Cost-earnings Study and Economic Performance Analysis of the American Samoa Longline Pelagic Fishery—2016 Operation and Recent Trends

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U.S. DEPARTMENT OF COMMERCE
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Cover photo: Pago Pago Harbor, Home of the American Samoa Longline Fleet. Credit: Minling Pan.

ABSTRACT

Economic health and trends of the American Samoa pelagic longline fishery were examined by conducting in-person surveys with longline fishermen to collect fishing cost data and performing cost-earnings analyses on fleet operations in 2016. While keeping the definition of economic performance measures and the survey approach consistent with previous cost-earnings studies in the fishery, this study tried to improve data quality through linking the cost data with the fishing operation data, and the average costs per set and total number of sets were used to estimate the annual total variable costs. The findings of the 2016 cost-earnings status were compared with the previous studies done on 2001 and 2009 operations. Findings revealed improvement in the economic performance of the American Samoa fleet in 2016 over the 2009 operation, but was still poor compared to the 2001 operation. The differences of lower CPUE, lower fuel price, higher fish price, and lower fixed costs resulted in higher cash returns in 2016 operations over 2009. In addition, this study investigated the increasing demand for American Samoa longline permits from the Hawaii longline permit holders, while the number of active vessels in American Samoa longline declined. Two main factors contributed to this dual-permits-phenomenon: the poor economic performance of the American Samoa longline fishery and the advantage of continuing access to the Hawaii longline fishery even when the fishery was closed due to the bigeye catch limit for U.S. longline being reached.

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INTRODUCTION

The purpose of this study is to conduct a cost-earnings survey and examine the economic health of the American Samoa pelagic longline fishery. Previous cost-earning studies on the American Samoa fishery were conducted based on 2001 (O'Malley and Pooley 2002) and 2009 (Pan et al. 2017) operational years. O'Malley and Pooley (2002) found that the majority of vessels were profitable based on the 2001 operation, generating revenue sufficient to meet expenses and earned profit (approximately $251,000 per vessel per year). However, 8 years later, the cost-earnings study conducted by Pan et al. (2017) found that the economic performance of the 2009 fishing operation considerably decreased compared to 2001. Of the 23 vessels surveyed based on 2009 operation, only 52% (12 vessels) were able to make a net gain (earn a profit), while 48% of the vessels showed negative returns in fishery operations. On average, the vessel owners in 2009 generated a small margin of profit (approximately $6,000 per vessel), which equates to only 2% of the profit level in 2001.

The periodic economic valuations of the fisheries through cost-earnings studies have provided important information to support fisheries management. In addition, they are conducted in compliance with federal mandates; 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). This study was undertaken as part of the national initiatives supported under NOAA Fisheries' Office of Science and Technology (Thunberg et al. 2015).

To provide timely information and the evidence needed to support sustainable fishery resource utilization and fishery management, this study will update the assessment of the fleet's overall economic performance and assess how the economic performance of the fleet has changed relative to 2009. Following an approach similar to the previous two studies, we conducted a survey to collect cost-earnings data and performed a cost-earnings analysis using both primary and secondary sources of data on fleet operations in 2016. The cost data and fish price data of 2016 fishing operations were collected through in-person interviews conducted in February 2017, using a pre-designed survey form. Other fishery-related data (such as fishing activities and landings) were provided by the fishermen's logbook program that is managed by the National

[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."

Marine Fisheries Service (NMFS), the Pacific Islands Fisheries Science Center (PIFSC), and the Pacific Islands Regional Office (PIRO).

RESEARCH METHODOLOGY AND DATA SOURCES

The cost-earnings analyses, conducted at the individual vessel level for 2016 operations, used data from multiple sources, and the fleet-wide summary will be presented in the report. The key economic data were collected through in-person interviews with vessel owners and/or agents who managed daily fishing business on land. The in-person interviews were carried out during February 2017 in Pago Pago, American Samoa, by a PIFSC economist. The data collected through in person interviews used a pre-designed survey form (see Appendix). Survey administrators attempted to collect information from every active vessel. The survey questions mainly elicited variable costs (costs incurred when the vessel actively fished), fixed costs (costs incurred regardless of the number of trips the vessel took), labor costs (including initial payments to hired captains and crew), as well as other information, such as vessel characteristics and owner/operator demographics. We contacted the owners or agents and scheduled interviews with the assistance of the PIRO American Samoa Observer Program located in Pago Pago, American Samoa.

Since there were no official or published records for individual vessel level data, the revenue of each individual vessel was generated from estimated pounds landed and fish prices. The estimated pounds landed by species were provided by the PIFSC International Fisheries Program; this estimation was calculated from the number of fish recorded in the logbooks multiplied by the average fish size. Average fish size was estimated by the fork length measured in the observed trips by the PIRO American Samoa Observer Program. The fish price information was collected through the PIFSC economic data collection program for the five species sold to canneries. The other species that were not taken by the canneries were very limited (3% in 2016), and some of those were sold in the local markets or kept for home and crew consumption, based on in-person conversations during the interviews. The market shares and local market prices were provided by Western Pacific Fisheries Information Network (WPacFIN) program.

Survey Population and Response Rate

The American Samoa longline fleet consists of 4 vessel classes based on vessel length. Class A (40 ft and under) vessels are outboard-engine-powered catamarans, called *alias* locally[3]. These boats are generally less than 30 ft in overall length and often take one-day trips. Fishing by these boats is significantly different in terms of fishing operations, such trip length and fish markets targeted, from that of the larger vessels. Class B vessels are longer than 40 ft but less or equal to 50 ft; Class C vessels are longer than 50 ft but less or equal to 70 ft; and Class D vessels are longer than 70 ft. A total of 20 active vessels from all four classes conducted longline fishing in American Samoa in 2016 (Table 1). The definition of “active vessel” for this table was the number of permits that had submitted a logbook with a haul in the reporting year. There were

[3] Alia: Samoan fishing catamaran, about 30 ft long, constructed of aluminum or wood with fiberglass. Used for various fisheries including trolling, longline, and bottomfishing.

only two active Class A vessels and no active Class B vessels in 2016. The remaining 18 vessels were Class C or Class D.

Following previous cost-earnings methods, this study only focused on full-time and large size active vessels (C and D classes). Usually, the fisheries summary reports (such as the Stock Assessment and Fishery Evaluation (SAFE) Report) defined an active vessel by a "haul set," which means if a vessel hauled one set or more in the reporting year, it is considered active for the year. The cost-earnings studies define an active vessel by a landed trip, instead of a haul set, in the reporting year. Therefore, the number of active vessel counts in the cost-earnings study might differ slightly from the numbers in other fisheries reports. Among the 18 active large vessels defined by a haul in 2016, only 17 vessels reported landings. In addition, of the 17 vessels that reported landings, only 13 took more than one trip in 2016. The average days at sea for the 13 vessels in 2016 was 245, while the other four vessels only spent 13 days at sea. Among the four vessels that participated in the fishery only for a short period of time, three held dual permits[4] (holding both Hawaii longline and American longline permits) and fished in American Samoa for only a week or less. These dual permitted vessels were usually based in Hawaii, possibly coming to American Samoa in 2016 for a short while to fish in order to fulfill the minimum landing requirement for holding an American Samoa longline permit. Therefore, the 13 vessels were considered full-time active vessels, and they are the targeted population of the study. Participation in the survey was voluntary, and 10 out of the 13 vessels responded to the survey (a response rate of 77%).

Table 1. Number of active vessels and surveyed vessels by size class and sample size.[5]

Number of Vessels	Class A (≤ 40 ft)	Class B (40–50 ft)	Class C (50–70 ft)	Class D (≥ 70 ft)
Permits	7	3	12	20
Active	2	0	3	15
Full-time active	2	0	2	11
Surveyed	0	0	2	8

[4] Dual permitted vessels are those holding both Hawaii longline and American Samoa longline permits. The dual permitted vessels were usually based and landed in Honolulu, Hawaii. However, they might come to American Samoa to fish for one or two sets to fulfill the minimum landing requirement (5,000-lb minimum harvest requirement of PMUS caught with longline gear in the EEZ around American Samoa for the "large" vessel class would be maintained).

[5] Data sources: Summary from PIRO observer program and Annual report PFE on 2016 Council website.

