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# 2012 Economic Cost Earnings of Pelagic Longline Fishing in Hawaii

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**ABSTRACT**

This report presents findings from the Pacific Islands Fisheries Science Center (PIFSC) cost-earnings study of the Hawaii-based longline fleet. Fleet-wide expenditures and revenue are assessed for the 2012 operational calendar year. Captains or owners of 115 of the 126 vessels active at the time of the study voluntarily participated in the face-to-face survey, resulting in a response rate of 91 percent. This report also compares 2012 results with the previous cost-earnings studies of the Hawaii longline fleet that examines the economic profiles of the fleet for 2000 and 2005 operations.

Based on survey responses, the average indirect net returns for Hawaii-based longline operations were $72,855 with a direct net cash flow of $56,522 in 2012. Direct net cash flow represents a 233 percent change over 2005 ($16,955 adjusted value in 2012 dollars), when the last cost-earnings survey was conducted. However, economic performance varied widely in 2012. Not all owners earned a profit in 2012, with nearly one-third of study participants realizing negative net returns for the operating calendar year. In addition, vessel operators exclusively targeting bigeye tuna (deep set) generated relatively higher net returns than vessel operators who pursued only swordfish (shallow set) or a combination of swordfish and bigeye tuna during the fishing year. While vessel operators that targeted swordfish during the year generated relatively higher gross revenues than those who targeted only bigeye tuna, higher operating costs offset these gains. Analysis also indicates that vessel size tended to correlate with gross and net revenue in 2012, in that owners and captains of larger vessels generated more revenue and profit than did captains and owners of smaller vessels.

The survey instrument also included questions designed to elicit perspectives regarding catch share-based fishery management programs. Analysis of the fisher responses makes it clear that the majority of owners and captain respondents who are familiar with catch-share programs do not support the adoption of this form of management in Hawaii. Many respondents specifically expressed concerns about how a catch share program could be equitably implemented in the region.

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# INTRODUCTION

## Overview

This report establishes updated economic baseline information for the Hawaii-based domestic longline fishery, which primarily targets bigeye tuna (*Thunnus obesus*) and swordfish (*Xiphias gladius*). Regional fishery-management councils are required to consider the economic impacts of potential regulation in the planning stage of management actions under the Magnuson-Stevens Fishery Conservation and Management Act[1] (MSA) and the Regulatory Flexibility Act[2] (RFA). Periodic economic valuations of fisheries are conducted in compliance with these mandates.

Prior to this study, the most recent data on the economic and operational characteristics of the Hawaii-based longline fleet was collected for the 2005 calendar year. Previous cost-earning studies were conducted based on 1993 (Hamilton et al., 2006), 2000 (O'Malley & Pooley, 2003), and 2005 (PIFSC, unpublished data) operational years. In all three studies, portions of the Hawaii-based longline fleet were found to realize profits from owning a Hawaii-based longline vessel. Yet net returns varied across vessels, with a number of the vessels in the fleet realizing negative net returns. Following a similar approach as these previous studies, this study examines vessel economic performance according to various operational characteristics (target species, vessel size groups, and primary operator, i.e. hired captain or owner operator).

The data collection effort for this study was conducted in 2013 through in-person surveys (Appendix 1) to collect cost data and operational characteristics based on calendar year 2012. By integrating cost data with federal logbook data and commercial marine dealer report data, this study examines the economic performance of the Hawaii-based longline fleet in detail. This report is organized as follows: section 1 gives a brief background of the fishery; section 2 describes the methods used; section 3 describes the results of the survey and cost-earnings reports, followed by results of fisher perceptions of catch shares; and section 4 summarizes the findings of the study.

## Recent Trends and Developments in the Hawaii-Based Longline Fishery

Fleet characteristics and the operational environment for the Hawaii longline fleet have experienced various changes since 2005, when the last cost-earnings research was conducted. One of the most important changes is a 17% real increase in annual average fuel prices. However, the size of the fleet in both the number of active vessels and trips has remained relatively constant, as shown in Figure 1.

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[1] SEC. 301 Regional Fishery Management Councils 16 U. S. C. 1852 104-297. (8) Conservation and management measures shall, consistent with the conservation requirements of this Act (including the prevention of overfishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities in order to (B) the extent practicable, minimize adverse economic impacts on such communities… SEC. 303 Contents of the Fishery Management Plans 16 U. S. C. 1853 95-354, 99-659, 101-627, 104-296. (a) Required Provisions. --Any fishery management plan which is prepared by any council, or by the Secretary, with respect to any fishery shall-- (2) contain a description of the fishery, including…the cost likely to be incurred in management, actual and potential revenues from the fishery…

[2] The RFA requires agencies to conduct sufficient analyses to measure and consider the regulatory impacts of a rule and to determine whether there will be "a significant economic impact on a substantial number of small entities."

To confine the growth of the fleet, in 1991, the Western Pacific Regional Fishery Management Council (WPRFMC) capped the number of longline permits at 164 vessels. Since the implementation of this limited-entry program, the number of active vessels in Hawaii's longline fleet has fluctuated between 100 and 140 per year, where active vessels are defined as operating under an active permit. Between 2002 and 2012, the number of active vessels has oscillated around the 11-year average of 125 per year.

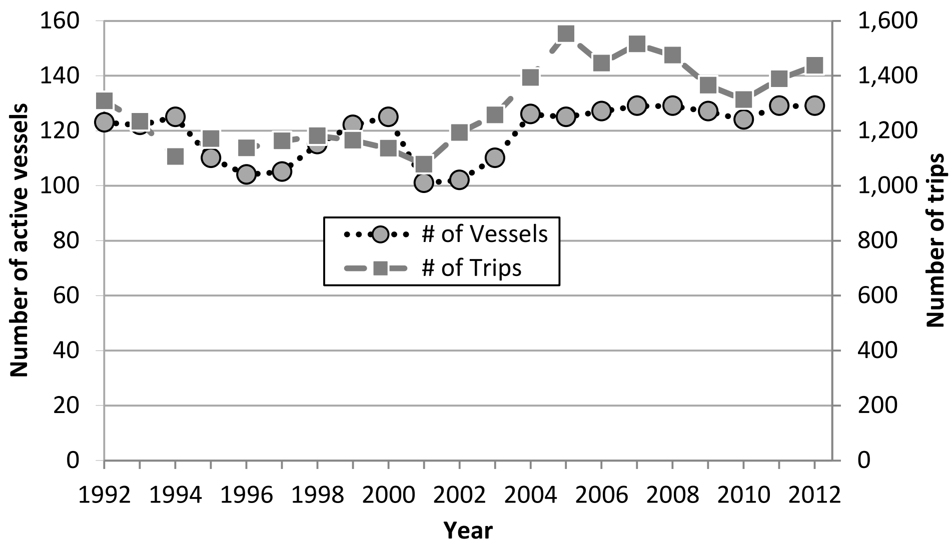



Figure 1.--Total numbers of active vessels and trips: 1992-2012[3].

Despite the number of trips and number of active vessels remaining relatively stable since 2005, the total number of hooks deployed fleet wide has increased by an average of 2 million per year from 2002 to 2012 (see Fig. 2). The number of hooks deployed per vessel has been trending upwards since the adoption of monofilament mainline in the mid-1980s. This technology has allowed for longer mainline length, and correspondingly more hooks per set. In addition to new technology, there has been a decrease in the number of vessels that target swordfish and an increase in the number of vessels that target only bigeye tuna over the same time period due to the price increase of bigeye tuna and the possible productivity improvement of tuna fishing (Pan 2013, Pan and Walden 2015) . This has also lead to an increase in the number of hooks deployed fleet wide, as a deep longline set targeting bigeye tuna deploys approximately 75% more hooks than a shallow set that targets swordfish.

[3] Data source: The Hawaii-based Longline Logbook Summary Reports, PIFSC Fisheries Research and Monitoring Division (FRMD) 2002-2012 http://www.pifsc.noaa.gov/fmb/reports.php accessed on 05/29/2014

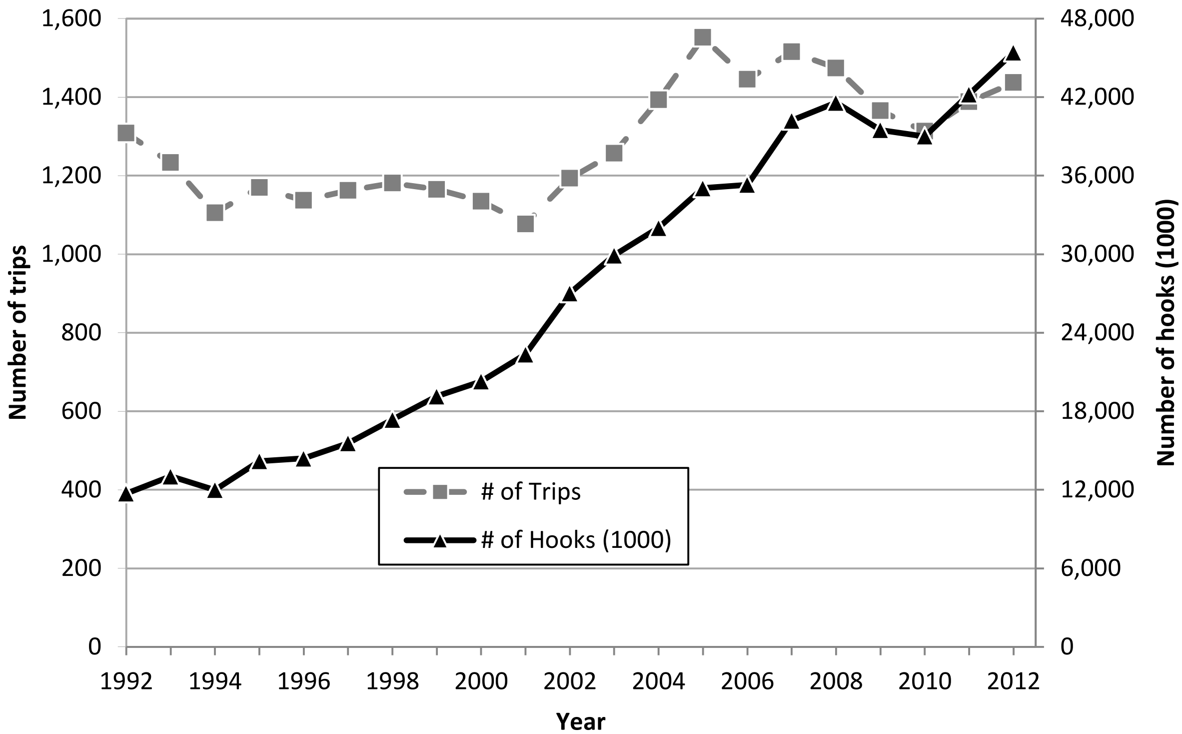



Figure 2.--Total numbers of trips and hooks used per year, Hawaii longline fleet: 1992-2012[4].

In the 2012 calendar year, there were 18,086 deep sets relative to 1,362 shallow sets in total for the Hawaii-based longline fishery. The number of bigeye tuna kept has trended upwards with the increase in the annual number of longline hooks deployed fleet wide, as shown in Figure 3. Effort and landings in the figure include declared tuna trips, swordfish trips, and mixed trips prior to 2001[5]. There was an almost 30 to 1 ratio of total annual deep-set hooks to shallow-set hooks deployed during 2012.

[4] Data source: The Hawaii-based Longline Logbook Summary Reports, PIFSC FRMD 2002-2012. http://www.pifsc.noaa.gov/fmb/reports.php accessed on 05/29/2014

[5] In April 2001, the Hawaii shallow-set longline fishery for swordfish was closed by the U.S. National Marine Fisheries Service as the result of a U.S. Federal court order to reduce incidental sea turtle bycatch, and the fishery was re-open in April 2004 after incorporating measures to reduce sea turtle bycatch. After reopening the swordfish fishery, NMFS required vessel operators to specify the target gear, either deep-set or shallow-set prior to the departure of the vessel, eliminating the mixed-gear option for declared longline trips.

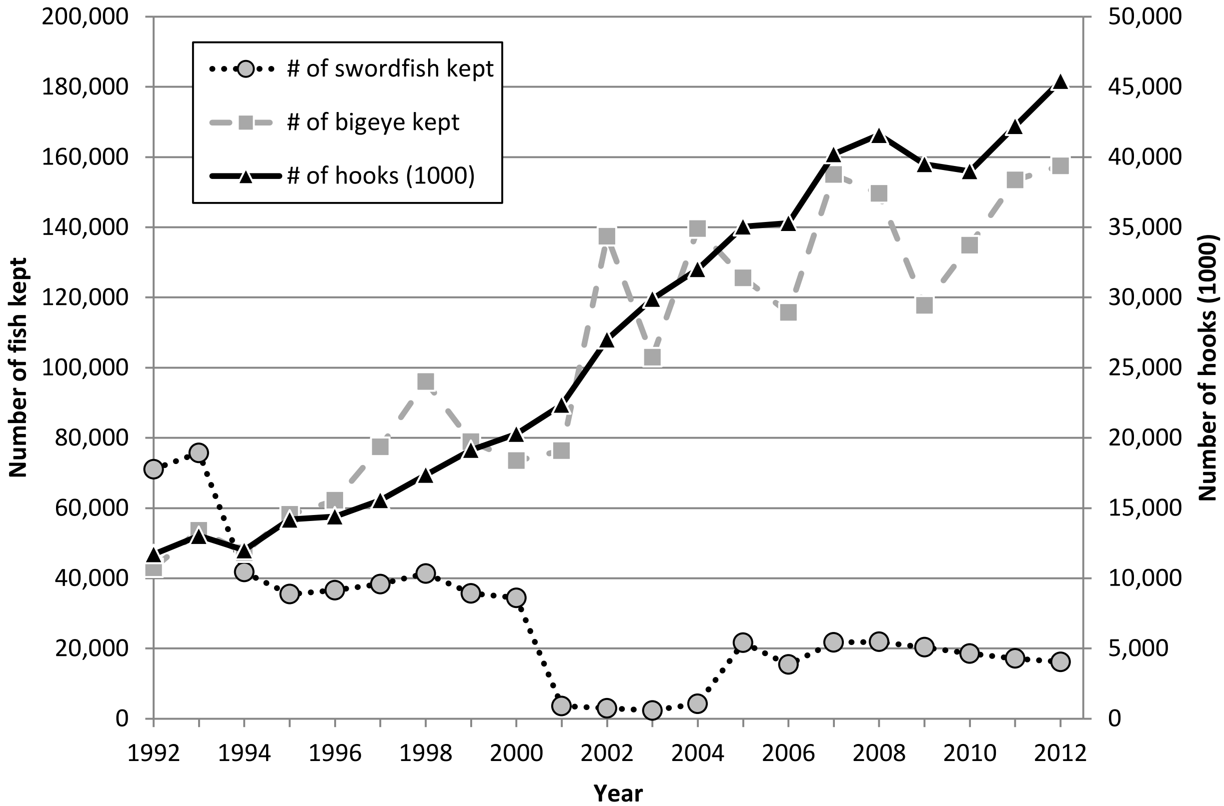



Figure 3.--Hawaii longline fleet total catch and effort: total numbers of bigeye tuna and swordfish caught per total hooks set: 1992-2012[6]

Catch per unit effort (CPUE), i.e., number of fish caught per a set number (1000) of hooks deployed, was higher for swordfish from declared shallow-set longline trips than for bigeye tuna from declared deep-set longline trips. From 2008 to 2012, there were three times more swordfish caught per unit of effort (10.8 fish per 1000 hooks) on declared shallow-set trips than bigeye tuna caught (3.6 fish per 1000 hooks) on declared deep-set trips. However, a shallow set targeting swordfish typically deploys fewer hooks on a longer stretch of mainline than does a deep set targeting bigeye tuna. Line plot trends in the number of target species kept and the numbers of hooks deployed per year are presented in Figure 4 and Figure 5 for declared shallow-set swordfish trips and deep-set bigeye tuna trips, respectively.

