by

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The University of Hawaii Sea Grant Program

COSTS AND EARNINGS OF TUNA VESSELS IN HAWAII

by

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INTRODUCTION

The fishing industry seems to be natural for Hawaii. Yet, it contributes only a small fraction to the economy of the state. In 1970 the annual commercial catch amounted to $3.9 million[1] and accounted for about 0.10 percent of the value of the Gross State Product, compared with 0.26 percent in 1955. This does not mean that commercial fishing is a dying industry, but it certainly has failed to keep pace with other elements of the state's booming economy.

Hawaii's fisheries can be classified into three main groups: (i) high-sea or pelagic, (ii) shallow-water and hand-line, and (iii) other fisheries. The high-sea or pelagic fishery is mainly directed to catching tuna fish. Depending on the method of catch, the local tuna fishery can be divided into pole and line fishing for skipjack tuna (locally called "aku") and long-line fishing for other tuna (locally called "ahi"): *e.g.*, yellowfin, big-eye, and albacore. This report is confined to the pelagic aku and ahi fishery.

TABLE 1. TUNA CATCH BY SPECIES, 1965-1969

Species	Catch (1,000 lb)	Value ($1,000)
Aku (skipjack)	9,773	1,493
Ahi		
Yellowfin	468	213
Big-Eye	692	520
Albacore	20	8
Kawa Kawa	32	5
Subtotal	10,985	2,239
Other commercial marine catches	2,445	1,103
Total	13,430	3,342

Source: Division of Fish and Game, Department of Land and Natural Resources, State of Hawaii.

Tuna provides the most significant component of the Hawaiian fishing industry. It accounted for approximately 82 percent of the weight and approximately 67 percent of the value of the total marine catches in Hawaii between 1965 and 1969 [Table 1]. During the past decade, both the amount and the value of the annual tuna catch have fluctuated showing no definite trend. However, the number of boats has declined steadily for the same period [Tables 2 and 3] and frozen tuna imports have increased significantly. Based on a recent economic analysis of the skipjack tuna industry, it was concluded that the lack of growth of this industry was due to profit margins which were too low to induce new investment. This conclusion was based on the estimated cost-return of a new fishing boat.

1. Source: Division of Fish and Game, Department of Land and Natural Resources, State of Hawaii.

No actual cost-return analysis of the existing skipjack fleet was performed. The study attempts to assess the cost-earning situation of both the aku and ahi fleets. Cost-earning data were derived primarily from personal surveys of boat owners and fishermen. It is hoped that this study will throw light on some aspects vital to the improvement of the tuna industry in Hawaii.

TABLE 2. NUMBER OF AKU BOATS AND CATCHES, 1960-1970

Year	Number of Boats	Catch (1,000 lb)	Value ($1,000)
1960	21	7,760	1,010
1965	19	16,242	2,042
1966	17	9,447	1,419
1967	18	8,174	1,248
1968	16	9,422	1,562
1969	15	6,040	1,248
1970	15	7,379	1,511

Source: Division of Fish and Game, Department of Land and Natural Resources, State of Hawaii.

TABLE 3. NUMBER OF AHI BOATS AND CATCHES, 1960-1970

Year	Number of Boats	Catch (1,000 lb)	Value ($1,000)
1960	-	-	-
1965	30	1,700	804
1966	28	1,653	843
1967	26	988	674
1968	22	813	668
1969	23	970	869
1970	24	1,558	1,273

Source: Division of Fish and Game, Department of Land and Natural Resources, State of Hawaii.

DESCRIPTION OF THE TUNA INDUSTRY

The industry can be divided into two operational phases: production (or catch) and marketing. Since aku and ahi fisheries differ both in fishing techniques and marketing systems, each is dealt with separately.

Aku and the Pole and Line Fishery

The Aku Boats

The length of an aku boat in Hawaii ranges from 50 to 100 feet; the beam measures about 12 to 17 feet. There is a pilothouse and flying bridge. The live-bait wells (usually four to six in number) are fitted below the main deck. The bait wells provide storage for the catch after fishing. The boats do not have refrigeration systems, and must carry ice for keeping the fish in a marketable condition.

The boats vary in their total bait-carrying capacity from 20 buckets to 50 buckets per trip. The capacity of a single bait well ranges from 500 gallons to 1200 gallons. All the boats have diesel-powered engines. Other physical characteristics of the boats such as engine power and tonnage are shown in Table 4 for the Oahu aku boats of 1971.

Aku are caught with bamboo poles whose lengths vary from 7½ to 15 feet. A length of line with a hook at the end is attached to each pole. Hook sizes vary, depending on the size of fish in the school fished. Each aku boat has a small bait-boat for catching bait. The aku boat has a captain, an engineer, and a crew of fishermen.

TABLE 4. PHYSICAL CHARACTERISTICS OF AKU BOATS IN THE STUDY, 1971

Boat (number)	Length (feet)	Width (feet)	Net Tonnage	Engine Power (hp)	Year Built
1	72.1	13.5	23	275	1938
2	72.8	14.9	31	330	1947
3	69.8	12.6	15	225	1926
4	59.3	12.6	17	225	1928
5	72.3	15.7	32	280	1947
6	80.5	16.9	52	250	1947
7	71.7	14.0	27	160	1950
8	71.5	13.6	20	250	1938
9	73.6	14.4	36	270	1955
10	69.4	16.9	40	330	1947
11	70.0	13.5	18	270	1935

Source: Division of Fish and Game, Department of Land and Natural Resources, State of Hawaii.

