NOTICE OF OFFICE OF MANAGEMENT AND BUDGET ACTION

Date 07/16/2013

Department of Commerce
National Oceanic and Atmospheric Administration

FOR CERTIFYING OFFICIAL: Simon Szykman
FOR CLEARANCE OFFICER: Jennifer Jessup

In accordance with the Paperwork Reduction Act, OMB has taken action on your request received 07/10/2013

ACTION REQUESTED: Generic IC
TYPE OF REVIEW REQUESTED:
ICR REFERENCE NUMBER: 201301-0648-009
AGENCY ICR TRACKING NUMBER:
TITLE: Economic Surveys for U.S. Commercial Fisheries
LIST OF INFORMATION COLLECTIONS: See next page

OMB ACTION: Approved without change
OMB CONTROL NUMBER: 0648-0369
The agency is required to display the OMB Control Number and inform respondents of its legal significance in accordance with 5 CFR 1320.5(b).

EXPIRATION DATE: DISCONTINUE DATE:

BURDEN:	RESPONSES	HOURS	COSTS
Previous	7,000	7,000	0
New	10,380	21,000	0
Difference			
Change due to New Statute	0	0	0
Change due to Agency Discretion	-3,431	900	0
Change due to Agency Adjustment	6,811	13,100	0
Change due to PRA Violation	0	0	0

TERMS OF CLEARANCE: Terms of the Generic ICR remain in effect.

OMB Authorizing Official: Dominic J. Mancini
Acting Deputy Administrator,
Office Of Information And Regulatory Affairs

List of ICs				
IC Title	Form No.	Form Name	CFR Citation	Hrs/$/Resp
Washington and Oregon Marine Charter Fishing 2012 Calendar Year Cost and Earnings Survey	NA	Washington and Oregon Charter Vessel 2012 Calendar Year Cost and Earnings Survey		180 / 0 / 452
Total Hours Actually Used for Information Collections Under Currently Approved ICR:				180

PAPERWORK REDUCTION ACT
DOC/NOAA ECONOMIC PERFORMANCE DATA SURVEYS FOR WEST COAST COMMERCIAL FISHERIES CLEARANCE
OMB CONTROL NUMBER 0648-0369

This form should only be used if you are submitting a collection of information for approval under the DOC/NOAA Information Collection Request for Economic Performance Data surveys for the West Coat Commercial Fisheries assigned OMB control number 0648-0369. Mail this form, responses to the supplemental questions, the collection instrument, and any additional documentation to: **Office of Information and Regulatory Affairs, Office of Management and Budget, Docket Library, Room 10102, 725 17th Street NW, Washington D.C. 20503.**
If the collection does not satisfy the requirements of the program clearance, you should follow the regular PRA clearance procedures described in 5 CFR 1320.

Title (Please be specific)

Washington and Oregon Marine Charter Fishing 2012 Calendar Year Cost and Earnings Survey

Burden Hour Estimates

Number of respondents **310**

Total Burden Hours **180**

Hours per response **telephone contact**

Cumulative Burden Hours under Program Clearance **6,808**

Agency Contact *(person who can best answer questions about the content of the submission)*

Name **Jerry Leonard**

Phone **206-302-1742**

Certification: The collection of information requested by this submission meets the requirement of the OMB approval for OMB control number 0648-0369.

Signed by Rita Curtis 7-3-13

Signature of Program Official Date

Signature of NOAA Paperwork Clearance Officer Date

OIRA Date

Washington and Oregon Marine Charter Fishing 2012 Calendar Year Cost and Earnings Survey
Responses to Supplemental Questions for PRA Clearance
OMB Review of Individual Instruments

Project Title: Washington and Oregon Marine Charter Fishing 2012 Calendar Year Cost and Earnings Survey

Justification under OMB Generic Clearance:
(Economic Survey of US Commercial Fisheries, OMB Control No. 0648-0369)

Commercial fisheries economic data collection programs implemented by National Marine Fisheries Service (NMFS) address statutory and regulatory mandates to determine the quantity and distribution of net benefits derived from living marine resources as well as predict the economic impacts from proposed management options on fishing vessels, shore side industries, and fishing communities. In particular, these economic data collection programs contribute to legally mandated analyses required under the Magnuson-Stevens Fishery Conservation and Management Act (MFCMS), the National Environmental Policy Act (NEPA), the Regulatory Flexibility Act (RFA), and Executive Order 12866 (E.O. 12866).

This particular survey instrument closely mirrors an instrument successfully fielded by the Northwest Fisheries Science Center (NWFSC) and Pacific States Marine Fisheries Commission in 2007 and research efforts recently approved under OMB Control No. 0648-0369 (commercial fisheries) for the California Commercial Passenger Fishing Vessel (CPFV), charter sector. Like the California charter sector, Washington and Oregon charter vessels are considered commercial ventures and not recreational pursuits. Therefore, to estimate the economic contribution of Washington and Oregon charter sector, and the impacts of federal actions on the Washington and Oregon charter sector, the survey will address the fishery as commercial rather than recreational. This request is for a one-time survey of the Washington and Oregon charter fleet which has been developed based on previously approved question categories as outlined in the OMB Control No. 0648-0369 (commercial fisheries) supporting statement.

Objective: The charter fishing industry has a long history in Washington and Oregon, as residents and tourists have come to experience a myriad of fishing opportunities, from salmon fishing in the Puget Sound and the Columbia River area to tuna fishing and rockfish fishing opportunities throughout both states. Charter fishing is a notable component of tourism along the Washington and Oregon coasts. In 2009, charter patrons in Washington and Oregon generated sales impacts of approximately $34 million and value-added impacts in the form of wages, salaries, and profits of $19 million[1].

[1] NOAA – Fisheries Economics of the United States 2009.

Timely costs and earnings data are needed in order to estimate the fishery's contribution to the state's economy. IMPLAN[2] sector (cost and earnings) data from Washington and Oregon charter vessels are required in the estimation of the Input Output Model for Pacific Coast Fisheries (IO-PAC) which is used to provide statutorily required estimates to the Pacific Fishery Management Council for fisheries under Fishery Management Plans (FMPs) administered in the Northwest and Southwest regions.

A prior study of the Washington and Oregon charter fleet, with a similar survey instrument, was completed in 2007 and collected cost earnings data pertaining to 2006. Since then, the industry has faced a variety of difficult circumstances. In 2008, Secretary of Commerce Carlos M. Gutierrez declared a commercial fishery failure for the West Coast salmon fishery (Upton, 2010), and the prior 2007 survey indicated that the industry was still highly dependent on salmon. In Washington, where salmon charter licenses are distinguishable from non-salmon licenses[3], there are still nearly five times as many salmon licenses as non-salmon licenses. Additionally, nominal marine fuel prices increased 47% in the six-year period from 2006 to 2012[4], and the 2007 survey indicated that fuel was the single largest non-labor expense of operating. Given the recent macroeconomic changes in the past 7 years and the regulatory changes, particularly for salmon, there is a need for a collection of economic cost and earnings data and related social data on the Washington and Oregon charter fleet to support the fishery management process.

1. The potential respondent universe and any sampling or other respondent selection method to be used and the expected response rate.

Potential Respondent Universe

The number of charter vessel license holders in Washington and Oregon in 2012 was 369. However, following the findings of the Washington and Oregon charter survey in 2007, a substantial portion of the 369 license holders will not go fishing in marine waters. Many will fish only in fresh water and others will carry passengers in marine waters but will do so for purposes other than fishing, such as wildlife watching. Absent contacting the vessels to ascertain their activities, the number of active marine fishing vessels in 2012 is unknown. Consequently, the number of marine charter fishing vessels is estimated to be the same proportion as in 2007, which was 70% or 258 vessels. Owners of each of the approximately 258 vessels, rather than captains, will be the target respondents because they possess the specific economic and social data for the operations they run. Contact information on the 2012 charter license holders was obtained from the Washington Department of Fish and Wildlife and the Oregon Department of Fish and Wildlife.

[2] IMPLAN (IMpact analysis for PLANning) is a data and software package designed to estimate local economic effects from regional economic activity.
[3] In Oregon there is not such distinction, so such a comparison is not easily made.
[4] See Pacific States Marine Fisheries Commission Washington and Oregon State average monthly marine fuel prices. www.psmfc.org/efin/data/fuel.html

Sampling and Other Respondent Selection Methods

The survey will be conducted as a census of all charter license holders that actively engaged in marine charterboat fishing in 2012. The survey will be conducted in two phases. Phase 1 will consist of a telephone pre-survey to determine license holders that actively engaged in marine charter fishing. Phase 2 consists of a mixed mode design to collect detail cost earnings data from active marine charterboat participants. Active marine charter vessel owners will then receive a formal letter of invitation to participate in the survey as well as a fact sheet of the commonly asked questions and answers about the survey. Following mailing of the letter of invitation, owners will be contacted by phone to confirm receipt of the letter of invitation, and asked to schedule a one hour interview appointment. Interviews will be conducted in-person for each owner during the scheduled time. Previous cost earnings surveys of charter vessels have demonstrated the effectiveness of in-person interviews in collecting data and obtaining accurate information[5]. In order to improve the quality of information collected, in-person survey administration will be the preferred mode for the study. However, to maximize the response rate and ensure the survey sample is representative of our respondent universe, respondents will be offered telephone or mail-in mode interviews.

Expected Response Rate

The expected rate among the target population of charter license holders actively engaged in marine charter fishing in 2012 is 55%. The response rates achieved in the 2007 marine charter survey in Washington and Oregon are instructive to determine the expected response rate. The initial contact (Phase 1) to determine the active marine charter vessels was done via telephone as currently planned. However, Phase 2 was a different because surveys were completed via mail only. In the prior survey, there were 287 license holders. 47 license holders or 16% of the total were unable to be contacted due to either bad contact information or failure to return phone calls. Of the remaining 240 license holders for which contact was made, 71 did not participate in marine charter fishing, 70 refused to participate in the survey, and 99 completed the survey. Using the conservative assumption that all 70 who refused to participate in the survey were active marine charter vessels, the total number of active participants was 169, and the percentage of active license holders was 70% (169/240). For the 47 vessels in which contact was not achieved, some were likely active marine charter vessels and some were not. Assuming that the non-contacts were distributed between active and not-active marine charter vessels in the same manner as the vessels in which contact was achieved, 70% or 33 of the vessels not contacted were active. The total population of active charter vessels in the 2007 survey was 202

[5] Hamilton, M. and S. Huffman, *Cost-Earnings Study of Hawaii's Small Boat Fishery, 1995-1996*, 104 pp, University of Hawaii, Joint Institute for Marine and Atmospheric Research, 1000 Pope Road, Honolulu, HI 96822, 1997
Hospital, J., S. Scholey and M. Pan. 2011. *Economic and Social Characteristics of the Hawaii Small Boat Pelagic Fishery*. Pacific Islands Fisheries Science Center. Administrative Report H11-01. 78p.

(completes+refusals+non-contact amount). The 99 surveys received were 49% of active vessels. We expect to be able to increase the response rate from the 2007 survey. We expect to reach our desired response rate by increasing the industry's awareness of the study and interest in participation through outreach and by offering a flexible mode design.

Washington has two formal charter vessel associations: Westport Charterboat Association and Charterboat Association of Puget Sound. Field staff have been working with leaders of these associations to improve the questionnaire and build support for the survey. Leaders in these organizations have agreed to promote the survey among their members and have provided positive feedback about the effort. These leaders have requested that prior to the initial telephone calls that they be notified, so that they can encourage their members to participate.

There is no formal association of vessels in Oregon. However, leaders in the Washington associations provided contact information for an influential Oregon charter owner who is involved in fishery management issues through his appointment in the Pacific Fishery Management Council. He has also agreed to promote the survey among Oregon charter vessel owners.

To address the potential for a low response rate a mixed mode data collection strategy[6] will be employed to increase the response rate. Mixed mode surveys combine two or more modes of communication to collect information and can be affective at achieving a higher response rate[7]. The prior Washington and Oregon charter survey employed only a mail-only design. The mixed mode strategy employed in this study is expected to increase the overall response rate.

2. Data collection procedures, including the statistical methodology for stratification and sample selection, the estimation procedures, the degree of accuracy needed for the intended purpose, expected dates of survey implementation, and any unusual problems requiring specialized sampling procedures.

Data Collection Procedures, Sample Selection and Stratification

Data collection and sample selection methods are detailed in Question 1 of this submission. Since we intend to conduct a census of all active marine charter vessels in Washington and Oregon, there is no stratification of the population.

Degree of Accuracy Needed for Intended Purpose

The primary importance of these data is to evaluate the cost and earnings structure of the entire Washington and Oregon marine charter fishery. To achieve this aim we plan to conduct a census

[6]de Leeuw, E., J. Hox and D. Dillman. 2008. *International Handbook of Survey Methodology*. New York, NY: European Association of Methodology/Lawrence Erlbaum Associates.
[7] Dillman et al. 2009. Response rate and measurement difference in mixed-mode surveys using mail, telephone, interactive voice response (IVR) and the Internet. Social Science Research (38) 1-18.

of all 258 vessels actively involved in the fishery. Assuming a response rate of 55%, we expect to obtain 142 complete and usable surveys. This would allow us to report sample means within 10% of the population mean at 99% confidence across the entire fishery[8]. This level of accuracy is sufficient to evaluate the economic impacts from proposed management options on the marine charter fishery, and to contribute to the development of the coast-wide I/O model for recreational fishing.

Expected Dates of Survey Implementation

The proposed start date for initiating the mail and telephone contact is August 1, 2013. The data collection is to be completed over a six month period ending January 31, 2014.

3. The methods used to maximize response rates and address non-response. The accuracy and reliability of the information collected must be shown to be adequate for the intended uses.

Strategy to Maximize Response Rates

We assume an estimated response rate of 55% based on the 49% response rate of the 2007 Washington and Oregon marine charter survey, our comprehensive outreach plan, and the mixed mode nature of the interviews. There are no previous studies of the fleet to suggest a higher expected response rate. A higher than expected response rate will increase the statistical confidence in the study's findings.

There are numerous methods we will administer to achieve the estimated 55% response rate. Extensive outreach activities informing the fishermen and fishing associations of the purpose and need for the cost-earnings survey are expected to facilitate survey participation and completion. Outreach efforts will be coordinated with industry representatives. Outreach will occur on a number of levels and may include the following:

- Contacting Westport Washington and Puget Sound charter professional organizations and an influential Oregon charter vessel owner.
- Generating a fact sheet of commonly asked questions and answers.
- Sending a formal briefing letter on the data collection effort to all active charter license holders.
- Maintaining information regarding the data collection effort on the internet.

Additional methods for improving the response rate include offering participants in-person, telephone or mail-in mode interviews.

[8] Percent confidence was calculated using equations adapted from Dillman, D.A., J.D. Smyth and L.M. Christian. 2009. *Internet, Mail, and Mixed-Mode Surveys: The Tailored Design Method*. Hoboken, New Jersey: John Wiley & Sons, Inc.

Strategy to Address Non-Response

All charter vessels in Washington and Oregon are required to be registered with the respective state fish and wildlife agencies. Using these resources, we are aware of the spatial distribution of registered vessels by homeport across Washington and Oregon. Additionally, the length of the vessel is maintained in the state databases. Based on the distribution of survey responses that we receive, these databases provide a link, both spatial and length-based, to validate the representativeness of our sample. If non-response bias appears evident in our survey responses, weighting methods will be developed to account for at least part of any non-response.

Accuracy of Data Collected

NMFS needs to measure the economic performance of Washington and Oregon charter operations in order to meet legal and regulatory requirements, support fisheries management decision making, and pursue more detailed economic research. Currently, the cost earnings data that are used to meet these needs are seven years old. This study will collect data that is needed to construct key economic performance measures such as profitability, productivity, economic impacts, and social aspects of the fishery. The data gathered and performance measures constructed will be used to address a wide range of issues.

While the data will be used to comply with legal and regulatory requirements, these requirements do not specify a level of data accuracy. Being able to detect a non-response bias, and correct through weighing methods will enable sufficient accuracy and fleet representation.

4. How the survey instrument was developed, including the steps taken to validate the questionnaire design.

The survey administration protocol is similar to the ones used for Oregon Trawl and Pacific Coast Open Access surveys conducted by Carl Lian at the Northwest Fisheries Science Center[9] and the For-Hire Cost and Earnings Survey for the Mid-Atlantic and New England conducted by Scott Steinback of the Northeast Fisheries Science Center[10].

The survey instrument closely mirrors an instrument successfully fielded by the NWFSC and Pacific States Marine Fisheries Commission in 2007 and a survey recently approved for the California Commercial Passenger Fishing Vessels (CPFV) OMB Control No. 0648-0369. The survey has been designed using the prior, 2007, survey of Washington and Oregon charter vessels and feedback from representatives of the Westport Charterboat Association, Charterboat Owners of Puget Sound and an Oregon charter vessel owner who is involved in fishery

[9] Lian, C. 2012. West Coast open access groundfish and salmon troller survey: Protocol and results for 2005 and 2006. U.S. Dept. of Commerce, NOAA Tech. Memo., NMFS-NWFSC-116, 52 p

[10] QuanTech and Gentner. 2011. Recreational For-Hire Economic Survey for the Mid-Atlantic and New England: Summarization and Results Report of Total In-Person Interviews Completed by Stratified Region.

management issues through his appointment in the Pacific Fishery Management Council. The proposed survey instrument also utilizes feedback from a pilot study of the San Diego CPFV industry consisting of interviews of eight CPFV owners representing 10 vessels from a total of 76 vessels registered in San Diego County in 2011.[11]

5. The reporting and use of the results of the survey

Use of Survey Results

NMFS needs to measure the economic performance of Washington and Oregon charter operations in order to meet legal and regulatory requirements, support fisheries management decision making, and pursue more detailed economic research. Currently, the cost earnings data used to meet these needs are seven years old. This study will collect data that is needed to construct key economic performance measures related to profitability, productivity, economic impacts, and social aspects of the fishery. The data gathered and performance measures constructed will be used to address a wide range of issues important to the Northwest Regional Office, Pacific Fishery Management Council, and the Washington and Oregon charter fleet including estimating the economic contribution of the Washington and Oregon fleet and the estimated impact of changes in environmental, economic, or management conditions on the on the Washington and Oregon charter fishery.

Reporting of Survey Results

Survey results will be reported through a series of reports and project summaries prepared for the survey respondents, general fishing public, fisheries managers, and academics. It is anticipated that results will also be reported in the form of a technical memorandum of the Northwest Fisheries Science Center, academic publications, presentations at conferences, and public meetings. All reporting of survey results will conform to data confidentiality requirements. Qualified researchers with data access and confidentiality agreements will have access to raw data for performing future analyses, if requested.

Information Quality Guidelines and Confidentiality

It is anticipated that the information collected will be disseminated to the public or used to support publicly disseminated information. NMFS will retain control over the information and safeguard it from improper access, modification, and destruction, consistent with NOAA standards for confidentiality, privacy, and electronic information. In particular, the data collected will be kept confidential as required by section 402(b) of the Magnuson-Stevens Act and NOAA Administrative Order 216-100, Confidentiality of Fisheries Statistics, and will not be released for public use except in aggregate statistical form without identification as to its source.

[11] Hanan, Doyle and Zachary Hanan. 2012. West Coast Charter Boat Cost-Earning Pilot Survey for FY 2011. NOAA commissioned pilot study.

The information collection is designed to yield data that meet all applicable information quality guidelines. Prior to dissemination, the information will be subjected to quality control measures and a pre-dissemination review pursuant to Section 515 of Public Law 106-554.

6. Contact information for agency coordinator and principal investigator.

Agency Coordinator
Jerry Leonard
NOAA Fisheries
Northwest Fisheries Science Center
2725 Montlake Blvd. E.
Seattle, WA 98117
206-302-1742
jerry.leonard@noaa.gov

Principal Investigator
Dave Colpo
Pacific States Marine Fisheries Commission
205 SE Spokane Street
Portland, OR 97202
503-595-3100 (voice)
503-595-3232 (fax)
dave_colpo@psmfc.org

7. Estimated burden and number of respondents

Completing the survey is expected to take 1 hour per respondent. As a result, the survey is expected to impose a total of 180 burden hours on the Washington and Oregon charter license holders. The burden hours per respondent are based on the results of a NOAA commissioned pilot study completed in West Coast Charter Boat Cost-Earning Pilot Survey for FY 2011 (Hanan and Hanan, 2012), which had a survey instrument very similar to the one for this study.

Total Charter License Holders Population	369
Average burden per initial telephone screen	5 min
Number reached for initial telephone screen	310
Burden hours for contact	26
Expected number active marine fishing charter operators	258
Expected survey response rate	55%
Expected # survey respondents	142
Average burden hours/survey and scheduling	1 hour, 5 min
Burden hours for survey and scheduling	154
Total burden hours (initial contact + survey and scheduling)	180.00

B. COLLECTIONS OF INFORMATION EMPLOYING STATISTICAL METHODS

1. Describe (including a numerical estimate) the potential respondent universe and any sampling or other respondent selection method to be used. Data on the number of entities (e.g. establishments, State and local governmental units, households, or persons) in the universe and the corresponding sample are to be provided in tabular form. The tabulation must also include expected response rates for the collection as a whole. If the collection has been conducted before, provide the actual response rate achieved.

Potential Respondent Universe

The number of charter vessel license holders in Washington and Oregon in 2012 was 369. However, following the findings of the Washington and Oregon charter survey in 2007, a substantial portion of the 369 license holders will not go fishing in marine waters. Many will fish only in fresh water and others will carry passengers in marine waters but will do so for purposes other than fishing, such as wildlife watching. Absent contacting the vessels to ascertain their activities, the number of active marine fishing vessels in 2012 is unknown. Consequently, the number of marine charter fishing vessels is estimated to be the same proportion as in 2007, which was 70% or 258 vessels. Owners of each of the approximately 258 vessels, rather than captains, will be the target respondents because they possess the specific economic and social data for the operations they run. Contact information on the 2012 charter license holders was obtained from the Washington Department of Fish and Wildlife and the Oregon Department of Fish and Wildlife.

Sampling and Other Respondent Selection Methods

The survey will be conducted as a census of all charter license holders that actively engaged in marine charterboat fishing in 2012. The survey will be conducted in two phases. Phase 1 will consist of a telephone pre-survey to determine license holders that actively engaged in marine charter fishing. Phase 2 consists of a mixed mode design to collect detail cost earnings data from active marine charterboat participants. Active marine charter vessel owners will then receive a formal letter of invitation to participate in the survey as well as a fact sheet of the commonly asked questions and answers about the survey. Following mailing of the letter of invitation, owners will be contacted by phone to confirm receipt of the letter of invitation, and asked to schedule a one hour interview appointment. Interviews will be conducted in-person for each owner during the scheduled time. Previous cost earnings surveys of charter vessels have demonstrated the effectiveness of in-person interviews in collecting data and obtaining accurate information. In order to improve the quality of information collected, in-person survey administration will be the preferred mode for the study. However, to maximize the response rate and ensure the survey sample is representative of our respondent universe, respondents will be offered telephone or mail-in mode interviews.

Expected Response Rate

The expected rate among the target population of charter license holders actively engaged in marine charter fishing in 2012 is 55%. The response rates achieved in the 2007 marine charter survey in Washington and Oregon are instructive to determine the expected response rate. The initial contact (Phase 1) to determine the active marine charter vessels was done via telephone as

currently planned. However, Phase 2 was a different because surveys were completed via mail only. In the prior survey, there were 287 license holders. 47 license holders or 16% of the total were unable to be contacted due to either bad contact information or failure to return phone calls. Of the remaining 240 license holders for which contact was made, 71 did not participate in marine charter fishing, 70 refused to participate in the survey, and 99 completed the survey. Using the conservative assumption that all 70 who refused to participate in the survey were active marine charter vessels, the total number of active participants was 169, and the percentage of active license holders was 70% (169/240). For the 47 vessels in which contact was not achieved, some were likely active marine charter vessels and some were not. Assuming that the non-contacts were distributed between active and not-active marine charter vessels in the same manner as the vessels in which contact was achieved, 70% or 33 of the vessels not contacted were active. The total population of active charter vessels in the 2007 survey was 202 (completes+refusals+non-contact amount). The 99 surveys received were 49% of active vessels. We expect to be able to increase the response rate from the 2007 survey. We expect to reach our desired response rate by increasing the industry's awareness of the study and interest in participation through outreach and by offering a flexible mode design.

Survey response rate from active marine vessels, 2007 survey	49%
Expected Response Rates 2012 Survey	
Total Charter License Holders Population	369
Number reached for initial telephone screen	310
Expected number active marine fishing charter operators	258
Expected survey response rate	55%
Expected # survey respondents	142

2. Describe the procedures for the collection, including: the statistical methodology for stratification and sample selection; the estimation procedure; the degree of accuracy needed for the purpose described in the justification; any unusual problems requiring specialized sampling procedures; and any use of periodic (less frequent than annual) data collection cycles to reduce burden.

Data collection and sample selection methods are detailed in Question 1. Since we intend to conduct a census of all active marine charter vessels in Washington and Oregon, there is no stratification of the population.

The primary importance of these data is to evaluate the cost and earnings structure of the entire Washington and Oregon marine charter fishery. To achieve this aim we plan to conduct a census of all 258 vessels actively involved in the fishery. Assuming a response rate of 55%, we expect to obtain 142 complete and usable surveys. This would allow us to report sample means within 10% of the population mean at 99% confidence across the entire fishery. This level of accuracy is sufficient to evaluate the economic impacts from proposed management options on the Washington and Oregon charter vessel fishery, and to contribute to the development of the coast-wide I/O model for recreational fishing.

The data will be summarized with mean and standard deviations reported for every revenue and cost variable. The methodology and presentation of the results will follow that contained in the NOAA Technical Memoranda by Lian (2012, 2010), also included as supplemental documents:

http://www.nwfsc.noaa.gov/assets/25/7569_11092010_161408_CostEarningsSurveyTM107WebFinal.pdf

http://www.nwfsc.noaa.gov/assets/25/8778_01232013_114027_LESurvey2008TM121WebFinal~Std.pdf

Tables will display the mean and standard deviations of each of the cost categories contained in the survey: payments to captain, payments to crew, fuel, principal payment, interest payments industry association fees/memberships, moorage, booking fees, haul out, repair and maintenance bait, ice, taxes, telephone and other communications, advertising services or charges, and insurance. Tables will display mean and standard deviations of revenue sources: recreational fishing for different species (salmon, groundfish, halibut, tuna/albacore, shellfish), commercial fishing, nature watching trips, Non-fishing scuba diving trips, burials at sea, souvenirs, lodging that is owned by charter boat owner, and equipment rental.

The data collection will yield data required in the estimation of the Input Output Model for Pacific Coast Fisheries (IO-PAC), which is used to provide statutorily required estimates to the Pacific Fishery Management Council for fisheries under Fishery Management Plans (FMPs) administered in the Northwest and Southwest regions. The results are 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 use of the data in the IO-PAC model is discussed in section 5.5 of the following document, also included as a supplemental document:

http://www.pcouncil.org/wp-content/uploads/IOPAC_SSC_Econ_Review_April_NWC.pdf

3. Describe the methods used to maximize response rates and to deal with nonresponse. The accuracy and reliability of the information collected must be shown to be adequate for the intended uses. For collections based on sampling, a special justification must be provided if they will not yield "reliable" data that can be generalized to the universe studied.

Strategy to Maximize Response Rates

We assume an estimated response rate of 55% based on the 49% response rate of the 2007 Washington and Oregon marine charter survey, our comprehensive outreach plan, and the mixed mode nature of the interviews. There are no previous studies of the fleet to suggest a higher

expected response rate. A higher than expected response rate will increase the statistical confidence in the study's findings.

There are numerous methods we will administer to achieve the estimated 55% response rate. Extensive outreach activities informing the fishermen and fishing associations of the purpose and need for the cost-earnings survey are expected to facilitate survey participation and completion. Outreach efforts will be coordinated with industry representatives. Outreach will occur on a number of levels and may include the following:

- Contacting Westport Washington and Puget Sound charter professional organizations and an influential Oregon charter vessel owner.
- Generating a fact sheet of commonly asked questions and answers.
- Sending a formal briefing letter on the data collection effort to all active charter license holders.
- Maintaining information regarding the data collection effort on the internet.

Additional methods for improving the response rate include offering participants in-person, telephone or mail-in mode interviews.

Strategy to Address Non-Response

All charter vessels in Washington and Oregon are required to be registered with the respective state fish and wildlife agencies. Using these resources, we are aware of the spatial distribution of registered vessels by homeport across Washington and Oregon. Additionally, the length of the vessel is maintained in the state databases. Based on the distribution of survey responses that we receive, these databases provide a link, both spatial and length-based, to validate the representativeness of our sample. If non-response bias appears evident in our survey responses, weighting methods will be developed to account for at least part of any non-response.

4. Describe any tests of procedures or methods to be undertaken. Tests are encouraged as effective means to refine collections, but if ten or more test respondents are involved OMB must give prior approval.

The survey instrument closely mirrors an instrument successfully fielded by the NWFSC and Pacific States Marine Fisheries Commission in 2007 and a survey currently underway of California Commercial Passenger Fishing Vessels (CPFV) OMB Control No. 0648-0369. The survey has been designed using the prior, 2007, survey of Washington and Oregon charter vessels and feedback from representatives of the Westport Charterboat Association, Charterboat Owners of Puget Sound and an Oregon charter vessel owner who is involved in fishery management issues through his appointment in the Pacific Fishery Management Council. The proposed survey instrument also utilizes feedback from a pilot study of the San Diego CPFV industry consisting of interviews of eight CPFV owners representing 10 vessels from a total of 76 vessels registered in San Diego County in 2011.

5. Provide the name and telephone number of individuals consulted on the statistical aspects of the design, and the name of the agency unit, contractor(s), grantee(s), or other person(s) who will actually collect and/or analyze the information for the agency.

There is no sampling involved in this survey, so there are minimal statistical aspects to the design. The two phase approach of reaching all active marine charter vessels and the merits of using in-person interviews in Phase 2 of the survey was discussed with the following individuals.

Dr. Leif Anderson, Economist Northwest Fisheries Science Center 206-302-2403

Dr. Carl Lian, Economist Northwest Fisheries Science Center 206-302-2414

The data will be collected via a grant to Pacific States Marine Fisheries Commission (PSFMC), who may employ a contractor to assist with the survey. The Northwest Fisheries Science Center has successfully completed 9 surveys previously in cooperation with PSFMC.

National Marine Fisheries Service
2725 Montlake Blvd E.
Seattle, WA 98112

Pacific States Marine Fisheries Commission
205 SE Spokane St, Suite 100
Portland, OR 97202

<< Date >>
<< Name >>
<< Address >>

Dear << First Name >>,

I am writing to ask your help in improving the understanding of Washington and Oregon's recreational fisheries and the charter fishing vessel industry by participating in a survey being conducted by the Pacific States Marine Fisheries Commission in cooperation with the Northwest Fisheries Science Center. The information collected will be used to provide estimates of the economic contributions of recreational fisheries, and the impact that changes in economic, environmental, and management conditions may have on these fisheries. The study survey will focus on two primary types of information: (1) information on business costs and earnings to be used for assessing the economic contribution and financial performance of this fleet, and (2) *your* opinions about the economic state of charter recreational fisheries. The information collected will be aggregated for reporting purposes to insure your confidentiality and reported to resource managers and the public.

As a licensed charter vessel owner, we are hoping that you can help in this study. Your contact information was obtained from either the Washington or Oregon Department of Fish and Wildlife through a cooperative agreement with the National Marine Fisheries Service. Data collected will be kept confidential as required by section 402(b) of the Magnuson-Stevens Act and NOAA Administrative Order 216-100, Confidentiality of Fisheries Statistics. When publishing survey results, we will combine your responses with information provided by other participants, and report it in summary form so that responses for any individual vessel cannot be identified. While your participation is voluntary, we hope that you can help us in this research. If you have any questions or concerns pertaining to this survey, please contact Jerry Leonard by telephone at 206-302-1742 or by email at jerry.leonard@noaa.gov.

Surveys will be conducted by << contractor>> through an in-person interview at a convenient location near you. Please see the attached FAQ sheet for more information. << contractor>> will be contacting you in the upcoming weeks to schedule an in-person interview. You may contact << contractor>> by telephone at << number>> or by email at << email>>.

Your participation is greatly appreciated. Let your voice be heard.

Sincerely,
< Signature >

Jerry Leonoard
NOAA Northwest Fisheries Science Center
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205 SE Spokane St, Suite 100
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Washington and Oregon Charter Vessel
2012 Calendar Year
Cost and Earnings Survey

Frequently Asked Questions

Why is this survey being conducted?
This survey is being conducted to collect information needed to increase the understanding of the important economic contributions of the Washington and Oregon charter fishery. This survey is an updated version of a survey completed in 2007. The results of the prior survey have enabled the estimated contribution in terms of jobs and economic output that charter businesses have in coastal communities. The data you provide you provide in this updated survey will enable improvements of these estimates and build understanding of the current economic conditions, and obstacles faced by charter businesses.

How long will the survey take?
The survey will take approximately one hour to complete.

What do I need to bring to my scheduled interview?
You should bring with you your accounting books containing your cost and earnings data from the 2012 calendar year, and information on the number and type of trips you took during 2012.

How do I benefit from participating?
Your participation is voluntary, however, through participation you will increase the understanding of the charter fishery in Washington and Oregon. Leaders in charterboat associations have supplied feedback to this survey to make the information collected valuable to charter vessel owners. Sharing your experience in the fishery will help provide information needed to estimate the economic impact and number of jobs supported by charter fishing in Washington and Oregon. Additionally, information will be used to understand the impact that changes in environmental, economic, and management conditions have had on the fishery. The results of the survey will be available online.

How will I be sure my data is confidential?
Data collected will be kept confidential as required by section 402(b) of the Magnuson-Stevens Act and NOAA Administrative Order 216-100, Confidentiality of Fisheries Statistics, and will not be released for public use except in aggregate statistical form without identification as to its source. Participation or lack of participation in the survey will remain confidential. All economic data will be aggregated into statistical form for all reports.

How will my data be used?
Your data, combined with data from all the other respondents, will form a critical component of a research study evaluating the economic contributions of the Washington and Oregon charter fishing, and the effects that changes in environmental, economic, and management conditions may have on the industry. Additionally, the questionnaire was developed in cooperation with leaders in industry associations to collect data that would be useful for the betterment of the industry.

If you have any further questions or concerns pertaining to this survey, please contact Jerry Leonard, by telephone at 206-302-1742 or by email at jerry.leonard@noaa.gov.

Washington and Oregon Charter Vessel 2012 Calendar Year Cost and Earnings Survey

All answers are confidential and voluntary. Please report 2012 calendar year statistics.

This survey is funded by the National Oceanic and Atmospheric Administration, National Marine Fisheries Service, to collect data on the Washington and Oregon Charter fishing industry to better understand their contribution to their local economy.

Data collected will be kept confidential as required by section 402(b) of the Magnuson-Stevens Act and NOAA Administrative Order 216-100, Confidentiality of Fisheries Statistics. We appreciate the confidential nature of the data being collected by this survey. When publishing survey results, we will combine your responses with information provided by other participants, and report it in summary form so that responses for any individual vessel cannot be identified. If a Freedom of Information Act (FOIA) request is received for the data collected by this survey, we will seek to protect the confidentiality of the survey responses under Exemption 4 of the FOIA, which protects trade secrets and commercial or financial information obtained from a person that is privileged or confidential.

