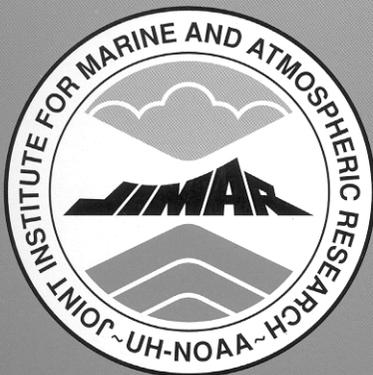


Non-Commercial Fisheries in the
Central and Western Pacific:
A Summary Review
of the Literature

Edward W. Glazier

SOEST 99-07

JIMAR Contribution 99-326



Pelagic
Fisheries
Research
Program

Non-Commercial Fisheries in the Central and Western Pacific: A Summary Review of the Literature

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National Marine Fisheries Services

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Honolulu, HI

This report reviews various articles, papers, technical reports, and other materials concerning selected aspects of non-commercial fisheries in the Central and Western Pacific, including the Commonwealth of the Northern Mariana Islands. The review is intended to meet informational needs of the nascent statewide Recreational Fisheries Council and the Western Pacific Regional Fishery Management Council (WPRFMC) toward improved understanding of non-commercial fishing activity and catch reporting in the region's waters. The review highlights economic and social aspects of the fishery, but given broad variation in the kinds of materials examined, some breadth of analytical focus is required. In all cases, the review addresses the research methods and analytical techniques used for each project, definitional problems related to "recreational" and other types of fishing, where evident, some general findings, conclusions, and implications for management. Hence, the piece is not a critical review of the literature, but a series of summaries focusing on topics relevant to the informational needs of the Councils.

The materials are reviewed in alphabetical order by author for easy referencing. Some authors cite pertinent materials not reviewed here; these are parenthetically referenced in the text. Some of the materials reviewed here are now dated, and specific findings in demographic numbers, economic dollars, and social and cultural processes must be considered in the temporal context in which they were written. Providing that context is beyond the scope of this review. Nevertheless, even the most dated materials provide some important information about research and sampling methods, analysis, and the problematics of the topic at hand, as manifest at the time of writing. Taken together, the following summary reviews are intended to provide an historically accountable picture of efforts taken thus far to further understanding of the non-commercial components of fisheries in the Western and Central Pacific.

This report was funded as part of cooperative agreement #NA67RJ0154 between the Joint Institute for Marine and Atmospheric Research (JIMAR) and the National Oceanic & Atmospheric Administration (NOAA). This study is part of the Hawaii Fleet Industry & Vessel Economics project, part of the University of Hawaii's Pelagic Fisheries Research Program. The views of the papers summarized in this annotated bibliography are those of the author and do not necessarily reflect the views of NOAA or any of its subdivisions.

Acknowledgments

A number of persons provided assistance in developing this review. They deserve acknowledgment and appreciation: Sam Pooley, Bert Kikkawa, Dave Hamm, and Sandra Abbott-Stout of the National Marine Fisheries Service, Honolulu Laboratory; Marcia Hamilton of the National Marine Fisheries Service, Pacific Islands Area Office; and Walter Ikehara of the State of Hawaii, Department of Land and Natural Resources, Division of Aquatic Resources.

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Preface

This report reviews various articles, papers, technical reports, and other manuscripts addressing selected aspects of non-commercial marine fisheries in Hawaii, American Samoa, Guam, and the Commonwealth of the Northern Mariana Islands. The review is intended to meet informational needs of the nascent statewide Recreational Fishing Task Force implemented by the Western Pacific Regional Fishery Management Council (WESPAC) toward improved understanding of non-commercial fishing activity and catch reporting in the region's nearshore and offshore waters. The review highlights economic and social aspects of the fishery, with some attention to its biological aspects, but given broad variation in the kinds of materials examined, some breadth of analytical focus is required. In all cases, the review addresses the research methods and analytical techniques used for each project, definitional problems related to "recreational" and other types of fishing, where evident, some general findings, conclusions, and implications of the research as reported by the authors. Hence, the piece is not a critical review of the materials *per se*, but rather a set of summaries focusing on topics relevant to the informational needs of the emerging Task Force.

The materials are reviewed in alphabetical order by author for easy referencing. In some cases, authors cite pertinent materials not reviewed here; these are parenthetically referenced in the text. Some of the materials reviewed here are now dated, and specific findings in demographic numbers, economic dollars, and social and cultural processes must be considered in the temporal context in which they were written. Providing that context is beyond the scope of this review. Nevertheless, even the most dated materials provide some important information about research and sampling methods, analysis, and the problematics of the topic at hand, as manifest at the time of writing. Taken together, the following summary reviews are intended to provide an historically accountable picture of efforts taken thus far to further understanding of the non-commercial components of fisheries in the Western and Central Pacific.

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Acronyms

ASA	American Sportfishing Association	1
CNMR	CNMI's Division of Fish and Wildlife	
CPUE	Catch per unit effort	
CNMI	Commonwealth of the Northern Mariana Islands	2
DAR	State of Hawaii, Division of Aquatic Resources	
DAWR	Guam's Division of Aquatic and Wildlife Resources	
DLNR	State of Hawaii, Department of Land and Natural Resources	
DMWR	American Samoa's Department of Marine and Wildlife Resources	
DOCARE	State of Hawaii, Division of Conservation and Resource Enforcement	3
DOT	State of Hawaii, Department of Transportation	
FDCS	Fishery Data Collection System	
FMAs	Fishery Management Areas	
FMP	Fishery Management Plan	3
JIMAR	Joint Institute for Marine and Atmospheric Research	
MFCMA	Magnuson Fishery Conservation and Management Act of 1976	
MHI	Main Hawaiian Islands	5
MRFSS	NMFS' Marine Recreational Fishery Statistics Survey	
NMFS	National Marine Fisheries Service, NOAA, Department of Commerce	
nmi	nautical mile	6
NOAA	National Oceanic and Atmospheric Administration	
ORI	Omnitrack Research & Marketing Group, Inc.	
PIAO	NMFS' Pacific Islands Area Office	7
RIMS II	Bureau of Economic Analysis Regional Input-Output Modeling System	
USACE	United States Army Corps of Engineers	
WESPAC	Western Pacific Regional Fishery Management Council	8
WTP	willingness-to-pay	

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In formulating Model Two, Adams recognizes (p. 6) that for fishermen who sell their catch, those selling 17 percent or less do not behave differently than those selling no fish at all. Persons selling more than 17 percent of total catch, however, appear to take more trips, a fact Adams asserts may be attributed to ability to sell that catch which is in excess of what is needed for home consumption or gifts. Thus, the author divides the fleet into individual recreational and commercial components, yielding a consumer surplus of \$1,620 for each of 166 recreational vessels, and a negative total net revenue of -\$1,415 per each remaining commercial vessel. Under the parameters of this model, the combined net benefits for the recreation and commercial components of the fleet total only \$267,505.

