

Hawaii's Marine Fisheries: Some History, Long-term Trends, and Recent Developments

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Introduction

Recently Hawaii's commercial marine fishery has experienced a period of rapid growth and structural change, and its characteristics are quite different from what they were a decade ago. Some of these changes are the result of governmental and private-sector decisions on fishery development in Hawaii, but many have occurred because of increasingly competitive pressures, particularly as they have affected mainland U.S. commercial fishing fleets. Further changes are anticipated as diverse fishing interests (including both large-scale and small-scale commercial, indigenous, and recreational fishing interests, as well as nonconsumptive marine resource interests) are worked out in fishery, marine, and

coastal zone management processes. This paper concentrates on the economic development of the offshore commercial fishery, and places somewhat greater emphasis on the large-scale fisheries. Biological and management features of Hawaii's marine fisheries are considered in other papers in this number (Mar. Fish. Rev. 55(2)).

Hawaii's marine fisheries can be divided into three geographical areas (Fig. 1):

1) The inhabited main Hawaiian Islands (MHI), with their surrounding reefs and offshore banks (the island of Hawaii to Niihau and Kauai);

2) The Northwestern Hawaiian Islands (NWHI), a 1,200 mile string of basically uninhabited reefs, shoals, and islets ranging west northwest from the main Hawaiian Islands (i.e., west of Niihau and Kauai);

3) The mid-North Pacific Ocean, ranging from lat. 40°N to the Equator, and from long. 145°W to long. 175°E.

Hawaii's fishing fleets can also be divided into three somewhat overlapping or interconnected segments:

1) Large-scale commercial fishing.

Although termed "large-scale" in Hawaii, by mainland U.S. and foreign fishing fleet standards almost all the vessels in this segment would be considered small. Most "large-scale" commercial fishing vessels in Hawaii are less than 100 feet in overall length. These include the older *aku* boats (pole-and-line sampans¹ fishing for skipjack

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ABSTRACT — This paper provides an overview of Hawaii's marine fisheries from 1948 to the present. After three decades of decline following a brief period of growth at the conclusion to World War II, Hawaii's commercial fisheries began a decade of sustained development in the 1980's. At the same time, fisheries management issues became more significant as different segments of the fishery came into more direct competition. This paper provides new estimates of commercial landings for the 1977–90 period, and summarizes limited information on recreational and subsistence fisheries in the 1980's. It also provides some historical context which may be useful in evaluating fishery development and management options.

Table 1.—List of common and scientific names of frequently caught commercial species in Hawaii.

| Common name | Scientific name |
|--|------------------------------------|
| Bottomfish | |
| Snappers | |
| Onaga | <i>Etelis coruscans</i> |
| Opakapaka | <i>Pristipomoides filamentosus</i> |
| Ehu | <i>E. carbunculus</i> |
| Kaikale | <i>P. seiboldii</i> |
| Gindai | <i>P. zonatus</i> |
| Uku | <i>Apion virescens</i> |
| Lehi | <i>Aphareus rutilans</i> |
| Yellowtail kalekale | <i>P. auricilla</i> |
| Taape | <i>Lutjanus kasmira</i> |
| Grouper | |
| Hapupuu | <i>Epinephelus quernus</i> |
| Jacks | |
| White ulua | <i>Caranx ignobilis</i> |
| Black ulua | <i>C. lugubris</i> |
| Butaguchi | <i>Pseudocaranx dentex</i> |
| Kahala | <i>Seriola dumerili</i> |
| Other | |
| Lobster | <i>Panulirus marginatus</i> |
| Spiny | <i>Scyllarides squammosus</i> |
| Slipper | |
| Pelagic Management Unit Species | |
| Blue marlin | <i>Makaira mazara</i> |
| Striped marlin | <i>Tetrapturus audax</i> |
| Broadbill swordfish | <i>Xiphias gladius</i> |
| Shortbill spearfish | <i>T. angustirostris</i> |
| Black marlin | <i>M. indica</i> |
| Indo-Pacific sailfish | <i>Istiophorus platypterus</i> |
| Mahi-mahi | <i>Coryphaena hippurus</i> |
| Ono (wahoo) | <i>Acanthocybium solandri</i> |
| Blue shark | <i>Prionace glauca</i> |
| Mako shark (short-fin) | <i>Isurus oxyrinchus</i> |
| Mako shark (long-fin) | <i>I. paucus</i> |
| Oceanic whitetip shark | <i>Carcharhinus longimanus</i> |
| Thresher shark | <i>Alopias superciliosus</i> |
| Tiger shark | <i>Galeocerdo cuvieri</i> |
| Tunas | |
| Bigeye Tuna | <i>Thunnus obesus</i> |
| Yellowfin tuna | <i>T. albacares</i> |
| Albacore | <i>T. alalunga</i> |
| Skipjack tuna (Aku) | <i>Katsuwonus pelamis</i> |
| Kawakawa | <i>Euthynnus affinis</i> |
| Frigate tunas | <i>Auxis spp.</i> |

tuna²) (Table 1) and tuna longline sampans (also wooden but of a different design), as well as modern tuna and swordfish longline vessels, distant-wa-

¹The term "sampan" in Hawaii refers primarily to wooden-hulled fishing craft of a design introduced by Japanese fishermen in the early 1900's. The vessels range from 35 to 75 feet with a flared bow, a low stern, and a deep profile to maintain seaworthiness in Hawaii's rough waters.

²Hawaiian common names for commercial marine fish and shellfish species are used throughout this paper. Scientific names and corresponding Hawaii, names are found in Table 1.

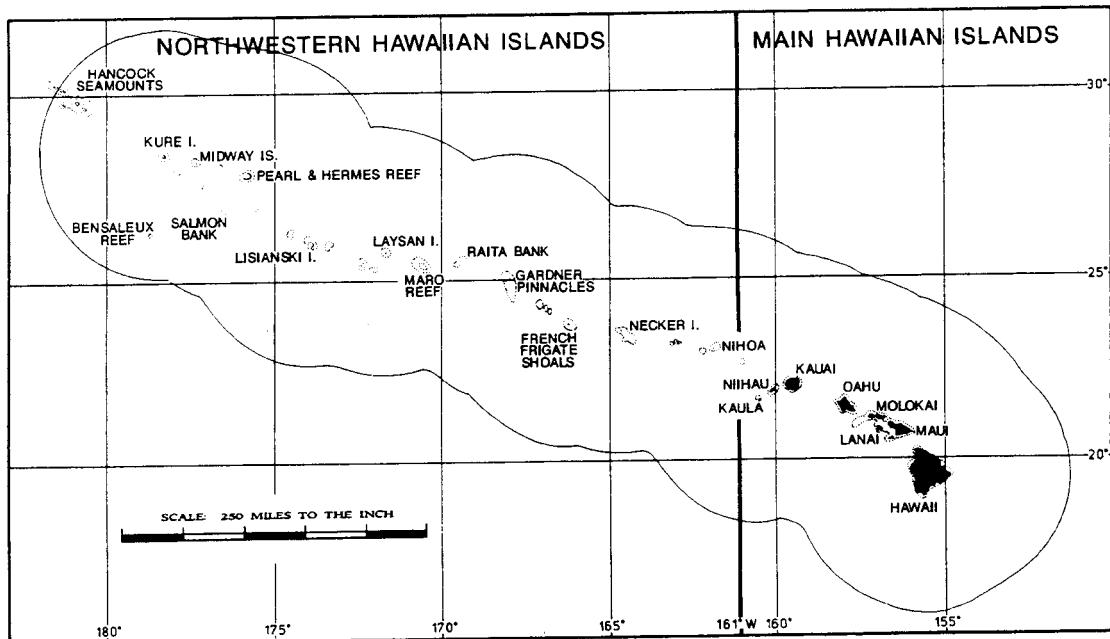


Figure 1.—Hawaii map, including NWHI.

ter albacore trollers, and multipurpose vessels which fish for bottomfish (deepwater snappers, groupers, and jacks) and spiny and slipper lobster in the NWHI. These vessels can operate as far as 1,000 nautical miles from Hawaii throughout the mid-North Pacific, and some span the South Pacific. Most operate within 200 miles of the MHI or within the NWHI.

