Dual-Frame Mail Survey: Enhancing Survey Mail Response Rates

FY 2010 Proposal

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1. Overview

1.1. Sponsor

1.2. Focus Group
Survey Design and Evaluation

1.3. Background
Development of survey methodologies that utilize angler registries as sampling frames was identified as the highest priority by the MRIP Operations Team for 2010. Current efforts to sample anglers from registries or license databases are limited by exemptions to registration requirements. To compensate for gaps in sampling frames resulting from registry exemptions, the MRIP License Survey Project Team has developed a dual-frame methodology that integrates registry frames (Angler License Directory or ALD Frames) with address-based frames from the USPS Delivery Sequence Files (DSF). A small pilot project on this approach began in late 2009. This project will result in enhancements in the response rates from mail surveys to both frames.

1.4. Project Description
The dual frame approach using mail to survey anglers has several distinct advantages over the alternative approach of using telephone (ALD and RDD sampling frames). One of the most important is the ability to reach anglers more easily from the ALD since address information is very often available in the ALD frame while telephones are not. Another distinct advantage is that identification of the domain of the household (whether the household could be sampled from both frames or only from one frame) is probably much more accurate with the DSF than with RDD. If true, this could substantially reduce biases.One of the keys to determining whether mail is a reasonable alternative to telephone data collection is the ability to obtain sufficiently high response rates by mail. Some of the methods for increasing response rates by mail are well-known and described very well in Dillman, Smyth, and Christian (2009). Some, but not all of these methods, were incorporated into the 2009 Dual-Frame Mail Survey. Some of these methods include using color covers, and improving the message by using appropriate sponsors and return addresses. We plan to implement these methods, but not as part of the experimental design.This project is proposed as a follow-up study to enhance the methods currently being tested in the North Carolina Dual-Frame Mail Survey. Two sets of experiments are proposed in an integrated testing program to examine some of the issues that the angler survey poses that are not addressed in the standard mail survey literature. The experiments directly address the response propensity issues associated with the two-phase and dual frame natures of the angler mail survey.One response propensity issue related to the dual frame design is whether the mailings for the ALD and the DSF frames should be nearly identical or individually tailored. We propose an experiment with two arms: in one arm, anglers from the ALD sample are sent a package that is very similar to those recruited from the DSF; in the second arm, anglers from the ALD are sent a package that acknowledges they have been sampled from theALD and tailors the message to encourage their special importance to the study. The purpose is to identify which method encourages the highest level of response from the ALD sample.The second set of experiments involves issues that are unique because of the two phases of data collection (phase 1 is the identification of households with anglers from a screener survey and phase 2 is surveying the anglers identified in the screener). These experiments involve using techniques such as special mailing (Priority and Fed-Ex for some mailings) and telephone follow-up of nonrespondents. The main goal is to developmethods that will maximize the response of anglers who are sampled in the 2nd phase given the 1st phase mailings. The experiment will test treatments (regular 1st class mail or R, special mailing such as FedEx or S, and telephone contact or T) by order and phase.Exhibit 1 outlines the proposed design that combines the two sets of experiments. The outcome variables are the response rate and yield of completed angler interviews (the two differ if the contact brings in different percentages of anglers). The sample sizes are the number of households (or anglers from the ALDS) sampled. The sample sizes for the ALDS mailings (treatments 2, 3 and 4) were set to be able to detect a 5 percentage point difference for the treatments at the 95% confidence level. These were based on expected response rates that are around 50 to 60 percent. The sample sizes for the other mailings (treatments 1 and 5-13) were set to be able to detect a 4 percentage point difference for the treatments at the 95% confidence level. These were based on expected response rates that are around 30 to 40 percent. The last treatment (13) is consistent with the approach used in the dual-frame mail survey pilot study. The total sample size for all the treatments is 14,900. Since roughly 10 percent of the sample will probably be out of scope (vacant or not deliverable), we propose to increase the selected sample size for each of the treatments to account for this, bringing the sample size to just over 16,400.The study will be conducted in North Carolina and at least one additional state. North Carolina is included since the initial pilot was conducted there and comparisons of these results to those of the first pilot will be useful for enhancing the methodology. The sample will be allocated to each state and then partitioned to each treatment condition proportionately.

1.5. Public Description

1.6. Objectives
This project will result in an assessment of response rates and yields of completed interviews with anglers that can be expected from the dual frame survey using mail as the primary mode. These experiments will also provide direct information on the costs of the alternative methods, and the amount of time required to obtain the data using the different approaches.

1.7. References

Dillman, D., Smyth, J., and Christian, L. (2009). Internet, Mail, and Mixed-Mode Surveys: The Tailored Design Method, 3rd Edition. Wiley & Sons, New York.

2. Methodology

2.1. Methodology

2.2. Region
Mid-Atlantic, South Atlantic

2.3. Geographic Coverage

2.4. Temporal Coverage

2.5. Frequency

2.6. Unit of Analysis

2.7. Collection Mode

3. Communication

3.1. Internal Communication

3.2. External Communication

4. Assumptions/Constraints

4.1. New Data Collection

4.2. Is funding needed for this project?

4.3. Funding Vehicle
ST Data Collection Contract

4.4. Data Resources

4.5. Other Resources

4.6. Regulations

4.7. Other
1. Assume response rates will be similar to those observed in dual-frame mail pilot study.2. The ability to conduct the pilot study in states other than NC is contingent upon state participation in the planning and execution of the study.3. The ability to conduct the pilot study in states other than NC is dependent upon the quality of angler license sample frames.

5. Final Deliverables

5.1. Additional Reports

5.2. New Data Set(s)

5.3. New System(s)

6. Project Leadership

6.1. Project Leader and Members

First Name	Last Name	Title	Role	Organization	Email	Phone 1	Phone 2
Rob	Andrews		Team Member				
Mike	Brick		Team Leader				
Nancy	Mathiowetz		Team Member				
Lynne	Stokes		Team Member				

7. Project Estimates

7.1. Project Schedule

Task #	Schedule Description	Prerequisite	Schedule Start Date	Schedule Finish Date	Milestone
6	Analyze data		11/01/2010	12/31/2010	
7	Draft Report		01/01/2011	02/28/2011	
9	Submit paper for publication		02/28/2011	02/28/2011	
1	Identify state or states for conducting study		03/01/2010	03/31/2010	
2	Draft sample design document		03/01/2010	05/31/2010	
3	Procure data collection contractor		03/01/2010	06/01/2010	
4	Develop survey materials		04/01/2010	06/30/2010	
5	Data Collection (Wave 4)		07/01/2010	10/31/2010	
8	Present findings at American Statistical Association Meetings		02/28/2011	02/28/2011	

7.2. Cost Estimates

Cost Name	Cost Description	Cost Amount	Date Needed
Data Collection Contracts: Includes mail and telephone data collection and data processing, as well as costs to develop/print/mail survey materials		$500000.00	05/01/2010
Project-specific Travel		$5000.00	09/01/2010

Cost Name	Cost Description	Cost Amount	Date Needed
TOTAL COST		$505000.00	

8. Risk

8.1. Project Risk

Risk Description	Risk Impact	Risk Probability	Risk Mitigation Approach

9. Supporting Documents
"Final Report", page 1

A Comparison of Recreational Fishing Effort Survey Designs

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Limitations of Use

The findings in this report have limitations. The comparisons of effort estimates described in this report are based upon a single wave of data collection in two states. Our findings may not be indicative of survey results in other states or waves. The surveys compared in this report were not administered in a controlled, experimental setting designed specifically to measure differences in sources of error between the survey designs. Rather, our purpose was to test the effectiveness of alternative survey methodologies for collecting recreational fishing effort data. Any attempt to model or apply the resulting changes in effort estimates to other states or waves may be an inappropriate use of this report.

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Executive Summary

A primary objective of the Marine Recreational Information Program (MRIP) is to implement improved surveys of recreational fishing effort. To that end, MRIP has funded several pilot studies to develop and test the feasibility of alternative data collection designs with a goal of increasing the efficiency of data collection and the accuracy of survey estimates. A focus of the research program has been to improve coverage of the population while also reducing nonresponse and measurement error. The objective of this report is to synthesize the results of the completed pilot studies, assess differences in the resulting estimates within a framework of survey errors, and provide recommendations for future testing and implementation.

To date, MRIP has considered four data collection designs for collecting recreational shore based and private boat fishing effort data: 1) the Coastal Household Telephone Survey (CHTS), which is the ongoing random-digit-dial (RDD) survey administered by NOAA Fisheries, 2) the Angler Licensed Directory Telephone Survey (ALDS), which samples from lists of licensed or registered saltwater anglers, 3) dual-frame telephone surveys, which integrate CHTS and ALDS sampling in a dual-frame design, and 4) dual-frame mail surveys, which sample from angler license frames and residential address frames. Because the components of the dual-frame surveys are sampled independently, we are also able to consider the effectiveness of single-frame, license surveys (ALDS and license mail survey) and general population surveys (CHTS and ABS).

All of these survey designs have been administered to collect data for a common time period (November-December, 2010) in common states (Louisiana and North Carolina), which provides an opportunity to make direct comparisons of survey estimates. Our goal was to examine, both qualitatively and quantitatively, the potential sources of survey error for each of the designs and explain, to the extent possible, observed differences in estimates within the context of these errors. The largest observed differences were between estimates generated from the CHTS and ABS general population samples. Subsequently, much of the assessment focused on explaining differences between these two survey designs. Comparisons between the license frame survey estimates (ALDS and license mail survey) revealed less substantial differences, but provided insight into the observed differences between mail and telephone survey designs.

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In general, the mail survey designs produce larger estimates of fishing effort than the corresponding telephone survey designs, particularly for estimates of shore-based fishing effort generated from the general population samples. The larger estimates of effort are driven by differences in the estimated number of anglers rather than the estimated mean trips per angler.

Nonresponse, incomplete coverage, and measurement error were examined to evaluate the observed differences in survey estimates. Evidence of nonresponse bias was found for both the ABS and CHTS designs, as avid anglers are more likely to respond to the surveys than non-anglers. While nonresponse bias is a concern, it is unlikely to contribute significantly to the observed differences between the ABS and CHTS estimates of effort. Similarly, both mail and telephone survey designs are susceptible to bias resulting from noncoverage, with a greater potential for bias in the CHTS due to the exclusion of non-landline households and households in noncoastal counties. As with nonresponse, noncoverage is a concern but does not appear to be responsible for large differences between the CHTS and ABS.

We concluded that differential biases due to measurement errors were likely to be the largest source of differences between the CHTS and ABS estimates. Specifically, we hypothesize that inaccurate responses to the telephone survey screening questions are producing biases in the estimates largely due to recall/salience effects. This error has a greater impact on estimates of shore fishing effort than boat fishing effort because boat fishing trips are more salient than shore fishing trips. The mechanism for this bias appears to be related to the tasks imposed on the telephone survey respondent. Specifically, telephone survey respondents, answering a "cold" telephone request, are asked to recall recreational fishing activity for all members of the household with minimal time to consider the request. Because the CHTS screening questions are administered to whomever answers the phone, it is very possible that the respondent did not personally participate in any or all the recreational fishing trips taken by the members of the household, and he or she may not recall or be aware of the fishing activities of other household members. This would result in an underestimate of fishing incidence and subsequently the estimated number of anglers who fished in the wave. In contrast, respondents to the mail survey have more time to consider the survey request, and the mail instrument provides a visual cue in the form of a calendar to aid in recall. In addition, we believe the mail questionnaire is more likely to end up in the hands of someone within the household who fishes or is likely to know about the fishing activities of other household members.   Because the surveys were not administered in a controlled, experimental setting, we cannot confirm this hypothesis with existing data. However, comparisons among the survey results consistently support this hypothesis.

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While we do not have external data sources to confirm that one approach has less bias than another, our investigations and hypotheses lead us to believe that the mail survey estimates are subject to less bias across all sources of error than the telephone survey estimates. Since the dual-frame approach is efficient in terms of identifying anglers, the dual-frame mail survey design is a reasonable alternative to the CHTS. However, we recommend testing a single-phase, stratified alternative to the dual-frame design that changes how the license frames are used, as well as the mailing procedures. Rather than using the license databases directly for sampling, we propose to use them to stratify ABS samples. Stratifying ABS sample into matched and unmatched strata will allow us to sample at different rates, effectively maintaining the efficiency of sampling directly from the license frame while avoiding some of the potential biases and complexities associated with the dual-frame design.

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Conclusions/Recommendations

The review of survey methods and results has led us to the following conclusions and recommendations:

- While both general population surveys are susceptible to bias resulting from noncoverage, the potential for bias is greater in the CHTS due to the exclusion of non-landline households and non-coastal county households. We did not find evidence to suggest noncoverage bias accounted for differences in the survey estimates, but noncoverage from excluding non-landline households is likely to continue to increase and this could lead to larger noncoverage biases in the CHTS in the future.

- In the states we studied, angler license frames are very incomplete and not suitable to be used exclusively as sample frames for recreational fishing surveys at this time. Undercoverage rates of license frames ranged from 40-50% in North Carolina and from 5-70% in Louisiana.

- Nonresponse error due to avidity bias is a concern in both the ABS and CHTS. Nonresponse adjustment methods, such as those used in the ABS, should be used to reduce avidity bias. Our analysis did not find that differential nonresponse bias contributed significantly to the observed differences between ABS and CHTS estimates.

- The large differences between CHTS and ABS estimates appear to be due primarily to measurement errors. The respondent tasks are very different for telephone and mail surveys, which is likely to result in differential bias due to differences in recall ability and the salience of different types of fishing activity.

- While we do not have external data sources to confirm that one approach has less bias than another, our investigations and hypotheses lead us to believe that the mail survey estimates are subject to less bias across all sources of error than the telephone surveys.

- Frame matching errors in the dual-frame designs are likely to result in a small overestimate of fishing effort for the dual frame mail survey. Since the dual-frame approach is efficient in terms of identifying anglers, the dual frame method is a reasonable alternative design to the CHTS.

- We recommend testing a single-phase, stratified alternative to the dual-frame design that changes how the license frames are used and the mailing procedures. Rather than using the license databases directly for sampling, we propose to use them to stratify ABS samples. Stratifying ABS sample into matched and unmatched strata will allow us to sample at different rates, maintaining the efficiency of sampling directly from the license frame while avoiding some of the potential biases and complexities associated with the dual-frame design.

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1.   Introduction

Traditionally, marine recreational fishing effort data for the U.S. Atlantic Coast and the Gulf of Mexico have been collected by NOAA Fisheries through the Marine Recreational Fisheries Statistics Survey's (MRFSS) Coastal Household Telephone Survey (CHTS). The CHTS utilizes a random digit dialing (RDD) telephone survey approach to contact residents of coastal county households and collect information on fishing activities that occurred within a two-month reference period (wave). In recent years, the efficiency and effectiveness of RDD surveys in general, and the CHTS specifically, have been questioned due to declining rates of coverage and response.

In a review of the MRFSS conducted by the National Research Council (NRC) of the National Academies of Science, reviewers noted that the CHTS design suffers from inefficiency due to the low rate of saltwater angler participation among the general population, as well as potential coverage bias due to the survey's limitation to coastal county residences and landline-based telephone numbers (National Research Council 2006). The review further recommended the development of and subsequent sampling from a comprehensive list of registered saltwater anglers or, in the absence of such a list, implementation of dual-frame procedures that include sampling from both lists of licensed saltwater anglers and residential household frames.