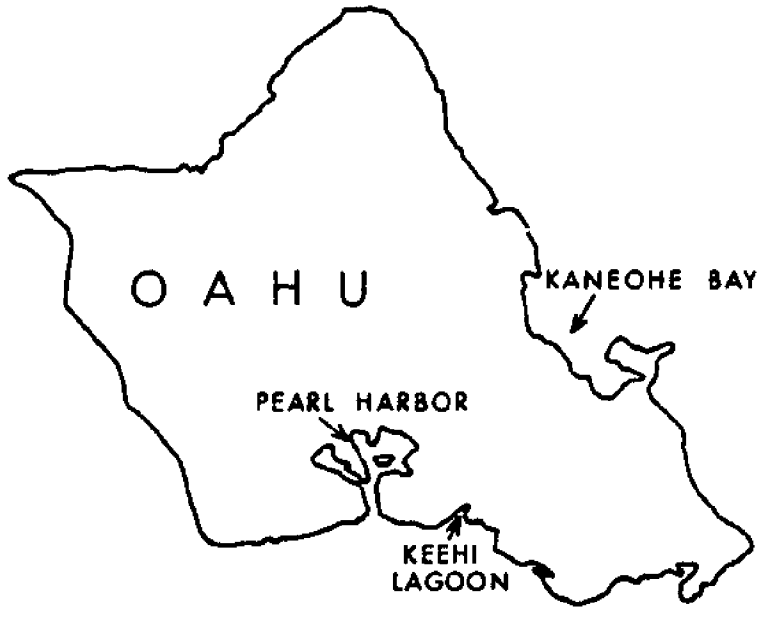


Figure 1. Locations of three bait catching areas off Oahu: Kaneohe Bay, Pearl Harbor, and Keehi Lagoon.

Adapted from: Uchida, Richard N. and Ray F. Sumida, ANALYSIS OF THE OPERATIONS OF SEVEN HAWAIIAN SKIPJACK TUNA FISHING VESSELS, JUNE-AUGUST 1967. Seattle: U.S. Dept. of Commerce, March 1971, p. 3.

Fishing Operations

The fishing operations for an aku boat start with a period of catching bait. The fishermen always catch their own bait. Bait is caught both during the day and at night. During the day, fishermen surround the school of baitfish with a seine and take them to the bait wells. At night, the baitfishes are attracted to a submerged light, which holds them until they are surrounded by the seine. Off Oahu, fishermen catch bait in three areas: Kaneohe Bay, Pearl Harbor, and Keehi Lagoon [Figure 1].

Live bait used for aku fishery are of many species. However, some species are more effective than the others. In the opinion of the fishermen, nehu (*Stolephorus purpureus*) is the best. However, there are two problems with nehu: a high mortality and a low average rate of capture. The mortality rate ranges between 25 and 30 percent. It has been reported that the mortality rate is lower for nehu caught during daylight.

The aku boats leave for fishing late at night or just before dawn. Scouting and fishing start with the daylight. Two or three men with binoculars continuously scan the horizon, looking for flocks of birds, the sign of a school of fish.

Aku is a schooling fish and the presence of a school is usually revealed by a flock of seabirds working above the fish. Anticipating the movements and behavior of the fish, the captain of the boat tries to reach the head of the school. The engine is then throttled down

and the water sprays are turned on. The chummer starts throwing live bait into the water rapidly, in an effort to bring the fish close to the stern of the boat. The fishermen take their position and move the lures across the surface in short arcs to simulate living fish. At this time, everybody on the boat catches fish except the chummer, who continues to throw live bait into the water.

Hooking the fish requires a great degree of skill, strength, and endurance. The fishermen change poles according to need during fishing. In general, short, heavy poles are used to catch larger fish; as the fishing slackens, longer poles are used to catch smaller fish. Actual fishing time is very brief. If chumming is not successful enough, the school is abandoned, the boat moves on in search of other schools, and scouting is resumed.

The boats encounter several schools of fish during a day. Scouting and fishing are discontinued as darkness approaches or the supply of bait is exhausted. Until the boat returns to port for unloading, the day's catch is stored in the empty bait wells and iced to prevent spoilage. The diagram in Figure 2 depicts the different operations of baiting and fishing.