RECENT TRENDS AND DEVELOPMENT OF THE FISHERY

Fleet Dynamic and Limited Entry Program

Longline fishing and landings in American Samoa started with foreign longline fleets in 1950s (Yamasaki 1993). The local American Samoa longline fleet started with small longline vessels (*alias*) in the early 1990s, and large longline vessels were introduced in the early 2000s. During its nearly 3 decade history, the fleet structure of the American Samoa longline has undergone great changes. Figure 1 shows the dynamic of the number of active vessels of different classes. The number of Class A vessels (*alias*) started with 4 in 1995, and peaked in 2000 and 2001 with 37 active vessels. Thereafter, the number of *alias* rapidly declined, with only one *alia* active in recent years (2008–2017). Conversely, the number of large size vessels (Classes C and D) sharply rose from 5 in 1997 to 27 active vessels by 2001.

A limited entry program was enacted in May 2005, in which a maximum of 60 permits was allowed in the American Samoa longline fishery. Since then, a federal permit is required for any longline fishing in American Samoa. The 60 permits are distributed among 4 vessel size classes: Class A (22), Class B (5), Class C (12), and Class D (21). Permits are issued by the vessel size class, and permit holders are restricted to using vessels within their size class or smaller (Federal Register, 2009).

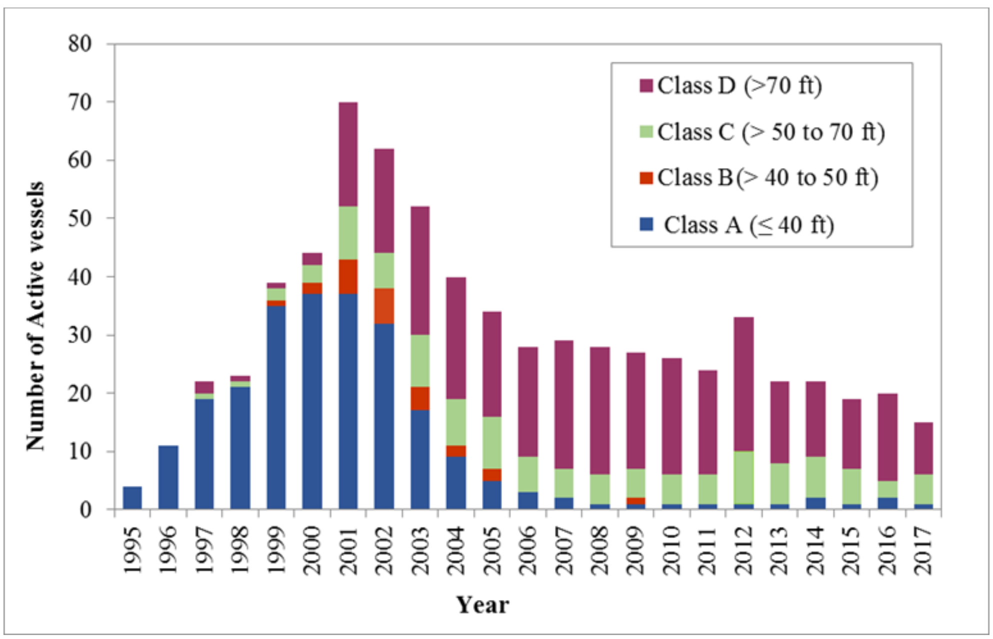

Figure 1. Number of active longline vessels by size class, 1995–2017[6].

[6] Data source: Data for 2011–2017 are from WPRFMC (2018), and data prior to 2011 from Pan et al. (2017).

Permit and Dual Permit and Linkage with Hawaii Longline Fleet

Unlike Hawaii longline permits that can be renewed without any requirement of minimum landings, an American Samoa longline permit expires three years from issuance, and renewal entails meeting minimum landing requirements and having a current Protected Species Workshop certificate. Thus, comparing the number of active vessels and the number of permits, respectively, may help us to further understand the trends of the fisheries. Figure 2 shows the number of large vessels, and Figure 3 shows the number of small vessels. The numbers of permits and active vessels have both declined for small vessels; while the number of permits for large vessels has remained relatively steady from 2005 to 2017, although the number of active large vessels has slowly declined.

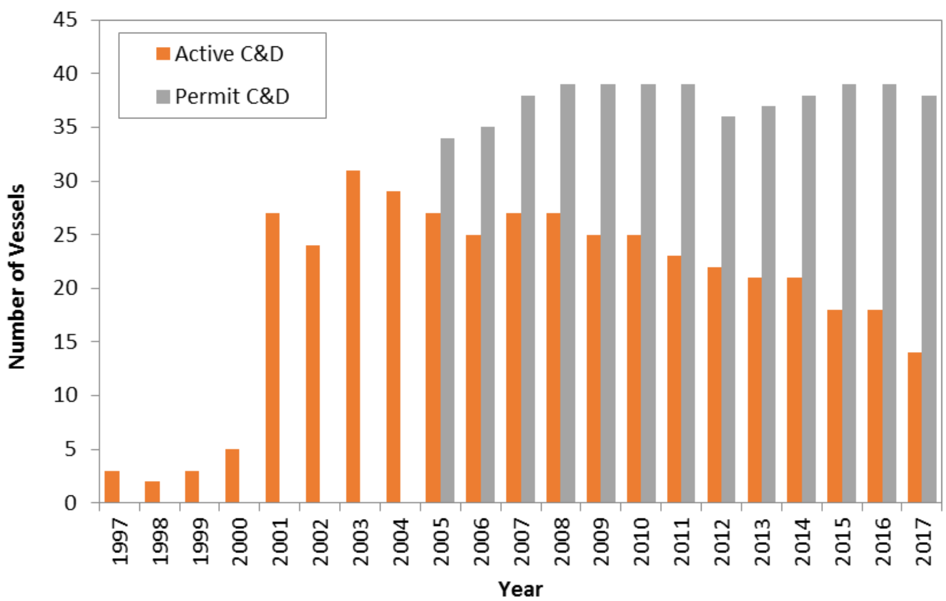

Figure 2. Number of active vessels and permits for vessels of C and D classes 1997–2017[7].

[7] Data source: Data for 2011–2017 are from WPRFMC (2018) and data prior to 2011 from Pan et al. (2017).

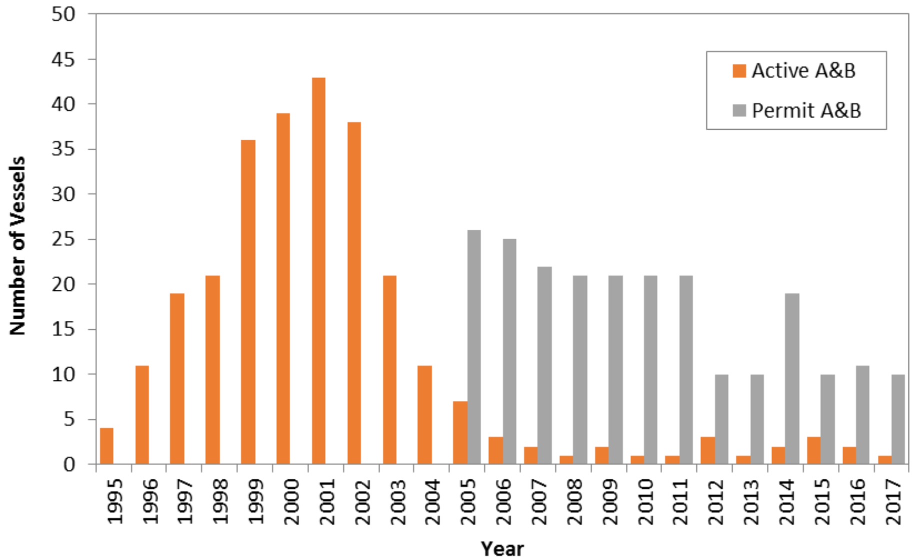

Figure 3. Number of active vessels and permits for vessels of A and B classes[8].

To understand the dynamic of the large longline vessels in the fishery, we need to include the "dual permits" since some permit holders in American Samoa held both Hawaii longline permits and American Samoa longline permits. There were no class A vessels with dual permits. In the B class, the number of dual permits went from zero in 2005 to three in 2011, with no changes thereafter. All B class vessels fished in Hawaii longline only. Since this cost-earnings study focuses on large longline vessels, the discussion on the dynamic of dual permits will also focus on the large vessels (C and D classes). The total number of permits allowed for the large vessels is fixed at 33 as set by the limited entry program.