2) Small-scale commercial fishing.

The vessels in this segment include a wide variety of trailered and moored boats between 12 and 45 feet in length. These vessels primarily use trolling and handline techniques, although some traps and surrounding nets are used. The target species include tunas, billfish, mahimahi, ono (wahoo), bottomfish for the trollers and handliners; bottomfish, reef fish, and crustaceans for the trap vessels; and small mid-water scads (known locally as akule and opelu) for the surrounding-net fishery. These vessels operate almost exclusively in the MHI.

3) Small-scale recreational, part-time

commercial, and subsistence fishing.

This segment includes the same kind of vessels as found in the small-scale commercial fleet, as well as some very small boats (including surf boards and sail boards), charter fishing boats and dive fishing boats. Although charter fishing is a commercial operation, its clients are oriented toward recreational opportunities and thus it is distinguished from commercial fishing. The target species for this segment of the fishery are more varied than those of the commercial segments, and include a variety of reef species, as well as the more familiar tunas, billfish, mahimahi and ono (wahoo), bottomfish, and crustaceans. The fishing methods used are also considerably more varied.

The issue of categorizing Hawaii's small-boat fisheries is a difficult one, and is discussed later in this paper. For the moment we would categorize this segment as one where the fishery has limited fishing power and its fishermen have mixed motivations in terms of fishing activity.

Hawaii's Traditional Commercial Marine Fisheries

Shortly after Statehood, a U.S. Department of Interior, Bureau of Commercial Fisheries proposal labeled the Hawaii fishery as "dying" (Iversen³). Hawaii's major commercial fisheries had been dominated by traditional practices that reflected Hawaii's Japanese immigrant heritage and its impact on the local fishery and seafood markets. The predominant commercial fishery was aku (skipjack tuna), which was caught by a live-bait, pole-and-line, wooden sampan fleet, known as aku boats (Fig. 2), and which was landed primarily for canning. In 1960, over 60% of Hawaii's total recorded commercial fishery landings (by weight) was aku, and the percentage remained over 50% until 1970.

By the mid-1970's the number of aku boats and their companion sam-

³R. T. B. Iversen, 45-626 Halekou Place, Kaneohe, HI 96744. Personal commun., 1991.

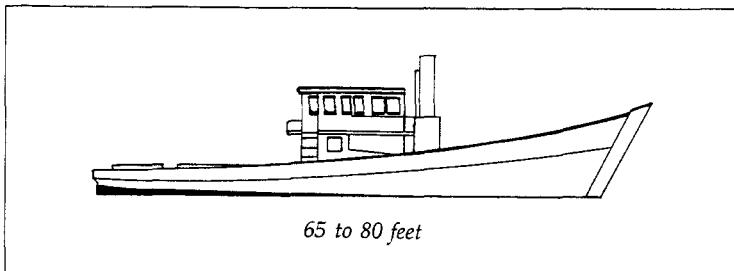


Figure 2.—Drawing of typical Hawaii aku (skipjack tuna pole-and-line) boat.

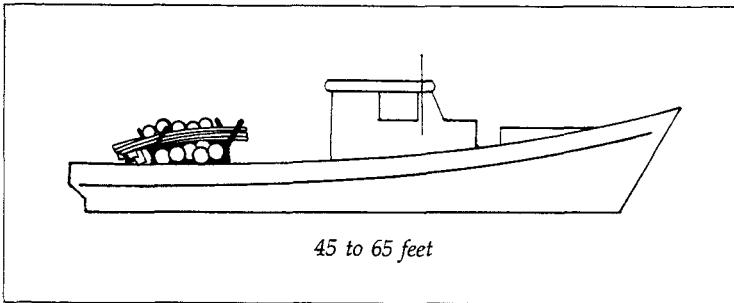


Figure 3.—Drawing of typical Hawaii flagline (longline sampan) boat.

pans, the longline tuna boats (known locally as flagline boats, Fig. 3), had decreased substantially, and the condition of many of the boats was poor. Fishing remained close to the main Hawaiian islands, although some older bottomfish boats fished the NWHI. Volume of fish in the fresh fish market had declined, and few improvements in marketing were apparent. Most fresh seafood appeared to be consumed in the home, and ethnic identification with particular species was very strong. Nearshore reef and schooling fish were still relatively abundant, but Hawaii's commercial fishery reached its nadir in 1975.⁴

Figures 4 and 5 provide estimates of Hawaii's long-term commercial fishing landings and revenue.⁵ Revenues throughout this paper are inflation-adjusted values to a 1990 base year. Figures on landings and revenue for the period 1948–76 are based entirely on the Hawaii Division of Aquatic Resources (HDAR) commercial fishing landings reports. Figures for the period 1986–90 are based largely on NMFS estimates of Hawaii's commercial landings and on our own wholesale market monitoring program. The period 1977–85 is a combination of the HDAR data with NMFS estimates of particular gear types (longline and NWHI lobster).⁶ Table 2 provides a breakdown of the NMFS data for 1990 by gear type.

Figure 4 differentiates the aku boat fishery (skipjack tuna) from the rest of the fishery (identified as "non-aku") because the aku fleet has been the source of most annual variation in land-

Table 2.—Hawaii commercial fisheries, 1990. NMFS estimates based on logbooks and shoreside monitoring. MHI = main Hawaiian Islands; NWHI = North-western Hawaiian Islands.

| Fleet | Weight (1,000 lb.) | | Thousand dollars |
|-----------------------------|--------------------|--------|------------------|
| | Caught | Sold | |
| Longline | 13,090 | 12,200 | \$28,800 |
| Troll and handline pelagics | 4,460 | 4,050 | 6,980 |
| Aku boat | 1,005 | 1,005 | 1,838 |
| MHI bottomfish | 830 | 810 | 3,300 |
| NWHI bottomfish | 420 | 400 | 1,070 |
| NWHI lobster | 949 | 949 | 4,887 |
| Other | 1,700 | 1,594 | 3,513 |
| Total | 22,454 | 21,008 | 50,388 |

ings. The average annual variation in detrended aku landings was 164% (compared with 27% for non-aku landings) in the period 1948–90.⁷ Any analysis of the overall Hawaii commercial fishery over time must differentiate the overall trend from these fluctuations in the aku fishery.

Aku landings declined through the mid-1970's to the closing of the cannery in 1984, and then continued to fall through 1990. Aku landings fell as a percentage of total landings (by weight) from over 70% in the 1960's to less than 20% in the last five years of the 1980's, and to only 4.5% in 1990. However aku revenue has not fallen as appreciably because of the higher market price of fresh aku (compared with the cannery price in the pre-1985 period).

Major Developments Since the Mid-1970's

The nature and value of Hawaii's present day fisheries and seafood industry have changed dramatically since the 1970's. The commercial fishery has more than doubled in inflation-adjusted ex-vessel value since 1970 to \$50 million in 1990 and \$60 million in 1991. The seafood market is probably worth over \$100 million (including imported seafood), there is a \$10-15 million char-

⁴In terms of inflation-adjusted revenue. The lowest landings were in 1969 using NMFS estimates, but 1975 was the second lowest year.

⁵Estimates are required because official records of commercial fisheries landings were not comprehensive in some years during that period.

⁶Appendix A, available from the author, provides additional detail on the NMFS estimates for the period 1979–90, as well as time-series for individual gear types (aku boat, longline, NWHI lobster, NWHI bottomfish, main Hawaiian Islands, and other gears) from 1948 to 90.

⁷Detrending is a simple statistical procedure to remove the long-term change (growth or decline) in a time series. The resulting figures then reflect more accurately the shorter-term variation, in this case, the year-to-year variation, in the 1948 to 1990 time period.