[6] Data source: The Hawaii-based Longline Logbook Summary Reports, PIFSC FRMD 2002-2012 http://www.pifsc.noaa.gov/fmb/reports.php accessed on 05/29/2014

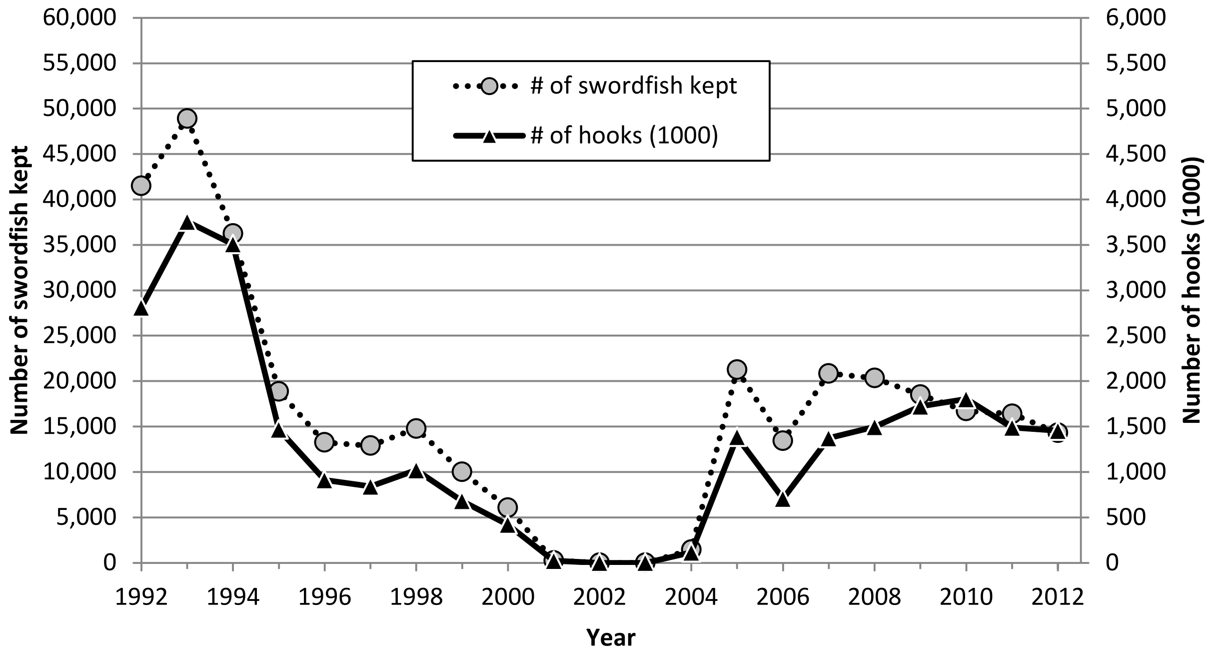



Figure 4.--Declared swordfish trips catch and effort: numbers of swordfish caught per total 1000 shallow-set hooks: 1992-2012[6].

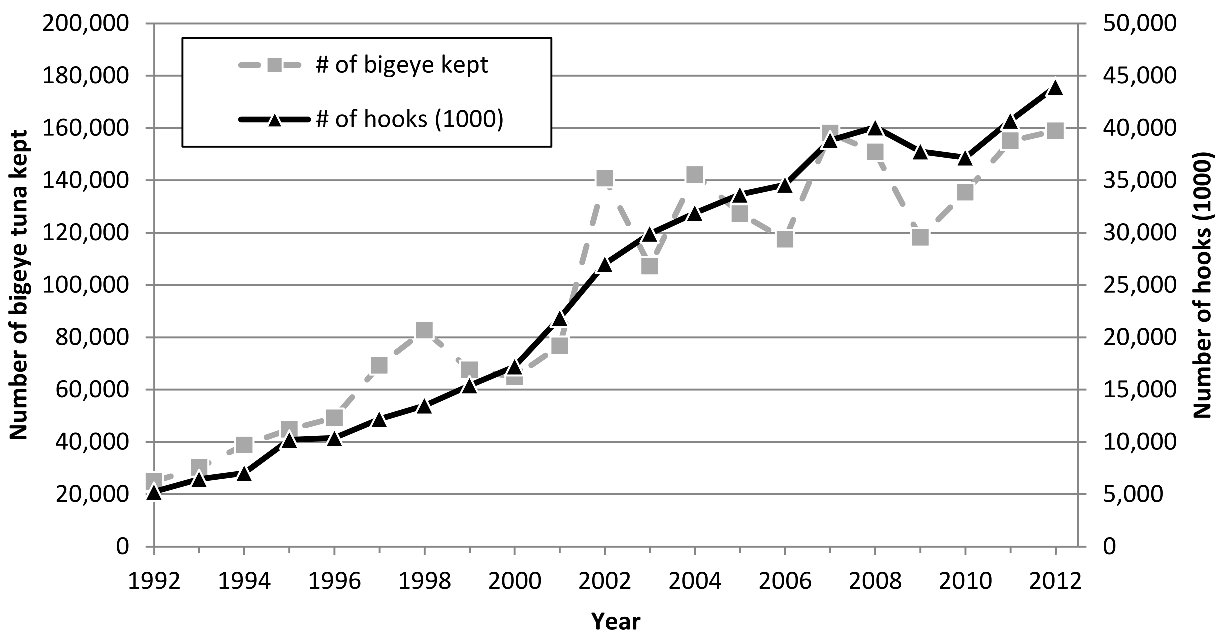



Figure 5.--Declared tuna trips catch and effort: total numbers of bigeye tuna caught per total 1000 deep-set hooks 1992-2012[7].

[6]Data source: The Hawaii-based Longline Logbook Summary Reports, PIFSC FRMD 2002-2012 http://www.pifsc.noaa.gov/fmb/reports.php accessed on 05/29/2014
[7]Data source: The Hawaii-based Longline Logbook Summary Reports, PIFSC FRMD 2002-2012 http://www.pifsc.noaa.gov/fmb/reports.php accessed on 05/29/2014

When the shallow-set longline fishery targeting swordfish closed in 2001, there was a sharp spike in the number of bigeye kept due to an increase in deep-set fishing effort. This reflected an increase from 841 tuna trips in the year 2000 to 1,193 tuna trips in the year 2002. The number of bigeye tuna retained has continued to increase in recent years even after the swordfish fishery reopened in 2004, whereas the number of captured swordfish returned to only half of the historical catch level prior to the closure. However, it is important to note that a decrease in targeted swordfish effort and overall swordfish landings was observed before the swordfish closure (see Figs. 3 and 4).

# METHODS

## Survey and Supplementary Data

Multiple data sources are utilized in this report to provide an economic summary of the Hawaii-based longline fishery in 2012. These include: cost information from two PIFSC sources; (1) in-person interviews fielded by PIFSC economists and (2) the Hawaii Longline Trip Expenditure Data Collection Program (Pan et al., 2012); sales revenues from the Hawaii Department of Aquatic Resources (HDAR) dealer database; and reported catch and trip related data from National Marine Fisheries Service (NMFS) federal logbooks. The information from these sources were integrated using vessel permit numbers or vessel names and landing dates, return dates, or sales dates. The economic details in this report cover revenues and variable costs from permitted longline trips that landed catch in 2012, as well as fixed costs incurred within the 2012 calendar year.

Vessel owners and operators were interviewed from January through September 2013 at Piers 16, 17, and 35-38 of Honolulu Harbor and at Barbers Point Harbor. At least one representative of all vessels that were operational during the 2012 calendar year and active during the time of interviewing were approached to participate in the study. Those willing to participate were voluntarily interviewed in-person using a structured survey (Appendix A). Two surveys were conducted over the phone because the respondents were off island or not available to meet in person.

The fishery comprised owners and operators of three distinct ethnic groups defined as European-American, Korean-American, and Vietnamese-American. These groups were found to have strong within-group cohesion, while ties across groups are relatively rare (Barnes-Mauthe et al. 2013). Therefore, to maintain consistent sampling across ethnic groups, Vietnamese-English and Korean-English interpreters were hired to assist with the in-person survey effort since a significant portion of Vietnamese-American and Korean-American owners and captains prefer communicating in their first language. Survey questions were verbally proctored during interviews with the vessel owner or hired captain.

Survey questions focused on annual fixed costs incurred during the 2012 calendar year. Respondents were also asked about variable (trip-based) costs as a secondary support mechanism to verify information collected through the Hawaii Longline Trip Expenditure Study, which was established as a joint effort between the PIFSC Economics Program and the Pacific Island

Regional Office (PIRO) Observer Program. Since 2004, The Hawaii Longline Trip Expenditure Data Collection Program collects trip-level cost information from observed longline fishing trips on an ongoing basis. There is 100 percent observer coverage for shallow-set trips that target swordfish, and 20 percent coverage for deep-set tuna trips. Among observed trips, approximately 60 percent returned with economic data.

Using this sample set of trip cost data, regression models were developed to estimate a trip cost function in relation to individual vessel and trip characteristics, such as vessel length, number of sets, trip length, travel distance, etc., to generate cost information for trips that do not have the trip expenditure data collected by the observer program. The estimated trip costs were estimated using a series of regression equations and mean time-series values. The estimated complete trip costs were generated from the equation as follows:

$$Trip\ Cost = Fuel\ Price \times Fuel\ Used + Oil\ Price \times Oil\ Used + Bait\ Price\ 1 \times Bait\ Used\ 1 + Bait\ Price\ 2 \times Bait\ Used\ 2 + Ice\ Price \times Ice\ Used + Gear\ Replacement\ Cost + Provisions\ Cost + Communications\ Cost + Lightstick\ Price \times Lightstick\ Used$$

Usually, the quantity of usages for each cost item was estimated through a set of explanatory predictors and the price was generated by the mean time-series values. In the example of fuel cost estimation for a particular trip, the fuel usage is estimated based on its trip length (days), travel distance (miles), vessel size (feet), and a dummy variable to represent an individual vessel's unobservable heterogeneity. For fuel prices, mean weekly fuel prices are used for those weeks with more than three observations (from the observed trip cost data) or replaced by mean monthly fuel prices for weeks with less than three observations. Fuel cost for a specific trip for the vessel would be the product of fuel usage and fuel price. The detailed regression equations and coefficients for all the cost items are included in Appendix B.

The survey also included questions to gauge the knowledge and perceptions of catch share programs and the level of support in implementing an individual fishing quota (IFQ) or individual transferable quota (ITQ) catch share program in the Hawaii-based longline fishery. With privatization of fishery resources in other regions on the rise, these questions were included to help Pacific Island Regional fisheries manager better understand the views and perceptions of the stakeholders within the fishery and allow for initial indexes to be established and tracked over time.

HDAR provided sales records (number of fish sold, price per pound, weight, and value) from the Hawaii dealer reports for all records of commercial fish sales within the state. Trip revenue data was therefore directly acquired from the HDAR dealer reports for all trips that landed in Hawaii. Some trips landed their catch outside of Hawaii and are reported in the federal logbook but not in the HDAR dealer reports.[8] For these trips, the HDAR dealer data was used to calculate average weekly fish prices and average weights by species. The Hawaii-based longline logbook (NMFS) catch information, which recorded the number of fish kept, was then multiplied by the average

[8] It is common for Hawaii-based vessels to land catch from a swordfish trip during the winter months when the swordfish migration is farther east. Based on personal communications with the swordfish longliners that land in California, swordfish prices in California are similar to those in Hawaii but the distance is shorter to the west coast and thus fuel costs are lower.

weekly price and weight (HDAR) for each species to estimate trip revenues for those trips not included in the dealer reports. Weekly average prices and weights were used to mitigate the variations that a single vessel can influence in a daily average, while still maintaining the temporal variations in both price and weight per piece of fish kept.[9]

**Vessel, Operational, and Economic Data Summaries**

The Hawaii-based longline fishery can be summarized in more detail as several unique subgroups of the 129 vessels active during 2012. First, there are two distinct longline fishing trip types, deep-set (tuna) or shallow-set (swordfish). There are some vessels that targeted just bigeye tuna for the entire year, while other vessels conducted tuna and swordfish trips in different seasons. There is one vessel that had only declared swordfish trips in 2012. For confidentiality of data purposes, that vessel was grouped with the vessels that target both bigeye tuna and swordfish. For this report, vessels that target both bigeye tuna and swordfish will be referred to as swordfish vessels relative to tuna vessels that only target bigeye tuna. In addition to target species, vessels were classified by overall length into three groups; less than or equal to 56 ft (small), over 56 ft and under 74 ft (medium), and greater than or equal to 74 ft (large). Vessels that target both swordfish and bigeye tuna are all over 74 ft in length (i.e., large) with only one exception. Swordfish vessels are therefore not grouped by size for confidentiality reasons. Vessel characteristics were obtained from the in-person survey, while operational characteristics were summarized from logbook data (NMFS). A calendar year was either defined at the set-level based on 2012 set end-haul date, or at the trip level based on trips that have a return date in 2012. The annual set-level information including number of hooks per set and length of mainline, whereas trip-level information included number of trips, distance in miles of the begin set location from Honolulu Harbor, and number of sets per trip.

The total cost of owning a Hawaii-based longline vessel can be split into three types: fixed costs, labor costs, and variable costs, (C, D, and E, Table 1). Fixed costs include dry dock, engine work, gear added/replaced, and continuous maintenance. Variable costs, which can also be referred to as trip-based costs, are those that are incurred every trip. These costs include fuel, bait, engine oil, provisions, ice, fishing gear replacement, communication, and lightsticks for swordfish trips. Labor costs are compensation paid to the crew and captain.

All fixed-cost information was obtained through the in-person surveys, and only these vessels were used in the cost-earnings analysis. Missing fixed-cost information from individual vessels, either due to incomplete information or values outside reasonable ranges, were replaced using the average values of vessels within the summary group to calculate net returns. However, vessel and operational characteristics were summarized based on only the information that was provided by respondents.

All repair costs, not including fishing-gear replacement costs, were considered fixed costs even if they occurred on a routine basis. Dry-dock and engine overhaul costs were prorated as annual

[9] Average auction prices for the same species often vary significantly between vessels due to fishing grounds, fish handling practices of the vessel and by the average time between catching the fish and selling it. Fish size can also vary substantially by factors at the trip and vessel level (HDAR, Unpublished data).

installments across the time period between repairs. The capital cost of owning and operating a longline vessel is reported two different ways, directly and indirectly.

For this report, labor costs could be classified as either fixed or variable costs depending on the contractual basis of the labor agreement. Foreign crews are usually hired on a 1- to 3-year contract and are paid regular monthly wages. In contrast, wages for all captains and domestic crew are paid on a share of trip revenue after auction fees or a share of trip revenue after variable trip-based expenses are deducted. Thus, part of the cost of labor is proportional to net revenue. For this reason, labor costs are summarized separately from the variable and fixed costs associated with operating a longline vessel.

For vessels that are owner-operated, a shadow wage was applied to the captain’s share to account for the operator portion of the owner-operator’s position as captain. The average hired captain’s share after trip expenditures was used to calculate the shadow price for a captain of an owner-operated vessel.

Table 1.--Description of data sources and methods used to calculate economic data fields.

| Economic Data Field | Data Source | Primary Method | Secondary Method |
|---|---|---|---|
| **Annual Revenue Per Vessel** | **HDAR/NMFS** | **all sales from dealer reported LL[1] Trips** | **Avg. Weight × Avg. Price × Number of Pieces** |
| A. Annual Sales Costs Per Vessel | HDAR/NMFS | 10% of all sales at UFA auction | Percentage from questionnaire (non-HI trips) |
| B. Hawaii Longline Association Fee | PIFSC1/HDAR | $0.02 per lbs. of fish sold at UFA auction | None for vessel not in Hawaii Longline Assoc. |
| C. Annual Variable Costs of Trip | PIFSC2/NMFS | Sum Costs from *Trip Expenditure Form* | Sum Predicted Costs from estimated functions |
| *Fuel* | PIFSC2/NMFS | Fuel Cost | Predicted Fuel Used × Weekly Avg. Fuel Price |
| *Oil* | PIFSC2/NMFS | Oil Cost | Predicted Oil Used × Monthly Avg. Oil Price |
| *Ice* | PIFSC2/NMFS | Ice Cost | Predicted Ice Used × Monthly Avg. Ice Price |
| *Bait* | PIFSC2/NMFS | Bait1 Cost + Bait2 Cost | Predicted Bait Used × Monthly Avg. Bait Price |
| *Fishing Gear and Equipment* | PIFSC2/NMFS | Gear Cost | Predicted Gear Cost |
| *Provisions* | PIFSC2/NMFS | Provisions Cost | Predicted Provisions Cost |
| *Communication* | PIFSC2/NMFS | Communications Cost | Predicted Communications Cost |
| *Lightsticks* | PIFSC2/NMFS | Lightstick Cost | Predicted Lightstick Cost |
| **Net Revenue** | **All** | **Annual Revenue – (Annual Sales Cost + HLA Fees + Annual Variable Costs)** | |
| D. Annual Labor Costs Per Vessel | All | Sum of Labor Costs | |
| Captain Wages (By Share) | All | Captain Share ×G/N[2] Revenue for HC[3] | Average HC[3] Share × Revenue after VC[4] for OO[5] |
| Crew Wages (By Share) | All | Sum (Crew Share × G/N[2] Revenue) | Zero for crew paid by flat rate |
| Crew Wages (By Flat Rate) | PIFSC1 | Sum (Flat Rate Crew Pay) | Zero for crew paid by shares |
| Crew Bonus | All | Sum (Crew Bonuses) | |
| Miscellaneous Labor Costs | PIFSC1 | Sum ((Visa + Travel Cost + Agency Fees) ÷ Year of Contract) | |
| E. Annual Fixed Costs Per Vessel | PIFSC1 | Sum of Fixed Cost | |
| Mooring Fees | PIFSC/NMFS | Price per Day × Days at Port | Annual Mooring Fees |
| Bookkeeping Fees | PIFSC1 | Cost of Bookkeeper | Zero for vessels that keep books in-house |
| Insurance | PIFSC1 | Cost of Insurance | Zero for vessels without Insurance |
| Dry Dock | PIFSC1 | Cost of Drydock ÷ Years between drydocking vessel | |
| Engine(s) Overhaul | PIFSC1 | Cost of Overhauling Engine(s) ÷ Years between engine(s) overhaul | |
| Major Repair | PIFSC1 | Major repair and major gear replacement and/or gear upgrade costs | |
| Routine Repair | PIFSC1 | Periodic cost to maintain and repair vessel | |
| Miscellaneous Fixed Costs | PIFSC1 | Cost associated with owning a managing a vessel (i.e. travel cost, registration etc.) | |
| Loan Payments | PIFSC1 | Annual (Principle + Interest) | None for vessels that do not have a loan |
| **Net Cash Flow** | **All** | **Net Revenue – (Annual Labor Costs + Annual Fixed Costs)** | |
| **Net Cash Flow (*without Loan*)** | **All** | **Net Cash Flow + Loan Payment** | |
| Interest on Loan | PIFSC1 | Loan Payment – Principle | |
| Appreciation/ Depreciation | PIFSC1 | Current Value * Rate of ((Current Value ÷ Purchase Value) ^ (1/ Years Owned)) - 1 | |
| **Net Returns to Owner** | **All** | **Net Cash Flow + (Loan Payment – Principle) +/- ( Appreciation/ Depreciation)** | |

