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EXPERIMENTAL VALUATION OF RECREATIONAL FISHING IN HAWAII FINAL REPORT

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PREFACE

This study was prepared by SMS Research of Honclulu with Karl Samples, Professor of Resource Economics at the University of Hawaii, Honolulu, as the chief investigator. The contract objective was to test the feasibility of estimating the economic value of offshore recreational fishing in Hawaii. The study involved testing a variety of survey techniques to measure consumer surplus, gross expenditures, and responsiveness of recreational anglers to changing catch rates. The study builds on theoretical work undertaken by the National Marine Fisheries Service, NOAA and university economists across the nation in developing new means for properly analyzing the tradeoffs involved in fisheries management and development and in environmental assessment. Although the study reports quantitative results, these are not considered representative. Further field work is required before definitive estimates of recreational fishing values will be available in Hawaii. Because the report has been prepared under contract (82-ABC-00251), its statements, findings, conclusions, and recommendations are those of the contractor and do not necessarily reflect the view of the National Marine Fisheries Service.

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INTRODUCTION

Offshore recreational fishing in Hawaii is a popular pasttime for a significant number of residents throughout the state. Attracted by the possibilities of fighting and landing large gamefish, and by the availability of recently constructed boat launching facilities, Hawaii's offshore recreational fishing fleet has expanded to include an estimated 3,500 trailered and permanently moored vessels. Although the number of individuals currently engaged in offshore recreational fishing is uncertain, data collected in 1968 indicated that the offshore angling population numbered just under 15,000 persons (Hoffman and Yamauchi). Evidence suggests that offshore anglers are also particularly enthusiastic about their sport. For example, it has been calculated that approximately 100,000 individual offshore recreational fishing trips targeted in catching billfish, tuna, mahimahi and ono were taken in 1976 (Research Associates).

In light of the popularity of offshore recreational fishing in Hawaii, there is reason to suspect that the sport generates sizeable economic and social benefits for participants, as well as for the state as a whole. Three basic types of benefits can be identified. One benefit, which also has biological implications, stems from the landings of certain fish species by recreational fishermen. An illustration of the magnitude of offshore recreational catches in Hawaii is found in the fact that sport fishermen operating out of the Kailua-Kona area of the Island of Hawaii were responsible for landing nearly 600,000 pounds of marlin, tuna, ono and mahimahi in 1976 (Cooper and Adams). In most instances, recreational landings satisfy private households' protein demands. Surpluses are either given away as gifts or sold through established commercial fish marketing channels to generate supplementary household incomes. Regardless of actual disposition, the economic value of these catches is probably quite large, compared to the value of Hawaii's commercial finfish landings. In this regard, the estimated value of the 1976 Kailua-Kona recreational catch sold commercially (60 percent of the total) equaled approximately $260,000 (Cooper and Adams). Such a finding should not be viewed as unusual, especially in light of research findings which indicate recreational landings of finfish in the United States in 1970 were equivalent in terms of poundage to domestic commercial landings of finfish (United States Comptroller General). Economically significant recreational fish catches have also been reported for various geographical areas of the United States (see for example Ditton et al., Carls and Bresnan, and Cicin-Sain, Moore and Wyner). A more exact approximation of the magnitude and disposition of Hawaii's offshore recreational landings will be forthcoming with the publication of the results of the National Marine Fisheries Service (NMFS) "Marine Recreational Fishery Statistics Survey" (Human Sciences Research, Inc).

A second social value or benefit associated with offshore recreational fishing in Hawaii stems from the sizeable expenditures which anglers make on fishing vessels, food, tackle, fuel, beverages, accommodations, vessel repairs, berth rentals, and the like. The value of recreational expenditures is normally measured in terms of the additional income (or employment) that is generated in a specified geographical area as a result of the initial spending activities by anglers. In Hawaii, the financial impact of multiple respending could be quite large due to relatively high marginal propensities to consume on the part of residents (Ghali and Renaud). Consequently, the gross economic contribution of offshore anglers' fishing-related expenditures is undoubtedly non-trivial (Hoffman and Yamauchi). For example, using local income-expansion multipliers developed by Hoffman and Yamauchi, along with their 1969 estimate of offshore anglers' annual expenditures, a gross economic value of $2.6 million per year can be associated with the offshore recreational fishing that took place in Hawaii in 1969. The current expenditure value is probably different due to structural changes in the local economy over the last decade. However, there is reason to suspect that the value is at least of the same order of magnitude based on similar gross economic contribution values (calculated on a capita basis) which have been reported for other offshore recreational fisheries (see for example Samples and Bishop, 1981, and United States Department of Interior).

In addition to producing high quality fish for household consumption, stimulating employment, and encouraging further sales of goods and services within Hawaii's island economy, offshore recreational fishing produces another source of benefits for participants. These benefits, technically called "consumer surplus," represents the subjective value which anglers assign to their fishing activities, over the above opportunity costs associated with fishing. Stated differently, consumer surplus is the maximum amount which anglers would be willing to pay for offshore fishing opportunities (beyond their current expenditure levels) before they would stop fishing altogether. It is generally recognized by fishery economists that anglers' consumer surplus can represent a sizeable sum. For sport fishing in Wisconsin, annual consumer surplus was calculated to be $7.2 million compared to direct (not incorporating multiplier effects) expenditures of $1.7 million per year (Samples and Bishop, 1981). Although little is understood about the consumer surplus value of offshore recreational fishing in Hawaii, one study directed at the Kailua-Kona offshore fishery estimated an annual consumer surplus value of $1.6 million for a fleet of 386 vessels in 1976 (Adams). Similar comparative results (on a per trip basis) have been reported by Boland, Talhelm and others.

The stated purpose of this project was to test the feasibility of estimating the value of offshore recreational fishing in Hawaii. Specific objectives were to determine the practicality of estimating: (1) the gross economic impacts of offshore recreational fishing; (2) the consumer surplus value of offshore recreational fishing; and (3) the responsiveness of recreational values to changes in catch rates, levels of congestion and availability of recreational substitutes.