The Marine Recreational Information Program (MRIP) has designed and tested several different sampling alternatives to address concerns about the CHTS. The objectives of this document are to:

> ➢ summarize the various fishing effort survey design alternatives developed through MRIP;
> ➢ provide an overview of common sources of survey error and their potential impacts on estimates;
> ➢ assess observed differences in fishing effort estimates generated through the different survey design alternatives within the context of survey errors; and,
> ➢ Suggest additional design alternatives for consideration by MRIP leadership that may better address potential sources of error identified in this review.

Below, we outline the various approaches to collecting fishing effort data that are currently being used or studied by MRIP. The next section provides a framework of common survey errors used to explore the differences in estimates produced from the different data collection designs. The third section presents the estimates from the different surveys and analyzes the differences with respect to

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measurement, coverage, response, and matching errors. Given the complexity of the analysis, we include a synopsis of the findings at the end of this section. The final section proposes alternative design options based on the findings of the analyses with the goal of finding solutions that may minimize the most important errors identified.

1.1   Coastal Household Telephone Survey

The CHTS, which was implemented by NOAA Fisheries in 1981, is a cross-sectional, random-digit dial (RDD) telephone survey of coastal county residences (residences in counties within 25-50 miles of coast). Sampling is stratified by state and county, and the data are collected for a two-month reference period (wave). The survey utilizes computer assisted telephone interviewing (CATI) to contact households and collect information on recreational saltwater fishing activity, including the number of people who participate in saltwater fishing and the number of shore and private boat fishing trips they take (Van Voorhees et al., 2002).

Once a household has been contacted for a CHTS interview, the initial respondent is asked a series of questions to determine if anyone in the household participated in saltwater fishing during the two month reference wave. Specifically, the respondent is sequentially asked the following conditional questions:

1. How many people in this household go fishing?
2. How many people in your household, including children and adults, have been recreational saltwater fishing in the last 12 months anywhere in the US or in a US territory?
3. Thinking just about the past 2 months, how many of the people living in your household, including children and adults, have been recreational saltwater fishing in the last 2 months in the US or a US territory?

If the responses to all three of these questions are affirmative, then each household member who fished during the wave is sampled and an attempt is made to collect detailed information about his or her fishing activity. Specifically, each angler is asked to report the total number of days fished during the wave, then asked a series of questions about each individual trip, including the date and fishing mode, beginning with the most recent trip and working backward through the wave. The complete CHTS questionnaire is included as Appendix A.

Because the CHTS is limited to coastal counties, estimates of total fishing effort are dependent upon expansion factors derived through an independent intercept survey of completed fishing trips.

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Specifically, CHTS estimates are adjusted upward by the inverse of the ratio of CHTS-covered trips (intercepted trips taken by anglers in coastal households) to total trips (CHTS-covered trips plus intercepted trips taken by anglers from non-coastal counties).

1.2   Angler License Directory Telephone Survey

As noted by the NRC (2006), a more efficient approach for surveying anglers is to sample directly from lists of individuals who are licensed to participate in saltwater fishing. Working collaboratively with the Gulf States Marine Fisheries Commissions, the Gulf Coast states, and the North Carolina Division of Marine Fisheries, MRIP has designed and tested Angler License Directory Telephone Surveys (ALDS), which sample from state databases of licensed anglers. The ALDS was implemented as a pilot project in Florida, Alabama, Mississippi and Louisiana in 2007 and expanded to North Carolina in 2008. Currently, the survey is being administered in LA and NC.

The data collection procedures for the ALDS are nearly identical to the CHTS, with the exception of the screening portion of the survey; the ALDS requests to speak with the individual licensed angler by name and then proceeds to determine if the angler, or any other individuals who reside in the same household as the angler, fished during the wave. As with the CHTS, trip details are collected through episodic recall beginning with the most recent trip.

As predicted, the ALDS is more efficient than the CHTS at contacting anglers. However, exemptions to state licensing requirements, as well as incomplete and inaccurate contact information for individuals included on the sample frames, create gaps in the coverage of the survey.

1.3   Dual-Frame Telephone Survey

As noted above, the CHTS and the ALDS, considered individually, do not provide complete coverage of the angler population. To compensate for potential sources of coverage error in the CHTS and ALDS, MRIP has developed an estimation design that integrates CHTS and ALDS sampling in a dual-frame design (Lai and Andrews 2008). The union of the CHTS and ALDS sample frames defines three domains: 1) anglers who can only be sampled from the CHTS frame (unlicensed anglers who reside in coastal counties covered by the CHTS); 2) anglers who can only be sampled from the ALDS frame (licensed anglers who reside outside of the coverage area of the CHTS); and, 3) anglers who can be sampled from both the CHTS and ALDS frames (licensed anglers who reside in coastal counties). A fourth domain includes anglers who cannot be sampled by either the CHTS or ALDS (unlicensed anglers without landline telephones within the CHTS coverage area and unlicensed anglers residing outside the coverage

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area of the CHTS). This design is currently being implemented in NC and LA, and has also been tested in the other states where the ALDS and CHTS have been conducted concurrently, including FL, AL and MS, as well as Washington.

While the dual-frame telephone survey design certainly increases the coverage over either the CHTS or the ALDS, the methodology is not without limitations. As mentioned, the union of the CHTS and ALDS sample frames excludes a segment of the angling population, creating a potentially significant gap in coverage. Previous studies suggest that up to 38% of fishing trips in NC are taken by anglers who are excluded from either the CHTS or ALDS (Andrews et al. 2010). In addition, partitioning anglers into the appropriate domains, and subsequently adjusting sample weights, is based upon the survey respondents' willingness and ability to classify themselves as licensed or unlicensed anglers. This has been demonstrated to be an unreliable approach for defining dual-frame domains (Andrews et al. 2010) and subsequently calculating unbiased survey weights.

1.4   Dual-Frame Mail Survey

An alternative to the dual-frame telephone survey is to identify and contact anglers through a dual-frame mail survey design. MRIP initially tested the feasibility of a dual-frame mail survey design in NC in 2009, and conducted a follow-up study aimed at enhancing response rates and the timeliness of responding in NC and LA in 2010.

The specific details of the dual-frame mail survey design are described elsewhere (Andrews et al. 2010). Briefly, anglers are sampled both from state databases of license saltwater anglers and from residential address frames maintained and made commercially available by the United States Postal Service. The address-based sample (ABS) is matched to the license databases by searching the license frame for the same address and/or telephone number (for the cases in which a telephone number can be located through a commercial service for the ABS sampled address).

The License frame sampling is conducted in a single phase; sampled anglers are mailed a brief questionnaire that asks respondents to report the number of days fished from the shore and from a boat during a two-month reference wave. The instrument used in the mail mode is substantially different from the CHTS and ALDS instruments. The impact of these differences on survey estimates is discussed in some detail below in section 3.

The ABS sampling is conducted in two phases. Residential addresses are sampled and mailed a screening questionnaire to identify individuals who fished during the previous twelve months. Anglers

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identified in the screening phase are sent a second-phase questionnaire that is identical to the license sample questionnaire.

The screening and angler questionnaires are included as appendices, B and C, respectively.

1.5   Comparisons of Survey Estimates

All of the surveys described above have been administered in overlapping geographic locations (LA and NC) and time periods (wave 6, 2010), which allows us to directly compare estimates generated through the various designs. In addition, because the components of the dual-frame designs are independent (e.g. ABS mail sample is independent from the license mail sample), we can compare components within a dual-frame design, as well as compare components among dual-frame designs. For example, we can compare estimates from the ABS component of the dual-frame mail survey to both license mail estimates (within dual-frame design comparison) and CHTS estimates (among dual-frame design comparison). There are some situations where the comparisons are limited to specific geographic regions; for example, the CHTS only covers households in coastal counties, limiting some comparisons to these counties. The geographic limitations of the comparisons are noted as appropriate.

The differences between some of the estimates were substantial enough that a review of the differences, and an attempt to reconcile these differences, was deemed necessary. This review was developed in the tradition of an investigation of differential error sources, and data from the surveys was used in the evaluation. The next sections briefly introduce the sources of error considered in the review and describe observed differences between survey estimates within the context of these errors. The surveys were not designed to provide experimental evidence about specific error sources, so most of the evaluations are observational in nature. As a result, the conclusions drawn are tentative. Every attempt was made to be even-handed in the review, but this type of analysis is invariably affected by the reviewers' experiences and opinions. The final section is a presentation of two alternative designs that might perform differently from the current design based on the analysis conducted.

2.   Survey Error

It is useful to establish a common language concerning sources of survey error when comparing estimates from substantially different survey designs. A common conceptual framework that is often used (Groves, 1989) is that of Total Survey Error (or mean squared error) –the sum of all variable errors and all biases (more precisely, the sum of variance and squared bias). Bias is the type of error that affects the statistic in all implementations of a survey design; variable error arises because achieved values differ over the units (e.g. sampled persons; interviewers used; questions asked) that are the sources of error.

Most methodologists further classify errors in terms of errors of observation (or representation) and errors of non-observation (or measurement). Coverage error, sampling error, nonresponse error, and adjustment error all fall within the framework of errors of representation; measurement error encompasses all sources of error that lead to a difference between the edited response derived from the survey and the "true value" of the construct of interest. Coverage error refers to issues related to the sampling frame—the extent to which all members of the population of interest have a non-zero probability of being sampled from the frame. Although one can have both under- as well as over-coverage, the focus of most coverage investigations is related to who (or what) is not covered by a particular frame. Coverage error is a function of both the proportion of the population not covered by the frame and the extent to which those who are not covered differ from those who are covered. Similar to coverage error, nonresponse error is a function of both the proportion of the sample that does not respond to the survey request and the extent to which those who do respond differ from those who do not on the characteristics of interest to the study. Sampling error exists in all sample surveys and simply reflects the variability associated with the selection of a particular sample from the distribution of all possible samples, given a specific design.

The sources of measurement error (or errors of observation) include the interviewer, the instrument (both the individual questions and the overall questionnaire), the respondent, and processing error. Interviewer errors are those errors related to the variation in the delivery and recording of the questions by interviewers across respondents; for example, failure to read a question, changes in intonation either across interviewers or across respondents within an interviewer, or errors in the recording of an answer. Instrumental errors (both individual questions and the overall questionnaire) arise from wording of questions, wording of response options, the flow of the questionnaire (e.g., order effects), as well as the

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mode and method of data collection. Respondent errors – those arising from the respondent –may be due to errors in recall ability, knowledge (when proxy reporting), motivation of the respondent to report accurately, saliency of the event to the respondent, social desirability bias (e.g., the willingness to report socially undesirable information), as well as respondent fatigue. Processing error –the least well studied of the sources of survey error –arise from the editing and processing of data.

Figure 2.1 in the NRC report "Review of Recreational Fisheries Survey Methods," reproduced from Groves, et al (2009) illustrates the life cycle of a survey from a quality perspective. For convenience the figure is included here as Figure 1.

Figure 1. Survey Process from a Quality Perspective
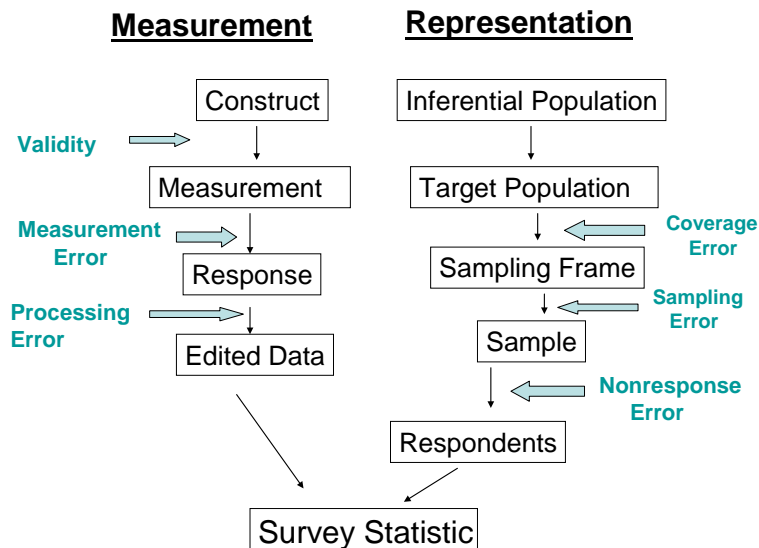
Source: Groves, et al, 2009

3.   Comparisons and Analysis

Estimates of total angler trips by state, geographic domain and fishing mode for the CHTS and ABS are provided in Table 1.   In the CHTS, coastal resident effort is estimated directly through telephone survey data. Because the coverage of the survey is limited to coastal counties, estimates of noncoastal resident effort are generated by expanding coastal resident effort upward by correction factors generated through an onsite survey of completed fishing trips. Table 1 and all subsequent tables and figures show the expanded estimates from the CHTS, unless explicitly noted.

Table 1. Comparison between CHTS and ABS for estimated total angler trips (in thousands).

	CHTS (000's)	ABS (000's)	Ratio (ABS:CHTS)
Overall	1129	2640	**2.3***
North Carolina	421	1334	**3.2***
Private Boat	200	474	**2.4***
Coastal	157	308	2.0
Noncoastal	43	167	3.9
Shore	221	860	**3.9***
Coastal	117	493	**4.2***
Noncoastal	104	367	**3.5***
Louisiana	708	1306	**1.8***
Private Boat	584	608	1.0
Coastal	504	457	0.9
Noncoastal	80	151	1.9
Shore	124	699	**5.6***
Coastal	102	587	**5.7***
Noncoastal	22	112	5.1

* Ratio is significantly different from 1.0 at the $\alpha=0.05$ level.

ABS estimates of the total number of angler trips are significantly greater than CHTS estimates in aggregate over all comparison cells and overall for each of the two states. Within the state of North Carolina, we see significant differences by fishing mode whereas in Louisiana, the difference is only significant in the reporting of shore fishing trips. The increased reporting of shore trips for the ABS sample in North Carolina persists across geographic domains whereas in Louisiana, only the coastal geographic domain exhibited significantly more angler trips.

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CHTS and ABS estimates of mean trips per angler and the total number of anglers who fished during the wave are provided in Table 2.   The table is limited to the coastal stratum to correspond to the geographic coverage of the CHTS and to make the comparison more direct. For private boat fishing, ABS and CHTS estimates of mean trips per angler are not significantly different. For shore fishing, ABS estimates of mean trips per angler are not significantly different from CHTS estimates in LA, but are significantly greater in NC. ABS estimates of the total number of anglers who fished during the wave are significantly larger than CHTS estimates for both states and modes, with the exception of private boat fishing in LA, for which the estimates are not significantly different.

Table 2. Estimated mean trips per angler and total anglers (000's) who fished by mode for the CHTS and ABS, Coastal County Residents.

	Mean Trips per Angler			Total Anglers (000's)		
	CHTS (SE)	ABS (SE)	ABS:CHTS	CHTS (SD)	ABS (SD)	ABS:CHTS
NC Private Boat	4.75 (0.69)	5.43 (0.90)	1.14	30.34 (4.51)	57.83 (7.06)	**1.91***
NC Shore	3.81 (0.48)	6.97 (1.01)	**1.83***	28.25 (5.40)	76.96 (8.12)	**2.72***
LA Private Boat	5.32 (0.93)	4.27 (0.38)	0.80	88.30 (13.78)	108.00 (9.70)	1.22
LA Shore	3.82 (0.77)	6.05 (0.73)	1.58	24.63 (5.31)	101.12 (9.50)	**4.11***

* Ratio is significantly different from 1.0 at the $\alpha=0.05$ level.