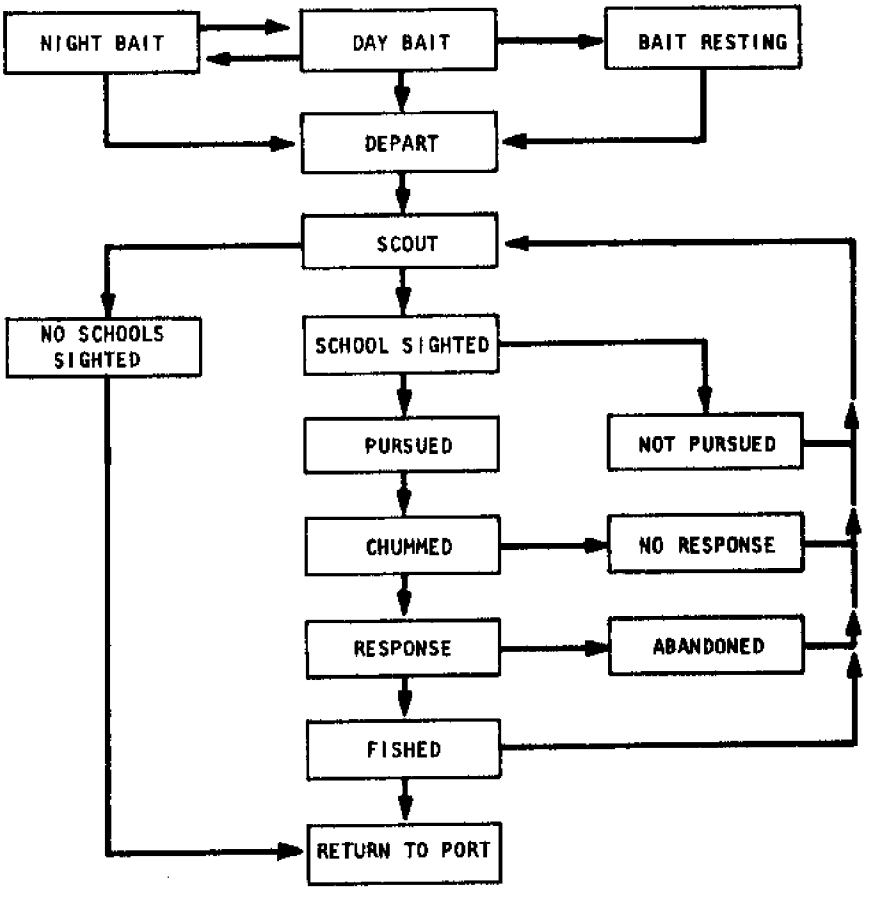


Figure 2. Block diagram of baiting and fishing operation.

Adapted from: *Uchida, Richard N. and Ray F. Sumida, ANALYSIS OF THE OPERATIONS OF SEVEN HAWAIIAN SKIPJACK TUNA FISHING VESSELS, JUNE-AUGUST 1967. Seattle: U.S. Dept. of Commerce, March 1971, p. 3.*

Marketing

There were altogether 11 aku boats operating during 1971 off Oahu. Each boat, along with its owner and his fisherman employees, belong to one of two institutions; the Tuna Boat Owners' Association has nine operating boats, and the other two boats operate under the United Fishing Agency. These two agencies give short-term credit for maintenance and repair. They also supply selling representatives for the fishermen. There is only one processing firm for aku in Hawaii. This firm also acts as the sales agent for the Tuna Boat Owners' Association.

Two major markets exist for aku in Hawaii: the fresh-fish market and the cannery market. The fresh-fish market for aku in Hawaii is the largest in the nation. People in Hawaii consume more than two million pounds of fresh aku annually. About two-thirds of the catch is sold to the cannery at prices lower than the fresh-fish market price. Actually, the local supply of aku is not sufficient for the cannery, particularly during winter. As a result, the cannery uses frozen skipjack tuna imported from Japan.

Ahi and Long-Line Fishery

Long-line fishing for ahi in Hawaii was first introduced by a Japanese immigrant in 1917. Since then it has become an important fishing method for exploiting large, deep-swimming pelagic tunas in Hawaii. This fishery catches not only yellowfin, big-eye, and albacore tuna, but also marlin and mahimahi. The ahi fishery, unlike the aku fishery, does not employ live bait. Frozen fish are used as bait. Among many species of baitfish for ahi fishing, opelu and sardines seem to be most commonly used. Opelu are more popular because they are cheaper than sardines.

Long-Line Boats

Hawaiian long-line boats are patterned on Japanese models. They range from 40 to 80 feet in length. The beam measures 12 feet and the draft is 6 feet. These boats are characterized by a high, narrow bow, angular lines, a modified V-bottom, and moderate freeboard aft. They are all wooden except for one recently built of steel. The physical characteristics are shown in Table 5.

The pilothouse is located slightly forward of amidships. There is also a flying bridge; in some boats it is completely enclosed, while in others it is merely covered by a canvas windscreen. Inside the pilothouse there is a raised trunk cabin which is used to store fishing gear.

The engines in the long-line boats are all diesel powered. None of the vessels have mechanical refrigeration except the new one built in 1969. The fish holds consist of insulated compartments in which the fishermen carry ice to preserve the catch.

Long-line gear is designed for fishing about 500 feet below the surface. The basic unit of the gear is called by the fishermen a "basket". It has a main line and a number of branch or hook lines. The main line, supported by lines attached to floats, varies from 150 to 200 fathoms in length; it supports the pendant, vertical branch lines. Each branch or hook line consists of four pieces: a length of cotton line, the *shanawa*, the leader, and the hook.

TABLE 5. PHYSICAL CHARACTERISTICS OF AHI BOATS IN THE STUDY, 1971

Boat (number)	Length (feet)	Width (feet)	Net Tonnage	Engine Power (hp)	Year Built
1	45	9-5	10	43	1949
2	58	14-6	15	115	1934
3	47	10	NA	165	1950
4	51	12	NA	115	1947
5	58	11	12	165	1953
6	61	12	10	115	1948
7	43	13	7	77	1946
8	52	11	NA	165	1947
9	79	22	NA	425	1969

Source: Division of Fish and Game, Department of Land and Natural Resources, State of Hawaii.

The shanawa is fabricated by hand from Irish linen, twisted together and wrapped with cotton thread. It prevents the lower section of the branch line from twisting and becoming fouled when the branch line carries a hooked fish.

The leader, made of galvanized steel wire, is fitted to the end of the shanawa with a loop to prevent undue fraying of the shanawa and to facilitate disassembling. The leader is from 8 to 10 feet long. It terminates in a loop which passes through the eye of the hook.

Most of the floats used in long-line fishing are empty oxygen tanks, obtained as army surplus material. Wooden floats are also used. Flagpoles, attached to the wooden floats, are placed at the beginning of each basket and mark the union between successive baskets.

Fishing Operations

A fishing trip for most long-line boats lasts about 10 days. However, one new vessel with higher bait-holding capacity, fish storage capacity, and mechanical refrigeration remains at sea up to 20 days. The length of the trip depends on weather, fishing success, distance to fishing grounds, damage or loss of fishing gear, and other factors.

In preparation for fishing, 3 or 6 baskets are made ready. The ends of the main lines between these adjacent baskets are fastened together. Wooden floats are fastened to the flagpoles, and the poles are separated into piles on the aft deck. The bait is removed from the wooden storage boxes and placed in buckets of water. The buckets are placed in a convenient position along the port deck, so that the bait may be handled most efficiently.

