

# Economics and Hawaii's Marine Fisheries

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## Introduction

Fishing and seafood consumption permeate society in Hawaii, although neither the total volume of seafood harvesting nor the market value of seafood is a particularly large share of the state's economic activity.<sup>1</sup> Seafood consumption is an integral aspect of Hawaii's culture, from traditional Polynesian uses of nearshore and reef species to the importance of seafood in Asian cultures. As a result of cultural adaptation by the rest of the population and energetic promotion of local seafood in restaurants oriented toward tourism, per capita seafood consumption in Hawaii is high, and a very large

<sup>1</sup>The ex-vessel value of Hawaii's commercial fishery is less than 2/10% of gross state product, while the wholesale value of the seafood market (including imports) is less than 5/10%. (General statistics for Hawaii are taken from the State of Hawaii Data Book, 1990. Dep. Planning and Econ. Development. Honolulu, Hawaii.)

<sup>2</sup>W. K. Higuchi and S. G. Pooley. 1985. Hawaii's retail seafood volume. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Southwest Fish. Cent., Honolulu Lab., Southwest Fish. Cent. Admin. Rep. H-85-06, 16 p.

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*ABSTRACT—This paper reviews economic research conducted on Hawaii's marine fisheries over the past ten years. The fisheries development and fisheries management context for this research is also considered. The paper finds that new approaches are required for marine fisheries research in Hawaii: A wider scope to include other marine resource and coastal zone issues, and increased and closer collaboration between researchers and the fishing community.*

percentage is fresh fish (Higuchi and Pooley<sup>2</sup>; East-West Research Inst.<sup>3</sup>).

Fishing and seafood marketing also have been important bridges into commercial society for several immigrant groups, from the Japanese, Chinese, and Portuguese who came to Hawaii as plantation workers at the turn of the century to Koreans and North Americans who came for more varied reasons over the past 20 years. Fishing has also been important in tourism, particularly for Kailua-Kona on Hawaii (the Big Island), through the promotion of deep-sea fishing and sport fishing tournaments.

Hawaii is not the "paradise" promoted by the tourism industry, although probably for most people living here it is the only place to live. Hawaii is a densely populated state,<sup>4</sup> with an economy dominated by tourism (as much as 50% of the gross state product) and with a natural resource policy dominated by land use and coastal zone development issues. Nonetheless, subsistence fishing in rural areas and recreational fishing for city residents are important releases from urban culture, as well as sources of food and income.

With this in mind, the following sections attempt to delineate important components of the economics of Hawaii's fisheries. However, there has been no comprehensive survey of recreational and subsistence fishing activity in Hawaii, and economic surveys have been episodic. Thus the information with

<sup>3</sup>East-West Research Inst. 1989. Hawaii seafood consumption: a survey of seafood consumption in Hawaii. Contract Rep., State of Hawaii, Dep. Business and Economic Development, Honolulu, Hawaii.

<sup>4</sup>The Island of Oahu, on which Honolulu sprawls, has a density greater than New Jersey, the most densely populated state.

which to estimate the economic value of the Hawaii fishery is limited.

## Economic Values

Determining the economic value of Hawaii's marine fisheries is not simply a process of adding up commercial values, nor the straightforward valuation of subsistence and recreational resources and cultural practices, nor even a recitation of the kind of economic processes which affect the use, development, and management of these resources. The common yardstick for determining the economic value of commercial fisheries is ex-vessel revenue from the sale of harvested fish (and shellfish). In Hawaii, where there is essentially no processing industry, this is a good start. Ex-vessel revenue from Hawaii's commercial fisheries has been estimated at \$50 million in 1990 (Pooley, unpubl. data).<sup>5</sup> This revenue was generated from 21 million pounds (9,500 t) of marine fish landed in Hawaii by Hawaii-based fishing vessels. The composition of ex-vessel revenue by the major fleet components is shown in Figure 1.

However, there are three additional direct components to the economic value of Hawaii's marine fisheries: recreational fishing values, subsistence fishing values, and charter fishing values.<sup>6</sup> First, it is important to realize that the distinction between "commercial" and "recreational and subsistence" fishing in Hawaii is a weak distinc-

<sup>5</sup>The nominal (not adjusted for inflation) ex-vessel revenue from commercial fishing was \$3.9 million in 1970, \$13.0 million when adjusted for inflation to 1990 consumer price levels.

<sup>6</sup>We exclude the lucrative ocean recreation sector, as well as the aquarium fish market and dive shops since these rely primarily on in-shore and reef resources.

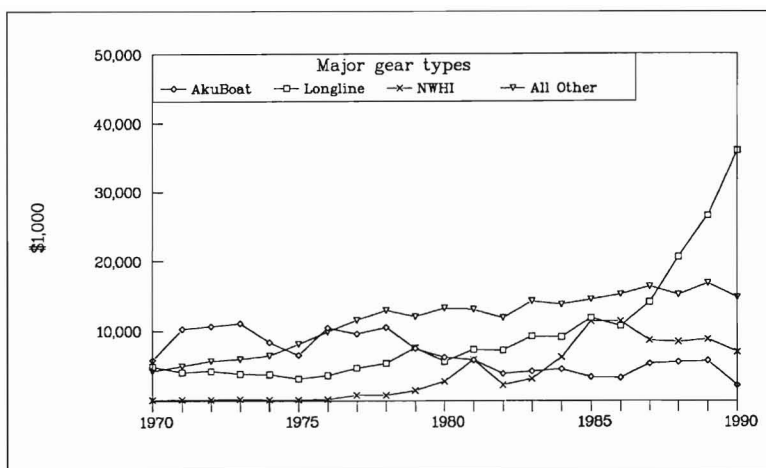


Figure 1.—NMFS estimates of commercial fishing revenue, adjusted for inflation, by major fleet components, 1970–92.

tion. The State of Hawaii commercial fishing license is quite inexpensive, and enforcement of its requirements is limited. A survey in 1984 found that 27% of small boat<sup>7</sup> owners sold a portion of their catch and 17% sold at least half their catch (Skillman and Louie<sup>8</sup>). Further study by Meyer<sup>9</sup> found that 35% of small boat catches were sold on the market and 13% were sold “off” the market, while 23% were retained for home consumption and 21% were given away to family and friends.