Figure 2 demonstrates the distribution of anglers among types of fishing activity for the ABS mail, CHTS, license mail and ALDS. Anglers who reported fishing during the wave were classified into one of the following categories: 1) Fished only in private boat mode, 2) fished only in shore mode, or 3) fished in both private boat mode and shore mode. There are substantial differences in the types of reported fishing activity among the types of surveys. Specifically, more anglers reported participating in both boat and shore fishing in the mail surveys (ABS mail and license mail) than the telephone surveys (CHTS and ALDS). Generally, the higher incidence of anglers who reported both types of fishing activity in the mail surveys is at the expense of anglers who only reported boat fishing, which is considerably lower in the mail surveys than the phone surveys. This observation is consistent across states, although it is more pronounced in NC than in LA. In NC, the proportion of anglers reporting only shore fishing was relatively consistent across surveys. This was not case in LA, where more anglers reported only shore fishing in the mail surveys than in the phone surveys.

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Figure 2. Distribution of anglers among type of recreational saltwater fishing trips for four independent data collections, Wave 6, 2010, Coastal County Residents.
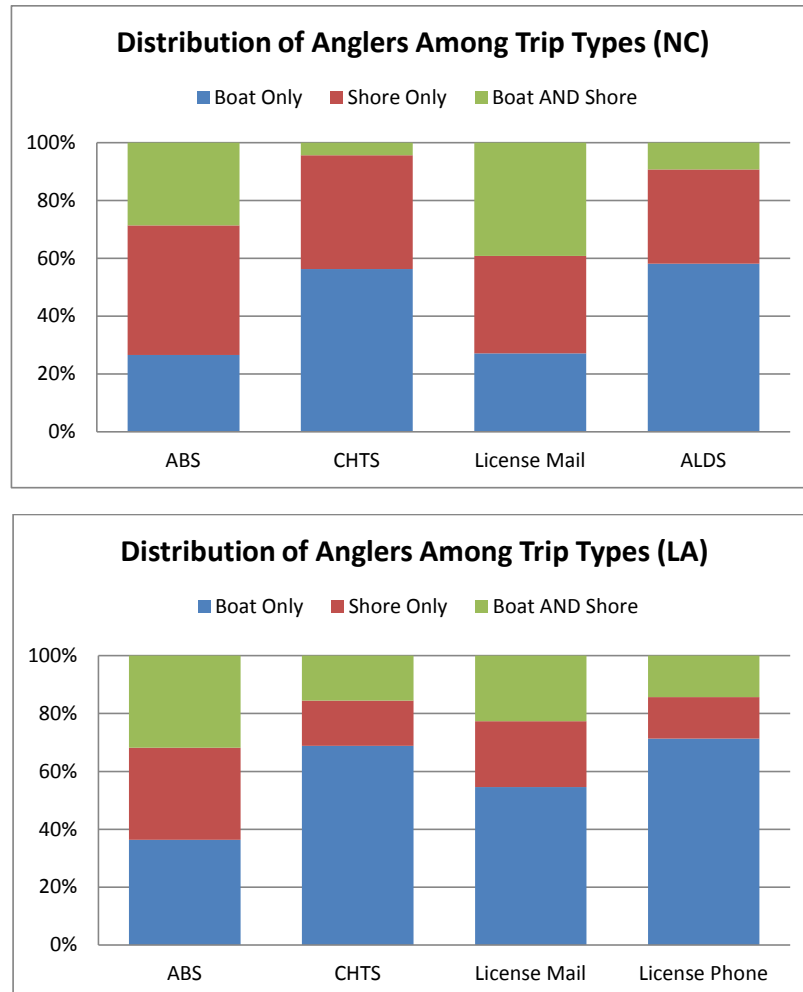
Tables 3 and 4 present the estimated number of angler trips, anglers, and average number of trips per angler for the license frame surveys, similar to those given in tables 1 and 2 for the general population surveys. Since the license frame surveys are not restricted to the coastal counties for either of the two modes, the estimates are of all anglers licensed in the states. While often significant, the differences between estimates are generally smaller than those observed in the CHTS and ABS general population surveys. As a result, in the remainder of this section, we focus on differences between the ABS and

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CHTS and try to explain those differences in terms of potential sources of biases for the different survey designs. While the differences between the license mail survey and ALDS are less pronounced they may provide insight into differences between the ABS and CHTS. These results are presented and discussed accordingly.

Table 3. Comparison between ALDS and License Mail Survey for estimated total angler trips (in thousands).

	License Mail (000's)	ALDS (000's)	Ratio (License Mail:ALDS)
Overall	1787.8	1075.0	**1.7***
North Carolina	799.9	478.4	**1.7***
Private Boat	281.5	180.3	**1.6***
Coastal	187.0	118.7	1.6
Noncoastal	85.7	59.7	1.4
Outstate	8.8	1.9	**4.7***
Shore	518.3	298.2	**1.7***
Coastal	270.2	149.7	1.8
Noncoastal	188.1	102.2	**1.8***
Outstate	60.0	46.3	1.3
Louisiana	987.9	596.5	**1.7***
Private Boat	537.4	433.7	1.2
Coastal	433.2	351.9	1.2
Noncoastal	60.0	72.8	0.8
Outstate	44.2	9.0	**4.9***
Shore	450.5	162.9	**2.8***
Coastal	402.3	134.3	**3.0***
Noncoastal	30.9	23.8	1.3
Outstate	17.3	4.8	3.6

* Ratio is significantly different from 1.0 at the α=0.05 level.

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Table 4. Estimated mean trips per angler and total anglers (000's) who fished by mode for the ALDS and License Mail Survey.

	Mean Trips per Angler			Total Anglers (000's)		
	ALDS (SE)	License Mail (SE)	License Mail:ALDS	ALDS (SE)	License Mail (SE)	License Mail:ALDS
North Carolina						
Private Boat	2.67 (0.31)	3.80 (0.40)	1.42	67.54 (6.69)	74.98 (8.13)	1.11
Coastal	3.17 (0.52)	4.18 (0.55)	1.32	37.42 (4.67)	45.20 (5.72)	1.21
Non Coastal	2.05 (0.25)	3.28 (0.63)	1.60	29.19 (4.70)	26.68 (5.71)	0.91
Non Resident	2.00 (0.00)	2.83 (0.34)	**1.42 ***	0.93 (0.93)	3.10 (0.90)	3.35
Shore	4.51 (0.74)	4.75 (0.36)	1.05	66.06 (6.74)	112.17 (9.24)	**1.70***
Coastal	6.44 (1.91)	5.43 (0.64)	0.84	23.23 (4.47)	49.74 (5.77)	**2.14***
Non Coastal	2.96 (0.36)	3.99 (0.48)	1.35	34.50 (4.73	49.76 (7.04)	1.44
Non Resident	5.56 (1.99)	4.87 (0.37)	0.88	8.34 (1.72)	12.66 (1.63)	1.52
Louisiana						
Private Boat	4.10 (0.42)	4.69 (0.61)	1.14	105.88 (4.58)	119.16 (8.06)	1.13
Coastal	4.36 (0.53)	5.02 (0.80)	1.15	80.75 (3.91)	89.75 (7.47)	1.11
Non Coastal	3.38 (0.47)	3.65 (0.59)	1.08	21.55 (1.97)	17.52 (2.84)	0.81
Non Resident	2.50 (0.42)	3.72 (0.50)	1.49	3.58 (1.32)	11.90 (1.66)	3.32
Shore	5.58 (1.35)	6.44 (0.89)	1.15	29.20 (4.38)	71.99 (7.22)	**2.47***
Coastal	5.85 (1.66)	6.97 (1.07)	1.19	22.95 (3.91)	59.45 (6.86)	**2.59***
Non Coastal	5.33 (2.09)	3.75 (0.91)	0.70	4.46 (1.69)	8.43 (1.98)	1.89
Non Resident	2.67 (1.67)	4.30 (0.97)	1.61	1.79 (0.99)	4.11 (1.08)	2.29

* Ratio is significantly different from 1.0 at the $\alpha=0.05$ level.

3.1   Differential Bias due to Measurement Errors

An important consideration in all comparisons of estimates from different surveys is the effect of measurement errors. Since the CHTS and ALDS are telephone surveys and the ABS and license mail surveys are self-administered mail surveys, the data collection mode and the effects of the interviewers are key differences that need to be considered. In addition, the questionnaires used in the telephone surveys and in the mail surveys differ significantly. However, the surveys were not administered in a controlled, experimental setting designed specifically to test for mode or interviewer effects. Consequently, assessment of measurement error is subject to confounding influences of other types of error (e.g., nonresponse error)

 The tasks imposed on the respondents in the mail surveys are dramatically different from those in the telephone surveys. In particular, in the self-administered mail survey the respondent is asked to report the number of days fished by fishing mode (shore and/or boat) during a two-month reference period, and respondents are only asked to provide information about his or her own trips; proxy reporting is not permitted although it cannot be controlled. In contrast, telephone survey respondents are initially

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asked to report the total number of days fished during the same two-month reference period and then asked to provide details, including the fishing mode, for each trip through episodic recall (although there are mechanisms to reduce the response burden for similar trips). In addition, telephone survey respondents may answer for other members of the household (proxy responses), regardless of whether or not the actual respondent participated in fishing activity during the reference wave. The telephone and mail surveys differ in other aspects as well. For example, the mail respondent can immediately see the survey request in its totality and can recognize that the request is relatively simple and not very time-consuming. The telephone respondent must wait to see how the interview unfolds and may or may not have much faith in the interviewer's declaration about the length of the survey. Thus, the demands on the respondents, the respondent rules (who can report on the trips), and the context for telephone surveys are very different from those in the mail surveys.

We try to address many of these issues within the framework of measurement error, even if this is not a completely accurate moniker. We begin with some hypotheses related to the generic observed differences in the estimates between the mail and telephone surveys. In particular, we focus on some of the biggest differences noted in Tables 1, and 2 and Figure 2. In doing this, we will include various measurement error topics such as respondent rules and proxy reporting.

The largest differences between ABS and CHTS estimates are for total trips, mean trips per angler for shore fishing, and the distribution of anglers among the types of fishing activity, with the mail surveys estimating many more anglers who took shore trips. Figure 2 indicates that the distribution of anglers who took both shore and boat trips during the reference wave differs also, and we will explore this in more detail below.

Consistent with previous literature (Schwarz, Stack, Hippler, and Bishop 1991), we would anticipate that context has a larger impact on the telephone survey than the mail survey. Since the telephone interviews are sequential, the order of the questions might influence responses. We briefly set up the context of the telephone survey interview and then present hypotheses related to this context (see the instruments in the appendix for more details).The CHTS begins by asking a respondent a series of household-level screener questions to determine if anyone in the household has been fishing during the previous two months, and if anyone in the household had a recreational saltwater fishing license that was valid during the reference period (respondents are sequentially asked how many people in the household fish, how many people in the household fished during the previous 12 months and how many people fished during the previous 2 months). If the screening questions determine that the household is

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a fishing household, then the interviewer attempts to administer angler-level questions to each household member that fished during the wave. Specifically, each person is asked if he or she had a saltwater fishing license that was valid during the previous two months, and on how many days during the past two months he or she fished both within state and in another state. They are then asked the date of their most recent trip and if the fishing on that date was from a boat (if yes, some details on the boat trip are requested). They are then asked if they (also) fished from shore on that date, or if the only fishing on that date was from the shore. The same pattern is followed for each day of fishing, with a profile attempted for each trip that occurred during the reference wave. The same person may respond for his/her activities and then respond for others in the household, in that order.

Respondents to the mail survey are also asked if they had a recreational saltwater fishing license. However these questions are asked later in the instrument, after questions about the number of days fished in each mode. In addition, respondents to the mail survey can view the entire questionnaire before answering any of the questions, which is one of the hypothesized reasons that context effects tend to be lower in self-administered mail surveys than in modes involving the use of an interviewer.

License Question Hypothesis

Since the license question arises very early in the telephone interview and much later and less prominently in the mail instrument, we hypothesized that asking about a license might suppress responses about fishing in the CHTS compared to the ABS. In other words, CHTS respondents who weren't licensed may not report fishing activity because doing so might somehow be viewed as illegal or socially undesirable. If this hypothesis is correct, then we would expect the estimated percent of anglers who reported having a fishing license to be much higher in the CHTS than the ABS.

Table 5 shows estimates of the proportion of coastal resident anglers that reported having a license for saltwater fishing in the ABS and CHTS. The estimates show that CHTS respondents who reported fishing are also more likely to have reported having a fishing license than ABS respondents, although the differences are not exceptionally large. In the CHTS, nearly all (98%) respondents who reported fishing during the wave also reported that they had a fishing license, while 87% of ABS respondents reported both fishing and having a saltwater fishing license. While the differences are in the direction of the hypothesis, the fact that most anglers in both surveys report having a license implies that the differences are not likely to be major influence on the differences in the estimates.

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Table 5. Proportion of anglers who reported having a recreational saltwater fishing license that was valid during the reference wave, Wave 6, 2010 (n=total number of respondents, including both those were licensed and unlicensed). Coastal counties only.

	CHTS (n)	ABS (n)
North Carolina	0.97 (121)	0.87 (165)
Boat	0.94 (67)	0.86 (76)
Shore	1.00 (54)	0.88 (89)
Louisiana	0.98 (171)	0.85 (254)
Boat	0.99 (139)	0.87 (136)
Shore	0.97 (32)	0.82 (118)

The ALDS questionnaire is nearly identical to the CHTS questionnaire. However, we would not expect the mechanism generating the license hypothesis to operate in either the license mail survey or the ALDS, since everyone who was surveyed was licensed. Figure 3 and Table 3 show that the license mail surveys estimates more trips than the ALDS, but the differences are not as large as the differences between the CHTS and ABS, and significant differences are limited to shore fishing. This finding provides some additional support to the hypothesis that the license question suppresses reported fishing activity in the CHTS, even though the evidence is neither overwhelming nor quantifiable.