Data Sources[10]:

HDAR Dealer reports from the Hawaii Division of Aquatic Resource

NMFS Federal logbook data from the National Marine Fishery Service

PIFSC1 Cost-earning survey from the Pacific Islands Fisheries Science Center's Economic Program

PIFSC2 Trip expenditure data managed by the Pacific Islands Fisheries Science Center's Economic Program and fielded by the Pacific Island Regional Office's Observer Program. All refers to information compiled from fields or derived from data sources compiled from all data sets described in this report

[1]LL is used to abbreviate the word longline

[2]G/N is used to abbreviate share of Gross/Net revenue as specified on the survey for captains and crew shares bases

[3]HC is used to abbreviate Hired Captain

[4]VC is used to abbreviate Variable Costs

[5]O is used to abbreviate Owner-Operator

[10] Metadata associated with the datasets used in this analysis can be viewed through the NMFS Enterprise Data Management Program, InPort. For access to the metadata visit:
HDAR: *https://inport.nmfs.noaa.gov/inport/item/5610*
NMFS: *https://inport.nmfs.noaa.gov/inport/item/2720*
PIFSC1 [2012]: *https://inport.nmfs.noaa.gov/inport/item/29942*
PIFSC1 [2005]: *https://inport.nmfs.noaa.gov/inport/item/10417*
PIFSC1 [2000]: *https://inport.nmfs.noaa.gov/inport/item/1060*
PIFSC2: *https://inport.nmfs.noaa.gov/inport/item/5662*

The following section describes the economic baseline of the fleet using certain terminologies that need to be defined. Revenue or gross revenue is defined in this report as the ex-vessel value of all fish landings during the 2012 calendar year. Revenue from fish sale was the sole income source for the fleet in 2012 as known. Net revenue is gross revenue minus variable costs; i.e., the total value of landings after variable costs (United Fishing Agency (UFA) auction fees, Hawaii Longline Association (HLA) fees, fuel, bait, etc.) are subtracted. Direct net returns or net cash flow is the annual profits or losses the vessel directly accrued in the calendar year; i.e., gross revenues minus all expenditures (variable costs, labor costs, and fixed costs). Whereas, indirect net returns are the annual profits or losses the vessel accrued from all direct revenues, with adjustments to account for non-cash items realized in the same period (Table 1).

The economic summary of the costs and earnings report is investigated in two ways, the direct method or "cash flow statement" and the indirect method or "costs and earnings summary." Previous cost-earnings studies of the Hawaii-based longline fishery (such as Hamilton et al., 1996, O'Malley and Pooley, 2003) only used "direct cash flow" to represent the cost-earnings status for the fishery. Direct cash flow takes into consideration the entire loan payment (principle and interest) without accounting for the appreciation/depreciation of capital investments. The indirect method specifies net returns at full equity, considering only the interest on loans as the cost to borrow capital while also accounting for the annual depreciation or appreciation of the capital investment(s) that are accrued in that time period.

In the indirect cost and earnings summary, vessel real economic depreciation is difficult to calculate, as vessels in the Hawaii-based longline fleet are periodically dry-docked to update equipment at regular intervals. The realized expenditures of adding equipment and maintaining the physical condition of vessels may offset deprecation in terms of actual market value, while these expenses are accounted for as fixed costs of owning a longline vessel. In addition, the limited-entry permit system creates a special circumstance wherein longline permits, which are attached to and transferred with the vessel, can have scarcity value related to the economic viability of the fishery. Therefore, this study used both concepts to present cost-earnings results, aiming to investigate the economic performance of the Hawaii-based longline fleet in a consistent manor with previous studies, while also considering indirect values for a comprehensive economic appraisal of a Hawaii-based longline vessel.

Standard accounting principles that calculate depreciation using a set amortization period do not account for the change of the vessel's real market value and fishing permit value associated with the limited-entry longline fishery. The rate of change in value of the vessel plus the limited-entry permit can be calculated using Equation 1 as:

$$i = \left(\frac{FV}{PV}\right)^{\frac{1}{n}} - 1 \qquad \text{(Equation 1)}$$

where $i$ is the rate of change in value, *FV* is the market and/or appraisal value of the vessel in 2012, *PV* is the value of the vessel during the time of purchase (purchase price plus startup costs), and *n* is the number of years from when the vessel was purchased to 2012. The information for appraisal value, purchase and startup costs, along with the year the vessel was purchased for each vessel was obtained through the in-person survey mechanism. Summaries of the values used in Equation 1 are found in Tables 4 and 5 in the following section. Using the indirect method of cost and earnings section of this report, the results from Equation 1 were used to calculate the rate of change in value for each vessel. The lowest three and highest three rates were replaced by the next closest rates to reduce the influence of extreme values, defined as those laying outside a reasonable range for the rate of change in value of the vessel per year.

In addition to the appreciation and depreciation of vessel value per year, the indirect method of cost and earnings summary includes only the loan payment interest as operational costs of borrowing capital and not the principle. To separate principle from interest in the indirect reporting of 2012 cost-earnings, the Federal Reserve Bank of St. Louis Economics Federal Reserve Economic Data (FRED) historic 15-year term loan rates, capped at 4 percent,[11] were used to calculate the annual interest payment for those vessels with loans. The term loans were assumed to be consistent with average 15-year fixed rate loans under the cap, such that vessel owners have the option to refinance to a lower interest rate when rates are lower than the original loan rate.

When relating information between the 2000, 2005 and 2012 cost and earnings reports, two methods were used to compare the changes in values between reports. The percent change (PC) from the previous cost and earnings report (Equation 2) and the average change between (ACB) values being compared (Equation 3).

$$PC = \frac{(v_2 - v_1)}{v_1} \qquad \text{(Equation 2)}$$

$$ACB = \frac{(v_2 - v_1)}{\left(\frac{(v_2 + v_1)}{2}\right)} \qquad \text{(Equation 3)}$$

In both Equation 2 and Equation 3, $v_1$ and $v_2$ are the previous cost and earnings value and the current cost and earnings value, respectively. The percent change describes the change in value from the previous cost and earnings report while the average change between reports is the percent change in values between the two reports being compared. The absolute value of the average change between years is not affected by which of the two years is chosen as the base, while the percent change value is dependent of the base year's value (previous value).

## RESULTS

### Response Rate

Of the 129 vessels that were active during the 2012 calendar year, 126 vessels, still active during the time of fielding the questionnaire (January to September 2013), were asked to participate in the study. A total of 115 active Hawaii-based longline vessels completed the survey. This equates to an 89 percent response rate among all vessels active in 2012, and a 91 percent response rate among those that were still active in 2013. One of the 115 vessels took only one logged trip in 2012 so this vessel was excluded from the economic summaries to better represent

[11] The annual average term loan rate has trended under 4 percent since 2009 and is the rate at which the vessel owner could have refinanced at a higher rate loan during the 2009-2012 period.

the average cost-earnings of the fleet. Therefore, 114 of 125 vessels were used to summarize the economic data of the Hawaii-based longline fishery with an overall, 91 percent representation of all vessels still active in 2013.

As mentioned before, the vessel owners and operators that comprise the Hawaii-based longline fishery span three ethnic groups. The number of vessels and response rates by ethnic group is provided in Table 2. The response rates of those vessels still active during the fielding of the survey were consistent across ethnic groups.

Table 2.--Number and percentage of Hawaii-based longline vessels interviewed.

| **Ethnic Group*** | **Active during 2012** | **Number interviewed** | **Active during 2012 % interviewed** | **Active during survey** | **Active during survey % interviewed** |
|---|---|---|---|---|---|
| Vietnamese-American | 70 | *58* | 83% | 68 | 85% |
| European-American | 44 | *43* | 98% | 44 | 98% |
| Korean-American | 15 | *14* | 93% | 14 | 100% |
| Fleet total | 129 | *115* | 89% | 126 | 91% |

Data source: 2012 in-person cost-earnings survey (PIFSC1)
* Vessel ethnic group is classified by the owner's ethnicity

In previous research, the Hawaii-based longline fleet has often been segmented into three vessel size classifications. In addition, there are vessels that target just bigeye tuna and those that target both bigeye tuna and swordfish. The number and response rate by target species and vessel size is provided in Table 3.

Table 3.--Number and percentage of interviewed Hawaii-based longline vessels by target species and vessel size.

| | **Active during 2012** | **Number interviewed** | **Active during 2012 % interviewed** | **Active during survey** | **Active during survey % interviewed** |
|---|---|---|---|---|---|
| *Target Species* | | | | | |
| Tuna | 111 | *99* | 89% | 108 | 92% |
| Swordfish | 18 | *16* | 89% | 18 | 89% |
| *Vessel Size* | | | | | |
| Small | 13 | *12* | 92% | 12 | 100% |
| Medium | 57 | *49* | 86% | 56 | 88% |
| Large | 59 | *54* | 92% | 58 | 93% |
| **Fleet** | **129** | ***115*** | **89%** | **126** | **91%** |

Data source: 2012 in-person cost-earnings survey (PIFSC1).

Vessels in each of the three size groups are representative in the study. Furthermore, vessels that only target bigeye tuna and vessels that declared shallow-set swordfish trips are almost equally representative in the study.

## Vessel and Operational Characteristics

The physical and operational characteristics of vessels according to target species and vessel size group are provided in Table 4. In general, vessels that set shallow to target swordfish tend to be larger, newer, and more expensive than the vessels that only target bigeye tuna. In 2012, Hawaii-based swordfish vessels operated with an average mainline of 44 miles, compared to an average of 36.6 miles for the tuna targeting vessels. However, declared swordfish trips deploy fewer hooks between floats, and correspondingly less hooks per set (1803 hooks) when compared with deep-set tuna trips (2433 hooks per set). Medium and large vessels share many of the same operational characteristics, such as number of trips per vessel, number of hooks per set, and length of mainline deployed per sets. However, vessel characteristics differ between size groups.

Table 4.--Vessel and operational characteristics by target species and vessel size: 2012 calendar year.

| | Tuna | | Swordfish | | Small | | Medium | | Large | |
|---|---|---|---|---|---|---|---|---|---|---|
| | ***n*** | **Mean** ◊ | ***n*** | **Mean** ◊ | ***n*** | **Mean** ◊ | ***n*** | **Mean** ◊ | ***n*** | **Mean** ◊ |
| **Vessel Characteristics** | | | | | | | | | | |
| Year vessel was built | *90* | 1984 | *16* | 1992 | *11* | 1978 | *46* | 1982 | *49* | 1990 |
| Year vessel was purchased | *89* | 1999 | *11* | 2003 | *11* | 1998 | *42* | 1998 | *47* | 2001 |
| Purchase price of vessel* | *84* | $394,214 | *11* | $567,546 | *10* | $228,000 | *43* | $321,488 | *42* | $553,643 |
| Startup cost* | *85* | $121,412 | *11* | $173,636 | *10* | $89,000 | *43* | $124,186 | *43* | $139,535 |
| Current/ appraisal value | *93* | $570,323 | *16* | $813,750 | *12* | $369,583 | *46* | $505,544 | *51* | $752,353 |
| Length (feet) | *98* | 74 | *16* | 82 | *12* | 55 | *48* | 71 | *54* | 84 |
| Width/beam (feet) | *97* | 21 | *16* | 24 | *12* | 17 | *48* | 21 | *53* | 24 |
| Fuel capacity (gallons) | *92* | 11,264 | *14* | 16,214 | *12* | 4,583 | *44* | 9,295 | *50* | 15,986 |
| Daily fuel consumption (gallons/day) | *89* | 206 | *16* | 264 | *12* | 117 | *45* | 189 | *48* | 264 |
| Maximum speed (knots) | *98* | 8.7 | *16* | 9.3 | *12* | 9.0 | *48* | 8.5 | *54* | 9.0 |
| Cruising speed (knots) | *98* | 7.0 | *15* | 7.3 | *12* | 6.7 | *48* | 7.2 | *53* | 7.1 |
| Fish holding capacity + ice for tuna (lbs) | *98* | 39,888 | *16* | 56,250 | *12* | 21,083 | *48* | 35,792 | *54* | 51,722 |
| Main engine horsepower (hp) | *93* | 425 | *16* | 538 | *12* | 325 | *47* | 415 | *50* | 495 |
| Secondary main engine horsepower (hp) | *17* | 367 | *6* | 413 | - | - | *4* | 345 | *18* | 376 |
| Vessel's total number of operational reels | *96* | 1.4 | *15* | 1.9 | *12* | 1.0 | *46* | 1.3 | *53* | 1.7 |
| **Operational Characteristics** | | | | | | | | | | |
| Average number of trips per vessel | *111* | 10.8 | *18* | 9.6 | *13* | 11.9 | *57* | 10.6 | *59* | 10.4 |
| Average number of sets per trip | *1,213* | 13.7 | *172* | 16.7 | *161* | 11.0 | *602* | 13.8 | *622* | 15.1 |
| Average number of hooks per set | *16,532* | 2,433 | *2,921* | 1,803 | *1,779* | 2,181 | *8,351* | 2,394 | *9,323* | 2,319 |

| | Tuna | | Swordfish | | Small | | Medium | | Large | |
|---|---|---|---|---|---|---|---|---|---|---|
| | ***n*** | **Mean** ◊ | ***n*** | **Mean** ◊ | ***n*** | **Mean** ◊ | ***n*** | **Mean** ◊ | ***n*** | **Mean** ◊ |
| Average length of mainline (miles) | *16,532* | 36.6 | *2,921* | 44.0 | *1,779* | 30.8 | *8,351* | 36.8 | *9,323* | 39.8 |
| Average miles to begin set (miles)[1] | *16,532* | 535 | *2,921* | 799 | *1,779* | 405 | *8,351* | 546 | *9,323* | 630 |
| Total number of crew (excluding operator) | *97* | 4.7 | *16* | 5.3 | *12* | 3.9 | *48* | 4.7 | *54* | 5.1 |
| Total number of U. S. crew | *97* | 0.7 | *16* | 0.1 | *12* | 1.1 | *48* | 0.7 | *54* | 0.4 |
| Total number of foreign crew | *97* | 4.0 | *16* | 5.3 | *12* | 2.8 | *48* | 4.0 | *54* | 4.6 |

Data sources: 2012 in-person cost-earnings survey (PIFSC1) and logbooks (NMFS)

◊Dollar values are in nominal terms

[1]Average miles to set distance is the distances from Honolulu Harbor in miles to the beginning of the set as calculated by longitude and latitude coordinates from NMFS logbooks

## Direct Cash Flow Summary of Cost and Earnings

Fleet-wide summary statistics for annual direct cash flows are provided in Table 5. The fleet-wide average annual direct net cash flow (direct net returns to the owner) in 2012 was $56,522 per vessel. Vessels that targeted only bigeye tuna had, on average, better economic performance than the vessels that also targeted swordfish. The average annual direct net cash flow for vessels that target bigeye tuna is assessed at $66,029, and at -$1,707 for vessels that had one or more declared swordfish trips. Although the annual gross revenues for swordfish targeting vessels are on average $100,000 greater than vessels that target only bigeye tuna, net revenues are considerably lower largely due to greater fuel costs. In addition, average non-fuel variable costs of vessels that target swordfish are around 24 percent greater than vessels that target bigeye tuna only. This is despite the fact that swordfish vessels hire proportionately more foreign crew, and are thus able to save 25 percent more than tuna targeting vessels in total average annual labor costs (not including operators' wages). When considering fixed costs, differences between tuna and swordfish vessels are more a factor of vessel size (see Table 4) than target species. Variable costs for swordfish vessels includes almost $20,000 spent on lightsticks on average, which is not realized by vessels that only go on deep-set tuna trips. The cost of using lightsticks to fish for swordfish has increased by 125 percent between 2005 and 2012. Nonetheless, there was a real decrease in the price of a 500-unit case of lightsticks, falling from the 2012-base average adjusted price of $252 in 2005, to the price of $208 in 2012. This suggests that the increase in costs are related to an increase in the number of lightsticks used per set, as the fleetwide total number of shallow-set hooks deployed remained comparable at 1,385,457 and 1,453,234 hooks in 2005 and 2012 respectively (a 5 percent increase).