The history of dual permits can be traced to the implementation of the limited entry program in the American Samoa longline fishery. When the American Samoa longline limited entry program began in 2005, some vessels with Hawaii longline permits entered the fishing operations in American Samoa longline fishery while simultaneously keeping their Hawaii longline permits[9]. At that time, 9 large vessels, among the 27 total in the American Samoa longline fishery, were from Hawaii and held dual permits. The number of dual permits did not go up until 2009, and then continued increasing to 22 in 2017. Conversely, the number of large active longline vessels in American Samoa declined; in 2017, there were only 14. Figure 4 shows the trends of dual permits and number of active large vessels in American Samoa longline from 2005 to 2017.

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[8] Data source: Data for 2011–2017 are from WPRFMC (2018), and data prior 2011 from Pan et al. (2017).

[9] The limited entry program for the Hawaii longline fishery began in 1993. Unlike the American Samoa longline permits, obtaining a Hawaii longline permit does not require any minimum landings.

It seems that the increasing trend of dual permits has arisen due to two main factors. One has been the declining economic performance of the American Samoa longline fishery, which will be discussed later in the report. Another is the benefit of being able to continue bigeye tuna (*Thunnus obesus*) fishing in the waters around the Hawaii EEZ when the fishery was closed to vessels with only Hawaii longline permits. Although dual permits existed from the beginning of the American Samoa limited entry program, the demand did not seem to increase until the bigeye tuna catch limit[10] was implemented in Hawaii longline in 2009, and the first fishery closure occurred from November 22, 2010, through the end of that year[11]. Since the bigeye tuna catch from the vessels with American Samoa longline permits did not count against Hawaii bigeye tuna catch limits, dual permitted longline vessels were able to continue fishing and landing bigeye tuna in Hawaii even when fishing for bigeye tuna was closed to the Hawaii longline fleet. As a result, more Hawaii longline vessels acquired American Samoa longline permits. The number of dual permitted large vessels increased from 8 in 2008 to 10 in 2009.By the end of 2011, the total dual permits of C and D vessels increased to 16, and the interest among Hawaii longline permit holders to obtain an American Samoa longline permit continued. While the number of active vessels in American Samoa longline has declined, the trends suggest that the newly increased dual permits after 2009 were not actually for pursuing fishing opportunities in the American Samoa fishery. In 2016, three dual permitted vessels reported only one trip in the American Samoa fishery. It is likely these vessels came to American Samoa to fish for a short period of time in order to fulfill the minimum landing requirement.

[10] The rule effective December 12, 2009 (74 FR 63999), the Hawaii fishery was implemented with an annual bigeye catch limit of 3,763 mt in the western and central Pacific Ocean under the Western and Central Pacific Fisheries Commission (WCPFC). Effective in November 21, 2009 (74 FR 61046), the Hawaii fishery implemented an annual bigeye catch limit of 500 mt in the Eastern Pacific Ocean.
[11] Effective November 22, 2010 (75 FR 68725), NMFS closed the U.S. pelagic longline fishery for bigeye tuna in the western and central Pacific Ocean as a result of the fishery reaching the catch limit.

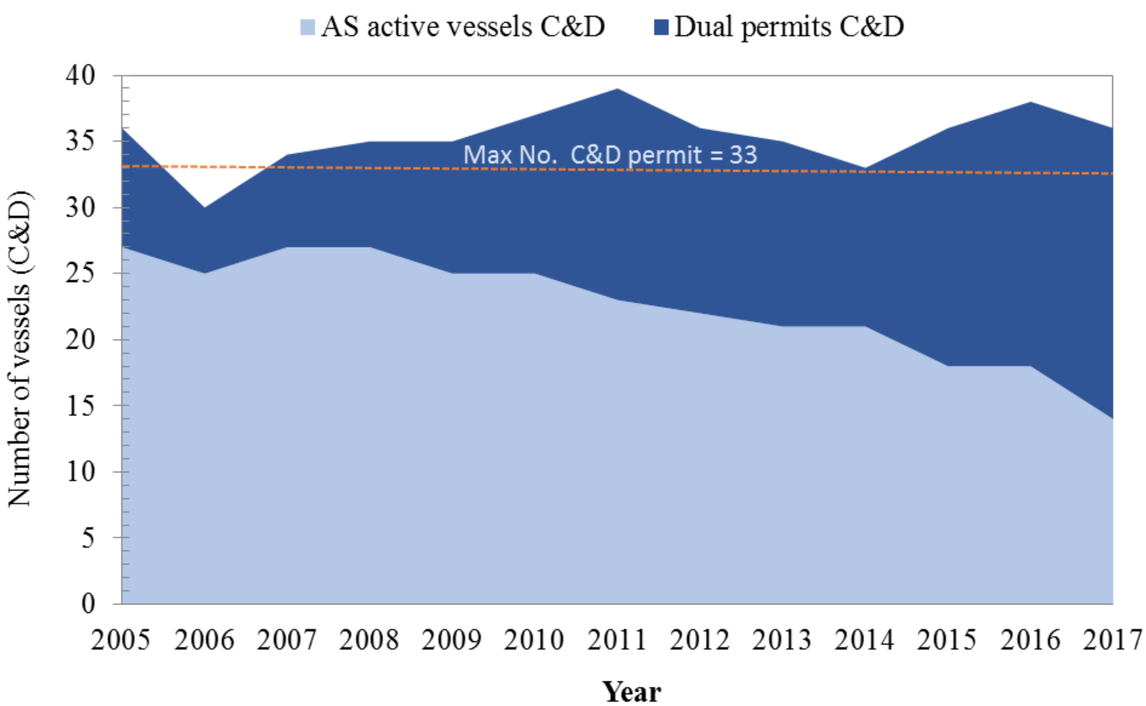

Figure 4. Number of dual permits[12], number of active vessels[13] in American Samoa longline fishery (Classes C and D), 2005–2017.

Although vessels with dual permits are allowed to fish in both Hawaii and American Samoa, the majority of dual permitted vessels did not hop between the two fisheries during the season. In recent years, almost all the dual permitted vessels were based and fished only in Hawaii.

Fisheries Operation and Fishery Performance Trends 2005–2017

When the limited entry program was initially implemented (2005–2007), fishing efforts (total hooks) in American Samoa longline increased rapidly. Landings and revenue also increased over those three years. However, after peaking in 2007, fishing efforts (hooks set) declined, as well as total landings and revenue. Figure 5 and Figure 6 present the trends of fishing efforts, total landings, and revenue for the period of 2005–2017.

[12] The figures of dual permits across years were from the PIRO permit data system (Walter Ikehara),
[13] The number of active vessels are from WPRFMC (2018, 2012).

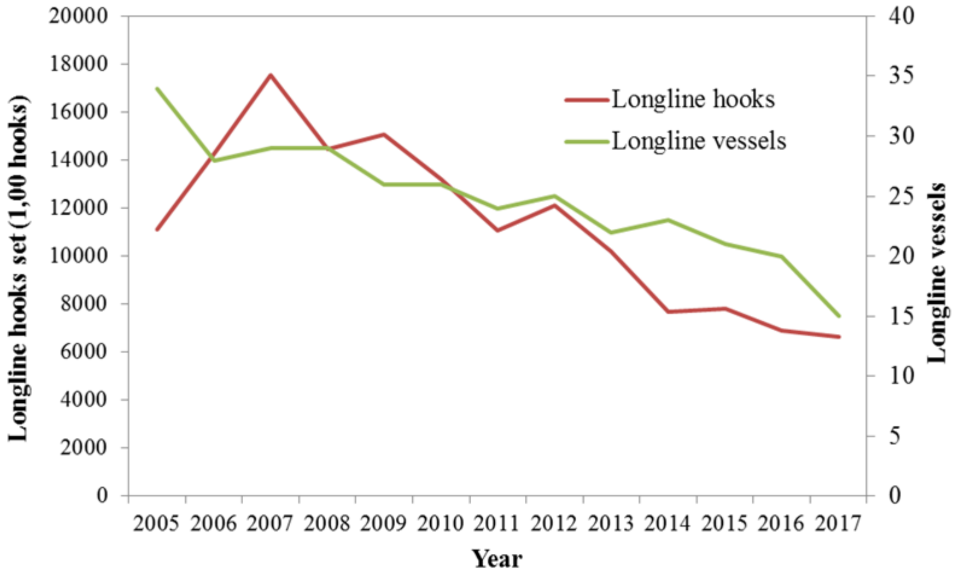

Figure 5. Total Longline Fishing efforts in American Samoa[14], 2005–2017[15].

