3.10.3.2 Hawai'i-based Troll Fisheries

This section discusses pelagic fisheries conducted around Hawai'i by trolling.

Trolling is the most popular pelagic fishing method in Hawai'i and has a long tradition of use by small boat recreational and commercial fishers using simple gear (WPRFMC, 1995). Hawai'i also has been the site of important innovations in big-game trolling techniques. The fishery is composed of several sectors, including commercial troll, charter, and recreational and expense fisheries (recreational/expense vessels sell all or a part of the landings to cover fishing trip costs). Each of these fisheries is discussed in a separate subsection providing information on existing conditions and historical.

The definitions of these fishing categories follow from those developed by Hamilton (Hamilton *et al.*, 1996). Commercial vessels are classified as such if the survey respondents sold fish to create income, or considered themselves as commercial fishers. Survey respondents who indicated that they sold fish to cover fishing expenses resulted in a vessel being coded as an expense vessel. Recreational vessels were associated with respondents that did not sell any fish during the previous 12 months (Hamilton and Huffman, 1997).

Catch and sales data for commercial and expense vessels in Hawai'i are collected through State of Hawai'i fish catch reports, and compiled by NMFS from the reports. These publications contained the most current information available when this report was being prepared. Catch reports must be submitted by commercial license holders who make commercial landings in Hawai'i. If license holders sell any of their catch during the year, they are required to report all of their catch, even the portions kept for personal consumption. Catch reports do not distinguish among types of troll fishing.

Hawai'i's recreational and subsistence fishers sometimes operate commercially in that they occasionally sell some of their catch to cover boat operating expenses. Charter boats may also operate as commercial trollers on days when they do not have charters. However, some fishers may sell large quantities of fish without holding a commercial fishing license or without filing catch reports (Hamilton and Huffman, 1997). As a result, the reliability of catch data for the pelagic troll fishery is uncertain, although catch data for the commercial troll sector are thought to be more reliable than data for the other troll fleets (charter and recreational/expense).

The quality of recreation and charter fishery data in Hawaii is expected to improve in the near future. The Marine Recreational Fishery Statistics Program which is being resumed in Hawai'i after a 20 year hiatus, will collect survey information from participants in the fisheries on a regular basis.

3.10.3.2.1 Commercial Troll Fishery

Commercial troll fisheries produce high-quality wahoo and *mahimahi*, as well as large yellowfin tuna, for the Hawai'i market. Careful onboard handling and freshness of the fish yield a product that is highly valued in the marketplace. However, tuna taken by troll fishers can have the "burnt tuna syndrome," which reduces shelf life and limits market options.[25]

Trolling is conducted by towing lures or baited hooks from a moving vessel, using big-game-type rods and reels as well as hydraulic haulers, outriggers, and other gear. Up to six lines rigged with artificial lures may be trolled when outrigger poles are used to keep gear from tangling. When using live bait, trollers move at slower speeds to permit the bait to swim naturally (WPRFMC, 1995).

According to respondents to a 1996 survey of commercial and recreational boat owners and captains in Hawai'i's small boat fleet (which includes troll as well as other types of fishing), troll vessels are as large as 26 m (85 ft), but most are trailered boats ranging from five to eight meters (15 to 25 ft) in length, and are typically operated with a one- or two-person crew (Hamilton and Huffman, 1997; WPRFMC, 1995). Larger trailered boats are particularly prevalent on the windward sides of the islands, where ocean conditions are rougher. The average reported crew size was 1.7 persons, including the captain (Hamilton and Huffman, 1997).[26]

Full-time pelagic trollers surveyed usually fished at an average distance of 5.2 to 7.9 miles from shore, with a maximum distance of about 28.7 miles from shore. Part-time pelagic trollers operated at greater distances from shore, with the average ranging from 4.9 to 28.8 miles, depending on the island from which the vessel operated. The maximum distance from shore ranged from 16.1 to 53.5 miles for part-time trollers (Hamilton and Huffman, 1997). Trollers fish where water masses converge and where submarine cliffs, seamounts, and other underwater features dramatically change the bathymetry. Drifting logs and other flotsam aggregate tuna, dolphinfish (*mahimahi*), and wahoo, and trollers search for these features during the fishing trip. Trollers search for and attempt to get beneath aggregations of birds, especially "working" birds, those attacking prey. FADs also increase fish aggregation, and waters near these manmade structures are preferred fishing locations (WPRFMC, 1995).

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[25] The syndrome is thought to be related to changes in the fish's body chemistry and elevated body temperatures caused by struggling on the line, warm water, or improper handling after being caught.

[26] These survey data were collected through a statewide intercept survey at Hawai'i small boat harbors and trailer ramps. Due to personnel limitations, sites were sampled with the intent of intercepting the maximum number of fishers on any given day. Thus there is geographic as well as avidity bias and seasonal bias in the data. It is believed that the survey results presented here provide insight into Hawai'i's small boat fishery and are representative of a large portion of the population. This is especially true of information relating to fixed and variable costs, but less true of data on vessel operations such as number of trips per year.

Most pelagic trollers reportedly conducted their operations as single-day trips lasting more than eight hours, although a few vessels, primarily larger boats, engaged in multi-day trips (Hamilton and Huffman, 1997; WPRFMC, 1995). In 1995-1996, respondents that were full-time commercial trollers averaged about 168 fishing trips per year. Eleven of these trips were recreational, 134 were troll fishing, and the balance of 23 were other types of commercial fishing. Part-time commercial trollers averaged less than half of the number of trips per year made by full-time trollers (Table 3.10.3-25). Commercial troll vessels fished year-round, with peak catches in May. In September through January, commercial harvests are significantly lower (Figure 3.10.3-21). Catch reports do not distinguish types of trolling (e.g., commercial or expense), so the term "all commercial troll" is used when the data or discussion includes troll vessels other than full-time or part-time commercial vessels as defined in Hamilton and Huffman (1997).

The particular ethnicity of participants in the commercial troll fisheries (vessel owners and operators as well as crew) is unknown. However, the 1996 survey (Hamilton and Huffman, 1997), found that:

> The overall distribution of survey participants' ethnicities is similar to that found in Hawai'i's statewide population by the Hawai'i Department of Health in 1992 (the most recent year for which data is available) in that the three most common ethnicities are Caucasian, Japanese, and Mixed with part-Hawaiian. Differences exist in the ranking and proportions of these groups. Census records reveal that Caucasians comprise 23 percent of our state's population, Japanese 20 percent, and Mixed with part-Hawaiian 19 percent. In our sample Japanese represent 33 percent, followed by part-Hawaiians at 16 percent, and Caucasians at 12 percent. These variations between Hawai'i's total population and our sample seem in accordance with expectation of a greater identification with the sea by Japanese and Hawaiians.

To the extent that participants in the commercial troll fisheries resemble all participants in Hawai'i's small boat fleet, these survey findings are relevant to troll fishery participants.

The State of Hawai'i requires that all fishers on commercial fishing vessels have a license issued by the state. Applicants are asked to identify their primary fishing gear or method. A total of 3,658 fishers were licensed in 1997 and 3,657 were licensed in 1998. About 43 percent of total licenses in each year were issued to applicants that identified trolling as their primary fishing method (1,589 in 1997 and 1,574 in 1998) (WPRFMC, 1999d).

Figure 3.11-7 (Trolling Licenses by Zip Code) in Section 3.11 shows residency of participants in the commercial troll fisheries. The larger concentrations of troll license holders are found near the urban centers of each island, although certain zip codes in west Hawai'i and Moloka'i are distinguished by relatively large numbers of license holders.

Table 3.10.3-26 shows 1998 catch and sales amounts for all commercial MHI troll vessels by island. Residents of the Island of Hawai'i accounted for the largest number of fish caught by troll vessels and the highest gross revenue from fish sales. O'ahu residents had the next highest catch and fish sale totals (Table 3.10.3-26 includes data for all fish and for all types of troll vessels) (HDAR, 1998).

Pelagic landings for all commercial trollers increased from 1970 to 1988 and then declined slightly and remained relatively stable from 1988 through 1998. In contrast, total pelagic landings for all gear types declined from 1971 through 1985 and then increased dramatically with expansion of the commercial longline pelagic fishery (Figure 3.10.3-22 and Table 3.10.3-27). The all commercial troll information includes landings that are sold and reported by commercial trollers as well as other troll gear sectors (charter and expense).

Reported catches for all commercial trollers in Hawai'i (NMFS and the State of Hawai'i do not include recreational fishing data in Hawai'i) totaled 2.15 million pounds of pelagic fish in 1998, down 16 percent from 1997. The 1998 catch was 33 percent yellowfin tuna, 18 percent blue marlin, 17 percent wahoo, 16 percent *mahimahi*, and six percent albacore tuna, with the remainder composed of striped marlin, skipjack tuna, bigeye tuna and other miscellaneous pelagic species (Table 3.10.3-28 and Table 3.10.3-29). A total of 21,112 troll trips were reported in 1998, down 11 percent from 1997 (Table 3.10.3-30).

Table 3.10.3-25: Distribution of Trip Types by MHI Full-time and Part-time Commercial Trollers, 1995-1996. Source: Hamilton and Huffman, 1997.

Trip Types Per Vessel	Full-Time		Part-Time	
	No. of Trips	Percent of Total Trips	No. of Trips	Percent of Total Trips
Total Fishing Trips	168	100	73	100
Total Recreational Fishing Trips	11	7	4	5
Total Commercial Fishing Trips	157	93	69	94
Commercial Troll	135	80	62	85
Commercial Palu Ahi	1	1	0	0
Commercial Ika Shibi	2	1	2	3
Commercial Bottomfish	13	8	4	6
Commercial Akule/Opelu	4	2	0	0
Commercial Reef Fish	0	0	1	1
Commercial Aquarium Fish	2	1	-	0
Commercial Other Gear	0	0	2	2

Figure 3.10.3-21: Hawai'i Monthly Commercial Fishery Landings by Category. Source: Hamm *et al.*, 1999.

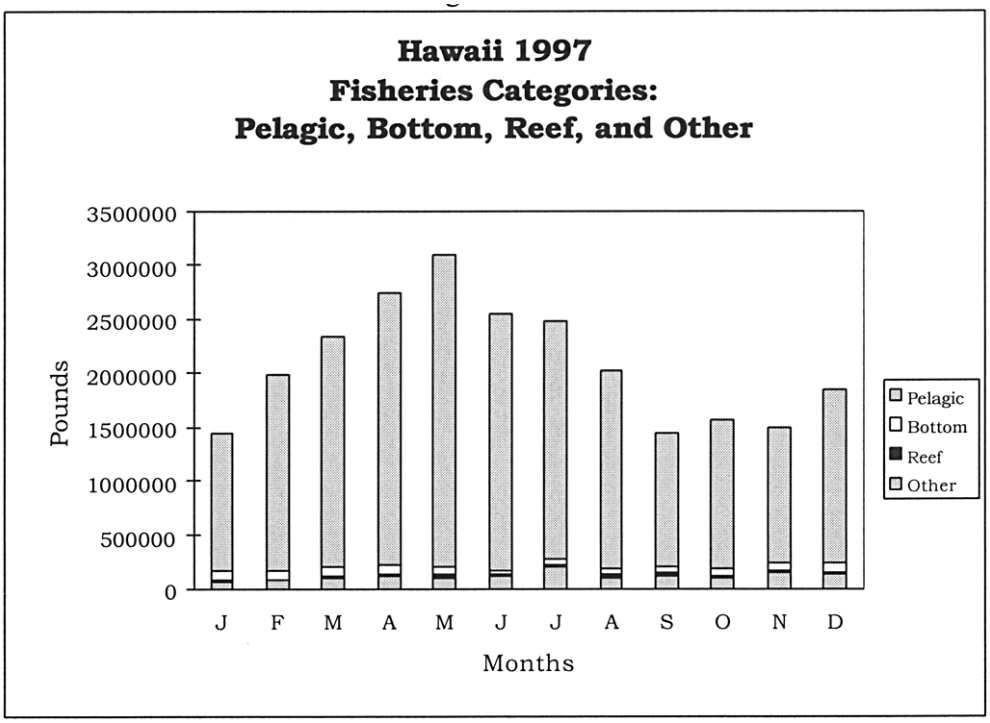


Table 3.10.3-26: MHI Catch and Sales by All Commercial Troll Vessels, by Island, 1998. Source: HDAR, 1998.

Island	Catch		Sold	
	Number of Fish	Pounds	Pounds	Gross Revenue ($)
Hawai'i	42,077	1,074,381	934,558	1,540,754
Kaua'i	22,904	404,368	336,136	768,000
Lana'i	1,568	14,379	10,110	20,272
Maui	22,206	256,189	178,217	419,224
Moloka'i	1,312	12,068	9,592	18,917
O'ahu	39,671	726,100	603,755	1,284,663
Unknown	5	115	115	253
Total	**129,743**	**2,487,600**	**2,072,483**	**4,052,082**

Figure 3.10.3-22: Annual Pelagic Landings by Commercial Troll and All Gear Types, 1987-1998. Source: WPRFMC, 1999d.

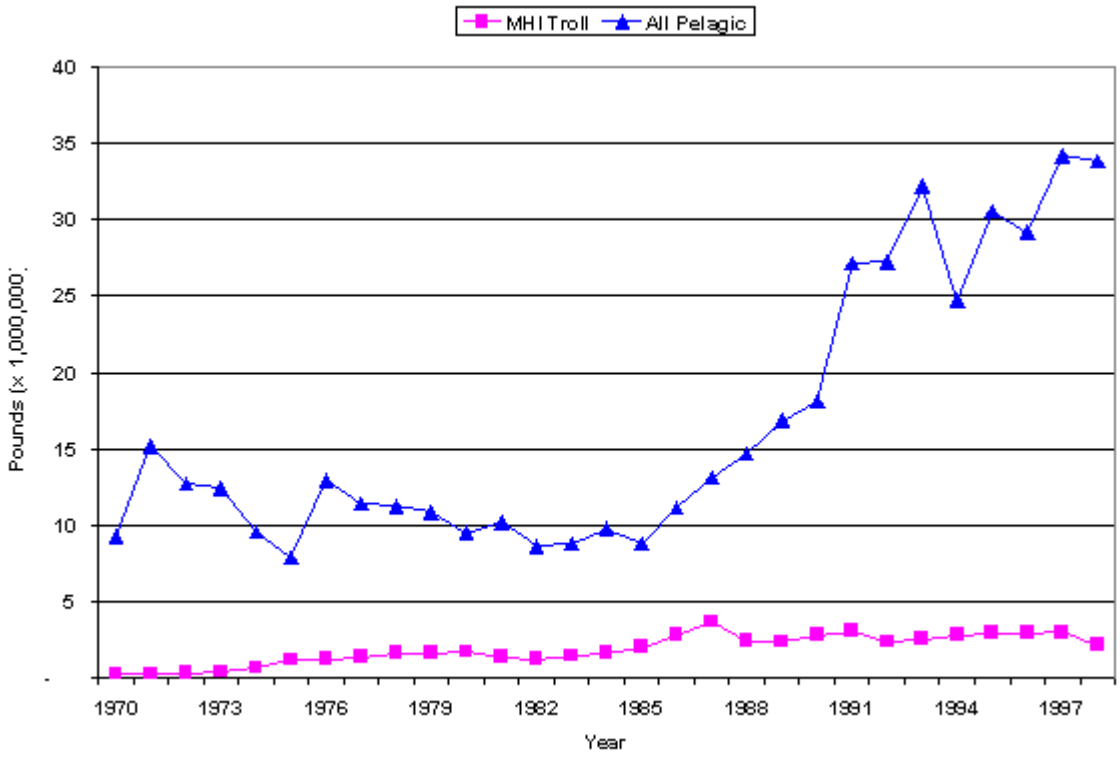


Table 3.10.3-27: MHI All Commercial Troll Landings, all Pelagic Species, 1970 - Present. Source: P8798N.xls (22 April 1999) *in* WPRFMC, 1999d.

Year	Landings (Thousands of Pounds)	Year	Landings (Thousands of Pounds)	Year	Landings (Thousands of Pounds)
1970	275	1980	1,743	1990	2,838
1971	279	1981	1,368	1991	3,087
1972	321	1982	1,238	1992	2,381
1973	436	1983	1,473	1993	2,572
1974	692	1984	1,655	1994	2,833
1975	1,188	1985	2,046	1995	2,973
1976	1,273	1986	2,820	1996	2,951
1977	1,372	1987	3,693	1997	3,003
1978	1,669	1988	2,414	1998	2,188
1979	1,667	1989	2,386		

Table 3.10.3-28: MHI All Commercial Troll Catch for Tuna Species, 1987-Present. Source: WPRMFC, 1999d.

Year	Catch by Species (Thousands of Pounds)					
	Albacore	Bigeye	Skipjack	Yellowfin	Other Tuna	Total
1987	1	11	275	1,820	19	2,126
1988	1	10	346	752	16	1,124
1989	1	11	314	551	14	891
1990	1	15	274	1,053	18	1,361
1991	2	11	501	612	14	1,139
1992	3	9	344	602	16	974
1993	3	4	331	614	11	963
1994	21	6	283	934	19	1,263
1995	10	10	317	954	11	1,302
1996	5	4	420	702	7	1,138
1997	7	6	374	717	6	1,110
1998	2	5	274	544	9	834

Note: Data were compiled by NMFS staff from HDAR commercial catch reports (data for 1997 are extrapolated from preliminary reports). These data reflect only trolling gear codes and MHI locations. Some offshore seamounts (e.g., Cross) are excluded, as are distant-water albacore catches. However some offshore seamounts (e.g., Jagger) are included, based on the HDAR area code determinations (area codes lower than 1,000).

Table 3.10.3-29: MHI All Commercial Troll Catch for Billfish and Non-Tuna Species, 1987-Present. Source: Ito and Machado, 1999.

Year	Catch by Species (Thousands of Pounds)				
	Blue Marlin	Striped Marlin	Swordfish	*Mahimahi*	*Ono* (Wahoo)
1987	553	65	1	576	323
1988	566	117	2	261	294
1989	712	52	2	375	296
1990	626	60	1	484	257
1991	745	88	1	714	336
1992	562	82	0	459	260
1993	673	150	0	443	288
1994	645	76	1	545	250
1995	681	114	1	419	392
1996	866	116	1	436	349
1997	799	82	1	514	455
1998	438	43	1	404	430

Table 3.10.3-30: Annual Trips for All Commercial Troll Vessels, 1979-1998. Source: WPRFMC, 1999d.

Year	Number of Annual Trips	Year	Number of Annual Trips
1979	10,185	1989	18,924
1980	12,692	1990	20,468
1981	11,975	1991	23,184
1982	10,039	1992	20,109
1983	12,842	1993	20,647
1984	14,556	1994	20,905
1985	15,291	1995	23,527
1986	20,139	1996	21,611
1987	23,391	1997	23,674
1988	20,202	1998	21,112

Figure 3.10.3-23 shows total annual gross revenues for troll and other gear types fishing for pelagic species for 1948-1998. Total gross revenues for the troll, handline, and other gear (e.g., baitboat) type fisheries were relatively stable after the early 1980s, although the reduced harvest in 1998 resulted in lower gross revenues.

Until the mid-1980s, the troll-handline-other gear category received prices higher than the average for all gear types landing pelagic species, as shown in Figure 3.10.3-24. This situation has reversed since that time. Prices received by the troll-handline-other gear category declined below the average prices received for all gear types at about the time that longline catches increased substantially.

Figure 3.10.3-23: Total Annual Gross Revenues for All Commercial Troll and Other Pelagic Fisheries, Inflation-Adjusted for Year 2000 Dollars, 1948-1998. Source: NMFS, 2000e.

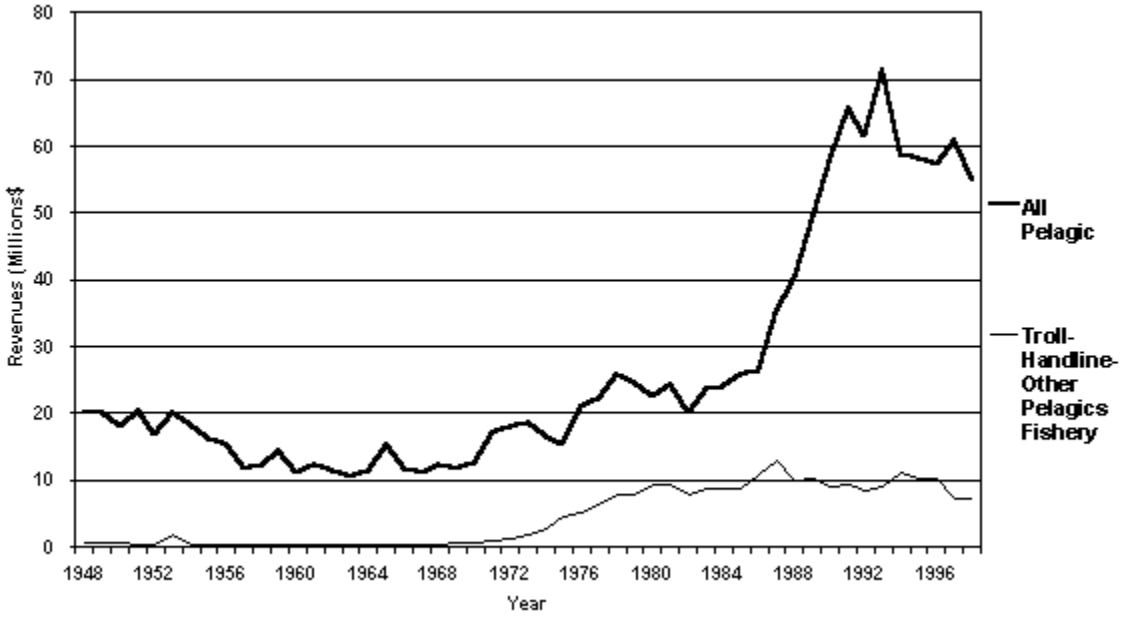
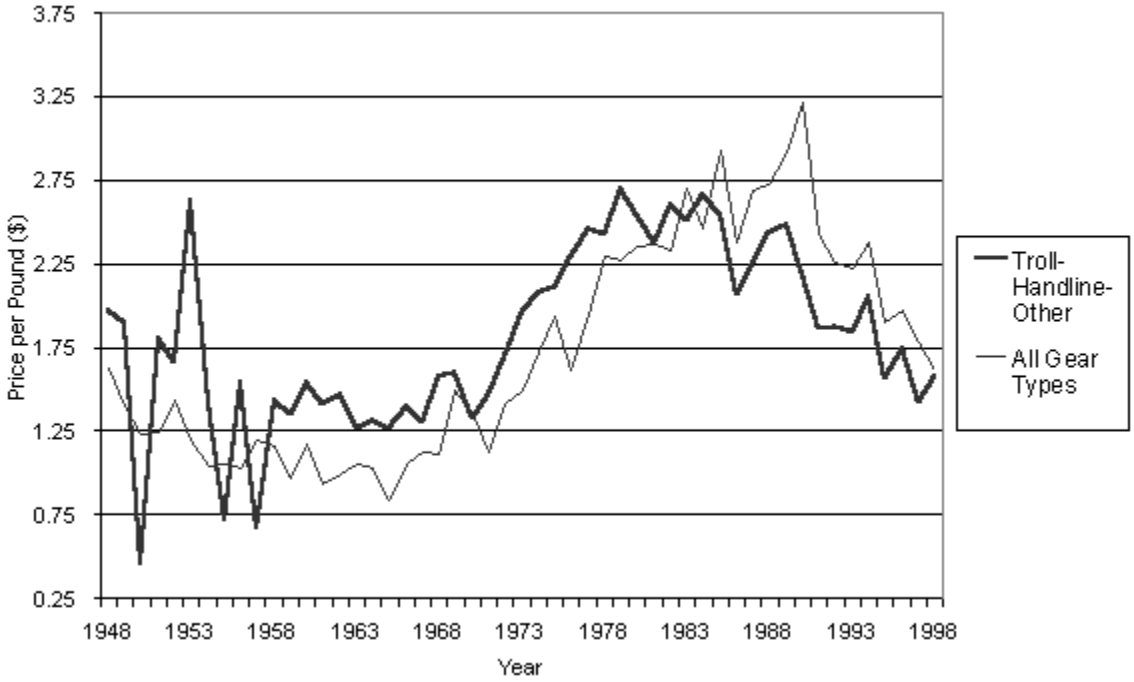


Figure 3.10.3-24: Average Price per Pound for Pelagic Landings by All Commercial Troll-Handline-Other and All Pelagic Gear Types, Inflation-Adjusted for Year 2000 Dollars, 1948-1998. Source: Adapted from NMFS, 2000e.



A 1995-1996 survey of Hawai'i's small boat fishery reported cost and earnings information for full-time and part-time trollers (Hamilton and Huffman, 1997). The average full-time troller generated $59,786 in gross revenues from the sale of pelagic species in 1995-1996. After fixed costs and trip costs for the average of 135 pelagic trips during the year are subtracted, the vessel had a net operating income of about $28,168. After one-third of net operating income for crew share is subtracted (Glazier, 1999), income to the owner and/or the captain of the vessel was $18,872. Based on Hamilton and Huffman (1997), the average part-time troller had $11,794 in pelagic fish sale gross revenues in 1995-1996. After pelagic-fishing-related operating expenses are subtracted, the average fisher had a net operating loss of about $4,100. This result suggests a reason why most part-time fishers have another occupation – to support their fishing activity.

Table 3.10.3-31 is a hypothetical pro forma income statement for a commercial pelagic trolling operation in 1995-1996, and was derived from Hamilton and Huffman (1997).

Table: 3.10.3-31: Pro Forma Income Statement for Commercial Pelagic Trollers, 1995-1996. Source: Adapted from Hamilton and Huffman, 1997.

	Amount ($)	Amount ($)
	Full-Time	**Part-Time**
Total Pelagic Sales Gross Revenue [1]	59,786	11,794
Cost Item		
Fixed Costs [2]		
Insurance	689	394
Loan Payments	1,461	1,027
Maintenance and Repairs	2,113	1,850
Fishing Gear	1,497	1,202
Ramp, License, and Registration Fees	87	79
Miscellaneous	252	89
Total Fixed Costs	6,100	4,641
Trip Costs		
Ice	38	18
Boat Fuel	50	69
Bait	71	10
Food	20	18
Truck Fuel	11	15
Miscellaneous	0	-
Total Trip Costs	189	129
Average No. of Commercial Pelagic Trips	135	73
Total Annual Trip Costs	25,518	9,446
Total Annual Costs	31,618	14,086
Net Operating Income (Loss)	28,168	(2,292)
Crew Share [3]	9,295	1,769
Return to Owner and/or Captain's Salary	18,872	(4,061)

NA = not applicable.
[1] Gross sales revenue data for pelagic species are not available from Hamilton and Huffman, 1997. Pelagic gross sales revenue is assumed to be the same percent of total fish sales as pelagic catch is to total catch. Non-pelagic species represent about ten percent of total catch for full-time trollers and 25 percent of total catch by part-time trollers. Therefore, potential changes in gross sales revenue caused by price differentials between pelagic and non-pelagic species are moderated by the low percentage of non-pelagic species to total catch.
[2] Fixed costs are apportioned to commercial pelagic trolling according to the ratio of commercial pelagic trolling trips to total number of trips. Total annual trip costs are calculated as average trip costs multiplied by the average number of commercial pelagic trips.
[3] Crew shares presented in Glazier, 1999 are equivalent to about 33 percent of net operating income, or 15 percent of gross revenue. These percentages are used to estimate crew shares for these fisheries.

Based on the survey information in Hamilton and Huffman (1997) and estimates of the total number of vessels in the commercial troll fishery (Sharma *et al.*, 1999b), total gross revenues

(sales) for the pelagic commercial troll fishery (excluding fish sales by charter boats and expense boats) are estimated at $6,500,799 for 1995-1996. This total is composed of $3,751,729 in sales for full-time fishers, and $2,749,070 for part-time fishers. The calculations for these estimates are shown in Table 3.10.3-32. More recent information on catch and gross revenue by specific small boat fishing group was unavailable, so information from the 12-month period presented in Hamilton and Huffman (1997) is used in this analysis. The period is considered representative of calendar years in the mid- to late-1990s in the pelagic troll fishing sector. The other boat category represents vessels using other gear types such as handline and seamount gears.

Table 3.10.3-32: Estimated Economic Contributions by Hawai'i's Pelagic Commercial Small Boat Fishing Sector, 1998. Source: Estimated from Table 3.10.2-1 and Table 3.10.3-29.

	Economic Contribution by Type of Boat ($)			Total
	Full-time Troller	Part-time Troller	Other	
Estimated total number of non-longline boats[1]	unknown	unknown	unknown	381
Estimated percentage of non-longline boats[2]	0.16	0.61	0.22	100
Estimated number of boats by type	63	233	85	381
Average gross revenues by troller type[3]	59,786	11,794	not applicable	unknown
Total gross revenues by troller type	3,751,729	2,749,070	not applicable	6,500,799

[1] From Pan *et al.*, 1999 *in* Sharma *et al.*, 1999. Other boat category, which includes pelagic handline boats, is included here to show derivation of estimated number of boats by type. Other boat category does not include recreational or expense boats that use troll gear. Information on recreational and expense boats is presented in Section 3.10.3.2.3.
[2] Percentages estimated from number of types of non-longline commercial boats reported in survey sample *in* Hamilton, 1998.
[3] From Table 3.10.3-29.

The $6.5 million in total commercial troll gross revenues shown in Table 3.10.3-32 is slightly smaller than the $7.2 million reported to HDAR for all commercial troll, handline, and other pelagic gears as shown in Figure 3.10.3-23. The addition of fish sale gross revenues from the charter, expense, handline, and other pelagic gears (calculated from survey data in a manner similar to that described above for the commercial troll fishery) and presented in subsequent sections, would result in substantially larger total gross revenues for the troll, charter, expense, handline, and other gear types than reported by HDAR. The difference between the HDAR reported gross revenues and gross revenues calculated from survey data is likely a function of several factors including under-reporting of landings by some fishers and overstating fish sale gross revenues by survey respondents. Since the degree of under-reporting of landings or overstating gross revenues is unknown, it is not possible to adjust for potential reporting or response errors. This analysis uses survey-based data to estimate gross revenues and economic effects for each fishing sector. The approach used in this section for the troll fisheries, and subsequent sections for the handline and pole-and-line fisheries, is similar to that used in Sharma *et al.* (1999) to estimate total fisheries sales, and

the results for the various fishing sectors in this analysis are comparable to results presented in Sharma *et al*. (1999).

Total sales for the commercial troll fleet do not take into account that additional employment and income are generated in the state's economy by businesses whose goods and services are purchased by trolling sector participants, as well as businesses that use troll-caught products as inputs for their production of goods and services. People earning incomes directly or indirectly from the fishery also make expenditures within the economy that generate additional employment and income.

A more complete assessment of the contribution of the pelagic commercial troll fishery to the state's economy can be obtained by combining the I/O multipliers and other coefficients from Sharma *et al*. (1998) with estimates of total sales from the commercial troll fishing sector. Section 3.10.2.2 presents more details on the methodology and describes the coefficients and multipliers. The economic contribution of the commercial troll fishery is shown in Table 3.10.3-33. Comparing the information in the table with data for the state's fishing industry presented in Section 3.10.2.2 shows that the commercial troll fishery accounts for about eleven percent of output of Hawai'i's fishing fleet and about six percent of total output (including direct, indirect and induced outputs) and 12.5 percent of the labor income generated by the fisheries. The 305 jobs in the troll fishery also account for about 20 percent of total employment in the fishing industry in Hawai'i.[27]

Table 3.10.3-33: Estimated Economic Contributions by Hawai'i's Pelagic Commercial Troll Fishing Sector, 1998. Source: Table 3.10.2-8.

Fishing Sector	Industry Output ($Millions)	Industry Labor Income ($Millions)	Industry Inputs ($Millions)	Jobs	Total Output ($Millions)
Commercial Troll	6.50	2.57	3.13	305	8.82

The commercial troll fishing sector generates about $8.8 million in total output from industry output (sales) of about $6.5 million. About 53 percent of industry output is sold to final demand sectors (personal consumption expenditures, visitor expenditures, and exports) Sharma *et al*. (1999). Estimates of total output are calculated by applying the Type II output to final demand multiplier of 2.38 from Sharma *et al*. (1999) for the "other commercial fishery" sector, to final demand for the commercial troll industry. This commercial troll fishery has a relatively small effect on the Hawai'i economy compared to its sales because of the low portion of sales that are made to final demand sectors. The coefficients used in the input-output model were estimated using the cost and earnings information from Hamilton and Huffman (1997) as well as dealer and supplier surveys (Sharma *et al.,* 1999). The total output estimates do not include "forward linkages" which are the changes in economic outputs of purchasers of fish, such as the fishery distribution and trade sector, and

[27] Part-time jobs are not distinguished from full-time jobs in this analysis.

restaurants and retailers. In the Hawai'i market, where a substantial portion of the local catch is sold through these channels or directly to restaurants and retailers, these forward linked effects could be significant to the extent that the local retailers and restaurants are dependent on the local supply (Sharma *et al.*, 1999).

The commercial troll fishery is not affected by the FMP, except for the condition that commercial boats operating in the EEZ are required to follow state law. Subsequently, boats in the commercial troll fishery are required to report their catch to the State of Hawai'i. Commercial trollers have limited interaction with the longline fleet because the troll fleet usually fishes closer to shore than the 50-mile closure zone (or 25 miles in certain seasons) that is imposed on the longline fleet. The maximum fishing distance from shore reported by trollers in the 1995-1996 survey (Hamilton and Huffman, 1997) was 53.5 miles, so limited interaction is anticipated. The FMP does not preclude the possibility of indirect effects on the commercial troll fishery in the event that longline catches result in localized depletion that might affect commercial troll vessels fishing near the boundary of the closure zone.

3.10.3.2.2 Charter Sport Fishery

This section describes the charter sport fishery of Hawai'i. The charter fishery is primarily a troll fishery focusing on billfish. Charter fishing is a significant activity in Hawai'i. Although the number of participants is uncertain, available information suggests that possibly 100,000 persons paid to engage in charter activities in a 12-month period in 1996-1997,[28] and approximately 77,000 participated in 1990. The Kona Coast of the Island of Hawai'i has a long-standing reputation as a premier location to fish for big blue and black marlin, and charter activity occurs on most of the main islands of Hawai'i. The Island of Hawai'i accounts for the largest share of the entire charter fleet in the state, primarily due to its reputation as the best location to catch blue marlin.