Table 5.--Direct cash flow statement by target species group for 2012 operations.

| | All (*n* = 114, *N* = 129) | Tuna Only (*n* = 98, *N* = 111) | | | | Swordfish and Tuna (*n* = 16, *N* = 18) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Mean** | **Mean** | **Std. Dev.** | **Min 3 mean[•]** | **Max 3 Mean[•]** | **Mean** | **Std. Dev.** | **Min 3 mean[•]** | **Max 3 Mean[•]** |
| **Annual Revenue Per Vessel** | **$745,825** | **$731,80** | **264,766** | **$194,764** | **$1,448,139** | **$831,702** | **223,355** | **$527,456** | **$1,122,248** |
| **Annual Cost Information Per** | | | | | | | | | |
| A. Annual Sales Costs Per Vessel | $74,582 | $73,180 | 26,477 | $19,476 | $144,814 | $83,170 | 22,336 | $52,746 | $112,225 |
| B. Hawaii Longline Association | $3,329 | $3,316 | 1,286 | $0 | $6,028 | $3,798 | 1,437 | $1,641 | $5,497 |
| C. Annual Variable Costs Per | $339,660 | $320,79 | 91,710 | $112,402 | $508,820 | $455,200 | 75,564 | $360,271 | $567,736 |
| *Fuel* | $201,165 | $187,48 | 68,189 | $58,884 | $340,776 | $284,962 | 53,234 | $217,395 | $360,897 |
| *Oil* | $6,287 | $6,051 | 2,485 | $1,846 | $12,179 | $7,726 | 1,617 | $5,306 | $9,802 |
| *Ice* | $10,717 | $12,133 | 8,712 | $0 | $29,757 | $2,042 | 4,911 | $0 | $9,559 |
| *Bait* | $63,503 | $62,415 | 15,885 | $21,365 | $88,438 | $70,165 | 12,763 | $52,571 | $86,615 |
| *Fishing Gear and Equipment* | $26,008 | $24,458 | 8,520 | $6,593 | $42,700 | $35,503 | 12,604 | $25,000 | $58,517 |
| *Provisions* | $23,958 | $23,008 | 6,320 | $7,417 | $39,917 | $29,783 | 7,792 | $21,250 | $42,350 |
| *Communication* | $5,293 | $5,248 | 3,389 | $0 | $16,467 | $5,569 | 2,622 | $2,033 | $9,183 |
| *Lightsticks* | $2,730 | | | | | $19,450 | 6,982 | $9,907 | $28,494 |
| **Net Revenue (Rev. less A, B and** | **$328,253** | **$334,51** | **184,787** | **-$5,941** | **$899,268** | **$289,533** | **161,541** | **$71,742** | **$508,491** |
| D. Annual Labor Costs Per Vessel | $173,148 | $170,53 | 98,697 | $25,211 | $509,088 | $189,133 | 67,107 | $104,071 | $284,194 |
| *Captain Wages (By Share)* | $100,528 | $96,355 | 55,242 | $6,932 | $239,675 | $126,087 | 65,497 | $46,641 | $215,839 |
| *Crew Wages (By Share)* | $36,145 | $41,129 | 72,373 | $0 | $317,709 | $5,619 | 22,476 | $0 | $29,968 |
| *Crew Wages (By Flat Rate)* | $24,056 | $22,456 | 15,500 | $0 | $56,000 | $33,855 | 7,017 | $24,800 | $42,160 |
| *Crew Bonus* | $2,798 | $1,441 | 3,580 | $0 | $16,543 | $11,109 | 13,709 | $379 | $36,486 |
| *Miscellaneous Labor Costs* | $9,621 | $9,157 | 6,947 | $0 | $24,000 | $12,464 | 8,576 | $0 | $23,750 |
| E. Annual Fixed Costs Per Vessel | $98,529 | $97,944 | 38,780 | $40,213 | $232,263 | $102,108 | 30,015 | $71,472 | $153,692 |
| *Mooring Fees* | $5,571 | $5,617 | 3,327 | $1,515 | $19,427 | $5,288 | 2,251 | $2,580 | $8,950 |
| *Bookkeeping Fees* | $2,281 | $2,609 | 3,575 | $0 | $14,289 | $269 | 905 | $0 | $1,433 |
| *Insurance* | $27,230 | $26,867 | 7,639 | $7,800 | $47,333 | $29,452 | 5,555 | $23,667 | $38,667 |
| *Dry Dock* | $14,825 | $14,151 | 9,148 | $3,472 | $48,889 | $18,950 | 10,022 | $11,083 | $35,556 |
| *Engine(s) Overhaul* | $6,293 | $6,421 | 4,026 | $178 | $25,000 | $5,515 | 1,965 | $2,133 | $7,002 |
| *Major Repair* | $14,908 | $14,499 | 17,451 | $0 | $83,333 | $17,415 | 16,169 | $0 | $45,000 |
| *Routine Repair* | $21,082 | $21,551 | 20,261 | $0 | $100,000 | $18,208 | 9,488 | $1,667 | $28,667 |
| *Miscellaneous Fixed Costs* | $1,219 | $1,384 | 4,270 | $0 | $24,000 | $211 | 456.781 | $0 | $1,123 |
| *Loan Payments* | $5,119 | $4,845 | 14,014 | $0 | $73,810 | $6,802 | 12,848 | $0 | $27,744 |
| **Net Cash Flow (Net Rev. less D and** | **$56,522** | **$66,029** | **123,813** | **-$203,248** | **$413,679** | **-$1,707** | **134,315** | **-$163,251** | **$185,964** |

Data source: 2012 cost-earnings in-person survey (PIFSC1), dealer reports (HDAR), federal logbooks (NMFS), and trip expenditure form (PIFSC2)

[•]Mean of the lowest three or largest three values; used as a proxy for the minimum and maximum values of confidential information

Summarized annual direct cash flow statements among vessel size groups for vessels that only targeted bigeye tuna during 2012 are provided in Table 6.

Table 6.--Direct cash flow statement for tuna vessels by size: 2012 operations.

| | **Small (n = 12, *N* = 13)** | | **Medium (*n* = 47, *N* = 56)** | | **Large (*n* = 39, *N* = 42)** | |
|---|---|---|---|---|---|---|
| | **Mean** | **Std. Dev.** | **Mean** | **Std. Dev.** | **Mean** | **Std. Dev.** |
| **Annual Revenue Per Vessel** | **$552,840** | **210,112** | **$698,836** | **256,531** | **$826,600** | **257,774** |
| **Annual Cost Information Per Vessel** | | | | | | |
| A. Annual Sales Costs Per Vessel | $55,284 | 21,011 | $69,884 | 25,653 | $82,660 | 25,777 |
| B. Hawaii Longline Association Fees | $2,344 | 1,068 | $3,172 | 1,318 | $3,788 | 1,116 |
| C. Annual Variable Costs Per Vessel | $245,018 | 46,298 | $295,059 | 71,428 | $375,131 | 95,035 |
| *Fuel* | $115,635 | 31,624 | $166,934 | 46,498 | $234,356 | 67,522 |
| *Oil* | $4,048 | 2,452 | $5,563 | 2,462 | $7,257 | 1,911 |
| *Ice* | $15,928 | 5,354 | $12,898 | 8,737 | $10,043 | 9,144 |
| *Bait* | $56,529 | 13,416 | $59,078 | 14,579 | $68,247 | 16,620 |
| *Fishing Gear and Equipment* | $23,717 | 7,321 | $23,423 | 7,780 | $25,933 | 9,675 |
| *Provisions* | $23,892 | 8,120 | $22,341 | 5,751 | $23,539 | 6,494 |
| *Communication* | $5,269 | 5,564 | $4,822 | 3,055 | $5,756 | 3,003 |
| **Net Revenue (Rev. less A, B and C)** | **$250,194** | **150,054** | **$330,721** | **189,387** | **$365,021** | **185,113** |
| D. Annual Labor Costs Per Vessel | $132,079 | 60,623 | $171,045 | 114,585 | $181,761 | 90,324 |
| *Captain Wages (By Share)* | $72,271 | 33,366 | $91,873 | 54,021 | $109,167 | 59,670 |
| *Crew Wages (By Share)* | $38,842 | 45,338 | $47,061 | 91,323 | $34,684 | 61,625 |
| *Crew Wages (By Flat Rate)* | $15,005 | 11,264 | $21,600 | 15,839 | $25,780 | 15,697 |
| *Crew Bonus* | $233 | 808 | $1,424 | 4,592 | $1,834 | 3,359 |
| *Miscellaneous Labor Costs* | $5,729 | 6,032 | $9,087 | 6,805 | $10,296 | 7,184 |
| E. Annual Fixed Costs Per Vessel | $91,125 | 21,962 | $97,566 | 45,121 | $100,497 | 35,222 |
| *Mooring Fees* | $3,933 | 2,144 | $5,737 | 4,638 | $5,992 | 2,496 |
| *Bookkeeping Fees* | $3,101 | 3,607 | $2,401 | 2,989 | $2,709 | 4,249 |
| *Insurance* | $23,460 | 6,289 | $25,280 | 7,178 | $29,829 | 7,878 |
| *Dry Dock* | $11,555 | 5,040 | $13,667 | 10,005 | $15,533 | 8,995 |
| *Engine(s) Overhaul*[3] | $8,269 | 12,040 | $6,021 | 2,993 | $6,334 | 2,170 |
| *Major Repair* | $13,117 | 14,167 | $15,465 | 22,453 | $13,760 | 15,322 |
| *Routine Repair* | $20,290 | 13,362 | $23,495 | 23,896 | $19,595 | 17,199 |
| *Miscellaneous Fixed Costs* | $3,477 | 10,030 | $1,444 | 4,308 | $668 | 1,269 |
| *Loan Payments* | $3,923 | 9,044 | $4,057 | 14,952 | $6,078 | 15,413 |
| **Net Cash Flow (Net Rev. less D and E)** | **$26,990** | **116,498** | **$62,110** | **126,250** | **$82,763** | **124,756** |

Data source: 2012 cost-earnings in-person survey (PIFSC1), dealer reports (HDAR), federal logbooks (NMFS), and trip expenditure form (PIFSC2).

On average, the large vessel group had the greatest net cash flow. In general, net cash flow averaged between 5 to 10 percent of gross revenues depending on vessel size group. The proportion of revenue that went towards variable costs (38 to 41 percent) and labor costs (22 to 24 percent) and fixed costs (12 to 16 percent) were relatively uniform across vessel size groups. The small vessel group had proportionally lower fuel costs; however, had proportionally higher non-fuel variable costs.

## Vessel Operators and Crew Wages

A direct cash flow summary between vessels that are operated by a hired captain and those that are owner-operated (not including the shadow price of the captain's wages) is provided in Table 7. There were more vessels operated by hired captains than those that were owner-operated in 2012. Among the 114 surveyed vessels, approximately three fifths of the vessels were operated by hired captains. Overall, variable costs and fixed costs between these two types of operations were very similar, while the revenue per vessel operated by a hired captain was higher than an average vessel operated by the owners. The net cash flow per vessel between these two groups was statistically different at the 90% confidence level, with a p-value of 0.064. This is due to the combination of Owner Operators having slightly lower average gross revenues and the compounding of slightly higher operational and fixed costs.

Table 7.--Direct cash flow summary by hired captain and owner operator: 2012 operations.

| | **Hired Captains (*n* = 69)** | | **Owner Operators (*n* = 45)** | |
|---|---|---|---|---|
| | **Mean** | **Std. Dev.** | **Mean** | **Std. Dev.** |
| Annual Revenue Per Vessel | $753,596 | 295,945 | $733,908 | 199,032 |
| Annual Variable Costs Per Vessel | $329,647 | 98,767 | $355,014 | 103,342 |
| Net Revenue | $345,188 | 204,438 | $302,147 | 138,889 |
| Annual Labor Costs | $175,182 | 93,868 | $170,029 | 101,074 |
| Annual Fixed Costs Per Vessel | $96,296 | 33,460 | $101,951 | 43,607 |
| Net Cash Flow (Net Rev. less C and D) | $73,709 | 134,397 | $30,167 | 112,581 |

Data source: 2012 cost-earnings in-person survey (PIFSC1), dealer reports (HDAR), federal logbooks (NMFS), and trip expenditure form (PIFSC2).

Average annual pay for crew is presented in Table 8. Hired captains on average earned more than $100,000 in 2012. It is important to note that there are proportionately more highliner vessels that are operated by hired captains.[12] Whereas, there are proportionately more owner-operated vessels that target swordfish (Table 5), which on average had lower net cash flows but larger average gross revenues than did tuna vessels.

[12]Highliners are those vessels that are the highest earning vessels within a fishery. Fifteen vessels grossed more than a million dollars in revenue in 2012; 14 of those where vessels were operated by a hired captain for at least part of 2012.

Table 8.--Individual crew payments by wage type and position for 2012 operations.

| | Swordfish | Small Tuna | Medium. Tuna | Large Tuna | All Vessels |
|---|---|---|---|---|---|
| **Portion of foreign crew** | 99% | 71% | 84% | 89% | 86% |
| **Hired Captain** | $135,233 | $74,572 | $93,015 | $108,532 | $101,845 |
| **Crew Shares** | Confidential | $25,743 | $24,070 | $24,147 | $25,945 |
| **Crew Flat Pay** | $6,818 | $6,600 | $6,830 | $6,869 | $6,820 |

Data source: 2012 cost-earnings in-person survey (PIFSC1), dealer reports (HDAR), federal logbooks (NMFS), and trip expenditure form (PIFSC2)

## Indirect Cash Flow Summary of Cost and Earnings

The costs and earnings summary of the indirect net returns for the Hawaii-based longline fishery is presented in Table 9. The value of the vessel at the time of purchase and the value of the vessel in 2012 (for all the vessels surveyed) were used to calculate the average annual percentage rate of appreciation, which was found to be 2.2 percent.[13] The positive rate indicates that, on average, Hawaii-based permitted longline vessels appreciated in value as a capital investment at about the same rate as inflation during the same time period. However, the calculated depreciation/appreciation values differed significantly across vessels within the fleet, with some vessel indicating depreciation since time of purchase.

Table 9.--Indirect cash flow summary by swordfish vessels and by size groups for tuna vessels based on 2012 operations.

| | **Total** | **Swordfish** | **Small Tuna** | **Med. Tuna** | **Large Tuna** |
|---|---|---|---|---|---|
| | **(*n* = 114)** | **(*n* = 16)** | **(*n* = 12)** | **(*n* = 47)** | **(*n* = 39)** |
| Net Cash Flow (*w/o Loan Payments*) | $61,641 | $5,094 | $30,913 | $66,167 | $88,841 |
| *Interest on Loan* | -$1,271 | -$1,747 | -$981 | -$1,050 | -$1,431 |
| *Appreciation/ Depreciation of Vessel* | $12,485 | $18,058 | $9,366 | $8,925 | $15,450 |
| Net Returns to the Owner | $72,855 | $21,405 | $39,298 | $74,042 | $102,860 |

Data source: 2012 cost-earnings in-person survey (PIFSC1), dealer reports (HDAR), federal logbooks (NMFS), trip expenditure form (PIFSC2).

Using Equation 1, a vessel in the Hawaii-based longline fleet was found to appreciate by an average of $12,485 in value during the course of the 2012 calendar year. Since almost all vessels in the Hawaii-based longline fleet are required to be regularly maintained and updated by insurance carriers, which are accounted for in fixed costs, the majority of the depreciation/appreciation of a vessel is believed to be attributed to permit values. Permit values are directly related to the economic health of the limited entry fishery.

[13] The rate calculated using only the 50 vessels owned for 10 or more years was found to be 0.5 percent.

## Economic Distribution of the Fleet

The histograms and kernel density estimates for vessel revenues, net revenues, and net cash flows (solid lines) in relation to the normal density function around the mean (dotted lines) are shown in Figure 6. The 2012 gross revenue distribution among vessels in the Hawaii-based longline fleet resemble a normal curve, with the majority of vessels grossing revenues within plus or minus one standard deviation ($261,196) from the mean ($745,825). A few high-line vessels in the fleet have net revenues outside the right tail of the normal distribution function. However, high-line vessels have a larger relative frequency of hired captains and crews which are compensated by shares of gross or net revenues than the relative frequency of owner-operator and crews compensated by a flat monthly payment. These vessels were also found to invest more of their net returns into vessel upgrades and major repairs (fixed costs), which in effect, helped to normalize the right tail of the direct net returns distribution.

