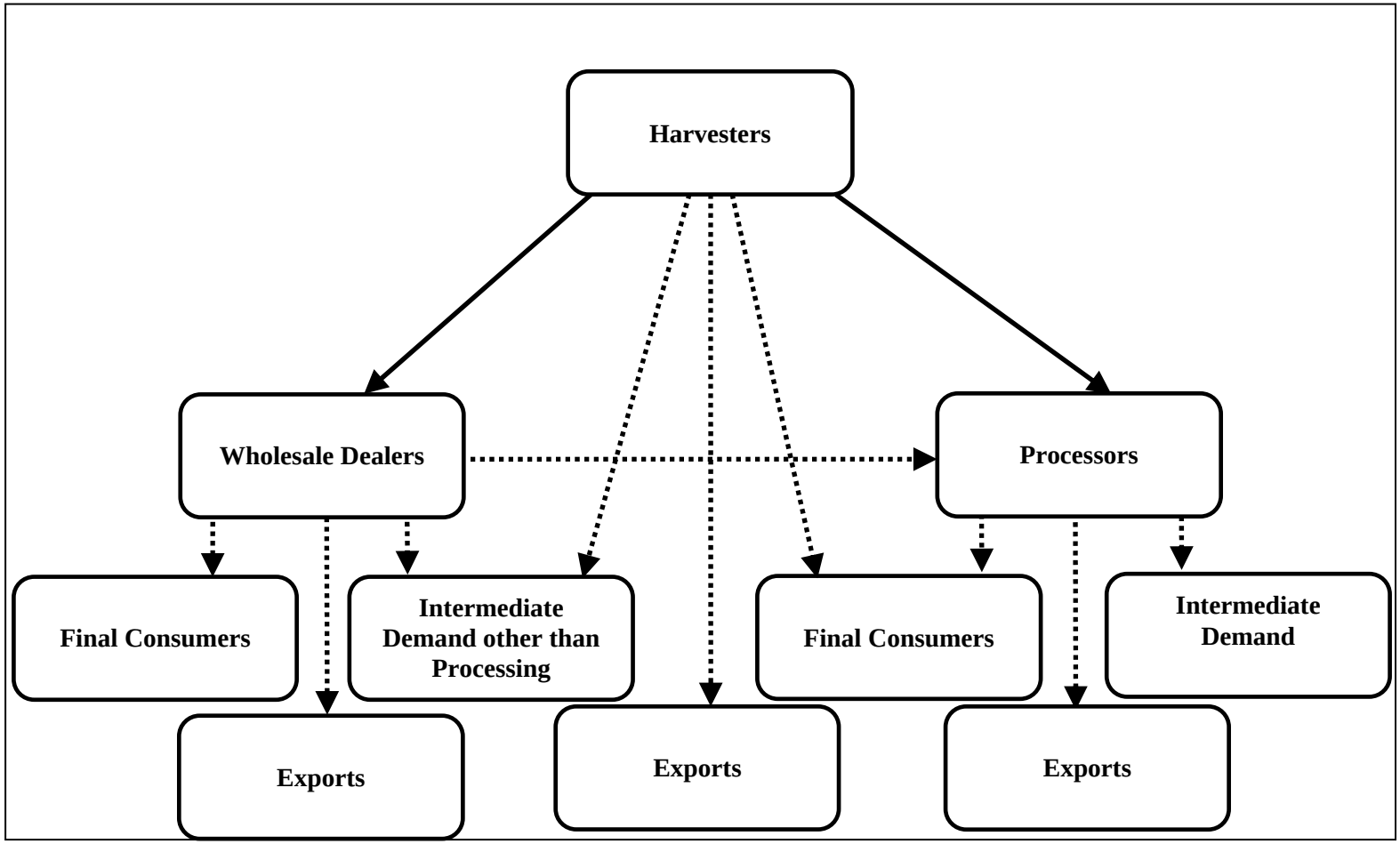


Figure D-2. IO-PAC Product Flows (Product flows illustrated by solid lines are captured in IO-PAC, and those illustrated with the dashed lines are excluded.)

Table D-3. Taxes on Commercial Fishing Vessel Landings

California (Levied on Landing Pounds)	**Rate Per Pound**
All species of fish and shellfish unless otherwise specified	$0.0013
Mollusks and crustaceans, excluding squid and crab	$0.0125
Crab	$0.0019
Squid	$0.0019
Salmon, based only on the weight in the round	$0.0500
Lobster	$0.0125
Abalone	$0.0125
Anchovies	$0.0013
Sardines	$0.0063
Mackerel	$0.0013
Halibut	$0.0125
Angel shark, based only on the weight in the round	$0.0113
Swordfish, based only on the weight in the round	$0.0125
Thresher shark, based only on the weight in the round	$0.0113
Bonito shark, based only on the weight in the round	$0.0113
Herring	$0.0125
Sea urchin	$0.0013
The following fish: Barracuda, Flying fish, Frogs, Giant sea bass, Saltwater worms, White sea bass, Yellowtail	$0.0125
Oregon	**Rate Per Dollar**
All species of fish and shellfish unless otherwise specified	1.09%
Salmon and steelhead	3.15%
Black/Blue Rockfish and Nearshore fish	5.00%
Washington	**Rate Per Dollar**
Food fish or eggs unless otherwise specified	2.30%
Chinook, Coho and Chum salmon, anadromous game fish and eggs	5.60%
Sea urchins and cucumbers	4.90%
Pink and Sockeye fish or eggs	3.40%
Oysters	0.10%
Federal Fees	**Rate Per Dollar**
Pacific Coast Groundfish (using trawl gear)	5.00%
California coastal Dungeness crab	1.24%
California pink shrimp	5.00%
Oregon coastal Dungeness crab	0.55%
Oregon pink shrimp	4.70%
Washington coastal Dungeness crab	0.16%
Washington pink shrimp	1.50%

Table D-4 Industry Categories and Associated IMPLAN Codes

IMPLAN Code	**Category Description**
510	Mothership catcher processor
511	Alaska fisheries vessel
512	Pacific whiting trawler
513	Large groundfish trawler
514	Small groundfish trawler
515	Sablefish fixed gear
516	Other groundfish fixed gear
517	Pelagic netter
518	Migratory netter

IMPLAN Code	Category Description
519	Migratory liner
520	Shrimper
521	Crabber
522	Salmon troller
523	Salmon netter
524	Other netter
525	Lobster vessel
526	Diver vessel
527	Other, more than 15K
528	Other, less than 15K
561	Bait ship
563	Wholesale seafood dealers

Table D-5. Commodities Added to IMPLAN and Associated Codes

IMPLAN Code	Species Gear Combinations
529	Whiting, At Sea
530	Whiting, Trawl
531	Whiting, Fixed Gear
532	Sablefish, Trawl
533	Sablefish, Fixed Gear
534	Dover/Thornyhead, Trawl
535	Dover/Thornyhead, Fixed Gear
536	Other Groundfish, Trawl
537	Other Groundfish, Fixed Gear
538	Other Groundfish, Net
539	Crab, Trawl
540	Crab, Fixed Gear
541	Crab, Net
542	Crab, Other Gear
543	Shrimp, Trawl
544	Shrimp, Fixed Gear
545	Salmon, Trawl
546	Salmon, Fixed Gear
547	Salmon, Net
548	HMS, Fixed Gear
549	HMS, Net
550	CPS, Trawl
551	CPS, Fixed Gear
552	CPS, Net
553	CPS, Other Gear
554	Halibut, Trawl
555	Halibut, Fixed Gear
556	Halibut, Net
557	Other Species, Trawl
558	Other Species, Fixed Gear
559	Other Species, Net
560	Other Species, Other Gear
562	Bait

Table D-6. Gear Groupings and Associated PacFin Variables

IO-PAC	GearID	Description
Trawl	TWL	TRAWLS EXCEPT SHRIMP TRAWLS
Trawl	TWS	SHRIMP TRAWLS
Fixed Gear	NTW	NON-TRAWL GEAR
Fixed Gear	HKL	HOOK AND LINE GEAR EXCEPT TROLL
Fixed Gear	TLS	TROLL GEAR
Fixed Gear	POT	POT AND TRAP GEAR
Net	NET	NET GEAR EXCEPT TRAWL
Other Gear	MSC	OTHER MISCELLANEOUS GEAR
Other Gear	DRG	DREDGE GEAR

