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OMNITRAK RESEARCH
& MARKETING GROUP, INC. AN AFFILIATE OF STARCH INRA HOOPER AND THE ROPER ORGANIZATION

SAMPLING METHODOLOGY FOR A BOAT FISHING SURVEY DESIGN FOR HAWAII

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TABLE OF CONTENTS

	Page
1. INTRODUCTION AND BACKGROUND	1-1
2. PROJECT OBJECTIVES	2-1
3. PROPOSED SURVEY DESIGN	3-1
4. STATISTICAL REVIEW OF ON-GOING AND AVAILABLE FISHING SURVEYS	4-1
A. COMMERCIAL LANDING REPORTS BY THE HAWAII DIVISION OF AQUATIC RESOURCES (HDAR).	4-4
B. MARINE RECREATIONAL FISHING STATISTICAL SURVEY	4-23
5. PRETEST FOR THE PILOT INTERCEPT SURVEY	5-1
6. PILOT INTERCEPT SURVEY SCHEME FOR OAHU	6-1
7. PILOT MAIL SURVEY FOR OAHU	7-1
8. SAMPLE SIZE DETERMINATION	8-1
9. CONCLUSIONS	9-1
10. RECOMMENDATIONS	10-1
11. ACKNOWLEDGEMENTS	11-1
12. LITERATURE CITED	12-1
APPENDICES	

1. INTRODUCTION AND BACKGROUND

Fishery data in Hawaii are required by a wide range of state and federal government agencies, the fishing industry and the general public. The collection of valid and reliable statistics from recreational/commercial boat fishermen (who may sell some but not necessarily all their catch) is extremely important, particularly as the state and the federal government do not have any legal requirements for the reporting of non-sale statistics by the recreational fishing community. Nor is there a method for verifying the catch of small-boat commercial fishermen. As a result, there is at present no statistically valid and efficient sampling plan available for estimating total fisheries catch in Hawaii. Therefore, the Western Pacific Fishery Management Council (WPFMC), the Southwest Fisheries Center, the Honolulu Laboratory, and the National Marine Fisheries Service (NMFS) initiated this project to derive reliable estimates of the amount of fish by each major marine species being taken by boat fishers from the waters surrounding Hawaii on an annual basis. This project was funded by the WPFMC.

The goal of this project is to develop a boat fishing survey design to be implemented in Hawaii.

2. PROJECT OBJECTIVES

The objectives of this project are as follows:

A. Appraise the contribution of existing programs for gathering fish catch and fishing effort statistics in Hawaii in meeting the goal of this project.

B. Review the methodology and the results of the Marine Recreational Fishery Statistics Survey (MRFSS) sponsored by the National Marine Fisheries Service in meeting the goal of this project.

C. Design catch and effort data gathering procedures covering boat fisheries for major marine species in Hawaii which are not covered by existing fisheries data collection programs.

D. Pretest the survey design for its workability in producing reliable annual estimates of catch and effort.

E. Specify the costs of surveys for producing five, 10, and 30 percent coefficients of variation for annual estimates of catches of major marine species in Hawaii and effort levels in making the catches.

3. PROPOSED SURVEY DESIGN

INTRODUCTION

The proposed survey is based upon the results of several pretests conducted on various design alternatives for estimating recreational boat fishing catch and effort. These pretests will be described in detail in the following sections. Also, there will be a description and evaluation of various ongoing and past efforts to measure boat catch and effort in Hawaii. This section will present a general description of the proposed survey design for measuring catch and effort for recreational boat fishing. A detailed description of the proposed survey is presented in Section 10 of this report.

The proposed survey comprises a boat intercept survey. The boat intercept survey is designed to obtain information on all recreational boat fishing, i.e. including commercially licensed and unlicensed fishermen as well as catch which may be sold or not sold (Illustration A, Domains D, D-1, E, F and A). The estimates derived for small and medium sized commercial boats engaged in recreational and subsistence fishing (Domains A, D and D-I) and estimates for non-commercial recreational fishing boats in Domains E and F will be obtained from the intercept survey. The estimates for both the commercial and non-commercial recreational catch and effort will provide a more complete estimate of recreational fishing in Hawaii than has been possible previously.

