Tracking Changes on Fishery Economic Performance

— Continuous Economic Data Collection Programs for the Hawaii and American Samoa Longline Fisheries 2005–2016

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U.S. DEPARTMENT OF COMMERCE
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Executive Summary

The purpose of this report is twofold. First, it provides a first-time comprehensive review of the establishment and implementation of continuous economic data collection programs of two important fisheries, the Hawaii longline fishery and the American Samoa longline fishery, managed under the Western Pacific Regional Fishery Management Council's fishery management plans. Second, this report presents trends of the economic performance indicators from the beginning of the continuous economic data collection programs, 2005 being the first full year for the Hawaii longline fishery, and 2006 for the American Samoa longline fishery, through 2016. The economic performance indicators presented in this report include not only fishing cost data collected through the data collection programs, but also net revenue information resulting from the integration of primary data (from the economic data collection programs) and secondary economic data. In addition, since database development and management are necessary to ensure data quality and timely products, this report illustrates the database system designs and management associated with products of these economic data collection programs.

The trend data show declining economic performance of the American Samoa longline fishery. They also show substantial changes in bigeye tuna (deep-set) fishing and swordfish (shallow-set) fishing in the Hawaii longline fishery, a gradually increasing trend of the economic returns (net revenue) for deep-set tuna fishing, with fluctuations of economic returns for shallow-set swordfish fishing. Compared to 2005, the average net revenue per trip of deep-set tuna fishing has increased 83%, from $26,694 per trip in 2005 (adjusted to 2016 dollars) to $48,782 per trip in 2016. The annual average of trip net revenue of the highest year was more than twice the net revenue of the lowest year for shallow-set swordfish fishing (2016 vs. 2010). However, there was no particular downward or upward trend with respect to shallow-set swordfish fishing trip net revenue during the report period.

Fuel cost is the main expenditure for both Hawaii longline and American Samoa longline trips, approximately 50%. The study shows that variations of trip expenditures across years corresponded closely to changes in fuel prices. Linking fishing cost data with vessel logbook data also allows us to examine fishing costs by area. The data show that average trip costs for EPO (Eastern Pacific Ocean) fishing trips were the highest compared to trip costs within EEZs (exclusive economic zones) or WCPO (Western and central Pacific Ocean) areas for both deep-set tuna fishing and shallow-set swordfish fishing. The data suggest that travel distance is another important determinant of fishing trip cost of Hawaii longline, as EPO is farther away from Honolulu port compared to WCPO.

Introduction

To track the changes of economic performance of the Hawaii longline and American Samoa longline fisheries on a continuous basis, the economic data collection programs for these two fisheries were established in mid-2004 and 2006, respectively. The purpose of this report is twofold. The first goal is to conduct a comprehensive review and describe how the first two systematic data collection programs in these regions were established, especially the main challenges and lessons learned from the program implementation and the database development. The success of the program is a result of a collaborative effort between industry, the NOAA Observer Program, and PIFSC scientists. Second, the report presents trends in the economic performance (in terms of net revenue) from the beginning of the programs to 2016. Because 2005 was the first full year for implementation of the Hawaii fisheries program, the data summary presented in the report covers 2005 to 2016 for the Hawaii longline fishery, and 2006 to 2016 for the American Samoa longline fishery.

The Hawaii and American Samoa longline fisheries are the main fisheries managed by the Western Pacific Regional Fishery Management Council's (WPRFMC). These two longline fisheries that harvest pelagic fish, comprised 86% and 96% of the total commercial fishing revenue of their respective regions in 2015. While the majority of the fish landed by the Hawaii longline fisheries were caught outside of the United States exclusive economic zone (EEZ), the majority of the fish landed by the American Samoa longline fishery were caught inside of its EEZ. The continuous economic data collection programs are add-ons to the Pacific Islands Regional Office (PIRO) observer program for these two fisheries providing valuable long-term data streams to support fishery management. Program Establishment

Need for the Continuous Economic Data Collection Programs

The need and the authorization to collect economic data are found in the Magnuson-Stevens Act (MSA) (16 U.S.C. 1801 et seq.), the Regulatory Flexibility Act (RFA, 5 U.S.C. 601 et seq.), the National Environmental Policy Act (NEPA, 42 U.S.C. 4372 et seq.), and Executive Order (EO) 12866. These statutes and Executive Order require evaluations about how fishery regulatory programs may affect net benefits to society and the profitability of fishing firms. In addition, NOAA Fisheries have developed and adopted measures of economic performance to monitor whether fishery regulatory programs are meeting their management goals. The key indicators of the economic performance measures include costs, earnings, and profitability (net revenue), as indicated in the NOAA Technical Memorandum where a snapshot of 2014 cost data collection programs across regions is provided (Thunberg et al., 2015).

Like many fisheries in the nation, cost information of fishing operations in the Pacific Islands region was usually missing, although partial economic data such as fish prices and landings are commonly available. Before the continuous Trip Level Economic Data Collection Programs for the two longline fisheries were established, there was no means for the Pacific Islands Fisheries Science Center (PIFSC), the agency providing scientific support to the Western Pacific Regional Fishery Management Council (WPRFMC), to collect cost information about commercial fisheries on a continuous basis. Previously, the cost information of the fisheries in this region was collected through episodic surveys on an ad hoc basis. Episodic studies found limited success in tracking changes and were often outdated due to the varying nature of costs incurred on a per trip basis and changes over time. For example, the first cost-earnings survey of the Hawaii longline fishery was conducted in 1994, based on the 1993 operations (Hamilton, Curtis, and Travis 1996). A similar cost-earnings study of the Hawaii-based longline fisheries did not occur until seven years later (O'Malley and Pooley 2003).

Prior to 2000, continuous data collection programs were limited to the Atlantic highly migratory species (HMS) fisheries and the Northeast trip cost data collection in the observed fisheries in that region. Under a national initiative of the NOAA Fisheries with funding support in the 2000s, 15 new continuous cost data collection programs were established during 2002-2012. By 2012, there were 18 continuous cost data collection programs established in U.S. fisheries (Thunberg et al. 2015). The two continuous cost data collection programs for the longline fisheries in the Pacific Islands described in this report were also implemented during this period.

Options for Continuous Economic Data Collection Program Designs

According to a recent report summarizing national NOAA Fisheries cost data collection programs (Thunberg et al., 2015), most of the continuous economic data collection programs were built on existing data collection programs that were set up to collect non-economic data, such as observer programs or federal logbooks. Other options included mail-out surveys, telephone calls, in-person interviews, or websites. The cost data collection "add-on" to federal logbooks is mandatory, since federal logbooks are required. However, the cost data collection "add-on" to the federal observer programs is somewhat different. While the observers are required (mandated) to collect cost data from fishermen, response from the fishermen is voluntary.

The two continuous cost data collection programs for the longline fisheries in the PIFSC are "add-ons" to the NOAA Fisheries Pacific Islands Regional Office (PIRO) observer program, which began in Hawaii in 1994. There are benefits to using the "add-on" approach for cost data collections. First, it is cost effective to add-on the economic data collection to an existing and on-going fisheries data collection program. Second, the cost data collected are concurrent and on a continuous basis, not after the fact. Third, the cost data can be integrated with other fisheries dependent data collected during the same fishing trips. It is easier from a legal standpoint to establish a voluntary program compared to a mandated one. The federal logbook reports are usually mandated program requiring the forms and contents to be reviewed and approved by the fisheries management council. The first continuous cost data collection program in the nation, the Northeast trip cost data program, was implemented in 1995 by all Northeast fisheries that carried observers. Data are continuously collected by observers while at sea

With the support and collaboration of the PIRO observer program, the first Continuous Economic Data Collection Program in the Hawaii longline fishery was implemented in August 2004 as an add-on to the PIRO observer data collection program. The Continuous Economic Data Collection Program for the American Samoa longline fishery was established in 2006 concurrently with the PIRO observer program for that fishery.

Data Form Design

Trip expenditures include the items that are commonly applied to longline fishing trips, as listed below. For the main cost items, such as fuel and bait, both the quantity of usage and unit price are collected. Other cost items include engine oil, ice, gear, provisions, and communications. For shallow-set swordfish fishing trips, the trip costs also included lightsticks and swordfish certificates. From 2004-2010, swordfish certificates represented annual effort cap of shallow-set fishing. As the fleet-wide effort cap, 2200 sets (the fishing line was set and hauled once a day, which is called a set) were equably distributed to all active longline vessels/permit holders (including the permit holders who did not conduct any shallow-set swordfish trips). Each permit holder owned only 17 certificates, which were not usually sufficient for an average shallow-set swordfish trip, requiring the purchase of additional certificates from the other permit holders. Additional information about the crew and operator on a fishing trip was also requested on the survey form. In recent years, the number of foreign crew employed in the fishery increased considerably. Additional questions on number of foreign crew were added to the survey for understanding this trend and status. In summary, the complete list of cost items and other information collected is presented below.

- Diesel fuel cost
- Engine oil cost
- Bait cost
- Ice cost
- Gear cost (the cost of replacing gear that was lost on previous trips [i.e., hooks, line, swivels, sleeves, etc.])
- Provisions cost
- Communications cost (i.e., satellite imagery, email, satellite phone calls, weather faxes, sea charts, etc.)
- Swordfish certificates cost (only if shallow-set fishing during 2004-2010)
- Lightsticks cost (only if shallow-set fishing)
- Type of operator (owner or captain operator)
- Number of crew (excluding captain)
- Number of foreign crew

The survey forms for the two fisheries are presented in Appendices A (Hawaii) and B (American Samoa). The main contents of the two forms are similar, although the survey form for the American Samoa longline fishery was slightly modified based on the form for the Hawaii longline fishery. The survey form for the Hawaii longline fisheries was translated into Korean and Vietnamese since the vast majority of operators in the fishery comprise three distinct ethnic groups: Vietnamese-American, European-American, and Korean-American. Only the English version is presented in the Appendix. The survey was designed for the observers to complete. However, some responses were given by captains, especially during the trips where the captains were Vietnamese-American or Korean-American and language presented a challenge to communications.

The initial design of the form for continuous economic data collection in the Hawaii longline fisheries included both fixed costs and variable costs. However, a majority of the responses only included variable costs, without fixed cost information. In follow-up communications with the observers and fishermen, we realized that a large portion of the vessel operators did not know the fixed costs because they were not the owners. The operators that were also owners often did not remember the actual figures for all the fixed costs since they usually did not carry their accounting books on board. The survey form with fixed cost questions was much longer and more complex and was more difficult for the observers, who were not trained economists, to handle the data collection. Thus, little fixed cost data were collected from the observers in the testing period. Therefore, the fixed cost questionnaires were dropped after a two-month trial, and variable trip expenditures became the sole focus of the continuous economic data collection program.

Program Protocol

There are challenges in using an “add-on” approach to collecting economic data through the observer program. First, the PIRO Observer Program, established in 1994, was mainly designed to collect biological (fish catch) data and record interactions of fishing activities with protected species. While catch and interactions with protected species are observable, most of the economic data are not, so collection requires an interview with the captain or asking the captains to fill out the form. Observers typically did not have experience collecting data through interviews; and fishermen were not obligated to participate and provide economic information, since it is a voluntary program. Some fishermen may hesitate to give out economic information as these data are often viewed as private. In addition, the Observer Program is managed under PIRO, while the economic data collection initiatives were associated with the PIFSC. Therefore, it requires active commitments, communication, and collaborations across agencies to ensure and maintain high response rates and quality data.

To ensure the tasks were carried out, procedures and protocols were developed collaboratively between PIRO and PIFSC to define duties/responsibilities for each step and the responsible personnel associated with each step. The main activities and procedures are described as follows in Table 1.

Table 1. Tasks and coordination associated with the continuous cost data collection program.

Tasks	Detailed activities	Responsible personnel
1. Observer training	Provide training on the economic data collection	PIFSC economists
2. Survey form print-out and distribution	An economic form should be included in the package that observers take to sea	PIRO debriefers, observer contractor, observers
3. Data collection at sea	Collect trip cost data	Observer on board
4. Verification of data collection status	Check on the status of data collection and send an automated email notification if no cost data collected	PIRO debriefers
5. Data entry	Pick up hardcopy of survey responses on a monthly basis and enter data	PIFSC economists
6. Data quality control and data analysis	Check data quality and perform data analysis and data summaries	PIFSC economists

Observer Training

Observer training on the economic add-on form is provided by PIFSC economists. Usually there are one or two training sessions per year and are included as part of new observer training sessions. The training is also provided to the debriefers who perform the acceptance check of data collected when observers return to the office.

Survey Form Print-out and Distribution

The observers for the PIRO observer program are employed through a contractor (currently Techsea International, Inc.) rather than hired directly by the federal government. The survey forms are distributed to observers through the contractor. Since economic data collection is an add-on program, the survey form is not printed out in a booklet with other data forms. In the early stages of the economic data collection program, observers often did not take the economic data collection forms on trips, creating a source of missing data. Therefore, providing the observers going to sea with the economic survey form is an important step. Because the operators in the fishery are largely comprised of three distinct ethnic groups, the observers carry forms in all three languages.