Table D-7. IO-PAC Commodity Groupings

IO-PAC	SPID	Common Name	Scientific Name
CPS	CMCK	CHUB MACKEREL	SCOMBER JAPONICUS
CPS	JMCK	JACK MACKEREL	TRACHURUS SYMMETRICUS
CPS	NANC	NORTHERN ANCHOVY	ENGRAULIS MORDAX
CPS	PBNT	PACIFIC BONITO	SARDA CHILIENSIS
CPS	PHRG	PACIFIC HERRING	CLUPEA HARENGUS PALLASI
CPS	PSDN	PACIFIC SARDINE	SARDINOPS SAGAX
CPS	UMCK	UNSP. MACKEREL	N/A
Crab	BTCR	BAIRDI TANNER CRAB	CHIONOECETES BAIRDI
Crab	DCRB	DUNGENESS CRAB	CANCER MAGISTER
Crab	OCRB	OTHER CRAB	N/A
Crab	RCRB	ROCK CRAB	CANCER PRODUCTUS
Crab	UCRB	UNSPECIFIED CRAB	N/A
Crab	UKCR	UNSP. KING CRAB	N/A
Dover/Thornyhead	DOVR	DOVER SOLE	MICROSTOMUS PACIFICUS
Dover/Thornyhead	LSP1	NOM. LONGSPINE THORNYHEAD	N/A
Dover/Thornyhead	SSP1	NOM. SHORTSPINE THORNYHEAD	N/A
Dover/Thornyhead	THDS	THORNYHEADS (MIXED)	SEBASTOLOBUS SPP
Other Groundfish	ARR1	NOM. AURORA ROCKFISH	N/A
Other Groundfish	ART1	NOM. ARROWTOOTH FLOUNDER	N/A
Other Groundfish	ARTH	ARROWTOOTH FLOUNDER	ATHERESTHES STOMIAS
Other Groundfish	BCC1	NOM. BOCACCIO	N/A
Other Groundfish	BGL1	NOM. BLACKGILL ROCKFISH	N/A
Other Groundfish	BLK1	NOM. BLACK ROCKFISH	N/A
Other Groundfish	BLU1	NOM. BLUE ROCKFISH	N/A
Other Groundfish	BNK1	NOM. BANK ROCKFISH	N/A
Other Groundfish	BRW1	NOM. BROWN ROCKFISH	N/A
Other Groundfish	BRZ1	NOM. BRONZESPOTTED ROCKFISH	N/A
Other Groundfish	BSOL	BUTTER SOLE	ISOPSETTA ISOLEPIS
Other Groundfish	BYL1	NOM. BLACK-AND-YELLOW ROCKFISH	N/A
Other Groundfish	CBZ1	NOM. CABEZON	N/A
Other Groundfish	CBZN	CABEZON	SCORPAENICHTHYS MARMORATUS
Other Groundfish	CHN1	NOM. CHINA ROCKFISH	N/A
Other Groundfish	CLP1	NOM. CHILIPEPPER	N/A

IO-PAC	SPID	Common Name	Scientific Name
Other Groundfish	CNR1	NOM. CANARY ROCKFISH	N/A
Other Groundfish	COP1	NOM. COPPER ROCKFISH	N/A
Other Groundfish	CSOL	CURLFIN SOLE	PLEURONICHTHYS DECURRENS
Other Groundfish	CWC1	NOM. COWCOD ROCKFISH	N/A
Other Groundfish	DBR1	NOM. DARKBLOTCHED ROCKFISH	N/A
Other Groundfish	DSRK	SPINY DOGFISH	SQUALUS ACANTHIAS
Other Groundfish	DVR1	NOM. DOVER SOLE	N/A
Other Groundfish	EGL1	NOM. ENGLISH SOLE	N/A
Other Groundfish	EGLS	ENGLISH SOLE	PAROPHRYS VETULUS
Other Groundfish	FLG1	NOM. FLAG ROCKFISH	N/A
Other Groundfish	FSOL	FLATHEAD SOLE	HIPPOGLOSSOIDES ELASSODON
Other Groundfish	GBL1	NOM. GREENBLOTCHED ROCKFISH	N/A
Other Groundfish	GPH1	NOM. GOPHER ROCKFISH	N/A
Other Groundfish	GRDR	UNSP. GRENADIERS	N/A
Other Groundfish	GRS1	NOM. GRASS ROCKFISH	N/A
Other Groundfish	GSP1	NOM. GREENSPOTTED ROCKFISH	N/A
Other Groundfish	GSR1	NOM. GREENSTRIPED ROCKFISH	N/A
Other Groundfish	HNY1	NOM. HONEYCOMB ROCKFISH	N/A
Other Groundfish	KGL1	NOM. KELP GREENLING	N/A
Other Groundfish	KLP1	NOM. KELP ROCKFISH	N/A
Other Groundfish	LCOD	LINGCOD	OPHIODON ELONGATUS
Other Groundfish	LCD1	NOM. LINGCOD	N/A
Other Groundfish	LSRK	LEOPARD SHARK	TRIAKIS SEMIFASCIATA
Other Groundfish	MXR1	NOM. MEXICAN ROCKFISH	N/A
Other Groundfish	NUSF	NOR. UNSP. SHELF ROCKFISH	N/A
Other Groundfish	NUSP	NOR. UNSP. SLOPE ROCKFISH	N/A
Other Groundfish	NUSR	NOR. UNSP. NEAR-SHORE ROCKFISH	N/A
Other Groundfish	OFLT	OTHER FLATFISH	N/A
Other Groundfish	OGRN	OTHER GROUNDFISH	N/A
Other Groundfish	OLV1	NOM. OLIVE ROCKFISH	N/A
Other Groundfish	PCOD	PACIFIC COD	GADUS MACROCEPHALUS
Other Groundfish	PDAB	PACIFIC SANDDAB	CITHARICHTHYS SORDIDUS
Other Groundfish	PDB1	NOM. PACIFIC SANDDAB	CITHARICHTHYS SPP.
Other Groundfish	PLCK	WALLEYE POLLOCK	THERAGRA CHALCOGRAMMA
Other Groundfish	PNK1	NOM. PINK ROCKFISH	N/A
Other Groundfish	POP2	NOMINAL POP	N/A
Other Groundfish	PTR1	NOM. PETRALE SOLE	N/A
Other Groundfish	PTRL	PETRALE SOLE	EOPSETTA JORDANI
Other Groundfish	QLB1	NOM. QUILLBACK ROCKFISH	N/A
Other Groundfish	RATF	SPOTTED RATFISH	HYDROLAGUS COLLIEI
Other Groundfish	RCK2	UNSP. BOLINA RCKFSH	N/A
Other Groundfish	RCK4	UNSP. REDS RCKFSH	N/A
Other Groundfish	RCK5	UNSP. SMALL REDS RCKFSH	N/A
Other Groundfish	RCK6	UNSP. ROSEFISH RCKFSH	N/A
Other Groundfish	RCK7	UNSP. GOPHER RCKFSH	N/A
Other Groundfish	RDB1	NOM. REDBANDED ROCKFISH	N/A
Other Groundfish	REX	REX SOLE	GLYPTOCEPHALUS ZACHIRUS
Other Groundfish	REX1	NOM. REX SOLE	N/A
Other Groundfish	ROS1	NOM. ROSY ROCKFISH	N/A
Other Groundfish	RSOL	ROCK SOLE	LEPIDOPSETTA BILINEATA
Other Groundfish	RST1	NOM. ROSETHORN ROCKFISH	N/A
Other Groundfish	SBL1	NOM. SHORTBELLY ROCKFISH	N/A

IO-PAC	SPID	Common Name	Scientific Name
Other Groundfish	SCR1	NOM. CALIF. SCORPIONFISH	N/A
Other Groundfish	SFL1	NOM. STARRY FLOUNDER	N/A
Other Groundfish	SNS1	NOM. SPLITNOSE ROCKFISH	N/A
Other Groundfish	SPK1	NOM. SPECKLED ROCKFISH	N/A
Other Groundfish	SSO1	NOM. SAND SOLE	N/A
Other Groundfish	SSOL	SAND SOLE	PSETTICHTHYS MELANOSTICTUS
Other Groundfish	SSRK	SOUPFIN SHARK	GALEORHINUS ZYOPTERUS
Other Groundfish	STR1	NOM. STARRY ROCKFISH	N/A
Other Groundfish	STRY	STARRY FLOUNDER	PLATICHTHYS STELLATUS
Other Groundfish	SWS1	NOM. SWORDSPINE ROCKFISH	N/A
Other Groundfish	TGR1	NOM. TIGER ROCKFISH	N/A
Other Groundfish	TRE1	NOM. TREEFISH	N/A
Other Groundfish	UDAB	UNSP. SANDDABS	CITHARICHTHYS SPP.
Other Groundfish	UDNR	UNSP. DEEP NEAR-SHORE RF	N/A
Other Groundfish	UFLT	UNSP. FLATFISH	N/A
Other Groundfish	UPOP	UNSP. POP GROUP	N/A
Other Groundfish	URCK	UNSP. ROCKFISH	N/A
Other Groundfish	USHR	UNSP. NEAR-SHORE ROCKFISH	N/A
Other Groundfish	USLF	UNSP. SHELF ROCKFISH	N/A
Other Groundfish	USLP	UNSP. SLOPE ROCKFISH	N/A
Other Groundfish	UTRB	UNSP. TURBOTS	N/A
Other Groundfish	VRM1	NOM. VERMILLION ROCKFISH	N/A
Other Groundfish	WDW1	NOM. WIDOW ROCKFISH	N/A
Other Groundfish	YEY1	NOM. YELLOWEYE ROCKFISH	N/A
Other Groundfish	YTR1	NOM. YELLOWTAIL ROCKFISH	N/A
Halibut	CHL1	NOM. CALIF HALIBUT	N/A
Halibut	CHLB	CALIFORNIA HALIBUT	PARALICHTHYS CALIFORNICUS
Halibut	OCRK	OTHER CROAKER	N/A
Halibut	PHLB	PACIFIC HALIBUT	HIPPOGLOSSUS STENOLEPIS
Halibut	WCRK	WHITE CROAKER	GENYONEMUS LINEATUS
HMS	ALBC	ALBACORE	THUNNUS ALALUNGA
HMS	BTNA	BLUEFIN TUNA	THUNNUS THYNNUS
HMS	ETNA	BIGEYE TUNA	THUNNUS OBESUS
HMS	STNA	SKIPJACK TUNA	KATSUWONUS PELAMIS
HMS	UTNA	UNSPECIFIED TUNA	N/A
HMS	YLTL	YELLOWTAIL	SERIOLA LALANDI
HMS	YTNA	YELLOWFIN TUNA	THUNNUS ALBACARES
Other	ASRK	PACIFIC ANGEL SHARK	SQUATINA CALIFORNICA
Other	BCLM	BUTTER CLAM	SAXIDOMUS GIGANTEUS
Other	BMSL	BLUE OR BAY MUSSEL	MYTILUS EDULUS
Other	BSRK	BLUE SHARK	PRIONACE GLAUCA
Other	BTRY	BAT RAY	MYLIOBATIS CALIFORNICA
Other	CKLE	BASKET COCKLE	CLINOCARDIUM NUTTALLIL
Other	CMSL	CALIFORNIA MUSSEL	MYTILUS CALIFORNIANUS
Other	CUDA	PACIFIC BARRACUDA	SPHYRAENA ARGENTEA
Other	DRDO	DORADO	CORYPHAENA HIPPURUS
Other	EELS	UNSPECIFIED EELS	N/A
Other	ESTR	EASTERN OYSTER	CRASSOSTREA VIRGINICA
Other	EULC	EULACHON	THALEICHTHYS PACIFICUS
Other	EURO	EUROPEAN OYSTER	OSTREA EDULIS
Other	GBAS	GIANT SEA BASS	STEREOLEPIS GIGAS
Other	GCLM	GAPER CLAM	TRESUS CAPAX
Other	GDUK	GEODUCK	PANOPE ABRUPTA
Other	GSTG	GREEN STURGEON	ACIPENSER MEDIROSTRIS