PILOT INTERCEPT SURVEY

This survey is a sample survey of boat trips. The design can best be described as a multi-stage stratified probability sample, with islands, ports, days, and time of day as strata and the ultimate sampling unit is the boat fishing trip. The length of the survey is one year.

This survey consists of a sampling of ports on each island in the State, with a sub-sampling of days throughout the year. For each day selected, half the day is selected at random. This is done by dividing each day into AM or PM segments. The AM is defined as one hour before sunup until noon and PM is defined as from noon until one hour after sunset. Within each AM/PM segment, every other hour is spent in intercepting small and medium size fishing boats and obtaining information on their catch, such as whether any fish were caught during the trip and if so, the number and weight of different species caught and the number of hours spent fishing and type of gear used. All hours during each segment are spent in counting the number of small and medium sized fishing boat landings. This way, both catch and effort (number of landings) and catch per unit of effort can be measured.

The detailed rationale and methods for selecting ports and days and methods of producing estimates of catch and effort are described in Section 10 of this report.

It is proposed that each island survey be conducted separately. Small islands such as Lanai and Molokai may be combined into one strata for purposes of increasing the accuracy (increased sample size) of the estimates of catch and

effort. Island or island group estimates can be combined to produce county and state estimates for catch and effort for each species.

It is proposed that ports be selected based on a probability proportional to the number of landings, as determined from data available from the latest year. Also, ports are selected to represent different locations on each island. The number of recreational fishing boat ports selected, as discussed in Section 10, is based on the resources available as well as the accuracy of the estimates of catch and effort desired. Section 10 proposes, on any given island, that six port strata be sampled as a minimum number below which the estimates of catch and and effort would exceed a 15 percent error (coefficient of variation). On the other hand, if as many as eight ports are surveyed during the year, the error would drop to an estimated 10 percent. The more port strata included the higher the cost: thus, it is important to balance the available resources with the level of accuracy in order to optimize the outcome.

It was discovered in analyzing existing and past catch and effort statistics that weekdays and weekend days are quite different: thus, days were stratified by this characteristic. In the proposed sample of days, some one-half of weekend/holiday days are selected and only one-fifth of weekdays are selected in order to produce independent estimates for weekday or weekend/holiday strata.

Also, the rationale for dividing days into half-day segments is in part, due to the length of time an interviewer can work efficiently. By randomly selecting the initial half-day and by alternating these half-day segments from day to day, the estimates of catch and landings are more representative, since it is known that the number of landings vary by time of day.

Based upon the number of days selected and the amount of time spent interviewing and counting at each port, it is estimated that a total of 29,040 hours will be required of interviewing and supervising time. Other resources required are costs of mileage, materials and costs of editing and coding the completed Answer Sheets and Boat Logs, as well as the programming and tabulating the results. In addition there will be some time required to calculate the inflated estimates from the tabulated data.

The estimates produced from the above survey are for an entire year. It is proposed that when the relationship of these estimates of catch and effort with the ongoing catch and effort statistics collected by the Hawaii Division of Aquatic Resources is analyzed that some annual estimates can be constructed of the recreational boat fishery. This is not to say that an intercept survey should not be conducted periodically, in order to test this relationship and in order to update the estimates of recreational boat catch and effort statistics for the State.

MAIL SURVEY

A mail survey of persons with licensed medium and small boats, in order to ask questions about boat fishing, would enable the collection of information about fishing activities for persons who use public as well as private and restricted port facilities. Since the intercept survey sample is drawn only from public, non-restricted ports, it is expected that the overall estimates of trips and catch would be improved, especially on Oahu where there are many private and restricted ports, with the use of a mail survey. It would be particularly valuable to conduct a mail survey during the first survey year, in order to compare the mail survey and intercept survey results.

