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Hawaii Marine Recreational Fishing Survey: A Summary of Current Sampling, Estimation, and Data Analyses

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National Oceanic and Atmospheric Administration
U.S. Department of Commerce

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Hawaii Marine Recreational Fishing Survey: A Summary of Current Sampling, Estimation, and Data Analyses

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EXECUTIVE SUMMARY

Hawaii is the only U.S.-associated island area (state) in the NOAA Pacific Islands Region that currently participates in recreational fishing surveys under the NOAA Fisheries Marine Recreational Information Program (MRIP), formerly known as Marine Recreational Fisheries Statistics Survey (MRFSS). The on-site interviews (for catch rate) of the Hawaii Marine Recreational Fishing Survey (HMRFS) are conducted by the Hawaii Division of Aquatic Resources while the telephone survey for fishing effort in Hawaii is currently conducted by a Hawaii contractor and is managed by a mainland company. For a MRIP project in 2010, the HMRFS protocol and data were evaluated to determine whether the new MRIP methods for catch-rate estimation could be directly applied to HMRFS. More recently, MRIP statistical consultants were contracted to review the current HMRFS sampling design and evaluate alternative survey options. After the review, the same consultants worked with the Hawaii project team to design and test alternative shore-fishing surveys for HMRFS. Several recent MRIP project reports included key findings and recommendations for HMRFS. In addition to discussing the major recommendations from previous/ongoing MRIP projects, this manuscript covers HMRFS sampling, estimation algorithm, catch/effort estimates, and data analyses. At the beginning of this contribution, the sampling design and expansion procedures were described. Major pelagic species were used to demonstrate how catch-and-effort estimates are calculated from HMRFS data. The authors then presented Hawaii-specific information from HMRFS data and provided comparisons and analyses. To conclude, the caveats in HMRFS catch estimates were discussed and recent efforts to improve HMRFS sampling procedures were highlighted.

CONTENTS

INTRODUCTION

The Hawaii Marine Recreational Fishing Survey (HMRFS) follows a survey design that was re-initiated in Hawaii in 2001 after a 20-year hiatus from the NOAA Fisheries Marine Recreational Fisheries Statistics Survey (MRFSS). The HMRFS surveys consist of an on-site access point angler intercept survey (APAIS) for catch rate and a coastal household telephone survey (CHTS) for fishing effort. The on-site intercept surveys in Hawaii are conducted and managed by the State of Hawaii's Division of Aquatic Resources. The coastal household telephone survey in Hawaii is currently conducted by a local contractor and managed by a mainland company that also runs the CHTS for the Atlantic costal states.

The CHTS utilizes a computer-assisted, random digit dialing (RDD) approach to contact residential households. The respondents are asked to recall all marine recreational fishing trips made during the 60 days prior to the interview. The critical data elements of the telephone survey include household information (participation and number of anglers), angler information (number of fishing trips), and detailed trip information. The APAIS consists of on-site interviews. Fishers are intercepted upon returning from a boat fishing trip or completing a period of shore fishing. The interviews gather catch and demographic data including angler information (e.g., state and county of residence, type of fishermen, number of fishing trips taken in the past 2 months and past 12 months), trip information (e.g., fishing from shore vs. boat, fishing method/gear type, fishing area), and catch information (species caught, catch observed by the interviewer, angler-reported catch, catch disposition, and weight and/or length measurements from the observed catch).

A MRFSS review by the National Research Council (NRC) provided recommendations for improving MRFSS intercept and telephone surveys (NRC 2006). One of the MRIP's primary responses to the NRC's recommendations was to develop an alternative method for estimating catch from the available data (Breidt et al., 2011). In response to the NRC recommendations for improving the fishing effort survey, NOAA Fisheries also developed the National Saltwater Angler Registry (NSAR) to provide a more efficient sampling frame. Most U.S. coastal states (and U.S. territories, commonwealths, etc.) have applied for an exemption to the NSAR based on pre-existing angler registries, newly created licensing programs or other alternative databases.

The State of Hawaii currently does not require a saltwater fishing license or registration for most recreational fishermen. Only commercial fishers, defined as those who sell any part of their catch, are required to obtain a license and report their catch and effort. Hawaii has a Federal permit requirement for non-commercial bottom fishing, but this affects only a small number of fishers. As a result, Hawaii is now the only state where recreational fishermen fishing in Federal waters are required to register with the NSAR. Although NSAR was designed to register anglers catching ocean fish that traveled from Federal waters through state waters to breed in fresh water (anadromous fish), Hawaii's shoreline and boat-based fishers that fish solely within 3 miles of shore are not required to register with the NSAR since there are no anadromous fish in Hawaii. Therefore, the NSAR from Hawaii is a very incomplete sampling frame for boat-based fishing effort surveys. This registry does not include anglers who fish solely from the shoreline or who fish solely within 3 miles, which is a substantial number of people.

The Hawaii MRIP project team recently worked on several MRIP projects (Ma et al., 2011a, b; Breit et al., 2012; Ma et al., 2013a; Ma et al., 2014; Ogawa and Ma ,2014; Ma and Ogawa, 2015) to identify issues with current HMRFS data collection and estimation procedures and to evaluate/develop alternative options. Ma et al. (2011b) evaluated the HMRFS protocols and data to determine whether the new MRIP estimation methodology could be directly applied to HMRFS data sets. The focus of that project was to assess the sampling procedures for HMRFS, including a review of the survey sampling frame (based on a site register, with information on fishing pressure), sample draw, and other files essential to the alternative estimation methods. More recently, MRIP statistical consultants reviewed the current HMRFS survey design and assessed possible improvement options (Breidt et al., 2012, Ma et al., 2013a). The key findings and recommendations from the review covered 1) historical data and metadata from HMRFS, 2) a private (not chartered) boat effort survey based on a boat registry, and 3) a pilot study to obtain on-site effort estimates for shore fishing. After the review, the same consultants worked with the Hawaii MRIP project team to design and test alternative shoreline fishing effort surveys for HMRFS (Ma et al., 2014; Ogawa and Ma, 2014). A current project focuses on modifying the survey design of onsite interviews of private boat fishers (Ma and Ogawa, 2015).

In this manuscript, the authors described the current HMRFS sampling and estimation process and presented catch-and-effort estimates using pelagic species as an example. To add local value to this manuscript, we also analyzed the Hawaii-specific information in the APAIS and CHTS data. Key recommendations from completed MRIP projects were also briefly discussed.

HMRFS Sampling and Estimation

The data collection in HMRFS consists of 2 independent and complementary surveys: a telephone survey of households (CHTS) and an intercept survey of anglers (APAIS) at sites with access to fishing. The random digital dialing (RDD) sampling of the telephone survey works with groups of phone numbers organized into blocks. Only blocks that have a least one working phone number are retained (Lai and Foster, 2008). Within an area code, each block consists of the first 5 digits of a 7 digit telephone number (e.g., 808-xxx-xx00 for Hawaii).

Within each state, sampling effort is stratified by coastal counties. The telephone household surveys are carried out in 2-week periods starting from the last week of a 2-month period (i.e., wave) and continuing in the first week of the following wave. The sampling is stratified by county, but cannot be stratified by fishing mode in advance. The data collected in the telephone survey include household information, angler information, and trip information such as fishing mode (shore fishing vs. boat), fishing methods/gears, state/county of trip, date of fishing trip, and time of return. Each angler in a household is asked to profile fishing trips in the last 60 days. Proxy data consisting of information obtained from someone in the fishing household other than the angler is allowed under certain circumstances. Examples of allowed proxy data include: 1) household group trips for individual fishers' trips; 2) an adult's description of a child's fishing trips; 3) information from other household members because of language barriers or extended travel (away from the household) of the fishers.

The intercept survey collects angler, trip, and catch information via in-person interviews with fishers at accessible locations (shoreline, boat ramp, etc.). The targeted population of the intercept survey is specified by wave (wave 1 = January–February, wave 2 = March–April, wave

3 = May–June, wave 4 = July–August, wave 5 = September–October, wave 6 = November–December), state, and fishing mode. The fishing mode is defined as being either from 1) shore, 2) a private boat or 3) a for-hire (charter) boat. For each fishing mode, the sampling frame is a matrix of sites associated with site-specific fishing pressure categories (ranges of the expected number of angler trips during week days or weekend days at each site) and calendar days. The sampling frame is stratified by month and county. For each mode, site-day is a primary sampling unit (PSU) within a sampled stratum. Site-days are sampled with probability proportional to the expected number of angler trips. Within a selected PSU, the ultimate sampling unit is an individual angler-trip. After a PSU is selected, the secondary and/or tertiary sampling units are selected with equal probability (without replacement) when they cannot be completely included for interviews.

Data from the telephone survey (CHTS) is used to estimate mean number of trips per household during each wave ($\bar{t}_m$) by fishing mode (Fig. 1). The mean number of trips per household ($\bar{t}_m$) is a weighted mean from all coastal counties, based on individual county means ($\bar{t}_{cm}$) weighted by proportions of households (with landline telephones) in each county (w_c). The mean number of trips per household ($\bar{t}_m$) is multiplied by the total number of permanent households with landline telephones in all coastal counties (θ) to estimate total number of fishing trips in a state (Fig 1). The state-level trip estimate ($T_{1wt,m}$) is then adjusted for the households not covered by the sampling frame (e.g.,, households without a telephone $T_{wot,m}$, non-coastal households T_{2m}, and out-of-state households T_{3m}, see Fig. 1). Finally, these fishing trips are partitioned to trips in different fishing areas including inland (bays, estuaries, and sounds), ocean 3 miles or less from shore, and ocean more than 3 miles from shore. The partition is based on the proportions (a_{ma}) of intercepted trips in different fishing areas from the onsite intercept survey. The ratio of angler trips from resident households with no land-line telephone to those with a land-line (the expansion factor, r_m) is treated as a measurement without uncertainties.

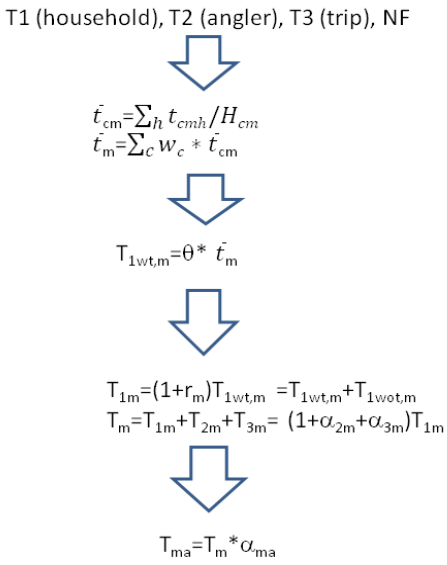

Figure 1.--Major steps of fishing trip expansion using CHTS data. T1–T3 and NF are the household, angler, trip, and non-fishing household date files from the telephone survey. Subscripts c, m, and h are for county, fishing mode, and household. H_{cm} is the number of interviewed households by county and t_{cmh} is the number of angler trips (by county and fishing mode) from individual households. θ (= $\Sigma\theta_c$) is the number of households with landline telephones in a state and $w_c = \theta_c/\theta$ are the ratios of households from each county to the state total.

The variances of the key effort estimates are calculated as (Lai and Foster, 2008; Lai, pers. comm.):

$$V(\bar{t}_{cm})=\frac{\sum_h(t_{cmh}-\bar{t}_{cm})^2}{H_{cm}(H_{cm}-1)}$$

$$V(\bar{t}_m)=\Sigma_c W_c^2\, V(\bar{t}_{cm})$$

$$V(T_{1,m}) = (1+r_m)^2\theta^2 V(\bar{t}_m)$$

$V(T_m) = T_{1m}^2 V(P_{1m}^{-1}) + P_{1m}^{-2}V(T_{1m}) - V(P_{1m}^{-1})V(T_{1m})$ where $P_{1m}^{-1} = 1+\alpha_{2m}+\alpha_{3m}$ and $T_m = (1+\alpha_{2m}+\alpha_{3m})T_{1m}$

$$V(T_{ma}) = \alpha_{ma}^2 V(T_m) + T_m^2 V(\alpha_{ma}) - V(T_m)V(\alpha_{ma})$$

The variance estimates for T_m and T_{ma} are based on Goodman's method (1960) for estimating the variance of products, and the product of variances (last term in the equations) carries a negative sign.

Table 1.--Symbol definitions for variables used for catch-and-effort estimation.

α_{ma} =	Proportion of mode specific fishing trips in different fishing areas
α_{2m} =	Ratio of fishing trips from non-coastal households to those from the coastal households in a state
α_{3m} =	Ratio of fishing trips from out-of-state anglers to the coastal county anglers in a state
θ_c =	Households with landline telephones in a county
θ =	Total households with landline telephones in a state
A =	Harvest inspected by the surveyors during onsite interviews
B1 =	Harvest reported by fishermen and not examined by the surveyors
B2 =	Estimated fish released alive
H_{cm} =	Number of surveyed households by county
K_{ma} =	Total number of fishing groups surveyed in a mode and fishing area combination
n_{ma} =	Number of onsite interviews in a mode and fishing area combination
P_{1m} =	Proportion of onsite interviews from costal households within a state to the total onsite interviews
r_m =	Ratio of fishing trips from households without landline telephones to those with landline telephones
S_{yx} =	Covariance between two variables *y* and *x*
S_x^2 S_y^2 =	Variance of *X* or *Y*
t_{cmh} =	Number of mode specific fishing trips in household *h* and county *c*
$\bar{t}_{cm}$ =	Mean number of fishing trips in mode *m* per household in county *c*
$\bar{t}_m$ =	Weighted mean number of trips (in mode *m*) per household in a state
T_{1wtm} =	Expanded number of fishing trips from costal households with landline telephones
T_{1wotm} =	Expanded number of fishing trips from costal households without landline telephones
T_{1m} =	Expanded number of fishing trips (by mode) from coastal households in a state
T_{2m} =	Expanded number of fishing trips from non-coastal households within a state
T_{3m} =	Expanded number of fishing trips from out-of-state anglers
T_m =	Sum of T_{1m}, T_{2m}, and T_{3m}
T_{ma} =	Estimated number of fishing trips in a specific mode and fishing area combination
W_c =	Ratio of households with landline telephones in a county to the total households with landline telephones in the state
x_{mak} =	Number of contributing angler trips in a group *k*
Y_{maj} =	Number of fish in mode *m* and area a for species *j*
Y_{maji} =	Number of fish in mode *m* and area a for species *j* by angler *i*
y_{majk} =	Number of fish in mode *m* and area a for species *j* by angler group *k*

The onsite intercept survey design is based on stratified multi-stage cluster sampling with unequal selection probability for site-days within a targeted population. In the MRFSS estimation method (used in HMRFS), the interviewed angler trips are treated as a simple random selection without replacement. The average number of fish caught per trip in a particular fishing mode and area combination (estimation domain) is estimated by the total number of fish and trips intercepted in the domain. Type A catch is the harvested fish inspected by the interviewer. Type B1 catch is the harvested fish reported by fisherman during the survey, but not examined by the interviewer. B2 is the fish released alive. Type A catch can include catch from a group of fishers, but type B catch records can only be from individual fishers only. The catch per unit effort (CPUE = average number of fish per angler trip) for type B catch is calculated as:

$$\bar{y}_{maj} = \sum_i y_{maji}/n_{ma}$$

$$V(\bar{y}_{maj}) = \frac{1}{n_{ma}} \sum_i ((y_{maij} - \bar{y}_{maj})^2/(n_{ma} - 1))$$

where y_{maij} is the number of fish in mode m and area a for species *j*, from a particular trip *i*. n_{ma} is the number of angler trips in mode m and area a.

The CPUE for type A catch is estimated as (Lai and Foster, 2008):

$$\bar{y}_{maj} = \frac{\sum_k y_{majk}}{\sum_k x_{mak}} = \frac{\sum_k y_{majk}/K_{ma}}{\sum_k x_{mak}/K_{ma}} = \frac{\overline{y'}_{maj}}{\overline{x'}_{ma}}$$

$$V(\bar{y}_{maj}) = \frac{1}{K_{ma}\overline{x'}^2_{ma}} (s_y^2 + \bar{y}^2_{maj} s_x^2 - 2\bar{y}_{maj} s_{yx})$$

where y_{majk} is the number of fish in mode m and area a for species j in fishing group k. X_{mak} is the number of contributed angler trips in a group and K_{ma} is the total number of fishing groups. s_y^2 and s_x^2 are the variance of y and x, respectively. s_{yx} is the covariance between y and x. For an estimator $\theta = Y_1/Y_2$, the variance $V(\theta) = \theta^2(\sigma_{11}/Y_1^2 + \sigma_{22}/Y_2^2 - 2\sigma_{12}/(Y_1Y_2))$ (page 234, Wolter, 2010). σ_{11}, σ_{22} are the variances of Y_1 and Y_2, and σ_{12} is the covariance between Y_1 and Y_2.