IO-PAC	SPID	Common Name	Scientific Name
Other	HCLM	HORSE CLAMS	TRESUS SPP.
Other	ISRK	BIGEYE THRESHER SHARK	ALOPIAS SUPERCILIOSUS
Other	KSTR	KUMAMOTO OYSTER	CRASSOSTREA GIGAS
Other	LCLM	NATIVE LITTLENECK	PROTOTHACA STAMINEA
Other	LOBS	CALIF. SPINY LOBSTER	PANULIRUS INTERRUPTUS
Other	LSTR	OLYMPIA OYSTER	OSTREA LURIDA
Other	MACL	MUD CLAMS	MACOMA SPP.
Other	MAKO	SHORTFIN MAKO SHARK	ISURUS OXYRINCHUS
Other	MCLM	MANILA CLAM	TAPES PHILIPPINARUM
Other	MEEL	MONKEYFACE EEL	CEBIDICHTHYS VIOLACEUS
Other	MISC	MISC. FISH/ANIMALS	N/A
Other	MSC2	MISCELLANEOUS FISH	N/A
Other	MSHP	PLAINFIN MIDSHIPMAN	PORICHTHYS NOTATUS
Other	MSQD	MARKET SQUID	LOLIGO OPALESCENS
Other	OABL	OTHER ABALONE	N/A
Other	OBAS	OTHER BASS	N/A
Other	OCTP	UNSP. OCTOPUS	N/A
Other	OMSK	OTHER MOLLUSKS	N/A
Other	OSKT	OTHER SKATES	OTHER RAJIDAE
Other	OSRK	OTHER SHARK	N/A
Other	OURC	OTHER SEA URCHINS	N/A
Other	PROW	PROWFISH	ZAPRORA SILENUS
Other	PSRK	PELAGIC THRESHER SHARK	ALOPIAS PELAGICUS
Other	PSTR	PACIFIC OYSTER	CRASSOSTREA GIGAS
Other	RCLM	RAZOR CLAM	SILIQUA PATULA
Other	RURC	RED SEA URCHIN	STRONGYLOCENTROTUS FRANCISCANUS
Other	SCLM	SOFT-SHELLED CLAM	MYA ARENARIA
Other	SCLP	UNSP. SCULPIN	COTTIDAE SPP.
Other	SHAD	UNSPECIFIED SHAD	N/A
Other	SHP1	NOM. CALIFORNIA SHEEPHEAD	N/A
Other	SMLT	UNSP. SMELT	N/A
Other	SQID	UNSP. SQUID	DECAPODA
Other	SRFP	SURFPERCH SPP.	SURFPERCH SPP.
Other	SWRD	SWORDFISH	XIPHIAS GLADIUS
Other	TSRK	COMMON THRESHER SHARK	ALOPIAS VULPINUS
Other	UCLM	UNSPECIFIED CLAM	N/A
Other	UECH	UNSPECIFIED ECHINODERM	N/A
Other	UHAG	UNSPECIFIED HAGFISH	EPTATRETUS SP.
Other	UMSK	UNSPECIFIED MOLLUSKS	N/A
Other	USCU	UNSP. SEA CUCUMBERS	N/A
Other	USKT	UNSP. SKATE	UNSPECIFIED RAJIDAE
Other	USRK	UNSP. SHARK	N/A
Other	WBAS	WHITE SEABASS	ATRACTOSCION NOBILIS
Other	WEEL	WOLF EEL	ANARRICHTHYS OCELLATUS
Other	WSTG	WHITE STURGEON	ACIPENSER TRANSMONTANUS
Salmon	CHNK	CHINOOK SALMON	ONCORHYNCHUS TSHAWYTSCHA
Salmon	CHUM	CHUM SALMON	ONCORHYNCHUS KETA
Salmon	COHO	COHO SALMON	ONCORHYNCHUS KISUTCH
Salmon	PINK	PINK SALMON	ONCORHYNCHUS GORBUSCHA
Salmon	SOCK	SOCKEYE SALMON	ONCORHYNCHUS NERKA
Salmon	STLH	STEELHEAD	ONCORHYNCHUS MYKISS
Salmon	USMN	UNSP. SALMON	N/A
Sablefish	SABL	SABLEFISH	ANOPLOPOMA FIMBRIA

IO-PAC	SPID	Common Name	Scientific Name
Shrimp	BSRM	UNSP. BAIT SHRIMP	N/A
Shrimp	GPRW	GOLDEN PRAWN	PENAEUS CALIFORNIENSIS
Shrimp	GSRM	GHOST SHRIMP	CALLIANASSA CALIFORNIENSIS
Shrimp	MSRM	MUD SHRIMP	UPOGEBIA PUGETTENSIS
Shrimp	OSRM	OTHER SHRIMP	N/A
Shrimp	PSHP	PINK SHRIMP	PANDALUS JORDANI
Shrimp	RPRW	RIDGEBACK PRAWN	EUSICYONIA INGENTUS
Shrimp	SPRW	SPOTTED PRAWN	PANDALUS PLATYCEROS
Shrimp	USRM	UNSP. OCEAN SHRIMP	N/A
Whiting	PWHT	PACIFIC WHITING	MERLUCCIUS PRODUCTUS

Table D-8. Landings by Vessel Type and Commodity Code, 2006 Value

IMPLAN Code		Vessel Classification 510	511	512	513	514
529	Whiting, At Sea					
530	Whiting, Trawl			16,049,437	1,135,712	126,452
531	Whiting, Fixed Gear					
532	Sablefish, Trawl			1,068,257	5,730,702	138,606
533	Sablefish, Fixed Gear			138,319	28,729	38,053
534	Dover/Thornyhead, Trawl			551,623	4,604,122	83,753
535	Dover/Thornyhead, Fixed Gear			21	2,423	45
536	Other Groundfish, Trawl			665,810	9,788,725	352,668
537	Other Groundfish, Fixed Gear			235	17,014	3,888
538	Other Groundfish, Net				3,284	45,670
539	Crab, Trawl			35	1,850	77
540	Crab, Fixed Gear			3,349,458	6,782,547	36,395
541	Crab, Net				6,090	1,894
542	Crab, Other Gear					
543	Shrimp, Trawl			21,632	1,300,335	1,182
544	Shrimp, Fixed Gear					
545	Salmon, Trawl			35,861	1,326	1,147
546	Salmon, Fixed Gear				87,169	82,705
547	Salmon, Net					
548	HMS, Fixed Gear			3,629	123,084	
549	HMS, Net				46	1,724
550	CPS, Trawl			6,422	446	
551	CPS, Fixed Gear					
552	CPS, Net				7	1,342
553	CPS, Other Gear					
554	Halibut, Trawl			4,257	1,112,077	597,291
555	Halibut, Fixed Gear			13,817	31,021	41,902
556	Halibut, Net				77,175	198,605
557	Other Species, Trawl			66,680	355,360	39,601
558	Other Species, Fixed Gear			865	487	41,364
559	Other Species, Net				36,319	169,934
560	Other Species, Other Gear					
	Total			**21,976,357**	**31,226,049**	**2,004,297**

IMPLAN Code		Vessel Classification 515	516	517	518
529	Whiting, At Sea				
530	Whiting, Trawl				
531	Whiting, Fixed Gear	76	564		
532	Sablefish, Trawl	53,272			
533	Sablefish, Fixed Gear	7,919,824	661,001	40,726	23
534	Dover/Thornyhead, Trawl	47,975			
535	Dover/Thornyhead, Fixed Gear	269,410	951,126		
536	Other Groundfish, Trawl	72,835			
537	Other Groundfish, Fixed Gear	499,699	1,711,622	2,111	7,336
538	Other Groundfish, Net			24	20,694
539	Crab, Trawl				
540	Crab, Fixed Gear	2,822,517	787,886	608,683	
541	Crab, Net				64
542	Crab, Other Gear				
543	Shrimp, Trawl	40,758			