Primary targets are marlin and large yellowfin tuna. Wahoo is another popular target species. Troll fisheries, including charter boats, can produce high-quality *mahimahi* and wahoo that are greatly valued in the marketplace. If handled correctly and iced well, these species bring high prices for charter vessel fish sales. However, tuna caught by charter boats can be subject to the burnt tuna syndrome and consequent reduction in prices. Information on landings and prices paid for fish sold by the charter sport fleet are unavailable because charter sport fleet landings are reported as commercial troll landings. Historical price information for pelagic species landed by commercial troll, handline, and other gear types was provided in Figure 3.10.3.2-4.

[28] Annual reported charter gross revenue of $63,314 (excluding fish sales and mount commissions) from Table 3.10.3-38 divided by the full day shared charter charge of $128.56 (Hamilton, 1998), and multiplied by 199 active charter vessels. While this method may have some avidity bias, the analysts believe the estimate is better than not attempting to develop an estimate more current than 1990.

Big game sportfishing rods and reels are used, with four to six lines trolled at any time with outriggers. Both artificial and natural baits are used. In addition to lures, trollers occasionally use freshly caught skipjack tuna and small yellowfin tuna as live bait to attract marlin, the favored catch for charter vessels, as well as yellowfin tuna. Other baitfish such as bigeye scad, mackerel scad, or strips of skipjack tuna may be used when a school of dolphinfish is encountered.

According to survey respondents in 1996-1997, Hawai'i charter sportfishing vessels range from 20 to 59 feet, and average 40 feet in length. Most were equipped with inboard diesel engines and had accommodations for the crew and up to six passengers. In 1995-1996, there were approximately 199 moored, six-passenger charter fishing vessels operating out of Hawai'i (Hamilton, 1998), with vessels on the Island of Hawai'i accounting for about 65 percent of the entire charter fleet (Figure 3.10.3-25) (Hamilton and Huffman, 1997).[29]

The vessels are chartered for full- or partial-day trips. Trips can be booked exclusively or shared, or specific trips such as tournament trips may be made. The 1996-1997 survey of Hawai'i charter boat operators found that on average, vessels had taken 80 full-day trips, 34 day trips, and 62 half-day trips in the previous 12 months. In addition to fishing charters, the vessels had engaged in about five trips for non-fishing and tournament charters, and 27 trips for recreational and commercial fishing.

Vessels operating from Kaua'i averaged the greatest number of trips per vessel (Figure 3.10.3-26). However, if only charter trips are considered, vessels based at Lahaina (Maui) were the most active (Hamilton and Huffman, 1997).

Charter vessels usually had a crew of two persons, including the captain. Charter vessels fished year-round, focusing on target species that were available during different seasons. According to survey respondents, the vessels typically operated about 7.5 miles from shore, with an average maximum distance from shore of 22.5 miles. The typical fishing distance from the home port was about 24.4 miles (Hamilton, 1998).

The majority of charter participants viewed the activity as one of a number of entertainment-oriented activities to engage in while visiting the state. For a number of participants, the intent was to catch fish, but the experience of being on a boat and spending time on the ocean resulted in a positive experience even if fish were not caught. However, for some individuals the primary motive for traveling to the state and engaging in charter fishing was to catch a giant blue marlin, and these individuals spent large sums in pursuit of

[29] These survey data were collected through a statewide intercept survey at Hawai'i small boat harbors and trailer ramps. Due to personnel limitations, sites were sampled with the intent of intercepting the maximum number of fishers on any given day. Thus there is geographic as well as avidity bias and seasonal bias in the data. It is believed that the survey results presented here provide insight into Hawai'i's small boat fishery and are representative of a large portion of the population. This is especially true of information relating to fixed and variable costs, but less true of data on vessel operations such as number of trips per year.

fish. Their satisfaction with the charter was based solely on the catching and landing of fish (Glazier, 2000; WPRFMC, 1999d; Our Living Oceans 1999 Report *in* NMFS, 2000j).

The residency of charter boat operators and crew was suggested by the distribution of registered charter vessels by island and harbor in which they are homeported. The Island of Hawai'i accounted for almost two-thirds of the active charter boats in 1997, and O'ahu accounted for about 15 percent (Table 3.10.3-34).

The ethnicity of charter boat owners and operators is primarily Caucasian, based on the 1996 -1997 survey. About 58 percent of survey respondents reported their ethnicity as white/Caucasian, with part-Hawaiian respondents accounting for 10.5 percent, the highest percentage after white/Caucasian (Table 3.10.3-35). Information on the particular ethnicity of crew members is not available.

The vast majority of persons involved in the actual fishing operation were males, and a 1996 study reported two females involved as owner/deckhand or as part-owner/operator with her husband. Many females were engaged in other aspects of the industry, such as accounting or marketing, and some businesses staffed booths with women to sell charters to potential customers (Walker, 1997). The average number of workers engaged in shore activities was about 0.5 per vessel (Hamilton, 1998).

Charter boat customers were primarily male (about 85 percent), and most were from the United States, although less than one percent were from Hawai'i (Glazier, 2000).

Figure 3.10.3-25: Estimated Distribution and Number of Active Charter Vessels by Island, 1996-1997. Source: Hamilton, 1998.

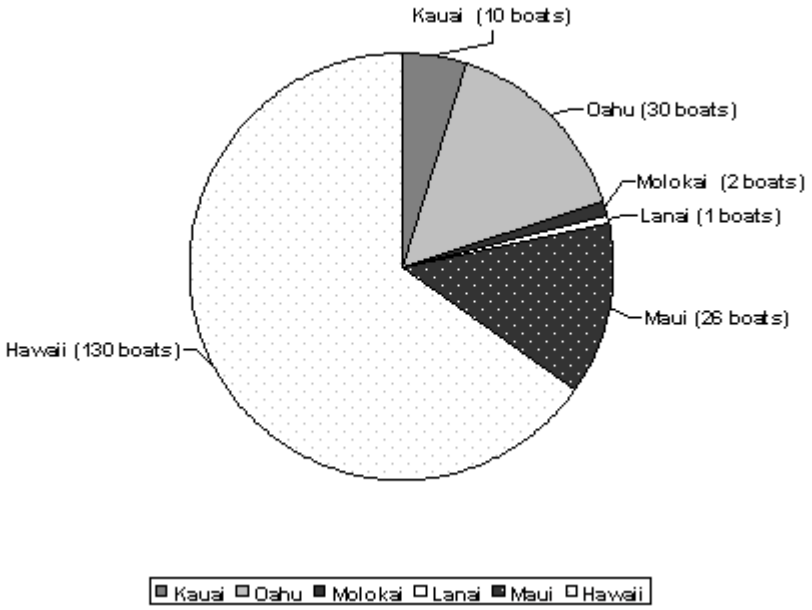


Figure 3.10.3-26: Average Annual Trips by Surveyed Hawai'i Charter Vessels, by Port and Trip Type, 1996-1997. Source: Hamilton and Huffman, 1997.

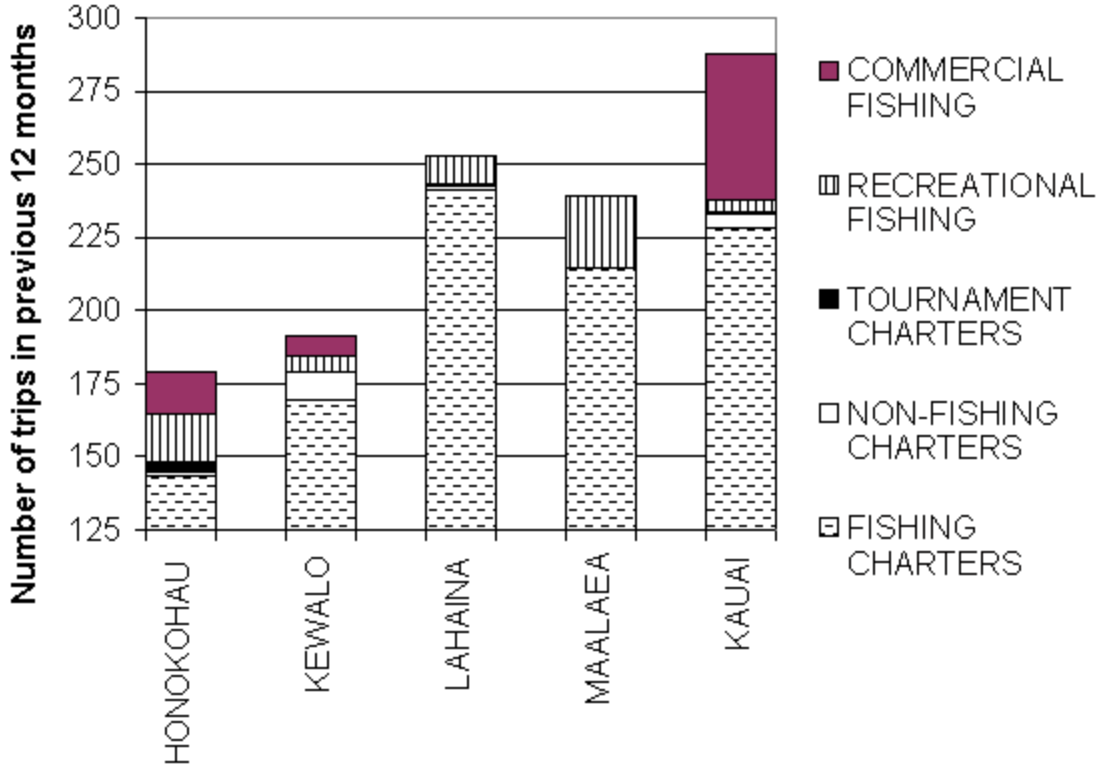


Table 3.10.3-34: Distribution of Active Charter Vessels Across Hawai'i by Island and Harbor, 1997. Source: Glazier, 2000.

Island/Harbor	Active Charter Boats 1997	Percent of Active Charter Fleet
Kaua'i		
Nawiliwili	5	2.5
Port Allen	2	1.0
Other Kaua'i	3	1.5
O'ahu		
Kewalo	19	9.5
Other O'ahu	11	5.5
Moloka'i		
Kaunakakai	1	0.5
Other Moloka'i	1	0.5
Lana'i		
Manele Bay	1	0.5
Maui		
Lahaina	18	9.0
Ma'alaea	6	3.0
Other Maui	2	1.0
Hawai'i		
Honokohau	124	62.3
Other Hawai'i	6	3.0
Total	**199**	**100.0**

Table 3.10.3-35: Ethnicity of Surveyed Charter Vessel Owners and Captains, 1996-1997. Source: Hamilton and Huffman, 1997.

Ethnicity of Respondent	Number of Respondents	Percent of sample
White/Caucasian	33	57.9
Part-Hawaiian	6	10.5
American	5	8.8
European	5	8.8
Portuguese	4	7.0
Japanese	2	3.5
Greek	2	3.5
Other/Missing	2	1.8
Total	**57**	**100.0**

Note: Table 6 of the source document (Hamilton and Huffman, 1997) shows a total of 57, although the number of respondents by category sums to 59. The two responses for Other/Missing shown in Table 6 of the source document would equal 3.5 percent and not 1.8 percent as shown in the original data. This table shows the information reported in the source document, and no attempt has been made to correct the information.

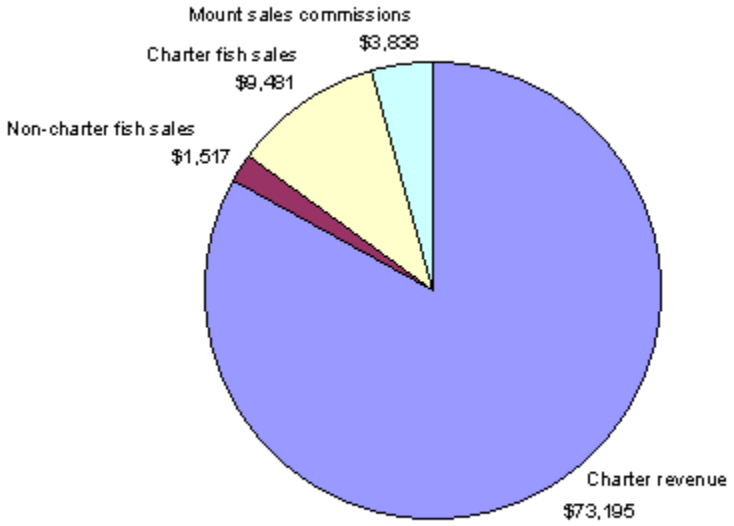
Total landings for the charter fishery in 1993 were estimated at 1,105,000 lb, but species composition is unknown. The total ex-vessel value of these landings was reported as $9.1 million (NMFS, 2000j). However, survey information from Hamilton (1998) suggests that total fish sales in 1996-1997 for each of the 199 charter vessels averaged about $11,000, for a total ex-vessel value of $2.2 million. The reported 1993 estimates may include charter gross revenue as well as fish sales.

The average annual number of pounds of fish reported caught per surveyed charter vessel was 9,272 in 1996-1997. This average suggests total landings of about 1.8 million pounds in that 12-month period. Of the 9,272 average pounds caught per surveyed boat, an average of 6,481 pounds were sold. The remaining fish were given to customers, kept by the captain, crew, and owner for personal consumption, and given to charity, friends, and others. Most fish caught by charter vessels participating in the survey were retained for sale or other use. Over a 12-month period in 1996 and 1997, an average of 13.2 fish were released by each surveyed charter vessel (Hamilton, 1998).

In 1996-1997, sales from charter-caught and non-charter-caught fish were about $11,000 and represented about 12 percent of the $88,031 in annual gross revenues for a typical charter fishing vessel as reported by survey respondents. The majority of charter vessel gross revenues were associated with charges for the exclusive or shared charter of the vessel. Commissions paid for sales of mounts for the caught fish were about four percent of total annual gross revenues, as shown in Figure 3.10.3-27. Gross revenues associated with pelagic charter fishing are estimated at $76,752 per vessel after gross revenues are apportioned according to the ratio of charter fishing trips as a portion of total trips. Costs and earnings for other trip types (for example, commercial, recreational, and non-fishing

trips), would be included in the data for those fishing sectors, or are not part of the costs and earnings associated with pelagic fishing activities.

Figure 3.10.3-27: Composition of Annual Gross Revenues Per Charter Fishing Vessel, 1996-1997. Source: Hamilton, 1998.



Annual charter fishing vessel costs consist of fixed and variable costs. Fixed costs include such items as insurance and moorage or slip costs. Vessels also incur costs for fuel, ice, bait, and food. These costs vary according to the number of trips that the vessel makes during the year. For charter boats, average annual fixed costs associated with pelagic troll fishing are estimated at $33,885 based on survey responses (Table 3.10.3-36), and average annual variable costs for pelagic fishing trips are estimated at $23,916 (Table 3.10.3-37). These variable costs exclude returns to the owner or salary to the vessel captain. Based on survey responses, when an average salary for a captain and the return to the vessel owner is included, the average charter vessel may operate at a loss for the year (Table 3.10.3-38). Depreciation and other tax items could offset this cash flow loss, or the vessel owner may realize lower returns. Nonmonetary returns such as personal use of the vessel, the desire to maintain a certain lifestyle, and other factors may provide the incentive to own and operate a charter vessel.

The total number of active charter sportfishing vessels was estimated at 199 in 1997 (Glazier, 2000), which suggests that about 498 people are employed in the fishery (an average of two persons, one captain and one crew, on the vessel; and 0.5 person onshore).

Table 3.10.3-36: Average Annual Fixed Cost Information for Hawai'i-based Pelagic Charter Vessels, 1996-1997. Source: Hamilton, 1998.

Category	Amount $
Maintenance	5,646
Drydock	6,698
Insurance	4,329
Advertising	4,184
Loans	3,995
Moorage Costs	3,433
Tackle	1,954
Office	2,358
Miscellaneous	1,288
Total Fixed Costs	**33,885**

Notes: Fixed costs apportioned according to ratio of charter fishing trips to total number of trips.

Table 3.10.3-37: Variable Cost Information for Hawai'i Pelagic Charter, 1996-1997. Source: Table developed from data presented in Hamilton, 1998.

Trip Type	Trips per Year	Variable Costs per Trip ($)		Total Cost ($)
		Fuel, Ice, Bait, Food	Crew	
Full day charter	79.8	100	71	13,635
3/4 day charter	33.5	83	53	4,554
Half-day charter	62.5	56	35	5,726
Totals	**202.9**			**23,916**

Notes: Total trips include non-charter trips.

Table 3.10.3-38 is a hypothetical pro forma income statement for a pelagic charter fishing operation in 1996-1997 and was derived from information in Hamilton (1998). This table adjusts charter vessel costs and gross revenues to account for the percent of gross revenues generated by pelagic charter or fish sales, presented for charter vessels. Total payments to labor are difficult to estimate because of the many variations in payment modes that exist, such as salary, trip, commission, and base rate plus commission. In addition, some activities in this fishery are undertaken by friends or family members who are not paid for their labor. Using an average salary of $24,289 for the captain (Table 3.10.3-38), and $9,632 for crew costs (derived from Table 3.10.3-37) results in average payments to labor of about $33,921 per vessel. Tips received by the captain and crew can be substantial, but are not included in this analysis, which focuses on vessel costs and earnings. Payments to labor for shore workers cannot be calculated because data on the percent of trips that are booked through

shore workers are not available, and most paid shore workers are paid on a commission basis per trip sold.

Table 3.10.3-38: Pro Forma Income Statement for Hawai'i Pelagic Charter Vessel, 1996-1997. Source: Developed from data in Hamilton, 1998.

Category	Amount ($)
Income	
Charter gross revenue	63,433
Pelagic charter fish sales	9,481
Commissions on mount sales	3,838
Total gross revenues	76,752
Costs	
Fixed costs	33,885
Variable costs	23,916
Captain's salary	24,289
Total costs	82,090
Net Income	(5,338)

Note: Captain's salary apportioned according to ratio of charter trips to total number of trips.

Charter fishing vessels may operate at a loss, but provide depreciation and other tax benefits to the owners and ensure that the owner has a vessel available for an occasional fishing trip.

Total gross revenues for the pelagic charter fishery, including charter fees and fish sales, are estimated at $15,273,700 for 1996-1997.[30] (Average gross revenue of $76,752 multiplied by 199 charter vessels.)

Total sales for the charter fleet do not take into account that additional employment and income are generated within the state's economy by businesses whose goods and services are purchased by participants in the charter fishing sector, and by businesses that use charter products as inputs for their production of goods and services. People earning incomes directly or indirectly from the fishery also make expenditures within the economy that generate additional employment and income. A more complete assessment of the contribution of the pelagic charter fishery to the state's economy can be obtained by combining the I/O multipliers and other coefficients from Sharma *et al.* (1999) with estimates of total sales from the troll charter fishing sector. Section 3.10.2.2 presents more details on the methodology and describes the coefficients and multipliers.

[30] More recent information on the pelagic charter fishery is not available, so this 12-month period, is used in the following analyses.

The estimated economic contributions of the charter fishery are shown in Table 3.10.3-39. Comparing the information in Table 3.10.3-39 with data for the state's fishing industry in Section 3.10.2.2 shows that the charter fishery accounts for about 13 percent of the output of Hawai'i's fishing fleet and about 26.6 percent of total output (including direct, indirect, and induced output) and 14.5 percent of the labor income generated by the fisheries. The 398 jobs in the charter fishery also account for about 26 percent of total employment in the fishing industry in the state.[31]

Table 3.10.3-39: Estimated Economic Contributions by Hawai'i's Pelagic Charter Fishing Sector. Source: Table 3.10.2-2.

Fishing Sector	Industry Output ($Millions)	Industry Labor Income ($Millions)	Industry Inputs ($Millions)	Jobs	Total Output ($Millions)
Charter	15.27	5.92	8.24	398	39.29

The charter fishing industry generates more than $39 million in total output from industry output of about $15.27 million (about $12.6 million in charter fees and $2.7 million in fish sales and mount commissions). This large total output from charter industry output, in comparison to other commercial fisheries including the longline fishery, is due, in part, to the fact that a substantial portion of total industry output (about 96 percent, according to Sharma *et al.*, 1999) is final demand. In addition, the Type II output to final demand multiplier estimated by Sharma *et al.* for the charter fishing industry is the largest multiplier of the four fisheries (longline, 2.32; other commercial, 2.38; charter, 2.59; and recreational/expense, 2.33). When the large charter industry multiplier is associated with the charter industry's high proportion of final demand to industry output, the result is a relatively large estimate of total output.

The coefficients used in the input-output model were estimated using the cost and earnings information from Hamilton (1998), as well as dealer and supplier surveys (Sharma *et al.*, 1999). The industry output and total output estimates do not include other visitor expenditures such as air fares or hotels. The total output estimates also do not include "forward linkages," which are the changes in economic outputs of fish purchasers such as the fishery distribution and trade sector, restaurants, and retailers. In the Hawai'i market, where a substantial portion of the local catch is sold through these channels or directly to restaurants and retailers, these forward-linked effects could be significant to the extent that the local retailers and restaurants are dependent on the local supply (Sharma *et al.*, 1999).

The charter fishery is not affected by the FMP, except for the condition that commercial boats operating in the EEZ are required to follow state law. Subsequently, boats in the charter fishery are required to report their catch to the State of Hawai'i. Charter vessels have limited interaction with the longline fleet because the charter fleet fishes closer to

[31] Part-time jobs are not distinguished from full-time jobs in this analysis.

shore than the 50-mile closure zone (or 25 miles in certain seasons) that is imposed on the longline fleet. However, charter and other small boat captains "tend to blame the longline fleet for what is perceived to be a diminishing resource base" (Glazier, 2000).

3.10.3.2.3 Recreational and Expense Fisheries

The small boat recreational and expense fishers discussed in this section engage in fishing "with highly varied, mixed, and situation-based motives relating to economic return, subsistence, enjoyment, competition, and self-identification (as fishers)" (Glazier, 1999). This section describes the recreational and expense fisheries that target pelagic species around Hawai'i. In addition to the commercial troll fleet and the charter sport fleet, there is a large fleet of recreational boats that predominantly employ troll gear, some of which sell a portion of their catch to cover expenses (expense boats).

According to research conducted between October 1997 and August 1999, which included a survey of 150 captains of small trolling vessels, these fishers primarily target pelagic species, with *aku* being the most commonly landed fish per trip for small troll vessels (*aku* were landed on 21.9 percent of total trips for small troll vessels). *Ahi* was the second most commonly landed fish (18.2 percent), followed by *mahimahi* (13.9 percent), all marlin species (12 percent), and *ono* (6.6 percent) (Glazier, 1999). Recreational and expense vessels operate primarily as trollers. While some of their fishing methods and other characteristics are similar to those of the commercial troll fleet (Section 3.10.3.2.1), there are substantial differences in equipment, avidity, and catches by surveyed participants compared to commercial fishers.

A 1995-1996 statewide survey of small boat fishers classified 41 percent of respondents as expense fishers ("those who reported that they sold fish only to try and cover expenses rather than as a source of income"), and 28 percent were classified as recreational fishers ("those who did not sell any portion of their catch in the 12 months previous to being surveyed"). The balance were full-time or part-time commercial fishers that fished to generate personal income (Hamilton and Huffman, 1997).[32]

Operators of recreational boats are not required to possess commercial fishing licenses or submit fish catch reports, but their boats must be registered. Operators of expense boats are required to report all of their catch on a monthly basis, whether it is sold or retained for other uses. The data are not broken out according to the motivation of the operator (to generate income, to cover expenses, or recreation only). Some individuals that sell a portion

[32] These survey data were collected through a statewide intercept survey at Hawai'i small boat harbors and trailer ramps. Due to personnel limitations, sites were sampled with the intent of intercepting the maximum number of fishers on any given day. Thus there is geographic as well as avidity bias and seasonal bias in the data. It is believed that the survey results presented here provide insight into Hawai'i's small boat fishery and are representative of a large portion of the population. This is especially true of information relating to fixed and variable costs, but less true of data on vessel operations such as number of trips per year.

of their catch consider themselves recreational fishers and may or may not have a commercial fishing license (Hamilton and Huffman, 1997). In addition, some fishers may sell large quantities of fish without holding a commercial fishing license or without filing catch reports (Hamilton and Huffman, 1997; Glazier, 1999). These circumstances make it difficult to evaluate the reliability of reported commercial catch data. The absence of reporting requirements for recreational vessels also makes it difficult to provide reliable information for those vessels.

A reliable estimate of the number of recreational and expense boats engaged in pelagic fishing is not available. However, there are data that indicate the potential number of boats engaged in these fisheries. In 1998 there were an estimated 15,138 state-registered vessels in Hawai'i, with 7,549 boats in the 16- to 40-foot range. Boats smaller than 16 feet can also engage in pelagic fishing, but larger boats have better seagoing capability and fuel capacity, which can result in more trips per vessel. More than 11,000 of the 15,138 state-registered vessels are kept on land and trailered to launching sites for fishing trips (Glazier, 1999). Pan *et al*. (1998) estimated the total number of recreational boats at 2,490 based on an earlier study (Skillman and Louie, 1984), and the number of expense boats at 952 based on 1993 HDAR data (Sharma, 1999).

The vessel registration data also provide an indication of the residency of recreational and expense fishers. In 1998, 9,568 of the 15,138 state-registered vessels were registered on O'ahu. Hawai'i had 2,235 registered boats, while Kaua'i (1,552) and Maui (1,509) had approximately the same number of registered vessels. Moloka'i (182) and Lana'i (92) had substantially fewer registered vessels (Glazier, 1999).

The particular ethnicity of recreational and expense fishers is suggested by a 1996 survey of the Hawai'i small boat fleet (Hamilton and Huffman, 1997), which is summarized in the troll fishery discussion (Section 3.10.3.2.1).

Activity by the small boat fleet increases or decreases according to the presence of targeted fish species. Almost 60 percent of vessel captains interviewed in 1996 reported that they fished year-round, but 36 percent reported that they fished only during summer months, when the peak of the *ahi* bite occurs (Glazier, 1999). The boats concentrate their activities around FADs or around flotsam.

In addition to the value of the fish that are sold or kept and consumed for personal use, recreational and expense fishing activities have value that is not captured by the fish sales in the marketplace or the value of the fish consumed. The experience of a day on the ocean has value. The non-market value of recreational fishing is discussed in Section 3.10.2.4, Valuation of Environmental Goods.

The following paragraphs provide additional information on expense boats, followed by recreational boats.

Expense Boats

In 1995-1996, the average length of pelagic expense boats surveyed was 23 feet. For the 12 months before the survey, the average number of fishing trips per vessel was approximately 56, and an average of about 53 (94 percent) of these trips were commercial (led to sale of fish). Recreational trips made up the balance (three trips and six percent). Slightly more than 38 trips (68 percent) were commercial troll trips, with commercial bottomfish accounting for five trips (about ten percent of total fishing trips). The remaining commercial fishing trips were distributed among the other fishing categories (Hamilton and Huffman, 1997).

Expense boats had an average crew size of about 2.3 persons, including the captain. The usual fishing distance from shore ranged from 2.47 to 23.55 miles, with a mean of 16.9 miles. The maximum distance reported was 50 miles.

Survey respondents caught an average of 3,737 pounds in 1995-1996, with pelagic species accounting for 3,234 pounds. Respondents sold a total of 2,242 pounds, including 1,987 pounds of pelagic species. Total sales gross revenues for respondents averaged $4,131 for all species (Hamilton and Huffman, 1997). Information on catch or sales by species are not available for this vessel category, although commercial catch information would be included by troll gear or other gear types that are used by these vessels.

Total annual expenditures for survey respondents with expense vessels averaged $6,695 in 1995-1996. This amount is the sum of fixed costs associated with pelagic fishing (Table 3.10.3-40) and trip costs (Table 3.10.3-41), multiplied by the average number of pelagic fishing trips in a year. According to the survey data, annual costs exceeded annual fish sales income by $2,564 for these vessels.

Table 3.10.3-40: Average Annual Fixed Costs, Expense Pelagic Vessel, 1995-1996. Source: Hamilton and Huffman, 1997.

Cost Item	Amount ($)
Insurance	259
Loan Payments	369
Maintenance and Repairs	1,046
Fishing Gear	628
Ramp, License, and Registration Fees	55
Miscellaneous	91
Total	**2,448**

Note: Fixed costs are apportioned to pelagic fishing according to ratio of pelagic fishing trips to total number of trips.

Table 3.10.3-41: Average Trip Costs, Expense Pelagic Vessel 1995-1996. Source: Hamilton and Huffman, 1997.

Cost Item	Amount ($)
Ice	15
Boat fuel	58
Bait	7
Food	16
Truck fuel	10
Miscellaneous	0
Total	**107**

Recreational Boats

In 1995-1996, the average length of pelagic recreational boats surveyed was 21 feet. For the 12 months before the survey, the average number of recreational fishing trips per boat was approximately 31, and about 25 (79 percent) of these trips involved troll fishing. Small boats can use a variety of fishing techniques and pursue a number of different target species. For example, the average for bottomfishing trips was slightly more than three trips (almost eleven percent), and the average for reef fishing trips was approximately two trips (seven percent). The remaining recreational fishing trips were distributed among the pelagic handline, other gear, and *akule/opelu* fisheries. Bottomfish and *akule/opelu* are not pelagic species and are caught with quite different techniques.

Recreational boats reportedly had an average crew size of about 2.5 persons, including the captain. The usual fishing distance from shore ranged from approximately 5.5 to 15.8 miles, with a mean distance from shore of about nine miles. The maximum distance reported for recreational boats was 30.4 miles. Survey respondents caught an average of 1,060 pounds in 1995-1996, although skill differences among fishers can result in substantial differences in catch for recreational boats. Pelagic species accounted for 860 pounds of this total (Hamilton and Huffman, 1997). Information on catch by species is not available for this vessel category, and by definition this category did not sell any fish during the 12 months prior to the survey.

Total annual expenditures for survey respondents with recreational vessels averaged $6,284 in 1995-1996. This amount is the sum of fixed costs (Table 3.10.3-42), and trip costs (Table 3.10.3-43) multiplied by the average number of fishing trips in a year.

Table 3.10.3-42: Average Annual Fixed Costs, Recreational Pelagic Vessel. Source: Hamilton and Huffman, 1997.

Cost Item	Amount ($)
Insurance	215
Loan Payments	266
Maintenance and Repairs	842
Fishing Gear	423
Ramp, License, and Registration Fees	57
Miscellaneous	15
Total	**1,819**

Note: Fixed costs apportioned to pelagic fishing according to ratio of pelagic fishing trips to total number of trips.

Table 3.10.3-43: Average Trip Costs, Recreational Pelagic Vessel. Source: Hamilton and Huffman, 1997.

Cost Item	Amount ($)
Ice	13
Boat fuel	80
Bait	3
Food	18
Truck fuel	13
Miscellaneous	0
Total	**127**

The economic impact of the combined recreational and expense fleets is a function of the total expenditures and sales by the two sectors, plus indirect and induced effects from the subsequent spending of these amounts throughout the regional economy. The direct effect is estimated at approximately $18,418,000 for 1995-1996 (Table 3.10.3-44). This estimate is based on procedures described in WPRFMC (2000e) and information in Hamilton and Huffman (1997) and Sharma *et al.* (1999).

Table 3.10.3-44: Estimated Total Expenditures and Sales for Recreational and Expense Troll Fleets, 1995-1996. Source: Hamilton and Huffman, 1997; Sharma, 1999.

Average vessel costs and gross revenues	Amount ($)	
	Recreational	**Expense**
Number of pelagic fishing trips	25.2	39.8
Trip costs	127	106
Fixed costs	1,819	2,447
Pelagic fish sales	0	4,131
Subtotal	4,461	7,678
Fleet size (No. of vessels)	2,490	952
Total by fleet	11,108,388	7,309,517
Total (Recreational and Expense)	**18,417,905**	

The total expenditures and sales for the recreational and expense fleets do not account for the additional employment and income generated within the state's economy by businesses whose goods and services are purchased by participants in this fishery sector, and by businesses that use products from this sector as inputs for their production of goods and services. People earning incomes directly or indirectly from the fishery also make expenditures within the economy that generate additional employment and income.

A more complete assessment of the contribution of the pelagic recreational and expense fishery to the state's economy can be obtained by combining the I/O multipliers and other coefficients from Sharma *et al.* (1999b) with estimates of total sales (or expenditures in the case of recreational and expense boats) from the various fishing sectors. Section 3.10.2.2 presents more details on methodology and describes the coefficients and multipliers.

The estimated economic contributions of the recreational and expense fishery for 1998 are shown in Table 3.10.3-45. Comparing the information in Table 3.10.3-45 with data for the state's fishing industry in Section 3.10.2.2 shows that the recreational and expense fishery accounts for slightly less than 30 percent of output of Hawai'i's fishing fleet and about 29 percent of total output (including direct, indirect and induced outputs) generated by the fisheries.

Table 3.10.3-45: Estimated Economic Contributions by Hawai'i's Pelagic Fishing Sectors, 1998. Source: Table 3.10.2-2.

Fishing Sector	**Industry Output** ($Millions)	**Industry Inputs** ($Millions)	**Total Output** ($Millions)
Recreational/Expense	18.87	14.84	42.39

The recreational/expense fishing sector generates more than $42 million in total output from industry output of about $18.87 million. Most of this industry output represents personal consumption expenditures by participants in the fishery. This relatively large total output from the recreational/expense sector industry output, in comparison to the longline and other commercial fishery sectors, is due, in part, to the fact that a substantial portion of total industry output (about 88 percent, according to Sharma, 1999) is final demand. In addition, the Type II output to final demand multiplier estimated by Sharma *et al.* for the recreational/expense fishing sector (2.33) is comparable to the multipliers for the longline (2.32) and other commercial fishery sectors (2.38). As discussed previously, the charter fishery multiplier is the largest among the four fishing industry sectors. When the recreational/expense multiplier is associated with that sector's high proportion of final demand to industry output, the result is a relatively large estimate of total output.

The coefficients used in the input-output model were estimated using the cost and earnings information from Hamilton and Huffman (1997), as well as dealer and supplier surveys (Sharma *et al.*, 1999b). The total output estimates do not include "forward linkages" which are the changes in economic outputs of purchasers of fish, such as the fishery distribution and trade sector, restaurants, and retailers. In the Hawai'i market, where a substantial portion of the local catch is sold through distribution channels or directly to restaurants and retailers, these forward-linked effects could be significant to the extent that the local retailers and restaurants are dependent on the local supply (Sharma, 1999).

The recreational and expense fisheries are not affected by the Pelagics FMP, except that commercial boats operating in the EEZ are required to follow state law. Subsequently, expense boats are required to report their catch to the State of Hawai'i. Recreational and expense boats have limited interaction with the longline fleet because the recreational and expense boats fish closer to shore than the 50 mile (or 25 miles in certain seasons) closure zone that is imposed on the longline fleet. The usual fishing distance for recreational and expense boats is about 12 to 17 miles from shore, with the maximum fishing distance from shore reported as 32.5 miles. As a result, there is limited direct interaction with the longline fleet. However, small boat captains perceive declines in the pelagic resource base and blame the longline fleet for this change (Glazier, 2000).