The mean catch per trip of a given species (base on onsite interview data) is multiplied by the estimated number of trips in a domain (based on CHTS data), producing an estimate of the total number of each species caught ($\bar{y}_{maj} * T_{ma}$), for each estimation domain (fishing mode and area combinations in a wave). Catch and catch rate estimates are mode-, area-, and species-specific, while the effort estimates are mode- and area-specific. The mean weight by species and domain is multiplied by the estimated number of fish to estimate the total weight of the catch for each species in a domain. Length-and-weight data can only be obtained from fish that are examined by the interviewer (type A catch). It is assumed that the mean weight of type B1 catch is the same as that of type A catch.

MATERIALS AND METHODS

Methods for Data Summary and Data Analysis

Catch-and-Effort Estimates

The duration over which a catch or fishing effort estimate is made in HMRFS is a 2-month period (wave). The effort estimate provides the number of angler trips. The catch rate and catch can be estimated for all species encountered in intercept surveys. However, these estimates are more precise for species encountered more frequently. This report presents catch estimates for major pelagic species as an example.

The data files of catch and effort estimates for 2004–2012 were downloaded from NOAA Fisheries Office of Science and Technology website.[1] The files for 2003 were downloaded from a different directory of the website.[2]. A correction factor of 1/1.22 was applied to the 2003–2010 estimates of catch and effort to compensate for an error in the population household count for Maui County that was identified in 2010 (Ma, 2013). This error affected the effort estimates for years prior to 2011. No adjustment was needed for 2011 and 2012 catch and effort estimates.

For some species, there were no weight measurements in some waves and mean weight estimation was not available. The catch weight was left as missing in these waves for the catch number estimates in the data file that lacked corresponding weight measurements. For catch weight summary in this manuscript, the weight estimates for these estimated fish numbers were substituted by using average weight from other waves in the same year. If there were no weight estimates for a whole year, the mean weight from the previous year (or the closest year) was used as a proxy (see Ma, 2012; Ma, 2013).

Analyses of Fishing Method and Fishermen Types

The Hawaii on-site and telephone survey forms contain questions regarding Hawaii-specific fishing methods and fishermen categories. Such Hawaii-specific information has not yet been used in HMRFS catch and effort estimation. Those fishing methods and fishermen types were analyzed for CHTS data and on-site survey data in 2003–2010 for the private or rental boat fishing trips. The CHTS data was downloaded from NOAA Fisheries Office of Science and Technology website.[3]. Only trips within Hawaii by Hawaii residents were included in the CHTS data set for the fishing method and fishermen type analyses. More than 99% of the trips by Hawaii residents were within the state. For onsite survey data, the compiled raw data (up to 2010) from the Hawaii Division of Aquatic Resources (HDAR) was used since the data archived at the NOAA Fisheries website did not retain all Hawaii specific information. Data from the telephone survey and onsite survey during the same period (2003–2010) was used for comparisons.

[1] **http://www.st.nmfs.noaa.gov/st1/recreational/MRIP_Estimate_Data/SAS/**
[2] **http://www.st.nmfs.noaa.gov/st1/recreational/MRFSS_Estimate_Data/Atlantic_Gulf/SAS/**
[3] **http://www.st.nmfs.noaa.gov/st1/recreational/MRFSS_Survey_Data/Telephone/SAS/**

The choices for fishing methods in the CHTS questionnaire include trolling, handlining, bottomfishing, casting, netting, spearfishing, other, do not know, and refusal. The CHTS follow-up questions classify handlining as tuna handlining, deep-water bottomfishing, shallow-water bottomfishing, and other (Table 2). Deep-water bottomfishing and shallow-water bottomfishing under handlining were regrouped as bottomfishing for the analysis in the report. After regrouping, the fishing method "handlining" covers mainly tuna handlining. Ma et al. (2011b) analyzed the raw telephone survey data (provided by NMFS staff) for 2001–2010 for the proportions of different methods. The processed telephone survey data archived at the NMFS website was used in this paper.

Table 2.--Type of gears and fishing methods asked in onsite and telephone surveys.

CHTS (fishing methods)	**Intercept (gears and methods)**	**Intercept (follow-up)**
01 Trolling	01 Rod & reel[♣]	[♣] For 01 Rod & reel
02 Handlining[*]	02 Handline[§]	1 Trolling
03 Bottomfishing[+]	03 Hand pole	2 Casting
04 Casting	04 Scoop net	3 Bottomfishing
05 Netting	05 Throw net	4 Handlining
06 Spearfishing	06 Gill net	[§] For handline or bottomfishing
07 Other	07 Cross net	1 Shallow water (< 20 fathoms)
[*]**For 02 Handlining**	08 Hukilau	2 Deep water (> 20 fathoms)
1 Tuna handlining	09 Surround net	3 Tuna handlining (Handline)
2 Deep-water bottomfishing	10 Trawl	
3 Shallow-water bottomfishing	11 Trap	
4 Other	12 Spear	
[+]**For 03 Bottomfishing**	13 Hand	
1 Deep-water bottomfishing	14 Crab net	
2 Shallow-water bottomfishing	Other (specify)	
3 Both deep and shallow	98 Unknown	
4 Other	99 Refused	

The type of gears listed on the onsite survey form are rod and reel, hand line, hand pole, scoop net, throw net, gill net, cross net, hukilau net, surround net, trawl, trap, spear, hand, crab net, other, unknown, and refusal (Table 2). Fishing methods included under the gear type "rod and reel" are trolling, casting, bottomfishing, and handlining. Under gear type "handline", or with bottomfishing and handlining under gear type "rod and reel", the follow-up question is whether fishing was shallow water bottomfishing, deep-water bottomfishing, or tuna handlining when a handline was used. To form a consistent classification of fishing methods, bottomfishing and handlining were grouped the same as for the CHTS data. The fishing method "netting" included all net gears (i.e., scoop net, throw net, gill net, cross net, hukilau net, surround net). Gear "spear" was considered to be spearfishing while diving. The fishing method categories used for analyses in this paper include trolling, bottomfishing, spearfishing, handlining (for tuna handlining), netting, casting, and other.

For both CHTS and APAIS data, the fishermen who never sell any of their catch were classified as "pure recreational" fishermen. Those who sometime sell fish to help cover fishing expenses were classified as "recreational expense" fishermen. Commercial fishermen that sell fish for

profit to pay living expenses were classified as "part-time commercial" fishermen if they did not consider themselves to be full-time commercial fishermen.

RESULTS

Catch Estimates For Major Pelagic Species In 2003–2012

The estimated annual harvest in number of fish (type A + B1) is shown in Figure 2 for six major pelagic species including blue marlin, mahimahi (dolphin fish), skipjack tuna, striped marlin, wahoo, and yellowfin tuna. A is for observed catch (observed by the surveyors) and B1 is for reported catch (unavailable for the surveyors to examine and reported by fishermen). HMRFS is a voluntary survey and fishermen can decline to participate in the survey or let the surveyors to examine the catch. The error bars in Figure 2 are represented by ± 1.96*square root of the variance for catch estimate and the error bars are equivalent to 95% confidence intervals (CIs) for normal distributions. The revised estimates (using the MRIP new estimation algorithm) for Atlantic and Gulf states indicate that the error bars are generally wider than with the previous estimation method (Breidt et al., 2011).

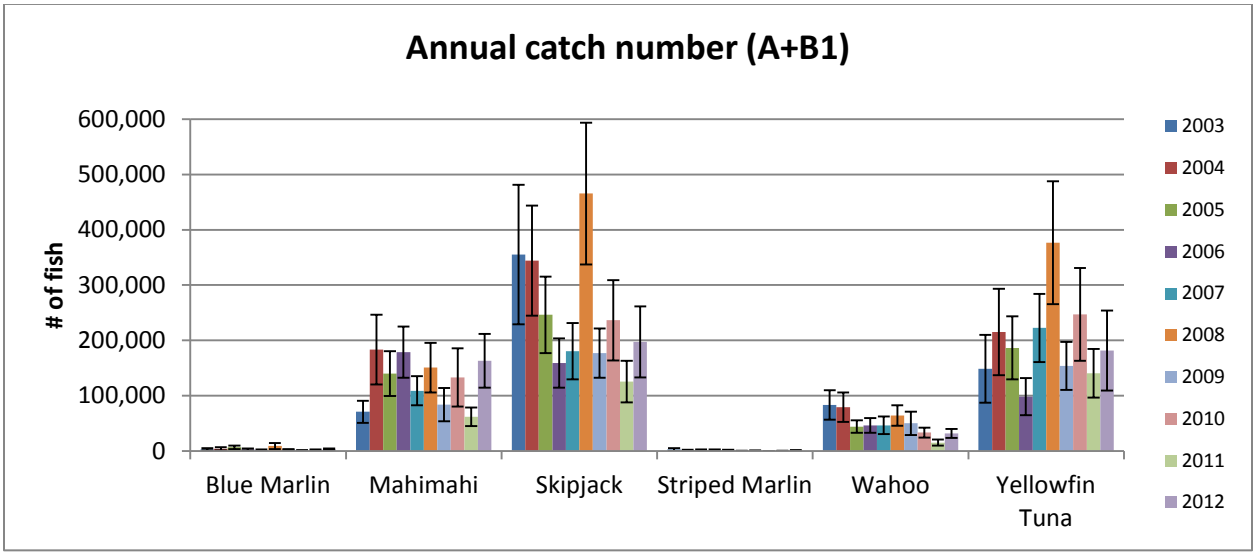

Figure 2.--Catch number estimates for six major pelagic species in 2003–2012. Black vertical bars are for ± 1.96 * $\sqrt[2]{variance\ of\ catch\ estimate}$. The variance of catch estimate comes from the variance of catch rate estimate and the variance of fishing effort estimate. A is for observed catch and B1 for reported catch (A and B1 are exclusive).

The catch weight estimates are shown in Figure 3. The error bars are not included. However, the error bars for catch weight estimates would be larger (proportionally) than those for catch number estimates in Figure 2. The total variation in weight estimates includes variation in the catch number estimates and variation in the mean weight estimation (catch weight = number of fish caught × mean weight of a fish). The issues in acquiring accurate estimation of mean weight are covered later (see caveats in HMRFS catch estimates in the Discussion section).

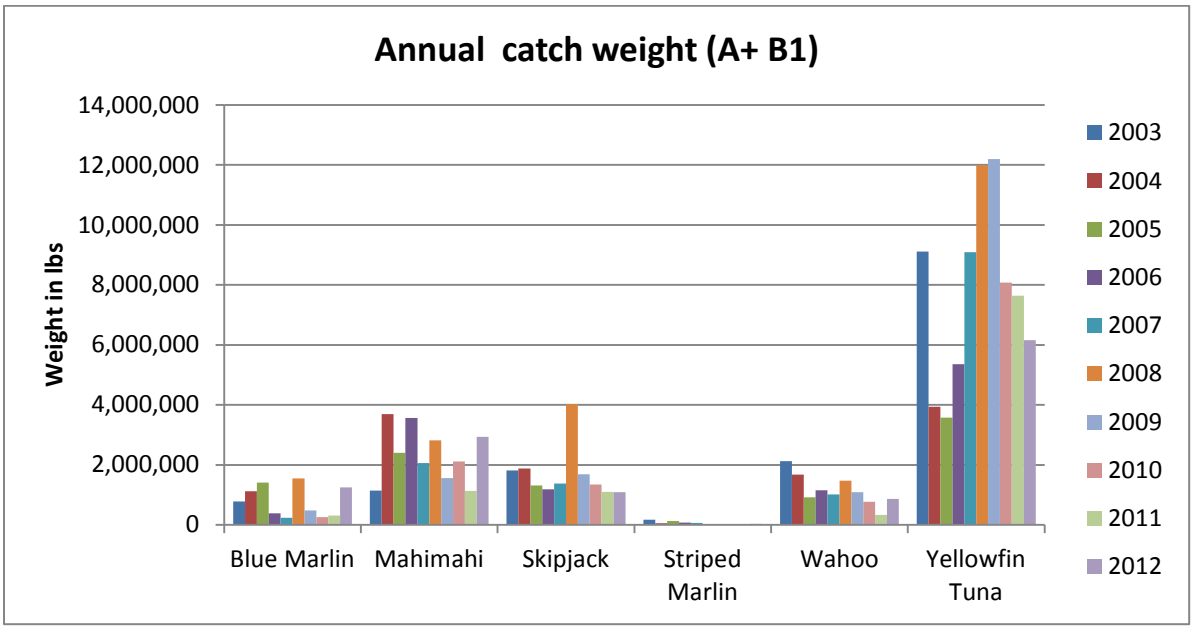

Figure 3.--Catch weight estimates for six major pelagic species in 2003–2012. A is for observed catch and B1 for reported catch (A and B1 are exclusive).

The mean weight estimates for blue marlin, striped marlin, and yellowfin tuna vary frequently from year to year while the mean weights for mahimahi and wahoo are more constant from year to year (Fig. 4). Variation is sometimes due to very small sample sizes, such as only one blue marlin weighted in 2012. In Figures 2 and 3, A is observed catch and B1 reported catch during the onsite interviews. The weight measurements can only be made for the observed catch because the reported catch B1 is not examined and verified by the surveyors. The mean weight from the observed catch is applied to both observed and reported catch in Figure 3. The fluctuations in catch number (among different years) and mean weight contribute to the fluctuation in catch weight estimates. For yellowfin tuna, the high catch weight in 2008 is due to a relatively high catch number. For 2009, the catch number estimate is modest but the catch weight estimate is highest due to a high mean weight.

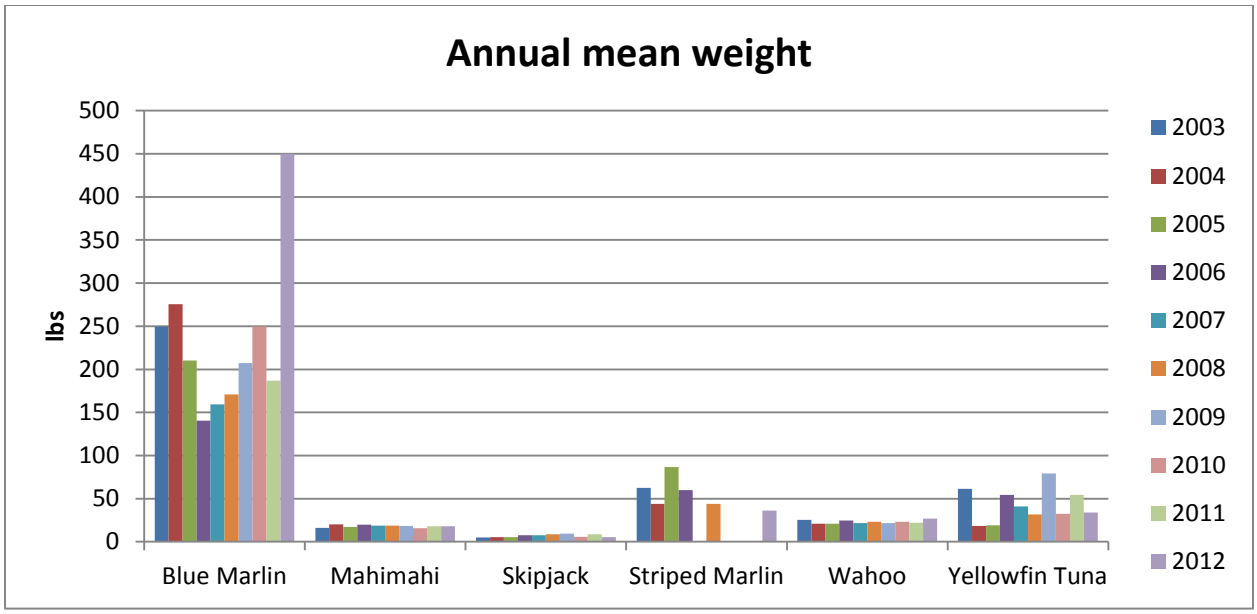

Figure 4.--Mean weight estimates for six pelagic species in 2003–2012. The mean weight of blue marlin in 2012 was the highest in 2003–2012, but there was only one weight measurement for blue marlin in 2012.

Effort Estimates for Private-Boat Fishing In 2003–2012

The catch estimates for pelagic species presented above were for private boats. Catch of pelagic species is less common for fishing from shoreline. For instance, only striped marlin (1163 pieces) was estimated from shore fishing in 2012 and there was no weight measurement for the species. In 2011, only mahimahi with a catch weight of 14,216 lbs was estimated for shore fishing. Current HMRFS does not include surveys of charter boats. Charter fishing trips and catch are required to be reported in the Hawaii commercial fishing report system (Ma et al., 2013b).

Figure 5 shows angler trips for private boat fishing from each wave in 2003–2012. The trip estimate in each wave fluctuates from year to year and the error bars (95% CIs for a normal distribution) are wide (Fig. 5). The fishing trips in Hawaii occur throughout the year, contrary to many continental U.S. coastal states that have relatively low fishing activity during the winter.