544	Shrimp, Fixed Gear	5,175			
545	Salmon, Trawl				
546	Salmon, Fixed Gear	913,815	119,999	11,461	63,198
547	Salmon, Net	97,408	30,329	431,989	
548	HMS, Fixed Gear	248,577	15,015	1,464	326,417
549	HMS, Net			99,204	28,216
550	CPS, Trawl				
551	CPS, Fixed Gear	7	1,383	14,157	10
552	CPS, Net	482		13,428,930	2,525
553	CPS, Other Gear			130	
554	Halibut, Trawl	2,167	191		578
555	Halibut, Fixed Gear	1,937,697	4,419,302	374	57
556	Halibut, Net			4,532	24,823
557	Other Species, Trawl	580			
558	Other Species, Fixed Gear	103,281	35,273	14,958	5,768
559	Other Species, Net	294	23,352	26,808,914	2,481,457
560	Other Species, Other Gear	2,176	22,474		556,267
	Total	**15,038,025**	**8,779,517**	**41,467,657**	**3,517,434**

		Vessel Classification			
IMPLAN Code		**519**	**520**	**521**	**522**
529	Whiting, At Sea				
530	Whiting, Trawl		248	120,114	
531	Whiting, Fixed Gear			75	
532	Sablefish, Trawl			404,879	
533	Sablefish, Fixed Gear	164,342	22,474	5,692,071	325,330
534	Dover/Thornyhead, Trawl			265,548	
535	Dover/Thornyhead, Fixed Gear	85		6,655	1,133
536	Other Groundfish, Trawl		5,046	428,986	
537	Other Groundfish, Fixed Gear	5,537	20,897	382,240	94,442
538	Other Groundfish, Net			2,321	
539	Crab, Trawl	738	149		
540	Crab, Fixed Gear	2,456,793	3,265,246	120,966,903	156,663
541	Crab, Net		212	10,137	
542	Crab, Other Gear			23,912	1,677
543	Shrimp, Trawl	26,239	5,068,270	685,320	
544	Shrimp, Fixed Gear		4,073,820	784,724	
545	Salmon, Trawl			4	
546	Salmon, Fixed Gear	819,124	9,952	2,857,295	4,633,803
547	Salmon, Net		85,904	3,952,646	21,664
548	HMS, Fixed Gear	17,765,249	123,245	4,887,944	204,346
549	HMS, Net	2,424		2,803	146
550	CPS, Trawl		40	11	
551	CPS, Fixed Gear	2,884	36	894	357
552	CPS, Net	38		262,979	11
553	CPS, Other Gear			2,152	
554	Halibut, Trawl		20,490	10,972	
555	Halibut, Fixed Gear	140,159	49,680	2,536,750	279,460
556	Halibut, Net		582		
557	Other Species, Trawl		69,948	13,421	
558	Other Species, Fixed Gear	116,537	575,411	434,165	372

559	Other Species, Net	160,485	1,918	397,151	514
560	Other Species, Other Gear	80,051	263	39,955	
	Total	**21,740,683**	**13,393,830**	**145,173,028**	**5,719,919**

		Vessel Classification			
IMPLAN Code		**523**	**524**	**525**	**526**
529	Whiting, At Sea				
530	Whiting, Trawl				
531	Whiting, Fixed Gear				
532	Sablefish, Trawl				
533	Sablefish, Fixed Gear	11,554		17,637	
534	Dover/Thornyhead, Trawl				
535	Dover/Thornyhead, Fixed Gear			33	
536	Other Groundfish, Trawl				
537	Other Groundfish, Fixed Gear	160	5,379	65,764	51,480
538	Other Groundfish, Net	3,006	19,625	758	
539	Crab, Trawl			40	
540	Crab, Fixed Gear	492,963	50,117	190,637	587
541	Crab, Net			365	
542	Crab, Other Gear				148
543	Shrimp, Trawl	8,032			
544	Shrimp, Fixed Gear	89,887		19,811	
545	Salmon, Trawl				
546	Salmon, Fixed Gear	17,435	6,087	10,338	
547	Salmon, Net	18,003,891	18,040		
548	HMS, Fixed Gear	28		5,946	58
549	HMS, Net		13,205		
550	CPS, Trawl				
551	CPS, Fixed Gear			5,894	
552	CPS, Net	7,316	459	18,440	
553	CPS, Other Gear				
554	Halibut, Trawl		96	224	
555	Halibut, Fixed Gear	14,731	827	225,269	46,328
556	Halibut, Net		79,352	22,218	
557	Other Species, Trawl		45	84	58
558	Other Species, Fixed Gear	744	165,103	6,818,270	34,364
559	Other Species, Net	524,956	1,607,932	39,449	1,730
560	Other Species, Other Gear			71,345	5,264,819
	Total	**19,174,704**	**1,966,268**	**7,512,522**	**5,399,571**

		Vessel Classification		
IMPLAN Code		**527**	**528**	**Total for all Vessel Classifications**
529	Whiting, At Sea			
530	Whiting, Trawl			17,431,963
531	Whiting, Fixed Gear		12	727
532	Sablefish, Trawl	323	2,810	7,398,850

533	Sablefish, Fixed Gear	122,157	424,009	15,606,247
534	Dover/Thornyhead, Trawl	467	1,973	5,555,461
535	Dover/Thornyhead, Fixed Gear	1,193	36,329	1,268,452
536	Other Groundfish, Trawl	5,084	16,031	11,335,185
537	Other Groundfish, Fixed Gear	10,211	804,012	3,682,029
538	Other Groundfish, Net	107	13,314	108,804
539	Crab, Trawl		235	3,125
540	Crab, Fixed Gear	101,143	1,705,317	143,773,854
541	Crab, Net	193	1,937	20,892
542	Crab, Other Gear	250	36,397	62,383
543	Shrimp, Trawl	16,300	26,905	7,194,972
544	Shrimp, Fixed Gear	1,168	82,518	5,057,102
545	Salmon, Trawl			38,338
546	Salmon, Fixed Gear	64,544	461,978	10,158,902
547	Salmon, Net	628,156	1,470,652	24,740,680
548	HMS, Fixed Gear	5,452	390,513	24,100,967
549	HMS, Net		4,008	151,777
550	CPS, Trawl	2		6,920
551	CPS, Fixed Gear	1,859	11,647	39,129
552	CPS, Net		285,975	14,008,503
553	CPS, Other Gear			2,282
554	Halibut, Trawl	16,092	27,270	1,791,705
555	Halibut, Fixed Gear	185,968	312,887	10,236,229
556	Halibut, Net	4,238	54,062	465,586
557	Other Species, Trawl	92,431	7,696	645,904
558	Other Species, Fixed Gear	592,652	277,637	9,217,251
559	Other Species, Net	190,355	247,098	32,691,859
560	Other Species, Other Gear	80,754,211	417,122	87,208,682
	Total	**82,794,555**	**7,120,343**	**434,004,758**

Table D-9. WA Enhanced Food Fish Tax by NAICS, Calendar Year 2006

NAICS	NAICS Title	Share of Tax
114111	FinFishing	12.6%
114112	Shellfish Fishing	1.1%
311711	Seafood Canning	12.1%
311712	Fresh and Frozen Seafood Processing	30.1%
423910	Sporting and Recreational Goods and Supplies Merchant Wholesalers	0.1%
424460	Fish and Seafood Merchant Wholesalers	30.2%
424490	Other Grocery and Related Products Merchant Wholesalers	4.2%
445220	Fish and Seafood Markets	4.6%
451110	Sporting Goods Stores	0.1%
454390	Other Direct Selling Establishments	1.3%
713930	Marinas	0.7%
999999	Miscellaneous	2.9%

Table D-10. Commercial Fishing Production Functions. ***Percentages not shown due to confidentiality restrictions.

Expenditure Categories	Mothership Catcher/ Processor	Alaska	Pacific Whiting Trawler	Large Groundfish Trawler	Small Groundfish Trawler	Sablefish Fixed Gear	Other Groundfish Fixed Gear	Migratory Liner	Pelagic Netter	Migratory Netter
					Percentage Distribution					
Captain			14.3%	18.9%	18.9%	18.2%	30.1%	20.1%	20.1%	20.1%
Crew			18.4%	20.9%	20.9%	33.6%	18.1%	20.2%	20.2%	20.2%
Fuel & lubricants			12.0%	12.4%	12.4%	4.5%	12.0%	9.3%	9.3%	9.3%
Food and crew provisions			1.4%	1.1%	1.1%	1.6%	2.8%	1.8%	1.8%	1.8%
Ice			0.1%	1.9%	1.9%	0.3%	0.7%	1.0%	1.0%	1.0%
Bait			0.4%	1.2%	1.2%	4.5%	5.6%	2.4%	2.4%	2.4%
Repair & maintenance: vessel, gear, and equipment			19.8%	18.2%	18.2%	8.0%	17.2%	15.5%	15.5%	15.5%
Insurance			***	5.7%	5.7%	2.2%	1.0%	3.8%	3.8%	3.8%
Interest and financial services			***	1.7%	1.7%	0.9%	1.0%	1.1%	1.1%	1.1%
Purchases of permits			1.0%	1.8%	1.8%	0.6%	0.5%	1.1%	1.1%	1.1%
Leasing of permits			0.0%	1.2%	1.2%	5.8%	0.1%	1.0%	1.0%	1.0%
Moorage			0.3%	0.8%	0.8%	1.0%	2.0%	1.3%	1.3%	1.3%
Landings Taxes			3.7%	4.1%	1.1%	0.9%	0.6%	2.0%	2.0%	2.0%
Other Miscellaneous			5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
Proprietary income			13.9%	5.2%	8.2%	12.9%	3.4%	14.5%	14.5%	14.5%
Total			100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Expenditure Categories	Shrimper	Crabber	Salmon Troller	Salmon Netter	Other Netter	Lobster	Diver	Other >15,000	Other <15,000
					Percentage Distribution				
Captain	20.1%	17.3%	30.2%	20.1%	20.1%	20.1%	20.1%	***	10.8%
Crew	20.2%	22.7%	12.1%	20.2%	20.2%	20.2%	20.2%	***	1.9%
Fuel & lubricants	9.3%	5.7%	11.6%	9.3%	9.3%	9.3%	9.3%	***	11.1%
Food and crew provisions	1.8%	1.1%	4.0%	1.8%	1.8%	1.8%	1.8%	***	2.1%
Ice	1.0%	0.5%	1.8%	1.0%	1.0%	1.0%	1.0%	***	0.7%
Bait	2.4%	3.1%	1.4%	2.4%	2.4%	2.4%	2.4%	***	0.3%
Repair & maintenance: vessel, gear, and equipment	15.5%	12.0%	20.3%	15.5%	15.5%	15.5%	15.5%	***	9.5%
Insurance	3.8%	3.1%	2.7%	3.8%	3.8%	3.8%	3.8%	***	1.2%
Interest and financial services	1.1%	0.5%	1.4%	1.1%	1.1%	1.1%	1.1%	***	0.5%
Purchases of permits	1.1%	0.7%	1.5%	1.1%	1.1%	1.1%	1.1%	***	0.8%
Leasing of permits	1.0%	0.4%	0.0%	1.0%	1.0%	1.0%	1.0%	***	0.0%
Moorage	1.3%	0.7%	3.1%	1.3%	1.3%	1.3%	1.3%	***	3.3%
Landings Taxes	2.0%	1.0%	1.3%	2.0%	2.0%	2.0%	2.0%	***	0.7%
Other Miscellaneous	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	***	5.0%
Proprietary income	14.5%	26.2%	3.6%	14.5%	14.5%	14.5%	14.5%	***	52.1%
Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Table D-11. Seafood Wholesale Dealer Production Function