This report presents a description of the work performed in meeting these objectives. In the following section, survey procedures are discussed. In the third section, a statistical profile of surveyed anglers is presented and interpreted. This overview is followed by a description of our findings regarding application of alternative recreation valuation approaches. In the fifth section, the discussion centers on alternative tools for measuring the economic impact of offshore recreational fishing in Hawaii. Recommendations concerning questionnaire design and fielding, along with suggestions for economic impact measurement, are given in the final section of this report.

SURVEY PROCEDURES

Questionnaire Development

The survey instruments were designed and developed by both Dr. Karl Samples, Principal Investigator, and SMS Research, Inc. in conjunction with the National Marine Fisheries Service (NMFS).

The primary objective in tailoring the questionnaire was to test the practicality of applying various valuation approaches within the specific context of Hawaii's offshore recreational fishery. One aspect of this objective entailed determining which valuation techniques can be used to generate valuation estimates. A second aspect involves identifying sources and direction of biases (if any) in survey responses which may result in subsequent economic value estimation errors. Other objectives considered in questionnaire development include determination of: (1) respondents' ability to recall catch quantities and expenditure amounts; (2) respondents' willingness to participate in a personal interview survey, and (3) respondents' perceived importance of various quality attributes of offshore recreational fishing. As best as possible, the questionnaire was designed to accomplish these objectives within the context of 20 minute personal interviews.

Included in the survey instrument were questions relating to angler expenditures, fishing activities, and subjective valuation of offshore recreational fishing experiences. Information on angler expenditures is important because it provides the basis for economic impact assessment and travel cost demand estimation. Included were detailed questions on annual fixed and variable costs of fishing and cost imported equipment of boats. Questions were designed to permit evaluation of respondents' ability to recall and categorize expenditures for the previous year, as well as the fishing trip just completed.

Questions relating to fishing activities included those concerned with identifying launching sites used, desired characteristics of launching sites, reasons for traveling to certain launching sites rather than others, number of fishing trips taken, annual catch (poundage and number) by species, disposition, and proportion caught near a Fish Agregating Device (FAD). Questions were designed to test respondents' recollection of fishing activity data, and to detect possible multiple-purpose trip and launching site quality biases which could influence travel-cost demand estimates.

Considerable attention was given to developing sets of questions useful in guiding subsequent work on recreational valuation. To begin, the survey included a series of questions on respondents' subjective perceptions of the relative importance of offshore sportfishing vis-a-vis other recreational pursuits. Questions concerning anglers' attitudes about changes in catch rates and congestion levels were also included.

Twelve different question formats were developed to measure angler responses to hypothetical valuation inquiries. Six of these questions related to valuing a single day of fishing while the remaining six related to valuing an entire fishing season. Both sets of questions included the following formats:

(1) Willingness to pay (take-it-or-leave-it offers)

(2) Willingness to sell (take-it-or-leave-it offers)

(3) Willingness to pay (interative bidding game)

(4) Willingness to sell (interactive bidding game)

(5) Willingness to pay (open-ended format)

(6) Willingness to sell (open-ended format)

The question set was designed to test for the following issues: (1) internal consistency between responses; (2) consistency between estimated values of a fishing day versus a fishing season; (3) question format biases; (4) upper range of individual valuation; and (5) starting point biases in bidding games.

The development of the instrument (in its several versions) was considerably more involved than originally anticipated. The development process involved three different stages of pretesting, with the final stage featuring six pretest interviews conducted with six fishermen at Keehi Boat Harbor. Each stage involved substantial instrument revision.

It was particularly challenging to reduce the time needed to administer an interview which originally ranged up to an hour in length when administered to actual fishermen who had to ponder their replies. The solution adopted was to split the fishing activity and characteristics questions into two sets to be administered in two different versions of the instrument. Certain questions in the longer of the two versions were again divided into subsets, to be administered separately to different

sub-versions. The two basic versions of the questionnaire also featured two sets of recreational fishing valuation questions to be independently tested. The "split sample" approach was considered appropriate because the main objective of this pilot study was to test the questions and instrument.

A second challenge was to improve and simplify the wording of the scenarios used in the recreational fishing valuation questions. The need for this emerged as a result of the third round of pretesting. The wording that emerged sought to preserve the main features of the scenario while taking into account the impatience of fishermen respondents.

The final challenge in design was to clarify the instructions for the "take-it-or-leave-it" and "bidding" questions. These instructions will be put on cards for field use. As an aid to clarity, "tree" diagrams for the "bidding" questions were developed that showed the sequence of stimuli and the resulting range of accuracy for final estimates.

The basic questionnaire versions are in Appendix A. Alternative subsets of questions that were included in different versions of the basic questionnaire are also given.

Sample Design

The sample consisted of 100 recreational fishing vessel owners launching trailered boats at Waianae (Pokai Bay) Small Boat Harbor during Spring, 1983. For a variety of reasons, this sample was probably unrepresentative of the total offshore sportfishing population in Hawaii. For example, it likely did not include anglers who prefer to launch their boats at alternative launching sites on Oahu. By design it did not include owners of permanently moored fishing boats who do not trailer their boats to launching sites. Furthermore, because the interviews were conducted with vessel owners (or owner surrogates), no attention was devoted to interviewing passengers or dockside spectators who partake of sportfishing in a vicarious fashion.

Concentrating survey efforts on an isolated geographical area and on a select group of sportfishing beneficiaries did have certain scientific advantages by creating a relatively homogenous study group. Increased homgeneity of the sample reduced overall variances in survey responses and allowed for less ambiguous evaluation of questionnaire design features. This feature also allowed for comparative evaluation of survey responses between respondents and hence increased the degree to which a variety of question formats can be tested.

