

HARVEST SPECIFICATIONS AND MANAGEMENT MEASURES FOR 2015-2016 AND BIENNIAL PERIODS THEREAFTER

**Includes the Reorganization of
Groundfish Stock Complexes,
Designation of Ecosystem Component Species
and Amendment 24 to the
Pacific Coast Groundfish Fishery Management Plan to Establish a
Process for Determining Default Harvest Specifications**

Final Environmental Impact Statement

Prepared by

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January 2015

A.2 Input-Output Model for Pacific Coast Fisheries, 2013 Revisions and Extensions

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April 2013

Acknowledgments

There are several individuals to thank for their contributions to this effort. We thank Scott Steinback, Northeast Fisheries Science Center, for advice in modeling economic effects of recreational fishing; Brad Stenberg, Pacific Fisheries Information Network (PacFIN), who supplied fish ticket landings data and consultations about PacFIN related data issues; Erin Steiner and Abigail Hartley for assistance with EDC data; and Carl Lian for assistance with the voluntary cost earnings survey data.

Abbreviations and Acronyms

| | |
|--------|---|
| AKFIN | Alaska Fisheries Information Network |
| BEA | Bureau of Economic Analysis |
| CDFG | California Department of Fish and Game |
| EDC | Economic Data Collection Program |
| IMPLAN | Impact Analysis for Planning (regional input-output software) |
| IO | input-output |
| IO-PAC | input-output model for Pacific Coast fisheries |
| NAICS | North American Industry Classification System |
| NERIOM | Northeast Region Commercial Fishing Input-Output Model |
| NMFS | National Marine Fisheries Service |
| NWFSC | Northwest Fisheries Science Center |
| ODFW | Oregon Department of Fish and Wildlife |
| PSMFC | Pacific States Marine Fisheries Commission |
| PacFIN | Pacific Fisheries Information Network |
| WDFW | Washington Department of Fish and Wildlife |
| WDOR | Washington Department of Revenue |

A.2.1 Introduction

The NWFSC's Input-Output model for Pacific Coast Fisheries (IO-PAC) is designed to estimate the changes in economic contributions and economic impacts resulting from policy, environmental, or other changes that affect fishery harvest. IO-PAC was built by customizing the Impact Analysis for Planning (IMPLAN) regional input-output software. The original methodology employed in developing this model was similar to that used in the Northeast Fisheries Science Center's Northeast Region Commercial Fishing Input-Output Model (Steinback and Thunberg, 2006). The development and design of IO-PAC is documented in detail in Leonard and Watson (2011). This paper presents recent updates to IO-PAC. The updates presented are part of an ongoing effort to continually improve the IO-PAC model with the latest available data and improvements in regional impact modeling capabilities. The updates of IO-PAC include incorporating more recent available data, the addition of a recreational fishing component, the addition of separate catcher processor and mothership sectors, and revisions to the model construction.

The data updates made to date include the following. One, the underlying Impact Analysis for Planning (IMPLAN) data is changed from the 2006 base year to 2010. Two, the fish-ticket (landings) data from

Pacific Fisheries Information Network (PacFIN) is changed from 2006 to 2012. Three, the commercial vessel production functions incorporate the latest data from the voluntary Limited Entry and Open Access Surveys conducted by the Northwest Fisheries Science Center. Four, it incorporates data collected as part of the Economic Data Collection (EDC) program for first receivers and shorebased processors. Five, it incorporates data from the 2011 Marine Recreational Expenditure Survey.

The addition of a recreational fishing component involves incorporating data collected on marine recreational expenditures (Lovell et al. 2013), charter vessel cost earnings data collected by the Pacific States Marine Fisheries Commission and Southwest Fisheries Science Center (Pacific States Marine Fisheries Commission, 2004) and the Northwest Fisheries Science Center in 2006.

The revisions to IO-PAC construction are done to reduce effort involved in making changes to fishing sector production functions over time and simplify the process of building numerous port level models. 2010 IMPLAN data uses the Version 3 software update of IMPLAN. The original version of IO-PAC modified IMPLAN Version 2 software. Transitioning the unique fishing industry information in IO-PAC from IMPLAN Version 2 to Version 3, provides numerous initial obstacles, but ultimately enables a more efficient method to incorporate fishing sector production function changes and changing model study areas.

A.2.2 IMPLAN Data

IMPLAN collects, organizes, and econometrically estimates the data that is necessary to construct regional economic impact models. These data, collectively referred to as the region's social accounts, consist of purchases of inputs, labor, and capital by the respective sectors of the economy, the 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 region's 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 employment and wages covered by unemployment insurance data.

The current update to IO-PAC changes the underlying IMPAN data from 2006 to 2010. The IMPLAN data are used in IO-PAC to characterize 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. A major revision in the industry sectoring scheme was made in the 2008 IMPLAN data. In 2008 the IMPLAN data transitioned to 440 unique industry sectors from the 509 used in 2006. This change necessitated a new mapping of factor expenditures made by seafood harvesters and wholesalers into IMPLAN sectors. The new mapping scheme for the 440 IMPLAN sectors is presented in detail in Appendix A.

A.2.3 PacFIN Data

The current update changes the fish-ticket data utilized by IO-PAC from 2006 to 2012. PacFIN data include fish ticket and vessel registration information that is supplied by California Department of Fish and Game (CDFG), Oregon Department of Fish and Wildlife (ODFW), and Washington Department of Fish and Wildlife (WDFW). Each time a commercial fishing vessel lands fish along the West Coast, it is documented by a fish ticket. For all commercial landings sold to shoreside 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. 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. These data, when aggregated into vessel classifications and commodity types, comprise the total revenue or industry output estimates that are included in the model. PacFIN also contains information on the vessel identification of the seller, gear type used to catch the fish, date of transaction, and port where the fish were landed. Vessel registration information supplied by the states

includes some physical characteristics such as length and engine horsepower. Table A-7 provides a summary of the data that is currently used in IO-PAC, and its application. For commercial fishing vessels, it indicates that the PacFIN data are used in generating vessel production functions, estimates of total industry output (revenue), and total vessel employment. For processors the data are used in generating processor industry output and processor employment¹.

The IO-PAC update makes two changes in how the PacFIN data are used in the model. Previously, the length of the vessel, which is contained in PacFIN, was used in conjunction with moorage rates by length at a sample of ports along the West Coast to estimate average annual moorage expenditures by vessel classification. This approach to estimating moorage expenditures is no longer necessary due to changes in the NWFSC's cost earnings surveys. The cost earnings surveys now directly query vessel owners about moorage expenditures. Additionally, PacFIN data is no longer used exclusively to assign vessels to the Radtke and Davis (2000) classification scheme. Because PacFIN contains fish-ticket data from only shoreside landings made on the West Coast, there are no landings data for Alaska fisheries vessels and at-sea vessels (motherships and catcher processors). In the last version of IO-PAC both of these vessel classifications were blank, so impacts could not be estimated for these sectors. In this update vessels are assigned to the Alaska category by using information derived from the Alaska Fisheries Information Network (AKFIN). For vessel IDs that appear in PacFIN, personnel from the Pacific States Marine Fishery Commission (PSMFC) provided data that indicates whether a vessel had landings in Alaska in 2008. Vessels with landings in Alaska were assigned to the Alaska fisheries vessel category.

¹ For a detailed discussion of how the PacFIN data fulfills these roles, see Leonard and Watson (2010).

Table A-7. IO-PAC data sources and applications.

| | Open Access Survey (2009, 2008) | Limited Entry Fixed Gear Survey (2010, 2009) | Marine Rec. Exp. Survey (2011) | WA and OR Charter Vessel Survey (2006) | West Coast Charter Vessel Survey (2000) | EDC DATA (2011) |
|---------------------------|--|---|---|---|--|----------------------------|
| Data Year | 2009 | 2010 | 2011 | 2006 | 2000 | 2011 |
| Application | | | | | | |
| Commercial Vessels | | | | | | |
| Production Functions | X | X | | | | X |
| Vessel Industry Output | | | | X | X | X |
| Vessel Employment | X | X | | | | X |
| Processors | | | | | | |
| Production Functions | | | | | | X |
| Processor Industry Output | | | | | | X |
| Processor Employment | | | | | | X |
| Recreational Fishing | | | | | | |
| Expenditures | | | X | | | |
| Charter Prod. Functions | | | | X | X | |
| Charter Industry Output | | | X | X | X | |
| Charter Employment | | | X | X | X | |
| Non-Fishing Data | | | | | | |

Table A-7 (continued horizontally). IO-PAC data sources and applications.

| | IMPLAN | PacFIN Fish Ticket |
|---------------------------|--------|--------------------|
| Data Year | 2010 | 2012 |
| Application | | |
| Commercial Vessels | | |
| Production Functions | | X |
| Vessel Industry Output | X | X |
| Vessel Employment | | X |
| Processors | | |
| Production Functions | X | |
| Processor Industry Output | X | X |
| Processor Employment | X | X |
| Recreational Fishing | | |
| Expenditures | | |
| Charter Prod. Functions | | |
| Charter Industry Output | | |
| Charter Employment | | |
| Non-Fishing Data | X | |

A.2.4 Commercial Fisheries Economic Data

Cost earnings surveys provide the data necessary to construct the commercial fishing vessel and processor production functions. Since the last version of IO-PAC, the EDC program has been established as a data source. Previously, the model relied solely on the voluntary limited entry trawl, limited entry fixed gear, and open access surveys for commercial fishery cost data. The commercial vessel production functions now rely on EDC data for limited-entry trawl, catcher processors, motherships and shorebased processors.

A.2.4.1 Voluntary Cost-Earnings Surveys

The vessel production functions currently use data from the most recent voluntary, limited entry fixed gear survey and open access survey. Since the first version of IO-PAC was completed, the voluntary surveys have been reprised. Because of the expanded scope and increased detail of the more recent surveys, incorporating the data has the added benefit of likely increasing the accuracy of IO-PAC, especially for vessel classifications that were previously not covered or partially covered. The expanded scope is the result of a changed target population of the open access survey. The increased detail is the result of an increased number of cost categories for all the voluntary surveys. These additional cost categories permit improved specification of the production functions. Previous costs categories used in the model included fuel and oil; food and crew provisions; ice; bait; repairs, maintenance, and improvements; insurance; permit leases; permit purchases; interest and financial services; crew expense; and captain expense. The new additional cost categories include moorage, enforcement, dues, offloading, and trucking. Responses to the 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 follows².

The survey population for the limited entry fixed gear survey consisted of all vessels with a limited entry fixed gear permit and at least \$1,000 in landings in 2010. This survey collected information for 2009 and 2010, and used in-person interviews. There were 57 completed responses out of a total of 138 vessels for a response rate of 41%. The principle classification of respondents was sablefish (*Anoplopoma fimbria*) fixed gear, and other vessel classifications covered were Alaska, crabber, other groundfish fixed gear, and other < \$15,000.

The survey population for the open access survey consisted of all commercial fishing vessels that: 1) landed at least \$1,000 of salmon, groundfish, crab or shrimp at West Coast ports during 2008, 2) had at least one trip on which groundfish, salmon, crab or shrimp accounted for a majority of revenue from landings, and 3) did not hold a limited entry permit. Survey data was collected via in-person interviews and mail questionnaires. The population of targeted vessels for the most recent survey was expanded considerably from the 2005 and 2006 version because of the addition of crab and shrimp to the first two requirements. There were 1,712 vessels that met the above three requirements, and 1,098 vessels for which a telephone and address was obtainable. There were 440 completed responses for a response rate of 40.0% among those vessels where contact information was available. Responses came from vessels classified as Alaska, crabber, sablefish fixed gear, other groundfish, salmon troller, salmon netter, shrimper, and other less than \$15,000.

A.2.4.2 Mandatory EDC Surveys

In January 2011, the West Coast groundfish trawl fishery transitioned to a new, management approach known as a Catch Share Program. The Catch Share Program consists of an IFQ program for the shorebased trawl fleet and cooperative programs for the at-sea mothership and CP trawl fleets. The economic benefits of the West Coast groundfish trawl fishery and their distribution will likely change under trawl rationalization. To monitor these changes, the rationalization program includes a mandatory

² For a more detailed description of the survey programs and summary statistics used in constructing the production functions, see the forthcoming NOAA Technical Memoranda by Lian.

economic data collection program. Using data collected from industry members, the EDC program monitors whether the goals of the Catch Share Program have been met. The EDC program will also help meet the requirements of the Magnuson-Stevens Act for catch share evaluation. The regulations detailing the Economic Data Collection program are available in 50CFR 660.114.

The EDC program collects vessel/plant characteristics, capitalized investments, annual expenses, annual earnings, crew/labor payments, and quota and permit expenses from the following types of businesses.

Limited Entry Trawl Catcher Vessels - All owners, lessees, and charterers of a catcher vessel registered to a limited entry trawl endorsed permit.

Motherships - All owners, lessees, and charterers of a mothership vessel registered to a mothership permit.

CPs - All owners, lessees, and charterers of a catcher processor vessel registered to a CP-endorsed limited entry trawl permit.

First Receivers/Shorebased Processors - All owners and lessees of a shorebased processor that received round or headed-and-gutted IFQ species groundfish or whiting from a first receiver, and all owners of a first receiver site license in 2011 and beyond.

The EDC data are used for several purposes in IO-PAC. For the shoreside trawl catcher vessel fleet, the EDC data replace the voluntary trawl survey data previously used. Additionally, it provides the first cost earnings data to permit the inclusion of the at-sea fleet (motherships and catcher processors) in the model. Last, it provides the data necessary to replace the default IMPLAN approach to generating shorebased processing employment, industry output (revenue), and production function used in the previous version IO-PAC. The default IMPLAN processor approach used in the previous version of IO-PAC had notable disadvantages, particularly that all species contained in IO-PAC were limited to the same markup to develop processor impacts.

A.2.5 The IO-PAC Model

Several aspects of the IO-PAC model are modified in the revision. To the existing vessel classification scheme in IO-PAC, the revision adds vessel sectors for motherships, catcher processors, and charter recreational fishing vessels. The underlying product flow assumptions are changed. The commercial vessel production functions are changed through the inclusion of more recent cost earnings data. Processor sector production functions and estimates of appropriate processor markups for different species are altered through the use of EDC data. Last, a recreational module is added to enable impact and contribution estimates of recreational fishing.

A.2.5.1 Industry/Commodity Scheme

The revised industry classification scheme modifies the Radtke and Davis (2000) vessel classification scheme by separating motherships and catcher processors and adding a sector for recreational charter vessels. In the Radtke and Davis (2000) sector scheme motherships and catcher processors are grouped together. In the revision they are separated into two industry classifications. The addition of a sector for recreational charter vessels is discussed in detail in Section 5.5 below. The IO-PAC codes for the industry sectors included in the model are displayed in Table A-8. The classification rules for the commercial fleet are presented in Table A-9. The classification scheme is hierarchical. Working from the top down, the rule description of the category that is met, is the classification for a vessel.