3.10.3.3 Hawai'i-based Handline Fisheries

This section describes the pelagic handline fishery for Hawai'i. Handline fishing is an ancient technique used to catch yellowfin and bigeye tunas with simple gear and small boats. The technique was developed by Polynesians and Micronesians living on atolls and small islands (WPRFMC, 1995). Handline gear are set below the surface to catch relatively small quantities of large, deep-swimming tuna that are suitable for *sashimi* markets. This fishery continues in isolated areas of the Pacific, and is the basis of an important commercial fishery in Hawai'i (WPRFMC, 1995). Three types of pelagic handline fishing methods are practiced

in Hawai'i, the *ika-shibi* (nighttime) method, the *palu-ahi* (daytime) method, and seamount fishing and weather buoy fishing (which uses both handline and troll methods).[33]

A wide variety of pelagic fish are caught in both the day and night handline fisheries, but the composition of the handline catch is almost exclusively tuna, with yellowfin tuna predominating. Non-tuna species make up less than ten percent of the catch (Hamilton and Huffman, 1997).

The Hawai'i-based handline fishery has nearshore and offshore components. The nearshore fishery targets large yellowfin and bigeye tunas. Nearshore areas have public sector supported fish aggregating device (FAD) systems. The offshore fishery targets juvenile bigeye and yellowfin tuna around seamounts and weather buoys that are 50 to 320 km (35 to 200 nm) from shore (WPRFMC, 1995). Some of the larger vessels are able to fish near sea mounts and weather buoys located 100 to 200 nm from shore. These vessels use a combination of handline and troll gear and have trip lengths averaging five days (NMFS and WPRFMC, 2000).

Handline fishers are able to hook and quickly land tuna, and are capable of producing extremely fresh tuna that play a significant role in supply. However, the fishery has been plagued by a condition known as "burnt tuna syndrome," which is potentially related to the fish struggling on the line, elevating the fish's body temperature. The syndrome may also be related to inadequate handling(bleeding, gutting, and chilling). Burnt (discolored and/or soft) tuna has a reduced shelflife and limited market options. This problem, however, is not unique to the handline fishery.

The three handline methods for which information is available are *palu-ahi* (chum-tuna), *ika-shibi* (squid-tuna), and seamount fishing. Offshore vessels fishing at seamounts use handline gear in addition to doing some trolling. The *ika-shibi* or night handline fishery developed from a squid (*ika*) fishery that switched to targeting the incidental catch of tuna (*shibi*). The *ika-shibi* fishery is known to yield larger, higher-quality fish than can be provided by either the *palu-ahi* or troll fisheries.

Although handline vessels use more than one gear type, operations appear to be relatively specialized, with at least 80 percent of trips reported in a 1995-1996 survey attributed to the predominant gear type. *Palu-ahi* vessels took the most trips, but this statistic is undoubtedly attributable to both the seasonality of the *ika-shibi* fishery (approximately five months) and the length of trips to the seamounts (average of 4.87 days).

[33] According to a recent study, the 1990 ex-vessel value of Hawai'i's commercial fishing industry as a whole totaled $50 million, which represented less than one percent of Hawai'i's gross state product. Of this, approximately 60 percent was derived from longlining operations, 15 percent from troll and pelagic handline operations, and the remaining 25 percent from *aku*, albacore, bottomfish, lobster, and other gear types combined (Pooley, 1993).

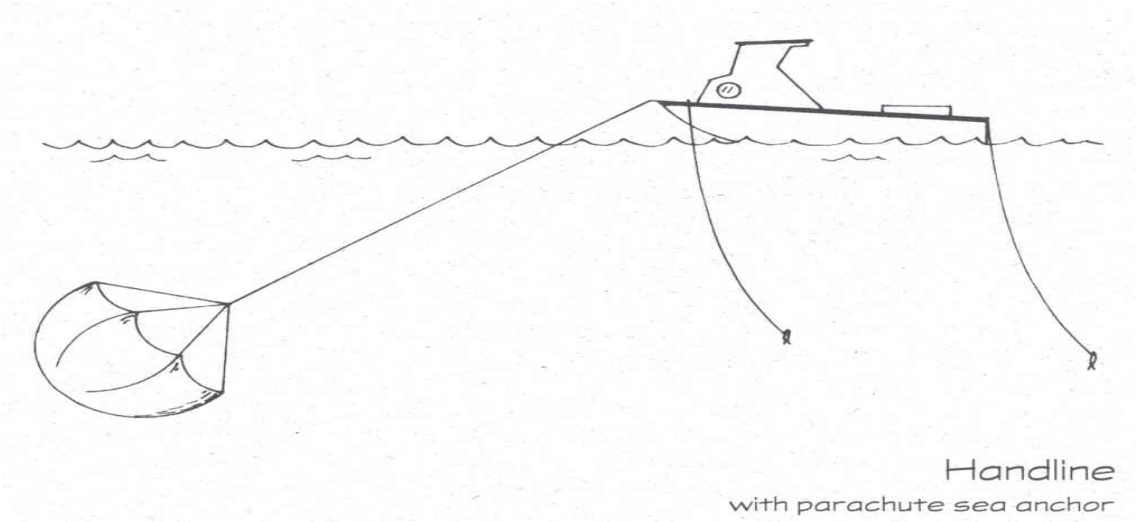
According to survey respondents, *ika-shibi* and seamount vessels are larger on average than *palu-ahi* vessels, and are associated with higher levels of investment. Because of their larger size, longer trips and larger catches are possible. Most vessels were reportedly powered by gasoline outboard or inboard/outboard engines. However, some larger vessels had diesel-powered units (Hamilton and Huffman, 1997).

The full- and part-time commercial boats engaged in the nearshore fishery are about seven to ten meters in length (23 to 33 ft). In comparison, the mostly full-time commercial offshore handline boats are about 10 to 17 meters in length (33 to 56 ft) (WPRFMC, 1995). In 1995-1996 the average vessel length was six meters (20.2 ft) for *palu-ahi* vessels, eight meters (26.65 ft) for *ika-shibi* vessels, and 12 meters (40.17 ft) for seamount vessels (Hamilton and Huffman, 1997).

Surveys indicate that the *ika-shibi* fishery grew from 30 to 40 boats in 1976 to at least 230 boats by 1980 (Yuen, 1979). In recent years some of the smaller longline vessels and larger commercial troll vessels have also engaged in handline fishing (NMFS, 2000j).

When the fishing area is reached, a parachute sea anchor is deployed to slow the vessel's drift while the fishermen engage in fishing. Figure 3.10.3-28 illustrates a simple handline vessel using a parachute-type anchor.

Figure 3.10.3-28: Sketch of Handline Vessel. Source: WPRFMC, 1995.



In the nighttime *ika-shibi* fishery, three to four handline sets, each consisting of a long nylon rope, are connected to a dacron or polypropylene mainline attached to a monofilament nylon leader. The hook is usually baited with mackerel scad, and is lowered with a lead

weight. To attract baitfish and tuna, a low-wattage light bulb is placed in the water, and the surface is chummed with chopped squid and/or chopped anchovies (WPRFMC, 1995).

The daytime *palu-ahi* technique adds a weighted, retrievable bag stuffed with chum that is released at a depth of 120 to 140 meters (400 to 650 ft) to attract tuna to the baited hook. When a fish is hooked, it is manually hauled in, gaffed and then killed with a bullet or wooden bat. Once the fish is onboard, fishers may bleed it and remove its head and viscera, and then place the fish in a mixture of ice and saltwater 'brining'. These handling methods help to quickly cool the flesh (WPRFMC, 1995).

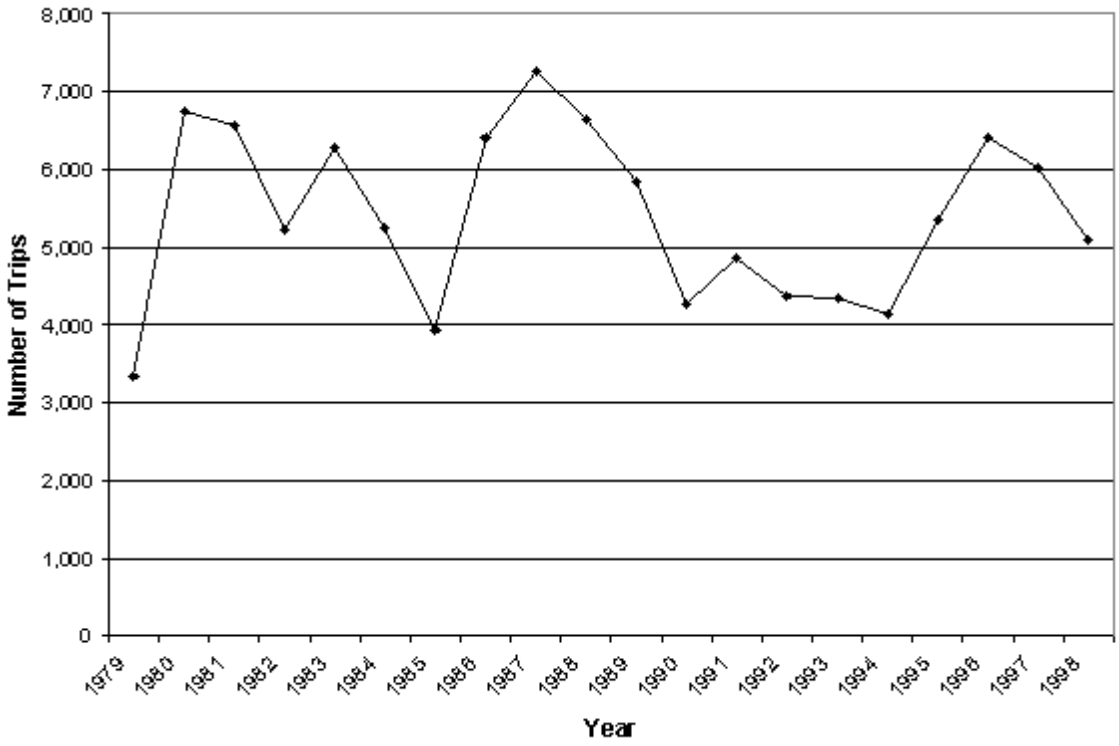
According to respondents, a nearshore handline trip usually lasts one-two days, while an offshore trip may last one-five days (WPRFMC, 1995). For the *ika-shibi* fishery, the average trip length during 1995-1996 was one day, while fishing between five and 6.5 miles from shore. Longer trips were between 11 and 14 miles from shore. The average reported trip length for the *palu-ahi* vessels during 1995-1996 was 1.25 days. Seamount trips were typically longer and averaged 4.87 days during 1995-1996. Fishing usually took place within 6.5 miles of shore, with most trips lasting about 1.5 to 2.5 days (Hamilton and Huffman, 1997).

Survey respondents on *palu-ahi* and *ika-shibi* vessels fished with a crew of one to two persons fishing two to three lines; seamount vessels typically fished with three to four crew members. In 1995-1996, the average number of crew (including the captain) was 1.61 persons on a *palu-ahi* vessel, 1.72 persons on an *ika-shibi* vessel, and 3.35 persons on a seamount vessel (Hamilton and Huffman, 1997).

After a period in the late-1980s to mid-1990s with a low number of commercial handline trips, the number of commercial handline trips increased in 1996 and 1997. Figure 3.10.3-29 illustrates that although the number of trips dropped by 16 percent in 1998, it remained within range of the number of trips conducted since 1979 (WPRFMC, 1998). A total of 5,091 commercial handline trips were reported in 1998, down 16 percent from 1997.

To estimate the average number of days per year fished, the average number of trips reported by respondents for each type of handline vessel was multiplied by the average duration of a fishing trip from a 1996 survey of Hawai'i's small boat fisheries. Table 3.10.3-46 illustrates that an estimated 267 days per year are fished by *palu-ahi* vessels, 120 days per year are fished by *ika-shibi* vessels, and 189 days per year are fished by seamount vessels (sample sizes of three, ten, and six, respectively) (Hamilton and Huffman, 1997).

Figure 3.10.3-29: Hawai'i Commercial Pelagic Trips by Handline Gear, 1979-1998. Source: WPRFMC, 1999d.



Note: Data were compiled from HDAR commercial catch reports (preliminary as of May 1999) using unique license number-date combinations for species caught > 0 (zero-catch trips are not included). 1997 data were updated with more complete data available in 1999. Non-commercial data are not available (WPRFMC, 1999d).

Table 3.10.3-46: Estimated Average Number of Days Fished per Year, by Gear Type, 1995-1996. Source: Hamiton and Huffman, 1997.

Gear Type	Average Number of Trips	Length of Trip (Days)	Estimated Average Days Fished per Year
Palu-Ahi (n=3)	213.57	1.25	267
Ika-Shibi (n=10)	119.9	1.0	120
Seamount (n=6)	38.83	4.87	189

Note: Caution should be used in extrapolating these data because of the small sample sizes.

Section 3.11 discusses in detail the human environment in terms of linkages among the economic activity of fishing itself and the regions and communities involved in fishing. Figure 3.11-8 in Section 3.11 indicates that most handline fishers reside on eastern Kaua'i (near the urban center) and on the eastern side of the Island of Hawai'i.

The particular ethnicity of participants, vessel owners and operators as well as crew, is relatively unknown. A survey of commercial and recreational boat owners and captains in Hawai'i's small boat fleet (which includes trolling, reef, bottom and other types of fishing) conducted in 1996 found that:

> "The overall distribution of survey participants' ethnicities is similar to that found in Hawai'i's statewide population by the Hawai'i Department of Health in 1992 (the most recent year for which data is available) in that the three most common ethnicities are Caucasian, Japanese, and Mixed with part-Hawaiian. Differences exist in the ranking and proportions of these groups. Census records reveal that Caucasians comprise 23 percent of our state's population, Japanese 20 percent, and Mixed with part-Hawaiian 19 percent. In our sample, Japanese represent 33 percent, followed by part-Hawaiians at 16 percent, and Caucasians at 12 percent. These variations between Hawai'i's total population and our sample seem in accordance with expectation of a greater identification with the sea by Japanese and Hawaiians" (Hamilton and Huffman, 1997).

This provides a general idea of the ethnicity of the fishers, but the survey included all of Hawai'i's small boat fisheries. It is therefore difficult to identify the particular ethnicity of handline fishers.

The composition of the handline catch is almost exclusively tuna, with yellowfin tuna predominating. Non-tuna species make up less than ten percent of the catch. Hawai'i commercial handline boats (Hawai'i does not collect recreational fishing data) reported total tuna catches of 998,000 pounds in 1998, down 26 percent from 1997. Yellowfin tuna comprised 82 percent of this total, albacore tuna 14 percent, and skipjack tuna three percent. However, both yellowfin and bigeye tuna share the Hawaiian name *ahi* and are often combined in reports (Boggs and Ito, 1993 *in* NMFS document in progress).

Since 1948, the number of landings by vessels using troll/handline gear has increased, *aku* boat landings have decreased, and longline landings have shown dramatic increases, especially since the mid-1980s (see Figure 3.10.3-30). Figure 3.10.3-31 shows the trend over the last 50 years of Hawai'i pelagic commercial fishing landings, by gear type. Figure 3.10.3-32 shows that in 1997 and 1998 the MHI handline catch was down for albacore and yellowfin tuna (the mainstays of the fishery) (WPRFMC, 1999d).

Figure 3.10.3-30: Hawai'i Commercial Pelagic Landings by Major Gear Types, 1948 - Present. Source: Ito and Machado, 1999; WPRFMC, 1999d.

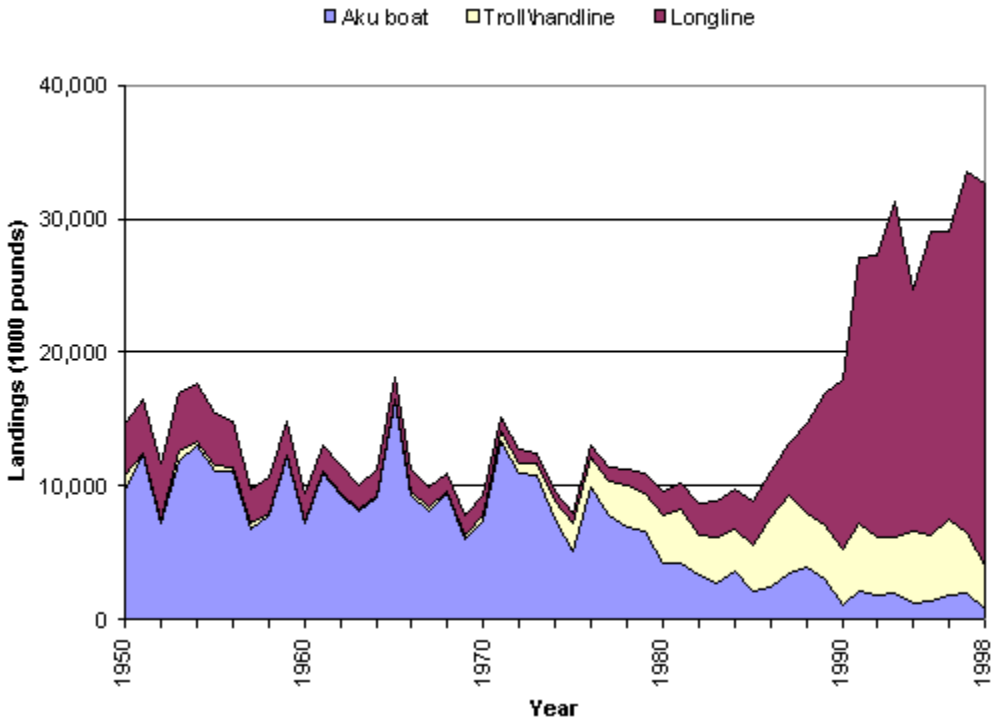


Figure 3.10.3-31: Hawai'i Commercial Fishing Landings of Pelagic Species by Gear Type, 1948 - Present. Source: WPRFMC, 1999d.

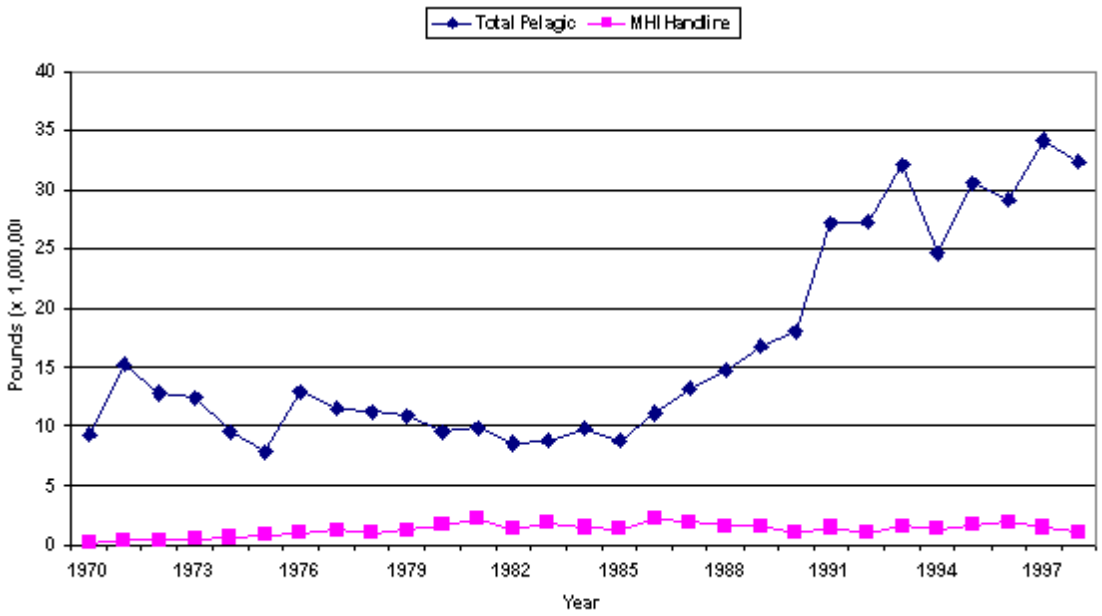


Figure 3.10.3-32: Main Hawai'i Islands Handline Catch (Excluding distant seamounts): Major Species, 1987-1998. Source: WPRFMC, 1999d.

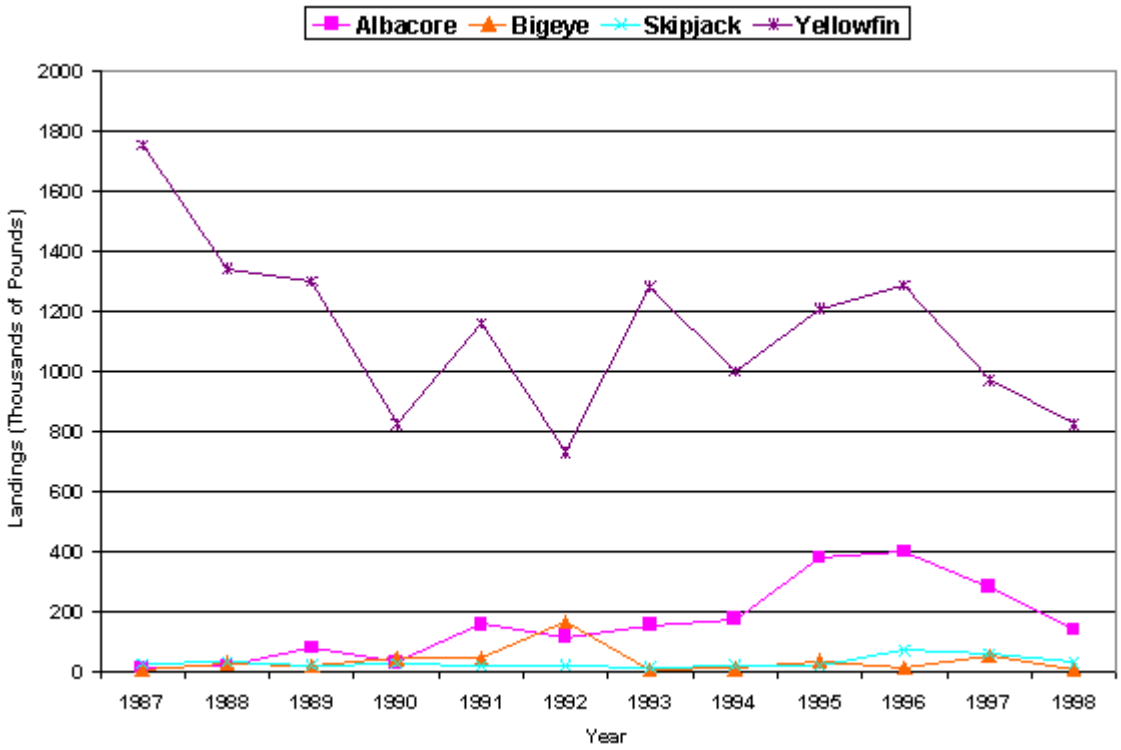


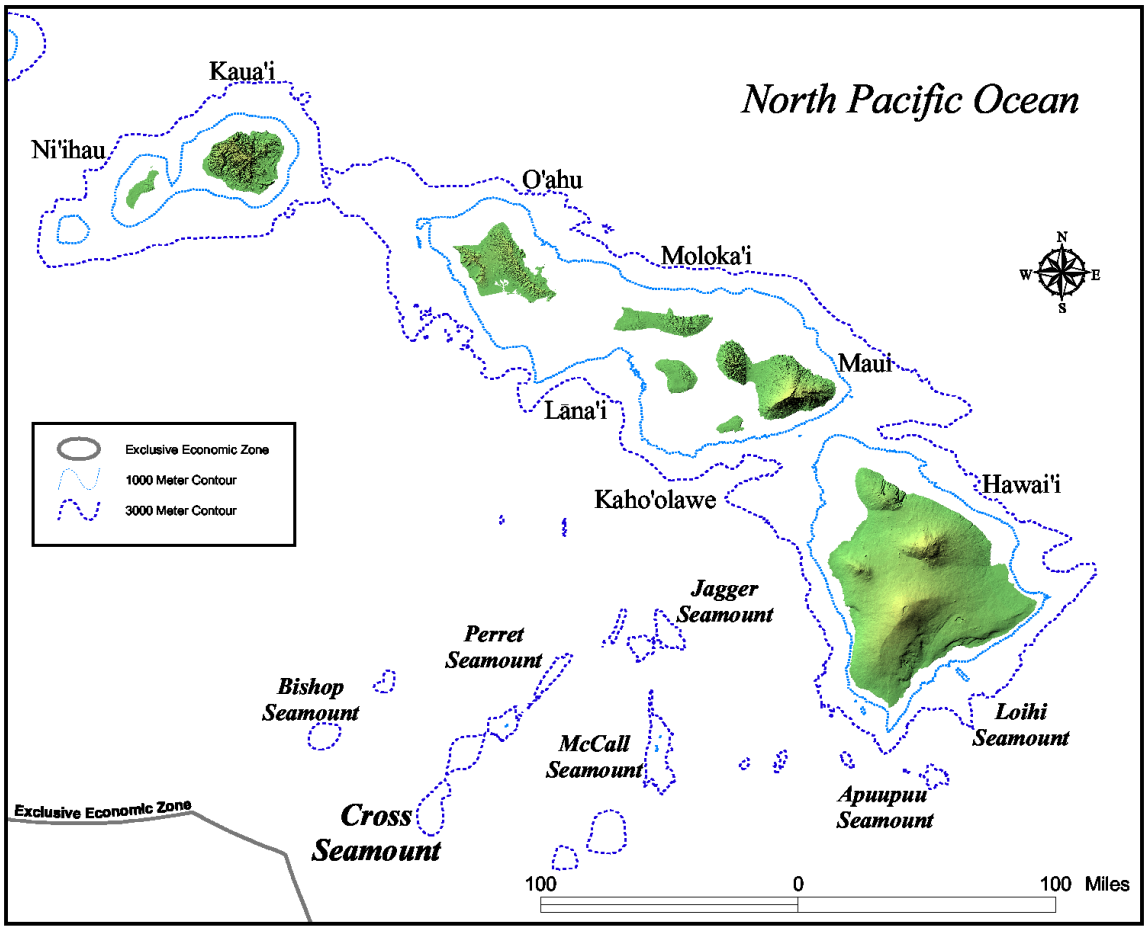
Table 3.10.3-47: Main Hawai'i Islands Handline Catch (Excluding Distant Seamounts) – Major Species, 1987-98. Source: WPRFMC, 1999d.

Year	MHI Handline (Thousands of Pounds Caught)					
	Albacore	**Bigeye**	**Skipjack**	**Yellowfin**	**Other Tuna**	**Total Tuna**
1987	12	6	25	1,750	5	1,798
1988	19	28	31	1,341	11	1,430
1989	77	19	20	1,297	7	1,420
1990	29	42	26	822	6	925
1991	156	45	19	1,158	9	1,386
1992	115	164	21	728	0	1,028
1993	154	2	13	1,280	0	1,449
1994	175	10	21	999	0	1,205
1995	378	33	17	1,207	0	1,635
1996	399	11	70	1,284	0	1,764
1997	280	52	57	969	0	1,358
1998	138	8	30	823	0	999

Note: Data were compiled by NMFS staff from HDAR commercial catch reports (data for 1997 are extrapolated from preliminary reports). These data reflect the various handline gear codes in the state data, for fishing within the MHI. The more distant offshore seamounts (e.g., Cross) are excluded. However, other offshore seamounts (e.g., Jagger) are included, based on the HDAR area code determinations (area codes less than 1,000) (WPRFMC, 1999d).

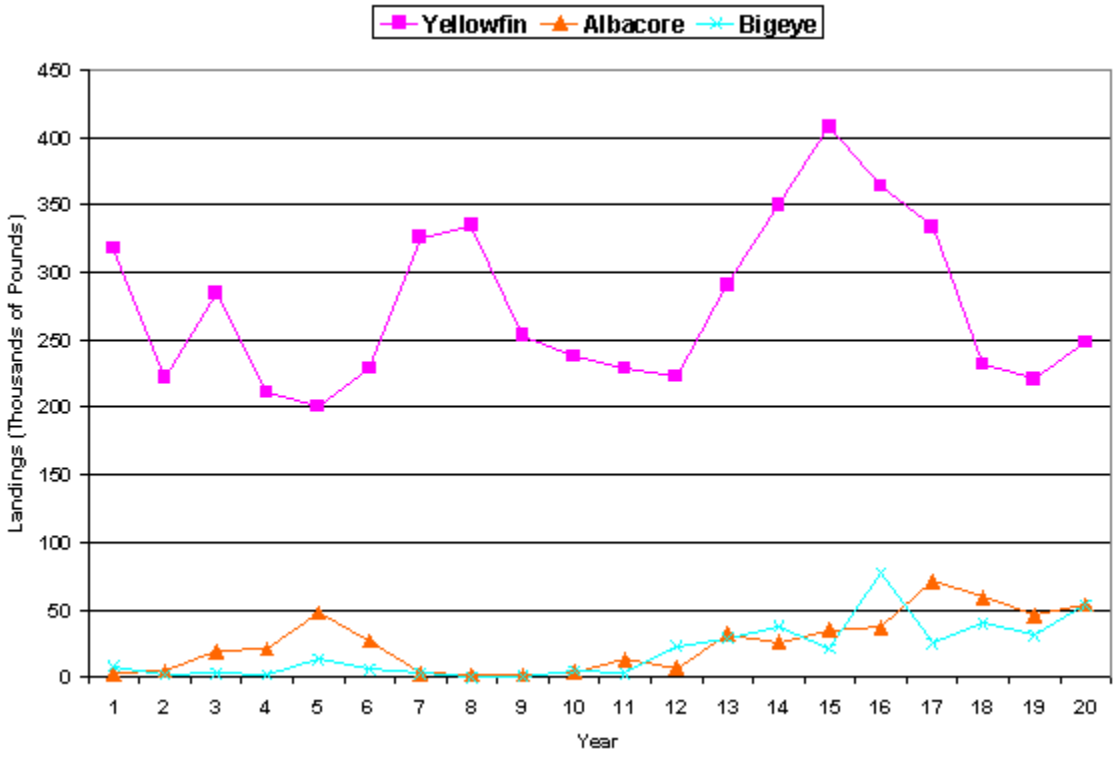
The more distant offshore seamounts are excluded from the above figure and table. Cross Seamount and several other seamounts are shown in Figure 3.10.3-33.

Figure 3.10.3-33: Hawai'i's Cross Seamount, Other Seamounts, and Depths.



The catch rates (catch per trip) for the three tuna species rose significantly from 1997 to 1998, as shown in Figure 3.10.3-34. The yellowfin tuna catch rate remained within the long-term average, while albacore and bigeye were well above the long-term averages. (WPRFMC, 1999d).

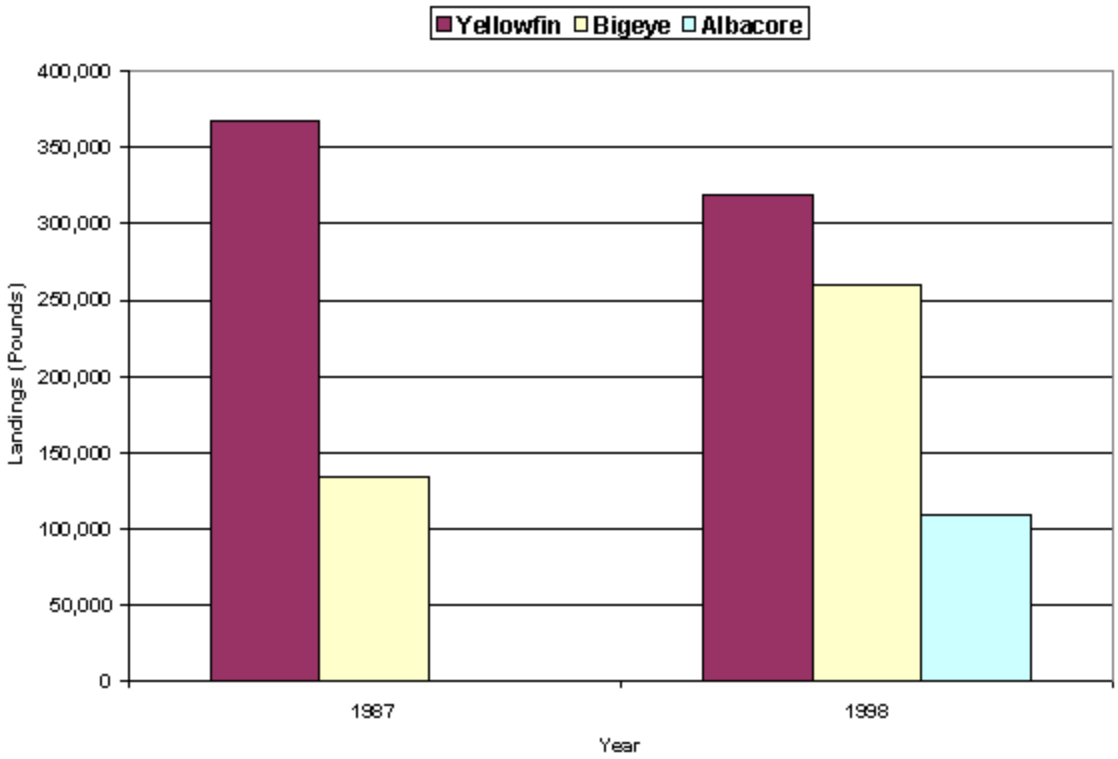
Figure 3.10.3-34: Combined Commercial Handline Catch per Trip: Yellowfin, Albacore and Bigeye Tuna, 1979-1998. Source: WPRFMC, 1999d.



Note: Data compiled from HDAR commercial catch reports (preliminary as of May 1999) using unique license number-date combinations for species caught > 0 (zero catch trips are not included). Data are combined from reported *ika-shibi*, *palu-ahi*, and drifting handline fishing from all areas. 1997 data were updated with more complete data available in 1999. Non-commercial data are not available (WPRFMC, 1999d).

Landings of major species by the offshore tuna handline fleet in 1997-1998 are shown in Figure 3.10.3-35. Table 3.10.3-48 also shows the number of trips reported, catch rates, and the percent contribution of offshore handline landings to the total handline landings. The handline fleet that fishes on offshore seamounts makes most of the reported bigeye landings and significant proportions of the total yellowfin and albacore landings of the combined tuna handline fleet. Their catch rates are also higher, although these are based on multi-day trips and cannot be directly compared to the nearshore fleet. Part of the reported yellowfin landings may actually be bigeye, due to species misidentification. Observers have reported that most of the small tuna landed are actually bigeye (WPRFMC, 1999d).

Figure 3.10.3-35: Offshore Tuna Handline Landings. Source: WPRFMC, 1999d.