The overall sample of 100 anglers was further divided into two subsamples comprised of 50 anglers each. This procedure

allowed for more questionnaires format to be fielded without making individual interviews longer than 20 minutes to complete. Anglers comprising subsample I were queried about their vessel characteristics, frequency of use of alternative launching sites, total catch, valuation of a fishing day, and basic demographic characteristics. Anglers included in subsample II were asked questions relating to trip variable costs, costs associated with fishing during 1982, attitudes about fishing and fishing quality, valuation of a fishing season, and basic demographic characteristics.

Data Collection

Interviewers selected for this pilot study were trained and experienced SMS Research personnel. As part of standard procedure, each interviewer attended a special training session to acquaint him with the instrument, procedures, and special instructions appropriate to this study. Training included an item-by-item review of each version of the survey instrument along with refreshment in general intercept interviewing techniques.

A letter of introduction from NMFS was provided to all SMS interviewers. The letter served to validate the authenticity of the study, to describe the purpose and objectives, and to aid in soliciting participation among respondents.

The NMFS Laboratory sent out letters to the following key persons in order to provide them with knowledge regarding the survey prior to it being fielded:

Ms. Alana McKinney, Charter Captain, HFN Assoc. Editor

Mr. "Uncle" Paul Blakeman, notable Waianae fishing resident

Mr. Glenn Nishihara, President - Hawaii Fishing Coalition

Mr. Winfred Ho, Board of Governors, HIATT

Mr. Henry Sakuda, Dept. of Land & Natural Resources

Letters to Ms. McKinney and Mr. Blakeman may have allowed them to provide Waianae fishermen with sufficient notice and information about the study.

The survey was conducted between April 27 and May 7, 1983 at the Waianae (Pokai Bay) Small Boat Harbor. Interviews were conducted between 9:00 a.m. and 7:00 p.m. The majority of respondents were interviewed at the "wash area" of the parking

lot. This area was deemed to be convenient for both interviewers as well as respondents.

All respondents were qualified as recreational fishermen prior to conduct of the survey. Fishermen who went out for commercial purposes were not included in the survey.

Immediately following the conduct of the surveys, all interviewers attended a debriefing session at SMS Research. Interviewers were asked to comment on the administration of the instrument, effectiveness/appropriateness of specific questions, participation among fishermen and any related problems or events that occurred in the field. This information proved to be very valuable in a pilot or test situation. Results of the debriefing session are presented as part of the Recommendation section in this report.

All completed questionnaires were edited and coded by SMS staff members. Editing included checking for completeness, the following of proper skip patterns, and follow-up encouraging multiple responses on appropriate questions. Open-ended questions were coded, placing responses into appropriate categories.

The edited/coded questionnaires were keypunched onto a magnetic tape and 100 percent key-verified. Keypunched data were checked by special SMS software to detect logic and keypunch errors. The resulting tape served as the basis for all income-expansion analysis performed on this study.

STATISTICAL PROFILE OF RESPONDENTS

Statistical Comparisons of Sub-Samples

As noted above, two almost totally different questionnaire instruments were fielded to two separate subsamples. This split sampling approach created a need to determine whether individuals included in the two subsamples exhibit similar characteristics as if they all came from the same underlying population. The questionnaire instruments were intentionally designed to allow statistical comparisons between the two subsample groups. Four questions relating to ownership status, income, age, and employment status were asked of both subsamples. Sex of respondents was also recorded for all interviewees. Data obtained for these variables for the two subsamples are given in Tables 1-12.

Two-tailed t-tests were used to measure the degree of statistical similarity between the two subsamples. Results of the statistical tests are given in Appendix C. At the 95 percent confidence level (N=50), the hypotheses could not be rejected that age and income class proportionality, sex proportionality, proportion of interviewees who were skippers versus owners, proportion of employed persons, and proportions of certain job occupations were the same between the two subsamples.

Taken together, these comparisons strongly suggest that the two questionnaire intruments were likely administered to anglers drawn from the same underlying population of offshore recreational fishermen. Consequently, the analysis which follows treats both sample groups as statistically homogeneous.

Demographic Characteristics

With the exception of one interviewee, all respondents were male. Respondent ages ranged from 18 years to over 65 years. The mean age category observed was 35-44 years. A majority of respondents (84 percent) were currently employed. The most frequently reported occupations were "professional," "service," and "structural." Annual income of respondents was highly variable ranging from less than $5,000 to over $40,000. The median reported annual income category was $20,001 to $30,000. Five percent of the total survey group reported annual incomes less than $10,000 and four percent reported incomes exceeding $40,000.

Fishing Activity Characteristics

Extensive data were collected on respondents' fishing activity levels, catch rates, motivations and fishing-related costs. Most questions related specifically to offshore recreational sportfishing. However, certain data (such as those pertaining to vessel characteristics) reflect the fact that some sampled anglers are also engaged in commercial fishing activities. Of the fifty anglers queried about their status as commercial fishermen, 40 percent claimed to be licensed (Table 13). Of this group, 22 percent had sold fish during the past twelve months (Table 14). Due to the nature of the small sample size, the influence of commercial fishing status on anglers' responses is impossible to statistically evaluate.

Vessel Characteristics

Almost all (92 percent) of the respondents owned the vessels they were using at the time of the interview (Table 15). Most (94 percent) had owned their boats for five years or less (Table 16). All boats used by respondents were less than or equal to 28 feet in length (Table 17). Four boats were in the 13 to 15 foot range. Typically, vessel lengths were between 16 and 25 feet.

Initial cost of boats was reported to range from less than $1,000 to between $20,000 and $30,000. Most (86 percent) of the boats were purchased for an amount between $1,000 and $20,000 (Table 18).

As a result of the size of vessels used in the fishery, fuel use rates were relatively small (1-4 gallons per hour). Respondents were generally aware of fuel use rates for their own boats. Only four percent of the sampled group indicated that they did not know this information (Table 19).