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Figure 3. . Estimates of total angler trips for licensed anglers in North Carolina (i) and Louisiana (ii. Within domains (state/stratum/fishing mode), estimates with different letters are significantly different at the α=0.05 level, Wave 6, 2010.
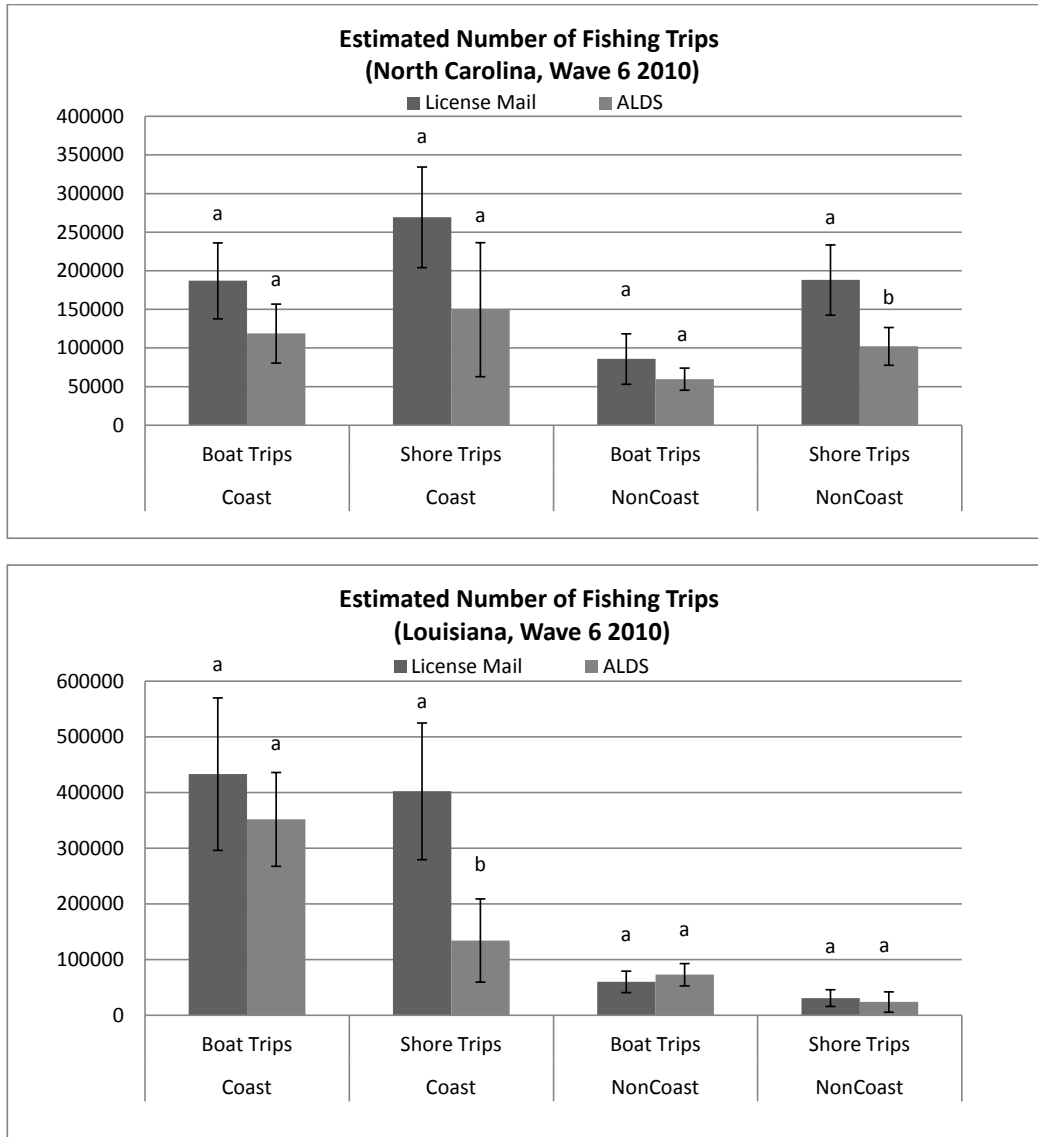
Proxy Reporting Hypothesis

We speculated that proxy responses might give rise to differences in the mean number of trips (persons for whom reports are obtained by proxies might report fewer trips) between the surveys since proxy reporting was more likely to occur for the telephone survey than for the self-administered mail survey. In the literature, self and proxy reports diverge as a function of (1) shared experience; (2) salience of the event; and/or (3) level of communication between the self and proxy. Increased reliance on proxy reports might lead to suppressed reporting of shore fishing trips and higher reports of boat fishing in the telephone surveys. The mechanism for this would be that proxy respondents might be less likely to know about shore fishing trips than boat trips due to the more salient nature of boat trips. This would lead to under-reports of shore-based trips compared to self-responses. However, if fishing trips were shared experiences, we would expect no difference in the rate of fishing trips for those reported by self versus those reported by proxy.

To investigate this we compared the proportion of trips reported by respondent type (self or proxy) and by trip mode (see table 6). Contrary to the hypothesis, proxy respondents were actually more likely to report shore trips than respondents who reported for themselves. We also explored the distribution of the number of trips by mode (not shown) and the proxy distribution was no more heavily skewed toward boat trips than that of the self-responses. A proxy reporting hypothesis is not supported by these data.

Table 6. Proportion of reported trips by mode for self and proxy CHTS interviews with coastal county residents, Wave 6, 2010.

	Private Boat	Shore
North Carolina		
Self	0.59	0.41
Proxy	0.48	0.52
Louisiana		
Self	0.77	0.23
Proxy	0.72	0.29

Imputation Hypothesis

The CHTS and the ALDS have high missing data rates due to the repeating sequence of questions about each trip. Respondents (and possibly interviewers) may find this design burdensome and terminate interviews prior to discussing all trips. The telephone surveys account for incomplete interviews through hot-deck imputation; using the total number of trips reported as the basis, trips are imputed first from

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completed trip profiles of the same respondent and then from completed trip profiles of respondents within the same household. Fishing mode was imputed for approximately 70% of fishing trips reported in the CHTS and ALDS during wave 6, 2010. We hypothesized that the relatively large magnitude of imputation in the telephone surveys, combined with the sequence of questions in the surveys (if the respondent says they have taken a trip they are first asked if that trip was a boat trip), and the greater salience of boat trips contributed to the higher reports of boat trips in the telephone than in the mail.

Table 7 shows the proportion of reported trips among fishing modes for complete and incomplete CHTS interviews. In complete interviews, trip mode was provided for all reported trips. For incomplete interviews, not all reported trips were discussed, so mode had to be imputed. If the hypothesis has merit, we would expect the incomplete interviews to have a higher proportion of boat trips than the complete trips. The table shows that the distributions of trips among modes are virtually identical for complete and incomplete interviews, providing no evidence to support the hypothesis. We also examined the proportions separately by self and proxy respondents and found the relationship was the same.

Table 7. Proportion of reported trips among modes for complete and incomplete CHTS interviews (Wave 6, 2010), Coastal County Residents.

	Private Boat	Shore
North Carolina		
Complete	0.53	0.47
Incomplete	0.50	0.50
Louisiana		
Complete	0.77	0.23
Incomplete	0.81	0.19

Recall Memory/Saliency Hypothesis

Here we discuss two measurement error topics, recall bias and saliency bias, which are rarely discussed together. In this particular instance, the two potential sources of error are closely related, and both could create bias that is differential between the surveys. Recall bias might arise because the respondent task is different for the mail and telephone surveys. In the mail survey the respondent is asked separate questions to determine the total number of trips by fishing mode during the reference period. Next to each of these questions is a calendar depicting the two months of the reference period that provides the respondent with a visual image to aid recall. In the telephone interview, the

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respondent is asked a single question to determine the total number of trips during the reference period. It is not until the detailed questions about individual trips that the mode of fishing is requested and recorded. While the mail survey affords the respondent time to consider a total for each mode, the telephone mode requires a summary judgment across all modes with minimal time to consider the request.

The differences in the respondent task across the two data collection modes may be further exacerbated by the differential salience of shore vs. boat trips. The salience hypothesis suggests that boat trips are more salient than shore trips (as we mentioned in the discussion of the proxy hypothesis boat trips may be more memorable events that are stored and retrievable from memory in ways that shore trips are not). To cause a differential bias in the estimates of trips by mode, we hypothesize that anglers with only shore trips might not remember such trips when answering a "cold" telephone request about the trips they have taken, while the mail response can be contemplated longer, resulting in more reports of shore fishing.

If the relatively greater reporting of shore trips for the ABS sample was a function of the different approaches to measurement used in the mail and the telephone surveys, we should see the same pattern of differential reporting for the licensed angler samples (comparing the mail license angler survey to the ALDS).   As can be seen in Table 4, there is no evidence of higher *rates* of shore fishing (mean trips per angler) in the license mail survey compared to the ALDS. However, similar to Table 2, we consistently observe a greater *number* of shore-based anglers in the license mail survey than the ALDS. Thus we suspect the source of the difference may be responses to the screening questions presented to the respondent at the outset of the telephone interview.   The consistency of the results across the two surveys tends to support the hypothesis that saliency affects the responses differently depending on data collection mode.

We hypothesize that inaccurate responses to the telephone survey screening questions are resulting in recall/salience bias. We further assert that recall/salience bias has a greater impact on estimates of shore fishing effort than boat fishing effort. One approach to test this hypothesis is to assess the responses to the screening questions by gender. If the respondents to the screening questions are more likely to be female, then it might suggest that female respondents are less likely to report fishing in general, and more likely to exclude shore trips due to the lower salience of these events (both the mail and telephone surveys find that men are more likely to fish than women, and this is consistent across fishing modes.)

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Table 8 shows the distribution of responses to the CHTS screening questions by gender. Women are more likely than men to be the person who answers the phone and responds to the screening questions about household fishing activity. In both Louisiana and North Carolina, nearly two-thirds of the initial respondents are female, a percentage which is consistent with other RDD studies. An interesting finding is that women are less likely than men to respond affirmatively to any of the fishing screening questions; the rates at which women respond affirmatively to the general saltwater fishing question, the 12-month saltwater fishing question and the 2-month saltwater fishing question are 40-45%, 10-26%, and 34-44% lower, respectively, than the rates of men. The cumulative effect of these observations over all screening questions (later questions are conditional upon affirmative responses to earlier questions) is that the rate at which women report household fishing during the 2-month wave is 72% lower than the rate of men.

 This observation could be the result of different compositions of the households. For example, households with women respondents could be less likely to have men present. However, it is also consistent with the recall/saliency hypothesis; women are less likely to fish than men and subsequently may not remember or may not be aware of the fishing activities of other members of the household. The impact of this may be greater for shore fishing than boat fishing, which generally requires a larger investment in both time and money and may be more salient to other members of the household.

If this is the case, or at least a contributing factor, then it might be considered a "gatekeeper effect." The generic question of whether nonresponse bias is introduced in screening surveys like the CHTS has been raised often, with little in terms of resolution. For example, in 1999 at the Joint Statistical Meeting a session on this topic found some strong evidence for gatekeepers reducing the coverage of the target population in one survey (Horrigan et al., 1999), no evidence in another survey (Meier,1999), and mixed results (Judkins et al., 1999) in a review of several surveys. While we do not know of research that specifically addresses it, we assume the gatekeeper effect is less of an issue in a mail screening survey, where we believe the questionnaire is more likely to end up in the hands of someone within the household who fishes or is likely to know about the fishing activities of other household members.

Given the rate at which women are the respondents to the CHTS, the salience hypothesis could explain some of the observed differences between CHTS and ABS estimates, and also why similar differences are not as evident in the comparison between the mail and telephone surveys of licensed anglers. If women are screening fishing households out of the CHTS, as suggested by the differences in rates of reported household fishing between men and women, then the CHTS is underestimating fishing

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incidence and subsequently the number of anglers who fished in the wave. As discussed, the impact of this could be greater for shore fishing than boat fishing. Since this is not a designed experiment, the data are merely in the direction consistent with the hypothesis rather than confirmatory of it.

Table 8. Percent of CHTS responding households that reported fishing during the wave by gender of initial respondent, Coastal Households Only.

State	Initial Respondent Male		Initial Respondent Female	
	% of Sample	% Reporting Fishing	% of Sample	% Reporting Fishing
North Carolina	36.5	11.5	63.5	3.7
Louisiana	35.9	17.5	64.1	4.3
Total	36.2	14.3	63.8	4.0

As noted previously, the differences between the ALDS and license mail survey are not as pronounced as the differences between the ABS and CHTS. One of the interesting differences between the CHTS and ALDS telephone surveys is the initial set of screening items. The ALDS asks to speak with a specific individual, the sampled licensed angler, rather than accepting any adult respondent to the initial set of items. As such, the ALDS is not as susceptible to a "gatekeeper effect" as the CHTS. The more subtle differences between the ALDS and license mail survey further support the possibility that the differences may be associated with the screening approaches taken in the surveys.

Finally, another possibility is that infrequent shore trips might be suppressed because they are less frequent and salient (if an angler goes shore fishing often salience is not relevant). To explore this, we compared the distribution of the number of shore trips from the mail ABS (coastal counties) and the CHTS. If the hypothesis were true we might find a smaller percentage of the CHTS respondents with one or two trips. This comparison failed to support the hypothesis; the percentage of respondents in the CHTS with one or two trips was greater than or equal to the percentage in the ABS mail survey.

3.2   Differential Bias due to Noncoverage

While both the mail and telephone surveys have noncoverage issues, the differences in the sources and rates of noncoverage are starkly different for the ABS and CHTS surveys; for the license samples, these differences are less pronounced. The CHTS is a landline RDD sample and only samples households in coastal counties. Since about one in three U.S. households did not have a landline by the end of 2010 (Blumberg and Luke 2011), the exclusion of cell-only households is potentially significant. The exclusion

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of non-coastal households is also substantial. Adjustments are made for both of these sources of noncoverage as discussed below.

The ABS also has some undercoverage, including the omission of some addresses from the commercial address files. This may be more concentrated in the rural populations where we find that fishing is more prevalent. A second source of undercoverage in the ABS results from the two-phase design that screens households for fishing prior to the reference wave. Some people may fish in the wave but screen themselves out of the ABS sample because they didn't fish in the 12 months prior to the wave. This however, is not a feature of the frame but rather how the sample using the ABS frame was implemented in this survey. One other issue is that the ABS is limited to persons over 18 years old, while the CHTS surveys all anglers irrespective of their age. Since the age of the angler is not obtained in the CHTS it is not possible to compare the estimates from the two surveys by age of the angler. The inclusion of children in the CHTS clearly increases its coverage and thus would increase the difference between the ABS and CHTS estimates beyond that already observed rather than account for some of the observed differences. Once again, this was a design decision for the 2009 and 2010 studies and impacts the present comparisons but could be altered in future implementations of an ABS sample.

Noncoverage Bias: ABS Mail and CHTS

Iannacchione (2011) reviews coverage rates from surveys using USPS files as the frame and states that mail surveys offer near complete coverage of the U.S. household population. He notes that overcoverage due to households having two addresses that receive mail (a street address and a P.O. Box) is likely to be a bigger issue than undercoverage for mail surveys. Even though people living in coastal households are more likely to be rural and also to participate in saltwater fishing, it appears that the ABS provides a frame with relatively minor coverage losses due to this source.

The other source of potential undercoverage is the use of a retrospective question concerning saltwater fishing to determine eligibility. In the two-phase mail survey the screener is mailed prior to the end of wave and some people may not have fished in the last 12 months (the screener item) but may fish in the next two or three weeks that are remaining during the reference period of interest. The 2010 mail screener included a prospective question about fishing in the next three months to help assess the potential for undercoverage. In both states and strata (coastal and non-coastal), about 3 to 5 percent of the households reported that someone in the household might fish in the next 3 months but no one in the household had fished in the last 12 months. Because the question asked about 3 months rather than the next few weeks (the in-scope period) and prospective questions are not very reliable as predictors,

we believe that this exclusion is relatively minor for the estimates of the ABS. Furthermore, the noncoverage of the ABS would increase the difference between the ABS and CHTS and does not account for the observed difference.

For the CHTS the exclusion of the cell phone and non-coastal counties is more problematic, and the difference varies by state. In a state like Louisiana, nearly half of the population lives in coastal counties, while in North Carolina only about 20 percent of the population resides in coastal counties. Although non-coastal counties are not sampled in CHTS, an adjustment is made by expanding estimates of coastal fishing effort upward by correction factors derived through an access-point intercept survey of completed fishing trips. Specifically, intercepted anglers are asked for their state and county of residence, and CHTS estimates are then expanded by the inverse of the ratio of CHTS-covered trips (trips taken by anglers in coastal households) to total trips (CHTS-covered trips, as well as trips taken by anglers from non-coastal counties). For example, if 80% of the intercept anglers live in coastal counties then the CHTS estimate is inflated by 1/0.8=1.25. The exclusion of cell phone only households uses a different approach described below.

The total effort estimates by stratum based on the ABS (Table 1) showed that a substantial percentage of the fishing effort was by non-coastal residents, but this differed by fishing mode and state. The ABS estimated that in Louisiana about 75% of boat trips and 84% of shore trips were by coastal residents; in the CHTS the corresponding percentages (derived from the intercept surveys) were 86% for boat trips and 82%for shore trips. In North Carolina the ABS estimated that 65% of boat trips and 57% of shore trips were by coastal residents; the CHTS estimated that 79% of boat trips and 53% of shore trips were by coastal residences. The errors on these estimates are likely to be large so it is difficult to determine whether the adjustments fully adjust for the exclusion of the non-coastal counties. However, it seems fair to conclude that the adjustment for noncoverage in the CHTS based on the data from the intercept survey is not a major factor in accounting for the observed differences between CHTS and ABS estimates.