Table A-8. Industry categories and associated IMPLAN codes.

| IO-PAC Code | Category description |
|--------------------|-----------------------------|
| 509 | Catcher processor |
| 510 | Mothership |
| 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 |
| 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 \$15,000 |
| 528 | Other, less than \$15,000 |
| 561 | Bait ship |
| 563 | Wholesale seafood dealers |
| 570 | Recreational charter |

Table A-9. Vessel sectors used in the IO-PAC. Modified from Radtke and Davis (2000).

| Order | Vessel sector | Rule description |
|-------|--|--|
| 1 | Catcher processor | Vessel registered to a catcher processor permit. |
| 2 | Mothership | Vessel registered to a mothership permit. |
| 3 | Alaska fisheries vessel | Alaska revenue is > 50% of vessel's total revenue. |
| 4 | Pacific whiting offshore and onshore trawler | Pacific whiting (<i>Merluccius productus</i>) PacFIN revenue plus U.S. West Coast offshore revenue is > 33% of vessel total revenue and total revenue is > \$100,000. |
| 5 | Large groundfish trawler | Groundfish (including sablefish, halibut, and California halibut [<i>Paralichthys californicus</i>]) revenue from other than fixed gear is > 33% of vessel total revenue and total revenue is > \$100,000. |
| 6 | Small groundfish trawler | Groundfish (including sablefish, halibut, and California halibut) revenue from other than fixed gear is > 33% of vessel total revenue and total revenue is > \$15,000. |
| 7 | Sablefish fixed gear | Sablefish revenue from fixed gear is > 33% of vessel total revenue and total revenue is > \$15,000. |
| 8 | Other groundfish fixed gear | Groundfish (including halibut and California halibut), other than sablefish, revenue from fixed gear is > 33% of vessel total revenue and total revenue is > \$15,000. |
| 9 | Pelagic netter | Pelagic species revenue is > 33% of vessel total revenue and total revenue is > than \$15,000. |
| 10 | Migratory netter | Highly migratory species revenue from gear other than troll or line gear is > 33% of vessel total revenue and total revenue is > \$15,000. |
| 11 | Migratory liner | Highly migratory species revenue from troll or line gear is > 33% of vessel total revenue and total revenue is > \$15,000. |
| 12 | Shrimper | Shrimp revenue is > 33% of vessel total revenue and total revenue is > \$15,000. |
| 13 | Crabber | Crab revenue is > 33% of vessel total revenue and total revenue is > \$15,000. |
| 14 | Salmon troller | Salmon revenue from troll gear is > 33% of vessel total revenue and total revenue is > \$5,000. |
| 15 | Salmon netter | Salmon revenue from gill or purse seine gear is > 33% of vessel total revenue and total revenue is > \$5,000. |
| 16 | Other netter | Other species revenue from net gear is > 33% of vessel total revenue and total revenue is > \$15,000. |
| 17 | Lobster vessel | Lobster revenue is > 33% of vessel total revenue and total revenue is > \$15,000. |
| 18 | Diver vessel | Revenue from sea urchins, geoduck (<i>Panopea abrupta</i>), or other species by diver gear is > 33% of vessel total revenue and total revenue is > \$5,000. |
| 19 | Other > \$15,000 | All other vessels not above with total revenue > \$15,000. |
| 20 | Other ≤ \$15,000 | All other vessels not above with total revenue ≤ \$15,000. |

The IO-PAC revision does not alter the commodities added to IMPLAN. The commodities are displayed in Table A-10, and include 32 different species/gear combinations as well as one bait commodity. The gear type portion of the commodity classification was constructed by grouping PacFIN fish ticket data with the gear categories presented in Table A-11.

Table A-10. Commodities added to IMPLAN and associated codes.

| IO-PAC Code | Species and 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 | Highly migratory species, fixed gear |
| 549 | Highly migratory species, net |
| 550 | Coastal pelagic species, trawl |
| 551 | Coastal pelagic species, fixed gear |
| 552 | Coastal pelagic species, net |
| 553 | Coastal pelagic species, 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 A-11. Gear groupings and associated PacFIN variables.

| IO-PAC | Gear ID | Description |
|---------------|----------------|---------------------------------|
| Trawl | TWL | Trawls except shrimp trawls |
| Trawl | TWS | Shrimp trawls |
| Fixed gear | NTW | Nontrawl 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 |

The total landings by vessel type and species/gear combinations are displayed in Table A-12. Landings are classified in the species/gear classifications even if species for particular gear types are considered bycatch.

Table A-12. Landings by vessel type and commodity code, 2012 value (\$).

| IMPLAN code | Species and gear combinations | Vessel classification | | | | | |
|----------------|----------------------------------|-----------------------|-------------------|-------------------|----------------|-------------------|------------------|
| | | 511 | 512 | 513 | 514 | 515 | 516 |
| 529 | Whiting, at sea | | | | | | |
| 530 | Whiting, trawl | 4,180,920 | 16,068,218 | 196,799 | 194,596 | | |
| 531 | Whiting, fixed gear | | | | | 1,776 | 9 |
| 532 | Sablefish, trawl | 130,366 | 567,313 | 4,514,073 | 29,955 | 16,814 | |
| 533 | Sablefish, fixed gear | 2,451,307 | 328,698 | 63,023 | 6,032 | 14,174,786 | 183,881 |
| 534 | Dover/thornyhead, trawl | 27,471 | 490,942 | 7,327,862 | 66,764 | 21,744 | |
| 535 | Dover/thornyhead, fixed gear | 36,714 | | 1,830 | 69 | 874,941 | 541,715 |
| 536 | Other groundfish, trawl | 165,730 | 1,128,407 | 7,839,678 | 213,820 | 46,821 | |
| 537 | Other groundfish, fixed gear | 45,131 | 199 | 2,855 | 534 | 549,742 | 2,117,212 |
| 538 | Other groundfish, net | | | 1,511 | 481 | | 8 |
| 539 | Crab, trawl | | | 3,102 | 19 | | |
| 540 | Crab, fixed gear | 5,634,280 | 1,182,112 | 2,846,861 | 44,053 | 5,151,838 | 93,344 |
| 541 | Crab, net | | | 13,486 | 885 | | |
| 542 | Crab, other gear | | | | | | 1,364 |
| 543 | Shrimp, trawl | 255,907 | 61,031 | 3,544,891 | 1,175 | 289,949 | |
| 544 | Shrimp, fixed gear | | | 366 | | | 7,548 |
| 545 | Salmon, trawl | | | | | | |
| 546 | Salmon, fixed gear | 111,144 | | 154,630 | 59,176 | 1,275,711 | 207,983 |
| 547 | Salmon, net | 2,497,833 | | 27,823 | 49 | 63,045 | 1,275 |
| 548 | HMS, fixed gear | 590,379 | | 40,308 | | 772,928 | 84,174 |
| 549 | HMS, net | | | | 317 | | |
| 550 | CPS, trawl | 1,308 | 2,598 | 61 | 217 | | |
| 551 | CPS, fixed gear | | | | | 370 | 486 |
| 552 | CPS, net | 858,628 | | | | 11,124 | |
| 553 | CPS, other gear | | | | | | |
| 554 | Halibut, trawl | | | 584,206 | 160,391 | | |
| 555 | Halibut, fixed gear | 3,071,024 | | 1,447 | 2,343 | 934,188 | 484,131 |
| 556 | Halibut, net | | | 146,113 | 91,936 | | |
| 557 | Other species, trawl | 360 | 21,668 | 329,054 | 52,528 | | |
| 558 | Other species, fixed gear | 10,827 | | 1,607 | 17,184 | 113,009 | 177,950 |
| 559 | Other species, net | 2,535,623 | | 78,153 | 54,138 | | |
| 560 | Other species, other gear | | | | | 2,415 | 1,920 |
| | Total | 22,604,951 | 19,851,185 | 27,719,736 | 996,662 | 24,301,202 | 3,903,000 |

Table A-12 continued horizontally. Landings by vessel type and commodity code, 2012 value (\$).

| IMPLAN code | Species and gear combinations | Vessel classification | | | | | | |
|-------------|-------------------------------|-----------------------|------------------|-------------------|-------------------|--------------------|-------------------|-------------------|
| | | 517 | 518 | 519 | 520 | 521 | 522 | 523 |
| 529 | Whiting, at sea | | | | | | | |
| 530 | Whiting, trawl | | | | | 493 | | |
| 531 | Whiting, fixed gear | | | | | | | |
| 532 | Sablefish, trawl | | 75 | | 496,037 | 259,158 | | |
| 533 | Sablefish, fixed gear | 171 | | 197,586 | 85,294 | 3,960,871 | 250,232 | 152 |
| 534 | Dover/thornyhead, trawl | | | | 586,773 | 304,982 | | |
| 535 | Dover/thornyhead, fixed gear | 8,714 | | 296 | 6 | 34,590 | 11,663 | |
| 536 | Other groundfish, trawl | | | | 415,665 | 471,869 | | |
| 537 | Other groundfish, fixed gear | 2,369 | | 28,015 | 14,311 | 491,626 | 87,132 | 23 |
| 538 | Other groundfish, net | 115 | 4,606 | | 642 | 595 | 24 | 134 |
| 539 | Crab, trawl | | 3,093 | | 8,864 | 627 | | |
| 540 | Crab, fixed gear | 1,081,542 | 3,137 | 9,222,841 | 9,882,193 | 137,731,075 | 392,270 | 508,197 |
| 541 | Crab, net | | 2,090 | | | | | |
| 542 | Crab, other gear | | | 936 | | 194,176 | 8,526 | |
| 543 | Shrimp, trawl | | | 64,331 | 27,879,377 | 605,586 | 200 | 1,995 |
| 544 | Shrimp, fixed gear | | | | 5,812,584 | 1,451,710 | | 105,843 |
| 545 | Salmon, trawl | | | | | | | |
| 546 | Salmon, fixed gear | | | 2,528,100 | 8,253 | 6,584,447 | 10,359,841 | 174,575 |
| 547 | Salmon, net | 317,836 | | 772 | 23,878 | 4,229,227 | 55,935 | 16,256,078 |
| 548 | HMS, fixed gear | 138,017 | 133,575 | 37,491,377 | 109,229 | 5,313,433 | 604,137 | |
| 549 | HMS, net | 67,936 | 50,379 | 5,719 | 5,377 | | | |
| 550 | CPS, trawl | | | | 59 | | | |
| 551 | CPS, fixed gear | 257 | | | | 16,160 | | |
| 552 | CPS, net | 22,084,029 | 3 | | 69 | 179,168 | | 2,984 |
| 553 | CPS, other gear | | | | | 10,543 | | |
| 554 | Halibut, trawl | | 1,101 | | 50,316 | 83,628 | | |
| 555 | Halibut, fixed gear | 27,382 | 814 | 231,177 | 78,101 | 2,172,220 | 189,467 | 35,405 |
| 556 | Halibut, net | 13,750 | 22,321 | | 207 | | | |
| 557 | Other species, trawl | | | | 65,775 | 3,601 | 8 | |
| 558 | Other species, fixed gear | 25,641 | 4,188 | 1,491,324 | 905,219 | 1,387,966 | 115,412 | 4,464 |
| 559 | Other species, net | 61,572,591 | 974,600 | 198,548 | 63,085 | 637,303 | 20,141 | 291,812 |
| 560 | Other species, other gear | 41,604 | 38,418 | | 4,002 | 154,089 | | |
| | Total | 85,381,953 | 1,238,400 | 51,461,022 | 46,495,312 | 166,279,144 | 12,094,987 | 17,381,661 |

Table A-12 continued horizontally. Landings by vessel type and commodity code, 2012 value (\$).

| IMPLAN code | Species and gear combinations | Vessel classification | | | | | Total |
|-------------|-------------------------------|-----------------------|-------------------|------------------|------------------|------------------|--------------------|
| | | 524 | 525 | 526 | 527 | 528 | |
| 529 | Whiting, at sea | | | | | | |
| 530 | Whiting, trawl | | | | | 867 | 20,641,893 |
| 531 | Whiting, fixed gear | | | | | | 1,785 |
| 532 | Sablefish, trawl | 518 | | | | | 6,014,310 |
| 533 | Sablefish, fixed gear | | 54,683 | 297 | 110,404 | 379,612 | 22,247,027 |
| 534 | Dover/thornyhead, trawl | | | | 8 | | 8,826,546 |
| 535 | Dover/thornyhead, fixed gear | | 22,705 | | 374 | 27,210 | 1,560,828 |
| 536 | Other groundfish, trawl | | | | 1,478 | 7,477 | 10,290,944 |
| 537 | Other groundfish, fixed gear | 506 | 86,607 | 31,053 | 42,692 | 856,865 | 4,356,871 |
| 538 | Other groundfish, net | | 1,512 | | 266 | 778 | 10,672 |
| 539 | Crab, trawl | | | | 1,469 | 35 | 17,209 |
| 540 | Crab, fixed gear | 200,780 | 523,631 | 28,257 | 237,965 | 1,737,713 | 176,502,088 |
| 541 | Crab, net | 2,371 | 931 | | 1,217 | 1,357 | 22,338 |
| 542 | Crab, other gear | | | 70 | | 50,970 | 256,041 |
| 543 | Shrimp, trawl | | | | 36,322 | 44,779 | 32,785,542 |
| 544 | Shrimp, fixed gear | 7,857 | 8,583 | | 560 | 163,799 | 7,558,850 |
| 545 | Salmon, trawl | | | | | | |
| 546 | Salmon, fixed gear | 13,072 | 99,871 | | 99,485 | 572,937 | 22,249,225 |
| 547 | Salmon, net | 44,961 | | | 26,149 | 2,028,927 | 25,573,788 |
| 548 | HMS, fixed gear | | 7,161 | | 131,360 | 631,190 | 46,047,266 |
| 549 | HMS, net | 4,417 | 682 | | | 396 | 135,222 |
| 550 | CPS, trawl | | | | 28 | | 4,270 |
| 551 | CPS, fixed gear | | 32 | | | 3,493 | 20,797 |
| 552 | CPS, net | 216 | 9,032 | | | 219,876 | 23,365,127 |
| 553 | CPS, other gear | | | | | 112 | 10,655 |
| 554 | Halibut, trawl | 12,196 | | 63 | 22,739 | 12,020 | 926,660 |
| 555 | Halibut, fixed gear | 28,173 | 198,512 | 4,862 | 94,286 | 413,280 | 7,966,813 |
| 556 | Halibut, net | 35,329 | 36,826 | | 2,179 | 22,646 | 371,308 |
| 557 | Other species, trawl | 524 | | 13,133 | 627,988 | 4,333 | 1,118,971 |
| 558 | Other species, fixed gear | 219,647 | 11,890,192 | 25,017 | 3,405,400 | 491,854 | 20,286,901 |
| 559 | Other species, net | 4,548,738 | 53,267 | | 9,689 | 203,450 | 71,241,136 |
| 560 | Other species, other gear | | 38,538 | 9,118,385 | 382,526 | 284,985 | 10,066,881 |
| | Total | 5,119,304 | 13,032,764 | 9,221,137 | 5,234,585 | 8,160,958 | 520,477,963 |

A.2.5.2 Commercial Catcher-Vessel Production Functions

The vessel production functions in IO-PAC rely on the data from the voluntary fixed gear and open access surveys and mandatory EDC surveys. Table A-13 presents the vessel production functions included in IO-PAC. The expenditure categories shown in Table A-13 must be mapped into IMPLAN commodity codes for inclusion in the model. The mapping of the expenditure categories into IMPLAN commodity codes is presented in detail in Appendix A. While the expenditure categories have changed little in the IO-PAC update, the mapping to IMPLAN commodity codes has changed considerably due to the shift in the IMPLAN industry classification scheme from 509 unique sectors to 440.