When the boat reaches the fishing grounds, the captain signals for the lines to be set. Setting of lines is usually done early in the morning. The hauling then begins in the late afternoon. After all the lines are set, the boat is allowed to drift until the crew starts patrolling the line against sharks, which damage hooked fish. A submerged flag and tipped float are indications of a hooked fish. At this time, the port side of the boat is brought into position alongside the float. As the float line is retrieved and the main line comes up to the surface, the branch line with the hooked fish is hauled aboard until the catch is brought to the surface and retrieved. The empty hook is again baited and put back into the water. At the end of the patrol, the catch is stowed on top of the ice and covered with burlap.

Marketing

The ahi vessels in Hawaii belong to the Fishermen's Cooperative or the United Fishing Agency. Both hold auctions every morning. All fishermen sell their fish at the auction; they pay auction fees and other service fees to the agencies.

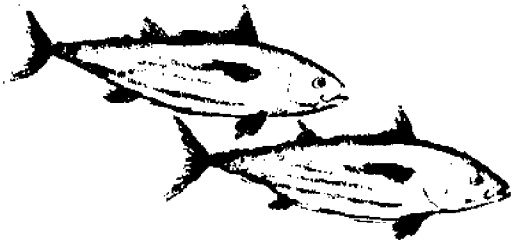


TABLE 6. FISHING EFFORTS AND CATCHES OF AKU BOATS, AVERAGE FOR 1965-1969

Boat (number)	Number of Trips Made	Catch (lb)	Value ($)	Category by Earning
1	116	424,900	74,400	Low
2	97	523,700	81,900	Low
3	152	429,900	75,900	Low
4	128	602,200	89,400	Low
Average for Low-Earning Boats	123	495,175	80,400	
5	112	636,900	103,600	Average
6	135	625,700	114,400	Average
7	130	587,600	92,800	Average
8	150	589,300	96,000	Average
Average for Average-Earning Boats	132	609,875	101,700	
9	169	1,249,300	196,100	High
10	155	839,100	130,500	High
11	170	837,300	131,300	High
Average for High-Earning Boats	165	975,233	152,633	

Source: Division of Fish and Game, Department of Land and Natural Resources, State of Hawaii.

COSTS AND EARNING OF TUNA FISHING

The main objective of this section is to present the cost-earning situation of boat owners and fishermen. Primary information was collected by a survey of boat owners and fishermen. Various secondary sources were also searched, such as office records of the State of Hawaii Division of Fish and Game, Tuna Boat Owners' Association, Hawaiian Tuna Packers, United Fishing Agency, and the National Marine Fisheries Service. The survey included all 11 aku boats and 9 of the 17 ahi boats operating in Oahu. Some of the ahi boats could not be included because of nonavailability of boat owners and crew members, language problems, and limited time available for this study. The survey was conducted during late June, July, and early August of 1971.

Enumeration of Catches and Costs

Annual Catches

The amount and value of catch of individual boats were compiled directly from official records. For individual boats the level of annual catch fluctuated from year to year, depending on the availability of fish and bait and the weather conditions. Considering this wide annual variation in catch, the catch figure for any particular year would not be a representative one. Therefore, a five-year (1965-1969) average catch was calculated [Tables 6 and 7]. This period covers both good and poor fishing years.

TABLE 7. FISHING EFFORTS AND CATCHES OF AHI BOATS, AVERAGE FOR 1965-1969

Boat (number)	Number of Trips Made	Catch (lb)	Value ($)	Category by Earning
1	22	41,380	22,285	Low
2	23	55,397	24,206	Low
3	21	34,330	19,047	Low
Average for Low-Earning Boats	22	43,702	21,846	
4	17	48,451	34,884	Average
5	23	55,277	36,798	Average
6	23	62,822	39,151	Average
Average for Average-Earning Boats	21	55,517	36,941	
7	26	86,499	53,704	High
8	21	88,213	56,367	High
9	16	102,650	54,872	High
Average for High-Earning Boats	21	92,454	54,981	

Source: Division of Fish and Game, Department of Land and Natural Resources, State of Hawaii.

Boats are grouped into three categories—high, average, and low-earning—on the basis of their average gross earnings. In the aku fishery, the average gross earnings vary from $74,400 to $196,100 per year. The range has been categorized as follows:

Earnings/Year	Category of Boats
Below $90,000	Low-Earning Boat
$90,000 to $120,000	Average-Earning Boat
Above $120,000	High-Earning Boat

For ahi boats, however, the range is from $19,047 to $56,367 per year. This range has been categorized as follows:

Earnings/Year	Category of Boats
Below $30,000	Low-Earning Boat
$30,000 to $50,000	Average-Earning Boat
Above $50,000	High-Earning Boat

The average catch and gross earnings among three groups of both fisheries vary widely. The variation in catch among the three groups is mainly due to the average number (for aku boats) and length (for ahi boats) of fishing trips made and the experience of the captain.

Costs of Fishing

Average costs per trip were developed. These cost figures were then converted into annual statistics. Some cost figures, such as license fees, repair, moorage, insurance, interest, and taxes, were available on a yearly basis. The cost items are classified into two categories: owners' expenses and operating expenses.

Owners' Expenses. The owners' expenses are those items which are solely paid by the boat owners.

Registration and License Fee for the Boat. All fishing boats must be registered with the Harbors Division (formerly, with the Department of Land and Natural Resources, Division of Fish and Game). The registration fee is determined by the length of the boat ($3.00 for the first 12 feet and 25¢ per additional foot). A registration fee corresponding to the average length of all the boats under study was used to calculate an average figure for this cost item. Separate averages were calculated for aku and ahi boats. The average annual registration fee was $17.80 for aku boats and $12.42 for ahi boats.