4. STATISTICAL REVIEW OF ON-GOING AND AVAILABLE FISHING SURVEYS

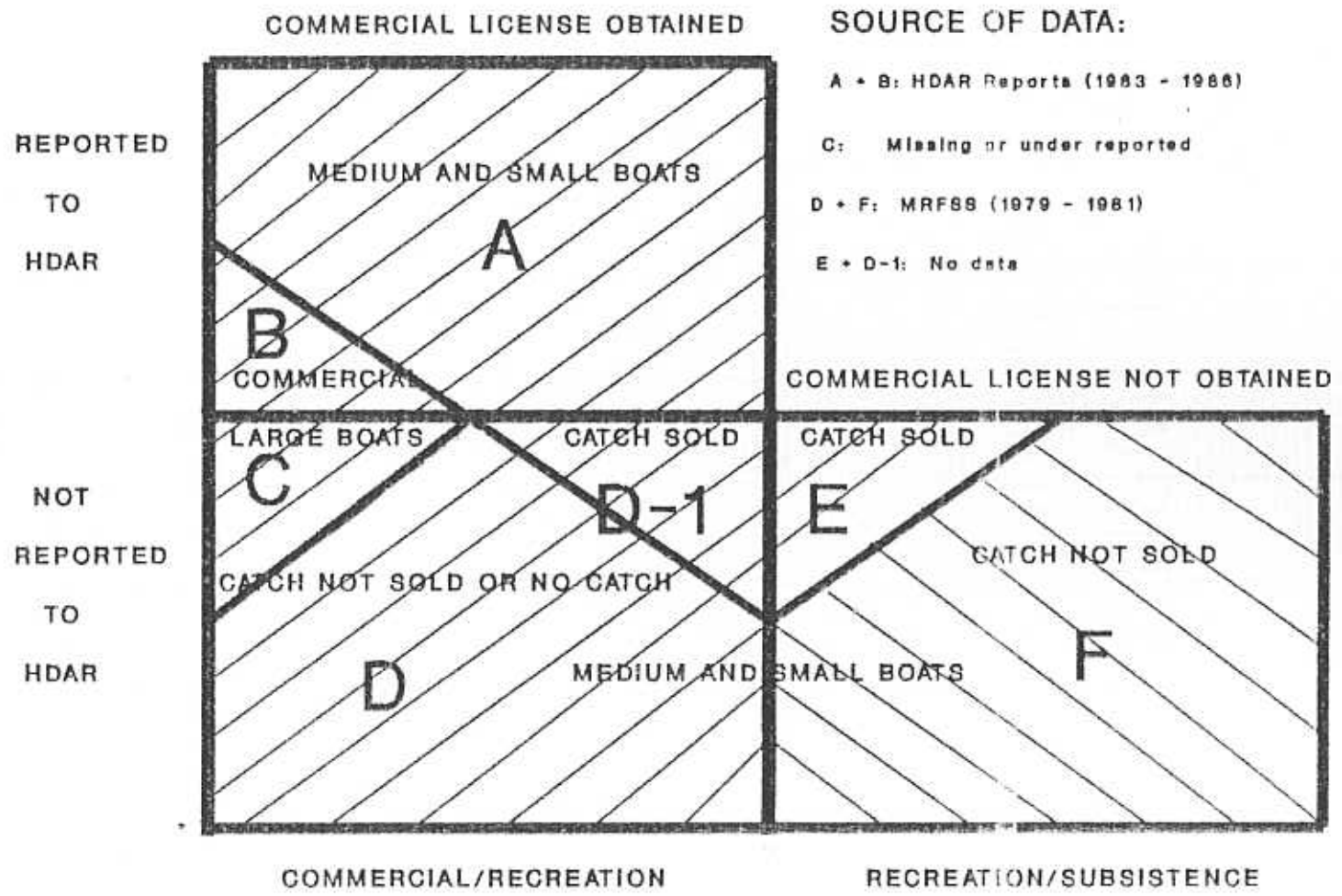
The boat fishery, as part of the overall Hawaii fishery, is shown in Illustration A. The boat fishery can be divided into the following subdomains, commercially licensed boat fishermen and non-commercial boat fishermen. Non-commercial fishermen use primarily small and medium sized recreational craft. The catch on these is used for subsistence, gifts, released or used for bait (F), however, some of the catch may be sold to help recover costs (See E). There is no reporting requirement for non-commercial fishermen. Data on this type of fishing as well as shoreline fishing is only available from ad hoc studies such as the MRFSS.