Expenditure Category	Seafood Wholesale Dealer
Ice	2.80%
Packaging: boxes	2.70%
Shipping	4.10%
Storage	14.70%
Advertising	4.00%
Rent	6.80%
Repair & Maintenance: building	6.90%
Vehicle	4.10%
Utilities: electric	1.37%
Utilities: gas	1.37%
Utilities: telephone	1.37%
Insurance	4.10%
Professional fees	0.70%
Building principal payment	4.00%
Interest payment: building	1.40%
Bank service charge	0.08%
Taxes	2.12%
Employee compensation	33.35%
Proprietary income	4.05%
Total	100.00%

Table D-12. IMPLAN Tables. Table reprinted nearly in entirety from Steinback and Thunberg (2006).

Table Name	Description
Industry/Commodity Codes Type Codes	Codes (Modified)
Margins Codes	Codes
*US Absorption Table *US Absorption Totals *US Byproducts Table *SACommodity Sales *SAEmployment *SAFinal Demands *SAForeign Exports *SAOutput *SAValue Added	Raw input data (Modified)
SATransfers	Raw input study area data
*Observed RPCs *RPC Methods	Raw input data (Modified)
Margins Deflators	Raw input data
General Information Model Specs Multiplier Specs	Model-building information
SARatios	Ratios for impact and multiplier calculations
IMCommodity Transactions IMEvents IMFactor Transactions IMGroups IMIndustry Transactions IMInstitutions Transactions IMMargins IMProjects	Impact report data (Empty before impact analysis)
Regional Absorption Regional Byproducts Regional Commodity Balances Regional Direct Institutional Requirements Regional Factor Balances Regional Industry Balances Regional Institution Balances Regional Institution Demand Regional IxI Regional Market Shares Regional Multipliers Induced Regional Multipliers Type I Regional SAM Balances Regional SAM Balances Aggregated Regional SAM Balances Industry Detail Regional SAM Balances IxI Regional SAM Balances IxI Industry Detail Regional Sam Distribution Regional Value Added Coefficients	Output/report data for regional I-O model (Empty before impact analysis)
rptEC Multipliers rptEmployment Multipliers rptIBT Multipliers rptOPTI Multipliers rptOutput Multipliers rptPersonal Income Multipliers rptPropInc Multipliers rptTotal VA Multipliers	Ouput reports
rptSAFinal Demands rptSAIndustry Data	Data from SAFinal Demands and SAForeign Exports (Modified) Data from SAOutput, SAEmployment & SAValue Added (Modified)
SAM Rollup	SAM report data
Tax Impacts	Tax report data
Type Code Rollup	Type code report data
CGE Account	Output data for computable general equilibrium models

Table D-13. Impact of Reduced Harvest among Sablefish Fixed Gear Vessels

Aggregated Output Impact Report (2009 dollars)

Industry	Direct	Indirect	Induced	Total
11 Ag, Forestry, Fish & Hunting	0	-12,863	-4,186	-17,049
21 Mining	0	-2,829	-2,061	-4,890
22 Utilities	0	-12,670	-9,947	-22,616
23 Construction	0	-9,481	-3,432	-12,913
31-33 Manufacturing	-756,412	-47,847	-74,074	-878,333
42 Wholesale Trade	0	-126,517	-35,489	-162,006
48-49 Transportation & Warehousing	0	-45,520	-16,217	-61,736
44-45 Retail trade	0	-22,131	-71,503	-93,635
51 Information	0	-13,633	-22,645	-36,278
52 Finance & insurance	0	-37,516	-54,589	-92,106
53 Real estate & rental	0	-25,595	-32,416	-58,011
54 Professional- scientific & tech services	0	-43,213	-29,217	-72,431
55 Management of companies	0	-47,187	-7,835	-55,022
56 Administrative & waste services	0	-18,581	-13,163	-31,743
61 Educational services	0	-240	-9,578	-9,818
62 Health & social services	0	-12	-86,372	-86,384
71 Arts- entertainment & recreation	0	-9,719	-9,098	-18,817
72 Accommodation & food services	0	-5,856	-32,900	-38,756
81 Other services	0	-10,052	-24,500	-34,553
92 Government & non NAICs	0	-8,099	-78,316	-86,415
Sablefish fixed gear	-500,000	0	0	-500,000
Bait Ship	0	-22,309	0	-22,309
Wholesale Seafood	-100,000	0	0	-100,000
Total	**-1,356,412**	**-521,870**	**-617,538**	**-2,495,820**

Table D-14. (continued)

Aggregated Value Added Impact Report (2009 dollars)

Industry	Direct	Indirect	Induced	Total
11 Ag, Forestry, Fish & Hunting	0	-2,302	-1,554	-3,856
21 Mining	0	-1,627	-1,185	-2,812
22 Utilities	0	-7,145	-6,362	-13,507
23 Construction	0	-4,493	-1,695	-6,188
31-33 Manufacturing	-154,787	-9,345	-17,619	-181,750
42 Wholesale Trade	0	-85,321	-23,933	-109,254
48-49 Transportation & Warehousing	0	-28,418	-9,040	-37,458
44-45 Retail trade	0	-14,917	-47,817	-62,734
51 Information	0	-6,793	-11,110	-17,903
52 Finance & insurance	0	-22,450	-30,940	-53,389
53 Real estate & rental	0	-16,666	-21,500	-38,166
54 Professional- scientific & tech services	0	-22,943	-16,410	-39,353
55 Management of companies	0	-28,348	-4,707	-33,054
56 Administrative & waste services	0	-11,280	-8,264	-19,544

61 Educational services	0	-140	-5,802	-5,942
62 Health & social services	0	-6	-55,027	-55,033
71 Arts- entertainment & recreation	0	-5,827	-5,664	-11,491
72 Accommodation & food services	0	-3,497	-17,367	-20,864
81 Other services	0	-5,324	-13,399	-18,723
92 Government & non NAICs	0	-4,299	-63,858	-68,158
Sablefish fixed gear	-360,311	0	0	-360,311
Bait Ship	0	-8,709	0	-8,709
Wholesale Seafood	-43,520	0	0	-43,520
Total	**-558,618**	**-289,850**	**-363,251**	**-1,211,719**

Table d-14. (continued)

Aggregated Employment Impact Report (Full and Part Time)

Industry	Direct	Indirect	Induced	Total
11 Ag, Forestry, Fish & Hunting	0	-0.3	0	-0.3
21 Mining	0	0	0	0
22 Utilities	0	0	0	0
23 Construction	0	-0.1	0	-0.1
31-33 Manufacturing	-2.4	-0.1	-0.2	-2.6
42 Wholesale Trade	0	-0.6	-0.2	-0.8
48-49 Transportation & Warehousing	0	-0.4	-0.1	-0.6
44-45 Retail trade	0	-0.3	-0.8	-1.1
51 Information	0	0	-0.1	-0.1
52 Finance & insurance	0	-0.1	-0.2	-0.4
53 Real estate & rental	0	-0.1	-0.2	-0.3
54 Professional- scientific & tech services	0	-0.3	-0.2	-0.5
55 Management of companies	0	-0.2	0	-0.2
56 Administrative & waste services	0	-0.3	-0.2	-0.5
61 Educational services	0	0	-0.2	-0.2
62 Health & social services	0	0	-0.9	-0.9
71 Arts- entertainment & recreation	0	-0.1	-0.1	-0.3
72 Accommodation & food services	0	-0.1	-0.5	-0.6
81 Other services	0	-0.1	-0.4	-0.5
92 Government & non NAICs	0	0	-0.1	-0.1
Sablefish fixed gear	-14.2	0	0	-14.2
Wholesale Seafood	-0.8	0	0	-0.8
Total	**-17.4**	**-3.1**	**-4.4**	**-25**