Repair and Maintenance. The annual repair and maintenance costs for individual boats were gathered mostly by interviewing the captains of the boats. However, in some cases these figures were obtained from the office records of boat owners, State of Hawaii Division of Fish and Game, the Tuna Boat Owners' Association, etc. Average costs have been calculated for boats in each of three earning categories in the aku fishery and in the ahi fishery.

Moorage. Moorage charge information came from Harbors Division records and from interviews. In some cases office records were the source of information.

Depreciation. Calculating depreciation for the existing tuna boats in operation posed a problem. The life of a boat is usually considered to be 30 years, and conventionally, depreciation was charged on that basis. However, in the Hawaiian tuna fishery, most of the existing tuna boats are more than 20 years old. For this reason, many owners do not recognize depreciation as an applicable cost. To recognize both points of view, the owners' earnings were calculated before and after depreciation. Depreciation was calculated based on the replacement cost: that is, the current cost of a new vessel to replace a similar vessel.[2] The life of the boat was considered to be 30 years, and a flat yearly rate of depreciation was charged.

TABLE 8. OWNERS' AVERAGE ANNUAL EXPENSES FOR AKU BOATS

Items	Categories of Boats		
	High-Earning	Average-Earning	Low-Earning
Registration and License of Vessel	$ 17.80	$ 17.80	$ 17.80
Vessel Repair	9,521.52	6,423.64	5,256.48
Equipment Repair	1,207.28	523.35	672.38
Moorage	369.28	310.84	305.84
Interest	1,884.86	1,695.25	1,487.76
Fishing Supplies	1,572.79	1,368.76	1,265.28
Unemployment Contribution	2,138.56	2,001.78	2,118.72
Insurance on Boat	5,228.84	4,352.38	4,128.51
FICA	1,435.32	1,034.56	874.33
Subtotal: Costs Before Depreciation	23,376.25	17,728.36	16,127.10
Depreciation	3,195.00	3,139.00	3,083.00
Total: Costs With Depreciation	26,571.25	20,867.36	19,210.10

2. The replacement cost is estimated to be about $1,350 per foot. Source: Shang, Y. C. *The Skipjack Tuna Industry in Hawaii: Some Economic Aspects.* Honolulu: Economic Research Center, University of Hawaii, 1969. P. 29.

Interest. An average amount of interest paid by each group was figured, based on data obtained by interviewing tne boat owners and from office records.

Fishing Supplies. Supplying gear such as poles and line is a direct cost to the boat owner.

Unemployment Contribution to the Government. This cost item was obtained by amalgamation of three individual items: unemployment contribution to the state government, contribution to the federal government, and protection and indemnity insurance.

Insurance on the Boat. Insuring a fishing boat is a cost item to the owner.

FICA. All boat owners are required to pay FICA charges.

Owners' estimated expenses are shown in Tables 8 and 9, for aku and ahi fishing respectively. Expenses were estimated for high-earning boats, average-earning boats, and low-earning boats.

TABLE 9. OWNERS' AVERAGE ANNUAL EXPENSES FOR AHI BOATS

Items	Categories of Boats		
	High-Earning	Average-Earning	Low-Earning
Registration and License of Vessel	$ 12.42	$ 12.42	$ 12.42
Vessel Repair	3,287.57	2,840.63	2,564.08
Equipment Repair	766.81	501.81	375.64
Moorage	385.16	342.37	285.45
Interest	876.28	523.19	438.16
Fishing Supplies	433.66	250.42	225.66
Unemployment Contribution	681.21	582.66	485.72
Insurance on Boat	1,084.37	882.15	735.81
FICA	805.91	623.14	433.65
Subtotal: Costs Before Depreciation	8,333.39	6,558.79	5,574.59
Depreciation	2,610.00	2,565.00	2,250.00
Total: Costs With Depreciation	10,943.39	9,123.79	7,824.59

Operating Costs. The operating costs include fuel and oil, ice, bait, business taxes and overhead, health coverage, fish transportation, sales commissions, miscellaneous entertainment costs, and others. Tables 10 and 11 summarize these costs for the Hawaii Tuna Fleet.

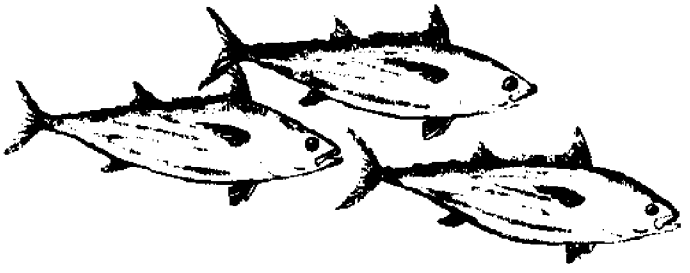
TABLE 10. AVERAGE ANNUAL OPERATING EXPENSES FOR AKU BOATS

Item	Categories of Boats		
	High-Earning	Average-Earning	Low-Earning
Fuel and Oil	$ 8,270.09	$ 7,158.26	$ 5,765.28
Ice	2,072.80	1,865.68	1,698.76
Telephone	29.80	31.50	27.60
Fees to Other Agencies	2,984.65	2,546.56	2,133.48
Medical	1,074.68	1,030.54	968.67
Fish Transportation	874.11	750.52	625.32
Business Tax	631.05	584.27	485.83
Miscellaneous	3,524.08	2,847.74	2,537.87
Total	19,461.26	16,815.07	14,242.81

TABLE 11. AVERAGE ANNUAL OPERATING EXPENSES FOR AHI BOATS

Item	Categories of Boats		
	High-Earning	Average-Earning	Low-Earning
Fuel and Oil	$ 3,780.66	$ 3,450.28	$2,743.46
Ice	2,185.50	1,654.66	1,250.65
Bait	5,130.66	3,836.52	1,585.06
Telephone	15.60	14.20	16.80
Fees to Other Agencies	2,784.18	2,147.38	1,284.21
Medical	1,070.28	750.18	450.33
Fish Transportation	563.46	575.14	463.85
Business Tax	615.36	405.66	280.12
Miscellaneous	2,150.21	1,523.82	910.87
Total	18,295.91	14,357.84	8,968.55