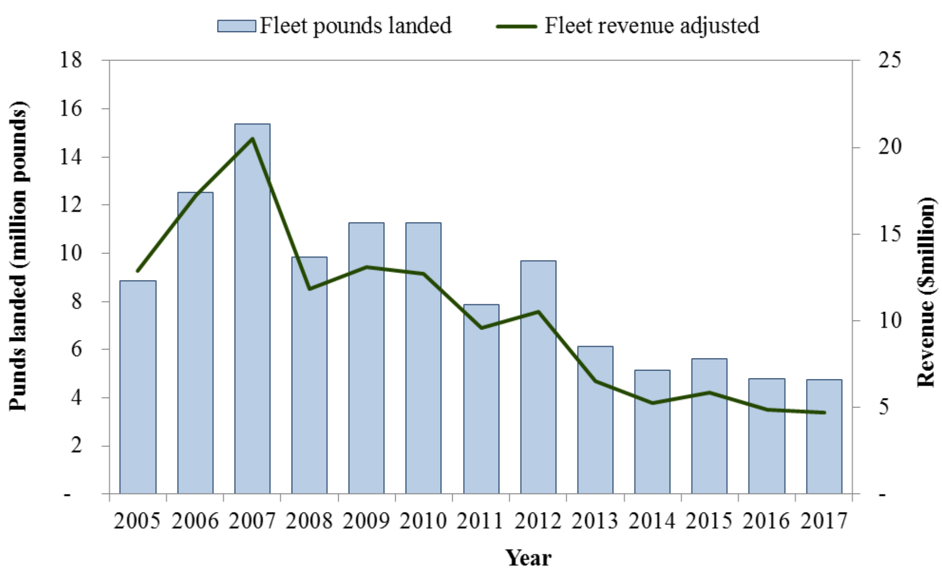

Figure 6. Commercial landings and revenue of American Samoa longline[14] from 2005–2017, adjusted to 2017 dollars[16].

[14] Alia vessels are not excluded in this figure due to the data confidentiality rule
[15] Data source: WPRFMC (2018, 2013).
[16] Data source: Pacific Islands Fisheries Science Center: Fishery Economic Performance Measures (Tier 1 indicators).

RESULTS

This section presents the 2016 cost-earnings results of the American Samoa longline fleet. First, it gives an overview of the fishery and its physical and operational characteristics. Second, it presents the cost-earnings status and compares it to the cost-earnings status reported by previous studies.

Fishery Overview in 2016

The longline fleet generated a total revenue of $4.8 million in 2016. Traditionally, landings of American Samoa longline consist primarily of five major species: albacore (*Thunnus alalunga*), yellowfin tuna (*Thunnus albacares*), skipjack tuna (*Katsuwonus pelamis*), bigeye tuna, and wahoo (*Acanthocybium solandri*). All five species were sold to local canneries; they composed 97% of the total landings in 2016, and 98% of the total revenue. Other minor pelagic species caught with market value include mahi-mahi (*Coryphaena hippurus*), swordfish (*Xiphias gladius*), and pomfret (*Bramidae*). These other pelagic species were not purchased by canneries and were usually sold to local restaurants or used for home consumption by the crew and owners. Figure 6 and Figure 7 illustrate the species compositions of landings and revenue of the American Samoa longline 2016.

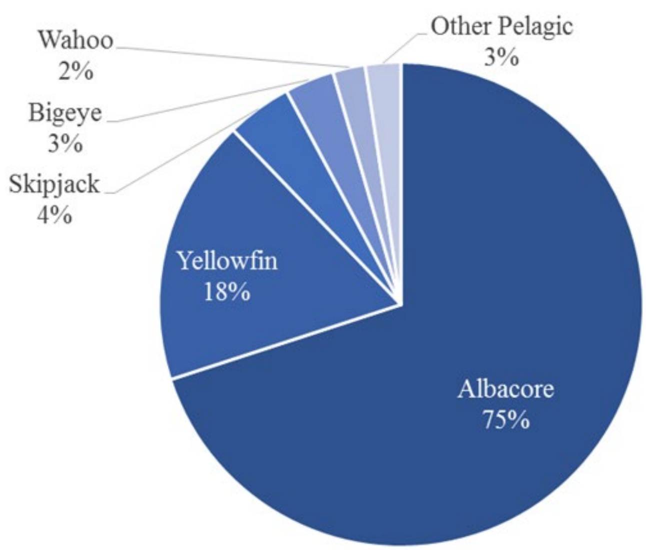

Figure 7. Landings Composition of American Samoa Longline Fishery in 2016.

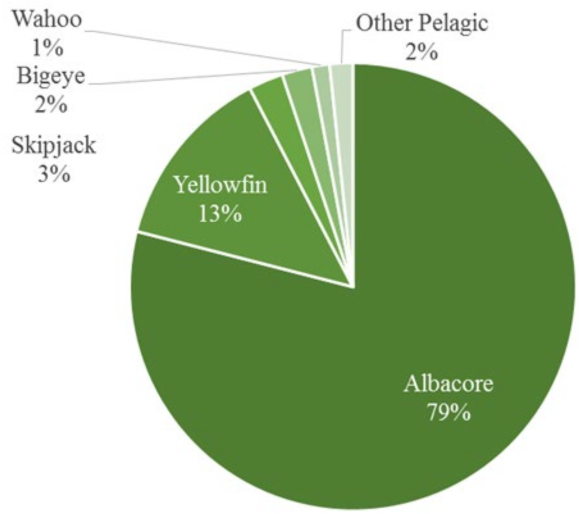

Figure 8. Revenue Composition of American Samoa Longline Fishery in 2016.

Physical and Operational Characteristics

All the full-time active large vessels (C and D classes) operating in American Samoa longline fishery in 2016 were owned by companies that own multiple fishing vessels, according to the fishing activity logs maintained by the PIRO observer program. In addition, these companies were not solely dedicated to commercial fishing; in all three cases, non-fishing business comprised slightly more than half the company. Table 2 summarizes the main characteristics of the 10 surveyed vessels which were owned by three fishing companies, all of which were engaged in the American Samoa longline fishery prior to the implementation of the limited entry program. The number of responses (N) was presented when the responses for some physical and operational characteristics (such as vessel purchase price) were missing.

All the surveyed vessels were operated by hired captains. They usually took nearly five trips in 2016, with an average length of 51 days. Thus, there were more than 240 total days at sea in 2016 for the surveyed vessels. The crews, other than captains, were mostly composed of foreign nationals, including people from Western Samoa and other Pacific islands.

Based on survey responses, the average purchase price per vessel was $379,167 (nominal value at the year of purchase). The average vessel age was 30 years, and the average vessel length was 74 ft. Although the vessels had aged, their average appraised value (vessel purchase price plus additional improvements after purchase) was higher than the purchase value; the replacement value for the vessels was even higher. The replacement value was estimated by the fishermen based on their own judgment. The appraised value, given by an insurance company, could be much lower than the replacement value. The average fuel capacity was approximately 10,840 gal, and the average fish holding capacity was 52 mt.

Table 2. Physical and operational characteristics of surveyed classes C and D longline vessels (N = 10 unless otherwise indicated) based in American Samoa[17].

Business Characteristics	Average
Does your company own more than one fishing vessel?	Yes
Years of longline fishery history in 2016 (yr)	16
% income from non-fishing business	52%
% of hired captain as operator	100%
Operation Characteristics	
Number of total trips in 2016	5
Number of days at sea in 2016	241
Average trip length	51
Number of total sets	162
Number of crew	5.4
Number of foreign crew	3.5
Physical Characteristics	
Vessel age (yr)	30
Vessel length (ft)	74
Vessel width (ft)	22
Vessel purchasing price ($) (N=6)	379,167
Vessel current appraisal value ($) (N=7)	419,286
Vessel replacement value ($) (N=4)	962,500
Fuel capacity (gal)	10,840
Fish holding capacity (mt)	52

The Cost-earnings Status of 2016 Operation

Fleet-wide Average

The cost-earnings survey in 2016 showed an average of $26,340 per vessel. Table 3 lists the breakdown of costs by specific inputs. The figure presented here is the average for all 10 of the vessels surveyed. Fifty-four percent of the revenue received was spent on trip costs. Labor costs made up 22% of revenue, and fixed costs were 13%. We will compare the cost-earnings structure further when examining the cost-earnings structure in the previous years.