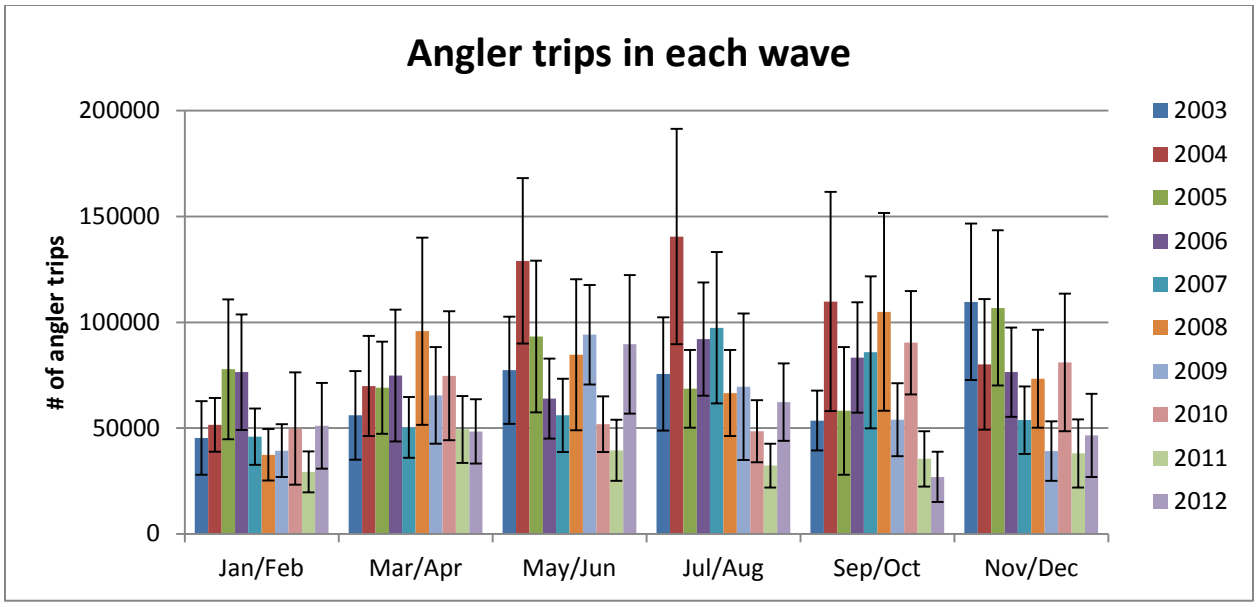

Figure 5.--Private boat fishing trip estimates (number of angler trips) by wave, 2003–2012. Black vertical bars are for $\pm 1.96 * \sqrt[2]{variance\ of\ trip\ estimate}$, and they are equivalent to 95% CIs if the distribution is normal.

The annual private boat fishing trip estimates have relatively narrower confidence intervals. The annual estimates are not significantly different among most years, except for 2004 and 2011. The estimate in 2011 is significantly lower than other years (Fig. 6).

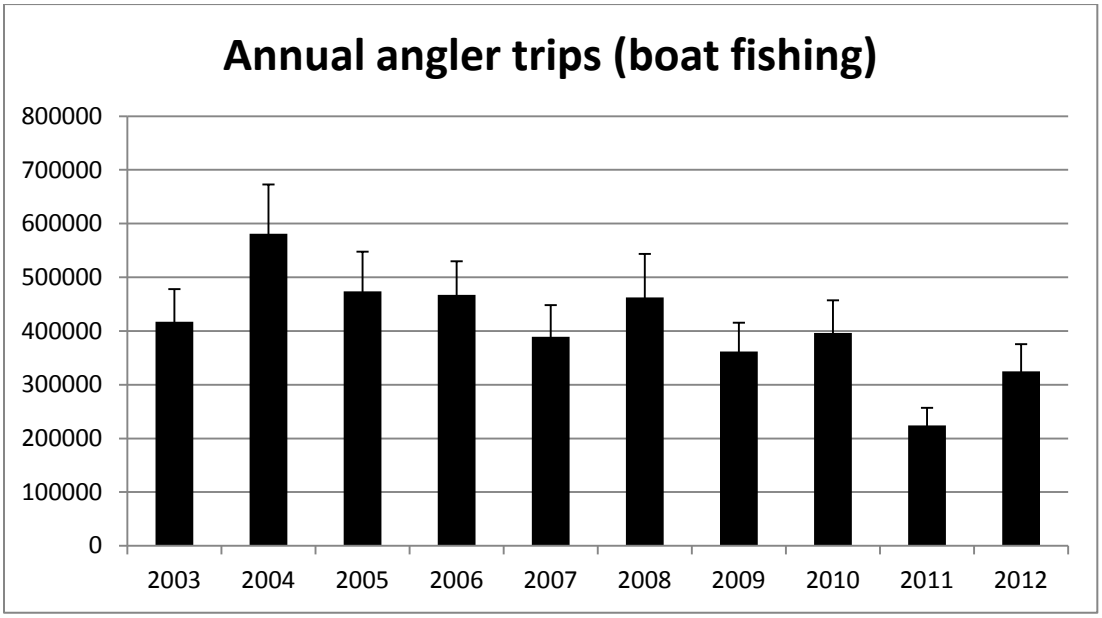

Figure 6.--Annual private boat fishing trip estimates in 2003–2012. Vertical bars are for $\pm 1.96 * \sqrt[2]{variance\ of\ trip\ estimate}$. The variance of the annual trip estimate is the sum of the variances in six-wave estimates.

Hawaii-specific Fishing Methods

Various fishing methods are used by private boat fishermen in Hawaii. Figures 7 (a–b) and Figures A1–A4 (Appendix A) summarize the percentage of each fishing method in the telephone survey data (2003–2010) for wave and county combinations. Trolling was the major fishing method. Seasonal changes in the proportion of trolling trips (out of all trip types) were not clear for most counties (Fig. 7 (a)). Next in percent occurrence was bottomfishing, where the proportions appeared low in the summer and higher in the winter (Fig. 7 (b)). Spear fishing and casting comprised smaller proportions of the trips but were present in all waves in all counties, comprising more than 10% in some waves. Handlining occurred more often in Hawaii. Netting had higher proportions in Maui and Kauai, with occurrence always less than 10%, and with no occurrence on some islands in some waves (Figs. A1–A4 in Appendix A).

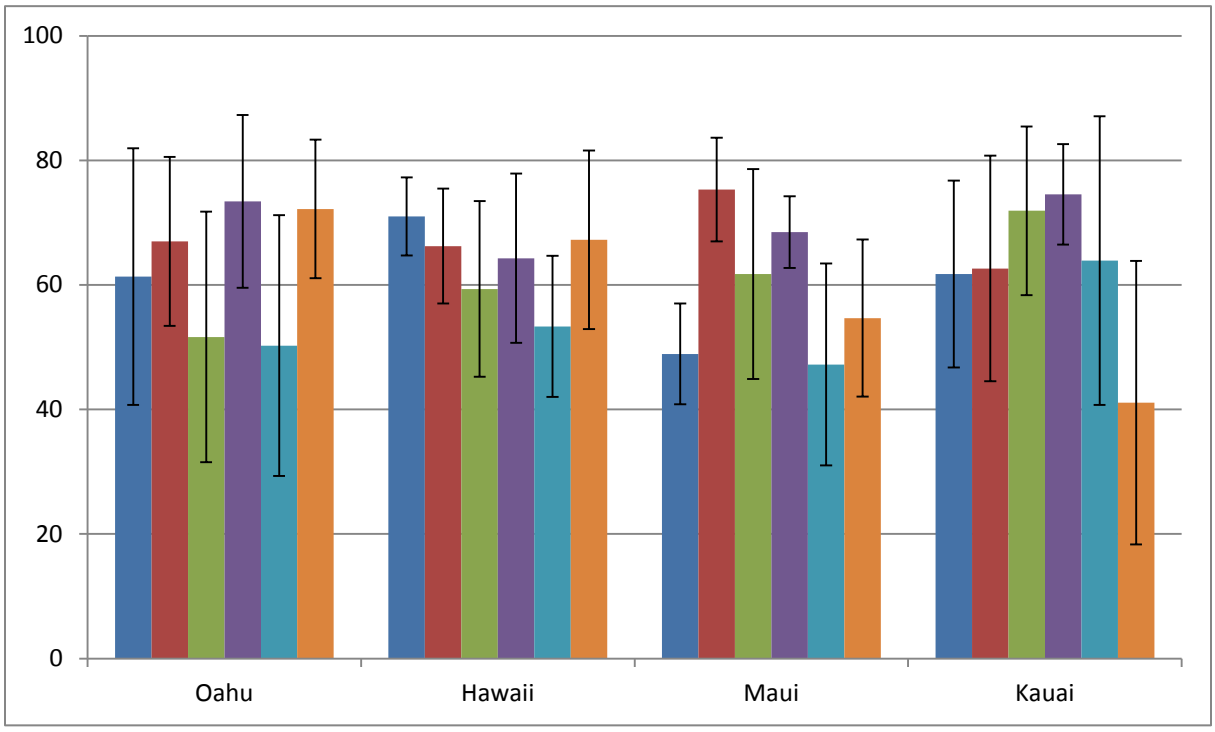

Figure 7 (a). --Percentage of occurrence of trolling trips in the telephone survey data by wave (six waves per year) and county (for years 2003–2010). The fishing methods include trolling, bottom fishing, spearfishing, handlining, netting, and casting. The error bars (±2*standard error (SE), SE = standard deviation/√n) show variation of proportion in a wave among n = 8 years (2003–2010).

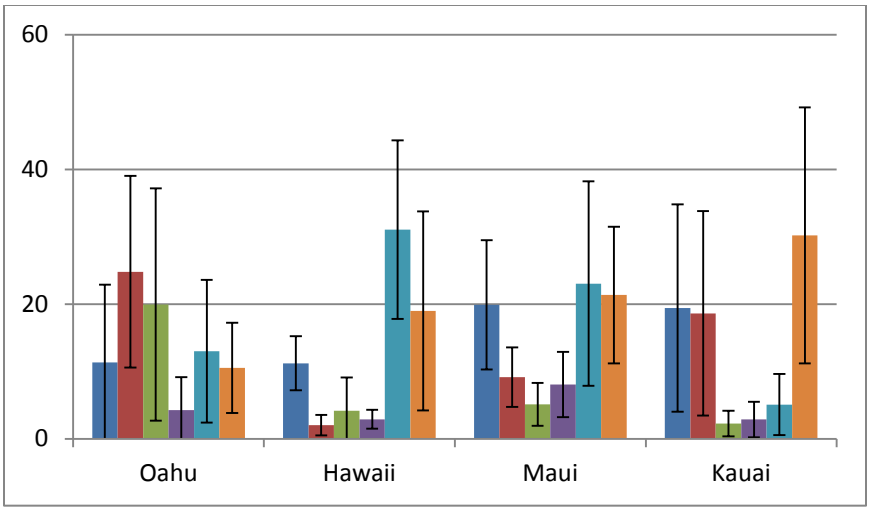

Figure 7 (b).--Percentage of occurrence of bottom fishing trips (by wave and county) in the telephone survey data.

The percentage of trolling trips accounted for > 70% of the total boat fishing trips interviewed onsite, except for Maui during non-summer waves (Fig. 8 (a)). On Maui, a significant proportion of the trips interviewed was from bottom fishing, especially during the winter (Fig. 8 (b)). A small proportion of trips intercepted onsite was from spearfishing, casting, and handlining (Figs. A5-A8 in Appendix A). Handlining trips were rarely interviewed except in Hawaii county. Otherwise, percentages of trips interviewed from handlining as well as from netting were very low (less than 2%).

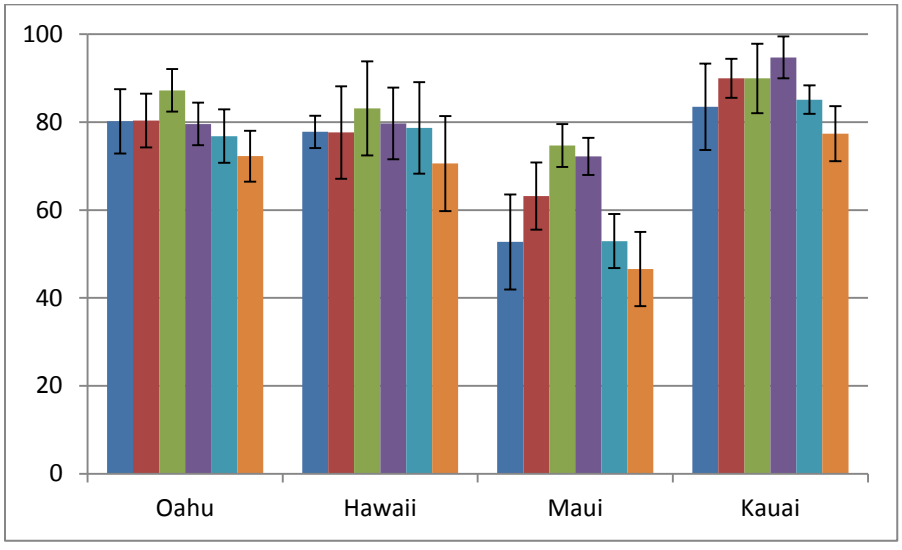

Figure 8 (a).--Percentage of occurrence of trolling trips in the onsite survey data by wave and county. The error bars (±2*standard error (SE), SE = standard deviation/√n) show variation of proportion in a wave among n = 8 years (2003–2010).

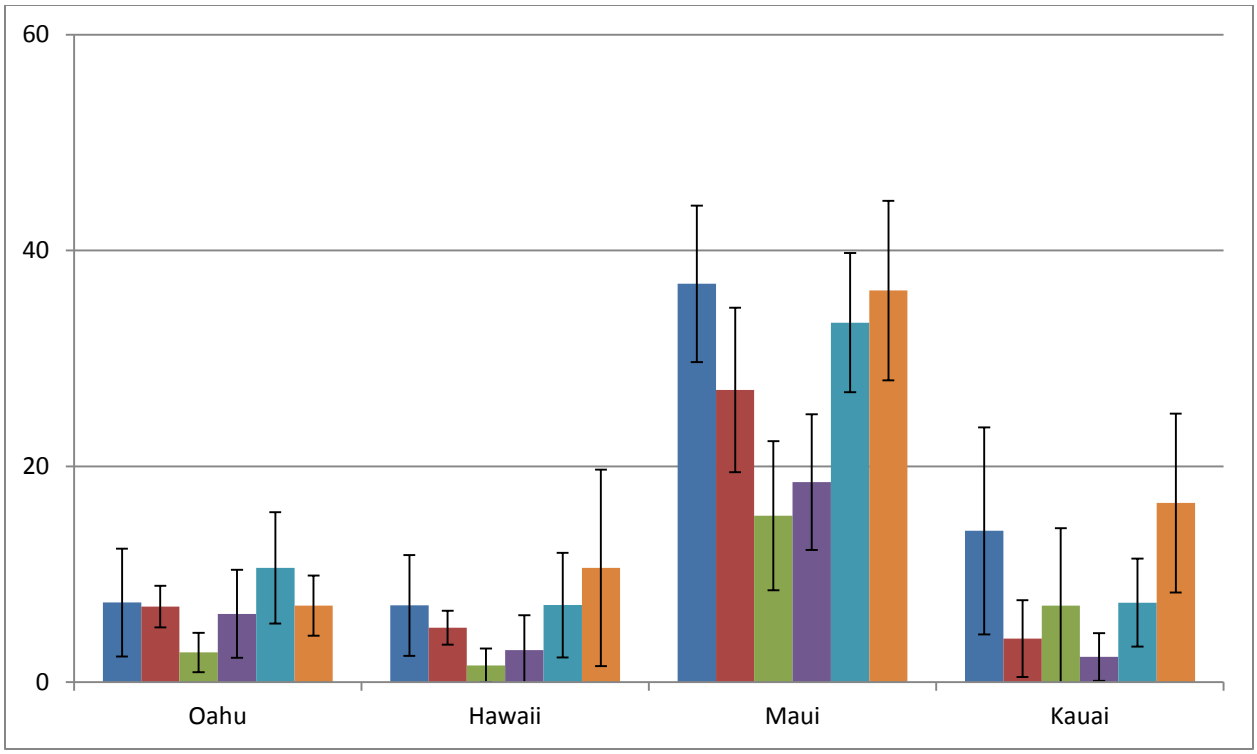

Figure 8 (b).--Percentage of occurrence of bottom fishing trips in the onsite survey data.