A.2.5.3 Motherships and Catcher Processor Production Functions

The mothership and catcher processor production functions rely solely on EDC data. Cost-earnings surveys necessary to create production functions for these vessels were previously unavailable. These production functions are not shown in Table A-13 because the cost categories do not align with those used for shoreside vessels.

Table A-13. Percentage distribution of commercial fishing production functions by expenditure categories.

| Expenditure categories (table continued horizontally below) | Alaska | Pacific whiting trawler | Large groundfish trawler | Small groundfish trawler | Sablefish fixed gear | Other groundfish fixed gear | Pelagic netter | Migratory Netter | Migratory Liner |
|---|--------------|-------------------------|--------------------------|--------------------------|----------------------|-----------------------------|----------------|------------------|-----------------|
| Captain | 9.7 | 16.8 | 19.7 | 11.4 | 15.7 | 16.8 | 18.1 | 18.1 | 11.7 |
| Crew | 18.4 | 16.7 | 13.1 | 11.4 | 23.0 | 20.9 | 17.8 | 17.8 | 8.9 |
| Fuel & lubricants | 8.8 | 12.5 | 11.1 | 8.5 | 5.9 | 10.1 | 8.4 | 8.4 | 5.7 |
| Food and crew provisions | 1.2 | 0.4 | 0.7 | 3.7 | 1.6 | 2.5 | 1.3 | 1.3 | 1.9 |
| Ice | 0.2 | 0.2 | 0.9 | 4.3 | 0.8 | 1.0 | 0.5 | 0.5 | 0.2 |
| Bait | 3.0 | 0.2 | 0.6 | 0.0 | 4.3 | 3.8 | 3.4 | 3.4 | 3.0 |
| Repair & maintenance: vessel, gear, equipment | 10.3 | 12.7 | 6.9 | 37.0 | 10.6 | 13.9 | 12.9 | 12.9 | 12.8 |
| Insurance | 6.3 | 4.0 | 3.7 | 0.0 | 3.2 | 5.4 | 4.3 | 4.3 | 3.8 |
| Interest and financial services | 1.1 | 0.0 | 0.0 | 0.0 | 0.2 | 0.9 | 0.7 | 0.7 | 3.2 |
| Purchases of permits | 6.3 | 0.0 | 0.0 | 0.0 | 7.9 | 3.1 | 3.5 | 3.5 | 0.8 |
| Leasing of permits | 0.3 | 0.0 | 0.4 | 0.0 | 0.9 | 0.0 | 0.1 | 0.1 | 0.0 |
| Moorage | 0.9 | 0.5 | 0.6 | 7.1 | 1.2 | 2.3 | 1.6 | 1.6 | 1.7 |
| Landings taxes | 1.4 | 3.8 | 5.0 | 6.4 | 1.5 | 0.8 | 1.6 | 1.6 | 0.0 |
| Enforcement | 0.2 | 0.5 | 0.4 | 1.8 | 0.2 | 0.6 | 0.2 | 0.2 | 0.1 |
| Dues | 0.3 | 0.3 | 0.8 | 0.0 | 0.3 | 0.1 | 0.4 | 0.4 | 0.4 |
| Freight supplies | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 | 0.1 | 0.1 | 0.0 |
| Offloading | 0.1 | 0.1 | 0.7 | 1.4 | 0.4 | 0.9 | 0.4 | 0.4 | 0.0 |
| Trucking | 0.1 | 0.1 | 0.1 | 0.0 | 0.2 | 1.3 | 0.2 | 0.2 | 0.0 |
| Other miscellaneous | 0.7 | 0.5 | 1.0 | 2.8 | 0.9 | 7.0 | 5.4 | 5.4 | 16.7 |
| Communications | 0.1 | 0.3 | 0.4 | 0.0 | 0.4 | 0.4 | 0.1 | 0.1 | 0.0 |
| Travel | 0.0 | 0.0 | 0.1 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Proprietary income | 9.7 | 16.8 | 19.7 | 11.4 | 15.7 | 16.8 | 18.1 | 18.1 | 11.7 |
| Total (%) | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

Table A-13 continued horizontally. Percentage distribution of commercial fishing production functions by expenditure categories.

| Expenditure categories (column list repeated from above) | Shrimper | Crabber | Salmon troller | Salmon netter | Other netter | Lobster | Diver | Other >15,000 | Other <15,000 |
|--|--------------|--------------|----------------|---------------|--------------|--------------|--------------|---------------|---------------|
| Captain | 17.9 | 22.1 | 7.8 | 24.8 | 18.1 | 18.1 | 18.1 | 18.1 | 32.7 |
| Crew | 15.2 | 21.8 | 12.0 | 20.0 | 17.8 | 17.8 | 17.8 | 17.8 | 25.9 |
| Fuel & lubricants | 12.7 | 6.6 | 11.2 | 7.2 | 8.4 | 8.4 | 8.4 | 8.4 | 18.1 |
| Food and crew provisions | 1.5 | 1.1 | 3.8 | 1.5 | 1.3 | 1.3 | 1.3 | 1.3 | 4.8 |
| Ice | 1.1 | 0.4 | 0.3 | 0.6 | 0.5 | 0.5 | 0.5 | 0.5 | 1.5 |
| Bait | 3.9 | 4.6 | 0.5 | 1.6 | 3.4 | 3.4 | 3.4 | 3.4 | 3.4 |
| Repair & maintenance: vessel, gear, equipment | 22.2 | 11.1 | 18.3 | 14.2 | 12.9 | 12.9 | 12.9 | 12.9 | 31.4 |
| Insurance | 3.6 | 4.6 | 5.4 | 2.2 | 4.3 | 4.3 | 4.3 | 4.3 | 10.9 |
| Interest and financial services | 0.0 | 0.5 | 3.6 | 0.3 | 0.7 | 0.7 | 0.7 | 0.7 | 0.6 |
| Purchases of permits | 13.9 | 0.9 | 3.5 | 1.3 | 3.5 | 3.5 | 3.5 | 3.5 | 5.0 |
| Leasing of permits | 0.1 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 |
| Moorage | 2.5 | 1.2 | 5.1 | 2.1 | 1.6 | 1.6 | 1.6 | 1.6 | 9.0 |
| Landings taxes | 2.6 | 0.9 | 0.6 | 1.0 | 1.6 | 1.6 | 1.6 | 1.6 | 0.6 |
| Enforcement | 0.2 | 0.1 | 0.2 | 0.3 | 0.2 | 0.2 | 0.2 | 0.2 | 0.9 |
| Dues | 0.3 | 0.3 | 0.9 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 1.0 |
| Freight supplies | 0.3 | 0.1 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| Offloading | 0.4 | 0.5 | 0.0 | 0.2 | 0.4 | 0.4 | 0.4 | 0.4 | 0.2 |
| Trucking | 0.3 | 0.3 | 0.6 | 0.9 | 0.2 | 0.2 | 0.2 | 0.2 | 1.0 |
| Other miscellaneous | 0.7 | 7.4 | 10.1 | 2.5 | 5.4 | 5.4 | 5.4 | 5.4 | 6.1 |
| Communications | 0.1 | 0.1 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 |
| Travel | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Proprietary income | 0.6 | 15.4 | 16.2 | 19.0 | 19.0 | 19.0 | 19.0 | 19.0 | -53.0 |
| Total (%) | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

*Percentages not shown due to confidentiality restrictions

A.2.5.4 Shoreside Processor Production : unctions and Aark-ups

For shoreside processors located on the West Coast, the EDC data permits the building of a production function and mark-up by species. The Benchmark Input-Output data produced by the Bureau of Economic Analysis (BEA) contains a production function for seafood processors, which is used in IMPLAN for the default seafood processing sector. This production function is not specific to processors on the West Coast, so to the extent that processors on the West Coast differ from seafood processors nationally, the use of the Benchmark Input-Output production function will be a source of error. In the last version of IO-PAC, shoreside processor sales of seafood were made by using the markup margin information imbedded in the IMPLAN default seafood processing production function. Additionally, the output per-employee information in the default production function was used to make employment estimates. This previous approach has a couple of notable disadvantages. First, it is derived from data on all U.S. processors. The national data is heavily influenced by the processing activity that occurs in Alaska, where the production costs for fish and output per employee are likely different than shoreside seafood processors on the West Coast. To the extent that West Coast shoreside processors deviate from the processors nationally, there will be errors in both income and employment impact estimates. Second, the markup margin in the default approach is not species specific. While this approach will approximate the markup received by processors for all species on average, it lacks species specific detail. Based on the EDC data, markups differ substantially among different species.

The EDC data permits the specification of a production function specific to processors on the West Coast, and perhaps more importantly, it provides information on species specific mark-up for different fish species. IO-PAC uses data collected through the EDC to represent all shoreside processors on the West Coast. Using the EDC data in this application is a potential source of error, because not all processors of on the West Coast are required to complete a survey. An EDC survey is required of all owners and lessees of a shorebased processor that received round or headed-and-gutted IFQ species groundfish or whiting from a first receiver, and all owners of a first receiver site license in 2011 and beyond.³ Processors that do not receive fish fitting this description are not included in the EDC program. Thus, no cost data is available for them. Because the lack of available data, we assume that all West Coast shoreside processors are represented by those who complete an EDC survey.

The processor production function was generated through dividing each of the expenditures displayed in Table A-14 by total revenue. The production function is built using 2011 data. The mapping of the cost categories into the appropriate IMPLAN sectors is detailed in Appendix A. The default production function in IMPLAN, which is based on the BEA's input-output table, is useful in mapping expenditure categories covered in the EDC to the appropriate commodity codes.

³ For a complete definition see 50 CFR 660.114. Under NAICS some of these entities may be classified as fish and seafood merchant wholesalers, frozen specialty food manufacturing, or something else. For the purposes of IO-PAC they are considered processors.

Table A-14. Percentage distribution of processor production functions by expenditure categories.

| Expenditure categories | Allocation Percent |
|--|---------------------------|
| Employee and worker payroll | 15.7 |
| Additives | 0.4 |
| Custom processing | 1.3 |
| Electricity | 1.2 |
| Freight | 0.4 |
| Insurance | 0.5 |
| Natural gas | 0.1 |
| Offsite storage and freezing | 1.6 |
| Packaging | 3.5 |
| Production supplies | 0.4 |
| Propane | 0.2 |
| Rental or lease of buildings, job-site trailers, and other structures | 0.8 |
| Rental or lease of processing machinery or equipment | 0.2 |
| Repair and maintenance on facility buildings, machinery, and equipment | 1.6 |
| Sewer and waste | 0.3 |
| Shoreside monitor | 0.0 |
| Water | 0.7 |
| Fish purchases | 61.4 |
| Cleaning supplies | 0.1 |
| Lease or purchase of quota pounds or shares | 0.0 |
| Licensing fees | 0.1 |
| Taxes | 0.4 |
| Nitrogen gas | 0.1 |
| Offload fees | 0.2 |
| Other | 1.0 |
| Proprietary income | 7.8 |
| Total (%) | 100.0 |

Costs by category in Table A-14 were allocated to relevant cost categories in the default production function in proportion to their share in the default production function. The Benchmark Input-Output Table (BIOT) may have more than one category relevant to each EDC cost category. In other words, BIOT has greater detail about a specific cost category than is captured by the EDC. Information related to the use of these commodities by seafood processors is contained in their default production function in IMPLAN. For example, commodity codes relevant to the EDC category “Packaging” are shown in Table A-15. The default production function contains five categories that are applicable. These are the five industry categories that are involved in the production of a commodity that is likely used to make “Packaging.” The default absorption numbers in the table are the allocation percentages of total industry output (revenue) to the respective expenditure categories. These percentages are used to guide the allocation of the EDC category “Packaging.” The IO-PAC allocation is done in proportion to the default absorption.

Table A-15. IO-PAC distribution of processor cost example.

| IMPLAN Code | Expenditure categories | Default Absorption | IO-PAC Allocation Percent |
|--------------------|---|---------------------------|----------------------------------|
| 3107 | Paperboard containers | 1.668 | 80.335 |
| 3108 | Coated and laminated paper, packaging paper and plastics film | 0.289 | 13.924 |
| 3105 | Paper from pulp | 0.019 | 0.910 |
| 3146 | Polystyrene foam products | 0.010 | 0.477 |
| | | | 100.0 |

The markups by species groups contained in IO-PAC are shown in Table A-16. The markups were generated using 2011 EDC data. The markups are shown on the basis of revenue earned by processors for every dollar spent on the respective species.

Table A-16. IO-PAC processor markups by species group.

| Expenditure categories | Markup |
|-------------------------------|---------------|
| Whiting | 2.52 |
| Sablefish | 1.50 |
| Dover/thornyhead | 5.18 |
| Other groundfish | 1.15 |
| Crab | 1.35 |
| Shrimp | 1.68 |
| Salmon | 1.28 |
| HMS | 1.48 |
| CPS | 1.83 |
| Halibut | 3.26 |

A.2.5.5 Recreational Fishing

The IO-PAC revision includes a new module to estimate economic impacts and contributions related to recreational fishing trips. Recreational expenditures by type and by fishing mode were obtained from Lovell et al. (2013). Table A-17 shows the recreational expenditures by type and mode.