This study used similar metrics to evaluate economic performance as previous cost-earnings studies done on 2009 operations (Pan et al. 2017). The key concepts applied in this study are summarized as follows. First, the net return measured in this study is "cash flow," calculated from revenue of fish sales minus variable costs (trip costs), labor costs, and fixed costs. All cost

[17]Data sources: The data for business and physical characteristics were generated from the primary data collected through the current study, and the metadata was published in NMFS InPort, https://inport.nmfs.noaa.gov/inport/item/52998. The data for operation characteristics were generated from American Samoa Longline Logbook, https://inport.nmfs.noaa.gov/inport/item/1775.

and revenue information was collected and compiled at an individual vessel level, but only non-confidential summaries are presented in the report. Revenue per vessel was generated by multiplying the annual total landings reported in the logbook by the fish size from the Observer Program and fish price from in person interviews (Pan 2018). Variable costs were mainly trip expenditures, including fuel, oil, ice, bait, provisions, fishing supplies, etc.

The approach to generate annual variable costs was somewhat different in this study compared to those from 2001 and 2009 (O'Malley and Pooley 2002, Pan et al. 2017). The first step in the previous studies found the "typical" trip cost during in-person survey. Then, the annual variable costs were calculated by taking the "typical" trip costs and multiplying the number of trips taken by the vessel that year. However, the "typical" trip costs may have limited representation since the lengths varied from trip to trip. In 2016, the average trip length (days at sea of the 10 surveyed vessels) was approximately 51 days, with a standard deviation of 25 days. First, this study collected the trip costs (variable costs) of at least two fishing trips for each individual vessel to increase the sample size. We then calculated the average variable costs per set by linking the trip cost information with the number of sets recorded in the logbooks for the particular trip. Next, the total annual variable costs were estimated by multiplying the variable costs per set by the total number of sets (recorded in the logbooks) taken by the vessel for all of 2016. We believe that this approach provides better data quality and improves the estimation of annual variable costs for each individual vessel.

Traditionally, captain and crew were paid by share—a certain percentage of gross net revenue (revenue after subtracting operating costs)—in the fishery. In 2016, when the survey was conducted, all hired captains were still paid by share, while some of the crew were paid by share and some by flat rate, depending on the fishing company. The flat rate system began when foreign crews were introduced to the fishery. According to the survey, about 65% of crewmembers (not including the captain) were foreign crew, consistent with estimates from the PIFSC Continuous Data Collection Program (Pan 2018, in review). Shares earned by a captain and shares or flat rates for other crew members varied and were arranged by vessel. Some responders gave detailed shares for captain and crew while some provided a lump sum amount of labor costs for their captain and crew separately. Thus, labor costs were either compiled from the share and calculated net revenue for a specific vessel or a lump sum for crew and captain, respectively. Labor costs included agent fees which were usually charged on a trip by trip basis.

Fixed costs consist of maintenance, insurance, loan payments, other non-trip miscellaneous costs (such as accounting), drydock, engine overhaul, major repairs, and routine repairs. Drydock engine overhaul did not occur every year, so expenses were calculated on a pro-rated basis, meaning that if a vessel went into drydock or an engine required overhaul once every 5 years, one fifth of those costs was included as the annual expense for these items. The definition of major or routine repairs may differ by vessel owners. Some vessel owners considered maintenance and repair costs as variable costs (trips expenditure) while some vessels considered them a type of fixed cost when they calculated payments to captain and crew under the share system. For consistency in the data summary, maintenance costs were listed as fixed costs in the cost-earnings table (Table 3). In addition, depreciation was not counted as a cost in "cash flow" net returns because it is a non-cash charge and not an out-of-pocket expense, as in previous cost-earnings studies. Similarly, opportunity costs for the owners' time involved in the fishing business were not counted as costs. Accordingly, the net returns to owner reported here can be regarded as optimistic.

Negative vs. Positive Returns

Although the average cash return to vessel owners was positive, there were great variations in profitability among the vessels. Table 4 compares characteristics and cost earnings performance for vessels that made a net gain against vessels that suffered a net loss. With both categories having similar average annual variable costs and fixed costs, it can be observed that profitability was mainly determined by the total annual revenue received. The vessels with positive returns were 60% higher in annual revenue compared to those with negative returns, while the differences between the two groups were 5% in variable costs and 6% in fixed costs. Labor costs for the vessels with positive returns were also higher than that for the vessels with negative returns since the captain's income was proportional to the net revenue (revenue minus variable costs), implying that that the income of captain and crew was lower for the vessels with negative returns. The differences in revenue across vessels mainly resulted from the amount of fish caught, as there was little variation on the fish prices received among vessels.

Table 3. Cost-earnings table 2016 operation (N=10).

Annual Figure per Vessel	**Average (N=10)**	**Std**	Coefficient of variation (CV)
Annual Revenue	258,975	65,895	25%
Annual Variable Costs per Vessel	**140,049**	**20,696**	**15%**
Fuel costs	56,483	12,122	—
Bait costs	44,002	10,763	—
Provisions	16,322	2,901	—
Fishing gear costs	15,433	2,878	—
Oil costs	5,610	2,309	—
Freon costs	1,235	663	—
Communication	964	570	—
Net Revenue (revenue - variable costs)	*118,927*	*65,987*	*55%*
Annual Labor Costs per Vessel	**57,675**	**27,385**	**47%**
Total Capt Payments (by share system)	17,255	11,853	—
Total Crew Payments (not include captain)	33,221	17,202	—
Agent fee	7,200	1,183	—
Annual Fixed Costs per Vessel	**34,911**	**8,479**	**24%**
Mooring	3,480	2,501	—
Bookkeeping	—	—	—
Insurance	7,845	8,280	—
Loan payments	—	—	—
Drydock costs	6,616	3,104	—
Overhaul costs	1,785	1,613	—
Major repairs	—	—	—
Routine repairs	4,300	7,181	—
Other fixed costs (misCost)	10,885	5,511	—
Total Expenditures	232,635	33,911	15%
Cash Return	**26,340**	45,251	172%

Table 4. Comparison of cost-earnings performance in positive vs. negative vessels in the American Samoa longline fishery.

Annual Figure per Vessel	Average of negative return (N=3)	Std	Average of positive return (N=7)	Std
Annual Revenue	**182,052**	19,231	**291,942**	46,512
Annual Variable Costs per Vessel	**135,211**	36,233	**142,122**	13,717
Fuel costs	53,198	16,147	57,891	11,215
Bait costs	40,213	12,121	45,625	10,703
Provisions	16,447	4,340	16,268	2,516
Fishing gear costs	16,892	4,598	14,808	1,963
Oil costs	6,196	3,380	5,359	1,986
Freon costs	951	831	1,356	609
Communication	1,314	883	814	374
Net revenue (revenue - variable costs)	46,840	23,758	149,821	51,298
Annual Labor Costs per Vessel	**36,456**	21,913	**66,770**	25,481
Total Capt. Payments (by share system)	5,286	4,217	22,384	10,123
Total Crew Payments (not include captain)	24,169	17,720	37,100	—
Agent fee	7,000	866	7,286	1,350
Annual Fixed Costs per Vessel	**33,540**	4,824	**35,499**	9,936
Mooring	4,800	3,270	2,914	2,139
Bookkeeping	—	—	—	—
Insurance	5,189	8,988	8,983	8,419
Loan payments	—	—	—	—
Drydock costs	9,335	4,071	5,451	1,910
Overhaul costs	1,667	1,443	1,835	1,788
Major repairs	—	—	—	—
Routine repairs	—	—	6,143	8,009
Other fixed costs (misCost)	12,549	3,029	10,172	6,365
Total Expenditures	205,207	41,602	244,390	24,713
Cash Return	**(23,156)**	22,999	**47,553**	33,842

Comparison of 2016 Cost-earnings Status vs. 2001 and 2009

Table 5 lists the main cost-earnings items of the studies for three periods (2001, 2009, and 2016), and Figure 9 illustrates the content presented in Table 5. A slow improvement in economic performance of the American Samoa fleet in 2016 over the 2009 operation was shown. However, compared to the 2001 operation, the economic performance of the 2016 fleet was poor; the net return in 2016 was only 10% of that in 2001[18]. In addition, the increase in economic performance in 2016 over 2009 was not necessarily sourced from the improvement of fishing operations in the American Samoa longline fishery. Comparisons of economic performance among the studies in the different periods will be discussed below.

The previous cost-earnings study (Pan et al. 2017) reported the status of the 2009 operation, as well as presented the declining trend of the economic performance of the American Samoa fishery from 2006 to 2013. The study indicated that three key elements showed great impacts on the economic performance of the American Samoa longline fleet: the CPUE of the targeted species (albacore), fish price, and fuel price. It suggested that the declining fishery performance was related to declining CPUE, higher fuel prices, and lower or flat fish prices.