Data Collection at Sea

Observers are advised to conduct surveys with vessel operators on the return home rather than on the way to fishing grounds. Vessel operators are usually less busy when returning to port after fishing activities end, so conducting the economic survey at that time may increase the likelihood of vessel operators divulging information. More importantly, key items of trip expenses (such as fuel and bait usage) become clearer toward the end of the trip. So far, observers have quite successfully employed this method of collecting economic data. Depending on the ethnicity and personality of the vessel operator, most of the observers have also found success in collecting data by giving the form to the operator directly. Sometimes vessel operators allow the observers to sort through their receipts to record costs (if the vessel operator expresses a lack of interest or if they are busy). The response rates for the data collection programs will be discussed later where the summary data for each fishery are presented.

Verification of Data Collection Status

Though it is voluntary for vessel operators, the economic data collection program wants to emphasize that it is the observer's responsibility to attempt to collect the economic data. When observers return from a trip, PIRO debriefers verify that all required data (including the add-on economic data) were collected. The overall response rate of the economic data collection over the observed trips was approximately 60%. If economic data were not collected, the observers are asked to identify the reasons and fill out the last portion of the survey form regarding the status of the data collection.

Beginning on August 1, 2016, an automatic electronic notification system was developed and implemented to report on economic data collection status. If an observed trip returns without any cost data, an email notification from the observer (when he/she returned to PIRO office to enter data) will be sent to the responsible personnel in both PIRO and PIFSC. This notification system provides timely updates on the data collection status and reasons for missing data allowing follow-up actions toward improving the data collection and coordination to be taken accordingly. The preliminary results generated from the first 10 months of data from the automated reporting system indicated three main reasons economic data were not collected including: (1) "captain did not know" (29%), (2) "captain refused" (34%), and (3) no responses from the observers (29%, including 19% "observers forgot to ask" and 10% "no reports from observers"). The results suggest that the response rate could be further improved if the second and third issues can be better addressed.

Data Entry

PIFSC economists are responsible for entering economic data. Once the observers return, photocopies of the economic data forms are made, and staff from the PIFSC program pick up the photocopies from the PIRO observer program office on a regular basis (the original copies are kept in the PIRO observer office). In the first a few years, the economic data collected were entered into a simple Microsoft ACCESS database without an integrated data quality control process. Unfortunately, many errors were discovered when summary reports were generated. To improve data quality and build linkages of the cost data with other fisheries-dependent data (such as catch and fish price data), effort has been devoted to developing an interface ACCESS database, which will be discussed in the next section.

Database Management

Data Entry Design for Data Quality Control

In 2016, development of an interface ACCESS database began. The effort included redesigning the database structure, creating data entry form with data quality control, a built-in linkage between the cost data and other data resources through Open Database Connectivity (ODBC), pre-designed queries for data integration and data summary. Thus, the interface ACCESS database includes many new features. For example, the data entry design includes the following functions:

1) Data quality control: The cost data entered are evaluated within minimum and maximum ranges. The data also are evaluated with fisheries-dependent data to make sure that vessel names, trip start and return dates are recorded and consistent with other NOAA Fisheries information, and trip numbers are consistent with the data recorded in the logbook for the same trip. This system also prevents duplicate data entries.

2) A role-based multi-user database: The database is classified with different access roles: (A) data entry can be performed from multiple work stations; (B) only designated manager(s) with an administrative access role can modify main tables and run queries or can override min and max ranges in a control mode; (C) data entry personnel-only access to the data entry form. The new data are entered into a temporary/intermediate space and then transmitted into the main table that is password protected and saved on a server.

3) Classification of data completeness: After data are entered, they are categorized (A, B, or C) based on the completeness of the data collected on each trip: (A) "completed" if all of the cost-related items are collected; (B) "bait and fuel" if at least these two key cost items are collected but missing part or all of the other cost items; (C) "other incomplete" for all others (including those missing bait and fuel information) with few or no cost-related data collected.

4) Imputation methods for the missing cost items: The database has a built-in function to estimate the costs for certain items for those trips with the key cost information (such as bait and fuel costs), labeled as "bait and fuel" trips in the previous step. Fuel and bait costs comprise approximately 70% of the total trip costs. However, about 38% of the trips with fuel cost and bait cost information missed at least one other item. The database has a built-in a function to add missing values using the average value of the completed trips. A raw data table, without any filled value is kept in a separate file from the tables that have been modified. Thus, users may choose different data tables to use based on their research needs.

Data Integration with Other Fisheries-Dependent Data

Another new feature of the interface ACCESS database is the built-in linkages with other fisheries-dependent data. The built-in linkages make integration among the cost, fish catch, and fish sales data much easier and more effective. The three types of data are linked together in the same database allowing data summary products, such as costs, revenues, and net revenues, to be generated in a timely manner. The flow chart below shows the database structure and data flow from various data sources. Because the interface ACCESS was built with Oracle compliant sync function and pre-defined queries, the database and data summaries can be updated with the data sources within the PIFSC domain.

AS the flow chart (Figure 1) shows, the Interface ACCESS database is composed of several elements (four boxes): 1) Trip Cost Data Entry, 2) Trip Level Catch and Effort Data from logbook data stored in PIFSC domain, 3) Fish Sale Data generated from Hawaii Division of Aquatic Resources (**DAR**) data from PIFSC domain, 4) Relational/Interface ACCESS database with functions of data sync, queries, and reports, etc.

The functions of the first box, Trip Cost Data Entry, were descripted in the previous section “Data Entry Design for Data Quality Control.” Users who have access to the first box (performs data entry) do not require access to the other three boxes as the database is set up as role-based multi-user. The main function of the second box is "data sync", acquiring trip level logbook data (such as fishing effort and catch data) stored in PIFSC domain. The raw data of the fishermen logbooks (for both Hawaii longline and American Samoa longline fisheries) are at set level, because the two longline fisheries usually have multiple sets in one trip. The set level data were aggregated into trip level data by a pre-designed “data sync” query. The trip level data are then linked and uploaded into the ACCESS database through “Open Database Connectivity” (ODBC), a function in ACCESS. Thus, the trip level fishery data in the interface ACCESS database are updated constantly as the trip level data are directly linked to the logbook dataset in PIFSC domain where data are updated constantly. Similar to the second box, the function of the third box is "data sync" function to pull fish sale data from the DAR dataset stored in PIFSC domain to the interface ACCESS database through ODBC. Finally, the fourth box merges data from the three sources and conducts data summary and analysis. The data summaries are produced by pre-design queries.

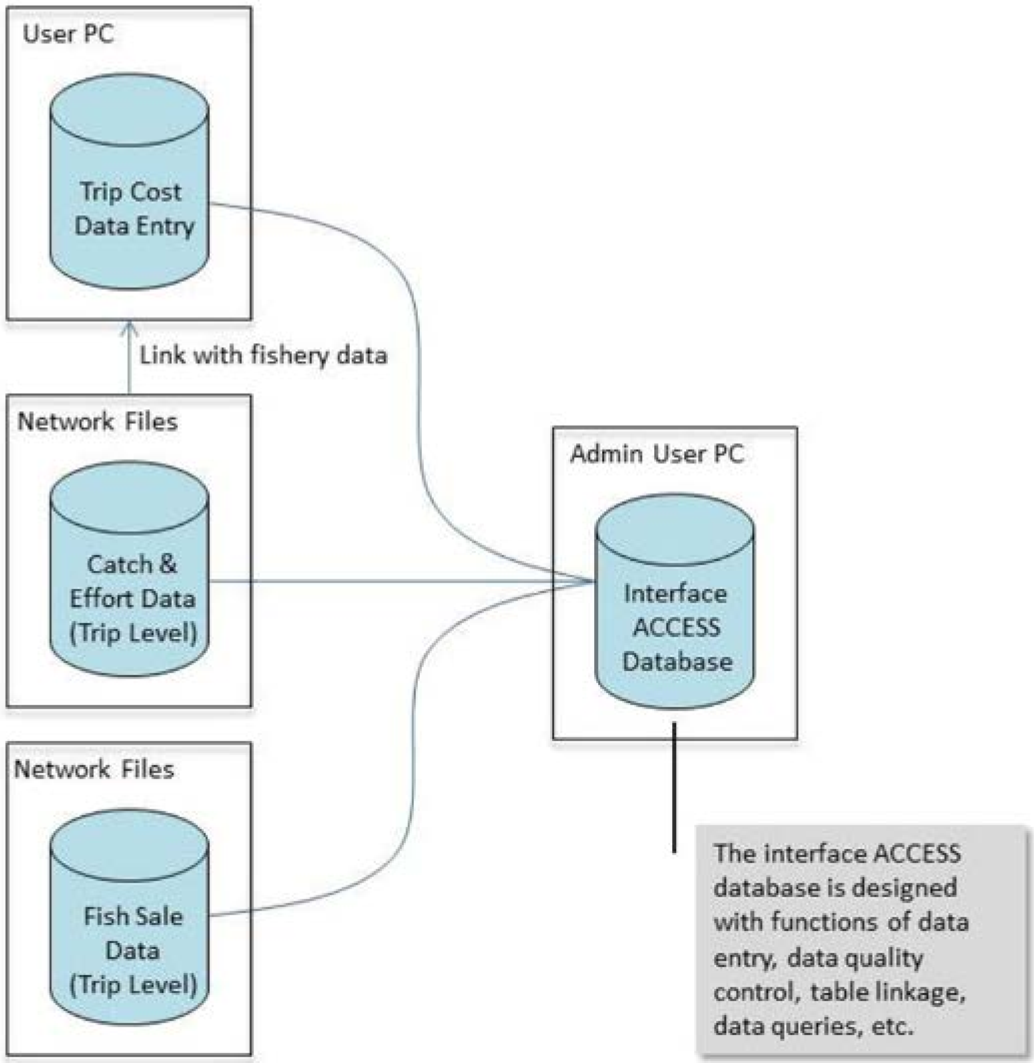

Figure 1. The flow chart of Interface Access database design.

Economic Performance of the Hawaii Longline Fisheries, 2005-2016

Population and Response Rate

The economic data collection program for the Hawaii-based longline fishery covers both the deep-set (targeting bigeye tuna) and shallow-set (targeting swordfish) components of the fishery. The Hawaii-based longline fishery landed over 39.8 million pounds of pelagic fish, valued at $112.8 million in 2016, with 142 active longline vessels. The number of active vessels in the fishery had been stable from 2004 to 2012, ranging from 123 to 129, but increased gradually in recent years, up to 142 in 2016. The fishery is managed under a limited entry program with 164 permits and is subject to bigeye tuna catch limits imposed by two Regional Fisheries Management Organizations: The Western and Central Pacific Fisheries Commission and the Inter-American Tropical Tuna Commission.

The statistical sample design of the economic data collection program is defined by the PIRO observer program. In the early period of the observer program (1994-1999), observer coverage was approximately 5% but has since increased. By 2004, when the economic data collection program was started, the observer coverage rate in the Hawaii fisheries was up to 25%.[1] Since then, observers are required aboard 100% of Hawaii-based pelagic longline vessels targeting swordfish (shallow-set) and 20% of vessels targeting tuna (deep-set). American Samoa-based longline vessels targeting tuna (albacore), require 20% coverage. Observer samples are randomly chosen through a sample design created by a PIFSC scientist. Both the current high coverage rate and the continuity of the observer program allow the economic add-on survey to provide a timely and informative cross-sectional analysis of the variable cost figures for vessels of varying targets (shallow-set to target swordfish or deep-set to target bigeye tuna) and vessel sizes on a continuous basis. Table 2 lists the population, sample size, and response rate for the cost data collection program of the Hawaii longline fishery.

The response rate of the cost data collection was high in general, 61% for the entire period from 2005 to 2016. Only trips with completed data or with key cost items (fuel and bait costs) collected are counted for the number of trips with economic data in the response rate calculation. The coverage rate of trips with cost data among all longline trips was 15.4% for the entire period from 2005 to 2016. The details for each individual year are listed in Table 2. Table 3 and Table 4 show the population, sample size, and response rates for tuna (deep-set) trips and swordfish (shallow-set) trips, respectively. Overall, the response rate for shallow-set swordfish trips to observers is higher than the deep-set tuna trips.

[1] http://www.fpir.noaa.gov/OBS/obs_hi_ll_ds_rprts.html

Table 2. Hawaii longline fishery population, sample size, and response rate to trip cost data collection, 2005-2016.