Considerable variation was observed in the frequency of offshore fishing trips reportedly taken each year by respondents (Table 20). The number of trips taken during the previous 12 months ranged from one to 180; the average being about 45 trips. Over half (56 percent) of the sample took less than 40 offshore fishing trips during the previous year and 12 percent took over 100 trips.

Nearly all (92 percent) of respondents reported that primary purpose of their "fishing trips" was for fishing (Table 21). This result ws corroborated by the finding that only four percent of the survey group had engaged in non-fishing related activities on their current trip (Table 22). Presumably, other activities

might include commercial fishing and other forms of recreation. Diving and other pleasure boating were mentioned by two anglers as activities which they had engaged in during their current trip (Table 23).

Respondents were asked about the typs of records they keep on fishing activities (Table 24). Approximately a third of the group kept records on: (1) number of trips taken, (2) hours at sea, and (3) types of fish caught. Between 40 and 50 percent of anglers kept records on: (1) engine running time, (2) number of fish caught, and (3) fishing related catch.

Catch Characteristics

When asked to provide estimates of the number of various fish types landed during the previous twelve months, all surveyed anglers provided numerical catch estimates (Reported catch data are summarized in Table 25). No refusals or "Don't know" responses were recorded. Often, the catch numbers provided by anglers were multiples of 5 or 10, indicating that the numbers are probably rough estimates at best. More accurate catch statistics could probably be gleaned from boat records. Approximately 40 anglers surveyed anglers reported that they maintained records on numbers and types of fish caught. Unfortunately, in a personal interview setting, it is difficult to utilize historical catch records. Perhaps leaving a form with respondents to complete (and return by mail) may be a way of utilizing angler catch records more effectively.

Relatively small catches were reported for shark and individual marlin species. Perhaps these species can be combined into a single catch category to simplify and improve accuracy of catch data collection.

Nearly 84 percent of the survey group reported fishing within half a mile of fish aggregating devices (FADs). When asked to estimate the percentage of trips that involved at least some FAD fishing activity, about five percent of the group claimed they did not know. Of those who offered usable estimates, the mean value observed was 35 percent. Over a third of all fish types, except ono, mahi, and bottomfish, were caught near FADs.

Fishermen willingly stated the percentage of the fish catch that was sold commercially. No refusal or "Don't know" responses were recorded. Survey data do not enable an estimate to be made as to whether fish sold commercially were caught while recreational fishing. Future studies should clarify this issue. One possible way may be to ask fishermen to state the purpose of their intercepted trip, and identify their disposition plans for their current catch.

Importance of Fishing

In terms of amount of time spent offshore fishing since they first began, a slight majority (58 percent) of respondents indicated they had changed their fishing behavior (Table 26). The proportion of anglers reporting an increase in trips (28 percent) was not significantly different from the proportion of anglers reporting a decrease in fishing activity (30 percent).

Eighty percent of the survey group reported that they would miss offshore fishing a lot if it was no longer available. A much smaller group of anglers (18 percent) would miss fishing "somewhat" or "only a little" (Table 27). The most commonly mentioned specific substitutes for offshore sport fishing were shore fishing, diving, and hunting (Table 28).

Crowding at launch sites and fishing areas appear to affect the satisfaction level of a majority of angler respondents. Nearly 75 percent of the survey group indicated that their satisfaction would change "alot" or "somewhat" if congestion was somehow reduced (Table 29). Some anglers (four percent) stated they would be willing to travel over 50 miles to reach an uncrowded fishing location. A majority (56 percent), however, would be willing to travel less than 10 miles at the most to reach an uncrowded location (Table 30).

Many anglers (66 percent) reported that they would respond to a 50 percent change in catch rates by altering frequency of their fishing grips (Table 31). A majority (60 percent) claimed they would take less trips.

Response was mixed about how many fewer trips would be taken. One angler claimed he would quit fishing altogether. Less than 10 percent indicated they would cut back fishing activities by over 50 percent if catch rates were halved for some reason. A slight majority (53 percent) of anglers reported they would reduce fishing activities by 30 percent or less (Table 32).

Fishing Cost Characteristics

Travel Behavior

All respondents who were queried about launch site selection behavior reported that Pokai Bay was a "usual" launch site. Other frequently used launch sites mentioned used included Kaneohe, Keehi, Hawaii Kai, Haleiwa, and Ala Wai (Table 33). These data suggest that some degree of substitution may exist among different launch sites. However, the majority of anglers who visit Pokai Bay tend to launch their boat regularly at that location.

In selecting a launch site, the deciding factors which a majority of anglers reported as being important include: (1) "closeness to home"; (2) "closeness to good fishing"; (3) "good launch facilities"; (4) "good weather"; and (4) "uncrowded launch" (Table 34). Non-fishing related factors such as: (1) "scenic drive"; (2) "closeness to friends and relatives"; and (3) "good food and beverage stores nearby," were mentioned as being important by 40 percent or less of respondents. When asked to identify the single most important factor considered in fishing launch site selection, 48 percent of anglers mentioned "closeness to good fishing." Other factors that were ranked high by 10 to 20 percent of the sample were "closeness to home," "good launch facilities," and "good weather."

Reported distances traveled to reach the Pokai Bay launch site ranged from one to 60 miles (Table 35). The mean distance traveled was 16.7 miles and the standard deviation around the mean was 16.4 miles. Many respondents traveled very short distances, 46 percent reached Pokai Bay after less than five miles of road travel. In terms of travel time, a slight majority (56 percent) spent less than 30 minutes in travel. On the other hand, 28 percent reported spending 1-2 hours in travel time (Table 36).