Since the CHTS only samples landlines, the estimates from this survey also have to be adjusted to account for the substantial loss of coverage resulting from cell-only households. This is implemented by poststratifying the CHTS weights, which have already been adjusted to account for the exclusion of the non-coastal counties, to the number of total households in the state. The implicit assumption is that the fishing activities of the landline sample are the same as the activities in the excluded households. If this

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assumption is valid, then the residual noncoverage bias due to the exclusion of the cell phone households would be small.

To examine this, estimates of mean fishing trips were computed from the ABS sample by whether the household had a landline or not. The contribution of the households excluded from the CHTS but included in the ABS can be estimated from these data. Note that the way the ABS is weighted produces estimates of the total population that fished in the wave, but does not produce estimates of the total population of all adults (although this could be done). Thus, the estimates from the ABS are of the percent of anglers who live in cell-only households and the percent of fishing trips taken by anglers who live in cell-only or nontelephone households.

Table 9 shows that within a domain, the estimated percentage of anglers and the percent of trips by phone status are fairly consistent. This implies that the anglers from the households excluded from the CHTS take trips at roughly the same rate as the included population. This is one critical assumption that is made in the adjustment of the CHTS estimates. The second assumption made in the CHTS is that the fishing population and nonfishing population are covered by the CHTS at the same rate (i.e., the fishing population has the same rate of cell-only households as the non-fishing population). This assumption cannot be tested from the ABS data because the estimates are only for those who reported fishing in the past 12 months. For example, it is possible, but perhaps unlikely, that households that fish are more likely to be cell-only than those that do not fish. Despite the uncertainty associated with the second assumption, there is no evidence that undercoverage of the CHTS due to non-landline households is a significant contributor to the observed differences between the ABS and CHTS.

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Table 9. Percent of Anglers and trips with no landline telephone service, ABS Wave 6, 2010, Coastal County Residents.

State/Mode	Angler	Trips	Ratio of Trips:Anglers
NC Total	35.9	35.3	0.98
NC Boat	38.5	43.2	1.12
NC Shore	32.9	29.3	0.89
LA Total	38.4	43.6	1.14
LA Boat	34.4	31.7	0.92
LA Shore	42.2	49.7	1.18

### *Noncoverage Bias: License Mail and ALDS*

The same license frames are used for the license mail survey and ALDS. Nonetheless, there are some differences that could be attributed to coverage, at least in the sense that the licensed angler could not be reached because of insufficient data on the frame to contact the person. The license frames do not have a current and valid telephone number for about 25 percent of the anglers, making them inaccessible by telephone. We classify this as a nonresponse problem rather than a coverage problem in this discussion because the angler can be sampled but not contacted. In the mail survey, nearly all of the sampled anglers can be contacted by mail (although less than 10 percent of the sampled anglers may have the mail returned as being no longer at that address and for other similar reasons).

To assess the extent of undercoverage related to the use of the license frames for sampling anglers in general, we compared the relative distribution of effort between licensed and unlicensed anglers by domain (Figure 4). The estimates presented in Figure 4 are generated through the ABS and license mail surveys. Effort estimates for licensed anglers were derived through the angler license mail survey, while estimates for non-licensed angers were derived by subtracting license estimates from total effort estimates, which were derived through the ABS mail survey and include both licensed and unlicensed fishing activity.

In North Carolina, the distribution of effort between licensed and unlicensed anglers is fairly consistent among strata and modes, with unlicensed fishing activity accounting for 40-50% of the total effort estimates. This contrasts sharply with LA, where fishing activity by unlicensed anglers varies considerably among strata and fishing modes, accounting for less than 5% of total fishing effort for private boat fishing by coastal residents up to nearly 75% of total effort for shore fishing by noncoastal residents. Despite the variability in coverage among domains, these results clearly demonstrate that

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fishing activity by unlicensed anglers is substantial and cannot be ignored by sampling exclusively from state databases of licensed anglers for either telephone or mail surveys.

Figure 4. Relative distribution of effort between licensed and unlicensed anglers, Wave 6, 2010 mail surveys.
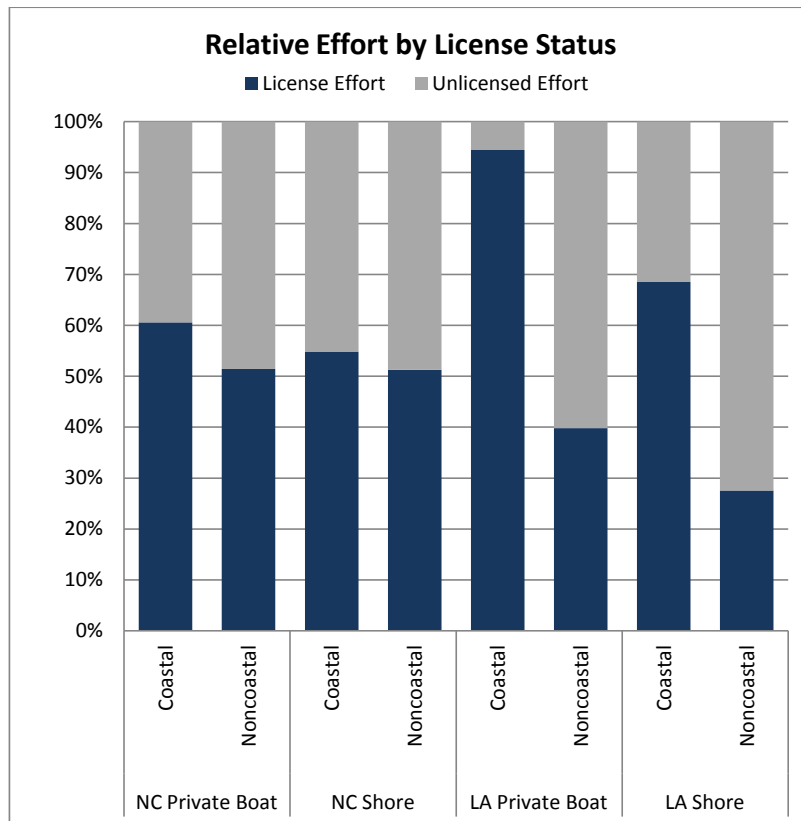
3.3   Differential Bias due to Nonresponse

Unit response rates for each of the surveys are presented in Table 10. Response rates for the ABS screener and the CHTS were calculated using AAPOR RR3[1]. For the ABS screener, '*e*' was calculated separately for addresses that could and could not be matched to a telephone number, and for the CHTS, '*e*' was calculated separately for telephone numbers that could and could not be matched to an address.

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[1] The terminology used in this section is from the American Association of Public Opinion Research's "Standard Definitions: Final Dispositions of Case Codes and Outcome Rates for Surveys." The report is at www.aapor.org.

For the license sample and 2nd phase ABS sample, we assumed that all sample units were eligible and consequently calculated response rates using AAPOR RR1.

Table 10. Unit response rates, Wave 6, 2010.

	ABS Frame			License Frame		
	Screener	Angler Survey	Total ABS	Mail	ALDS (phone)	CHTS (RDD)
Overall	46.69	65.4	30.54	49.3	28.9	17.57
North Carolina	48.07	68.9	33.12	50.6	30.9	21.7
Coastal	49.19	68.9	33.89	51.39	31.25	21.7
Noncoastal	47.8	68.9	32.93	48.44	30.32	NA
Nonresident	NA	NA	NA	62.97	34.48	NA
Louisiana	43.78	60.1	26.31	47.2	25.35	14.06
Coastal	45.48	62	28.20	47.7	24.28	14.06
Noncoastal	41.76	55.9	23.34	45.2	26.9	NA
Nonresident	NA	NA	NA	50.9	28.2	NA

Overall, the response rate for the ABS screener was 46.7%, and the response rate for the 2nd phase ABS angler questionnaire was 65.4% for an overall response rate for the ABS sample of 30.5%. This compares to an overall response rate of 17.6% for the CHTS.   Sampling from the License frame resulted in overall response rates of 49.3% for the mail mode and 28.9% for the telephone mode.

These response rates are all relatively low, introducing the potential for bias due to nonresponse error. The mail surveys have response rates that are up to twice that of the CHTS survey. In addition, compared to the ABS survey, the CHTS response rates would probably be lower if it were not restricted to landline telephone households (AAPOR 2010). However, response rates alone are poor indicators of nonresponse bias, and it is even possible that the lower response rate survey could be less biased than the higher one (Groves 2006).

Nonresponse bias in estimates of means and proportions only occurs when response rates are differential across domains, and those domains are correlated to the characteristic being estimated. In these surveys, these conditions would exist if those who fish more often are also more likely to respond to the survey than those who don't fish or those who fish less often. For estimates of totals, such as total fishing effort, nonresponse bias may be even more of a problem since totals are always underestimated unless some type of nonresponse adjustment is made (Brick and Jones, 2008). If the

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adjustment does not account for differential nonresponse related to the outcome measure, then the bias for the estimated total can be in either direction.

Total fishing effort can be written as the product of the number of anglers who fished in the time period and the average number of trips they took. The survey estimates of totals can be biased if either or both of these components of total effort are over-estimated or under-estimated. Overestimation in recreational fishing surveys is common and is referred to as avidity bias, which is a form of saliency bias in more generic survey terminology and is discussed in our measurement error section. We concentrate on avidity bias here as it relates to unit nonresponse because it is likely to be a major source of nonresponse bias.

Avidity Bias: ABS Mail and CHTS

The only existing measure of avidity bias available at this time is obtained by comparing response rates from the general population surveys (ABS mail and CHTS) by whether or not the household could be matched to the license frame for the state. This is an imperfect measure of avidity because it classifies households as avid solely by whether they live in a household with at least one licensed angler. In addition, there are other issues, such as matching error, that affect these estimates of bias and are discussed later. Despite its limitations, this measure of avidity bias provides some insight into the effects of nonresponse bias.

For this analysis we restrict the ABS sample to the coastal stratum to be consistent with the geographic coverage of the CHTS. We also focus mainly on the estimation of the number of anglers. Estimates of mean trips per angler are not highly variable by matching status.

Table 11 provides response rates for the CHTS and ABS by matching status. The overall response rate for the matched ABS address cases was 1.57 times that of the unmatched address cases (44.1% compared to 28.1%), where this accounts for both the screening rates (59.7% matched and 45.3% unmatched) and the extended response rates (73.9% matched and 62.1% unmatched). For the CHTS the ratio of the response rates for the matched to the unmatched was similar at 1.48, where the response rates were 24.1% for the matched households and 16.3% for the unmatched households.

Table 11. Response rates by license match, Wave 6, 2010.

	Screener		Angler Survey		Total ABS		CHTS	
	Matched	Unmatched	Matched	Unmatched	Matched	Unmatched	Matched	Unmatched
Overall	59.7	45.3	73.9	62.1	44.1	28.1	24.1	16.3
North Carolina	62.4	46.8	76.6	66.3	47.8	31.0	31.4	19.8
Coastal	61.0	46.9	77.3	64.3	47.1	30.1	31.4	19.8
Noncoastal	64.0	46.8	75.9	67.2	48.6	31.4	NA	NA
Louisiana	55.3	42.2	70.8	55.0	39.2	23.2	17.4	13.5
Coastal	57.3	43.3	69.9	57.6	40.0	24.9	17.4	13.5
Noncoastal	51.0	40.9	73.8	50.3	37.6	20.6	NA	NA

Montaquila et al. (2008) used ratios of rates like these to approximate the magnitude of nonresponse bias in estimates. Using their formulation and assuming that the estimated percent of anglers is 25%, and a ratio of response rates of 1.6 between the matched and unmatched samples, results in an overestimate of about 30 percent. Instead of estimating that 25% of the coastal households have active anglers, the higher response rate for avid anglers yields an estimate of about 33%, an absolute bias of nearly 8 percentage points.

Since the response rate ratios between matched and unmatched households for the ABS and CHTS are both considerably greater than one, we would expect estimates from both surveys to be biased due to this source of nonresponse error. However, the ABS employed a nonresponse weighting adjustment to account for this potential source of nonresponse bias while the CHTS did not. This was done by defining nonresponse adjustment cells by whether or not the household was matched to the license frames. This adjustment reduces the effect of avidity bias substantially for the ABS; a pilot study conducted in North Carolina in 2009 demonstrated that adjusted ABS estimates of the number of anglers who fished in a wave were 25% lower than unadjusted estimates (Andrews et al., 2010).   As a result, avidity bias in the ABS is the residual after accounting for the license population, i.e., only avid anglers in households that could not be matched to license frames could have contributed to avidity bias in the ABS.

We note that the CHTS estimates could use the same types of nonresponse adjustments as used in the ABS sample to reduce avidity bias. The adjustments are likely to be slightly less efficient due to higher matching errors, as evidenced by the lower response rate ratio between matched and unmatched households. This is discussed in more detail below, but the estimates would undoubtedly have lower nonresponse bias due to avidity. In fact, Andrews et al. (2011) demonstrated that CHTS estimates of total fishing effort employing this type of nonresponse weighting adjustment were 13% lower than

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unadjusted estimates over a three year period from 2008-2011. However, the lack of an adjustment for avidity bias in the traditional CHTS design is clearly an important difference between the ABS and CHTS and a likely contributor to the observed differences in estimates.

A second consideration is that errors in matching the ABS sample to license databases have an effect on the ratios of the response rates and the size of the bias. As discussed later, about 13.4% of the CHTS sample can be matched to the license frame, which accounts for approximately 66% of the total number of anglers on the license frame[2]. For the ABS, about 14.5% of the coastal sample matched to the License frame, which accounts for about 77% of the license frame. We assume that both would match at 100%, within sampling error, if there were no other errors. The matching errors are largely the result of errors in the frame data that was used for matching (address and telephone number). The response rate ratio is a function of this error. For example, the cases that should have matched to the license frame but didn't due to matching errors are likely to respond at a higher rate than "true" unmatched cases (i.e. they are likely to respond at the rate of the cases that could be matched). This artificially increases the response rate for the unmatched domain and subsequently depresses the ratio described above and the estimated avidity bias. Based on the simple percentage matched, it is possible that matching error is more prevalent for the CHTS than the ABS, and thus the effect is larger for the CHTS. However, since less than 20% of the general household population is on the license frame, the overall effect of this matching error through response rates is not very large.

Overall, differences between the ABS mail estimates and the CHTS telephone estimates can be attributed to differences in the ways the estimates are adjusted rather than to the underlying response propensities between the two surveys. Both surveys suffer from differential response rates due to the propensity of households with avid anglers to respond at a higher rate than other households. The adjustment of the weights for the ABS sample significantly reduces the estimated number of anglers (specifically those with licenses). However, since the ABS estimates are higher than CHTS estimates in terms of estimated numbers of anglers and total effort, the effect of avidity bias as postulated above would increase the differences between the surveys if the CHTS estimates were adjusted in the same way. The evidence in this case does not explain the observed difference between the ABS and CHTS as

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[2] Based upon matching, the estimated number of licensed anglers from the CHTS sample is 66% of the actual number of individual anglers on the license frames.

much as it suggests that the difference would be even larger if not for the differential avidity bias adjustment.

Avidity Bias: License Mail and ALDS

Like the general population surveys, the license mail surveys have higher response rates than the telephone surveys. Across the two states, the license mail survey response rate was 1.7 times higher than the ALDS response rate (49.3% for the mail and 28.9% for the telephone). The ratio was relatively consistent across states and strata, ranging from 1.6 to 2.0. As noted above, this does not necessarily imply that the mail survey has smaller nonresponse biases.