The overall level of recreational and subsistence fishing activity is difficult to assess. Meyer<sup>9</sup> estimates that the total catch by small boat fishermen (including some commercial landings) in 1985 was approximately 21 million pounds, of which 10 million pounds were sold. These are substantial numbers for Hawaii, when the recorded commercial fish landings by the small boat fleets was 5 million pounds in 1985.<sup>10</sup> The NMFS Marine Recreational Fishing Statistical Survey

<sup>7</sup>“Small boat” is a ubiquitous term referring primarily to troll, handline, and dive fishing vessels under 45 feet in length overall.

<sup>8</sup>R. 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.

<sup>9</sup>Meyer 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.,

(MRFSS) which has served as the basic yardstick for recreational fishing landings (in weight and number, not value) across the mainland U.S. has not been conducted in Hawaii since 1981, and the results from the 1979–81 survey in Hawaii were not published. However, the unpublished MRFSS estimates suggest the volume of small-boat noncommercial marine landings in Hawaii was roughly 9 million pounds a year in that time period.<sup>11</sup> Assuming some positive relationship between small-boat commercial and noncommercial volume, there is no evidence from small-boat commercial landings in the late 1980’s to suggest any dramatic change in the relative volume of the noncommercial sector. Furthermore, in a recent study reported by Hamm and Lum<sup>12</sup>, recre-

Southwest Fish. Cent., Honolulu Lab., Southwest Fish. Cent. Admin. Rep. H-87-8C, 74 p.

<sup>10</sup>Unfortunately there is believed to be substantial underreporting in the state data. The extent of this underreporting for small boats is unknown.

<sup>11</sup>There was tremendous year-to-year variation in the estimates provided by the MRFSS survey which is primarily attributable to variation in number of fish landed and by average weight of fish (a composite of species composition and average weight per species). Clearly there were some substantial estimation problems with this survey approach, but the estimates probably indicate the relevant range of these fisheries.

<sup>12</sup>D. 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., Honolulu Lab, Southwest Fish. Sci. Cent. Admin. Rep. H-92-08, 35 p.

ational and subsistence landings (i.e., fish landed but not for sale) for the Island of Oahu amounted to 1.9 million pounds, based on a year-long small-boat survey. This amounted to 59% of the landed weight by these vessels (which excluded the charter boat fleet operating out of the Port of Honolulu and other larger commercial trolling vessels).

The monetary value of recreational and subsistence landings is even more difficult to assess, and comparison between the monetary value of recreational landings and commercial landings is a complex theoretical, indeed philosophical, issue. Meyer<sup>9</sup> estimated that the market value of the fish sold by recreational and subsistence fishermen was approximately \$30 million (adjusted for inflation to 1990 price levels). However, the hedonic (or non-market) value of the recreational fishing experience was estimated at \$335 million (inflation-adjusted) from direct expenditures on small-boat recreational and subsistence fishing of \$33 million (inflation-adjusted). Since there are complex personal motivations for recreational and subsistence fishing, it is difficult to assess how much of this value should be associated with landing the fish, per se, and how much to other motivations.

In terms of participation, Skillman and Louie<sup>8</sup> estimated that there were at least 5,000 small boats actively used for fishing in Hawaii. The State of Hawaii recorded 3,500 commercial fishing licenses for fiscal year 1989, but this included licenses for crews on large-scale commercial fishing vessels as well as for small-boat fishermen. The state registers 1,100 vessels as commercial fishing boats (1989), but this excludes the larger vessels (documented by the U.S. Coast Guard), and choice of registration categories is somewhat dependent on tax status.

Figures on the level of recreational fishing activity in Hawaii are not entirely consistent. The MRFSS estimated the number of boat fishing trips in 1979–81 at 0.5 million annually. However, this amounts to over 1,350 trips per day, which seems excessive. Meyer<sup>9</sup> estimated that the average par-

ticipation by small-boat fishermen was 38 trips per year, which would lead to an estimated 13,200 people who participated in small boat fishing in the mid-1980's. This seems like a generous number of trips per year (as an overall average) and a conservative number of actual participants. Until a comprehensive survey is conducted, these figures will remain elusive.

The value of fishing for subsistence by contemporary native Hawaiians and others has also not been calculated, but it is known to be an important component of some communities, particularly rural communities. Fish also have played an important cultural role. Iversen et al., in a study of anthropological sources, noted:

"There is abundant historical and archaeological evidence for the social and religious importance of bottomfish, aku (skipjack tuna), and sharks in traditional Hawaiian culture . . . . At the family level, sharks and aku were often conceived as 'aumakua — family or personal gods. The boundary between the supernatural world of these personal gods and the natural world of the Hawaiian people was not sharply defined" (Iversen et al.<sup>13</sup>).

For this paper I will not attempt to place a monetary-value estimate on subsistence fishing (separate from that identified above by Meyer<sup>9</sup>), except to acknowledge its importance.