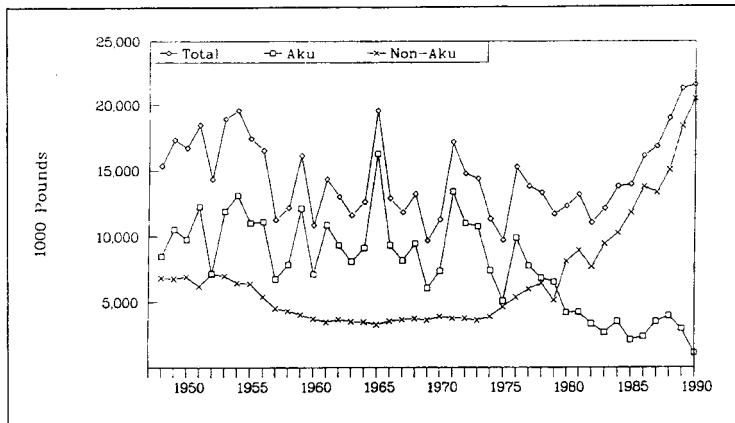


Figure 4.—Hawaii commercial fishery landings (pounds), 1948-90. NMFS estimates, total, aku (skipjack tuna), and all other species.

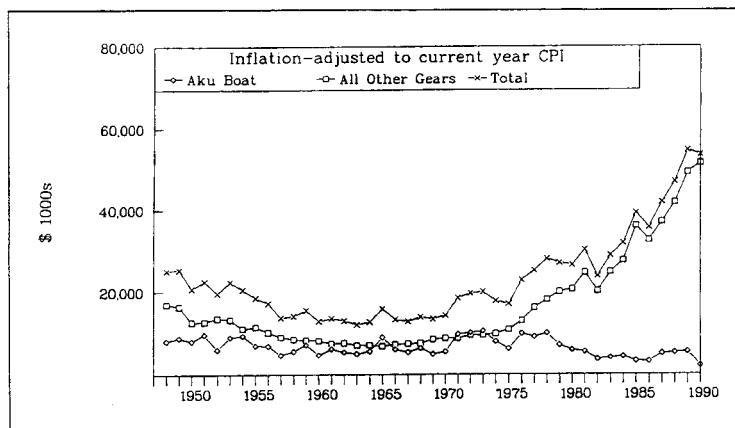


Figure 5.—Hawaii commercial fishery revenue, 1948-90. NMFS estimates, total, aku boat (pole-n-line skipjack tuna), and all other gears. Revenue adjusted for inflation to 1990 U.S. \$ base.

ter boat industry, probably an equivalently valued tournament fishery, and there is a recreational and subsistence marine fishery with direct expenditures of \$24 million.⁸ Figure 6 displays our estimate of the Hawaii seafood market supply in 1990, with 20 million pounds (\$50 million) from commercial fishing, 9 million pounds from recreational fishing, 15 million pounds (\$30 million) from foreign imports, 24 million pounds (\$45 million) from the mainland U.S., and 3.5 million pounds (\$10 million) exported.⁹

Perhaps the most notable long-term trend in Hawaii's overall commercial

fishery is the dramatic increase in inflation-adjusted ex-vessel revenue in the 1980's (Fig. 5). The increase in revenue (240%), which is reflected in

⁸The definition and determination of "value" for recreational and subsistence fisheries is a complex methodological issue. Direct comparison of the expressed dollar values of commercial vs. recreational fisheries is generally not appropriate; see Edwards (1990) for a primer on these issues. Meyer (footnote 20) estimated the nonmarket value of small-boat noncommercial fishing in Hawaii at \$200 million, using hedonic valuation methods, compared to actual direct expenditures of \$24 million.

⁹Hawaii's seafood marketing sector is described in: J. C. Cooper and S. G. Pooley. 1982. Total seafood volume in Hawaii's wholesale fish

markets. Southwest Fish. Cent. Admin. Rep. H-82-15, 12 p.; J. C. Cooper and S. G. Pooley. 1983. Characteristics of Hawaii's wholesale seafood market. Southwest Fish. Cent. Admin. Rep. H-83-22, 33 p.; W. K. Higuchi and S. G. Pooley. 1985. Hawaii's retail seafood volume. Southwest Fish. Cent. Admin. Rep. H-85-06, 16 p.; and MacDonald and Deese (1988).

the increased value of the marketing sector, is even greater than the increase in pounds landed (200%), although less than the increase in non-aku landings (300%). The increase in average aggregate price reflects a substantially growing demand, particularly in the restaurant and export (U.S. mainland and foreign) markets, more than matching the increased supply for most species during the period.

There are many elements to these recent changes in Hawaii's seafood industry. Perhaps the first harbinger of change was the arrival of albacore trollers from the west coast en route to newly discovered fishing grounds north of Midway Islands late in the 1970's. This caused a new perspective on the nature of Hawaii's role in the Pacific-wide fishery and led to some substantial changes on the Honolulu waterfront. Not the least of these changes was the technological demonstration effect of the mere presence of these distant-water, highly mobile vessels¹⁰. In 1985, there were 75 albacore trollers in the U.S. North Pacific fishery (Hawaii Division of Aquatic Resources, 1986). Landings peaked at 3.8 million pounds, but because of logistics, the closure of the Honolulu cannery, and the changing world tuna market, Hawaii did not become the tuna processing and transshipment center that was anticipated. Eventually less than 20 albacore vessels chose to make Honolulu their home port.

Also in the 1980's, the Northwestern Hawaiian Islands spiny lobster fishery began to bloom. The NWHI possess a large EEZ but have relatively limited fishing grounds for nonpelagic species. During a cooperative research effort of the NMFS, HDAR, University of Hawaii, and U.S. Fish and Wildlife Service in the 1970's (Grigg and Tanoue,

markets. Southwest Fish. Cent. Admin. Rep. H-82-15, 12 p.; J. C. Cooper and S. G. Pooley. 1983. Characteristics of Hawaii's wholesale seafood market. Southwest Fish. Cent. Admin. Rep. H-83-22, 33 p.; W. K. Higuchi and S. G. Pooley. 1985. Hawaii's retail seafood volume. Southwest Fish. Cent. Admin. Rep. H-85-06, 16 p.; and MacDonald and Deese (1988).

¹⁰The demonstration effect reflects indirect learning initiated by the presence of a new technology or methodology, usually introduced into a culture or a society from outside.

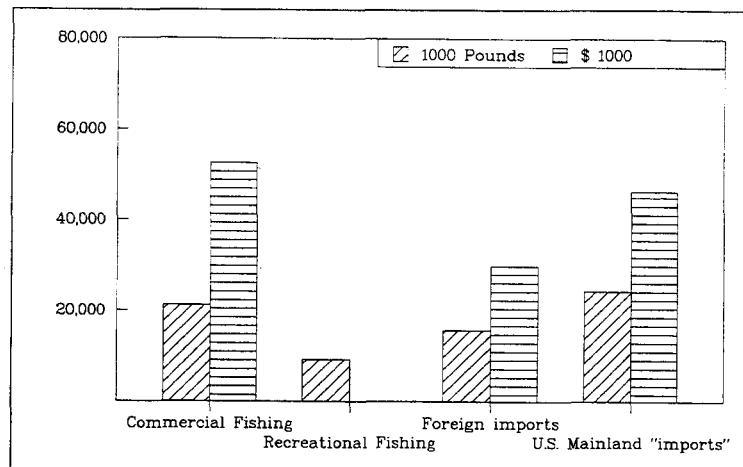


Figure 6.—Hawaii seafood market shares, 1990. NMFS estimates.

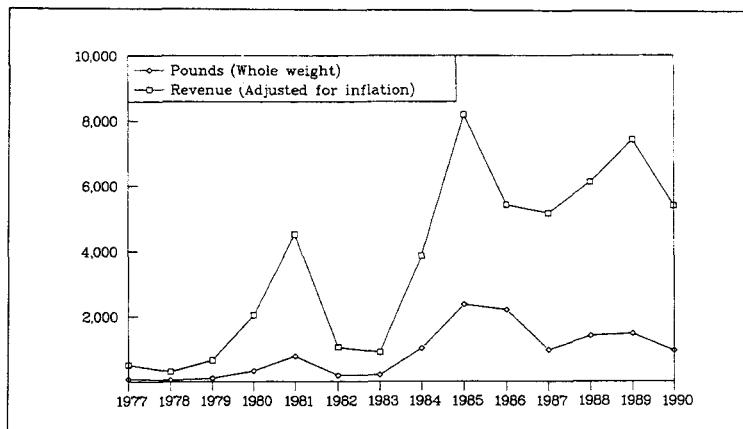


Figure 7.—NWHI lobster landings, pounds and revenue, 1977-90. NMFS estimates and figures. Revenue adjusted for inflation to 1990 U.S. \$ base.