It was found that the greatest expenditures of the boat owners in both fisheries, for all three earning groups, were for repair and maintenance of boats and equipment. The most expensive items of operating costs were found to be the cost of fuel and oil for aku fishery and the cost of bait for ahi fishery. Since an aku boat spends a significant part of its total travel time for baiting, the cost of bait is partially included in the cost of fuel and oil.[3] The variation both in owners' expenses and in operating costs among the three earning groups was directly related to fishing effort. The owners' average annual expenses are much higher for aku boats than for ahi boats, for all earning groups. This is mainly due to differences in the cost of repair and maintenance.



Earnings of Boat Owners and Crew Members

Fishermen's earnings in Hawaii's tuna industry are based on a fixed-share system. That is, the operating costs are subtracted from the gross revenue and the remainder is shared by the fishermen and boat owner. In the aku industry, the fixed shares are as follows:

Boat owner ..... 39 percent

Crew members (all) ..... 61 percent

Each crew member gets an equal share. However, the captain (if he is not the owner) and the engineer get 7 and 2 percent allowance, respectively, from the owner's share. In the ahi fishery most boat owners are the captains of their boats, and the shares of catch are distributed as follows:

Boat owner ..... 45 percent

Crew members (all) ..... 55 percent

There is no separate allowance for the engineer, in this case. For one ahi boat, the distribution of share of catch was found to be 50–50.

The cost-earning situation was analyzed by a simple budgeting technique for both fisheries, and for each group of boats according to its earning category. Average gross earnings per year for boat owners, individual fishermen, captains, and engineers were calculated before and after deducting depreciation. The results are presented in Tables 12 and 13.

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3. A recent study (Shang and Iverson) estimated, based on the opportunity cost approach, that the cost of nehu is about $12.50 per bucket. This estimate is not used here, since it is not appropriate for the purpose of this study.

TABLE 12. COSTS AND EARNINGS OF AKU BOATS

Items	Categories of Boats		
	High-Earning	Average-Earning	Low-Earning
I. Gross total return per year	$152,633.00	$101,700.00	$80,400.00
II. Total operating expense	- 19,461.26	- 16,815.07	-14,242.81
III. Gross return available for share distribution	133,171.74	84,884.93	66,157.19
IV. Owner's income			
A. Owner's gross share (39% of Item III)	51,936.98	33,105.12	25,801.30
B. Captain's 7% of IVA	- 3,635.59	- 2,317.36	- 1,806.09
C. Engineer's 2% of IVA	- 1,038.74	- 662.10	- 516.03
D. Owner's expenses			
1. Before deducting depreciation	- 23,376.25	- 17,728.36	-16,127.10
2. Including depreciation	- 26,571.25	- 20,867.36	-19,210.10
E. Owner's net return (Income tax not deducted)			
1. Before deducting depreciation	23,886.40	12,397.34	7,352.08
2. Including depreciation	20,691.40	9,258.34	4,269.08
V. Crew members' income			
A. Total crew members' share (61% of Item III)	81,234.76	51,779.81	40,355.89
B. Number of crew	10	9	10
C. One man's share	8,123.48	5,753.31	4,035.59
D. Cost incurred by each member			
1. Food	- 592.67	- 620.37	- 523.16
2. Fishing license	- 10.00	- 10.00	- 10.00
E. Net amount to one fisherman (Income tax not deducted)	7,520.81	5,122.94	3,502.43
VI. Captain's return (Items IVB + VE)	11,156.40	7,440.30	5,318.52
VII. Engineer's return (Items IVC + VE)	8,559.55	5,785.04	4,028.46

TABLE 13. COSTS AND EARNINGS OF AHI BOATS

Items	Categories of Boats		
	High-Earning	Average-Earning	Low-Earning
I. Gross total return per year	$54,981.00	$36,941.00	$21,846.00
II. Total operating expense	-18,295.91	-14,357.84	- 8,968.55
III. Gross return available for share distribution	36,685.09	22,583.16	12,877.45
IV. Owner's income			
A. Owner's gross share (45% of item III)	16,508.29	10,162.42	5,794.85
B. Owner's expenses			
1. Before deducting depreciation	- 8,333.39	- 6,558.79	- 5,574.59
2. Including depreciation	-10,943.39	- 9,123.79	- 7,824.59
C. Owner's net return (Income tax not deducted)			
1. Before deducting depreciation	8,174.90	3,603.63	220.26
2. Including depreciation	5,564.90	1,038.63	- 2,029.74
V. Crew members' income			
A. Total crew members' share (55% of item III)	20,176.80	12,420.74	7,082.60
B. Number of crew	4	3	3
C. One man's share	5,044.20	4,140.25	2,360.87
D. Cost incurred by each member			
1. Food	- 612.37	- 582.67	- 514.33
2. Fishing license	- 10.00	- 10.00	- 10.00
E. Net amount to one fisherman (Income tax not deducted)	4,421.83	3,547.58	1,836.54

Aku Boats

The aku boat owners' annual average income, before taxes, is $20,691 for high-earning boats, $9,258 for average-earning boats, and $4,269 for low-earning boats. These figures represent about 21.6 percent, 9.8 percent, and 4.6 percent, respectively, of the estimated current replacement cost of a similar boat (excluding the costs of equipment). In spite of the high proportion of owners' annual earning with respect to replacement costs, especially for the high-earning boats, there is still a lack of investment in this industry. This situation could be attributed to the following reasons:

Annual Catch and Income. Annual catches of individual boats fluctuate widely, reflecting the availability of fish and the weather conditions. The same is true for income.