In formulating Model Three, Adams notes that the recreational fisherman will keep fishing until the marginal value is equal to the price of fishing, and the fishermen will take additional trips only when benefits beyond existing recreational benefits are perceived as attainable. Thus, the fact that fishermen can sell part of their catch in Kailua-Kona prompts many to take additional trips (with inherent costs, p. 8). Adams notes that while motivations to sell include the price of fish at market, the net revenue received for additional trips yields considerable net benefits to the fleet.

Adams, Michael F.

1978 Alternative estimates of net economic benefits for billfish-tuna recreational-commercial fishermen in Kailua-Kona, Hawaii. Southwest Fisheries Center Administrative Report H-78-18.

In response to initial passage of the Fishery Conservation and Management Act in 1976, this paper addresses economic aspects of what the author terms Hawaii's "weekend trolling fleet," estimated at some 1,500 vessels (p. 1). Using unspecified data collection methods and a sample of 386 vessels in Kailua-Kona, Adams calculates net benefits for the weekend fleet by summing consumer surplus and net revenue. The author defines consumer surplus and net revenue for the recreational fisherman as

... the difference between what the individual is willing to pay for different quantities of a good and what he actually pays . . . Net revenue [meanwhile] is based the sale of fish and the cost of the fishing trips attributed to the fisherman's choice to make some commercial sales (p. 2).

Adams generates demand models where T_i is the number of passenger trips for the i th vessel during 1976, where P_i is the operating cost per passenger trip for the i th vessel, where V_i is the current value of the i th vessel and gear, where C_i is kilograms of fish caught per passenger trip for the i th vessel, where y_i is the annual income for the owner of the i th vessel, and where E_i is the "disturbance term." The author notes that leisure time is an important explanatory variable not specified in the models due to absence of data.

Model One, which considers all members of the fleet as "recreationalists," generates total net benefits of \$1,637,412. Model Two, which divides the fleet into autonomous recreational and commercial units, yields total net benefits of only \$267,505. Model Three considers the economic costs and benefits of "weekend" fishermen who sell fish but without dividing them into discrete groups, yielding total net benefits of \$1,117,470.

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CIC Research, Inc.

**1983 Fishery data collection system: Saipan. Southwest Fisheries Science Center
Administrative Report H-83-20C.**

This contract report recommends modifications to the then fledgling fisheries data collection system used by the Division of Fish and Wildlife, Commonwealth of the Northern Mariana Islands. Specific survey and sampling techniques and expansion algorithms are recommended. While the small size of the island, commercial fleet (then 150 small vessels), and market (40 businesses buying locally caught products) enable "certain data collection procedures not normally feasible" (p. 6), CIC reports (p. 1) that increasing rates of tourism activity coupled with part-time commercial vessel activity (68.8 percent of vessels), full-time commercial activity (23.4 percent), recreational fishing activity (7.1 percent), and an unspecified level of subsistence fishing activity, were elevating pressures on the area's resource base, requiring comprehensive compilation and assessment of relevant data. CIC responds to a stated high likelihood that the fishery will expand over time, providing detailed insight on how to best modify the then current census system to accommodate that change, with due attention to precision and accuracy.

CIC reviews (pp. 19-26) critical design components for a successful Fishery Data Collection System (FDCS). These include (1) areal fishing experience considered in its human, spatial, and temporal terms; (2) surveying factors addressing issues of cost, key variables, and error margins; (3) sampling design including statistical and qualitative inference methods, and survey implementation; (4) development and operation of the system database; (5) operation of expansion algorithms with assessment of their reliability; (6) quality assessment methods including both internal and external components; and (7) a presentation strategy. The FDCS components are then used to address the unique attributes of the situation in Saipan.

Among the most important considerations in applying the FDCS to the Saipan case is the sampling strategy. CIC recommends (p. 41) a triangulated effort with face-to-face interviews focusing on the inshore fishery, a voluntary logbook census focusing on catch and effort for the offshore fishery, and observation of participation in both fisheries. Sample size for the inshore interviews would be derived from classical sample size determination formulas and would be applied to four distinct geographical regions across the island. If the logbook effort for the offshore fishery were to fail, a survey method would be implemented. Surveys would be modeled after the roving creel survey of Malvestuto and Davies ("An Evaluation of the Roving Creel Survey with Non-uniform Probability Sampling," *Transcript American Fishery Society*, 107 (2):255-26, 1979) wherein the sampling strategy "generates an unbiased sampling and estimation of fishing success, defined as the weight of fish caught per [intercepted] fisherman per fisherman hour or catch per unit effort

(CPUE), in this case stratified by island region and across temporal units (p. 52). CIC warns of the potential difficulty in intercepting and gaining quick rapport with fishermen. Surveys potentially implemented for both fisheries would ideally also be complemented with a qualitative component to assess night and illegal fishing.

Cooper, James C. and Michael F. Adams

1978 Preliminary estimates of catch, sales, and revenue of game fish for the fishery conservation zone around and between the Main Hawaiian islands, by types of troll and longline vessels and by species, 1976. Southwest Fisheries Center Administrative Report H-78-24.

Cooper and Adams note that this report “presents the best available data to satisfy specific requirements of the Pacific Billfish Fishery Management Plan until statewide surveys can be completed for Hawaii” (cover page). The first section of the report estimates number of vessels active in each of the following Hawaii fisheries: (1) charter fishing, (2) non-charter recreational-commercial, (3) full-time commercial trolling, (4) domestic longlining, and (5) foreign longlining.

The authors estimate number of vessels per category using a variety of data sources. These include State of Hawaii, Division of Fish and Game statistics; Department of Transportation (DOT), Harbors Division statistics; a 1973 report by Information Concepts that included an assessment of Hawaiian vessels; and a 1977 study of Billfish prepared for NMFS by Research Associates, Inc.

Of interest, the report notes that Harbors Division lists only 1,186 of the then total 16,947 undocumented fishing vessels in Hawaii as fishing vessels. Of these, 117 are listed as charter vessels and 1,069 as non-charter. Information Concepts, Inc. lists 2,986 unspecified fishing vessels, while Hawaii’s Division of Fish and Game counts 1,437 unspecified fishing vessels.

The work of Research Associates (entitled “A Study of Bioeconomics and Optimal Management Criteria for Utilization of Pacific Billfish, Module I,” prepared for NMFS, Honolulu Laboratory, 1977, 139 pp.), extrapolates from a survey-generated count of 426 Kailua-registered troll vessels that includes 386 non-charter “recreational-commercial” troll vessels and 40 commercial troll vessels, to assert a total of 730 and 1,704 troll vessels for the Big Island and the state, respectively. The term “recreational-commercial” denotes vessels whose captains fish with recreational motives but who sell part of the catch to cover expenses. While Cooper and Adams champion these findings which include catch, sales, and revenue extrapolations for each category of charter, private recreational-commercial, and private commercial vessels in Kailua-Kona for 1976, an account of the study’s research design is not provided.

Everson, Alan

1994 Fishery data collection system for fishery utilization study of Kaneohe Bay two-year interim report. State of Hawaii Division of Aquatic Resources Technical Report 94-01. Honolulu.

Everson reports on a project funded by the State of Hawaii Department of Land and Natural Resources (DLNR) to estimate total catch and effort at Kaneohe Bay, Oahu by means of a creel survey. The study, conducted from December 1990 through May 1992, also sought to chronicle perceptions about fishing in Kaneohe Bay from local experts. Data were collected bi-weekly on alternate weeks, and expanded catch and effort estimates were generated for all major fishing methods.