Year	Number of active vessels	Total longline trips	Total observed trips	Trips with cost data	Response rate to observed trips	% of trips with cost data to the total trips
2005	124	1483	462	265	57%	18%
2006	127	1357	342	228	67%	17%
2007	129	1451	349	242	69%	17%
2008	128	1412	370	241	65%	17%
2009	127	1325	353	209	59%	16%
2010	123	1320	356	219	62%	17%
2011	128	1342	336	213	63%	16%
2012	129	1381	338	198	59%	14%
2013	135	1387	324	183	56%	13%
2014	139	1376	335	214	64%	16%
2015	141	1443	331	203	61%	14%
2016	142	1453	326	162	50%	11%

Table 3. Hawaii longline fishery population, sample size, and response rate to trip cost data collection of tuna (deep-set) trips, 2005-2016.

Year	Number of active vessels	Total Tuna trips	Total observed tuna trips	Tuna trips with cost data	Response rate to observed trips	% of trips with cost data to the total trips
2005	124	1377	364	208	57%	15%
2006	127	1300	282	184	65%	14%
2007	129	1382	270	181	67%	13%
2008	127	1314	288	174	60%	13%
2009	127	1221	250	141	56%	12%
2010	122	1216	250	134	54%	11%
2011	129	1260	253	148	58%	12%
2012	128	1309	263	148	56%	11%
2013	135	1334	273	148	54%	11%
2014	139	1301	257	161	63%	12%
2015	143	1377	273	148	54%	11%
2016	142	1411	283	141	50%	10%

Table 4. Hawaii longline fishery population, sample size, and response rate to trip cost data collection of swordfish (shallow-set) trips, 2005-2016.

Year	Number of active vessels	Total Swordfish trips	Total observed swordfish trips	Swordfish trips with cost data	Response rate to observed trips	% of trips with cost data to the total trips
2005	31	98	98	57	58%	58%
2006	35	60	60	44	73%	73%
2007	27	79	79	61	77%	77%
2008	27	82	82	67	82%	82%
2009	28	103	103	68	66%	66%
2010	28	106	106	85	80%	80%
2011	20	83	83	65	78%	78%
2012	18	75	75	50	67%	67%
2013	15	51	51	35	69%	69%
2014	20	78	78	53	68%	68%
2015	22	58	58	55	95%	95%
2016	13	43	43	21	49%	49%

Metadata for the main data sources

The main data presented in this report are sourced from the primary data collection efforts by PIFSC economists as discussed in the previous sections. Secondary data, such as landings and fish price information collected by other programs in PIFSC and PIRO, are also used in this report. The full metadata records for the data sources are available at InPort, the NOAA Fisheries Enterprise Data Management Program (https://inport.nmfs.noaa.gov/inport). The links to the metadata records in InPort are listed in parentheses for each associated data source as follows:

1) Trip Level Cost Data Collection Program of the Hawaii Longline Fishery (https://inport.nmfs.noaa.gov/inport/item/5662)
2) The Hawaii Longline Observer program (https://inport.nmfs.noaa.gov/inport/item/16865) and the annual summary of observer trips (http://www.fpir.noaa.gov/OBS/obs_qrtrly_annual_rprts.html)
3) Hawaii Longline Logbook (https://inport.nmfs.noaa.gov/inport/item/2721)
4) Hawaii DAR Dealer Reporting System Data (https://inport.nmfs.noaa.gov/inport/item/5610)

Adjustments for inflation

The prices, costs, and net revenue trends in this report will be presented in both nominal and inflation-adjusted 2016 dollars. The general level of prices in the economy increase over time (i.e., inflation) and as a result, a dollar cannot buy as much today as it could in the past. To make valid comparisons of monetary estimates over time, a price index is used to remove the effects of changes in the general level of prices. A price index is used to convert “nominal” or unadjusted values into “real” or inflation-adjusted values so that valid comparisons of monetary estimates across time can be made. Many price indices can be used to convert nominal into real values, with the Consumer Price Index (CPI) being the most widely used and best known of these indexes. This report uses the Honolulu Consumer Price Index (HCPI) to convert nominal into real values for the Hawaii longline fishery. The use of the HCPI is consistent with other technical reports, such as plan team reports from PIFSC to the Council.

Average Trip Costs Trend

The Hawaii longline fishery conducts two types of fishing; deep-set targets bigeye tuna, and shallow-set targets swordfish. Most of the vessels target only tuna although some vessels switch between these two types of fishing depending on the season. Vessel operators need to declare the type of their fishing trip before departing and report that to the NOAA Fisheries office. Since the reopening of the fishery in 2004, all shallow-set swordfish trips are required to carry a NOAA Fisheries observer on broad. The average cost for this type of trip is usually higher than a deep-set tuna trip as it is frequently longer. The average length for shallow-set swordfish trips was 32 days during the 2005-2016 period, while it was 22 days for deep-set tuna trips (based on the logbook information during the period). Therefore, this study assessed the economic performance for these two components of the fishery separately. Please note that the trip costs in this report do not include labor. Figure 2 and Figure 3 show the trend of average trip costs and one standard deviation for the deep-set tuna and shallow-set swordfish trips, respectively for 2005-2016. Detailed data on trip costs for the two types of fishing are presented in Table 5 and Table 6.

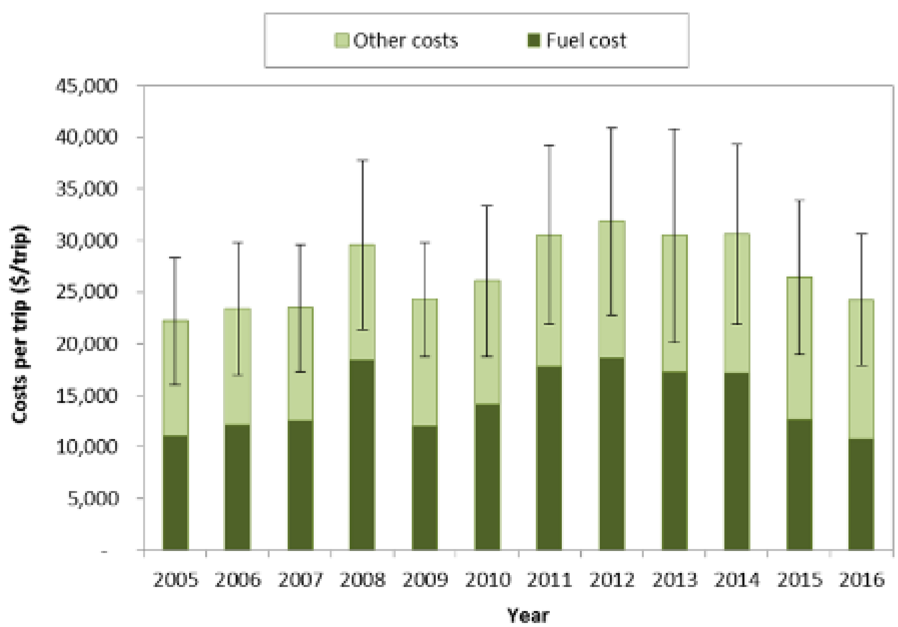

Figure 2. The trend of average trip costs with standard deviation for Hawaii longline deep-set tuna trips, 2005-2016 (adjusted to 2016 dollars).

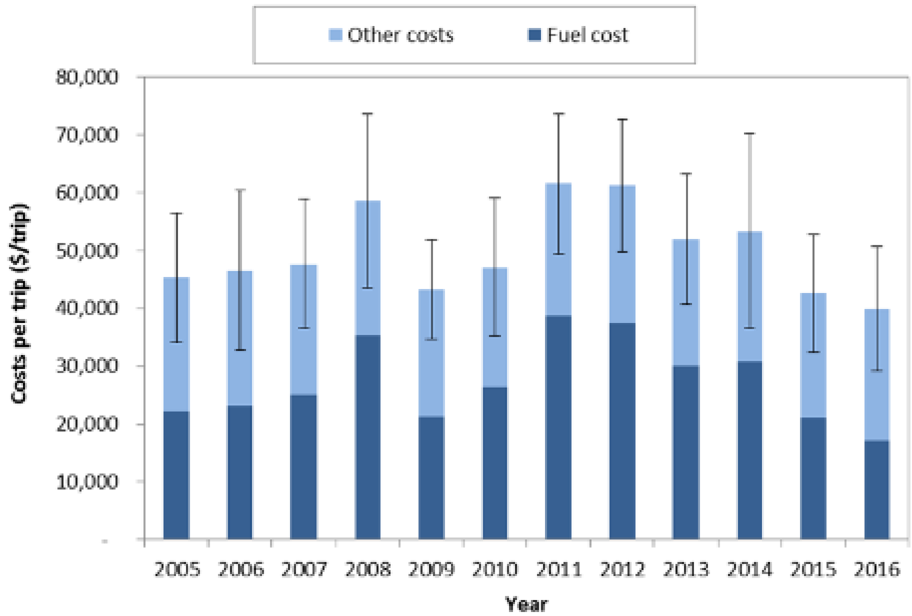

Figure 3. The trend of average trip costs with standard deviation for Hawaii longline shallow-set swordfish trips, 2005-2016 (adjusted to 2016 dollars).

Figure 2 shows the trend of average trip costs for Hawaii longline deep-set tuna fishing trips between 2005-2016 (adjusted to 2016 dollars). Since 2005, trip costs for Hawaii longline deep-set tuna fishing increased steadily to 2012, and the average trip cost increased 36%, from $22,207 per trip in 2005 to $31,842 per trip in 2012. The trip costs then slightly decreased in 2013 and 2014, then dropped substantially in 2015 and 2016. The average deep-set tuna trip cost of $31,842 at the peak in 2012, dropped to $26,398 and then $24,242 in 2015 and 2016, respectively. Compared to the peak in 2012, the tuna trip costs in 2016 had decreased by 24%. Trip costs in 2008 were high due to a sharp rise in fuel prices which made up 62% of total trip costs that year. Overall, the rise and fall of trip costs have been due, primarily, to changes in fuel prices.

Shallow-set swordfish fishing trips are usually longer than deep-set tuna fishing trips, as mentioned previously, even when the trips are carried out by the same vessel, which makes them more expensive in general. For example, the costs of an average shallow-set swordfish trip were 65% higher in 2016. Figure 3 shows the trend of Hawaii longline shallow-set swordfish trip costs, 2005-2016 (adjusted to 2016 dollars). The average shallow-set swordfish trip costs were relatively steady during the 2005-2010 period, but were particularly high in 2008, and again in 2011 and 2012. At its peak in 2011 and 2012, the average shallow-set swordfish trip cost totaled over $61,000, while the average deep-set tuna trip cost peaked at $31,824 in 2012. Fuel made up over 60% of trip costs in 2008 and 2011.

Table 5. Average trip cost, revenue, and net revenue for Hawaii longline deep-set deep-set tuna fishing trips (adjusted to 2016 dollars), 2005-2016.

Year	HCPI Adjustor	Fuel cost	Other costs	Trip costs	StDev of trip costs	Trip revenue	Trip net revenue	% fuel cost to total	No. of trips with cost data
2005	1.341	11,138	11,069	22,207	6,140	48,900	26,694	50%	208
2006	1.267	12,159	11,202	23,361	6,404	47,642	24,281	52%	184
2007	1.209	12,585	10,863	23,448	6,110	49,658	26,210	54%	181
2008	1.159	18,459	11,115	29,574	8,212	57,505	27,932	62%	174
2009	1.153	12,054	12,225	24,279	5,546	48,808	24,529	50%	141
2010	1.129	14,106	11,949	26,055	7,300	60,674	34,619	54%	134
2011	1.089	17,835	12,722	30,558	8,651	63,235	32,677	58%	148
2012	1.063	18,609	13,233	31,842	9,057	71,957	40,115	58%	148
2013	1.045	17,241	13,229	30,470	10,319	68,351	37,882	57%	148
2014	1.030	17,158	13,498	30,656	8,708	63,799	33,143	56%	161
2015	1.020	12,673	13,725	26,398	7,444	69,699	43,301	48%	148
2016	1.000	10,768	13,474	24,242	6,343	73,024	48,782	44%	141

Table 6. Average trip cost, revenue, and net revenue for Hawaii longline shallow-set swordfish trips (adjusted to 2016 dollars), 2005-2016.