Fishing Techniques. The present fishing technique, employing pole and line with live bait, is a labor-intensive operation. Local boats are not as efficient as foreign fishing boats and the purse-seining boats used by the West Coast tuna fisheries.

Earnings of Experienced Fishermen. Fishermen's annual average incomes are $7,521 for a high-earning boat, $5,123 for an average-earning boat, and $3,502 for a low-earning boat. The estimated hourly earnings are about $2.07, $1.76, and $1.29[4], respectively, and the average for the three earning groups is about $1.71. Table 14 shows average wages in several other industries. A fisherman earns much less in spite of the danger and intensive work involved in fishing, the inconvenience and the other disadvantages of having to spend much time away from the family, and the difficult living conditions aboard fishing boats.

TABLE 14. AVERAGE HOURLY EARNINGS OF SELECTED WORKERS, 1970

Occupation	Wage
Watchman	$2.35
Groundskeeper	2.39
Janitor	2.42
Laborer (heavy)	2.74
Carpenter Helper	2.83
Carpenter	3.75
Painter	3.63
Warehouseman	3.17

Source: Pay Rates in Hawaii, Hawaii Employers Council, 1970.

Ahi Boats

The ahi boat owners' annual average income, before taxes, varies widely among earning groups: $5,565 for high-earning boats, $1,039 for average-earning boats, and -$2,030 for low-earning boats. These figures represent about 7.1 percent, 1.4 percent, and -3.0 percent of the estimated current replacement cost of a similar boat for the respective earning groups. A fisherman's annual average income was $4,422, $3,548, and $1,837, for high-earning, average-earning, and low-earning groups. Compared with the aku fishery, both owners' and fishermen's incomes from the ahi fishery are low. The low earnings of both owners and fishermen in the average and low-earning groups is probably responsible for the decline in the number of boats in this industry.

All of the catches of ahi boats are sold to fresh-fish markets and consumed as *sashimi* (raw fish). The market potential for sashimi in Hawaii appears to be limited. Increase in catch will depress the price of sashimi and reduce the revenue. This could be another factor restricting the expansion of this industry.

4. The calculations are based on 22 hours per trip: fishing and traveling 14 hours, baiting and traveling 8 hours.

SURVEY OF FINANCIAL SUPPORT TO THE FISHING INDUSTRY

Low returns are well understood as a reason for the lack of growth in the local fishing industry. One often hears that the lack of investment capital also limits the growth potential of the fleet. A large amount of money would be required for modernizing the present fishing technology. For this reason a review of the problems and alternative ways of financing commercial fishing ventures is included as part of this study.

Private Financial Institutions

The fishing industry involves a wide variety of uncertainties and risks. Capital for this industry is not easily obtainable from banks and other traditional, private-credit institutions. Some boat owners have borrowed from banks, but they always put up other assets as security, and the interest rates were very high.

The two institutions which have been providing short-term financing of the local fishery are Hawaiian Tuna Packers and United Fishing Agency. They provide a limited amount of capital to the boat owners for repairs and maintenance of boats. They also extend other types of credit, to a very limited extent. Members of a particular agency usually use that facility. However, loans of such short term and small amount are inadequate to assure the growth and expansion of the fishing industry.

Government Sources

Both federal and state governments have loan programs available to the Hawaiian fishery.

Federal Loan Programs

At present four different loan programs are available through the federal government.

Fisheries Loans for Vessels and Gear. A loan fund was established by the Fish and Wildlife Act of 1956, and amended to approve loans to owners of fishing vessels for certain purposes: *e.g.*, purchasing, constructing, equipping, maintaining, repairing, or operating new or existing commercial fishing vessels. Since this program does not compete with banks or other lending agencies, one of the criteria for obtaining such a loan is that the owner must furnish proof that the needed funds are not otherwise available. Each loan is processed by the Division of Financial Assistance, National Marine Fisheries Service, now under the Department of Commerce. This program provides for loans up to a maximum of $40,000, repayable by installment in 10 years with interest at the rate of 8 percent per annum. The payment period has recently been extended to 14 years.

The response from local tuna boat owners has not been appreciable. Till 1970, 26 fishermen had placed applications with the Bureau of Commercial Fisheries (now NMFS), and 17 of these applications were approved. But only 3 loans were made to tuna boat owners. Boat owners felt the poor response was due to the complex procedure, bureaucratic controls, and the fact that the full amount asked is unobtainable. The repayment period of 10 years was also inconvenient for most of them.

Subsidy Program for Construction of New Vessels. This federal program was designed to help boat owners build their fishing boats in domestic shipyards at costs which compare with those of foreign shipyards. The federal subsidy amounts to either the difference between the construction cost in foreign and domestic shipyards or 50 percent of the domestic cost of construction, whichever is lower. The terms and conditions of this subsidy program are rather strict and the fishermen are not encouraged by this stringency.

The Capital Construction Fund. The Capital Construction Fund is a new federal program administered out of NOAA in the Department of Commerce covering United States vessels. The fund allows certain tax benefits on moneys deposited in special accounts for the purpose of replacing, adding to, or reconstructing vessels.

Accounts may be set up to receive deposits of ordinary income, capital gain, and capital funds. Whereas the first two of these are normally taxed, when deposited in these accounts and then withdrawn for "qualified" purposes, no taxes are paid. However, the depreciation base of the new vessels or improvements is reduced by the full amount of the funds from the income account and a fraction of the amount of funds from the capital gains account.

Forms and instructions are available from:

Chief, Financial Assistance Division
National Marine Fisheries Service
1801 N. Moore Street
Arlington, Virginia 22209

The Sea Grant Program Office at the University of Hawaii will provide information and advice regarding this and other loan and tax programs from federal and state sources.