Avidity bias is possible even from within the License frame, since some license holders may fish more often than others and may have a greater propensity to respond to the survey. We might expect avidity bias to be less problematic for these surveys because everyone on the License frame is more likely to participate in at least some type of outdoor recreational activity. In fact, the differences between the estimates of the number of anglers as computed in the license mail survey and the ALDS are much smaller than the differences between the ABS and CHTS discussed above. Most are not statistically significant, and the big differences are mode-specific (shore trips), which suggests a different error source rather than unit nonresponse.

It is obvious that possession of a fishing license in the samples cannot be used as a measure to assess avidity bias since, by definition, all sampled individuals have a license. An approach we examined for these surveys was to use the type of license to create nonresponse weighting adjustment categories, assuming that anglers with some types of license were more likely to be frequent saltwater anglers than others. Andrews et al. (2010) describe an initial investigation of this in the 2009 pilot study in North Carolina and suggested that despite inconsistent results the approach was worth further study.

For the current study, we defined categories based upon the duration of the license (e.g. lifetime, annual, short-term) and the scope of privileges that the license permitted (e.g. saltwater fishing only, combination licenses, etc.). The categories were designed such that anglers within each category were expected to be similar in terms of both propensity to respond to the survey and fish.

After adjusting the weights within these categories, estimates of total fishing effort were recalculated and compared to the original estimates. The differences in effort between the two weighting procedures were small and generally not substantive. One hypothesis consistent with this result is that

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avidity bias is not large in the license mail survey and doing the revised weighting adjustment is ineffectual. Another possible explanation is that avidity bias is present, but not highly correlated with the type of license. Due to the null effect in the mail survey, the same type of weighting adjustment was not considered for the telephone survey.

We conclude that avidity bias is not likely to be a major source of nonresponse bias for the license samples. At the least, our investigation has not been able to detect avidity bias. More importantly, we found no evidence that differences between the licensed mail estimates and the ALDS telephone estimates of effort are related to avidity bias.

While avidity bias may not be a major concern in the license samples, there may be other sources of differential unit nonresponse in these samples. For example, the ALDS uses the telephone number in the license frame and it may be either a landline or cell phone number. It is possible that cell phones have lower response rates than landlines, but we do not have any data on this specific issue.

3.4   Differential Bias due to Matching Errors in Dual-Frame Designs

The current dual frame designs have overlapping domains and produce "unbiased" estimates for the overlap domain from the two surveys. Those estimates are then averaged or composited to produce unbiased and more precise estimates for the overlap domain. For the mail surveys, the overlap is the group of licensed anglers who reside in the state and have an address that can be used to send the mail questionnaire. For the telephone surveys, it is the group of licensed anglers who have a telephone number that can be used to reach them rather than an address. Conceptually, these two are similar, but operationally there are differences that might induce differential bias. The main culprit is the ability to match the general population samples (either the RDD or ABS) to the license frame. Before we describe the matching issue in more detail we cover some related issues.

Self-reported Domains

Matching the general population survey to the license frame is difficult. An alternative option that is worth considering is to rely on the general population survey respondents to report whether or not they have a license and use this to define the overlap. One problem with relying on self-reports is that no data on the domain are obtained for those that do not respond. Since the response rates are very different for the two samples (e.g., the ABS response rate is much lower than the license survey response rate), there is a serious potential bias if we ignore this (see Brick et al. 2011 for the same

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problem but in the context of cell and landline dual frame surveys). Brick et al. (2011) suggest using an adjusted compositing factor based on the differential response rates to reduce bias, but this has not been explored in the current context.

A second issue, and part of the reason the alternative compositing factor has not been investigated more thoroughly, is that respondents do not necessarily report their license status accurately. Andrews et al. (2010) investigated this in the pilot study in North Carolina and found both under-reporting and over-reporting of license status. Until this phenomenon is better understood, it is difficult to implement any estimation scheme that relies on self-reported license status.

Matching Bias

We refer to matching bias as the error in dual frame estimates that occurs because units that should or should not be identified as part of the overlap are misclassified: some units should have been included in the overlap and are not appropriately down-weighted, and some units should have been excluded and are down-weighted when they should not be. Both types of error are possible, but we observed that in the 2010 survey the failure to match was likely to be the dominant error. Thus, we expect over-estimation because units were excluded from the overlap and not down-weighted appropriately..

 Note that the matching error discussed here does not affect comparisons between ABS and CHTS estimates except when we are talking specifically about dual frame estimates. In the nonresponse bias section, we did discuss matching error as a source of nonresponse bias. We are not discussing that error at this time, but instead are considering the effect on dual frame estimates.

As mentioned earlier, about 13.4% of the CHTS sample was matched to the license frame accounting for about 66% of the total License frame. For the ABS, about 14.5% of the coastal sample matched to the license frame, which accounts for about 77% of the license frame. The CHTS sample is lower due to the exclusion of the non-telephone population and the imperfect link between telephone numbers and addresses (less than two-thirds of valid phone numbers can be linked to an address that was used in matching). Part of the problem of matching telephone numbers is the prevalence of multiple phone numbers in a household when we include both cell and landline numbers.

Given the adjustments in the CHTS for noncoverage, it is difficult to specify the magnitude of the matching error on estimates of totals for the dual frame telephone surveys. Instead, we concentrate on the effect of matching errors on estimates from the mail dual frame survey. The overlap constitutes

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38% of the number of total trips as estimated from the ABS. Let's assume that 10% of the sample that are in the overlap are mis-classified into the non-overlap domain due to matching error. These cases should have their weights reduced by a factor of 2. If matched properly, the estimate of total trips would be reduced by less than 4 percent, hardly a substantial difference given the other sources of error. Even if the matching error was 33%, the reduction in the number of total trips would be less than 12 percent. Furthermore, since the error is not one directional as assumed in these calculations, the errors of overmatching would reduce any bias due to matching error implied by these figures.

While matching error is likely to result in an overestimate in the dual frame design, the effect is not large for the dual frame mail survey, at least not in the two states that were tested. If the percentage of total trips in the overlap were larger, as is likely to be the case as state license frames become more complete, then the effects would be more substantial. This finding suggests that the dual-frame approach, with the efficiencies it brings in terms of identifying anglers at a relatively high rate, is likely to be a reasonable alternative design to the CHTS in terms of coverage, at least while the license frames are being improved. However, we propose an alternative design below that maintains the efficiency and coverage of the dual-frame design, but eliminates much of the complexity and the potential for matching bias.

3.5   Summary of Differences and Errors

Differences in estimates of fishing effort between the mail and telephone surveys are large. ABS mail survey estimates of total angler trips are significantly greater than CHTS estimates overall, and the differences are especially large for estimates of shore fishing. The differences are largely due to the estimated number of anglers, rather than the estimated mean trips per angler. The mail surveys (both ABS mail and license mail) result in higher estimates of participation in both shore and boat fishing than the comparable telephone surveys (CHTS and ALDS). The differences are more pronounced in the general population surveys (ABS and CHTS) than the license surveys.

When such differences exist for estimates of phenomenon such as fishing that are relatively rare activities, a common approach has been to assume that "more is better" whenever social desirability bias would lead to under-reporting. However, this approach does not always apply. For example, Leigh, Gillmore, and Morrison (1998) examine differences between diary and retrospective recall approaches for estimating alcohol consumption and sexual activity and conclude that errors for the two

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characteristics go in opposite directions due to the important measurement errors. In this case, alcohol consumption in excess is a socially undesirable characteristic and is generally under-reported while sexual activity is over-reported due to prestige bias. In our analysis, we did not assume that higher estimates of fishing effort were necessarily better and took a balanced approach.

We explored the potential influence of measurement error, noncoverage error and nonresponse error on the observed differences between mail and telephone survey estimates. We also assessed matching error, but this only affects dual frame estimates, so it is not central to our review. We found evidence of nonresponse bias in both the ABS and CHTS, and we observed that the propensity of more avid anglers to respond appears to affect both surveys roughly equally. The ABS estimates are at least partially adjusted for this type of bias while the CHTS estimates are not. However, the impact of avidity bias on CHTS estimates is in the opposite direction from the observed differences between ABS and CHTS estimates (i.e. adjusting for avidity bias in CHTS would make the estimates more different). We conclude that while nonresponse bias is an issue of concern in recreational fishing surveys it is not a major contributor to the differences between the ABS and CHTS estimates.

For noncoverage, we found the potential for error in both general population surveys, but with greater potential in the CHTS because it excludes households without landline telephone service and only samples coastal households. CHTS estimates are adjusted to account for these exclusions, and these adjustments seem reasonable, but one crucial assumption, that the survey covers the fishing and non-fishing populations at the same rate, cannot be evaluated from our data. Clearly, the adjustments improve the CHTS estimates substantially and appear to make them more comparable to the ABS estimates, which do not suffer from the same sources of noncoverage errors. We again found no evidence that undercoverage is a significant contributor to the observed differences between the ABS and CHTS. Of course, with the use of cell phones continuing to rise each year, relying on this type of adjustment has considerable risks.

We found that the most likely contributor to the differences between telephone and mail survey estimates is the measurement approach, although the evidence for this is not overwhelming. The tasks imposed on the respondents are dramatically different for the telephone and mail surveys. To evaluate the potential for measurement errors to account for the differences, we examined the respondent tasks

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and developed hypotheses that could be tested, at least approximately, to shed some light on the mechanisms at work.

One hypothesis was that the placement of the license question very early in the telephone interview, compared to the later and less prominent position in the mail instrument, might suppress responses from persons without a license, and subsequently depress the telephone estimates. When tested, we found that the differences are in the direction of the hypothesis, but they are not very substantial.

Another hypothesis was that proxy reporting, which is permitted in the telephone survey, might give rise to differences in the mean number of trips between the surveys and produce higher reports of boat fishing in the telephone surveys. No evidence for this was found; persons for whom the data were collected by proxy had approximately the same mean number of trips as those who responded for themselves, and the distribution of trips by mode for the proxies was no more heavily skewed toward boat trips than self-responses.

A third hypothesis was that incomplete and imputed responses in the CHTS, when combined with the structure of the questions in the telephone interview, might be responsible for some of the differences between the CHTS and ABS. We hypothesized that incomplete CHTS responses might have a higher proportion of boat trips than the complete trips. However, there was no evidence to support this hypothesis as the distributions of trips among trip modes were virtually identical for complete and incomplete interviews.

Finally, we explored recall bias and saliency bias. Although the nature of the recall task is essentially the same for estimating the total number of trips for the ABS and CHTS, the CHTS requires episodic recall to determine the fishing mode of each trip, although no testable relationships were found to explore this. The salience component of the conjecture is that boat trips are more salient than shore trips, and anglers with only shore trips might not remember such trips when answering a "cold" telephone request about the trips taken.

We hypothesized that the responses to the screening questions by gender might be indicative of this type of error because females are less likely to fish and may be especially likely to exclude shore trips if they are lower salience events. We found that in the CHTS women are more likely than men to be the person who responds to the screening questions about household fishing activity and are less likely than

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men to respond affirmatively to any of the fishing screening questions. The cumulative effect was that the rate at which women report household fishing during the 2-month wave was 72% lower than the rate of men. While this could be due various reasons, it was consistent with the hypothesis. We also assume that the error might be greater for shore fishing than boat fishing because of the larger investment associated with boat fishing, making such trips more salient than shore fishing trips

The CHTS and ALDS telephone surveys have very different screening items, but are nearly identical otherwise. We suspect that the ALDS approach of speaking with a specific individual (e.g. the sampled license holder) reduces the recall/saliency error differential between the mail and telephone surveys. Again, this is consistent with the much larger differences between the CHTS and ABS mail estimates than the license frame survey estimates.

Our general conclusion is that measurement errors are very different in the current mail and telephone general population surveys, and these differences are responsible for most of the differences in estimates. We especially suspect that the screening approaches in the mail and telephone surveys are at the heart of the differences. While we do not have external data sources to confirm that one approach has less bias than another, our investigations and hypotheses lead us to believe that the mail survey estimates are subject to less bias (across all sources of error) than the telephone surveys.

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4.   Design Alternatives

The review of the differences between the mail and telephone surveys has provided some insights into the potential for using different designs to reduce errors in angler effort surveys. Two alternative design options are discussed below. We begin with the alternative that is already being tested starting in early 2012, since the findings from these analyses have implications for the way we view this alternative.

4.1   Mixed Mode Alternative

The approach being tested in 2012 is to use a mail survey to screen the general household population to identify anglers and then divide the respondents into random subsamples and conduct the second-phase angler survey by both telephone and mail. The license surveys, which only have one phase, will be similarly subsampled into random telephone and mail treatments.

The main rationale for testing this approach is to increase the timeliness of the data collection, which is a key concern when the estimates are required quickly to support management action. If the telephone approach to the second phase is successful, then the estimates can be produced in the same time frame as current CHTS estimation. The corresponding approach being considered for the mail surveys is to use the early returns from the second-phase mail survey to produce preliminary estimates that will be adequate for the same purpose.

Figure 5 shows the percentage of all the second-phase responses in the 2010 mail surveys that were completed and returned by the elapsed time from the initial mailing by whether the adult fished in the wave or not. The survey tested both regular 1st class mailing and special Priority mailing, and the graph shows the results for both of these conditions. Of primary interest in this context is the result that about 70 percent of all the responses were obtained within 15 days of mailing, with the lowest percentage being 65 percent. The percentages who fished are also relatively stable supporting the idea that preliminary estimates based upon early responses might be valid.

Another very important feature of this alternative design is that it moves the screening operation to the self-administered mail mode. Our review of the differences in the previous section concluded that the telephone screening could be responsible for many of the differences between the ABS and CHTS estimates. This difference is eliminated under this alternative. In addition, the angler questionnaires are

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also being drastically altered for the telephone component of the mixed-mode approach, simplifying the response tasks to be more consistent with those imposed on the mail survey respondents.

These two changes will be confounded, and it will be difficult to ascribe specific differences in the estimates to changes in one of the two phases of the survey. The license frame surveys should help to clarify these effects because this survey does not have a mail screener, and it will use the revised angler telephone survey questionnaire. Thus, any differences between the ALDS (which continues without changes in the interview) and the mixed mode telephone interviews should be easier to attribute to the new instrument. A limitation of this design is that it will continue to be susceptible to matching bias resulting from frame matching errors, as described above.

Figure 5 . Distribution of returned angler questionnaires in the ABS survey by elapsed time between first survey mailing and receipt of completed questionnaire, Wave 6, 2010.