Fishermen Types

Another Hawaii specific question on the telephone and onsite surveys is fishermen types, differentiating between fishers who sell their catch and those who do not. In the telephone survey data, the trips from those not selling their catch (pure recreational) accounted for the majority of the total boat fishing trips (Fig. 9 (a)). The percentage of trips from fishermen who sometimes sell fish to help cover fishing expenses ranged from 13 to 36% (Fig. 9 (b)). The non-commercial trips from part-time commercial fishermen (who sell fish for profit to pay living expenses) were mostly < 5% of the trips from all fishermen categories in the telephone survey data and the non-commercial trips from full-time commercial fishermen were even less (Figs. A9–A10 in Appendix A).

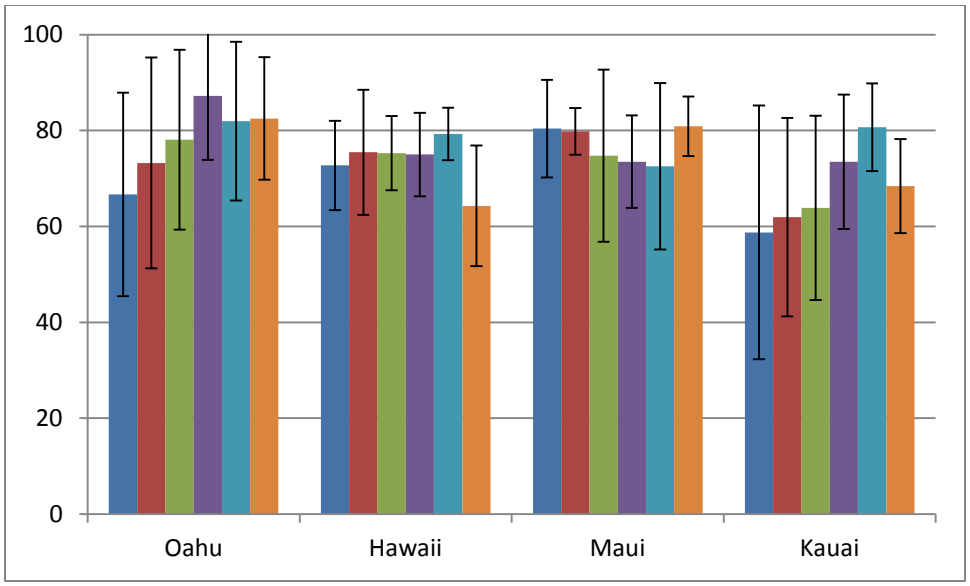

Figure 9 (a).--Percentage of trips from pure recreational fishermen (who do not sell their catch) in the telephone survey data by wave and county (for years 2003–2010). The fishermen types include pure recreational, recreational expense, part-time commercial, and full-time commercial fishermen. The error bars (2*standard error (SE), SE = standard deviation/√n) represent variations for a wave among different years (n = 8 years).

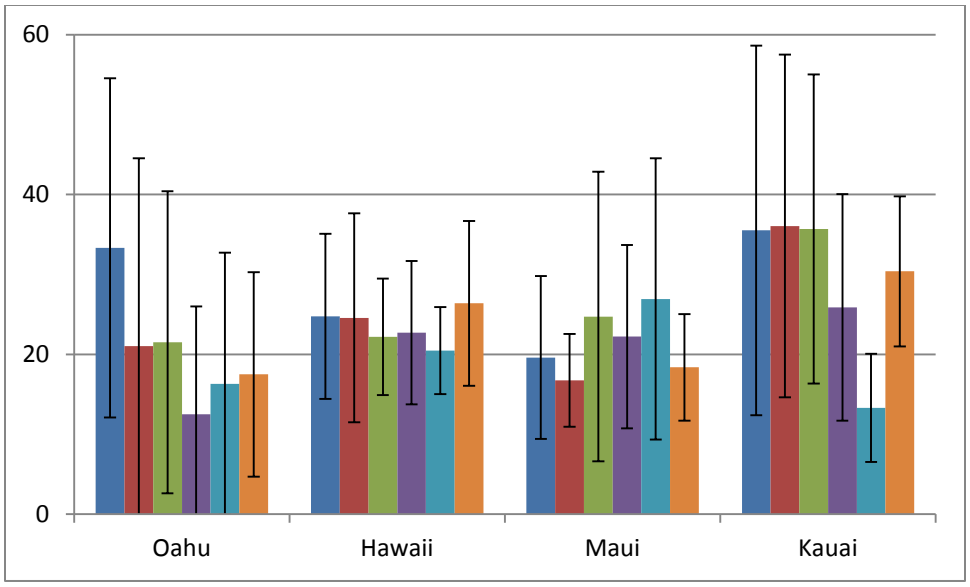

Figure 9 (b).--Percentage of trips from recreational expense fishermen (who sometimes sell their catch to help cover fishing expenses) in the telephone survey data.

The majority of the trips from the onsite interviews were from pure recreational fishermen (Fig. 10 (a)). The proportions of interviews from recreational expense fishermen varied from 8% to 27% where Maui had the lowest proportion. The proportions of trips from part-time commercial

fishermen ranged from 1 to 6% where Maui had the highest proportion. The trips from full-time commercial fishermen accounted for 0–3% (Figs. A11–A12 in Appendix A). The onsite surveyors usually avoided interviewing full-time fishermen and the catch data from full-time commercial fishermen were not included for catch rate estimation.

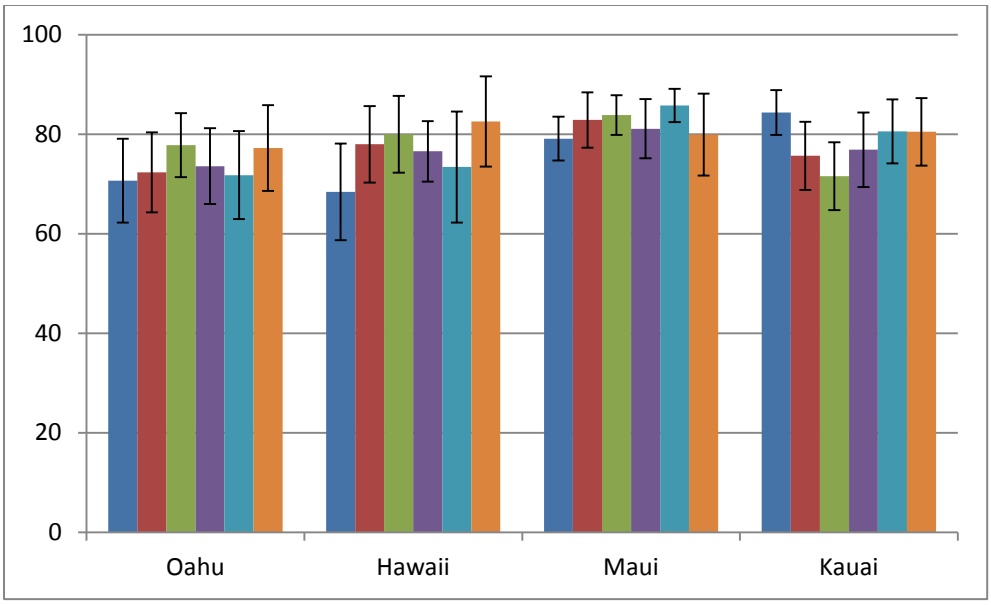

Figure 10 (a).--Percentage of trips by pure recreational fishermen from the onsite survey data (2003–2010). The fishermen types include pure recreational, recreational expense, part-time commercial, and full-time commercial fishermen. The error bars (± 2*standard error (SE), SE = standard deviation/√n) represent variations in a wave among different years (n = 8).

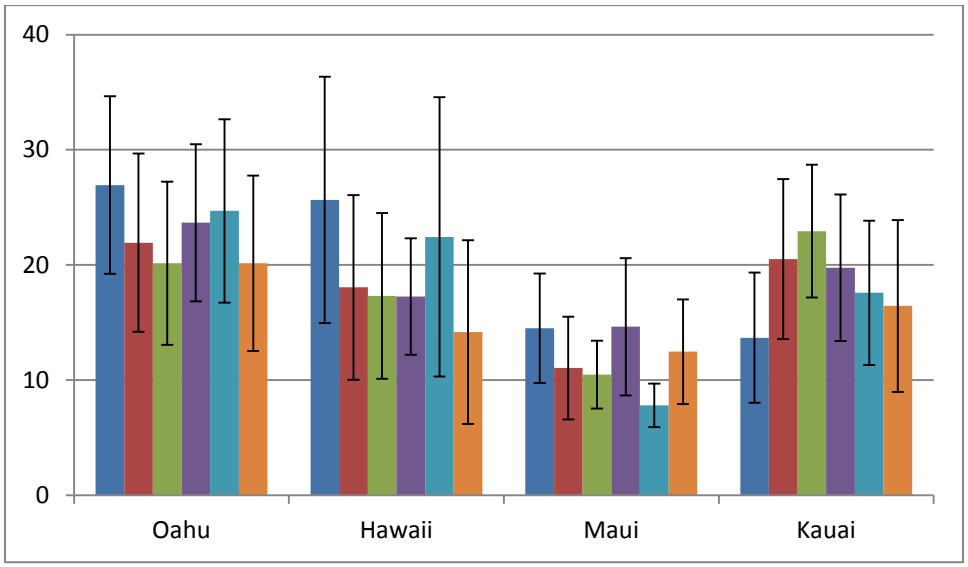

Figure 10 (b).--Percentage of trips by recreational expense fishermen from the onsite survey data.

DISCUSSION

Proportions of Fishing Methods in Onsite and Telephone Survey Data

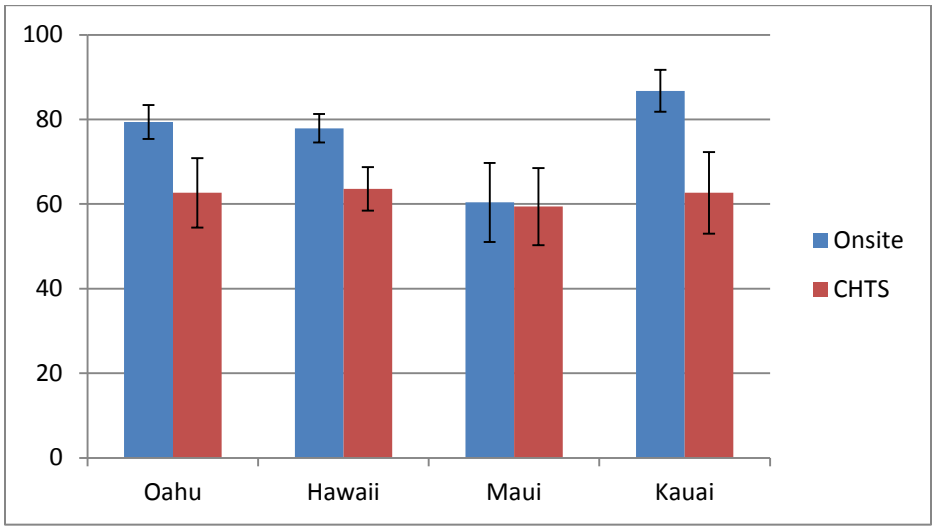

Figure 11 (a).--The percentage of trips from trolling (average over six waves from Figs. 7(a) and 8(a)) in telephone and onsite intercept data. The error bars (± 2* standard errors (SE), SE = standard deviation/√n) indicate variation among different waves (n = 6).

The percentages of trolling trips were consistent in the telephone survey data (around 60%) across the counties (Fig. 11 (a)). The percentages of trolling were higher in the onsite survey data on Oahu, Hawaii, and Kauai. However, the percentages of bottom fishing were lower in the onsite survey data at the same three counties (Fig. 11 (b)). It is suspected that the common fishing method, trolling, might be intercepted more than its actual proportion in the population and the bottom fishing method was intercepted less than its actual proportion. The return times for some bottom-fishing trips fell outside the time period when the surveyors conducted the interviews, and this may explain why the proportions of bottom fishing trips were lower in the intercept data than in the telephone survey data. The fishing sites with high fishing pressure (expected number of fishing trips) were selected more often for intercept surveys (sampling probability proportional to size, PPS sampling). If trolling was more common at the sites with high fishing pressure or less-common fishing methods occurred more often at low fishing pressure sites, the proportions of fishing methods in the intercept data from PPS sampling would not reflect the true fishing method proportions in the population. The proportions of less-common fishing method “spearfishing” in Kauai, and netting in Kauai and Maui were lower in the intercept surveys compared to telephone surveys (Figs. 11 (c) and (e)). Casting had a higher proportion in the telephone survey (Fig. 11 (f)). In the telephone survey, casting was one of the choices for the question “What kind of fishing did you do on this trip? Was it trolling, handlining, bottom-fishing, casting with a rod and reel or pole and line, netting, scuba or spearfishing or something else?” In the onsite survey, casting, trolling, bottomfishing, and

handlining are the fishing methods included under gear type “rod and reel” (see Methods section). The differences in the proportion of the fishing method “casting” between the onsite and telephone surveys could be due to the fact that the question for this fishing method is not raised the exact same way.

The comparison of proportions among fishing methods between the two surveys was based upon averages over six waves (see the caption for Fig. 11 (a)). The weighted average (using proportions of boat fishing trips from different waves in each county as a weighting factor) only had very slight changes and did not alter the patterns.

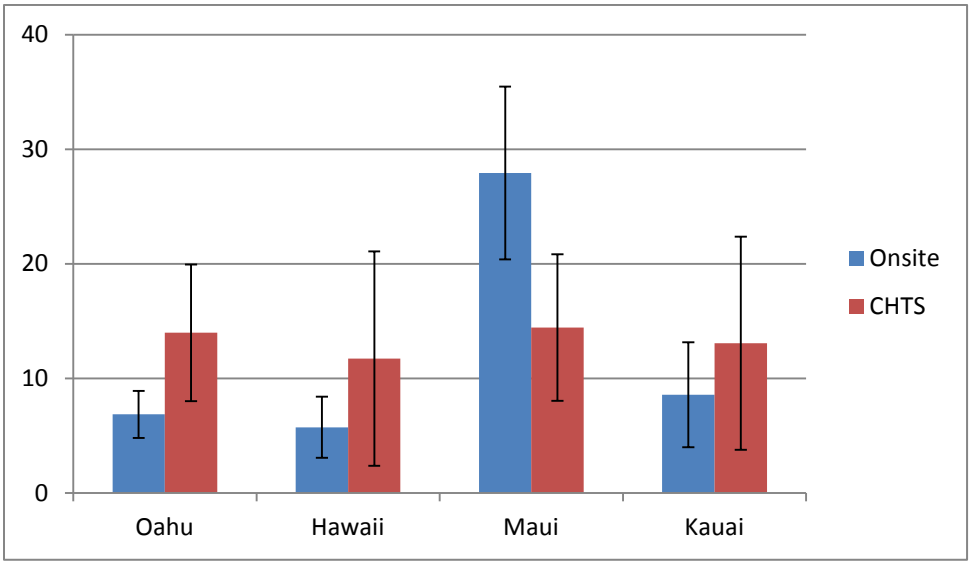

Figure 11 (b).--Percentage of trips from bottomfishing.

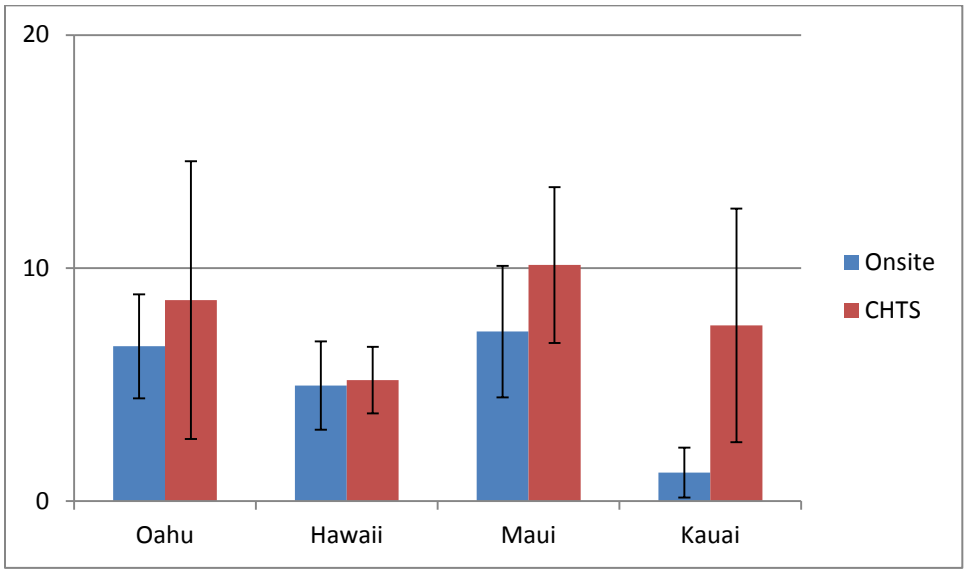

Figure 11 (c).--Percentage of trips from spearfishing.