A combination of roving creel/vantage point and access point surveys were used in the field. The *roving creel* survey was implemented primarily in daylight hours wherein the researcher would traverse, by automobile, a predetermined route along the Kaneohe Bay shoreline to assess rates and kinds of participation, including both shoreline and boat fishing. Given problems of access, a high-powered spotting scope served to aid observation. Data collected during this part of the effort included number of boats and fishers by sector; kind of activity per vessel or fisher; type of fishing and number of gear; number of non-fishing vessels; and weather and sea conditions. Fishing activity was also considered in terms of its active or passive attributes and participants enumerated as such; certain net users, for instance, were enumerated only once per day (pp. 4-5).

The *access point* survey required that researchers intercept vessels returning from fishing trips to record the area fished, gear used and total time of use, catch (pieces and weight), and perceptions about general problems in the fishery. Since Heeia Kea is the primary access point in Kaneohe Bay, researchers conducted the intercepts from this location (pp 5-6).

Total catch and effort estimates were generated using basic data expansion technique used by Malvestuto et al. (S.P. Malvestuto, W.D. Davies, and W.L. Shelton, 1978, An evaluation of the roving creel survey with nonuniform probability sampling, *Transactions of the American Fisheries Society*, 107:255-262). Results are enumerated for six quarters, winter 1990 through spring 1992, while annual catch and effort statistics are presented for 1991-1992. The author ranked frequency of gear usage in Kaneohe by type per survey results noting the following outcome, most frequently used followed by successively less frequently used (1) pole and line, (2) spear, (3) troll, (4) crab net, (5) cast net, (6) invertebrate collecting (for aquarium), (7) limu harvesting, (8) dip net for bait, (9) fence net for shrimp and small fish, (10) aquarium dip net, (11) trapping for fish, lobster and crab, (12) gillnet, and (13) surround net. Data analysis per gear use also includes total effort in hours per weekday and weekend, and CPUE by subregion, by season, and annually.

Of concern to gillnet interests, 1,160 gillnet effort days were observed in 1991, with most effort occurring in the fall (438), and the least in winter (146). Gillnetting accounted for the greatest percentage of harvest among all observed methods, with over 40,000 pounds taken during the period 1991-1992 (p. 27). The author notes (p. 36) that "a few full-time commercial netters fish in Kaneohe Bay, but most net fishers have another full-time job and supplement this income by selling all or part of the catch." By way of contrast, pole and line anglers had the lowest CPUE of all methods, and under one percent of these persons reported selling any catch (p. 35).

With respect to pelagic-related activity, the author reports (p. 21) that most of Oahu's aku boats seek (anchovy or *Encrasicholina purpurea*) for bait in Kaneohe Bay, with an estimated 768 hours applied to the effort annually. Some 58 percent of trolling was observed in the central section of the Bay, usually adjacent to the barrier reef and scattered reef patches. Most boat fishing occurred on weekends and holidays (p. 21). Troll fishing accounted for a relatively small percentage of the overall take of fish in Kaneohe Bay; only trap fishing accounted for less. Approximately 3,000 pounds were taken by troll methods during 1991-1992 (p. 27).

Harvest was also analyzed by species (pp. 28-33). Tako (octopus) accounted for the vast percentage of take, at 44.7 percent. Most tako was taken by spear (p. 36). Goatfish followed at 8.6 percent,

followed by crabs at 7.8 percent, and jacks at 7.8 percent. Other species taken include, by order of estimated percentage: akule, taape, awa'awa, awa, uhu, various sharks, oio, barracudas, wrasse (hinalea), humu, palani, and kala. Miscellaneous other fish, fish-like species and crustaceans account for the remainder. Species takes varied by season, though tako remained most frequently harvested throughout (p. 29).

Interviews with fishermen in the Kaneohe Bay area suggest that resource abundance in the bay is diminishing. Although explanations for why this is perceived to be the case are highly variable, Everson notes (p. 35) that urbanization and pollution are seen as the major causes for the decline. In some cases, however, internal pressures are cited for the reduction of some species. Some local fishermen assert that nehu and other species are declining as a result of bycatch pressure from aku boats. The authors note, however, that these arguments are largely unsubstantiated, and that the size of the fleet and amount of pressure suggest other factors are at work, though "evaluation of nehu netting on the bay was one of the recommendations of the Kaneohe Bay Task Force, which in 1992 developed a comprehensive plan for protection, maintenance and sharing of the bay's natural, cultural and aesthetic resources" (p. 38; Office of State Planning, 1992, Kaneohe Bay Master Plan, Honolulu).

The author suggests that more and better data about the status of Hawaii's near and offshore fisheries is essential for sound management in the future. Everson also indicate problems potentially involved in instituting changes in he deems as a currently relaxed regulatory climate, noting that the public perceives regulations and imposition of licenses as an "infringement on rights to use the resource" (p. 38). They also mention a need to enumerate the total sportfishing population, and assert that "identifying specific areas and species of concern through fishing survey could be the first step in establishing effective management criteria" (p. 38).

Hamilton, Marcia S.

1998 A system for classifying small boat fishermen in Hawaii. *Marine Resources Economics*, Volume 13, pp. 289-291.

This paper discusses findings from a statewide economic survey of small vessel fishing operators (reviewed later in this document) to clarify the term "commercial" as it applies to small vessel marine fishing in Hawaii. The author reviews this definitional problem for Hawaii's fishery managers, noting (p. 289) that, according to state law, "any fisherman who sells at least one fish in a year is considered a commercial fisherman and must obtain a commercial marine license for that year," but that fishermen and other industry members "generally consider a commercial fisherman to be one who depends on profits derived from fishing for at least a portion of his income," and that "this would exclude a large number of Hawaii's fishermen who sell fish in an attempt to cover their fishing costs but never realize, or expect to realize, an economic profit from their operations" (p. 289).

Hamilton used a series of screening questions to ultimately classify fishermen as (1) "recreational," defined as persons who claim not having sold fish over the previous 12 months, (2) "expense," defined as persons who reported selling fish only to cover the cost of their fishing trips, (3) "part-

time” commercial, defined as persons reporting 50 percent or less of personal income derived from fishing, and (4) “full-time” commercial, defined as persons putatively earning more than 50 percent of income from fishing. Analysis of variance across a subsample of 382 pelagic fishermen was then conducted to determine the validity of the categories. Eleven variables were considered in the analysis: number of fishing trips taken annually, total annual catch, catch per trip, percent of annual catch sold, annual gross fishing revenue, percent of income from fishing profits, total investment, annual fixed costs, average price per pound received, annual household income, and operator’s age.

The author notes that statistically significant differences ($p < .05$) were found between each of the four groups for the following variables: (1) number of trips, (2) total catch, (3) catch per trip, (4) percent sold, (5) gross fishing-related revenue, and (6) percent of income from fishing profits. Total investment and annual fixed costs were not significantly different for part-time and full-time commercial respondents, and prices received for all respondents selling fish were also comparable, suggesting similar “access to fish of similar quality and to similar markets.”