Commercially licensed fishing is done primarily for commercial purposes, and the Hawaii Division of Aquatic Resources (HDAR) requires these fishermen to report monthly. This domain can be divided into fishing with large boats and either medium or small boats. Some large boats report to HDAR as required (B) and some under-report or fail to report (C). Some commercially licensed fishermen who use medium and small boats report regularly as required (A) and others who fish mostly for recreation may report less regularly or not at all (D). Some commercially licensed fishermen using smaller boats, do not report regularly or at all. They may sell part of their catch to recover their costs (similar to those in subdomain E), these are labelled D-1 since they comprise licensed fishing in medium or small craft.

The HDAR data comes primarily from A and B subdomains in the illustration and the MRFSS data (1979-81) cover the recreational boat fishing in subdomains D and F. Excluded from the MRFSS data is recreational boat fishing in which part or all of the catch was sold (sub domains D-1 and E).

The following discussion will review the methods and findings of these two major data sources for recreational fishing in Hawaii. While there will be a little overlap (D) in their data there will be a comparison of the findings of catch and effort statistics from these two sources in order to study their relationship.

ILLUSTRATION A
BOAT FISHING IN HAWAII



COMMERCIAL: Should be licensed and reported to HDAR

NON-COMMERCIAL: Not required to be licensed or reported

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4.A. COMMERCIAL LANDING REPORTS BY THE HAWAII DIVISION OF AQUATIC RESOURCES (HDAR)

Presently, fishery statistics for Hawaii are collected by the HDAR, which is mainly responsible for the collection of landing reports from commercial fishermen. A person fishing for commercial purposes is required to obtain a fishing license every fiscal year at a cost of $10.00 to the applicant ($20.00 for non-residents). Once licensed, a commercial fisherman is required to file a monthly fish catch report, the C-3 form. This form lists species; area, location and date caught; port of landing; gear used; number and pounds of catch; and amount and price of sale. Each trip must be recorded on a separate line, even if there was no catch. If there is more than one species caught then there are as many lines as species caught on that trip. Each line in the form is entered as one record into the DAR commercial catch data base, along with a confidential code number for each fisherman. Even though there were no fishing trips during the month the form must be returned to HDAR indicating that. Detailed information on this system is provided in the HDAR report, Hawaii Fisheries Statistics System Design Study (1984).

The purpose in analyzing the HDAR data is to measure catch and effort for all licensed fishermen using small and medium sized boats, and to measure the effects of various factors such as time of day, season, and port upon the amount of catch. Licensed fishermen include those who fish primarily for commercial purposes (domain A in Illustration A) and who file regular and reasonably complete reports with HDAR. Also, included are licensed fishermen using small and medium sized

boats who either fail to report (as required) or report irregularly or inaccurately to HDAR. This latter group of fishermen comprise recreational and/or subsistence fishers who may sell part of their catch to defray costs (domain D and D-1, Illustration A). Information for this group of fishermen is largely absent or inaccurate and may be obtained through ad hoc surveys or studies.

Zero-catch trip information is not reported in the HDAR data, so while a valid measure of catch for those who caught at least something on a trip is available, a valid estimate of catch per unit effort (CPUE) cannot be derived; however, it can be estimated. The data can be used to study the effects of various factors on catch and on effort. Structural rearrangement of the data set at the Honolulu Laboratory enabled us to obtain statistics of catch and effort for two groups:

(a) active fishermen with no catch for a particular species per trip but with catch for one more of other species, and

(b) successful fishermen with some catch for a given species on all trips reported.

We will present estimates of catch and effort for both groups separately and combined.

In a "Review of Hawaii's Fishery Statistics and a Review of a Fishery Data Base," Richard Shomura commented that the state's landing reports seriously underestimated the catch landed. However, a statistical review of this large data set

would still provide information on the relative contribution of significant factors such as ports, seasons, and day of week (weekend or weekday) to the total variation of catch and effort and, hence, on the sampling methodology to be developed through this study.