Annual revenue per vessel in 2016 was lowest compared to 2009 and 2001, due largely to a continually declining CPUE. Figure 10 shows the CPUE for albacore and all pelagics for the period of 2001–2016. In 2016, CPUE dropped to 12 albacore per 1000 hooks, down from 15 per 1000 hooks in 2009, and 33 per 1000 hooks in 2001.

Table 5. Comparison of cost-earnings performance in 2016, 2009, and 2001 in the American Samoa longline fishery.

	2016		2009		2001	
Cost-earnings Items	Value	% of revenue	Value	% of revenue	Value	% of revenue
Revenue	258,975	—	448,817	—	930,476	—
Variable Costs	140,049	54%	68,016	60%	284,530	31%
Labor Costs	57,675	21%	78,167	17%	251,918	27%
Fixed Costs	34,911	13%	96,256	21%	143,083	15%
Cash return	26,340	11%	6,379	1%	250,945	27%

[18] It is important to note that the O'Malley and Pooley study estimated revenues based on a subsample of longline vessels, which may not have been representative of all vessel activity (Pan et al. 2017). As a result of these methodological differences, our ability to meaningfully compare the two studies is limited.

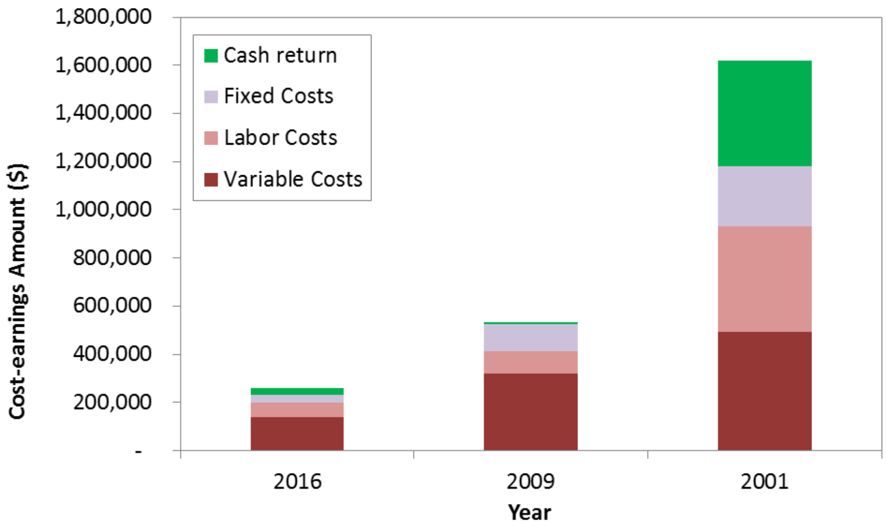

Figure 9. Comparison of cost-earnings performance in 2016 with the previous studies (2009[19] and 2001[19]) in the American Samoa longline fishery[20].

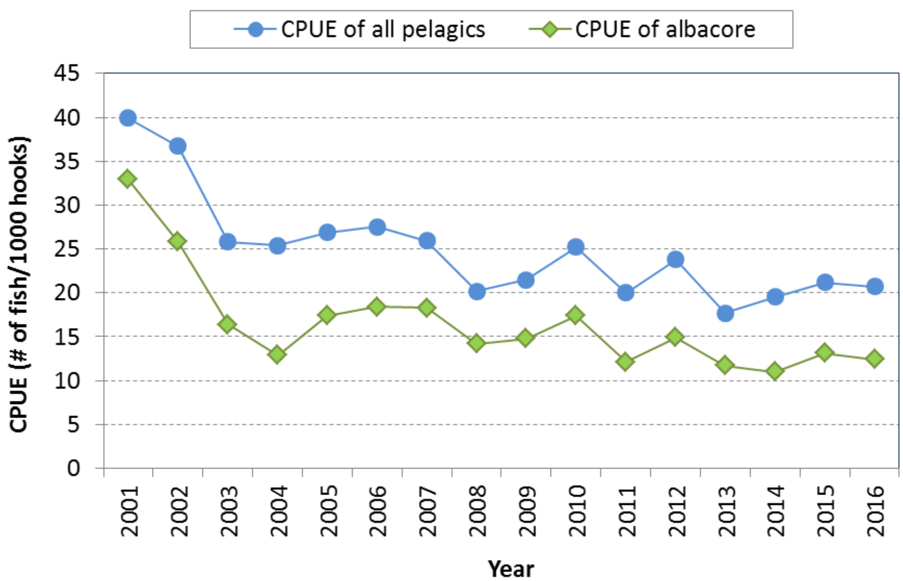

Figure 10. The CPUE (number of fish per 1000 hooks) of albacore and total pelagics during 2001–2016[21].

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[19]Data adjusted to 2016 dollars using CPI adjustor is 1.19 for 2009 and 1.74 for 2001.

[20] Data sources: 2016 from current study, 2009 data from (Pan 2017), and 2001 data from (O'Malley and Pooley 2002).

[21] Data Source: the data for 2008–2016 were from WPRFMC (2018), and the data for 2001–2007 were from WPRFMC (2009). The CPUE figures during the period of 2001–2005 were the averages for the large vessels (monohulls), and the figures after 2006 were the average for all the longline vessels. Due to limited numbers, the CPUE figures for active small vessels were not reported separately following the data confidential rule from 2006–2016.

Fish price is another element that has great impact on revenue. In 2016, the albacore price was \$1.13/lb (2016 \$)—13 cents higher than in 2009 (2009 \$). Figure 11 shows the albacore price trend from 2001–2016. If the albacore price was as low as in 2009, revenue per vessel in 2016 would have declined even further.

Figure 11. Albacore price trend that fishermen received 2001–2016, both nominal and adjusted to 2016 dollars[22].

[22] Data sources: 2001–2011 Western Pacific Fisheries Information Network (WPacFIN), https://www.pifsc.noaa.gov/wpacfin/as/Pages/as_data_8.php (accessed on July 23, 2018); price data since 2012 were collected through PIFSC economic data collection program (Pan 2018, in review).

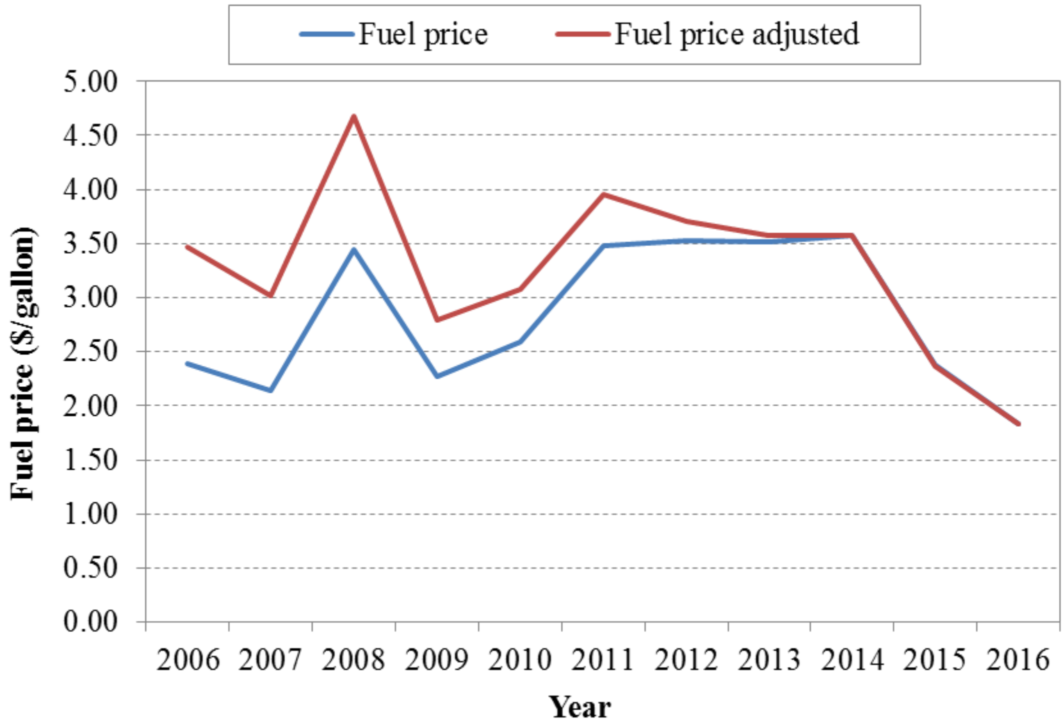

Figure 12. Fuel price trend 2006–2016, both nominal and adjusted to 2016 dollars.[23]

Figure 12 shows the fuel price trend from 2006–2016. Fuel prices in 2016 reached a 10-year low, with average annual fuel costs of $56,483 per vessel—approximately 52% of the fuel cost per vessel in 2009.