Table A-17. Estimated 2011 Recreational Expenditures by Mode (Thousands of 2006 dollars).

| Expenditure Category | California | | Oregon | | Washington | |
|-----------------------------|-------------------|-----------------|-----------------|-----------------|-------------------|-----------------|
| | For Hire | Private | For Hire | Private | For Hire | Private |
| Auto Fuel | \$15,658 | \$18,725 | \$1,418 | \$7,728 | \$1,917 | \$18,435 |
| Auto Rental | \$1,998 | \$136 | \$3 | \$12 | \$129 | \$74 |
| Bait | \$2,319 | \$10,513 | \$73 | \$3,295 | \$34 | \$3,699 |
| Boat Rental | \$1,050 | \$22,003 | \$1 | \$11,916 | \$9 | \$26,749 |
| Charter Fees | \$59,012 | \$571 | \$6,372 | \$37 | \$7,090 | \$0 |
| Crew Tips | \$8,733 | \$0 | \$516 | \$0 | \$840 | \$0 |
| Fish Processing | \$56 | \$0 | \$42 | \$11 | \$127 | \$0 |
| Food from Grocery Stores | \$9,784 | \$13,176 | \$726 | \$4,041 | \$864 | \$12,231 |
| Food from Restaurants | \$9,457 | \$5,237 | \$525 | \$2,505 | \$870 | \$3,943 |
| Gifts & Souvenirs | \$2,737 | \$174 | \$116 | \$188 | \$170 | \$415 |
| Ice | \$1,163 | \$2,310 | \$64 | \$870 | \$93 | \$1,704 |
| Lodging | \$4,180 | \$1,264 | \$599 | \$626 | \$843 | \$4,376 |
| Parking & Site Access Fees | \$2,419 | \$3,837 | \$42 | \$1,126 | \$16 | \$3,486 |
| Public Transportation | \$1,048 | \$169 | \$3 | \$11 | \$149 | \$884 |
| Tournament Fees | \$2,240 | \$237 | \$8 | \$291 | \$155 | \$625 |
| Trip Total | \$121,968 | \$78,352 | \$10,625 | \$32,655 | \$13,337 | \$76,621 |

Angler expenditures in Table A-17 were used to create expenditure vectors for calculating economic contribution and impacts associated with changes in recreational spending. Expenditures by category were divided by total trip expenditures by mode and state to apportion recreational spending among different IMPLAN and IO-PAC sectors.

The expenditure vectors can be used to calculate contribution and impact estimates from recreational trip spending. To use the expenditure vector, effort estimates must be transformed to recreational spending. Effort estimates are mapped into recreational spending for each state using the expenditure estimates in Table A-17 in conjunction with effort measured in number of trips obtained from Lovell et al. (2013). Expenditures by state were divided by trips to obtain state level mean expenditures per trip and mode.

The expenditure vectors and mean recreational expenditures can be used for contribution and impact estimates for the sub-state level port areas in IO-PAC under the assumption that recreational spending within a port area does not differ from the state averages. For example, this assumes a recreational angler in Puget Sound purchases the same basket of goods and services as a recreational angler who fishes off the Washington coast. There is therefore a potential source of error in applying the expenditure vectors to all port areas within each state. Expenditures in some port areas could deviate from the state-level expenditure vectors. However, to make sub-state level estimates this assumption is necessary because it is unknown how expenditures differ among port areas. By assuming the same expenditure profile for each port area in a state, differences in the economic effects of changes in recreational spending are driven by changes in recreational fishing trips in each area and differences in their respective regional economies rather than differences in the types of goods purchased in each region.

A "charter vessel" is not contained in the default version of IMPLAN. In the standard IMPLAN model, the charter vessel industry is included in "Other amusement, gambling, and recreation industries" (IMPLAN sector 410), along with many other diverse industries. This IMPLAN sector includes charter vessel operations, but it also includes other important industries such as skiing. A charter sector was added using an approach similar to that used for adding the commercial fishing sectors. The results from surveys of charter vessels in CA, OR, and WA were used to create production functions for charter businesses. In addition, survey results were used to create total industry output, employment, employee compensation, proprietor income and taxes paid. For every dollar of output, amounts are paid to providers of inputs from other sectors, so that every dollar of charter vessel output can be broken into material input costs and value above costs of inputs, which is value-added

The WA and OR charter sectors were created using the results of a 2006 survey of marine charter fishing businesses in WA and OR by the Northwest Fisheries Science Center⁴. The marine charter survey collected information about cost and revenue, vessel characteristics, operator characteristics, and current market conditions in the industry. The marine charter fishing industry in Washington and Oregon consisted of an estimated 217 vessels in 2006 with \$15.4 million in direct revenue and employed an estimated 345 individuals. Completed surveys were received from 95 ocean going vessels in 2006. Seven surveys were incorrectly completed and were treated as non-responses. The effective sample was 53 vessels in Oregon and 35 vessels in Washington for a total survey response rate of 41%.

Total industry output was apportioned to value added and material components as displayed in Table A-18 along with their associated IMPLAN sectors. Some of the associated sectors indicate "Margined." In I/O models, expenditures are expressed in terms of producer prices, which is the value of goods at the point of production rather than at the retail level. Consequently, for goods that are not produced at the time of service, such as gasoline, the prices paid by final consumers must be allocated to the portion going to the retailer, wholesaler, transportation, and manufacturing (Olson and Lindall, 1999).

According to the production function, an average of 53% of each dollar generated by charter vessel operations is spent on inputs from other sectors. The remaining 47% is value added, which goes to employee compensation, proprietary income, taxes, and other income. The intermediate expenditures were translated into absorption coefficients, which are the percentages of each dollar of revenue spent on each input. For example, an absorption coefficient of 0.05 was calculated for insurance expenses,

⁴ The survey methodology and complete results will appear in a forthcoming manuscript by Leonard and Watson: "The role of charter boat operations in fishing communities: a social and economic analysis of the marine charter boat fleets in Oregon and Washington." The manuscript is obtainable from the author by request.

meaning that, on average, charter businesses spend 5 cents of each dollar of revenue on inputs from the insurance sector. In this same way, absorption coefficients were calculated for each input sector.

Table A-18. Estimated 2006 Average WA and OR Charter Industry Production Function and Associated IMPLAN Sectors.

| Outlay Categories | Allocation (%) | IMPLAN Sector |
|----------------------------------|-----------------------|---|
| Vessel Related | | |
| Proprietary Income | 27.2 | Proprietary Income |
| Captain's Payments | 8.6 | Employee Compensation |
| Other Crew Payments | 3.2 | Employee Compensation |
| Office Labor and Other Labor | 1.1 | Employee Compensation |
| Engine Overhaul | 3.7 | Ship building and repairing |
| All Other Vessel Maintenance | 3.8 | Ship building and repairing |
| Electronics Maintenance | 0.8 | Electronic equipment repair and maintenance |
| Haulout | 1.4 | Ship building and repairing |
| Moorage | 2.0 | Other amusement and recreation |
| Purchase of New Gear | 1.5 | Sporting goods, hobby, book stores (Margined) |
| Vessel Insurance | 5.0 | Insurance carriers |
| Vessel Professional Services | 0.6 | Other miscellaneous prof. and tech. services |
| Vessel Advertising | 2.1 | Advertising and related services |
| Fuel | 10.8 | Petroleum refineries (Margined) |
| Fishing Supplies | 3.0 | Sporting goods and athletic goods mfg. (Margined) |
| Bait Expenses | 1.2 | Animal prod., except cattle, poultry (Margined) |
| Food and Drink | 0.1 | PCE vector 1111 |
| Taxes and Government Fees | 6.6 | |
| Domestic | | Indirect Business Taxes |
| Taxes and Government Fees | 0.0 | |
| Foreign | | Indirect Business Taxes |
| Commissions for Booking Agents | 5.7 | Travel arrangement and reservation services |
| Telephone and Other | 1.1 | |
| Communications | | Telecommunications |
| Other Vessel Related | 8.4 | Monetary authorities and depository credit |
| Booking Operation Related | | |
| Labor for Shorebased Personnel | 0.15 | Employee Compensation |
| Advertising | 0.40 | Advertising and related services |
| Insurance | 0.44 | Insurance carriers |
| Professional Service | 0.07 | All other miscellaneous prof. and tech. |
| Association Fees | 0.01 | Civic, social, professional organizations |
| Telephones | 0.39 | Telecommunications |
| Other Office Expenses | 0.65 | All other miscellaneous mfg. (Margined) |
| Lease/Loan Payments on Vehicles | 0.04 | Monetary authorities and depository credit |
| Legal/Financial Services | 0.01 | All other miscellaneous prof. and tech. |
| Other Booking Related | 0.01 | All other miscellaneous mfg. (Margined) |

The CA charter sector was created using the results of a survey conducted by Pacific States Marine Fisheries Commission (PSMFC) and Southwest Fisheries Science Center. The survey collected cost and earnings information for the year 2000 from the West coast charter and head boat fleet (PMFC, 2004). The population targeted by the survey consisted of vessels operating out of California, Oregon and

Washington that provided ocean recreational fishing trips on a commercial basis during 1997-1998. Approximately 12% of the charter and head boats licensed to operate in California, Oregon and Washington were sampled using a stratified random sampling approach. Each stratum consisted of a particular combination of region and size class. Vessels were categorized according to the region of their home port: southern California (for homeports from the Mexican border to Point Conception), northern California (for homeports north of Point Conception to the Oregon border), Oregon, and Washington. Vessel size class was defined in terms of vessel length: "small" for lengths of 15-30 feet, "medium" for lengths of 31-49 feet, and "large" for lengths greater than 49 feet.

To develop a single production function for charter vessel businesses in CA, a weighted average of the survey results was used. The cost and earnings data collected in the survey was weighted by category for Northern CA Large, Northern CA Medium, Northern CA Small, Southern CA Large etc. based on the relative frequency of the cohort in the total population. The weighted average cost function for CA charter businesses along with the assigned IMPLAN categories appears in Table A-19.

Table A-19. Estimated 2000 Average California Charter Industry Production Function and Associated IMPLAN Sectors.

| Outlay Categories | Allocation (%) | IMPLAN Sector |
|------------------------------------|-----------------------|---|
| Proprietary Income | 45.21 | Proprietary Income |
| Captain and crew | 12.19 | Employee Compensation |
| Labor for Shorebased Personnel | 1.25 | Employee Compensation |
| Engine Overhaul | 1.21 | Ship building and repairing |
| All Other Vessel Maintenance | 3.57 | Ship building and repairing |
| Electronics Maintenance | 0.22 | Electronic equipment repair and maintenance |
| Haulout | 1.09 | Ship building and repairing |
| Moorage | 1.89 | Other amusement and recreation |
| Purchase of Gear or Equipment | 3.50 | Sporting goods and athletic goods mfg. (Margined) |
| Insurance | 1.16 | Insurance carriers |
| Professional Services | 0.37 | Other miscellaneous prof. and tech. services |
| Advertising | 1.31 | Advertising and related services |
| Fuel | 7.20 | Petroleum refineries (Margined) |
| Supplies | 2.27 | Sporting goods and athletic goods mfg. (Margined) |
| Bait | 5.18 | Animal prod., except cattle, poultry (Margined) |
| Food and Drink | 2.59 | PCE vector 1111 |
| Fees Paid to Domestic Governments | 1.72 | Indirect Business Taxes |
| Fees Paid to Foreign Governments | 2.00 | Indirect Business Taxes |
| Commissions Paid for Booking Trips | 5.02 | Travel arrangement and reservation services |
| Telephones | 0.60 | Telecommunications |
| Other | 0.15 | All other miscellaneous mfg. (Margined) |
| Other Office Expenses | 0.32 | All other miscellaneous mfg. (Margined) |
| Landing Taxes | 0.41 | Indirect Business Taxes |
| Mortgage for Vessel | 4.32 | Monetary authorities and depository credit |
| Association Fees | 0.23 | Civic, social, professional organizations |
| Lease or Loan of Motor Vehicles | 0.25 | Monetary authorities and depository credit |

Total industry output for charter vessels in CA were estimated using weighted revenues from the survey. Average revenue in each stratum was weighted in the same manner as costs. The weighted average revenue estimate was then multiplied by the total number of charter vessels in CA in 2000 to estimate

total industry revenue. Employment by charter vessels in CA was estimated by dividing total industry output by the weighted average output per employee collected in the survey. The weighted average output per employee was estimated through the same stratum weighting method discussed above.

A.2.5.6 Product Flow

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. Product flow refers to the flow of fish from harvesters to processors, wholesale seafood dealers, restaurants, households, and other sources of demand for fish. Like other fishery IO models (Kirkley et al. 2004, Steinback and Thunberg 2006), IO-PAC relies on simplifying assumptions. The assumptions about the flow of fish in IO-PAC are changed in the revision. For the state and West Coast level study areas, the revisions involve different product flow assumptions for groundfish trawl fish from other gear/species combinations. For port level models, groundfish trawl fish is treated the same as all other fish, and a new approach of using IMPLAN to develop product flow assumptions is used. The collections data by the Washington Department of Revenue (WDOR) Enhanced Food Fish Tax is no longer used.

For fish harvested with groundfish IFQ, the assumptions about product flow are driven by data collected through the EDC program. Under trawl rationalization, all IFQ fish sold by harvesters must be received by an entity with a First Receivers License. Those with Licenses are required to complete an EDC survey, so there is no harvested fish that is bypassing these first receivers. As described above, these first receivers are treated as processors. Hence, for the West Coast as whole and the state level study areas, all groundfish trawl quota fish flows to “processors” as defined here. None goes directly to other businesses and households that demand fish without going through the processing channel.

Due to cross hauling, it is possible that fish landed in a port, will not be processed therein. At this time we are unable to quantify this cross-hauling activity for either IFQ or non-IFQ fish. Consequently, we handle both in the same manner. Because we currently cannot quantify the cross-hauling activity, IMPLAN data about processor demand for fish within a study area (port group) are utilized. The IMPLAN commodity balance sheets were used in the last version of IO-PAC for this same purpose.

The revision uses the trade flow information in IMPLAN differently because the previous approach underestimates the amount of fish that flows from harvesters to processors. In the last version of IO-PAC, it was assumed that processor demand for fish from harvesters followed the econometrically derived regional purchase coefficient (RPC) in IMPLAN. The primary issue with this approach is that processor demand for fish from harvesters is equivalent to all other sources of fish demand (households, restaurants, grocery stores, hospitals, etc.). All agents of demand are treated the same. They all source the same proportion of their demand for fish from harvesters within the study area. This issue is exemplified by examining the demand for harvested fish in Oregon. Figure A-4 was generated by constructing a default IMPLAN model for each study area, then viewing the Industry/Institution RPC tab under the Edit Trade Flows function in IMPLAN. Figure A-4 indicates that Gross Commodity Demand for fish among processors in the state of Oregon is \$154,402,400. Essentially, this indicates that in order to support their level of production in Oregon, processors needed \$154 million in raw fish. The Local Commodity Demand column indicates that \$20 million of this demand for raw fish was sourced from harvesters in Oregon. The reason 12.9% of demand was fulfilled by harvesters in Oregon, is that the RPC of 0.129738 applies to all sources of demand, which are shown in the figure as Other animal food manufacturing, Frozen food manufacturing, Poultry processing, and all the household income groups.