Thus, Hamilton asserts (p. 291) that the classification system is useful, that “screening criteria were meaningful to survey participants, and analysis of the data collected indicates that there were many significant differences between groups.” The author further argues that the results “provide a structure and a baseline for assessing the potential and actual impacts of any new regulations,” and that these “may help us to devise more effective fishery management systems” (p. 291).

Hamilton, Marcia S.

1998 Cost-earnings study of Hawaii’s charter fishing industry, 1996-97. SOEST 98-08. University of Hawaii.

This report addresses selected operational and economic aspects of Hawaii’s charter fishing fleet through analysis of variables related to vessel operation and characteristics, demographics, investment and gross revenue, fixed costs, trip costs, and catch. The initial sampling frame was derived from the State of Hawaii Division of Aquatic Resource (HDAR) commercial marine license database which includes a charter fishing variable on its application questionnaire. While 265 licensed charter operators were listed in 1996, incomplete records, duplications and trailered vessels reduced the frame of active boats to 160. Direct observation at the harbors during the course of the study, however, yielded a count of 199 active boats. Thus, captains and/or owners from 62 of the state’s 199 active six-passenger boats were interviewed during 1997. The survey addressed charter activities occurring during the previous year at the major small vessel ports of Honokohau on Hawaii, Lahaina and Maalaea on Maui, Kewalo on Oahu, Port Allen and Nawiliwili on Kauai, and Kaunakakai on Molokai.

Summarizing an array of survey findings, Hamilton reports (p. 96) that when averaged across the existing fleet of 18 vessels, Lahaina was the busiest port for charters during 1996, with a per vessel average of 243 trips. Honokohau’s fleet, while the largest in the state at 124 vessels, took the fewest trips on average at only 126. Honokohau also offered the least expensive trips on average at \$524 for a full day exclusive charter, and \$60 for a full day shared charter. Kauai-based vessels charged the highest rates on average at \$725 for a full day exclusive charter and \$168 for a shared full day

charter but operated with the lowest advertising expenditures at an average annual rate of \$3,420. Kewalo-based vessels spent more than the rest of the fleet on average for advertising expenditures at \$10,940 per annum, and at \$563 for a full day exclusive charter and \$117 per full day shared charter, averaged second only to Honokohau for cheapest rates. As regards catch, Kauai vessels were most successful at an average of 17,669 pounds per vessel annually, followed by Lahaina at 12,220 pounds, Kewalo at 8,723 pounds, Honokohau at 6,625 pounds, and Maalaea at 4,333 pounds. Hamilton's analysis indicates (p. 96) that various factors underlay successful charter operations in Hawaii. These include close proximity and/or ease of access to the harbor by prospective patrons, the presence of sales booths at the harbor, numerous referrals from hotel or activity desks, active ownership, and limited competition, i.e., relatively few charter vessels per port. Lahaina meets all of these requirements, while Honokohau suffers in each category.

Hamilton, Marcia S., and Stephen W. Huffman

1997 Cost-earnings study of Hawaii's small boat fishery, 1995-96. University of Hawaii SOEST 97-06/JIMAR 97-314.

Hamilton and Huffman report on a survey of small vessel fishermen through which a variety of data were collected, including operator demographics, vessel operations and characteristics, investment and fixed costs, catch and effort, and sales and gross revenue. The survey did not seek to determine the magnitude of the small vessel fishery in terms of participation, landings, or revenue, but rather sought to "provide a picture of the costs and earnings associated with typical small pelagic fishing vessels as well as information on vessel operations and operator characteristics" (p. 3).

A total of 808 small boat fishermen were approached for survey, with 602 persons ultimately participating in person, and 23 agreeing to complete a mailback version. The effort yielded a total of 569 surveys completed in a manner sufficient for analysis. Pelagic and bottomfish fishermen were separated for analysis *post factum* the survey. Sampling involved stratification by four groups: full-time fishermen were defined as persons earning over 50 percent of income through fishing-derived profits, part-time fishermen were defined as earning less than 50 percent of income through fishing-derived profits, expense fishermen were defined as persons selling fish to cover trip costs, and recreational fishermen were defined as persons not selling fish for any reason during the past year. Surveys were conducted on each of the major islands including Lanai and Molokai, at each of the 21 major ramps and ports accommodating small vessels. The vast majority of captains surveyed trailed their boats to the harbor.

The authors report that 72 percent of respondents sold some of their catch during the previous year. Of these, nearly 40 percent reported that the fish were sold to cover trip expenses; the remainder were considered "income" fishermen, that is, full-time or part-time commercial fishermen. Nearly 28 percent of the sample reported not having sold fish during the last year; these persons were considered "recreational" fishermen. The authors address uncertainties in the term "recreational," noting at once the possibility that self-reporting opportunities may lead to prevarication about not selling fish, but also that this group was unique in terms of having higher household income, lower levels of fishing activity, and less success at catching fish. Given reportedly lower levels of fishing

activity, the authors posit that recreational fishermen as defined may be under-represented in the sample and that, of those sampled, levels of activity may be relatively higher than the entire group.

The report provides a wide array of descriptive statistics and cross-tabulations descriptive of the small vessel operation in Hawaii. Of potential note for definitional concerns, gross revenues and percentage of catch sold were reported as highest for full-time fishermen (91 percent sold), followed by part-timers (85 percent sold), and finally, expense fishermen (57 percent sold). Levels of investment and fixed costs also followed this pattern. Importantly, the expense fishermen typically operated at a significant loss. Average annual gross revenue was about \$4,000 with annual fixed costs at about \$3,700 and annual operating costs at about \$9,500. Gear usage differed by island in relation to known underwater topographic features, and while the majority of fishermen reported having used more than one gear type over the past year, trolling was most popular across the groups, followed by bottomfish fishing, and finally, reef fishing.

Hamm, David C., Nathan T.S. Chan, and Michael M.C. Quach
1998 Fishery statistics of the Western Pacific, Volume XIII. Southwest Fisheries
Science Center Administrative Report H-98-04.

This Western Pacific Fisheries Information Network (WPacFIN) report provides fisheries statistics and a brief discussion of methods used to gather and process the data for management jurisdictions in the central and western Pacific. This is the thirteenth in a series of annual reports generated through the WPacFIN Fisheries Data Coordinating Committee. Participating jurisdictions include NMFS, WESPAC, American Samoa's Department of Marine and Wildlife Resources (DMWR), the Commonwealth of the Northern Mariana Islands Division of Fish and Wildlife (CNMR DFW), Guam's Division of Aquatic and Wildlife Resources (DAWR), and HDAR. The 1996 report contains summary commercial landings and creel survey landings data for American Samoa, and commercial landings for the Commonwealth of the Northern Mariana Islands, Guam, and Hawaii.