Lower fixed costs in 2016 also had a positive effect on cost-earnings. Loan payments and vessel insurance were less than in 2009. Based on the 2016 surveys, not a single vessel carried a loan payment (no payment in interests and no premium), while back in 2009, the average annual loan payment per vessel was $19,000 (Pan et al., 2017). In addition, vessel insurance (usually required for vessels with loans) was much lower in 2016 at $7,845 per vessel vs. $24,940 per vessel in 2009. Taking all of these factors into consideration—lower CPUE, lower fuel price, higher fish price, and lower fixed costs—the data suggest that the improvement in net returns during 2016 mainly resulted from the decrease in fixed costs from 2009.

Sensitivity Analysis – ISO curve

As indicated above, albacore price, CPUE, and fish price play important roles in determining revenue and profit in the American Samoa longline fleet. We estimated a matrix of CPUE and

[23]Data source: PIFSC economic data collection program (Pan 2018, in review). Fuel price was not available prior to 2006 when the program was established.

fish price to examine how profit correlates, while keeping other factors unchanged, such as fixed and variable costs, fishing effort, and non-albacore catches. The average annual fishing effort per vessel was 392 sets, and albacore comprised 83% of the total revenue. A matrix was developed to construct isoprofit curves associated with albacore CPUE and price changes, which ranged from $500 to $4,000 per metric ton whole weight (which is approximately $0.227/lb to $1.815/lb), and CPUE ranging between 10 to 40 fish per 1000 hooks. Revenue is generated given different combinations of CPUE and price level; thus, the profit at each CPUE or price level can be calculated accordingly, while keeping other factors, such as fixed and variable costs, total effort, and non-albacore catches unchanged. The matrix of CPUE, price, and profit resulting from the simulation is illustrated in Figure 13. At the current profit level, the pair of the price-CPUE values is 12.4 fish per 1000 hooks and $2,486 per metric ton ($1.13/lb), shown as the white spot on Figure 13.

Each curve (isocurve) in this figure presents a fixed profit level given combinations of albacore CPUE and albacore price. For example, the $0 isocurve shows the combinations of CPUE-price pairs (fish price, CPUE) that result in no profit. At the current profit level, if CPUE declined by 2 fish per 1000 hooks (from 12.4 to 10.2), or if fish price dropped $0.18 per pound (from $2,486/mt to $2,090/mt), an average vessel would yield $0 profit (holding other factors unchanged). This suggests that the American Samoa longline fleet operated on a very thin profit margin in 2016. Historically, fluctuations in fish price or CPUE have had major impacts on the American Samoa fishery. In recent history, albacore prices hit their lowest in 2013 ($1.02/lb), while the lowest CPUE (11 albacore per 1000 hooks) appeared in 2014. In both years, poor fishery performance and economic conditions brought a majority of the vessels to the verge of shutting down (Pan 2017).

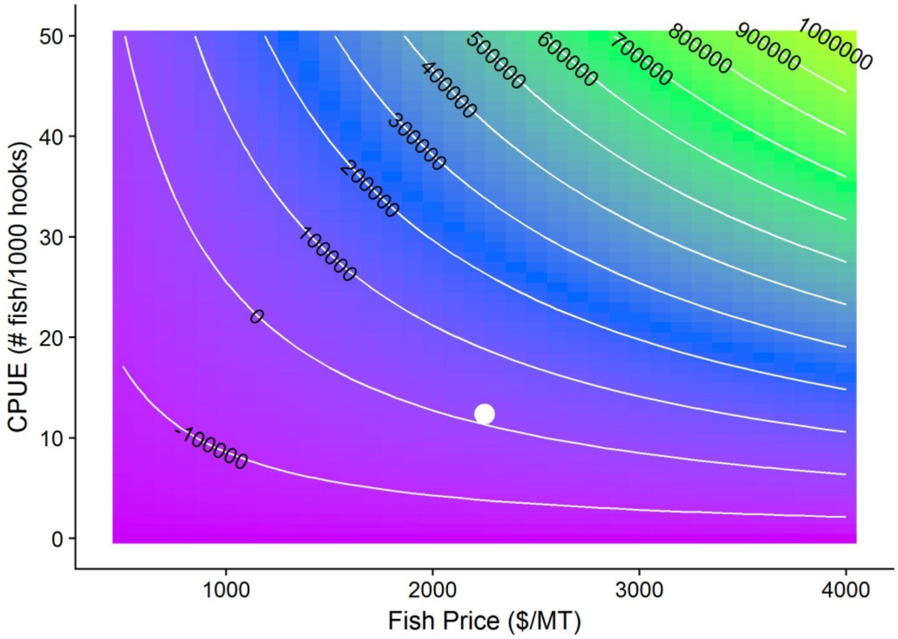

Figure 13. Isocurves of profit in response to changes of albacore CPUE and price in the American Samoa longline fishery.[24]

[24]Data Source: The data for the isocurves were developed from the cost-earnings (Table 3).

CONCLUSIONS AND DISCUSSION

The cost-earnings study shows, on average, the 2016 fishing operations had positive cash returns to vessel owners—approximately $26,000 annually per vessel—before subtracting the possible costs involved with the fishing business. All the active vessels in the fishery in 2016 were operated by hired captains. An improvement in the economic performance of the American Samoa fleet in 2016 was evident over the 2009 operation, yet was still poor compared to the 2001 operation. In addition, the improvement of economic performance in 2016 over 2009 was not necessarily due to the improvement of fishing operations in the American longline fishery. Rather, the decline in CPUE (number of fish per 1000 hooks) contributed to declining revenue per vessel in 2016, while higher fish prices positively impacted the revenue. Lower fuel costs (due to lower fuel prices) and lower fixed costs (due loans for vessel purchases being paid off) had positive impacts on the net returns in 2016. Thus, the mixed changes of lower CPUE, lower fuel price, higher fish price, and lower fixed costs resulted in the higher cash returns of 2016 operations over 2009.

Although the average return to vessel owner was positive, there were great variations among vessels. Of the 10 vessels surveyed, 30% (3 vessels) were not able to make net earnings (cash returns). While the fishing costs across vessels were in a similar range, the considerable disparity among vessels in net returns was caused by variations in revenue by individual vessels. The sensitivity analysis show that the American Samoa longline fleet operated on a thin profit margin, and it was vulnerable to changes in CPUE and fish price.

The study also illustrated the increasing trend in the dual permits (permitted fishing in both Hawaii and American Samoa longline fisheries) since 2009, when the bigeye catch limit was implemented in Hawaii longline, while the number of active vessels in American Samoa longline continued to decline. Two main factors were suggested to contribute to this phenomenon: the poor economic performance of the America Samoa longline fishery and the advantage of continuing access to the Hawaii longline fishery even when the fishery was closed due to the WCPO bigeye catch limit being reached. As a result, the newly add-on dual permitted longline vessels still continued fishing in Hawaii longline fisheries after obtaining American Samoa longline permits.