A. Industry Participation Background

#	Question	
1.	What year did you become involved in the charter industry in any capacity?	_____ (YYYY)
2.	Do you serve as the vessel captain for a charter vessel?	☐ Yes ☐ No
3.	How many charter fishing vessels do you own?	_____ vessel(s).
4.	If you own a vessel, what year did you purchase the first vessel?	_____ (YYYY)

B. Business Expenditures for the 2012 Calendar Year

	Vessel Expenditures	**Amount Paid**
5.	All payments made to skipper and crew (include wages, bonuses, benefits, payroll taxes, retirement payments and life, health, and unemployment insurance)	$
6.	Vessel fuel costs	$
7.	Annual principal payment on vessels	$
8.	Annual interest payment on vessels	$
9.	Industry association fees/memberships	$
10.	Moorage	$
11.	Booking fees	$
12.	Haul out costs	$
13.	Vessel and on-board equipment purchases, repair and maintenance (expensed in 2012) (Engine, electronics, tanks, icemaker. fishing equipment, etc.)	$
14.	Food and drink costs (for passengers, captain, crew)	$
15.	Bait costs	$
16.	Ice (purchased dockside)	$
17.	U.S. taxes, government fees and vessel permits (local, state, and federal)	$
18.	Foreign taxes, government fees, visas, vessel permits, and foreign fishing licenses	$

#	General Overhead Expenses	Expenses
19.	Total payroll of non-vessel personnel (include wages, bonuses, benefits, payroll taxes, retirement payments and life, health, and unemployment insurance) **Exclude captain and crew payroll.**	$
20.	Professional services (legal, accounting, etc.)	$
21.	Rent paid on office space used for business	$
22.	Lease or loan payments for business motor vehicles	$
23.	Telephone and other communications (business satellite phone, cell phone, internet/network)	$
24.	Advertising services or charges. Exclude if included in booking fee charges.	$
25.	Insurance (Vessel, property, liability, cars and trucks, etc.)	$

C. Vessel Characteristics

Please provide information for each vessel that you own. If you are a single vessel owner please provide information for your vessel under "Vessel 1" and disregard questions related to additional vessels.

#	Vessel	Coast Guard ID	City/port this vessel primarily operates out of	Overall length of the vessel	Total horsepower of the main engine(s)
26.	Vessel 1				
27.	Vessel 2				
28.	Vessel 3				
29.	Vessel 4				

#	Vessel	Operating capacity of vessel while fishing (including captain and crew)	Average number of crew per trip (including the captain)	Total number of passengers in 2012	Total number of fishing trips in 2012
30.	Vessel 1				
31.	Vessel 2				
32.	Vessel 3				
33.	Vessel 4				

D.Vessel Related Revenue for the 2012 Calendar Year

#	Primary Purpose of Trip	Number of Passengers by Type in 2012	2012 Revenue by Trip Type
34.	Combination salmon/other fish	(anglers)	$
35.	Recreational salmon fishing	(anglers)	$
36.	Recreational groundfish fishing	(anglers)	$
37.	Recreational halibut fishing	(anglers)	$
38.	Recreational tuna/albacore fishing	(anglers)	$
39.	Recreational shellfish fishing	(anglers)	$
40.	Other recreational fishing	(anglers)	$
41.	Commercial fishing		$
42.	Nature watching	(Passengers)	$
43.	Non-fishing scuba diving	(Passengers)	$
44.	Burial at sea	(Passengers)	$
45.	Other purpose: (please specify)		$

E. Non-Fishing Operations Revenue for the 2012 Calendar Year

The following questions pertain to sources of revenue other than that generated by the charter vessel.

#	NON-FISHING	2012 Total Annual Revenue
46.	Souvenirs	$
47.	Lodging that is owned by charter boat owner	$
48.	Equipment rental	$
49.	Other (please specify)_____	$

F. Economic Conditions

How would you rate each of the following potential problems as problems for your charter business? Circle the number to indicate if it's extremely important, very important, moderately important, slightly important, or not important.

#	Potential Problem	Not Important	Slightly Important	Moderately Important	Very Important	Extremely Important	Not Sure
50.	Unsafe boats in industry	1	2	3	4	5	9
51.	Unsafe captains in industry	1	2	3	4	5	9
52.	High cost of overhead	1	2	3	4	5	9
53.	Competition with other operators	1	2	3	4	5	9
54.	Shoreline growth and development	1	2	3	4	5	9
55.	Getting customers	1	2	3	4	5	9
56.	Cost of insurance	1	2	3	4	5	9
57.	Too many operators	1	2	3	4	5	9
58.	Fishing regulations	1	2	3	4	5	9
59.	Weather/natural events	1	2	3	4	5	9
60.	Poor fishing/too few available fish	1	2	3	4	5	9
61.	Profitability	1	2	3	4	5	9
62.	Fuel costs	1	2	3	4	5	9
63.	Crew personnel problems	1	2	3	4	5	9
64.	Safety of bar crossing	1	2	3	4	5	9
65.	Poor bait availability	1	2	3	4	5	9
66.	High cost of bait	1	2	3	4	5	9
67.	Other_____	1	2	3	4	5	9

Please rate the effect on your business of the following types of fishery regulations.

#	Regulations	Not Challenging	Slightly Challenging	Moderately Challenging	Very Challenging	Extremely Challenging	Not Sure
68.	Day of week restrictions	1	2	3	4	5	9
69.	Depth/area closures	1	2	3	4	5	9
70.	Bag limits for Salmon	1	2	3	4	5	9
71.	Bag limits for species other than Salmon	1	2	3	4	5	9
72.	Minimum size limits for Salmon	1	2	3	4	5	9
73.	Minimum size limits for species other than Salmon	1	2	3	4	5	9
74.	Seasonal closures	1	2	3	4	5	9
75.	In season regulation changes	1	2	3	4	5	9
76.	Coast Guard regulations	1	2	3	4	5	9

How would you rate the following business practices in importance to running a successful charter business?

#	Business Practice	Not Important	Slightly Important	Moderately Important	Very Important	Extremely Important	Not Sure
77.	Leading clients to catch more fish	1	2	3	4	5	9
78.	Public relations with clients	1	2	3	4	5	9
79.	Other (please specify) _____	1	2	3	4	5	9

G. Business Structure and Outlook

Please check the appropriate box.

#	Question	Response
80.	Approximately, what percent of your 2012 total household income is generated from the charter boat operations?	☐1% - 20% ☐21% - 40% ☐41% - 60% ☐61% - 80% ☐81% - 99% ☐100%
81.	Compared to 5 years ago, how many clients are you servicing in a year?	☐Many Fewer ☐A Bit Fewer ☐About the Same ☐A Bit More ☐Many More
82.	What percent of your customers are return customers?	☐1% - 20% ☐21% - 40% ☐41% - 60% ☐61% - 80% ☐81% - 99% ☐100%
83.	How do you see the economic outlook for the charter boat industry over the next 5 years?	☐Very Unfavorable ☐Somewhat Unfavorable ☐About the Same ☐Somewhat Favorable ☐Very Favorable

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NOAA Technical Memorandum NMFS-NWFSC-107

West Coast Limited Entry Groundfish Trawl Cost Earnings Survey

Protocols and Results for 2004

September 2010

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

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NOAA Technical Memorandum NMFS-NWFSC-107

West Coast Limited Entry Groundfish Trawl Cost Earnings Survey

Protocols and Results for 2004

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September 2010

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

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Executive Summary

This technical memorandum describes the fielding protocols and empirical results from an economic cost earnings survey of the limited entry trawl fleet. The survey was conducted by the Fishery Resource Analysis and Monitoring Division of the Northwest Fisheries Science Center in cooperation with the Pacific States Marine Fisheries Commission. The survey population was all owners of commercial fishing vessels holding a West Coast limited entry groundfish permit with a trawl endorsement. Only vessels with at least $1,000 of West Coast landings during 2004 were included in the survey. The species composition of landings was not a factor used in selecting the survey population. The survey population included vessels that participate in the shoreside whiting (*Merluccius productus*) fishery, vessels that participate in the nonwhiting groundfish fishery, vessels that participate in both the nonwhiting groundfish fishery and the shoreside whiting fishery, and vessels that participated in neither the nonwhiting groundfish fishery nor the shoreside whiting fishery (but still held a limited entry trawl permit and had at least $1,000 of West Coast landings during 2004).

The survey sample was a census of the 143 vessels in the survey population. Data for 2003 and 2004 were collected from each participating vessel owner through an in-person interview. Because the groundfish trawl buyback program took effect in December 2003 and removed 91 vessels and their associated permits from the limited entry groundfish trawl fishery, this document reports results from 2004 (which is expected to be more representative of future economic conditions in the fishery than 2003). Interviews were conducted with the owners of 99 of the 143 limited entry trawl vessels active during 2004. Of the 99 interviews conducted, 91 were deemed to provide acceptable quality data to be used for statistical inference and economic analysis. The 91 survey respondents represent 64% of the limited entry trawl vessels and accounted for 69% the West Coast landings revenue earned by limited entry trawl vessels during 2004.

These 91 responses were used for statistical inference of operating costs, revenue from sources other than West Coast landings, and vessel operating characteristics (such as crew size and fuel consumption). Data collected from the survey were combined with economic data available from other sources, such as the Pacific Fisheries Information Network, to provide harvester revenues and costs at the vessel level. This document presents the results of this statistical inference for both the entire limited entry trawl fleet and the primary vessel types within the trawl fleet. Primary vessel types within the fleet include large groundfish trawlers, whiting vessels that deliver to shoreside processors, and crabbers.

Tests for nonresponse bias indicated that there was no statistically significant difference between survey respondents and nonrespondents when examining results for vessel types such as crabbers, large groundfish trawlers, and vessels participating in the shoreside whiting fishery. However, results for the aggregate limited entry trawl fleet exhibited statistically significant nonresponse bias, with survey respondents having revenue from West Coast crab landings which

was significantly larger than that of nonrespondents. While the mean per vessel level of revenue from West Coast landings of all species for the entire limited entry trawl fleet was $327,425, the mean per vessel level of revenue from West Coast landings for the 91 survey respondents was $356,771.

For the limited entry trawl fleet, the average vessel had revenue from all sources of $488,507 during 2004. West Coast landings accounted for $356,771 and Alaska landings accounted for $111,168 of the $488,507 in revenue earned during 2004. While the mean level of revenue from Alaska landings was $111,168, at the individual vessel level almost all survey respondents had either more than $500,000 of Alaska landings revenue or no Alaska landings revenue. The mean level of costs collected by the survey for a limited entry trawl vessel was $376,637. The largest cost categories reported by survey respondents were $97,042 for repair, maintenance, and improvements, $96,072 for crew, $81,100 for the captain, and $53,857 for fuel. As discussed in subsection 7.1 of this report, the cost figures reported here reflect expenditures during 2004, which in some cases differ from opportunity costs. A number of adjustments to the survey data should be made before calculating economic profits or quasi-rents.

Acknowledgments

The cost earnings survey described in this document was developed through collaboration and consultation with numerous individuals. The following individuals made important contributions to the survey design, fielding protocol, analysis of data, or reporting of data: Leif Anderson, Jim Hastie, Todd Lee, Jerry Leonard, and Mark Plummer, Northwest Fisheries Science Center (NWFSC); Dave Colpo, Pacific States Marine Fisheries Commission (PSMFC); Stephen Freese, NMFS Northwest Regional Office; Pete Leipzig, Fishermen's Marketing Association; Brad Pettinger, Oregon Trawl Commission; Cindy Thomson, Southwest Fisheries Science Center; Phil Watson, University of Idaho; and Quinn Weninger, Iowa State University. The NWFSC and the PSMFC are grateful to the Fishermen's Marketing Association and the Oregon Trawl Commission for endorsing the survey. The NWFSC and the PSMFC also thank all of the vessel owners who volunteered their time and data for the survey.

1. Introduction

This technical memorandum describes the survey design and fielding protocol for the cost earnings survey of the limited entry trawl fleet, which was conducted by the Fishery Resource Analysis and Monitoring Division of the Northwest Fisheries Science Center (NWFSC) in cooperation with the Pacific States Marine Fisheries Commission (PSMFC). Summary statistics computed with data collected through the survey are provided with accompanying discussion. The survey was fielded between May 2006 and September 2006 and collected data for 2003 and 2004. Since the limited entry trawl buyback program took effect in December 2003, responses for 2004 were viewed as more relevant to current conditions in the limited entry trawl fishery than responses for 2003.[1] As a result, this document focuses on reporting results for 2004.

Section 2 discusses survey design and questionnaire development. Section 3 discusses survey fielding. Section 4 discusses response rates. Section 5 compares respondents and nonrespondents and summarizes the results of tests for nonresponse bias. Section 6 discusses the issue of correcting for nonresponse bias. Section 7 presents empirical results obtained from analysis of the survey data. Section 8 provides concluding remarks.

[1] The buyback program allowed the holders of federal limited entry groundfish permits with a trawl endorsement to submit a bid to have their groundfish permit as well as any other associated permits purchased by the government. The buyback program purchased not only the limited entry groundfish trawl permit associated with the vessel, but also any other federal fishing permit as well as state crab and shrimp permits. The vessel with which these permits were associated was not purchased, but was prohibited from engaging in commercial fishing activities. Vessels whose permits were purchased through the buyback program ceased commercial fishing activities in December 2003.

2. Survey Design

The limited entry trawl fleet accounts for about two-thirds of groundfish landings on the West Coast (on a revenue basis). In addition, members of the limited entry trawl fleet participate in other fisheries such as crab and shrimp. The objective of this survey was to obtain the vessel-level information on earnings and expenditures that would support the calculation of economic performance measures (such as quasi-rents and efficiency) as well as regional economic impact analysis.

Because this survey was conducted on a voluntary basis and a survey of the limited entry trawl fleet conducted in 2000 had obtained a response rate of about 15%, survey design placed an emphasis on obtaining an adequate response rate. Discussions with industry participants indicated that vessel owners are more likely to respond to an in-person interviewer than a mail questionnaire, so all data collection was conducted through in-person interviews. Questionnaire length was limited to four pages (the questionnaire is provided in Appendix A). As discussed in this report, limiting questionnaire length imposed constraints on the number of cost categories and the collection of data on purchases of capital goods.

2.1. Survey Population and Sample

The population of interest for this survey is all active commercial fishing vessels holding a limited entry permit with a trawl endorsement. Active fishing vessels were defined as having at least $1,000 of West Coast (Washington, Oregon, and California) landings during 2004. Vessels with less than $1,000 landings were considered to have too low a level of activity to provide useful cost earnings data. Fish ticket data obtained through the Pacific Fisheries Information Network (PacFIN) system indicated that there were 143 vessels in the survey population.

While vessels were required to have at least $1,000 of revenue from West Coast landings during 2004, no restrictions were placed on the species landed. While most of the vessels in the survey population obtained a majority of their revenue from whiting (*Merluccius productus*) and other groundfish species, some vessels obtained a majority of their revenue from crab or other nongroundfish species. Of the 143 vessels in the survey population, 12 had no revenue from West Coast groundfish landings during 2004 but did have a limited entry permit. These 12 vessels earned the majority of their revenue from crab and shrimp.

These vessels are included in the survey population, as the objective of the survey is to obtain a representative sample of the entire population of vessels that have an associated limited entry trawl permit. Applications of survey data focusing on groundfish management can choose

to omit responses from vessels with no groundfish landings if so desired.[2] Of course, survey objectives also include obtaining data on a representative sample of vessels engaging primarily in groundfish harvesting.

Because of the relatively small size of the survey population, this survey attempted to collect data from all members of the population. All 143 vessels in the survey population were in the sample population due to the use of this census approach.

2.2. Questionnaire Development

The survey questionnaire was developed initially by representatives of the NWFSC, National Marine Fisheries Service (NMFS) Northwest Regional Office, Southwest Fisheries Science Center, and PSMFC. After survey content was determined, a draft questionnaire was prepared. The draft was discussed with members of the limited entry trawl fleet by PSMFC personnel. In addition, NWFSC personnel provided presentations on survey content and timing to the Pacific Fishery Management Council (PFMC) Groundfish Advisory Panel and the PFMC Scientific and Statistical Committee. Comments received through these discussions and presentations improved questionnaire content and format.

[2] Of the 12 vessels in the survey population with no West Coast groundfish landings, 7 provided survey responses. Of these 7 respondents with no revenue from groundfish landings, 6 earned a majority of revenue from crab and one earned a majority of revenue from shrimp.

3. Survey Fielding Protocol

This section describes the protocol used to field the survey and collect data from respondents. Because of the low response rate to an earlier cost earnings survey of the limited entry trawl fleet conducted by mail, particular emphasis was placed on implementing protocol that would maximize response rates. Steps taken to maximize response rates are discussed in subsection 3.2.

3.1. Fielding Schedule

Fielding began with each member of the survey population receiving a package by mail containing an introductory letter describing the survey, a one-page description of reasons for conducting the survey, and a copy of the questionnaire (the latter provided in Appendix A). Enclosing the questionnaire gave recipients an opportunity to see firsthand the data being collected by the survey and collect the requested data prior to the in-person interview. The cover letter noted that the survey had been endorsed by two industry associations, the Fishermen's Marketing Association and the Oregon Trawl Commission.

About two weeks after the letter and questionnaire mailing, attempts to contact each recipient by telephone began in order to schedule a time and location for the in-person interview. During the following three weeks, up to six additional attempts were made to contact each member of the survey population until an interview date was scheduled. Survey fielding moved across geographic areas over time, so as to reduce the travel costs involved in conducting in-person interviews. Interviews were conducted at a location chosen by the respondent. The most frequent interview locations were the respondent's residence, vessel, or a restaurant.

Interviewers used the questionnaire during the in-person interviews, asking some additional follow-up questions when appropriate. For example, interviewers were prompted to ask questions about the nature of repair and maintenance expenses when survey respondents reported large repair and maintenance expenditures.

The survey was fielded by the PSMFC and its subcontractors. Survey fielding began in October 2005 and was completed in September 2006. The unusually long time period for fielding resulted from administrative hurdles that prevented fielding between January 2006 and May 2006.

3.2. Maximizing Response Rates

A number of methods were used to maximize survey response rates.[3] First, the questionnaire is short, consisting of only four pages in written form. Data collection through the

[3] While data collection occurred through in-person interviews, many of the protocols used to maximize survey response were taken from Mail and internet surveys: The tailored design method (Dillman 1999).

in-person interview usually took less than one hour. Second, respondents were asked only to provide information about major cost and earnings categories, thus avoiding what may seem to respondents like unnecessary detail. Third, data was collected through in-person interviews, which typically have higher response rates than mail or telephone surveys. Fourth, there were extensive follow-up telephone calls and mailings after the initial letter and questionnaire mailing in order to schedule in-person interviews and obtain responses. These follow-up telephone calls were distributed among weekend/weekday and day/evening time periods to maximize the likelihood of reaching the contact person. Finally, as noted in the cover letter, the survey carried the endorsements of the Fishermen's Marketing Association and the Oregon Trawl Commission.

4. Survey Response Rates

Responses were received from 99 of the 143 vessels in the survey population, a 69% response rate. However, some respondents failed to provide complete cost data or provided data that were deemed suspect.[4] After removing 8 incomplete responses, there were 91 responses (63% response rate), which were used for empirical analysis.

Table 1 presents a summary of survey response rates by vessel type and geographic location. The vessel type classification scheme used in this report is described by Radtke and Davis (2000). Within the limited entry trawl fleet, most vessels have landing patterns that place them in the whiting, large groundfish trawler, or crabber vessel types. Whiting vessels are defined as having at least $100,000 in annual revenue from West Coast landings and obtaining at least 33% of revenue from whiting. Large groundfish trawlers are defined as having at least $100,000 in annual revenue from West Coast landings and obtaining at least 33% of revenue from groundfish. Crabbers are defined as having at least $15,000 in annual revenue from West Coast landings and obtaining at least 33% of revenue from crab landings. Vessels were classified on the basis of their 2004 landings. Vessels that had more than $100,000 in annual revenue from West Coast landings during 2004 and earned at least 33% of their revenue from whiting and at least 33% of their revenue from non-whiting groundfish were classified as whiting vessels.

The survey population includes all vessels operating on the West Coast that are classified as shoreside whiting vessels or large groundfish trawlers. The survey population also includes some vessels classified as crabbers (these vessels earn more revenue from crab landings than groundfish landings, even though they do have a limited entry trawl permit). Geographic classification is based on the home port of the vessel. While this survey provides representative data on the population of shoreside whiting vessels and large groundfish trawlers operating on the West Coast, it also provides representative data on a unique subset of West Coast crabbers.

The response rate for crabbers (74%) is higher than the response rate for either large groundfish trawlers (65%) or whiting vessels (63%). No responses were received from the five small groundfish trawlers in the survey population. The response rate was higher for vessel owners living in Oregon than owners living in Washington and California. A 76% response rate was obtained from limited entry trawl vessels in Oregon, while responses were obtained from 51% of the limited entry trawlers in California and 50% of the limited entry trawlers in Washington.

There are three possible reasons for the higher response rate in Oregon. First, the Oregon Trawl Commission provided a valuable endorsement of the survey. Second, the survey was

[4] The most common response regarded as suspect had variable costs (captain, crew, fuel, food, bait, and ice) greatly exceeding revenue. Large changes in landings between 2003 and 2004 without a corresponding change in variable costs were also flagged during data analysis.

fielded first in Oregon, then lengthened with additional questions on insurance and interest expenditures before fielding in California and Washington. Finally, trawlers in Oregon have higher average earnings than those in Washington and California, and survey response rates tend to be higher as vessel revenues increase.

5. Comparing Respondents and Nonrespondents

A considerable amount of information is available about vessel characteristics and landings for each member of the survey population. This information can be used to compare respondents and nonrespondents and perform statistical tests to determine whether differences between them are statistically significant. This section compares vessel physical characteristics and revenue from landings for respondents and nonrespondents. Appendix B discusses the results of statistical tests aimed at determining whether the differences between respondents and nonrespondents are statistically significant. Subsection 5.3 provides a brief summary of the statistical tests discussed in Appendix B.

5.1. Data Used to Test for Nonresponse Bias

Data on vessel physical characteristics, West Coast landings (by species, gear type, and port), and revenue from West Coast landings (also by species, gear type, and port) is available for all members of the survey population. Available information on vessel characteristics includes vessel length and horsepower. PacFIN provides vessel-level information on West Coast (Washington, Oregon, and California) landings by date, species, gear type, and port for all vessels in the survey population. As a result, it is possible to compare respondents and nonrespondents with regard to seasonal patterns, species landed, and location of landings. In addition, some information is available from the Alaska Fisheries Information Network (AKFIN) regarding landings in Alaska by population members. This information is used to compare the activities of respondents and nonrespondents in Alaskan waters. This information is important, as some members of the population are believed to earn considerable revenue in Alaskan waters. Available information on Alaska landings includes 1) whether each vessel had any landings in Alaska and 2) whether revenue from landings in Alaska was greater or smaller than revenue from landings in Washington, Oregon, and California.

5.2. Comparison Results

Vessel physical characteristics and landings revenue for survey respondents and nonrespondents are compared in Table 2 through Table 5. Table 2 provides a comparison for the entire limited entry trawl fleet of respondents, nonrespondents, and all limited entry trawl vessels with landings on the West Coast. Comparisons are provided for engine horsepower, vessel length, vessel revenue from crab, revenue from groundfish, and revenue from all species.

Table 2 shows that all 143 vessels in the survey population had average West Coast landings revenue of $327,425. Respondents had average revenue of $356,771 and nonrespondents had average revenue of $276,069. Respondents earned greater revenue than nonrespondents from both groundfish and crab. Mean groundfish revenue during 2004 was $214,341 for respondents and $198,678 for nonrespondents. Crab landings exhibited a greater

proportional difference between respondents ($109,499) and nonrespondents ($55,940) during 2004. The difference in revenue from crab landings accounts for about two-thirds of the difference in revenue from all West Coast landings for respondents and nonrespondents. Respondents also had vessels with greater length (67 vs. 62 feet) and horsepower (431 vs. 373) than nonrespondents.

Table 3 through Table 5 present results for the three major vessel types within the limited entry trawl fleet. Crabbers, large groundfish trawlers, and whiting vessels account for 88 of the 91 survey respondents and 132 of the 143 vessels in the survey population. The results for the entire limited entry trawl fleet in Table 2 include not only the 88 respondents in these 3 vessel types, but also the 3 survey respondents in other vessel types.

Table 3 shows that while the mean West Coast landings revenue from all species was $383,987 for all 30 crabbers in the survey population, it was $391,463 for the 22 respondents and $363,428 for the 8 nonrespondents. Respondents had higher levels of both crab and groundfish landings than nonrespondents, as well as larger vessels with more horsepower.

Among large groundfish trawlers in Table 4, respondents had higher mean revenue from all West Coast landings ($325,719) than nonrespondents ($267,063). Respondents and nonrespondents earned similar levels of revenue from groundfish landings ($230,961 vs. $234,005). However, respondents earned considerably more revenue from landings of crab and other nongroundfish species than nonrespondents. Respondents also had vessels with greater length (67 vs. 60 feet) and horsepower (401 vs. 339) than nonrespondents.

Table 5 shows that groundfish and crab account for almost all revenue from West Coast landings for members of the shoreside whiting fleet. While some members of the shoreside whiting fleet earn almost all of their West Coast revenue from whiting landings (and earn all other revenue in Alaska), other members remain on the West Coast outside of the whiting season and participate in other groundfish fisheries and crabbing. The 12 survey respondents had nearly identical revenue from groundfish (which includes whiting) landings as the 7 nonrespondents ($420,924 vs. $421,705). Revenue from crab landings was about twice as large for respondents as nonrespondents ($74,021 vs. $36,233). Respondents had smaller vessels (82 vs. 89 feet in length) with smaller engines (685 vs. 742 horsepower) than nonrespondents.

5.3. Statistical Tests for Nonresponse Bias

A two sample t-test was used to determine whether the differences observed between survey respondents and nonrespondents were statistically significant. The two sample t-test is based on a null hypothesis that the mean value of the variable being tested is the same for respondents and nonrespondents. Detailed results from the two sample t-tests are presented in Appendix B. This subsection provides a summary of the results from the two sample t-tests.

The two sample t-tests indicate that for each of the three primary vessel types within the limited entry trawl fleet, the difference in revenue from West Coast landings between respondents and nonrespondents was not statistically significant. However, there is a statistically significant difference in revenue from all West Coast landings for survey respondents and nonrespondents when results are examined for the entire limited entry trawl fleet.

The combination of 1) larger though not statistically significant landings for respondents than nonrespondents in each of the three primary vessel types and 2) absence of small groundfish trawlers results in a statistically significant difference between revenue from all West Coast landings for respondents and nonrespondents for the entire limited entry trawl fleet. Thus the average survey respondent had $356,771 of revenue while the average member of the survey population had $327,425 of revenue; that is, respondents had average revenue which was $29,346 (9.0%) larger than that of the average member of the population.

6. Correcting for Nonresponse Bias

Survey respondents have greater revenue from total West Coast landings than nonrespondents for each of the three primary vessel types within the limited entry trawl fleet, but these differences are not statistically significant at the 95% confidence level. For the entire limited entry trawl fleet, respondents have revenue from West Coast landings that is 9.0% larger than that of all limited entry trawl vessels. Since much of the statistically significant bias among the entire limited entry trawl fleet results in part from not having any survey responses from the five small groundfish trawlers, weighting responses would not be an effective way of reducing this bias. Since no responses were received from small groundfish trawlers, there is no data to weight. As a result, this report presents only unweighted results for both the major vessel types within the limited entry trawl fleet and the entire limited entry trawl fleet. Since respondents had greater revenue from West Coast landings than the survey population, estimates of variable costs (which depend on the level of fishing activity) derived from the data provided by respondents are biased upwards. All estimates of costs, revenues, and operating characteristics reported in Table 6 through Table 12 were calculated using PROC SURVEYMEANS in SAS.

7. Empirical Results

This section provides empirical results from the survey for the limited entry trawl fleet and the major vessel types within each fleet.

Before examining cost and earnings data from 2004, it is worthwhile to consider the health of the West Coast groundfish and crab fisheries during 2004. That year, total commercial and tribal groundfish landings (including whiting) for all gear types on the West Coast were 240,172 mt, slightly below the average of 251,488 mt observed from 2005 to 2009. Commercial and tribal groundfish landings for all gear types during 2004 included 213,478 mt of whiting and 38,010 mt of non-whiting groundfish. Both whiting and non-whiting groundfish landings were slightly lower during 2004 than the annual average over the 2005–2009 period.

Revenue from commercial and tribal West Coast groundfish landings (for all gear types) was $68.1 million in 2004, well below the annual average of $85.1 million observed during 2005–2009. Revenue from groundfish landings during 2004 included $24.2 million from whiting landings and $43.9 million from non-whiting groundfish landings. Both figures are below the annual average of $33.8 million from whiting landings and $51.3 from non-whiting groundfish landings recorded during the 2005–2009 period. Revenues from landings during 2004 are further below the 2005–2009 annual average than landings, reflecting the rise in whiting and sablefish (*Anoplopoma fimbria*) prices that occurred between 2004 and 2009.

The West Coast crab fishery had a high level of landings and revenue during 2004. That year, West Coast commercial and tribal crab landings (with all gear types) were 28,537 mt, the third largest annual harvest during the 1998–2009 period and higher than the average of 24,465 mt recorded during 2005–2009. Revenue from crab landings was also higher than normal during 2004. West Coast crab landings provided revenue of $115.7 million during that year, well above the average of $106.3 million recorded during 2005–2009.

7.1. Costs and Earnings Categories

Table 6 provides average expenditures and revenues for all survey respondents in the limited entry trawl fleet. Some respondents did not respond to all questions, so the number of observations varies across variables. Cost categories covered by the survey include payments to captain, payments to crew, fuel, food, ice, bait, repair, maintenance, and improvements (RMI), insurance, interest, permit purchases, and permit leases.

The mean limited entry trawl survey respondent earned $356,771 from West Coast landings, $111,168 from Alaska landings, $11,319 from at sea deliveries, $2,041 from the sale and leasing of permits, and $7,209 from all other sources. As shown in Table 10, this results in total revenue of $488,507 for the average limited entry trawl vessel.

The $111,168 revenue from Alaska landings and the $11,319 in at sea deliveries reported in Table 6 are averages that are rarely observed. Most Alaska landings were reported by vessels in the whiting vessel type. These vessels typically participate in the West Coast shoreside whiting fishery for a few months and spend most of the year fishing in Alaska. Among the 91 survey respondents, 12 reported revenue from Alaska during 2004 averaging $843,024, and 79 reported no revenue from operations in Alaska. Similarly, only 5 of the 91 survey respondents reported at sea deliveries to motherships in the West Coast at sea whiting fishery during 2004. While the average revenue from at sea deliveries across all 91 respondents was $11,319, the average revenue from at sea deliveries for the 5 vessels reporting non-zero at sea deliveries was $206,000.

The largest variable cost categories for limited entry trawlers are crew expenditures ($96,072), captain expenditures ($81,100), and fuel expenditures ($53,857). These three cost categories account for more than 60% of all costs. These three variable costs plus RMI account for about 85% of the costs reported on this survey.

In an effort to keep the questionnaire length short and boost response rates for this voluntary survey, data was collected on all expenditures for RMI. No distinction is made in Table 6 through Table 9 between purchases that are expensed and purchases that are capitalized and depreciated in future years. As a result, individual vessel level costs show considerable variation due to variation in purchases of capital goods that provide services over many years.

A more theoretically desirable way to have collected data on purchases of capital goods would have been to collect information on 1) purchases expensed during 2004, 2) purchases capitalized during 2004, and 3) depreciation taken during 2004 for capital goods purchased in previous years. However, this approach increases questionnaire length and complexity, and was rejected for use in this voluntary survey.

7.2. Calculating Profits and Quasi-rents from Survey Data

Using the survey data provided in Table 6 through Table 9 to calculate economic performance measures such as quasi-rents (the difference between total revenue and variable costs) and profit requires that a number of issues be considered and addressed. The first two issues discussed in this subsection affect the calculation of both quasi-rent and economic profit. The third issue affects the calculation of economic profit but not the calculation of quasi-rents, as it affects fixed costs that do not enter into the calculation of quasi-rent.

First, the survey does not cover all costs incurred by vessel owners. In an effort to limit survey length and boost response rates, the questionnaire (provided in Appendix A) did not collect data on costs such as moorage, unloading fish, and transporting fish to the buyer. Of course there is no way of knowing the exact magnitude of the cost categories not covered by the survey, but conversations with industry participants suggest it is in the range of 5% to 10% of total costs.

Second, calculating economic profit would require adjustment for the vessel owners who serve as captain and do not always pay themselves a salary as captain. Rather, these vessel owners derive their compensation for service as captain through their earnings as the recipient of

vessel profits. Since actual expenditures differ greatly from opportunity costs in such cases, it is necessary to develop another way of estimating captain costs for vessels where the captain receives no salary on some trips.

The third issue that must be addressed when using this survey data to derive a measure of economic profit is the opportunity cost of the money tied up in marketable capital goods such as the fishing vessel and equipment. The fishing vessel and onboard equipment represents an opportunity cost for the vessel owner. Were the vessel to be sold, the money received for the vessel could be invested and earn a positive rate of interest.

As a result of these three considerations, this document (whose function is to report survey results) does not attempt to perform and report the considerable additional work required to estimate economic profit.[5] However, quasi-rents can be calculated without the fixed costs that are also included in the definition of profit, and can be calculated from the available survey data with fewer adjustments than economic profit. Since fewer and simpler adjustments are required to calculate quasi-rents, this document does report quasi-rents.

7.3. Costs, Earnings, and Quasi-rents

Table 10 reports revenues, variable costs, and quasi-rents calculated using the survey data with no adjustment for vessel owners who serve as captain without salary compensation on some groundfish trips. The table also reports adjusted variable costs and adjusted quasi-rent, which attempt to correct for the bias created by vessel owners taking their compensation for serving as captain through being the residual claimant. Based on an examination of captain expenditures reported for vessels where the owner does not serve as captain, this adjustment assumed that the vessel captain should earn at least $80,000 annually. In cases where the reported captain expenditure is less than $80,000, the reported captain expenditure is replaced with $80,000.

Table 10 shows revenue (total revenue from West Coast landings and all other sources such as Alaska landings), total costs (the total of all expenditures shown in Table 6 through Table 9), variable costs (the total of expenditures for captain, crew, food, fuel, bait, and ice), and quasi-rents (total revenue minus variable costs). Costs in Table 10 are derived by summing the cost categories shown in Table 6 through Table 9. Table 10 also includes columns labeled adjusted variable costs and adjusted quasi-rent. Adjusted variable cost was obtained by making two adjustments to variable costs for each vessel. First, annual captain expenditures were assumed to be equal to a minimum of $80,000 per vessel. Second, variable costs were increased by 10% to account for those expenditures not captured by the survey questionnaire.