After reaching their Pokai Bay destination, anglers generally traveled at least a short distance by boat before beginning to fish (Table 37). The mean distance anglers reportedly traveled by boat before fishing was 3.2 miles. A third of the sample group began fishing immediately after leaving the Pokai Bay vicinity. Only 16 percent traveled over five miles by boat before beginning to actively fish. Survey data suggest this behavior may not be typical of anglers fishing out of other launch locations. Specifically, 76 percent of respondents reported that the distance they usually traveled before fishing depends on the launch site (Table 38).

Including time spent reaching fishing locations, anglers reportedly spend between one and 22 hours at sea during the intercepted trip. A large majority (86 percent) of trips lasted between four and nine hours (Table 39). Overall, the mean trip length was 7.3 hours and the standard deviation was 3.07 hours.

In terms of average total trip length, surveyed anglers spend approximately eight hours. Of this amount, 12 percent of the time was spent traveling to and from Pokai Bay. The remaining time was allocated to reaching and returning from the offshore fishing site, and in actual fishing activities.

Fishing Expenses

Respondents were asked to recollect specific fishing-related

costs for their current trip, as well as for certain expense incurred during the previous 12 months. A summary of anglers average annual expenditures for various items is given in Table 40. Average total costs per trip were estimated to be $104, assuming a trip frequency of 45.5 trips per annum. Of this amount, 52 percent ($55) represents direct out-of-pocket costs for fuel, oil, bait, ice, food, and beverages. The remaining 48 percent ($45) represents on average of annual expenses for repairs, tackle, licenses, insurance, and so forth. Average fuel and oil expenditures made to reach Pokai Bay was $8. This amount represents about eight percent of total trip costs and approximately 15 percent of anglers' average out-of-pocket travel expenses. The single largest average trip expense was $31 for boat fuel and oil.

Average annual fishing-related expenses totaled $4,780. This number is computed using the asumption that anglers spend $104 per trip (45.4 trips annually) on out-of-pocket expenses. Boat fuel and oil costs contribute 33 percent of the total. Truck fuel and oil costs represent on average nine percent of annual fishing-related costs.

No lodging costs were reportedly incurred by interviewees. This finding is consistent with the fact that only three percent of the survey group reported staying overnight in the Waianae area while on the current fishing trip (Table 41).

A majority (70 percent) of anglers reported sharing current out-of-pocket trip expenses with others in their fishing party. Respondents shared expenses with up to five other people. The median number of persons, who anglers claimed they shared expenses with, was three (Table 42).

Anglers were asked to give the amount of fishing-related purchases made directly from supply sources outside of Hawaii. The mean amount stated was $24. This amount is less than one half of one percent of total average annual expenditures (Table 43).

Considerable variation was observed in anglers' annual fishing expenses. Standard deviations of mean estimates were often three to four times the mean value. For example, reported annual expenditures on haul-out charges ranged from zero to $5,600. The mean value was $342 and standard deviation was $1,116. Similarly, wide variations were noted in values reported for safety equipment expenditures, engine repair costs, and radio and navigation purchases, among others.

Considerably less variability was observed in anglers' reported out-of-pocket expenses for the current trip. This may be due to increased accuracy in respondents' ability to recall recent expenses. It may also reflect the fact that out-of-pocket

expenses are somewhat unavoidable and are not particularly sensitive to travel distance. By comparison, reported expenditures on improving or repairing boats or fishing equipment may reflect anglers' discretionary spending behavior.

EXPERIMENTAL VALUATION FINDINGS

Overview of Valuation Approaches

A variety of procedures have been developed for determining the social value of recreational fisheries, some of which are more straightforward than others (Spargo). Looking first at the problem of estimating the gross economic impact of offshore sport fishing, two procedures can be used, both of which entail collecting detailed expenditure data from anglers. The first precedure involves using secondary economic data to contruct income expansion multipliers. Estimated multipliers can then be used to measure the long-term impact of offshore fisheries related expenditures. Provided that the effects of income leakages are included in the multiplier formulation, this procedure is useful in yielding estimates of gross economic impacts on a local or statewide basis. The alternative is to use a modified version of Hawaii's multi-sector input/output model to estimate gross economic impacts on a statewide basis. Both procedures are consistent with methods employed in a wide range of recreational valuation settings (Leitch and Scott).

Estimating the net economic benefits (consumer surplus) associated with offshore recreational fishing in Hawaii could perhaps be accomplished using the travel cost and hypothetical valuation (contingent valuation) techniques. Considerable research has been conducted on the travel cost method of recreational valuation since its introduction. Notable refinements include: (1) inclusion of travel time and congestion levels in the model specification; (2) inclusion of the effects of substitute recreational activities in model formulation; (3) use of individual rather than aggregated observations in equation estimation, and (4) adjustment for multi-purpose trips. Despite these developments, the travel cost method is still under scrutiny by some who consider the technique to be invalid in principle (Bockstael and McConnell). Aside from purely theoretical concerns, there are reasons to suspect the travel cost method may not be particularly useful in ascertaining angler consumer surplus in Hawaii. One problem relates to the fact that travel costs are probably not in and of themselves significant determinants in anglers' participation rates. Furthermore, because travel-related costs are relatively insignificant for Hawaii resident anglers, one would anticipate very little variations in travel costs between individuals. Consequently, recreational demand estimation may prove to be statistically impractical.

While applications of the travel cost method is widespread, use of hypothetical valuation techniques has also gained popular acceptance. For the case at hand, use of the hypothetical valuation approach would entail placing anglers in hypothetical situations designed to elicit their true valuation of offshore recreational fishing. Three basic questioning approaches could be used: (1) open-ended questions, (2) bidding games, and (3) take-it-or-leave-it offers. Each approach has its unique advantages and disadvantages, particularly in regard to strengths and directions of biases in elicited valuations (Samples, Schulze et al., Thayer).