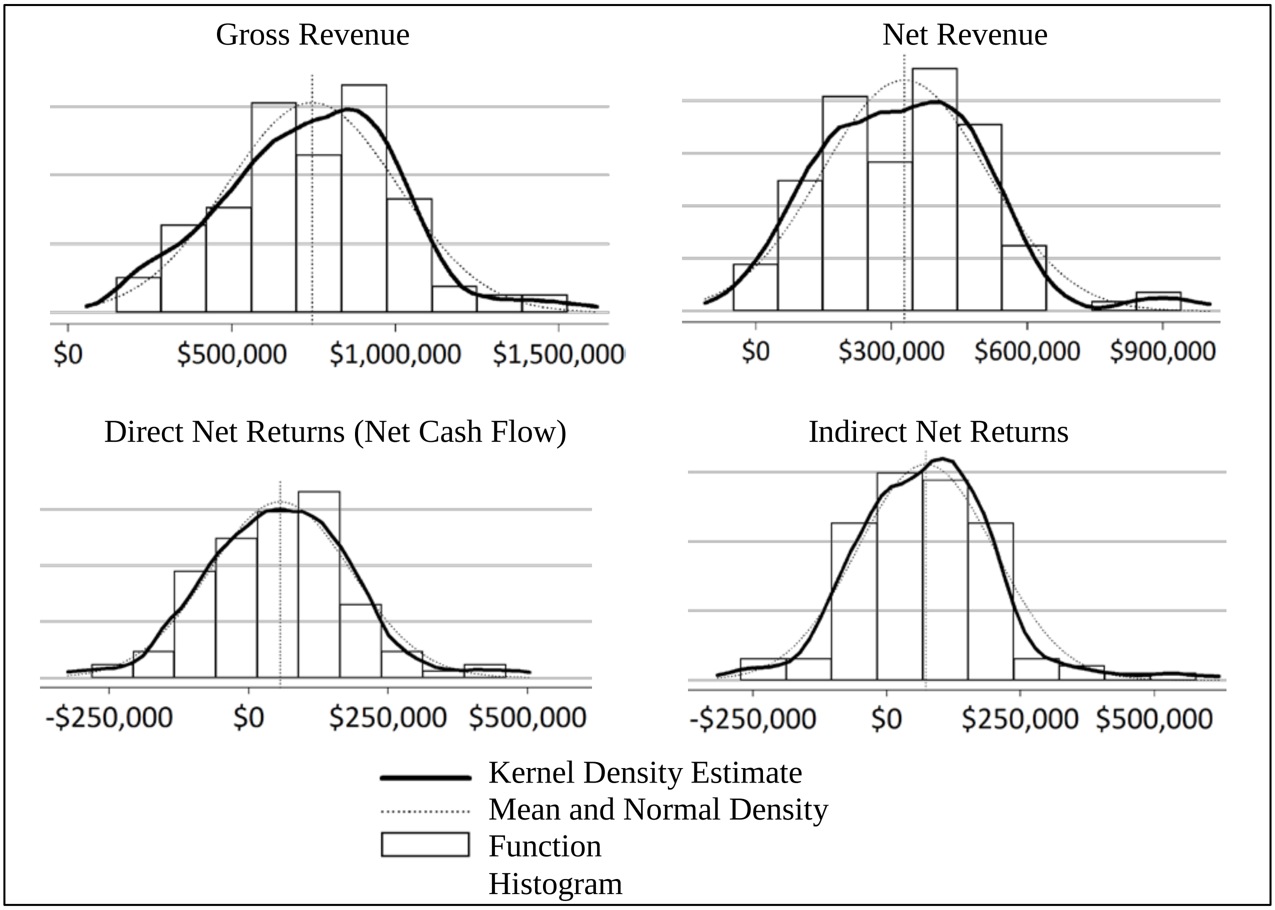



Figure 6.--2012 sample distribution for revenues, net revenues, direct net cash flow, and indirect net returns density estimate and histogram[14].

[14] Data source: 2012 cost-earnings in-person survey, dealer reports (HDAR), federal logbooks (NMFS), trip expenditure form (PIFSC2)

## Economic Trends

The direct cash flow statement for average cost and earnings between operating a Hawaii-based longline vessel in 2005 and operation in 2012 is provided in Table 10. In 2012, average revenue per vessel was $745,825, up 18 percent from 2005 (2012 adjusted value) with a 16 percent average change (ACB) between 2005 and 2012. The fleet-wide real revenue increase is primarily a result of more bigeye tuna landings in 2012.[15] After deducting variable costs (fuel cost, bait cost, etc.), fixed costs, and labor costs, the annual net direct cash flow averaged $56,522, up 233 percent from the 2005 level, or up 108 percent from the average level between 2005 and 2012.

[15] The average Hawaii-based longline vessel landed 19 percent more bigeye tunas in 2012 when compared with 2005 from declared tuna trips. However, the total number of deep-set hooks per vessel increased by 23 percent between 2005 and 2012 based on NMFS logbooks.

Table 10.--Fleet-wide adjusted and nominal average direct cash flow statement for 2005 and average direct cash flow for 2012.

| | 2005 (*n* = 98, *N* = 125) | | | | | | 2012 (*n* = 114, *N* = 129) | | | | | Average Percent Change between □ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Adj. Mean □** | **Nominal Mean** | **Std. Dev. †** | **Min 3 mean •†** | **Max 3 Mean •†** | **C. V. □** | **Mean** | **Std. Dev.** | **Min 3 mean •** | **Max 3 Mean •** | **C. V.** | |
| **Annual Revenue Per Vessel** | **$634,506** | **$503,079** | **218,588** | **$128,244** | **$1,148,682** | **0.34** | **$745,825** | **261,196** | **$194,764** | **$1,448,139** | **0.35** | **16%** |
| **Annual Cost Information Per Vessel** | | | | | | | | | | | | |
| A. Annual Sales Costs Per Vessel | $63,451 | $50,308 | 21,859 | $12,824 | $114,868 | 0.34 | $74,582 | 26,120 | $19,476 | $144,814 | 0.35 | 16% |
| B. Hawaii Longline Association Fees[1] | $4,009 | $3,179 | 1,342 | $817 | $7,215 | 0.33 | $3,384 | 1,314 | $0 | $6,058 | 0.39 | -17% |
| C. Annual Variable Costs Per Vessel | $261,452 | $207,297 | 79,722 | $72,814 | $416,136 | 0.3 | $339,660 | 100,915 | $112,402 | $567,736 | 0.3 | 26% |
| *Fuel* | $121,463 | $96,304 | 43,216 | $30,124 | $202,914 | 0.36 | $201,165 | 74,334 | $58,884 | $367,827 | 0.37 | 49% |
| *Oil* | $4,820 | $3,822 | 1,941 | $801 | $9,717 | 0.4 | $6,287 | 2,449 | $1,846 | $12,179 | 0.39 | 26% |
| *Ice* | $13,660 | $10,831 | 9,533 | $0 | $32,664 | 0.7 | $10,717 | 8,992 | $0 | $29,757 | 0.84 | -24% |
| *Bait* | $59,641 | $47,287 | 16,982 | $19,486 | $92,732 | 0.28 | $63,503 | 15,682 | $21,365 | $89,493 | 0.25 | 6% |
| *Fishing Gear and Equipment* | $29,985 | $23,774 | 12,871 | $4,688 | $63,289 | 0.43 | $26,008 | 9,926 | $6,593 | $58,517 | 0.38 | -14% |
| *Provisions* | $23,213 | $18,405 | 8,882 | $3,679 | $51,411 | 0.38 | $23,958 | 6,934 | $7,417 | $44,333 | 0.29 | 3% |
| *Communication* | $2,595 | $2,058 | 2,547 | $0 | $9,670 | 0.98 | $5,293 | 3,307 | $0 | $16,467 | 0.62 | 68% |
| *Certificates*[2] | $1,384 | $1,097 | 3,729 | $0 | $14,883 | 2.69 | | | | | | |
| *Lightsticks* | $4,691 | $3,719 | 9,582 | $0 | $36,551 | 2.04 | $2,730 | 7,247 | $0 | $28,494 | 2.65 | -53% |
| **Net Revenue (Rev. less A, B and C)** | **$305,594** | **$242,296** | **139,689** | **$32,921** | **$641,377** | **0.46** | **$328,198** | **181,958** | **-$20,152** | **$899,268** | **0.55** | **7%** |
| D. Annual Labor Costs Per Vessel | $160,385 | $127,164 | 63,091 | $20,699 | $303,890 | 0.39 | $173,148 | 96,367 | $25,211 | $509,088 | 0.56 | 8% |
| *Captain Wages (By Share)* | $67,140 | $53,234 | 31,659 | $9,442 | $140,890 | 0.47 | $100,528 | 57,422 | $6,932 | $244,674 | 0.57 | 40% |
| *Crew Wages (By Share)* | $20,989 | $16,641 | 38,018 | -$7,427 | $142,851 | 1.81 | $36,145 | 71,570 | $0 | $317,709 | 1.98 | 53% |
| *Crew Wages (By Flat Rate)* | $52,960 | $41,991 | 37,186 | $0 | $144,311 | 0.7 | $24,056 | 15,156 | $0 | $56,000 | 0.63 | -75% |
| *Crew Bonus*[3] | | | | | | | $2,798 | 6,998 | $0 | $36,486 | 2.5 | |
| *Miscellaneous Labor Costs* | $19,296 | $15,299 | 17,084 | $0 | $82,569 | 0.89 | $9,621 | 7,249 | $0 | $25,000 | 0.75 | -67% |
| E. Annual Fixed Costs Per Vessel | $128,253 | $101,688 | 54,657 | $35,385 | $289,548 | 0.43 | $98,529 | 37,708 | $40,213 | $232,263 | 0.38 | -26% |
| *Mooring Fees* | $5,829 | $4,622 | 3,417 | $1,535 | $18,162 | 0.59 | $5,571 | 3,513 | $1,515 | $19,427 | 0.63 | -5% |
| *Bookkeeping Fees* | $3,080 | $2,442 | 3,772 | $0 | $15,766 | 1.22 | $2,281 | 3,435 | $0 | $14,289 | 1.51 | -30% |
| *Insurance* | $33,738 | $26,750 | 13,435 | $830 | $63,062 | 0.4 | $27,230 | 7,477 | $7,800 | $47,333 | 0.27 | -21% |
| *Dry Dock*[4] | | | | | | | $14,825 | 9,383 | $3,472 | $50,000 | 0.63 | |
| *Engine(s) Overhaul*[4] | | | | | | | $6,293 | 4,515 | $44 | $25,000 | 0.72 | |
| *Major Repair* | $28,772 | $22,813 | 21,596 | $4,755 | $99,736 | 0.95 | $14,908 | 18,445 | $0 | $83,333 | 1.24 | -63% |
| *Routine Repair* | $32,574 | $25,827 | 21,569 | $0 | $98,159 | 0.66 | $21,082 | 19,123 | $0 | $100,000 | 0.91 | -43% |
| *Miscellaneous Fixed Costs* | $4,703 | $3,729 | 12,430 | $0 | $59,278 | 2.64 | $1,219 | 4,328 | $0 | $24,000 | 3.55 | -118% |
| *Loan Payments* | $19,557 | $15,506 | 36,501 | $0 | $157,403 | 1.87 | $5,119 | 14,217 | $0 | $73,810 | 2.78 | -117% |
| **Net Cash Flow (Net Rev. less D and** | **$16,955** | **$13,443** | **108,308** | **-$231,681** | **$281,955** | **6.39** | **$56,522** | **127,521** | **-** | **$413,679** | **2.26** | **108%** |

Data source: 2012 cost-earnings in-person survey (PIFSC1), dealer reports (HDAR), federal logbooks (NMFS), and trip expenditure form (PIFSC2)

- • Mean of the lowest three or larges three values; used as a proxy for the minimum and maximum values of confidential information
- † Honolulu Hawaii CPI adjusted values adjusted to 2012 were applied to compare 2005 values with 2012 values
- 1 Hawaii Longline Association membership was not accounted for in the 2005 Cost-Earnings Survey, therefore all vessels were considered Hawaii Longline Association member for 2005 due to lack of information
- 2 In 2005, 2,074 swordfish certificates were issued to 122 permit holders and then could be transferred in a certificate market (WPRFMC, 2006)
- 3 Crew bonuses in the 2005 cost-earnings report were considered part of the miscellaneous labor costs
- 4 Dry dock and engine overhaul expenditures were summarized as part of the major, routine or miscellaneous cost in the 2005 cost-earnings report and may not be accurately compared

The 233 percent increase in direct net returns to the owner is a result of the revenue to cost ratio, which was 1.082 percent in 2012, compared to only 1.027 percent in 2005. Although there was an 18 percent increase in gross revenue in 2012 over 2005, there was also a 12 percent increase in overall annual costs (A + B + C + D + E, Table 10).

In 2012, fuel costs (29 percent of total cost) exceeded labor cost (25 percent) as the largest input cost of operating a Hawaii-based longline vessel. Whereas in 2005, labor was the single largest cost associated with operating a vessel in the Hawaii-based longline fleet (25 percent of total costs), with fuel and fixed costs both coming in around 20 percent of total costs. On average, trip-based costs have increased over time. However, ice is one item where the cost has decreased between 2005 and 2012. Despite the average 2012 adjusted price of a block of ice increasing from $9.80 in 2005 to $11.50 in 2012, ice costs have decreased as a result of more vessels having the capability to make their own ice with an onboard ice maker.

Overall labor costs have increased by 8 percent, primarily due to an increase in captains' wages which is a percentage of earnings. In addition to captain's share increases of 40 percent (50 percent average change), average annual crew labor costs have also increased. In 2005 and 2012, labor costs ($160,385 and $173,148, respectively) accounted for a quarter of the total costs ($617,550 and $689,303, respectively) of operating a Hawaii-based longline vessel. However, the switch to foreign crew has reduced the proportion of labor costs tied to a share of the vessel earnings.

The fixed costs of owning and operating a vessel in the Hawaii-based longline fleet was found to be relatively constant between the 2005 and 2012 cost-earnings studies, besides a few line items. In 2005, fixed costs ($128,253) accounted for 21 percent of the total costs ($617,550) of owning a Hawaii-based longline vessel. In 2012, fixed costs ($98,529) accounted for 14 percent of the total costs ($689,303). The 26 percent decrease, or negative 23 percent average change in fixed costs between 2005 and 2012 appears to be linked to a decrease in loan payments. The decline in average annual loan payments is attributed to many of the loans maturing over the course of the 7 years between studies, as on average, vessels were acquired over 12 years prior to 2012 (Table 4).

The direct cash flow summary comparison of the economic condition of the Hawaii-based longline fishery among 2000, 2005, and 2012 operating years, along with the percent change between studies, is provided in Table 11. In 2000 tuna vessels had real gross revenues and real total costs similar to those observed in 2012, with only a 4 percent average change between gross revenues in 2000 and 2012. Vessels that targeted swordfish had a real 12 percent and 6 percent average change in gross revenues between 2000 and 2005, and 2005 and 2012, respectively. Similarly, total costs for vessels that target swordfish also increased by an average of 11 and 13 percent between each study. Although some of the methodologies used to calculate direct net cash flow might differ slightly between studies, a general comparison indicates that on average, operations in the year 2000 were the most profitable for tuna vessels, with a 2012 adjusted net cash flow of $77,910, while 2005 appears to have been the most profitable year for swordfish vessels among the three operational years studied.

Table 11.--Cash flow trends by targets: 2000, 2005, and 2012.