Year	HCPI Adjustor	Fuel cost	Other costs	Trip costs	StDev of trip costs	Trip revenue	Trip net revenue	% fuel cost to total	No. of trips with cost data
2005	1.341	22,319	22,967	45,286	11,137	102,281	56,995	49%	57
2006	1.267	23,199	23,330	46,529	13,814	96,000	49,471	50%	44
2007	1.209	25,089	22,543	47,632	11,164	107,721	60,088	53%	61
2008	1.159	35,412	23,189	58,601	15,108	99,233	40,632	60%	67
2009	1.153	21,340	21,960	43,299	8,628	78,492	35,192	49%	68
2010	1.129	26,376	20,765	47,140	11,986	81,645	34,505	56%	85
2011	1.089	38,689	22,848	61,537	12,115	114,209	52,671	63%	65
2012	1.063	37,471	23,760	61,231	11,455	106,835	45,604	61%	50
2013	1.045	30,117	21,860	51,977	11,194	110,753	58,776	58%	35
2014	1.030	30,716	22,668	53,384	16,841	87,947	34,563	58%	53
2015	1.020	21,139	21,554	42,694	10,229	79,609	36,915	50%	55
2016	1.000	17,131	22,780	39,912	10,796	112,978	73,066	43%	21

Trip Cost Structure

Fuel accounted for the largest share of total fishing trip costs (non-labor items) from 2005-2016, ranging from 44% to 62% for deep-set tuna fishing trips and 43% to 63% for shallow-set swordfish fishing trips. Figure 4 and Figure 5 show the cost structures of an average deep-set tuna trip and shallow-set swordfish trip, respectively, in 2016. At that time, fuel comprised 44% of deep-set tuna trip costs. Bait was the second largest item, making up 27% of the cost. Therefore, if information for at least bait and fuel was gathered, the trip was defined as successful in terms of economic data collected. Otherwise, it was defined as an “incomplete” trip (not counted as a response in the response rate calculation). The other costs of deep-set tuna trips included gear (12%) and provisions (11%). The remaining 6% of the trip costs were for engine oil, ice, and commutations, each accounting for 2% of the deep-set tuna trip costs.

The trip cost structure for shallow-set swordfish fishing was similar to deep-set tuna fishing. On average for the period of 2005-2016, the fuel cost comprised 54% of total trip expenditures for both types of trips. In 2016, fuel made up 43% of shallow-set swordfish trip costs. Bait was the second largest item, making up 20% of those trip costs. The third largest item for shallow-set swordfish trip costs was lightsticks, comprising 15% of trip costs in 2016. Deep-set tuna fishing does not use these. Gear and provisions also were substantial portions of shallow-set swordfish trip costs, each comprising 9% of trip costs. The other two small cost items were engine oil and commutations, each accounting for 2% of the shallow-set swordfish trip. While ice made up 2% of deep-set tuna trip costs, it is zero or negligible for shallow-set swordfish trips since those vessels are equipped with icemakers. Even on deep-set tuna trips, ice costs have declined over time (from 6% in 2005 to 2% in 2016) because more vessels are equipped with icemakers in the Hawaii longline fleet.

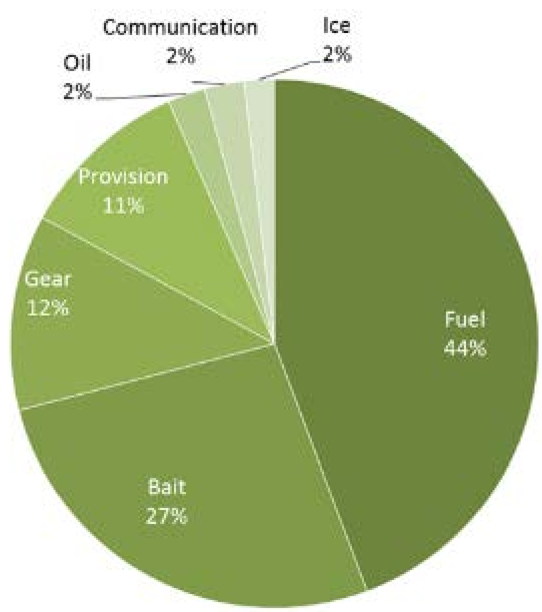

Figure 4. The cost structure of an average deep-set tuna fishing trip in 2016.

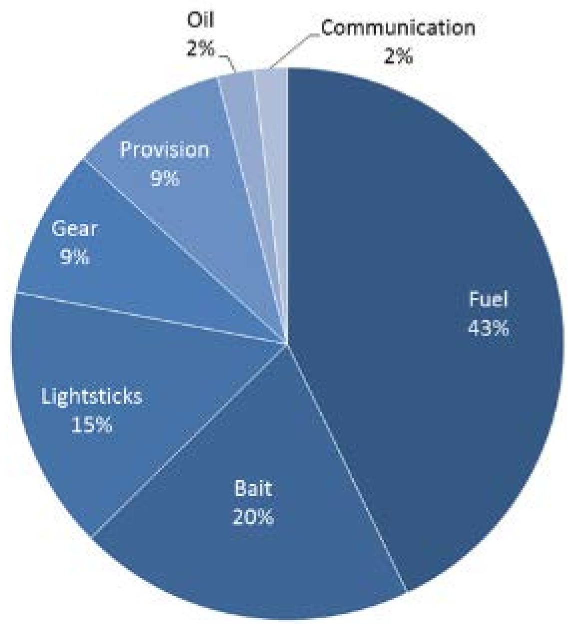

Figure 5. The cost structure of an average shallow-set swordfish trip in 2016.

Trip Costs and Fuel Prices Trends

In the previous section, we indicated that the fluctuations in trip costs over time are correlated with fluctuations in fuel prices. Figure 6 shows the trend of the annual average fuel price paid by fishermen (recorded through the data collection program) during the period of 2005-2016 (adjusted to 2016 dollars), along with the standard deviation of the average fuel price. The data for Figure 6 are presented in *Error! Reference source not found.*. The first peak in average trip costs appeared in 2008, when fuel prices spiked to an all-time high of $4.20 per gallon. Fuel prices went down substantially in 2015 and 2016, with the lowest fuel price during the reporting period occurring in 2016. As a result, the proportion of fuel cost to total trip costs in 2016 was the lowest recorded for both deep-set tuna trips and shallow-set swordfish trips.

Figure 7 shows the quarterly average fuel price (nominal) and deep-set tuna trip cost (nominal) trends for 2005-2016. Both time series data moved up and down synchronously. Since fuel price changes are an exogenous variable that is beyond the control of fishermen, the uncertainty of fuel markets unavoidably brings uncertainty to the economic performance of the fisheries. This report does not present quarterly fuel prices and trip cost figures for shallow-set swordfish trips due to the limited and unevenly distributed (across seasons) observations.

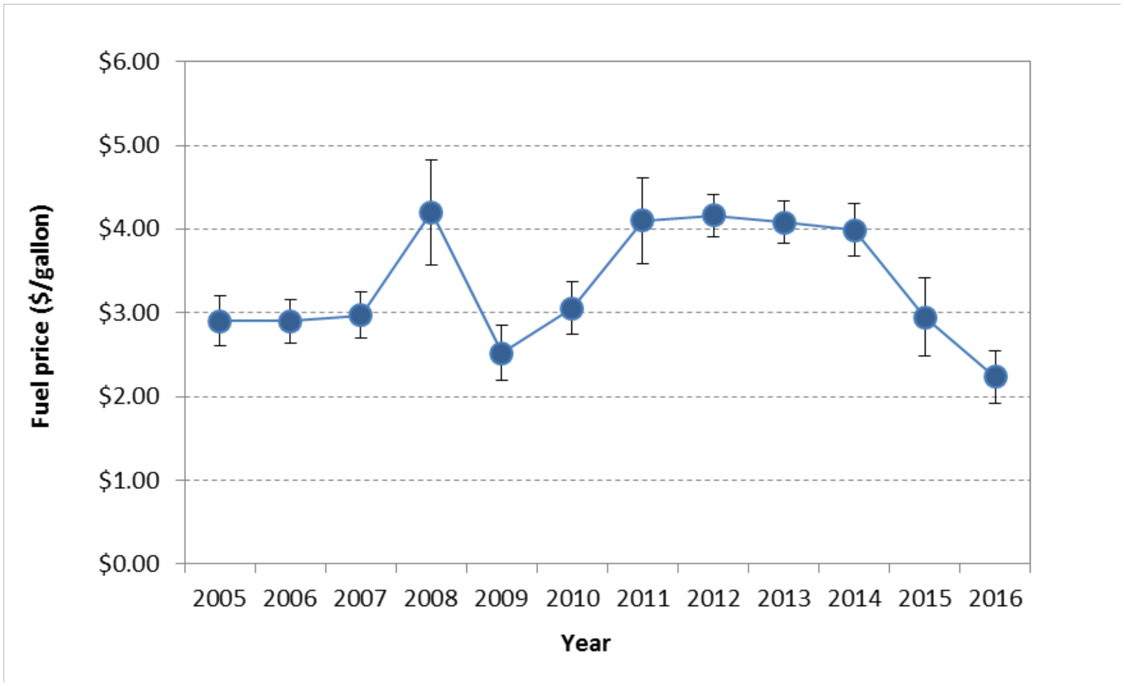

Figure 6. The annual average fuel price trend with standard deviation: 2005-2016 (adjusted to 2016 dollars).

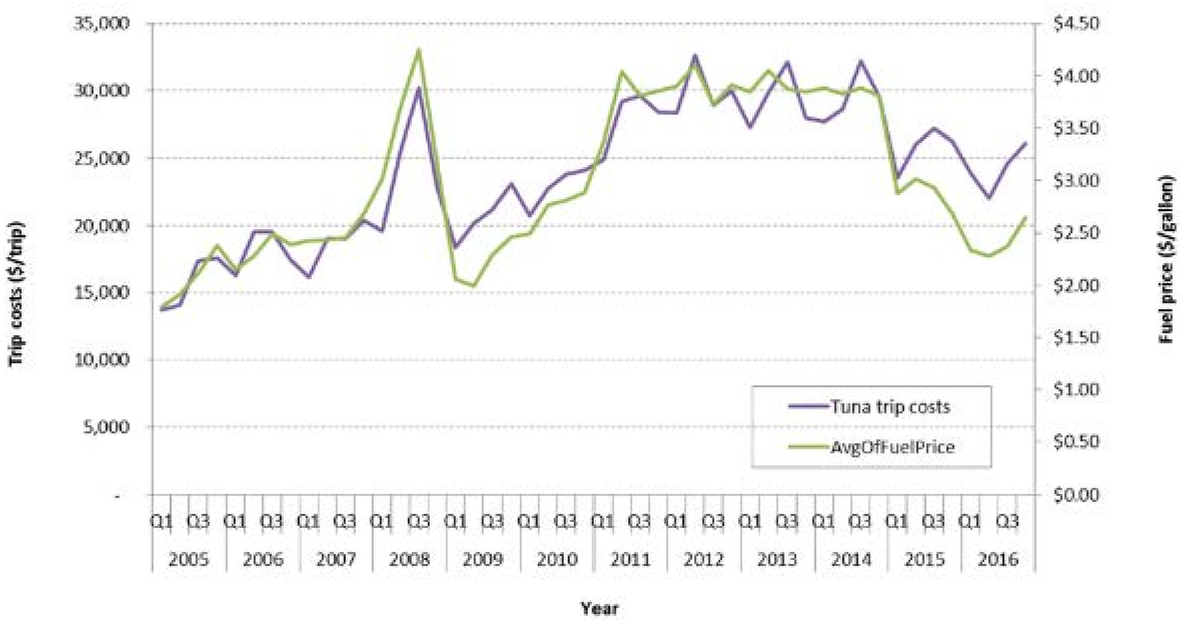

Figure 7. The quarterly average fuel price and deep-set tuna trip cost trend for the 2005-2016 period (nominal value).

Table 7. Average annual fuel price and fuel costs per trip and inflation adjustors of the Honolulu Consumer Price Index (HCPI) (adjusted to 2016 dollars), 2005-2016.

Year	HCPI adjustor	Fuel price	StDev of fuel price	Average trip costs (for all tuna and swordfish trips)
2005	1.341	$2.90	0.30	25,924
2006	1.267	$2.90	0.26	28,711
2007	1.209	$2.97	0.28	30,704
2008	1.159	$4.20	0.63	38,662
2009	1.153	$2.52	0.33	32,197
2010	1.129	$3.06	0.32	35,132
2011	1.089	$4.10	0.51	41,930
2012	1.063	$4.16	0.25	41,655
2013	1.045	$4.08	0.26	35,350
2014	1.030	$3.99	0.31	37,668
2015	1.020	$2.95	0.47	32,641
2016	1.000	$2.23	0.31	20,948

Trip Net Revenue Trends

Figure 8 and Figure 9 present the trip net revenue for the Hawaii deep-set (tuna) fishery and the shallow-set (swordfish) fishery, respectively. In this analysis, we define trip net revenue as trip revenue less trip costs (not including labor cost). In some economics literature, the net revenue, revenue less variable costs, is called "quasi-rent" rather than profit.[2] The fishing trip costs used in calculating trip net revenue do not include labor (payment to captain and crew) or fixed costs (e.g., insurance and major repairs). In the following analyses, we present the average trip net revenue by trip type: deep-set in Figure 8, and shallow-set in Figure 9. The detailed data for the two figures are also presented in Table 5 and Table 6.