Table 10 indicates that the average limited entry trawler earns adjusted quasi-rents of $216,761. These quasi-rents are equal to 44% of total revenue. The average crabber earned adjusted quasi-rents of $234,204, which equals 49% of total revenue. The average large groundfish trawler earned adjusted quasi-rents of $131,134, which equals 38% of revenue. While large groundfish trawlers earn $133,950 less revenue than crabbers, their adjusted variable

[5] See Lian et al. (2010) for an example of how these adjustments to the survey data can be made to derive an estimate of economic profit. That journal article adjusts the survey data to account for 1) costs which were not reported on the survey questionnaire, 2) vessel owners who served as captain and did not pay themselves a salary, and 3) the opportunity cost of capital (vessel and onboard equipment) used in harvesting groundfish.

costs are only $30,880 lower. As a result, a large groundfish trawler on average earns less than 60% of the quasi-rents earned by a crabber in the limited entry trawl fleet. Whiting vessels, which not only earn the most revenue on the West Coast of any vessel type but also earn the most revenue in Alaska, earned adjusted quasi-rents of $551,188 per vessel. Quasi-rents for whiting vessels averaged 50% of total revenue. While crabbers and whiting vessels earned nearly identical adjusted quasi-rents as a percentage of revenue, large groundfish trawlers earned considerably lower adjusted quasi-rents as a percentage of revenue. In other words, adjusted variable costs consume a greater share of total revenue for large groundfish trawlers than for crabbers or whiting vessels.

Since quasi-rents represent the difference between total revenue and variable costs, they do not consider the fixed costs (such as insurance, interest, permits, and RMI) that a vessel owner incurs.[6]

The data in Table 10 cannot be used to directly calculate a measure of accounting profit or economic profit. Accounting profit measures the difference in a given time period between revenue and cost, where cost includes items that are being expensed in the current period as well as depreciation from capital goods purchased in earlier time periods. Measuring accounting profit would require adjusting the survey data for 1) adjustment for those minor cost categories not collected by the survey and 2) knowledge of how much of the current expenditure on capital goods is depreciated and how much is expensed, as well as knowledge of how much depreciation for capital goods purchased in earlier years is being taken in the current year. Economic profit measures the difference between revenue and the opportunity costs incurred during a given time period. Calculating a measure of economic profit that accounts for all opportunity costs incurred by the vessel owner would require adjusting the survey data for 1) vessel owners who serve as captain without an explicit payment for their provision of captain services, 2) the interest income lost by having capital tied up in the vessel rather than an interest earnings asset, and 3) cost categories not collected by the survey.

7.4. Crew Size, Fuel Use, and Vessel Speed

Table 11 provides crew size, fuel use (gallons per hour), and vessel speed (knots per hour) for the limited entry trawl fleet and major vessel types. Crew size exhibited little variation across fisheries. For all limited entry trawl vessels, the average crew size (not including the captain) was 1.9 for groundfish trawl, 2.0 for shrimping, and 2.1 for crabbing. When crew size is examined by vessel type, whiting vessels and large groundfish trawlers report similar crew sizes, and crabbers report smaller crew sizes by activity than whiting vessels or large groundfish trawlers.

Fuel use showed considerable variation across fisheries, ranging from 19.1 for groundfish trawling to 8.2 for crabbing. While the average member of the limited entry trawl fleet uses 19.1

[6] The 2004 data used in these calculations come from a period before implementation of the buyback program landing taxes. In December 2003, NMFS required all accepted bidders to permanently cease fishing with the fishing vessels and permits whose privileges had been relinquished in exchange for buyback program reduction payments. Landings taxes on groundfish, crab, and shrimp are used as a source of funding for the buyback program. Collection of these taxes began in September 2005, so the 2004 data reported herein does not reflect the impact of buyback landings taxes.

gallons of fuel per hour when trawling, this figure ranges considerably across vessels and vessel types. Vessels targeting whiting are typically larger than vessels in the large groundfish trawler and crabber vessel classifications, and hence have higher fuel use. Because of the small number of whiting vessels engaged in shrimping, confidentiality considerations prohibit providing fuel use or speed for whiting vessels engaged in shrimping.

7.5. Crew Share System and Owner as Captain

Table 12 reports the share of revenue on groundfish trips paid to the captain, crew, and vessel owner. For the limited entry trawl fleet, the vessel owner served as captain for 82% of trips targeting groundfish. On trips where the vessel owner served as captain, landings revenue minus deductions was allocated at 21% to the captain, 22% to the crew, and 57% to the vessel. These percentages are nearly identical for trips where the vessel owner is not the vessel captain. While the captain receives a 20% share when he is not the owner, the captain receives a 21% share when he is the vessel owner.

Results for the major vessel types indicate that whiting vessels are less frequently captained by the vessel owner than crabbers or large groundfish trawlers. The vessel owner served as captain on 60% of the trips targeting groundfish made by whiting vessels, but 85% of the trips made targeting groundfish by crabbers and 86% of the trips made targeting groundfish by large groundfish trawlers.

The allocation of landings revenue minus deductions also varies across vessel types. Whiting vessels pay the captain a somewhat lower percentage of revenues after deductions than crabbers or large groundfish trawlers. It should be remembered that whiting vessels typically have higher revenue from landings than crabbers or large groundfish trawlers.

Table 12 shows that whiting vessels had a similar allocation of landings revenue after deductions when the owner served as captain and when the owner did not serve as captain. On the 60% of trips where the owner served as captain, landings revenue after deductions was allocated at 15% to the captain, 25% to the crew, and 61% to the vessel (numbers do not add to 100% due to rounding).

For large groundfish trawlers on the 86% of groundfish trips where the owner served as captain, landings revenue after deductions was allocated at 23% to the captain, 22% to the crew, and 55% to the vessel. On trips where the owner did not serve as captain, landings revenue after deductions was allocated at 20% to the captain, 20% to the crew, and 60% to the vessel. On trips where the owner is not on board, a larger percentage of landings revenue is allocated to the vessel and a smaller percentage to the captain and the crew.

Crabbers were captained by the vessel owner on 85% of trips targeting groundfish, almost identical to the 86% figure obtained for large groundfish trawlers. On trips where the vessel owner served as captain, the allocation of landings revenue after deductions by crabbers was 22% to the captain, 21% to the crew, and 57% to the vessel. The allocation changes slightly when the vessel owner did not serve as captain, with 26% to the captain, 19% to the crew, and 55% to the vessel.

8. Concluding Comments

The NWFSC and PSMFC thank all of the vessel owners who participated in this voluntary survey. The NWFSC and PSMFC also are grateful for the survey endorsement provided by the Fishermen's Marketing Association and the Oregon Trawl Commission. The quality of data and summary statistics provided in this report depends on the willingness of commercial fishermen to provide their time and confidential data.

While this report provides a considerable amount of information taken from the survey responses, it does not provide all possible summary statistics that could be derived from the survey responses. Individuals interested in further information about the survey should contact either the NWFSC or PSMFC.

The NWFSC and PSMFC intend to conduct cost earnings surveys of the limited entry trawl fleet on a regular basis. This will allow for the development of a time series database that will support evaluation of the economic performance of the limited entry trawl fleet.

Tables 1–12

Table 1. Summary of survey response by entire fleet, vessel type, state, and revenue.

	Survey population	Complete responses	Response rate (%)
Limited entry trawlers	143	91	64
Trawl vessel type			
Crabber	30	22	73
Large groundfish trawler	83	54	65
Other	6	3	50
Small groundfish trawler	5	0	0
Whiting	19	12	63
Trawl by state			
California	49	25	51
Oregon	76	57	75
Washington	18	9	50
Trawlers by annual WOC landings revenue			
<$200,000	51	27	53
$200,000 to $400,000	52	34	65
>$400,000	40	30	75

Table 2. Comparison of vessel physical characteristics and revenue sources for limited entry trawler respondents and nonrespondents.

Variable	Response status	Number of observations	Mean	Standard error
Engine horsepower	All	135	410	19
	Respondents	85	431	26
	Nonrespondents	50	373	29
Vessel length (feet)	All	135	65	1
	Respondents	85	67	1
	Nonrespondents	50	62	2
Revenue from crab (US$)	All	143	89,961	11,848
	Respondents	91	109,402	16,363
	Nonrespondents	52	55,940	14,572
Revenue from groundfish (US$)	All	143	208,645	14,228
	Respondents	91	214,341	17,177
	Nonrespondents	52	198,678	25,217
Revenue from all species (US$)	All	143	327,425	17,127
	Respondents	91	356,771	21,314
	Nonrespondents	52	276,069	27,599

Table 3. Comparison of vessel physical characteristics and revenue sources for the crabber fleet respondents and nonrespondents.

Variable	Response status	Number of observations	Mean	Standard error
Engine horsepower	All	30	351	39
	Respondents	22	376	52
	Nonrespondents	8	281	31
Vessel length (feet)	All	30	56	3
	Respondents	22	57	3
	Nonrespondents	8	53	4
Revenue from crab (US$)	All	30	265,796	30,397
	Respondents	22	276,134	37,734
	Nonrespondents	8	237,367	49,500
Revenue from groundfish (US$)	All	30	75,573	19,305
	Respondents	22	85,603	24,846
	Nonrespondents	8	47,990	23,424
Revenue from all species (US$)	All	30	383,987	46,026
	Respondents	22	391,463	56,270
	Nonrespondents	8	363,428	81,892

Table 4. Comparison of vessel physical characteristics and revenue sources for the large groundfish trawler respondents and nonrespondents.

Variable	Response status	Number of observations	Mean	Standard error
Engine horsepower	All	76	378	18
	Respondents	48	401	22
	Nonrespondents	28	339	32
Vessel length (feet)	All	76	65	1
	Respondents	48	67	2
	Nonrespondents	28	60	2
Revenue from crab (US$)	All	83	44,776	9,520
	Respondents	54	55,414	13,564
	Nonrespondents	29	24,967	9,470
Revenue from groundfish (US$)	All	83	232,024	15,339
	Respondents	54	230,961	17,228
	Nonrespondents	29	234,005	30,425
Revenue from all species (US$)	All	83	305,225	17,366
	Respondents	54	325,719	20,777
	Nonrespondents	29	267,063	30,435

Table 5. Comparison of vessel physical characteristics and revenue sources for the whiting fleet respondents and nonrespondents.

Variable	Response status	Number of observations	Mean	Standard error
Engine horsepower	All	18	704	74
	Respondents	12	685	104
	Nonrespondents	6	742	90
Vessel length (feet)	All	18	84	2
	Respondents	12	82	1
	Nonrespondents	6	89	4
Revenue from crab (US$)	All	19	60,099	26,030
	Respondents	12	74,021	37,794
	Nonrespondents	7	36,233	29,622
Revenue from groundfish (US$)	All	19	421,212	33,546
	Respondents	12	420,924	46,833
	Nonrespondents	7	421,705	47,642
Revenue from all species (US$)	All	19	487,931	43,456
	Respondents	12	501,557	58,991
	Nonrespondents	7	464,571	65,771

Table 6. Cost and earnings by category for the entire limited entry trawl fleet.

Variable	Number of observations	Mean (US$)	Standard error (US$)
Cost of:			
Captain	89	81,100	3,656
Crew	89	96,072	4,958
Food	88	5,257	591
Fuel	90	53,857	3,687
Bait	91	5,697	592
Ice	91	4,711	372
Insurance	33	18,893	1,846
Interest payments	33	5,210	1,369
Leasing permits	91	2,444	700
Purchasing permits	91	12,052	3,552
RMI[a]	91	97,042	8,704
Revenue from:			
Alaska	91	111,168	19,620
Hawaii	91	0	0
Other sources	91	7,209	2,616
At sea deliveries	91	11,319	3,157
Sale/leasing of permits	91	2,041	692
All species[b]	91	356,771	12,692
Groundfish	91	214,341	10,229
Crab	91	109,402	9,744
Shrimp	91	17,976	3,065
Salmon	91	3,614	825
Pelagic	91	322	64
HMS[c]	91	3,563	722
Halibut	91	7,386	2,245

[a] RMI = repair, maintenance, and improvements.
[b] Groundfish, crab, shrimp, salmon, pelagic, HMS, and halibut do not represent 100% of species landed; as a result, the sum of revenue for these species is less than revenue reported for all species.
[c] HMS = highly migratory species.

Table 7. Cost and earnings by category for the crabber fleet.

Variable	Number of observations	Mean (US$)	Standard error (US$)
Cost of:			
Captain	22	76,764	12,105
Crew	22	91,370	15,084
Food	20	2,689	763
Fuel	22	34,621	10,438
Bait	22	11,005	2,448
Ice	22	2,963	855
Insurance	7	7,286	2,395
Interest payments	7	286	169
Leasing permits	22	0	0
Purchasing permits	22	6,591	4,754
RMI[a]	22	83,041	14,721
Revenue from:			
Alaska	22	54,545	50,110
Hawaii	22	0	0
Other sources	22	28,682	16,235
At sea deliveries	22	0	0
Sale/leasing of permits	22	2,955	2,714
All species[b]	22	391,463	51,694
Groundfish	22	85,603	22,825
Crab	22	276,134	34,665
Shrimp	22	8,037	7,383
Salmon	22	11,674	4,885
Pelagic	22	158	69
HMS[c]	22	7,953	3,447
Halibut	22	1,894	1,055

[a] RMI = repair, maintenance, and improvements.
[b] Groundfish, crab, shrimp, salmon, pelagic, HMS, and halibut do not represent 100% of species landed; as a result, the sum of revenue for these species is less than revenue reported for all species.
[c] HMS = highly migratory species.

Table 8. Cost and earnings by category for the large groundfish trawlers.

Variable	Number of observations	Mean (US$)	Standard error (US$)
Cost of:			
Captain	52	64,794	3,256
Crew	52	71,841	4,442
Food	53	3,368	434
Fuel	53	42,535	2,979
Bait	54	4,261	824
Ice	54	6,282	715
Insurance	25	19,582	2,223
Interest payments	25	5,805	2,272
Leasing permits	54	4,119	1,535
Purchasing permits	54	6,050	2,260
RMI[a]	54	62,467	6,746
Revenue from:			
Alaska	54	12,037	9,455
Hawaii	54	0	0
Other sources	54	370	291
At sea deliveries	54	5,556	4,364
Sale/leasing of permits	54	13	10
All species[b]	54	325,719	16,320
Groundfish	54	230,961	13,533
Crab	54	55,414	10,655
Shrimp	54	24,283	5,899
Salmon	54	572	373
Pelagic	54	34	18
HMS[c]	54	2,676	1,026
Halibut	54	11,635	4,944

[a] RMI = repair, maintenance, and improvements.
[b] Groundfish, crab, shrimp, salmon, pelagic, HMS, and halibut do not represent 100% of species landed; as a result, the sum of revenue for these species is less than revenue reported for all species.
[c] HMS = highly migratory species.

Table 9. Cost and earnings by category for the whiting fleet.

Variable	Number of observations	Mean (US$)	Standard error (US$)
Cost of:			
Captain	12	155,819	24,158
Crew	12	200,793	33,111
Food	12	15,280	5,398
Fuel	12	130,844	27,847
Bait	12	3,850	2,357
Ice	12	1,500	617
Insurance	1	—[a]	—
Interest payments	1	—	—
Leasing permits	12	0	0
Purchasing permits	12	10,417	9,964
RMI[b]	12	216,726	72,238
Revenue from:			
Alaska	12	538,040	142,046
Hawaii	12	0	0
Other sources	12	417	399
At sea deliveries	12	60,833	27,295
Sale/leasing of permits	12	5,000	4,783
All species[c]	12	501,557	56,425
Groundfish	12	420,924	44,796
Crab	12	74,021	36,150
Shrimp	12	0	0
Salmon	12	3,429	604
Pelagic	12	2,000	590
HMS[d]	12	395	373
Halibut	12	179	65

[a] An em dash (—) is placed to maintain confidentiality when fewer that three respondents.
[b] RMI = repair, maintenance, and improvements.
[c] Groundfish, crab, shrimp, salmon, pelagic, HMS, and halibut do not represent 100% of species landed; as a result, the sum of revenue for these species is less than revenue reported for all species.
[d] HMS = highly migratory species.

Table 10. Limited entry trawl fleet costs, revenues, and quasi-rents (in US$).

Fleet	Total cost	Variable cost	Adjusted variable cost	Total revenue	Quasi-rent	Adjusted quasi-rent
All trawlers	376,637	240,996	271,746	488,507	247,511	216,761
Crabber	305,610	208,407	243,441	477,645	269,238	234,204
Large groundfish trawler	286,842	188,819	212,561	343,695	154,876	131,134
Whiting	839,093	504,236	554,660	1,105,848	601,611	551,188

Table 11. Limited entry trawl fleet crew size, fuel use (gallons per hour), and speed (knots per hour).

Fleet	Variable	Number of observations	Mean	Standard error
All trawlers	Crew size for crabbing	19	2.1	0.1
	Crew size for shrimp trawling	12	2.0	0.0
	Crew size for groundfish trawling	33	1.9	0.1
	Crew size for salmon trolling	12	4.3	0.3
	Fuel use for crabbing	46	8.2	0.5
	Fuel use for shrimp trawling	44	13.5	0.5
	Fuel use for groundfish trawling	86	19.1	1.1
	Speed when crabbing	42	3.5	0.2
	Speed when shrimp trawling	43	2.1	0.0
	Speed when groundfish trawling	86	3.0	0.1
Crabber	Crew size for crabbing	6	1.8	0.3
	Crew size for shrimp trawling	2	—	—
	Crew size for groundfish trawling	7	1.3	0.2
	Crew size for salmon trolling	3	3.0	0.5
	Fuel use for crabbing	20	8.4	1.1
	Fuel use for shrimp trawling	13	15.1	1.9
	Fuel use for groundfish trawling	21	14.7	2.6
	Speed when crabbing	20	3.8	0.3
	Speed when shrimp trawling	13	2.2	0.1
	Speed when groundfish trawling	21	2.4	0.1
Lg. groundfish trawler	Crew size for crabbing	10	2.2	0.2
	Crew size for shrimp trawling	7	2.0	0.0
	Crew size for groundfish trawling	22	2.1	0.1
	Crew size for salmon trolling	7	5.4	0.3
	Fuel use for crabbing	23	6.6	0.4
	Fuel use for shrimp trawling	29	13.1	0.6
	Fuel use for groundfish trawling	51	14.9	1.0
	Speed when crabbing	19	3.4	0.3
	Speed when shrimp trawling	28	2.1	0.0
	Speed when groundfish trawling	51	3.1	0.2
Whiting	Crew size for crabbing	3	2.3	0.3
	Crew size for shrimp trawling	2	—	—
	Crew size for groundfish trawling	3	2.0	0.0
	Crew size for salmon trolling	2	2.0	0.0
	Fuel use for crabbing	3	18.3	5.7
	Fuel use for shrimp trawling	1	—	—
	Fuel use for groundfish trawling	11	44.6	7.2
	Speed when crabbing	3	3.0	1.1
	Speed when shrimp trawling	1	—	—
	Speed when groundfish trawling	11	3.7	0.1

Table 12. Limited entry trawl fleet share for captain, crew, and vessel.

Fleet	Variable	Number of observations	Mean (%)	Standard error
All trawlers	Captain share without owner as captain	74	20.1	0.7
	Crew share without owner as captain	74	20.6	0.5
	Vessel share without owner as captain	74	59.4	0.7
	Captain share with owner as captain	44	21.3	1.3
	Crew share with owner as captain	44	22.0	0.6
	Vessel share with owner as captain	44	56.6	1.4
	Percent of trips with owner as captain	44	82.3	2.6
Crabber	Captain share without owner as captain	16	26.1	3.8
	Crew share without owner as captain	16	18.6	2.0
	Vessel share without owner as captain	16	55.3	3.7
	Captain share with owner as captain	16	21.7	3.9
	Crew share with owner as captain	16	20.9	1.7
	Vessel share with owner as captain	16	57.4	4.2
	Percent of trips with owner as captain	16	85.3	5.7
Lg. groundfish trawler	Captain share without owner as captain	43	19.7	0.9
	Crew share without owner as captain	43	20.1	0.9
	Vessel share without owner as captain	43	60.1	1.0
	Captain share with owner as captain	24	22.8	2.1
	Crew share with owner as captain	24	22.4	1.2
	Vessel share with owner as captain	24	54.8	2.3
	Percent of trips with owner as captain	24	86.0	4.6
Whiting	Captain share without owner as captain	12	14.1	1.2
	Crew share without owner as captain	12	24.5	1.4
	Vessel share without owner as captain	12	61.4	1.4
	Captain share with owner as captain	3	14.7	0.6
	Crew share with owner as captain	3	24.7	1.1
	Vessel share with owner as captain	3	60.7	1.1
	Percent of trips with owner as captain	3	60.0	9.6

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Appendix A: Limited Entry Survey Questionnaire

OMB No. 0648-0369 Expiration date: 7/31/09

CONTACT INFORMATION FOR SURVEY RESPONDENT

1. Name: _____ 2. E-mail: _____

3. Date (month/day/year): _____ 4. Telephone: (____)_____

5. Mailing address (street, city, state, and zip code):

_____

VESSEL OWNERSHIP AND CHARACTERISTICS

6. Please verify the following information on record about your vessel's characteristics. If the information on record is correct, please place a check mark in the Corrections column. If the information on record is incorrect or there is no information on record, please provide the correct information in the Corrections column.

Item	Information on record	Corrections
a. Owner's name	*Charles Smith*	
b. Owner's address	*333 1st Street, Waldport, OR 97005*	
c. USCG vessel ID	*33221843*	
d. State vessel ID	*OR33214*	
e. Home port	*Newport, OR*	
f. Length (feet)	*75*	
g. Fuel capacity	*300*	
h. Engine make and model	*No information on record*	

7. What is the approximate market value of your vessel (not including associated permits) in dollars?

$_____

8. Please provide your vessel's fuel consumption, speed, and crew size (not including captain) when engaged in each of the following activities. If this vessel does not engage in an activity, please write "NA" in the appropriate columns.

Activity	Fuel consumption (gallons per hour)	Speed (knots per hour)	Crew size (not including captain)
a. Trawling (while towing)			
b. Longlining			
c. Shrimping (while towing)			
d. Crabbing			
e. Trolling			
f. Steaming (fully loaded)			Not applicable
g. Steaming (empty)			Not applicable

COSTS AND EARNINGS

Questions 9 through 11 collect information about this vessel's costs and earnings **while operating in all fisheries** (groundfish, crab, shrimp, salmon, etc.). This survey's primary objective is to collect data on costs and earnings for 2004. However, we recognize that conditions in the fishery change from year to year and that two years of data can provide a more complete picture than a one-year snapshot. If possible, we would appreciate receiving your cost and earnings data for both 2003 and 2004.

9. In what month does your vessel's fiscal year begin? _____

10. For each of the earnings (income) sources listed below, please indicate the income earned during your fiscal year 2003 and fiscal year 2004. If no income was earned from a particular source during a particular year, please write NA in the appropriate box.

Earnings (income) source	2003 ($)	2004 ($)
a. Landings in Alaska		
b. Landings in Hawaii		
c. Landings outside of the United States		
d. West Coast at sea deliveries		
e. Sale and leasing of permits associated with this vessel		
f. Other (please specify)_____		

11. For each cost category below, please provide total annual expenditures during your fiscal year 2003 and fiscal year 2004. If you do not have separate data on expenditures for captain (part a) and crew (part b), please write combined expenditures in part a and write NA in part b. If no expenditures were incurred in a particular category during a particular year, please write NA in the appropriate box. For location of expenditures, please indicate the location of expenditures in either dollars or percentages in the following location categories: hp = home port, hs = home state but not home port city, wc = West Coast (WA, OR, or CA) state but not home state, ak = Alaska, us = United States outside of West Coast and Alaska, ot = outside the United States. For crew expenditures please indicate the percent of crew that reside in each location category.

Cost (expenditure) category	**2003 ($)**	**2004 ($)**	**Location of expenditures**	
a. Captain (including share payments, bonuses, other forms of compensation, and payroll taxes)			hp: hs: wc:	ak: us: ot:
b. Crew (including share payments, bonuses other forms of compensation, and payroll taxes)			hp: hs: wc:	ak: us: ot:
c. Fuel and lube			hp: hs: wc:	ak: us: ot:
d. Food and crew provisions			hp: hs: wc:	ak: us: ot:
e. Ice			hp: hs: wc:	ak: us: ot:
f. Bait			hp: hs: wc:	ak: us: ot:
g. Repair, maintenance, and improvements for vessel, gear, and equipment			hp: hs: wc:	ak: us: ot:
h. Insurance			hp: hs: wc:	ak: us: ot:
i. Interest and financial services			hp: hs: wc:	ak: us: ot:
j. Purchase of permits used with this vessel			NA	NA
k. Leasing of permits used with this vessel			NA	NA

CREW COMPENSATION

Questions 12 through 16 collect information about crew payments when this vessel is participating in the West Coast (Washington, Oregon, and California) **groundfish fisheries**.

12. Does this vessel use a crew share system to pay its crew when operating in West Coast **groundfish fisheries**?

a. Yes (proceed to question 13).
b. No (proceed to question 17).

13. Which of the following expenses were deducted from total revenue before calculating the crew share when this vessel operated in West Coast **groundfish fisheries**?

	Deducted before calculating crew share?	
a. Fuel and lube	Yes	No
b. Food and other crew provisions.	Yes	No
c. Landing taxes	Yes	No
d. Unloading expenses	Yes	No
e. Trucking expenses	Yes	No
f. Other. Please specify _____	Yes	No

14. On what percentage of fishing trips does the vessel owner serve as captain? _____%

15. On trips when the vessel owner serves as captain, please indicate the share of net revenue (revenue minus the deductions listed in question 13) going to the vessel, captain, and crew. If the vessel owner does not serve as captain on any trips, please circle NA.

Vessel share _____% Captain share _____% Crew share _____% NA

16. On trips when the vessel owner does not serve as captain, please indicate the share of net revenue (revenue minus the deductions listed in question 13) going to the vessel, captain, and crew. If the vessel owner always serves as captain, please circle NA.

Vessel share _____% Captain share _____% Crew share _____% NA

VESSEL EARNINGS AND HOUSEHOLD INCOME

17. Approximately what percentage of your annual household income comes from earnings associated with this vessel?

a. less than 20% b. 20% to 40% c. 40% to 60% d. 60% to 80% e. greater than 80%

Appendix B: Testing for Nonresponse Bias

This appendix presents the numerical results of the two sample t-tests, which were used to determine whether the differences observed between survey respondents and nonrespondents are statistically significant. Results from these tests were summarized in subsection 5.3. This appendix provides the actual numerical results of the test as well as interpretation of whether the test results indicate the presence of nonresponse bias that requires corrective measures.

The two sample t-test is based on a null hypothesis that the mean value of the variable being tested is the same for respondents and nonrespondents. The form of the tests reported in Table B-1 assumes that respondents and nonrespondents do not have equal variances.

Table B-1 indicates that for each of the three primary vessel types within the limited entry trawl fleet, the difference in revenue from West Coast landings between respondents and

Table B-1. Two sample t-tests for statistical significance of differences between respondents and nonrespondents in five variables.

Fleet	Variable	T-statistic	Degrees of freedom	Probability > T if H0 true
All trawlers	Engine horsepower	1.52	115	0.13
	Vessel length	2.05	99	0.04
	Revenue from crab	2.44	137	0.02
	Revenue from groundfish	0.51	97	0.61
	Revenue from all species	2.31	108	0.02
Crabber	Engine horsepower	1.57	28	0.13
	Vessel length	0.78	20	0.45
	Revenue from crab	0.62	16	0.54
	Revenue from groundfish	1.10	22	0.28
	Revenue from all species	0.28	14	0.78
Lg. groundfish trawler	Engine horsepower	1.62	52	0.11
	Vessel length	2.88	54	0.01
	Revenue from crab	1.84	81	0.07
	Revenue from groundfish	−0.09	46	0.93
	Revenue from all species	1.59	54	0.12
Whiting	Engine horsepower	−0.42	15	0.68
	Vessel length	−1.44	6	0.20
	Revenue from crab	0.79	17	0.44
	Revenue from groundfish	−0.01	15	0.99
	Revenue from all species	0.42	14	0.68

nonrespondents was not statistically significant. When respondents and nonrespondents are compared at the vessel type level, the only statistically significant difference is in the length of large groundfish trawlers. Table 4 indicates that among large groundfish trawlers, respondents had a mean length of 67 feet and nonrespondents had a mean length of 60 feet, producing a t-statistic of 2.88.

Because respondents and nonrespondents at the vessel type level were not statistically different for revenue from groundfish landings, revenue from crab landings, and most physical characteristics, there is no need to weight survey responses at the vessel type level. The unweighted survey responses provide a representative picture of revenues and costs earned by each of the three major vessel types operating in the limited entry trawl fishery. There is no need to correct the vessel type level data for nonresponse bias, and consequently, all results presented in this document at the vessel type level are unweighted.

For the entire limited entry trawl fleet, respondents had values for vessel length, crab landings, and total West Coast landings that were significantly higher than those of nonrespondents. The difference between respondents and nonrespondents was not only statistically significant, but also of large magnitude. Survey respondents had mean revenue from crab landings of $109,402 while nonrespondents had mean revenue from crab landings of only $55, 940.

Respondents also had higher groundfish landings than nonrespondents, but the difference was not statistically significant. As shown in Table 2, revenue from all landings had a mean value of $356,771 for respondents and $276,069 for nonrespondents.

While it may at first appear paradoxical that there is no statistically significant difference between revenue from West Coast landings for respondents and nonrespondents in any of the three primary vessel types when there is a statistically significant difference for the limited entry trawl fleet as a whole, it should be remembered that the three primary vessel types only include 132 of the 143 vessels in the limited entry trawl fleet. The other 11 vessels tend to have relatively small levels of revenue from landings. In particular, 5 of the 11 vessels are small groundfish trawlers, for which no survey responses were received. As a result, the average respondent had $356,771 of revenue from landings while the average member of the survey population had $327,425 of revenue from landings.

It should be noted that the three primary vessel types within the limited entry trawl fleet include 132 of the 143 limited entry trawl vessels. The other 11 vessels fall into three other vessel types. Since no responses were received from the five small groundfish trawlers, they are not represented in the survey results for the entire limited entry trawl fleet. The combination of 1) larger though not statistically significant landings for respondents than nonrespondents in each of the three primary vessel types and 2) absence of small groundfish trawlers results in a statistically significant difference between revenue from all West Coast landings for respondents and nonrespondents for the entire limited entry trawl fleet.

While nonresponse bias is statistically significant and of sufficient magnitude to make calculation of weighted survey results desirable, the lack of data on vessel types such as small groundfish trawlers makes the calculations of weighted survey results to correct for nonresponse

bias impossible. It is not possible to weight responses in strata with lower response rates more heavily when there are no respondents in that strata. As a result, only the unweighted results are provided in this document for the entire limited entry trawl fleet.

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West Coast Limited Entry Groundfish Cost Earnings Survey

Protocol and Results for 2008

December 2012

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West Coast Limited Entry Groundfish Cost Earnings Survey

Protocol and Results for 2008

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Seattle, Washington 98112

December 2012

U.S. DEPARTMENT OF COMMERCE
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Executive Summary

This technical memorandum describes the fielding protocols and empirical results from an economic cost earnings survey of the West Coast (Washington, Oregon, and California) limited entry groundfish fleet. The survey was conducted by the Fishery Resource Analysis and Monitoring Division of the Northwest Fisheries Science Center in cooperation with the Pacific States Marine Fisheries Commission. Measuring the economic performance and impact of a fishery requires data on the costs incurred by harvesters. Since harvesting vessels operating with a limited entry groundfish permit account for more than 80% of the value of West Coast groundfish landings, economic data on the limited entry groundfish fleet is essential for evaluating the economic performance and impact of the West Coast groundfish fishery. The results published here are expected to be used in regional economic impact models, measures of economic performance, and a variety of analyses that arise regarding the management of groundfish off the West Coast.

The surveyed population was owners of active commercial fishing vessels that 1) landed at least $1,000 of fish on the West Coast during 2008 and 2) had a limited entry groundfish permit. Because of the requirement for at least $1,000 of West Coast landings during 2010, vessels that participated in the at sea whiting (*Merluccius productus*) fishery but did not participate in any shoreside West Coast fisheries were not surveyed. Any vessel that participated in the shoreside whiting fishery was included in the survey population. There were 255 vessels in the survey population.

This survey updates an earlier cost earnings survey of the limited entry fleet. In-person interviews were completed with the owners of 123 vessels, representing a 48% response rate. The response rate was higher for vessels in the limited entry groundfish trawl fleet (57%) than for vessels in the limited entry groundfish fixed gear fleet (39%).

These 123 responses were used for statistical inference of costs, revenues, and vessel operating characteristics (such as crew size and fuel consumption). This document presents the results of that statistical inference for both the trawl and fixed gear fleets, as well as for the primary vessel types in each fleet. Primary vessel types in the limited entry groundfish trawl fleet include large groundfish trawlers, shoreside whiting harvesters, Alaska vessels, crabbers, and shrimpers. Primary vessel types in the limited entry groundfish fixed gear fleet include sablefish (*Anoplopoma fimbria*) vessels, other groundfish vessels, Alaska vessels, and crabbers.

Tests for nonresponse bias indicated that differences between survey respondents and nonrespondents did not exhibit significant nonresponse bias when examined at the vessel type level. Results for the limited entry groundfish trawl fleet as a whole also did not exhibit significant nonresponse bias. In the limited entry groundfish fixed gear fleet, response rates varied considerably across vessel types, and as a result, nonresponse bias was significant for the fixed gear fleet as a whole. Results reported in this document for the entire limited entry groundfish fixed gear fleet incorporate weights for each response that offset nonresponse bias.

For the limited entry groundfish trawl survey respondents, the average vessel had revenue from all sources of $585,041, reported costs of $469,068, economic costs of $507,660, and economic net revenue of $77,381 during 2008. Since economic cost only includes costs incurred prior to the shoreside delivery of fish and does not include shoreside management and administration costs, it provides a measure of economic profit that is biased upward. Amounts such as revenue, cost, and net revenue reflect operations in all fisheries (West Coast and Alaska). Vessels that operated primarily in Alaska fisheries and the West Coast shoreside whiting fishery earned higher economic net revenue than vessels that operated primarily in the West Coast non-whiting groundfish trawl fishery. Vessels that operated primarily in the West Coast non-whiting groundfish trawl fishery earned positive but smaller economic net revenue, on average ($16,562 in 2008).

For the limited entry groundfish fixed gear survey respondents, the average vessel had revenue from all sources of $324,189, costs reported on the survey of $247,003, economic costs of $261,876, and economic net revenue of $62,313 during 2008. As in the limited entry groundfish trawl fleet, the vessels earning the most net revenue were Alaska vessels, which earned per vessel economic net revenue of $422,151. Economic net revenue was lower for vessels that operated primarily in the West Coast limited entry fixed gear fishery. Sablefish fixed gear vessels earned an average economic net revenue of $36,410 in 2008 and other groundfish fixed gear vessels earned an average economic net revenue of $8,641.

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1. Introduction

This technical memorandum describes the fielding protocol and empirical results from an economic cost earnings survey of the U.S. West Coast (Washington, Oregon, and California) limited entry groundfish fleet. The survey was conducted by the Fishery Resource Analysis and Monitoring Division of the Northwest Fisheries Science Center (NWFSC) in cooperation with the Pacific States Marine Fisheries Commission (PSMFC). Measuring the economic performance and impact of a fishery requires data on the costs incurred by harvesters. Since harvesting vessels operating with a limited entry groundfish permit account for more than 80% of the value of West Coast groundfish landings, economic data on the limited entry fleet is essential for evaluating the economic performance and impact of the West Coast groundfish fishery. The results published here are expected to be used in regional economic impact models, measures of economic performance, and a variety of analyses that arise regarding the management of groundfish off the West Coast.