Note: Offshore handliners use a combination of methods to catch fish, not strictly limited to the classic *ika-shibi* or *palu-ahi* methods used in areas closer to the islands. Data were compiled from HDAR commercial catch reports (preliminary as of May 1999) using unique license number-date combinations for species caught > 0 (zero-catch trips are not included). These data are a subset of the combined tuna handline data reported earlier. Data are combined from reported *ika-shibi, palu-ahi,* and drifting handline methods for HDAR fishery statistical areas 15217 (NOAA weather buoy 4), 15717 (W2), 15818 (Cross Seamount), 16019 (W3) and 16223 (W1). 1997 data were updated with more complete data available in 1999. Non-commercial data are not available (WPRFMC, 1999d).

Table 3.10.3-48: Number of Trips Reported, Catch Rates, and the Percent Contribution of Offshore Handline Landings. Source: WPRFMC, 1999d.

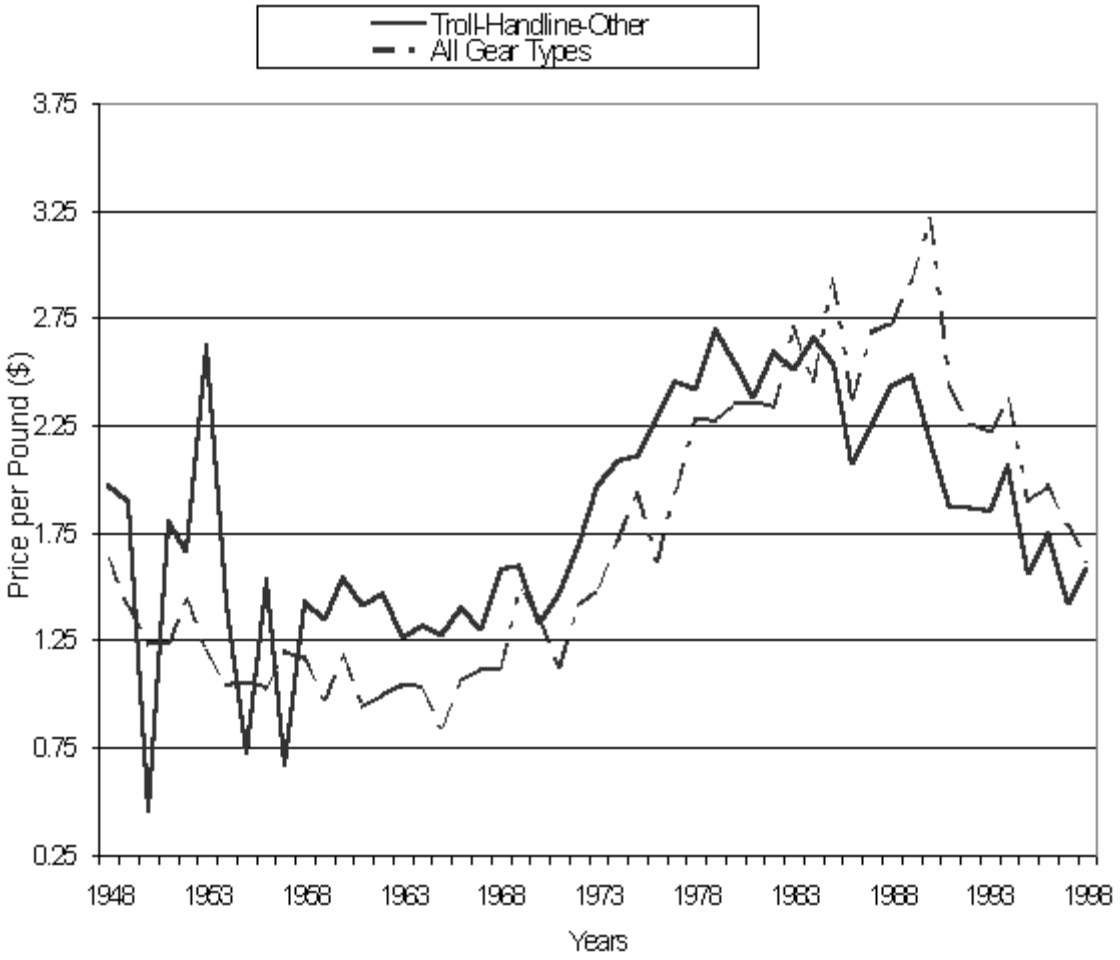
Year	Trips	Yellowfin			Bigeye			Albacore		
		Pounds	Percent Handline	Pounds per Trip	Pounds	Percent Handline	Pounds per Trip	Pounds	Percent Handline	Pounds per Trip
1997	137	367,860	27.6	2,685	133,393	70.5	974	0	0	0
1998	122	319,550	25.3	2,619	259,917	96.8	2,130	109,537	39.9	898

Swordfish and wahoo (*ono*) catch rates (pounds per trip) in the handline fishery remained generally in line with their long-term averages. However, *mahimahi* and blue marlin catch rates were low. The *mahimahi* catch rate dropped substantially in both 1997 and 1998. The blue marlin catch rate reached a record low, less than half the rate in 1997. Landings were also lower than 1997. Reported handline swordfish landings were 14,086 pounds, *mahimahi*

30,744 pounds, wahoo 21,549 pounds, and blue marlin 7,229 pounds. Non-tuna species are usually a minor component of the handline fishery landings (WPRFMC, 1999d).

Until the mid-1980s, the troll-handline-other gear category received higher prices than the average for all gear types landing pelagic species. This situation has reversed since that time. The decrease in prices received by the troll-handline-other gear category coincides with substantial increases in reported catch by longline boats. As Figure 3.10.3-36 illustrates, the average price per pound has declined since the late 1980s.

Figure 3.10.3-36: Average Price per Pound for Pelagic Landings by All Commercial Troll-Handline-Other and All Pelagic Gear Types, Inflation-Adjusted for Year 2000 Dollars, 1948-1998. Source: Adapted from NMFS, 2000e.



Note: Data compiled from HDAR commercial catch reports (preliminary as of May 1999) using unique license number-date combinations for species caught > 0 (zero-catch trips are not included). Data are combined from reported *ika-shibi*, *palu-ahi*, and drifting handline fishing from all areas. 1997 data were updated with more complete data available in 1999. Non-commercial data are not available (WPRFMC, 1999d).

Table 3.10.3-49 illustrates trip costs per vessel for Island of Hawai'i full-time pelagic vessels for 1995-1996. Figure 3.10.3-37 depicts the commercial fishing gross revenue in Hawai'i (adjusted for inflation) for the last 50 years. Table 3.10.3-50 shows the catch, sales, and gross revenue for full-time pelagic vessels by gear type. The seamount vessels landed the most fish, sold the most fish, and had the highest gross revenue from the sales. The 1996 survey respondents also indicated that a higher percentage of personal income is earned by fishers on seamount vessels (99 percent), whereas *ika-shibi* fishers earned 92 percent and *palu-ahi* fishers earned 87 percent of their personal income from fishing (Hamilton and Huffman, 1997).

Table 3.10.3-49: Trip Costs per Vessel (Mean of All Fishing Trips over Previous 12 Months), Island of Hawai'i Full-time Pelagic Vessels by Gear Type. Source: Hamilton and Huffman, 1997.

Cost Item ($)	Palu-Ahi	Ika-Shibi	Seamount
Ice	11.31	41.81	262.76
Boat Fuel	78.17	41.83	426.78
Bait	43.50	92.83	359.36
Food	36.04	19.41	221.64
Truck Fuel	10.78	11.73	22.29
Miscellaneous	0.00	0.00	10.60
Total	179.80	207.61	1,303.43

Figure 3.10.3-37: Hawai'i Commercial Fishing Gross Revenue, Adjusted for Inflation, 1948-Present. Source: Hamilton and Huffman (1997).

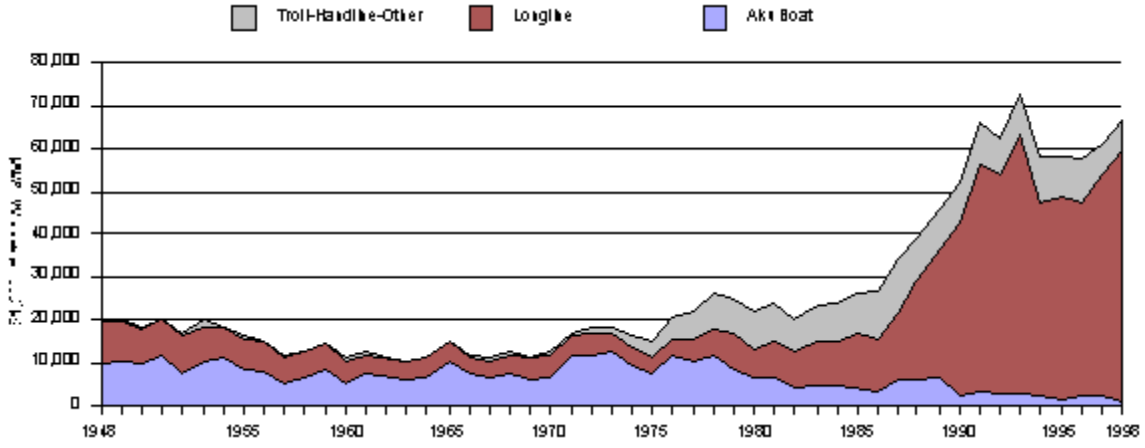


Table 3.10.3-50: Catch, Sales and Gross Revenue (Previous 12 Months) per Vessel, Island of Hawai'i Full-time Pelagic Vessels by Gear Type. Source: Hamilton and Huffman, 1997.

Catch, Sales and Gross Revenue	Palu-Ahi	Ika-Shibi	Seamount
Total Pounds Caught	37,667	31,563	183,583
Total Pelagic Pounds Caught	21,667	28,056	177,750
Total Non-Pelagic Pounds Caught	16,000	3,333	5,833
Total Pounds Sold	35,533	31,150	178,188
Total Pelagic Pounds Sold	20,333	27,656	172,563
Total Non-Pelagic Pounds Sold	15,200	3,333	5,625
Total Sales Gross Revenue ($)	46,667	70,813	236,979

Table 3.10.3-51: Respondent Characteristics (Mean), Island of Hawai'i Full-Time Pelagic Vessels by Gear Type. Source: Hamilton and Huffman, 1997.

Respondent Characteristic	Palu-Ahi	Ika-Shibi	Seamount
Percent of Personal Income from Fishing	86.67	92.50	99.17
Total Household Income	28,333	46,111	80,833
Age	43.33	42.10	50.00

Pro forma cost and earnings estimates for handline vessels in Hawai'i are shown in Table 3.10.3-52. The estimates are based on Hamilton and Huffman, 1997. The average full-time *palu-ahi* handline vessel generated $26,704 in gross revenues from the sale of pelagic species in 1995-1996. After operating expenses are subtracted, the average fisher had a net operating loss of about $9,234. The average full-time *ika-shibi* handline vessel generated $62,870 in gross revenues from the sale of pelagic species in 1995-1996.[34] After fixed costs and trip costs for the average of 101 pelagic trips during the year are subtracted, the vessel has a net operating income of about $32,542. After one-third of net operating income for crew share is subtracted (Glazier, 1999), income to the owner and/or the captain of the vessel is $21,803.

The average full-time seamount handline vessel generated $229,498 in gross revenues from the sale of pelagic species in 1995-1996. After fixed costs and trip costs for the average of 37 pelagic trips during the year are subtracted, the vessel has a net operating income of

[34] Gross sales revenue information for pelagic species is not available from Hamilton and Huffman (1997). Pelagic sales gross revenue is assumed to be the same percent of total sales gross revenue as pelagic pounds caught is to total pounds caught. Non-pelagic species represented roughly ten percent of the catch for full-time handline vessels in 1995-1996. Potential changes in sales gross revenue caused by price differentials between pelagic and non-pelagic species are therefore moderated by the low percentage of non-pelagic pounds caught.

about $151,667. After one-third of net operating income for crew share is subtracted (Glazier, 1999), income to the owner and/or the captain of the vessel is $101,617.

Despite taking the fewest trips, seamount vessels had the highest total catch, sales, and gross revenue. In fact, in 1995-1996, seamount vessels accounted for 78 percent of the pounds landed of pelagic species, whereas *ika-shibi* accounted for only 12 percent, and *palu-ahi* for only 10 percent. Although *ika-shibi* vessels took fewer trips and caught fewer total pounds, they realized higher gross revenues compared with *palu-ahi* vessels. This circumstance is probably partially attributable to the price differential for *ika-shibi*-caught fish (generally believed to be larger and of better quality) relative to fish caught by other methods (Hamilton and Huffman, 1997).

Table 3.10.3-52: Pro Forma Income Statement for Full-time Commercial Pelagic Handline Vessels, 1995-1996. Source: Adapted from Hamilton and Huffman, 1997.

Gross Revenue and Costs	Amount ($)		
	Palu-Ahi	Ika-Shibi	Seamount
Total Pelagic Sales Gross Revenue	26,704	62,870	229,498
Cost Item			
Fixed Costs			
Insurance	-	1,201	7,833
Loan Payments	1,190	2,176	3,400
Maintenance and Repairs	427	3,862	9,250
Fishing Gear	2,534	1,847	3,993
Ramp, License, and Registration Fees	66	101	-
Miscellaneous	-	244	1,480
Total Fixed Costs	4,216	9,430	29,956
Trip Costs			
Ice	11	42	263
Boat Fuel	78	42	427
Bait	44	93	359
Food	36	19	222
Truck Fuel	11	12	22
Miscellaneous	-	-	11
Total Trip Costs	180	208	1,303
Average Number of Palu-Ahi and Ika-Shibi Trips	176	101	37
Total Annual Trip Costs	31,722	20,898	47,875
Total Annual Costs	35,939	30,328	77,831
Net Operating Income (Loss)	(9,234)	32,542	151,667
Crew Share (33% of operating income (Glazier, 1999)*	NA	10,739	50,050
Return to Owner and/or Captain's Salary	NA	21,803	101,617

Notes: (1) Pelagic sales gross revenue is assumed to be the same percentage of total sales gross revenue as pelagic catch is of total catch; (2) Fixed costs are apportioned to commercial pelagic handline according to ratio of commercial pelagic handline trips to total number of trips; (3) NA = not applicable. Crew shares and return to owners cannot be calculated with a net operating loss.

Output of the pelagic commercial handline fishery is estimated at $9.35 million in 1995-1996. This total is composed of $0.36 million in sales for *palu-ahi* vessels, $2.82 million for *ika-shibi* vessels, and $6.17 million for seamount vessels. These estimates were calculated by multiplying the pelagic sales gross revenues for each group of fishers (Table 3.10.3-52) by the number of vessels in each group (Table 3.10.3-53). More recent information on catch

and gross revenue by specific small boat fishing group is unavailable, so information from the 12-month period presented in Hamilton and Huffman (1997) is used in the following analyses of economic contributions of the handline fleet.

The output of the handline fleet does not take into account the additional outputs generated within the state's economy by businesses whose goods and services are purchased by handline sector participants. A more comprehensive estimate of the contribution of the handline fishery to the state's economy can be obtained by combining the I/O multiplier with estimates of output of the handline sector. Section 3.10.2.2 presents more details on the methodology and describes the multiplier. Table 3.10.3-53 shows the estimated economic contributions of Hawai'i's commercial handline fishing sector. Based on 1995-1996 information, the handline fishery is estimated to contribute $12 million and 207 full-time jobs to Hawai'i's economy. Handline fishing is estimated to contribute eight percent of Hawai'i's pelagic fisheries output (including direct, indirect, and induced outputs), 10.5 percent of the fishery's labor income, and 12.3 percent of the fishery's jobs.

Table 3.10.3-53: Estimated Economic Contributions by Hawai'i's Commercial Handline Fishing Sector, 1998. Source: Table 3.10.2-2.

Handline Sector	Industry Output ($Millions)	Industry Labor Income ($Millions)	Industry Inputs ($Millions)	Jobs	Total Output ($Millions)
Palu-Ahi	0.36	.14	.17	21	.49
Ika-Shibi	2.82	1.12	1.36	77	3.83
Seamount	6.17	2.44	2.97	91	8.37
Total	**9.35**	**3.70**	**4.51**	**188**	**12.69**

Note: Fleet size estimates are based on the following assumptions:

- Number of MHI non-longline commercial boats (from Pan *et al.*, 1999 *in* Sharma and Leung,, In Press) 381
- Number of "Other" handline boats (22.4%) 85
- Percent of boats by vessel category (Hamilton and Huffman, 1997):
  - *Palu-ahi* 16.5%
  - *Ika-shibi* 61.2%
  - Seamount 22.4%
- Number of commercial handline vessels in MHI fleet:
  - *Palu-ahi* 13
  - *Ika-shibi* 45
  - Seamount 27

The commercial handline fishing sector generates about $12.7 million in total output in the Hawai'i economy from an industry output of about $9.34 million. The commercial handline fishing sector is part of the "other commercial fishery" in Sharma (1999) and, as a result, has the same final demand percent (53) and same multiplier (2.38) as the commercial troll fishery.

The commercial handline fishery has a relatively small effect on the Hawai'i economy compared to its sales because of the low portion of sales by the "other commercial fishery"

sector that are made to final demand sectors. The total output estimates do not include "forward linkages," which are the changes in economic outputs of purchasers of fish, such as the fishery distribution and trade sector, restaurants, and retailers. In the Hawai'i market, where a substantial portion of the local catch is sold through distribution channels or directly to restaurants and retailers, these forward-linked effects could be significant to the extent that the local retailers and restaurants are dependent on the local supply (Sharma, 1999).

While the handline vessels are not directly managed by the Pelagics FMP, the fishery potentially could be affected by changes in the FMP for longline boats. The changes would directly affect only the longline fleet, but depending on the changes that occur, the potential exists for indirect effects on all Hawai'i-based fisheries.

3.10.3.4 Hawai'i-based Pole-and-Line Fisheries

This section describes the pelagic pole-and-line fisheries for Hawai'i. In Hawai'i this fishery is known as the *aku* fishery, *aku* is the Hawaiian term for skipjack tuna. The primary targets of the pole-and-line method are skipjack tuna and juvenile yellowfin tuna. This fishery is also called the baitboat fishery, because of its use of live bait. The pole-and-line fishery is a labor-intensive, highly selective process. Live bait is broadcast to entice tuna to bite on barbless hooks with feather skirts. During the fast and furious catching activity, tuna are hooked lines and in one motion swung onto the boat deck by crew members (WPRFMC, 1995).

Much of the information in this section was taken directly from reports published by NMFS and the Council. The primary sources were as follows:

- WPRFMC. 1995. Pelagic Fishing Methods in the Pacific.
- NMFS. 2000. Pelagic Fisheries of the Western Pacific Region, Environmental Assessment for an Interim Period Pending Completion of an Environmental Impact Statement. August 2000.
- WPRFMC. 1999. Pelagic Fisheries of the Western Pacific Region. 5 November 1999.1998 Annual Report (Draft).

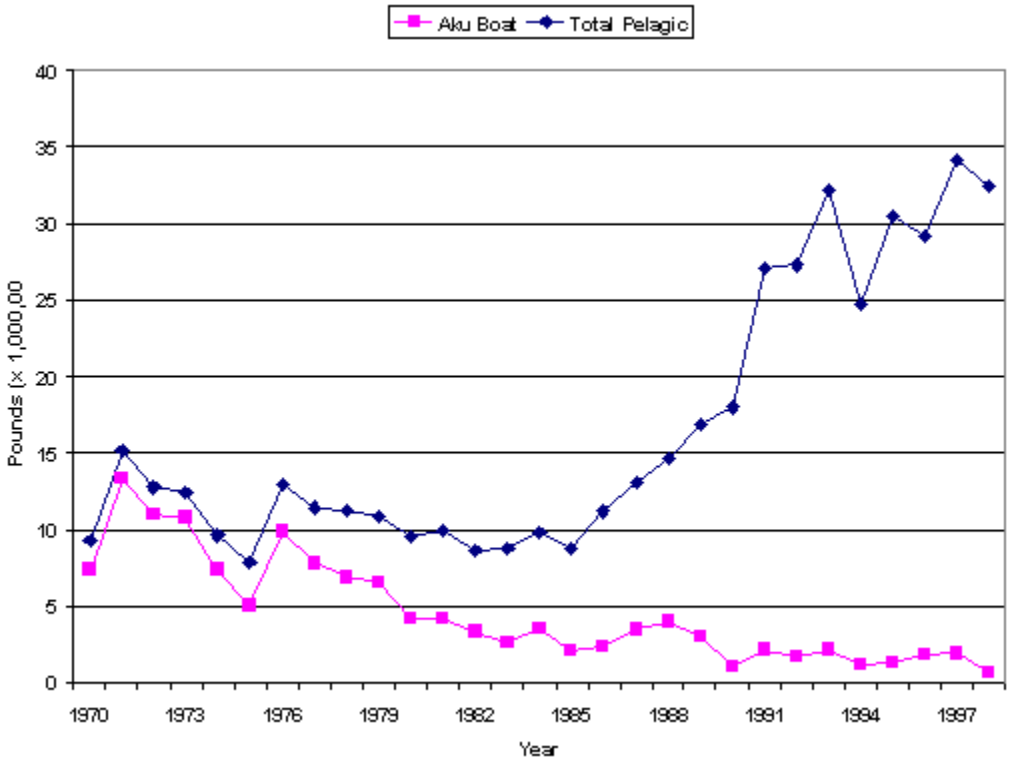
In the past, the global pole-and-line fishery was a primary supplier of the world's tuna. This gear type included commercial and domestic fisheries operating in the Pacific and Atlantic oceans. Currently, commercial fisheries take place off southern Japan, Hawai'i, southern California, southern Australia and parts of the Atlantic Ocean. Smaller-scale pole-and-line fisheries occur off Fiji, Kiribati, Indonesia, and the Solomon Islands (WPRFMC, 1995; NMFS, 2000j).

Historically, skipjack landed in the pole-and-line fishery were primarily canned. Currently most Hawai'i catch is sold on the fresh fish market (WPRFMC, 1995). The pole-and-line

fishery is on the decline globally because of cannery closures, the labor-intensive nature of the fishery, limited availability of live bait, and aging of vessels (NMFS, 2000j; WPRFMC, 1995). However, there is still a demand for the high-quality tuna that this fishery brings to market.

The Hawai'i pole-and-line fishery began declining in the mid-1970s. The Honolulu tuna cannery closed in 1984, resulting in a reduced demand for skipjack tuna, the primary catch of this fishery (NMFS, 2000j). Figure 3.10.3-38 compares landings in the Hawai'i pole-and-line fishery to landings in all Hawai'i pelagic fisheries from 1970 to 1998.

Figure 3.10.3-38: Hawai'i-based Pole-and-Line Landings Compared to Total Pelagic Landings, 1973-1998. Source: WPRFMC, 1999d.



The number of vessels participating in the Hawai'i-based pole-and-line fishery has declined from its peak several decades ago. In 1991, the Hawai'i-based pole-and-line fishery had only six boats – only four of these were operating full-time. Information providing more details on the current or historical participants in the Hawai'i-based fishery is not available at this time.

Table 3.10.3-54 provides a summary of the Hawai'i-based pole-and-line fishery for 1998. The table (based on a similar table in NMFS, 2000j) shows that the six active vessels in the Hawai'i-based pole-and-line fishery landed more than 696,000 pounds PMUS, more than 99 percent of which was skipjack tuna. The fish were harvested in more than 223 trips and generated an estimated $932,000 in ex-vessel gross revenue.

Table 3.10.3-54: Fishery Information for Hawai'i-based Pole-and-Line Fishery, 1998. Source: Adapted from NMFS, 2000j, which was based on Ito and Machado, 1999, and Our Living Oceans, 1999.

Area Fished	Inshore and EEZ
Total Landings	696,000 pounds
Target Species	Skipjack tuna
Catch Composition	99.6 percent skipjack tuna
MSY/OLO Status	Skipjack tuna: 2,000,000 mt/"under"
Season	All year
Active Vessels	6
Total Permits	NA
Total Trips	223
Total Ex-vessel Value	$932,000

Pole-and-line fishing is conducted year-round (NMFS, 2000j). However, during the summer season (April to September) larger skipjack tuna move into Hawai'i waters in greater abundance (DBEDT, 2000). In the 1970s and 1980s, most of the catch came from areas around O'ahu, Kaua'i, Moloka'i, and Lana'i. By 1993, all of the vessels were working out of Kewalo Basin or Kaneohe Bay on O'ahu (NMFS, 2000j). The availability of bait fish and the distance from the home port influence the location where the Hawai'i-based pole-and-line fishing activity occurs (Kawamoto, 2000).

In this fishery, hooks and lures are attached by line to bamboo or fiberglass poles. The lures are made of chrome, feathers, and soft plastic. The hooks are barbless. Single poles are normally used, but more than one pole can be attached to one lure to bring in a large fish. The poles range from 2.13 to 4.88 meters (7-16 ft) in length; the line is 2.13 to 3.96 meters (7-13 ft) long, with a wire leader approximately 0.49 meters (1.6 ft) long. Poles and line are of equal length. Automatic poles can be used in place of crew members (WPRFMC, 1995). Some boats may be equipped with seawater spray systems, which are used to stimulate a feeding frenzy and to conceal the boat. Bird-detecting radar units are sometimes used to help the crew locate schools of fish.

Most pole-and-line vessels currently in use were built in the 1940s and 1950s. Hawai'i vessels range from 23 to 30.5 meters (76-100 ft) in length. The vessels are equipped with

bait wells and fish holds. A nozzle from a seawater spray system is located at each fishing station (WPRFMC, 1995). In Hawai'i, a typical pole-and-line vessel uses a 5- to 7- member crew (WPRFMC, 1995; NMFS, 2000j).

Most Hawai'i boats go out at dawn and return to port at dusk (NMFS, 2000j). While cruising the crew scans the horizon for feeding bird flocks, which indicate the presence of a school of fish. Figure 3.10.3-39 is a picture of a pole-and-line boat engaged in catching tuna in Hawai'i. A flock of birds is shown hovering above the fishing activity.

Figure 3.10.3-39: Hawai'i Pole and Line Boat. Source: WPRFMC, 1995.

After a school of fish is located, the vessel is positioned in front of the school. Live bait in the form of anchovies, herring, and sardines is thrown out into the oncoming school of fish. The seawater spray system is activated to stimulate the fish to begin a feeding frenzy. Fishing stations are located in the bow, stern, and port foredeck. The fish that bite the lures are pulled onto the vessel and removed from the hook in one swift motion. The line and lure are returned to the water to continue the process. This rapid pace is continued until the fish stop biting. Within 10 to 20 minutes, one to four tons of tuna can be caught. After a catching session, the vessel is cleaned and the search for more tuna resumes (WPRFMC, 1995).

The pole-and-line fishery depends on live bait, and the primary baitfish in the Hawai'i-based fishery is *nehu* (NMFS, 2000k). Bait is captured either during the day or at night in underwater lift nets. Lights are used to attract the baitfish during nightfishing. Bait is stored in bait wells on the vessel.

The availability of bait is important to this fishery. Areas where competitive uses for the bait exist are likely to see a decline in pole-and-line fishing activity (WPRFMC, 1995). The Hawai'i Division of Aquatic Resources regulates the taking of bait fish (Kawamoto, 2000). In addition, the U.S. Navy requires a permit to take bait fish from Pearl Harbor. Fishers are required to purchase insurance to obtain this permit, which effectively precludes this activity for some boats (NMFS, 2000k).

Table 3.10.3-55 shows the annual average pounds per trip of catch for pole-and-line boats from 1990 to 1998. Since 1979, the average catch per trip has been 3,444 pounds, with a standard deviation of 753 pounds.

Table 3.10.3-55: Average Annual Pounds per Trip for Pole-and-Line Boats, 1990-1998. Source: Adapted from WPRFMC, 1999d.

Year	Pounds per trip
1990	2,840
1991	4,722
1992	3,297
1993	4,447
1994	3,240
1995	3,341
1996	3,928
1997	4,231
1998	3,325
Average (since 1979)	3,444
Standard deviation (since 1979)	753

The pole-and-line fishery is a highly selective fishery, and very little bycatch occurs. Skipjack tuna accounts for 90 to 99 percent of the total catch (NMFS, 2000j). The incidental catch is primarily mahimahi. In areas near reefs, seamounts, fish aggregation devices (FADs), drifting logs, and flotsam, there may be *kawakawa*, frigate tuna, and rainbow runner mixed in with the skipjack tuna. Bycatch is sold or retained for personal consumption by the crew (WPRFMC, 1995; NMFS, 2000j).

Landings of skipjack tuna fell as a percentage of the total Hawai'i tuna landings (by weight) from more than 70 percent in the 1960s to four percent in 1998. This decline is due in part to the closure of the Honolulu cannery in 1984, problems in obtaining live bait, and the aging of vessels 50 years old or older (WPRFMC, 1994 *in* NMFS, 2000j). However, the decline has resulted in higher retail prices for fresh skipjack tuna (Boehlert, 1993 *in* NMFS, 2000j).

Annual landings from 1990 to 1998, and annual gross revenues for the pole-and-line fishery and the total Hawai'i-based pelagic fishery (excluding charter boats) are shown in Table 3.10.3-56. In 1998, 0.7 million pounds of product from pole-and-line activity were caught and sold, generating $0.9 million in gross revenue.

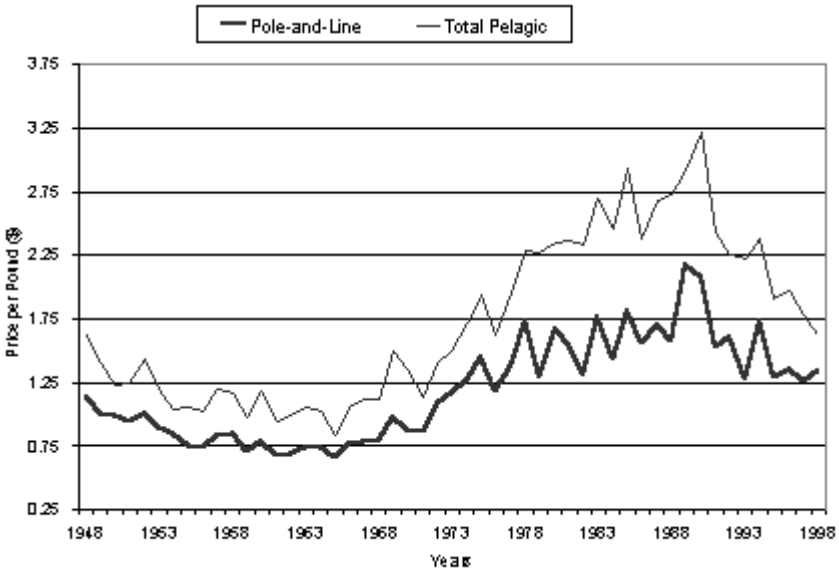
Table 3.10.3-56: Pole-and-Line Landings and Gross Revenue, 1990-1998. Source. Adapted from NMFS, 2000e.

Year	Pole-and-Line	Total Pelagic	Pole-and-Line	Pole-and-Line	Total Pelagic	Pole-and-Line
	Landings (Millions of lb)		% of Total	**Gross Revenue** ($Millions)		% of Total
1990	1.18	18.10	7	2.46	58.12	4
1991	2.15	27.17	8	3.28	65.80	5
1992	1.74	27.26	6	2.79	61.52	5
1993	2.14	32.19	7	2.71	71.49	4
1994	1.16	24.70	5	2.01	58.66	3
1995	1.29	30.57	4	1.66	58.09	3
1996	1.84	29.18	6	2.50	57.44	4
1997	1.95	34.20	6	2.44	61.04	4
1998	0.70	33.87	2	0.93	54.82	2

Note: Gross revenue is inflation-adjusted to Year 2000 prices.

Figure 3.10.3-40 shows the price per pound for the pole-and-line product and the total pelagic fisheries product. The pole-and-line fishery price appears to follow the total pelagic fishery market price.

Figure 3.10.3-40: Average Price Per Pound for Landings of Pelagic Species by Pole-and-Line Fishery and Total Pelagic Fishery, 1948-1998. Source: Adapted from NMFS, 2000e.



Note: Prices are inflation-adjusted to 2000 dollars.

Total gross revenue of the pole-and-line fleet does not account for the additional employment and income that are generated in the state's economy by businesses who provide goods and services to participants in this fishery, and by businesses that use pole-and-line products as inputs for their own production of goods and services. People earning incomes directly or indirectly from the fishery also make expenditures within the economy that generate additional employment and income.

Ideally, estimation of the economic contributions of a sector would be based on estimates of its costs as well as its earnings. Unfortunately, because of the small number of vessels in the pole-and-line fleet, cost and earnings studies have not been conducted in recent years. However, Sharma *et al.* (1999b) developed an input-output (I/O) model for Hawai'i's marine fisheries, that allows estimation of the economic contribution to Hawai'i's economy by the pole-and-line fishery (Sharma *et al.*, 1999b), if reasonable approximations of the costs and earnings of the fleet are available. Based on the assumption that generated economic impacts are similar in proportion for the pole-and-line fishery and other (non-longline) commercial fishing fleets in Hawai'i, an estimate of the total economic contribution of the pole-and-line fleet was developed. Details of the I/O model are in Section 3.10.2.2.

Table 3.10.3-57 shows the estimated economic contribution of the pole-and-line fleet. The pole-and-line fishery is included in the "other commercial fishery" sector of the Sharma I/O model. The other commercial fishery I/O multiplier was applied to the 1998 industry output of the pole-and-line fishery to generate the total output (including direct, indirect, and induced outputs).

Table 3.10.3-57: Estimated Economic Contributions by Hawai'i-based Pole-and-Line Fishing Sector for 1998. Source: Table 3.10.2-2.

Fishery Sector	Industry Output ($Millions)	Industry Labor Income ($Millions)	Industry Inputs ($Millions)	Jobs	Total Output ($Millions)
Pole-and-Line	0.93	.37	.45	25	1.26

The output of the pole-and-line fishery is approximately one percent of output of the entire Hawai'i-based pelagic fishery, and contributes a minor amount to the fishery. It is a selective fishery, and does not generally interact with protected species. In spite of the demand for its high-quality product, the labor-intensive nature of the fishery, specifically capturing live bait, has led to its decline. However, a new boat was recently developed that may alter the fishery's declining course (NMFS, 2000k).

The pole-and-line fishery is not directly affected by the Pelagics FMP, except to the extent that fishers must comply with State of Hawai'i licensing and reporting requirements. The FMP's closure of longline fishing within 50 nm of shore indirectly affects the fishery. At the present time it does not compete with the Hawai'i-based longline fleet for fishing areas. Although the Pelagics FMP does not have a direct impact on the pole-and-line fishery currently, the fishery is governed by the plan, and future changes to the plan could have a direct impact.