It should be mentioned that techniques used to estimate anglers' consumer surplus discussed above can also be formulated to measure the economic consequences associated with exogenous pertubations in quality charactertistics of offshore recreational fishing experiences (see for example, Samples and Bishop, forthcoming; Vaughan and Russell). For instance, hypothetical valuation techniques can be used to measure the value to anglers of additional fish landings. Similarly, the costs associated with increasing congestion on offshore fishing grounds and in harbors can be evaluated. Collection of information on anglers' marginal valuations of recreational sport fishing quality increments and decrements is quite important given the dynamic character of Hawaii's offshore sport fishing.

Travel Cost Demand Estimation Findings

The travel cost approach to recreational demand estimation has been most successfully applied in contexts where: (1) recreational demand at a single site is being evaluated; (2) travel costs represent a large proportion of the total costs associated with recreating; (3) trips are taken with one primary objective in mind -- to visit the site in question for purposes of recreating; and (4) recreationists are fairly homogeneous in their tastes and preferences for the recreational experience being evaluated. Survey data collected at Pokai Bay indicate that all four conditions are probably not met in Hawaii.

Offshore recreational fishing occurs at many sites around the State. If one considers a launch location as a "fishing site," survey data show that sampled anglers regularly visit at least six launch sites on Oahu. Furthermore, the launch areas do not seem to be perceived as homogeneous in terms of qaulity by interviewees. This is evidenced by the finding that a large majority (60 to 80 percent) of anglers mentioned launch characteristics (available facilities and degree of congestion) as important factors in launch site selection. Survey data were

not completed enough to determine the degree of substitutability between sites. However, it is clear that if the travel cost model is to be successfully applied, a multiple-site model should be used to account for perceived launch site quality differences.

A second, and perhaps more important concern about the potential application of the travel cost approach, is the relatively insignificant travel costs (mileage and time) observed in the Pokai Bay sample data. As noted above, travel costs for fuel and lodging to reach the launch site represent about eight percent of total trip costs and approximately 15 percent of anglers' average out-of-pocket travel expenses. Similarly, time costs associated with traveling to Pokai Bay represents only 12 percent of total trip time costs. In comparison, Samples and Bishop (1981) and Ditton, Graffe, and Lapotka reported travel-related costs (not including time) of offshore sport fishermen to be 45 to 55 percent of total annual fishing costs. The percentage of travel costs to direct out-of-pocket trip expenses was much higher (60 to 80 percent).

A crude test was conducted using sample data to determine whether travel distance to the Pokai Bay launch (a surrogate variable for time and mileage costs) was correlated with frequency of fishing trips taken per annum. Following normal travel-cost estimation assumptions, it was hypothesized that the correlation between trips and distance would be negative and significantly different from zero. The estimated simple correlation coefficient (N=50) was .23. A test of the coefficient's statistical significance at the 95 percent confidence level could not support the hypothesis that the estimated correlation coefficient was different from zero. The calculated t-value in this case was 1.81. This result casts some doubts on the negative impact of travel costs on anglers' demand for fishing trips.

Survey data suggest that for the most part, anglers took "fishing trips" primarily to be able to fish. Side visits to relatives', or opportunities to enjoy Hawaii's scenery do not appear to weigh heavily in anglers' launch site selection. Nevertheless, of the sample group, 32 percent and 14 percent mentioned "closeness to friends and relatives" and "scenic drive," respectively, as important factors in selecting a boat launch site. These findings suggest that some multiple-purpose trips are probably taken by anglers, a feature which the travel cost model is not particularly well suited to deal with.

Anglers interviewed at Pokai Bay appear to be a fairly homogeneous group in terms of their attraction for offshore sportfishing, types of boats owned, and sex composition. Considerable variation was observed in respondents' substitute

recreational opportunities, fishing activity levels, and fishing expenditure behavior, and income levels. Due to these and other undetected differences, estimation of travel cost demand equations using individuals as the units of observation may prove to be exceedingly difficult.

Hypothetical Valuation Findings

Open-Ended Questions

As the name suggests, open-ended questions provide no information to the respondent about the anticipated value which is being measured. Aside from the general hypothetical framework of the question, the respondent is not guided in his or her response. The question format simulates a market situation similar to a closed bid auction where buyers have no information about other potential buyers' bids, and have no clear understanding of the seller's desired disposition price.

Four different open-ended questions were experimented with in the Pokai Bay interviews. Two questions were designed to measure anglers' consumer surplus per fishing trip. These questions were asked to 50 anglers comprising subsample I. The first of the two questions measured anglers' willingness to pay a "fair price" for a daily launch fee:

> "Hawaii does not charge a daily launch fee. Suppose, however, that one was planned. What do you think would be a fair price to charge fishermen to fish for one day offshore?"

The second question measured anglers' willingness to accept compensation to forego a day of fishing:

> "Suppose that instead of offering a specific amount of money, he let you decide how much you would have to have. What is the smallest amount of money that would persuade you not to go offshore fishing as planned?"

Two additional open-ended questions were designed to measure anglers' consumer surplus per year. These two questions were asked to 50 anglers comprising subsample II. The first of the questions measure anglers' willingness to pay for a season fishing license:

> "Hawaii does not require offshore fishermen to purchase fishing licenses. But, suppose that a law requiring annual licenses was being planned. What do you think would be a fair price to charge fishermen for a license that allows them to fish offshore for one year?"

The second measured anglers' willingness to accept compensation

to forego a season of fishing:

> "Suppose that instead of offering you a certain amount of money, he let you decide how much you should have. What is the smallest amount of money that would persuade you to agree not to go fishing offshore during all of 1983?"

Tabulated responses to these four questions are given in Tables 44-47, respectively. Looking at the responses to each question in turn, only 38 anglers responded with a positive value to the boat launch fee question. The mean value reported by the 36 anglers was $3.76. Nearly 25 percent of the group either refused to answer or indicated they did not know a fair price. Twenty-eight percent of those responding reported a zero value. The maximum value stated was $50.