Given the nature of the fish harvester and processor relationship on the West Coast, we contend that it is more appropriate to assume that harvesters will satiate demand for fish among processors before they sell fish to any other type of buyer. Due to Trawl Rationalization, this is certainly the case with groundfish, where fish landed with trawl quota must be sold to a licensed First Receiver and we contend that this approach is more accurate even for non-trawl quota species as well. Hence, for all port group study areas,

IO-PAC assumes that landings from the fish harvesting sectors flow to seafood processors in the same proportion as the ratio of default IMPLAN processor demand (sector 61) to the available fish harvesting sector (17) supply. This proportion can be determined using Figure A-4. The Gross Commodity Demand of seafood processors in Oregon is \$154 million. The Total Commodity Supply in the figure of \$241.7 million represents the total fish landings in Oregon. Utilizing this assumption, the amount that flows to processors is $(154.40/241.72) \approx 0.639$. Since this is a state level model, the 63.9% would apply to of all non-IFQ fish. For IFQ fish at the port level, the same approach is used.

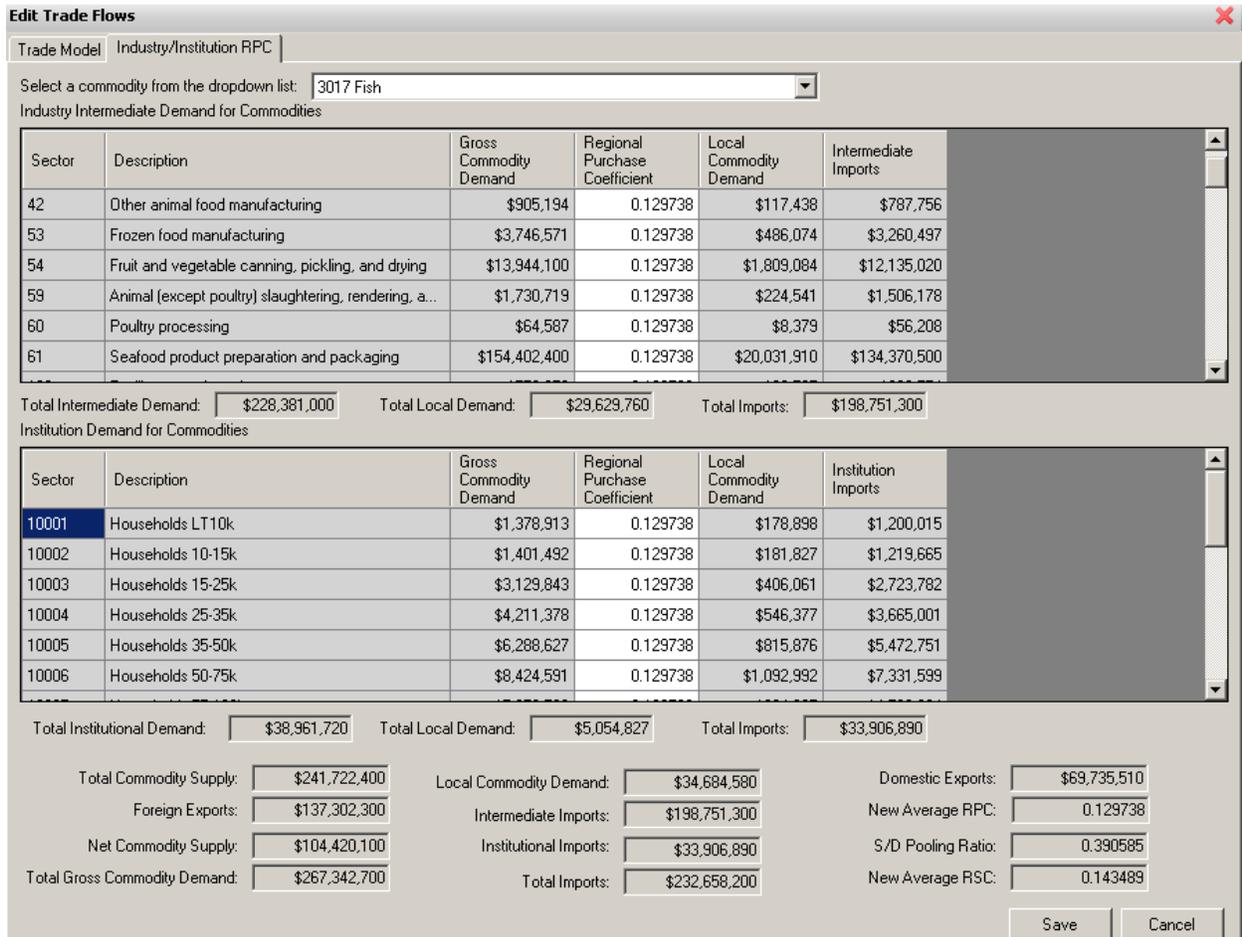


Figure A-4. IMPLAN trade flow of fish in Oregon (2010).

A.2.6 Model Construction

The revisions to IO-PAC construction are done to reduce effort involved in making changes to fishing sector production functions over time and simplify the process of building numerous port level models. The original version of IO-PAC modified IMPLAN Version 2 software. IMPLAN Version 3 software is used for in the IO-PAC revision. Version 3 provides a new method for importing changes in expenditures made by fishing vessels and recreational anglers. Expenditure changes can now be imported into IMPLAN using EXCEL templates provided by IMPLAN. Model construction in IO-PAC is constructed through the use of several of these EXCEL templates. With the change, the modeling is done primarily using spreadsheets rather than with modifications to the IMPLAN database. The change permits easy modification of production functions used in the model, and also changes in study areas can be accomplished easily. The ease in changing production functions is important because the survey data from which they are built are continually being updated. The ease in changing study areas is important

because study areas of interest often deviate from those used in groundfish management. For example, the new approach permits an easy shift to study areas of interest in salmon management. The following discussion borrows content from the Version 3.0 User's Guide (MIG, 2010).

In IMPLAN Version 3, contributions and impacts are estimated by setting up activities of different types. Activities are groupings of one or more Events that represent spending changes within a study area. Activities come in six different types: industry change, commodity change, labor income change, household spending change, industry spending pattern, and institutional spending pattern. Each activity type is appropriate for different types of analysis. By enabling spending changes of six different types, IMPLAN Version 3 is more flexible than Version 2, but skill by the analyst is more critical in determining which type of activity is most appropriate for a particular estimate. The activity types used in IO-PAC are briefly described below.

A.2.6.1 IMPLAN Activity Types

Industry Change is used to estimate the economic impact or contribution of a particular industry, where industry refers to a group of establishments that engage in similar types of economic activity. The most widespread industry classification scheme is the North American Industrial Classification System (NAICS). IMPLAN has its own industry classification scheme where each group consists of one or more NAICS categories. An example of an industry change is to estimate the effect of a \$1 million change in demand among "wood window and door" manufacturers in a particular study area.

Commodity Change is used to estimate the economic impact or contribution of a particular good or service. Commodities may be produced by one or more industries and institutions, where institutions are households and governments. All industries in IMPLAN have a primary commodity of the same name as the industry. Thus, the primary commodity of wood window and door manufacturers is the commodity "Wood windows and doors". However, wood window and door manufacturers also produce the commodity "Wood kitchen cabinets and countertops." An impact or contribution estimate due to a demand change for a particular commodity will affect all industries that produce the commodity. For example, shocking the commodity "wood windows and doors" will affect wood window and door manufacturers, but it will also affect the industry "sawmills and wood preservation."

It is important to note that multipliers used to develop estimates are produced for each endogenous industry or institution in IMPLAN. The effective multiplier for a commodity-based estimate is a weighted combination of the multipliers of the affected industries and institutions. The weighting among industries for a particular commodity is the respective market share for the commodity. The government institutional sectors (State and Local Government, Federal Govt. Non-Defense, etc.) are often treated as exogenous. As a result, their institutional contribution to production is treated as a leakage in impact/contribution estimates. This is a principle difference between industry-based versus commodity-based estimates.

Labor Income Change is used to estimate how changes in employee compensation or proprietor income will affect the economy. This would be the appropriate approach if one wanted to estimate the impact of increased payments to employees in a study area.

Industry Spending Patterns are particularly useful in modeling the fishing industry with primary cost earnings data collected from participants. The following was taken from Version 3.0 User's Guide (MIG, 2010).

"Industry Spending Patterns allow you to import an Industry's production function, or build an Industry from data about its expenditures. This Activity type works with coefficients of total budget spending, allowing you to use Level to create a series of estimates about the impacts of different expenditures to a single Industry. One thing to remember when using

Industry Spending patterns is that their coefficients typically do not include their labor income spending, and therefore the coefficients sum to less than 1.00. To ensure that the full impact of spending in an Industry is captured, you will need to create a Labor Income impact to compliment your Industry Spending pattern.”

Institution Spending Patterns are useful in modeling the change in households or government spending. In IO-PAC, we use the State and Local Government Non-Education spending pattern to model the effect of taxes paid by fishing industry participants. This marks a departure from the last version of IO-PAC in which taxes were shifted to the value-added account “Indirect business taxes.” Because of changes in the IMPLAN software, this approach is no longer possible.

A.2.6.2 Importing Fishery-Specific Information

All of the above activity types can be created in EXCEL and imported into the IMPLAN software. For the industry additions in IO-PAC, the procedure involves mapping the production function information in Tables A-13, A-14, A-18, and A-19 into IMPLAN commodities using the bridge information displayed in Appendix A.

Table A-20 displays an example of an Industry Spending Pattern activity EXCEL template that is imported into IMPLAN. After the activity is imported into IMPLAN the “Local Direct Purchase” that is set to 100% on the import must be set to the “SAM Model Value” using the IMPLAN interface. All of these SAM model values will be unique to the study area in question. The Large Groundfish Trawler activity is now ready to estimate the indirect and induced effects of goods and services purchased by the Large Groundfish Trawl vessels. The effects of payments to captain, crew, and proprietors using the analysis by parts approach.

Table A-20. Large Groundfish Trawler industry spending pattern example.

| Activity Type | Activity Name | Activity Level |
|---------------------------|--------------------------|----------------|
| Industry Spending Pattern | Large Groundfish Trawler | 1 |

| Sector | Event Value | Local Direct Purchase |
|--------|-------------|-----------------------|
| 3001 | 0.00000093 | 100% |
| 3002 | 0.00000553 | 100% |
| 3003 | 0.00033032 | 100% |
| 3004 | 0.00020865 | 100% |
| 3005 | 0.00001093 | 100% |
| 3006 | 0.00000951 | 100% |
| 3010 | 0.00000296 | 100% |
| 3013 | 0.00009052 | 100% |
| 3015 | 0.00000200 | 100% |
| 3017 | 0.00775418 | 100% |
| 3027 | 0.00000015 | 100% |
| 3041 | 0.00024154 | 100% |
| 3042 | 0.00003284 | 100% |
| 3043 | 0.00005496 | 100% |
| 3044 | 0.00003994 | 100% |
| 3045 | 0.00000112 | 100% |
| 3046 | 0.00006533 | 100% |
| 3047 | 0.00023512 | 100% |
| 3048 | 0.00007519 | 100% |
| 3050 | 0.00005003 | 100% |
| 3051 | 0.00022556 | 100% |
| 3052 | 0.00019185 | 100% |
| 3053 | 0.00051625 | 100% |
| 3054 | 0.00074862 | 100% |
| 3055 | 0.00061542 | 100% |
| 3056 | 0.00021462 | 100% |
| 3057 | 0.00012303 | 100% |
| 3058 | 0.00007312 | 100% |
| 3059 | 0.00164051 | 100% |
| 3060 | 0.00040442 | 100% |
| 3062 | 0.00075784 | 100% |
| 3063 | 0.00042171 | 100% |
| 3064 | 0.00003310 | 100% |
| 3065 | 0.00032730 | 100% |
| 3066 | 0.00018928 | 100% |
| 3067 | 0.00007958 | 100% |
| 3068 | 0.00022747 | 100% |
| 3069 | 0.00027572 | 100% |
| 3070 | 0.00976184 | 100% |
| 3083 | 0.00024055 | 100% |
| 3085 | 0.00021683 | 100% |
| 3105 | 0.00112477 | 100% |

Table A-20 (continued). Large Groundfish Trawler industry spending pattern example.

| Activity Type | Activity Name | Activity Level | Activity Year |
|---------------------------|--------------------------|----------------|---------------|
| Industry Spending Pattern | Large Groundfish Trawler | 1 | 2010 |

| Sector | Event Value | Local Direct Purchase |
|--------|-------------|-----------------------|
| 3107 | 0.00508185 | 100% |
| 3109 | 0.00066741 | 100% |
| 3115 | 0.06619659 | 100% |
| 3138 | 0.00245623 | 100% |
| 3141 | 0.00000244 | 100% |
| 3142 | 0.00152794 | 100% |
| 3149 | 0.00023378 | 100% |
| 3150 | 0.00018634 | 100% |
| 3216 | 0.00020329 | 100% |
| 3225 | 0.00210726 | 100% |
| 3227 | 0.00012873 | 100% |
| 3256 | 0.00021006 | 100% |
| 3259 | 0.00034217 | 100% |
| 3266 | 0.00014568 | 100% |
| 3271 | 0.00028796 | 100% |
| 3283 | 0.00133483 | 100% |
| 3290 | 0.14267499 | 100% |
| 3319 | 0.06811651 | 100% |
| 3321 | 0.00000141 | 100% |
| 3323 | 0.00005121 | 100% |
| 3324 | 0.01079769 | 100% |
| 3326 | 0.03849354 | 100% |
| 3329 | 0.00048528 | 100% |
| 3330 | 0.00118954 | 100% |
| 3332 | 0.00000710 | 100% |
| 3333 | 0.00120790 | 100% |
| 3334 | 0.00002567 | 100% |
| 3335 | 0.00028480 | 100% |
| 3337 | 0.00083260 | 100% |
| 3339 | 0.00002267 | 100% |
| 3340 | 0.00001297 | 100% |
| 3354 | 0.01136448 | 100% |
| 3357 | 0.04634027 | 100% |
| 3393 | 0.00087277 | 100% |
| 3394 | 0.00145541 | 100% |
| 3410 | 0.00677249 | 100% |
| 3416 | 0.00414619 | 100% |
| 3425 | 0.00867350 | 100% |
| 3436 | 0.00009212 | 100% |

A.2.6.3 Analysis by Parts

In typical IO analysis, a shock to aggregate demand is placed on one of the industry sectors or commodities that are included in the model. Total economic impacts or contributions are then estimated as the backward linked effect of a demand change on the target industry or commodity. To calculate the estimate, the direct effect of the demand change is multiplied with the respective industry multipliers.