1984), scientists discovered substantial quantities of spiny lobster in the NWHI. By the mid-1980's, with the additional discovery of slipper lobster, NWHI lobster was one of Hawaii's largest fisheries in terms of ex-vessel revenue (Fig. 7). To develop the lobster fishery, new fishermen and new boats came to Hawaii, primarily from the Pacific Northwest (Fig. 8). Large vessels, some over 100 feet in length, with advanced technology freezing and processing equipment, entered the fishery. New traps were introduced from California which made fishing not

only more efficient but also allowed the slipper lobster to be caught commercially.

Although the first lobsters were sold locally as a live product, soon almost all were produced as a frozen tail product and sold to mainland U.S. buyers. This was the first premium product of Hawaii's new commercial fisheries, with prices ranging up to \$13.50 per pound for the tails. However, neither the albacore nor the lobster fishery changed the basic structure of the Hawaii fresh fish market.

The NWHI also proved to be a good location for bottom fishing (mecha-

nized "handline" fishing for snappers, groupers, and jacks), which required a medium-scale modern fishing vessel (Fig. 9) similar to those used in the lobster and albacore fisheries. The expanding supply of pink and red snappers (opakapaka and onaga) locally made possible the expansion of the restaurant market by allowing a regular and consistent supply of relatively fresh fish (Fig. 10). At the same time, the restaurant market for fresh mahimahi also expanded, providing a new source of income for local trollers (Takenaka et al.¹¹). Local wholesale dealers were able to promote fresh local mahimahi as a substitute for some of the large imports of frozen mahimahi. Since both bottom fish and mahimahi were landed fresh and sold primarily at the Honolulu auction, this marked an important change in the local fishery and reinvigorated the local fresh fish market.

With a much larger restaurant market in Honolulu, bottomfishermen from the main Hawaiian Islands were able to obtain premium prices for their considerably fresher catch, and thus were motivated to increase their landings (Fig. 11). Finally, some wholesale seafood dealers began sending opakapaka and mahimahi to the mainland, establishing a distinctively Hawaiian seafood presence linked to Hawaii's tourism market.

In the late 1970's and early 1980's the traditional Hawaiian tuna handline fisheries, known as ika shibi (Ikehara¹²) and palu ahi, revived owing to fuel-efficient small-scale vessels (Fig. 12). These fisheries, which targeted yellowfin and bigeye tuna (both known locally as ahi, along with albacore), were centered on the Big Island (Hawaii), but much of the product at the time was shipped to Honolulu for the restaurant market. This was a useful de-

¹¹B. Takenaka, L. Toricer, S. G. Pooley, and J. C. Cooper. 1984. Recent trends in the commercial fishery and marketing of mahimahi and ono in Hawaii. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Southwest Fish. Cent., Honolulu Lab., Southwest Fish. Cent. Admin. Rep. H-84-9, 20 p.

¹²W. Ikehara. 1981. A survey of the ika-shibi fishery in the state of Hawaii, 1980. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Southwest Fish. Cent., Honolulu Lab., Southwest Fish. Cent. Admin. Rep. H-82-4C, 11 p.

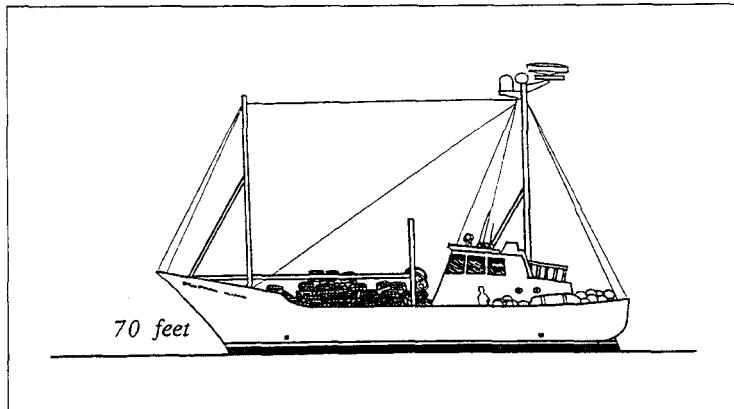


Figure 8.—Drawing of typical NWHI lobster boat.

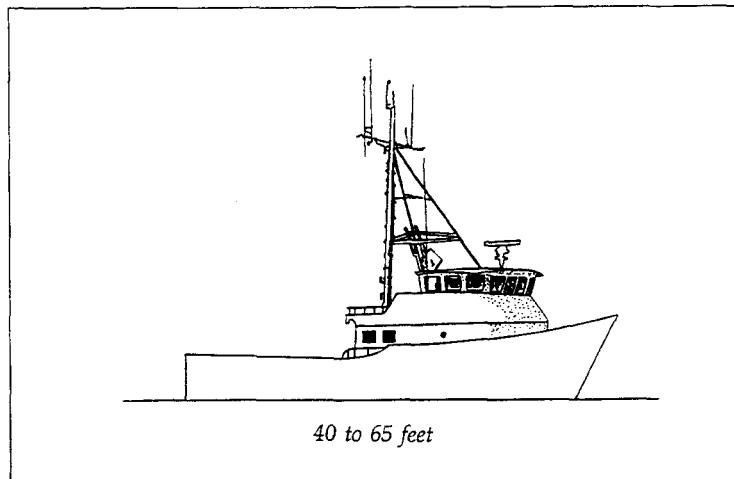


Figure 9.—Drawing of typical NWHI bottomfish boat.

velopment for the neighbor islands whose commercial fishery appeared to be left behind by the growth of the large-scale fishing fleets based in Honolulu. Today, there are strong local markets for fresh fish on the neighbor islands, associated with the expansion of the tourist trade on those islands, and there is considerable "export" of fresh fish to the U.S. mainland. However, access by handline boats to the higher value-added market has been limited on account of a phenomenon known as the "burnt tuna phenom-

enon," a condition in which the meat of handline and troll caught yellowfin tuna is metabolically degraded during fishing when not offset by rapid icing. Nonetheless, landings of tuna and other pelagics (primarily billfish, mahimahi, and ono) by troll, handline, and miscellaneous gears (i.e., excluding longline and aku boat) increased by elevenfold from 1970 to 1990 (Fig. 13).

In 1984 the tuna cannery Hawaiian Tuna Packers closed, coinciding with a period of substantial reorganization in the multinational canned tuna in-

dustry. As a result, the aku boat fleet declined from 12 active boats in 1979 (Hudgins, 1980) to just 7 active boats in 1986, selling solely to the fresh market (Boggs and Pooley, 1987; Pooley et al.¹³). Attempting to expand that market was a major project of State government in the 1980's (MacDonald et al., 1991), but current conditions in the fishery suggest that an entirely new start will be required, including a solution to the perceived bait problem and limitations on market penetration (primarily due to limited shelf life), if the potential yield of the skipjack resource is to be achieved in the future (Boggs and Pooley, 1987). Landings in the past five years have averaged less than 5 million pounds, with only 4 full-time aku boats active in the fishery.

By the mid-1980's, the export market for Hawaii's fresh bigeye tuna rose dramatically, largely as a result of marketing efforts by major wholesale dealers and the favorable exchange rate between the dollar and the yen. This marked the early resurgence of Hawaii's traditional longline tuna fleet, which produces a superior-grade tuna for sashimi (raw tuna). In the late 1980's, both NWHI bottomfish and lobster boats began facing lower catch rates and increased regulation, so that a number of these vessels began to transfer to the longline fishery.