As expected, higher mean values were observed in anglers' stated minimum compensation to forgo a day of fishing (Table 45). In this instance, the estimated mean required compensation was $563, based on usable responses of 33 anglers. Once again, nearly a quarter of the sample group either refused to answer or claimed they did not know a proper dollar amount. Only eight percent reported a zero dollar compensation value. The maximum value stated was $50.

The second set of open-ended questions was asked to a different group of 50 anglers. These questions were concerned with valuing a season of fishing. The question which attempted to determine anglers' perception of a fair price for an annual fishing license yielded a mean value of $13.73 based on usable answers of 34 anglers who reported with positive dollar amounts (Table 46). Thirty-two percent of those queried refused to answer the question or did not know a proper answer. A zero value was given by 14 percent of the group. The maximum reported value was $50.

The final open-ended question generated still higher reported recreational fishing values (Table 47). The mean minimum compensation amount was $9,632, based on the response of 26 anglers. Nearly half (48 percent) of those surveyed either refused to answer or did not know a proper answer. Only four percent gave a value of zero. The highest value observed was $40,000.

The following observations can be made concerning the open-ended question results. First, the relatively high percentage (20 to 30 percent) of respondents who did not supply monetary value responses is disconcerting since the statistical validity of the mean value estimates are therefore suspect. Second, the high number of zero values reported for certain questions suggests that some anglers are not responding

accurately. Such a response may likely reflect a distaste or distrust of the hypothetical context of the question rather than a true monetary valuation. Third, the mean estimated values appear to be consistent in the sense that annual consumer surplus values are higher than per trip value estimates. That is, willingness to pay for a day of fishing (launch fee) is less than willingness to pay for a season of fishing (license fee). However, the values are not internally consistent when directly compared using an average trip frequency conversion constant of 45 trips per year. For example, at 45 trips per year, the $563 mean compensation value per trip expands to $23,335 of consumer surplus per year. This value is substantially higher (no statistical test conducted) than the $9,632 value calculated for annual consumer surplus in a separate question.

Bidding Games

Bidding game question formats differ from open-ended questions in two important ways. In a bidding game, respondents are provided an initial dollar value (bid) which can be accepted or rejected. Because an initial starting bid is given, information about the "true" or final value is revealed to the respondent. The manner in which this information affects the final bidding game outcome has been studied elsewhere by Thayer. A second difference in bidding games from open-ended questions is that bidding games entail more interaction between interviewer and respondent. When a respondent does not consider the initial bid amount acceptable in a bidding game, the interviewer incrementally (following a defined bidding schedule) raises or lowers the bid amount until a value is reached that is just marginally agreeable to the respondent. Through this interactive process, a respondent's minimum compensation amount or maximum willingness to pay is measured.

Eight different bidding game situations were experiemented with, using four question formats. As in the case of the open-ended questions, two of the bidding game questions were designed to measure anglers' consumer surplus per trip. These two questions were asked to anglers comprising subsample I. Of the two trip-related questions, the first measures maximum willingness to pay for a special fuel tax:

> "Suppose that you were going to fill up your boat's fuel tank to go out fishing the next day. You hear that a new tax has been placed on fuel used for sportfishing. Would you go ahead and buy the fuel so that you could go fishing if the tax increased that cost of a fishing trip by $------?"

The other measured anglers' willingness to accept compensation to forgo a day of fishing:

"Finally, imagine that the day before you are planning to go offshore sportfishing, you find out that all sportfishing trips for the next day will have to be cancelled because of top secret Navy operations. However, you will get a cash reward to make up for the trouble caused you. Would you be satisfied with a cash reward of $------ if you could not go offshore sportfishing as planned?"

Two additional bidding game questions were designed to measure the amount of angler consumer surplus received per year. These two questions were asked to anglers comprising subsample II. The first question attempted to measure respondents' willingness to pay an annual user fee:

"Suppose that the Federal Government just passed a law that required all boat users to pay an annual user fee. Would you go ahead and pay the annual tax so that you could go offshore fishing in 1983 if the amount which you had to pay was set at $------?"

The second measured anglers' willingness to accept a compensatory amount to forego fishing for one year:

"Finally, suppose that the government asked you to stop fishing for the rest of 1983. In return, you will receive a cash award. Would you go along and not go offshore fishing in 1983 if the cash award was $------?"

Strict procedures were followed by interviewers in increasing or decreasing bid amounts. The procedures are outlined in "Instructions to Interviewers" found in Appendix A. Two different bid ranges were used. The selected ranges depended on whether the question was aimed at measuring annual consumer surplus or consumer surplus per trip. For questions aimed at valuing a fishing trip, buds were limited to be between $1 and $800. In the two questions concerned with valuing a fishing season, bids were constrained to range between $1 and $8000.

Due to interview time constraints, only six bid interactions were used. That is to say that the maximum possible bids given to respondents to consider was six. A constraint on number of interactions shortened what could otherwise be a lengthy interview process, especially considering the lack of a priority knowledge about expected final bid amounts. Even with this procedural constraint, the bidding structure developed for interviewers allowed for only a 10 percent valuation error by the time the final bidding iteration was reached.

To test the effect of using different initial bid values, each subsample was divided into two respondent groups of 25 anglers. Each group received different initial bids. Members of

subsample I received initial bids of either $1 or $800. Members of subsample II received initial bids of $1 or $8000.

Angler responses to the four bidding game question are given in Tables 48 to 51. The bidding game question relating to anglers' willingness to pay the special fuel tax yielded a mean value of $41, based on usable responses of 38 anglers. Twenty-four percent of the survey group either refused to answer the question or indicated they did not know a proper answer. Although the bidding range did not include zero as a bid amount, six percent of the group insisted on reporting a $0 final bid.

Higher mean bids were observed in the question concerned with compensation for a day of fishing (Table 49). Here, the mean bid was $422, based on 30 usable responses. Once again, six percent of the group insisted on reporting a zero bid.