As explained by Manshel (2012) “Analysis-by-parts (ABP) does not start with an impact on a target industry sector or commodity. Instead, we will specify the goods and services the target industry

purchases in order to satisfy a demand or production level. The purchase of these goods and services from local sources actually represent the first round of indirect purchases by the target industry. In addition to the goods and services (first part) we need to analyze the impact of the payroll (second part) of our target industry necessary to meet the new demand or production level.”

In ABP the indirect and induced effects of goods and services purchased by a fishing vessel sector is the “first part” of calculating the economic impact of a given level fishery harvest. The “second part” is payments to captain, crew, and proprietors. The impact of payments to captain, crew, and owners for a given level of harvest is estimated separately using the Labor Income Activity described above. The sum of these two impacts is the total indirect and induced effects of a given level of fishery harvest. To these indirect and induced effects the direct effects must be added to reach the total effects of a given level of harvest. An example of the approach is shown below.

In IO-PAC, there are a few additional wrinkles in the ABP approach. First, on the commercial side because we are modeling the effect to both processors and harvesters, the ABP must be done for both. Additionally, the treatment tax revenue paid by harvesters is one additional “part” needed to estimate each impact for state and West Coast level study areas. Taxes are part of the production function of the commercial fishing harvesters. These taxes paid are not part of their industry spending patterns. For state and West Coast study areas, these taxes are assumed to be endogenous. The implication is that government spending will be affected by changes in tax payments from fishery participants. These payments are assumed to be subsequently spent by state and local governments. State and local government spending is expected to follow the State and Local Government Non-Education institutional spending pattern that is contained in IMPLAN.

A.2.7 Impact Estimation

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 an 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. On the commercial side, economic impacts can be made on a commodity or industry basis.

IO models are designed to estimate the backward linked effects of a change in demand on a given industry or change in demand for a given commodity. For commercial vessel landings, IO-PAC utilizes a technique outlined by Steinback (2004) to use IO models for a change in production rather than a change in demand. If we were using the IO model in the standard way to estimate the backward linked impact of a shock to processed seafood demand, we would run a single direct commodity effect on processed seafood. The backward linked effect of that change in processed seafood demand would hit every firm involved in the production and distribution of seafood. A margin would hit the retailers, wholesalers, and processors. Harvesters would be hit as an indirect effect, because they supply the processors with a production input. The processor multiplier would have an embedded indirect effect of a change in harvester landings. The approach outlined by Steinback (2004) involves exogenously shocking the relevant seafood sectors (harvesters and processors) and setting their regional purchase coefficients (RPCs) to 0 to avoid double counting and feedback effects. By following this approach the IO model gives us the economic impact of a change in "demand" for seafood at the processor and harvester stages of production separately. Because the RPC on harvesters is set to 0, there is no indirect effect on harvesters from a change in processor production. Because the indirect effect on harvesters of a shock to processors is absent, the two effects can be summed without double counting.

With a given change in commercially harvested fish, how are the economic impacts estimated? One must decide whether a shock is more appropriately targeted on a commodity or industry sector included in

the model. The appropriateness of commodity versus industry shocks depends on the research question.⁵ Assuming the appropriate target is the Large Groundfish Trawlers (LGT) industry sector, the impacts are estimated as follows. First, the LGT revenue is run through their production function. The LGT production function is in the form of an industry spending pattern imported into IMPLAN. The function can be seen using the “Setup Activities” screen in IMPLAN (Figure A-5). The activity is named “Large Groundfish Trawler.” Choosing the activity will cause the production function information specific to LGTs to show up in the events window. The “Sum of Event Values” at the bottom of Figure 3 shows the total share of LGT output that is used for factors of production excluding labor, so 45% of LGT revenue is used for inputs such as fuel, insurance, etc. The exogenous change in LGT harvest is entered in the “Level” cell. In this example, \$1 million in revenue is entered.

Activities

| Activity Name | Level | Activity Type |
|--------------------------|----------------|---------------------------|
| Large Groundfish Trawler | 1,000,000.0... | Industry Spending Pattern |
| LGT Labor | 1,000,000.0... | Labor Income Change |
| Large Groundfish Trawler | 1,000,000.0... | Industry Spending Pattern |
| Pacific Whiting Trawler | 1,000,000.0... | Industry Spending Pattern |
| Small Groundfish Trawler | 1,000,000.0... | Industry Spending Pattern |
| Sablefish Fixed Gear | 1,000,000.0... | Industry Spending Pattern |
| Groundfish Fixed Gear | 1,000,000.0... | Industry Spending Pattern |
| Pacific Netter | 1,000,000.0... | Industry Spending Pattern |
| Migratory Netter | 1,000,000.0... | Industry Spending Pattern |

Events

| Sector | Coefficient | Event Year | Local Purchase Percentage |
|---|-------------|------------|---------------------------|
| 3001 Oilseeds | 0.000001 | 2010 | 5.56 % |
| 3002 Grains | 0.000006 | 2010 | 24.75 % |
| 3003 Vegetables and melons | 0.000330 | 2010 | 74.79 % |
| 3004 Fruit | 0.000209 | 2010 | 65.14 % |
| 3005 Tree nuts | 0.000011 | 2010 | 49.57 % |
| 3006 Greenhouse, nursery, and floriculture products | 0.000010 | 2010 | 85.86 % |
| 3010 All other crop farming products | 0.000003 | 2010 | 64.21 % |
| 3013 Poultry and egg products | 0.000091 | 2010 | 54.05 % |
| 3015 Forest, timber, and forest nursery products | 0.000002 | 2010 | 72.83 % |
| 3017 Fish | 0.007754 | 2010 | 17.34 % |
| 3027 Other nonmetallic minerals | 0.000000 | 2010 | 26.65 % |
| 3041 Dog and cat food | 0.000242 | 2010 | 36.70 % |
| 3042 Other animal food | 0.000033 | 2010 | 95.19 % |

Number of Events in the Current Activity: 81 Sum of Event Values: 0.45

Figure A-5. Large Groundfish Trawler industry spending pattern activity.

Second, employee compensation and proprietary income is shocked with the same \$1 million. The labor effect is contained in the activity “LGT Labor.” It is imported as a Labor Income Change. The labor income in the event is set to the proportion of total industry output (TIO) among LGTs that is paid to employees (captain and crew) and proprietors (vessel owners). Figure A-6 indicates that among LGTs the shares paid to employees and proprietor are 0.39 and 0.11 respectively. Importing labor income as a share of TIO, allows the “Level” to be shocked with the same exogenous revenue run through the LGT spending pattern. In this example, we shocked LGT revenue by \$1 million.

⁵ See Leonard and Watson (2011) for a more detailed discussion of commodity versus industry impacts.

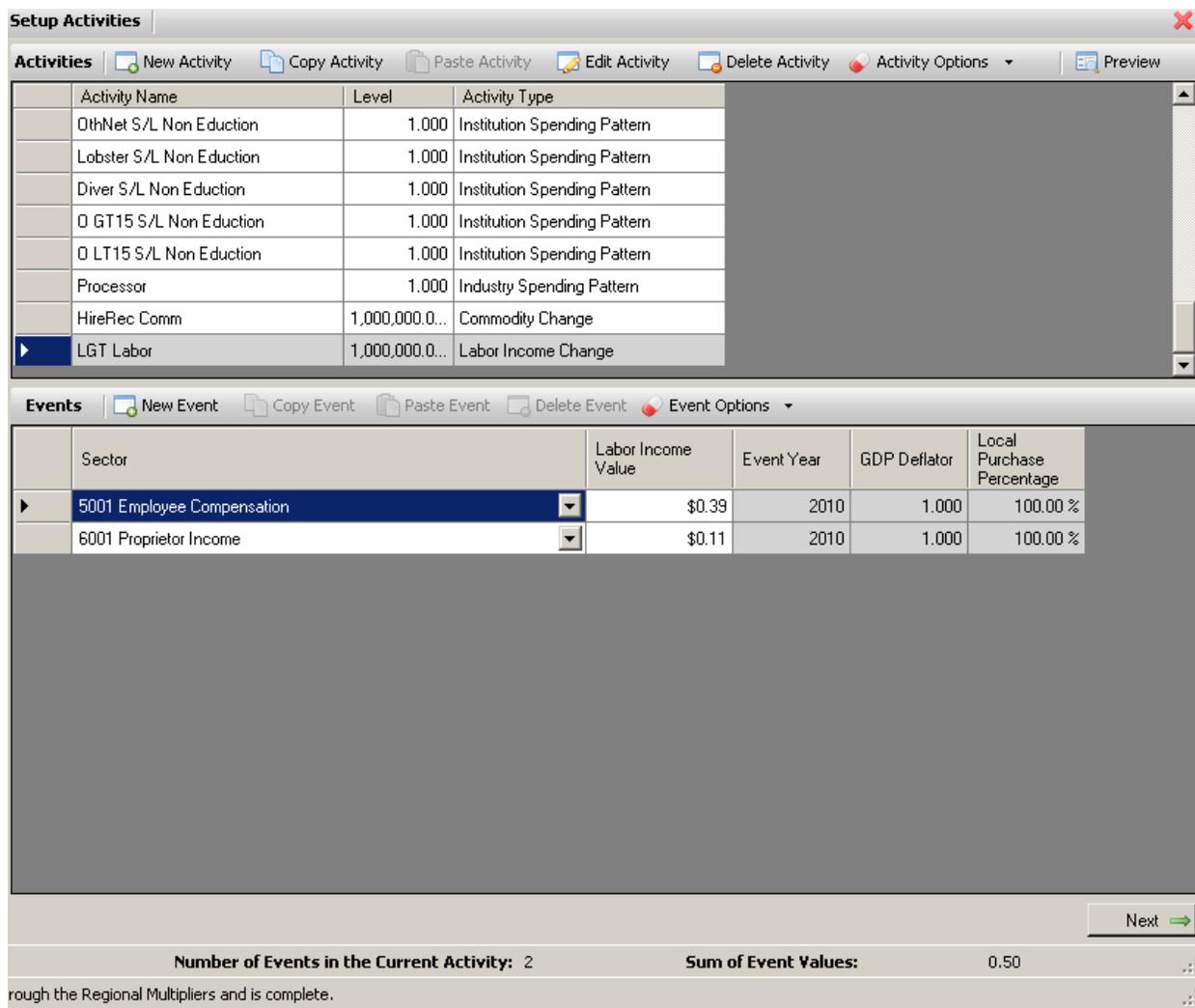


Figure A-6. Large Groundfish Trawler labor income.

Third, since the study area for this model is the whole West Coast, we import the institution spending pattern for State and Local Government Non-Education (SLG). The share of industry output paid in taxes is treated as endogenous in the state level and West Coast study areas. The base institution spending pattern for SLG is put in EXCEL and coefficients for each of the commodity purchases’ are scaled so that the sum of commodity purchases equals the share of TIO paid in taxes among LGTs. This enables the “Level” to be shocked with the same exogenous revenue run through the LGT spending pattern. In this example, we shocked LGT revenue by \$1 million (Figure A-7).

Setup Activities

Activities | New Activity | Copy Activity | Paste Activity | Edit Activity | Delete Activity | Activity Options | Preview

| Activity Name | Level | Activity Type |
|------------------------------|----------------|------------------------------|
| Other GT 15,000 | 1,000,000.0... | Industry Spending Pattern |
| Other Less Than 15,000 | 1,000,000.0... | Industry Spending Pattern |
| PWT S/L Non Education | 1,000,000.0... | Institution Spending Pattern |
| Alaska S/L Non Education | 1,000,000.0... | Institution Spending Pattern |
| LGT S/L Non Education | 1,000,000.0... | Institution Spending Pattern |
| SGT S/L Non Education | 1,000,000.0... | Institution Spending Pattern |
| SableFixed S/L Non Education | 1,000,000.0... | Institution Spending Pattern |
| OGF S/L Non Education | 1,000,000.0... | Institution Spending Pattern |

Events | New Event | Copy Event | Paste Event | Delete Event | Event Options

| Sector | Coefficient | Event Year | Local Purchase Percentage |
|--|-------------|------------|---------------------------|
| 3137 Adhesives | 0.000006 | 2010 | 77.68 % |
| 3138 Soaps and cleaning compounds | 0.000079 | 2010 | 61.95 % |
| 3139 Toilet preparations | 0.000009 | 2010 | 48.35 % |
| 3141 All other chemical products and preparations | 0.000137 | 2010 | 34.38 % |
| 3142 Plastics packaging materials and unlaminated films and sheets | 0.000015 | 2010 | 54.53 % |
| 3144 Plastics pipes and pipe fittings | 0.000005 | 2010 | 68.18 % |
| 3146 Polystyrene foam products | 0.000007 | 2010 | 52.00 % |
| 3147 Urethane and other foam products (except polystyrene) | 0.000000 | 2010 | 70.08 % |
| 3149 Other plastics products | 0.000128 | 2010 | 43.50 % |
| 3150 Tires | 0.000014 | 2010 | 7.12 % |
| 3151 Rubber and plastics hoses and belts | 0.000008 | 2010 | 25.97 % |
| 3152 Other rubber products | 0.000060 | 2010 | 45.65 % |
| 3153 Battery operated and lubricating fixtures | 0.000003 | 2010 | 11.04 % |

Next →

Number of Events in the Current Activity: 265 Sum of Event Values: 0.04

Figure A-7. Large Groundfish Trawler state and local govt. non-education.

To complete the intermediate and induced effect of a \$1 million change in LGT revenue, the Large Groundfish Trawler spending pattern, LGT labor income, and LGT S/L Non-Education are all combined in a single analysis scenario dubbed “LGT” in Figure A-8.

Analyze Scenarios

New Scenario | Scenario Name: LGT | Delete

Select a Scenario from the drop down list box or click New Scenario.

Activity Selection

1. Select the Activity(s) you want to include in the Scenario.
2. Click Analyze to run your Scenario.

Scenario Level: 1.00

| Available Activity(s) | Selected Activity(s) |
|--------------------------|--------------------------|
| Pacific Whiting Trawler | Large Groundfish Trawler |
| Small Groundfish Trawler | LGT S/L Non Education |
| Sablefish Fixed Gear | LGT Labor |
| Groundfish Fixed Gear | |
| Pacific Netter | |
| Migratory Netter | |
| Migratory Liner | |
| Shrimper | |
| Crabber | |
| Salmon Troller | |

Select → ← Unselect Analyze Single Region

Figure A-8. Large Groundfish Trawler impact scenario.

The analysis by parts results indicate the total indirect and induced effects of a \$1 million change in LGT revenue. The impact results for the West Coast study are for an increase in output of \$1.58 million and an employment change of 11.28 jobs. This is the total indirect and induced effect of a \$1.0 million change in LGT harvest. To this amount, the direct effects on harvesters must be added (Steinback et. al, 2008). The direct output and employment of LGTs are \$1.0 million and 4.4, respectively. Altogether, the direct, indirect, and induced effect on output is \$2.58 million and on employment is 15.7 jobs.