Finally, Samples et al.<sup>14</sup> and Samples and Schug<sup>15</sup> estimated that the direct market value of charter boat fishing

(i.e., the fees paid by patrons) was \$8.5 million (inflation-adjusted) annually. At that time the charter boat fleet consisted of approximately 120 boats which took 75,000 trips annually. The charter boat fleet is understood to have grown fairly substantially over the past decade, particularly on the neighbor islands and in rural Oahu.

There is no direct comparison between the ex-vessel value of commercial fishing landings and the direct revenues of charter boat fishing, on the one hand, and the expenditures and hedonic values of recreational and subsistence fishing, on the other hand. Furthermore, there is substantial overlap in the estimates of landings by the small-boat fleets. However, a rough

estimate of the direct input costs for all types of fishing combined would be \$100 million<sup>16</sup>. Table 1 presents estimates of landings (pounds) for both sectors and dollar values for the commercial sector, including the seafood markets.

Only for commercial fishing can we estimate long-term trends in economic values. These appear in Figures 2 and 3. Inflation-adjusted ex-vessel revenue increased almost fourfold from 1970 to 1990, with dramatic increases in the past five years (threefold) owing to the

<sup>16</sup>Data on charter boat and recreational costs taken from Samples (1984, 1985), and the unpublished MRFSS for 1979-81. Commercial fishing costs were estimated to be equal to commercial fishing ex-vessel revenue.

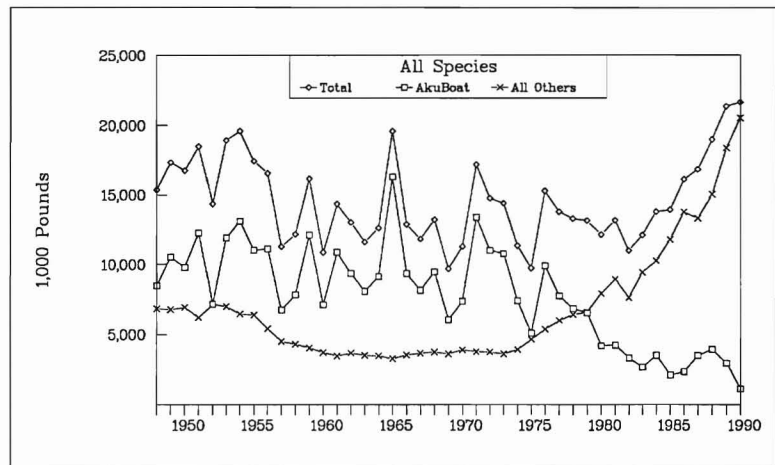


Figure 2.—NMFS estimates of commercial fishing landings, 1948-91.

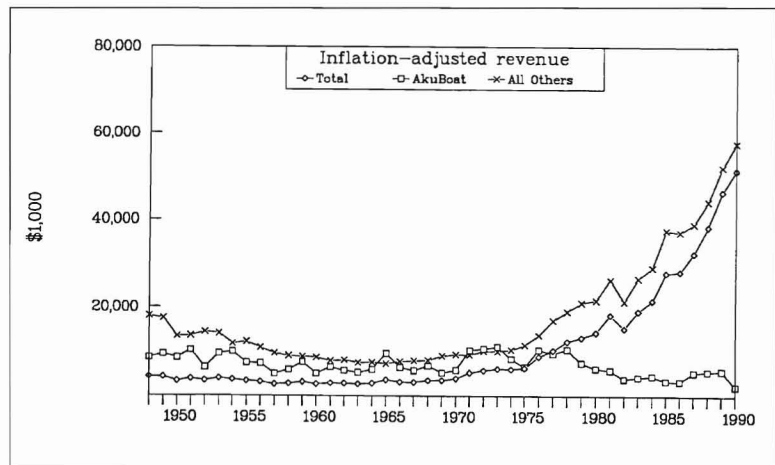


Figure 3.—NMFS estimates of commercial fishing revenue, adjusted for inflation, 1948-90.

<sup>13</sup>R. Iversen, T. Dye, and L. M. B. Paul. 1989. Rights of native Hawaiian fishermen with specific regard to harvesting bottomfish in the Northwestern Hawaiian Islands and with regard to harvesting bottomfish, crustaceans, precious corals, and open-ocean fish in offshore areas surrounding the entire Hawaiian island chain. A report prepared for the Western Pacific Regional Fishery Management Council. Honolulu, Hawaii.

<sup>14</sup>K. 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., Honolulu Lab., Southwest Fish. Cent. Admin. Rep. H-84-6C, 130 p.

<sup>15</sup>K. C. Samples and D. M. Schug. 1985. Charter fishing patrons in Hawaii: a study of their demographics, motivations, expenditures and fishing values. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Honolulu Lab., Southwest Fish. Cent. Admin. Rep. H-85-8C, 95 p.

**Table 1.—NMFS estimates<sup>1</sup> of Hawaii fishery components, 1990. MHI = Main Hawaiian Islands; NWHI = Northwestern Hawaiian Islands.**

Hawaii seafood supply and market, 1990 wholesale purchase level NMFS estimates (1,000's)			
Source of supply	Pounds	Dollars	
Commercial fishing <sup>2</sup>	21,000	50,400	
Recreational fishing <sup>3</sup>	9,200		
Hawaii fishery	30,200	50,400	
Foreign imports <sup>4</sup>	15,600	29,800	
U.S. mainland "imports" <sup>5</sup>	24,300	46,500	
Export (foreign and U.S. mainland) <sup>6</sup>	3,400	8,200	
Hawaii consumption <sup>7</sup>	66,700		
Hawaii market (commercial) <sup>8</sup>	57,500	118,500	

Hawaii commercial fisheries, 1990 NMFS estimates based on logbooks and shoreside monitoring NMFS estimates			
Fleet	Pounds caught	Pounds sold	Dollar
Longline	13,090	12,200	28,800
MHI troll-hand	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

<sup>1</sup> Honolulu Laboratory, National Marine Fisheries Service, Fishery Management Research Program.