Table D-14. Impact of Reduced Sablefish Harvest Using Fixed Gear (Commodity Scenario

Aggregated Output Impact Report (2009 dollars)

Industry	Direct	Indirect	Induced	Total
11 Ag, Forestry, Fish & Hunting	0	-12,858	-4,174	-17,032
21 Mining	0	-3,037	-2,055	-5,092
22 Utilities	0	-12,710	-9,918	-22,628
23 Construction	0	-9,091	-3,423	-12,514
31-33 Manufacturing	-756,412	-50,524	-73,861	-880,797
42 Wholesale Trade	0	-128,903	-35,387	-164,290
48-49 Transportation & Warehousing	0	-45,498	-16,170	-61,669
44-45 Retail trade	0	-23,714	-71,298	-95,011
51 Information	0	-13,741	-22,580	-36,321
52 Finance & insurance	0	-38,496	-54,433	-92,929
53 Real estate & rental	0	-25,752	-32,322	-58,074
54 Professional- scientific & tech services	0	-43,414	-29,133	-72,548
55 Management of companies	0	-47,338	-7,812	-55,150
56 Administrative & waste services	0	-18,692	-13,125	-31,816
61 Educational services	0	-243	-9,551	-9,794
62 Health & social services	0	-12	-86,124	-86,136
71 Arts- entertainment & recreation	0	-9,757	-9,072	-18,829
72 Accommodation & food services	0	-5,887	-32,806	-38,693
81 Other services	0	-10,080	-24,430	-34,511
92 Government & non NAICs	0	-8,119	-78,092	-86,211
Pacific whiting trawler	-4,432	0	0	-4,432
Large groundfish trawler	-920	0	0	-920
Small groundfish trawler	-1,219	0	0	-1,219
Sablefish fixed gear	-253,739	0	0	-253,739
Other groundfish fixed gear	-21,177	0	0	-21,177
Pelagic netter	-1,305	0	0	-1,305
Migratory liner	-5,265	0	0	-5,265
Shrimper	-720	0	0	-720
Crabber	-182,365	0	0	-182,365
Salmon troller	-10,423	0	0	-10,423
Salmon netter	-370	0	0	-370
Lobster vessel	-565	0	0	-565
Other, more than 15K	-3,914	0	0	-3,914
Other, less than 15K	-13,585	0	0	-13,585
Bait Ship	0	-18,839	0	-18,839
Wholesale Seafood	-100,000	0	0	-100,000
Total	**-1,356,412**	**-526,706**	**-615,765**	**-2,498,883**

Table D-15 (continued)

Aggregated Value Added Impact Report (2009 dollars)

Industry	Direct	Indirect	Induced	Total
11 Ag, Forestry, Fish & Hunting	0	-2,301	-1,550	-3,850
21 Mining	0	-1,747	-1,182	-2,929
22 Utilities	0	-7,170	-6,343	-13,513
23 Construction	0	-4,312	-1,690	-6,002
31-33 Manufacturing	-154,787	-9,706	-17,568	-182,061
42 Wholesale Trade	0	-86,930	-23,864	-110,794
48-49 Transportation & Warehousing	0	-28,375	-9,014	-37,389
44-45 Retail trade	0	-15,996	-47,679	-63,676
51 Information	0	-6,846	-11,078	-17,924
52 Finance & insurance	0	-22,867	-30,851	-53,718
53 Real estate & rental	0	-16,773	-21,437	-38,210
54 Professional- scientific & tech services	0	-23,055	-16,363	-39,418
55 Management of companies	0	-28,438	-4,693	-33,131
56 Administrative & waste services	0	-11,350	-8,241	-19,591
61 Educational services	0	-142	-5,785	-5,927
62 Health & social services	0	-6	-54,869	-54,875
71 Arts- entertainment & recreation	0	-5,851	-5,648	-11,499
72 Accommodation & food services	0	-3,515	-17,317	-20,832
81 Other services	0	-5,339	-13,360	-18,699
92 Government & non NAICs	0	-4,312	-63,677	-67,988
Pacific whiting trawler	-2,265	0	0	-2,265
Large groundfish trawler	-479	0	0	-479
Small groundfish trawler	-634	0	0	-634
Sablefish fixed gear	-182,850	0	0	-182,850
Other groundfish fixed gear	-11,154	0	0	-11,154
Pelagic netter	-769	0	0	-769
Migratory liner	-3,102	0	0	-3,102
Shrimper	-424	0	0	-424
Crabber	-124,696	0	0	-124,696
Salmon troller	-5,081	0	0	-5,081
Salmon netter	-218	0	0	-218
Lobster vessel	-333	0	0	-333
Other, more than 15K	-1,479	0	0	-1,479
Other, less than 15K	-9,005	0	0	-9,005
Bait Ship	0	-7,354	0	-7,354
Wholesale Seafood	-43,520	0	0	-43,520
Total	**-540,795**	**-292,385**	**-362,209**	**-1,195,388**

Table D-15 (continued)

Aggregated Employment Impact Report (Full and Part Time)

Industry	Direct	Indirect	Induced	Total
11 Ag, Forestry, Fish & Hunting	0	-0.3	0	-0.3
21 Mining	0	0	0	0
22 Utilities	0	0	0	0
23 Construction	0	-0.1	0	-0.1
31-33 Manufacturing	-2.4	-0.1	-0.2	-2.6
42 Wholesale Trade	0	-0.6	-0.2	-0.8
48-49 Transportation & Warehousing	0	-0.4	-0.1	-0.6
44-45 Retail trade	0	-0.3	-0.8	-1.1
51 Information	0	0	-0.1	-0.1
52 Finance & insurance	0	-0.2	-0.2	-0.4
53 Real estate & rental	0	-0.1	-0.2	-0.3
54 Professional- scientific & tech services	0	-0.3	-0.2	-0.5
55 Management of companies	0	-0.2	0	-0.2
56 Administrative & waste services	0	-0.3	-0.2	-0.5
61 Educational services	0	0	-0.2	-0.2
62 Health & social services	0	0	-0.9	-0.9
71 Arts- entertainment & recreation	0	-0.1	-0.1	-0.3
72 Accommodation & food services	0	-0.1	-0.5	-0.6
81 Other services	0	-0.1	-0.4	-0.5
92 Government & non NAICs	0	0	-0.1	-0.1
Small groundfish trawler	-0.1	0	0	-0.1
Sablefish fixed gear	-7.2	0	0	-7.2
Other groundfish fixed gear	-0.7	0	0	-0.7
Migratory liner	-0.2	0	0	-0.2
Crabber	-3.8	0	0	-3.8
Salmon troller	-0.8	0	0	-0.8
Other, less than 15K	-7.1	0	0	-7.1
Wholesale Seafood	-0.8	0	0	-0.8
Total	**-23.2**	**-3.2**	**-4.4**	**-30.7**

APPENDIX A: IO-PAC Port Groupings

APPENDIX A - IO-PAC Port Groupings				
IO-PAC State	**IO-PAC Port Group**	**PCID**	**PORT NAME (PNAME)**	**AGID**
CA	Bodega Bay	BDG	BODEGA BAY	C
CA	Bodega Bay	RYS	POINT REYES	C
CA	Bodega Bay	SLT	SAUSALITO	C
CA	Bodega Bay	TML	TOMALES BAY	C
CA	Bodega Bay	OSM	OTHER SONOMA AND MARIN COUNTY OUTER COAST PORTS	C
CA	Crescent City	CRS	CRESCENT CITY	C
CA	Eureka	ERK	EUREKA	C
CA	Eureka	FLN	FIELDS LANDING	C
CA	Eureka	OHB	OTHER HUMBOLDT COUNTY PORTS	C
CA	Eureka	TRN	TRINIDAD	C
CA	Fort Bragg	ALB	ALBION	C
CA	Fort Bragg	ARE	POINT ARENA	C
CA	Fort Bragg	BRG	FORT BRAGG	C
CA	Fort Bragg	OMD	OTHER MENDOCINO COUNTY PORTS	C
CA	Los Angeles	DNA	DANA POINT	C
CA	Los Angeles	LGB	LONG BEACH	C
CA	Los Angeles	NWB	NEWPORT BEACH	C
CA	Los Angeles	OLA	OTHER LA AND ORANGE COUNTY PORTS	C
CA	Los Angeles	SP	SAN PEDRO	C
CA	Los Angeles	TRM	TERMINAL ISLAND	C
CA	Los Angeles	WLM	WILLMINGTON	C
CA	Monterey	CRZ	SANTA CRUZ	C
CA	Monterey	MNT	MONTEREY	C
CA	Monterey	MOS	MOSS LANDING	C
CA	Monterey	OCM	OTHER SANTA CRUZ AND MONTEREY COUNTY PORTS	C
CA	Morro Bay	AVL	AVILA	C
CA	Morro Bay	MRO	MORRO BAY	C
CA	Morro Bay	OSL	OTHER SAN LUIS OBISPO COUNTY PORTS	C
CA	San Diego	OCN	OCEANSIDE	C
CA	San Diego	OSD	OTHER SAN DIEGO COUNTY PORTS	C
CA	San Diego	SD	SAN DIEGO	C
CA	San Francisco	ALM	ALAMEDA	C
CA	San Francisco	BKL	BERKELEY	C
CA	San Francisco	OAK	OAKLAND	C