The survey was fielded between July 2009 and February 2010, and collected data for the 2007 and 2008 vessel fiscal years It updates results from a previous cost earnings survey of the limited entry groundfish fleet that collected data for the 2003 and 2004 vessel fiscal years.

Section 2 discusses survey design and questionnaire development. Section 3 discusses survey fielding. Section 4 discusses response rates. Section 5 compares respondents and nonrespondents and summarizes the results of tests for nonresponse bias. Section 6 presents empirical results obtained from analysis of the survey data. Section 7 provides concluding remarks.

2. Survey Design

This survey was designed to provide economic data on vessels that participate in the West Coast limited entry shoreside groundfish fishery. The objective was to obtain vessel-level information on earnings and expenditures needed to support the calculation of economic performance measures (such as net revenue and efficiency), as well as regional economic impact analysis.

2.1. Survey Population and Sample

The population of interest for this survey was all vessels with at least one limited entry groundfish permit at the end of 2008 and at least $1,000 of West Coast landings during 2008. There were 255 vessels in the survey population. Vessels with less than $1,000 of West Coast landings were considered too small in revenue to justify the expense of data collection.

Due to the relatively small number of vessels in the limited entry fleet and the high level of landings per vessel, an attempt was made to collect cost earnings data from each member of the survey population. The survey sample is a census of the survey population.

Fielding a survey requires contact information on each member of the survey population. Contact information (vessel owner name, address, and telephone number) for each vessel in the survey population was obtained from vessel and limited entry permit registration data.

2.2. Questionnaire Development

The survey questionnaire was an update of the questionnaire previously used to collect 2004 data from the West Coast limited entry groundfish fleet.[1] The updated questionnaire was developed initially by representatives of NWFSC, National Marine Fisheries Service's (NMFS) Northwest Regional Office, Southwest Fisheries Science Center, and PSMFC. After survey content was determined, a draft questionnaire was prepared and discussed with members of the limited entry fleet.

For this second economic cost earnings survey of the limited entry fleet, a few modifications were made to the questionnaire. Cost data were collected for three categories (moorage, enforcement, and dues) that did not appear on the initial questionnaire. In addition, an "other" cost category appeared, which provided the survey respondent a chance to report any expenses not covered by the listed categories.

[1] For a description of questionnaire development for the previous limited entry survey, see Lian 2010.

2.3. Defining Revenues and Costs Directly Related to Commercial Fishing

The objective of this survey was to provide the economic data needed to evaluate the economic performance and economic impacts of the West Coast limited entry groundfish fishery. Evaluating performance and impacts requires data on the revenues earned by and costs incurred through the operation of commercial fishing vessels in the fishery. Since the same entity that owns a commercial fishing vessel may also be engaged in any number of other fishing-related or nonrelated activities, it is important to define which revenues and costs are included in the measurement of net revenue.

This survey focused on collecting revenue and cost information directly related to the operation of a commercial fishing vessel. Some expenses incurred by the owner of the vessel may not be directly related to the operation of a commercial fishing vessel. Expenses incurred after the fish have been landed are not directly related to the operation of the vessel. The vessel owner may also own a processing plant, but expenses related to operating the processing plant are not directly related to operation of the fishing vessel. Additionally, some expenses incurred before the point of landing may be difficult to separate into expenses that are directly related to operation of the vessel and expenses that are not. For example, expenses such as office space and a shore-based truck may be associated with the operation of a vessel, but are difficult to separate from other possible uses. Such expenses are therefore excluded from the costs collected in the survey. As a result, estimates of net revenue in this report should be considered "maximum estimates" due to the fact that some costs are not collected through the survey.

The survey collected annual revenue and cost data for the 2007 and 2008 fiscal years. Revenue sources collected by this survey include Alaska landings, Hawaii landings, at sea deliveries, the sale and leasing of permits, salmon disaster relief payments, and other activities directly related to the operation of the vessel (e.g., chartering as part of a NMFS research project). The survey did not collect information on West Coast landings because this information can be obtained from the Pacific Fisheries Information Network (PacFIN). Cost categories collected by the survey included captain, crew, fuel, food, ice, bait, insurance, interest, moorage, dues, enforcement, purchase of permits, leasing of permits, and RMI (repair, maintenance, and improvements). Since most vessels operate in multiple fisheries, much of the available cost data pertain to multiple fisheries. While some of the costs such as vessel repairs and maintenance are joint costs, other costs such as fuel are not necessarily joint costs but are not reported separately by fishery in the survey.[2]

[2] Joint costs are production costs incurred by the firm when two or more outputs are jointly produced. Joint costs can occur when the cost of an input is a fixed cost and when that input is used to produce multiple outputs either concurrently or consecutively. In the case of concurrent outputs, a variable cost can be a joint cost. Repair and maintenance costs that prepare the vessel for use in all fisheries are joint costs. If a single trawl tow harvests both sablefish (*Anoplopoma fimbria*) and Dover sole (*Microstomus pacificus*), the fuel used to harvest the sablefish and Dover sole from the same tow is a joint cost.

3. Survey Fielding Protocol

This section describes the protocol used to field the survey and collect data from respondents. Particular emphasis was placed on implementing a protocol that would maximize response rates. Steps taken to maximize response rates are discussed in subsection 3.2.

3.1. Fielding Schedule

Survey fielding was divided into three stages, with each stage corresponding to one of the West Coast states. Fielding began in Washington, moved to Oregon, and finished in California. It moved southward over time so as to reduce the travel costs involved in conducting in-person interviews. Fielding began with each member of the survey sample receiving a package by mail containing an introductory letter describing the survey, a one-page description of reasons for conducting the survey, and a copy of the questionnaire (the latter supplied in Appendix A). About two weeks after the letter and questionnaire mailing, attempts began to contact each survey recipient by telephone and schedule an in-person interview. During the following three weeks, up to six additional attempts were made to contact each member of the survey population until an interview date was scheduled or the vessel owner declined to participate in the survey. Interviews were conducted at a location chosen by the respondent. The most frequent interview locations were the respondent's residence, vessel, or a restaurant.

Interviewers used the questionnaire during the in-person interviews, asking some additional follow-up questions when appropriate. The interviewer's questionnaire contained not only the questions for which responses were collected, but also examples of how responses to each question would be used by NWFSC staff to address fisheries management issues. For example, interviewers were prompted to ask questions about the nature of repair and maintenance expenses when survey respondents reported large repair and maintenance expenditures.

Survey fielding began in July 2009 and was completed in February 2010. The extended period of data collection reflects the fact that some members of the survey population travel to Alaska during part of the year, and obtaining their responses to the survey required waiting for their return. Data were collected through in-person interviews by Gilmore Research. To aid in preparation, survey respondents received a copy of the questionnaire in the mail prior to the in-person interview.

3.2. Maximizing Response Rates

A number of methods were used to maximize survey response rates. First, the survey was short, four pages in written form. Data collection through in-person interviews usually took less than one hour. Second, respondents were asked only to provide information about major cost and earnings categories, thus avoiding what might seem to respondents like unnecessary

detail. Third, data were collected through in-person interviews, which typically have higher response rates than mail or telephone surveys. Fourth, there were extensive follow-up telephone calls and mailings after the initial letter and questionnaire mailing in order to schedule in-person interviews and obtain responses. These follow-up telephone calls were distributed among weekday/weekend and day/evening time periods to maximize the likelihood of reaching the contact person.

4. Survey Response Rates

Responses for this voluntary survey provided a representative sample of the vessels in each of the major vessel types in the limited entry trawl fleet and the limited entry fixed gear fleet. Because response rates varied considerably across vessel types in the limited entry fixed gear fleet, it is necessary to weight survey responses when developing summary statistics for the entire fixed gear fleet, even though weighting survey data is not necessary when examining summary statistics for each individual vessel type. Table 1 presents a summary of survey response rates. A complete survey form with data judged usable was received from 123 of the 255 survey population members, a 48% response rate.[3] Complete responses were received from 73 of 127 vessels in the trawl fleet, a 57% response rate. Complete responses were received from 50 of 128 vessels in the fixed gear fleet, a 39% response rate.

Response rates are reported by vessel type, state of home port, and revenue from West Coast landings. The vessel type definitions used in this report are taken from page 55 of Radtke and Davis (2000). The primary vessel types in the limited entry groundfish trawl fleet are large groundfish trawlers (at least $100,000 annual revenue, of which at least 33% comes from trawl-caught groundfish), whiting (*Merluccius productus*) vessels (at least $100,000 revenue, of which at least 33% comes from whiting), crabbers (at least $15,000 revenue, of which at least 33% comes from crab), shrimpers (at least $15,000 revenue, of which at least 33% comes from shrimp), and Alaska vessels (at least $100,000 revenue, of which at least 50% comes from Alaska fisheries). Vessels that participate in the shoreside whiting fishery are typically classified as either whiting vessels or Alaska vessels, depending on whether or not they operated in Alaska. The primary vessel types in the limited entry fixed gear fleet are sablefish (*Anoplopoma fimbria*) fixed gear (at least $15,000 revenue, of which at least 33% comes from sablefish caught with fixed gear), other groundfish fixed gear (at least $15,000 revenue, of which at least 33% comes from groundfish caught with fixed gear), crabbers (already defined), and "other less than $15,000" (vessels landing less than $15,000 of fish during the year). While most vessels that participate in the primary sablefish fishery are classified as sablefish fixed gear vessels, there are some vessels (especially those with a single tier 3 sablefish permit) that are classified as crabbers or other groundfish fixed gear vessels.

In the limited entry trawl fleet, large groundfish trawlers accounted for 83 of the 127 vessels and provided a 63% response rate. Responses were received from 43% of the 14 Alaska vessels, 67% of the 12 whiting vessels, 33% of the 9 crab vessels, 75% of the 4 shrimp vessels, and 25% of the 4 vessels that were in other vessel types. In the limited entry fixed gear fleet, responses were received from 37% of the 59 sablefish fixed gear vessels, 24% of the 34 other

[3] Some survey respondents completed only some of the survey questions and as a result did not provide complete data sources of costs and earnings. Other survey respondents provided data which were deemed suspect, such as having variable costs that exceeded revenue from landings. The response rate figures in this section only count complete responses that do not contain any suspicious responses.

groundfish fixed gear vessels, 53% of the 17 crab vessels, 75% of the 12 Alaska vessels, and 40% of the 5 vessels that were in other vessel types.

Table 1 presents response rates by geographic location and revenue class. In the limited entry groundfish trawl fleet, response rates were 61% for vessels with a home port in California, 58% for vessels with a home port in Oregon, and 42% for vessels with a home port in Washington. In the limited entry groundfish fixed gear fleet, response rates were 27% for vessels based in California, 49% for vessels based in Oregon, and 47% for vessels based in Washington. The low response rate in California reflects the low response rate among participants in the live thornyhead (*Sebastolobus* spp.) fishery.

Response rates were positively correlated with revenue from West Coast landings during 2008. Among limited entry trawl vessels, the response rate was 65% for vessels with more than $500,000 of West Coast landings revenue, 57% for vessels with between $100,000 and $500,000 of West Coast landings, and 30% for vessels having West Coast landings under $100,000. Among limited entry groundfish fixed gear vessels, the response rate was 43% for vessels with more than $500,000 of West Coast landings, 51% for vessels with between $100,000 and $500,000 of West Coast landings, and 27% for vessels with under $100,000 of West Coast landings.

5. Comparing Respondents and Nonrespondents

A considerable amount of information about vessel characteristics and landings for each member of the survey population is available from federal and state vessel registration records and PacFIN landings data. That information can be used to compare respondents and nonrespondents and perform tests to determine whether differences between them are statistically significant. This section compares vessel physical characteristics and revenue from West Coast landings for respondents and nonrespondents.

5.1. Data Used to Test for Nonresponse Bias

Data on vessel physical characteristics, West Coast landings (by species, gear type, and port), and revenue from West Coast landings (also by species, gear type, and port) are available for all members of the survey population. Available information on vessel characteristics includes vessel length and horsepower. PacFIN provides vessel-level information on West Coast (Washington, Oregon, and California) landings by date, species, gear type, and port for all vessels in the survey population. As a result, it is possible to compare respondents and nonrespondents with regard to seasonal patterns, species landed, and location of landings.

5.2. Comparison Results

Vessel physical characteristics and landings revenue for survey respondents and nonrespondents are compared in Table 2 through Table 13. Table 2 through Table 7 report results for the limited entry groundfish trawl fleet and Table 8 through Table 13 report results for the limited entry groundfish fixed gear fleet. These tables compare vessel physical characteristics and revenue from West Coast landings for the survey population, survey respondents, and survey nonrespondents. While this section compares respondents and nonrespondents (providing the magnitude of differences between them), subsection 5.3 and Table 14 and Table 15 provide tests of statistical significance for the differences between respondents and nonrespondents.

Table 2 compares respondents and nonrespondents for the entire limited entry groundfish trawl fleet during 2008. The mean engine horsepower for survey respondents (436) was slightly lower than the mean engine horsepower for nonrespondents (446). Both respondents and nonrespondents had a mean vessel length of 66 feet. Mean revenue from West Coast landings was greater for respondents ($451,877) than nonrespondents ($413,832). Respondents earned greater revenue than nonrespondents from groundfish ($339,504 vs. $306,926) and crab ($48,909 vs. $40,304) landings.

Table 3 through Table 7 compare respondents and nonrespondents for the primary vessel types in the limited entry groundfish trawl fleet. Table 3 compares respondents and

nonrespondents for the Alaska trawl fleet. Survey respondents had vessels with smaller engine horsepower than nonrespondents (a mean of 650 vs. 801) and nearly identical length (a mean of 88 feet for respondents vs. 89 feet for nonrespondents). The revenue from West Coast landings earned by vessels classified as Alaska vessels comes primarily from whiting, and was lower for survey respondents than nonrespondents ($416,584 vs. $466,737).

Table 4 compares respondents and nonrespondents for vessels in the limited entry groundfish trawl fleet classified as crabbers.[4] Responses were received from three of the nine vessels. Respondents had vessels with greater mean length (46 feet) than nonrespondents (41 feet) and more powerful engines (horsepower of 298 vs. 193). Revenue from West Coast landings was also greater for respondents than nonrespondents (a mean of $259,718 vs. $114,117). Respondents not only had greater revenue from crab landings than nonrespondents, but also averaged $53,367 in revenue from groundfish landings, while the six nonrespondents did not earn any revenue from groundfish landings.

Table 5 compares respondents and nonrespondents for vessels in the limited entry groundfish trawl fleet classified as large groundfish trawlers. This type accounts for almost two-thirds of the vessels in the limited entry groundfish trawl fleet, and consists of vessels that earn more than $100,000 revenue from West Coast landings annually with at least one-third of the revenue coming from groundfish caught with trawl gear. Physical characteristics for respondents and nonrespondents show almost no difference. Respondents had vessels with mean engine horsepower of 385 while nonrespondents had vessels with mean engine horsepower of 384. Similarly, respondents had a mean vessel length of 63 feet while nonrespondents had a mean vessel length of 62 feet. While revenue from groundfish and crab landings was very similar for respondents and nonrespondents, revenue from all West Coast landings was smaller for respondents ($414,266) than nonrespondents ($440,575). This difference reflects the greater shrimp landings recorded by nonrespondents than respondents during 2008.

Table 6 indicates that whiting vessels had smaller engines (mean horsepower of 663 for respondents vs. 758 for nonrespondents) and shorter length (77 vs. 85 feet). While respondents landed less groundfish on the West Coast than nonrespondents, survey respondents landed more crab on the West Coast than nonrespondents. Revenue from landings of all species on the West Coast was $813,966 for respondents and $776,175 for nonrespondents.

The limited entry groundfish trawl survey population also included four vessels that were classified as shrimpers during 2008. As shown in Table 7, three of these four vessels responded to the survey. Since confidentiality restrictions prevent publication of data based on fewer than three responses, it is not possible to publish data in Table 7 for nonrespondents that would allow a comparison of respondents and nonrespondents. Table 7 does supply information from survey respondents on how the physical characteristics and revenue from West Coast landings of shrimpers compare with other vessel types.

Table 8 compares respondents and nonrespondents for the entire limited entry groundfish fixed gear fleet during 2008. Survey respondents had vessels with greater engine horsepower

[4] The statistical significance of the differences between respondents and nonrespondents in Table 4 through Table 13 is shown in Table 14 and Table 15.

than nonrespondents (a mean of 292 vs. 226) and greater vessel length (a mean of 46 feet vs. 37 feet). While survey respondents and nonrespondents had similar revenue from West Coast groundfish landings (a mean of $90,673 for respondents vs. $88,862 for nonrespondents), survey respondents earned more than twice as much revenue from crab landings as nonrespondents (a mean of $91,287 vs. $45,590). As a result of their greater revenue from crab landings, the mean revenue from all West Coast landings for survey respondents was $202,637 while the mean revenue from all West Coast landings for nonrespondents was $147,296.

Table 9 compares survey respondents and nonrespondents that were classified as Alaska vessels in the limited entry groundfish fixed gear fleet. While the mean vessel length for respondents was 66 feet, the mean vessel length for nonrespondents was 58 feet. While respondents had higher revenue from crab landings on the West Coast than nonrespondents (a mean of $94,065 vs. $48,068), respondents had lower revenue from West Coast groundfish landings than nonrespondents (a mean of $110,062 vs. $167,464). As a result, respondents had slightly lower revenue from all West Coast landings than nonrespondents ($212,304 vs. $226,147).

Table 10 compares survey respondents and nonrespondents in the limited entry fixed gear fleet classified as crabbers. Respondents had vessels with a shorter length than nonrespondents (a mean of 47 feet vs. 51 feet) and smaller engine (a mean horsepower of 341 vs. 515). Respondents earned greater revenue from West Coast crab landings than nonrespondents (a mean of $231,156 vs. $209,649), but respondents earned less from groundfish landings than nonrespondents (a mean of $59,500 vs. $128,085). As a result of their lower revenue from groundfish landings, survey respondents had lower revenue from all West Coast landings than nonrespondents (a mean of $325,812 vs. $387,268).

Table 11 compares survey respondents and nonrespondents for those members of the limited entry fixed gear fleet classified as other groundfish fixed gear vessels (other groundfish meaning other than sablefish). While responses were received from only 8 of the 34 vessels in this vessel type, the physical characteristics of survey respondents and nonrespondents were similar. Survey respondents had vessels with slightly smaller engines than survey nonrespondents (a mean horsepower of 214 vs. 225), and vessel length was nearly identical (a mean of 29 feet for respondents vs. 28 feet for nonrespondents). The short length of vessels in the other groundfish fixed gear vessel type reflects the fact that many of these vessels participate primarily in the southern California live thornyhead fishery. Survey respondents earned more revenue from West Coast crab landings than nonrespondents (a mean of $29,039 vs. $7,986), but earned less revenue from West Coast groundfish landings (a mean of $62,210 vs. $77,069). When all West Coast landings are considered, survey respondents earned slightly more revenue than nonrespondents (a mean of $89,420 vs. $73,269).

All vessels in the limited entry fixed gear fleet with under $15,000 of landings on the West Coast are placed in the under $15,000 vessel type. The survey population contained five vessels of this type during 2008. Of them, two responded to the survey and three were nonrespondents. Since confidentiality restrictions prohibit reporting results based on fewer than three independent observations, it is not possible to report results for the two respondents. It is also not possible to report results for the five vessels in the survey population and the three nonrespondents, as it would then be possible to easily calculate the values omitted for the two

respondents. As a result, Table 12 only reports results for the survey population of five vessels. The vessels had a mean length of 41 feet and mean engine horsepower of 160. They consisted primarily of small-scale harvesters of crab and groundfish. The mean vessel had West Coast landings of $5,998.

Table 13 compares the survey population, respondents, and nonrespondents in the limited entry groundfish fixed gear fleet classified as sablefish fixed gear vessels. In terms of number of vessels, this is the largest vessel type in the limited entry groundfish fixed gear fleet. All of the vessels in this type have at least one limited entry groundfish fixed gear permit with a sablefish endorsement. Survey respondents had vessels with greater mean horsepower than nonrespondents (a mean of 246 vs. 180) and greater length (a mean of 42 feet vs. 39 feet). Respondents had greater revenue from West Coast crab landings (a mean of $63,532 vs. $41,183) and West Coast groundfish landings (a mean of $117,271 vs. $102,095) than nonrespondents during 2008. As a result, survey respondents had greater revenue from West Coast landings of all species than nonrespondents (a mean of $207,120 vs. $154,292).

5.3. Statistical Tests for Nonresponse Bias

A two sample t-test was used to determine whether the differences observed between survey respondents and nonrespondents were statistically significant. The two sample t-test is based on a null hypothesis that the mean value of the variable being tested is the same for respondents and nonrespondents.[5] Two sample t-tests were performed using data on vessel length, engine horsepower, value of West Coast crab landings, value of West Coast groundfish landings, and value of all West Coast landings.

Two sample t-tests for the limited entry groundfish trawl fleet are reported in Table 14. Test results are reported for the entire limited entry groundfish trawl fleet as well as the primary vessel types in the fleet. A total of 5 two sample t-tests were performed for the entire survey population and 20 two sample t-tests were performed at the vessel-type level. In some cases, the limited number of observations prevents reporting results due to confidentiality considerations.[6]

Table 14 shows that for the entire limited entry trawl fleet as well as the primary vessel types in the fleet, none of the two sample t-tests demonstrated a statistically significant difference between survey respondents and nonrespondents at even the 90% confidence level. While the difference in revenue from West Coast landings of all species for respondent and nonrespondent crab vessels appears large (respondents had more than twice as much revenue as nonrespondents from West Coast landings of all species during 2008), the difference is not statistically significant at the 90% confidence level because of the small number of observations and the large variance in revenue among the few observations.

[5] In addition to testing for statistically significant differences between survey respondents and nonrespondents using a two sample t-test, survey respondents and nonrespondents were compared using permutation tests, which do not require any assumption about the distribution of the variable being used to compare respondents and nonrespondents. Since the outcome of the permutation tests was similar to the outcome of the t-tests and the intent of this document is to summarize survey responses, results from the permutation tests are not provided. For an outline of the permutation testing methodology, see Goode 2006.

[6] In order to protect the confidentiality of survey respondents, responses from at least three separate business entities are required in order to report values for survey means and standard deviations.

Table 15 indicates that the difference in revenue from crab landings earned by respondents and nonrespondents for the entire limited entry fixed gear fleet was statistically significant at the 95% confidence level. However, the difference in revenue from all West Coast landings earned by respondents and nonrespondents was not significant at even the 90% confidence level.

Revenue from landings (for crab, groundfish, or all species) and physical characteristics did not show a statistically significant difference at the 95% level for any of the vessel types in the limited entry groundfish fixed gear fleet. Only engine horsepower in Alaska vessels displayed a statistically significant difference between respondents and nonrespondents at the 90% level. Differences between respondents and nonrespondents are more frequently significant for the entire limited entry groundfish fixed gear fleet than for the vessel types in the fleet, because the different survey response rates across vessel types create distortions in the inferences for the entire limited entry groundfish fixed gear fleet that are not present in the inferences for the individual vessel types.

5.4. Correcting for Nonresponse Bias

Subsection 5.2 and subsection 5.3 indicate that statistically significant differences do not exist at the vessel-type level between survey respondents and nonrespondents. A comparison of respondents and nonrespondents for the limited entry groundfish trawl fleet also does not show a consistent pattern of differences that are statistically significant. As a result, there is no reason to adjust survey data at the vessel-type level or for the entire limited entry groundfish trawl fleet for nonresponse bias.

While the response rate for Alaska vessels in the limited entry groundfish fixed gear fleet was 75%, the response rate for vessels in the other groundfish fixed gear vessel type was only 24%. The different response rates create bias when data from the survey is aggregated without weighting. While the survey population has 12 Alaska vessels and 32 other groundfish fixed gear vessels, the survey respondents include 9 Alaska vessels and 8 other groundfish fixed gear vessels. Aggregating the survey respondents without adjusting for the different response rates would result in the Alaska vessels accounting for too large a share of the limited entry groundfish fixed gear fleet, and would cause results reported for the limited entry groundfish fixed gear fleet to be biased upward, as Alaska vessels are much larger scale operations than other groundfish fixed gear vessels. This is the reason unweighted survey respondents have mean West Coast landings of $202,637 while unweighted survey nonrespondents have unweighted West Coast landings of $147,296 in Table 8.

In order to weight the survey responses for calculation of revenue and cost figures for the entire limited entry groundfish fixed gear fleet, a survey weight is calculated for responses from each vessel type in the fleet. The weight for each vessel type is equal to the number of vessels in the survey population divided by the number of respondents. For example, in the limited entry groundfish fixed gear fleet, there were 12 Alaska vessels in the survey population and responses were obtained from 9 of these vessels. The weight for Alaska vessels is 12 / 9 = 1.33. There were 34 other groundfish fixed gear vessels in the survey population and responses were obtained from 8 vessels, so the survey weight for other groundfish fixed gear vessels is 34 / 8 = 4.25. Statistics reported for the entire limited entry groundfish fixed gear fleet in section 6 are

calculated using these weights with SAS PROC SURVEYMEANS.[7] All other results reported in section 6 for individual vessel types and for the entire limited entry groundfish trawl fleet are calculated using unweighted data from survey respondents.

[7] For a description of the weighting procedure used by PROC SURVEYMEANS, see the documentation online at http://support.sas.com/documentation/cdl/en/statug/63347/HTML/default/viewer.htm#statug_surveymeans_sect007.htm

6. Empirical Results

Before examining cost and earnings data from 2008, it is worthwhile to consider the health of the West Coast groundfish and crab fisheries during 2008. Total commercial groundfish landings (including whiting) for all gear types on the West Coast were 97,858 mt during 2008. This is the sixth largest annual groundfish landings total on the West Coast during the 10 year period between 2001 and 2010. Total commercial crab landings for all gear types on the West Coast were 20,487 mt during 2008. The 2008 value is the seventh highest annual landings total during the 10 year period between 2001 and 2010, and the lowest annual landings total since 2003.

Revenue from commercial West Coast groundfish landings in 2008 was $70,029,024. This is the highest annual revenue from groundfish landings during the 2001–2010 period on both a nominal and an inflation-adjusted basis. The historically high revenue from groundfish landings reflects the high prices for whiting and sablefish that prevailed during 2008. Ex vessel whiting prices averaged $0.10 per pound during 2008, the highest annual average (on both a nominal and an inflation-adjusted basis) during the 2001–2010 period. Ex vessel sablefish prices averaged $2.10 a pound during 2008, higher than annual average prices observed during 2001–2007, but below annual average prices observed during 2009 and 2010.

In summary, the West Coast groundfish fishery in 2008 can be characterized by average harvest levels and strong prices for key species such as whiting and sablefish. As a result, the revenue earned from landings of groundfish on the West Coast was unusually high. In contrast, the crab fishery during 2008 experienced its lowest level of ex vessel landings revenue since 2003.

6.1. Calculated Costs

The tables discussed in subsection 6.2 present the costs and revenues associated with operation of a commercial fishing vessel. While information on revenue from West Coast landings was taken from PacFIN data, information on all other sources of revenue was taken from survey responses. Although most of the cost categories report information collected by the survey, there are four cost categories that were calculated using PacFIN and cost earnings survey data. The cost of landings taxes and buyback fees was calculated from PacFIN data and published tax rates, while the opportunity cost of capital and adjusted captain costs were calculated based on survey responses and PacFIN data. Combining all of this information on revenue sources and costs permits calculation of the net revenue earned through operation of commercial fishing vessels.

6.1.1. Landings Taxes

Calculating the landing taxes paid by the owner of a commercial fishing vessel requires consideration of not only the tax rates charged by each state, but also the incidence of the tax

between the fish seller (vessel owner) and fish buyer. Calculating landings taxes is straightforward, as PacFIN provides information on the location of landings (landings taxes vary by state), species landed (as tax rates differ by species in some cases), landed weight (for California taxes charged on a per pound basis), and revenue from landings (for Washington and Oregon taxes, which are calculated as a percentage of revenue).

Determining the incidence of the landings tax between the harvester and the first receiver is more difficult. Neither the Oregon tax code nor the California tax code include any provision to shift some of the tax back to harvesters. As discussed in Leonard and Watson (2011), the ex vessel price of fish reported in PacFIN is believed to be the price net of taxes, so no adjustment to revenue reported in PacFIN for taxes is required in California and Oregon for fish sold to a first receiver. In California and Oregon, the only landings taxes assumed in this analysis to be paid by the vessel owner from the revenue reflected on the fish ticket are incurred on fish sold directly to the final consumer. In contrast to California and Oregon, the Washington tax code states that first receivers can shift half of the landings tax back to the fish seller. As a result, this analysis assumes that the vessel owner incurs half of the 2.3% landings tax levied in Washington when fish are sold to a first receiver. In California and Oregon, the first receiver cannot shift any portion of the landings tax back to the fish seller.

6.1.2. Trawl Buyback Fees

PacFIN data is also used as the basis for calculating the fees paid by vessels owners to repay the buyback program that removed 91 permits from the groundfish trawl fishery in 2003, along with their associated crab and shrimp permits. Buyback fees are charged on trawl-caught groundfish, crab, and shrimp. The fees on crab and shrimp landings are paid by all vessels making landings of crab and shrimp, regardless of whether they have a limited entry groundfish permit. Trawl groundfish landings in all states are subject to a 5% tax. Crab landings are taxed at a 1.24% rate in California, 0.55% in Oregon, and 0.16% in Washington. Shrimp landings are taxed at a 5.0% rate in California, 3.75% in Oregon, and 1.50% in Washington. The incidence of buyback taxes is assumed to fall entirely on the vessel owner. Buyback fees are legally placed on the fish harvesters who sell the fish, but fish buyers are directed to collect the fee and deduct it from the net trip proceeds that fish buyers pay to the fish sellers.

6.1.3. Adjusted Captain Costs

Calculating economic net revenue requires adjustment for vessel owners who serve as captain and do not pay themselves a salary for the provision of captain services. Even though some vessel owners do not receive a payment for captain services, they are forgoing other employment opportunities to serve as captain. These vessel owners derive their compensation for service as captain through their earnings as the recipient of vessel net revenue. Since actual expenditures on captain services differ greatly from the opportunity cost of providing captain services in such cases, it is necessary to estimate the opportunity cost of serving as the vessel captain.[8]

[8] Responses to the cost earnings survey indicate that the vessel owner serves as captain on 36% of trips targeting groundfish. Vessel owners rarely serve as captain on the larger vessels that operate in the West Coast whiting fishery.

The estimate of opportunity cost of serving as captain is based on the payment to captains of vessels where the owner does not serve as captain.[9] Examination of survey responses from vessels where the owner did not serve as captain indicated that the expenditures for captain as a share of vessel revenue decline as vessel revenue increases, and generally remain above 15% for vessels with under $750,000 of annual revenue. Given that almost all vessels in the survey population that exceed $750,000 of annual revenue operate in both the West Coast and Alaska, a minimum expenditure for captain services of 15% of vessel revenue was imposed on all vessels not categorized as Alaska vessels. No adjustment was made to the captain expenditures of vessels that participate in the shoreside whiting fishery, as these vessels rarely have an owner serving as captain and typically operate on a much larger scale where captain costs are below 15% of revenue.

6.1.4. Opportunity Cost of Capital

Vessel owners have a substantial capital investment in their vessel, gear, and fishing permits. If the vessel owner were to quit fishing, these assets could be sold and the proceeds could be used to purchase an asset providing a stream of future interest payments. Considering the opportunity cost of capital is important because it is an economic cost incurred by the vessel owner. Terry et al. (1996) note that conventional practice in fisheries economics has been to estimate the opportunity cost of capital as P(i+d) where P is the market value of capital, i is the interest rate, and d is the depreciation rate. They suggest a Moody's Baa rated corporate bond as providing an interest rate that incorporates some of the economic risk inherent in fishing and straight-line depreciation as a viable approach. After examining interest rates on corporate bonds with a Baa rating, a 5% interest rate was chosen for calculation of the opportunity cost of capital.[10]

6.2. Costs and Earnings during 2008

Table 16 through Table 22 provide average costs (expenses) and revenues for the limited entry groundfish trawl fleet and the primary vessel types in the fleet. Each table was constructed by taking the relevant survey responses and calculating the mean and standard error of each cost and revenue category. For those survey respondents who reported having a fiscal year that did not match the calendar year (i.e., they use a fiscal year that does not begin on January 1), the revenue and cost values used were for that vessel's fiscal year. This procedure insures that the revenues and costs used for each vessel are measured over the same time period, but does result in some difference across vessels as to the time period included in their 2008 data. While a vessel that uses a fiscal year identical to a calendar year reports 2008 expenditures from January 2008 to December 2008, a vessel with a fiscal year starting in October reports cost and revenue figures for 2008 measured from October 2007 to September 2008.[11]

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[9] The limited entry and open access cost earnings survey questionnaires collected information on the percentage of trips where the vessel owner served as captain, so it was possible to identify a subset of survey respondents for which the vessel owner did not serve as captain on any trips and the payments to captain reflect expenditures for captain services when an explicit payment is made to the captain on each trip.

[10] The interest rate on a Moody's Baa corporate bond during November 2010 was 5.18%. This information was online at http://research.stlouisfed.org/fred2/series/BAA.

[11] Fiscal year differed from calendar year for 9 of the 73 limited entry groundfish trawl survey respondents and 4 of the 50 limited entry groundfish fixed gear survey respondents.

Table 16 provides average costs (expenditures) and revenues for all survey respondents in the limited entry groundfish trawl fleet. Some respondents did not respond to all questions, so the number of observations varies across cost and revenue categories. Cost categories reported in Table 16 include payments to captain, adjusted payments to captain, crew, fuel, food, ice, bait, insurance, interest, moorage, dues, enforcement, leasing permits, purchasing permits, RMI, opportunity cost of capital, other costs, landings taxes paid by the vessel owner, and buyback fees paid by the vessel owner. The cost of captain, crew, fuel, food, ice, bait, insurance, interest, moorage, dues, enforcement, leasing permits, purchasing permits, RMI, and other expenses were taken directly from survey responses. As described in subsection 6.1, the cost of landings taxes and buyback fees was calculated using PacFIN data. Adjusted captain cost and the opportunity cost of capital were calculated following the methodology described in subsection 6.1. Table 16 indicates that the largest cost categories for the average limited entry groundfish trawler are crew expenses ($117,552), adjusted captain expenses ($96,788), fuel ($91,741), RMI ($71,885), the opportunity cost of capital ($34,496), insurance ($25,481), and buyback fees ($19,367) Each other cost category involved less than $10,000 of expenditure during 2008. Figure 1, a pie chart constructed from the data in Table 16, shows the share of costs accounted for by each cost category. Figure 1 aggregates all of the cost categories with average expenditures under $10,000 into "other costs," as the relatively small expenditures on these cost categories are not clearly visible on a pie chart.