<sup>2</sup> Hawaii commercial fishing: Domestic landings estimated by detailed NMFS logbooks and shoreside sampling, augmented by available State of Hawaii data for nonsampled fisheries.

<sup>3</sup> Recreational: Volume estimated in 1981 by NMFS Marine Recreational Fishing Statistical Survey.

<sup>4</sup> Foreign imports: volume (pounds) recorded by U.S. Food & Drug Administration monitoring; revenue estimated from Honolulu market prices by NMFS.

<sup>5</sup> U.S. mainland "imports": Volume and revenue estimated as proportion of Foreign imports using raising factors calculated from 1981 NMFS seafood market survey in Hawaii.

<sup>6</sup> Exports: Estimated from domestic landings of lobster, bottomfish, swordfish, and bigeye and yellowfin tuna.

<sup>7</sup> Hawaii consumption: Hawaii fishery + Imports - Exports.

<sup>8</sup> Hawaii market: Hawaii consumption - Recreational.

growth of the domestic longline fishing fleet. With a change in species and product composition from cannery tuna (34% of landings in 1980) to highly valued species (frozen lobster tails and fresh tunas, pelagics, and bottomfish), the inflation-adjusted price of fish in Hawaii also has risen dramatically, doubling from 1970 to 1990.

While it appears that some substantial profits have been made by some highliner sectors of the fishing fleet for short periods of time (e.g., the NWHI lobster fishery in the mid-1980's and the more technologically

advanced swordfish boats in recent years), like most fisheries, Hawaii's commercial fishing sector provides employment and income more than an independent source of wealth. Many fisheries are characterized by limited profitability and declining incomes, and participation in commercial fisheries other than longline has probably been stable or declining (and there is a moratorium on entry into the longline fishery and the NWHI bottomfish and lobster fisheries). The seafood marketing sector may have a more stable profit-basis, but its competitiveness also suggests that capital income is relatively limited. This makes the public policy issues of fisheries management and development much more pointed than might be believed.

### Fishery Development

Fisheries development economics is a difficult blend of industry economics and the bioeconomics of fisheries management. Some of these problems have been considered in a planning context (Pooley<sup>17</sup>) which suggests that an interactive approach to fisheries development and management may be a more fruitful means for long-term sustainable development. However, most of the fisheries development work in Hawaii has been more traditional in its orientation, and there was relatively little conceptual work investigating the framework of fisheries development (Pooley<sup>18</sup>).

Throughout the late 1960's and the 1970's, fishery development was the predominant fisheries theme in Hawaii. The Pacific Tuna Development Foundation (PTDF)<sup>19</sup> was a joint State/Territory-Federal-industry body which initiated development projects through-

out the Pacific, from advanced purse seine techniques which led to the initial movement of the U.S. tuna fleet from southern California to the western Pacific (primarily Papua New Guinea), to small-scale development activities such as teaching handline fishing techniques and building new boat launching ramps. The State of Hawaii through its Department of Land & Natural Resources sponsored the Hawaii Fishery Development Plan in 1979 (Hawaii Department of Land & Natural Resources<sup>20</sup>) which proposed a multi-million-dollar program of capital improvements and development projects aimed at establishing Hawaii as a base for distant water commercial fishing<sup>21</sup> and reinvigorating local fisheries<sup>22</sup>. Much of the NMFS research during this period was also directed toward fisheries development, including the tripartite study of the essentially uninhabited Northwestern Hawaiian Islands (NWHI) in the late 1970's (Grigg and Pfund, 1980). This study identified important lobster fishing grounds which at one point grew to be Hawaii's most lucrative single fishery (\$6 million ex-vessel revenue in 1989).

Two important exogenous changes altered the climate for Hawaii's commercial fisheries during this period. In the mid-1970's, the increase in frequent neighbor island jet flights made possible the expansion of the domestic market for neighbor island fresh fish to Honolulu. This assisted the development of the neighbor island handline tuna and bottomfish fisheries. Furthermore, with the tremendous expansion of tourism and jumbo jet traffic between Hawaii and the mainland U.S. and between Hawaii and Japan, fresh

<sup>20</sup>Hawaii Dep. of Land and Natural Resour. 1979. Hawaii Fisheries Development Plan. Dep. of Land and Natural Resources. State of Hawaii, Honolulu, Hawaii.

<sup>21</sup>Such as domestic purse seining (C. D. MacDonald and J. A. Mapes, 1985. Hawaii as a base for tuna purse seining operations. State of Hawaii, Dep. Planning and Econ. Develop., Honolulu, Hawaii).

<sup>22</sup>A parallel effort was made to develop on-shore aquaculture (Hawaii Dep. Business and Economic Development, 1978), and despite a number of business failures, the wholesale value of aquaculture products produced in Hawaii was \$9 million in 1990 (Corbin, 1992).

<sup>17</sup>S. G. Pooley. 1989. The role of government planning and economic analysis in the development of the private fisheries sector. Southwest Fisheries Center, Honolulu Laboratory manuscript MRF-003-90H, paper contributed to the International Symposium on Agriculture and Fisheries Development in Oman, Muscat, Oman.

<sup>18</sup>S. 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.