In general, the returns on deep-set tuna fishing increased steadily for the 2005-2016 period (adjusted to 2016 dollars), although some years experienced a drop in net revenue compared to previous years (Table 5). The average trip net revenue of deep-set tuna fishing has increased 83%, from $26,694 per trip in 2005 to $48,782 per trip in 2016. Revenue per trip in 2016 was the highest during the entire 2005-2016 period, and trip costs were low as a result of reduced fuel costs during the report period.

The trend of returns on shallow-set swordfish fishing shows a different pattern than deep-set tuna fishing. The average shallow-set swordfish trip net revenue was usually greater than the average deep-set tuna trip net revenue. In some years, such as 2009, 2010, 2014, and 2015, the average net revenue for a shallow-set swordfish trip was approximately $35,000. In other years (2005, 2008, 2013, and 2016), the average net revenue was over $55,000, more than 50% higher compared to years with low returns. Table 6 shows the detailed cost and revenue figures for

[2] http://www.economicsdiscussion.net/rent/quasi-rent/quick-notes-on-quasi-rent-with-diagram/17197

shallow-set swordfish trips. As with deep-set tuna fishing, 2016 was a particularly good year for shallow-set swordfish fishing with the lowest trip costs and the highest trip revenue ($73,000).

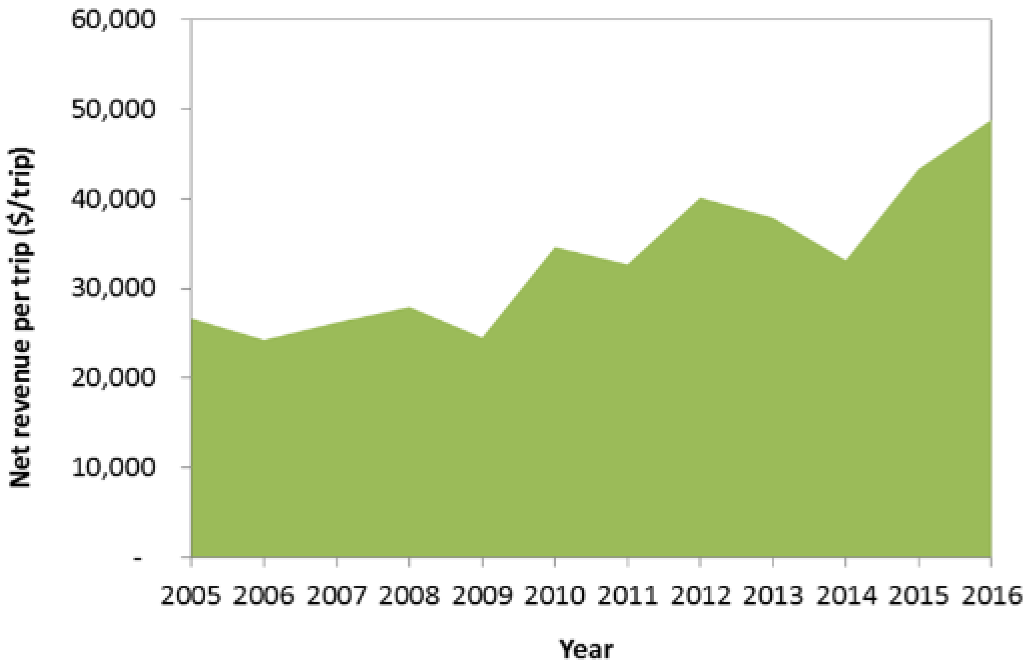

Figure 8. Average Trip Net Revenue for Hawaii Longline Deep-set tuna trips (adjusted to 2016 dollars), 2005-2016.

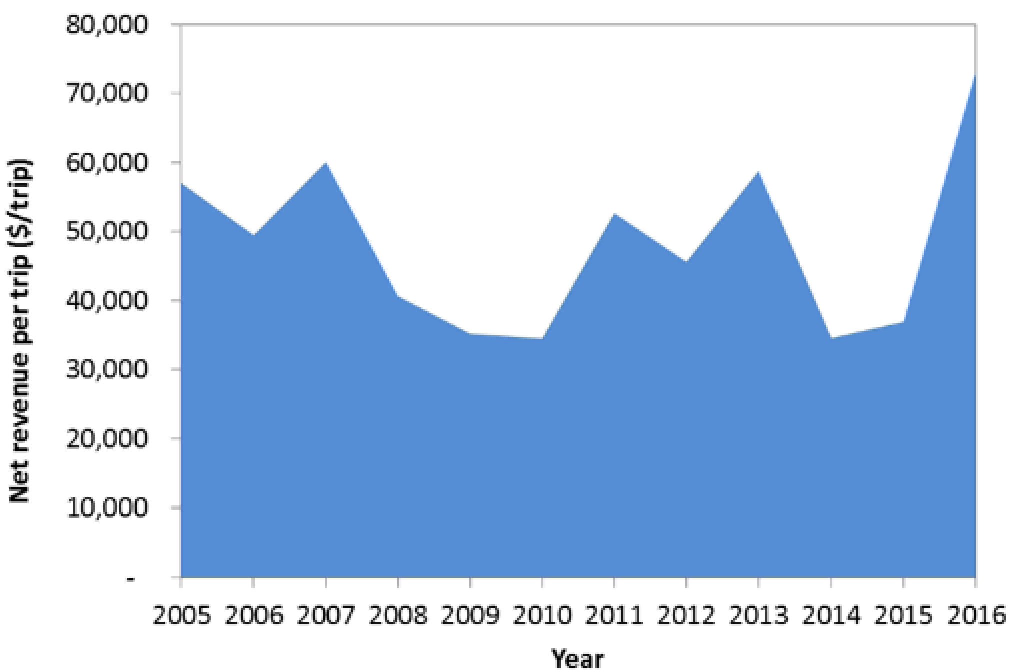

Figure 9. Average Trip Net Revenue for Hawaii Longline Shallow-set swordfish trips (adjusted to 2016 dollars), 2005-2016.

Trip Costs by Area

Linking fishing cost data with vessel logbook data allows us to examine costs by area. The fishing grounds of the Hawaii longline fisheries encompass broad regions, and span three areas with different management regimes: the Hawaiian Islands Exclusive Economic Zone (EEZ), the Western and Central Pacific Ocean (WCPO), and the Eastern Pacific Ocean (EPO). The EPO and WCPO are basically divided by the 150°W longitude in the Hawaii longline fishing ground. Figures 10 and 11 show the average trip costs by the three areas. The three areas and their boundaries are illustrated in Figure 10. A Hawaii longline fishing trip usually lasts over two weeks and might fish across all three areas on the same trip. A trip was assigned to a specific area in the report based on the following definitions and priorities: 1) a fishing trip with at least one set fished in the EPO is defined as an EPO trip; 2) a fishing trip with at least one set fished in the Hawaiian Islands (including the Northwestern Hawaii Islands and the Main Hawaii islands) EEZ is defined as an EEZ trip; and 3) a fishing trip without any sets in the Hawaii EEZ or the EPO is defined as a WCPO trip. Under these definitions and priorities, an EPO trip fished in the EPO might have also fished in both the WCPO and the EEZ during the trip; an EEZ trip fished in the EEZ might also have fished in the WCPO (but not in the EPO) during the trip; and a WCPO trip fished only in the WCPO area.

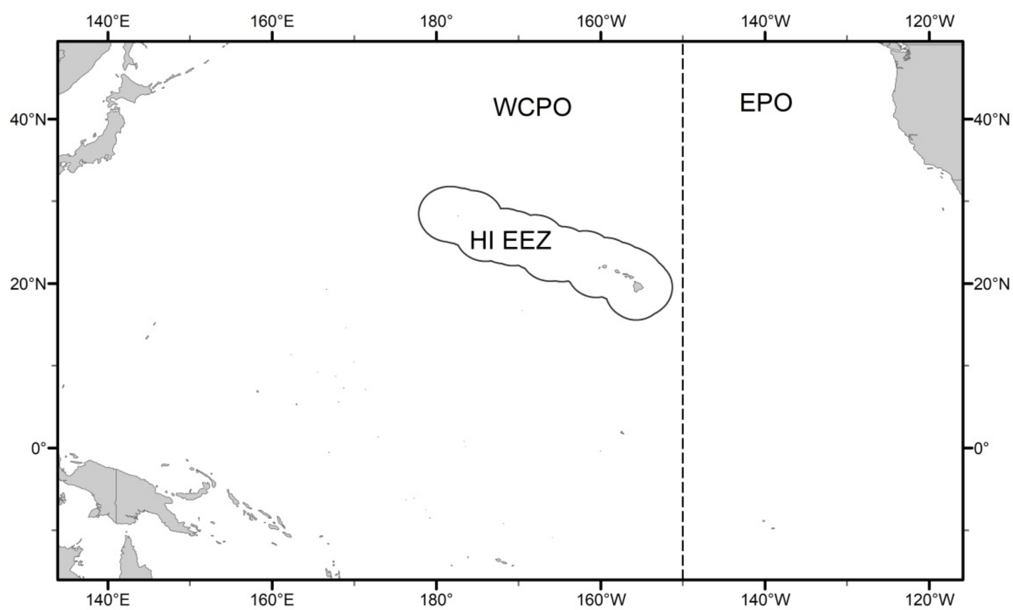

Figure 10. The map of the three areas with different management regimes: WCPO, EPO, and Hawaii EEZ (map courtesy of Dr. Haiying Wang, JIMAR PIFSC).

The average deep-set tuna trip costs for EPO fishing trips were the highest compared to trip costs in the EEZ or WCPO. The average deep-set tuna trip costs of EEZ trips were higher compared to trips to the WCPO. One may expect that the fishing costs within EEZ are lower than the other areas due to its proximity to fishing ports. However, since Hawaii EEZ covers the entire Hawaiian Archipelago that stretches 1,500 miles northwest of the island of Hawaii to Midway Island, the travel distance alone from Honolulu to further north of the Northwestern Hawaii Islands EEZ can be longer than the entire expanse of fishing ground in WCPO. Shallow-set swordfish trip costs across areas show similar patterns to deep-set tuna fishing. The magnitude of differences of shallow-set swordfish fishing costs among the three areas was less compared to the differences of deep-set tuna trip costs. Trip costs in the Hawaii EEZ and WCPO for shallow-set swordfish fishing were actually quite similar. Most years, the average trip costs of shallow-set swordfish trips in the EEZ were higher than in the WCPO; however, in some years the average costs in the EEZ were lower than in the WCPO. The detailed data to support Figure 11 and Figure 12 are in Table 8 and Table 9, respectively.

The Hawaiian volcanic island chain of 137 islands spans more than 1,500 miles from the island of Hawaii (the Big Island) in the southeast to Kure Atoll in the northwest. The detailed spatial variations of fishing costs in the EEZ can be examined by linking trip costs to the actual distances between fishing grounds and the departure ports. The maps, published in the brochure titled Hawaii Longline Trip Expenditure 2004-2012 (PIFSC 2014) illustrated the spatial variations of Hawaii Longline trip costs for both deep-set tuna trips and shallow-set swordfish trips, respectively (see Figure 13). The maps were developed based on the estimated cost functions using the trip cost data from our continuous economic data collection program and vessel logbook data for all the longline trips during the 2010 to 2012 period. Kalberg and Pan (2016) presented the detailed method for the estimations of the fishing trip costs with the associated distances from port to fishing grounds.

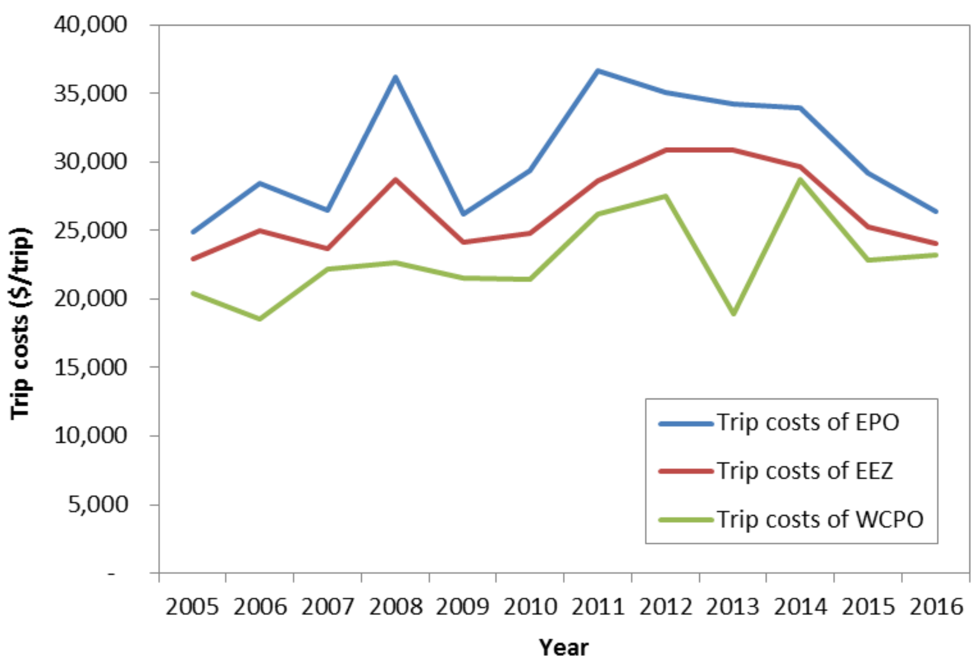

Figure 11. Average trip costs by areas of Hawaii deep-set tuna trips (adjusted to 2016 dollars), 2005-2016.