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Appendix. **The Survey form for in person interviews to collect 2016 cost and operation data**

Survey Form (Page - 1 -)

AMERICAN SAMOAN LONGLINE COST-EARNINGS QUESTIONNAIRE
2016 OPERATION

Date of interview: ____________________

Vessel Name: ______________________

Vessel's permit number: ______________

Interviewee's name: Contact (phone):

Interviewee position (check all if apply)
- ☐ Vessel/business owner
- ☐ Agent
- ☐ Operator Captain

I. About the owner OR owner operator

1. How many fishing vessels do you (or the company you work for) own? _______ vessel(s)
   How many vessels fish in **Am. Samoa Longline** Fishery
   How many vessels fish in **other fisheries** _______
2. When did you (or your company) start longline fishing in Am. Samoa? _________yr
3. In 2016, does your household (or the fishing company you work for) have other income sources besides the fishing business in Am. Samoa?
   - ☐ No
   - ☐ Yes. Income from longline fishing was % of the total household income
4. Do the vessel owner live in Am. Samoa? ☐ Yes ☐ No
5. How long have you (or the fishing company you work for) owned this vessel? _________ yrs
6. Is this vessel operated by a hired captain or by owner?
   - ☐ by hired captain
   - ☐ by owner
7. If it was operated by a hired a captain, how did you find the captain for this vessel *write down the details*
   ____

II. About the Vessel

8. When was the vessel built? ___________ year
9. When was the vessel purchased?___________ year
10. What was the vessel purchasing price? $

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Survey Form (Page - 2 -)

11. What is the vessel current (appraisal) value? $____________
12. What is the vessel length? ft
13. What is the vessel width/beam? ____________ ft
14. Holding capacity of **fuel** Gallons?
15. Holding capacity of **fish**:___________ (lbs)

III. About Vessel Operation and Fish Sold in 2016

16. How many trips this vessels landed in 2016 trips
17. What areas did this vessels operated (fishing) in 2016 (check all if apply)
    - ☐ American Samoa EEZ
    - ☐ Other EEZ (i.e. Cook Islands)
    - ☐ High Sea
18. Where do you usually sell/distribute fish landed by this vessel? What was the % among those outlets?
    - ☐ Give away to friend to family ________ %
    - ☐ Sell to the Cannery _________ %
    - ☐ Sell to restaurant _________ %
    - ☐ Other distributors or brokers (list the name(s) _______

IV. About Labor Costs in 2016

19. How many crew do the vessel usually had __________ (NOT including captain)?
20. How many crew are foreign __________ (NOT including captain)?
21. On average, how long of the crew have been working with this vessel/company?
    _________ yr
22. What is the longest time a current crew has been working with this vessel? _________ yr
23. How captain was paid?
    - ☐ By shares ______ % of GROSS revenue
      ______ % of NET revenue
    - ☐ Flat rate $
    - ☐ Flat rate with bonus (details: $______ +)
24. If shares by net revenue, which of the following trip expenses do you include as the trip costs?
    - ☐ Trip costs (fuel, bait, gears, provision, fishing gears, freon, engine oil, communications)
    - ☐ Agent fee, insurance, parts for repairs
    - ☐ Any others

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Survey Form (Page - 3 -)

25. Does all the crew get pay by the same method?

If YES
- ☐ By shares ______ % of GROSS revenue
  % of NET revenue
- ☐ Flat rate $_______ per month or year
- ☐ Flat rate with bonus $ + bonus

If **NO**, (means that each crew paid differently), please fill out the table below

Position	**Shares or flat**	**If share by Net Revenue**	**If flat rate Trip or Month**	**Flat rate $**	**Bonuses (how)**	**Initial payment (get this crew)**	**What year**
Owner operator	☐Share ☐Flat	☐Net Rev ☐Rev	☐month ☐Trip				
Hired captain	☐Share ☐Flat	☐Net Rev ☐Rev	☐month ☐Trip				
Crewmember 1	☐Share ☐Flat	☐Net Rev ☐Rev	☐month ☐Trip				
Crewmember 2	☐Share ☐Flat	☐Net Rev ☐Rev	☐month ☐Trip				
Crewmember 3	☐Share ☐Flat	☐Net Rev ☐Rev	☐month ☐Trip				
Crewmember 4	☐Share ☐Flat	☐Net Rev ☐Rev	☐month ☐Trip				
Crewmember 5	☐Share ☐Flat	☐Net Rev ☐Rev	☐month ☐Trip				
Crewmember 6	☐Share ☐Flat	☐Net Rev ☐Rev	☐month ☐Trip				

26. As an owner of a fishing vessel, do you hire an agent to take care of the fishing business?
    - ☐ Yes
    - ☐ No

    If NO, what types of works that the owner usually takes care of?
    - ☐ Book keeping
    - ☐ Buying parts
    - ☐ Look for crew and captain
    - ☐ Getting the boats ready to depart (such as getting supplies, parts, call PIRO)
    - ☐ Others ?

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Survey Form (Page - 4 -)

V. About Trip Costs

1. Does trip cost varied by trip by trip?
   If Yes. The main reasons for the variation by trip length? Or others ?
2. To list the costs of one trip in Jun and the one of the last trip landed 2016

1. TRIP INFORMATION

TRIP NUMBER: A S

DATE OF DEPARTURE: 2 0

DATE OF RETURN: 2 0

VESSEL NAME

NO. OF SETS

2. FUEL

PRICE PER GALLON $

GALLON USED

TOTAL COST OF FUEL $

3. ENGINE OIL AND HYDRAULIC OIL

UNIT (Check One)	PRICE PER UNIT	QUANTITY USED
Gallon		
Bag/bucket (5 Gallons)		
Drum (55 Gallons)		

TOTAL COST OF OIL $

4. BAIT

TYPE OF BAIT (Check One)

	Squid		Mackerel
	Sardine		Anchovy
	Sanma		

PRICE PER BOX $

BOXES USED

TOTAL COST OF BAIT $

5. FREON AND OTHER FREEZER COSTS (amount spent for this trip to operate freezer)

$

6. FISHING GEAR COSTS (amount spent on re-supply vessel for this trip for hooks, lines, floats, raingear, etc.)

$

7. PROVISIONS COSTS (amount spent re-supply vessel for this trip on food, bottled water, cigarettes, etc.)

$

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Survey Form (Page - 5 -)

8. TRIP COMMUNICATIONS COST (amount spent for this trip on satellite phone and/or data calls, email, etc.)

$ __,___

9. FREIGHT OR EXPORT COST (the cost of transporting fish to other markets other than canneries)

$ __,___

10. MISCELLANEOUS COSTS (please list the details)

$ __,___

Details of misc. costs

Items	Cost
1.	
2.	
3.	

11. TOTAL ESTIMATED COSTS (ask, don't add)

$ ____,___

Fish price ☐ GG ☐ Round

Species	Price
1. Albacore	
2. Yellowfin	
3. Bigeye	
4. Skipjack	
5. Wahoo	

12. CAPTAIN OF THIS TRIP (check one)

☐ Owner Operated ☐ Hired Captain

13. CREW INFORMATION

Number of crew (DO NOT include captain) Number of foreign crew

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Survey Form (Page - 6 -)

VI. Fixed Costs

27. Total mooring fees (port fees for all the trips before departures) in 2016? $___________

28. Did you hire someone to do 2016 bookkeeping or share bookkeepers with other family business?
    - ☐ Yes. Pay $ ___________ a month/year
    - ☐ No. Owner does it.
    - ☐ No. It is done by the agent.
    - ☐ No. Share with business $ __________ of total

29. What were your insurance costs per year for this vessel (or for the all ______ the fishing vessels) in 2016?
    $
    This includes (Check if all apply)
    - ☐ Vessel only
    - ☐ Liability only ("P" and "I")
    - ☐ Vessel and liability
    - ☐ Pollution
    - ☐ Health (Please specify who is covered) ______________

30. Did you have any vessel loan payments in 2016? ☐ Yes ☐ No
    If yes 1) How much were your payments in 2016? $ _______________

31. When did you last dry dock your vessel? ___________ yr

32. When do you plan for the next dry dock? ___________ yr

33. How much it costs in in total for the last drydock $ __________ …

    Please list the major repairs in the dry dock and the cost associated with the report (if the data are available)
    cost $______________ for ____________________________________
    cost $______________ for ____________________________________
    cost $______________ for ____________________________________
    cost $______________ for ____________________________________

34. Have you overhauled your engine in the past? ☐ Yes ☐ No
    If yes 1) When did you last overhaul your engine? _____________ yr
    2) How much did it cost $ _________________
    3) How often do you overhaul your engine? ______ yrs

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Survey Form (Page - 7 -)

35. Do you have any routine repairs and maintenance in trip base? ☐ Yes ☐ No
    If YES, does it include in the trip costs above? ☐ Yes ☐ No
    If NOT, how much it costs? $______________ in 2016

36. Beside the routine repairs and maintenance list above, do you have any major repairs and maintenance works done in 2016 for this vessel? If yes, the cost is $______________

    Please list the major repairs and the cost associated with the report (if the data are available)
    cost $______________ for ____________________________________
    cost $______________ for ____________________________________
    cost $______________ for ____________________________________
    cost $______________ for ____________________________________

36. Are there any other vessel costs which I haven't included? ☐ Yes ☐ No
    If yes (Please list)________________________________ $______________

37. Open Ended Questions? Is there anything else you would like to say? (present challenges, comments on fishing management)

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