The primary sources of revenue for the average limited entry groundfish trawler were West Coast groundfish landings ($339,504), Alaska landings ($85,648), West Coast shrimp landings ($53,332), West Coast crab landings ($48,909), at sea deliveries ($26,788), and other sources ($16,843, a category that includes activities such as working on NMFS groundfish stock surveys). Each other revenue source on Table 16 provided average revenue below $10,000 during 2008. It should be noted that since the figures reported in Table 16 are averages, the figure may be at a level rarely observed for an individual vessel. For example, the average vessel earned $85,648 in revenue from Alaska landings, but individual vessels typically have Alaska earnings more than $500,000 or equal to $0. Similarly, the average vessel had at sea deliveries of $26,788, while individual vessels either had more than $250,000 of at sea deliveries or $0 of at sea deliveries. Table 17 through Table 21 report average earnings and costs by individual vessel type (Alaska, crab, large groundfish trawler, shrimp, and whiting) in the limited entry groundfish trawl fleet during 2008. When examining the data in those tables, it is important to remember that about two-thirds of the revenue earned by Alaska vessels came from fisheries outside the West Coast, and that the results reported for both crabbers and shrimpers are based on three respondents.

Table 22 provides cost and earnings data for the average limited entry groundfish fixed gear vessel. As discussed in subsection 5.4, the values reported in Table 22 are calculated by weighting survey responses to account for the different response rates across vessel types in the limited entry groundfish fixed gear fleet. Table 16 indicates that the largest cost categories for the average limited entry groundfish trawler were crew expenses ($72,051), adjusted captain expenses ($51,234), RMI ($31,892), fuel ($24,874), the opportunity cost of capital ($14,281), bait ($11,597), and insurance ($10,388). Each of the other cost categories involves less than $10,000 of expenditure during 2008. Figure 2, a pie chart constructed from the data in Table 22, shows the share of costs accounted for by each cost category. Figure 2 aggregates all of the cost categories with average expenditures under $10,000 into "other costs," as the relatively small

expenditures on these cost categories are not clearly visible on a pie chart. The primary sources of revenue for the average limited entry groundfish fixed gear vessel were Alaska landings ($119,664), West Coast groundfish landings ($87,053), and West Coast crab landings ($77,264). Each other revenue source in Table 22 provided average revenue below $10,000 during 2008. Table 23 through Table 27 report average costs and earnings by individual vessel type (Alaska, crab, other groundfish fixed gear, other < $15,000, and sablefish fixed gear) for the limited entry groundfish fixed gear fleet. Note that while Alaska vessels in the fixed gear fleet earned an average of $1,266,444 from Alaska landings, they earned $212,304 from West Coast landings. Revenue from operations in West Coast fisheries accounts for less than 20% of the total revenue earned by these vessels.

6.3. Profitability during 2008

This document presents two measures of profitability, accounting net revenue and economic net revenue. Accounting net revenue seeks to construct a measure of accounting profit, while economic net revenue seeks to measure economic profit (which considers opportunity costs incurred by operating a commercial fishing vessel that are not considered by accounting profit). While accounting net revenue is an appropriate measure to use if trying to determine whether the vessel owner's financial statement will show a profit, economic net revenue provides a measure of economic profit that considers the opportunity costs that do not appear in a vessel owner's financial records but are a foregone opportunity.

Both net revenue measures use revenue from West Coast landings, Alaska landings, at sea deliveries, the sale and leasing of permits, salmon disaster relief payments, and other activities directly related to operation of the commercial fishing vessel (e.g., chartering as part of a NMFS research project). Costs included in the calculation of accounting net revenue include costs reported for captain, crew, fuel, food, ice, bait, insurance, interest, moorage, dues, enforcement, purchase of permits, leasing of permits, RMI, unloading, trucking to the fish buyer, and freight supplies.[12] Costs calculated for landings taxes and trawl buyback fees are also included in the calculation of accounting net revenue. Economic net revenue replaces reported captain costs with adjusted captain costs and considers the opportunity cost of capital.

While the cost earnings surveys seek to collect information on all revenues and costs directly related to the operation of a commercial fishing vessel, it is known that the list of costs omits some costs. Because a small share of costs are not considered in these calculations, accounting net revenue is greater than accounting profit and economic net revenue is greater than economic profit.

Since most vessels operate in multiple fisheries, much of the available cost data pertains to multiple fisheries. While it is not necessary to disaggregate costs in order to analyze net revenue for all vessel operations, it is necessary in order to analyze net revenue at the fishery level.

[12] Costs for unloading, trucking to the buyer, and freight supplies were collected by the open access groundfish survey, but not the earlier limited entry groundfish survey. These three costs added 1.2% to the total costs reported by vessel owners.

Table 28 reports limited entry groundfish trawl fleet results for total revenue from all sources, reported costs, accounting net revenue, economic costs, and economic net revenue. Accounting net revenue and economic net revenue are reported for both the entire limited entry groundfish trawl fleet and the primary vessel types in the fleet. All revenues, costs, and net revenue figures are calculated over all operations of the vessel (in all fisheries in all geographic areas). Figure 3 is a bar chart summarizing sources of revenue for the average limited entry groundfish trawl vessel, Figure 4 is a bar chart summarizing costs incurred by the average trawl vessel, and Figure 5 is a bar chart depicting economic net revenue earned by the average trawl vessel.

For the entire limited entry groundfish trawl fleet, average accounting net revenue was $115,983 and economic net revenue was $77,381 over all fisheries during 2008. Economic net revenue equaled 13.2% of total revenue. The amount of accounting net revenue and economic net revenue earned per vessel varied considerably across vessel types. The different levels of economic net revenue reflect not only different scales of operation, but also different rates of profitability. Alaska vessels in the groundfish trawl fleet earned mean economic net revenue of $493,915, which represents 28.3% of revenue from all sources. Whiting vessels earned mean economic net revenue of $167,457, which represents 19.2% of revenue from all sources. Shrimpers earned mean economic net revenue of $131,160 per vessel, which represents 25.4% of revenue from all sources. Crabbers earned mean economic net revenue of $33,577 per vessel, which represents 11.8% of revenue from all sources.[13] Large groundfish trawlers accounted for about two-thirds of the vessels in the limited entry trawl fleet and earned average economic net revenue of $16,562 per vessel, which represents 3.7% of revenue from all sources.

Table 29 shows that for the entire limited entry groundfish fixed gear fleet, average accounting net revenue was $77,185 and economic net revenue was $52,313 across all fisheries during 2008. Economic net revenue equaled 16.1% of total revenue. The amount of accounting net revenue and economic net revenue earned per vessel varies greatly across vessel types. Alaska vessels in the fixed gear fleet earned economic net revenue of $422,151 per vessel, which equals 28.5% of revenue from all sources. Among the other vessel types (which include vessels earning less than 50% of their total revenue in Alaska), the highest level per vessel was earned by sablefish vessels; they earned per vessel economic net revenue of $36,410, which equals 15.3% of total revenue. Other groundfish fixed gear vessels earned per vessel economic net revenue of $8,851, which equals 9.7% of total revenue. Figure 6 is a bar chart summarizing sources of revenue for the average limited entry groundfish fixed gear vessel, Figure 7 is a bar chart summarizing costs incurred by the average fixed gear vessel, and Figure 8 is a bar chart depicting economic net revenue earned by the average fixed gear vessel.

The profitability data in Table 28 and Table 29 indicate that members of the limited entry groundfish fleet (both trawl and fixed gear) that participate in Alaska fisheries earn higher accounting net revenue and economic net revenue than members of the fleet that only operate in West Coast fisheries. Net revenues are higher for vessels operating in Alaska in both absolute terms and as a percentage of revenue. Vessels in the limited entry groundfish trawl fleet that participate in the West Coast shoreside whiting fishery yet do not participate in Alaska fisheries

[13] One should recall that this information on the profitability of crabbers and the profitability of shrimpers is based on only three observations for each vessel type.

also earn substantial accounting net revenue and economic net revenue, but less than vessels participating in Alaska fisheries. Accounting net revenue and economic net revenue among vessels operating primarily in the West Coast non-whiting groundfish fishery was much smaller, although still positive when examined at the vessel-type level. On average, sablefish fixed gear vessels earned a higher rate of economic net revenue than other groundfish fixed gear vessels.

6.4. Crew Size, Fuel Use, and Speed

Table 30 has a summary of survey responses on crew size (not including the captain), fuel use, and vessel speed for limited entry groundfish trawl fleet respondents and major vessel types in the fleet. For the entire trawl fleet, crew size exhibits some variation by activity, with a larger crew size reported for crabbing (2.8 members) than groundfish trawling (2.0 members) or shrimp trawling (2.0 members). Except for a few cases where the number of observations is low, crew size does not vary greatly across vessel types; fishing activity is a greater determinant of crew size than vessel type. For all vessels in the trawl fleet, fuel use was greater when groundfish trawling (17.1 gallons per hour) than shrimp trawling (11.7 gallons per hour) or crabbing (8.3 gallons per hour). Vessel speed was greater when crabbing (2.7 knots per hour) than groundfish trawling (2.6 knots per hour) or shrimp trawling (2.2 knots per hour). Like crew size, fuel use and speed are determined more by fishing activity than vessel type.

Table 31 has a summary of survey responses on crew size, fuel use, and vessel speed for the limited entry groundfish fixed gear fleet and the primary vessel types in the fleet. Crew size is similar for crabbing (2.4 members) and longlining (2.5 members) and smaller for salmon trolling (1.2 members). One should consider that 2008 was a year of very little harvesting activity in the salmon troll fishery. Fuel use was greater when longlining (5.9 gallons per hour) than crabbing (4.8 gallons per hour) or trolling (3.6 gallons per hour). Higher fuel use by trawl vessels than fixed gear vessels reflects both the different gear used when targeting groundfish and the larger engine size typically observed in trawl vessels. Fixed gear fleet vessel speed was greater when longlining (4.7 knots per hour) and crabbing (4.6 knots per hour) than when salmon trolling (3.8 knots per hour).

6.5. Owner as Captain

Table 32 reports the percentage of trips on which the vessel owner served as captain for members of the limited entry groundfish trawl fleet. For the entire fleet, the owner served as captain on 35.5% of trips. This percentage varied considerably by vessel type. Owners of vessels classified as crabbers served as captain on 66.7% of trips, while owners of vessels classified as large groundfish trawlers served as captain on 39.5% of trips. The result for crab vessels is based on only three survey responses. Large groundfish trawlers show a lower likelihood of being captained by the vessel owner as vessel length increases. Alaska vessels were captained by the vessel owner on 33.3% of trips. Whiting vessels and shrimp vessels were captained by the vessel owner on less than 5% of trips. The result for shrimp vessels, like that for crab vessels, is based on only three survey responses.

For the entire limited entry groundfish trawl fleet on trips where the owner does not serve as captain, the average allocation of revenue after deductions is 18.1% to the captain, 22.5% to the crew, and 59.5% to the vessel. On trips where the vessel owner serves as captain, the

allocation of revenue after deductions is 8.1% to the captain, 25.7% to the crew, and 66.2% to the vessel. Placing the vessel owner on the ship as captain reduces the revenue share paid to the captain and increases the revenue share paid to the vessel, reflecting the choice of some vessel owners to not explicitly pay themselves for captain services.

Table 33 has survey results regarding percentage of trips with the vessel owner serving as captain and the distribution of revenue after deductions for the limited entry groundfish fixed gear fleet. For the entire fixed gear fleet, 76.8% of trips were made with the owner serving as captain. This is nearly double the 39.5% owner on board figure obtained for the trawl fleet and reflects the smaller scale of operation of vessels in the fixed gear fleet, as well as the owner on board requirement for vessels operating in the limited entry fixed gear primary sablefish fishery. The percentage of trips with the owner serving as captain was 62.3% for Alaska vessels, 99.1% for crabbers, 57.5% for other groundfish fixed gear vessels, and 84.9% for sablefish fixed gear vessels.

For the entire limited entry groundfish fixed gear fleet on trips where the owner does not serve as captain, the average allocation of revenue after deductions is 19.0% to the captain, 28.1% to the crew, and 52.3% to the vessel. On trips where the vessel owner serves as captain, the allocation of revenue after deductions is 16.0% to the captain, 30.7% to the crew, and 61.4% to the vessel. As in the limited entry groundfish trawl fleet, placing the vessel owner on the ship as captain reduces the revenue share paid to the captain and increases the revenue share paid to the vessel, reflecting the choice of some vessel owners to not explicitly pay themselves for captain services.

6.6. Market Value of Vessels

The survey asked vessel owners to provide the market value of their vessel. This information is a key input in estimating the opportunity cost of capital for the vessel owner. Table 34 indicates that the average value of a vessel in the limited entry groundfish trawl fleet was $589,926. Vessels used in Alaska fisheries and the West Coast whiting fishery have a much higher market value (and are much larger) than crabbers and large groundfish trawlers. Table 35 indicates that the average market value of a limited entry fixed gear vessel was $246,449. In the limited entry groundfish fixed gear fleet, Alaska vessels have a reported market value nearly double that of crabbers and more than twice that of sablefish fixed gear or other groundfish fixed gear vessels. While the reported market value of a vessel does not affect accounting net revenue, higher reported market value for a vessel does increase the opportunity cost of capital and reduce economic net revenue.

6.7 Comparison of 2004 and 2008 Survey Results

During 2004 the average vessel in the West Coast limited entry groundfish trawl fleet earned revenue of $488,507. As shown in Figure 3, the primary sources of revenue were West Coast groundfish landings ($214,341), Alaska landings ($111,168), West Coast crab landings ($109,402), West Coast shrimp landings ($17,976), and at sea deliveries ($11,319). Revenue earned from all sources by the average limited entry groundfish trawl vessel increased to $585,041 in 2008 as revenues from West Coast groundfish landings increased to $339,503 and revenue from shrimp landings increased to $53,331. Revenue earned per vessel from West Coast

crab landings ($48,909), Alaska operations ($85,648), and at sea deliveries declined in 2008 relative to 2004. The increase in revenues from West Coast groundfish landings from $214,341 in 2004 to $339,503 reflects the rise in whiting and sablefish prices between 2004 and 2008.

Economic costs incurred by the average limited entry groundfish trawl vessel related to operations in all fisheries rose from $458,392 in 2004 to $507,660 in 2008. Figure 4 shows per vessel costs during 2004 and 2008 for the major cost categories. Higher costs in 2008 were the result of higher fuel prices in 2008 (fuel expenses rose from $53,857 during 2004 to $91,741 in 2008) and fees to pay for the groundfish trawl buyback program. While the buyback program removed 91 vessels from West Coast fisheries in December 2003, collection of fees to pay off the buyback program did not begin until 2005. During 2008 the average vessel in the limited entry groundfish trawl fleet paid $19,367 in buyback fees. As shown in Figure 5, economic net revenue earned by the average limited entry groundfish trawl vessel in all fisheries rose from $30,114 in 2004 to $77,381 in 2008.

During 2004 the average vessel in the West Coast limited entry groundfish fixed gear fleet earned revenue of $327,916. Figure 6 shows that the primary sources of revenue during 2004 were Alaska operations ($130,997 per vessel), West Coast crab landings ($93,721 per vessel), and West Coast groundfish (primarily sablefish) landings ($74,654 per vessel). Revenue earned from all sources by the average fixed gear vessel declined slightly to $324,189 during 2008. While the increase in sablefish prices caused revenue earned from West Coast groundfish landings to rise to $87,053, revenue earned from Alaska operations ($119,664) and West Coast crab landings ($77,264) declined in 2008 relative to 2004. While crab prices were higher during 2008 than 2004, the West Coast crab harvest declined by more than one-third from 31,232 mt during 2004 to 20,487 mt in 2008. The decline in crab harvest affected the limited entry groundfish fixed gear fleet more than the limited entry groundfish trawl fleet, as the fixed gear fleet typically derives a greater percentage of its revenue from the West Coast crab fishery.

Economic costs incurred by the average limited entry groundfish fixed gear vessel related to operations in all fisheries rose slightly from $268,517 to $271,876. Because fixed gear vessels use less fuel than trawlers, their fuel costs rose less than fuel costs for limited entry groundfish trawl vessels. As shown in Figure 7, average expenditure on fuel for a fixed gear vessel rose from $13,634 during 2004 to $24,874 during 2008. While members of the fixed gear fleet pay buyback fees on West Coast crab and shrimp landings, they do not pay buyback fees on groundfish landed with fixed gear. As a result, the implementation of fees to pay for the trawl buyback program in 2005 imposed costs of $850 on the average member of the limited entry groundfish fixed gear fleet during 2008. Figure 8 shows that the average economic net revenue earned from operations in all fisheries by the average member of the fixed gear fleet declined from $84,653 during 2004 to $62,313 during 2008. Despite the rise in sablefish prices, higher fuel costs and a smaller crab harvest resulted in slightly lower economic net revenue for the average member of the limited entry groundfish fixed gear fleet during 2008 than during 2004.

7. Concluding Comments

The NWFSC and PSMFC thank all of the vessel owners who participated in this voluntary survey. The quality of data and summary statistics in this report depend on the willingness of commercial fishermen to provide their time and confidential data. While this report supplies a considerable amount of information taken from the survey responses, it does not provide all possible summary statistics that could be derived from the survey responses. Individuals interested in further information about the survey should contact either NWFSC or PSMFC.

The NWFSC and PSMFC will continue to conduct voluntary cost earnings surveys of the limited entry groundfish fixed gear fleet. With implementation of the catch shares management regime in the limited entry groundfish trawl fishery, submission of economic data is mandatory for catcher vessels participating in the groundfish trawl fishery (as well as for catcher processors, motherships, and first receivers/shoreside processors). Economic data will continue to be collected from the limited entry groundfish fixed gear fleet on a voluntary basis.

Figures 1–8

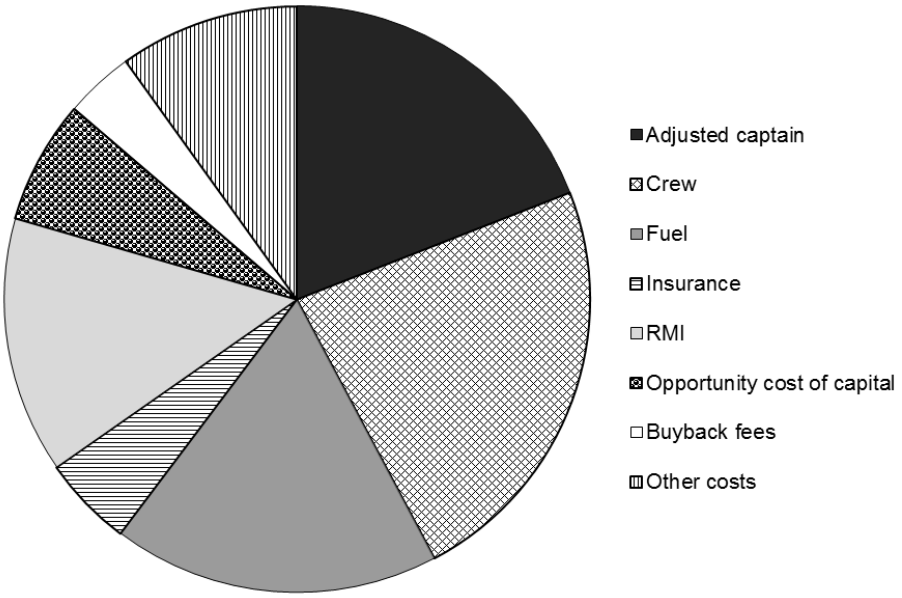

Figure 1. Economic costs in 2008 for the trawl fleet. RMI = repair, maintenance, and improvements. "Other costs" include bait, ice, interest, moorage, dues, enforcement, permit leasing, permit purchasing, landings taxes, and food.

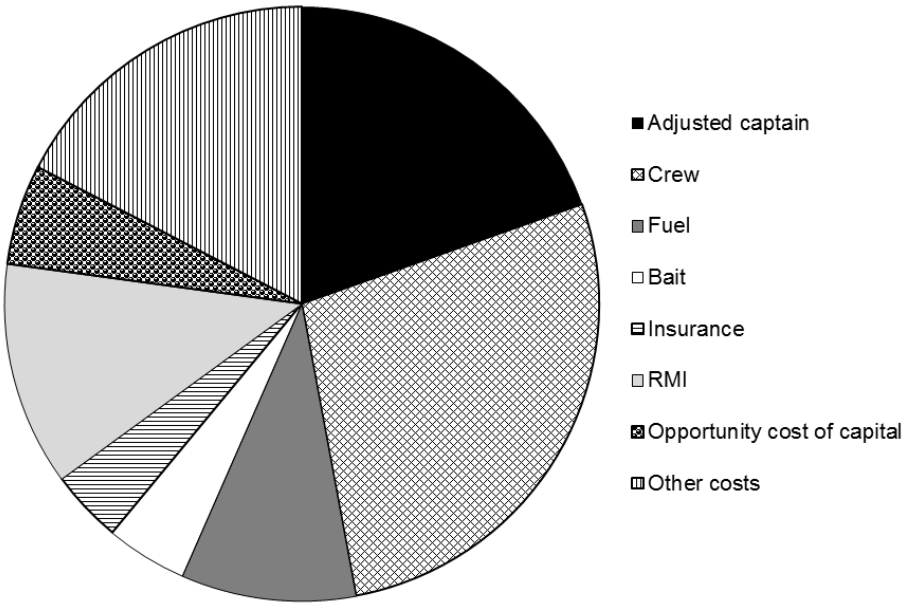

Figure 2. Economic costs in 2008 for the fixed gear fleet. RMI = repair, maintenance, and improvements. "Other costs" include ice, interest, moorage, dues, enforcement, permit leasing, permit purchasing, landings taxes, buyback fees, and food.

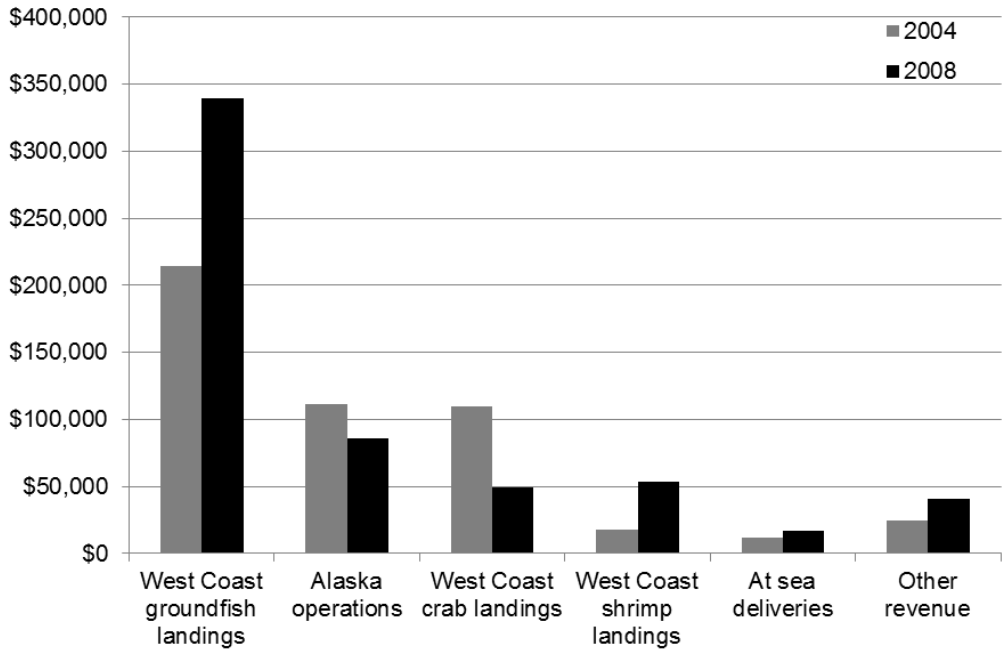

Figure 3. Revenue per vessel in 2004 and 2008 for the trawl fleet.

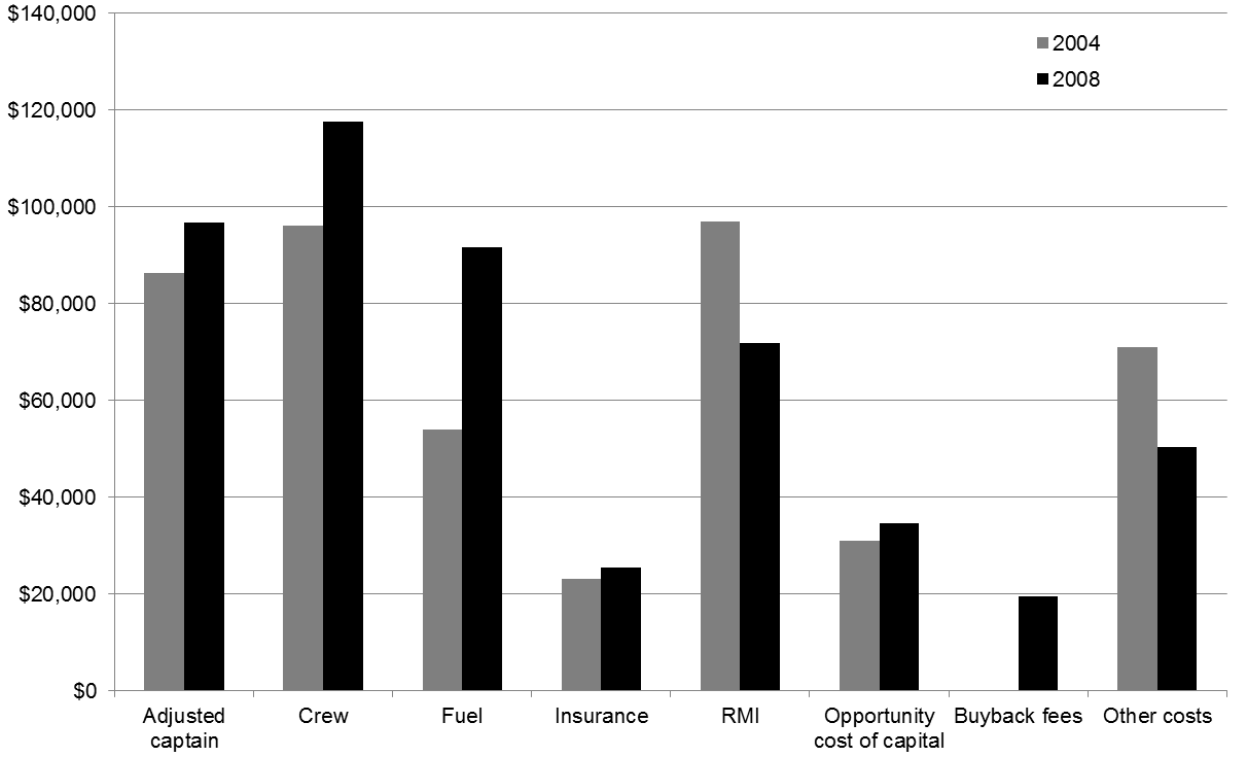

Figure 4. Economic costs per vessel in 2004 and 2008 for the trawl fleet. Economic costs are shown on a per vessel basis. RMI = repair, maintenance, and improvements. "Other costs" include bait, ice, interest, moorage, dues, enforcement, permit leasing, permit purchasing, landings taxes, and food.

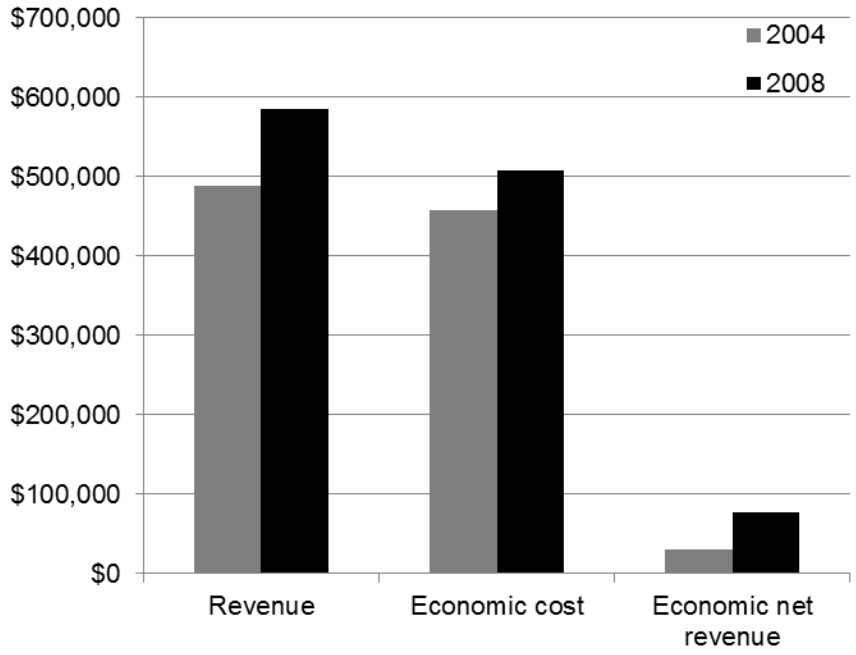

Figure 5. Economic net revenue per vessel in 2004 and 2008 for the trawl fleet.

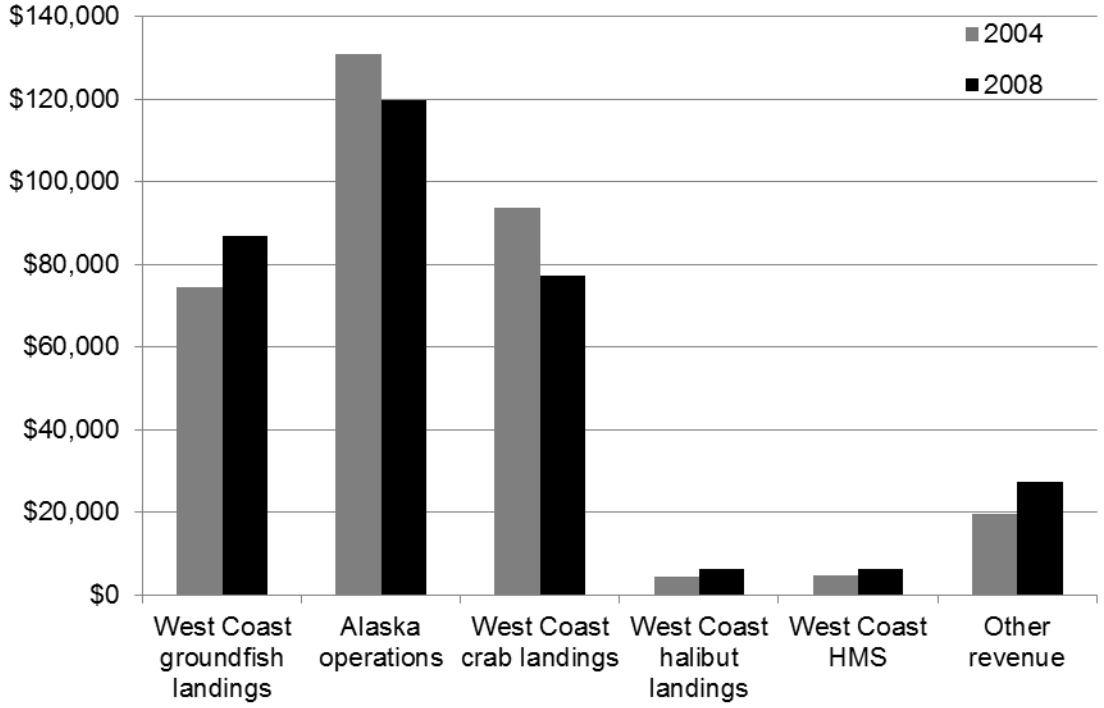

Figure 6. Revenue per vessel in 2004 and 2008 for the fixed gear fleet.

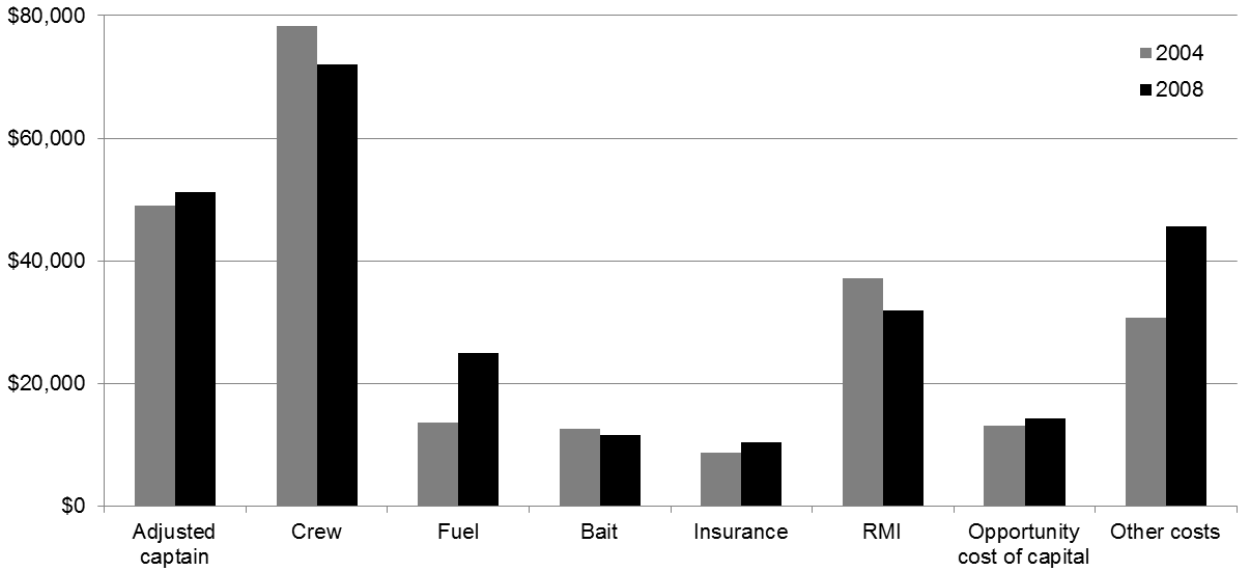

Figure 7. Economic costs per vessel in 2004 and 2008 for the fixed gear fleet. Economic costs are shown on a per vessel basis. RMI = repair, maintenance, and improvements. "Other costs" include ice, interest, moorage, dues, enforcement, permit leasing, permit purchasing, landings taxes, buyback fees, and food.

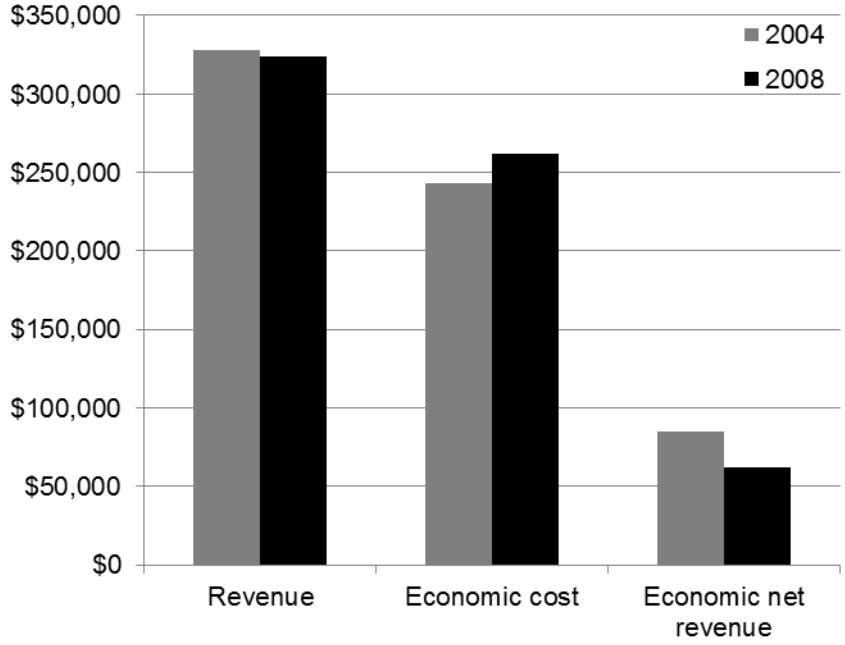

Figure 8. Economic net revenue per vessel in 2004 and 2008 for the fixed gear fleet.