In the early 1980's, perhaps as few as 15 vessels were fishing with longline gear in Hawaii. Today, over 150 vessels are in the longline fleet. Most of the vessels are newer and larger. Whereas the older sampans are about 45 feet, the new steel-hulled vessels range from 65 to 115 feet (Fig. 14). Many of the older vessels have new owners and have been refurbished. The longline crews have been trying a number of different fishing strategies, from fishing as far as 1,200 miles from Honolulu to fishing right off the reef,¹⁴

¹³S. G. Pooley, S. Teramoto, and A. C. Todoki. 1988. Hawaii's aku fishery in 1986 and 1987. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Southwest Fish. Cent. Admin. Rep. H-88-16, 15 p.

¹⁴Fishing off the reef provides a major fisheries management controversy. The Western Pacific Fishery Management Council has closed the waters around the main Hawaiian Islands to

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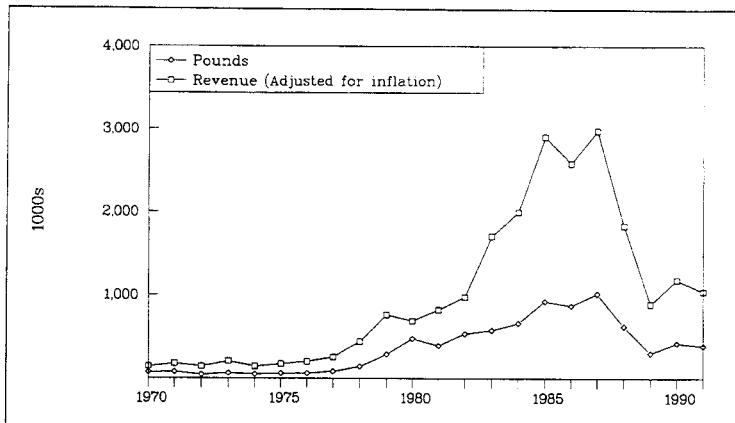


Figure 10.—NWHI bottomfish landings, pounds and revenue, 1970-91. NMFS estimates. Revenue adjusted for inflation to 1990 U.S. \$ base.

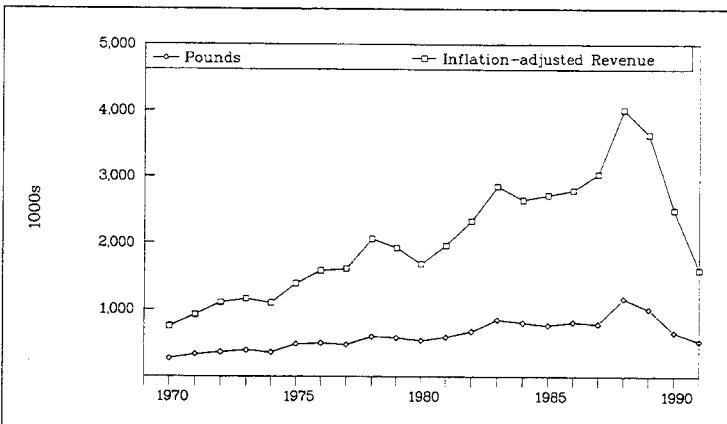


Figure 11.—MHI bottomfish landings, pounds and revenue, 1970-91. NMFS estimates. Revenue adjusted for inflation to 1990 U.S. \$ base.

from fishing for the high-valued big-eye tuna to fishing for the lower-valued but more abundant yellowfin tuna, to long-distance fishing for swordfish destined for export to the east coast. The new vessels deployed a new gear which has now become the predominant gear throughout the Hawaiian

longline fishery, the more efficient monofilament mainlines stored on reels, frequently set by powered line throwers (Kawamoto et al.¹⁵). The growth of the longline fishery is depicted in Figure 15.

Hawaii's market for fresh tuna (and other pelagics such as mahimahi) is now highly competitive, with competition in supply from Florida to Australia. The local fish market must now

longline fishing and has imposed a moratorium on new entry into the Hawaii-based longline fishery from 1991 through 1994 (Amendments 2, 4, and 5 to the Fishery Management Plan for the Pelagic Fisheries of the Western Pacific Region, Western Pacific Regional Fishery Management Council, Honolulu, Hawaii 1986, as amended in 1991.)

¹⁵K. E. Kawamoto, R. Y. Ito, R. P. Clarke, and A. Chun. 1989. Status of the Hawaiian tuna longline fishery 1987-88. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Southwest Fish. Cent., Honolulu Lab., Southwest Fish. Cent. Admin. Rep. H-89-10, 33 p.

compete with the Tskiji market in Tokyo for the raw product, and local consumers must compete with the local restaurant trade and the export market.

If we take a brief look in retrospect, in 1979 the Hawaii Fisheries Development Plan predicted commercial fisheries growth to 50 million pounds in 1990 and 85 million pounds in the year 2000 (Department of Land and Natural Resources, 1979b). As one of the Plan's co-authors, I would say we failed to anticipate the likelihood and potential consequences of the collapse of U.S. production of canned tuna (the closure of the California and Hawaii canneries, and the emphasis on purse-seine tuna processing at the American Samoa and Puerto Rico canneries), and thus our forecasts for skipjack and albacore tuna landings were far afield. We also expected a rapid development of the oceanic shrimp fishery, but ultimately the resource did not support large-scale development (Tagami and Ralston¹⁶). But for ahi, NWHI lobster and bottomfish, the projections for growth have been quite reasonable. The prospects for further development in pelagics remain strong, although development must now be tempered by fisheries management considerations.¹⁷

Fleets and Current Landings

Hawaii's commercial fishery exceeds \$50 million in ex-vessel revenues, from 22 million pounds of landings in 1990. The longline tuna

Cent., Honolulu Lab., Southwest Fish. Cent. Admin. Rep. H-89-10, 33 p.

¹⁶D. T. Tagami and S. Ralston. 1988. An assessment of exploitable biomass and projection of maximum sustainable yield for *Heterocarpus laevigatus* (shrimp) in the Hawaiian Islands. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Southwest Fish. Cent., Honolulu Lab., Southwest Fish. Cent. Admin. Rep. H-88-14, 22 p.

¹⁷The relationship, or lack thereof, of fishery development and fishery management has been a difficult one. The Western Pacific Fishery Management Council initially tried to bridge the gap, but it had few resources which could be placed on fishery development issues. Within the State of Hawaii government, the two functions exist in different departments, while within NMFS, fishery development functions have been phased out since the late 1970's except for awards to private sector projects (the Saltonstall-Kennedy grants). Most State of Hawaii fishery

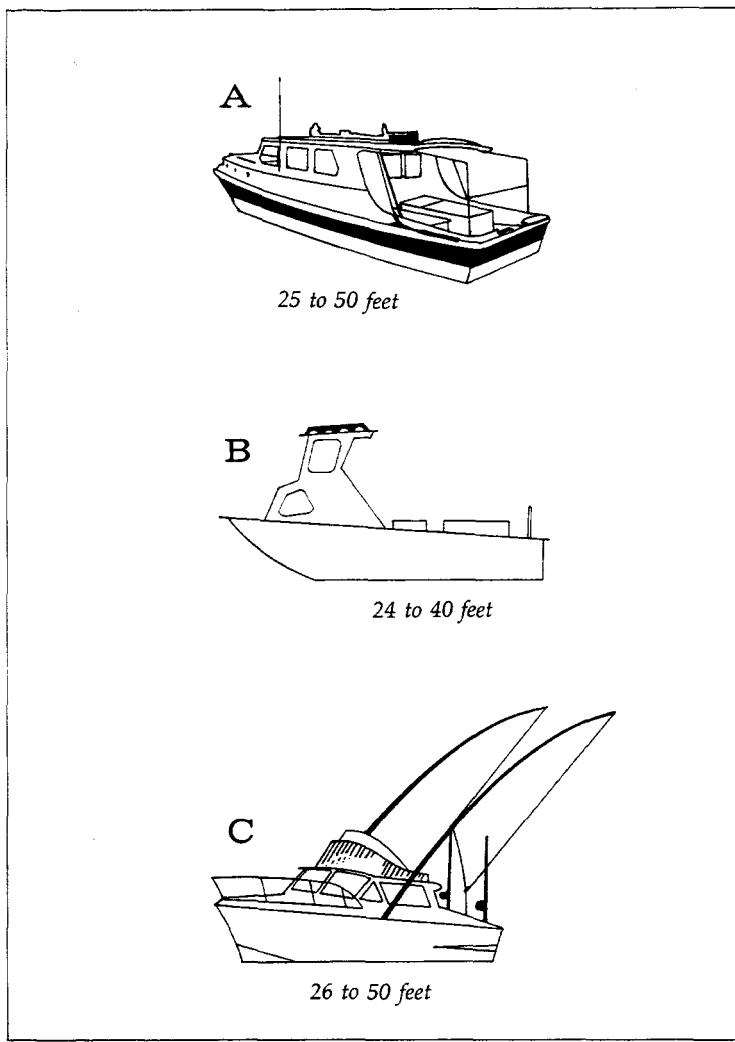


Figure 12.—Drawing of typical MHI (A) bottomfish, (B) pelagic handline, and (C) trolling boats.