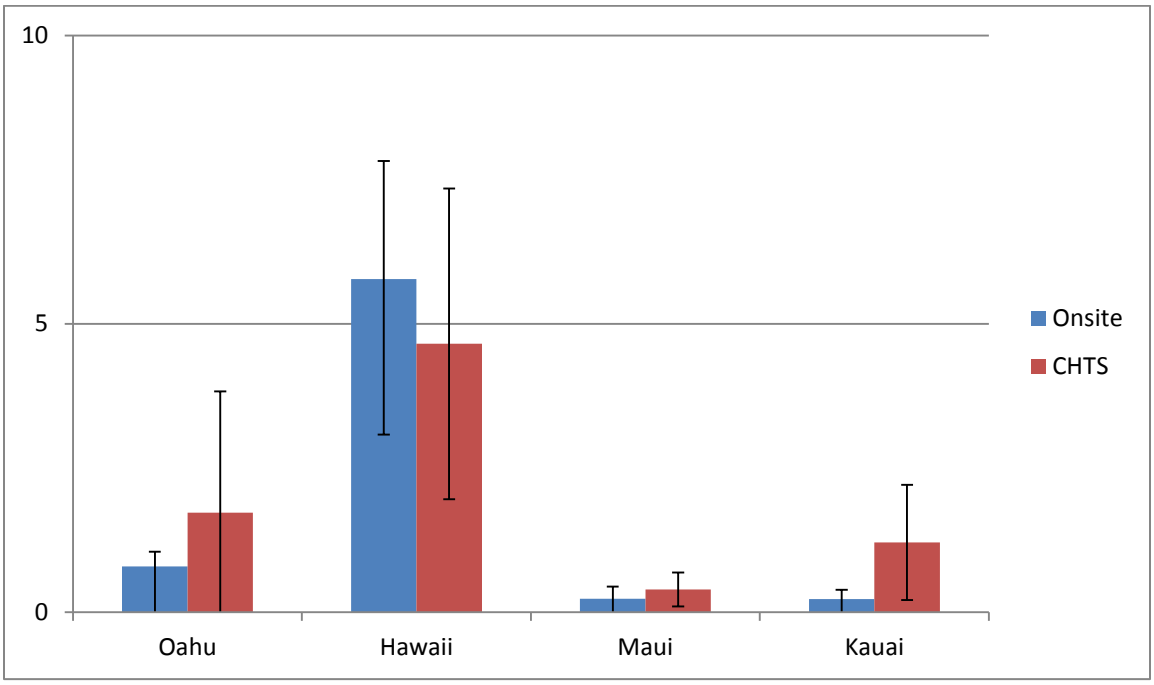

Figure 11 (d).--Percentage of trips from handlining.

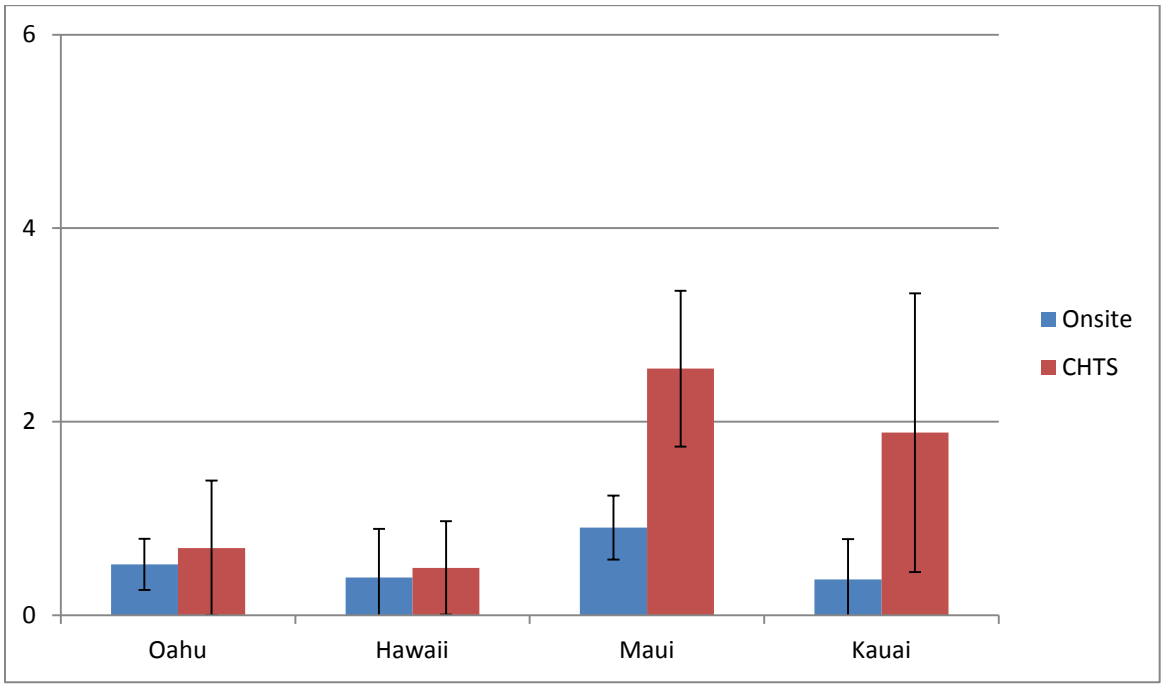

Figure 11 (e).--Percentage of trips from netting.

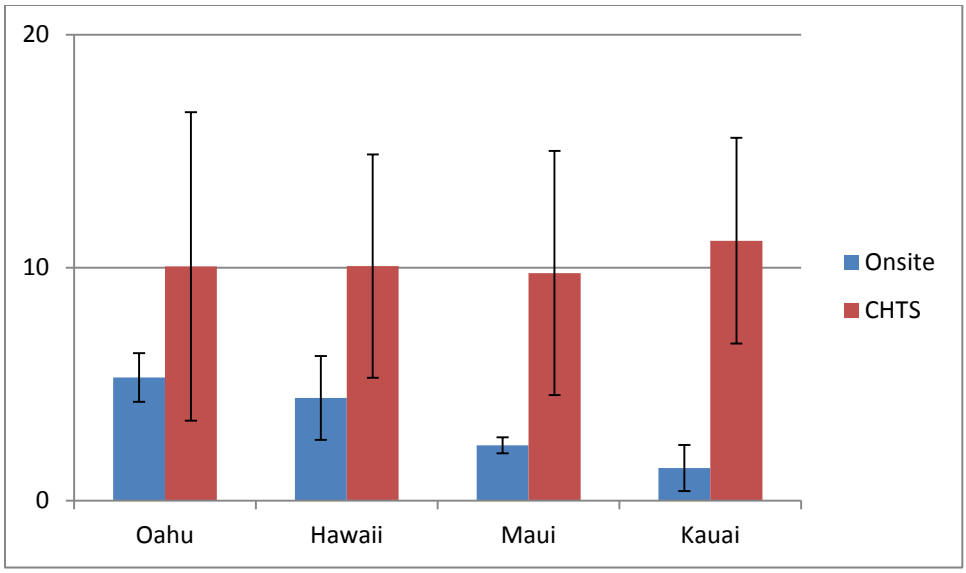

Figure 11 (f).--Percentage of trips from casting.

Different fishing methods target very different species. For instance, the usual target species for trolling are pelagic species such as yellowfin tuna, skipjack tuna, mahimahi, ono, and billfish. The usual target fish for bottom fishing are pink snapper (opakapaka), red snapper (onaga), Hawaiian grouper (Hapuupuu), squirrelfish snapper (ehu), Von Siebold's snapper (kalekale), Brigham's snapper (gindai), silverjaw snapper (lehi), and other bottomfish species. If the fishing method "trolling" was over-represented in the onsite survey, the catch rate for the pelagic species would be overestimated as well. Estimating catch by fishing method would be able to correct the potential biases in the catch estimates where fishing method information was not incorporated. Using 2008 intercept data, Ma et al. (2011b) showed that estimating catch by county led to a 10% change in the annual catch estimate of yellowfin tuna compared with the estimate without differentiating counties.

Proportions of Trips from Different Fishermen Types

For pure recreational fishermen, there were no significant differences across the counties and between telephone and onsite surveys (Fig. 12 (a)). The proportion of recreational expense trips was lower in the onsite data for Maui and Kauai (Fig. 12 (b)). The trips from part-time and full-time commercial fishermen in the telephone survey only included the non-commercial trips while the onsite interviews from the commercial fishermen were for both commercial and non-commercial trips. This could be one of the reasons why the proportion of trips from commercial fishermen was lower in the telephone survey data than in the onsite survey data (Fig. 12 (c) and Fig. 12 (d)). The proportion of trips from commercial fishermen would be even higher in the onsite survey data if the surveyors did not avoid interviewing the full-time commercial fishermen whose data are excluded for catch rate estimation. In the catch rate estimation, catch from full-time commercial fishermen was not included.

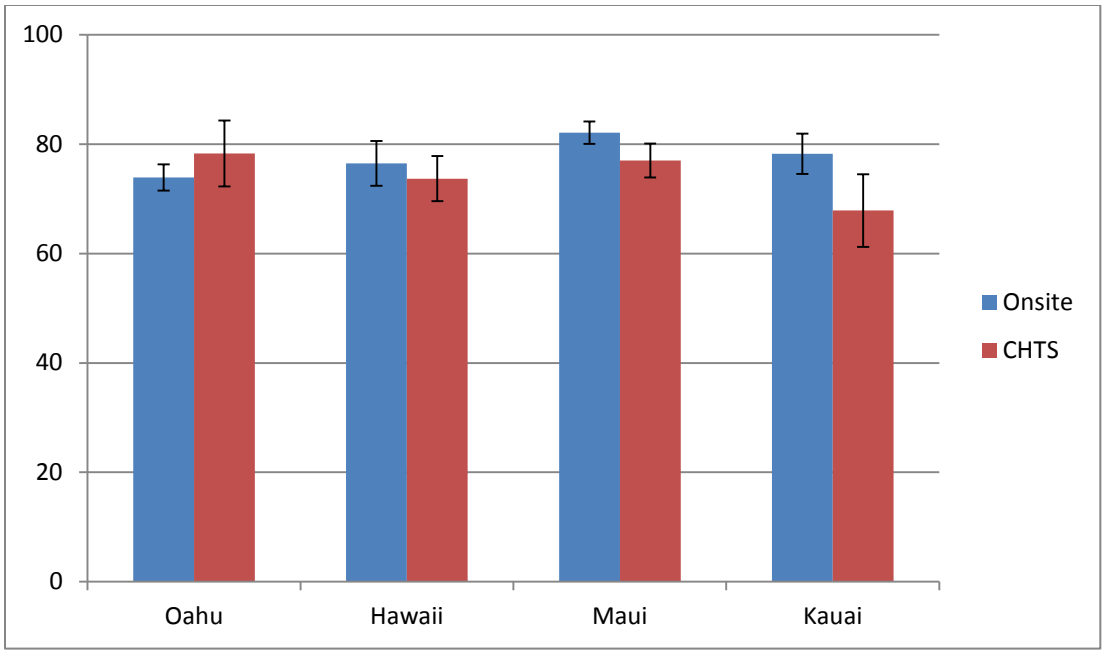

Figure 12 (a).--Percentage of trips by pure recreational fishermen (average over six waves from Fig. 8 and Fig. 10) in telephone and onsite intercept data. The error bars indicate variation among different waves.

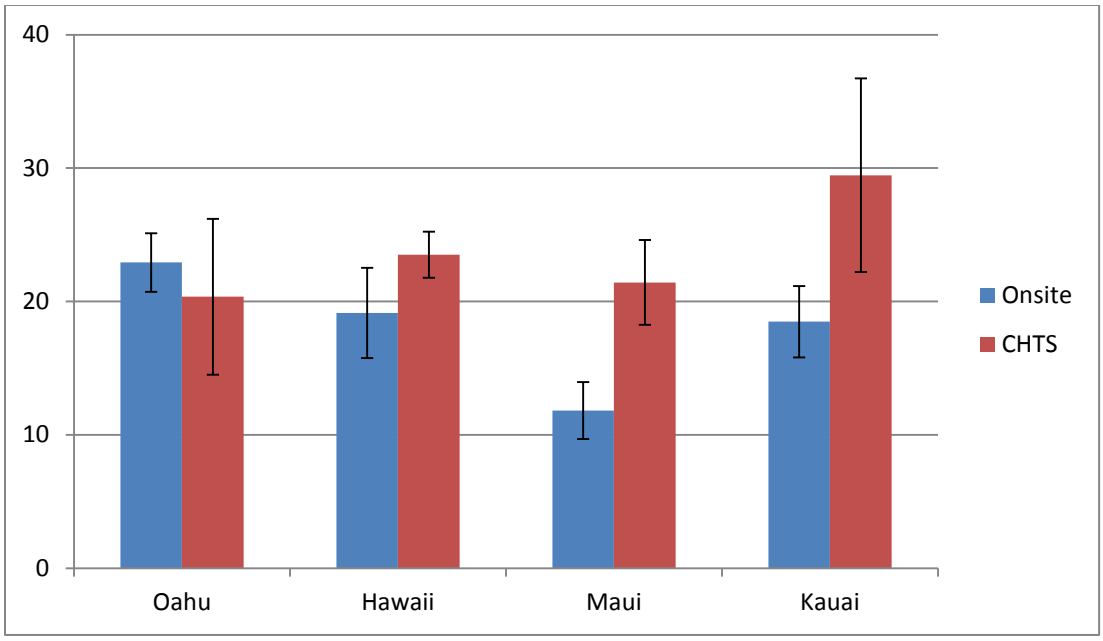

Figure 12 (b).--Percentage of trips by recreational expense fishermen.

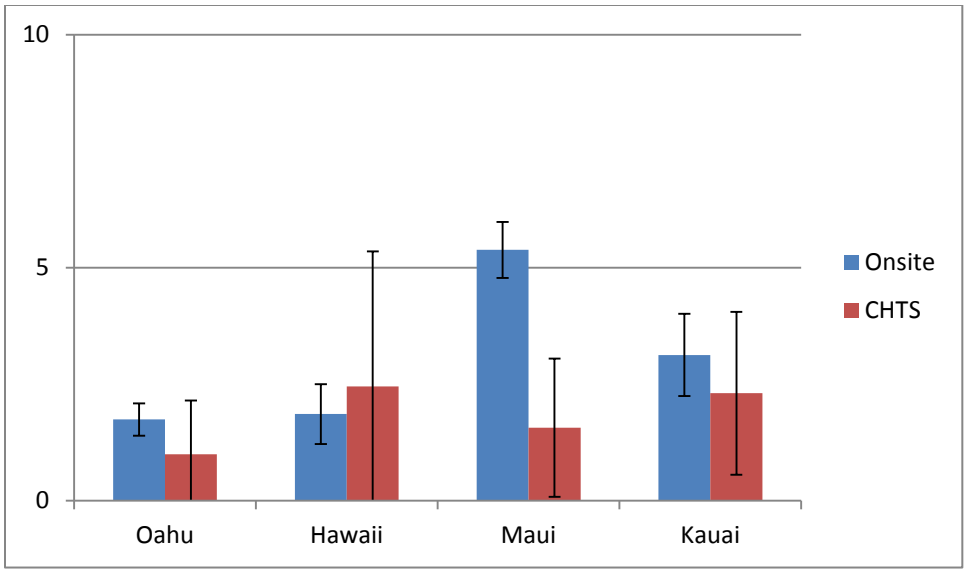

Figure 12(c).--Percentage of trips by part-time commercial fishermen.

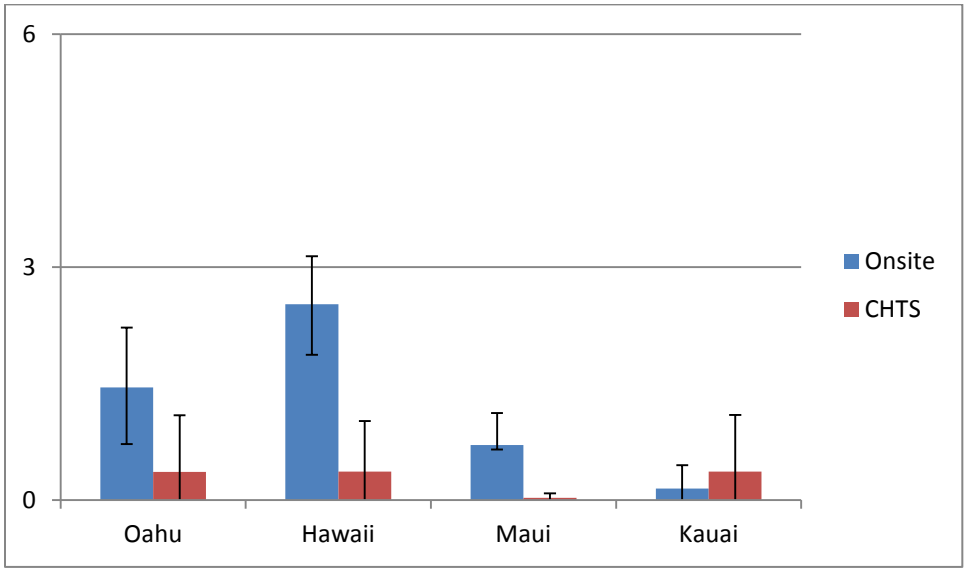

Figure 12 (d).--Percentage of trips by full-time commercial fishermen.