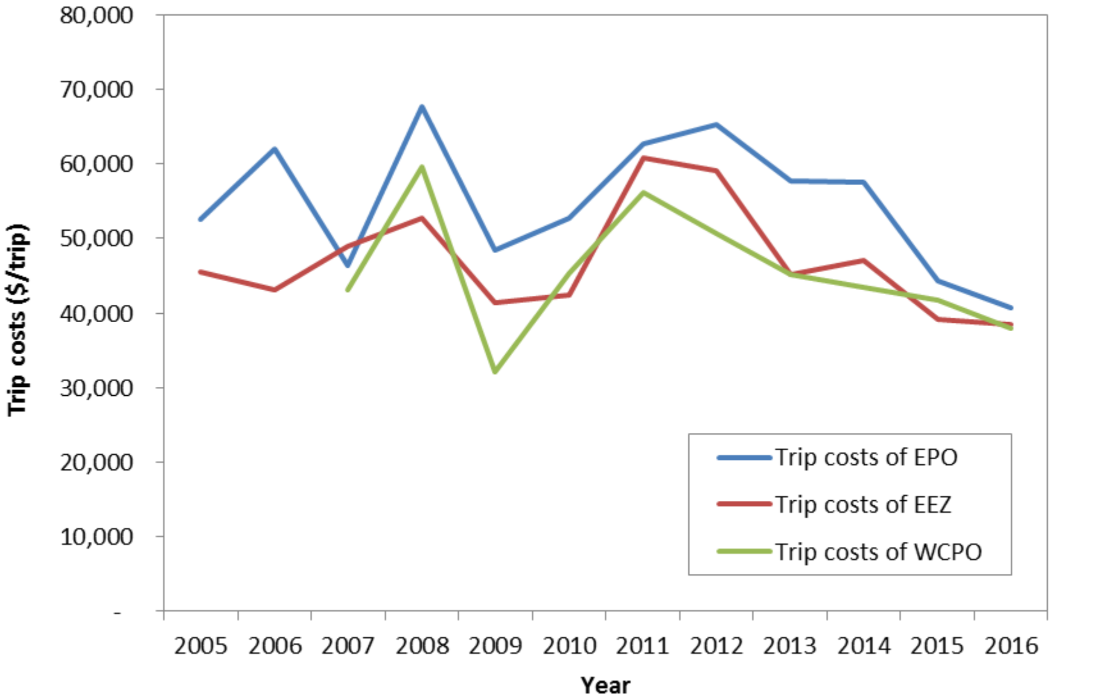

Figure 12. Average trip costs by areas of Hawaii shallow-set swordfish trips (adjusted to 2016 dollars), 2005-2016.

Table 8. Average deep-set tuna trip costs by three areas EEZ, EPO, and WCPO (adjusted to 2016 dollars), 2005-2016.

		EPO			EEZ			WCPO only		
Year	HCPI adjustor	Trip costs of EPO	StDev of trip costs	No. of Trips	Trip costs of EEZ	StDev of trip costs	No. of Trips	Trip costs of WCPO	StDev of trip costs	No. of trips
2005	1.34	24,869	8,265	22	22,983	5,362	105	20,396	6,114	78
2006	1.27	28,424	10,647	7	25,017	5,680	122	18,558	5,516	53
2007	1.21	26,502	6,430	11	23,718	5,832	126	22,152	6,606	43
2008	1.16	36,179	8,007	41	28,703	7,369	105	22,648	6,303	28
2009	1.15	26,235	6,191	29	24,177	5,404	95	21,510	4,373	17
2010	1.13	29,396	8,125	45	24,821	6,120	77	21,445	7,695	12
2011	1.09	36,669	9,156	40	28,618	7,460	91	26,164	7,786	16
2012	1.06	35,089	8,963	35	30,885	8,391	82	27,544	9,351	22
2013	1.05	34,259	8,328	38	30,859	10,542	79	18,966	6,652	17
2014	1.03	33,985	8,803	44	29,668	8,571	92	28,700	7,091	15
2015	1.02	29,201	7,865	48	25,310	6,312	66	22,868	6,950	26
2016	1.00	26,421	5,618	28	24,102	6,202	87	23,220	8,024	12

Table 9. Average shallow-set swordfish trip costs by three areas EEZ, EPO, and WCPO (adjusted to 2016 dollars), 2005-2016.*

		EPO			EEZ			WCPO only		
Year	HCPI adjustor	Trip costs of EPO	StDev of trip costs	No. of Trips	Trip costs of EEZ	StDev of trip costs	No. of Trips	Trip costs of WCPO	StDev of trip costs	No. of trips
2005	1.34	52,616	11,587	7	45,543	11,349	41	38,412	8,225	9
2006	1.27	61,942	14,830	8	43,104	12,212	36			
2007	1.21	46,410	11,641	20	48,936	10,701	36	43,138	13,815	5
2008	1.16	67,735	17,210	24	52,689	11,409	38	59,688	15,437	5
2009	1.15	48,429	8,678	24	41,343	7,162	40	32,085	9,772	4
2010	1.13	52,659	11,180	37	42,479	10,335	41	45,271	16,799	7
2011	1.09	62,681	12,851	35	60,823	11,270	26	56,172	12,331	4
2012	1.06	65,298	11,604	21	59,166	10,870	26	50,663	6,319	3
2013	1.05	57,658	9,592	19	45,241	10,028	13	45,186	9,199	3
2014	1.03	57,524	17,402	33	47,117	14,524	17	43,361	10,838	3
2015	1.02	44,243	9,869	35	39,221	11,399	16	41,756	7,198	3
2016	1.00	40,733	13,169	13	38,427	7,365	5			

*The figures of WCPO in 2005 and 2015 are not presented because the number of trips were less than 3.

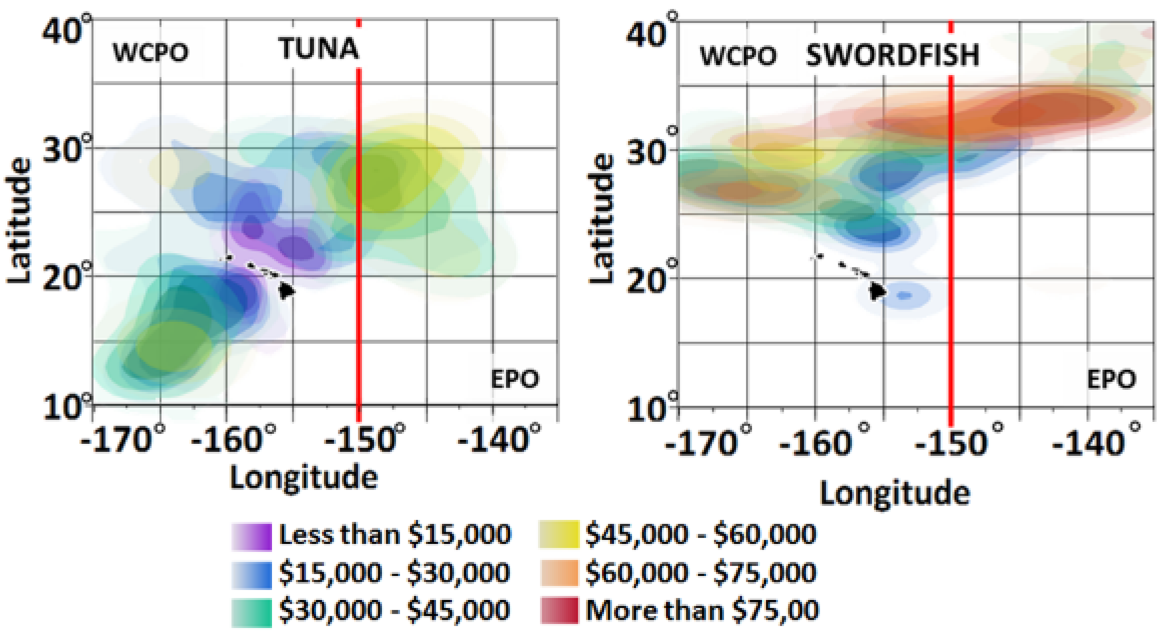

Figure 13. Spatial variations of Hawaii longline trip costs (2010-2012).

Foreign Crew in the Fisheries

In addition to trip cost data, information on the total number of crew employed is also collected in the economic data collection program. Since employing foreign crew became more common in the Hawaii longline fisheries, the number of foreign crew vs. local crew was added into the questionnaire in 2006. However, the data collected for total numbers of crew before and after 2011 were inconsistent due to the change in the survey forms. Some vessels included a captain as a “crew member” while others (especially vessels with owner operators) did not. Thus, the number of crew was not comparable from vessel to vessel. To address this issue, the survey form was revised in 2011 to specify that the number of crew “DOES NOT include” the captain so that the number of fishermen on board is the number of “crew” plus captain making these data comparable across vessels after 2011. Table 10 presents the trends in the number of crew (available since 2011) and foreign crew (available since 2006). It is required that vessel operators are U.S. citizens. The figures in Table 10 show that the number of crew per trip was stable over the years, averaging five (not including the captain) per vessel. The number of foreign crew increased over the past 11 years. In 2016, the foreign crew was 94% of the total, while in 2011, foreign crew was about 88%. Assuming the total number of crew did not change over the 2006 to 2016 period, the percentage of foreign crew was about 81% in 2006. Due to these high ratios, any policy changes related to the employment of foreign crew in U.S. fishing industry would greatly affect the fishery.

Table 10. Number of crew and foreign crew trends per vessel in Hawaii longline fisheries (2006-2016).

Year	Total number of crew (not including captain)	Number of Foreign crew	% foreign crew
2006		4.1	
2007		3.9	
2008		4.1	
2009		4.0	
2010		4.1	
2011	5.0	4.4	88%
2012	4.9	4.3	89%
2013	4.7	4.4	93%
2014	5.1	4.8	94%
2015	5.2	4.8	92%
2016	5.1	4.8	94%

Economic Performance of the American Samoa Longline Fishery 2006-2016

This section covers the long-term trend of trip and set level fishing costs, revenues, and net returns for the period 2006 to 2016 in the American Samoa longline fishery. The fishing cost data were collected through the Continuous Economic Data Collection Program similar to the program that collects Hawaii longline fisheries costs data. The trip revenues have been estimated using algorithms (the number of fish kept (not sold), fish size, fish price, and market decomposition) that are consistent with those from PIFSC and WPacFIN. The report shows a downward trend in economic performance of the American Samoa longline fishery for this period.

American Samoa longline fleet uses deep-set longline gear and mainly targets albacore. Unlike the shallow-set fishery, the deep-set does not have regulations regarding the time of day that the gear may be set. However, it is more common for fishermen of the American Samoa longline fleet to set their gear early in the day and haul in the afternoon, mainly to improve their catch rates. During the reported period (2006-2016), the fishery declined in both number of active vessels and revenue. In 2016, there were a total of 17 active longline vessels that landed 3.9 million pounds of fish valued at $4.0 million. Albacore was 84% of the total revenue in 2016. The highest peak of revenue was $19 million ($13.9 million nominal) in 2006.

Population and Response Rate

The observer add-on economic data collection program was implemented in 2006, coincident with start of the PIRO observer program in the American Samoa longline fishery. Table 11. Number of trips of American Samoa longline fishery and simple size in economic data collection, 2006-2016. shows the total number of longline trips taken by the American Samoa longline fishery, total observed trips, the total number of trips with economic data collected, and the response rate of the cost data collection. The economic data collection program has been improved over time in terms of the coverage rate (total trips with cost data to the total fishing trips).

In the beginning, fishing cost data collection relied solely on the PIRO observer program. Due to limited observer coverage and unstable response rates of economic data collection, the average number of trips with economic data collected was less than 7 per year during the period of 2006 to 2011. Though 2008 had 82% response rates from the observer program, the total number of trips with economic data collected was only 6% for that year. The average response rate on the observed trips was 43% in American Samoa fishery during the 2006-2011 period. However, in 2011, there were 50 fishing trips with observers on board, but only 10 trips with economic data collected, resulting in a 20% response rate and only 7% of total longline trips covered. In order to increase the sample size, we conducted in-person surveys with fishermen in addition to collecting cost data through the observer program. Since 2012, PIFSC economists have traveled to American Samoa annually and conducted in-person interviews with fishermen, owners, or agents to collect cost data. The number of trips with economic data collected averaged less than 7 per year from 2006 to 2011. That figure improved to 21 trips per year on average for 2012 to 2016, as we began in-person surveys with the fishermen or the agents who manage the fishing business. Therefore, the coverage rate went from 5% on average for 2006 to 2011, to an average of 23% for 2012 to 2016.