American Samoa, historically the domain of small troll and bottomfish vessels, is experiencing an increasing number of larger vessels in the newly developing longline fishery and a concomitant increase in catch of some pelagic species. DMWR has traditionally kept track of catch and effort by interviewing fishermen at the end of their trips as part of a commercial fishery monitoring system. Hamm notes, however, that this was labor-intensive and did not address recreational and subsistence trips. Thus, in 1985, a new creel sampling program was initiated on Tutuila to include all aspects of the offshore fishery. This involves systematic random sampling stratified by type of day (weekday or weekend-holiday); DWMR staff normally sample two weekdays and one weekend-holiday per week. Survey estimates are expanded to generate Tutuila-wide values. Data are collected on date, type of day, time, boat name, captain or owner's name, fishing method, disposition of catch, species and number of pieces, weight and price per pound per species, area fished, home island, number of trips since last interview, total trip weight in pounds, total hours fished, number of fishermen participating, and type and number of gear used. Expansion algorithms implemented in 1992 calculate the monthly mean CPUE for each fishing method (sum of catch divided by sum of the effort), using all interviews for the time period analyzed:

WPacFIN also The variance of the CPUE is estimated by using the standard, but more complex, formula for a ratio estimator. Sample day participation counts and percent coverage estimates are still used to estimate total effort, but the split of the effort between fishing methods and the mean CPUE for each method are now calculated using interviews collected during the entire time period, thus reducing the potential biases caused by the small number of interviews on any given sample day (Hamm, p. II.3).

American Samoa's offshore fishery data are reported by month, including species composition by gear; annual summary data are also provided. The longline fishery is most active and productive, followed by the troll fishery, then bottom, and finally, troll/bottom mix (p. II.46).

The fishery in the **Commonwealth of the Northern Mariana Islands (CNMI)** is dominated by small runabout type vessels, though the authors report (p. III.2) a growing charter fleet and a rapid increase in the number of commercial vessels. Trolling is most common, but bottom and reef fishing are also important. Subsistence fishing is popular. Commercial activities yield fish sold locally and exported to Guam, Hawaii and Japan. In 1983, vessels from various nations began using the port at Tinian to facilitate transshipment of tuna; this continues today.

The CNMI DFW uses a dealer invoicing system on Saipan to collect commercial fisheries data. Invoices are provided to all purchasers of fish products including hotels, stores, restaurants, markets, and roadside vendors. These are completed each time fish are purchased; one copy is kept and the other returned to DFW. The system has advantages in that it is relatively labor-forgiving and provides relatively comprehensive coverage of fish that is sold. Its disadvantages include the need to educate all buyers about the process, omission in enumeration of fish landed but not sold, and problems with accurate species identification. DFW estimates the survey has captured 90 percent of fish landed commercially in Saipan since 1983. Data include date, buyer's name (dealer), seller's name (fisherman), species or family names, weight, price per pound, value, and invoice number.

A creel survey was implemented in 1982 to aid in estimating non-commercial elements of the CNMI catch but these data are not reflected in the report. Monthly, and some yearly data summaries are provided for a range of pelagic, reef, and bottom species for poundage, total value, and price per pound. The report also summarizes monthly averages for these variables for the period 1979-1996.

The authors describe two basic kinds of fishing for **Guam**: offshore and inshore; the former involving small vessels from 12 to 48 feet that take one to two day troll or bottom trips originating from the western and southern harbors. Charter fishing is reported to be a growing enterprise. Inshore fishing typically involves casting, netting and spearfishing without a boat. Guam's DAWR reportedly has been conducting inshore and offshore creel surveys since the early 70s (p. IV.1) though the particulars of this process are not discussed in the report. Sampling methods were improved in 1982 through the efforts of WPacFIN, and computers were introduced to assist data processing and analysis. A revamped computer system and analyses were in progress at the time of the 1996 report writing and so the statistics provided in Hamm et al. reflect the now outdated system.

WPacFIN also initiated a cooperative dealer invoicing program with Guam Fisherman's Cooperative in 1982 to track commercial landings. This voluntary reporting system has been used with various dealers besides the co-op and the effort continues today. Because no license is required to sell fish in Guam and because reporting is voluntary, the database is not fully reflective of total commercial activity. Data collected with the invoice system include date, fisherman, number of fishermen, hours fished, area fished, species, number of pieces, pounds, and price per pound.

Hamm et al. report that in 1996 some 4,200 commercial fishermen submitted the standard C-3 monthly reports to **Hawaii** DAR, and that nearly 76 percent of Hawaii's commercial catch was landed on Oahu. About 17 percent was landed on Hawaii, four percent on Kauai, and three percent on Maui. The authors also report that about 90 percent of Hawaii's 18,000 vessels are pleasure boats, with five percent commercial or charter fishing boats, and the remainder non-fishing commercial vessels. The pleasure category is said (p. V.1) to include "boats used for recreational, subsistence, and part-time commercial fishing as well as boats not typically used for fishing such as sailboats."

DAR has been collecting statistics of Hawaii's fisheries for the last 50 years (p. V.1). The 1996 summary data for commercial landings provided in the report are believed to represent about 99 percent of what will eventually be processed (ibid.). The Standard C-3 reporting form includes the following variables: name and license number, boat name and registration number, date, area or buoy fished, species caught, number of pieces caught, pounds caught, pounds sold, value of sales, and port of landing. There are also fishery-specific reporting forms that require more specific information. While the self-reporting system has the advantages of low cost, comprehensive coverage and efficiency, it requires active and committed cooperation on the part of the fisherman to achieve accuracy and completeness. The authors note (p. V.2) that the degree of accurate coverage achieved by the reporting system ranges widely between species but probably averages about 80 percent across the fisheries. The report does not address the lack of a data collection system for non-commercial landings.

Hamm, Thomas S., and Robert A. Skillman

Hamm, David C., and Henry K. Lum

1992 Preliminary results of the Hawaii small-boat fisheries survey. Southwest Fisheries Science Center Administrative Report H-92-08.

Hamm and Lum report on analysis of a 1990-1991 small vessel catch and effort survey conducted at eight public launching facilities on Oahu (Pokai Bay, Heeia Kea, Keehi Lagoon, Hawaii Kai, Haleiwa, Ala Wai, Lanikai, and Kahana Bay). HDAR coordinated a subcontractor during the data collection phase of the project which involved counting vessels from before sunrise to after sunset, and interviewing captains as possible to determine catch, effort and species composition. NMFS and WPacFIN conducted data verification, quality control, data processing, analysis and summarization. A consulting firm was used to ensure the statistical validity of expansion algorithms for survey-derived estimates of island-wide catch and effort. The sample design included both "commercial" and "recreational" small boats trailered to or moored at the facilities, and was stratified by (1) port (four "major" and four "minor" ports around the island), (2) day

(weekend/holiday versus weekday), and (3) fishing method. Surveys were conducted four to five days per month during a total of five three-month periods.