Based on Figures 12 (a)–(d), the trips by recreational expense and commercial fishermen (i.e. excluding pure recreational fishermen) ranged from 22 to 32% in the telephone survey. These fishermen (who sell their catch) must lawfully possess a Hawaii Commercial Marine License (CML) and report their fishing trips and catch (including catch sold and not sold) in the monthly fishing reports or other mandatory logbooks. Therefore, there would be a certain degree of overlap between HMRFS catch estimates and the catch reported in the Hawaii commercial fishing report system. The proportion of catch in HMRFS estimates by fishermen who sell their catch can be higher than the proportion of their trips (see discussion in next session).

Caveats in HMRFS Catch Estimates

HMRFS is supposed to capture non-commercial/recreational fishing catch and effort. However, the divisions between commercial, non-commercial or recreational are not clearly defined in Hawaii. Some fishermen who do not consider themselves as commercial fishermen may occasionally sell some of their catch to cover fishingtrip expenses. The catch to be sold is recorded with a unique catch disposition (see question 24 unavailable catch and question 30 available catch on the onsite survey form, Appendix C) in the intercept survey form but such information has not been used in the catch estimation yet. In Hawaii, if any fishermen intend to sell the catch, they are supposed to have a CML and report all the catch in the fishing reports regardless whether the catch is to be sold or not. Therefore, there can be overlap between HMRFS catch estimates and the catch reported in commercial fishing reports.

In addition to the catch disposition, there is also angler information in the intercept (see questions 19, 19a, and 19b on the survey form, Appendix C) and telephone surveys to categorize fishermen as pure recreational, recreational expense, part-time or full-time commercial. Intercept data from full-time commercial fishermen are excluded for catch rate estimation in HMRFS. The records from recreational expense and part-time commercial fishermen are included for catch rate estimation. Only pure recreational fishermen do not sell any of the catch.

Based on the data analysis using catch disposition information from 2006 HMRFS data, the proportions of catch to be sold were > 40% for major pelagic species except for skipjack, for which catch disposition indicted “plan to sell” amounted to less than 10% (Fig. 13). In contrast, according to a domain estimation based on fishermen types, the proportion of catch from recreational expense and part-time commercial fishermen was still > 40% for skipjack (Fig. 13). The discrepancy in proportion for skipjack tuna between the two types of information (disposition vs. angler type) may suggest that the majority of the catch of skipjack tuna from recreational expense and part-time commercial fishermen were consumed by themselves or given away. Recreational expense and part-time commercial fishermen should have a CML and thus report all catch (including the fish consumed at home or given away) in their commercial fishing reports. These analyses again suggest that there can be significant overlap between HMRFS catch estimates and the catch in the commercial fishing reports for these pelagic species.

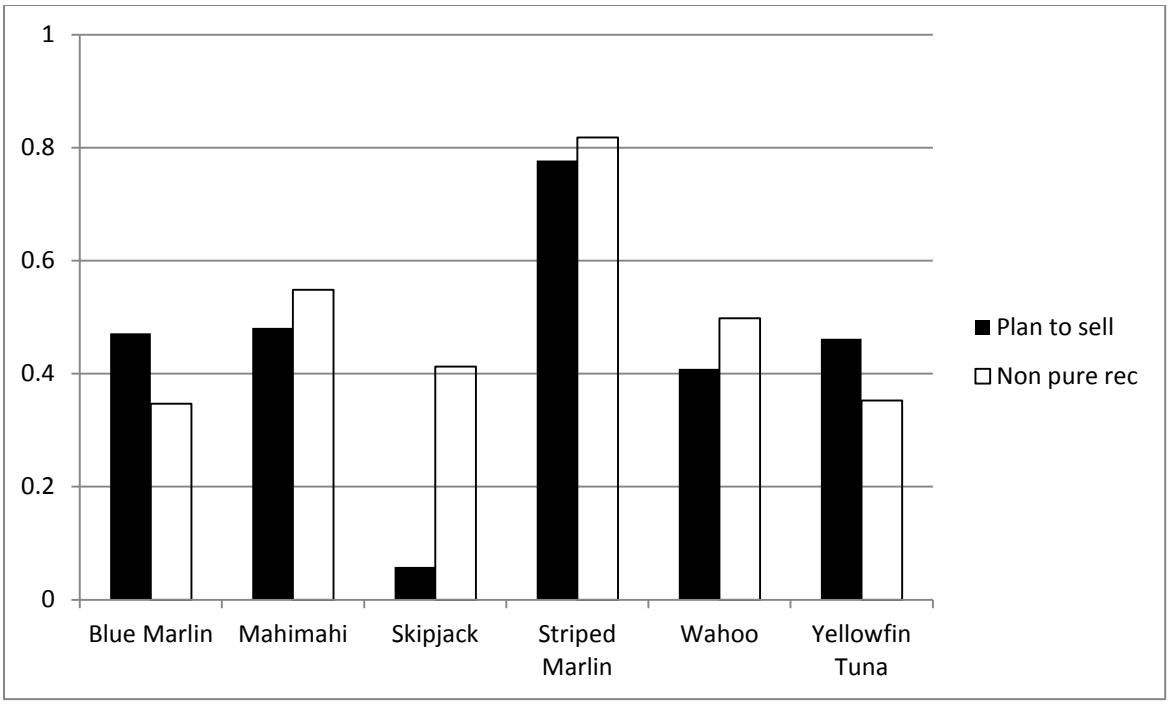

Figure 13.--Proportion of catch from catch disposition "plan to sell" and proportion of catch from non-pure recreational fishermen (i.e. excluding pure recreational fishermen) according to a domain estimation using fishermen type information.

According to 2004–2011 catch estimates, the average proportions of reported catch (B1) in total harvest A + B1 were ~ 50% or higher for most major pelagic species (Fig. 14). The reported catch were not observed or examined by the surveyors. The species identification and the number of pieces in the reported catch are not as certain as for these from the observed catch (A). The weight measurements can only be made for the observed catch. It is unknown what the mean weight of reported catch would be because the reported catch is not measured or weighted by the surveyors. The mean weight from observed catch is applied to total catch (A+B1) for catch weight estimation assuming equal mean weights. Among observed catch, only a portion of the catch was measured for weight when the catch number was large. Randomly selecting fish for weight measurements was not always feasible in the field (or allowed by fishermen). For reef fish species, Williams and Ma (2013) noted that some species were never measured for weight in years 2004–2011. For these species, they used weights of typical harvest sizes as the substitution for the mean weights.

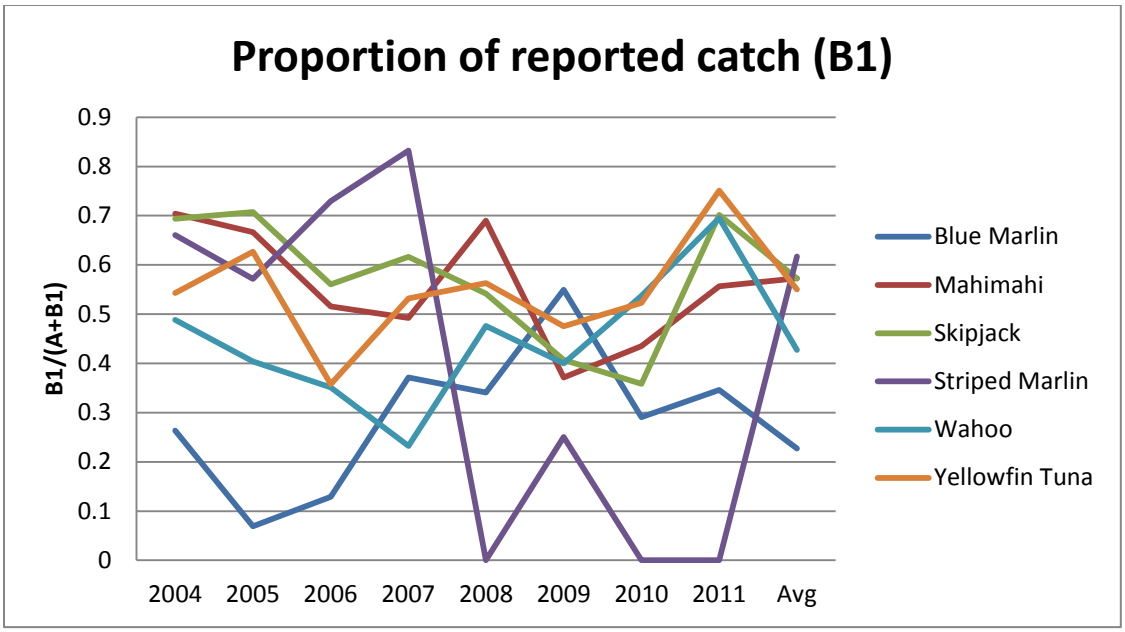

Figure 14.--Percentage of reported catch (B1 in number) in total landing (observed catch A + reported B1, in number) in 2004–2011.

Evolving HMRFS

Allen and Bartlett (2008) described some early efforts to reach a common understanding of HMRFS data and procedures and learn how catch estimates are developed. Recently several projects have been funded by NOAA Fisheries MRIP to improve HMRFS and other non-commercial data collection methods in Hawaii. The project on the Hawaii charter fishing sector documented the for-hire sector's level of compliance with the State's commercial fishing report system and identified a series of suggestions to improve the system (Ma et al., 2011a; Ma et al., 2013b). A pilot study for the intercept survey improved the HMRFS sampling and data management procedures and suggested approaches to apply alternative catch estimation methods to historic HMRFS catch estimates (Ma et al., 2011b). A team of expert consultants completed a review of the current HMRFS sampling and estimation methods and made recommendations regarding 1) catch re-estimation for historic HMRFS survey data using the alternative estimation program developed by MRIP, 2) effort survey for private boat fishing based on a boat registry maintained by the state, 3) a pilot study to obtain on-site effort estimates for shore fishing, using instantaneous counts and other information (Breidt et al., 2012; Ma et al., 2013a; Appendix B).

The vessel registry maintained by the State of Hawaii's Division of Boating and Ocean Recreation has been used as a sampling frame for a pilot mail survey, as part of a MRIP project (Hawkins et al., 2015). A hybrid survey design for shore fishing was designed recently and it incorporated roving surveys for catch and effort, an aerial effort survey to cover remote and private fishing activities, and a mail-in effort survey covering both remote/private shoreline areas and night fishing activities (Ma et al., 2014). The design was tested in 2015 (Ma et al., submitted). Currently, the sampling design of the onsite intercept survey for private boat fishing is being modified and tested (Ma and Ogawa, 2015). When data from these surveys are analyzed,

the feasibility of the pilot survey designs will be evaluated. With these pilot studies, we are trying to establish a more appropriate survey for Hawaii non-commercial fisheries.

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APPENDICES

APPENDIX A—ADDITIONAL FIGURES FOR PROPORTIONS OF FISHING METHODS AND FISHERMEN TYPES

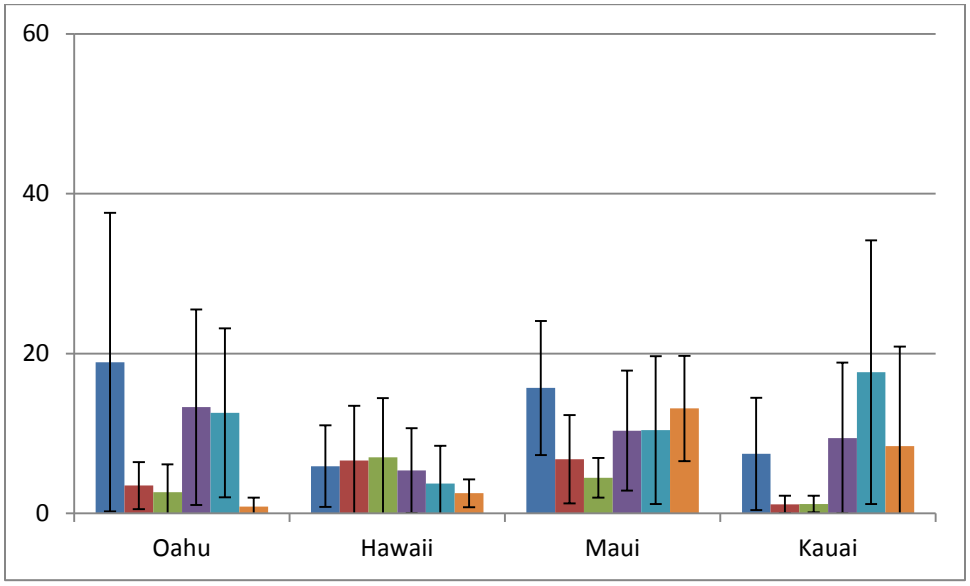

Figure A-1.--Percentage of occurrence of spear fishing trips in the telephone survey data by wave, 2003–2010 (six waves per year) and county. The error bars are ± 2*standard errors.

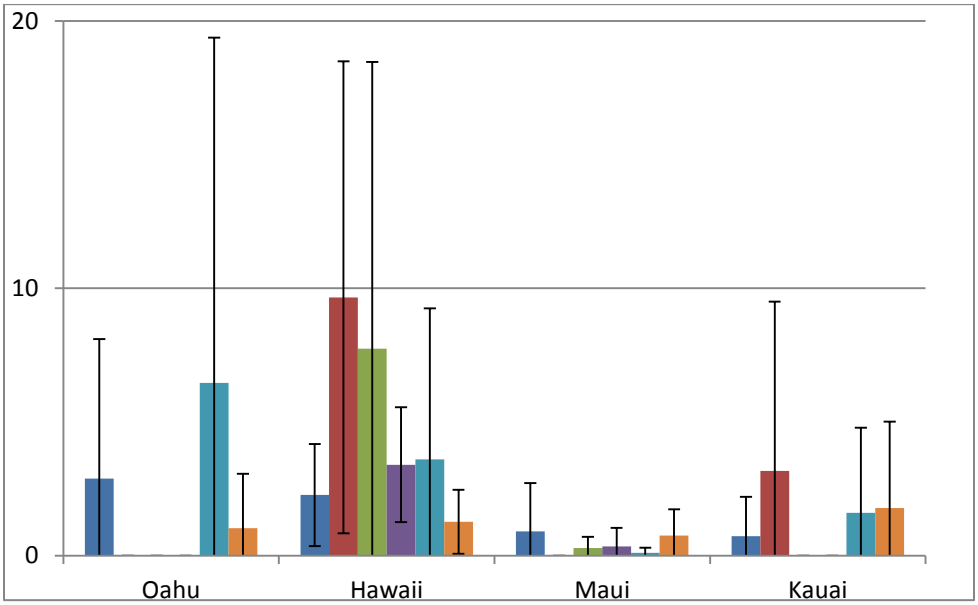

Figure A-2.--Percentage of occurrence of hand lining trips in the telephone survey data.

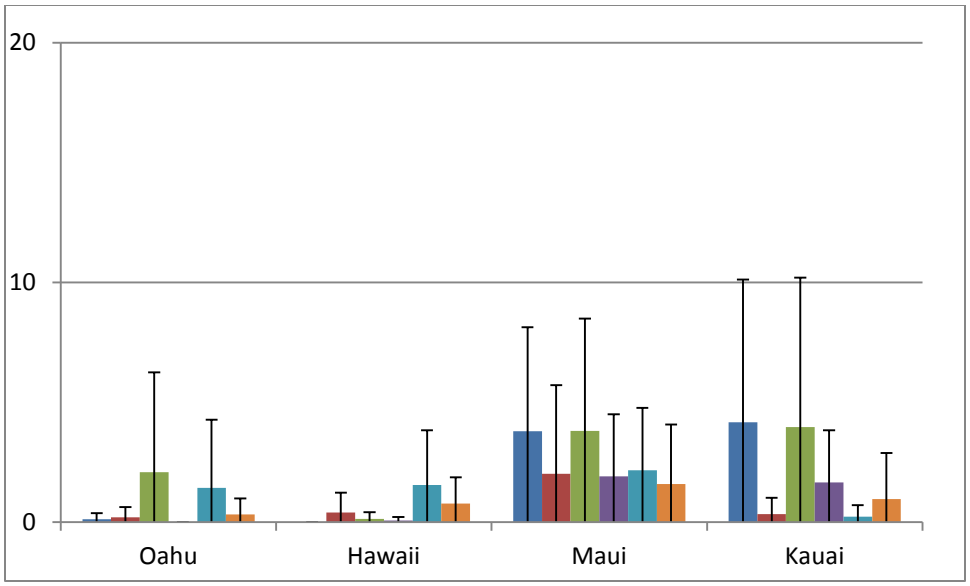

Figure A-3.--Percentage of occurrence of netting trips in the telephone survey data.