3.10.3.5 Pacific Remote Island Areas Troll and Handline Fishery

This section briefly describes the pelagic troll and handline fishery in the PRIA, which comprises EEZ waters around Howland, Baker, Jarvis, Wake, and Midway Islands, Kingman Reef, and Palmyra and Johnston Atolls. The above sections adequately describe both fishing methods that are of interest here. This section, therefore, is limited to describing the extent of fishing activity and the targeted species in this fishing area. Currently, it is thought that more than ten vessels are active in the fishery.

Much of the information in this section was taken directly from the *Regulatory Amendment Establishing Permit and Reporting Requirements for the Pelagic Troll and Handline Fishery in the U.S. Remote Island Areas of the Western Pacific Region*, which was released by the Council on 23 August 2000.

There is limited knowledge of fishing activity and effort in the PRIA because of limited reporting requirements for vessels active in this fishery. Longline vessels that fish in EEZ waters around the PRIA must be registered under a longline general permit or the Hawai'i-based longline limited access permit. These vessels have federal reporting requirements. There are no federal reporting requirements for commercial troll and handline vessels targeting pelagic species in these areas. The only existing reporting requirement for recreational and charter vessels in this area is a U.S. Fish and Wildlife Service requirement for maintaining a "Midway Sports Fishing Boat Trip Log." This requirement applies to fishing within the Midway Atoll National Wildlife Refuge. The log, however, need not include any information about interactions with protected species.

Two Hawai'i-based troll and handline vessels are known to have fished recently in EEZ waters around Palmyra and Kingman Reef targeting pelagic (including yellowfin and bigeye tuna, wahoo, *mahimahi*, and sharks) and bottomfish species. Catch and effort data on these vessels are unavailable.

Five charter vessels are known to be based on Midway, two of which troll for pelagic species. The other three are used for nearshore and lagoon fishing. Approximately seven vessels are maintained and used for recreational fishing by Midway residents. Three of these are known to troll for pelagic species including yellowfin tuna, *ono*, and marlin.

3.10.4 Pelagic Fisheries in American Samoa

This section focuses on the participants in pelagic fisheries that operate out of American Samoa. American Samoa-based pelagic fisheries consist of a small fleet of *alia* longliners, a few mid-size and larger longliners, and a small fleet of trolling vessels. In addition, the U.S.-owned distant-water pelagic purse seine fleet delivers much of its landings to canneries in Pago Pago, the capital city of American Samoa. Of the U.S. operations, the purse seine fleet lands the largest share of PMUS. However, most of that share is caught in waters outside the EEZ around American Samoa. There is also substantial offloading at the canneries by foreign purse seine and longline vessels and occasional offloading by U.S. distant-water albacore trollers.[35]

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[35]American Samoa, like Guam and the CNMI, is exempt from both the Nicholson Act and the Jones act. These exemptions allow fisheries products of foreign flagged vessels to be landed in American Samoa, Guam, and the CNMI and then shipped to other U.S. ports in Hawai'i, Alaska, and the U.S. mainland. In addition, products from U.S. territories and possessions have duty-free status if the foreign component of the product is less than 50 percent (Hamnett *et al.*, 1996). These legal provisions make it feasible for large-scale tuna processing operations in American Samoa, Guam, and CNMI to utilize the products of foreign flagged vessels and the U.S. purse seine fleet.

The U.S. distant-water purse seine fleet, which was reported to have landed more than 400 million pounds of pelagic species in 1999, is authorized to fish under the Treaty on Fisheries Between the Governments of Certain Pacific Island States and the Government of the United States of America (SPTT). The fleet is not directly managed by the Pelagics FMP except when fishing in the EEZs of American Samoa, Guam, or the CNMI or other American Pacific Islands, at which time these vessels must obey the regulations of the FMP. Future changes to the FMP, such as closure of areas to large vessels, may have an affect on the purse seining activity occurring in the EEZ of U.S. territories.[36] The U.S. distant-water fishery is discussed in Section 3.14, and therefore this section focuses only on longliners and trollers based in American Samoa.

Much of the information used in this section was taken directly from reports published by NMFS and the Council. The primary sources were as follows:

- WPRFMC. 2000. Prohibition on fishing for pelagic management unit species within closed areas around the islands of American Samoa by vessels more than 50 feet in length. October 2000.
- NMFS. 2000. Pelagic Fisheries of the Western Pacific Region, Environmental Assessment for an Interim Period Pending Completion of an Environmental Impact Statement. August 2000.
- WPRFMC. 1999. Pelagic Fisheries of the Western Pacific Region. November 5, 1999. 1998 Annual Report (Draft).

Figure 3.10.4-1 compares the landings by weight for the treaty-managed purse seine fleet and the FMP-managed pelagic fleets operating out of America Samoa. The purse seine activity and the FMP-managed domestic activity are shown on two different scales due to the dramatic difference in quantities landed. Even with the adjusted scale, the treaty-managed purse seine fishery dwarfs the domestic FMP-managed pelagic fisheries in American Samoa.

[36]As an example, the U.S. distant-water purse seine and albacore fleets would be prohibited from fishing in the near-shore area closures around American Samoa if approved by the Council and the Secretary of Commerce.

Figure 3.10.4-1: Purse Seine Activity Compared to All FMP-Managed Pelagic Activity, American Samoa, 1998. Source: Compiled from data in WPRFMC, 1999d.

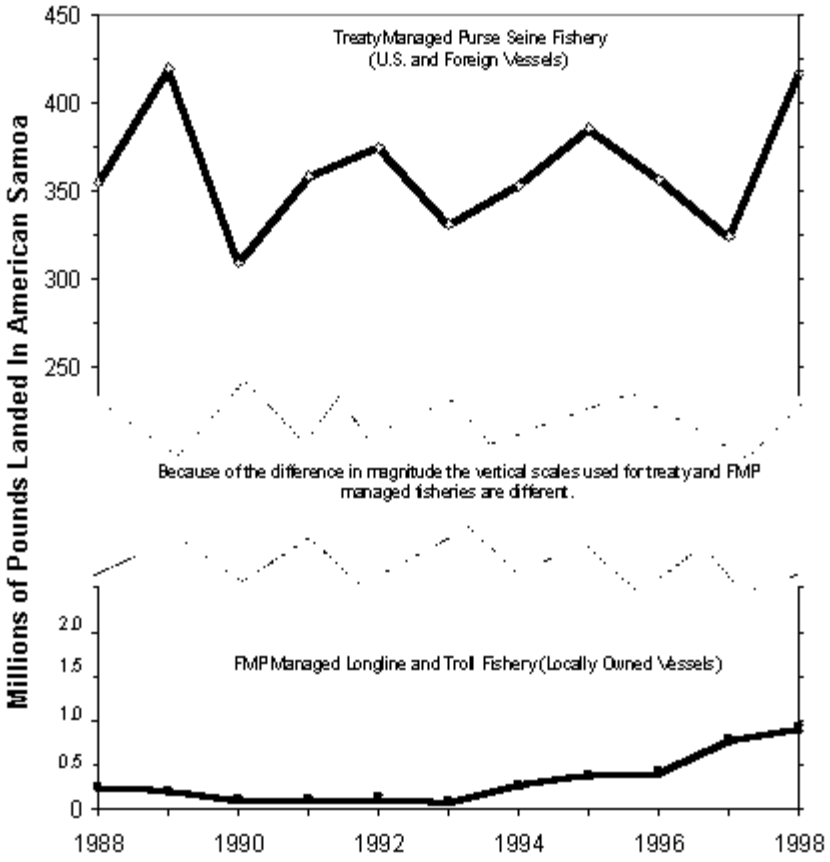


Table 3.10.4-1 contains a summary of the American Samoa-based fisheries managed under the western Pacific Pelagics FMP. The table reveals that the 26 active longline vessels landed more than 97 percent of the total PMUS harvested by the two managed gears. The 19 troll/charter vessels landed only 25,271 pounds of the 909,271 pounds landed in total.

Table 3.10.4-1: Pelagic Fishery Information for American Samoa, 1998. Source: Adapted from WPRFMC 1998 Annual Report and Our Living Oceans 1999, *in* NMFS, 2000j.

Gear	Longline	Troll/Charter
Area Fished	Inshore and EEZ	Inshore and EEZ
Total Landings	884,000 lb	25,271 lb
Catch Composition	72% albacore tuna 8% yellowfin tuna < 5% all others	74% skipjack tuna 6% barracuda 4% yellowfin tuna
Season	All year	All year
Active Vessels	26	19
Total Permits	50 (open access)	NA
Total Trips	2,359	123
Total Ex-vessel Value	$976,913 [a]	$22,017

[a] The ex-vessel value of longline landings as originally listed in NMFS, 2000j was determined to be inaccurate. The value shown in this table was estimated by subtracting the value of troll landings from the total estimated value of commercial landings, as shown in Table 3.10.4-6.

The following inset text provides background information about the history of fishing in American Samoa. The text is taken directly from WPRFMC, 2000f.

> Subsistence fishing traditionally provided most of the protein in the diet of the indigenous people who originally settled the Samoa islands. As American Samoa's economy shifted from purely subsistence toward a more commercial orientation in contemporary times, so did small-scale fisheries (Hill, 1978).
>
> Inshore fishery potential around the islands of American Samoa is quite limited. Samoa lacks the broad, shallow shelves characteristic of most continental margins. The coastal zone is characterized by narrow reefs sitting on steep island slopes. The relatively small area of shallow water and the general inability of small-island profiles to induce much upwelling of nutrient-rich colder water from the deep ocean greatly limit productivity (Adams *et al.*, 1999). A long-term decline in landings of coral reef fish in American Samoa's shoreline fishery is well documented (Saucerman, 1995; Craig, 1999; Tuilagi and Green, 1995). Attempts to develop deep slope fishing in American Samoa from mid-1960s to the mid-1980s were not sustained (Itano, 1991).

The American Samoa Economic Advisory Commission was recently established to formulate a strategy that will stimulate economic development in the private sector and, over the long term, reduce dependence on Federal spending. One of the highest priorities of the commissioners is to encourage fisheries development as a way of expanding and diversifying the local economy and helping the Territory attain a higher level of economic self-sufficiency. The only fishery in American Samoa with significant potential for expansion is the harvest of offshore pelagic fish resources. In the past, Federal and American Samoa government agencies have funded a variety of projects to develop the harvesting and marketing capabilities of small-scale tuna fisheries.

Despite a 40 year history of tuna canning in American Samoa by two large processors, commercial fishing for tuna by domestic (local) vessels in Samoa's EEZ is a relatively recent endeavor. The importance of pelagic fish as a source of income and employment in American Samoa's small-scale fishery has increased rapidly since 1996, following the adoption of longline fishing methods patterned after those in the neighboring country of Samoa. American Samoa's small-scale fishery is presently evolving from the realm of traditional subsistence activities to more commercial activities. This change involves considerable risk, not only financial risk for small-scale fishermen, but also a risk of developing overcapacity in the fishery that could be detrimental to the domestic economy, traditional social organization and cultural continuity of the American Samoa community.

The small-scale pelagic fishery in American Samoa employs small-scale vessels and relatively simple troll and longline fishing technology. More than 90 percent of the respondents in a survey of 20 longline fishermen planned to increase their efforts at longlining (Severance *et al.*, unpub. research). Until very recently, most of the small-scale fleet was comprised of boats under 30 ft in overall length. New and safer types of small-scale vessels have begun to enter the pelagic fishery and they are capable of extending the safe range of fishing farther offshore.

3.10.4.1 The Longline Fishery in American Samoa

The following inset text introducing the longline fishery in American Samoa was taken directly from WPRFMC, 1999d.

The general longline fishery consists of vessels that fish under a western Pacific general longline permit. This permit allows the vessel to fish for PMUS using longline gear in the EEZs around American Samoa, Guam, the

Commonwealth of the Northern Mariana Islands (CNMI) or other U.S. island possessions excluding the Hawaiian Islands. Unlike Hawai'i longline permits the number of Western Pacific general longline permits is not restricted. As of 1998, there were 48 general longline permitted vessels in American Samoa, three in Guam and one in the CNMI, however, only those based in American Samoa were active during 1998.

Prior to 1995, the non-purse seine pelagic fishery in American Samoa was largely a troll-based fishery. In mid-1995 four vessels began longlining and by 1997, 33 vessels had permits to longline. Approximately 17 of these were actively fishing on a monthly basis. In 1998, only 26 of the 50 federally permitted longliners actually fished. These 26 vessels reported total landings of 884,000 pounds in 1998.

Apart from a few larger (> 40 ft) inboards, longlining out of American Samoa generally takes place on alias, twin-hulled (wood with fiberglass or aluminum) boats about 30 feet long, and powered by small gasoline outboard engines. Navigation on the alias is visual using landmarks. The gear is stored on deck attached to a hand crank reel which can hold as much as 10 miles of monofilament mainline. Participants set between 100 and 300 hooks on a typical eight-hour trip. The gear is set by spooling the mainline off the reel and retrieved by hand cranking back onto the reel. Currently most fishing is done within 25 miles of shore, but with better equipped vessels, fishing activity may extend further. Generally, gear setting begins in early morning; with retrieval in the mid-morning to afternoon. The fish are stored in containers secured to the decks or in the hulls. Albacore tuna is the primary species landed followed by skipjack tuna and yellowfin tuna. Most fish are sold to large scale canneries, but some are sold to restaurants, and donated for family functions.

A NMFS longline general permit is required for longline fishing in American Samoa's EEZ. This fishery is presently open access, with no limits on the number of longline vessels, individual or total vessel capacity, catch or effort. A control date of November 13, 1997, has been established and some applicants for longline permits after that date are informed that they may not qualify for exemptions to limitations placed on longline vessels greater than 50 ft in overall length. In anticipation of the possibility of a limited entry program for domestic longline fishing vessels, the Council and NMFS have established a control date of July 15, 2000, after which any vessel of any size entering the fishery will not be assured of being allowed to use longline gear to fish for pelagic management unit species in the EEZ around American Samoa (WPRFMC, 2000f).

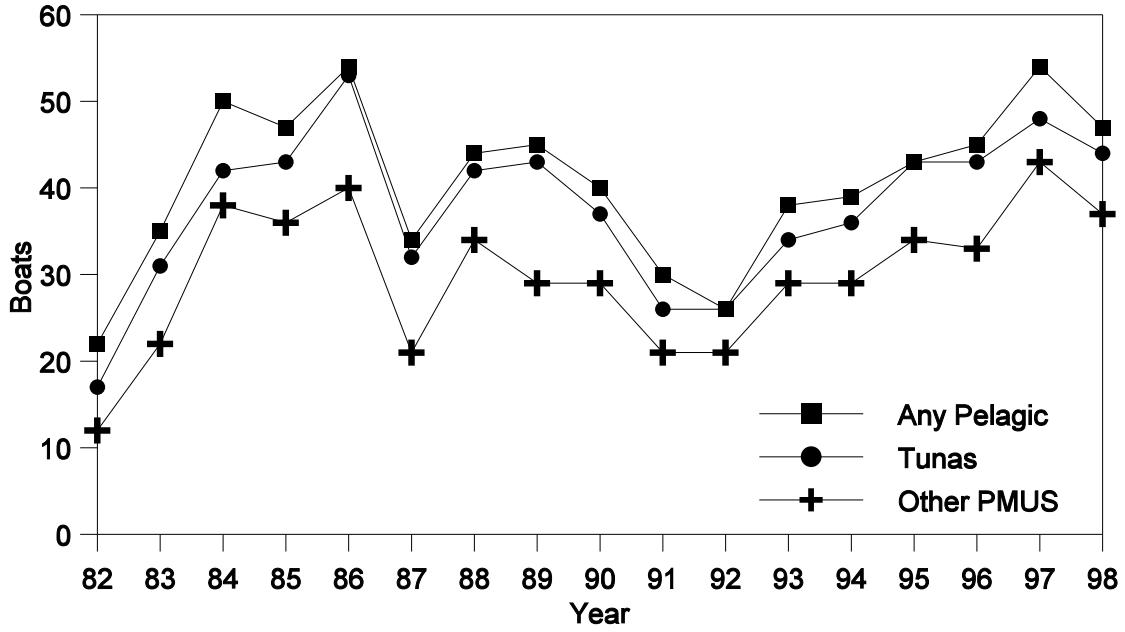
The length distribution of vessels owned by longline permit holders, as of October 2000, is summarized in Table 3.10.4-2. Figure 3.10.4-2 shows the number of annual active boats in the pelagic fishery in American Samoa. An increase in the number of participating boats is seen from 1992 to 1997, which likely reflects the addition and buildup of the domestic longline fleet.

Table 3.10.4-2: Longline Permit Holders Based in American Samoa, October 2000. Source: NMFS *in* WPRFMC, 2000f.

No. of Vessels, by Length Overall					
< 30 ft	**31-35 ft**	**35-40 ft [a]**	**41-45 ft [b]**	**46-50 ft [c]**	**50+ ft**
34	14	9	2	0	5

[a] A newer and safer version of *alia* (a catamaran-style vessel that is the most common type of fishing boat in American Samoa and Samoa) is being assembled in Samoa from pre-cut aluminum plates manufactured in New Zealand. Mostly 38 to 42 ft in length, this version is equipped with a larger fuel tank, navigational aids, higher free board, and more safety equipment to extend fishing range to well over 100 nm from shore. Several new fishing enterprises in American Samoa have plans to acquire vessels of this type.
[b] In addition to planned acquisitions in this length class, FAO is designing a 45 ft catamaran-style vessel for the next phase of longline fishery expansion in neighboring Samoa. This design will also be available for boatbuilding in American Samoa.
[c] A design for a monohull vessel assembled from precut steel plates in the 46 to 50 ft class has been prepared in American Samoa.

Figure 3.10.4-2: Number of Active Boats in the American Samoa Pelagic Fishery, 1982-1998.



Note: The sampling program is extensive enough, and the number of boats is small enough, to allow use of raw data base counts of the number of vessels in a given year. Each boat counted in the figure made at least one recorded landing of at least one pelagic species during a given year.

The following inset text, figure and table (WPRFMC, 2000f) describe the efforts of American Samoa to expand its locally owned fleet.

> Fishermen in American Samoa are acquiring new and safer types of small-scale vessels, not only to extend the range of pelagic fishing to at least 50 nm from shore, but also to be able to deliver larger landings of higher quality than previously.
>
> The harvesting sector is supported in its expansion efforts by a growing number of local businesses which are becoming involved in small-scale fleet support and processing and marketing of pelagic fish landings. The two canneries based in American Samoa provide a ready market for tuna landed by the small-scale (and large-scale) domestic fleet but this quantity of fish is insignificant compared to cannery deliveries by purse seine and longline fleets of distant-water fishing nations. Not only do most fishermen in American Samoa lack the financial resources to acquire large purse seine or longline vessels but such vessels would greatly increase the financial risk and debt burden for boat owners and could possibly lead to overcapitalization of the

domestic fishery. The newest (and safest) 40 ft version of the *alia*-style vessel can be purchased for about $60,000, with earlier versions available for $24,000-40,000. By comparison, a 65 ft longline vessel would cost about $350,000 and a purse seiner would cost several million dollars. Assuming a 30 percent down payment and a 10-year loan at 10 percent annual interest rate, the initial payment of $18,000 and an annual loan and interest payment of $6,835 for a 40 ft *alia* would be an affordable investment for many small-scale fishing enterprises in American Samoa, whereas a down payment of $105,000 with an annual loan and interest payment of nearly $40,000 for a 65 ft longliner would be financially feasible only for a select few.

Incremental expansion of the small-scale pelagic fishery in American Samoa guards against unsustainable development; i.e., a "boom" of uncontrolled fishing by large vessels with greater fishing power, followed by a "bust" of overcapacity and reduced availability of pelagic fish. Neighboring Tonga provides a model for domestic tuna fishery growth at a controlled pace. Development of a small-scale domestic longline fishery in the northern portion of Tonga's EEZ was encouraged by a U.S. Agency for International Development sponsored project in 1992-1994. The project concluded that a venture using a 40 to 45 ft vessel would be most cost-effective for a small-scale longline fishery. The initial project results were so successful that a commercial fishery was initiated to exploit the potential demonstrated by the fishing trials. Until its commercial feasibility was proven, the new fishery reduced risk and generated early profits by fishing at a single, highly productive seamount more than 200 nm from port (S. Swerdloff, RDA International Chief of Party, pers. comm.; S. Taunaholo, Capricorn Fishing Co., pers. comm.).

Most of the island nations which are neighbors to American Samoa have, or are developing, domestic longline fisheries which will compete for pelagic fish resources within the region. Rapid and uncontrolled expansion of the longline fleet in the adjacent country of Samoa may already be affecting catch rates in American Samoa's small-scale pelagic fishery. Between 1995 and 1999, the number of longline vessels in neighboring Samoa increased from 25 to more than 200 vessels presently active (Mulipola, 2000). Samoa's EEZ is the smallest of any Pacific island nation, and the EEZ boundary it shares with the American Samoa lies only 20 miles from Tutuila.

Table 3.10.4-3: Profile of Vessels of Different Sizes Operating in American Samoa and Neighboring Samoa Domestic Longline Fisheries. Source: Mulipola, 2000; pers. comm. in Samoa and American Samoa *in* WPRFMC, 2000f.

Vessel Size and Type	28 ft *Alia*	40 ft *Alia*	50+ ft Monohull
Purchase price (USD)	$25,000	$60,000	$250,000
Miles of mainline set	7-10	20-25	35-50
Sets/trip	1-2	up to 4	6-8
Hooks/set	250-350	500-900	1,200-1,600
Trips/year	100-200 (weather-dependent)	50	40
Hooks/year	30,000-60,000	160,000	400,000

Figure 3.10.4-3 shows a map of the American Samoan Islands and its surrounding waters. Dashed and solid lines delineate geographic areas fished by domestic longline vessels longer than 50 ft, the older *alia* vessels, and the purse seine vessels within the EEZ. Lines also demonstrate the expected fishing range of the new *alia* catamarans (38 to 42 ft) and the future generation of *alia* catamarans longer than 50 ft. A few of the larger domestic longline vessels (75 to 100 ft) range throughout the EEZ and into international waters.

Figure 3.10.4-3: Map of American Samoa Showing Range and Fishing Grounds of Pelagic Fishing Vessels. Source: Adapted from WPRFMC, 2000f.

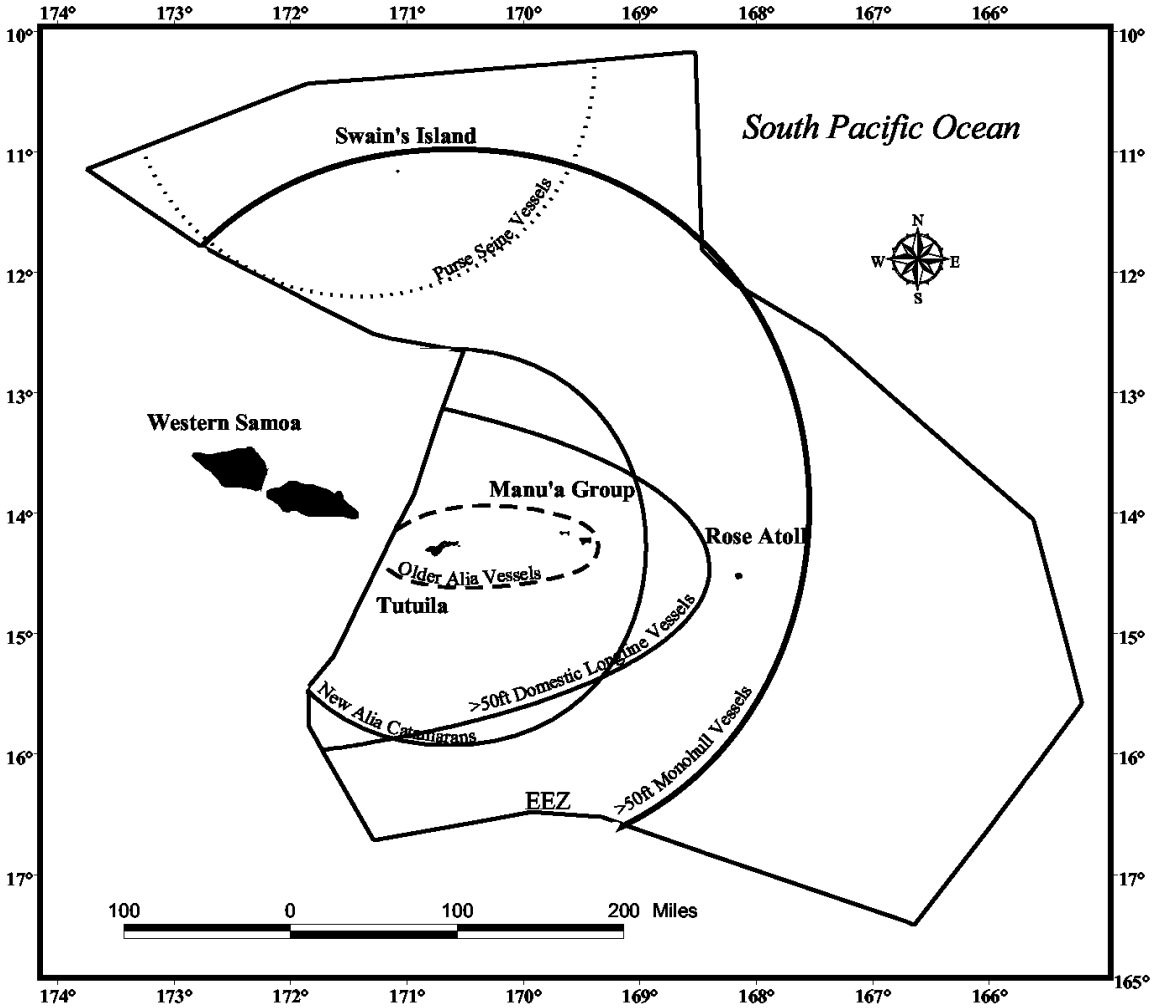


Table 3.10.4-4 shows a profile of the domestic pelagic fishing fleet currently operating in the EEZ of American Samoa. The table lists the number of vessels by length and indicates the number operating out of each port on a regular basis. The table also indicates how many vessels are either using troll or longline gear – in this section of the table, vessels may be counted in both gears. The rightmost columns show the area of the EEZ fish and indicate the generally safe fishing range.

Table 3.10.4-4: Profile of Domestic Pelagic Fishing Fleet Operating in EEZ of American Samoa, October 2000. Source: American Samoa Department of Marine and Wildlife Resources (DMWR), October 2000 vessel identification *in* WPRFMC, 2000f.

Vessel Length (ft)	No. of Vessels by Regular Port			No. of Vessels by Fishing Method		Areas of EEZ Fished	Generally Safe Fishing Range
	Tutuila	Aunu'u	Manu'a	Longline	Troll		
< 30	45	7	7	18	41	< 20 nm from port	< 50 nm from port
31-40	22	1		13	10	< 50 nm from port	50+ nm from port
41-50	3				3	50-100 nm from port	200+ nm from port
50-90	4			4		Entire EEZ	Hundreds of nm from port
> 90	1			1		Entire EEZ and beyond	Several thousand nm from port

Longline fishing on vessels in American Samoa is different from longline fishing on larger boats that operate in the distant water fleet or out of Hawai'i. Longline gear is stored on deck and attached to a hand-crank reel, which can hold as much as ten miles of monofilament mainline. The gear is set by spooling the mainline off the reel and retrieved by hand-cranking the mainline back onto the reel. Trips are about a day long (about eight hours). Setting the equipment generally begins in the early morning; haulback is generally from midday to afternoon. The fish are stored in containers secured to the deck, or in the hulls. Albacore tuna is the primary species landed, and generally is stored in personal freezers until a sufficient amount is accumulated to sell to the canneries. At times, some of the landings are sold to stores, restaurants, or local residents, or are donated for family functions. One of the two biggest inboard vessels delivers it fish to the canneries. These landings are not included in this report, but could be in future reports (WPRFMC, 1999d).

3.10.4.2 Landings and Revenues in American Samoa

In 1998, only 26 vessels longlined out of a total of 50 boats holding federal longline permits. Local boats have been targeting albacore mostly for the cannery market and caused the albacore harvest to increase by more than 100 percent during 1996 to 1997. In 1998 a slight increase in albacore landings was recorded. The indicated total reported landings, however, will increase significantly when landings of the biggest domestic inboard longliner are included in future reports (WPRFMC, 1999d).

Landings in the domestic pelagic fishery are monitored by American Samoa's Department of Marine and Wildlife Resources (DMWR), through a program established in conjunction with the Western Pacific Fishery Information Network (WPacFIN). Table 3.10.4-5 uses DMWR information obtained by surveying domestic pelagic fishing activities throughout the year and shows landed weight by species and by gear type in American Samoa for 1998. Albacore is the primary target species of the domestic fishery, and constituted 72 percent of the total pelagic take. All tuna species combined constituted 85 percent of the total pelagic landings. The longline fleet brought in the bulk of total pelagic landings (97 percent).

Table 3.10.4-5: American Samoa Estimated Total Landings for Pelagic Species by Gear Type, 1998. Source: WPRFMC, 1999d.

Species	Landings by Fishing Sector (Pounds)		
	Longline	Troll	Total
Skipjack Tuna	35,306	18,767	54,073
Albacore	637,821	0	637,821
Yellowfin Tuna	73,942	1,110	75,052
Kawakawa	0	82	82
Bigeye Tuna	5,695	0	5,695
Unidentified Tunas	366	0	366
Subtotal Tunas	**753,130**	**19,959**	**774,695**
Mahimahi	30,021	940	30,961
Blue Marlin	41,203	894	42,097
Wahoo	36,017	235	36,252
Dogtooth Tuna	114	554	668
Sharks	7,196	208	7,404
Swordfish	3,231	142	3,373
Sailfish	6,604	97	6,701
Subtotal other PMUS	**124,386**	**3,070**	**127,456**
Other Miscellaneous	6,638	2,242	8,880
Total Pelagics	**884,154**	**25,271**	**909,425**

Table 3.10.4-6 shows the estimated commercial landings, value, and average price for each pelagic species in 1998 in American Samoa. Swordfish sold for the highest price per pound and skipjack tuna sold for the lowest price per pound. Recreational landings are not included in the table.

Table 3.10.4-6: American Samoa 1998 Estimated Commercial Landings, Value and Average Price of Pelagic Species, 1998. Source: WPRFMC, 1999d.

Species	Landings (lb)	Price Per Pound ($)	Value ($)
Skipjack Tuna	16,672	0.91	15,172
Albacore	636,622	1.07	683,254
Yellowfin Tuna	67,249	1.91	128,655
Kawakawa	20	1.20	24
Bigeye Tuna	5,478	2.14	11,741
Other Tunas	366	1.00	366
Subtotal Tunas	**726,484**	**1.16**	**839,730**
Mahimahi	22,220	2.01	44,560
Blue Marlin	35,646	1.13	40,268
Wahoo	26,110	1.95	51,042
Dogtooth Tuna	401	1.84	738
Swordfish	3,326	3.57	11,880
Sailfish	3,327	1.49	4,967
Subtotal other PMUS	**91,029**	**1.69**	**153,453**
Other Miscellaneous	3,346	1.72	6,268
Total Pelagics	**820,783**	**1.22**	**998,930**

Figure 3.10.4-4 shows total annual landings for all pelagic species, tuna, and other PMUS species for 1982-1998. Landings in all categories increased after 1993. In 1995 longlining vessels began operating in America Samoa, and their activity increased the annual landings. Data are collected by creel survey, which does not sample cannery landings. Including cannery landings in future reports will significantly increase the indicated total landings. Estimated landings for tuna and other PMUS were calculated by summing the total landings for the species in each category. Estimated landings for all pelagic species represent the sum of tuna and other PMUS plus landings from the miscellaneous category (see Table 3.10.4-5). These figures include both commercial and recreational/subsistence components of the fishery but do not include all landings made to the tuna cannery by the largest longliner (WPRFMC, 1999d).

Figure 3.10.4-4: American Samoa Total Annual Landings: All Pelagics, Tuna and Other PMUS, 1982-1998. Source: WPRFMC, 1999d.

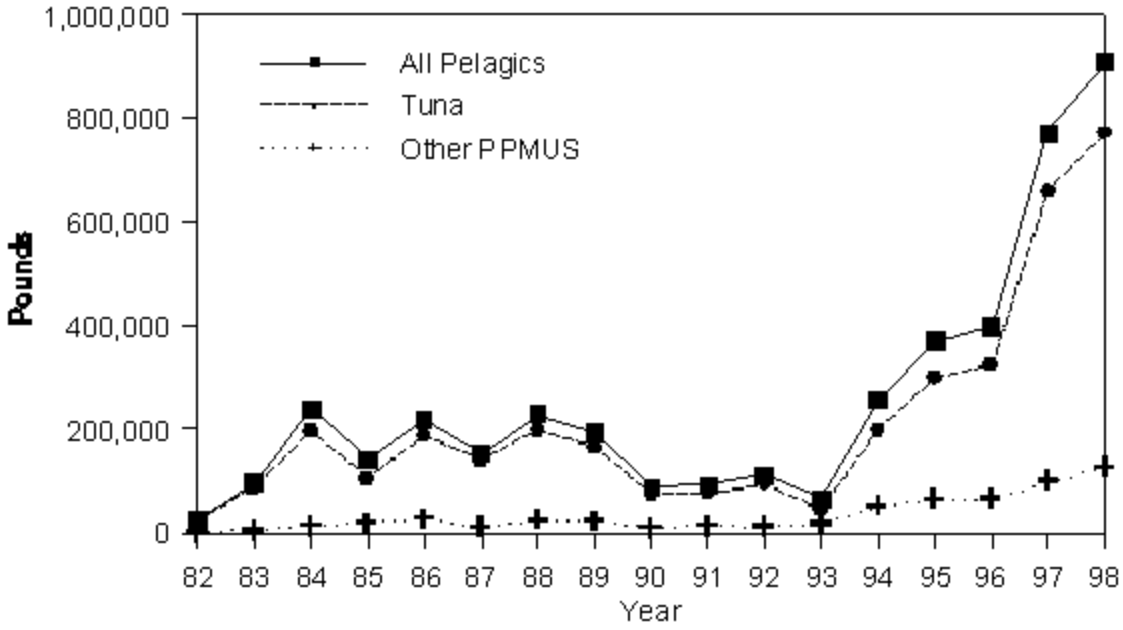


Figure 3.10.4-5 shows the fishing effort, in number of hours and trips, for trolling and longline vessels in American Samoa for 1982 to 1998. The increase in longline effort and decrease in trolling effort beginning in 1995 reflect the switch over by vessels from trolling to the more profitable longline fishing. For 1982 to 1994, estimated total annual landings were used as a base for estimating trolling effort. The resulting number was divided by the average trolling catch per hour (CPUE) to give an estimate of the hours trolled. Trolling CPUE was calculated using only those trips in which trolling was the only method used, and for which the number of hours was recorded. The number of trips was calculated by dividing the estimated total hours of effort by the average length of a trolling trip. For 1995, 1996, and 1997, total longline landings were subtracted from the total landings prior to using the above calculation, standardizing non-longline effort to trolling effort (WPRFMC, 1999d).