<sup>19</sup>Later renamed the Pacific Fishery Development Foundation.



fish from Hawaii gained new adherents and easier access to these external markets. This has been particularly true of the longline fishery, which reached its nadir in the late 1970's and which expanded steadily through the 1980's until the discovery of the swordfish fishery, at which point longlining exploded in volume. The closure of the Honolulu tuna cannery in 1984, coincident with worldwide changes in the structure of the U.S. tuna industry, reduced the basic infrastructure available for the commercial fishery for a number of years and also changed the low end of the tuna market (with increased supplies of fresh skipjack tuna competing with yellowfin tuna caught by handline vessels). No substantial alternative market has been developed for skipjack tuna, despite marketing assistance from two state agencies, the aku boat fleet has declined substantially, and the skipjack resource is essentially untapped around Hawaii.

State of Hawaii fishery development activities continued throughout the 1980's<sup>23</sup>, although the emphasis began to shift to "recreational" development (such as the deployment of fish aggregating devices [FAD's]) and to value-added seafood marketing (MacDonald et al., 1991). NMFS fishery development activity was increasingly directed through the Saltonstall-Kennedy grant process, and many of these funds were directed to other U.S.-associated areas in the western Pacific such as American Samoa, Guam, and the Northern Mariana Islands. The Saltonstall-Kennedy grant process also represented a privatization of development efforts in Hawaii, where most projects were carried out by individual fishing and seafood marketing companies.

### Economic Research

Hudgins<sup>24</sup> surveyed economic re-

<sup>23</sup>Including an update of the fishery development plan (State of Hawaii, 1986) and the Hawaii Ocean Resources Management Plan (Hawaii Ocean and Marine Resources Council, 1991. Hawaii Ocean Resources Management Plan. Hawaii Dep. Business and Economic Development, Honolulu, Hawaii.).

<sup>24</sup>L. L. Hudgins. 1980. Economic analysis of Hawaii fisheries: a survey. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Honolulu Lab., Southwest Fish. Cent. Admin. Rep. H-80-07, 8 p.

search to date in Hawaii. Since then there has been a suite of studies directed toward fisheries management issues and seafood marketing. A substantial amount of this research has been funded by the Southwest Fisheries Science Center's regional economics program (Pooley et al.<sup>25</sup>). The following is a précis of economic research in which the Honolulu Laboratory was the principal investigator or a major collaborator.

Economic research directed toward fisheries management began with attempts to estimate the value of the recreational billfish fishery (Adams<sup>26</sup>) using household production models. An alternative methodology, primarily travel cost and contingent valuation, was attempted by Samples and SMS Research, Inc.<sup>27</sup> and Meyer<sup>9</sup>, but funds have never been adequate to conduct full-scale socioeconomic surveys of the recreational and subsistence fisheries in Hawaii.

The most applied set of studies, however, has concentrated on detailed cost-earnings profiles of various fleets. Most productive of these studies was the analysis of the Northwestern Hawaiian Islands (NWHI) lobster fleet. Clarke and Pooley (1988) reported a detailed breakdown of lobster fishing economic profiles by class of vessel. Samples and Sproul<sup>28, 29</sup> and Gates and Samples<sup>30</sup>, in work funded by the Western Pacific Regional Fishery Manage-

<sup>25</sup>S. G. Pooley, S. F. Herrick, D. E. Squires, C. J. Thomsen, and G. W. Silverthorne. 1991. Southwest Fisheries Science Center and Southwest Region economics research plan, 1990-95. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Honolulu Lab., Southwest Fish. Cent. Admin. Rep. H-91-07, 20 p.

<sup>26</sup>M. F. Adams. 1978. Alternative estimate of net economic benefits for billfish-tuna recreational commercial fishermen in Kailua-Kona, Hawaii. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Honolulu Lab., Southwest Fish. Cent. Admin. Rep. H-78-18, 10 p.

<sup>27</sup>K. C. Samples and SMS Research, Inc. 1983. Experimental valuation of recreational fishing in Hawaii. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Honolulu Lab., Southwest Fish. Cent. Admin. Rep. H-83-13C, 42 p.

<sup>28</sup>K. C. Samples and J. T. Sproul. 1987. Potential gains in fleet profitability from limiting entry into the Northwestern Hawaiian Island commercial lobster trap fishery. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Honolulu Lab., Southwest Fish. Cent. Admin. Rep. H-87-17C, 30 p.

ment Council, undertook a preliminary investigation of management alternatives for the NWHI lobster fishery. This was followed by a detailed bioeconomic model of the fishery by Clarke et al. (1992) which identified the relationship between the lobster resource and fleet dynamics.

In 1979-81, NMFS conducted some broad research surveys of the Hawaii seafood markets (NMFS<sup>31</sup>) which attempted to identify the important market channels (Cooper and Pooley<sup>32, 33</sup>). Further studies were conducted on the nature of competition in the seafood market (Adams<sup>34</sup>, Pooley<sup>35</sup>). These studies generally concluded that the existence of auction markets and a high level of competition between fresh and frozen food distributors had been beneficial for market development in Hawaii. However, there has been little follow-up to the initial surveys in the subsequent ten years. Research on market dynamics has continued, however,

<sup>29</sup>K. C. Samples and J. T. Sproul. 1988. An economic appraisal of effort management alternatives for the Northwestern Hawaiian Islands commercial lobster fishery. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Honolulu Lab., Southwest Fish. Cent. Admin. Rep. H-88-12C.

<sup>30</sup>P. D. Gates and K. C. Samples. 1986. Dynamics of fleet composition and vessel fishing patterns in the Northwestern Hawaiian Islands commercial lobster fishery: 1983-86. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Honolulu Lab., Southwest Fish. Cent. Admin. Rep. H-86-17C, 32 p.