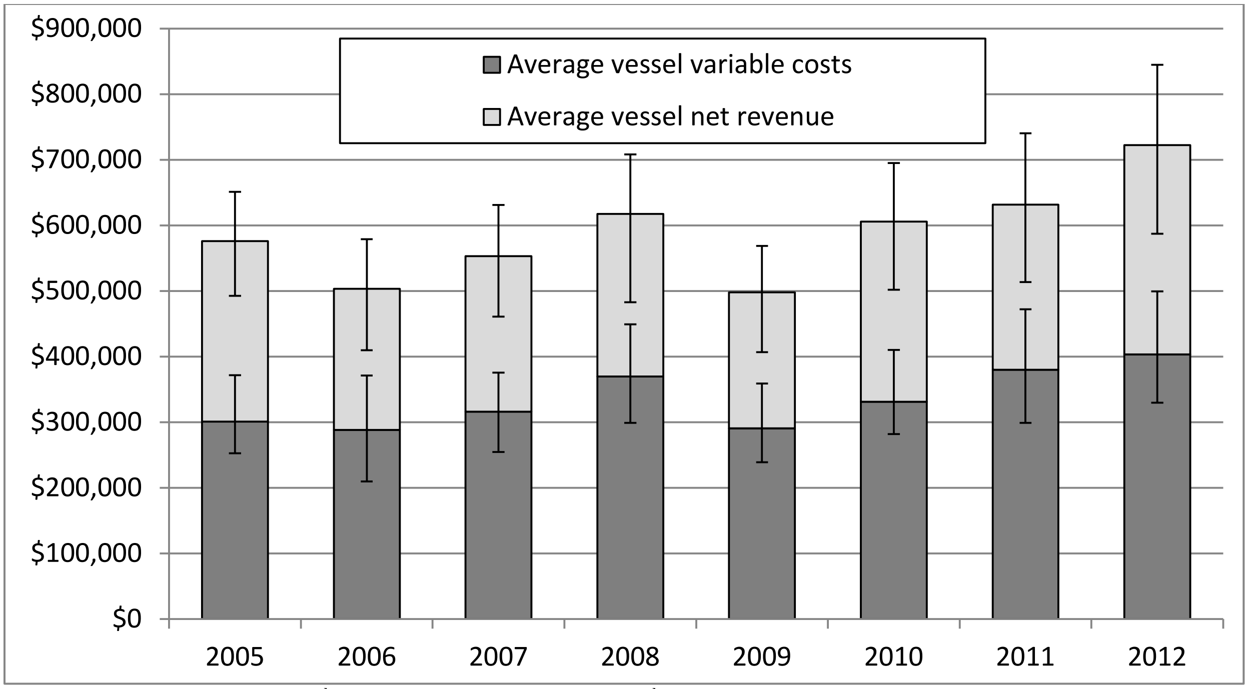
Data source: 2012 cost-earnings in-person survey (PIFSC1), dealer reports (HDAR), federal logbooks (NMFS), and

| | 2000 † | 2005 † | 2012 | Average Percent (%) Change | | |
|---|---|---|---|---|---|---|
| | | Tuna Only | | 2005 & 2000 | 2012 & 2000 | 2012 & |
| Annual Gross | $701,097 | $589,613 | $731,804 | -17 | 4 | 22 |
| Annual Variable | $261,765 | $303,394 | $397,293 | 15 | 41 | 27 |
| Annual Labor Costs | $233,222 | $154,069 | $170,538 | -41 | -31 | 10 |
| Annual Fixed Costs | $128,200 | $124,540 | $97,944 | -3 | -27 | -24 |
| Net Cash Flow | $77,910 | $7,611 | $66,029 | -164 | -17 | 159 |
| | | Swordfish | | | | |
| Annual Gross | $693,802 | $780,895 | $831,702 | 12 | 18 | 6 |
| Annual Variable | $325,791 | $412,123 | $542,168 | 23 | 50 | 27 |
| Annual Labor Costs | $197,229 | $180,984 | $189,133 | -9 | -4 | 4 |
| Annual Fixed Costs | $131,893 | $140,363 | $102,108 | 6 | -25 | -32 |
| Net Cash Flow | $38,890 | $47,426 | -$1,707 | 20 | -218 | -215 |

trip expenditure form (PIFSC2)

† Honolulu Hawaii CPI adjusted values adjusted to 2012 were applied to compare 2000 and 2005 values with 2012 values.

It is useful to look at the economic trends since 2005 to help explain the change in fleet-wide revenues and variable costs over the previous eight years. Annual values (adjusted to 2012 values) for average gross revenues, net revenues, and variable costs for all active vessels during 2005 to 2012 are shown in Figure 7. Average gross revenues and average variable costs are highly correlated and fluctuate together among years. Net revenues are highly dependent on three primary factors; fuel prices, fish prices, and landings. The variability in gross revenues coincides with variable costs via fishing effort such as total landings and other endogenous factors.




The error bars indicate the 25th percentile (lower) and the 75th percentile (upper) to encompass the middle two quarters of the fleet.

Figure 7.--Annual adjusted average vessel revenues and variable costs: 2005-2012[16].

The fishery has seen a significant economic improvement since the previous cost-earnings study in 2005. In 2012, gross revenues were the highest to date, with average revenues exceeding $700,000 per vessel. The 2012 calendar year was a particularly profitable year for the Hawaii-based longline fleet (Table 7), due in part to higher-than-average bigeye tuna landings and elevated bigeye prices. The annual 2012 adjusted average price per pound[17] of bigeye tuna and swordfish over the 2005–2012 period, along with the average price of fuel are shown in Figure 8.

[16] Data Sources: logbooks (NMFS), dealer reports (HDAR), and trip expenditure form (PIFSC-PIRO)
[17] Price per pound is based on the weight of the fish when sold at auction. Depending on the species, the weight of fish landed at auction often is less than the whole weight of the fish prior to removing the guts and gills.

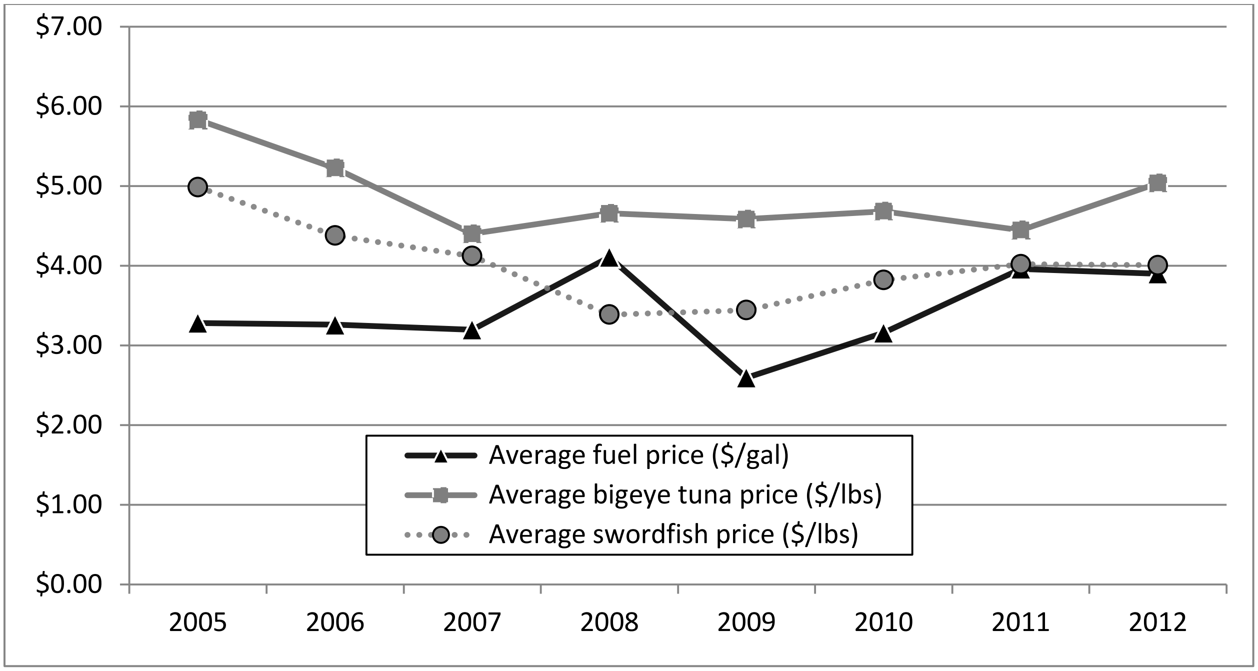



Figure 8.--Annual adjusted average price trends, bigeye tuna, swordfish, and fuel: 2005-2012[18].

Average bigeye tuna prices trended greater than swordfish prices, although they are also more variable. The real price of bigeye remained relatively constant from 2007 to 2011, but increased 13 percent, from $4.45 per pound to $5.04 per pound, between 2011 and 2012. Besides the improvement of bigeye tuna prices over 2011, increases in gross revenue are primarily a factor of increases in effort (see Figs. 2-5), measured by the number of annual hooks set per vessel.

## Catch Shares

Three questions on the survey addressed the vessel owners' and/or operators' knowledge and perceptions of catch share programs. The first question asked, "Are you familiar with catch share/individual transferable quotas (ITQ or IFQ)?" Respondents were also asked, "Do you support a catch share/ITQ program in Hawaii's longline fishery?" The cross-tabulated response to these two questions that gauge the knowledge and perceptions of catch share programs in the Hawaii-based longline fishery is presented in Table 12.

[18] Data Sources: logbooks (NMFS), dealer reports (HDAR), and trip expenditure form (PIFSC2)
Price per pound is based on the weight of the fish when sold. Depending on the species, the weight of fish landed is often less than the whole weight of the fish prior to removing the guts and gills.

Table 12.--Cross-tabulation of responses to the knowledge by perceptions of catch shares in Hawaii-based longline fishery.

| | | Are you familiar with catch share/ individual transferable quotas (ITQ or IFQ)? | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | No | | Somewhat | | Yes | | Total |
| Do you support a catch share/ ITQ program in Hawaii's longline fishery? | No | 15 | 34% | 2 | 5% | 27 | 61% | 44 |
| | Unsure | 28 | 78% | 1 | 3% | 7 | 19% | 36 |
| | Yes | 7 | 50% | 1 | 7% | 6 | 43% | 14 |
| | Total | 50 | 53% | 4 | 4% | 40 | 43% | 94 |

Data sources: 2012 in-person cost-earnings survey (PIFSC1).

Of the respondents that answered questions that address knowledge and perceptions about catch shares, more than half (50 of the 94 participants) were not familiar with catch shares. Among the 40 owner and/or operators who were familiar with catch-share programs, the majority (27) opposed a catch-share program in the Hawaii-based longline fishery. Similarly, half of the four respondents that were somewhat familiar with catch shares were not supportive of a catch-share program in the Hawaii-based longline fishery. In total, 44 respondents opposed a catch-share program, 36 were unsure, and 14 were in favor.

In addition to the two questions that gauged the knowledge and perceptions about catch-share programs, respondents were also asked to briefly state why they were or were not in support of a catch-share program being implemented in the Hawaii-based longline fishery. Based on the survey answers, the three biggest concerns mentioned were allocation, fairness, and consolidation. Additionally, more than a quarter of these individuals also voiced concerns of a catch-share program enabling influence from either governing entities or corporations that are not current stakeholders in the fishery. Some of these stakeholders mentioned that a catch share program would make it difficult for new entrants and would be bad for growth of the fishery. In contrast, overfishing and time management were the two most mentioned reasons for supporting a catch share program in the Hawaii-based longline fishery. Among the 14 respondents that were in favor of a catch-share program, nearly half still mentioned allocation, and three mentioned fairness as important issues.

The tabulated response to the questions that gauge the knowledge and perceptions for catch-share programs by ethnic group is presented in Table 13. The vast majority of European-American stakeholders were familiar with catch shares and opposed such a program for the Hawaii-based longline fishery. The majority of Vietnamese-Americans were unfamiliar with catch shares and were either unsure or opposed to such a program. There were proportionally more Korean-Americans that, after learning what a catch-share program was, were in favor of adopting of a catch-share program to replace the limited-entry, bigeye-tuna-catch quota system that is currently being used to manage the fishery.

Table 13.--Cross-tabulation of responses to the knowledge and perceptions of catch shares in Hawaii-based longline fishery by ethnic group.

| | Are you familiar with catch share/ individual transferable quotas (ITQ or IFQ)? | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | No | | Somewhat | | Yes | | Total |
| Ethnicity | Vietnamese-American | 38 | 81% | 2 | 4% | 7 | 15% | 47 |
| | European- American | 2 | 6% | 2 | 6% | 30 | 88% | 34 |
| | Korean-American | 10 | 77% | 0 | 0% | 3 | 23% | 13 |
| | Total | 50 | 53% | 4 | 4% | 40 | 43% | 94 |
| | **Do you support a catch share/ ITQ program in Hawaii's longline fishery?** | | | | | | | |
| | | No | | Unsure | | Yes | | Total |
| Ethnicity | Vietnamese-American | 18 | 38% | 26 | 55% | 3 | 6% | 47 |
| | European- American | 22 | 65% | 7 | 21% | 5 | 15% | 34 |
| | Korean-American | 4 | 31% | 3 | 23% | 6 | 46% | 13 |
| | Total | 44 | 47% | 36 | 38% | 14 | 15% | 94 |

Data sources: 2012 in-person cost-earnings survey (PIFSC1).

Concerns regarding allocation and equity of catch share programs were shared almost equally among ethnic groups in the fishery. Individuals from the Vietnamese-American group indicated that the management program currently in place is working and they prefer the status quo. A larger frequency of Vietnamese-Americans and Korean-Americans expressed fairness as a particular issue with how the catch limit of bigeye tuna is managed. In contrast, more European-Americans specifically voiced concerns regarding consolidation, corporate influence, and an increase in regulatory powers that have been associated with the implementation of catch share programs in other U.S. fisheries.

## SUMMARY

For 2012, the direct net cash flow of Hawaii-based longline fleet was $56,522 per vessel. The economic status of the fleet was improved based on a general comparison to 2005 cost earning by a 233 percent increase in direct net cash flow.  Counting the appreciation of the vessel and permit value, the average indirect net return was $72,855 in 2012.  However, economic performance among vessels varied widely. Not all vessels experienced positive direct net cash flows for 2012. In fact, over one third of Hawaii-based longline vessels experienced negative direct net cash flows for 2012. Vessels that target only bigeye tuna had, on average, larger net returns than the vessels that seasonally target swordfish. Vessels that target both swordfish and bigeye tuna had larger average gross revenue, but higher average operational costs. Larger vessels in the fleet had greater mean gross revenues and net returns than did smaller vessels. Since 2005, the Hawaii-based longline fleet has experienced a significant real increase in fuel prices. However, revenue also increased due to higher bigeye prices and greater bigeye landings. Swordfish prices initially decreased but then remained relatively constant over the same time period.

There are mixed perceptions of a catch share program being introduced in the Hawaii-based longline fishery. However, it is clear that a majority of stakeholders are unfamiliar with catch share systems and are unsure of their support for a catch share program in the fishery. Fishers that were familiar with catch shares expressed concerns related to allocation, equity, and consolidation associated with the adoption of an IFQ or ITQ system.

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# APPENDICES

## APPENDIX A--HAWAII LONGLINE COST-EARNINGS QUESTIONNAIRE 2012

Surveyor's name: ________________ Date of interview: ___/____/2013 Location of interview: _________________

Vessel Name: ___________________________________ Vessel's permit number:________________________

Interviewee's name: ______________________________ Contact (phone): (______) ________-____________

Vessel operator: ❑Owner operated ❑ Hired captain

Interviewee position: ❑Vessel owner ❑ Owner operated ❑ Hired captain

What species did you target in 2012? ❑ Tuna only ❑ Swordfish only ❑ Both

……………………………………………………………………………………………………………………

**About the owner *OR* owner operator (skip questions 1-14 if you are interviewing a hired captain, and proceed directly to Q. 15)**

1. How many fishing vessels do you own (including this one)? _______vessel(s)
   How many vessels fish in **Hawaii longline fishery**? _______

2. In 2012, did your vessel fish in other areas (like A. Samoa)? *If yes*, how many longline trips were in other waters?
   A. Samoa _______
   Guam _______
   CNverso
   MI (Commonwealth of Northern Mariana Islands) _______
   Others (like California) _______

3. How many years have you owned a longline vessel? ______ years

4. How long have you owned this vessel? ______ years

5. What is the ownership? ❑ Sole ownership *-or-* ❑ Corporation: *If Corporation*,
   Co-operation is with ❑ family *-or-* ❑Others Number of Partners (including you) __________

6. How many years of commercial fishing experience do you have? ______years

7. Have you captained a commercial fishing vessel? ❑ Yes ❑ No *If yes*, how many years? ______years

8. Have you captained a longline vessel (even if you are not the captain now)? ❑ Yes ❑ No
   *If yes*, how many years? ______years

9. Have you captained this vessel before? ❑ Yes ❑ No *If yes*, how many years? ______years

10. What main business do you handle with this vessel? *-check all that apply*
    ❑ Captain of the vessel ❑ Engine oil ❑ Hiring of Crew ❑ Order, *and/or* ❑ Pay, *and/or*
    ❑ Pick-up the supplies for each trip: What?____________________ ❑ Shopping for foods for each fishing trip
    ❑(other)____________________________________________________________________________

11. Do you live in Hawaii? ❑ Yes ❑ No *If yes*, how many years? _______

12. Do you and your family have other income sources besides Hawaii longline fishing? ❑ Yes ❑ No
    *If yes*, what is the percentage of your total household income that comes from longline fishing? _______%

13. What is your age? ______years

14. What is your highest education: ❑elementary ❑high school ❑college ❑(other/ details)______________________

**About the hired captain (Skip questions 15-18 if you are interviewing an owner or owner-operator, go to # 19)**

15. How many years of commercial fishing experiences do you have? ______years

16. How many years have you captained a commercial fishing vessel? ______years

17. How long have you been the captain of this vessel? ________ ❑ Years ❑ Months

18. What main business do you handle besides captaining the vessel while at sea? *-check all that apply*
    ❑ Engine oil ❑ Order, *and/or* ❑ Pay, *and/or* ❑ Pick-up, the supplies for each trip.
    *If so,* what supplies? ______________________ ❑ Shopping for foods for each fishing trip
    ❑ Hiring of Crew ❑ (other) __________________________________________________________