Figure 3.10.4-5: American Samoa Fishing Effort for Pelagic Species, 1982-1998.
Source: WPRFMC, 1999d.

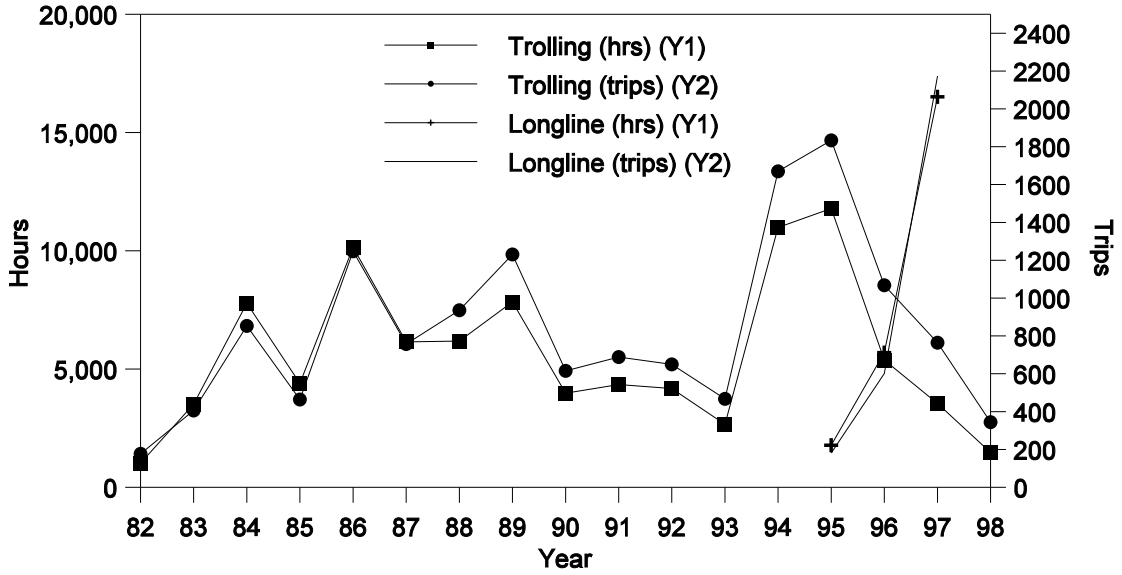


Table 3.10.4-7 shows the catch rate by species for the American Samoa longline fishery for 1996 through 1998. There was no notable change in catch rates or average size of fish from 1996 to 1997. In 1998 catch rates for albacore decreased, while average size increased. A three year period may not reflect the natural variation in the species and other fishery-related factors. Based on this table, the increase in total landings is likely due to an increase in the overall fishing effort, as opposed to the CPUE (WPRFMC, 1999d).

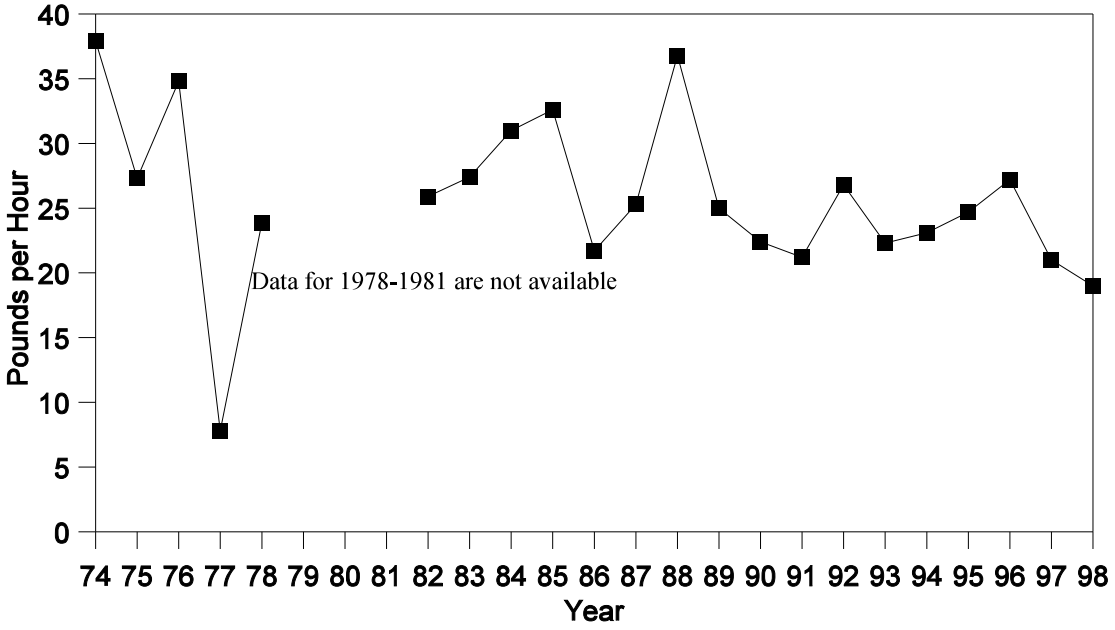
Table 3.10.4-7: Catch Rates by Species for the America Samoa Longline Fishery, 1996-1998. Source: WPRFMC, 1999d.

Species	1996	1997	1998	1996	1997	1998
	Number of fish per Thousand Hooks			Average Weight per Fish (lbs.)		
Albacore Tuna	30.91	31.18	20.3	40	43.9	45.5
Skipjack Tuna	0.3	0.6	3.9	9.6	8.4	12.4
Yellowfin Tuna	4.09	2.51	2.3	37.9	43.9	46.4
Bigeye Tuna	1.05	0.14	0.11	52.3	82.8	79.2
Mahimahi	1.25	2.81	1.84	26.3	25.6	23.2
Blue marlin	0.9	0.61	0.49	151.8	118	119
Wahoo	0.53	0.85	2.01	43	38.1	26.3
Sharks	0.4	0.18	0.09	109.4	98.9	114
Swordfish	0.03	0.01	0.02	150	100	213

Note: Estimated from sample data.

Figure 3.10.4-6 reflects the catch rate for vessels using trolling gear for American Samoa in 1974-1998 (with a gap in data for1978-1981). Skipjack and yellowfin tuna are the primary pelagic species taken with trolling gear in American Samoa. A decline in catch rates for trolling is seen beginning in 1995 and continuing to 1998.

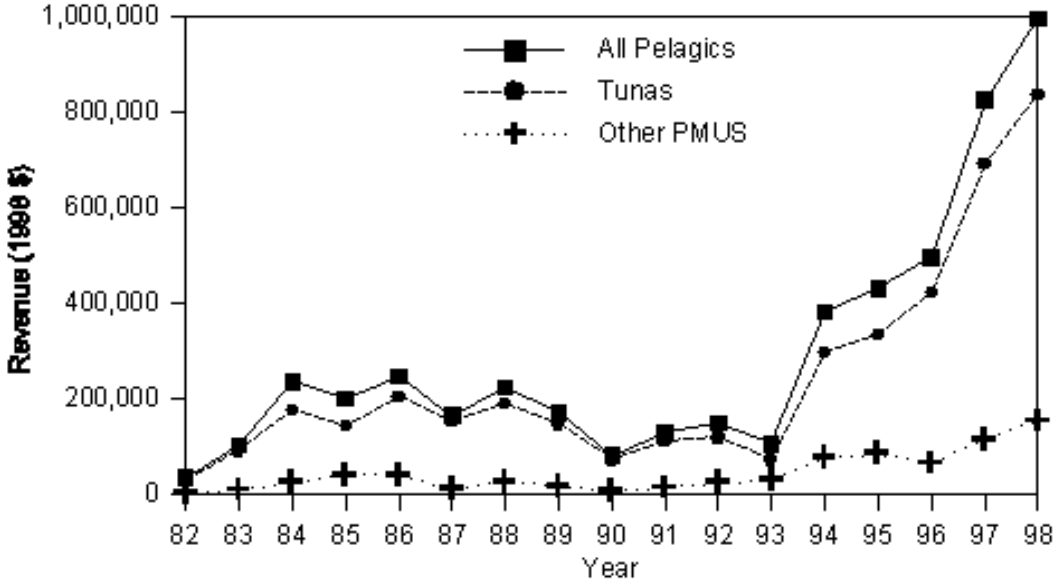
Figure 3.10.4-6: American Samoa Pelagic Fisheries, Overall Catch per Hour Trolling, 1974-1998. Source: WPRFMC, 1999d.



Note: For trips in which trolling was used exclusively and effort was recorded, the total catch was divided by the total number of trolling hours to obtain CPUE. Data are from three sources; 1974-1978 are from the Dory Project, 1992-1984 are from the commercial catch monitoring system, and 1985-1997 are from the creel survey program.

Figure 3.10.4-7 shows the annual inflation-adjusted gross revenue for the commercial pelagic fishery in American Samoa from 1982 to 1998. The increase in gross revenue within the pelagic fishery beginning in 1993 is due more to the increase in gross landings than to an increase in price. Gross revenues from commercial landings for all pelagic species were adjusted for inflation by multiplying a given year's gross revenue by the quotient of the 1998 consumer price index (CPI) divided by the CPI for that year.

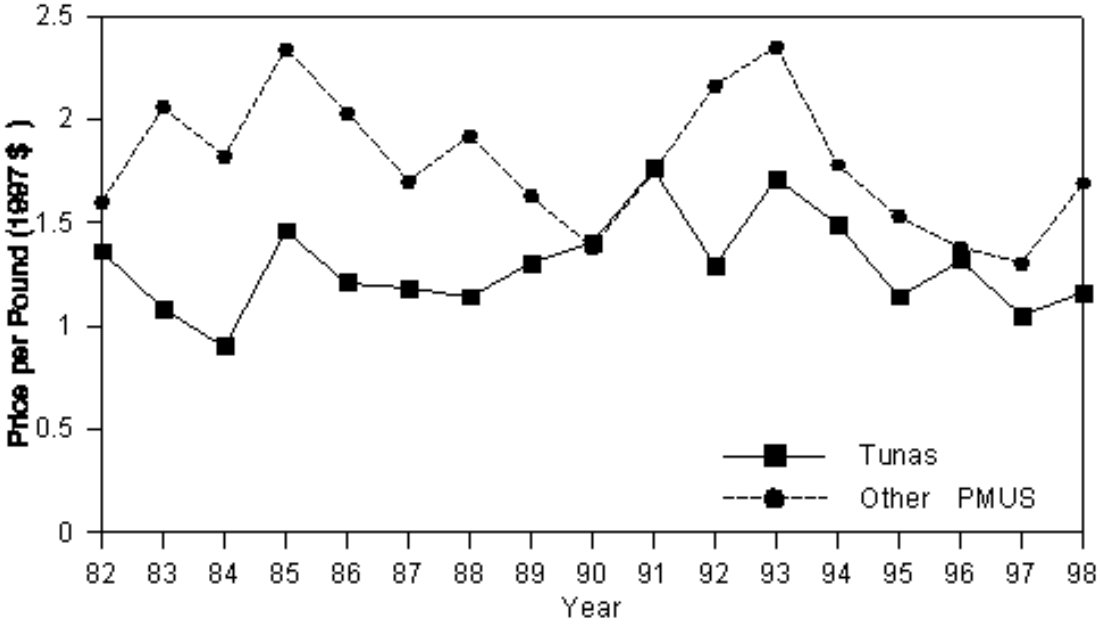
Figure 3.10.4-7: American Samoa Annual Inflation-Adjusted Gross Revenue for Commercially Landed Pelagic Species. Source: WPRFMC, 1999d.



Note: Gross revenues from commercial landings for all pelagic species were adjusted for inflation by multiplying a given year's gross revenue by the quotient of the 1998 consumer price index (CPI) divided by the CPI for that year.

Figure 3.10.4-8 shows the average inflation-adjusted price for tuna and other PMUS species in American Samoa for 1982 to 1998. Prices for pelagic species may remain low because of competition from frozen fish purchased from distant-water fleets (WPRFMC, 1999d).

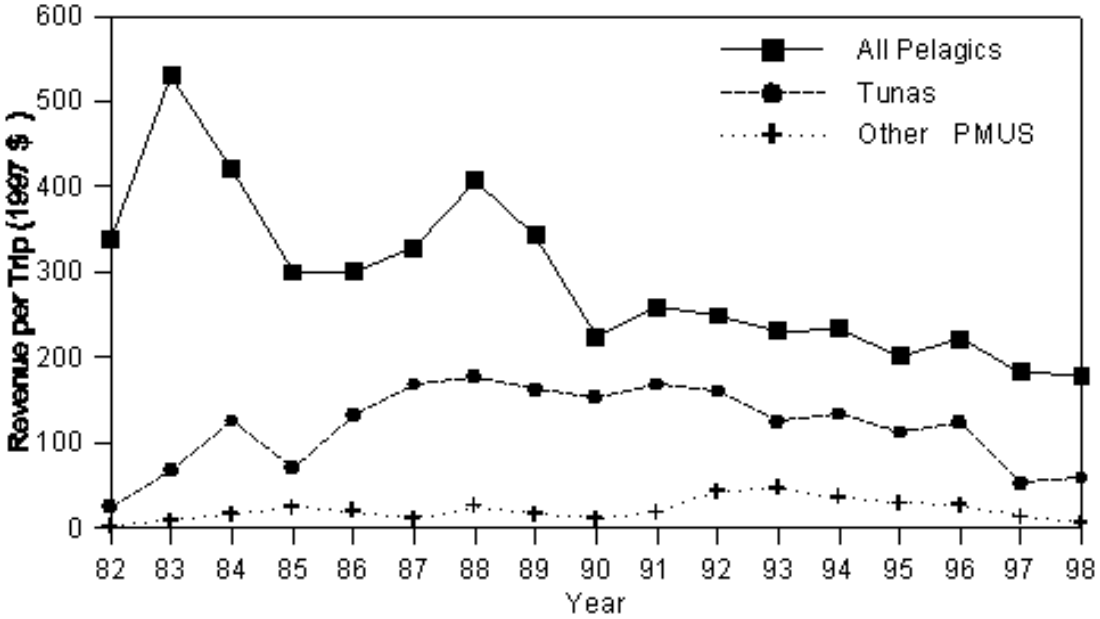
Figure 3.10.4-8: American Samoa Average Inflation-Adjusted Price for Tunas and Other PMUS, 1982-1998. Source: WPRFMC, 1999d.



Note: The average ex-vessel price per pound for each year was calculated by dividing the estimated gross revenue by the estimated weight sold. The adjustment for inflation was made by multiplying the annual average price for a given year by the 1996 CPI for American Samoa, and dividing by the CPI for the given year.

Figure 3.10.4-9 shows the average inflation-adjusted gross revenue per trip for non-longline vessels operating in America Samoa and landing PMUS for 1982 to 1998. This figure reflects the overall decrease in CPUE for most species caught by trolling vessels (WPRFMC, 1999d).

Figure 3.10.4-9: Average Inflation-Adjusted Gross Revenue per Trip for Troll Vessels, 1982-1998. Source: WPRFMC, 1999d.



Note: For commercial trips in which pelagic species were landed, the average gross revenue per trip was calculated for each category. Gross revenue was adjusted for inflation by multiplying it by the quotient of the 1998 CPI divided by the CPI for the respective years.

The following text and Table 3.10.4-8 provide estimates of average gross and net revenue and fixed and variable costs for small boats using longline gear. The discussion and table indicate that longline vessels in American Samoa that were surveyed by NMFS in 1997 generated an average of $39,520 in gross revenue, had fixed and variable costs of $24,600 resulting in net revenues of $14,920. The inset text and table were taken directly from WPRFMC, 2000f.

> Estimates of operating costs are based on a 1997 NMFS survey of *alia* vessels in American Samoa, and capital costs were estimated using information provided by Chapman (1998). Average trip revenues are derived from estimates of current effort, catch rates and average ex-vessel prices reported in WPRFMC (1998).
>
> It is estimated that the average 8.5 meters long (28 ft) *alia* catamaran equipped with longline gear earned a net revenue (before labor costs and taxes) of about $15,000 in 1997. Factors such as experience and skill level directly affect both revenues and costs and there is undoubtedly high variability across boats in the values of parameters. The cost-earnings analysis did not include a labor cost or identify how expenses, revenues and profits are shared among crew, captain and owner. Some owners pay each crew

member a flat salary, while others pay the crew a percentage of the revenues after certain expenses have been deducted. The average vessel is operated by a captain and three crew members. Most boats are not owner-operated.

Table 3.10.4-8: Average Annual Gross and Net Revenue (Before Labor Costs and Taxes) and Fixed and Variable Costs for a 8.5 meters long (28 ft) *Alia* Catamaran Using Longline Gear in the American Samoa Pelagic Fishery. Source: WPRFMC, 2000f.

Annual Revenue			
Number of fishing trips per year		100 (average trip length is 7.6 hrs)	
Number of hooks set per trip		214	
<>Catch per trip (lb)		Tuna - 300; Other PMUS - 50; Misc. fish - 5	
Ex-vessel price per pound ($)		Tuna - 1.06; Other PMUS - 1.40; Misc. fish - 1.44	
Total Gross Revenue		$39,520	
Required Capital			
Vessel [1]		13,000	
Engine		7,000	
Fishing gear (longline)		3,000	
Radio		200	
Safety		1,000	
Total Required Capital		24,200	
Fixed Costs		**Variable Costs**	
Debt service [2]	3,748	Fuel and oil	3,350
Insurance (5 percent)	1,210	Provisions	2,400
Maintenance and repair	1,500	Bait	10,300
Depreciation [3]	2,057		
Miscellaneous (permit, etc.)	35		
Subtotal	8,550	Subtotal	16,050
Total Costs		$24,600	
Net Revenue		$14,920	

[1] 28 ft *alia* catamaran constructed in American Samoa or Western Samoa.
[2] Debt service assumed to occur over a ten year period, with a 15 percent annual interest rate and 20 percent down payment.
[3] Depreciation calculated on a straight line, 15 percent salvage basis, assuming a vessel life span of ten years.

Reliable estimates of the total economic contribution of the domestic fishing fleets in American Samoa are currently unavailable. An analysis of the economic contribution of the distant-water fleet and transshipment industry in American Samoa, Guam, and the CNMI was undertaken in 1996 by Hamnett and Pinz (1996), but it does not appear that the input-output coefficients generated in that study can be applied reliably to the domestic longline fleet in American Samoa – the differences between the industrial-scale distant-water fleet

and the domestic fleet are simply too great. While it does not appear that reliable analytical estimates of the contribution of the domestic pelagic fisheries in American Samoa are available, it is certain that these fisheries are important both to the direct participants in the fishery and to consumers of their products. It is estimated that total reported sales from domestic pelagic fisheries approach $1 million per year. In addition to this direct effect, additional income and employment are created in the selling of inputs to fishers, and in the selling and handling of fish in the marketplace. While these additional impacts are not quantified, it can be expected that the additional economic output resulting from pelagic will be in the hundreds of thousands of dollars.

In summary, the American Samoa pelagic fishery is not directly affected by the western Pacific Pelagics FMP, except to the extent that domestic longliners are required to obtain general permits and to complete and submit federal logbooks. The trolling fleet is not directly affected by the Pelagics FMP at this time. Similarly, the FMP does not have regulations that currently restrict the activities of the distant-water purse seine fleet. Although the Pelagics FMP does not currently have a significant impact on the domestic fleets fishing within the American Samoa EEZ, fishing within the EEZ is governed by the plan, and future changes to the plan could have a direct impact.

3.10.5 Pelagic Fisheries in the Territory of Guam

This section describes the pelagic fisheries of the Territory of Guam. Pelagic fishing vessels based on Guam fall into two broad categories: (1) distant-water purse seiners and longliners that fish primarily outside the EEZ around Guam and transship through Guam; and (2) small, primarily recreational trolling boats that are either towed to boat launch sites or berthed in marinas and fish only local waters (within the EEZ around Guam or in the adjacent EEZ of the Northern Mariana Islands. This discussion covers primarily the local small boat pelagic fishery (WPRFMC, 1999d).

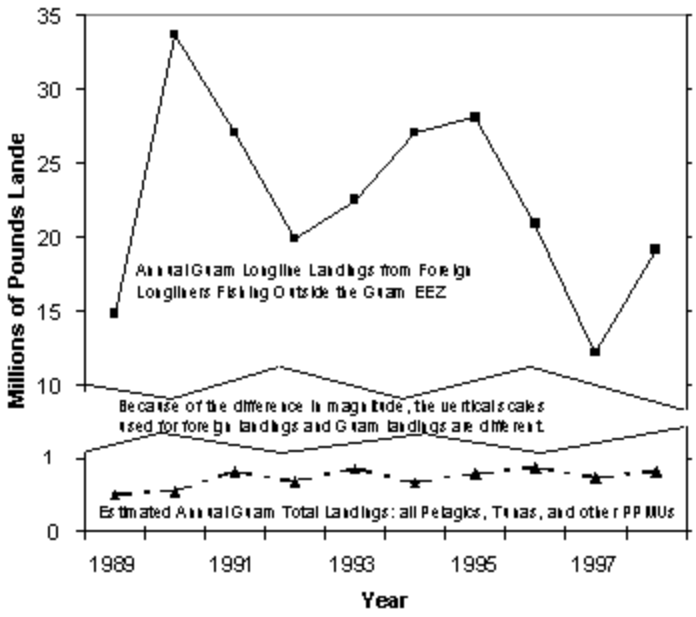
Much of the information used in this section was taken directly from reports published by NMFS and the Council. The primary sources used in this section of the document were as follows:

- NMFS. 2000. Pelagic Fisheries of the Western Pacific Region, Environmental Assessment for an Interim Period Pending Completion of an Environmental Impact Statement. August 2000.
- WPRFMC. 1999. Pelagic Fisheries of the Western Pacific Region. November 5, 1999.1998 Annual Report (Draft).

Figure 3.10.5-1 illustrates the difference in magnitude of estimated landings for a primarily foreign longline fishing fleet and for all small boat commercial landings on Guam since the

fishery began in the late 1980s. Landings from the primarily foreign longline fishing fleet ranged up to 34 million pounds of fish, primarily yellowfin and bigeye tuna. For the most part, these vessels fish outside the EEZ around Guam, but tranship their landings from Guam (WPRFMC, 1999d). Landings of PMUS by the small boat fleet ranged up to 865,000 pounds in 1996.

Figure 3.10.5-1: Guam Annual Landings: Landings from Foreign Longlines and Estimated Total Landings, 1989-1998. Source: WPRFMC, 1999d.



Aggregate landings of all pelagics, tuna, and non-tuna PMUS by the small boat fleet fluctuate greatly, but appear to be increasing. In the early 1980s, the pelagic landings consisted primarily of tunas. Then beginning in 1985, non-tuna PMUS, primarily *mahimahi*, began making up the bulk of the landings. The commercial landings of all pelagics also show a similar trend (WPRFMC, 1999d).

The total landings data are extrapolated from the Guam Division of Aquatic and Wildlife Resources (DAWR) offshore creel sampling program and other available commercial fishing data. Unfortunately, the information necessary to reconcile the difference between commercial and all landings is not available. Therefore, this analysis assumes that the balance of the total landings is associated with fishing for personal and recreational purposes.

Table 3.10.5-1 presents summary information on the Guam pelagic fishery for 1998. A total of 438 troll and charter vessels landed more than 817,000 pounds in 14,324 trips. The commercial vessels sold a total of 395,000 pounds (see Figure 3.10.5-10), for a total value of $711,066. The value of the remainder landed by noncommercial vessels (approximately 421,000 lb) was not reported in the data available.

Table 3.10.5-1: Pelagic Fishery Information for Guam, 1998. Source: Ito and Machado, 1999; Our Living Oceans 1999 Report, *in* NMFS, 2000j; WPRFMC, 1999d.

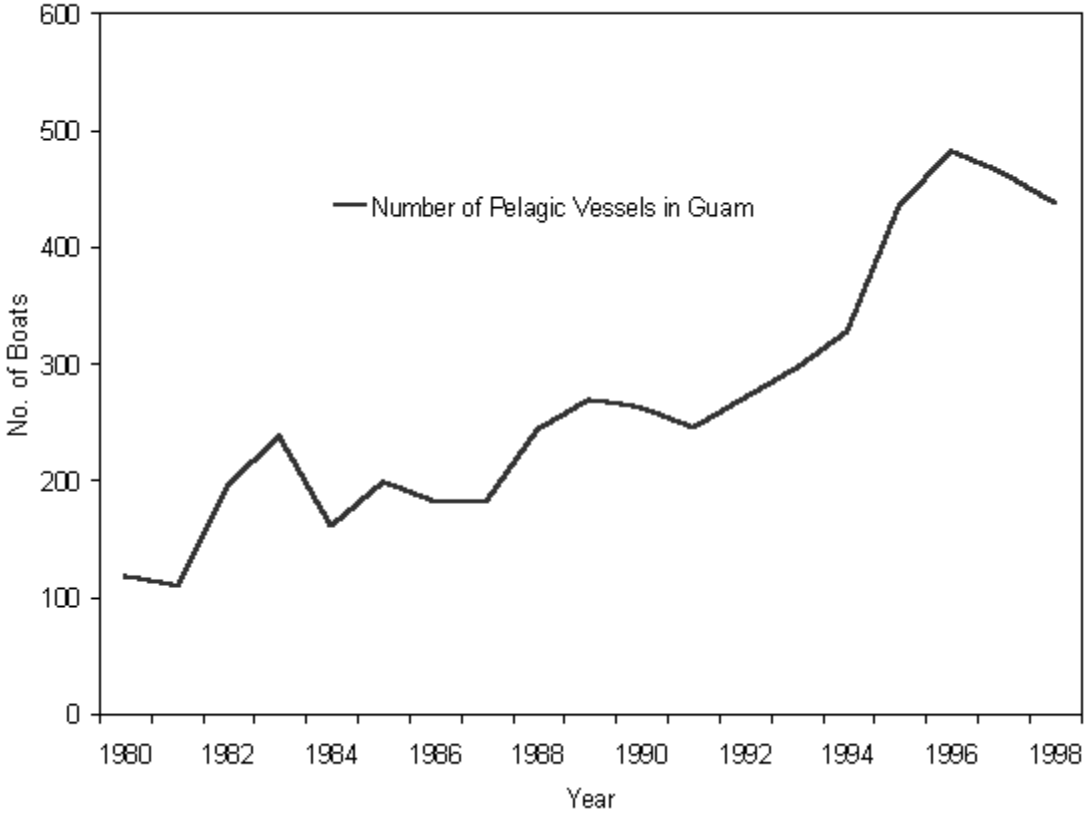
Gear	Troll/Charter
Area Fished	Inshore and EEZ
Total Landings	817,087 lb
Targets and Catch Composition	31% mahimahi 23% skipjack tuna 19% wahoo 17% yellowfin tuna
Season	All year
Active Vessels	438
Total Permits	NA
Total Trips	14,324
Total Commercial Landings	395,000 lb
Total Ex-vessel (Commercial) Value*	$711,066

*Data are available for commercial value, and unavailable for non-commercial values.

The domestic pelagic fishing vessels based in Guam are small, primarily recreational, trolling boats that are either trailered to launch sites or berthed in marinas (WPRFMC, 1999d). As of 1998, there were three vessels with general longline permits in Guam, but none were active (NMFS, 2000j). Quantitative demographic information about participants in the Guam troll fisheries is currently unavailable.

Figure 3.10.5-2 shows the historical number of vessels operating in Guam's domestic pelagic fishery. The number of boats steadily increased from 119 in 1980 to 482 in 1996. From 1996 to 1998 the number decreased to 438.

Figure 3.10.5-2: Number of Pelagic Vessels Operating in Guam, 1980-1998. Source: WPRFMC, 1999d.

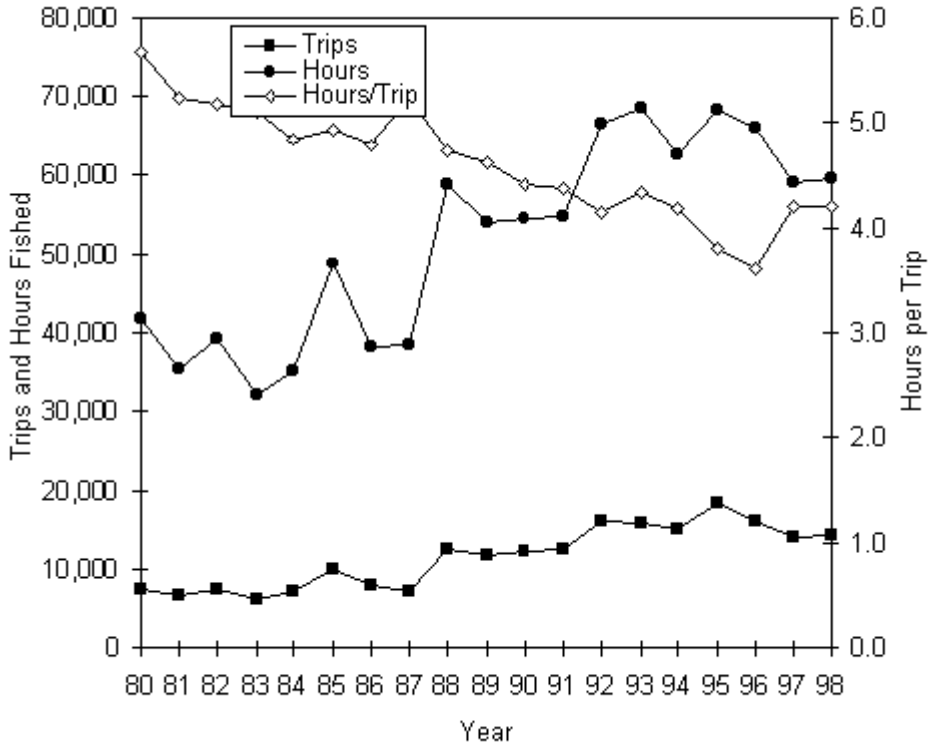


Most fishing boats are less than ten meters (33 ft) in length and are typically owner-operated by persons who earn a living outside of fishing (WPRFMC, 1999d). Most fishers sell a portion of their landings at one time or another, and it is difficult to distinguish among recreational, subsistence, and commercial fishers. A small, but significant, segment of the pelagic fleet consists of marina-berthed charter vessels that are operated primarily by full-time captains and crews (WPRFMC, 1999d).

In Guam, trolling with lures and (occasionally) baited hooks conducted from catamarans and other small commercial, recreational, and charter vessels in coastal waters, near seamounts, or around FADs. Charter boat activity decreased between 1997 and 1999, primarily because of a significant drop in the number of tourists as a result of the Asian economic crisis. Charter trolling trips decreased 26 percent, while non-charter trips increased by 15 percent. Charter trolling trips made up 25 percent of all trolling trips and 19 percent of hours spent trolling. The average duration of trolling trips was 3.2 hours for charter boats, and 4.5 hours for non-charter boats (WPRFMC, 1999d; Hamm, 2000).

Figure 3.10.5-3 illustrates that the trolling effort remained virtually the same in 1997 and 1998. The number of trolling trips and hours spent fishing increased slightly, while trolling trip length remained the same (WPRFMC, 1999d). Charter trolling trips decreased by 26 percent from 1997 to 1998.

Figure 3.10.5-3: Annual Estimated Number of Pelagic Trips, Total Hours Fished, and Average Trip Length, Guam, 1980-1998. Source: WPRFMC, 1999d.



Note: The data are from the DAWR offshore creel sampling program and its associated computerized data expansion system files. The expansion system is run on a calendar year's worth of survey data to produce catch and effort estimates for each fishing method surveyed. These plots are of the estimated hours spent fishing and number of trips for the trolling method, as taken directly from creel survey expansion system printouts (WPRFMC, 1999d).

3.10.5.1 Catch and Landings Data

Trolling catch rates vary widely for all pelagic species. As shown in Figure 3.10.5-4 and Figure 3.10.5-5, the trolling catch rate decreased for blue marlin and skipjack tuna, and increased for *mahimahi*, wahoo, and yellowfin tuna from 1980 to 1998. The CPUE was slightly higher for non-charter boats than for charter boats: 12.6 pounds per hour fished for non-charter boats, compared with 11.2 pounds per hour fished for charter boats (WPRFMC, 1999d).

Figure 3.10.5-4 shows that in 1998 the catch rate increased slightly (two percent) for mahimahi, increased 139 percent for wahoo, and decreased 53 percent for blue marlin from 1997. No general trend in CPUE is apparent (WPRFMC, 1999d).

Figure 3.10.5-4: Trolling Catch Rates for *Mahimahi*, Wahoo, and Blue Marlin, 1980-1998. Source: DAWR offshore creel sampling program and associated computerized data expansion system files (WPRFMC, 1999d).