<sup>31</sup>National Marine Fisheries Service. 1982. Preliminary results of a survey of wholesale fish dealers in Hawaii. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Honolulu Lab., Southwest Fish. Cent. Admin. Rep. H-82-14, 17 p.

<sup>32</sup>J. C. Cooper and S. G. Pooley. 1982. Total seafood volume in Hawaii's wholesale fish markets. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Honolulu Lab., Southwest Fish. Cent. Admin. Rep. H-82-15, 12 p.

<sup>33</sup>J. C. Cooper and S. G. Pooley. 1983. Characteristics of Hawaii's wholesale seafood market. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Honolulu Lab., Southwest Fish. Cent. Admin. Rep. H-83-22, 33 p.

<sup>34</sup>M. F. Adams. 1981. Competition and market structure in the Hawaii fish industry. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Honolulu Lab., Southwest Fish. Cent. Admin. Rep. H-81-05, 20 p.

<sup>35</sup>S. G. Pooley. 1986. Competitive markets and bilateral exchange: the wholesale seafood market in Hawaii. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Honolulu Lab., Southwest Fish. Cent. Admin. Rep. H-86-08, 14 p.

with data derived from systematic monitoring of the primary wholesale markets. Whereas results on the dynamics of the bottomfish market showed a strong relationship between quantity supplied and price, thus identifying the demand function (Pooley, 1987a), results from the more wide-ranging tuna markets were less robust because of either inadequacies in the data or substantial discontinuities in the market (Pooley<sup>36, 37</sup>). Work was also conducted by the Council in collaboration with NMFS on the marketing dynamics of the lobster fishery (Samples and Gates<sup>38</sup>).

Economic research with a development slant was conducted on the future of the Hawaii skipjack tuna cannery which closed in 1984. NMFS sponsored an industry and academic workshop on factors affecting the supply and market of skipjack tuna (Boggs and Pooley<sup>39</sup>, 1987; Pooley, 1987b). This work supplemented earlier research on the supply function for domestic tuna production in Hawaii (Hudgins, 1980) and subsequent research on the future for tuna fisheries in the western Pacific (Hudgins and Pooley, 1987). The gist of the workshop was that while a substantial tuna resource (primarily skipjack tuna) existed which could be exploited, the dynamics of the international canned tuna market would probably preclude reestablishment of the pole-and-line aku fishery in Hawaii for the foreseeable future (King<sup>40</sup>, 1987). Emphasis has instead been on export of fresh bigeye and yellowfin tuna. Research was also

conducted on the nature of the skipjack tuna as a discrete economic product, with identification of price vectors based on the size of fish (Hudgins<sup>41</sup>, 1987), and there was marketing research conducted on extending the shelf-life of skipjack tuna (Hawaii Department of Business and Economic Development, 1989). Finally, there is an additional economic value of longline fishing to Hawaii, but this is from the port visits of foreign fishing and reefer vessels which operate throughout the mid-Pacific region (outside the U.S. EEZ's). Hudgins and Iversen<sup>42</sup> estimate the value of these visits at \$46 million based on 2,500 port calls.

Finally, several collaborative economic studies were carried out by NMFS on behalf of the Corps of Engineers concerning small-boat fishing from the islands of Hawaii (Pooley<sup>43</sup>), Maui (Pooley<sup>44</sup>) and Oahu (Pooley<sup>45</sup>). These studies emphasized applying prototypical cost-earnings results from each fishery to estimate the net economic benefits of alternative fishery development schemes<sup>46</sup>.

<sup>40</sup>D. M. King. 1986. Global tuna markets and Hawaii aku. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Honolulu Lab., Southwest Fish. Cent. Admin. Rep. H-86-12C, 15 p.

<sup>41</sup>L. L. Hudgins. 1986. Economic issues of the size distribution of fish caught in the Hawaiian skipjack tuna fishery, 1964-82. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Honolulu Lab., Southwest Fish. Cent. Admin. Rep. H-86-14, 16 p.

<sup>42</sup>L. L. Hudgins and R. T. B. Iversen. 1990. Foreign flag fishing vessel expenditures in the Port of Honolulu, 1986-88. Report prepared for the State of Hawaii, Dep. Business, Economic Development and Tourism, Honolulu, Hawaii.

<sup>43</sup>East Hawaii commercial fishing mooring/launching facility project: economic and resources analysis. Southwest Fisheries Sci. Center, Honolulu Laboratory manuscript MRF-006-89H, report prepared for the U.S. Army Engineer Division, Pacific Ocean.

<sup>44</sup>Kahului small fishing boat facility: alternative net benefit estimates. Southwest Fisheries Sci. Center, Honolulu Laboratory manuscript MRF-004-89H, report prepared for the U.S. Army Engineer Division, Pacific Ocean.

<sup>45</sup>Report on Oahu small boat harbor fishery potential—Heeia Kea and Maunalua Bay. Southwest Fisheries Sci. Center, Honolulu Laboratory manuscript MRF-005-89H, report prepared for the U.S. Army Engineer Division, Pacific Ocean.

## Fishery Management

Most of Hawaii's offshore marine fisheries are now under some form of Federal regulation through the Western Pacific Regional Fishery Management Council (Council). The basic premise of management under the Council for the NWHI lobster fishery and for the precious coral fishery has been to avoid biological overfishing. For the NWHI bottomfish fishery, avoidance of economic overfishing has been the primary motivation. In the MHI bottomfish fishery, primary concern has been on biological overfishing. Finally, the pelagic fishery (troll, handline, and longline gears used for catching tunas, billfish, and other ocean-dwelling pelagics) has been regulated essentially to avoid gear conflicts and other negative interactions between the growing longline fleet (targeting swordfish and tuna) and the smaller-scale troll and handline fleets (targeting tunas and billfish) (Pooley, 1990). However, the longline fleet was also excluded from areas around the NWHI to avoid interaction with endangered species, in particular the Hawaiian monk seal.