We chose to examine only commercial landings reported in the HDAR data for Oahu. This strategy provided a convenient sample of total State landings and develops a methodology which easily can be applied to the other islands.

Table 1 lists codes and names for Oahu ports,* species and gear type in the same format as used by the Hawaii Division of Aquatic Resources (HDAR). Generally, this table lists the Hawaiian names for the species with only a few English and Japanese exceptions. Only a few ports, species and gear types will be considered for the development of the methodology to be recommended for the actual field study. However, overall estimates of catch, effort and CPUE will be based on all ports, species and gear types (excluding gears 1 and 2). We will exclude gears 1 and 2 i.e., pole-and-line and flagline, which are mainly used by large scale commercial boats which are not within the scope of this study.

Oahu HDAR data for two consecutive fiscal years (1983 and 1984) will be considered. Some analyses of variance reported in this study rely on bi-monthly sample data (1983, 1984 and 1985 calendar years); examined for specific ports and species. Unless otherwise stated, a year will be treated as a fiscal year.

*Although there are 29 codes for Oahu ports listed in Table 1 there are more than 29 fishing sites, but not necessarily 29 boat fishing sites.

TABLE 1
HDAR/OAHU CODES AND NAMES FOR PORT, SPECIES, GEAR

PORT**	SPECIES*	GEAR
501 Hawaii Kai		
Kokohead	2 Aku	1 Pole and Line (aku boats)
Maunalua Bay	3 Ahi	2 Flagline (long line tuna boats)
502 Diamond Head	8 Marlin/Misc.	3 Deep Sea Hand Line
Waikiki, Ala Wai	9 Marlin/Striped	4 Inshore Handline
511 Kewalo Basin	10 Marlin/Blue	5 Set Line
512 Honolulu Harbor	11 Marlin/Broadbill	6 Trolling
Sand Island, Keehi Lagoon	12 Marlin/Sailfish	8 Ika Shibi
513 Kalihi Basin	13 Mahimahi	11 Trap
515 Moanalua Bridge	14 Ono	13 Spear
522 Aiea	15 Hapuupuu	14 Lobster Diving
523 Pearl City	19 Opakapaka	20 Net-Unclass
Waipahu, Waipio	20 Uku	21 Opelu Net
524 Honouliuli	21 Ehu	22 Gill Net
Waikele	22 Onaga	25 Lobster Net
Apokaa, Hoaeae	28 Akule/Aji	26 Crab Net
525 Ewa	37 Akule/Halalu	28 Akule Net
531 Nanakuli	81 Opelu	30 Bait Net
532 Waianae	107 Marlin/Spearfish	31 Purse Seine
Pokai Bay	108 Marlin/Black	99 Others
533 Makua	706 Spiny Lobster	
540 Waialua	707 Slipper Lobster	
542 Haleiwa		
543 Waialee		
Waimea Bay		
561 Kahuku		
562 Laie, Hauula		
Punaluu	LBS CODE USED IN SAS DATA SETS	
563 Kahana		
570 Kaneohe Bay	LBS 1 = Aku	
571 Waikane	LBS 2 = Ahi	
572 Waiahole	LBS 3 = Mahimahi	
573 Heeia, Heeiakea	LBS 4 = Blue Marlin	
574 Kaneohe	LBS 5 = Misc. Marlin	
575 Kahaluu	LBS 6 = Opakapaka	
581 Kailua Bay	LBS 7 = Ehu	
582 Waimanalo	LBS 8 = Opelu	
599 Unknown	LBS 9 = Other	

On Oahu, during 1983, 571 licensed fishermen (excluding pole-and-line and flagline) reported making 10,121 trips landing on Oahu (trips counted as reports per license per port per day) and reported landings of 1,375,846 pounds of fish. This figure is from all ports and for all species listed in Table 1. It is a generally accurate assumption that their vessels fished in waters around Oahu, including the near shores of neighboring islands, except for fishermen that fished in the Northwestern Hawaiian Islands. On average, during 1983, each license holder caught 2,409.5 pounds annually (Table 2) in 17.7 trips including one or more of the species landed at Oahu ports. When counting all trips including those with no catch, the catch per trip would be much lower than when counting only trips with a catch (Table 2). To the extent that landed species are not included in these statistics (see table 1) this reduces the estimates of catch and will produce a downward bias in its estimates of average catch. The extent of this potential bias is not known.