Tables 1–35

Table 1. Summary of survey response by vessel type, state, and revenue.

	Survey population	Complete responses	Response rate (%)
Total survey	255	123	48
Limited entry trawlers	127	73	57
Limited entry fixed gear	128	50	39
Trawl vessel type			
Alaska	14	6	43
Crabber	9	3	33
Large groundfish trawler	83	52	63
Shrimper	4	3	75
Whiting	12	8	67
Other	5	1	20
Fixed gear vessel type			
Alaska	12	9	75
Crabber	17	9	53
Other groundfish fixed gear	34	8	24
Other < $15,000	5	2	40
Sablefish fixed gear	59	22	37
Other	1	0	0
Trawl by state			
California	36	22	61
Oregon	79	46	58
Washington	12	5	42
Fixed gear by state			
California	61	18	30
Oregon	37	18	49
Washington	30	14	47
Trawler by annual WOC landings revenue			
<$100,000	10	3	30
$100,000 to $500,000	69	39	57
>$500,000	48	31	65
Fixed gear by annual WOC landings revenue			
<$100,000	62	17	27
$100,000 to $500,000	59	30	51
>$500,000	7	3	43

Table 2. Comparison of vessel physical characteristics and revenue sources for all trawler respondents and nonrespondents.

Variable	Response status	Number of observations	Mean	Standard error
Engine horsepower	All	116	439	23
	Respondents	72	436	23
	Nonrespondents	44	445	46
Vessel length (feet)	All	127	66	1
	Respondents	73	66	2
	Nonrespondents	54	66	2
Revenue from crab (US$)	All	127	45,250	7,728
	Respondents	73	48,909	11,973
	Nonrespondents	54	40,304	8,356
Revenue from groundfish (US$)	All	127	325,652	20,773
	Respondents	73	339,504	25,365
	Nonrespondents	54	306,926	34,922
Revenue from all species (US$)	All	127	435,700	24,837
	Respondents	73	451,877	31,567
	Nonrespondents	54	413,832	40,042

Table 3. Comparison of vessel physical characteristics and revenue sources for Alaska trawler respondents and nonrespondents.

Variable	Response status	Number of observations	Mean	Standard error
Engine horsepower	All	12	725	120
	Respondents	6	650	117
	Nonrespondents	6	801	218
Vessel length (feet)	All	14	88	2
	Respondents	6	88	3
	Nonrespondents	8	89	3
Revenue from crab (US$)	All	14	17,779	12,144
	Respondents	6	18,733	18,733
	Nonrespondents	8	17,063	17,063
Revenue from groundfish (US$)	All	14	419,761	74,953
	Respondents	6	396,230	87,049
	Nonrespondents	8	437,410	118,723
Revenue from all species (US$)	All	14	439,529	82,756
	Respondents	6	416,584	89,016
	Nonrespondents	8	456,737	133,843

Table 4. Comparison of vessel physical characteristics and revenue sources for trawl crabber fleet respondents and nonrespondents.

Variable	Response status	Number of observations	Mean	Standard error
Engine horsepower	All	9	228	26
	Respondents	3	298	51
	Nonrespondents	6	193	21
Vessel length (feet)	All	9	43	2
	Respondents	3	46	5
	Nonrespondents	6	41	3
Revenue from crab (US$)	All	9	126,841	25,134
	Respondents	3	155,636	56,502
	Nonrespondents	6	112,444	27,445
Revenue from groundfish (US$)	All	9	17,789	14,697
	Respondents	3	53,367	40,530
	Nonrespondents	6	0	0
Revenue from all species (US$)	All	9	162,651	47,713
	Respondents	3	259,718	126,801
	Nonrespondents	6	114,117	28,889

Table 5. Comparison of vessel physical characteristics and revenue sources for large groundfish trawler respondents and nonrespondents.

Variable	Response status	Number of observations	Mean	Standard error
Engine horsepower	All	77	385	18
	Respondents	52	385	22
	Nonrespondents	25	384	30
Vessel length (feet)	All	83	63	1
	Respondents	52	63	1
	Nonrespondents	31	62	2
Revenue from crab (US$)	All	83	36,107	7,072
	Respondents	52	35,596	9,401
	Nonrespondents	31	36,964	10,676
Revenue from groundfish (US$)	All	83	317,738	17,207
	Respondents	52	318,879	23,757
	Nonrespondents	31	315,824	23,603
Revenue from all species (US$)	All	83	424,719	22,626
	Respondents	52	415,266	29,467
	Nonrespondents	31	440,575	35,458

Table 6. Comparison of vessel physical characteristics and revenue sources for trawl shoreside whiting vessel respondents and nonrespondents.

Variable	Response status	Number of observations	Mean	Standard error
Engine horsepower	All	12	695	61
	Respondents	8	663	34
	Nonrespondents	4	758	184
Vessel length (feet)	All	12	80	3
	Respondents	8	77	2
	Nonrespondents	4	85	7
Revenue from crab (US$)	All	12	90,185	55,832
	Respondents	8	122,564	82,219
	Nonrespondents	4	25,429	25,426
Revenue from groundfish (US$)	All	12	680,087	74,921
	Respondents	8	655,110	75,998
	Nonrespondents	4	730,040	183,151
Revenue from all species (US$)	All	12	801,368	107,555
	Respondents	8	813,965	142,417
	Nonrespondents	4	776,175	179,666

Table 7. Comparison of vessel physical characteristics and revenue sources for trawl shrimper fleet respondents and nonrespondents.

Variable	Response status	Number of observations	Mean	Standard error
Engine horsepower	All	2	†*	†
	Respondents	2	†	†
	Nonrespondents	0	—	—
Vessel length (feet)	All	4	†	†
	Respondents	3	69	9
	Nonrespondents	1	†	—
Revenue from crab (US$)	All	4	†	†
	Respondents	3	52,330	52,330
	Nonrespondents	1	†	—
Revenue from groundfish (US$)	All	4	†	†
	Respondents	3	135,869	43,184
	Nonrespondents	1	†	—
Revenue from all species (US$)	All	4	†	†
	Respondents	3	516,955	95,996
	Nonrespondents	1	†	—

* The dagger (†) indicates value not provided because of confidentiality restrictions when fewer than three respondents.

Table 8. Comparison of vessel physical characteristics and revenue sources for fixed gear vessel respondents and nonrespondents.

Variable	Response status	Number of observations	Mean	Standard error
Engine horsepower	All	105	256	18
	Respondents	48	292	24
	Nonrespondents	57	226	26
Vessel length (feet)	All	128	40	1
	Respondents	50	45	2
	Nonrespondents	78	37	1
Revenue from crab (US$)	All	128	63,440	10,250
	Respondents	50	91,287	18,360
	Nonrespondents	78	45,590	11,674
Revenue from groundfish (US$)	All	128	89,569	6,399
	Respondents	50	90,673	10,515
	Nonrespondents	78	88,862	8,106
Revenue from all species (US$)	All	128	168,914	16,656
	Respondents	50	202,637	29,084
	Nonrespondents	78	147,296	19,756

Table 9. Comparison of vessel physical characteristics and revenue sources for fixed gear Alaska vessel respondents and nonrespondents.

Variable	Response status	Number of observations	Mean	Standard error
Engine horsepower	All	12	407	57
	Respondents	9	444	72
	Nonrespondents	3	297	32
Vessel length (feet)	All	12	64	4
	Respondents	9	66	5
	Nonrespondents	3	58	3
Revenue from crab (US$)	All	12	82,566	36,735
	Respondents	9	94,065	47,067
	Nonrespondents	3	48,068	48,068
Revenue from groundfish (US$)	All	12	124,412	21,049
	Respondents	9	110,062	18,744
	Nonrespondents	3	167,464	65,538
Revenue from all species (US$)	All	12	215,765	48,316
	Respondents	9	212,304	57,591
	Nonrespondents	3	226,147	107,168

Table 10. Comparison of vessel physical characteristics and revenue sources for fixed gear crabber fleet respondents and nonrespondents.

Variable	Response status	Number of observations	Mean	Standard error
Engine horsepower	All	12	399	94
	Respondents	8	341	65
	Nonrespondents	4	515	266
Vessel length (feet)	All	17	49	3
	Respondents	9	47	3
	Nonrespondents	8	51	5
Revenue from crab (US$)	All	17	221,035	40,223
	Respondents	9	231,156	58,087
	Nonrespondents	8	209,649	59,037
Revenue from groundfish (US$)	All	17	91,775	28,951
	Respondents	9	59,500	19,266
	Nonrespondents	8	128,085	56,905
Revenue from all species (US$)	All	17	354,732	72,369
	Respondents	9	325,812	86,925
	Nonrespondents	8	387,268	124,249

Table 11. Comparison of vessel physical characteristics and revenue sources for fixed gear other groundfish fleet respondents and nonrespondents.

Variable	Response status	Number of observations	Mean	Standard error
Engine horsepower	All	32	222	12
	Respondents	8	214	34
	Nonrespondents	24	225	12
Vessel length (feet)	All	34	28	1
	Respondents	8	29	4
	Nonrespondents	26	28	1
Revenue from crab (US$)	All	34	12,940	5,618
	Respondents	8	29,039	17,888
	Nonrespondents	26	7,986	4,768
Revenue from groundfish (US$)	All	34	59,932	3,644
	Respondents	8	52,531	10,277
	Nonrespondents	26	62,210	3,597
Revenue from all species (US$)	All	34	77,069	7,691
	Respondents	8	89,420	24,845
	Nonrespondents	26	73,269	6,816

Table 12. Comparison of vessel physical characteristics and revenue sources for fixed gear "other less than $15,000" vessel respondents and nonrespondents.

Variable	Response status	Number of observations	Mean	Standard error
Engine horsepower	All	4	160	54
	Respondents	2	†*	†
	Nonrespondents	2	†	†
Vessel length (feet)	All	5	41	3
	Respondents	2	†	†
	Nonrespondents	3	†	†
Revenue from crab (US$)	All	5	2,108	1,448
	Respondents	2	†	†
	Nonrespondents	3	†	†
Revenue from groundfish (US$)	All	5	2,173	1,469
	Respondents	2	†	†
	Nonrespondents	3	†	†
Revenue from all species (US$)	All	5	5,998	2,308
	Respondents	2	†	†
	Nonrespondents	3	†	†

*The dagger (†) indicates value not provided because of confidentiality restrictions when fewer than three respondents.

Table 13. Comparison of vessel physical characteristics and revenue sources for fixed gear sablefish fleet respondents and nonrespondents.

Variable	Response status	Number of observations	Mean	Standard error
Engine horsepower	All	45	211	24
	Respondents	21	246	27
	Nonrespondents	24	180	37
Vessel length (feet)	All	59	40	1
	Respondents	22	42	2
	Nonrespondents	37	39	2
Revenue from crab (US$)	All	59	49,516	12,170
	Respondents	22	63,532	18,958
	Nonrespondents	37	41,183	15,832
Revenue from groundfish (US$)	All	59	107,754	8,633
	Respondents	22	117,271	18,520
	Nonrespondents	37	102,095	8,372
Revenue from all species (US$)	All	59	173,991	22,086
	Respondents	22	207,120	45,084
	Nonrespondents	37	154,292	22,788

Table 14. Two sample t-tests for statistical significance of differences between trawl fleet respondents and nonrespondents in five variables.

Fleet	Variable	T-statistic	Degrees of freedom	Probability > T if H0 true
Alaska	Vessel length	–0.26	12	0.80
	Engine horsepower	–0.61	8	0.56
	Revenue from groundfish	–0.28	12	0.78
	Revenue from crab	0.07	11	0.95
	Revenue from all species	–0.25	11	0.81
All trawlers	Vessel length	0.21	91	0.84
	Engine horsepower	–0.16	64	0.87
	Revenue from groundfish	0.75	103	0.45
	Revenue from crab	0.59	120	0.56
	Revenue from all species	0.75	109	0.46
Crabber	Vessel length	0.93	3	0.42
	Engine horsepower	1.91	3	0.16
	Revenue from groundfish	1.32	2	0.32
	Revenue from crab	0.69	3	0.54
	Revenue from all species	1.12	2	0.37
Lg. groundfish trawler	Vessel length	0.72	59	0.47
	Engine horsepower	0.00	50	1.00
	Revenue from groundfish	0.09	76	0.93
	Revenue from crab	–0.10	70	0.92
	Revenue from all species	–0.55	67	0.58
Shrimp	Vessel length	—	0	—
	Engine horsepower	—	0	—
	Revenue from groundfish	—	0	—
	Revenue from crab	—	0	—
	Revenue from all species	—	0	—
Whiting	Vessel length	–1.09	4	0.34
	Engine horsepower	–0.51	3	0.65
	Revenue from groundfish	–0.38	4	0.72
	Revenue from crab	1.13	8	0.29
	Revenue from all species	0.16	7	0.87

Table 15. Two sample t-tests for statistical significance of differences between fixed gear fleet respondents and nonrespondents in five variables.

Fleet	Variable	T-statistic	Degrees of freedom	Probability > T if H0 true
Alaska	Vessel length	1.58	10	0.15
	Engine horsepower	1.88	10	0.09
	Revenue from groundfish	–0.84	2	0.48
	Revenue from crab	0.68	6	0.52
	Revenue from all species	–0.11	3	0.92
All fixed gear	Vessel length	2.87	88	0.01
	Engine horsepower	1.89	103	0.06
	Revenue from groundfish	0.14	102	0.89
	Revenue from crab	2.10	88	0.04
	Revenue from all species	1.57	92	0.12
Crabber	Vessel length	–0.79	11	0.45
	Engine horsepower	–0.64	3	0.56
	Revenue from groundfish	–1.14	9	0.28
	Revenue from crab	0.26	15	0.80
	Revenue from all species	–0.41	13	0.69
Other < $15,000	Vessel length	†*	1	0.41
	Engine horsepower	†	1	0.44
	Revenue from groundfish	†	1	0.61
	Revenue from crab	†	1	0.61
	Revenue from all species	†	1	0.64
Other groundfish	Vessel length	†	9	0.92
	Engine horsepower	†	9	0.78
	Revenue from groundfish	†	9	0.40
	Revenue from crab	†	8	0.29
	Revenue from all species	†	8	0.55
Sablefish	Vessel length	1.09	43	0.28
	Engine horsepower	1.43	41	0.16
	Revenue from groundfish	0.75	30	0.46
	Revenue from crab	0.90	47	0.37
	Revenue from all species	1.05	32	0.30

* The dagger (†) indicates value not provided because of confidentiality restrictions when fewer than three respondents.

Table 16. Costs and earnings by category for trawl vessels.

Variable	Number of observations	Mean (US$)	Standard error (US$)
Cost of:			
Captain	70	92,682	5,472
Captain adjusted	73	96,788	5,204
Crew	73	117,552	6,915
Food	73	8,114	707
Fuel	72	91,741	6,464
Bait	69	4,361	762
Ice	72	5,405	403
Insurance	70	25,481	1,528
Interest payments	71	5,338	706
Moorage	70	4,122	340
Dues	67	3,022	552
Enforcement	70	3,649	439
Leasing permits	71	1,439	367
Purchasing permits	71	1,704	764
RMI[a]	70	71,885	5,180
Capital (imputed)	68	34,496	2,375
Other	69	11,970	1,907
Landings tax	73	1,225	184
Buyback tax	73	19,367	852
Revenue from:			
Alaska	72	85,648	23,636
Hawaii	73	0	0
Other sources	73	16,843	4,513
At sea deliveries	73	26,788	7,933
Salmon disaster fund	73	3,349	1,418
Sale/leasing of permits	73	534	341
All species[b]	73	451,877	20,692
Groundfish	73	339,504	16,627
Crab	73	48,909	7,848
Shrimp	73	53,332	8,741
Salmon	73	145	50
Pelagic	73	2,203	858
HMS[c]	73	593	207
Halibut	73	1,069	396

[a] RMI = repair, maintenance, and improvements.
[b] Groundfish, crab, shrimp, salmon, pelagic, HMS, and halibut do not represent 100% of species landed; as a result, the sum of revenue for these species is less than revenue reported for all species.
[c] HMS = highly migratory species.

Table 17. Costs and earnings by category for trawl Alaska vessels.

Variable	Number of observations	Mean (US$)	Standard error (US$)
Cost of:			
Captain	6	234,164	43,887
Captain adjusted	6	234,164	43,887
Crew	6	318,546	38,350
Food	6	21,372	7,688
Fuel	6	296,221	46,203
Bait	6	1,667	1,627
Ice	6	290	283
Insurance	6	60,909	7,526
Interest payments	6	833	814
Moorage	6	12,258	3,887
Dues	6	1,783	1,163
Enforcement	6	13,244	2,356
Leasing permits	6	0	0
Purchasing permits	6	0	0
RMI[a]	6	164,853	32,426
Capital (imputed)	6	78,333	12,646
Other	6	25,833	24,257
Buyback tax	6	19,915	4,249
Landings tax	6	657	137
Revenue from:			
Alaska	6	1,027,782	163,022
Hawaii	6	0	0
Other sources	6	36,667	35,797
At sea deliveries	6	263,761	91,874
Salmon disaster fund	6	0	0
Sale/leasing of permits	6	0	0
All species[b]	6	416,584	86,905
Groundfish	6	396,230	84,984
Crab	6	18,733	18,288
Shrimp	6	0	0
Salmon	6	275	205
Pelagic	6	883	388
HMS[c]	6	0	0
Halibut	6	59	57

[a] RMI = repair, maintenance, and improvements.
[b] Groundfish, crab, shrimp, salmon, pelagic, HMS, and halibut do not represent 100% of species landed; as a result, the sum of revenue for these species is less than revenue reported for all species.
[c] HMS = highly migratory species.

Table 18. Costs and earnings by category for trawl crabbers.

Variable	Number of observations	Mean (US$)	Standard error (US$)
Cost of:			
Captain	3	75,117	40,812
Captain adjusted	3	75,628	40,430
Crew	3	81,622	38,558
Food	3	1,647	1,038
Fuel	3	27,188	12,438
Bait	3	13,753	8,406
Ice	3	3,667	3,142
Insurance	3	3,333	3,294
Interest payments	3	1,817	1,578
Moorage	3	3,672	1,670
Dues	3	33	33
Enforcement	3	160	79
Leasing permits	3	0	0
Purchasing permits	3	0	0
RMI[a]	3	16,277	4,446
Capital (imputed)	3	16,667	6,588
Other	3	1,226	1,212
Buyback tax	3	6,452	4,931
Landings tax	3	374	198
Revenue from:			
Alaska	3	0	0
Hawaii	3	0	0
Other sources	3	9,707	9,593
At sea deliveries	3	0	0
Salmon disaster fund	3	17,667	16,480
Sale/leasing of permits	3	0	0
All species[b]	3	259,718	125,306
Groundfish	3	53,367	40,052
Crab	3	155,636	55,836
Shrimp	3	46,126	45,582
Salmon	3	0	0
Pelagic	3	552	546
HMS[c]	3	1,663	1,643
Halibut	3	2,294	1,317

[a] RMI = repair, maintenance, and improvements.
[b] Groundfish, crab, shrimp, salmon, pelagic, HMS, and halibut do not represent 100% of species landed; as a result, the sum of revenue for these species is less than revenue reported for all species.
[c] HMS = highly migratory species.

Table 19. Costs and earnings by category for large groundfish trawlers.

Variable	Number of observations	Mean (US$)	Standard error (US$)
Cost of:			
Captain	51	75,706	5,298
Captain adjusted	52	83,137	5,196
Crew	52	93,443	6,107
Food	52	6,316	441
Fuel	51	72,775	5,169
Bait	48	3,357	722
Ice	51	6,121	526
Insurance	49	20,062	1,367
Interest payments	50	4,920	681
Moorage	49	2,932	178
Dues	46	3,755	909
Enforcement	49	1,795	379
Leasing permits	50	2,043	603
Purchasing permits	50	2,308	1,271
RMI[a]	49	61,768	5,486
Capital (imputed)	48	23,917	1,129
Other	48	12,166	2,066
Buyback tax	52	18,267	1,018
Landings tax	52	929	96
Revenue from:			
Alaska	51	0	0
Hawaii	52	0	0
Other sources	52	16,912	6,689
At sea deliveries	52	0	0
Salmon disaster fund	52	3,644	2,226
Sale/leasing of permits	52	750	563
All species[b]	52	415,266	22,706
Groundfish	52	318,879	18,306
Crab	52	35,596	7,244
Shrimp	52	50,683	11,633
Salmon	52	27	20
Pelagic	52	1,875	1,357
HMS[c]	52	736	333
Halibut	52	719	435

[a] RMI = repair, maintenance, and improvements.
[b] Groundfish, crab, shrimp, salmon, pelagic, HMS, and halibut do not represent 100% of species landed; as a result, the sum of revenue for these species is less than revenue reported for all species.
[c] HMS = highly migratory species.

Table 20. Costs and earnings by category for trawl shoreside whiting vessels.

Variable	Number of observations	Mean (US$)	Standard error (US$)
Cost of:			
Captain	8	106,929	9,666
Captain adjusted	8	106,929	9,666
Crew	8	154,574	32,121
Food	8	14,280	5,202
Fuel	8	111,448	16,234
Bait	8	8,750	7,189
Ice	8	6,788	2,637
Insurance	8	46,901	5,067
Interest payments	8	14,693	6,913
Moorage	8	6,338	1,588
Dues	8	2,370	1,336
Enforcement	8	9,421	2,375
Leasing permits	8	0	0
Purchasing permits	8	695	673
RMI[a]	8	97,933	30,123
Capital (imputed)	8	73,438	17,207
Other	8	9,759	7,043
Buyback tax	8	33,369	3,785
Landings tax	8	4,197	2,209
Revenue from:			
Alaska	8	0	0
Hawaii	8	0	0
Other sources	8	8,750	8,472
At sea deliveries	8	46,624	45,143
Salmon disaster fund	8	0	0
Sale/leasing of permits	8	0	0
All species[b]	8	813,965	137,895
Groundfish	8	655,110	73,584
Crab	8	122,564	79,608
Shrimp	8	19,830	13,501
Salmon	8	943	599
Pelagic	8	7,047	3,017
HMS[c]	8	5	4
Halibut	8	30	19

[a] RMI = repair, maintenance, and improvements.
[b] Groundfish, crab, shrimp, salmon, pelagic, HMS, and halibut do not represent 100% of species landed; as a result, the sum of revenue for these species is less than revenue reported for all species.
[c] HMS = highly migratory species.

Table 21. Costs and earnings by category for trawl shrimpers.

Variable	Number of observations	Mean (US$)	Standard error (US$)
Cost of:			
Captain	3	70,497	25,196
Captain adjusted	3	80,888	15,521
Crew	3	104,515	22,280
Food	3	5,024	2,501
Fuel	3	42,726	10,137
Bait	3	6,000	5,929
Ice	3	3,333	1,647
Insurance	3	16,667	8,715
Interest payments	3	1,667	1,647
Moorage	3	1,800	1,195
Dues	3	0	0
Enforcement	3	3,973	2,981
Leasing permits	3	0	0
Purchasing permits	3	0	0
RMI[a]	3	55,804	23,531
Capital (imputed)	3	42,500	22,235
Other	3	1,003	991
Buyback tax	3	19,091	5,530
Landings tax	3	814	149
Revenue from:			
Alaska	3	0	0
Hawaii	3	0	0
Other sources	3	0	0
At sea deliveries	3	0	0
Salmon disaster fund	3	0	0
Sale/leasing of permits	3	0	0
All species[b]	3	516,955	94,865
Groundfish	3	135,869	42,675
Crab	3	52,330	51,713
Shrimp	3	320,246	101,578
Salmon	3	0	0
Pelagic	3	0	0
HMS[c]	3	0	0
Halibut	3	0	0

[a] RMI = repair, maintenance, and improvements.
[b] Groundfish, crab, shrimp, salmon, pelagic, HMS, and halibut do not represent 100% of species landed; as a result, the sum of revenue for these species is less than revenue reported for all species.
[c] HMS = highly migratory species.

Table 22. Costs and earnings by category for fixed gear vessels.

Variable	Number of observations	Mean (US$)	Standard error (US$)
Cost of:			
Captain	50	50,643	6,426
Captain adjusted	50	51,234	6,423
Crew	50	72,051	10,105
Food	50	5,720	808
Fuel	50	24,874	3,694
Bait	50	11,597	1,426
Ice	50	1,258	260
Insurance	50	10,388	1,458
Interest payments	50	6,207	1,362
Moorage	50	2,697	171
Dues	50	776	209
Enforcement	50	995	170
Leasing permits	50	8,662	3,098
Purchasing permits	50	13,894	6,180
RMI[a]	50	31,892	3,934
Capital (imputed)	50	14,281	1,544
Other	50	3,979	871
Landings tax	50	538	96
Buyback tax	50	850	197
Revenue from:			
Alaska	50	119,664	35,250
Hawaii	50	206	161
Other sources	50	4,788	1,723
At sea deliveries	50	0	0
Salmon disaster fund	50	14,697	3,530
Sale/leasing of permits	50	670	380
All species[b]	50	184,164	21,659
Groundfish	50	87,053	8,384
Crab	50	77,264	12,210
Shrimp	50	5,605	3,558
Salmon	50	555	234
Pelagic	50	322	246
HMS[c]	50	6,415	2,209
Halibut	50	6,461	1,735

[a] RMI = repair, maintenance, and improvements.
[b] Groundfish, crab, shrimp, salmon, pelagic, HMS, and halibut do not represent 100% of species landed; as a result, the sum of revenue for these species is less than revenue reported for all species.
[c] HMS = highly migratory species.

Table 23. Costs and earnings by category for fixed gear Alaska vessels.

Variable	Number of observations	Mean (US$)	Standard error (US$)
Cost of:			
Captain	9	215,111	30,487
Captain adjusted	9	241,069	31,116
Crew	9	317,000	66,894
Food	9	24,611	5,777
Fuel	9	114,444	22,627
Bait	9	35,944	3,173
Ice	9	2,900	1,624
Insurance	9	35,633	6,190
Interest payments	9	10,873	3,342
Moorage	9	5,478	978
Dues	9	2,411	1,269
Enforcement	9	2,591	879
Leasing permits	9	32,444	20,702
Purchasing permits	9	91,667	62,498
RMI[a]	9	97,129	16,718
Capital (imputed)	9	36,389	9,792
Other	9	4,467	2,328
Landings tax	9	1,030	197
Buyback tax	9	517	250
Revenue from:			
Alaska	9	1,266,444	212,455
Hawaii	9	0	0
Other sources	9	0	0
At sea deliveries	9	0	0
Salmon disaster fund	9	0	0
Sale/leasing of permits	9	0	0
All species[b]	9	212,304	55,529
Groundfish	9	110,062	18,073
Crab	9	94,065	45,382
Shrimp	9	0	0
Salmon	9	0	0
Pelagic	9	0	0
HMS[c]	9	0	0
Halibut	9	4,866	1,694

[a] RMI = repair, maintenance, and improvements.
[b] Groundfish, crab, shrimp, salmon, pelagic, HMS, and halibut do not represent 100% of species landed; as a result, the sum of revenue for these species is less than revenue reported for all species.
[c] HMS = highly migratory species.

Table 24. Costs and earnings by category for fixed gear crabbers.

Variable	Number of observations	Mean (US$)	Standard error (US$)
Cost of:			
Captain	9	58,222	13,713
Captain adjusted	9	59,547	13,736
Crew	9	88,758	28,779
Food	9	5,741	1,202
Fuel	9	32,834	9,177
Bait	9	12,190	3,542
Ice	9	1,928	949
Insurance	9	17,801	3,510
Interest payments	9	5,383	4,223
Moorage	9	2,389	376
Dues	9	264	255
Enforcement	9	2,117	1,048
Leasing permits	9	1,326	1,278
Purchasing permits	9	33,333	32,140
RMI[a]	9	54,578	17,195
Capital (imputed)	9	20,750	7,338
Other	9	13,127	6,170
Landings tax	9	831	538
Buyback tax	9	2,161	791
Revenue from:			
Alaska	9	0	0
Hawaii	9	0	0
Other sources	9	6,667	6,428
At sea deliveries	9	0	0
Salmon disaster fund	9	28,111	12,655
Sale/leasing of permits	9	3,111	3,000
All species[b]	9	325,812	83,814
Groundfish	9	59,500	18,576
Crab	9	231,156	56,007
Shrimp	9	948	914
Salmon	9	0	0
Pelagic	9	0	0
HMS[c]	9	30,894	15,968
Halibut	9	3,226	1,619

[a] RMI = repair, maintenance, and improvements.
[b] Groundfish, crab, shrimp, salmon, pelagic, HMS, and halibut do not represent 100% of species landed; as a result, the sum of revenue for these species is less than revenue reported for all species.
[c] HMS = highly migratory species.

Table 25. Costs and earnings by category for other groundfish fixed gear vessels.

Variable	Number of observations	Mean (US$)	Standard error (US$)
Cost of:			
Captain	8	13,725	2,531
Captain adjusted	8	14,845	3,406
Crew	8	22,375	4,349
Food	8	1,988	666
Fuel	8	7,162	1,673
Bait	8	6,347	2,024
Ice	8	625	205
Insurance	8	1,875	610
Interest payments	8	3,307	1,885
Moorage	8	1,875	282
Dues	8	63	31
Enforcement	8	498	206
Leasing permits	8	750	726
Purchasing permits	8	0	0
RMI[a]	8	11,890	5,274
Capital (imputed)	8	7,319	612
Other	8	1,363	824
Landings tax	8	93	45
Buyback tax	8	197	105
Revenue from:			
Alaska	8	0	0
Hawaii	8	0	0
Other sources	8	0	0
At sea deliveries	8	0	0
Salmon disaster fund	8	2,000	1,936
Sale/leasing of permits	8	0	0
All species[b]	8	89,420	24,056
Groundfish	8	52,531	9,951
Crab	8	29,039	17,320
Shrimp	8	0	0
Salmon	8	63	61
Pelagic	8	1,194	1,155
HMS[c]	8	3,880	3,757
Halibut	8	2,562	1,367

[a] RMI = repair, maintenance, and improvements.
[b] Groundfish, crab, shrimp, salmon, pelagic, HMS, and halibut do not represent 100% of species landed; as a result, the sum of revenue for these species is less than revenue reported for all species.
[c] HMS = highly migratory species.

Table 26. Costs and earnings by category for fixed gear "other less than $15,000" vessels.

Variable	Number of observations	Mean (US$)	Standard error (US$)
Cost of:			
Captain	2	†[a]	†
Captain adjusted	2	†	†
Crew	2	†	†
Food	2	†	†
Fuel	2	†	†
Bait	2	†	†
Ice	2	†	†
Insurance	2	†	†
Interest payments	2	†	†
Moorage	2	†	†
Dues	2	†	†
Enforcement	2	†	†
Leasing permits	2	†	†
Purchasing permits	2	†	†
RMI[b]	2	†	†
Capital (imputed)	2	†	†
Other	2	†	†
Landings tax	2	†	†
Buyback tax	2	†	†
Revenue from:			
Alaska	2	†	†
Hawaii	2	†	†
Other sources	2	†	†
At sea deliveries	2	†	†
Salmon disaster fund	2	†	†
Sale/leasing of permits	2	†	†
All species[c]	2	†	†
Groundfish	2	†	†
Crab	2	†	†
Shrimp	2	†	†
Salmon	2	†	†
Pelagic	2	†	†
HMS[d]	2	†	†
Halibut	2	†	†

[a] The dagger (†) indicates value not provided because of confidentiality restrictions when fewer than three respondents.
[b] RMI = repair, maintenance, and improvements.
[c] Groundfish, crab, shrimp, salmon, pelagic, HMS, and halibut do not represent 100% of species landed; as a result, the sum of revenue for these species is less than revenue reported for all species.
[d] HMS = highly migratory species.

Table 27. Costs and earnings by category for fixed gear sablefish vessels.

Variable	Number of observations	Mean (US$)	Standard error (US$)
Cost of:			
Captain	22	40,464	7,162
Captain adjusted	22	40,690	7,158
Crew	22	52,024	9,099
Food	22	4,482	883
Fuel	22	16,605	3,978
Bait	22	10,444	2,653
Ice	22	1,189	490
Insurance	22	8,785	2,353
Interest payments	22	7,641	2,974
Moorage	22	2,694	261
Dues	22	1,051	433
Enforcement	22	697	200
Leasing permits	22	11,232	6,453
Purchasing permits	22	1,659	1,047
RMI[a]	22	25,953	4,830
Capital (imputed)	22	12,357	1,927
Other	22	2,986	966
Landings tax	22	654	164
Buyback tax	22	987	414
Revenue from:			
Alaska	22	0	0
Hawaii	22	443	403
Other sources	22	8,259	3,857
At sea deliveries	22	0	0
Salmon disaster fund	22	22,173	7,597
Sale/leasing of permits	22	545	496
All species[b]	22	207,120	41,027
Groundfish	22	117,271	16,854
Crab	22	63,532	17,252
Shrimp	22	11,791	8,873
Salmon	22	1,072	571
Pelagic	22	5	4
HMS[c]	22	2,672	2,077
Halibut	22	10,513	4,153

[a] RMI = repair, maintenance, and improvements.
[b] Groundfish, crab, shrimp, salmon, pelagic, HMS, and halibut do not represent 100% of species landed; as a result, the sum of revenue for these species is less than revenue reported for all species.
[c] HMS = highly migratory species.

Table 28. Revenue, costs, and net revenue (in US$) for the trawl fleet.[a]

Fleet	Revenue all sources	Reported cost	Accounting net revenue	Economic cost	Economic net revenue
Alaska	1,744,793	1,172,545	572,248	1,250,878	493,915
All	585,041	469,058	115,983	507,660	77,381
Crab	287,092	236,338	50,754	253,515	33,577
Lg. groundfish trawler	436,572	388,663	47,909	420,010	16,562
Shrimp	516,955	332,913	184,042	385,804	131,150
Whiting	869,338	628,444	240,895	701,881	167,457

Table 29. Revenue, costs, and net revenue (in US$) for the fixed gear fleet.[a]

Fleet	Revenue all sources	Reported cost	Accounting net revenue	Economic cost	Economic net revenue
Alaska	1,478,749	994,251	484,498	1,056,598	422,151
All	324,189	247,003	77,185	271,876	52,313
Crab	363,700	332,985	30,716	355,059	8,641
Other < $15,000	†[b]	†	†	†	†
Other groundfish	91,420	74,129	17,290	82,568	8,851
Sablefish	238,540	189,547	48,993	202,130	36,410

[a] For Table 28 and Table 29, values are rounded to the nearest dollar. Revenue all sources includes landings, at sea deliveries, sale and leasing of permits, salmon disaster payments, and any other sources. Reported cost provides the total of all cost categories as collected by the survey. Accounting net revenue is the difference between Revenue all sources and Reported cost. Economic cost makes three adjustments to the Reported cost figure to get closer to a measure of economic opportunity cost: 1) a minimum captain payment equal to 15% of revenue from landings and at sea deliveries is imposed to compensate for some vessels not making an explicit salary payment to the owner-captain for his or her provision of captains services, 2) capital costs are estimated to equal 5% of the reported market value of the vessel, and 3) costs are increased by 5% to account for those costs that were not included in the cost categories collected by the survey instrument. Economic net revenue equals Revenue all sources minus Economic cost.