An estimated 78,261 trips were taken during the period March 1990 to February 1991 (p. 8). Trolling was reportedly the most frequent method used, accounting for 53 percent of the estimated trips, followed by bottomfishing at 12 percent, spearfishing at 11 percent, and spin casting at 8 percent. Trolling also accounts for 55 percent of the total annual catch by weight; bottomfishing accounts for about nine percent, and various netting methods account for 19 percent. Pokai Bay (Waianae) was the most popular port from which to fish, accounting for 37 percent of the trips. It was also the most frequent place of landing, with 38 percent of the total catch. Heeia Kea accounted for about 18 percent of trips and over 20 percent of landed catch. Keehi ranked third, with 12.3 percent of trips and 11.8 percent of catch. Pelagics constituted 55 percent of the total 75,000 pounds of sampled catch, followed by opelu and akule (18 percent), reef species (15 percent), and bottomfish (under six percent). Aku was caught most frequently, followed by mahimahi, goatfish, papio, akule, octopus, and yellowfin tuna. In terms of pounds of pelagic species landed, mahimahi ranked first with 11,706 sample pounds, yellowfin tuna second with 8,905 sampled pounds, aku third with 7,569 pounds, and blue marlin fourth with 7,342 pounds.

The authors express surprise that only 41 percent of catch was destined for sale and assert that it is undoubtedly a conservative figure, resulting from considerable non-response and prevarication to sales-related questions (p. 6). With respect to methods, netting and traps had the highest proportions of sales. Commercial fishermen are reported (p. 7) as having caught over three times as many fish per successful trip as the "purely recreational" fishermen. Commercial trips reportedly lasted an average of 8.5 hours, while "recreational" trips lasted six hours. Of interest to distribution of commercial activity and/or catch reporting issues, Hamm and Lum note (p. 6) that "although Pokai Bay had nearly twice the total estimated catch as Heeia Kea, it had only a slightly larger commercial catch."

Hida, Thomas S., and Robert A. Skillman
1983 A note on the commercial fisheries of Hawaii. Southwest Fisheries Center
Administrative Report H-82-20 (revised).

While the authors provide no explicit discussion of recreational or other non-commercial types of fishing, this piece elucidates history regarding level of participation, landings, and ex-vessel value for pelagic and other species from the 1940s through 1982. Noting historic fluctuations in the commercial fleet, the authors state (pp. 1-2) that there were approximately 3,532 licensed commercial fishermen in 1947, but only 715 by 1960, regaining to 2,500 at the time of writing. Further, in 1970, 80 or more commercial vessels over five tons and fewer than 700 smaller commercial vessels plied Hawaiian waters, regaining to 130 commercial vessels over five tons and more than 1,000 small commercial boats by 1980. Hida and Skillman note (p. 3) that the Post World War II ika-shibi fleet of three or four boats slowly grew to about 30 boats by 1976 with an estimated 250 boats and 500 fishermen by 1983. Meanwhile, the commercial troll fleet had about 200 active vessels and 240 fishermen during 1981-82, many of whom mixed gear types during the course of the year.

Hoffman, Robert G., and Hiroshi Yamauchi
1972 Recreational fishing—its impact on state and local economies. Departmental Paper 3. College of Tropical Agriculture, Hawaii Agricultural Experiment Station, University of Hawaii. Honolulu.

This report describes an effort to examine socioeconomic aspects of recreational fishing in Hawaii as manifest in the 60s and early 70s. The authors preface their work with some history about impetus for such analysis, noting that “lack of data prompted the Hawaii State Division of Fish and Game to conduct inshore surveys of recreational fishing activities during the period between July 1958 and June 1961” (Hoffman and Yamauchi 1972:5 cite Hawaii Division of Fish and Game, 1960, Survey of Fishermen and Creel Census, Project Report Number F-5-R-7). That research involved use of spotting aircraft and boats to count shoreline and offshore anglers and determine type of fishing and gear used in each quarter of the year. The work generated an estimate of 550,000 offshore sportfishing trips taken annually, and an approximate average of 9,000 persons per week engaged in shoreline fishing—32 percent on Sundays and 28 percent on Saturdays, the remainder distributed relatively uniformly throughout the remainder of the week. This enumeration effort was eventually abandoned due to a “serious shortage of manpower” (p. 6).

In 1966, the State Division of Fish and Game reportedly (p. 6) began monitoring the activities of shoreline and boat fishing clubs and designed a system wherein club members would complete log book-like surveys, thus allowing variation of fishing efforts and success between locations per island, and across islands and seasons. That system, however, was never tried since “unforeseen circumstances [not explicated here] altered the course of action.” A Marine Resources Advisory Panel, formed in 1967 as part of the Governor’s Advisory Committee on Science and Technology “to assess the economic potential of the marine resources of the state,” subsequently sought to develop a data collection system for recreational fishing that would putatively (p. 6) enable economic analysis comparable to that used for commercial fisheries at the time:

Information such as number, age . . . of sport fishermen and the expenditures they make . . . is not only desirable but essential for planning purposes. The findings of the survey will determine to a great extent how much emphasis to place on the development and management of our marine sport fishery resource and what alternative approaches to pursue in order to achieve our resource development and management objectives (Governors’s Advisory Committee, Science and Technology, First Report of the Marine Resources Advisory Panel, State of Hawaii, 1967).

This position led to a Senate Resolution during the Fourth Legislation Budget Session of 1968 that the Division of Fish and Game “determine what economic studies would be required for evaluating the sport potential of the state” (pp. 6-7). Resolution proceedings noted that

Whereas population growth and the explosion [sic] growth of tourism in the next few years will put even greater pressures on the recreational resources of the state, including ocean and freshwater

game fishing; and, whereas planning for the best utilization of sport fishing resources requires estimates of their contribution to the economy of the state, that a study on recreational fishing in Hawaii not only be found most useful, but also of necessity” (ibid.)

In 1968, the University of Hawaii signed a Memorandum of Agreement with DLNR to conduct research for the purpose of estimating (1) participation in Hawaii’s recreational fisheries, (2) the expenditures of recreational fishermen, and (3) the economic impact of recreational fishing in Hawaii. Hoffman and Yamauchi undertook the study and subsequently conducted a telephone survey on Oahu and an in-person household survey on the Neighbor Islands to generate the data and analyses. The sampling frame for Oahu was a mix of military and civilian households totaling 143,143 households, adjusted for households with no or unlisted phones, and ultimately represented 78 percent of the 1968 total of 171,329 Oahu households (the total population at the time was 633,200 persons per figures from the state Department of Planning and Economic Development, 1968). The target sample size was 6400 households. Meanwhile, a sample size of 1,600 households was derived from an unstated overall frame for the Neighbor Islands. This was partitioned into 107 clusters of 15 dwelling units each and stratified by enumeration district per island in proportion to the 1970 Census count. The sample was further proportionately stratified by finer geo-demographic distinctions the authors terms “measures,” and “segments.” In the end, dwelling units were identified for 110 segments across the islands and selected randomly for sampling from 1970 census and geologic survey maps” of unstated antiquity (p. 10).

Part A of the survey instrument was directed to both anglers and non-anglers and sought information regarding household size, outdoor recreational activity, and selected social and economic attributes of heads of households. Part B sought to determine recreational fishing expenditures, including those relating to equipment, food and other “on-site” items, transportation, vessel ownership, chartering, and club membership. This segment also queried about preferred fishing locations and estimated range of fishing activity. Part C sought information about all anglers in the family over 12 years of age, including types of fishing, number of days involved, age, ethnicity, education, occupation and income (p. 11).