The estimate of average trips per license holder was the most reliable (as judged by the coefficient of variation), followed by catch which was subject to higher error (Table 2). The coefficient of variation is defined as the percent the variance represents of the estimates. For example, if the estimate is 100 with a variance of 10 the coefficient found or C.V. would be 10%

In order to evaluate the catch per unit of effort (CPUE) there are two different approaches which might be taken. The approach which is best can be determined by which one produces a more reliable measure of CPUE. Fishermen can

be classified as active or successful on a given trip, depending upon whether they had some catch of at least one species (active) or had some of a specific species (successful). Thus, a fisherman who caught one species on a given trip would be considered "active" for the trip and "successful" for that one species. Comparison of the estimates of catch and effort for both active and successful fishermen (Tables 3, 4) based on reports received during 1983 and 1984 showed that the successful fisherman on the average, catches more, makes fewer trips and, therefore, catches more per trip of a particular species (S1-S9) during a year than the corresponding active fisherman. This is as expected because only trips on which a species were caught are counted. Also, the successful fisherman's estimate of mean trip per species was less reliable, and catch per trip more reliable than that of the active fisherman as judged by a comparison of the corresponding C.V.'s (coefficients of variation); the mean catch per species was about equally reliable. CPUE1 (catch per unit effort) is the catch per active fisherman and will be compared subsequently with CPUE2 which is the catch per trip by successful fisherman.

TABLE 2

ESTIMATES OF MEAN (TRIPS, CATCH IN LBS.) AND THEIR C.V.S. IN PERCENT FOR ALL PORTS OF OAHU, ALL SPECIES*, ALL GEAR TYPES (EXCEPT 1 AND 2) FOR ALL TRIPS FOR 1983 AND 1984 FISCAL YEAR

	1983			1984	
Variable	n**	Mean	C.V.	n	Mean	C.V.
Catch	571	2,409.5	11.5	499	3,373.3	14.3
Trips (Port) with Catch	--	17.7	5.5	--	18.1	5.7
Trips*** (Catch & No Catch)	--	33.2	--	--	33.9	--

* All species (2 to 707) listed in Table 1
** n = number of licenses (sample size)
*** Based on 53.4% of reports submitted (Non-Delinquent) have a catch and 46.6% have no catch. (See HDAR, 1984, p. 128)

NOTE: CATCH is the annual catch per license holder. Mean (lbs) is averaged over all trips by all license holders.

3. ESTIMATES OF MEAN CATCH IN LBS., TRIPS, CATCH PER TRIP AND THEIR C.V.'S IN PERCENT FOR ACTIVE FISHERMEN BY ALL SPECIES FOR ALL PORTS OF OAHU AND ALL GEAR TYPES (EXCEPT 1 AND 2) FOR 1983 AND 1984 FISCAL YEARS
SOURCE: HDAR

Species	1983								1984							
	Mean (lbs.) Catch	C.V.	n	Mean Trips	C.V.	n	Mean (lbs.) Catch per Trip	C.V.	Mean (lbs.) Catch	C.V.	n	Mean Trips	C.V.	n	Mean (lbs.) Catch per Trip	C.V.
Aku (S1)	115.6	11.0	571	17.7	5.5	571	6.8	8.0	131.2	12.1	499	18.1	5.7	499	8.0	13.4
Ahi (S2)	509.0	14.4	571	17.7	5.5	571	31.6	19.3	330.9	17.7	499	18.1	5.7	499	16.1	10.6
Mahimahi (S3)	292.4	14.0	571	17.7	5.5	571	10.1	7.5	382.6	17.2	499	18.1	5.7	499	11.9	9.3
Blue Marlin (S4)	168.2	12.3	571	17.7	5.5	571	9.1	14.5	218.6	12.3	499	18.1	5.7	499	11.0	10.8
Marlin (Misc) (S5)	135.4	12.2	571	17.7	5.5	571	6.7	13.2	78.3	13.6	499	18.1	5.7	499	4.2	12.4
Opakapaka (S6)	203.0	35.2	571	17.7	5.5	571	16.3	33.6	431.4	27.4	499	18.1	5.7	499	34.9	31.3
Ehu (S7)	31.4	36.4	571	17.7	5.5	571	1.8	24.6	37.5	26.3	499	18.1	5.7	499	3.1	29.4
Opelu (S8)	139.8	27.9	571	17.7	5.5	571	3.8	16.5	123.6	24.8	499	18.1	5.7	499	4.2	22.0
Others (S9)	814.7	25.8	571	17.7	5.5	571	85.9	52.6	1639.2	26.4	499	18.1	5.7	499	220.2	37.6