Federal Fishing Vessel Mortgage and Loan Insurance. The purpose of this program is to assist the fishing industry in financing, constructing, rebuilding, and reconditioning fishing vessels. The program may be considered as an indirect assistance to boat owners. An owner will arrange with a financial institution or other qualified lender for the required loan. The construction loan or the ship mortgage may be insured by the Secretary of Commerce. (Previously the program was under the Department of the Interior.) This program provides a maximum of 75 percent of the cost of construction or reconditioning of the vessel, with a maturity period of 15 years, at an interest rate not higher than the Secretary of Commerce determines to be reasonable. So far, not a single tuna boat owner has applied under this program. To them the whole process seems too complex.

State Government Loan Programs

There are two state loan programs available to Hawaiian fishing boat owners. One program is administered by the Division of Fish and Game, Department of Land and Natural Resources, under the name "Fisheries New Vessel Construction Loan Program". The other, called "Hawaii Capital Loan Program", is administered by the State Department of Planning and Economic Development.

Fisheries New Vessel Construction Loan Program. A fund was created by Act 193, Session Laws of Hawaii 1965, to assist the development of commercial fishing in the state.

The terms and conditions of this loan program appear more liberal than those of the federal loan programs mentioned earlier. The borrower must still furnish evidence that the credit applied for is not otherwise available from commercial sources on reasonable terms: *e.g.*, from a bank or other private lenders. The loan is to be used only for construction of new vessels of approved design.

The total available funds are limited by legislative appropriation. A limited amount of money has been available in the past. The applicant is allowed to borrow up to 80 percent of the cost of construction of a vessel. The loan is repayable in 20 years, with interest at the rate of 5½ percent per annum. This program seems more attractive than others to the boat owners because of a longer maturity period, a low interest rate, and other less strict requirements. So far in the tuna industry, two applications have been placed with the Board of Land and Natural Resources; in both cases the applicants obtained the loan.

Hawaii Capital Loan Program. This program, administered by the Department of Planning and Economic Development, provides a source of long-term financing for vessel construction. The boat owners are able to borrow a maximum amount of $50,000 for a maximum period of 20 years, at the interest rate of 5½ percent per annum. Short-term financing is also available to provide working capital, with a repayment period of 6 years. Like the other government loan programs, this program also requires that the borrower furnish evidence that the required credit is not otherwise available from traditional sources on reasonable terms.

Although this program has been utilized by a few Hawaiian boat owners, none of the tuna boat owners have ever applied for such a loan. The interview revealed that the tuna boat owners were not very familiar with this program.

Summary

A number of state and federal loan programs exist to encourage investment in the fishing industry. Response from the fishermen has been slow. During the period studied only two owners obtained loans from the state loan program for constructing new vessels, and only three persons utilized the federal loan programs. Restrictive requirements in the past, together with the risks involved in the local tuna fishery, appear to have discouraged the local owners from borrowing money from government sources.

SUMMARY OF FINDINGS

The main purpose of this study was to examine the cost-earning situation of boat owners and fishermen of Hawaii's tuna industry. All of 11 aku boats and 9 out of 17 ahi boats operating from Oahu were included in the survey. The cost data were collected directly from boat owners and fishermen, while data on catches and revenues were compiled from official records. Due to wide annual variations in the catch, five-year average catch figures were calculated for use in this study. These averaged figures cover both good and poor fishing years.

For both fisheries, boats were grouped into three categories–high, average, and low-earning–on the basis of their gross earnings. The amount of fishing effort made accounted for most of the differences in income among the three groups.

The costs of fishing were divided between the boat owners' costs and operating costs. In both fisheries and in all three earning groups, boat owners spent most on repair and maintenance. With respect to operating costs, the most expensive item for the aku fishery was the cost of fuel and oil; for the ahi fishery it was the cost of bait.

The cost-earning situation was calculated both with and without a deduction for depreciation, and was analyzed by a simple budgeting technique. The owners' average annual income before taxes for aku boat was $20,691 for high-earning boats, $9,258 for average-earning boats, and $4,269 for low-earning boats. These figures represent about 21.6 percent, 9.8 percent and 4.6 percent, respectively, of the estimated current replacement cost of a similar boat (excluding the costs of equipment). The estimated hourly earning of fishermen for the three earning groups was about $1.71. This is much lower than wages in other industries. The low earnings of fishermen and the attractiveness of other job opportunities, coupled with the high risk and uncertainty of fishing and more promising outside investment alternatives, appear to have discouraged employment and investment in this industry.

For ahi boats the owners' average annual income before taxes was much lower than for aku boats. It ranged from $5,565 for high-earning boats, through $1,039 for average-earning boats, to -$2,030 for low-earning boats. These figures represent about 7.1 percent, 1.4 percent and -3.0 percent, respectively, of the estimated current replacement cost of a similar boat. The fishermen's average annual income for high-earning, medium-earning, and low-earning boats was $4,422, $3,548, and $1,837, respectively. The low earnings of both boat owners and fishermen, together with the limited market potential for sashimi in Hawaii, appear to be the major factors restricting the expansion of this industry.

There are a number of government loan programs that were designed to encourage investment in the fishing industry. However, response from tuna boat owners has not been appreciable. The restrictive prerequisites in the past, the high risks involved in the local tuna fishing, and the low earnings of most of the boats appears to have discouraged the local fishermen from long-term investment in boats and equipment.

It has been found that most of the tuna boats in Hawaii are more than 20 years old. They lack facilities and equipment that typify modern fisheries. This affects the range, efficiency, and fishing effort which are the prime variables in determining income and return on investment.

Therefore, growth in the tuna industry depends upon the opportunity to increase productivity economically.

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