Despite the detailed cost-earnings and bioeconomic modeling of the NWHI lobster fishery, the limited entry program for NWHI lobster which was initiated in 1991 was based more on pragmatic grounds than on economic research per se. The limited entry program for bottomfishing in the NWHI was supported more directly by Council economic research in collaboration with NMFS (Meyer<sup>9</sup>) which attempted to identify the kinds of constraints facing the domestic fishing fleet. This work was not fully developed in terms of quantifying the pa-

<sup>46</sup>Similar survey work was conducted for American Samoa, Guam, and the Northern Mariana Islands in cooperation with the island fishery agencies (L. D. Kasaoka. 1989. Summary of small boat economic surveys from American Samoa, Guam, and the Northern Mariana Islands. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Honolulu Lab., Southwest Fish. Cent. Admin. Rep. H-89-4C, 47 p.). However development of cost-earnings profiles was not completed due to lack of research resources.

<sup>36</sup>S. G. Pooley. 1990. Pelagic species prices in 1987-88. Southwest Fisheries Center, Honolulu Laboratory manuscript MRF-002-90H.

<sup>37</sup>S. G. Pooley. 1991. Revised market analysis: Hawaii yellowfin tuna. Southwest Fisheries Science Center, Honolulu Laboratory manuscript 003-091H-MRF.

<sup>38</sup>K. C. Samples and P. D. Gates. 1987. Market situation and outlook for Northwestern Hawaiian Islands spiny and slipper lobsters. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Honolulu Lab., Southwest Fish. Cent. Admin. Rep. H-87-4C, 33 p.

<sup>39</sup>C. H. Boggs and S. G. Pooley. 1987. Strategic planning for Hawaii's aku industry. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Honolulu Lab., Southwest Fish. Cent. Admin. Rep. H-87-01, 15 p.

rameters, but Pooley and Kawamoto<sup>47</sup> developed a series of cost-earnings profiles of the NWHI bottom fishing fleet which have been used in Council determinations on potential new entry into the fishery.

The limited entry regimes for NWHI bottomfish and lobster are both based on break-even levels of fishing effort at maximum sustainable yield. However, there has been relatively little interest in actually optimizing these fisheries. Where the biological dynamics of these fisheries are not well understood, and where the economics of fleet behavior between fisheries are quite fluid, these regimes may be considered quite appropriately as second-best optima under the circumstances.

Attempts at constructing linear programming models of the NWHI fishery (both as a directed bottomfish fishery and as a multipurpose fishery) were not particularly successful, but some experiments have been undertaken to model the components of fishing vessel operator behavior (Miklius and Leung<sup>48</sup>). This represents a novel approach to modeling decision processes and is based on detailed examination of vessel owner and captain incentives.

Although a considerable part of the pelagic fishery management problem revolves around allocation issues between segments of the fishery, information for fully developed economic models has been inadequate. The economic research mentioned in the description of Hawaii's recreational and subsistence fisheries, as well as the collaborative Corps of Engineers surveys, has been useful for fishery management purposes. Qualitative information was provided in the regulatory impact analysis of one amendment to

the Pelagic Species Fishery Management Plan<sup>49</sup>, but considerably more research is required.

Finally, although almost all of this research has revolved around Hawaii and has been directly economic in orientation, other pieces of social science research have been quite productive. Perhaps the most promising was the application of political bargaining models to the potential of management of South Pacific albacore (Schug, *In press*). This model looked at the constituent elements to successful negotiations and evaluated the conditions in that fishery during the conflict over drift-net fishing. The work is being extended to the current era when drift-net fishing has ceased.

### Central Economic Issues

From one perspective, the central economic issues in Hawaii's marine fisheries are fairly simple. Because of the geographical isolation of Hawaii from other U.S. fishing fleets and because of the vastness of the central and western Pacific, as well as the distances and costs involved in fishing the NWHI, the large-scale commercial fisheries have tended to "manage themselves" to a certain extent. The regulatory structures at both a biological and economic level have been relatively simple, and interactions between fisheries are limited. On the other hand, since most of these fisheries have just completed their development stage, relatively little information is available on them, and both formal and informal management institutions, including associations of fishing participants, are even younger. Therefore each regulatory action is taken with a high degree of uncertainty concerning its effect on the participants in the fisheries and those associated with the fisheries<sup>50</sup>.

A good example has been the recent closure of waters around the main Ha-

waiian Islands to longline fishing. The closures were designed to reduce gear interactions between the longline fleet on the one hand and troll and handline boats on the other, while still allowing the longline fleet access to the remainder of the waters around Hawaii. At the time, a considerable portion of the fleet was traveling as much as 1,200 miles from Honolulu, but two segments of the longline fleet were adversely affected. It was anticipated that the smaller wooden and fiberglass longline sampans would be affected, and provision to allow them exemptions to fish in their customary waters inside the closure was recommended.<sup>51</sup> It was not anticipated that a substantial portion of the remaining portion of the fleet, as many as 30-40 modern longline vessels, would choose to tie-up rather than fish outside the closure area. (The reasons for this are not yet clear.) Furthermore, although there was a presumption that the closures would be a de facto allocation in favor of the commercial troll and handline boats, their landings apparently did not rise during the period. The resulting impact of reduced landings on the local seafood market for tuna and other pelagics was substantial during the summer and fall of 1991, and a number of dealers also indicated economic hardship as a result of the closures.