fishery is the largest commercial fishery in Hawaii, valued at \$29 million. The smaller-scale troll and handline fisheries for tuna and mixed pelagics, such as mahimahi, are next in value, at

Continued

¹⁷ *Continued*
conservation activities are oriented toward nearshore fisheries. The State's 1985 fishery development plan added an emphasis toward the noncommercial sectors Hawaii's fishery and warned: "Fisheries development can only be promoted for those fishery resources that can withstand increased fishing pressure without damaging the integrity of the resource. . . ." (Hawaii Division of Aquatic Resources, 1986).

\$7 million, while lobster, aku (skipjack tuna), and bottomfish (snappers, groupers, and jacks) are the other major commercial fisheries (Table 2).

While there were 15,000 boats registered (or documented) in Hawaii in the 1980's, only from 7,500 to 5,000 were used for fishing (Skillman and Louie¹⁸, Sumida, et al.¹⁹, Meyer Resources Inc.²⁰). Less than 2,000 vessels are presently registered for commercial fishing and, while there are less than 3,500 people holding com-

mercial fishing licenses (issued to individuals), most commercial fishing license holders make minimal record of landings. There are perhaps only 750–500 boats that could be considered full-time commercial and charter-boat fishing operations. Almost all the fishing boats in Hawaii are less than 100 feet overall; only a portion of the longline fleet is longer than 75 feet.

This mixture of small and medium-sized fishing vessels has been relatively beneficial for Hawaii's fisheries (Pooley²¹). Large vessels can easily overharvest many of the nonpelagic resources while having a hard time making ends meet over the long run in such limited fisheries²². Many of the medium-sized vessels have the advanced technology and mobility to make switching between fisheries a viable business strategy²³, while at the same time not having a strongly negative impact on the small-scale commercial and recreational fishermen. Indeed, it was believed that Hawaii's offshore pelagic fisheries, which are substantially less susceptible to overfishing by small and medium-sized

¹⁸R. A. Skillman and D. K. H. Louie. 1984. Inventory of U.S. vessels in the central and western Pacific: Phase 2—verification and classification. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Southwest Fish. Cent., Honolulu Lab., Southwest Fish. Cent. Admin. Rep. H-84-12, 21 p.

¹⁹R. F. Sumida, B. M. Ito, and J. P. Draper. 1985. Inventory and uses of vessels in Hawaii, 1984. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Southwest Fish. Cent., Honolulu Lab., nontechnical report.

²⁰Meyer Resources Inc. (P. A. Meyer.) 1987. A report on resident fishing in the Hawaiian islands. (A project to determine the economic value of recreational fishing in Hawaii.) U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Southwest Fish. Cent., Honolulu Lab., Southwest Fish. Cent. Admin. Rep. H-87-8C, 74 p.

²¹S. G. Pooley. 1985. The hopelessness of the invisible hand: small versus large fishing vessels in Hawaii. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Honolulu Lab., Southwest Fish. Cent. Admin. Rep. H-85-02, 16 p.

²²For example, Clarke and Pooley (1988) found that mid-sized vessels (65 feet overall length) were the most profitable in the NWHI lobster fishery, while the larger vessels (greater than 75 feet in overall length) were not profitable. However, the larger lobster vessels have participated in the NWHI lobster fishery and have a dramatic impact on available stocks of lobsters.

²³A strategy increasingly constrained by the implementation of limited entry in Hawaii's major commercial fisheries.

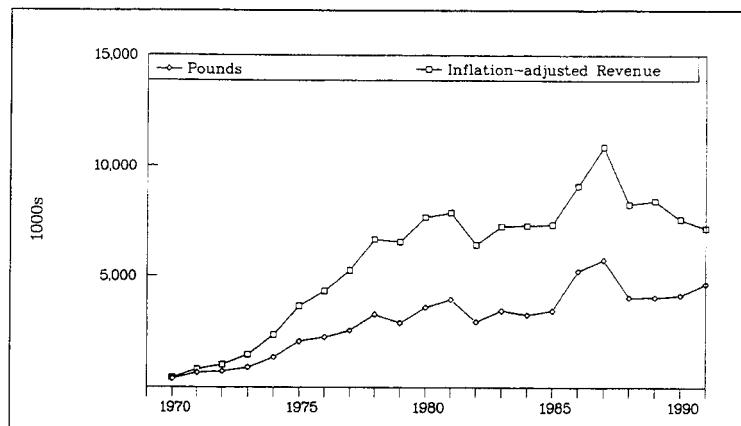


Figure 13.—MHI pelagic landings, pounds and revenue, 1970-91. NMFS estimates. Revenue adjusted for inflation to 1990 U.S. \$ base.

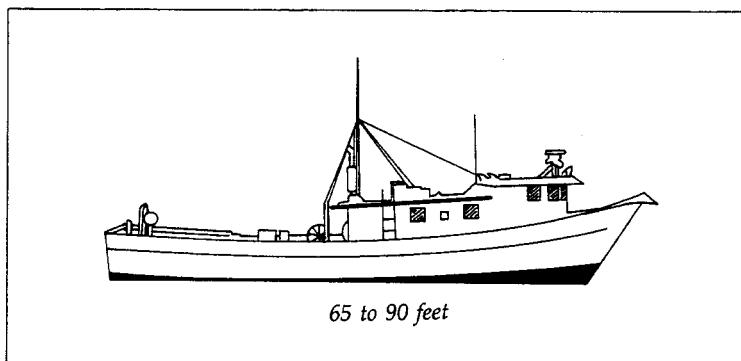


Figure 14.—Drawing of typical modern Hawaii longline boat.

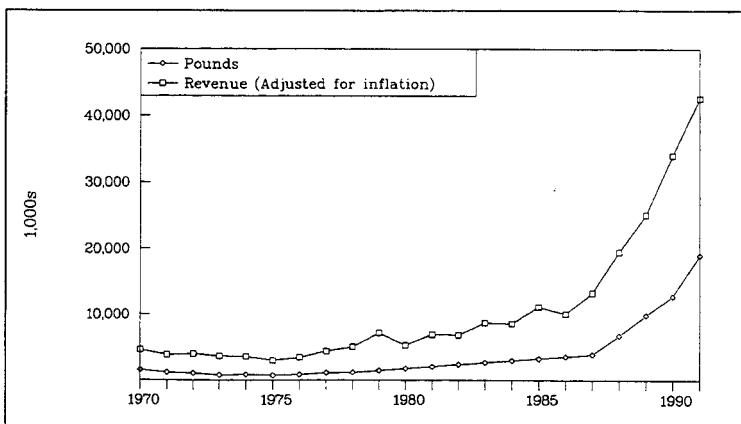


Figure 15.—Hawaii longline landings and revenue, 1970-91. NMFS estimates. Revenue adjusted for inflation to 1990 U.S. \$ base.

fishing vessels, would be an attractive avenue for future growth. Unfortunately the recent development of the longline fishery has been less benign, with substantial disputes amongst participants (Pooley, 1990).