Table 11. Number of trips of American Samoa longline fishery and simple size in economic data collection, 2006-2016.

Year	Number of vessels	Total longline trips	Total observed trips	Trips with cost data collected	Trips collected by observers	In-person interview*	Response rate to observers	Coverage to total longline trips
2006	28	124	9	4	4		44%	3%
2007**								
2008	28	140	11	9	9		82%	6%
2009	29	130	10	7	7		70%	5%
2010	26	132	26	8	8		31%	6%
2011	24	135	50	10	10		20%	7%
2012	25	121	22	26	10	16		21%
2013	22	98	20	24	8	16		24%
2014	22	98	20	18	4	14		18%
2015	20	82	20	11	3	8		13%
2016	17	67	15	25	4	21		37%

*In-person surveys conducted with fishermen by PIFSC economists, in addition to collecting cost data through the observer program.
** Due to limited number of observations, 2007 data are confidential and not presented.

Data Sources and Metadata

The main data presented in this report are sourced from the primary data collection efforts as discussed in the previous sections. The secondary data collected by other programs in PIFSC were also used in this report. The full metadata records for the data sources collected by PIFSC are available at InPort, the NOAA Fisheries Enterprise Data Management Program (https://inport.nmfs.noaa.gov/inport). The links to the metadata records in InPort are listed for each associated data source as follows:

1) Trip-Level Cost Data Collection Program of the American Samoa Longline Fishery: https://inport.nmfs.noaa.gov/inport/item/10373

2) Revenue per trip was calculated using annual revenue and the number of sets collected by PIFSC's WPacFIN Program and published at: http://www.pifsc.noaa.gov/wpacfin/as/Pages/as_data_5.php, where data are sourced from (A) the American Samoa Boat-based Creel Survey: https://inport.nmfs.noaa.gov/inport/item/5612 and (B) American Samoa Longline Logbook: https://inport.nmfs.noaa.gov/inport/item/1775

Adjustments for inflation

The price, cost, and net revenue trends in this report will be presented in both nominal and inflation-adjusted 2016 dollars by American Samoa CPI (CPI sources: American Samoa Statistical Yearbooks, 2006-2016).

Average Trip Costs Trend

Figure 13 presents the average per-trip costs and the respective standard deviation for 2006 to 2016. The figure shows two components, the fuel cost (blue) and other costs (light blue), for the average trip expenditure. Other costs include engine oil, bait, freezer operating costs (Freon), gear, provisions, communications, and miscellaneous items. Labor costs are not collected in the Continuous Economic Data Collection Program of PIFSC; therefore, labor costs are not included in the trip expenditures in Figure 13. Data from 2017 are excluded from the figure in accordance with the NOAA Fisheries rule on confidential data.

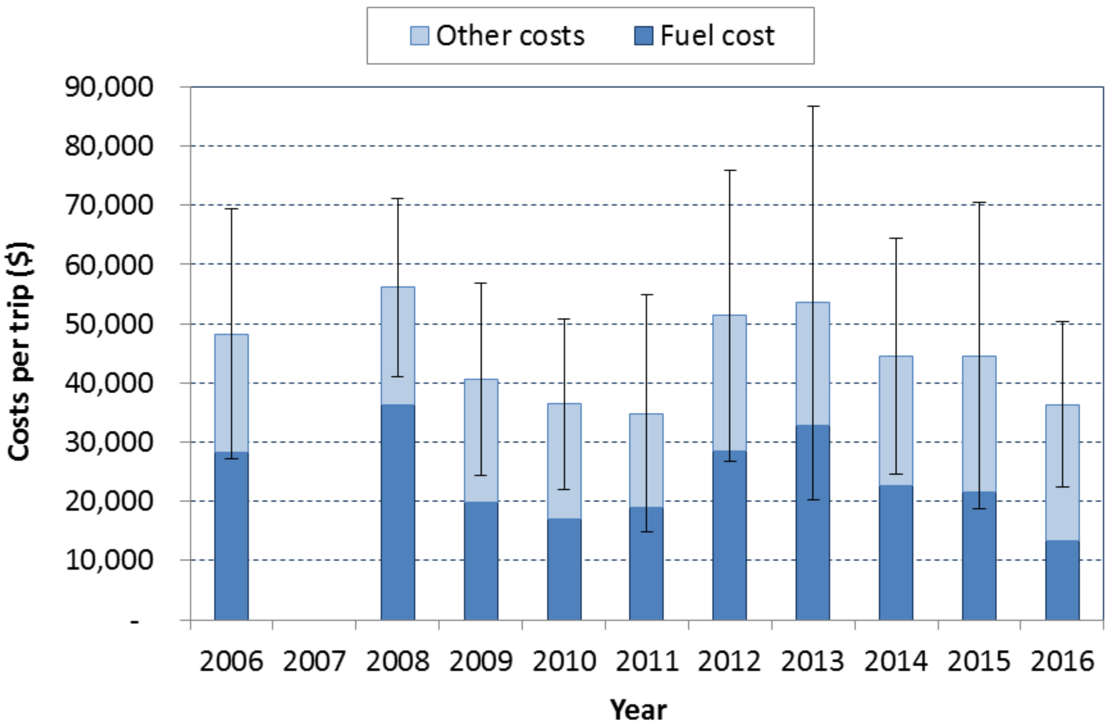

Figure 14. Average trip costs with standard deviation in American Samoa Longline Fishery Average Trip Costs, 2006-2016 (adjusted to 2016 dollars).

Figure 14 shows fluctuations in trip expenditures during the data collection period caused mainly by variations in fuel costs. Because there was only one observation in 2007, no data were presented for that year. Three years (2008, 2012, 2013) with average (adjusted) trip costs over $50,000 had high fuel prices, as shown in Figure 16.

Trip Cost Structure

Fuel costs usually comprised over 50% of trip costs but were lower in 2016 due to low fuel prices that year (the lowest of all the years studied). Figure 14 shows the cost structure for an average trip in 2016.

The average diesel fuel price (and the respective standard deviation) presented in Figure 16 was collected by the Continuous Economic Data Collection Program and has been adjusted to 2016 dollars. The fuel price from 2011 to 2014 was also high at over $3.50 per gallon, and then it dropped in 2015 and 2016. The fuel price in 2016 was $1.85 per gallon, the lowest price since data collection began in 2006. The data (fuel price and standard deviation) supporting Figure 15 are presented in Table 12.

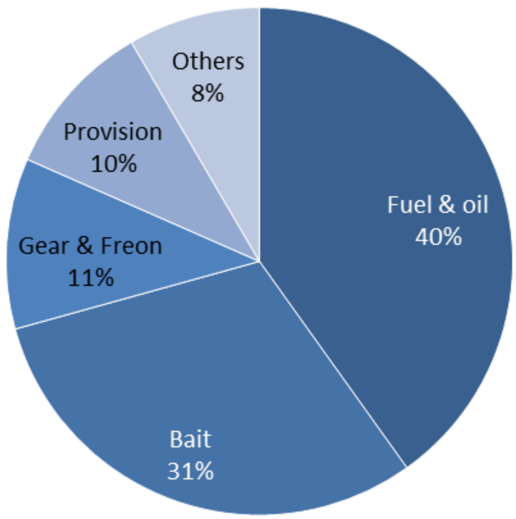

Figure 15. Cost Structure of an Average American Samoa Longline Trip in 2016.

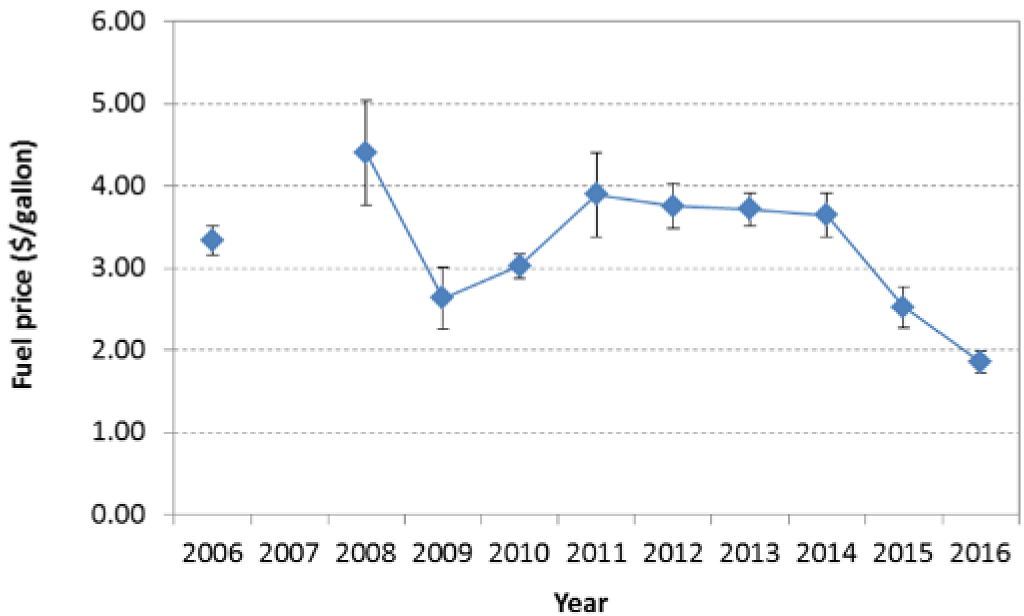

Figure 16. Average diesel fuel price and standard deviation reported by fishermen in the American Samoa longline fishery, 2006 to 2016 (adjusted to 2016 dollars).

Net Revenue per Set Trend

The average trip length (total trip days) for the American Samoa longline fleet varied substantially over the years, although the fishing style and main target were still the same. This may reflect true variation in fishing operations, or it may be due to statistical uncertainty resulting from very small sample sizes in the economic data collection, especially in the early years when the continuous data collection program was being established and the sample size was limited. Therefore, the cost and net return per set, instead of the cost per trip, may be a better index for comparisons across the years. Figure 17 shows net revenue per set for this fishery from 2006 to 2016. Data from 2007 are excluded from the figure in accordance with the NOAA Fisheries rule on confidential data. Net revenue is defined as revenue after subtracting trip costs, but trip costs do not include labor costs or fixed costs (such as dry dock and major repairs). Based on this definition, net revenue is the amount of earnings that can be distributed among the captain, crew, and vessel owners. However, if fixed costs per set are also considered, the net returns in certain years (2013, 2014, and 2016) would be negative (Pan 2017).

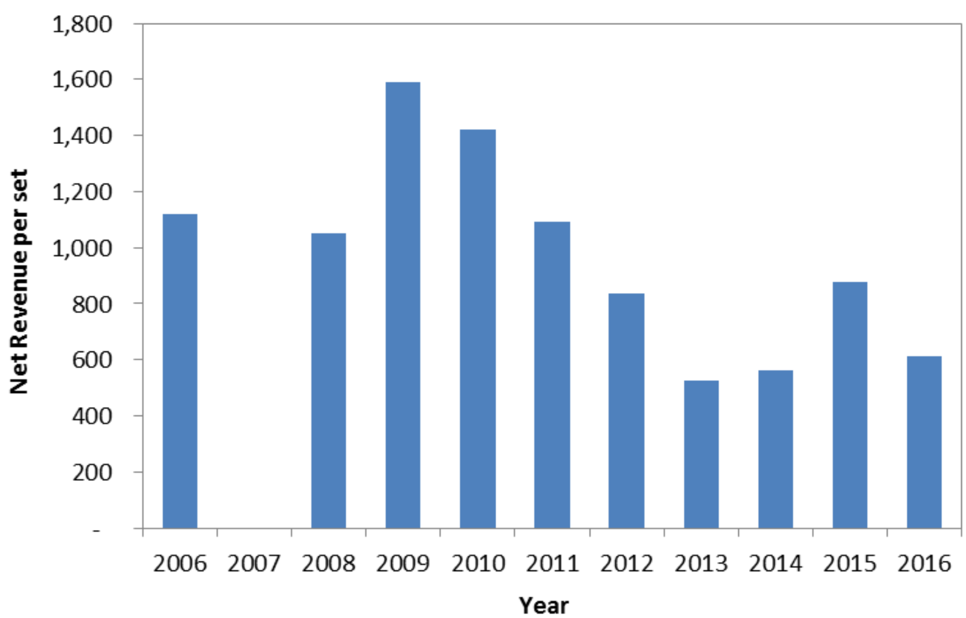

Figure 17. Net Revenue per Set for the American Samoa Longline Fishery, 2006-2016 (adjusted to 2016 dollars and not including labor cost and fixed costs).