This leads to the central economic issue in Hawaii's marine fisheries: the allocation of uncertain quantities of fish (primarily tunas and pelagics but also bottomfish) between the larger-scale commercial fishing fleets and the smaller-scale commercial, part-time commercial, subsistence, and recreational fishing boats. The subject may be intensified by native Hawaiian claims to preference in some of these fisheries (Iversen et al.<sup>13</sup>), but research on these issues is primarily in the purview of the Council and the State of Hawaii's Office of Hawaiian Affairs.

Biologically, a commercially caught fish is pretty much the same as a recreationally caught fish in Hawaii,

<sup>47</sup>S. G. Pooley and K. E. Kawamoto. 1990. Economic analysis of bottomfish fishing vessels operating in the Northwestern Hawaiian Islands, 1984-88. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Honolulu Lab., Southwest Fish. Sci. Cent. Admin. Rep. H-90-13, 21 p.

<sup>48</sup>W. Miklius and P. S. Leung. 1990. Behavior modeling in the multi-fishery: an evaluation of alternative methods. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Honolulu Lab., Southwest Fish. Sci. Cent. Admin. Rep. H-90-11C, 13 p.

<sup>49</sup>Proposed regulatory impact review: Amendment 4: Pelagic Fisheries FMP. Southwest Fisheries Science Center, Honolulu Laboratory manuscript 005-91H-MRF.

<sup>50</sup>This is true of many mainland U.S. fisheries as well. The difference is the very short time-series of information on which to base resource and economic assessments in Hawaii.

<sup>51</sup>As it turned out, only a few of these vessels met the stringent qualifying criteria.



although there are some size composition differences. U.S. fishery management history tended to favor domestic commercial fisheries until the late 1980's, with the pendulum now tending to swing more towards conservation and towards recreational and small-scale commercial interests. That has certainly been the case in Hawaii's pelagic fishery interaction issue. On the other hand, in the MHI bottomfish case, conservation has clashed substantially with recreational, subsistence, and small-scale commercial interests, with a large presumption going toward access, rather than conservation.

From one point of view, the political pluralism of the MFCMA fishery management system is an appropriate balancing of these concerns. Not only are there representatives of different fishing interests on the Council, there is also direct representation from different levels of government. Furthermore, at least in Hawaii, there is relatively easy access to the Council process, including a quite vocal and frequently educational public hearing process. On the other hand, some people fear that the decision-making process has not had or used enough information on the relative benefits and costs to the various human components of the fisheries. Weighing the market value of a commercially caught fish in terms of its income and employment generating impact against the nonmarket value of a recreationally caught fish in terms of enjoyment and personal consumption is hard enough. This is made more difficult by monetized and nonmonetary "rights" to fishing access and the probability that reducing large-scale commercial fishing probably will not generate an equivalent volume of landings (in weight or numbers) through the alternative fisheries. Then, the question becomes one of evaluating the marginal impact of fishing regulations on multiple interest groups. Furthermore, as contentious as the marine fisheries issues have been, a much more contentious set of marine resource issues faces Hawaii legislators and resource managers: the alternative uses of the near-shore and coastal environment (Hawaii Ocean

and Marine Resources Council<sup>52</sup>). In Hawaii, we are nowhere near making such determinations.

### Conclusion

What can economic and social science research contribute to the weighing of benefits and costs from development and conservation in Hawaii's marine fisheries? The answer to this question lies in the nature of the regulatory process.

Fisheries management, as codified by the MFCMA and various Federal rules, is a political process dominated by strategic bargaining on the part of its participating interest groups. As such, it is a classic example of political pluralism at the margin within tightly structured political boundaries and loosely structured economic and social systems. This political process contrasts strongly with three important presumptions in the MFCMA process:

- 1) Regulatory legalism,
- 2) Scientific rationalism, and
- 3) Laissez-faire economic ideology.

Clearly, in addition, there is a strong natural science presumption to issues of fisheries management, even though it is now commonplace to acknowledge that it is the people who participate in the fishery, from the harvesters to the dealers who are managed, not fish. Although participants in the fisheries management process know parts of this regulatory landscape, there is very little systematic knowledge of these basic contradictions.

Probably the most important potential contribution of social science research would be toward understanding the behavior of individuals and groups in the fishing community, particularly in terms of understanding changes in human behavior due to regulation (ex ante and contrapositive), endogenous changes in fishing technology, and exogenous events such as changes in alternative labor markets, changes in oil

prices, or changes in ocean and coastal zone use. This requires a fact-based, micro approach to social science research, not abstract models of fishing behavior. Unfortunately, although this kind of research promises important contributions to fisheries management decisions, neither its time frame nor its research resource requirements correspond to the short-term agendas of fisheries management bodies.

In Hawaii this should suggest two new approaches. First, there should be a wider scope for fisheries economics research to include a range of marine resource use issues as well as coastal zone and environmental economic issues. Second, this research should include a wider collaboration between university, state, and Federal researchers in a number of agencies, and probably a greater explicit collaboration with fishing (and similar user group) communities in the conduct of economic research. These approaches would take substantial new research resources, but they remain trivial compared to the overall cost of natural science research in fisheries and the social opportunity costs of overharvesting.

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<sup>52</sup>Hawaii Ocean and Marine Resources Council. 1991. Hawaii Ocean Resources Management Plan. Hawaii Dep. Business and Economic Development, Honolulu, Hawaii.



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