n = number of licenses
Active = caught something on a trip

4. ESTIMATES OF MEAN CATCH IN LBS., TRIPS, CATCH PER TRIP AND THEIR C.V.'S IN PERCENT FOR SUCCESSFUL FISHERMEN BY ALL SPECIES FOR ALL PORTS OF OAHU AND ALL GEAR TYPES (EXCEPT 1 AND 2) FOR 1983 AND 1984 FISCAL YEARS.
SOURCE: HDAR

Species	1983								1984							
	Mean (lbs.) Catch	C.V.	n	Mean Trips	C.V.	n	Mean (lbs.) Catch per Trip	C.V.	Mean (lbs.) Catch	C.V.	n	Mean Trips	C.V.	n	Mean (lbs.) Catch per Trip	C.V.
Aku (S1)	197.6	10.4	334	5.9	7.8	334	34.4	5.8	237.2	11.4	276	5.5	6.6	276	45.8	8.2
Ahi (S2)	867.7	14.0	335	4.9	7.5	335	142.0	9.9	609.3	17.3	271	4.8	7.4	261	106.7	6.4
Mahimahi (S3)	502.9	13.5	332	8.6	8.9	332	41.2	3.8	677.0	16.7	282	8.5	9.2	282	44.8	5.4
Blue Marlin (S4)	542.5	10.6	177	2.4	9.7	177	225.1	4.7	690.3	10.4	158	3.0	9.5	158	15.8	3.9
Marlin (Misc) (S5)	305.6	11.3	253	4.2	9.1	253	67.8	5.0	235.4	12.0	166	3.4	8.1	166	63.8	4.9
Opakapaka (S6)	828.0	34.5	140	4.7	13.8	140	105.5	24.3	1454.7	26.6	148	7.1	10.3	148	163.2	26.3
Ehu (S7)	170.6	35.3	105	4.5	4.2	105	22.4	15.1	187.0	24.8	100	5.2	12.7	100	34.0	21.4
Opelu (S8)	950.6	26.2	84	11.3	19.7	84	48.4	8.8	780.9	22.6	79	11.3	17.9	79	46.6	22.4
Others (S9)	983.5	25.7	473	8.4	7.1	473	122.3	44.4	2019.6	26.3	405	9.6	9.1	405	290.6	35.0

n = number of licenses
Successful = caught this species on this trip
NOTE: CATCH is the annual catch per license holder. Mean (lbs.) is averaged overall trips by all license holders.

Three gear types were evaluated with respect to catch and effort: deep sea handline (3), in-shore hand line (4) and trolling (6). These three gear types or methods comprised 92 percent of the fishing effort by license holders during 1983 and 1984. The error associated with the estimates of catch, effort (trips) and catch per unit effort (CPUE), or catch per trip (CPT), were generally higher for gear types 3 and 4 than for gear type 6. This is mainly attributable to the differences in sample size (Table 5) on which the estimates are based. Mean catch has a higher error than effort (trips) or catch per trip (CPT) for each gear type. Also, gear type 3 is less reliable than types 4 and 6 for mean catch and mean catch per trip (CPT).

In order to correct for the high error (C.V. > 20 percent) associated with the mean catch for gear type 3, the data for both years was pooled.* Thus, assuming that the samples in the two years are independent, the average catch and its C.V. pooled over the two years is:

Mean Catch = 1655 lbs.