[b] The dagger (†) indicates value not provided because of confidentiality restrictions when fewer than three respondents.

Table 30. Trawl fleet crew size, fuel use (gallons per hour), and speed (knots per hour).

Fleet	Variable	Number of observations	Mean	Standard error
Alaska	Crew size for crabbing	1	†*	—
	Crew size for shrimp trawling	0	—	—
	Crew size for groundfish trawling	6	2.7	0.2
	Fuel use for crabbing	1	†	—
	Fuel use for shrimp trawling	0	—	—
	Fuel use for groundfish trawling	6	44.3	1.9
	Fuel use for steaming full	6	34.5	2.2
	Fuel use for steaming empty	6	29.5	3.9
	Speed when crabbing	1	†	†
	Speed when shrimp trawling	0	—	—
	Speed when groundfish trawling	6	3.5	0.1
All trawlers	Crew size for crabbing	31	2.8	0.1
	Crew size for shrimp trawling	36	2.0	0.0
	Crew size for groundfish trawling	72	2.0	0.0
	Fuel use for crabbing	28	8.3	0.5
	Fuel use for shrimp trawling	38	11.7	0.9
	Fuel use for groundfish trawling	68	17.1	1.0
	Fuel use for steaming full	65	14.6	0.8
	Fuel use for steaming empty	63	13.7	0.7
	Speed when crabbing	28	2.7	0.1
	Speed when shrimp trawling	36	2.2	0.1
	Speed when groundfish trawling	71	2.6	0.1
Crabber	Crew size for crabbing	3	2.3	0.3
	Crew size for shrimp trawling	2	†	†
	Crew size for groundfish trawling	3	1.3	0.3
	Fuel use for crabbing	2	†	†
	Fuel use for shrimp trawling	2	†	†
	Fuel use for groundfish trawling	2	†	†
	Fuel use for steaming full	2	†	†
	Fuel use for steaming empty	2	†	†
	Speed when crabbing	2	†	†
	Speed when shrimp trawling	2	†	†
	Speed when groundfish trawling	3	2.3	0.1
	Speed when trolling	2	†	†
Lg. groundfish trawler	Crew size for crabbing	23	2.7	0.1
	Crew size for shrimp trawling	29	2.0	0.0
	Crew size for groundfish trawling	52	1.9	0.0
	Crew size for salmon trolling	13	1.5	0.1
	Fuel use for crabbing	20	7.7	0.5
	Fuel use for shrimp trawling	28	10.7	0.7
	Fuel use for groundfish trawling	48	12.1	0.7
	Fuel use for steaming full	45	11.2	0.6
	Fuel use for steaming empty	43	10.5	0.5
	Speed when crabbing	20	2.7	0.2

Table 30 continued. Trawl fleet crew size, fuel use (gallons per hour), and speed (knots per hour).

Fleet	Variable	Number of observations	Mean	Standard error
Lg. groundfish trawler (continued)	Speed when shrimp trawling	29	2.3	0.2
	Speed when groundfish trawling	50	2.5	0.1
	Speed when trolling	13	4.1	0.5
Shrimp	Crew size for crabbing	1	†	—
	Crew size for shrimp trawling	3	2.3	0.3
	Crew size for groundfish trawling	3	2.3	0.3
	Crew size for salmon trolling	1	†	—
	Fuel use for crabbing	1	†	—
	Fuel use for shrimp trawling	3	17.0	3.8
	Fuel use for groundfish trawling	3	18.3	4.4
	Fuel use for steaming full	3	14.0	3.0
	Fuel use for steaming empty	3	14.0	3.0
	Speed when crabbing	1	2.0	—
	Speed when shrimp trawling	3	1.9	0.1
	Speed when groundfish trawling	3	2.2	0.1
	Speed when trolling	1	†	—
Whiting	Crew size for crabbing	3	3.7	0.3
	Crew size for shrimp trawling	2	†	†
	Crew size for groundfish trawling	8	2.3	0.2
	Crew size for salmon trolling	0	†	—
	Fuel use for crabbing	3	13.0	2.1
	Fuel use for shrimp trawling	2	†	—
	Fuel use for groundfish trawling	8	30.6	5.9
	Fuel use for steaming full	8	22.4	3.5
	Fuel use for steaming empty	8	21.6	3.7
	Speed when crabbing	3	2.0	0.6
	Speed when shrimp trawling	2	†	†
	Speed when groundfish trawling	8	2.9	0.3
	Speed when trolling	0	—	—

* The dagger (†) indicates value not provided because of confidentiality restrictions when fewer than three respondents.

Table 31. Fixed gear fleet crew size, fuel use (gallons per hour), and speed (knots per hour).

Fleet	Variable	Number of observations	Mean	Standard error
Alaska	Crew size for crabbing	3	4.0	0.6
	Crew size when longlining	9	4.2	0.4
	Crew size for salmon trolling	1	†*	—
	Fuel use for crabbing	1	†	—
	Fuel use when longlining	6	18.7	9.9
	Fuel use for salmon trolling	1	†	—
	Fuel use for steaming full	5	10.0	2.1
	Fuel use for steaming empty	5	9.8	2.1
	Speed when crabbing	3	2.8	0.9
	Speed when longlining	7	3.6	1.1
	Speed when salmon trolling	1	†	—
All fixed gear	Crew size for crabbing	28	2.4	0.2
	Crew size when longlining	44	2.5	0.2
	Crew size for salmon trolling	23	1.2	0.1
	Fuel use for crabbing	25	4.8	0.5
	Fuel use when longlining	43	5.9	1.2
	Fuel use for salmon trolling	25	3.6	0.4
	Fuel use for steaming full	42	7.8	0.7
	Fuel use for steaming empty	42	7.0	0.6
	Speed when crabbing	28	4.6	0.4
	Speed when longlining	44	4.7	0.5
	Speed when salmon trolling	26	3.8	0.3
Crabber	Crew size for crabbing	9	2.4	0.4
	Crew size when longlining	9	2.3	0.3
	Crew size for salmon trolling	5	1.4	0.2
	Fuel use for crabbing	8	6.2	1.4
	Fuel use when longlining	8	6.2	1.4
	Fuel use for salmon trolling	4	5.5	2.5
	Fuel use for steaming full	8	8.4	2.2
	Fuel use for steaming empty	8	8.2	1.9
	Speed when crabbing	8	4.8	0.7
	Speed when longlining	7	4.6	1.2
	Speed when salmon trolling	4	4.0	1.0
Other < $15,000	Crew size for crabbing	1	†	—
	Crew size when longlining	1	†	—
	Crew size for salmon trolling	1	†	—
	Fuel use for crabbing	1	†	—
	Fuel use when longlining	1	†	—
	Fuel use for salmon trolling	1	†	—
	Fuel use for steaming full	2	†	0.5
	Fuel use for steaming empty	2	†	0.5
	Speed when crabbing	1	†	—
	Speed when longlining	1	†	—
	Speed when salmon trolling	1	†	—

Table 31 continued. Fixed gear crew size, fuel use (gallons per hour), and speed (knots per hour).

Fleet	Variable	Number of observations	Mean	Standard error
Other groundfish	Crew size for crabbing	3	2.3	0.3
	Crew size when longlining	6	2.5	1.1
	Crew size for salmon trolling	3	1.7	0.3
	Fuel use for crabbing	2	†	0.4
	Fuel use when longlining	6	2.2	0.4
	Fuel use for salmon trolling	2	†	1.5
	Fuel use for steaming full	6	11.0	3.0
	Fuel use for steaming empty	6	10.6	3.2
	Speed when crabbing	3	2.2	0.7
	Speed when longlining	7	4.6	1.2
	Speed when salmon trolling	3	4.6	0.9
Sablefish	Crew size for crabbing	12	2.0	0.3
	Crew size when longlining	19	1.7	0.2
	Crew size for salmon trolling	13	1.0	0.0
	Fuel use for crabbing	13	4.2	0.7
	Fuel use when longlining	22	3.5	0.5
	Fuel use for salmon trolling	17	3.1	0.5
	Fuel use for steaming full	21	6.5	1.1
	Fuel use for steaming empty	21	5.1	0.7
	Speed when crabbing	13	5.7	0.6
	Speed when longlining	22	5.2	1.0
	Speed when salmon trolling	17	3.5	0.3

* The dagger (†) indicates value not provided because of confidentiality restrictions when fewer than three respondents.

Table 32. Trawl fleet share for captain, crew, and vessel.

Fleet	Variable	Number of observations	Mean (%)	Standard error
Alaska	Captain share without owner as captain	6	19.3	3.7
	Crew share without owner as captain	5	23.2	0.6
	Vessel share without owner as captain	6	61.3	0.8
	Captain share with owner as captain	3	15.7	0.9
	Crew share with owner as captain	4	27.0	3.6
	Vessel share with owner as captain	4	61.3	1.1
	Percent of trips with owner as captain	6	33.3	10.3
All trawlers	Captain share without owner as captain	51	19.1	0.7
	Crew share without owner as captain	51	22.5	0.7
	Vessel share without owner as captain	51	59.5	0.5
	Captain share with owner as captain	35	8.1	1.2
	Crew share with owner as captain	35	25.7	0.9
	Vessel share with owner as captain	35	66.2	1.1
	Percent of trips with owner as captain	73	35.5	3.4
Crabber	Captain share without owner as captain	0	—	—
	Crew share without owner as captain	1	†*	—
	Vessel share without owner as captain	1	†	—
	Captain share with owner as captain	2	†	†
	Crew share with owner as captain	2	†	†
	Vessel share with owner as captain	2	†	†
	Percent of trips with owner as captain	3	66.7	32.9
Lg. groundfish trawler	Captain share without owner as captain	33	19.5	1.0
	Crew share without owner as captain	32	23.4	1.0
	Vessel share without owner as captain	34	59.1	0.8
	Captain share with owner as captain	19	10.7	1.7
	Crew share with owner as captain	28	25.5	1.2
	Vessel share with owner as captain	28	67.3	1.6
	Percent of trips with owner as captain	52	39.7	4.9
Shrimp	Captain share without owner as captain	2	†	†
	Crew share without owner as captain	2	†	†
	Vessel share without owner as captain	2	†	†
	Captain share with owner as captain	0	—	—
	Crew share with owner as captain	0	—	—
	Vessel share with owner as captain	0	—	—
	Percent of trips with owner as captain	3	3.3	3.3
Whiting	Captain share without owner as captain	7	18.6	1.7
	Crew share without owner as captain	8	23.5	1.9
	Vessel share without owner as captain	8	60.3	2.0
	Captain share with owner as captain	1	†	—
	Crew share with owner as captain	1	†	—
	Vessel share with owner as captain	1	†	—
	Percent of trips with owner as captain	8	2.0	1.9

* The dagger (†) indicates value not provided because of confidentiality restrictions when fewer than three respondents.

Table 33. Fixed gear fleet share for captain, crew, and vessel.

Fleet	Variable	Number of observations	Mean (%)	Standard error
Alaska	Captain share without owner as captain	6	11.5	1.0
	Crew share without owner as captain	6	44.5	6.8
	Vessel share without owner as captain	6	44.0	6.3
	Captain share with owner as captain	6	13.2	7.9
	Crew share with owner as captain	7	48.9	10.6
	Vessel share with owner as captain	7	39.9	7.8
	Percent of trips with owner as captain	9	62.3	13.0
All fixed gear	Captain share without owner as captain	18	19.0	1.4
	Crew share without owner as captain	18	28.7	3.1
	Vessel share without owner as captain	18	52.3	2.4
	Captain share with owner as captain	23	16.0	2.8
	Crew share with owner as captain	37	30.7	2.3
	Vessel share with owner as captain	39	61.4	2.7
	Percent of trips with owner as captain	49	76.8	4.3
Crabber	Captain share without owner as captain	2	†*	†
	Crew share without owner as captain	2	†	†
	Vessel share without owner as captain	2	†	†
	Captain share with owner as captain	4	20.0	10.3
	Crew share with owner as captain	8	28.1	3.1
	Vessel share with owner as captain	8	61.9	7.3
	Percent of trips with owner as captain	8	99.1	0.6
Other < $15,000	Captain share without owner as captain	2	†	†
	Crew share without owner as captain	2	†	†
	Vessel share without owner as captain	2	†	†
	Captain share with owner as captain	1	†	—
	Crew share with owner as captain	1	†	—
	Vessel share with owner as captain	1	†	—
	Percent of trips with owner as captain	2	†	†
Other groundfish	Captain share without owner as captain	3	25.0	0.0
	Crew share without owner as captain	3	12.0	0.0
	Vessel share without owner as captain	3	63.0	0.0
	Captain share with owner as captain	3	23.3	1.6
	Crew share with owner as captain	3	24.0	8.1
	Vessel share with owner as captain	4	64.5	12.4
	Percent of trips with owner as captain	8	57.5	16.9
Sablefish	Captain share without owner as captain	5	24.4	3.6
	Crew share without owner as captain	5	19.0	3.3
	Vessel share without owner as captain	5	56.6	4.4
	Captain share with owner as captain	9	13.3	5.6
	Crew share with owner as captain	18	25.3	2.7
	Vessel share with owner as captain	19	69.7	3.4
	Percent of trips with owner as captain	22	84.9	6.7

* The dagger (†) indicates value not provided because of confidentiality restrictions when fewer than three respondents.

Table 34. Trawl fleet market value of vessel.

Fleet	Number of observations	Mean (US$)	Standard error (US$)
Alaska	6	1,466,667	252,914
All trawler	68	589,926	47,502
Crab	3	233,333	131,762
Lg. groundfish trawler	48	378,333	22,579
Shrimp	3	750,000	444,695
Whiting	8	1,368,750	344,148

Table 35. Fixed gear fleet market value of vessel.

Fleet	Number of observations	Mean (US$)	Standard error (US$)
Alaska	9	627,778	195,849
All fixed gear	49	246,449	43,624
Crab	9	315,000	146,757
Other < $15,000	2	†*	†
Other groundfish	8	46,375	12,238
Sablefish	21	147,143	38,538

* The dagger (†) indicates value not provided because of confidentiality restrictions when fewer than three respondents.

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Appendix A: Limited Entry Survey Questionnaire

Conducted by the National Marine Fisheries Service's Northwest Fisheries Science Center
and the Pacific States Marine Fisheries Commission

CONTACT INFORMATION FOR SURVEY RESPONDENT

1. Name: _____ 2. E-mail: _____

3. Date (month/day/year): _____ 4. Telephone: (____)_____

5. Mailing address (street, city, state, and zip code):

_____

VESSEL OWNERSHIP AND CHARACTERISTICS

6. Please verify the following information on record about your vessel's characteristics. If the information on record is correct, please place a check mark in the Corrections column. If the information on record is incorrect or there is no information on record, please provide the correct information in the Corrections column.

Item	Information on record	Corrections
a. Owner's name	*Charles Smith*	
b. Owner's address	*333 1st Street, Waldport, OR 97005*	
c. Vessel name	*FV Smith*	
d. USCG or state vessel ID	*33221843 or OR33214*	
e. Home port	*Newport, OR*	
f. Length (feet)	*75*	
g. Fuel capacity (gallons)	*300*	
h. Engine make and model	*No information on record*	
i. Engine horsepower	*380*	

7. What is the approximate market value of your vessel (not including associated permits) in dollars?

$_____

8. Please provide your vessel's fuel consumption, speed, and crew size (not including captain) when engaged in each of the following activities. If this vessel does not engage in an activity, please write "NA" in the appropriate columns.

Activity	Fuel consumption (gallons per hour)	Speed (knots per hour)	Crew size (not including captain)
a. Trawling (while towing)			
b. Longlining			
c. Shrimping (while towing)			
d. Crabbing			
e. Trolling			
f. Steaming (fully loaded)			Not applicable
g. Steaming (empty)			Not applicable

ANNUAL COSTS AND EARNINGS

Questions 9 through 11 collect information about this vessel's costs and earnings **while operating in all fisheries** (groundfish, crab, shrimp, salmon, etc.). This survey's primary objective is to collect data on costs and earnings for 2008. However, we recognize that conditions in the fishery change from year to year and that two years of data can provide a more complete picture than a one-year snapshot. If possible, we would appreciate receiving your cost and earnings data for both 2007 and 2008.

9. In what month does your vessel's fiscal year begin? _____

10. For each of the earnings (income) sources listed below, please indicate the income earned during your fiscal year 2007 and fiscal year 2008. If no income was earned from a particular source during a particular year, please write "NA" in the appropriate box.

Earnings (income) source	2007 ($)	2008 ($)
a. Landings in Alaska		
b. Landings outside the West Coast (Washington, Oregon, and California) and Alaska. Please do not include at sea deliveries, which are covered in part c of this question.		
c. West Coast at sea deliveries		
d. Sale and leasing of permits associated with this vessel		
e. Salmon disaster relief payments		
f. Other (please specify) _____		

11. For each cost category below, please provide total annual expenditures during your fiscal year 2007 and fiscal year 2008. If you do not have separate data on expenditures for captain (part a) and crew (part b), please write combined expenditures in part a and write "NA" in part b. If no expenditures were incurred in a particular category during a particular year, please write "NA" in the appropriate box. For location of expenditures, please indicate the location of expenditures as a percentage in the following location categories: HP = home port, HS = home state but not home port city, WC = West Coast (WA, OR, or CA) state but not home state, AK = Alaska, and US = United States outside of West Coast and Alaska. For crew expenditures please indicate the percent of crew that reside in each location category.

Cost (expenditure) category	**2007 ($)**	**2008 ($)**	**Location of expenditures (percent of total)**				
			HP	**HS**	**WC**	**AK**	**US**
a. Captain (include share payments, bonuses, other forms of compensation, and payroll taxes)							
b. Crew (include share payments, bonuses, other forms of compensation, and payroll taxes)							
c. Fuel and lube							
d. Food and crew provisions							
e. Ice							
f. Bait							
g. Repair, maintenance, and improvements for vessel, gear, and equipment							
h. Insurance							
i. Interest and financial services							
j. Enforcement and monitoring (include cost of observers and electronics such as cameras)							
k. Commission dues							
l. Moorage							
m. Purchase of permits for this vessel			Not applicable				
n. Leasing of permits for this vessel			Not applicable				
o. All other expenses for this vessel			Not applicable				

CREW COMPENSATION AND FUEL USE WHILE TARGETING GROUNDFISH

Questions 12 through 17 collect information about labor and fuel costs when this vessel is participating in the West Coast (Washington, Oregon, and California) **groundfish fisheries**.

12. Does this vessel use a crew share system to pay its crew when operating in West Coast **groundfish fisheries**?

a. Yes (proceed to question 13).
b. No (proceed to question 17).

13. Which of the following expenses were deducted from total revenue before calculating the crew share when this vessel operated in West Coast **groundfish fisheries**?

a.	Fuel and lube	Yes	No
b.	Food and other crew provisions.	Yes	No
c.	Landing taxes	Yes	No
d.	Unloading expenses	Yes	No
e.	Trucking expenses	Yes	No
f.	Other. Please specify _____	Yes	No

14. On what percent of fishing trips does the vessel owner serve as captain? _____%

15. On trips when the vessel owner serves as captain, please indicate the share of net revenue (revenue minus the deductions listed in question 13) going to the vessel, captain, and crew. If the vessel owner does not serve as captain on any trips, please circle NA.

Vessel share _____% Captain share _____% Crew share _____% NA

16. On trips when the vessel owner does not serve as captain, please indicate the share of net revenue (revenue minus the deductions listed in question 13) going to the vessel, captain, and crew. If the vessel owner always serves as captain, please circle NA.

Vessel share _____% Captain share _____% Crew share _____% NA

17. In order to understand how regulatory changes affect your vessel's per trip operating costs, we need to collect data on your fuel costs as well as your labor costs. For trips where this vessel targets flatfish, roundfish, and rockfish, please indicate the typical daily fuel use in gallons. If this vessel did not make any trips targeting a particular type of fish, please write "NA" in the appropriate space.

Rockfish _____ Roundfish _____ Flatfish _____

Survey Conclusion and Paperwork Reduction Act Statement

Thank you for participating in this survey. The information you have provided will improve studies of the economic performance and economic impact of the West Coast limited entry fisheries. The public reporting burden for this information collection, including time for gathering data needed and completing the survey with an interviewer, is estimated to average **one hour** per respondent. Any questions about this survey may be directed to either Carl Lian of the Northwest Fisheries Science Center (206-302-2414) or Dave Colpo of the Pacific States Marine Fisheries Commission (503-595-3100). This survey is conducted under OMB No. 0648-0369, which expires on April 30, 2010.

Recent NOAA Technical Memorandums
published by the
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NOAA Technical Memorandum NMFS-NWFSC-

120 **Pollock, M.M., J.M. Wheaton, N. Bouwes, C. Volk, N. Weber, and C.E. Jordan. 2012.** Working with beaver to restore salmon habitat in the Bridge Creek intensively monitored watershed: Design rationale and hypotheses. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-120, 47 p. NTIS number PB2013-101722.

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114 **Bradburn, M.J., A.A. Keller, and B.H. Horness. 2011.** The 2003 to 2008 U.S. West Coast bottom trawl surveys of groundfish resources off Washington, Oregon, and California: Estimates of distribution, abundance, length, and age composition. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-114, 323 p. NTIS number PB2012-105507.

113 **Ford, M.J. (ed.). 2011.** Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-113, 281 p. NTIS number PB2012-104687.

Most NOAA Technical Memorandums NMFS-NWFSC are available at the Northwest Fisheries Science Center Web site, http://www.nwfsc.noaa.gov

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

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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

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.

As it stands currently, the model is not in its anticipated state for use in the 2015-2016 groundfish harvest specifications process. Several data sources that the model uses will be revised between the time of this writing and when the model is used in the groundfish harvest specifications process. Further discussion of the planned data updates is contained below, but in brief the planed updates include incorporating data collected through the Economic Data Collection program (EDC), the 2011 Marine Recreational Expenditure Survey, the 2009 and 2010 Limited Entry Fixed Gear Survey, the 2011 and 2012 Open Access Survey. Additionally, the planned updates will include 2012 Pacific Fisheries Information Network (PacFIN) fish ticket data. Nevertheless, at the time of this writing, IO-PAC makes use of the most recent data available, and the updates made since the first version of IO-PAC, provide insight into how these upcoming data sources will be incorporated into the model.

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 2010. Three, the commercial vessel production functions incorporate the latest data from the voluntary Limited Entry and Open Access Surveys conducted by the Norwest Fisheries Science Center. Four, it incorporates data collected as part of the EDC program for first receivers and shorebased processors.

The addition of a recreational fishing component involves incorporating data collected on marine recreational expenditures (Gentner and Steinback, 2006), 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.

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 nonfishing 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.

3. PacFIN Data

The current update changes the fish-ticket data utilized by IO-PAC from 2006 to 2010. 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. For this project, PacFIN personnel supplied data on pounds landed and revenue received by species, gear type, and port in 2010. Table 1 provides of 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 employment[1].

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.

While the PacFIN data currently included in IO-PAC is from 2010, the data will be updated to 2012 prior to the use of the model for the 2015-2016 groundfish harvest specifications process. The model's usage for groundfish specifications is expected to occur around the end of 2013. Table 1 presents the timeframe of expected data changes. The table indicates that the PacFIN data is expected to change to 2012 in the third quarter of 2013.

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

Table 1. IO-PAC data sources and applications

	Open Access Survey (2009, 2008)	Limited Entry Trawl Survey (2007, 2008)	Limited Entry Fixed Gear Survey (2007, 2008)	Marine Rec. Exp. Survey (2006)	WA and OR Charter Vessel Survey (2006)	West Coast Charter Vessel Survey (2000)	EDC DATA (2010)
Data Year	2008	2008	2008	2006	2006	2000	2010
Expected Date	Current	Current	Current	Current	Current	Current	Current
Application							
Commercial Vessels							
Production Functions	X	X	X				
Vessel Industry Output					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 1 (continued horizontally). IO-PAC data sources and applications

	IMPLAN	PacFIN Fish Ticket	Limited Entry Fixed Gear Survey (2009, 2010)	Open Access Survey (2011, 2012)	EDC Data (2011)	PacFIN Fish Ticket
Data Year	2010	2010	2010	2011	2011	2012
Expected Date	Current	Current	2013 Q3	2013 Q3	2013 Q3	2013 Q3
Application						
Commercial Vessels						
Production Functions		X	X	X	X	X
Vessel Industry Output	X	X	X	X	X	X
Vessel Employment		X	X	X	X	X
Processors						
Production Functions	X				X	
Processor Industry Output	X	X			X	X
Processor Employment	X	X			X	X
Recreational Fishing						
Expenditures						
Charter Prod. Functions						
Charter Industry Output						
Charter Employment						
Non-Fishing Data	X					

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 for IO-PAC. Previously, the model relied solely on the voluntary limited entry trawl, limited entry fixed gear, and open access surveys for commercial fishery cost data. Currently, the commercial vessel production functions still rely exclusively on the most recent voluntary survey data. Following the schedule in Table 1, a transition will be made to the EDC data for limited-entry trawl, catcher processors, motherships and shorebased processors. For shorebased processors, processors, preliminary data from the EDC survey is already incorporated into IO-PAC.

4.1. Voluntary Cost-Earnings Surveys

The vessel production functions are currently using data from the most recent voluntary limited entry trawl survey, limited entry fixed gear survey, and open access survey. Since the first version of IO-PAC was completed, all three surveys have been reprised. The updated results have been incorporated into IO-PAC. 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 follows[2].

The survey population for the limited entry trawl survey consisted of all vessels with a limited entry trawl permit and at least $1,000 in landings in 2008. The survey collected information for 2007 and 2008 through in-person interviews. There were 73 completed responses out of a total of 127 vessels for a response rate of 57%. Using a modified version of the vessel classification scheme suggested by Radtke and Davis (2000), shown in Table 3, the

[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.

principle classification of respondents was large groundfish trawler, and other vessel classifications covered were Alaska, whiting, crabber and shrimper.

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 2008. This survey also collected information for 2007 and 2008, and used in-person interviews. There were 57 completed responses out of a total of 125 vessels for a response rate of 46%. 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. There were 1,098 vessels for which a telephone and address was obtainable. There were 437 completed responses for a response rate of 39.8% 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.

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 individual fishing quota (IFQ) program for the shorebased trawl fleet and cooperative programs for the at-sea mothership and catcher/processor 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 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.

Catcher/Processors - All owners, lessees, and charterers of a catcher processor vessel registered to a catcher/processor-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 inclusion of data collected through the EDC program in IO-PAC is currently underway. When fully implemented following the schedule in Table 1 the EDC data will be used for several purposes in IO-PAC. For the shoreside trawl catcher vessel fleet, the EDC data will replace the voluntary trawl survey data currently in use. Additionally, it will provide the first cost earnings data to permit the inclusion of the at-sea fleet (motherships and catcher processors) in the model. Lastly, it will provide 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 last of these purposes, is currently operational in 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. Consequently, improving the processor specification in IO-PAC was given priority.

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. Lastly, a recreational module is added to enable impact and contribution estimates of recreational fishing.

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 2. The classification rules for the commercial fleet are presented in Table 3. 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 2. 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 3. 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 (*Merluccius productus*) 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 [*Paralichthys californicus*]) 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 (*Panopea abrupta*), 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 4, 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 5.

Table 4. 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 5. 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 6. Landings are classified in the species/gear classifications even if species for particular gear types are considered bycatch.

Table 6. Landings by vessel type and commodity code, 2010 value ($).

IMPLAN code	Species and gear combinations	Vessel classification							
		509	510	511	512	513	514	515	516
529	Whiting, at sea	—	—						
530	Whiting, trawl	—	—	$4,651,749	$4,252,637	$819,717	$193,316		
531	Whiting, fixed gear	—	—						$91
532	Sablefish, trawl	—	—	$509,429	$306,187	$9,586,355	$58,540		
533	Sablefish, fixed gear	—	—	$1,882,378	$175,820	$318,032		$17,245,631	$390,801
534	Dover/thornyhead, trawl	—	—	$248,490	$256,511	$6,825,393	$33,886		
535	Dover/thornyhead, fixed gear	—	—	$7,761	$238	$4		$499,013	$1,459,018
536	Other groundfish, trawl	—	—	$219,327	$261,608	$7,171,143	$285,748	$431	$502
537	Other groundfish, fixed gear	—	—	$17,446	$266	$880	$691	$742,018	$1,778,712
538	Other groundfish, net	—	—			$1,478	$1,411	$0	
539	Crab, trawl	—	—			$550	$1,198		
540	Crab, fixed gear	—	—	$2,574,985	$335,784	$5,527,716	$44,282	$6,097,718	$706,010
541	Crab, net	—	—			$8,810	$3,380		
542	Crab, other gear	—	—					$4,878	$321
543	Shrimp, trawl	—	—	$297,531	$58,581	$3,205,428	$5,314	$4,773	
544	Shrimp, fixed gear	—	—					$21,169	
545	Salmon, trawl	—	—						
546	Salmon, fixed gear	—	—	$6,255		$18,449	$47,262	$905,142	$22,032
547	Salmon, net	—	—	$897,014		$132,135	$244	$497,963	$24,764
548	HMS, fixed gear	—	—	$56,973		$202,436	$10,298	$599,921	$113,702
549	HMS, net	—	—				$759		$143
550	CPS, trawl	—	—		$3,430				
551	CPS, fixed gear	—	—					$1,645	$1,206
552	CPS, net	—	—				$70		
553	CPS, other gear	—	—						
554	Halibut, trawl	—	—			$901,739	$293,171	$3,635	$38
555	Halibut, fixed gear	—	—	$1,538,448		$35,892	$11,043	$1,012,898	$2,736,461
556	Halibut, net	—	—			$92,185	$67,189		$212
557	Other species, trawl	—	—	$5,727	$2,642	$94,573	$58,817	$211	$1
558	Other species, fixed gear	—	—	$1,013		$554	$1,240	$82,822	$67,496
559	Other species, net	—	—	$1,707		$10,969	$62,545	$1,178	$8,046
560	Other species, other gear	—	—					$94,978	$184
	Total			**$12,916,233**	**$5,653,704**	**$34,954,438**	**$1,180,402**	**$27,816,025**	**$7,309,739**

Table 6 continued horizontally. Landings by vessel type and commodity code, 2010 value ($).

IMPLAN code	Species and gear combinations	Vessel classification						
		517	518	519	520	521	522	523
529	Whiting, at sea							
530	Whiting, trawl					$6,674		
531	Whiting, fixed gear							
532	Sablefish, trawl				$93,967	$49,187		
533	Sablefish, fixed gear	$145		$120,968	$71,041	$4,052,348	$75,375	$61,822
534	Dover/thornyhead, trawl				$140,366	$12,630		
535	Dover/thornyhead, fixed gear			$109	$3	$3,214	$424	$538
536	Other groundfish, trawl				$68,998	$239,975		
537	Other groundfish, fixed gear	$45		$12,611	$15,547	$165,632	$39,826	$1,881
538	Other groundfish, net	$660		$14	$738			$76
539	Crab, trawl				$995			
540	Crab, fixed gear	$562,560		$5,504,969	$5,708,325	$102,250,685	$49,369	$914,489
541	Crab, net	$185	$52					
542	Crab, other gear					$53,646	$4,557	
543	Shrimp, trawl			$50,232	$11,810,093	$345,734		$434
544	Shrimp, fixed gear				$4,222,313	$1,245,050		$170,607
545	Salmon, trawl							
546	Salmon, fixed gear			$932,428	$46	$2,447,369	$3,647,338	$182,066
547	Salmon, net	$1,569,625		$1,860	$59,222	$6,035,306	$108,360	$29,065,941
548	HMS, fixed gear	$54,673	$626	$23,936,734	$71,357	$4,099,394	$237,555	
549	HMS, net	$209	$5,040	$55,430	$5,853			
550	CPS, trawl				$35	$27		
551	CPS, fixed gear					$13		
552	CPS, net	$13,440,855				$55,673		$39,749
553	CPS, other gear							
554	Halibut, trawl				$36,803	$73,203		
555	Halibut, fixed gear	$392		$57,981	$64,248	$1,100,042	$146,846	$161,830
556	Halibut, net	$8,303	$29,675		$383			
557	Other species, trawl	$13,293			$108,068	$4,148		
558	Other species, fixed gear	$39,196	$3,929	$1,611,343	$877,854	$820,951	$394	$20
559	Other species, net	$71,143,799	$328,537	$191,171	$88,306	$185,773		$370,701
560	Other species, other gear		$298,467	$65,830	$892			
	Total	**$86,833,939**	**$666,325**	**$32,541,679**	**$23,445,453**	**$123,246,673**	**$4,310,045**	**$30,970,157**

Table 6 continued horizontally. Landings by vessel type and commodity code, 2010 value ($).

IMPLAN code	Species and gear combinations	Vessel classification					
		524	525	526	527	528	Total all classifications
529	Whiting, at sea						$0
530	Whiting, trawl					$11,016	$9,935,110
531	Whiting, fixed gear		$7			$13	$111
532	Sablefish, trawl			$2,060	$13,899		$10,619,625
533	Sablefish, fixed gear		$158,147	$65,808	$33,905	$431,702	$25,083,923
534	Dover/thornyhead, trawl			$52	$3,454		$7,520,781
535	Dover/thornyhead, fixed gear		$6,068	$1,048	$2,039	$4,939	$1,984,416
536	Other groundfish, trawl				$7,359	$15,967	$8,271,059
537	Other groundfish, fixed gear		$59,206	$9,714	$7,877	$712,117	$3,564,469
538	Other groundfish, net	$3,636			$71	$1,152	$9,235
539	Crab, trawl				$1,612		$4,355
540	Crab, fixed gear	$149,770	$438,579	$54,056	$253,599	$1,514,385	$132,687,282
541	Crab, net	$5,715	$188			$1,169	$19,497
542	Crab, other gear			$1,425	$40,616	$49,634	$155,077
543	Shrimp, trawl	$837			$101,290	$5,579	$15,885,826
544	Shrimp, fixed gear	$13,366	$60	$42	$6,480	$172,460	$5,851,547
545	Salmon, trawl						$0
546	Salmon, fixed gear				$72,491	$414,247	$8,695,124
547	Salmon, net	$58,444			$489,636	$1,916,609	$40,857,123
548	HMS, fixed gear	$645	$1,936	$252	$70,200	$322,656	$29,779,359
549	HMS, net	$7,675					$75,109
550	CPS, trawl						$3,491
551	CPS, fixed gear		$17		$10,178	$168	$13,227
552	CPS, net	$696	$34,432			$50,827	$13,622,302
553	CPS, other gear					$1	$1
554	Halibut, trawl	$15,391			$29,164	$23,300	$1,376,443
555	Halibut, fixed gear	$35,767	$173,358	$30,887	$44,708	$435,256	$7,586,057
556	Halibut, net	$168,020	$4,807			$24,870	$395,643
557	Other species, trawl	$203		$12,616	$263,883	$4,511	$568,692
558	Other species, fixed gear	$306,862	$9,897,530	$7,466	$2,440,575	$450,556	$16,609,802
559	Other species, net	$3,370,252	$74,503	$42	$142,203	$232,412	$76,212,145
560	Other species, other gear		$77,842	$7,919,127	$108,510,837	$429,818	$117,397,975
	Total	**$4,137,277**	**$10,926,681**	**$8,104,596**	**$112,546,073**	**$7,225,366**	**$534,784,804**

5.2. Commercial Catcher-Vessel Production Functions

The vessel production functions in IO-PAC rely on the 2008 data from the voluntary limited entry trawl, fixed gear, and open access surveys. Table 7 presents the vessel production functions included in IO-PAC. Because these voluntary surveys do not extend to the at-sea fishery, the mothership and catcher processor production functions are left blank at this time. The expenditure categories shown in Table 7 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.