After estimating sales by seafood processors, the analysis by parts approach must be conducted in the same manner as for harvesters. Estimated sales changes for seafood processors are made by using product flow in IMPLAN for the default seafood processing sector (71) and markup margin information obtained through the EDC program. For all port level study areas, it is assumed that landings from the fish harvesting sectors flows to seafood processors in the same proportion as the default IMPLAN intermediate processor demand (sector 61) to fish harvesting supply (17) ratio. This value is determined by constructing a default IMPLAN model for the study area of interest, then examining the commodity balance sheet for the harvested fish (commodity 3017). For the West Coast example here, it is assumed that 100% is processed. 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 EDC data (Table A-12). These producer values are then entered as the change in direct sales for the seafood processing sector. For each study area, ΔL_k represents the change in total fish landings among vessel classification k , p represents the ratio of processor demand (sector 61) of the commodity fish to the available fish harvesting supply (sector 17), and m_j represents the markup for species j , then the change in sales for seafood processors (ΔPS) is given by

$$(11) \quad \Delta PS = \sum_k \sum_j \Delta L_k (p)(m_j)$$

In our example of a \$1.0 million change for LGT, assume that the landings are comprised only of sablefish. For the West Coast it is assumed that 100% of the sablefish is processed. Table A-16 indicates that the markup for sablefish is 1.5, so for a \$1.0 million increase in sablefish delivered to processors, processor revenue is \$1.5 million. The analysis by parts approach is used to estimate the impact of the \$1.5 million in the same manner as for harvesters. The total output and employment change resulting from a \$1.5 million change in processor revenue are \$2.4 million and 17.2, respectively.

The results from the analysis by parts results for both LGTs and processors are combined to reach the total change resulting from \$1.0 million change on LGT sablefish landings. Because LGTs and processor effects are separated as a result of our breaking the link between processors and harvesters, the results of each can be added together without double counting. The sum of both the LGT and processor effects is \$5.0 million in economic output and 36 jobs.

On the recreational side, recreational spending vectors for private and charter vessel effort are created in EXCEL and imported into IMPLAN as commodity and industry change vectors. The commodity change and industry change vectors are scaled so that the sum of all affected commodities and industries equals one. Because the vectors are scaled, a change in recreational spending is entered using the “Level” under “Set Up Activities” in IMPLAN. A snapshot of private boat recreational commodity purchases is shown Figure A-9. A hypothetical expenditure change of \$1.0 million is entered in the “Level.” Notice that the sum of event values near the bottom of the figure is 0.75. This indicates that 75% of every dollar in expenditure entered in the “Level” will be distributed to the commodity categories. The other 25% is accounted for in the industry changes for private boat recreational fishing. 25% of each dollar in the “Level” will be distributed to one of the industry categories. The total effect of the \$1.0 million change is done by creating an “Activity Scenario” that includes both the commodity changes and industry changes. In this \$1.0 million example, the total economic output estimate is \$1.88 million and 14.5 jobs.

| Setup Activities | | | | | |
|---------------------------|----------------|------------------------------|--|--|--|
| Activities | | | | | |
| Activity Name | Level | Activity Type | | | |
| Lobster S/L Non Education | 1.000 | Institution Spending Pattern | | | |
| Diver S/L Non Education | 1.000 | Institution Spending Pattern | | | |
| O GT15 S/L Non Education | 1.000 | Institution Spending Pattern | | | |
| O LT15 S/L Non Education | 1.000 | Institution Spending Pattern | | | |
| HireRec Comm | 1,000,000.0... | Commodity Change | | | |
| LGT Labor | 2,000,000.0... | Labor Income Change | | | |
| Processor | 1,480,000.0... | Industry Spending Pattern | | | |
| Processor Payroll | 1,480,000.0... | Labor Income Change | | | |
| PrivRec Comm | 1,000,000.0... | Commodity Change | | | |
| PrivRec Ind | 1,000,000.0... | Industry Change | | | |
| PrivRec Comm2 | 1,000,000.0... | Commodity Change | | | |

| Events | | | | | |
|---|-----------------|------------|-----------------|---------------------------|--|
| Sector | Commodity Value | Event Year | Output Deflator | Local Purchase Percentage | |
| 3115 Refined petroleum products | \$0.20 | 2010 | 1.000 | 80.04 % | |
| 3002 Grains | \$0.00 | 2010 | 1.000 | 24.75 % | |
| 3003 Vegetables and melons | \$0.00 | 2010 | 1.000 | 74.79 % | |
| 3004 Fruit | \$0.00 | 2010 | 1.000 | 65.14 % | |
| 3005 Tree nuts | \$0.00 | 2010 | 1.000 | 49.57 % | |
| 3006 Greenhouse, nursery, and floriculture products | \$0.00 | 2010 | 1.000 | 85.86 % | |
| 3010 All other crop farming products | \$0.00 | 2010 | 1.000 | 64.21 % | |
| 3013 Poultry and egg products | \$0.00 | 2010 | 1.000 | 54.05 % | |
| 3014 Animal products, except cattle, poultry and eggs | \$0.00 | 2010 | 1.000 | 27.27 % | |
| 3017 Fish | \$0.00 | 2010 | 1.000 | 100.00 % | |
| 3018 Wild game products, pelts, and furs | \$0.00 | 2010 | 1.000 | 22.83 % | |
| 3027 Other nonmetallic minerals | \$0.00 | 2010 | 1.000 | 26.65 % | |
| 3041 Dog and cat food | \$0.00 | 2010 | 1.000 | 36.70 % | |
| 3042 Other animal food | \$0.00 | 2010 | 1.000 | 95.19 % | |
| 3043 Flour and malt | \$0.00 | 2010 | 1.000 | 68.42 % | |
| 3044 Corn sweeteners, corn oils, and corn starches | \$0.00 | 2010 | 1.000 | 20.70 % | |
| 3045 Soybean oil and cakes and other oilseed products | \$0.00 | 2010 | 1.000 | 47.80 % | |

| | | |
|---|--|----------------------------------|
| Number of Events in the Current Activity: 69 | | Sum of Event Values: 0.75 |
|---|--|----------------------------------|

Figure A-9. Private Recreation Commodity Purchases.

A.2.8. Discussion

The revision of IO-PAC is intended to make use of the latest commercial fishery cost earnings data collected by the Northwest Fisheries Science Center, incorporate more recent IMPLAN data, add a recreational component that can be used for contribution and impact estimates resulting from recreational fishing trips, add separate mothership and CP sectors, and migrate IO-PAC to IMPLAN version 3.

Since the first version of IO-PAC was completed (Leonard and Watson, 2011), the voluntary cost earning surveys used to develop the production functions for the commercial fishing sectors in the model have been reprised and the EDC data has become available. The IO-PAC revision incorporates these latest survey results. Because of the expanded scope and increased detail of the more recent surveys, incorporating the more recent data has the added benefit of likely increasing the accuracy of IO-PAC, especially for vessel classifications that were previously not covered or partially covered.

The revision to IO-PAC increases the baseline IMPLAN data from 2006 to 2010. The IMPLAN data are based on economic relationships in 2010 as opposed to 2006 before the revision. The economy wide data that is contained in IMPLAN is slow to change. Technical change and demand remain in the economy as a whole remain relatively stable. As a result, the 2010 IMPLAN data will be suitable for use in IO-PAC for several years to come⁶.

The inclusion of a recreational component permits the revised version of IO-PAC to be used for recreational fishing contribution and impact estimates. The inclusion of the recreational component was enabled through the use of recreational expenditure data for 2011 (Lovell et al., 2013) and charter vessel cost earnings data collected by the PSMFC (2004) and the NWFSC in 2006.

The revision also includes shoreside processor data collected through the EDC. The inclusion of the EDC data likely reduces the error in estimating processor impacts. Prior to the EDC, estimates were made using non-species specific production function margins (mark-up) for seafood processors. A limitation to the prior approach is that a dollar of any species will generate the same revenue to processors. While less obvious, the prior approach was also prone to error because the default production functions contained in IMPLAN are based on Economic Census data for processors in the entire United States. If seafood production practices on the West Coast differ from those of the United States as a whole, this approach is prone to error.

The current revision includes a substantial change in model construction that migrates IO-PAC to IMPLAN version 3 software. This migration reduces the effort in making production function changes when newer cost earnings data are available and in creating models for different study areas. The real advantage of the new approach is that once the production functions for the different fishery sectors are completed in a model for one study area, such as the West Coast, they can be imported into an alternative study area with click of a button. Models for all 22 study areas included in the model can be completed in a couple of days rather than weeks. Additionally, the new approach permits customised study areas to be completed with minimal effort. Last

A.2.9. References

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⁶ Opinions differ as to how frequently the input output data should be update. Based on the CIE review of IO-PAC completed in October 2009, the opinion of reviewers was every 3-5 years. The Benchmark Input-Output Table constructed by Bureau of Economic Analysis is updated every five years.

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Appendix: Bridge between Expenditures and IMPLAN Sectors

Factor expenditures by harvesters and seafood wholesalers were allocated to IMPLAN sectors. The following lists represent the bridge between harvester and seafood wholesaler expenditures and IMPLAN sectors. The main difference between these allocations and those presented in Leonard and Watson (2011) is the movement to a new industry classification system in IMPLAN.

Harvester Expenditures

Fuel and lubricant expenses were allocated based on the IMPLAN default margin table for sector 115 (petroleum refineries).

| Sector | Title | Proportion |
|---------------|--|-------------------|
| 3115 | Refined petroleum products Wholesale trade distribution | 0.393794 |
| 3319 | services | 0.361077 |
| 3333 | Rail transportation services | 0.006754 |
| 3334 | Water transportation services | 0.005192 |
| 3335 | Truck transportation services | 0.008658 |
| 3337 | Pipeline transportation services | 0.004953 |
| 3326 | Retail Services - Gasoline stations | 0.219571 |
| | Total | 1.000000 |

Food and beverage expenses were allocated based on the IMPLAN personal consumption expenditure vector 1111. This 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), believed to better reflect likely consumption habits aboard commercial fishing vessels.

| Sector | Title | Proportion |
|---------------|---|-------------------|
| 3001 | Oilseeds | 6.36E-05 |
| 3002 | Grains | 0.000379 |
| 3003 | Vegetables and melons | 0.022642 |
| 3005 | Tree nuts | 0.000749 |
| 3004 | Fruit | 0.014302 |
| 3006 | Greenhouse, nursery, and floriculture products | 0.000652 |
| 3010 | All other crop farming products | 0.000203 |
| 3013 | Poultry and egg products | 0.006205 |
| 3015 | Forest, timber, and forest nursery products | 0.000137 |
| 3027 | Other nonmetallic minerals | 1.00E-05 |
| 3041 | Dog and cat food | 0.016556 |
| 3042 | Other animal food | 0.002251 |
| 3043 | Flour and malt | 0.003767 |
| 3044 | Corn sweeteners, corn oils, and corn starches | 0.002738 |
| 3045 | Soybean oil and cakes and other oilseed products | 7.65E-05 |
| 3046 | Shortening and margarine and other fats and oils products | 0.004478 |
| 3047 | Breakfast cereal products | 0.016116 |
| 3048 | Raw and refined sugar from sugar cane | 0.005154 |
| 3050 | Chocolate cacao products and chocolate confectioneries | 0.003429 |

| Sector | Title | Proportion |
|---------------|--|-------------------|
| 3051 | Chocolate confectioneries from purchased chocolate | 0.015461 |
| 3052 | Nonchocolate confectioneries | 0.01315 |
| 3053 | Frozen foods | 0.035386 |
| 3054 | Canned, pickled and dried fruits and vegetables | 0.051314 |
| 3055 | Fluid milk and butter | 0.042184 |
| 3056 | Cheese | 0.014711 |
| 3057 | Dry, condensed, and evaporated dairy products | 0.008433 |
| 3058 | Ice cream and frozen desserts | 0.005012 |
| 3059 | Processed animal (except poultry) meat and rendered byproducts | 0.112448 |
| 3060 | Processed poultry meat products | 0.027721 |
| 3062 | Bread and bakery products | 0.051946 |
| 3063 | Cookies, crackers, and pasta | 0.028906 |
| 3064 | Tortillas | 0.002269 |
| 3065 | Snack foods including nuts, seeds and grains, and chips | 0.022435 |
| 3066 | Coffee and tea | 0.012974 |
| 3067 | Flavoring syrups and concentrates | 0.005455 |
| 3068 | Seasonings and dressings | 0.015592 |
| 3069 | All other manufactured food products | 0.018899 |
| 3070 | Soft drinks and manufactured ice | 0.06019 |
| 3141 | All other chemical products and preparations | 0.000167 |
| 3319 | Wholesale trade distribution services | 0.098877 |
| 3332 | Air transportation services | 0.000487 |
| 3333 | Rail transportation services | 0.002832 |
| 3334 | Water transportation services | 0.001729 |
| 3335 | Truck transportation services | 0.013268 |
| 3339 | Couriers and messengers services | 0.001554 |
| 3340 | Warehousing and storage services | 0.000889 |
| 3321 | Retail Services - Furniture and home furnishings | 9.66E-05 |
| 3323 | Retail Services - Building material and garden supply | 0.001584 |
| 3324 | Retail Services - Food and beverage | 0.196583 |
| 3326 | Retail Services - Gasoline stations | 0.016591 |
| 3329 | Retail Services - General merchandise | 0.006296 |
| 3330 | Retail Services - Miscellaneous | 0.00834 |
| 3436 | Noncomparable foreign imports | 0.006314 |

Ice expenses were allocated based on the IMPLAN default margin table for sector 70 (soft drink and ice manufacturing).

| Sector | Title | Proportion |
|---------------|---------------------------------------|-------------------|
| 3070 | Soft drinks and manufactured ice | 0.628331 |
| 3319 | Wholesale trade distribution services | 0.10275 |
| 3333 | Rail transportation services | 0.000222 |
| 3334 | Water transportation services | 3.14E-05 |
| 3335 | Truck transportation services | 0.006453 |
| 3324 | Retail Services - Food and beverage | 0.193154 |
| 3326 | Retail Services - Gasoline stations | 0.069058 |
| | Total | 1.000000 |

Repair and maintenance expenses for vessel gear and equipment were allocated to sector 290, which includes ship building and repairing.

| Sector | Title | Proportion |
|---------------|--------------|-------------------|
| 3290 | Ships | 1.00 |
| | Total | 1.00 |

Moorage expenses were allocated to sector 410, which includes the activities of marinas. Marinas usually offer mooring, dockage, and haul out services for a fee.

| Sector | Title | Proportion |
|---------------|--------------------------------|-------------------|
| 3410 | Other amusement and recreation | 1.00 |
| | Total | 1.00 |