C.V. (mean catch) = 16.62 which is considerably less than the C.V. for the individual years (23.3, 1983; 23.1, 1984).

Similarly, the catch per trip (CPT) for gear type 3 pooled mean is estimated at 178.8 lbs. and its C.V. is 15.2 percent, substantially less than the estimates of 17.9 percent and 22.8 percent for 1983 and 1984 respectively.

*A technique commonly used where the variance of estimates is high is that of combining estimates from more than one year. Since two years of data were available (1983 and 1984) THEY WERE COMBINED OR (POOLED) GIVING a larger sample size and resulting in a lower variance (CV). This approach might be considered useful in future studies where the sample size for a single year may not be adequate to produce reliable estimates of some gear types or species.

5. ESTIMATES OF MEAN CATCH (LBS.), TRIPS, CATCH PER TRIP AND THEIR C.V.'S IN PERCENT FOR ALL PORTS OF OAHU** AND SPECIES* AND BY GEAR TYPES FOR 1983 AND 1984 FISCAL YEARS

SOURCE: HDAR

Gear Type Code	1983 Catch n	1983 Catch Mean (lbs)	1983 Catch C.V.	1983 Trips Mean	1983 Trips C.V.	1983 Catch Per Trip Mean (lbs)	1983 Catch Per Trip C.V.	1984 Catch n	1984 Catch Mean (lbs)	1984 Catch C.V.	1984 Trips Mean	1984 Trips C.V.	1984 Catch Per Trip Mean (lbs)	1984 Catch Per Trip C.V.
3	215	1374.6	23.3	7.1	10.3	150.7	17.9	205	1935.5	23.1	8.5	9.2	206.9	22.8
4	176	803.4	19.7	10.3	13.8	51.7	5.8	118	774.9	18.3	13.9	14.7	36.9	8.5
6	448	1526.5	11.0	14.5	6.5	85.6	6.4	387	1582.8	11.7	13.2	6.7	90.6	5.8

Gear Type Code	1983/84 Combined (Pooled) Catch n	Catch Mean (lbs)	Catch C.V.	Trips Mean	Trips C.V.	Catch Per Trip Mean (lbs)	Catch Per Trip C.V.
3	420	1655	16.62	9.26	-	178.8	15.2

1. *2 through 707)
) See Table 1 for Codes
2. **501 to 599)

3. n = number of licenses

Pooling data over time (e.g. years) and/or location is also recommended; i.e., for individual species where the estimates for individual years and/or landings at specific locations fluctuate widely. The C.V. of total catch, all trips, port and gear type show that estimates of catch per trip (CPT) are more reliable for a port for gear types 4 and 6 than estimates of mean trip and mean catch (Table 6). The estimates were more stable within each port for gear type 6, especially for mean trips.

As expected, mean catch (lbs.) varied considerably among ports and gear types, compared to trips and catch per trip. In order to obtain reliable estimates of mean catch, the estimates should either be pooled over ports or years or both. Pooled estimates allow the pooling of sample, which in turn increases the sample size and consequently improves the reliability of the estimates.

A comparison of the estimates of mean catch, effort (trips) and catch per trip (CPT) averaged over all ports, all trips (successful and unsuccessful), all gear types (except 1 and 2) show that both mean catch and trips for the species listed were significantly higher on weekdays (Table 7). The catch per trip was also generally higher though the difference was not significant. The results were consistent for both 1983 and 1984. Mean catch on weekdays was subject to greater error than on weekends though mean trips was estimated with about the same accuracy. Estimates of catch per trip (or unit effort) for some species on weekends were subject to greater error (than on weekdays) and less for some others.

Based upon a review of NMFS studies and other pretest and pilot intercept schemes described in subsequent sections of this report, recreational fishermen have more trips and larger catches on weekends than on weekdays. This is the opposite of commercial fishermen. Commercial fishermen also have larger catches

per trip than recreational fishermen. While zero catch data are not included in the above commercial data, when including zero catch data the catch per trip is reduced for commercial fishermen yet remains higher than for recreational fishermen. (Compare HDAR and MRFSS data in Tables 7 and 8-10)