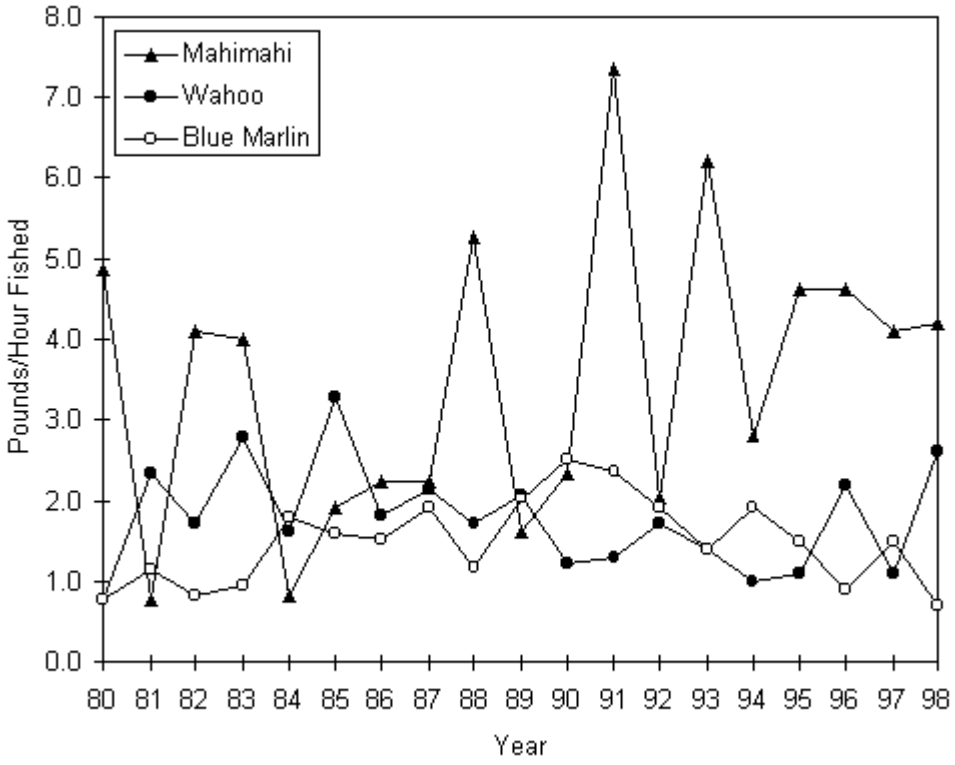
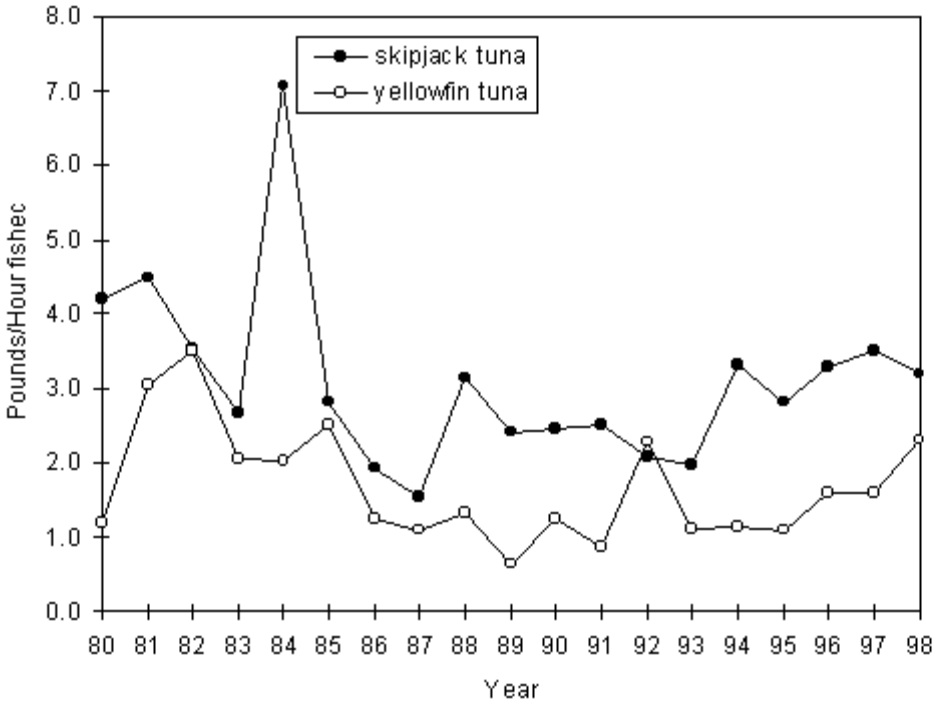


Figure 3.10.5-5 shows trolling catch rates for skipjack and yellowfin tunas for the period 1980 to 1998. The wide fluctuations in CPUE for both species are probably due to high variability in year-to-year abundance and availability of stocks. Since it is not possible to allocate species-specific effort, effort used to target other species can also result in an artificially high or low catch rate for a given species. Compared with 1997, the catch rate for yellowfin tuna increased by 30 percent, while the catch rate of skipjack tuna decreased by nine percent (WPRFMC, 1999d).

Figure 3.10.5-5: Guam Trolling Catch Rates: Skipjack and Yellowfin Tunas, 1980-1998. Source: DAWR offshore creel sampling program and its associated computerized data expansion system files (WPRFMC, 1999d).



There are wide year-to-year fluctuations in *mahimahi*, wahoo, marlin, and tuna landings. Yellowfin tuna landings declined from 1982 to 1989, then showed a general increase. Blue marlin began increasing in 1980, peaked in 1990, then showed a general decrease. Total landings of all pelagics, tuna, and non-tuna PMUS fluctuated, but appear to be increasing. In the early 1980s, pelagic landings consisted primarily of tunas. Then beginning in 1985, non-tuna PMUS, primarily *mahimahi*, began making up the bulk of pelagic landings. Commercial landings of all pelagics also show a similar trend (WPRFMC, 1999d).

Table 3.10.5-2 shows the estimated total landings of recreational and commercial PMUS in Guam in 1998. *Mahimahi* constituted the greatest percentage of total landings. Together, skipjack and yellowfin tuna made up 40 percent of the total. Estimates are based on statistical expansions of DAWR creel surveys.

Table 3.10.5-2: Total Landings of Recreational and Commercial PMUS in Guam, 1998. Source: WPRFMC, 1999d.

Species	Pounds Landed	Percent of Total
Sharks	8,017	0.98
Mahimahi	251,357	30.76
Wahoo	155,690	19.05
Blue Marlin	43,616	5.34
Skipjack Tuna	191,054	23.38
Yellowfin Tuna	137,881	16.87
Kawakawa	3,576	0.44
Other Species	25,896	3.17
Total Pelagics	**817,087**	**100.00**

Historical total landings of PMUS are shown in Figure 3.10.5-6 through Figure 3.10.5-9. The figures reflect estimates of both recreational and commercial landings. All of the data in the figures were developed using data from the DAWR offshore creel sampling program. A 365-day (366 days during leap years) expansion was run for each calendar year of survey data to produce catch and effort estimates for each fishing method surveyed. Percent of species composition was calculated by weight for the sampled catch for each method to produce catch estimates for each species for the expanded period. The annual landings for all pelagic species and for the PMUS separately were summed across all methods to obtain the numbers plotted in Figure 3.10.5-6.

In 1981 and 1984 the bulk of pelagic landings consisted of tunas. Figure 3.10.5-6 shows that after 1984 non-tuna PMUS began making up the bulk of pelagic landings due to an interest in targeting blue marlin, an increase in *mahimahi* landings, and a lack of interest in skipjack tuna. In 1998, total pelagic landings increased ten percent, tuna landings increased nine percent, and non-tuna PMUS increased nine percent. Charter trolling trips accounted for 15 percent of overall pelagic landings (WPRFMC, 1999d).

In 1998, skipjack tuna landings decreased by nine percent from 1997 landings, while yellowfin tuna landings increased 52 percent, as depicted in Figure 3.10.5-7. For most years, skipjack landings exceeded yellowfin landings by a two-to-one ratio. Given the relative unmarketability of skipjack tuna in the local market and the desirability of yellowfin tuna, the availability of skipjack tuna probably exceeds yellowfin availability by a wider margin.

Figure 3.10.5-8 shows *mahimahi* and wahoo landings in Guam for 1980-1998. *Mahimahi* remained the most important pelagic species in Guam's small boat fishery. Both species

show a pattern of long-term, extreme fluctuations, especially *mahimahi*. Virtually all landings were done by the trolling method (WPRFMC, 1999d).

Figure 3.10.5-6: Landings for Pelagic Species, Tunas and Other PMUS, Guam, 1980-1998. Source: The data are from the DAWR offshore creel sampling program (WPRFMC, 1999d).

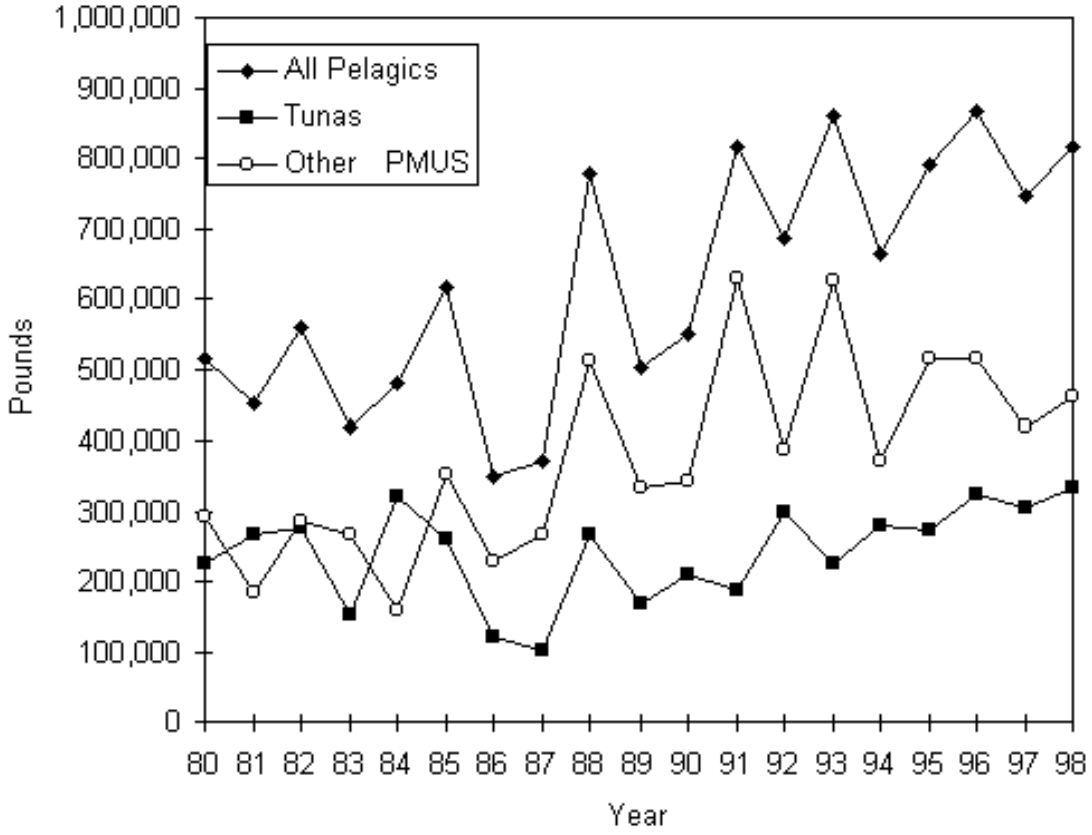


Figure 3.10.5-7: Total Landings of Skipjack and Yellowfin Tuna, Guam, 1998. Source: The data are from the DAWR offshore creel sampling program (WPRFMC, 1999d).

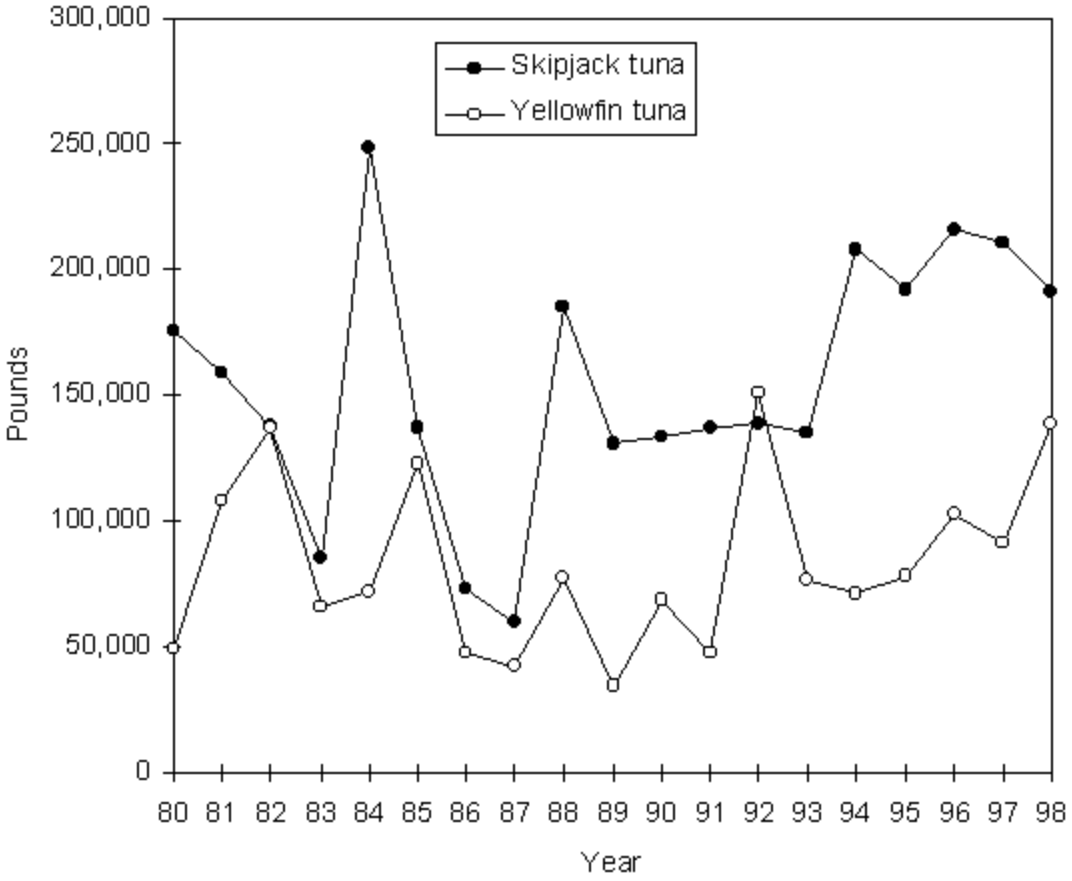


Figure 3.10.5-8: ***Mahimahi* and Wahoo Landings, Guam, 1980-1998.** Source: The data are from the DAWR offshore creel sampling program (WPRFMC, 1999d).

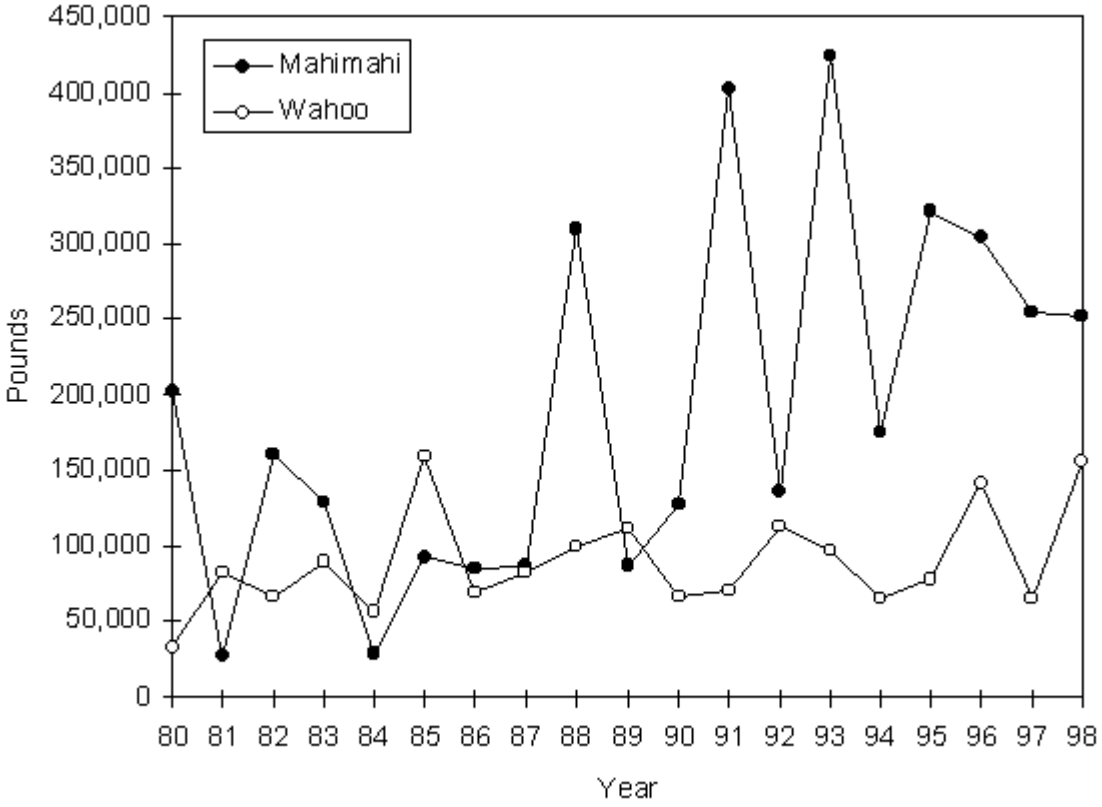
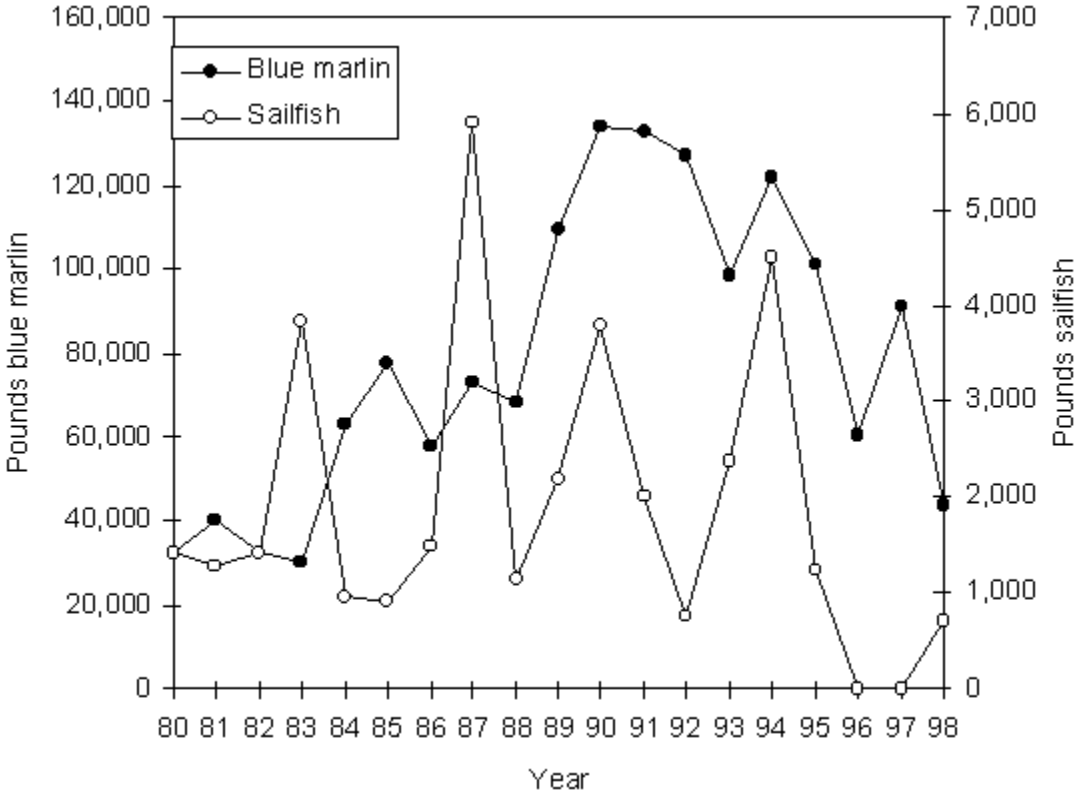


Figure 3.10.5-9 shows that blue marlin landings decreased by 52 percent from 1997 to 1998. A 26 percent decrease in charter boat trips during 1998 probably contributed to the decrease in blue marlin landings (WPRFMC, 1999d). Sailfish, which were not encountered during offshore creel surveys in 1996 and 1997, had an estimated landing of 700 pounds in 1998. The rapid increase in marlin landings beginning in 1988 may have been due to an increase in charter boat activity and targeting of this species by charter boats during the marlin season. After 1991, annual marlin landings generally decreased. All landings of blue marlin were by the trolling method.

Figure 3.10.5-9: Blue Marlin and Sailfish Landings, Guam 1980-1998. Source: The data are from the DAWR offshore creel sampling program (WPRFMC, 1999d).

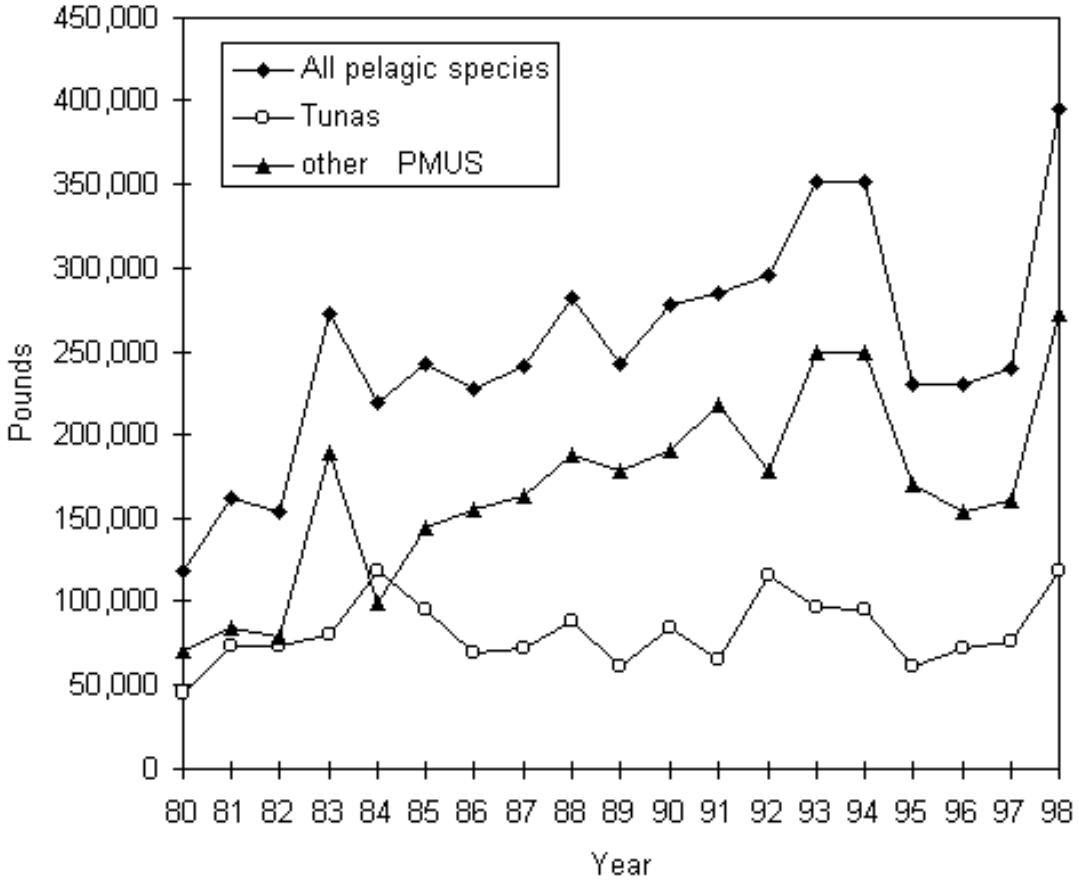


Commercial landings for all pelagic species, as shown in Figure 3.10.5-10, were approximately 400,000 pounds. The difference in landings between Figure 3.10.5-6 and Figure 3.10.5-10 reflects the recreational activities in the Guam pelagic fishery. The commercial pelagic fishery landings appear to have increased over the 18-year period, especially with the growth of the charter boat industry. In 1998, commercial landings increased 65 percent for all pelagics, increased 56 percent for tunas, and increased 71 percent for non-tuna PMUS. The increase in commercial landings may be due partly to major vendors competing for pelagic fish and improving their marketing (WPRFMC, 1999d).

The total estimated commercial landings for each year were calculated by summing the weight fields for the principal fish wholesalers on Guam in the DAWR commercial landings data base, and then multiplying by an estimated percentage for a coverage expansion factor. The annual expansion factors were created subjectively based on as much information as possible, depending on the year. The types of information incorporated include an analysis of the "disposition of catch" data from the DAWR offshore creel survey, an evaluation of the

fishermen in the fishery and their entry/exit patterns, general dockside knowledge of the fishery and the status of the marketing conditions and structure, the overall number of records in the database, and a certain measure of best guesses (WPRFMC, 1999d).

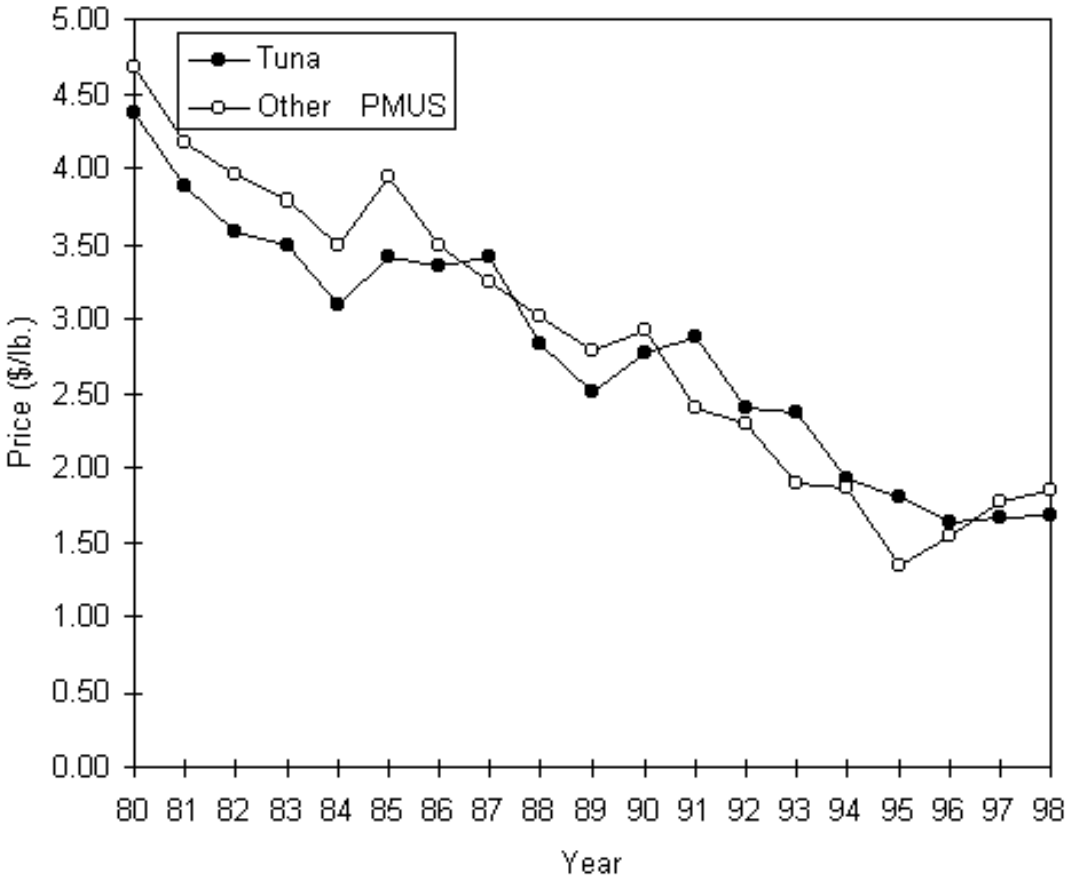
Figure 3.10.5-10: Annual Estimated Commercial Landings: All Pelagic Species, Tuna and Other PMUS, Guam, 1980-1998. Source: The WPacFIN-sponsored commercial landings system, WPRFMC, 1999d.



Commercial landings and commercial gross revenues for all pelagics, tuna, and non-tuna PMUS increased in 1998 from 1997, especially with non-tuna PMUS (See Figure 3.10.5-12). This increase may have been due to improved marketing of pelagic fish by vendors and competition among major vendors for pelagic fish (WPRFMC, 1999d). Inflation-adjusted gross revenues per trolling trip show a general decline, although they increased slightly in 1998. Since the vast majority of boaters in the pelagic fishery do not rely on catching or selling fish for a living, effort continues to occur, despite decreasing gross revenues. The average price of tuna and non-tuna PMUS also show a general decline, although the price of non-tuna PMUS increased after 1995 (WPRFMC, 1999d).

The inflation-adjusted price of tunas and other PMUS shows a general decline during the 18-year period from 1980 to 1998, although the adjusted price of PMUS increased from 1996 to 1998. Compared with 1997 prices, the 1998 adjusted price for tuna and other PMUS increased slightly, by one percent and four percent, respectively. The increase in price despite an increase in landings may be due to better marketing and an increased demand for pelagic fish. The average prices are depicted in Figure 3.10.5-11 (WPRFMC, 1999d).

Figure 3.10.5-11: Average Inflation-Adjusted Price of Tunas and Other PMUS, Guam, 1980-1998. Source: WPRFMC, 1999d.



The average ex-vessel prices of the tunas and other PMUS groups were calculated by dividing the total gross revenue for each species by the sold weight. The inflation adjustment was made by using the CPI for Guam and establishing the current year figure as the base from which to calculate expansion factors for all previous years (dividing the current year CPI by the CPI of any given year), and then multiplying that factor by the unadjusted average price for the given year (WPRFMC, 1999d). Estimated prices for the major commercial species in Guam are shown in Table 3.10.5-3.

Table 3.10.5-3: Average Ex-vessel Prices for Commercial Landings in Guam, 1998. Source: WPRFMC, 1999d.

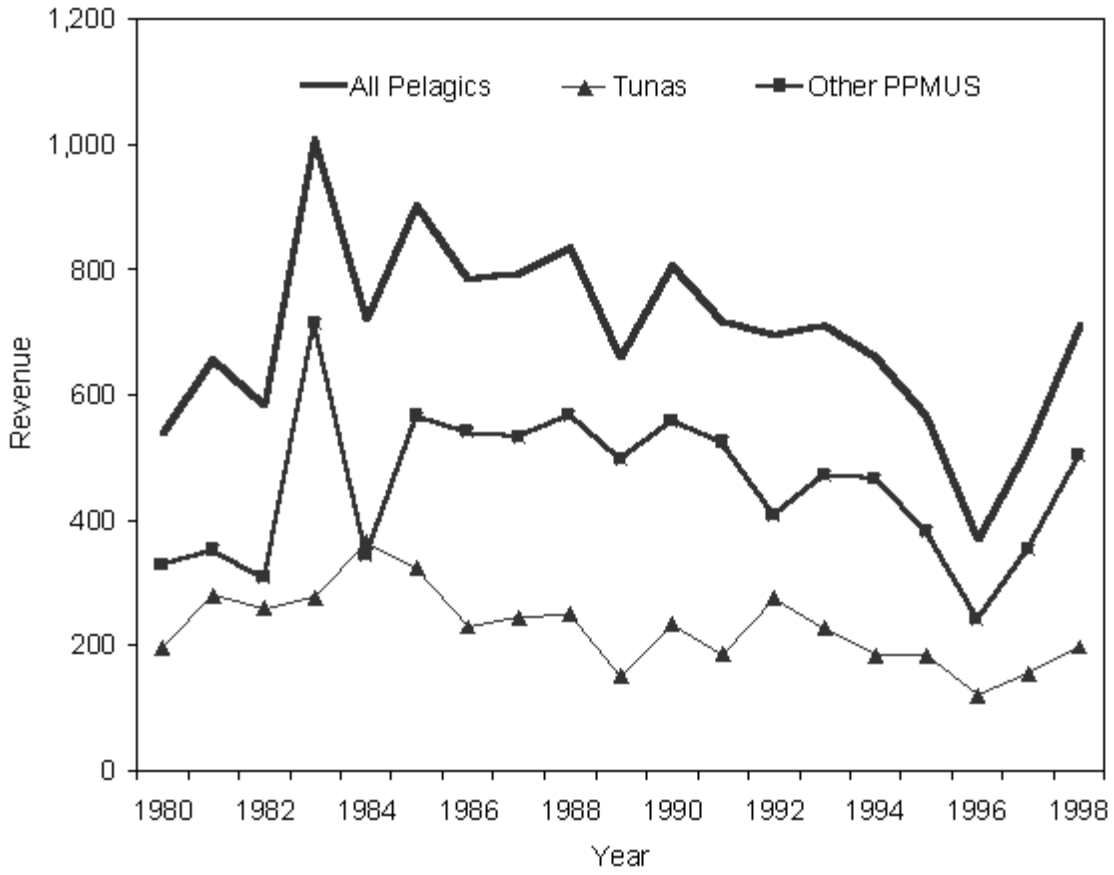
Species	Average Price ($ per Pound)
Sharks	0.5
Mahimahi	1.84
Wahoo	2.17
Marlin	1.15
Skipjack Tuna	1.25
Yellowfin Tuna	2.16
Kawakawa	1.27
Average All Pelagics	**1.8**

Note: The data are from the DAWR sponsored commercial landings system.

Adjusted gross revenues in 1998 increased for all pelagics, tunas, and other PMUS, compared to 1997 gross revenues. Gross revenues increased by 37 percent for all pelagics, by 27 percent for tunas, and by 43 percent for other PMUS. Figure 3.10.5-12 illustrates the inflation-adjusted gross revenues. The increase in ex-vessel revenue mirrors the increase observed in commercial landings. The increase in gross revenue may be due to better marketing by fish vendors, competition for pelagic fish among major fish vendors, and an increased demand for fish (WPRFMC, 1999d).

The total estimated gross revenue for each year (Figure 3.10.5-12) was calculated by summing the revenue fields for the principal fish wholesalers on Guam from the commercial landings data base, and then multiplying by the same percent coverage expansion factor as used for the landings in Figure 3.10.5-10. Inflation-adjusted total gross revenue per trip is derived from the Guam annual CPI (WPRFMC, 1999d).

Figure 3.10.5-12: Annual Estimated Commercial Inflation-Adjusted Total Gross Revenues: all Pelagics, Tunas, and Other PMUS, Guam, 1980-1998. Source: WPRFMC, 1999d.