The trend of net revenue per set (Figure 17) illustrates the poor economic performance of the American Samoa fishery in recent years since 2012. During the report period, net revenue per set fluctuated but reflects a sharp declining trend after 2009. Table 12 shows detailed figures for costs, revenues, and net revenues per trip and per set from 2006 to 2016.

The poor economic performance measured by net revenue per set was a result of either higher cost per set, lower revenue per year, or a combination of both factors. For example, in 2013, the cost of $1,527 per set was second highest during the period, while the revenue per set was

$2,051, the lowest in all the years up to that point. Due to both these factors, the net revenue per set in 2013 was the lowest for the entire report period.

Table 12. Costs, revenues, and net revenues per trip and per set for the American Samoa longline fishery (adjusted to 2016 dollar).

	Per Trip						Per Set		
Year	CPI	Fuel cost	Other costs	Trip costs	Standard Deviation of trip cost	Trip revenue	Revenue per set	Costs per set	Net revenue per set
2006	1.42	28,232	20,008	48,240	21,063	49,184	3,196	2,075	1,121
2007	1.36								
2008	1.27	36,272	19,860	56,133	15,048	42,319	2,506	1,456	1,050
2009	1.23	19,856	20,669	40,525	16,252	65,001	2,632	1,043	1,589
2010	1.17	16,903	19,489	36,392	14,474	47,155	2,719	1,300	1,419
2011	1.08	19,043	15,798	34,841	20,008	33,414	2,430	1,340	1,090
2012	1.05	28,439	22,923	51,362	24,525	44,835	2,376	1,538	838
2013	1.02	32,876	20,702	53,579	33,247	67,433	2,051	1,527	524
2014	1.02	22,739	21,743	44,481	19,875	26,587	1,779	1,219	560
2015	1.02	21,620	22,939	44,560	25,857	27,141	1,964	1,084	879
2016	1.00	13,301	23,076	36,377	13,873	18,598	1,687	1,074	613

While the cost per set fluctuated over the period and increased substantially in 2012 and 2013, the revenue per set was in a generally declining trend for the study period. Compared to 2013 and 2014 when the net return was negative after accounting for fixed costs (fixed costs are not shown in Table 1), the economic performance of the American Samoa longline fleet in 2015 improved slightly but turned negative again in 2016.

The cost per set across the years was indicative of changes in fuel prices. Figure 18 shows the cost per set (nominal) and fuel price in the American Samoa longline fishery, 2006-2016. The fuel price data for Figure 18 are included in Table 13. Over the period, these two time-series rise and fall together, signifying that they are highly correlated.

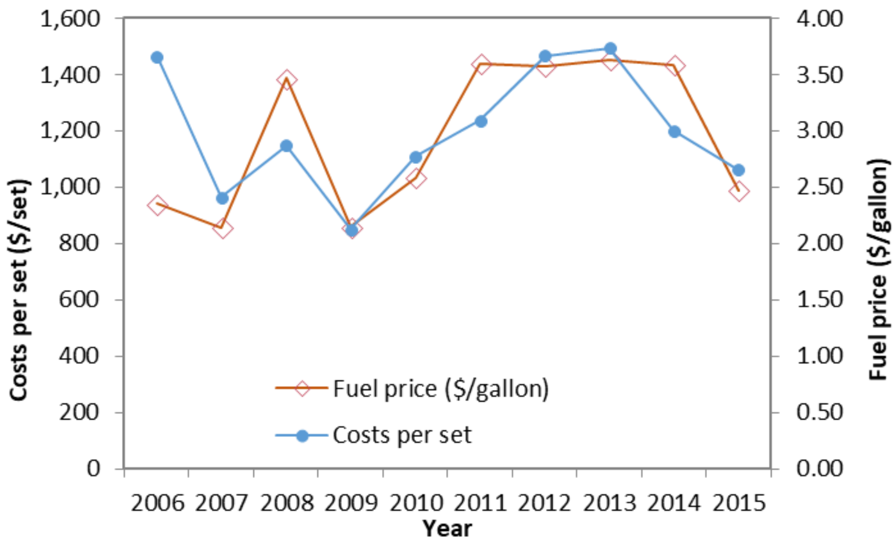

Figure 18. Cost per set and fuel price (both nominal) in the American Samoa longline fishery, 2006-2016.

Table 13. Average fuel price in the American Samoa longline fishery, 2006-2016, (adjusted to 2016 dollar).

Year	CPI adjustor	Fuel price adjusted	StDev of fuel price
2006	1.416	3.33	0.18
2007	1.361		
2008	1.267	4.40	0.63
2009	1.227	2.63	0.37
2010	1.171	3.03	0.14
2011	1.083	3.89	0.51
2012	1.049	3.75	0.27
2013	1.023	3.71	0.2
2014	1.016	3.64	0.27
2015	1.021	2.52	0.25
2016	1	1.85	0.14

Discussion on the Net Revenue Calculation

An earlier report (PIFSC Internal Report IR-15-015) provided to the Western Pacific Fishery Management Council covered the period 2006 to 2014, offering insight into the American or Samoan longline fishery's collapse in 2013. Although both the previous report and this one show a declining trend in the net returns during that period, there are some variations between the two. The differences resulted from several factors as discussed below.

Costs per set in the current report are lower than in the previous IR for most of the years

The number of set counts per trip documented in these two reports came from two different data sources. Thus, there was potential for the cost per set in the same year to differ, although this was not the case. In the PIFSC Internal Report IR-15-015, the number of set counts per trip was generated using the PIRO observer reports, while in the current report, the number of set counts per trip was generated using the NOAA Fisheries vessel logbooks.[3] We found discrepancy on trip definitions from these two data sources, and the average number of sets on the observed trips was lower than that on the logbook trips. The logbooks define a trip as ending when the fish caught are landed. Often, a trip in the American Samoa longline fishery was extensive requiring the vessel to make one or multiple port stops (return to dock to get supplies or for repairs) without unloading any of their catch. Then, the trip might continue without the observer remaining on board. That observed trip was recorded as ended before the fish were landed. The fishing trip might have continued with a new observer trip number assigned as the disrupted trip continued. Thus, the number of set counts in a vessel logbook was usually greater than the number of set counts in the PIRO observer data.

The definition of a fishing trip for the purpose of economic performance assessment is consistent with the logbook definition. As a result, the costs per set in the current report are generally lower than that reported in the previous report, IR-15-015.

For example, the average number of sets per trip recorded in 2013 was 22 in the previous IR (based on the observer data), while the average number of sets per trip for the same year in the current report (based on the logbook data) was 35 sets per trip. Thus, the costs per set for 2013 in the current report ($1,527) are substantially lower than that in the previous IR, although, the average costs per trip in the two reports are similar.

Revenue per set varies from year to year between these two reports

The revenue per set was not affected by set counts since the revenue per set was calculated the same way in both reports; the total revenue fleet-wide divided by the total number of sets fleet-wide. However, there are different algorithms used within the PIFSC for estimating fleet revenue. Revenue figures for the same year reported from different sources can vary, or the revenue figures for the same year are subject to change, depending on the date of publication.

In 2016, the economics program developed an interface ACCESS database system to link and summarize costs and revenues of the American Samoa longline fishery, as described in the section above on database management. The interface ACCESS database system follows one of the WPacFIN algorithms to estimate trip level revenue. We used the number of fish kept by fishermen (not sold) from the logbooks, prices for the fish sold to the cannery that were collected by the PIFSC economics program and PIRO observer programs, and the fish size and market decomposition from WPacFIN to generate fish weight and revenue. The revenue figures generated from the algorithm in some years are different from the figures in the previous IR, where revenue figures were sourced from the plan team reports published on the PIFSC website.

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[3] https://inport.nmfs.noaa.gov/inport/item/1775

Annual revenue aggregated by set level vs trip level

The interface ACCESS database system uses the same algorithm as the WPacFIN. The sum of revenue from multiple years (e.g., 2006 to 2016) in the interface ACCESS database is similar to the sum according to WPacFIN, though revenue values for individual years are not similar between the two sources. That is mainly because the WPacFIN generated annual revenues by aggregating revenue at the set level, while the interface ACCESS database system generated annual revenues at the trip level.

Summary and Conclusions

In summary, the continuous economic data collection programs of the longline fisheries in Hawaii and American Samoa are a success, with over 60% response rate on the observed trips in Hawaii longline fisheries and 43% in American Samoa fishery. The data collected provides insights into the two longline fisheries and supports fisheries management.

From the data series of 2005 to 2016, we can observe economic performances of two important commercial fisheries of this region. The trend data show the downward economic performance of the American Samoa longline fishery. The trend data also show substantial changes in deep-set tuna fishing and shallow-set swordfish fishing in the Hawaii longline fishery during the reporting period, a gradually increasing trend of the economic returns (net revenue) for deep-set tuna fishing, and fluctuations in the economic returns for shallow-set swordfish fishing. The difference of the annual average economic returns between highest and lowest for shallow-set swordfish fishing was also demonstrated. However, there was no particular downward or upward trend for shallow-set swordfish fishing during the report period.

We were able to identify and monitor a key element associated with the uncertainty of the economic performance of the fisheries. Fuel is the main cost item of trip expenditures for both Hawaii longline and American Samoa longline, approximately 50%. Linking fishing cost data with vessel logbook data also allows us to examine fishing costs by areas. The data summary results suggested that the average trip costs for EPO fishing trips were the highest compared to trip costs in the EEZ or WCPO areas for both deep-set tuna fishing and shallow-set swordfish fishing.

Finally, the success of the continuous economic data collection programs requires active commitments across agencies. In addition, good data management is an important step to ensure data quality. The development of the interface ACCESS database not only supports data quality control but also allows cost data integration with other fisheries dependent data. More importantly, the interface database system provides an opportunity to conduct further research with integrated fisheries data that can advance ecosystems science.

The economic data collection programs are expected to persist. While continuing to improve the database and further develop advanced automated reporting tools and summaries for more timely analysis and website publication, we also plan to conduct a pilot project for a mobile tablet-based data collection form for in-person surveys conducted by the PIFSC economists in the American Samoa longline fishery.

Acknowledgements

The continuous economic data collection programs were established and are maintained through collaboration between the Economics Program of the Pacific Islands Fisheries Science Center (PIFSC) and the Pacific Islands Regional Office (PIRO) Observer Program. The success of the programs is a result of a great team effort over a long period of time. The author, the lead of the team, greatly appreciates the support from PIRO's Observer Program and its staff, John Kelly, Kevin Busscher, Joseph Arceneaux, and Eric Forney in the Hawaii office, and Steve Kostelnik and Michael Marsik in the Pago Pago office, as well as all the debriefers with the PIRO observer programs. Special thanks to Eric Forney for his assistance in developing the auto-notification system on the economic data collection status of observer trips that was implemented on August 1, 2016.

I would also like to thank the support of my colleagues in the Socioeconomic Program, past and present, including Jonathon Sweeney, Kolter Kalberg, Timothy Ming, and Rick Chesler, for their support and assistance in data collection in the field and database management. PIFSC JIMAR researcher Dr. Haiying Wang and database developers Marci A. Sato and Troy Kanemura contributed greatly to the development of the Interface ACCESS database. Their efforts are highly appreciated. Special thanks to Michelle McGregor, my economist fellow at PIRO, for her thorough review and valuable comments on the manuscript. Also, thanks to the two external reviewers for their valuable comments and feedback.

The participation of fishermen in the two continuous data collection programs is voluntary, and the programs would not succeed without the generous support of the vessel owners and operators. Their friendly and generous cooperation is the solid foundation for the success of the data collection programs.

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Appendices

Appendix A. Cost Data Collection Form: Hawaii Longline

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 2 of 2

(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: Debriefer initials: ____________

[ ] Data from Captain

[ ] Observed data at sea

[ ] In office

If no data from Captain, please provide REASON:

OMB Control No. 0648-0593 exp. 10/31/2018

Appendix B. Cost Data Collection Form: American Samoa Longline

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

AMERICAN SAMOA OBSERVER PROGRAM LONGLINE TRIP EXPENDITURE FORM page 1 of 2

(Ask information on the way home)

1. TRIP INFORMATION

TRIP NUMBER	DATE OF DEPARTURE			DATE OF RETURN			DAYS FISHED
A S			2 0			2 0	
	DAY	MONTH	YEAR	DAY	MONTH	YEAR	

2. FUEL

PRICE PER GALLON	GALLONS USED	TOTAL COST OF FUEL
$.	,	$, .

3. ENGINE OIL

UNIT (Check One)		PRICE PER UNIT		QUANTITY USED		TOTAL COST OF OIL
	Gallon	.	Per gal		Gallons	$, .
	Bag/Bucket (5 Gallons)	.	Per bag		Bags	
	Drum (55 Gallons)	.	Per drum		Drums	

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. BOAT FREEZER COSTS (i.e. cost to operate refrigeration system onboard the vessel for this trip)

$, .

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 1/01/2011