…………………………………………………………………………………………………………………………

**About the Vessel**

19. When was the vessel built? ________ year

20. When was the vessel purchased? ________ year

21. What was the vessel purchase price? $______________

22. What was the startup cost when the vessel was purchased? $_____________

23. What is the vessel current (appraisal) value? $_____________

24. What is the vessel length? ________ ft

25. What is the vessel width/beam? ________ ft

26. Fuel capacity: ____________gallons *-and-* What is the average fuel usage? ________gallons / day

27. What is the maximum speed of the Vessel? ________knots *-and-* What is the average speed? ________knots

28. What is the fish holding capacity (with ice)? __________tuna trip (lbs) *-and-* _________swordfish trip (lbs)

**Equipment and Electronics**

29. What is the horsepower of the vessel's engines?
    Engine 1 (primary): __________horsepower
    Engine 2 (secondary): __________horsepower *-and-* Engine 3 (secondary): ________horsepower

30. In total, how many reels are aboard the vessel: _____ *-and-* how many reels are usually used in a fishing trip: _____

31. Did you use an icemaker in 2012? ❑Yes ❑ No

**About the Crew and Labor Costs**

32. How many crewmembers does the vessel usually have (*NOT including captain*)? _______
    How many of those crewmembers are from the U.S.? _________
    How many of those crewmembers are Foreign to the U.S.? _________

33. Was it difficult to find the crew that you needed? ❑ Yes, always ❑ Yes, sometimes ❑ No

34. What is the longest time a current crewmember has been working with this vessel? ______ ❑ Years ❑ Months

35. What is the shortest time a current crewmember has been working with this vessel?______ ❑ Years ❑ Months

36. Were the crew (not including captain) paid by flat rate or by shares?
❑ Flat rate ❑ Shares ❑ Some flat rate and some share

37. Was the vessel operator paid by flat rate or by shares?
❑ Flat rate ❑ Share after trip expenses including crews flat rate ❑ Shares of trip revenue

38. How income was distributed among boat (owner), captain, and crew?

| Position | Shares or | % | Trip Revenue* or Net Revenue* | Flat Rate | Bonuses | Initial payment | What year (for initial payment) |
|---|---|---|---|---|---|---|---|
| Owner(s) | / | % | ❑Trip ❑Net | | | | |
| Owner/Operator | / | % | ❑Trip ❑Net | | | | |
| Captain | / | % | ❑Trip ❑Net | $ | $ | $ | yr |
| Crewmember 1 | / | % | ❑Trip ❑Net | $ | $ | $ | yr |
| Crewmember 2 | / | % | ❑Trip ❑Net | $ | $ | $ | yr |
| Crewmember 3 | / | % | ❑Trip ❑Net | $ | $ | $ | yr |
| Crewmember 4 | / | % | ❑Trip ❑Net | $ | $ | $ | yr |
| Crewmember 5 | / | % | ❑Trip ❑Net | $ | $ | $ | yr |
| Crewmember 6 | / | % | ❑Trip ❑Net | $ | $ | $ | yr |

***Trip Revenue is defined as after sale revenue. Net revenue is defined as after sale and trip costs are deducted.***

39. Which of the following expenses do you subtract from the trip revenue to get net revenue? *-check all that apply*
❑ Fuel ❑ Engine oil ❑ Bait ❑ Ice
❑ Lightsticks ❑ Food ❑ Communications ❑ Gear resupply
❑ Daily maintenance (please list) ____________________________________________
❑ Swordfish certificate ❑ Other (please list) ____________________________________

40. Labor cost notes: (other costs such as VISA, return fees, unemployment…) – *please include details and costs*
____________________________________________________________ $ __________
____________________________________________________________ $ __________
____________________________________________________________ $ __________

**Fish Sale Costs**

41. Where did you sell your fish in 2012? ______________________________________
❑ UFA Auction ONLY. *If UFA*, is the paycheck of crew or captain handled by UFA? ❑Yes ❑ No
❑ UFA Auction and other distributors or brokers: Handling fee ________%
❑ Other distributors ONLY: Handling fee ________%

42. Did you donate ($0.02 per lb) to the Hawaii Longline Association (HLA) in 2012? ❑Yes ❑ No

**Fixed Costs**

43. Does your gear have the capability to switch between fishing for swordfish and tuna? ❑ Yes ❑ No
Were there extra costs associates with this transition? ❑ Yes ❑ No
*If yes*, what did the cost include? ❑ Labor $_________ ❑ Gear $__________ (*not trip resupply*)

***Please include all repair costs and gear/equipment replacement cost in only one of the categories listed in the table***

| | | | |
|---|---|---|---|
| Mooring | ♦ What were your mooring fees in 2012? | | **$** |
| Accounting | ♦ Did you have bookkeeping / accounting costs in 2012? ❑Yes ❑ No<br>If yes | | **$** |
| Insurance | ♦ What were your insurance costs per year in 2012?<br>❑ Vessel ❑ Liability (“P” and “I”) ❑ Health (Please specify who is covered)__________________________________ | | **$** |
| Loan | ♦ Did you have any vessel loan payments in 2012? ❑Yes ❑ No<br>*If yes* | | **$** |
| | ▪ How much time is left on this loan? | | **Yrs** |
| 48. Maintenance and Gear | ♦ How much did you spend **TOTAL in 2012** for maintenance on this vessel? | | **$** |
| | ▪ How much was from **trip-based** maintenance in 2012? | | $ |
| | ▫ What does this include? | | |
| | ▪ How much was from **other routine** repairs and maintenance in 2012? | | $ |
| | ▫ What does this include? | | |
| | ▪ How much was from **major repairs** (not done every year or in drydock) in 2012? What repairs and when was the last time repair was done? | | $ |
| | ▫ Major repair 1. | **Yrs** | $ |
| | ▫ Major repair 2. | **Yrs** | $ |
| | ▫ Major repair 3. | **Yrs** | $ |
| | ▪ How much was from **major gear/equipment** you replaced or added in 2012?<br>What gear/equipment and when was the last time the time it was replaced? | | $ |
| | ▫ Gear 1. | **Yrs** | $ |
| | ▫ Gear 2. | **Yrs** | $ |
| | ▫ Gear 3. | **Yrs** | $ |
| | ▪ Does this figure include **dry dock** maintenance in 2012? ❑Yes ❑ N<br>*If yes* | | $ |
| | ▪ Does this figure include **Engine Overhaul** in 2012? ❑Yes ❑ N<br>*If yes* | | $ |

49. When did you last dry dock your vessel? _______ year

How often do you dry dock? _______ years

What was the total cost for your dry dock (including costs paid to shipyard, repairs, painting, etc)? $_______

What was the total cost for haul/ launch and lay days? $ __________

What repairs/services were done in dry dock? What were the costs? How many years between repairs?

Which of the above repairs/services are performed routinely in drydock? (Please list)

______________________________________ $ __________ years ___________❑ preformed routinely

______________________________________ $ __________ years ___________❑ preformed routinely

______________________________________ $ __________ years ___________❑ preformed routinely

______________________________________ $ __________ years ___________❑ preformed routinely

50. Have you overhauled your engine in the past? ❑Yes ❑ No

*If yes* 1) When did you last overhaul your engine? ______________ year

2) How much did it cost $ _______________

3) How often do you overhaul your engine? _____________ years

51. Are there any other vessel costs which are not included above? ❑ Yes ❑ No *If yes*, please list

__________________________________________________________ $_____________ years __________

__________________________________________________________ $_____________ years __________

**Trip Costs** -*Fill out as if it were the average (most common) trip costs.*

52. What is the average total **Tuna Trip Cost**? $___________________

| | | | |
|---|---|---|---|
| Fuel | Average **Fuel Price** in 2012? | $ | Fuel Used Notes |
| | Average **Fuel Used** for a tuna trip? | Gal. | |
| | Average **Fuel Cost** for a tuna trip in 2012? | $ | |
| Oil | Average **Oil Price** in 2012? | $ | ❑ 1 Gallon |
| | Average **Oil Used** for a tuna trip? | | ❑ 5 Gallon (Bag/Buck |
| | Average **Oil Cost** for a tuna trip in 2012? | $ | ❑ 55 Gallon (Drum) |
| Bait 1 (Primary) | Average **Bait Price** in 2012? | $ | ❑ Sanma ❑ Sardines |
| | Average **Bait Used** for a tuna trip? | Box | ❑ Mackerel ❑ Squid |
| | Average **Bait Cost** for a tuna trip in 2012? | $ | |
| Bait 2 (Secondary) | Average **Second Bait Price** in 2012? | $ | ❑ Sanma ❑ Sardines |
| | Average **Second Bait Used** for a tuna trip? | Box | ❑ Mackerel ❑ Squid |
| | Average **Second Bait Cost** for a tuna trip in 2012? | $ | |
| Ice | Average **Ice Price** in 2012? | $ | ❑ Block |
| | Average **Ice Used** for a tuna trip? | | ❑ Ton |
| | Average **Ice Cost** for a tuna trip in 2012? | $ | ❑ lbs. |
| Fishing Gear | Average **Gear Cost** for a tuna trip in 2012? | $ | *Cost to re-supply vesse* |
| Provisions | Average **Provisions Cost** for a tuna trip in 201 | $ | *Groceries, water, etc.* |
| Communications | Average **Communications Cost** for a tuna trip 2012? | $ | *Satellite phone, email, etc.* |

53. What is the average total **Swordfish Trip Cost**? $____________________

| | | | |
|---|---|---|---|
| Fuel | Average **Fuel Price** in 2012? | $ | Fuel Used Notes |
| | Average **Fuel Used** for a swordfish trip? | Gal. | |
| | Average **Fuel Cost** for a swordfish trip in 2012 | $ | |
| Oil | Average **Oil Price** in 2012? | $ | ❑ 1 Gallon<br>❑ 5 Gallon (Bag/Buck<br>❑ 55 Gallon (Drum) |
| | Average **Oil Used** for a swordfish trip? | | |
| | Average **Oil Cost** for a swordfish in 2012? | $ | |
| Bait 1 (Primary) | Average **Bait Price** in 2012? | $ | ❑ Sanma ❑ Sardines<br>❑ Mackerel ❑ Squid |
| | Average **Bait Used** for a swordfish trip? | Box | |
| | Average **Bait Cost** for a swordfish trip in 2012 | $ | |
| Bait 2 (Secondary) | Average **Second Bait Price** in 2012? | $ | ❑ Sanma ❑ Sardines<br>❑ Mackerel ❑ Squid |
| | Average **Second Bait Used** for a swordfish trip | Box | |
| | Average **Second Bait Cost** for a swordfish trip 2012? | $ | |
| Ice | Average **Ice Price** in 2012? | $ | ❑ Block<br>❑ Ton<br>❑ lbs. |
| | Average **Ice Used** for a swordfish trip? | | |
| | Average **Ice Cost** for a swordfish trip in 2012? | $ | |
| Fishing Gear | Average **Gear Cost** for a swordfish trip in 201 | $ | *Cost to re-supply vesse* |
| Provisions | Average **Provisions Cost** for a swordfish trip i 2012? | $ | *Groceries, water, etc.* |
| Communications | Average **Communications Cost** for a SF trip i 2012? | $ | *Satellite phone, email, etc.* |
| Lightsticks | Average **Lightsticks Price** in 2012? | $ | |
| | Average **Lightsticks Used** for a swordfish trip? | Cases | |
| | Average **Lightsticks Cost** for a swordfish trip i 2012? | $ | |

**Ending Questions**

54. Are you familiar with catch share/ individual transferable quotas (ITQ or IFQ)? ❑ Yes ❑ No ❑ Somewhat
Do you support a catch share/ ITQ program in Hawaii's longline fishery? ❑ Yes ❑ No ❑ Unsure
Please write down the advantages and/ or disadvantages of having a catch share program.

## APPENDIX B

*Why do we collect economic data? Because the National Marine Fisheries Service is required to conduct economic analyses.*

**HAWAII OBSERVER PROGRAM LONGLINE TRIP EXPENDITURE FORM** page 1 of 2

(Ask information on the way home)

1. TRIP INFORMATION

TRIP NUMBER: L L _ _ _ _

DATE OF DEPARTURE: DAY _ _ MONTH _ _ _ YEAR 2 0 _ _

DATE OF RETURN: DAY _ _ MONTH _ _ _ YEAR 2 0 _ _

VESSEL NAME:

TRIP TYPE (Check one): ☐ SWORDFISH ☐ TUNA

2. FUEL

PRICE PER GALLON: $ _ . _ _

GALLONS USED: _ _ , _ _ _

TOTAL COST OF FUEL: $ _ _ , _ _ _ . _ _

3. ENGINE OIL

| UNIT (Check one) | | PRICE PER UNIT | | QUANTITY USED | |
|---|---|---|---|---|---|
| ☐ | Gallon | _ _ _ . _ _ | Per gal | | Gallons |
| ☐ | Bag/Bucket (5 gallons) | _ _ _ . _ _ | Per bag | | Bags |
| ☐ | Drum (55 Gallons) | _ _ _ . _ _ | Per drum | | Drums |

TOTAL COST OF OIL: $ _ _ _ . _ _

4. BAIT

TYPE 1 (Check one):

| | | | |
|---|---|---|---|
| ☐ | Squid | ☐ | Mackerel |
| ☐ | Sardine | ☐ | Anchovy |
| ☐ | Sanma | ☐ | |

PRICE PER BOX: $ _ _ . _

BOXES USED: _ _ _ _

TOTAL COST: $ _ , _ _ _ . _

TYPE 2 (Check one):

| | | | |
|---|---|---|---|
| ☐ | Squid | ☐ | Mackerel |
| ☐ | Sardine | ☐ | Anchovy |
| ☐ | Sanma | ☐ | |

PRICE PER BOX: $ _ _ . _

BOXES USED: _ _ _ _

TOTAL COST: $ _ , _ _ _ . _

5. ICE (Check one): ☐ ICE MAKER ☐ NO ICE MAKER

UNIT (Check one):

| | |
|---|---|
| ☐ | Blocks |
| ☐ | Tons |
| ☐ | Lbs |

PRICE PER UNIT: $ _ _ . _

UNITS USED: _ _ _ _

TOTAL COST OF ICE: $ _ , _ _ _ . _

6. FISHING GEAR COSTS (amount spent to re-supply vessel for this trip [e.g. hooks, line, floats, raingear])

$ _ , _ _ _ . _

7. PROVISIONS COSTS (amount spent to re-supply vessel for this trip [e.g. groceries, bottled water, cigarettes])

$ _ , _ _ _ . _

DON'T FORGET TO FILL OUT THE BACKSIDE!

Revised 1/01/11

*Why do we collect economic data? Because the National Marine Fisheries Service is required to conduct economic analyses.*

# HAWAII OBSERVER PROGRAM LONGLINE TRIP EXPENDITURE FORM



(Ask information on the way home)

8. TRIP COMMUNICATIONS COST (amount spent for this trip [e.g., satellite phone and/or data calls, email])

$ [ ][ ] , [ ][ ][ ] . [ ]

9. COST OF LIGHTSTICKS (for swordfish trips only)

PRICE PER CASE (500 LIGHTSTICKS): $ [ ][ ][ ] . [ ]

CASES USED: [ ][ ][ ] . [ ]

TOTAL STICK COST: $ [ ] , [ ][ ][ ][ ] . [ ]

10. TOTAL ESTIMATED TRIP COSTS (Ask, Don't Add!)

$ [ ][ ][ ] , [ ][ ][ ] . [ ]

11. CAPTAIN OF THIS TRIP (Check one)

☐ Owner Operated ☐ Hired Captain

12. CREW INFORMATION

Number of crew (DO NOT Include captain): [ ][ ]

Number of foreign crew: [ ][ ]

13. STATUS OF ECONOMIC DATA COLLECTION (For observer / debriefer only)

A. Observer Section

Observer number: ____________

Captain or trip operator phone number: (      ) ______________________________

B. Debriefer Section

Check only one box:

☐ Data from Captain

☐ Observed data at sea

☐ In office

Debriefer initials: ____________

If no data from Captain, please provide REASON:

[                                        ]

## Predicted Trip Cost

The predicted trip costs are estimated using a series of regression equations and mean time-series values. Since 2004, fishing-trip expenditure data has been collected from the Hawaii-based longline fisheries through a joint effort by the Pacific Islands Fisheries Science Center (PIFSC) Economics Program and the Pacific Islands Regional Office (PIRO) Observer Program. Observers collect the data directly from the longline vessel operator. Fisher participation in the economic data survey is voluntary. Regression-based predictions of these data are used to estimate missing cost information for trips without completed expenditure forms based on information assembled from NMFS logbooks of trip specific variables such as trip length and location. Complete trip costs are based on Equation 2.