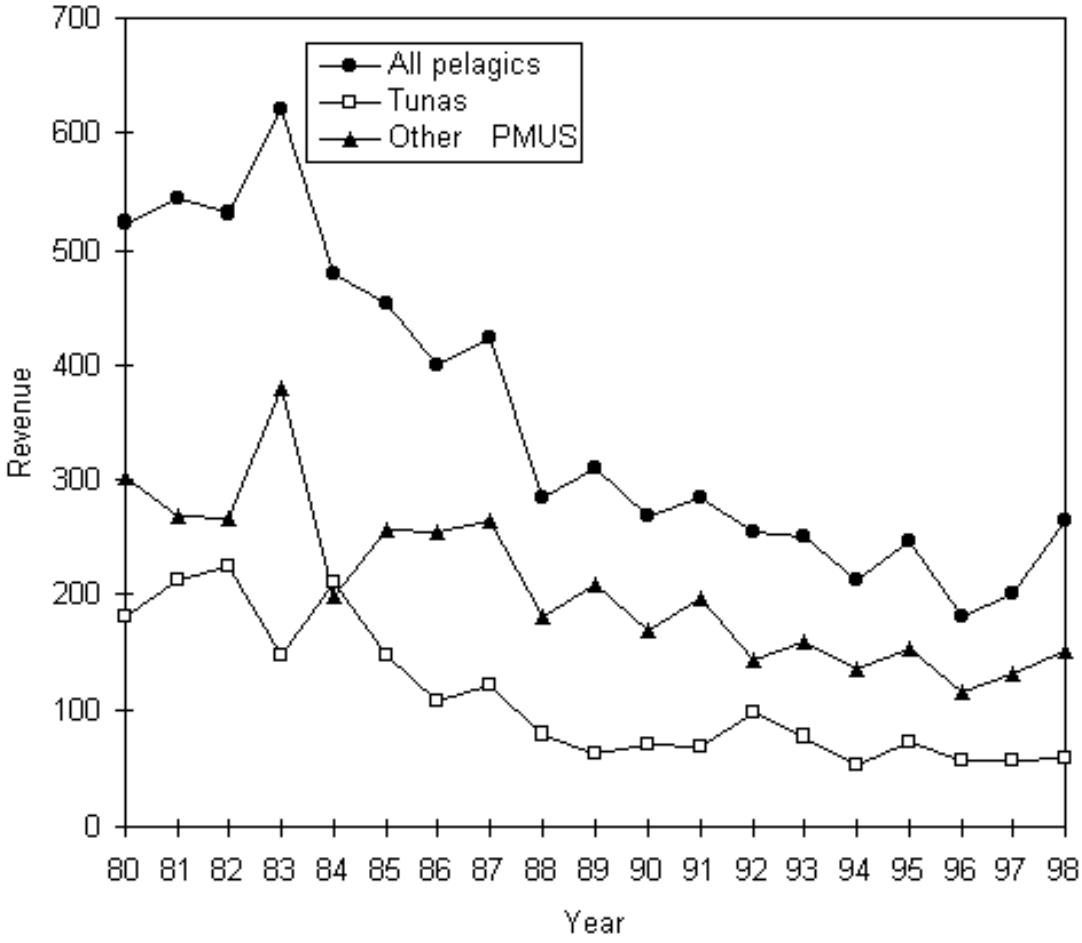


Note: The data are from the DAWR-sponsored commercial landings system.

The adjusted gross revenue per trip for all pelagics, tunas, and other PMUS increased in 1998, as shown in Figure 3.10.5-13. Adjusted gross revenue per trip increased by 32 percent for all pelagics, increased slightly (three percent) for tunas, and increased by 16 percent for other PMUS. Care must be taken in interpreting these data, since the Guam fishery is subject to biases created by marketing problems and the market structure upon which the data collecting system is based. During 1988, 1991, and 1993, record highs in the abundance and landings of *mahimahi* did not result in high gross revenues per trolling trip. A glut in the market and other marketing problems during those years resulted in low gross revenues per trolling trip. Beginning in 1997, however, several major fish vendors began competing for pelagic fish, with one placing no limit on fish sold to it by its members. Despite revenue fluctuations, effort still occurs since most charter and non-charter trolling boats do not rely on selling their fish for a living (WPRFMC, 1999d).

The average gross revenue per trip was calculated by summing the gross revenue of all species sold, then dividing by the number of trips, and summing the gross revenue of tunas and other PMUS sold, and then dividing each by the number of trips, respectively, for any trip that landed PMUS. Adjusted gross revenue per trip was derived from the Guam CPI (WPRFMC, 1999d).

Figure 3.10.5-13: Inflation-Adjusted Gross Revenues per Trolling Trip: all Pelagics, Tuna, and Other PMUS, Guam, 1980-1998. Source: WPRFMC, 1999d.



Note: The data are from the WPacFIN-sponsored commercial landings system.

Reliable estimates of the total economic contribution of the domestic fishing fleets in Guam are currently unavailable. An analysis of the economic contribution of the distant water fleet and transshipment industry in American Samoa, Guam, and the CNMI was undertaken by Hamnett and Pintz in 1996, but it does not appear that the input-output coefficients generated in that study can be reliably applied to Guam's troll fleet – the differences

between the industrial-scale distant-water fleet and the domestic troll fleet are simply too great.

3.10.6 Pelagic Fisheries in the Commonwealth of the Northern Mariana Islands

This section describes the pelagic fisheries of the Commonwealth of Northern Mariana Islands (CNMI). The CNMI is a string of islands in the western Pacific Ocean (longitude 145° E., and latitude 14° N. to 21° N.). Inhabitants live on three primary islands: Saipan, Rota, and Tinian. The pelagic fishery activities occur primarily from the island of Farallon de Medinilla south to the island of Rota (NMFS, 2000e). Commercial, subsistence, and recreational fishing are practiced.

Much of the information used in this section was taken directly from reports published by NMFS and the Council. All data included in this report are collected from Saipan only (WPRFMC, 1999d). The primary sources are as follows:

- NMFS. 2000. Pelagic Fisheries of the Western Pacific Region, Environmental Assessment for an Interim Period Pending Completion of an Environmental Impact Statement. August 2000.
- WPRFMC. 1999. Pelagic Fisheries of the Western Pacific Region. November 5, 1999. 1998 Annual Report (Draft).

In addition, the CNMI pelagic fishery description is based on data in the Commercial Purchase Data Base maintained by the Commonwealth Department of Lands and Natural Resources, Division of Fish and Wildlife (DFW). The data are collected from purchasers of fresh local fish, who report their purchases on special invoice forms. DFW staff are responsible for distributing and collecting invoice books from 60 to 70 participating local fish purchasers on Saipan. Purchasers include stores, restaurants, hotels, and roadside vendors ("fish-mobiles") (WPRFMC, 1999d).

The Saipan data collection system has been in operation since the mid-1970s. In 1982 improvements were made in the data collection method, and data collected since 1983 are considered reliable (WPRFMC, 1999d). In 1998 the commercial purchase database collection system documented only landings on Saipan. However, a data collection system for Tinian and Rota was implemented in mid-1999 (Hamm *et al.*, 1999). Overall, it is believed that the Commercial Purchase Data Base landings reports include more than 90 percent of all commercial landings on Saipan, and more than 80 percent of all CNMI commercial landings (WPRFMC, 1999d). Noncommercial landings of pelagic species for subsistence, recreational, or personal uses typically are not included in the data sets.

Trolling is the most common fishery in the CNMI, with bottomfishing and reef fishing also conducted (Glazier, 1999). The product is primarily skipjack tuna. This fishery is on the increase, most likely due to increasing population in CNMI (WPRFMC, 1999d). All domestic commercial fishery product is consumed locally. Yellowfin and *mahimahi* are targeted to a lesser degree, and are easier targets for the local fishermen during seasonal runs. (Yellowfin are preferred to skipjack, but are rarely encountered.) These species are accepted by all ethnic groups in the CNMI and have maintained their market demand with the ongoing in-migrating population growth on Saipan (more than half of the population on Saipan is non-native) (WPRFMC, 1999d).

No large-scale longline or purse seine activity occurs around the CNMI at this time. However, fishery development consultants for the CNMI have suggested providing incentives for the longline fleet to move into CNMI waters (University of Hawai'i, 2000). If longline fleets move into the CNMI, the domestic commercial fisheries will be affected. Currently only one vessel in CNMI has a General Longline Permit, which allows the vessel to fish with longline gear in the EEZs of CNMI, Guam, and American Samoa. This vessel was not active as a longliner in 1998 (WPRFMC, 1999d).

Table 3.10.6-1 provides a summary of the CNMI-based troll and charter fishery for 1998. The table is based on a similar table in NMFS (2000j), and shows that 89 active vessels landed approximately 192,568 pounds of PMUS, of which 70 percent was skipjack tuna and the remaining 30 percent consisted of mahimahi, dogtooth and yellowfin tuna. The fish were harvested over 2,230 trips and generated an estimated $398,000 in ex-vessel revenue.

Table 3.10.6-1: Pelagic Fishery Information for Commonwealth of the Northern Mariana Islands for 1998. Source: Ito and Machado, 1999 and Our Living Oceans 1999 Report, *both in* NMFS, 2000j.

Gear	Troll/Charter
Area Fished	Inshore and EEZ
Total Landings	192,568 lb
Catch Composition	70% skipjack tuna 11% mahimahi 8% dogtooth tuna 6% yellowfin tuna
Season	All year
Active Vessels	89[a]
Total Permits	NA
Total Trips	2,230
Total Ex-vessel Value	$398,086

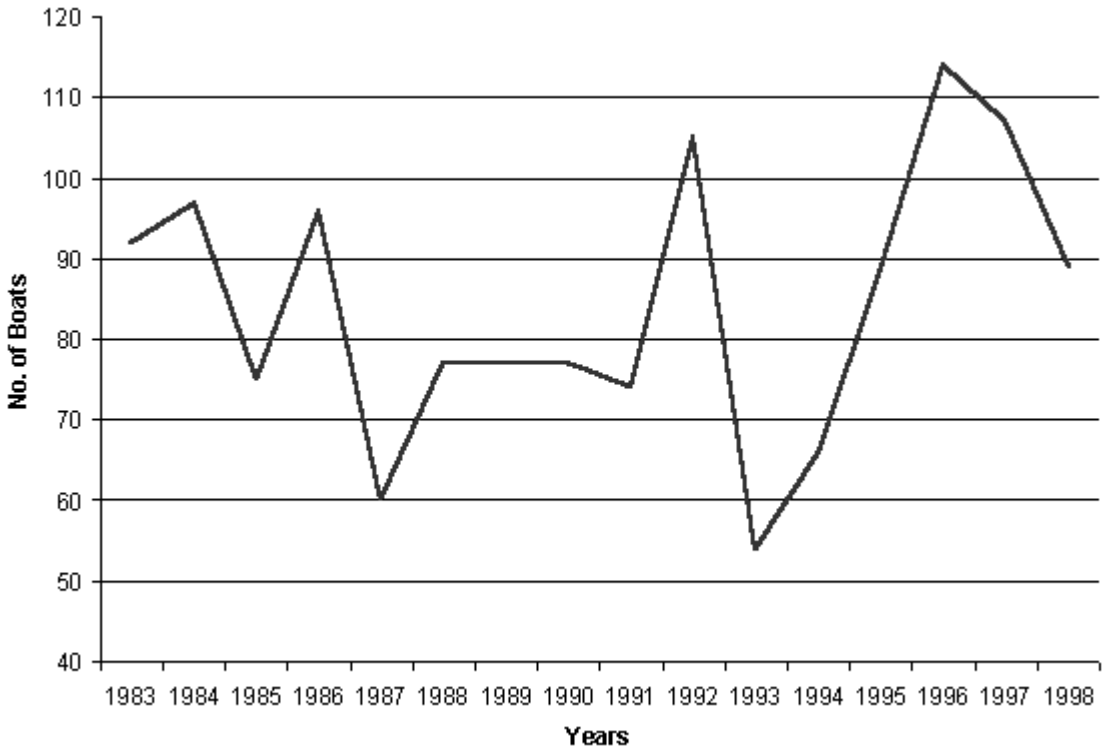
Note: Available data currently indude only commercial landings on Saipan – no data from other CNMI islands are included. Comprehensive data showing the total number of vessels that landed PMUS in CNMI do not exist.
[a] This number was estimated by counting the individual fishers that made commercial landings of any pelagic species in Saipan (WPRFMC, 1999d).

Because skipjack are common in nearshore waters off the CNMI, these fish are caught with minimal travel time and fuel costs. Trolling is the primary gear. Most trips are less than a full day. Trolling for skipjack tuna takes place throughout the year. The *mahimahi* season is February through April, and the yellowfin season is April to September (WPRFMC, 1999d).

The pelagic fishing fleet, other than charter boats, consists primarily of vessels less than 7.32 m (24 ft) in length, which usually travel in a limited 20-mile radius from Saipan (WPRFMC, 1999d). Most are 3.66-7.32 m (12-24 ft), outboard-powered, runabout-type vessels (NMFS, 2000e).

Figure 3.10.6-1 shows the number of individual vessels making commercial landings of skipjack tuna in Saipan from 1983 through 1998. The figure assumes that the number of individuals associated with commercial landing invoices equals the number of active commercial vessels. A 30 percent increase from 1991 to 1992 is shown. It is believed this increase is attributable to an influx of money into the local economy, and to fishers using more than one boat. Many of the new boats were believed to have left the fishery in 1993 and re-entered in 1994 (WPRFMC, 1999d). It is also possible that the variation in the estimated number of vessels is due in part to the lack of a comprehensive reporting system.

Figure 3.10.6-1: Estimated Number of Vessels Making Commercial Landings of Skipjack Tuna in Saipan, CNMI, 1998. Source: WPRFMC, 1999d.



Note: The data in the figure are derived from invoices in the DFW Commercial Purchase Data Base. The invoice records the name of the fisher from whom the fish were purchased. In this figure, each individual listed is assumed to have used a different vessel.

To fish commercially within the EEZ around CNMI, vessels weighing more than five net tons must have a Commercial Fishing License issued annually by the DFW. The DFW may impose restrictions on the license, depending on the form of the application. All fishing boats, regardless of size, must register with the CNMI Department of Public Safety (DPS) (WPRFMC, 1999d).

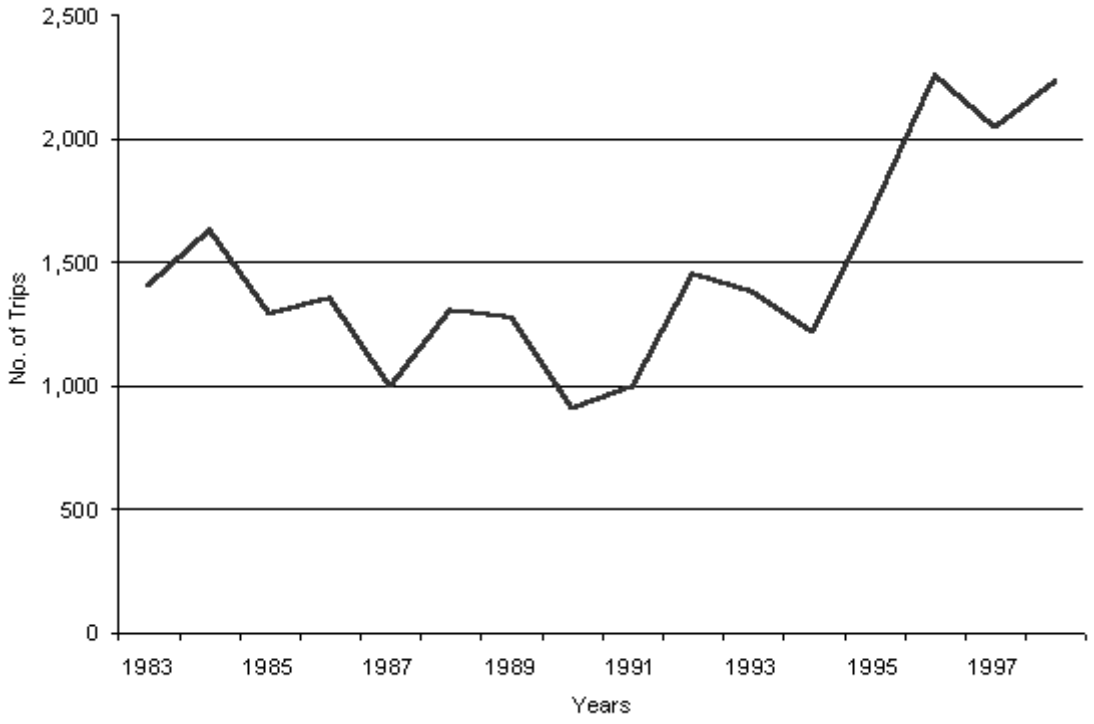
According to WPRFMC (1999d), about 82 percent of all boats registered with the DPS participated in some form of fishing activity in the CNMI in 1998 (75 full-time commercial, 65 part-time commercial, and 143 subsistence/ recreational). Of the registered vessels, 24 were charter vessels, which generally retain their landings and sell to local markets (WPRFMC, 1999d). The amount of charter boat sales is not known. However, it constitutes a small portion of the local fish market, and most fish are typically consumed by the charter crew (Hamm *et al.,* 1999).

Official estimates of the number of crewmembers involved in the commercial fishery in CNMI are not available. However, since the primary gear is trolling, it is reasonable to assume that there is one crew person in addition to the skipper, as is typical on troll boats in Hawai'i (Hamilton and Huffman, 1997).

Most vessels in the CNMI pelagic fishery are based on Saipan. Although available data do not indicate actual residence of vessel owners, it is reasonable to assume that most landings in Saipan are made by residents of Saipan.

Figure 3.10.6-2 shows the estimated number of trips with pelagic fish landings in the CNMI, based on invoices for commercial landings for 1983-1998. As the figure shows, the number of trips increased steadily after 1990.

Figure 3.10.6-2: Number of Reported Commercial Fishing Trips with Pelagic Landings in CNMI, 1993-1998. Source: WPRFMC, 1999d.



Note: Total trips for all pelagic species were derived from the Commercial Purchase Data Base. Trips were calculated based on the assumptions that no fisher made more than one trip per day, and that all sales from a single trip were made on a single day (WPRFMC, 1999d).

3.10.6.1 Catch and Landings Data

Figure 3.10.6-3 shows catch per trip of the primary species in the pelagic fishery of the CNMI from 1983 to 1998. As reflected in the figure, landings of skipjack declined significantly beginning in 1990. It is possible that non-tuna PMUS landings are increasing in value and the target of troll fishers is changing (WPRFMC, 1999d). The decline in landings may also be attributable to oceanographic conditions caused by the recent *La Niña* phenomenon (WPRFMC, 1999d).

Figure 3.10.6-3: Catch Rates of PMUS in CNMI, 1983-1998. Source: WPRFMC, 1999d.

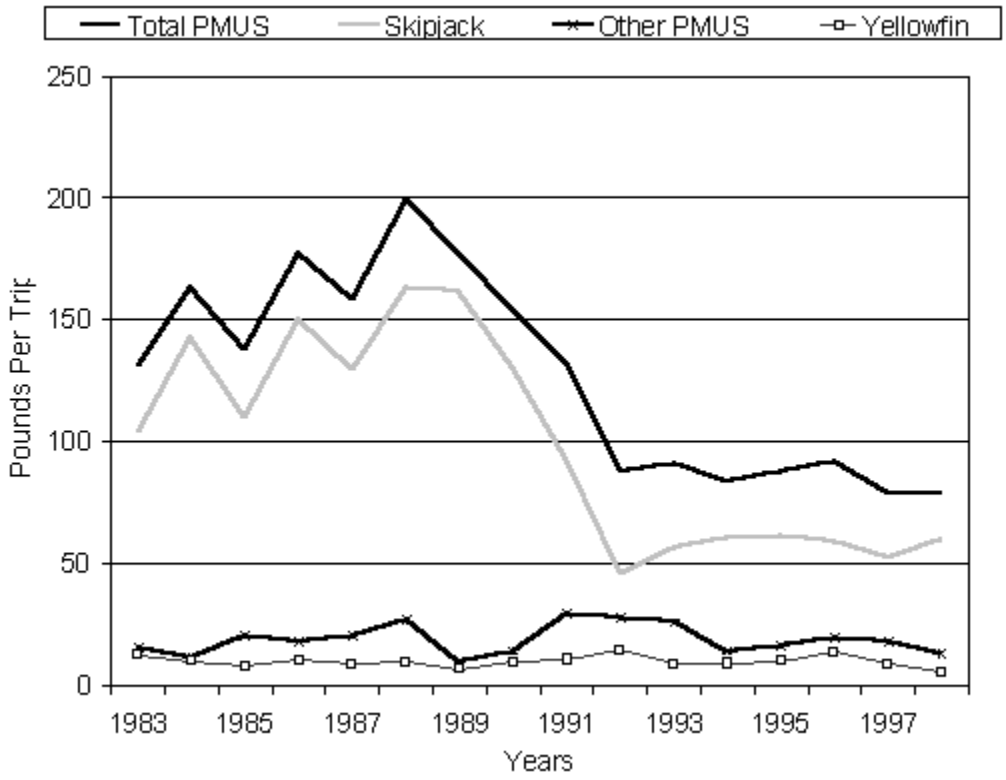


Figure 3.10.6-4 shows the annual landings of all PMUS for 1983 through 1998. Skipjack and yellowfin tuna are also shown, but landings of other non-tuna PMUS are aggregated as other PMUS within the CNMI. The commercial landings of skipjack tuna climbed steadily after a dramatic decline in 1992. Landings of yellowfin and other PMUS were not as variable as skipjack landings.

Figure 3.10.6-4: Annual Commercial Landings of PMUS in CNMI, 1983-1998. Source: WPRFMC, 1999d.

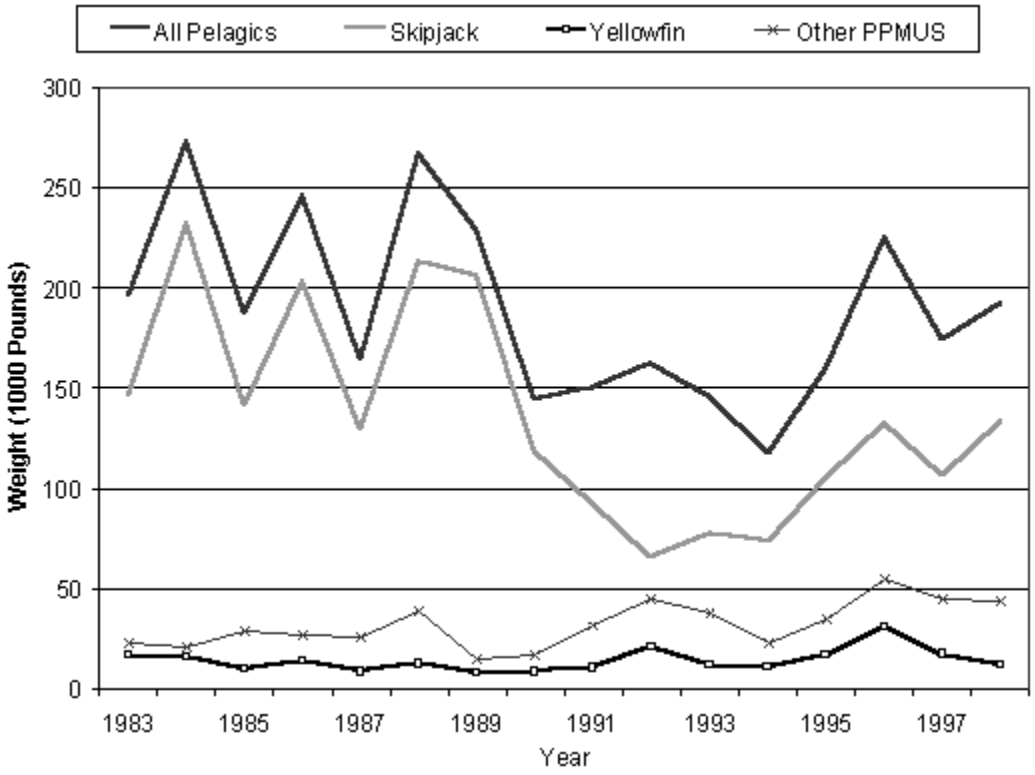


Table 3.10.6-2 shows the total landings, gross revenues and price per pound for pelagic species in the CNMI for 1998. Skipjack tuna was the primary species and *mahimahi* and yellowfin tuna were second and third, respectively in total landings during 1998.

Table 3.10.6-2: Landings, Gross Revenue, and Average Prices of PMUS in CNMI, 1998. Source: WPRFMC, 1999d.

Species	**Landings** (lb)	**Gross Revenue** ($)	**Average Price** ($ per lb)
Skipjack Tuna	133,819	267,718	2.00
Yellowfin Tuna	11,656	25,559	2.19
Dogtooth Tuna	14,426	34,775	2.41
Miscellaneous Tunas	2,213	4,629	
Mahimahi	20,529	44,413	2.16
Marlin	3,361	5,968	1.78
Wahoo	5,039	11,632	2.31
Other PMUS	1,525	3,393	2.22
All Pelagics	**192,568**	**398,087**	

Note: Data were summarized from the DFW Commercial Purchase Data Base, which provides average numbers of pounds caught per trip. Annual catch rates for selected species were obtained by calculating the average weight per trip for each year. Trips were assumed to be one day in length and each commercial invoice represents one trip (WPRFMC, 1999d).

Figure 3.10.6-5 shows the inflation-adjusted average price per pound for tuna and non-tuna pelagic species in the CNMI for 1983 to 1998. The price of tuna appears to have been stable from 1983 until 1989, after which an increase is indicated. The 1990-1992 rise in price can be related to the decrease in skipjack tuna landings shown in Figure 3.10.6-4. During the period from 1994 to 1997, there was an increase in price for all pelagic species. The 1998 prices for tuna reflect a price decrease from 1997.

Figure 3.10.6-5: Inflation Adjusted Price per Pound for Tuna and Other PMUS, CNMI, 1983-1998. Source: WPRFMC, 1999d.

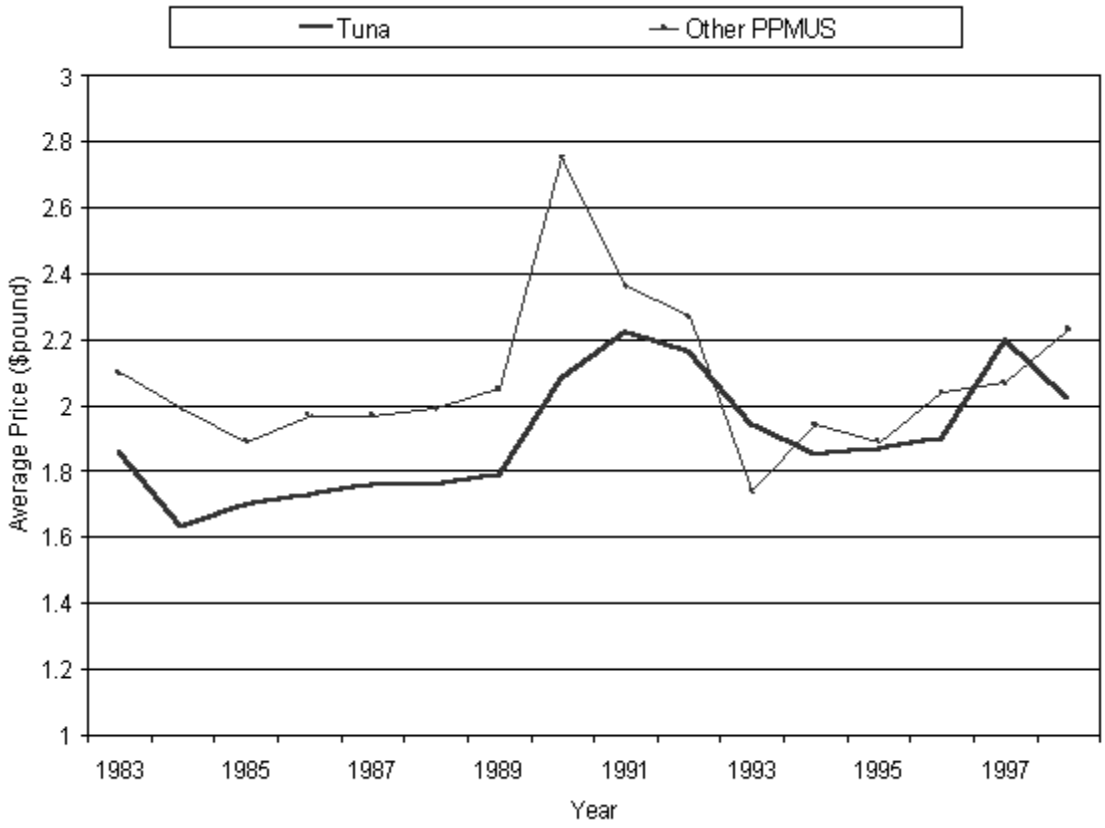
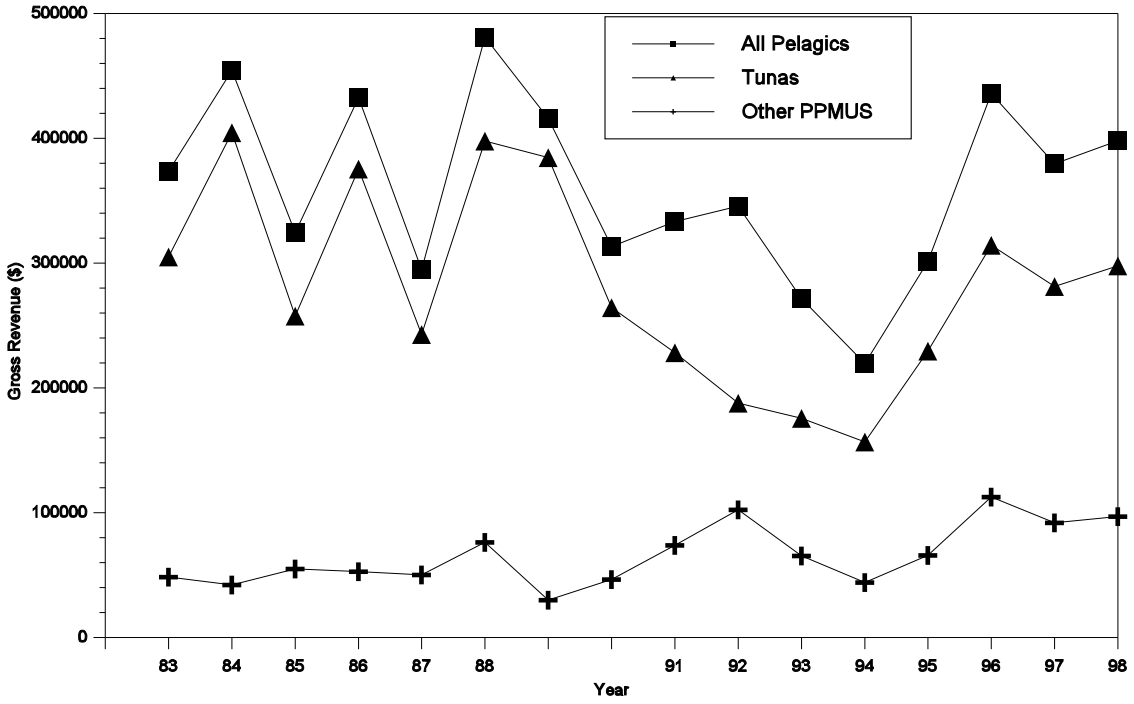


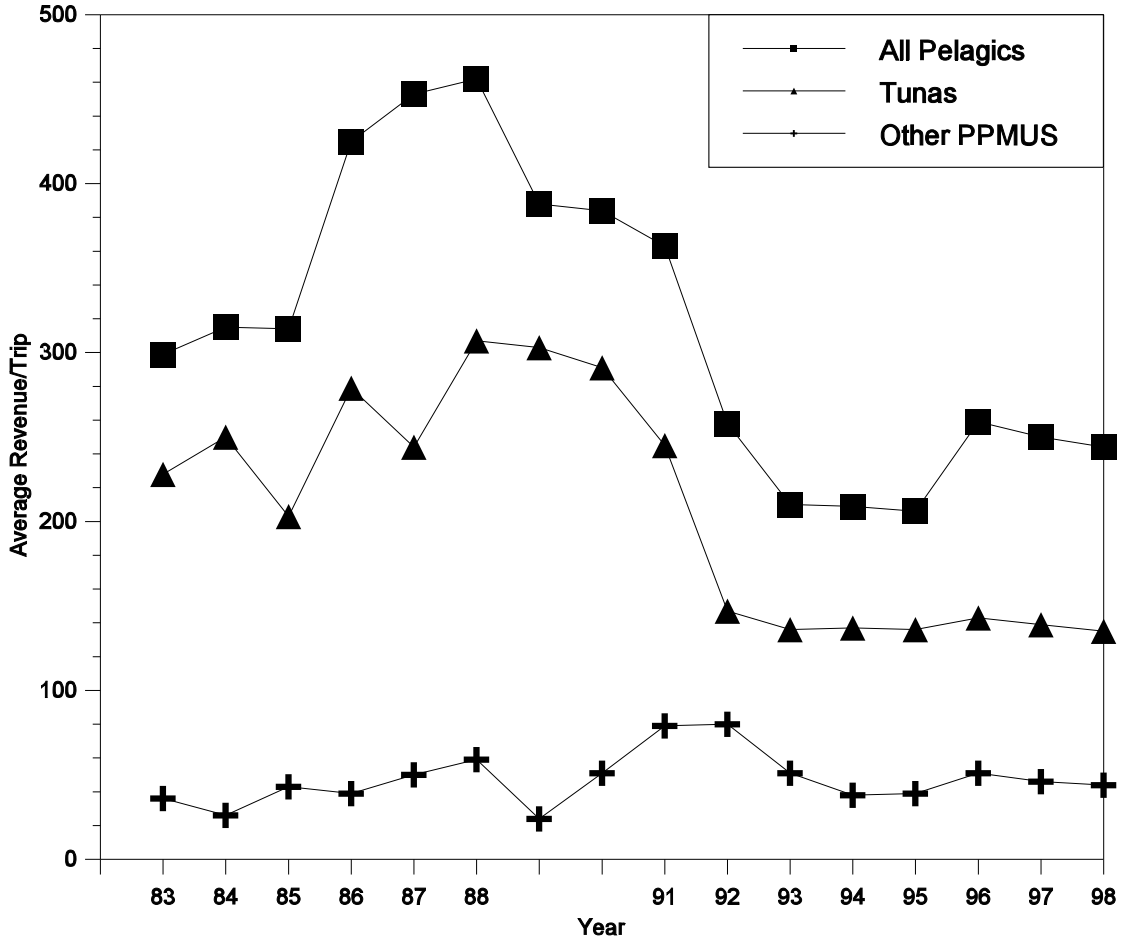
Figure 3.10.6-6 shows inflation-adjusted gross annual revenue generated within the pelagic fishery of the CNMI for 1983 through 1998. These values rose steadily after 1993.

Figure 3.10.6-6: Inflation-Adjusted Gross Annual Revenue, CNMI, 1983-1998.
Source: WPRFMC, 1999d.



As shown in Figure 3.10.6-7, the inflation-adjusted average gross revenue per trip fell from its peak in 1988, but leveled off in 1993, and increased in 1995.

Figure 3.10.6-7: CNMI Annual Commercial Inflation Adjusted Gross Revenues for PMUS Trips, CNMI, 1983-1998. Source: WPRFMC, 1999d.



Cost studies of the pelagic fisheries in CNMI similar to studies for Hawai'i in Hamilton and Huffman (1997) do not appear to have been conducted. Nor does it appear that an input-output study, similar to work in Sharma *et al.* (1999), is available. An analysis of the economic contribution of the distant water fleet and transshipment industry in American Samoa, Guam, and CNMI was undertaken by Hamnett and Pintz in 1996 (Hamnett and Pintz, 1996), but it does not appear that the input-output coefficients generated in that study can be reliably applied to CNMI's troll fleet – the differences between the industrial-scale distant water fleet and the domestic fleet are simply too great. Therefore, the DEIS does not make estimates of the total economic contribution of pelagic fisheries in CNMI, except to say that it is no less than the total gross revenue of the fisheries. In 1998, as documented in Table 3.10.6-2, total gross revenue from pelagic fisheries was estimated to have been nearly $400,000.