APPENDIX A - IO-PAC Port Groupings				
IO-PAC State	**IO-PAC Port Group**	**PCID**	**PORT NAME (PNAME)**	**AGID**
CA	San Francisco	OSF	OTHER S. F. BAY AND SAN MATEO COUNTY PORTS	C
CA	San Francisco	PRN	PRINCETON / HALF MOON BAY	C
CA	San Francisco	RCH	RICHMOND	C
CA	San Francisco	SF	SAN FRANCISCO	C
CA	Santa Barbara	HNM	PORT HUENEME	C
CA	Santa Barbara	OBV	OTHER SANTA BARBARA AND VENTURA COUNTY PORTS	C
CA	Santa Barbara	OXN	OXNARD	C
CA	Santa Barbara	SB	SANTA BARBARA	C
CA	Santa Barbara	VEN	VENTURA	C
OR	Astoria-Tillamook	AST	ASTORIA	O
OR	Astoria-Tillamook	CNB	CANNON BEACH	O
OR	Astoria-Tillamook	GSS	GEARHART - SEASIDE	O
OR	Astoria-Tillamook	NHL	NEHALEM BAY	O
OR	Astoria-Tillamook	NTR	NETARTS BAY	O
OR	Astoria-Tillamook	PCC	PACIFIC CITY	O
OR	Astoria-Tillamook	TLL	TILLAMOOK/GARIBALDI	O
OR	Brookings	BRK	BROOKINGS	
OR	Brookings	GLD	GOLD BEACH	O
OR	Brookings	ORF	PORT ORFORD	O
OR	Columbia River	CRV	PSUEDO PORT CODE FOR COLUMBIA RIVER	O
OR	Coos Bay	BDN	BANDON	O
OR	Coos Bay	COS	CHARLESTON (COOS BAY)	O
OR	Coos Bay	FLR	FLORENCE	O
OR	Coos Bay	WIN	WINCHESTER BAY	O
OR	Newport	DPO	DEPOE BAY	O
OR	Newport	NEW	NEWPORT	O
OR	Newport	WLD	WALDPORT	O
WA	North Washington Coast	LAP	LA PUSH	W
WA	North Washington Coast	NEA	NEAH BAY	W
WA	North Washington Coast	PAG	PORT ANGELES	W
WA	North Washington Coast	SEQ	SEQUIM	W
WA	North Washington Coast	TNS	PORT TOWNSEND	W
WA	Puget Sound	ANA	ANACORTES	W
WA	Puget Sound	BLL	BELLINGHAM BAY	W
WA	Puget Sound	BLN	BLAINE	W
WA	Puget Sound	EVR	EVERETT	W
WA	Puget Sound	FRI	FRIDAY HARBOR	W
WA	Puget Sound	LAC	LA CONNER	W
WA	Puget Sound	OLY	OLYMPIA	W
WA	Puget Sound	ONP	OTHER NORTH PUGET SOUND PORTS	W
WA	Puget Sound	SEA	SEATTLE	W

APPENDIX A - IO-PAC Port Groupings				
IO-PAC State	**IO-PAC Port Group**	**PCID**	**PORT NAME (PNAME)**	**AGID**
WA	Puget Sound	SHL	SHELTON	W
WA	Puget Sound	TAC	TACOMA	W
WA	South & Central WA Coast	CPL	COPALIS BEACH	W
WA	South & Central WA Coast	GRH	GRAYS HARBOR	W
WA	South & Central WA Coast	LWC	ILWACO/CHINOOK	W
WA	South & Central WA Coast	OCR	OTHER COLUMBIA RIVER PORTS	W
WA	South & Central WA Coast	WLB	WILLAPA BAY	W
WA	South & Central WA Coast	WPT	WESTPORT	W

APPENDIX B: Bridge between Expenditures and IMPLAN Pro Sectors

Factor expenditures by harvesters and seafood wholesalers were allocated to IMPLAN sectors. The following tables represent the bridge between harvester and seafood wholesaler expenditures, and IMPLAN sectors. These allocations often follow the scheme developed by Steinback and Thunberg (2006).

Harvester Expenditures

Fuel and lubricant expenses were allocated based on the IMPLAN default margin table for Sector 142 (Petroleum Refineries).

Fuel and Lubricants

IMPLAN Sector	Sector Title	Proportion
142	Petroleum Refineries	0.393794
390	Wholesale Trade	0.361077
392	Rail Transportation	0.006754
393	Water Transportation	0.005192
394	Truck Transportation	0.008658
396	Pipeline Transportation	0.004953
407	Gasoline Stations	0.219571
	Total	1.00

Food and beverage expenses were allocated based on the IMPLAN Personal Consumption Expenditure (PCE) vector 1111. This PCE vector represents the national average expenditure pattern for groceries that comes from The PCE vector represents the national average expenditure pattern for groceries. However, following the approach of Steinback and Thunberg (2005), purchases associated with the two default seafood sectors (i.e., commercial fishing and seafood product preparation and packaging) were reallocated to Sector 60 (frozen food manufacturing). This allocation is believed to better reflect likely consumption habits aboard commercial fishing vessels.

Groceries

IMPLAN Sector	Sector Title	Proportion
1	Oilseed farming	6.36E-05
2	Grain farming	0.000379
3	Vegetable and melon farming	0.022642
4	Tree nut farming	0.000749
5	Fruit farming	0.014302
6	Greenhouse and nursery production	0.000652
10	All other crop farming	0.000203
12	Poultry and egg production	0.006205
15	Forest nurseries, forest products, and timber	0.000137
26	Other nonmetallic mineral mining	1E-05
46	Dog and cat food manufacturing	0.016556
47	Other animal food manufacturing	0.002251
48	Flour milling	0.00234
49	Rice milling	0.001427

51	Wet corn milling	0.002738
52	Soybean processing	7.65E-05
54	Fats and oils refining and blending	0.004478
55	Breakfast cereal manufacturing	0.016116
56	Sugar manufacturing	0.005154
57	Confectionery manufacturing from cacao beans	0.003429
58	Confectionery manufacturing from purchased chocolate	0.015461
59	Nonchocolate confectionery manufacturing	0.01315
60	Frozen food manufacturing	0.035386
61	Fruit and vegetable canning and drying	0.051314
62	Fluid milk manufacturing	0.040036
63	Creamery butter manufacturing	0.002148
64	Cheese manufacturing	0.014711
65	Dry, condensed, and evaporated dairy products	0.008433
66	Ice cream and frozen dessert manufacturing	0.005012
67	Animal, except poultry, slaughtering	0.057514
68	Meat processed from carcasses	0.054934
70	Poultry processing	0.027721
72	Frozen cakes and other pastries manufacturing	0.005509
73	Bread and bakery product, except frozen, manufacturing	0.046437
74	Cookie and cracker manufacturing	0.016265
75	Mixes and dough made from purchased flour	0.009065
76	Dry pasta manufacturing	0.003576
77	Tortilla manufacturing	0.002269
78	Roasted nuts and peanut butter manufacturing	0.004765
79	Other snack food manufacturing	0.01767
80	Coffee and tea manufacturing	0.012974
81	Flavoring syrup and concentrate manufacturing	0.005455
82	Mayonnaise, dressing, and sauce manufacturing	0.00848
83	Spice and extract manufacturing	0.007112
84	All other food manufacturing	0.018899
85	Soft drink and ice manufacturing	0.06019
171	Other miscellaneous chemical product manufacturing	0.000167
390	Wholesale trade	0.098877
391	Air transportation	0.000487
392	Rail transportation	0.002832
393	Water transportation	0.001729
394	Truck transportation	0.013268
399	Couriers and messengers	0.001554
400	Warehousing and storage	0.000889
402	Furniture and home furnishings stores	9.66E-05
404	Building material and garden supply stores	0.001584
405	Food and beverage stores	0.196583
407	Gasoline stations	0.016591
410	General merchandise stores	0.006296
411	Miscellaneous store retailers	0.00834
500	Noncomparable imports	0.006314
	Total	1.00

Ice expenses were allocated based on the IMPLAN default margin table for Sector 85 (Soft drink and ice manufacturing).

Ice

IMPLAN Sector	Sector Title	Proportion
85	Soft drink and ice manufacturing	0.628331
390	Wholesale trade	0.10275
392	Rail transportation	0.000222
393	Water transportation	3.14E-05
394	Truck transportation	0.006453
405	Food and beverage stores	0.193154
407	Gasoline stations	0.069058
	Total	1.00

Bait expenses were allocated to a fishing bait sector that was created and added to the model. The production function for the bait sector that was created mirrors the production function in the default fishing sector.