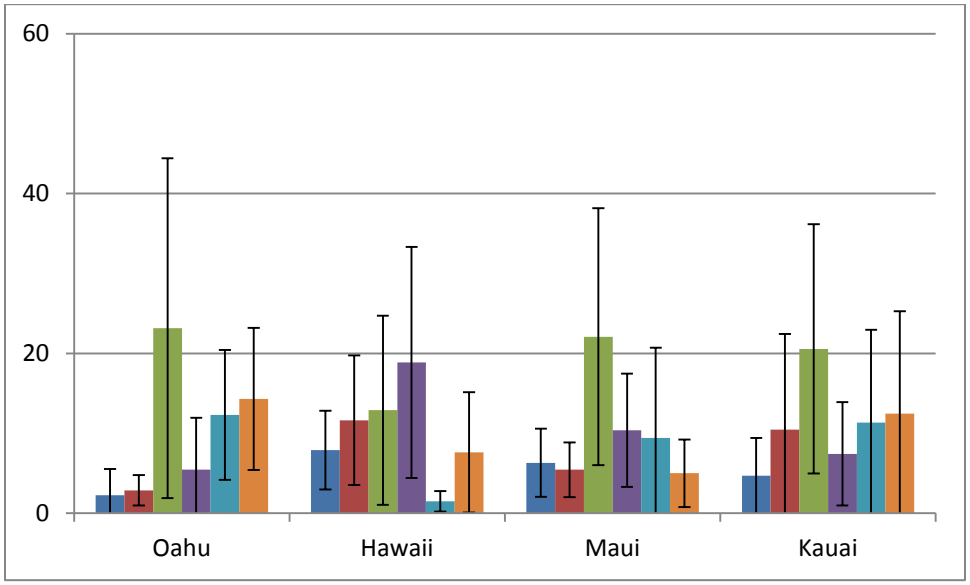

Figure A-4.--Percentage of occurrence of casting trips in the telephone survey data.

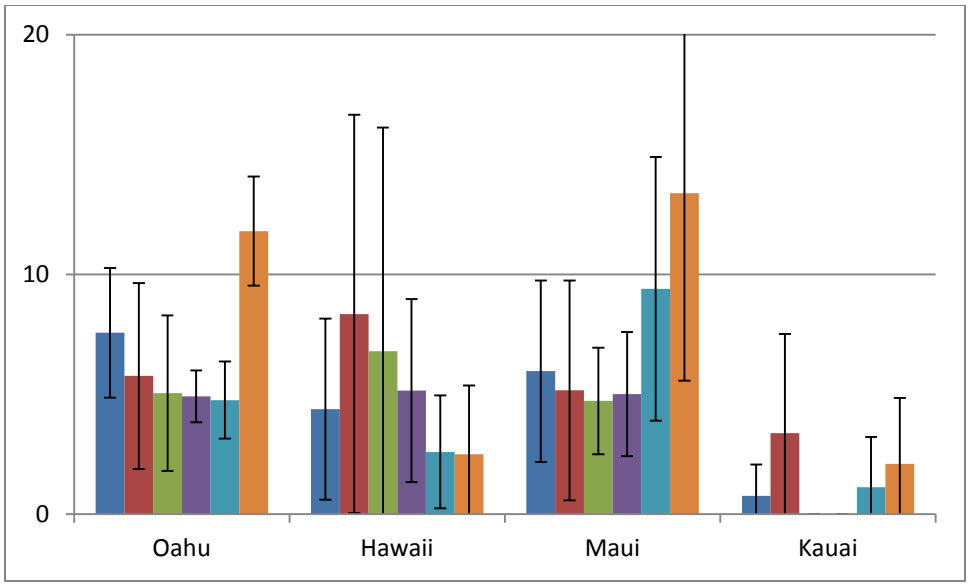

Figure A-5.--Percentage of spear fishing trips in the onsite survey data.

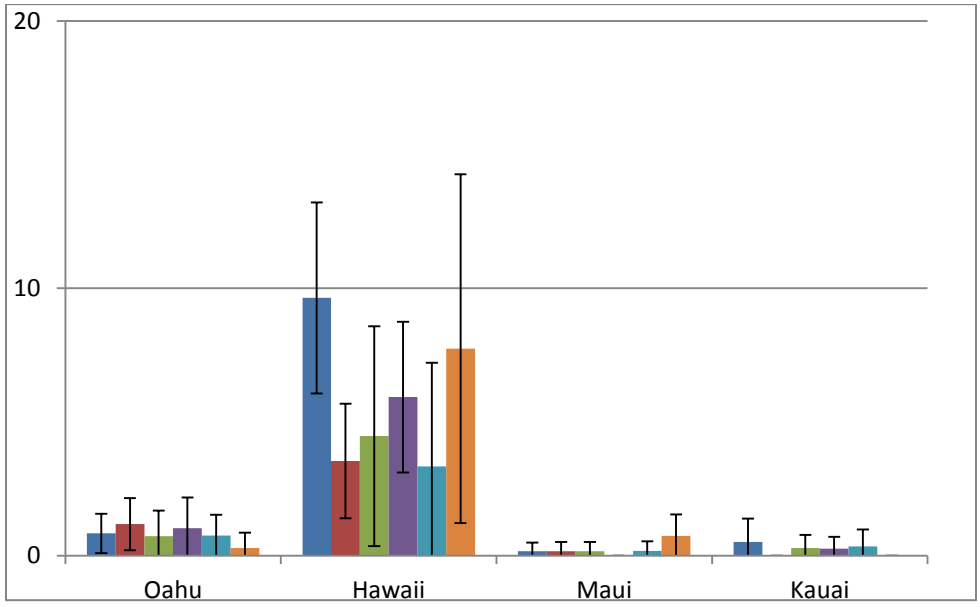

Figure A-6.--Percentage of hand lining trips in the onsite survey data.

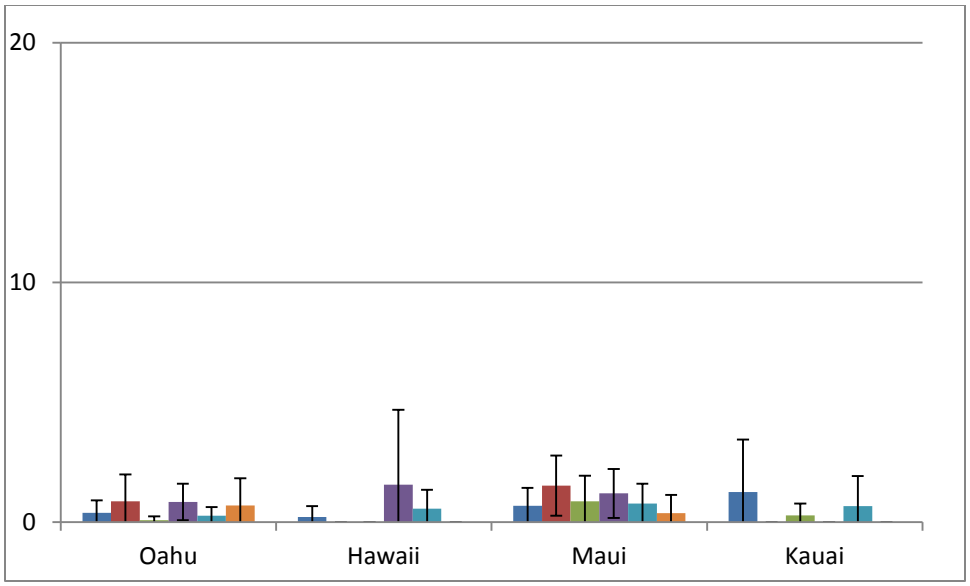

Figure A-7.--Percentage of netting trips in the onsite survey data.

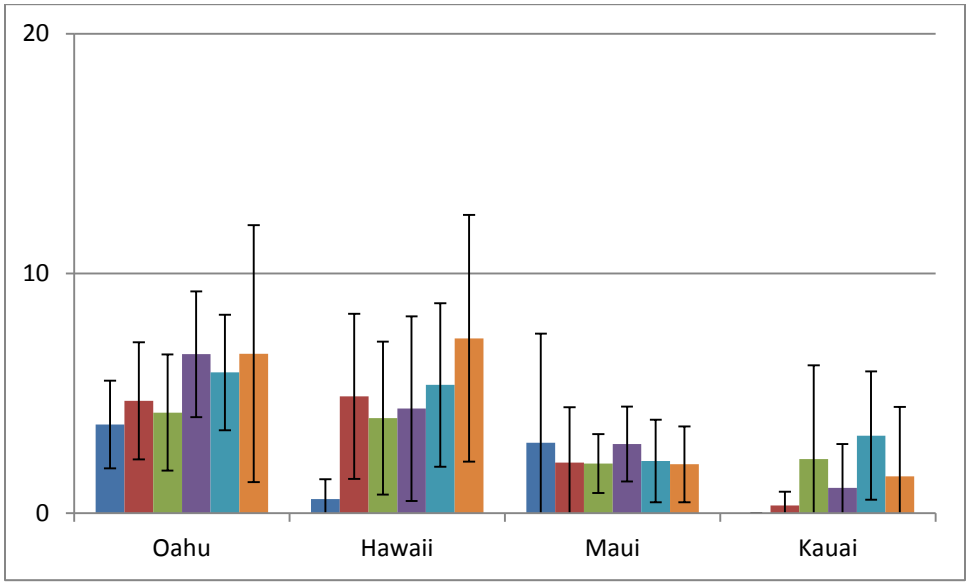

Figure A-8.--Percentage of casting trips in the onsite survey data.

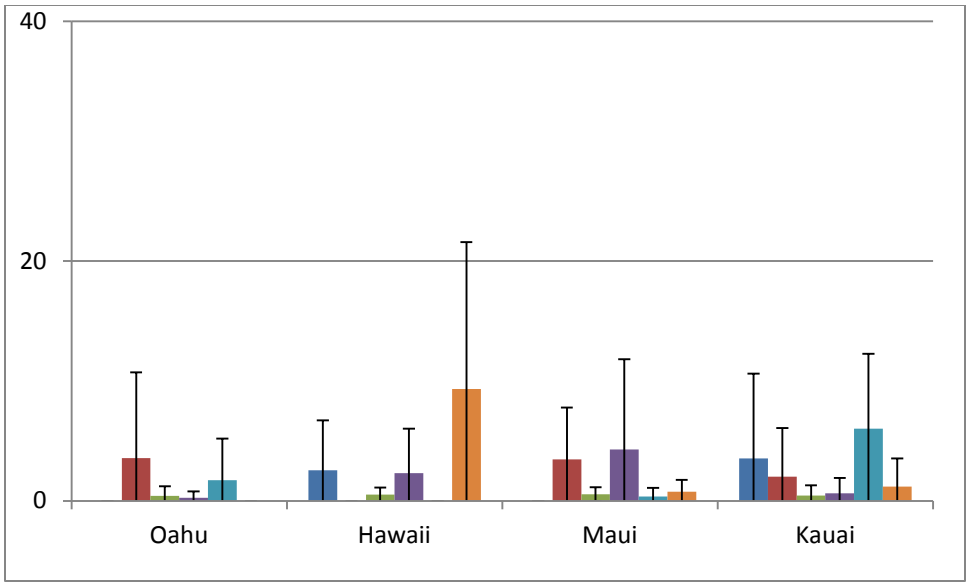

Figure A-9.--Percentage of trips for non-commercial purposes from part-time commercial fishermen in the telephone survey data.

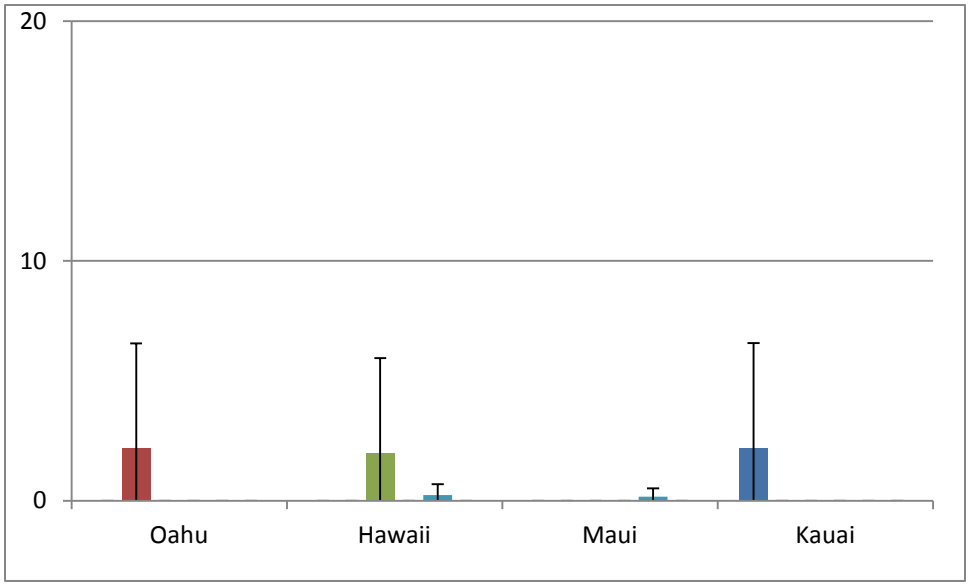

Figure A-10.--Percentage of trips for non-commercial purposes from full-time commercial fishermen in the telephone survey data.

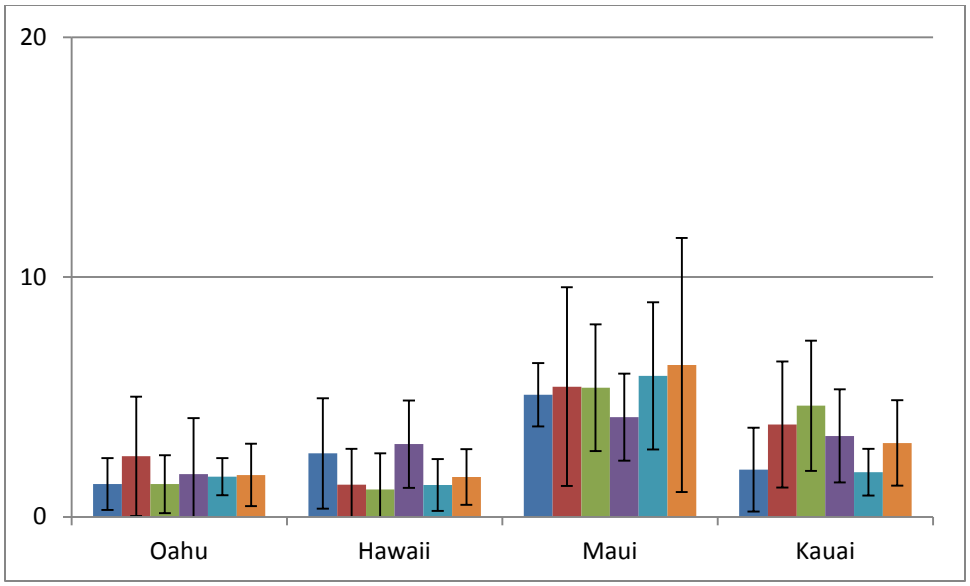

Figure A-11.--Percentage of trips from part-time commercial fishermen in the onsite survey data.

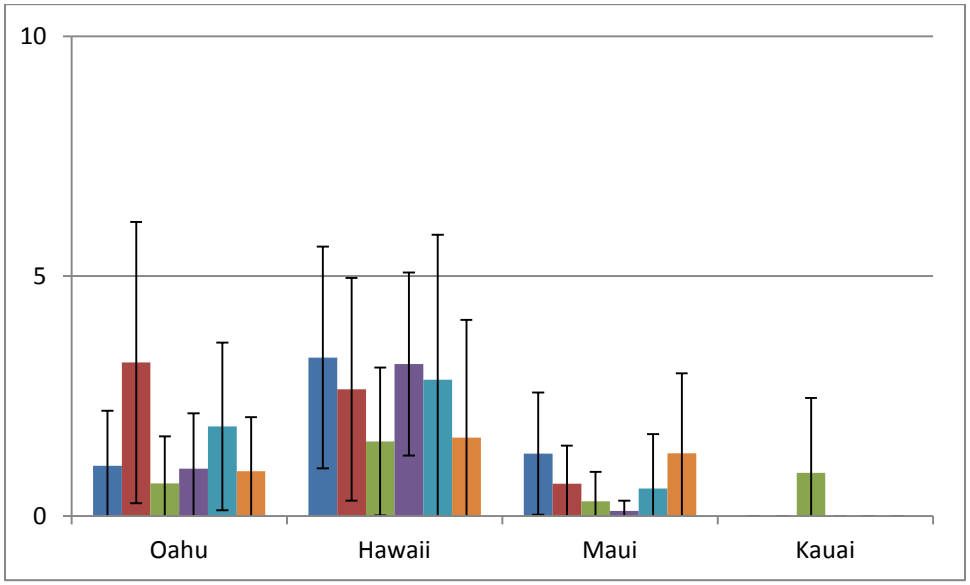

Figure A12.--Percentage of trips from full-time commercial fishermen in the onsite survey data.