The structure of Hawaii's seafood markets has encouraged value-added fisheries development (i.e., the production of a higher quality and higher-priced product through improved handling and marketing and the increased utilization of lower valued species), but with some definite side effects for Hawaii consumers (i.e., higher prices and lower availability). Whereas many mainland U.S. fisheries are "industrial-strength" with poor reputations for quality, low fresh fish prices, and poor incomes for fishermen, in Hawaii the combination of auctions and direct purchases from outside sources has meant a consistently high-quality product. However, fresh fish prices have risen considerably since 1970, even adjusted for the general rate of consumer price inflation (Fig. 16). This has been prompted by the explosion of restaurant demand, where fresh mahimahi can be found on local restaurant menus from Moiliili to Kaanapali, and on the U.S. mainland from Seattle to Des Moines to Boston. For local consumers, the loss of the aku (skipjack tuna) fleet has produced higher retail prices for fresh tuna. Our analysis of the price structure of Hawaii fresh fish prices (Pooley, 1987; Pooley^{24, 25}) indicates that the market provides strong quality premiums and is thus a competitive forum for most major fishery producers. However, as the export market develops from the sashimi "niche" to the swordfish "segment," transshipping operations are increasing. This reduces the "local content" of Hawaii's fishery landings, at some detriment to Hawaii's economy and to local consumers.

²⁴S. G. Pooley. 1986. Competitive markets and bilateral exchange: the wholesale seafood market in Hawaii. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Southwest Fish. Cent., Honolulu Lab., Southwest Fish. Cent. Admin. Rep. H-86-08, 14 p.

²⁵S. G. Pooley. 1991. Revised market analysis: Hawaii yellowfin tuna. NMFS Southwest Fish. Cent., Honolulu Lab. manuscr. 003-91H-MRF.

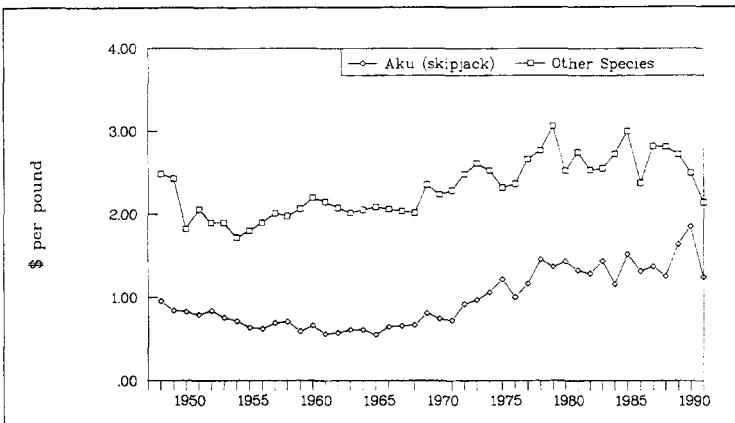


Figure 16.—Hawaii commercial fishery ex-vessel prices, 1948-91. U.S. \$ per pound (whole weight). NMFS estimates, aku (skipjack tuna) and all other species. Prices adjusted for inflation to 1990 U.S. \$ base.

Recreational Fisheries

The distinction between "recreational" and "commercial" marine fishing in Hawaii's small boat fleets is extremely tenuous. As opposed to most mainland U.S. states, there is relatively easy access to most fishing locations by most residents of Hawaii. Furthermore, and perhaps most important, Hawaii's seafood market is not as centralized and industrialized as mainland fisheries, so that it has always been feasible for small-scale fishermen to sell any or all of their catch for a respectable price. Many people sell a portion of their catch to offset fishing costs, while division of the catch amongst family and friends is also a common practice and indeed in some circles, an important cultural and social obligation. Many people who might be considered "commercial" fishermen in fact hold a full-time or part-time job which provides more income than fishing. Furthermore, charter-fishing boat captains generally retain their catch for sale in the local market, unless explicit arrangements are made to the contrary.²⁶ Even the catch at major sports

fishing tournaments is frequently sold by the charter captains. Not only are there overlapping structural factors in commercial and recreational fishing, but the legalistic differentiation is not particularly helpful. People who catch and sell at least a part of their catch are required to have a State of Hawaii commercial fishing license. However these licenses cost only \$25 (\$50 to nonresidents), and there is no marine recreational fishing license. Furthermore, there is no active dealer-reporting system, and Federal fisheries management has yet to require permits for the small-boat bottomfish and pelagic fleets.

Because of the lack of information on the small-boat fisheries, a number of survey approaches have been taken to estimate the extent of Hawaii's "recreational" fisheries. The most comprehensive was the NMFS Marine Recreational Fishing Statistical Survey (1979-81) which was a combined telephone and creel intercept survey.²⁷ The intercept included all modes of marine fishing: shoreline; piers and jetties, private vessel; and charter boat. The telephone and intercepts were fielded by a local company under contract to NMFS

²⁶Reporting of catch by charter boats to the Hawaii Division of Aquatic Resources was formalized in 1985. Prior to that, some charter boats reported their catch, and others did not. Charter boats are not explicitly differentiated in the State commercial fish catch reports, although the commercial fishing license identifies these vessels.

²⁷Data and methodology for the NMFS Marine Recreational Fishing Statistical Survey in the western Pacific were never published officially. These interpretations are based on project documents obtained by the Honolulu Laboratory several years after the survey was completed.

headquarters (with minimal actual involvement by NMFS staff in Hawaii), but the statistical expansions were undertaken by a firm on the mainland and delivered only to NMFS headquarters. For reasons not entirely understood, the expansions provided inconsistent estimates of various species and the results were never published. However, if we assume the major source of error was in individual species extrapolation, rather than in total participation and total or aggregate landings, then the following results can be derived.

The 1980 estimates of participation were 2.1 million fishing trips (620,000 by private boats and 88,000 by charter boats, the remainder being shoreside fishing) taken by 235,200 residents and 82,200 visitors (tourists). This amounted to 24% of the de facto resident population. The estimated weight of "recreational" fish caught was 4.4 million pounds, of which 94% was from boat fishing.²⁸

In 1984, the Honolulu Laboratory, NMFS, and the Division of Aquatic Resources, State of Hawaii, conducted a survey of vessel owners registered with the State of Hawaii's Department of Transportation²⁹ (Skillman and Louie³⁰; Sumida et al.³¹). Of the respondents who indicated they fished during the year, 70% said they never sold any of their catch, and only 16% sold at least half their catch.³²

²⁸These estimates were based on samples taken from the 8,033 people who were "intercepted" (sampled) in Hawaii. "Recreational" was not well defined, but is believed to indicate the fish weighed at the sample location were not to be sold. The expansion was based on 4,593 telephone interviews to Hawaii households, of which 15% contained people who went fishing.

²⁹Of the approximately 14,500 vessels registered in 1984 with the State Department of Transportation (or documented with the Coast Guard in Hawaii), 12,578 were deemed to have fishing vessel characteristics (cruise liners were excluded, for example). Sixty percent of the questionnaires were completed, with 5,496 vessel owners reporting their vessel was used for fishing. No examination of the nonrespondents was made, so it is not known to what extent returns on this survey were self-selected from fishing vessel owners or not. Presumably 9,200 vessels (60% of the initial population of vessels) could have been used for fishing, but we have tended to use the lower figure as more realistic on the expectation that many people who did not use their boat for fishing would not bother to answer and return a survey oriented

Continued

In 1987 the Hawaii Division of Aquatic Resources surveyed its license holders on a number of issues. Although the response rate was low (30% of the 2,529 license holders responded), the survey appears to confirm the impression that most "commercial" fishing license holders in Hawaii do not make their livelihood from fishing: 80% or more of the respondents on each island indicated they earned less than 51% of their gross income from fishing.

Karl Samples, University of Hawaii, prepared a series of studies on charter boat fishing during the early 1980's for NMFS. Samples found that the charter boat fleet consisted of 119 boats in 1982 (Samples et al.³³). These vessels are almost entirely 2-6 passenger vessels where half-day and whole-day charters are sold to the group, rather than to individuals (as in U.S. mainland "head" and "party" boats). This fleet generated 73,780 passenger trips with a direct income of \$8.1 million³⁴. Total fish catch by the charter boat fleet was 2.2 million pounds. It was also estimated that charter boat patrons spent \$39 million directly related to charter fishing as a vacation or leisure activity (Samples and Schug³⁵).

²⁹Continued towards fishing. We also noted through inspection of the respondents that most of the full-time commercial fishing boats also did not respond.