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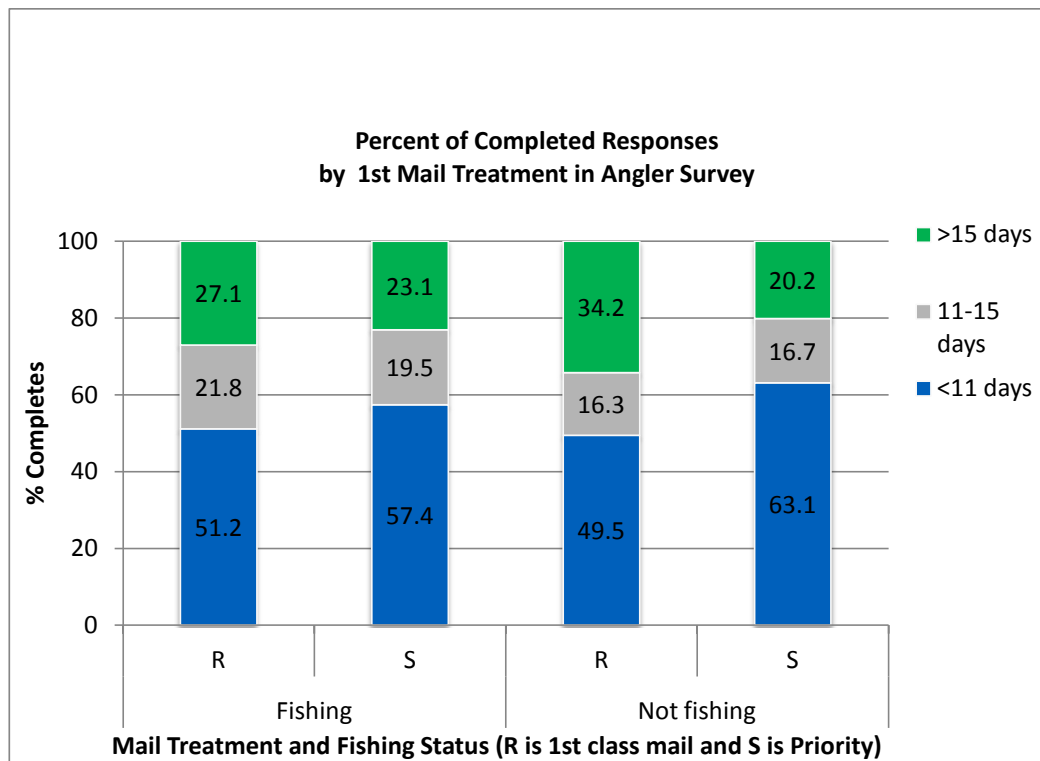
4.2   Single-Phase Mail Survey Alternative

A more radical alternative is to change the design of the mail survey from a two-phase sample to a single-phase sample. Before describing this alternative single-phase mail survey design, it is worthwhile to review the rationale that led to the adoption of the two-phase method for surveys of anglers. One reason for using a two-phase approach is that fishing is a relatively rare phenomenon and sending multi-page questionnaires to households to obtain responses may be more expensive and obtain lower response rates than the two-phase method. The two-phase approach uses a simple and short screener with a more extensive questionnaire sent only to anglers identified in the first phase. A second reason is that some households have more than one angler, which requires sending more than one questionnaire per household. This adds to the expense as noted above; it may also result in some loss of control of the sample in households with multiple anglers. Questions would arise on whether all the anglers in the households responded or not. With two phases, adults can be subsampled from multiple angler households based on the responses from the first phase. Finally, the first-phase responses provide data to personalize the second- phase angler survey to the specific adult and reduce reliance on proxy responses.

The single-phase approach seems more feasible now because several changes have been made in the angler survey instrumentation. First and foremost, the angler questionnaire itself has been revised substantially and is now shorter than it was before (see the appendix for the 2010 angler survey – it is only three or four pages of items for each angler). The reduction of the size and content of the angler questionnaire makes it considerably less expensive to send to a general population sample than the earlier version. It also may make it possible to achieve response rates as high as or even higher than the two-phase approach because the package will not appear to be bulky and may not be perceived of as imposing a major burden on the household. While this is conjecture that needs to be tested, the shorter angler questionnaire certainly improves the chances of achieving higher response rates in a single-phase survey.

The remaining advantage of the two-phase approach that cannot be addressed with a single-phase alternative is the ability to know the number of anglers in the household and personalize the

questionnaires to avoid proxy responses. It might be possible to include questions on other anglers in the household in the angler questionnaire itself (to deal with households with multiple anglers in which only one responds), but this needs to be explored. Specifically, the questionnaire items must be developed to obtain household-level data but not change the distinct advantages of a short angler questionnaire.

Nonresponse in a single-phase survey may also be qualitatively different from that in the two-phase surveys that have been studied to date. A serious concern is the potential for avidity bias to be more substantial in a single-phase survey. The 2010 two-phase ABS survey attempted, with little success it must be admitted, to reduce avidity bias by placing the fishing questions within a larger, outdoor recreation context. The single-phase survey cannot do this since the angler questionnaires are included in the initial mailings. The 2010 survey found evidence of avidity bias as measured by license status at both the first and second phase of the survey. The first phase is most troubling because the second phase can be addressed somewhat by nonresponse adjustments using the first-phase responses. An outstanding question is whether the single-phase survey will have more substantial nonresponse bias than the two-phase design.

Design features in the one-phase survey may be developed to help reduce this possibility. One particularly important component in the survey may be the use of incentives in the initial mailing. The literature on incentives generally does not show big effects in terms of reducing nonresponse bias, even though it is consistently effective in raising response rates in mail surveys. One of the most convincing examples of the ability of nominal incentives to reduce nonresponse bias is reported by Groves et al. (2006) and it parallels the situation faced in the angler effort surveys. Groves et al. (2006) showed that a $2 prepaid incentive in a mail survey of birding reduced the "avidity bias" in that survey substantially and thus improved estimates of totals.

The sample design we recommend for the one-phase survey is a stratified alternative to the dual frame approach that changes how the license frames are utilized. The goal of the stratified alternative is to retain the efficiency of sampling from the license frame while avoiding some of the potential biases and complexities associated with the dual-frame design. The current dual-frame approach is to sample independently from the general population (either RDD or ABS frames) and from the license frame, and then combine the overlap population (those on both frames) using a composite estimator. A problem

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with this design is that the identification of the overlap is difficult and error-prone. As we discussed previously, matching is required to identify the overlap because self-reported license status has a host of errors. Even with matching, errors in matching addresses and telephone numbers may result in biases in the estimates.

A solution to this problem is to use the license frame data for stratification rather than in the dual-frame structure described above. In the alternative design, sample is selected from the general population survey at a rate that will allow for subsampling. For purposes of illustration, let's assume we sample the general population with a sampling fraction of three times the rate needed for the target sample size. This sample is then matched to the license frame, and the sampled households are classified as either matches or non-matches. All of the matched households are retained in the sample, and the non-matched households are subsampled such that only one-third are retained in the sample. Essentially, the license frame has been sampled at three times the rate of the general population, which increases the efficiency of the survey. Because the matching is only used to determine the sampling rate, matching errors will only impact the efficiency of data collection; they will not result in biased estimates. This is a potentially substantial benefit over the dual-frame design, where matching errors are likely to introduce biases. This approach will be especially effective when sampling from the ABS frame, which is relatively complete. The design may be less suitable for RDD surveys, which are more susceptible to undercoverage.[3] The current license frame is also used to sample anglers with licenses who reside outside the state of the license. This group of anglers is not in the overlap and poses no overlap issues. It is recommended that out-of-state residents with licenses continue to be sampled directly from the license frame.

The stratification approach also provides some sampling flexibility that the current dual frame approach does not have. In particular, state license frames that are not up-to-date are less problematic in this design than in the current dual frame method. Assuming the household is still on the general population frame, the out-of-date license frame affects only the variance of the estimates because the newly licensed households, which would be absent from the license frames, are included in the non-matched strata and subsequently sampled at a lower rate than would be desired. However, they are assigned

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[3] The only concern potential for bias is that some households are on the License frame but are not on the general population frame. The ABS frame has high coverage as discussed in the previous chapter, while the RDD frame is less complete and this could cause problems in the context of RDD surveys.

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weights consistent with their sampling status so that the estimates are unbiased. Loss in precision resulting from out-of-date license frames can be compensated for by increasing the overall sample size, although this is accompanied by an increase in survey cost. With the current dual frame approach, the date of the license is a source of error that may result in biases due to matching errors. Of course, an out-of-date license frame is still a potential source of bias for sampling non-resident anglers, but this is the case regardless of how the available license is used for sampling.

The stratified alternative is especially well suited to the single-phase survey because the approach to all households is the same, regardless of whether the household is matched or not matched. In the current dual frame design, licensed anglers are sample as individuals rather than at the household level and in a single phase[4]. Finally, it is worth noting that the sampling design proposed is not new; it is called a dual frame sample with screening prior to data collection by Lohr (2009).

There are several issues that must be addressed to implement this design. One issue is data collection costs resulting from additional sampling and matching. These costs may be partially offset by gains in sampling efficiency. Another issue is determining the rate of oversampling such that gains in efficiency are maximized. Results from previous pilot studies may help determine optimum sampling levels. Perhaps the biggest challenge is developing the appropriate instruments for a single-phase survey. This could involve sending multiple questionnaires to all sampled households or a more innovative approach that uses a single questionnaire that accommodates multiple anglers. To deal with the timeliness issue, the preliminary estimates approach described in the mixed mode alternative would have to be used.

Despite some of the challenges and unknowns associated with the single-phase survey, we believe it has many advantages that warrant careful evaluation. We believe it has the potential to address many of the challenges that surveying angler effort presents.

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[4] In the current mail dual frame design, unlicensed anglers who live in a household with a licensed angler are covered when sampled from the ABS frame only because the licensed angler sample is a single-phase survey that does not cover other anglers in the household.

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References

AAPOR Cell Phone Task Force Report. (2010). New considerations for survey researchers when planning and conducting RDD telephone surveys in the U.S. with respondents reached via cell phone numbers.http://www.aapor.org/AM/Template.cfm?Section=Cell_Phone_Task_Force&Template=/CM/ContentDisplay.cfm&ContentID=2818.

Andrews, W.R, Brick, J. M., Mathiowetz, N., and Stokes, L. (2010). Pilot test of a dual frame two-phase mail survey of anglers in North Carolina. Final Report for National Oceanic and Atmospheric Administration.

Andrews, W.R, Foster, J., Brick, J. M., Mathiowetz, N., and Stokes, L. (2011). Nonresponse weighting adjustment in a telephone survey of recreational fishing activity, presentation at Annual Meeting for the American Fisheries Society in Seattle, Washington.

Blumberg S., and Luke J. (2011). Wireless substitution: Early release of estimates from the National Health Interview Survey, July–December 2010 [online]. National Center for Health Statistics. Available from: http://www.cdc.gov/nchs/nhis.htm.

Brick, J.M., and Jones, M.E. (2008). Propensity to respond and nonresponse bias. *Metron-International Journal of Statistics,* LXVI, 51-73.

Brick J. M., Cervantes, I. F., Lee, S., and Norman, G. (2011). Nonsampling errors in dual frame telephone surveys, *Survey Methodology*, 37, 1-12.

Groves, R. (2006). Nonresponse rates and nonresponse bias in household surveys, *Public Opinion Quarterly*, 70, 646-675.

Groves, R., Couper, M., Presser, S., Singer, E., Tourangeau, R., Acosta, G., and Nelson, L. (2006). Experiments in Producing Nonresponse Bias, *Public Opinion Quarterly*, 70, 720–736.

Horrigan,M., Moore, W., Pedlow, S., and Wolter, K. (1999). Undercoverage in a large national screening survey for youths, *Proceedings of the Survey Research Methods Section of the American Statistical Association*, 570-575, Alexandria, VA: American Statistical Association.

Iannacchione, V. (2011). The changing role of address-based sampling in survey research, Public Opinion Quarterly, 75, 556-575.

Judkins, D., DiGaetano, R., Chu, A. and Shapiro, G. (1999). Coverage in screening surveys at Westat, *Proceedings of the Survey Research Methods Section of the American Statistical Association*, 581-586, Alexandria, VA: American Statistical Association.

Lai, H-L. and Andrews, R. (2008). Development of a Dual-Frame Methodology for Estimating Marine Recreational Fishing Effort, *ICES Conference and Meeting Documents 2008*, K:06.

Leigh, B., Gillmore,M., and Morrison, D. (1998). Comparison of diary and retrospective measures for recording alcohol consumption and sexual activity, *Journal of Clinical Epidemiology*, 51, 119-127.

Lohr, S. (2009). Multiple Frame Surveys. Chapter 4 in Pfeffermann, D. (Ed.) *Handbook of Statistics: Sample Surveys Design, Methods and Applications* (vol. 29A). Elsevier, Amsterdam.

Mathiowetz (2011?) .

Meier, F. (1999). The effect of screening on coverage in the National Health Interview Survey, *Proceedings of the Survey Research Methods Section of the American Statistical Association*, 566-569, Alexandria, VA: American Statistical Association.

Montaquila, J. M., Brick, J.M., Hagedorn, M.C., Kennedy, C., and Keeter, S. (2008). Aspects of nonresponse bias in RDD telephone surveys, Chapter 25 in Lepkowski, J.M., Tucker, C., Brick, J.M., de Leeuw, E.D., Japec, L., Lavrakas, P. J., Link, M. W., Sangster, R. L. (Eds.) *Advances in Telephone Survey Methodology,* (pp. 561-586). Wiley, NewYork.

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National Research Council. (2006). *Review of Recreational Fisheries Survey Methods*. Washington, D.C.: National Academies Press.

Schwarz, Norbert, Strack, Fritz, Hippler, Hans_J, and Bishop, George. (1991). The Impact of Administration Mode on Response Effects in Survey Measurement, Applied Cognitive Psychology, 5, 193-212.

Van Voorhees, D., Sminkey, T. Schlechte, J.W., Donaldson, D., Anson, K., O'Hop, J., Norris, M., Shepard, J., Van Devender, T., and Zales II, R. (2002). The New Marine Recreational Fishery Statistics Survey method for Estimating Charter Boat Fishing Effort, *Proceedings of the Fifty-Third Annual Gulf and Caribbean Fisheries Institute*, 332-343.

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Appendix A: CHTS Questionnaire

Hello. I'm calling to conduct a survey for the National Marine Fisheries Service of the U.S. Department of Commerce.
[AS NEEDED: May I please speak with an adult in the household?]

We are collecting information for use in conservation of coastal resources and we would appreciate your help with this important study. Before we begin, I want to assure you that your answers will be kept confidential, and this call may be monitored for quality assurance.

We want to gather information about recreational saltwater fishing. Saltwater fishing includes fishing in oceans, bays, and brackish portions of rivers. This does not include fishing in freshwater, or for shellfish, such as crabbing. Recreational fishing means the primary purpose of the fishing is for fun or relaxation, as opposed to providing income from the sale of fish.

SECTION 1 - INTRODUCTION AND SCREENING

Q1 How many people in this household go fishing?
{If R end interview}

1	*{total response, range 1-20}*	
0	none	*{Set AngCat=1}*
99	R	*{Terminate; code as Resistant}*

Q2 Have I reached you in *{restore county name}* county?

1	YES	
2	NO	
8	DK	
9	R	*{Terminate; code as Resistant}*

Q3 Is this your permanent residence?
{If R end interview}

1	YES	
2	NO	
8	DK	
9	R	*{Terminate; code as Resistant}*

Q4 How many people in total, including yourself, live in your household?
Please include those people who fish and who don't fish.

1	*{total response}*

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| 98 | DK | *{Terminate; code as Resistant}* |
| 99 | R | |

We want to gather information from people who have been recreational saltwater fishing. Saltwater fishing includes fishing in oceans, sounds, or bays, or in brackish portions of rivers. This does not include fishing in freshwater, or for shellfish, such as crabbing. Recreational fishing means the primary purpose of the fishing is for fun or relaxation, as opposed to providing income from the sale of fish.

Q5   How many people in your household, including children and adults, have been recreational saltwater fishing in the last 12 months anywhere in the US or in a US territory?

1-20		
0	ZERO	*{go to Q7/Gender }*
98	DK	*{Terminate; code as Resistant}*
99	R	*{Terminate; code as Resistant}*

Q6   Thinking just about the past 2 months, how many of the people living in your household, including children and adults, have been recreational saltwater fishing in the last 2 months in the US or a US territory?

[Maximum = 20. If response is greater than 5, prompt to confirm number of people who have been recreational saltwater fishing in the last 2 months.]

1-20	*{range=1 to Q16 response}*	
0	NONE	
98	DK	
99	R	{If R end interview, schedule callback}

Q7   INTERVIEWER: Record gender of respondent

| 1 | male |
| 2 | female |

Q8   During the past 12 months, did anyone in the household have a FISHING LICENSE for the state of {restore state of residence}?

| 1 | YES | |
| 2 | NO | *{Go to Q11}* |

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| 8 | DK | *{Go to Q11}* |
| 9 | R | *{Terminate; code as Resistant}* |

Q9 Were any of the licenses valid during this period for Recreational Saltwater Fishing?"