Equation 2:

$$\begin{aligned} Trip\ Cost\ =\ & (Fuel\ Price\ \times Fuel\ Used) + (Oil\ Price \times Oil\ Used) \\ & + (Bait\ Price_1\ \times Bait\ Used_1) + (Bait\ Price_2\ \times Bait\ Used_2) \\ & + (Ice\ Price\ \times Ice\ Used) + Gear\ Replacement\ Cost + Provisions\ Cost \\ & + Communications\ Cost + (Lightstick\ Price\ \times Lightstick\ Used) \end{aligned}$$

Note: Discrepancies found among predicted trip costs were examined and corrected for within the statistical prediction models using the additional information collected in the cost-earnings survey and a dummy variable to allow these individual vessels to take values more specific to the particular cost profile of the vessel.

## Predicted Fuel Price

Fuel price information collected on the trip expenditure forms are used to create a time series of fuel price trends. Since fuel is purchased before the trip, time trends are based on the trip departure date. Only values within a reasonable range are used; outliers are flagged using a moving average and standard deviation around the time series mean of six or more observations. Mean weekly fuel prices are used for weeks with more than three observations and are replaced by mean monthly fuel prices for weeks with less than three observations.  Average monthly prices reported by vessel operators and AAA diesel fuel for Honolulu Hawaii prices for a comparison purpose are shown in Figure 9.

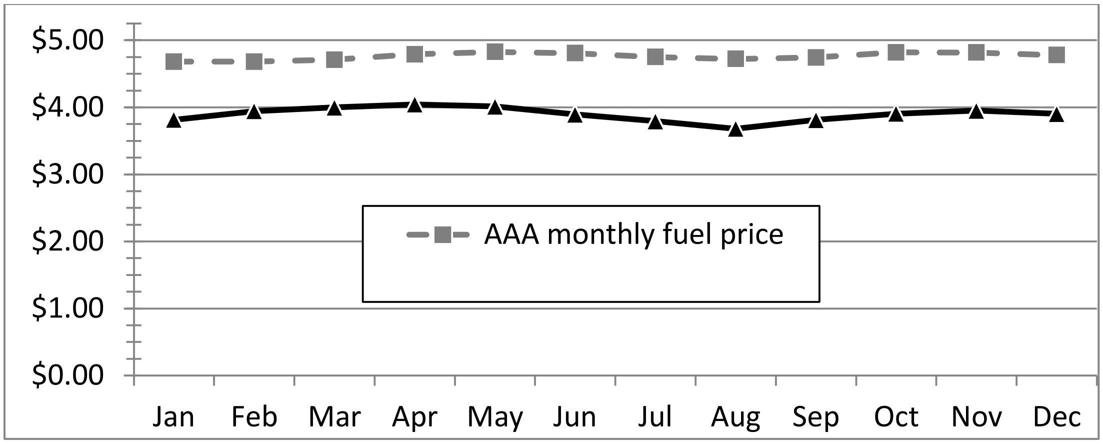


Figure 9.--Nominal average monthly fuel prices reported by longline vessel operators and nominal monthly road diesel fuel prices for Honolulu Hawaii reported by AAA 2012.[19]

**Predicted Fuel Usage**

Fuel usage per trip is based on trip length (days), travel distance (miles)[20], vessel size (feet), and other vessel characteristics that can be controlled for using dummy variables to represent individual vessel's unobservable heterogeneity, e.g. daily fuel consumption outliers, as shown in

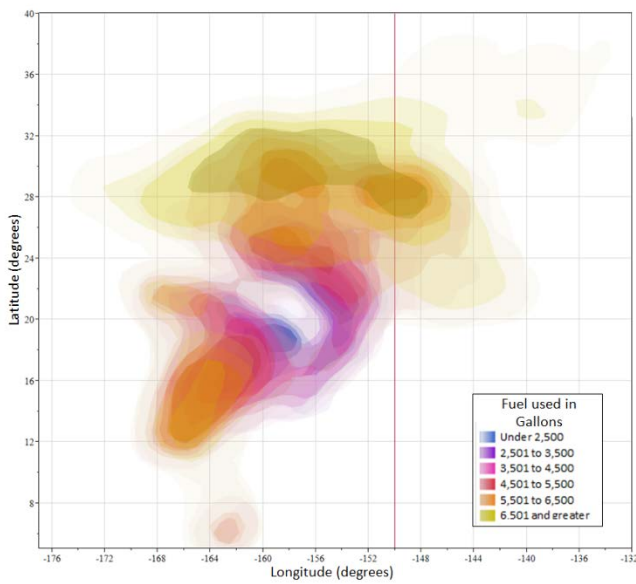


Figure 10.--Map of predicted fuel used by average trip set location by miles traveled during trip[21].

[19] Data source: Trip expenditure form (PIFSC-PIRO) and monthly energy trends (DBEDT, Hawaii)
[20] Distance traveled in the trip is calculated by adding up the total distance from departure port to begin first set, to end first set, to begin first haul, to end first haul, to begin second set continuing until the last set's end haul, to return port location using coordinates of port locations and the coordinates from logbook data.
[21] Data source: Trip expenditure form (PIFSC-PIRO) and logbooks (NMFS)

Table 14.--Regression equation, coefficients and statistics to predict fuel usage per trip

| | |
|---|---|
| Number of observations | 2,078 |
| Degrees of freedom | 1,978 |
| R-squared value | 0.8301 |
| Adjusted R-squared value | 0.8216 |
| Root mean squared error | 1,248.1 |

| Predicted fuel used per trip (gallons) by: | Coefficient | Standard Error | *t*-value | *p*-value | Lower 95% Interval | Upper 95% Interval |
|---|---|---|---|---|---|---|
| Number of days of trip (days) | 230.28 | 17.86 | 12.90 | 0.00 | 195.27 | 265.30 |
| Number days squared ($days^2$) | 2.17 | 0.31 | 7.07 | 0.00 | 1.57 | 2.77 |
| Distance per day (miles/day) | 11.43 | 2.65 | 4.32 | 0.00 | 6.24 | 16.62 |
| Vessel length (feet) | 114.48 | 9.02 | 12.69 | 0.00 | 96.79 | 132.17 |
| Vessel length squared ($feet^2$) | 1.84 | 0.49 | 3.78 | 0.00 | 0.88 | 2.79 |
| Distance per vessel length (miles./ ft.) | -30.43 | 8.54 | -3.56 | 0.00 | -47.19 | -13.68 |
| Constant | 1,912.06 | 1,260.19 | 1.52 | 0.13 | -559.38 | 4,383.50 |
| Dummy variable(s) for vessels in fleet† | - | - | - | - | - | - |

Data sources: Trip expenditure form (PIFSC2) and logbooks (NMFS)

† Individual dummy variables of each outlying vessel are not reported due to data confidentiality.

**Predicted Oil Price**

The temporal variation in lubrication-oil prices is less significant than the variation in lubricated oil price by vessel. Therefore, the average price of lubricated oil by vessel for each year is used as the proxy for lubrication-oil prices. An average annual lubrication-oil price is used for vessels that do not have an average oil price for a particular year.

**Predicted Oil Usage**

The oil cost is based on the quantity of oil the vessels uses per trip and the price of oil. Since oil usage is a set amount for each vessel, average oil used by vessel was the theoretically valid estimator for the quantity of oil used per trip.

**Predicted Bait Price**

The price of bait is broken up into the price of a box of sanma or sardines for tuna trips and mackerel for swordfish trips. The average quarterly price is used for a proxy of each of the bait type prices.

**Predicted Bait Used**

The number of cases of bait used during a longline trip is correlated with trip length (days), vessel length (feet), target type (deep-set tuna trip or shallow-set swordfish trip), average length of mainline per set (miles), average number of hooks per set, the total number of sets, and sardines vs. other bait along with dummy variable to control for individual vessel heterogeneity of vessels with bait usage outside the normal range as shown in Table 15. Mackerel is the bait used for targeting swordfish while sanma is the primary bait used for targeting bigeye tuna with sardines being used as secondary bait based on supplies of the two bait types.

Table 15.--Regression equation, coefficients and statistics to predict bait usage per trip.

| | |
|---|---|
| Number of observations | 2,085 |
| Degrees of freedom | 1,985 |
| R-squared value | 0.6961 |
| Adjusted R-squared value | 0.6809 |
| Root mean squared error | 63.629 |

| Predicted bait used per trip (boxes) by: | Coefficient | Standard Error | *t*-value | *p*-value | Lower 95% Interval | Upper 95% Interval |
|---|---|---|---|---|---|---|
| Number of days of trip (days) | 1.85 | 0.34 | 5.45 | 0.00 | 1.18 | 2.51 |
| Vessel length (feet) | 1.70 | 0.29 | 5.87 | 0.00 | 1.13 | 2.27 |
| Tuna Trip = 1; Swordfish Trip = 0 | -76.28 | 8.30 | -9.19 | 0.00 | -92.56 | -59.99 |
| Average Trip length of main line (miles) | 0.04 | 0.01 | 3.02 | 0.00 | 0.01 | 0.06 |
| Average number of hooks per set | 0.00 | 0.00 | 6.60 | 0.00 | 0.00 | 0.00 |
| Total number of sets | 8.47 | 0.74 | 11.48 | 0.00 | 7.02 | 9.92 |
| Sardines= 1; other bait type=0 | -22.67 | 5.31 | -4.27 | 0.00 | -33.09 | -12.25 |
| Constant | 228.19 | 46.29 | 4.93 | 0.00 | 137.41 | 318.98 |
| Dummy variables for vessels in fleet† | - | - | - | - | - | - |

Data sources: Trip expenditure form (PIFSC2) and logbooks (NMFS)

† Individual dummy variables of each outlying vessel are not reported due to data confidentiality.

**Ice Price**

Predicated ice price is the average quarterly trend in the price of ice as reported by vessel operators.

**Ice Used**

For vessels that consistently report no ice usage and indicate that they have the capability to make ice on board the vessel, ice usage is set to zero. However, for vessels that consistently purchase ice, the average vessel's ice used as reported by the trip operator is used.

**Gear Cost**

Gear replacement costs are dependent upon the number of days of a trip, vessel length, whether the trip is a deep-set trip or shallow-set trip, average length of the mainline per trip, total number of sets and the year of departure to correct for the increase in cost of gear over time, along with dummy variable to control for individual vessel heterogeneity of vessels with gear costs outside the normal range as shown in Table 16.

Table 16.--Regression equation, coefficients, and statistics to predict gear replacement costs per trip.

| | |
|---|---|
| Number of observations | 2,114 |
| Degrees of freedom | 1,969 |
| R-squared value | 0.4238 |
| Adjusted R-squared value | 0.3817 |
| Root mean squared error | 1,152 |

| Predicted gear replacement cost per trip (US dollars) by: | Coefficient | Standard Error | *t*-value | *p*-value | Lower 95% Interval | Upper 95% Interval |
|---|---|---|---|---|---|---|
| Number of days of trip (days) | 36.75 | 6.25 | 5.88 | 0.00 | 24.49 | 49.01 |
| Vessel length (feet) | 17.03 | 16.80 | 1.01 | 0.31 | -15.93 | 49.98 |
| Tuna Trip = 1; Swordfish Trip = 0 | -885.40 | 91.86 | -9.64 | 0.00 | -1,065.6 | -705.24 |
| Average Trip length of main line (miles) | 0.64 | 0.22 | 2.93 | 0.00 | 0.21 | 1.06 |
| Total number of sets | 3.90 | 10.08 | 0.39 | 0.70 | -15.88 | 23.67 |
| Year of departure | 29.54 | 10.12 | 2.92 | 0.00 | 9.68 | 49.39 |
| Constant | 1,945.5 | 1,268 | 1.53 | 0.13 | -540.57 | 4,431.62 |
| Dummy variables for vessels in fleet† | - | - | - | - | - | - |

Data sources: Trip expenditure form (PIFSC2) and logbooks (NMFS)

† Individual dummy variables of each outlying vessel are not reported due to data confidentiality.

**Provisions Cost**

Provisions costs are dependent based on the number of days of a trip, vessel length, whether the trip is a deep-set trip or shallow-set trip, average length of the mainline per trip, total number of sets and the year of departure to correct for the increase in cost of provisions over time, along with dummy variable to control for individual vessel heterogeneity of vessels with provisions costs outside the normal range as shown in Table 17.

Table 17.--Regression equation, coefficients and statistics to predict provisions costs per trip.

| | |
|---|---|
| Number of observations | 2,114 |
| Degrees of freedom | 1,992 |
| R-squared value | 0.6213 |
| Adjusted R-squared value | 0.5983 |
| Root mean squared error | 562.58 |

| Predicted provisions cost per trip (US dollars) by: | Coefficient | Standard Error | *t*-value | *p*-value | Lower 95% Interval | Upper 95% Interval |
|---|---|---|---|---|---|---|
| Number of days of trip (days) | 26.45 | 3.04 | 8.71 | 0.00 | 20.50 | 32.41 |
| Vessel length (feet) | 8.51 | 2.95 | 2.89 | 0.00 | 2.73 | 14.29 |
| Tuna Trip = 1; Swordfish Trip = 0 | -453.90 | 44.68 | -10.16 | 0.00 | -541.52 | -366.29 |
| Average Trip length of main line (miles) | 0.10 | 0.10 | 0.95 | 0.34 | -0.10 | 0.30 |
| Total number of sets | -7.00 | 4.88 | -1.43 | 0.15 | -16.57 | 2.58 |
| Year of departure | 79.34 | 4.87 | 16.29 | 0.00 | 69.79 | 88.89 |
| Constant | 910.71 | 566 | 1.61 | 0.11 | -199.29 | 2,020.70 |
| Dummy variables for vessels in fleet† | - | - | - | - | - | - |

Data sources: Trip expenditure form (PIFSC2) and logbooks (NMFS)

† Individual dummy variables of each outlying vessel are not reported due to data confidentiality.

**Communications Cost**

Communications cost is the average of each vessel's reported communications cost, controlling for the target species of the trip along with the changes over time.

**Lightsticks Price**

The price of a case of 500 lightsticks is the annual mean price of a case for each individual vessel that targets swordfish. The annual average lightstick price fleet-wide for the vessels that target swordfish is used to replace the vessels without an average annual price.

**Lightsticks Used**

The total cases of lightsticks used per swordfish trip is based on the total number of sets, vessel length, average number of hooks per set, and the year of departure to correct for the increase in lightstick usage over time, along with dummy variable to control for individual vessel heterogeneity for those vessels with unusually high or low lightstick usage, as shown in Table 18.

Table 18.--Regression equation, coefficients and statistics to predict lightstick used per swordfish trip.

| | |
|---|---|
| Number of observations | 551 |
| Degrees of freedom | 522 |
| R-squared value | 0.5799 |
| Adjusted R-squared value | 0.5573 |
| Root mean squared error | 4.8358 |

| Predicted lightsticks used per trip (cases) by: | Coefficient | Standard Error | *t*-value | *p*-value | Lower 95% Interval | Upper 95% Interval |
|---|---|---|---|---|---|---|
| Total number of sets | 0.777 | 0.082 | 9.470 | 0.000 | 0.616 | 0.938 |
| Average number of hooks per set | 0.0001 | 0.0001 | 2.030 | 0.043 | 0.000 | 0.000 |
| Year of departure | 0.312 | 0.099 | 3.140 | 0.002 | 0.117 | 0.507 |
| Constant | -0.146 | 0.051 | -2.880 | 0.004 | -0.246 | -0.046 |
| Dummy variables for vessels in fleet[†] | - | - | - | - | - | - |

Data sources: Trip expenditure form (PIFSC2) and logbooks (NMFS)

[†] Individual dummy variables of each outlying vessel are not reported due to data confidentiality

Availability of NOAA Technical Memorandum NMFS

Copies of this and other documents in the NOAA Technical Memorandum NMFS series issued by the Pacific Islands Fisheries Science Center are available online at the PIFSC Web site **http://www.pifsc.noaa.gov** in PDF format. In addition, this series and a wide range of other NOAA documents are available in various formats from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161, U.S.A. [Tel: (703)-605-6000]; URL: **http://www.ntis.gov**. A fee may be charged.

Recent issues of NOAA Technical Memorandum NMFS–PIFSC are listed below:

NOAA-TM-NMFS-PIFSC- 53 Design and implementation of a bottomfish fishery-independent survey in the main Hawaiian Islands.
B. L. RICHARDS, S. G. SMITH, J. S. AULT, G. T. DINARDO, D. KOBAYASHI, R. DOMOKOS, J. ANDERSON, J. TAYLOR, W. MISA, L. GIUSEFFI, A. ROLLO, D. MERRITT, J. C. DRAZEN, M. E. CLARKE, and C. TAM.
(August 2016)

54 Proceedings of the 2015 international summit on fibropapillomatosis: global status, trends, and population impacts.
S. HARGROVE, T. WORK, S. BRUNSON, A. M. FOLEY, and G. BALAZS.
(March 2016)

55 Hawaii Marine Recreational Fishing Survey: A summary of current sampling, estimation, and data analyses.
H. MA and T. K. OGAWA.
(September 2016)