The response rate for the Oahu survey, conducted over a year-long period between 1968 and 1969, was over 62 percent, with 30.6 percent fishing households and 69.4 percent non-fishing households responding. The Neighbor Island survey was conducted over a year-long period between 1970 and 1971. The response rate for Hawaii was over 73 percent, with 433 of 593 households responding, of which 43.4 percent were fishing households. The Maui County response rate was similar at 73.5 percent, with 411 of 559 Maui, Lanai and Molokai households responding, 53 percent of which were fishing households. Finally, the Kauai response rate was 73 percent, with 214 fishing households and 219 non-fishing households responding (p. 13).

The authors offer extensive, now dated, analysis of variables for which information was collected over the course of the study; readers are referred to the original document for more extensive review. Some summary findings and analytical comments are offered here. According to the report (p. 15), most “recreational” fishing at the time was conducted from the shoreline. This was true across the islands and for the state as a whole, where 68 percent of a total estimated 122,400 anglers fished

from beaches, rocks and cliffs. Just over twelve percent fished from boats, and about ten percent fished while diving (spear, Hawaiian sling, etc.). Most fishermen were male heads of household (50.9 percent across the state), followed by sons (20.2 percent), wives (16.1 percent), daughters (6.7 percent), and others (6.1 percent), with the high frequency age category being 12-18 years of age (pp. 16-17). All age groups between 12 and 53 years are relatively uniformly represented. Persons over 54 years comprise only 9.9 percent of the sample. The average number of days spent fishing per year across the state was 35.8. Most fishing costs were attributed to equipment purchases, followed by transportation costs, and trip-specific "living" costs such as food and beverages. On Oahu, Maile Point to Kaena Point was the most popular inshore fishing locale, with Diamond Head to Honolulu Airport the most popular offshore area. The area from Hoopuloa to Keahole Point was most popular for both inshore and offshore anglers on Hawaii Island. The most heavily used inshore and offshore areas in Maui County were from Puunoa Point, near Lahaina, to Makena Point, just south of Kihei. On Kauai, the most heavily used inshore and offshore fishing area extended from Moloaa Bay, north of Kapaa, to Kawelikoa, south of Lihue. The total economic impact of recreational fishing in Hawaii was estimated at around \$11.5 million for the survey years 1968-1971.

Hoffman and Yamauchi's analysis of "recreational fishing" is of particular interest given the current effort to better define the nature of "recreational" and other forms of fishing in Hawaii, and indicates the history of definitional problematics. While the authors fail to differentiate between various non-licensed user groups in terms of ultimate economic disposition of landed fish, they did recognize the problem in 1972 (p. 36):

This, then, leads to an important area of concern to the state. At the present time, there is wide consensus that, although many so-called "recreational" fishermen are not licensed to sell their catches in the fish markets, a substantial amount of these catches still find their way onto the local markets. The various dimensions that are involved in this gray area between "recreational" and "commercial" fishing were not addressed in this study and deserve further exploration.

Further complexity in definitional efforts is noted (pp. 36-37) as the authors recognize too, the fluidity of decision making across fisheries, gear types, and temporal parameters:

Even within the recreational fishing sector as adopted for this study (i.e., all unlicensed fishermen), definitional aspects still remain. Not only is the total recreational fishing experience a complex bundle of fishing activities including the early planning and latter recalling phases of the actual act of fishing; but, also, additional complexities are introduced by the overlapping and joint nature of various types of fishing activities that are carried out in one or more areas during a fishing day (or trip) and throughout the year.

Among the study's findings was a reportedly (p. 37) common concern, especially among shoreline fishermen, that in a perceived context of too few fish in accessible spots, more productive spots were legally inaccessible as a result of land ownership by the military, large estates, resorts, and

plantations. Perhaps intuiting the struggles to come, the authors suggest that this situation “extends far beyond simply fishery resource management and involves more complex institutional issues of easements, regulations, compensation, etc., which is another and perhaps the most important area of concern for the public control of recreational fishing” (p. 37).

Finally, Hoffman and Yamauchi note (pp. 37-38) that recreational fishing is typically regulated in some fashion on the Mainland, but that apart from an abortive regulatory attempt in 1948 [not reviewed in the report], citizens of Hawaii have traditionally enjoyed unregulated recreational fishing as per Section 3, Article X of the state Constitution. Tradition notwithstanding, the authors suggest (p. 37) that “there is always the possibility of appropriating additional social benefits by a positive management program which is both efficient and equitable.” The proposed form of such a program is vague however, although “increased monitoring” of “certain types of activities” is offered as one possibility. But the authors assert that the situation does (or did) not warrant a “comprehensive registration program for all recreational fishermen” (p. 37). Indeed, Hoffman and Yamauchi appear to resist the idea, noting that “participation in recreational fishing as a whole is distributed among fishermen in a skewed fashion toward the younger age groups and for older persons in the low income earning occupations, which suggests the strong possibility of a highly inequitable restriction of the total leisure time activities available in the state.” Yet this statement is ultimately qualified (p. 38), and the report concludes with a call for more and better refined data, “which might be developed through more concentrated site and resource-oriented surveys,” to aid in developing “selective registration and variable fee schedules which would be compatible with an efficient and equitable coastal fishery resource conservation program.” Such efforts, the authors note, “are, without a doubt, called for and should be given the highest priorities and at the earliest possible time” (p. 38).

Human Sciences Research

1982 Marine recreational fisheries survey: catch and effort statistics. Final Data Collection Report: Three Year. Prepared for NMFS Resource Statistics Division, F/SRP, Washington, D.C.

Human Sciences Research (HSR) reports on data collection methodology and results for 1981, the third year of the catch and effort component of the Marine Recreational Fisheries Survey in Subregion 8, which includes the State of Hawaii, American Samoa, Guam, and the Commonwealth of the Northern Mariana Islands (CNMI). HRS subcontracted Honolulu-based Survey and Marketing Services, Inc. for its data collection requirements. The work attends to recommendations from methodological studies conducted for NMFS that household surveys are insufficient for gathering the full spectrum of information about recreational fishing and should be complemented with an on-site intercept approach (e.g., Gary L. Brown, 1977, *A Review of the Literature in Selected Areas Relevant to the Conduct of Marine Recreational Fisheries Surveys*, McLean, Virginia: Human Sciences Research). HSR reviews its perspective on this approach (p. 3):

... the complemented surveys approach was developed in which data on the number of households with fishermen and the number of fishing trips during a two-month period was collected by a household

survey. Catch data, i.e., species, number, weight, length, etc., was collected by an on-site intercept survey. Data from these two separate sources were then combined to produce estimates of total catch and total participation.

The household portion of the 1981 data collection effort for **Hawaii** was conducted via a *randomized telephone survey*, with a sampling distribution reflecting distribution of the general population. Thus, 3,555 persons were interviewed on Oahu, 450 on Hawaii, 315 on Maui, and 180 on Kauai. Six waves of interviews reflected concern for observed seasonal variations in commercial catch across the islands. Meanwhile, a total of 11,000 *intercept surveys* were budgeted for Subregion 8 in 1981, with 7,500 allocated to Hawaii. The sample was stratified by “mode” of fishing, that is, by beach or bank, boat, or manmade structure (pier or jetty). The survey effort was allocated in four hour increments at sites “with a probability proportional to pressure data for each site,” pressure data being an understanding of relative level of usage at the sites as determined by previous year’s fieldwork. Reflective of concern for variability in fishing pressure, the authors note (p. 17) that “for the boat mode on all islands and for all modes on Oahu, 75 percent of all hours of interviewing effort were allocated to weekends,” while for “the beach/bank and man-made structure on the Neighbor Islands, 50 percent of all hours were allocated to weekdays and 50 percent to weekends.”