Insurance expenses for vessels were allocated to sector 357, which includes establishments primarily engaged in underwriting and assuming the risk of insurance policies.

| Sector | Title | Proportion |
|---------------|--------------|-------------------|
| 3357 | Insurance | 1.00 |
| | Total | 1.00 |

Interest and financial services were allocated to sector 354, which includes establishments primarily engaged in financial services.

| Sector | Title | Proportion |
|---------------|---|-------------------|
| 3354 | Monetary authorities and depository credit services | 1.00 |
| | Total | 1.00 |

Purchases and leases of permits were allocated to IMPLAN's value-added sector, other income.

| Sector | Title | Proportion |
|---------------|--------------|-------------------|
| Value-added | Other Income | 1.00 |
| | Total | 1.00 |

Enforcement expenses were allocated to sector 416, which includes electronic and precision equipment repair and maintenance.

| Sector | Title | Proportion |
|---------------|--|-------------------|
| 3416 | Electronic and precision equipment repairs and maintenance | 1.00 |
| | Total | 1.00 |

Dues were allocated to sector 425, which includes civic, social, professional, and similar organizations.

| Sector | Title | Proportion |
|---------------|--|-------------------|
| 3425 | Civic, social, and professional services | 1.00 |
| | Total | 1.00 |

Moorage expenses were allocated to sector 410, which includes the activities of marinas. Marinas usually offer mooring, dockage, and haul out services for a fee.

| Sector | Title | Proportion |
|---------------|--------------------------------|-------------------|
| 3410 | Other amusement and recreation | 1.00 |
| | Total | 1.00 |

Freight supplies expenses were allocated using the default IMPLAN margin table for sector 126 (paperboard container manufacturing).

| Sector | Title | Proportion |
|---------------|---------------------------------------|-------------------|
| 3107 | Paperboard containers | 0.581083 |
| 3319 | Wholesale trade distribution services | 0.016356 |
| 3332 | Air transportation services | 0.000463 |
| 3333 | Rail transportation services | 0.026539 |
| 3335 | Truck transportation services | 0.130381 |
| 3330 | Retail Services - Miscellaneous | 0.245178 |
| | Total | 1.000000 |

Offloading expenses were allocated to sector 410, which includes the activities of marinas. Marinas usually offer mooring, dockage, and haul out services for a fee.

| Sector | Title | Proportion |
|---------------|--------------------------------|-------------------|
| 3410 | Other amusement and recreation | 1.00 |
| | Total | 1.00 |

Truck transportation was allocated to sector 335, truck transportation.

| Sector | Title | Proportion |
|---------------|-------------------------------|-------------------|
| 3335 | Truck transportation services | 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 (2006) for the miscellaneous trip supplies cost category in the Northeast Region Commercial Fishing Input-Output Model. 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.

| Sector | Title | Proportion |
|---------------|---|-------------------|
| 3083 | Curtains and linens | 0.008560 |
| 3085 | All other textile products | 0.007716 |
| 3105 | Paper from pulp | 0.040025 |
| 3107 | Paperboard containers | 0.180838 |
| 3109 | All other paper bag and coated and treated paper | 0.023750 |
| 3138 | Soaps and cleaning compounds | 0.047259 |
| 3138 | Soaps and cleaning compounds | 0.040146 |
| 3142 | Plastics packaging materials and unlaminated films and sheets | 0.054372 |
| 3149 | Other plastics products | 0.008319 |
| 3150 | Tires | 0.006631 |
| 3216 | Air conditioning, refrigeration, and warm air heating equipment | 0.007234 |
| 3225 | Other engine equipment | 0.074987 |
| 3227 | Air and gas compressors | 0.004581 |
| 3256 | Watches, clocks, and other measuring and controlling devices | 0.007475 |
| 3259 | Electric lamp bulbs and parts | 0.012176 |
| 3266 | Power, distribution, and specialty transformers | 0.005184 |
| 3271 | Primary batteries | 0.010247 |
| 3283 | Motor vehicle parts | 0.047500 |
| 3333 | Rail transportation services | 0.001000 |
| 3319 | Wholesale trade distribution services | 0.161000 |
| 3323 | Retail Services - Building material and garden supply | 0.001000 |
| 3324 | Retail Services - Food and beverage | 0.185000 |
| 3326 | Retail Services - Gasoline stations | 0.013000 |
| 3329 | Retail Services - General merchandise | 0.014000 |
| 3330 | Retail Services - Miscellaneous | 0.038000 |
| | Total | 1.000000 |

Tax expenditures for state and West Coast models were allocated to IMPLAN's State and Local Government Non-Education expenditure vector.

| Sector | Title | Proportion |
|------------------------------|--|-------------------|
| Institution Spending Pattern | State and Local Government Non-Education | 1.00 |
| | Total | 1.00 |

Wages and salaries of employees (captain and crew) were allocated to the value-added sector, employee compensation.

| Sector | Title | Proportion |
|---------------|-----------------------|-------------------|
| Value-added | Employee compensation | 1.00 |
| | Total | 1.00 |

Vessel residuals were allocated to the value-added sector, proprietary income.

| Sector | Title | Proportion |
|---------------|--------------------|-------------------|
| Value-added | Proprietary income | 1.00 |
| | Total | 1.00 |

Seafood Processors

Seafood processor purchases were allocated as follows.

Additives

| Commodity | Title | Proportion |
|------------------|--|-------------------|
| 3046 | Shortening and margarine and other fats and oils products | 0.5860 |
| 3059 | Processed animal (except poultry) meat and rendered byproducts | 0.1989 |
| 3045 | Soybean oil and cakes and other oilseed products | 0.1428 |
| 3044 | Corn sweeteners, corn oils, and corn starches | 0.0077 |
| 3126 | Other basic organic chemicals | 0.0647 |
| | Total | 1.000000 |

Custom processing was allocated to the processed seafood commodity.

| Sector | Title | Proportion |
|---------------|------------------|-------------------|
| 3061 | Seafood products | 1.0000 |
| | Total | 1.00 |

Electrical utility expenses

| Sector | Title | Proportion |
|---------------|--|-------------------|
| 3031 | Electricity, and distribution services | 1.0000 |
| | Total | 1.00 |

Freight expenses

| Sector | Title | Proportion |
|---------------|-------------------------------|-------------------|
| 3335 | Truck transportation services | 0.853 |
| 3333 | Rail transportation services | 0.039 |
| 3332 | Air transportation services | 0.108 |
| | Total | 1.00 |

Insurance expenses

| Sector | Title | Proportion |
|---------------|--------------|-------------------|
| 3357 | Insurance | 1.0000 |
| | Total | 1.00 |

Natural gas and propane gas expenses

| Sector | Title | Proportion |
|---------------|--|-------------------|
| 3032 | Natural gas, and distribution services | 0.9924 |
| 3020 | Oil and natural gas | 0.0076 |
| | Total | 1.00 |

Offsite storage and freezing

| Sector | Title | Proportion |
|---------------|----------------------------------|-------------------|
| 3340 | Warehousing and storage services | 1.000 |
| | Total | 1.00 |

Packaging

| Sector | Title | Proportion |
|---------------|---|-------------------|
| 3107 | Paperboard containers | 0.8034 |
| 3108 | Coated and laminated paper, packaging paper and plastics film | 0.1392 |
| 3105 | Paper from pulp | 0.0091 |
| 3146 | Polystyrene foam products | 0.0048 |
| 3142 | Plastics packaging materials and unlaminated films and sheets | 0.0435 |
| | Total | 1.000000 |

Production supplies

| Sector | Title | Proportion |
|---------------|---|-------------------|
| 3327 | Retail Services - Clothing and clothing accessories | 0.2941 |
| 3325 | Retail Services - Health and personal care | 0.2206 |
| 3329 | Retail Services - General merchandise | 0.4853 |
| | Total | 1.000000 |

Rental or lease of buildings, job-site trailers, and other structures

| Sector | Title | Proportion |
|---------------|---|-------------------|
| 3360 | Real estate buying and selling, leasing, managing, and related services | 1.0000 |
| | Total | 1.00 |

Rental or lease of processing machinery or equipment

| Sector | Title | Proportion |
|---------------|---|-------------------|
| 3365 | Commercial and industrial machinery and equipment rental and leasing services | 1.0000 |
| | Total | 1.00 |

Repair and maintenance on facility buildings, machinery, and equipment

| Sector | Title | Proportion |
|---------------|---|-------------------|
| 3039 | Maintained and repaired nonresidential structures | 0.363 |
| 3388 | Services to buildings and dwellings | 0.364 |
| 3417 | Commercial and industrial machinery and equipment repairs and maintenance | 0.273 |
| | Total | 1.00 |

Sewer and waste

| Sector | Title | Proportion |
|---------------|---|-------------------|
| 3390 | Waste management and remediation services | 1.0000 |
| | Total | 1.00 |

Shoreside monitors

| Sector | Title | Proportion |
|---------------|---|-------------------|
| 3375 | Environmental and other technical consulting services | 1.0000 |
| | Total | 1.00 |

Water expenses

| Sector | Title | Proportion |
|---------------|---|-------------------|
| 3033 | Water, sewage treatment, and other utility services | 1.0000 |
| | Total | 1.00 |

Other processors expenditures were allocated according to proportions contained in the production function of the default processing sector in IMPLAN that were not allocated to any of the cost categories already used above.

| Sector | Title | Proportion |
|---------------|--|-------------------|
| 3319 | Wholesale trade distribution services | 0.2569 |
| 3014 | Animal products, except cattle, poultry and eggs | 0.2188 |
| 3381 | Management of companies and enterprises | 0.1361 |
| 3380 | All other miscellaneous professional, scientific, and technical services | 0.0636 |
| 3377 | Advertising and related services | 0.0411 |
| 3369 | Architectural, engineering, and related services | 0.0402 |
| 3354 | Monetary authorities and depository credit intermediation services | 0.0294 |
| 3190 | Metal cans, boxes, and other metal containers (light gauge) | 0.0189 |
| 3351 | Telecommunications | 0.0170 |
| 3366 | Leasing of nonfinancial intangible assets | 0.0135 |
| 3362 | Automotive equipment rental and leasing services | 0.0132 |
| 3374 | Management, scientific, and technical consulting services | 0.0125 |
| 3367 | Legal services | 0.0119 |
| 3368 | Accounting, tax preparation, bookkeeping, and payroll services | 0.0106 |
| 3413 | Restaurant, bar, and drinking place services | 0.0097 |
| 3338 | Scenic and sightseeing transportation services and support activities for transportation | 0.0084 |
| 3376 | Scientific research and development services | 0.0074 |
| 3356 | Securities, commodity contracts, investments, and related services | 0.0068 |
| 3414 | Automotive repair and maintenance services, except car washes | 0.0061 |
| 3149 | Other plastics products | 0.0047 |
| 3373 | Other computer related services, including facilities management | 0.0047 |
| 3425 | Civic, social, and professional services | 0.0043 |
| 3118 | Petroleum lubricating oils and greases | 0.0042 |
| 3411 | Hotels and motel services, including casino hotels | 0.0041 |
| 3021 | Coal | 0.0041 |
| 3202 | Other fabricated metals | 0.0040 |
| 3112 | All other converted paper products | 0.0035 |
| 3355 | Nondepository credit intermediation and related services | 0.0034 |
| 3372 | Computer systems design services | 0.0030 |
| 3416 | Electronic and precision equipment repairs and maintenance | 0.0028 |
| 3386 | Business support services | 0.0026 |
| 3138 | Soaps and cleaning compounds | 0.0025 |
| 3236 | Computer terminals and other computer peripheral equipment | 0.0022 |

| Sector | Title | Proportion |
|---------------|---|-------------------|
| 3375 | Environmental and other technical consulting services | 0.0021 |
| 3432 | Products and services of State & Local Govt enterprises (except electric utilities) | 0.0021 |
| 3433 | Used and secondhand goods | 0.0019 |
| 3418 | Personal and household goods repairs and maintenance | 0.0019 |
| 3352 | Data processing- hosting- ISP- web search portals | 0.0018 |
| 3384 | Office administrative services | 0.0015 |
| 3148 | Plastics bottles | 0.0014 |
| 3336 | Transit and ground passenger transportation services | 0.0014 |
| 3363 | General and consumer goods rental services except video tapes and discs | 0.0014 |
| 3382 | Employment services | 0.0010 |
| 3389 | Other support services | 0.0009 |
| 3405 | Independent artists, writers, and performers | 0.0008 |
| 3247 | Other electronic components | 0.0008 |
| 3216 | Air conditioning, refrigeration, and warm air heating equipment | 0.0007 |
| 3320 | Retail Services - Motor vehicle and parts | 0.0006 |
| 3283 | Motor vehicle parts | 0.0006 |
| 3387 | Investigation and security services | 0.0006 |
| 3331 | Retail Services - Nonstore, direct and electronic sales | 0.0005 |
| 3106 | Paperboard from pulp | 0.0005 |
| 3324 | Retail Services - Food and beverage | 0.0005 |
| 3415 | Car wash services | 0.0004 |
| 3195 | Machined products | 0.0004 |
| 3404 | Promotional services for performing arts and sports and public figures | 0.0004 |
| 3228 | Material handling equipment | 0.0003 |
| 3323 | Retail Services - Building material and garden supply | 0.0003 |
| 3407 | Fitness and recreational sports center services | 0.0003 |
| 3239 | Other communications equipment | 0.0003 |
| 3141 | All other chemical products and preparations | 0.0002 |
| 3403 | Spectator sports | 0.0002 |
| 3326 | Retail Services - Gasoline stations | 0.0002 |
| 3410 | Other amusements and recreation | 0.0002 |
| 3266 | Power, distribution, and specialty transformers | 0.0002 |
| 3330 | Retail Services - Miscellaneous | 0.0002 |
| 3163 | Other concrete products | 0.0002 |
| 3259 | Electric lamp bulbs and parts | 0.0002 |
| 3322 | Retail Services - Electronics and appliances | 0.0002 |
| 3321 | Retail Services - Furniture and home furnishings | 0.0002 |
| 3370 | Specialized design services | 0.0001 |
| 3328 | Retail Services - Sporting goods, hobby, book and music | 0.0001 |
| 3237 | Telephone apparatus | 0.0001 |
| 3238 | Broadcast and wireless communications equipment | 0.0001 |
| 3402 | Performing arts | 0.0000 |
| 3313 | Office supplies (except paper) | 0.0000 |
| | Total | 1.000000 |

Wages and salaries of employees were allocated to the value-added sector, employee compensation.

| Sector | Title | Proportion |
|---------------|-----------------------|-------------------|
| Value-added | Employee compensation | 1.00 |
| | Total | 1.00 |

Processor residuals were allocated to the value-added sector, proprietary income.

| Sector | Title | Proportion |
|---------------|--------------------|-------------------|
| Value-added | Proprietary income | 1.00 |
| | Total | 1.00 |