³⁰R. A. Skillman and D. K. H. Louie. 1984. Inventory of U.S. vessels in the central and western Pacific: Phase 2—verification and classification. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Southwest Fish. Cent. Admin. Rep. H-84-12, 21 p.

³¹R. F. Sumida, B. M. Ito, and J. D. Draper. 1985. Inventory and uses of vessels in Hawaii, 1984. NMFS Southwest Fish. Cent., Honolulu Lab., nontechnical rep.

³²Only 3% of the respondents said they made half their income from fishing, suggesting that the survey returns were biased toward small-scale recreational fishermen.

³³K. C. Samples, J. N. Kusakabe, and J. T. Sproul. 1984. A description and economic appraisal of charter boat fishing in Hawaii. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Southwest Fish. Cent., Honolulu Lab., Southwest Fish. Cent. Admin. Rep. H-84-6C, 130 p.

³⁴Income from charter fees was approximately \$5.8 million while income from selling fish was \$2.3 million.

³⁵K. C. Samples and D. M. Schug. 1985. Charter fishing patrons in Hawaii: a study of their demographics, motivations, expenditures and

The only major study of the economics of recreational fishing in Hawaii was undertaken by Meyer Resources Inc.²⁰ for NMFS. This study used a variation of the contingent (non-market) valuation technique on focus groups composed of recreational fishing clubs in Hawaii. Meyer estimated that there were 6,684 small boats used for "resident" fishing (defined as: "persons who are not making their primary living from commercial fishing," Meyer²⁰, p. 1) in Hawaii, with direct expenditures of \$24 million. Total catch by these vessels was 21 million pounds, of which 47% was sold. The remainder was used for home consumption (23%), given away to friends and family (21%), or otherwise used. Using contingent valuation techniques, Meyer estimated that the nonmarket value of these fishing trips to Hawaii resident fishermen was \$239 million.³⁶

Finally, in 1990 and early 1991 the State of Hawaii, with the assistance of NMFS, conducted a survey of small boat launch sites and harbors on Oahu (the island on which Honolulu and 80% of the population is situated) to understand better offshore fishing by recreational and subsistence fishermen. The results from this survey may provide a stronger basis for estimating current recreational and part-time commercial fishing activity (Hamm and Lum³⁷).

Recent Issues

Naturally, the transition from the old style to the new in Hawaii's offshore fisheries has not occurred without biological, economic, and social impacts. Hawaii's commercial and recreational

³⁵Continued fishing values. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Southwest Fish. Cent., Honolulu Lab., Southwest Fish. Cent. Admin. Rep. H-85-8C, 95 p.

³⁶Nonmarket value means in this case what the participants thought their fishing "experience" was worth in market terms. Frequently this is termed "willingness to pay," as in "How much would you be willing to pay to continue fishing ...?" although that is not the precise approach used by Meyer.

³⁷D. C. Hamm and H. K. Lum. 1992. Preliminary results of the Hawaii small-boat fisheries survey. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Southwest Fish. Cent., Honolulu Lab., Southwest Fish. Cent. Admin. Rep. H-92-08, 35 p.

fisheries are no longer what they were, and the relationship between Hawaii's people and the sea has changed. We have already mentioned the change in availability and price of locally caught fish for Hawaii's resident consumers, but there have been changes in the water and on the docks too.

Recognition that nearshore fish resources have diminished (as well as consumer fears concerning ciguatera toxins), combined with the rise in tourism-related ocean recreation, means that there will be more pressure for nearshore marine environment management, with a premium on nonconsumptive uses of marine resources. A number of State of Hawaii initiatives have focused on this recognition, including the Main Hawaiian Islands - Marine Resources Investigation (Pooley³⁸ and Hawaii Division of Aquatic Resources, 1988), and there has been a broad strategic planning approach to coastal zone management and development (Hawaii Ocean and Marine Resources Council, 1991). Furthermore, rights of native Hawaiians to fishery resources are being explored, primarily through the offices of the Western Pacific Fishery Management Council (Iversen et al., 1989), and these will undoubtedly affect the ultimate resolution to fishery management issues. How Hawaii balances all of these interests may be a major political issue for the 1990's.

There are also some direct competitive pressures accompanying the rapid growth of the longline fishery. The Western Pacific Regional Fishery Management Council (Council) is the center of commercial fisheries management in Hawaii, whereas the state government is concentrating on nearshore fishing issues. The early years of the Council involved laying out a fishery management structure with relatively little emphasis on the distributive issues which were central on the

³⁸S. G. Pooley (Editor). 1988. Recommendations for a five-year scientific investigation on the marine resources and environment of the main Hawaiian islands. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Southwest Fish. Cent., Honolulu Lab., Southwest Fish. Cent. Admin. Rep. H-88-2, 22 p.

U.S. mainland. The NWHI lobster and bottomfish fishery management plans (FMP's) addressed limited fisheries with limited interaction with other fisheries. The pelagic species FMP's orientation was simply toward displacing foreign longline fishing in the Council areas. However, with the growth of the domestic longline fishery in the late 1980's, the Council was suddenly faced with competing domestic issues.

Resolving these pressures has involved a real trade-off between the cost of regulation, in terms of the cost of biological and economic research and in terms of changes in life-styles, and the potential benefits of well-managed natural resources. People who go fishing are frequently very independent, more so than most. All one needs to do is examine the vastness and isolation of their working environment. They are also our most accessible observers of oceanographic conditions and marine biology. It seems that more needs to be done to encourage their community of interests with the rest of Hawaii's ocean and coastal users.

Foreign and U.S. mainland fisheries and markets are also influencing Hawaii's marine fisheries either through biological resource pressure and environmental effects which have led to displaced fleets or changes in market conditions, or through more direct changes in seafood markets. Foreign longline and baitboat fisheries for tuna have fished the central Pacific for decades. Although foreign longline vessels are effectively precluded from fishing within 200 miles of Hawaii (including the NWHI), the tuna and billfish stocks they seek probably are sufficiently migratory to hypothesize an interaction between their distant-water capture and fishing conditions in Hawaii. Furthermore, a number of local entrepreneurs have been exploring the importation of fresh fish directly into Honolulu from foreign longline vessels fishing just outside the U.S. Exclusive Economic Zone. The U.S. purse seine tuna fleet has expanded dramatically into the South Pacific, and the U.S. albacore trollers are now fishing the South Pacific, both using American Samoa as a base. Guam

and the Northern Mariana Islands are also used as transshipment centers for purse seine and longline fisheries. The apparent closing down of the Japanese, South Korean, and Taiwanese drift gillnet fleets fishing for squid and albacore tuna, due to their impact on sea birds and marine mammals, may affect both the commercial fisheries of the central Pacific and seafood markets. In addition, there are the potential impacts of ocean mining and other nonfishery related marine developments.

Ironically, perhaps one of the most important economic components of Hawaii's commercial fishing industry is not fishing at all; it is the resupply operations for the hundreds of foreign fishing boats and refrigerated transports which stop in Honolulu harbor for supplies. The direct economic impact of these vessels is \$46 million annually (Hudgins and Iversen, 1990). The whole question of harbor infrastructure has been a thorny one even before the original fisheries development plan (Department of Land and Natural Resources, 1979b). Similarly, the relationship between fisheries development and fisheries management and between fisheries and other coastal zone activities (cf. Department of Land and Natural Resources, 1979a) are central to Hawaii's political agenda in the 1990's.

Commercial fishing and the expenditures of the recreational and subsistence fisheries do not comprise a large industry in Hawaii, not even as a percentage of the overall ocean sector, although they are larger than many sectors of diversified agriculture and manufacturing. But fishing has a number of important linkages to Hawaii's current industrial and commercial structure and to Hawaii's cultural heritage. The commercial, recreational, and subsistence fisheries of Hawaii are important barometers of conditions in the ocean environment. Those of us whose job it is to monitor the marine fisheries and to conduct applied research on those fisheries are constantly fascinated by the variation which is displayed. The purpose of this paper has been to provide a better historical framework with which policymakers and the public can assess Hawaii's marine fisheries.

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