The mean bid for the game aimed at measuring anglers' willingness to pay an annual user fee was $400. However, 46 percent of respondents refused to answer this question. In the case of the award for foregoing fishing for a year, the mean bid was $6,039 with 32 percent of the group not responding.

Upon initial inspection of the survey data, it appeared that the mean values of bidding outcomes with lower starting values ($1 in all instances) were appreciably less than mean values of bidding outcomes when higher starting values ($800 or $8000) were used. For example, in the question concerning anglers' willingness to pay an annual user fee, respondents who started the bidding process at $8000 had a mean bid of $1,428. Given the magnitude of this dissimilarity, among others, statistical test of differences between means were conducted. Results of statistical tests concerning differences between mean bid outcomes are given in Appendix D. The power of these tests is small, however, due to small sample sizes. In all questions except one, the hypothesis could not be rejected at the 95 percent confidence level that the mean bids were the same for both initial starting values. The exception was the bidding question on anglers' willingness to accept compensation to forego a day of fishing. In this instance, anglers who were initially offered $800 to forego fishing had mean final bids of $667 while anglers who were offered only $1 in the initial bidding round had mean final bids of $189.15. These statistical tests support similar tests reported elsewhere by Thayer indicating that starting-point bias is not particularly evident in hypothetical valuation bidding games.

As in the case of open-ended question responses, mean consumer surplus estimates obtained through a bidding game process were consistent in the sense that estimates of trip consumer surplus were less than estimates of annual consumer

surplus. As would be expected based on economic theory, willingness to pay estimates were less than estimates of willingness to accept compensation.

Comparison between trip and annual valuation estimates are difficult to make based on bidding game results. Due to lack of prior information on expected bid outcomes, many final bids were equal to the highest allowable values ($800 or $8000) used in the bidding game. Care should be exercised in developing future bidding games so that top and bottom bid limits can accommodate all final bid outcomes.

Take-It-Or-Leave-It Questions

Take-it-or-leave-it question formats involved asking survey respondents to accept or reject a specified dollar offer. The respondent is only required to answer "yes" or "no" when presented with a hypothetical offer situation. It has been argued elsewhere by Samples, and Bishop and Heberlein, that this interview approach more closely resembled a typical market situation. Normally, American consumers, including Hawaii offshore fishermen, are confronted with market situations where prices of goods and services are fixed. The decision facing the consumer is whether to purchase or not; whether to take-it-or-leave-it.

Four different take-it-or-leave-it question formats were experimented with in the Pokai Bay survey. Two questions were designed to solicit information about anglers' valuation of a fishing day. Both of these questions were asked to members of subsample I. The first question inquired about anglers' willingness to pay a daily launch fee:

> "Suppose that the day before a fishing trip, you hear that a new law requires you to pay a launch fee everytime you take your boat out fishing. If the charge was set at (FIXED DOLLAR AMOUNT INSERTED HERE) per launch, would you pay the fee and go fishing as you had planned?"

A second question was designed to measure anglers' willingness to accept compensation to forego a day of fishing:

> "Suppose that the day before you planned to go on an offshore sportfishing trip, you got a call from a person who offered you cash if you agreed not to go fishing. If he offered to pay you (FIXED DOLLAR AMOUNT INSERTED HERE), would you agree not to go offshore sportfishing the following day?"

Fixed dollar amounts were randomly assigned to each respondent. Five different amounts were used: $1, $25, $150, and $450. Each value was used in 10 separate interviews. It was then recorded

whether the respondent accepted, or did not accept the offer.

The second two take-it-or-leave-it questions solicited information for valuing anglers' annual consumer surplus received from offshore sportfishing. The first of these measured willingness to accept compensation not to fish for a year:

> "Suppose someone offered you money if you agreed not to fish offshore at all during the rest of 1983. You would sign a legal contract that would stop you from going offshore fishing during 1983, although you could fish from shore or do other sport activities. If the money offered was (FIXED DOLLAR AMOUNT INSERTED HERE), would you agree to the deal and sign the contract?"

The last question asked fishermen's willingness to pay a certain fee for a fishing license:

> "Supppose a new law required offshore sport fishermen to purchase a fishing license. It would allow you to fish whenever you wished to in 1983. Without a license, you could not fish offshore at all. You would, however, be able to fish from the shore or do other sport activities. If the annual fee was set at (FIXED DOLLAR AMOUNT INSERTED HERE), would you purchase the license to be able to fish offshore during 1983?"

Again, different fixed dollar amounts were randomly assigned to respondents. Since these questions dealt with annual consumer surplus, five larger dollar amounts were used: $1, $250, $850, $1,500, and $4,500. Each value was used in 10 interviews. Respondents' acceptance or rejection of the offers was recorded.

Anglers' responses to the take-it-or-leave-it questions are summarized in Tables 52 to 55. The tables show the number of anglers either accepting or rejecting various dollar offer amounts. Two features of the results deserve special mention. First, compared with other question formats, relatively few anglers refused to answer the questions or reported that they did not know a proper answer. Out of a total of 200 separate occasions that take-it-or-leave-it questions were posed, only three (1.5 percent) anglers provided unusable answers. Secondly, it is encouraging that the pattern of responses corresponds closely with the response pattern hypothesized. Presumably, proportionally more anglers would accept higher compensatory payments than lower payments. Conversely, proportionally more anglers would accept lower imposed fees or costs than higher fees or costs. Such a pattern is evident in responses to all four logit questions.

Yes-no responses to take-it-or-leave-it offers are difficult

to interpret directly. A logit model provides a useful tool for dealing with such binary data (Samples). This experimental survey was not designed to provide the necessary data needed to estimate anglers' consumer surplus within the context of a logit framework. For this reason, no mean values can be calculated. Nevertheless, the survey provides clear indication that data needed for logit estimation could be supplied through take-it-or-leave-it type questions.