Default Fishing

IMPLAN Sector	Sector Title	Proportion
16	Fishing	0.001894
43	Maintenance and repair of nonresidential buildings	0.102952
68	Meat processed from carcasses	0.000061
85	Soft drink and ice manufacturing	0.010734
103	Other miscellaneous textile pro	0.007470
125	Paper and paperboard mills	0.000970
126	Paperboard container manufacturing	0.000022
129	Coated and laminated paper and	0.000017
130	Coated and uncoated paper bag m	0.000212
131	Die-cut paper office supplies m	0.000028
132	Envelope manufacturing	0.000016
133	Stationery and related product	0.000067
136	Manifold business forms printing	0.000038
138	Blankbook and looseleaf binder	0.000006
142	Petroleum refineries	0.022730
145	Petroleum lubricating oil and g	0.047874
163	Soap and other detergent manufacturing	0.000744
164	Polish and other sanitation goo	0.000303
170	Photographic film and chemical	0.000008
172	Plastics packaging materials- f	0.001415
177	Plastics plumbing fixtures and	0.000044
179	Tire manufacturing	0.000120
278	AC- refrigeration- and forced a	0.000171
325	Electric lamp bulb and part man	0.000097
333	Electric power and specialty transmission	0.000407
338	Primary battery manufacturing	0.000214
350	Motor vehicle parts manufacturing	0.000715
383	Office supplies- except paper-	0.000027
390	Wholesale trade	0.051741
391	Air transportation	0.000780

392	Rail transportation	0.006179
393	Water transportation	0.008966
394	Truck transportation	0.006553
396	Pipeline transportation	0.000325
397	Scenic and sightseeing transport	0.055514
398	Postal service	0.000641
401	Motor vehicle and parts dealers	0.000350
402	Furniture and home furnishings	0.000083
403	Electronics and appliance store	0.000100
404	Building material and garden supplies	0.000153
405	Food and beverage stores	0.000257
406	Health and personal care stores	0.000149
407	Gasoline stations	0.000083
408	Clothing and clothing accessory	0.000116
409	Sporting goods- hobby- book and	0.000042
410	General merchandise stores	0.000265
411	Miscellaneous store retailers	0.000146
412	Nonstore retailers	0.000107
425	Non-depository credit intermediaries	0.000254
426	Securities- commodity contracts	0.002401
427	Insurance carriers	0.009664
430	Monetary authorities and depository institutions	0.005333
431	Real estate	0.000403
432	Automotive equipment rental and	0.000259
434	Machinery and equipment rental	0.012181
435	General and consumer goods rent	0.000055
437	Legal services	0.000292
439	Architectural and engineering s	0.000577
445	Environmental and other technical services	0.001204
447	Advertising and related service	0.000650
450	All other miscellaneous profess	0.000424
457	Investigation and security services	0.001708
459	Other support services	0.000468
478	Other amusement- gambling- and	0.010884
479	Hotels and motels- including ca	0.000023
500	Noncomparable imports	0.001524
	Total	1.00

Repair and maintenance expenses for vessel gear and equipment were allocated to IMPLAN Sector 357, which includes ship building and repairing.

Repair & Maintenance: Vessel and Engine at Boat Yard

IMPLAN Sector	Sector Title	Proportion
357	Ship Building and Repairing	1.00
	Total	1.00

Moorage expenses were allocated to IMPLAN Sector 478, which includes the activities of marinas. Marinas usually offer mooring, dockage, and haulout services for a fee.

Mooring

IMPLAN Sector	Sector Title	Proportion
478	Other Amusement, Gambling, and Recreation Industries	1.00
	Total	1.00

Insurance expenses for vessels were allocated to IMPLAN sector 427 (Insurance carriers), which includes establishments primarily engaged in underwriting and assuming the risk of insurance policies.

Insurance

IMPLAN Sector	Sector Title	Proportion
427	Insurance Carriers	1.00
	Total	1.00

Interest and Financial Services were allocated to IMPLAN sector 430 (Monetary Authorities and Depository Credit Institutions), which includes establishments primarily engaged in financial services.

Insurance

IMPLAN Sector	Sector Title	Proportion
430	Monetary Authorities and Depository Credit	1.00
	Total	1.00

Permit and license fees are allocated to value-added in indirect business taxes. These fees are paid during the normal operation of a business.

Permits and License Fees

IMPLAN Sector	Sector Title	Proportion
Value-Added	Indirect Business Taxes	1.00
	Total	1.00

Payments received by vessel owners as income are known as are classified as proprietary income.

Profits: Owner

IMPLAN Sector	Sector Title	Proportion
Value-Added	Proprietary Income	1.00
	Total	1.00

All other vessel expenditures were allocated according to proportions contained in the production function of the default commercial fishing sector in IMPLAN. This allocation scheme is identical to that developed by Steinback and Thunberg for the "Miscellaneous Trip Supplies" cost category in the NERIOM. They summed the absorption coefficients associated with the manufacturing sectors that produce the commodities used in the commercial fishing production function and allocated the commodity expenditures to the appropriate manufacturing industries. Additionally their estimates include average wholesale, transportation, and retail margins across

all the manufacturing sectors since the majority of these purchases occur at the retail level.

Other vessel expenditures

IMPLAN Sector	Sector Title	Proportion
100	Curtain and Linen Mills	0.00856
103	Other Miscellaneous Textiles	0.007716
125	Paper and Paperboard Mills	0.040025
126	Paperboard Container Manufacturing	0.180838
130	Coated and Uncoated Paper Bag Manufacturing	0.02375
163	Soap and Other Detergent Manufacturing	0.047259
164	Polish and other Sanitation Good Manufacturing	0.040146
172	Plastics Packaging Materials	0.054372
177	Plastic Plumbing Fixtures and all other Plastics	0.008319
179	Tire Manufacturing	0.006631
278	Ac, Refrigeration	0.007234
286	Other Engine Equipment Manufacturing	0.074987
289	Air and Gas Compressor Manufacturing	0.004581
321	Watch, Clock, and Other Measuring and Controlling Devices	0.007475
325	Electric Lamp Bulb and Part Manufacturing	0.012176
333	Electric Power and Specialty Transformer Manufacturing	0.005184
338	Primary Battery Manufacturing	0.010247
350	Motor Vehicle Parts Manufacturing	0.0475
392	Rail Transportation	0.001
390	Wholesale Trade	0.161
404	Building Material & Gardening Supplies	0.001
405	Food and Beverage Stores	0.185
407	Gasoline Stations	0.013
410	General Merchandise Stores	0.014
411	Miscellaneous Store Retail	0.038
	Total	1.00

Tax expenditures were allocated to IMPLAN Pro's Value-Added Sector Indirect Business Taxes. This sector consists of excise taxes, property taxes, and sales taxes, but excludes income taxes paid by businesses.

Taxes

IMPLAN Sector	Sector Title	Proportion
Value-Added	Indirect Business Taxes	1.00
	Total	1.00

Wages and salaries of employees were allocated to the Value-Added Sector Employee Compensation.

Wages: Captain and Crew

IMPLAN Sector	Sector Title	Proportion
Value-Added	Employee Compensation	1.00
	Total	1.00

Vessel residuals were allocated to the Value-Added Sector Proprietary Income.

Wages: Captain and Crew

IMPLAN Sector	Sector Title	Proportion
Value-Added	Employee Compensation	1.00
	Total	1.00

Seafood Wholesale Dealer Expenditures

Wholesale seafood dealers purchase many of the same commodities and services as commercial harvesters are also purchased by wholesale seafood dealers. To avoid duplication, detailed descriptions of wholesale dealer expenditures are only provided for products and services that were not purchased by commercial harvesters.

Advertising fees were allocated to IMPLAN Pro Sector 447 Advertising and Related Services.

Advertising

IMPLAN Sector	Sector Title	Proportion
447	Advertising and Related Services	1.00
	Total	1.00

Packaging expenses were allocated using the default IMPLAN margin table for Sector 126 Paperboard Container Manufacturing.

Packaging: Boxes

IMPLAN Sector	Sector Title	Proportion
126	Paperboard Container Manufacturing	0.581083
390	Wholesale Trade	0.016356
391	Air Transportation	0.000463
392	Rail Transportation	0.026539
394	Truck Transportation	0.130381
411	Miscellaneous Store Retailers	0.245178
	Total	1.00

Rental payments were allocated to the IMPLAN sector 431 (Real Estate), which includes establishments that are primarily engaged in the renting or leasing real estate to others, including the leasing of mini warehouses and storage buildings.

Rent

IMPLAN Sector	Sector Title	Proportion
431	Real Estate	1.00
	Total	1.00

Building repair and maintenance payments were allocated to Sector 458 (Services to Buildings and Dwellings), which includes establishments primarily engaged in cleaning and maintaining building interiors, and providing landscape care and maintenance.

Repair & Maintenance: Building

IMPLAN Sector	Sector Title	Proportion
458	Services to Buildings and Dwellings	1.00
	Total	1.00

Shipping expenses were allocated to Sector 394 (Truck Transportation). The Truck Transportation Sector comprises establishments primarily engaged in providing general freight trucking.

Shipping

IMPLAN Sector	Sector Title	Proportion
394	Truck Transportation	1.00
	Total	1.00

Storage expenses were allocated to Sector 400 (Warehousing and Storage Sector), which are establishments primarily engaged in operating warehousing and storage facilities for general merchandise.

Storage

IMPLAN Sector	Sector Title	Proportion
400	Warehousing and Storage	1.00
	Total	1.00

Electrical utility expenses were allocated to sector 30 (Power Generation and Supply Sector), which comprises establishments primarily engaged in generating, transmitting, and/or distributing electric power.

Utilities: Electric

IMPLAN Sector	Sector Title	Proportion
30	Power Generation and Supply	1.00
	Total	1.00

Natural gas utility expenses were allocated to sector 31 (Natural Gas Distribution Sector), which comprises establishments primarily engaged in transmitting and distributing gas to final consumers.

Utilities: Gas

IMPLAN Sector	Sector Title	Proportion
31	Natural Gas Distribution	1.00
	Total	1.00

Telephone expenses were allocated to the sector 422 (Telecommunications), which contains establishments that are primarily engaged in operating, maintaining, and/or providing access to facilities for the transmission of voice, data, text, sound, and video.

Utilities: Telephone

IMPLAN Sector	Sector Title	Proportion
422	Telecommunications	1.00
	Total	1.00

Seafood Processor Expenditures

The default production function for Sector 71 Seafood Product Preparation and Packaging was used to allocate purchases by seafood processors. This production function includes over 140 industry sectors that sell commodities and services to processors.