5.3. Motherships and Catcher Processor Production Functions

The EDC is currently collecting data applicable to the at-sea fleet: motherships and catcher processors. Cost earnings surveys necessary to create production functions for these vessels were previously unavailable. These production functions will be assigned the EDC data following the schedule in Table 1.

Table 7. Percentage distribution of commercial fishing production functions by expenditure categories.

Expenditure categories (table continued horizontally below)	**Catcher processor**	**Mother-ship**	**Alaska**	**Pacific whiting trawler**	**Large groundfish trawler**	**Small groundfish trawler**	**Sablefish fixed gear**	**Other groundfish fixed gear**	**Migratory liner**	**Pelagic netter**
Captain	—	—	13.4	12.3	17.5	17.5	21.6	18.3	16.6	16.6
Crew	—	—	19.6	17.8	21.6	21.6	23.7	21.5	18.1	18.1
Fuel, lubricants	—	—	13.2	12.8	16.8	16.8	7.4	7.5	8.3	8.3
Food, crew provisions	—	—	1.4	1.6	1.5	1.5	2.0	1.9	1.2	1.2
Ice	—	—	0.1	0.8	1.4	1.4	1.2	1.1	0.7	0.7
Bait	—	—	0.8	1.0	0.8	0.8	4.4	4.3	2.8	2.8
Repair and maintenance: vessel, gear, equipment	—	—	8.7	11.3	14.3	14.3	10.7	12.4	10.4	10.4
Insurance	—	—	3.2	5.4	4.6	4.6	2.8	5.9	3.6	3.6
Interest and financial services	—	—	0.4	1.7	1.1	1.1	2.1	1.8	1.1	1.1
Purchases of permits	—	—	1.7	0.1	0.5	0.5	0.5	2.6	0.9	0.9
Leasing of permits	—	—	0.6	0.0	0.5	0.5	2.1	0.2	0.5	0.5
Moorage	—	—	0.8	0.7	0.7	0.7	2.4	1.6	1.2	1.2
Landings taxes	—	—	0.7	4.3	4.4	4.4	0.1	0.0	1.1	1.1
Enforcement	—	—	0.5	1.1	0.4	0.4	1.1	0.7	0.4	0.4
Dues	—	—	0.1	0.3	0.9	0.9	0.3	0.0	0.3	0.3
Freight Supplies	—	—	0.0	0.0	0.0	0.0	0.0	0.6	0.1	0.1
Offloading	—	—	0.0	0.0	0.0	0.0	0.0	1.0	0.2	0.2
Trucking	—	—	0.0	0.0	0.0	0.0	0.0	1.1	0.2	0.2
Other miscellaneous	—	—	1.1	1.1	2.8	2.8	2.4	6.7	4.7	4.7
Proprietary income	—	—	33.6	27.7	10.2	10.2	15.0	10.8	27.5	27.5
Total (%)			**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Table 7 continued horizontally. Percentage distribution of commercial fishing production functions by expenditure categories

Expenditure categories (column list repeated from above)	**Migratory netter**	**Shrimper**	**Crabber**	**Salmon troller**	**Salmon netter**	**Other netter**	**Lobster**	**Diver**	**Other >15,000**	**Other <15,000**
Captain	16.6	20.8	21.4	7.5	19.0	16.6	16.6	16.6	16.6	17.9
Crew	18.1	17.7	21.6	17.2	8.2	18.1	18.1	18.1	18.1	13.3
Fuel, lubricants	8.3	2.3	6.9	9.9	1.4	8.3	8.3	8.3	8.3	17.6
Food, crew provisions	1.2	13.4	1.1	3.0	4.3	1.2	1.2	1.2	1.2	3.6
Ice	0.7	1.2	0.4	0.3	0.0	0.7	0.7	0.7	0.7	1.0
Bait	2.8	2.2	4.4	0.2	0.0	2.8	2.8	2.8	2.8	2.7
Repair and maintenance: vessel, gear, and equipment	10.4	7.5	11.3	15.6	17.7	10.4	10.4	10.4	10.4	27.0
Insurance	3.6	4.4	4.2	5.0	2.2	3.6	3.6	3.6	3.6	4.7
Interest and financial services	1.1	0.0	1.0	3.1	0.0	1.1	1.1	1.1	1.1	0.6
Purchases of permits	0.9	0.0	1.2	3.2	0.2	0.9	0.9	0.9	0.9	5.9
Leasing of permits	0.5	0.0	0.4	0.3	0.3	0.5	0.5	0.5	0.5	0.3
Moorage	1.2	3.0	1.2	3.2	0.8	1.2	1.2	1.2	1.2	8.4
Landings taxes	1.1	1.2	0.1	0.0	1.0	1.1	1.1	1.1	1.1	0.0
Enforcement	0.4	0.3	0.1	0.3	0.0	0.4	0.4	0.4	0.4	0.7
Dues	0.3	0.2	0.2	0.8	0.5	0.3	0.3	0.3	0.3	0.8
Freight Supplies	0.1	0.4	0.1	0.0	0.0	0.1	0.1	0.1	0.1	0.0
Offloading	0.2	0.5	0.4	0.0	0.5	0.2	0.2	0.2	0.2	0.1
Trucking	0.2	0.0	0.2	0.6	1.7	0.2	0.2	0.2	0.2	1.1
Other miscellaneous	4.7	0.4	8.2	10.7	3.3	4.7	4.7	4.7	4.7	6.5
Proprietary income	27.5	24.4	15.6	19.1	38.9	27.5	27.5	27.5	27.5	-12.1
Total (%)	**100.0**	**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

5.4. Shoreside processor production functions and mark-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 8 by total revenue. The production function is built using 2010 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 8. Percentage distribution of processor production functions by expenditure categories.

Expenditure categories	Allocation Percent
Employee and Worker Payroll	14.02
Additives	0.22
Custom Processing	1.19
Electricity	1.31
Freight	0.57
Insurance	0.97
Natural Gas	0.34
Offsite storage and freezing	1.25
Packaging	3.99
Production Supplies	0.84
Propane	0.29
Rental or lease of buildings, job-site trailers, and other structures	0.89
Rental or lease of processing machinery or equipment	0.18
Repair and maintenance on facility buildings, machinery, and equipment	1.75
Sewer and Waste	0.31
Shoreside monitor	0.15
Water	0.65
Fish purchases	59.93
Other	1.99
Proprietary Income	9.15
Total (%)	**100.0**

Costs by category in Table 8 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 9. 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 9. 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 10. The markups were generated using 2010 EDC data. The markups shown on the basis of revenue earned by processors for every dollar spent on the respective species.

Table 10. IO-PAC processor markups by species group.

Expenditure categories	Markup
Whiting	3.63
Sablefish	1.61
Dover/thornyhead	2.33
Other groundfish	1.60
Crab	1.48
Shrimp	1.91
Salmon	1.28
HMS	1.16
CPS	2.23
Halibut	1.28

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 Gentner and Steinback (2008). Table 11 shows the recreational expenditures by type and mode.

Table 11. Estimated 2006 Recreational Expenditures by Mode (*Thousands of 2006 dollars*)

	California		Oregon		Washington		West Coast	
Expenditure Category	**Charter**	**Private**	**Charter**	**Private**	**Charter**	**Private**	**Charter**	**Private**
Access and Parking	771	995	21	173	8	59	800	1,227
Auto Rental	1,976	0	15	8	0	101	1,991	109
Bait	223	4,893	13	1,663	24	298	260	6,854
Boat and Equipment Rental	24	8,021	25	1,668	9	721	58	10,410
Boat Fuel	0	22,587	0	5,783	0	2,064	0	30,434
Catch Processing	157	0	24	324	70	7	251	331
Charter Crew Tips	4,355	0	191	0	353	0	4,899	0
Charter Fees	47,790	0	6,095	0	6,223	0	60,108	0
Food from Grocery Stores	6,084	10,846	526	4,764	828	948	7,438	16,558
Food from Restaurants	7,081	5,698	1,059	3,423	941	625	9,081	9,746
Gifts	2,244	1,243	268	650	266	105	2,778	1,998
Ice	892	1,602	50	666	56	126	998	2,394
Lodging	6,851	4,505	1,138	5,897	1,113	632	9,102	11,034
Private Transport	15,950	19,182	1,638	8,652	1,709	1,216	19,297	29,050
Public Transport	2,130	1,382	158	666	86	220	2,374	2,268
Tackle	12,039	16,010	90	4,388	132	895	12,261	21,293
Tournament Fees	1,643	250	3	62	110	72	1,756	384
Trip Total	110,210	97,214	11,316	38,786	11,929	8,087	133,455	144,087

Angler expenditures in Table 11 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 for West Coast charter and private boat anglers along with their associated IMPLAN and IO-PAC sectors are displayed in Table 12[4]. The percentages represent the proportion of total recreational expenditures by mode on each expenditure category. For example, for each dollar of spending on charter boat fishing on the West Coast, $0.45 is spent on charter fees and $0.068 is spent on lodging.

Table 12. West Coast Expenditure Vector by Mode and Associated IMPLAN/IO-PAC Sectors

	West Coast (%)		IMPLAN/IO-PAC Sector (Basis)
Expenditure Category	**Charter**	**Private**	
Access and Parking	0.6	0.9	Other amusement and recreation (Industry)
Auto Rental	1.5	0.1	Automotive equipment rental and leasing (Industry)
Bait	0.2	4.8	Animal production, except cattle and poultry and eggs (Commodity)
Boat and Equipment Rental	0.0	7.2	General and consumer goods rental (Industry)
Boat Fuel	0.0	21.1	Petroleum refineries (Commodity)
Catch Processing	0.2	0.2	Seafood product preparation and packaging (Industry)
Charter Crew Tips	3.7	0.0	Charter vessels (Industry)
Charter Fees	45.0	0.0	Charter vessels (Industry)
Food from Grocery Stores	5.6	11.5	Personal consumption expenditure vector 1111
Food from Restaurants	6.8	6.8	Food services and drinking places (Industry)
Gifts	2.1	1.4	All other miscellaneous manufacturing (Commodity)
Ice	0.7	1.7	Soft drink and ice manufacturing (Commodity)
Lodging	6.8	7.7	Hotels and motels, including casino hotels (Industry)
Private Transport	14.5	20.2	Petroleum refineries (Commodity)
Public Transport	1.8	1.6	Transit and ground passenger transportation (Industry)
Tackle	9.2	14.8	Sporting goods and athletic goods mfg. (Commodity)
Tournament Fees	1.3	0.3	Other amusement and recreation (Industry)

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 11 in conjunction with effort measured in number of trips obtained from Gentner and Steinback (2008). Expenditures by state were divided by trips to obtain state level mean expenditures per trip and mode. The mean expenditures by trip are then adjusted to meet the year of analysis by using Consumer Price Index data for the following goods and services: recreation, car rental, processed fish, motor fuel, food and beverages,

[4] The same procedure for charter and private boat anglers could be performed for shoreside anglers, which would enable economic impact estimates for this segment. This has not been done because there has not been a need, as yet, to make impact estimates for shoreside anglers.

sporting goods, lodging, private transportation, public transportation, and miscellaneous personal. Using mean expenditures by trip in conjunction with total recreational trip estimates yields expected changes in recreational spending.

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. It 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 Center[5]. 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 nonresponses. The effective sample was 53 vessels in Oregon and 35 vessels in Washington for a total survey response rate of 41%.

Total revenues estimated from the survey were adjusted by effort changes from 2006 to 2008 and were added to the model as total industry output. To bring estimated industry revenue to the 2008 base year of the revised IO-PAC model, effort changes of for-hire fishing trips from 2006 to 2008 from “Fisheries Economics of the United States 2009” were used. Total industry

[5] 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.

output was apportioned to value added and material components as displayed in Table 13 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, 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 13. 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 Domestic	6.6	Indirect Business Taxes
Taxes and Government Fees Foreign	0.0	Indirect Business Taxes
Commissions for Booking Agents	5.7	Travel arrangement and reservation services
Telephone and Other Communications	1.1	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 14.

Table 14. 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. The year 2000 estimate of industry output was then adjusted to 2008 by using effort changes of for-hire fishing trips in CA from 2000 to 2008 from Fisheries Economics of the United States 2009 (U.S. Dept. Commerce., 2011). Employment by charter vessels in CA was estimated by dividing total industry output in 2008 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.

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 individual fishing quota (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.

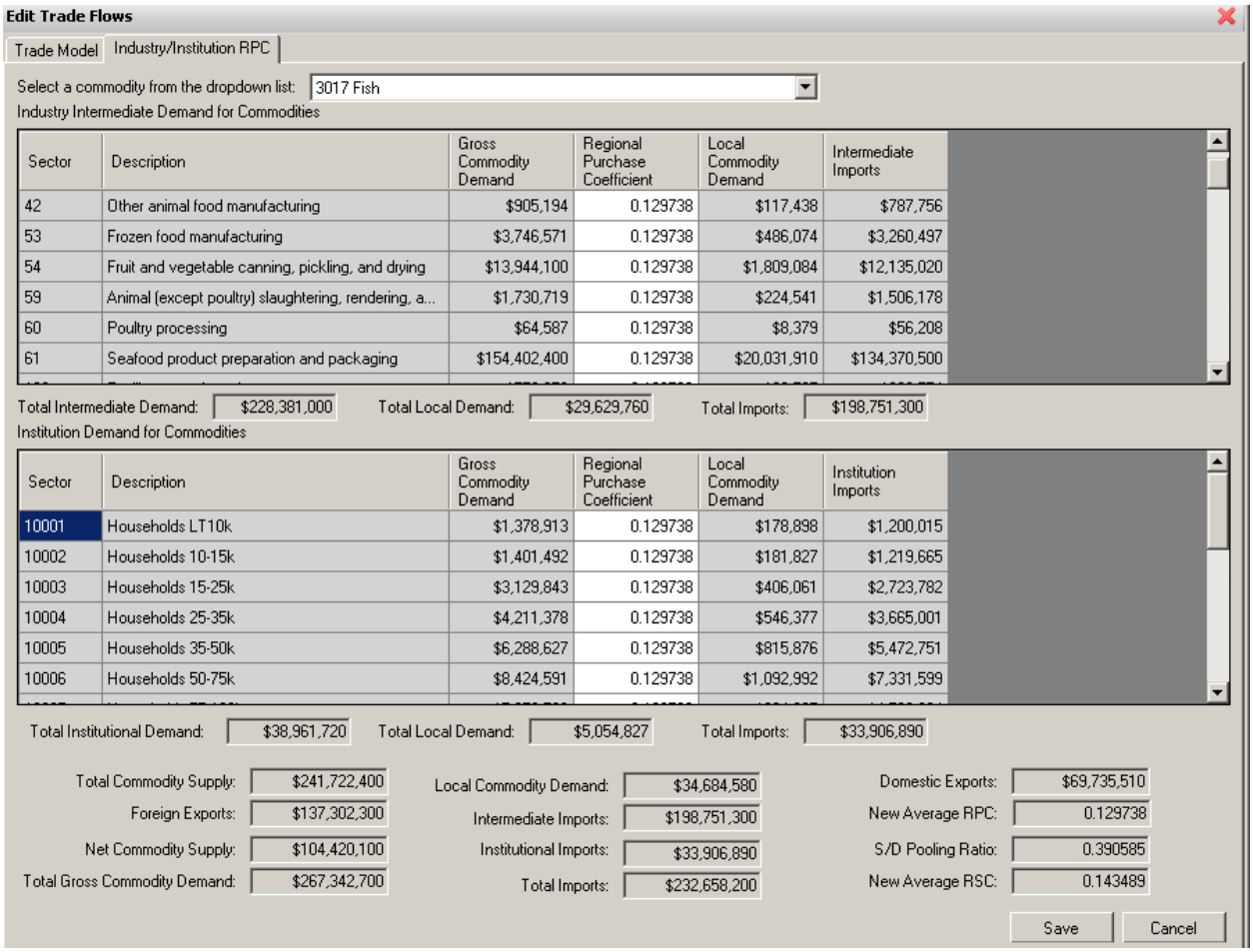
Due to cross hauling, it is possible that fish landed in a port, will not be processed therein. At this time we are unable to quantify this cross-hauling activity for either IFQ or non-IFQ fish. Consequently, we handle both in the same manner. Because we currently cannot quantify the cross-hauling activity, 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 1 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 1 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 1. 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) ≈ 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 1. IMPLAN trade flow of fish in Oregon (2010)



Edit Trade Flows

Trade Model | Industry/Institution RPC

Select a commodity from the dropdown list: 3017 Fish

Industry Intermediate Demand for Commodities

Sector	Description	Gross Commodity Demand	Regional Purchase Coefficient	Local Commodity Demand	Intermediate Imports
42	Other animal food manufacturing	$905,194	0.129738	$117,438	$787,756
53	Frozen food manufacturing	$3,746,571	0.129738	$486,074	$3,260,497
54	Fruit and vegetable canning, pickling, and drying	$13,944,100	0.129738	$1,809,084	$12,135,020
59	Animal (except poultry) slaughtering, rendering, a...	$1,730,719	0.129738	$224,541	$1,506,178
60	Poultry processing	$64,587	0.129738	$8,379	$56,208
61	Seafood product preparation and packaging	$154,402,400	0.129738	$20,031,910	$134,370,500

Total Intermediate Demand: $228,381,000 Total Local Demand: $29,629,760 Total Imports: $198,751,300

Institution Demand for Commodities

Sector	Description	Gross Commodity Demand	Regional Purchase Coefficient	Local Commodity Demand	Institution Imports
10001	Households LT10k	$1,378,913	0.129738	$178,898	$1,200,015
10002	Households 10-15k	$1,401,492	0.129738	$181,827	$1,219,665
10003	Households 15-25k	$3,129,843	0.129738	$406,061	$2,723,782
10004	Households 25-35k	$4,211,378	0.129738	$546,377	$3,665,001
10005	Households 35-50k	$6,288,627	0.129738	$815,876	$5,472,751
10006	Households 50-75k	$8,424,591	0.129738	$1,092,992	$7,331,599

Total Institutional Demand: $38,961,720 Total Local Demand: $5,054,827 Total Imports: $33,906,890

Total Commodity Supply:	$241,722,400	Local Commodity Demand:	$34,684,580	Domestic Exports:	$69,735,510
Foreign Exports:	$137,302,300	Intermediate Imports:	$198,751,300	New Average RPC:	0.129738
Net Commodity Supply:	$104,420,100	Institutional Imports:	$33,906,890	S/D Pooling Ratio:	0.390585
Total Gross Commodity Demand:	$267,342,700	Total Imports:	$232,658,200	New Average RSC:	0.143489

Save Cancel

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.

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.

6.1. 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 7, 8, 13 and 14 into IMPLAN commodities using the bridge information displayed in Appendix A. Recreational effort is mapped into IMPLAN commodities and industries as shown in Table 12.

Figure 2 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.

Figure 2. Large Groundfish Trawler industry spending pattern example

Activity Type	Activity Name	Actiity 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%

Figure 2. Large Groundfish Trawler industry spending pattern example (Continued)

Activity Type	Activity Name	Actiity 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%

6.1. 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.

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 we are tricking the IO model to give 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.[6] 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 3). 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.

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

Figure 3. Large Groundfish Trawler industry spending pattern activity

Setup Activities

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

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: New Event | Copy Event | Paste Event | Delete Event | Event Options

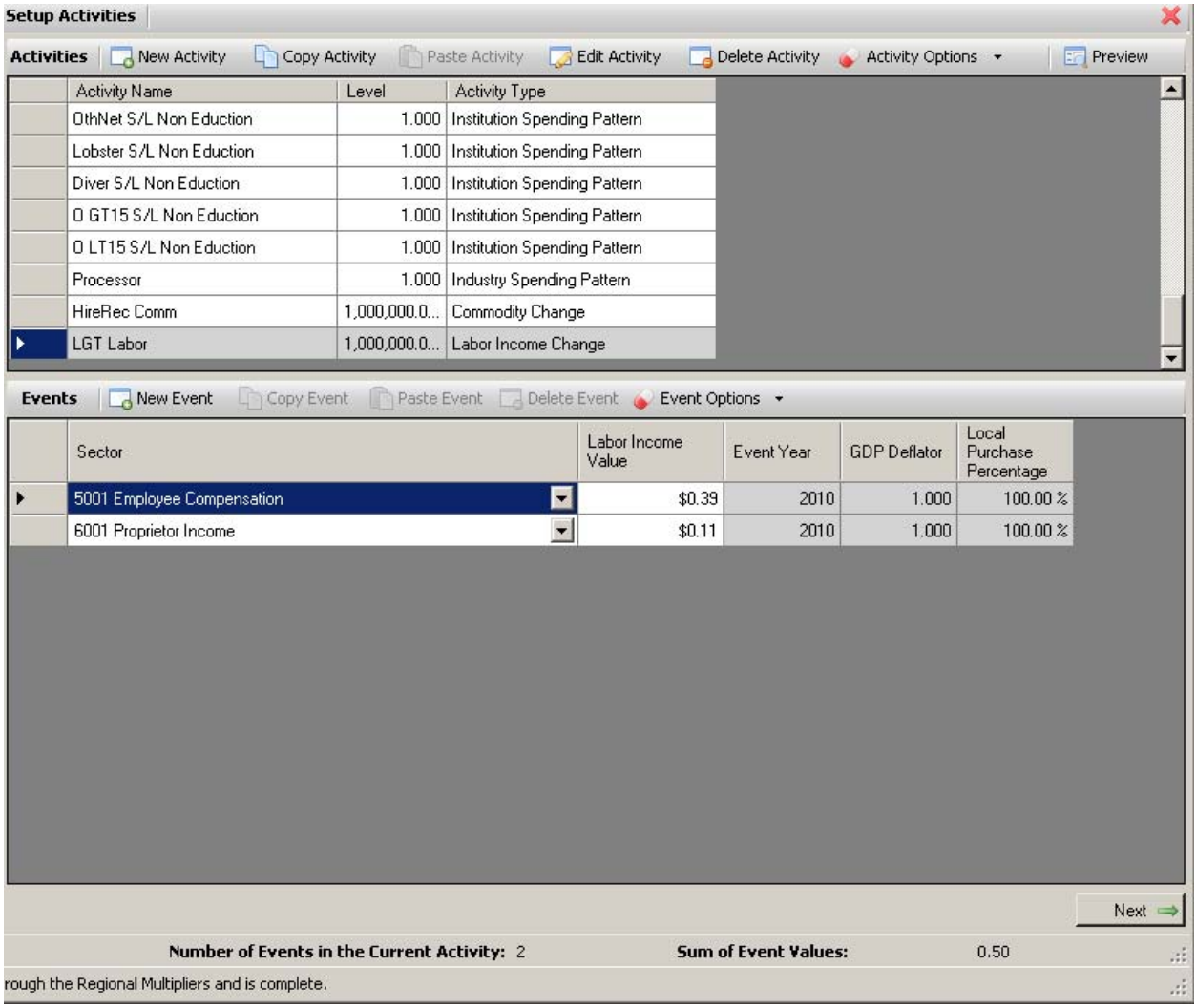
Sector	Coefficient	Event Year	Local Purchase Percentage
3001 Oilseeds	0.000001	2010	5.56 %
3002 Grains	0.000006	2010	24.75 %
3003 Vegetables and melons	0.000330	2010	74.79 %
3004 Fruit	0.000209	2010	65.14 %
3005 Tree nuts	0.000011	2010	49.57 %
3006 Greenhouse, nursery, and floriculture products	0.000010	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 %

Next

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

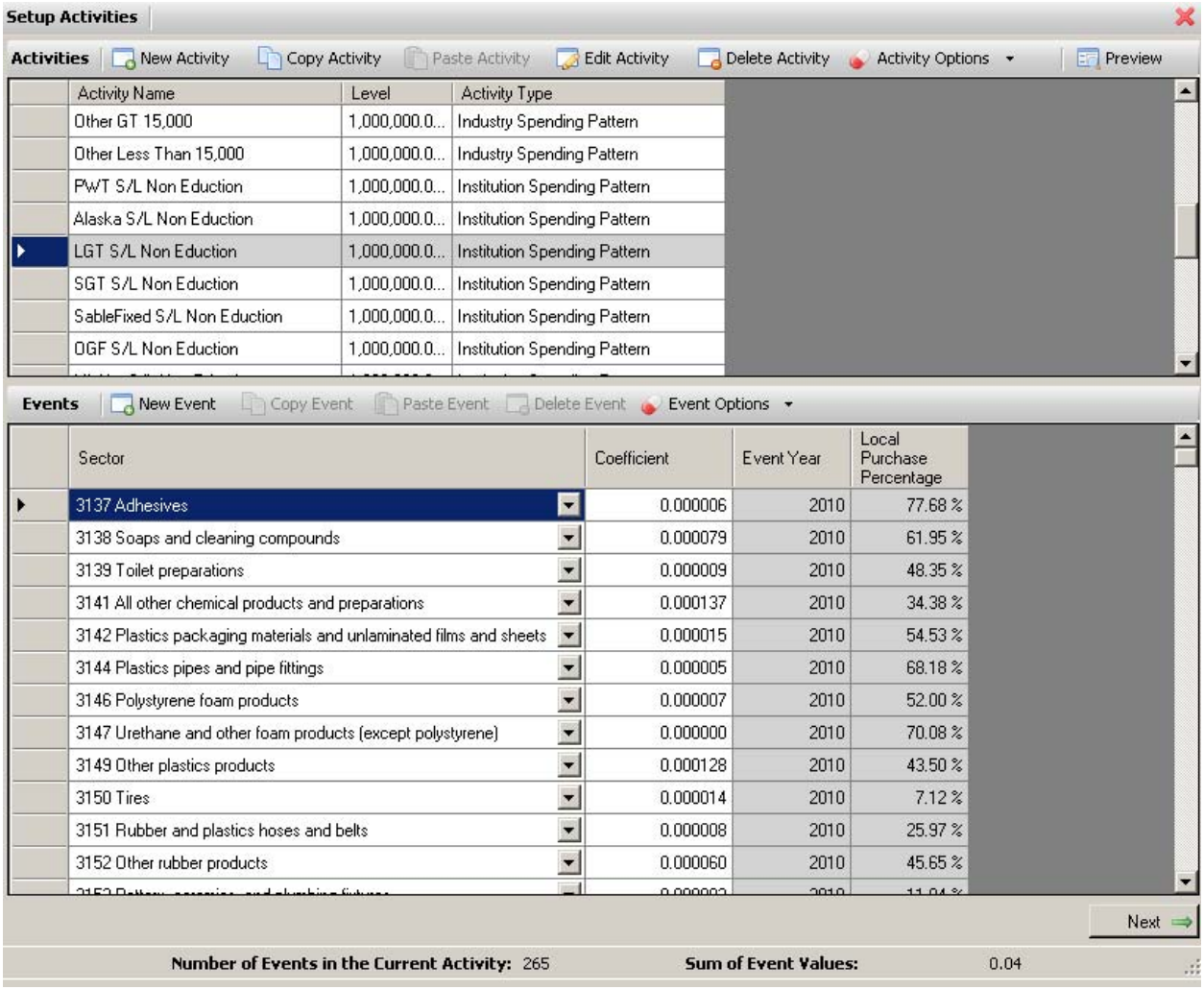
Second, employee compensation and proprietary income is shocked with the same $1 million. The labor effect is contained in the activity "LGT Labor." It is imported as a Labor Income Change. The labor income in the event is set to the proportion of total industry output (TIO) among LGTs that is paid to employees (captain and crew) and proprietors (vessel owners). Figure 4 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.

Figure 4. 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 5. Large Groundfish Trawler state and local govt. non-education



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 Eduction	1,000,000.0...	Institution Spending Pattern
Alaska S/L Non Eduction	1,000,000.0...	Institution Spending Pattern
LGT S/L Non Eduction	1,000,000.0...	Institution Spending Pattern
SGT S/L Non Eduction	1,000,000.0...	Institution Spending Pattern
SableFixed S/L Non Eduction	1,000,000.0...	Institution Spending Pattern
OGF S/L Non Eduction	1,000,000.0...	Institution Spending Pattern

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

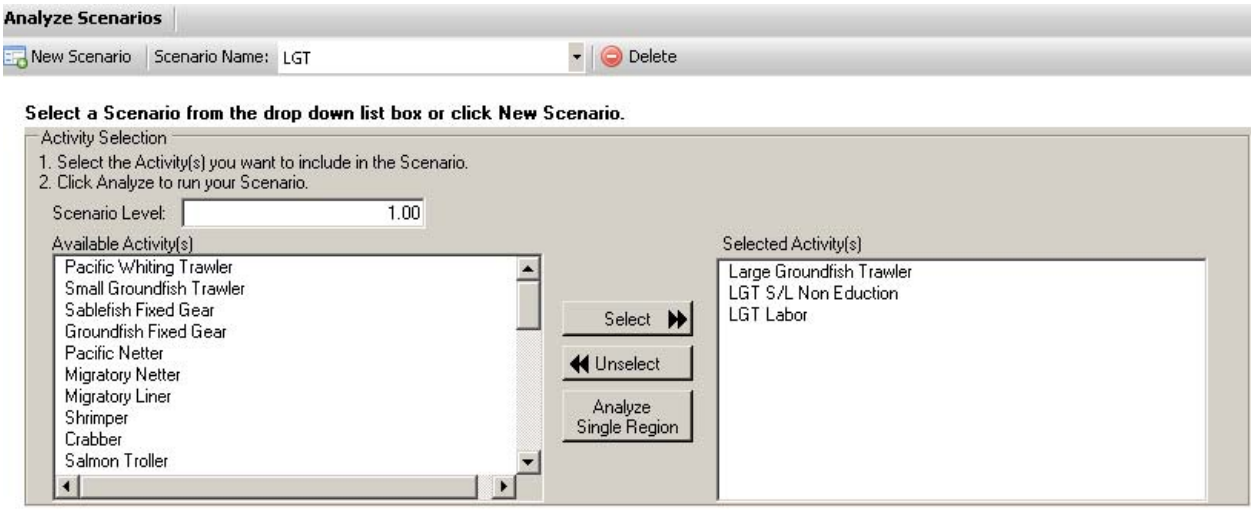
Sector	Coefficient	Event Year	Local Purchase Percentage
3137 Adhesives	0.000006	2010	77.68 %
3138 Soaps and cleaning compounds	0.000079	2010	61.95 %
3139 Toilet preparations	0.000009	2010	48.35 %
3141 All other chemical products and preparations	0.000137	2010	34.38 %
3142 Plastics packaging materials 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 %

Next

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

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 6.

Figure 6. 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 $1.37 million and an employment change of 9.5 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 8.4, respectively. Altogether, the direct, indirect, and induced effect on output is $2.37 million and on employment is 17.9 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 10). 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 10 indicates that the markup for sablefish is 1.61, so for a $1.0 million increase in sablefish delivered to processors, processor revenue is $1.61 million. The analysis by parts approach is used to estimate the impact of the $1.61 million in the same manner as for harvesters. The total output and employment change resulting from a $1.61 million change in processor revenue are $2.6 million and 18.53, 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 $4.95 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 7. 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.

Figure 7. Private Recreation Commodity Purchases

Setup Activities

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

Activity Name	Level	Activity Type
Lobster S/L Non Eduction	1.000	Institution Spending Pattern
Diver S/L Non Eduction	1.000	Institution Spending Pattern
O GT15 S/L Non Eduction	1.000	Institution Spending Pattern
O LT15 S/L Non Eduction	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 | New Event | Copy Event | Paste Event | Delete Event | Event Options

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 sweetners, 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

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 catcher-processor sectors, and migrate IO-PAC to IMPLAN version 3.

Since the first version of IO-PAC was completed (Leonard and Watson, 2010), the voluntary cost earning surveys used to develop the production functions for the commercial fishing sectors in the model have been reprised. 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. Impacts of management actions in succeeding years are determined by converting the estimated changes in gross revenues to year 2010 dollars before the impacts are estimated. IMPLAN then converts the impact estimates back to the year of the input data (through 2030). This process accounts for the effects of inflation on the impact estimates. 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 come[7].

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 2006 (Gentner and Steinback, 2008) 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 program and changes the method of assessing the proportion of harvested fish that is passed to processors. The inclusion of the EDC data likely reduces the error in estimating processor impacts. Prior to the EDC, estimates where 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

[7] 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.

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.

There are several areas where the revised IO-PAC can potentially be further improved. First, IO-PAC relies on a weighted average production function for the shoreside commercial vessels on the West Coast that are not currently covered by NWFSC cost earnings surveys. Second, for the at-sea fleet, which includes motherships and catcher-processors, IO-PAC does not currently include a production function due to their historical exclusion from the NWFSC's voluntary cost earnings surveys.

On the recreational side, IO-PAC's expenditure estimates are not port specific and were made based on expenditures that occurred in 2006. For port level impacts, estimates from IO-PAC may understate or overstate the effects of changes in recreational fishing effort if port area expenditures of recreational anglers differ from state level estimates. Additionally, recreational expenditures may have changed since 2006, both in the level of spending per trip and the basket of goods and services purchased. To the extent that mean recreational trip expenditures have changed since 2006, there is potential for error in the estimates.

Lastly, the charter vessel sector created for CA is based on cost earnings data from 2000 while WA and OR are based on cost earnings data from 2006. Although this represents the most recent data available, there is the potential for error if the cost and earnings of vessels operating as charter vessels has changed since the data were collected.

There are several improvements planned for IO-PAC to address these issues. Many of the planned improvements to IO-PAC will be enabled through the use of data collected in the mandatory EDC program.[8] It is expected that data collected through the EDC will lead to improvements in the vessel production functions in IO-PAC. Unlike the voluntary cost earnings surveys, nearly all of the vessels that participate in the West Coast groundfish fishery are expected to complete an EDC survey. This will lead to improvements in the specification of production functions currently covered by the voluntary cost earnings surveys, and increased coverage to sectors not previously covered by the voluntary efforts such as motherships and catcher-processors. Additionally, the EDC will provide the data necessary to construct unique production functions for mothership and catcher-processor sectors.

[8] The regulations detailing the Economic Data Collection program (50 CFR 660.114) are available online at: http://www.nwfsc.noaa.gov/research/divisions/fram/economic_data.cfm.

Additional planned improvements include updated recreational expenditure estimates and updated charter cost earnings data. The 2011 National Marine Recreational Fishing Expenditure Survey[9] is currently being compiled. The data is expected to be available in the next couple of months. On the charter recreational front, in 2013 cost earnings surveys of California vessels will be completed by the Southwest Fisheries Science Center and the NWFWSC will complete a survey of those in WA and OR.

[9] See additional information online at http://www.st.nmfs.noaa.gov/st5/documents/Nationwide_brochure.pdf

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Appendix A: 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	0.393794
3319	Wholesale trade distribution 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 sweetners, 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
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	1.0000

	equipment rental and leasing services	
	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
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	0.0007

	equipment	
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**