An *in-person household survey* was conducted in **Guam** with the assistance of Guam’s Bureau of Labor Statistics (BLS). BLS has maps documenting all residential units on the island, and each was assigned a number. Sample households were then randomly selected from the base map and 1,337 intercept surveys were conducted in Guam. Because the survey team was denied access to residences on military bases, a randomized telephone survey was implemented with this sub-population (p. 10). The sampling strategy was based on extensive existing information about fishing sites. Occurrence of tides was the most significant sampling factor since most fishing on Guam is done at low tide (p. 17).

An *in-person survey* of 624 households was conducted in **American Samoa**. Clusters of six households were chosen randomly from a Department of Planning map depicting each of American Samoa’s 76 villages. The number of clusters sampled from each village was determined by its population size. The sampling strategy for the *intercept survey* conducted in Samoa was based on recommendations of local fishing experts to adjust samples based on the size of villages adjacent to fishing areas. This reflected local fishing behavior wherein villagers rarely fished “further than the beach or bank immediately adjacent to their village” (p. 17).

An *in-person strategy* was also used to conduct a household survey in the **CNMI**, operationally defined here as Saipan, Rota, and Tinian. Households were randomly selected from a sample frame of all structures extant in 46 subareas in the region as depicted on a set of maps from the CNMI Planning Division of the Department of Public Works. Clusters of six dwelling units were selected from the frame, with number of clusters selected depending on population density per subarea. A total of 490 households were surveyed. The sample size for each island component of the CNMI *intercept survey* of 875 persons was proportional to the population of each island. Sample quotas by fishing mode were reflective of relative dedication of effort to each as determined by fieldwork during previous seasons. Thus, the authors note (p. 17) that “Beach/bank interviews were raised

from 50 to 58 percent of the total of Saipan, Rota and Tinian,” while “boat interview allocations were reduced to 25 percent on Rota and Tinian but kept at 40 percent for Saipan,” and “pier/jetty quotas were slightly more on the smaller islands than on Saipan.”

The report describes the project sampling methodology and provides data collection instruments. Survey results are not included in the document and were not published but are archived at NMFS Honolulu Laboratory.

Kahiapo, John, and M. Kimberley Smith

1994 Shoreline creel survey of Hilo Bay Hawaii: 1985-1990. A report on research for the Main Hawaiian Islands Marine Resources Investigation. Division of Aquatic Resources, Department of Land and Natural Resources. Honolulu.

Kahiapo and Smith review a creel survey conducted to generate a better biologic understanding of recreational fishing activity in three ecologically distinct areas in Hilo Bay, Hawaii: the Hilo Harbor Fisheries Management Area, Waiakea Pond Public Fishing Area, and adjacent Keaukaha shoreline. A total of 4,285 anglers were interviewed during the five-year period from 1985 to 1990. The earliest phase of the survey was initiated following public concerns that the area was being overfished; this was completed in 1986 (p. 3). A second phase was conducted from 1987 to 1988 after gillnetting was banned in the Harbor area. The final phase lasted from 1989 to 1990. Because the survey was intensified during the last phase, those results are considered most representative of the Hilo Bay recreational fishery and are used to estimate species, size of fish and invertebrates, and CPUE. The report focuses on changes in these factors “before and after the closure of Hilo Harbor to gillnetting in June 1987” (p. 1).

Much was learned from initial phases of research of the predominately pole and line, scoop net, and throw net anglers (p. 6). For instance, access to various fishing areas was gained, rapport was developed with sometime reticent and secretive anglers, and data collection protocols were modified as appropriate. The second phase of research included more area, with more intensity of researcher involvement, encompassing early mornings, nights, and weekends and holidays. In all phases, personnel walked and/or drove the coast, approached as many anglers as possible for interviewing, and examined catch directly (p. 5). The authors also allude to education of cultural issues associated with fishing in the area (p. 5):

Fishers were often interviewed individually. However, many groups of family and friends in the Hilo area fish together and throw all their catch into a single cooler or bucket. Furthermore, it is not the local custom to count or keep track of one’s fish. The people of Hilo fish for enjoyment, to have something to eat or to share with their neighbors; not in the interest of competition. When groups which had thrown all their fish together were encountered and it was not possible to say who caught which fish, group interviews were conducted for up to 10 individuals on a single survey form.

Final phase findings are tabulated and include some limited angler demographics; mean hourly CPUE by gear type; relative abundance of principal species by location and survey period (scientific names only); mean total length of selected principal species (vernacular family names and scientific names); summary of seasonal trends in abundance and size (scientific names only); some species-specific size-frequency distributions (for palani, weke a'a, kumu, white ulua, aholehole, and 'omomee); mean fishing activity by survey area, day of week, and time period; and estimated annual weight of landings and mean gear abundance.

According to Kahiapo and Smith (p. 20), despite limited data in the earlier phases of research, results indicate that the size of fish landed in Hilo Harbor increased after passage of the amendment to restrict gillnets. Interestingly, this is concurrent with an increase in the number of anglers visiting from off-island. Hilo residents, however, remain the heaviest Bay users throughout all phases of research, followed by non-Hilo Hawaii Island residents. The authors estimate that annual landings for the recreational sector in Hilo Bay during the final phase of the survey were in the range of 31 to 121 short tons, extrapolated from 145 to 179 pounds of fish per day. Finally, as regards direction for future research, the authors note (p. 21) that despite inherent difficulties in interpretation of data collected across the survey phases, "these surveys define the principal gears and species used in a recreational manner and indicate that management measures that restrict gillnetting may indeed be helping to restore fish populations in the Hilo area."

Kasaoka, Laurel D.

1989 Summary of small boat economic surveys from American Samoa, Guam, and the Northern Mariana Islands. Southwest Fisheries Center Administrative Report H-89-4C.

Kasaoka provides brief summary analysis for a 1987 survey addressing active small vessel operators in American Samoa, Guam, and Saipan. Data were collected for five general categories of economic information, including (1) investment costs (value of vessel and gear); (2) annual or fixed costs, defined as financing charges, annual maintenance including major repairs, insurance and other business expenditures; (3) trip costs, subsuming daily operating costs in fuel, ice, food, and trip-related repairs; (4) crew costs, including salary and/or crew share of catch or profit; and (5) product costs, or fish marketing expenses involving handling, transportation, and commission. Fishermen were also asked to assess changes in these categories as they were perceived to occur over the previous five years and during the current year (1988). The sample size was 36 operators for American Samoa, 35 for Guam, and 34 for Saipan.

There is no explicit discussion of research design, nor of sampling rationale. The survey appears to have been conducted through a dockside convenience sample. Results are provided in basic descriptive statistical form, listing range, average, standard deviation and sample size for variables in each of the aforementioned information categories.