APPENDIX B—FY 12 MRIP PROJECT REPORT (EXECUTIVE SUMMARY)

A Review of the Current Sampling and Estimation Methods of the Hawaii Marine Recreational Fishing Survey (HMRFS)

April 2013

This report was prepared by HMRFS review project team. Hongguang Ma (Pacific Islands Fisheries Science Center, NOAA Fisheries), Tom Ogawa (Hawaii Division of Aquatic Resources), and Joshua Demello (Western Pacific Regional Fishery Management Council) were the proposal authors. Statistical consultants Jay Breidt (Colorado State University), Virginia Lesser (Oregon State University), and Jean Opsomer (Colorado State University) were contracted by MRIP to conduct the review (the consultant's report was submitted to MRIP in November 2012). Other project team members include Dave Van Voorhees (Office of Science and Technology, NOAA Fisheries), David Hamm (Pacific Islands Fisheries Science Center), Tom Sminkey (Office of Science and Technology), Chris Hawkins (Pacific Island Regional Office, NOAA Fisheries), Walter Ikehara (Pacific Islands Regional Office), and Wade Van Buskirk (Electronic Consulting Service, Inc.).

EXECUTIVE SUMMARY

The main objectives of the project were to identify issues with current Hawaii Marine Recreational Fishing Survey (HMRFS) and to evaluate alternative data collection designs. HMRFS follows the standard dual-frame design that was re-initiated (in Hawaii) with the Marine Recreational Fisheries Statistics Survey (MRFSS) in 2001. The on-site intercept surveys (for catch rate) in Hawaii are conducted by HMRFS field surveyors and managed by the State of Hawaii's Division of Aquatic Resources (HDAR). The coastal household telephone survey (CHTS, for fishing effort) in Hawaii is currently conducted by a local contractor and managed by a mainland company that also runs the CHTS for the Atlantic and Gulf States. The review of MRFSS by the National Research Council (NRC) provided recommendations for improving intercept surveys and telephone surveys (NRC 2006). The alternative method for catch rate estimation developed by MRIP (Breidt et al., 2011) was one of the major responses to the NRC's recommendations. The new MRIP estimation procedures were mainly based on data from Atlantic and Gulf States. A review of HMRFS intercept survey data indicated that the available historical data files were not adequate for the new estimation procedures (Ma et al., 2011). Since early 2011, HMRFS sampling protocols and programs have been more similar to the Atlantic and Gulf States. Although the new estimation methods are currently applicable to HMRFS data, the new estimation procedures may need to be modified to re-estimate catch from HMRFS prior to 2011.

In response to the recommendations by the National Research Council panel (NRC, 2006) to improve the fishing effort survey, the National Saltwater Angler Registry (NSAR) was created to provide a more efficient sampling frame. Most states/territories have applied for exemptions based upon pre-existing state angler registries, newly-created license programs, or other alternative databases. However, the State of Hawaii does not require saltwater fishing licensing/registration for most recreational fishermen (though there is a Federal permit requirement for non-commercial bottom fishing). Consequently, Hawaii is now the only state where recreational fishermen are required to register with NSAR. There are no anadromous fish in Hawaii, and shoreline anglers and boat fishermen only fishing within 3 miles from the shore are exempted from NSAR. Therefore, Hawaii's NSAR database is an incomplete sampling frame for boat fishing effort surveys and the registry does not contain anglers who are involved in shoreline fishing only.

A major component of this project, a workshop, was held in Honolulu on July 16–19, 2012. Attendees included MRIP statistical consultants, NMFS staff (from Office of Science and Technology (OST), Pacific Islands Fisheries Science Center (PIFSC), and Pacific Islands Regional Office (PIRO)), HMRFS staff (project manager and all field staff), and a Council staff member. On the day (July 16) before the meeting, the HMRFS project manager and a PIFSC statistician gave the MRIP statistical consultants a field tour around the island of Oahu to demonstrate various survey sites and highlight the complexities associated with them. During the following three days (July 17-19), presentations followed by discussions were conducted. An OST staff began the presentations with a review of the implementation of HMRFS in 2001 and the subsequent development of the project in 2002–2004. The HMRFS project manager gave an overview of current HMRFS protocols, reviewed problems with the current shoreline survey

methodology, and discussed the unique characteristics of fishing activities in Hawaii. The OST Fisheries Statistics Division Chief gave two presentations: a) implementation of the new MRIP estimation methods (i.e., incorporating sampling weights/inclusion probabilities into catch estimation) and b) review of the new access point survey sampling design recently tested in North Carolina. MRIP efforts in developing license-frame surveys (to replace CHTS) were also presented by another OST staff member. The Council staff discussed the Hawaii-specific data needs for the Western Pacific Regional Fishery Management Council. The PIFSC statistician presented some results from HMRFS data analyses (2003–2010) on fishing methodology and fishermen categorization and outlined potential overlaps between HMRFS catch estimates and the catch totals from the Hawaii commercial fishing reports. PIRO staff presented a modified approach for collecting fishing effort information from the private boat mode using a vessel registry as the sampling frame. The PIFSC Fisheries Monitoring Branch Chief reviewed how creel surveys are currently conducted in Guam, American Samoa, and the Commonwealth of the Northern Mariana Islands (CNMI) via the Western Pacific Fisheries Information Network (WPacFIN).

The MRIP statistical consultants held a question-and-answer session with HMRFS field surveyors and the project team member and presented their initial reactions on the last day of the meeting. A draft consultant report was provided to the project team members in late September. The report was revised and finalized based on the comments from project members (Breidt et al., 2012, Appendix 2). The major recommendations include:

1) Historical data and metadata from HMRFS should be reviewed to determine if estimates can be revised to reduce the mismatch between the survey design and the estimation procedure. Current HMRFS should be reviewed to ensure that sufficient design information is being collected to construct appropriate weights for estimations.
2) Survey design improvements should focus on the private boat and shore fishing modes. The sample based on the boat registry looks very promising for the private boats, and should be developed further. Methods to improve data quality and compliance issues for fishing done from charter boats should be investigated even though no additional sampling of charter boats is recommended.
3) A pilot study to obtain on-site effort estimates for shore fishing, using instantaneous counts and other information should be conducted. These counts would have to be supplemented by off-site methods in order to capture areas that are not accessible. Methods for combining on-site and off-site effort data should be investigated.

A FY13 project plan has been submitted to MRIP to design an appropriate survey for the shore fishing effort survey in Hawaii. The same consultants are expected to help with the design. For another Hawaii MIRP FY12 project, the vessel registry maintained by the State of Hawaii's Division of Boating and Ocean Recreation (DBOR) is being used as a sampling frame for a pilot survey (mail survey). The MRFSS catch estimates (2004–2011) in Atlantic and Gulf State have been revised based on the new estimation methods reflecting the sampling design (a stratified, clustered, and unequal probability design). The issue of lacking some of the metadata necessary for constructing appropriate weights (for new estimation) in HMRFS may also exist in the Atlantic and Gulf surveys before 2004. The re-estimation for HMRFS catch can be synchronized with the re-estimation for MRFSS prior to 2004.

Appendix C—HMRFS/MRIP INTERCEPT SURVEY FORM (FRONT AND BACK)

2012 HMRFS / MRIP Intercept Survey Form — **OMB No. 0648-0052 (Exp. 04/30/13)**

2. ASSIGNMENT NO. ☐ *Please indicate if this is your first or second assignment today, by writing "1" or "2"*

3. INTERVIEWER ID ☐☐☐☐

4. YR/MO/DAY 2012 ☐☐ ☐☐

5. INTERCEPT NO. ☐☐

6. INTERVIEW TIME (use 2400 clock) ☐☐☐☐ *(Time this interview was completed)*

7. STATE CODE 15 ☐☐☐ 8. COUNTY CODE ☐☐☐ 9. SITE CODE ☐☐☐☐

10. INTERVIEW STATUS (Key Item = •)
1 ☐ Questionnaire Complete
2 ☐ Refused Non-Key Item
5 ☐ Refused Key Item

READ PRIVACY ACT: **this study is being conducted in accordance with the privacy act of 1974. You are not required to answer any question that you consider to be an invasion of your privacy.**

***11. Would you say you were fishing from a:**

SH
1 ☐ Pier/Dock — CH 7 ☐ Charter Boat
2 ☐ Jetty, Breakwater, Breachway — PR 8 ☐ Private Boat
3 ☐ Bridge, Causeway
4 ☐ Other Man-made Structure (specify) _____
5 ☐ Natural Shoreline (beach, cliffside, etc.).

***12. Was most of your (specify mode) fishing effort today in the:**

1 ☐ Ocean
4 ☐ Bay
5 ☐ Other (specify below) _____
Code Q13 as "8," Not Applicable

***13. Was that:** 1 ☐ Three miles or less from shore (always for SH mode)
2 ☐ More than three miles — 8 ☐ Not Applicable

13a. If Q13 = "More than three miles," then: Were you fishing at or near a Fish Attracting Device (FAD) today?

☐ Yes ☐ No
→ Which FAD(s) did you fish today? _____ _____ _____

14. What TYPE OF GEAR was primarily used?

01 ☐ Rod & Reel → *Go to Q14a*		09 ☐	Surround Net
02 ☐ Hand Line → *Go to Q14b*		10 ☐	Trawl
03 ☐	Hand Pole	11 ☐	Trap
04 ☐	Scoop Net	12 ☐	Spear
05 ☐	Throw Net	13 ☐	Hand
06 ☐	Gill Net	14 ☐	Crab Net
07 ☐	Cross Net	15 ☐	Other (specify) _____
08 ☐	Hukilau Net	98 ☐	Unknown
		99 ☐	Refused

14a. What METHOD was primarily used?

1 ☐ Trolling — 2 ☐ Casting → *Go to Q15a*
3 ☐ Bottom Fishing — 4 ☐ Hand Lining

14b. If bottom fishing or hand lining were you:

1 ☐ Shallow Water (<20 fathoms)
2 ☐ Deep Water (>20 fathoms)
3 ☐ Tuna Hand Lining (hand line only)

15a. To the nearest half-hour, how many hours have you spent (specify mode) fishing today? That is, how many hours have you actually spent with your gear in the water?

☐☐ . ☐ *Code 99.9 If Don't Know or Refused*

15b. (Only ask if natural shoreline mode [Q11, SH = 5]) How many additional hours do you expect to fish from shore today? That is, how many more hours will you actually have your gear in the water?

☐☐ . ☐ *Code 99.9 If Don't Know or Refused*

16. Were you fishing for any particular kinds of fish today? *If Yes*, what kinds?

☐ No Particular Species/Anything — Species Code

1st Target _____ ☐☐☐
2nd Target _____ ☐☐☐

16a. Were you fishing for finfish today?

1 ☐ Yes 2 ☐ No - ***Go to Q16b***

16b. Did you catch any finfish today?

1 ☐ Yes 2 ☐ No

17. Not counting today, within the past 12 MONTHS, that is since (insert month) of last year, how many days have you gone recreational saltwater fin fishing in Hawaii?

☐☐☐ *Code 998 If Don't Know; Code 999 If Refused*

18. Not counting today, within the past 2 MONTHS, how many days have you gone recreational saltwater fin fishing in Hawaii?

☐☐ *Code 98 If Don't Know; Code 99 If Refused*

19. Do you ever sell any of the fish you catch?

1 ☐ Yes 2 ☐ No - ***Go to Q20***

19a. When you sell your fish, do you consider yourself a commercial fisherman, making some income or do you sell only to cover your fishing expenses?

1 ☐ For Income 2 ☐ Trip Costs Only - ***Go to Q20***

19b. Do you consider yourself a full-time commercial fisherman?

1 ☐ Yes 2 ☐ No

***20. What is your state & island or county of residence? *If county unknown ask:* What city or town do you live in?**

☐☐ State Code; Name _____
☐☐☐ County-Island Code; Name _____

21. What is the zip code of your residence?

☐☐☐☐☐

Code 99997 If Foreign Country; Code 99998 If Don't Know; Code 99999 If Refused

22. Do you live in a private residence, or in some type of housing such as a dormitory, barracks, nursing home or rooming house?

1 ☐ Private Residence 8 ☐ Don't Know
2 ☐ Institutional Housing 9 ☐ Refused
→ ***Go to verification box below***

23. Does your home have a land line telephone?

1 ☐ Yes 8 ☐ Don't Know
2 ☐ No 9 ☐ Refused

VERIFICATION BOX

In the event my supervisor wishes to verify that I have been conducting interviews here today, may I have your name & phone number?

First Name _____

Last Name _____

☐ Check box if name & phone number not given.

Phone Number (___) ___ - ____

***24. UNAVAILABLE CATCH. Did you land any fish that are not here for me to look at? For example, any that you may have thrown back or used for bait? IF YES, COMPLETE TYPE 2 RECORD FOR THIS INDIVIDUAL FISHERMAN, NOT GROUP CATCH. NOTE: FILLETS ARE UNAVAILABLE CATCH.**

DISPOSITION CODES FOR Q24

1 Thrown back alive / legal
2 Thrown back alive / not legal / legality refused
3 Eaten / plan to eat
4 Used for bait / plan to use for bait
5 Sold / plan to sell
6 Thrown back dead / plan to throw away
7 Some other purpose, *Write in margin:* _____
8 Don't know / Didn't ask
9 Refused
0 Exchange, Trade

TYPE 2 RECORDS: (INDIVIDUAL CATCH NOT AVAILABLE IN WHOLE FORM)

	SPECIES NAME	SPECIES CODE	# OF FISH	DISP		SPECIES NAME	SPECIES CODE	# OF FISH	DISP
1.					6.				
2.					7.				
3.					8.				
4.					9.				
5.					10.				

***25. Did you catch any fish I can look at?**

1 ☐ Yes
2 ☐ No – ***Code Q26, 27, & 28 as "8's," Not Applicable***
3 ☐ Yes, BUT fish on another angler's form; record intercept no. where fish are listed → ☐☐ ***Code Q26, 27 & 28 as "8's," Not Applicable***

***26. Did you catch these fish yourself or did someone else catch some of them?**

1 ☐ All caught by fisherman – ***Code Q27 & 28 as "8's," Not Applicable***
2 ☐ Other Contributors 8 ☐ Not Applicable

***27. Can you separate out your individual catch?**

1 ☐ Yes – ***Code Q28 as "88," Not Applicable***
2 ☐ No 8 ☐ Not Applicable

***28. How many fishermen including yourself have their catch here? Please do not include anyone who did not catch fish; count only those who have their catch here.**

☐☐ No. of Contributors 88 ☐ Not Applicable

***29. How many people fished on your boat today?**

☐☐ No. of People 88 ☐ Not Applicable or Shoreline Mode

BOX D. If response to Q29 is 01 or Not Applicable/Shoreline Mode, *code as "8," Not Applicable or Shoreline Mode.* Otherwise, is this the first fisherman from this boat that I have interviewed?

1 ☐ Yes 8 ☐ Not Applicable or Shoreline Mode
2 ☐ No → Record intercept no. of 1st angler in the fishing party* ☐☐

***30. AVAILABLE CATCH. COMPLETE TYPE 3 RECORD BY ASKING: May I look at your fish? What do you plan to do with the MAJORITY of the catch?**

DISPOSITION CODES FOR Q30

3 Eaten / plan to eat
4 Used for bait / plan to use for bait
5 Sold / plan to sell
6 Thrown back dead / plan to throw away
7 Some other purpose
8 Don't know / Didn't ask
9 Refused
0 Exchange, Trade

TYPE 3 RECORDS: (INDIVIDUAL CATCH AVAILABLE IN WHOLE IDENTIFIABLE FORM)

	SPECIES NAME	SPECIES CODE	# OF FISH	PLAN TO SELL	LENGTH (mm)	WEIGHT (kg)		DISP
1.						.		
2.						.		
3.						.		
4.						.		
5.						.		
6.						.		
7.						.		
8.						.		
9.						.		
10.						.		

AVAILABILITY OF NOAA TECHNICAL MEMORANDUM NMFS

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B. L. RICHARDS, S. G. SMITH, J. S. AULT, G. T. DINARDO, D. KOBYASHI, R. DOMOKOS, J. ANDERSON, J. TAYLOR, W. MISA, L. GIUSEFFI, A. ROLLO, D. MERRITT, J. C. DRAZEN, M. E. CLARKE, and C. TAM.
(JUNE 2016)

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