1	YES	
2	NO	*{Go to Q11}*
8	DK	*{Go to Q11}*
9	R	*{Terminate; code as Resistant}*

Q10 Were any of these licenses valid between {conditional restore: w1="January, w2=March, w3= May, w4=July, w5= October, w6= December"}12th?

1	YES	
2	NO	*{Go to Q11}*
8	DK	*{Go to Q11}*
9	R	*{Terminate; code as Resistant}*

Q11 I'd like to ask each person who has been recreational saltwater fishing in the last 2 months a few questions about their fishing trip(s). What are the first names of the people in your household who have been recreational saltwater fishing in the past 2 months?

[If respondent will not give names, use identifiers such as mother, father, oldest child, second oldest child, etc]

1	*{record names}*	
8	DK	
9		*{suspend with "resistant" message}*

SECTION 2 - MAIN QUESTIONNAIRE

Q12 Are you one of the people in your household who has been saltwater fishing in the last 2 months?

1	YES	
2	NO	*{Ask to speak with angler}*
8	DK	*{Terminate; code as Resistant}*
9	R	*{Terminate; code as Resistant}*

Q13   *{skip if only 1 2month angler in HH}*

First, did all of the fishermen in your household take all of their fishing trips together over the last 2 months?

1   YES
2   NO
8   DK
9   R

Q14   During the past twelve months, did you have a FISHING LICENSE for the state of *{restore state of residence}* ?

1   YES
2   NO   *{Go to Q17}*
8   DK   *{Go to Q17}*
9   R   *{Go to Q17}*

Q15   Was this particular license for Recreational Saltwater Fishing?

1   YES
2   NO   *{Go to Q17}*
8   DK   *{Go to Q17}*
9   R   *{Go to Q17}*

Q16   LIC_ANG3 *{If LIC_ANG2 = 1 then ask:}*
Was this license valid between *{conditional restore: w1="January", w2="March", w3="May", w4="July", w5="September", w6="November"}* 1st and *{conditional restore: w1="February", w2="April", w3="June", w4="August", w5="October", w6="December" }* 12th?

1   YES
2   NO   *{Go to Q17}*
8   DK   *{Go to Q17}*
9   R   *{Go to Q17}*

{LABEL **LOOP1_START**} – {ANGLER PROFILING STARTS HERE}

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Q17   On how many days in the past two months, between *{restore TODAY-2 Months}* and *{restore TODAY-1}*, did you (s/he) go saltwater fishing in *{restore state}* or in a boat launched from *{restore state}*?

1-62   *{record response}*
0   NONE   *{Conclude Interview}*
98   DK
99   R   *{Terminate; code as Resistant}*

Q18   On how many days in the past two months, between *{restore TODAY-2 Months}* and *{restore TODAY-1}*, did you (s/he) go saltwater fishing in any coastal state or territory of the US other than *{restore state}* or from a boat launched from another coastal state or territory of the US?

1-62   *{record response}*
0   NONE   *{Conclude Interview}*
98   DK
99   R   *{Terminate; code as Resistant}*

{LABEL **TRIPLOOP START**} – {TRIP PROFILING STARTS HERE}

*Q*19   When did you (s/he) last go saltwater fishing? I have a calendar with me in case we need to look up some of the specific dates.

1   *{record month}*
99   R   *{Terminate; code as Resistant}*

Can you tell me the date of the **saltwater fishing** trip prior to that one?

1   *{record month}*
66   NO MORE TRIPS during time period
99   R   *{skip to LABEL TripLoop End}*

Q20   [INTERVIEWER: record day. If respondent can't remember the day, ask if it was a weekday or weekend. You may prompt for answers by using your calendar]

1   *{record day}*   *{range=1 through 31}*
2   If weekday, enter WD   *{record WD}*
3   If weekend, enter WE   *{record WE}*
98   If DK, enter DK   *{record DK}*
99   R

Q21   On that day, did you (he/she) fish from a boat?

1   YES
2   NO   *{Go to Q23}*

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8   DK   *{Go to Q23}*
9   R   *{Terminate; code as Resistant}*

Q22   *{Ask if fished from a boat}*

Was that from a ...

1   Party or head boat -- CATEGORY B
2   Charter boat -- CATEGORY B
3   Private boat -- CATEGORY C
4   Rental boat -- CATEGORY C
5   Boat - don't know what type -- CATEGORY C
8   DK
9   R   *{Terminate; code as Resistant}*

Q23   On that day, did you (also) fish from the shore?

1   YES
2   NO   *{Go to Q25}*
8   DK   *{Go to Q25}*
9   R   *{Terminate; code as Resistant}*

Q24   Was that from a …

1   Pier
2   Dock
3   Jetty / Breakwater / Breachway
4   Bridge / Causeway
5   Other manmade structure
6   Bank / Beach
8   DK
9   R   *{Terminate; code as Resistant}*

Q25   Now I'd like to ask you a series of questions about the {restore mode} trip you (s/he) took on that day.

Q26   Did the boat return to *{restore state}*?

1   YES
2   NO   *{Go to Q28}*
8   DK   *{Go to Q27}*
9   R   *{Terminate; code as Resistant}*

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Q27   To what coastal state or US territory did the boat return?

1   Alabama
2   Alaska
6   California
9   Connecticut
10   Delaware
12   Florida
13   Georgia
15   Hawaii
22   Louisiana
23   Maine
24   Maryland
25   Massachusetts
28   Mississippi
33   New Hampshire
34   New Jersey
36   New York
37   North Carolina
41   Oregon
44   Rhode Island
45   South Carolina
48   Texas
51   Virginia
53   Washington
72   Puerto Rico
55   Other - inland state or non-US territory
98   DK
99   R

Q28   To what **coastal** county did your boat return?

1   *{coastal county list displayed}*
99998 DK
99999 R

Q29   Does the public have access to the place from which the boat left, or is it private access?

1   public has access
2   private access only   *{Go to Q31}*
3   Military [do not read]
7   STOP RECORDING TRIP DETAILS
8   DK   *{Go to Q32}*

9   R

Q30   Was it a launch ramp, boat slip, dock or mooring, private property unlocked marina or
        something else?

        1   launch ramp
        2   boat slip
        3   dock or mooring
        4   private property unlocked marina
        5   something else
        7   STOP RECORDING TRIP DETAILS
        8   DK
        9   R

Q31   Was it from a personal residence or dock, a private locked-gate marina, a private property
        unlocked marina, or something else?

        1   personal residence or dock
        2   a private locked-gate marina
        3   a private property unlocked marina
        4   something else
        7   STOP RECORDING TRIP DETAILS
        8   DK
        9   R

Q32   What time did the boat return?

        1   1 am
        2   2 am
        3   3 am
        4   4 am
        5   5 am
        6   6 am
        7   7 am
        8   8 am
        9   9 am
        10   10 am
        11   11 am
        12   12 pm (NOON)
        13   1 pm
        14   2 pm
        15   3 pm
        16   4 pm
        17   5 pm

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18	6 pm	
19	7 pm	
20	8 pm	
21	9 pm	
22	10 pm	
23	11 pm	
24	12 am (MIDNIGHT)	
25	depends on tide	
77	Stop recording trip details	{goto end triploop}
98	DK	
99	R	

Q33   Was most of the boat fishing effort that day in the ocean, sound, river, bay or inlet?

1   ocean/ gulf
2   sound
3   river
4   bay
5   inlet, including inter-coastal waterways and canals
6   other {specify}
8   DK
9   R

Q34   {Ask if [Q60a = 1/Ocean,Gulf]}
Was most of the fishing less than or greater than THREE miles from shore?
1   *THREE miles or less from shore*
2   *Greater than THREE miles from shore*
8   DK
9   R

{LABEL **TripLoop End**} – {TRIP PROFILING ENDS HERE}

{LABEL **77**} – {IF INTERVIEW IS BROKEN OFF}

Q35   For the remaining {restore number of remaining trips not discussed} days, could you at least please tell me how many times and in what state and county or US territorial island you fished from a party/charter boat, a private/rental boat, and the shore?

1 respondent will continue
2 need to change number of initial trips   {set change=1}}
9 R   {skip to LABEL LANGUAGE}

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Q36   [Record the TOTAL number of days actually fished from *{restore recall period start date}* through *{restore recall period end date}*.]

     1 Record response

Q37   Of the remaining trips, how many were in party or charter boats?

     1 record response   *{range is 0 to 62}*
     98 DK   *{skip to Q40}*
     99 R   *{skip to Q40}*

Q38   In what state or US territory were the majority of your party or charter boat trips?

1	Alabama
2	Alaska
6	California
9	Connecticut
10	Delaware
12	Florida
13	Georgia
15	Hawaii
22	Louisiana
23	Maine
24	Maryland
25	Massachusetts
28	Mississippi
33	New Hampshire
34	New Jersey
36	New York
37	North Carolina
41	Oregon
44	Rhode Island
45	South Carolina
48	Texas
51	Virginia
53	Washington
72	Puerto Rico
55	Other - inland state or non-US territory
98	DK
99	R

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Q39   To what county?

        99998   DK
        99999   R

Q40   Of the remaining trips, how many were in private or rental boats?

1   record response   *{range is 0 to 62}*
98   DK   *{skip to Q43}*
99   R

Q41   In what state or US territory were the majority of your private or rental boat trips?

        1   Alabama
        2   Alaska
        6   California
        9   Connecticut
        10   Delaware
        12   Florida
        13   Georgia
        15   Hawaii
        22   Louisiana
        23   Maine
        24   Maryland
        25   Massachusetts
        28   Mississippi
        33   New Hampshire
        34   New Jersey
        36   New York
        37   North Carolina
        41   Oregon
        44   Rhode Island
        45   South Carolina
        48   Texas
        51   Virginia
        53   Washington
        72   Puerto Rico
        55   Other - inland state or non-US territory
        98   DK
        99   R

Q42   To what county?

        99998   DK

99999 R

Q43   Of the remaining trips, how many were from the shore?

1   record response   *{range is 0 to 62}*
98   DK   *{skip to Q46}*
99   R

Q44   In what state or US territory did you do the majority of your shore fishing?

1   Alabama
2   Alaska
6   California
9   Connecticut
10   Delaware
12   Florida
13   Georgia
15   Hawaii
22   Louisiana
23   Maine
24   Maryland
25   Massachusetts
28   Mississippi
33   New Hampshire
34   New Jersey
36   New York
37   North Carolina
41   Oregon
44   Rhode Island
45   South Carolina
48   Texas
51   Virginia
53   Washington
72   Puerto Rico
55   Other - inland state or non-US territory
98   DK
99   R

Q45   what county?

99998 DK
99999 R

65

Q46   [INTERVIEWER: Record language of this survey]
      1   English
      2   Spanish

{LABEL **Loop1-End**} – {ANGLER PROFILING ENDS HERE}

{LABEL **CLOSING**}

Q47   *{All 2--month angler households get the phone line questions, as well as 10% of households that do not house 2-month anglers.}*
Not including cell phones, how many different telephone numbers are there in your home?

      1   TOTAL NUMBER OF LINES   {Range 1-97}
      98   DK
      99   R

Q48   Of these *{Restore Q47}* telephone numbers, how many are never used for talking and instead are always connected to a fax machine or computer modem?

      1   TOTAL NUMBER OF LINES
      98   DK
      99   R

Q49   Of the remaining *{restore (PH_A – PH_B)}* telephone numbers, how many are for business use only?

      1   TOTAL NUMBER OF LINES
      98   DK
      99   R

Q50   I calculate that you have *{restore Q47 – Q48 – Q49}* residential telephone lines. Does this sound right?
[IF NEEDED: Your best guess is fine.]

1   YES
2   NO
98   DK
99   R

Thank you for your assistance. That concludes this survey. Have a good day/night.

Appendix B: Mail Survey Screener Questionnaire

Commonly Asked Questions

How did you get my address?
Your address was randomly selected from all North Carolina's addresses using scientific sampling. You and your household represent many other households in your part of the State.

How much time will this survey take?
On average, it should take less than five minutes to complete, including reviewing instructions, and answering the questions.

Nobody in my household participates in outdoor recreational activities. Should I still respond to the survey?
Yes. It is important that everyone who receives this short questionnaire complete it and return it. For this survey to be scientific, we need basic information about all households selected for the survey – regardless of whether they participate in outdoor recreational activities.

Why can't you interview another household instead of mine?
For the results to be scientific, we need all households who receive this short questionnaire to complete the questionnaire and send it back.

Who is sponsoring the survey?
This study is being sponsored by the National Oceanic and Atmospheric Administration (NOAA). NOAA's mission is to understand and predict changes in the Earth's environment and conserve and manage coastal and marine resources to meet our Nation's economic, social and environmental needs

How will the information I provide be used?
Your answers will help identify individuals in your state who participate in outdoor recreational activities. Those individuals who participate in outdoor recreational activities could receive a second survey. The second survey will collect information on how outdoor recreational resources are actually used. This information will help us manage these resources for the future.

Your answers are completely confidential and will be used only for this study in accordance with the Privacy Act of 1974. Questions about completing this questionnaire can be directed to Howard King toll-free at 1-888-640-7719.

Louisiana
Outdoor Recreation Survey

This study is being conducted with the assistance of the National Oceanic and Atmospheric Administration in accordance with the Magnuson-Stevens Fishery Conservation and Management Act of 2006. Your Participation is voluntary. All responses will be kept confidential under the Privacy Act of 1974.

The information you provide will be combined with information provided by other participants to produce statistical summaries and reports.

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Outdoor Recreation Survey

OMB # 0648-0052
Exp. Date 4/30/2011

Start Here

The National Oceanic and Atmospheric Administration is studying the recreational activities of Louisiana residents.

- Please return this form even if no one in the household participates in the recreational activities listed.
- This survey should be filled out by an adult household member living at this address.
- Please use blue or black pen if available.

1. How many adults ages 18 and older live in this household?

- Please answer questions 2–6 for each adult in the household. For more than 3 adults, please report for the 3 oldest adults.

|	Adult 1	Adult 2	Adult 3
2. What is this person's first name or initials?			
3. Is this person male or female?	☐ Male ☐ Female	☐ Male ☐ Female	☐ Male ☐ Female
4. What was this person's age on his or her last birthday?	☐ Age	☐ Age	☐ Age
5. In the last 12 months, has this person participated in:			
a. Backpacking, Climbing, or Hiking?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
b. Recreational Boating?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
c. Recreational Freshwater Fishing?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
d. Recreational Saltwater Fishing?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
e. Hunting?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
6. In the next 3 months, which of these activities do you think this person will participate in? Please check all that apply.	☐ Backpacking, Climbing or Hiking ☐ Recreational Boating ☐ Recreational Freshwater Fishing ☐ Recreational Saltwater Fishing ☐ Hunting ☐ None of these activities	☐ Backpacking, Climbing or Hiking ☐ Recreational Boating ☐ Recreational Freshwater Fishing ☐ Recreational Saltwater Fishing ☐ Hunting ☐ None of these activities	☐ Backpacking, Climbing or Hiking ☐ Recreational Boating ☐ Recreational Freshwater Fishing ☐ Recreational Saltwater Fishing ☐ Hunting ☐ None of these activities

Mail to:

Thank you for completing this survey. Please return your form in the postage paid envelope provided or mail to:

**Outdoor Recreation Survey
1009 Slater Rd, Suite 110
Durham, NC 27703**

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Appendix C: Mail Survey Angler Questionnaire

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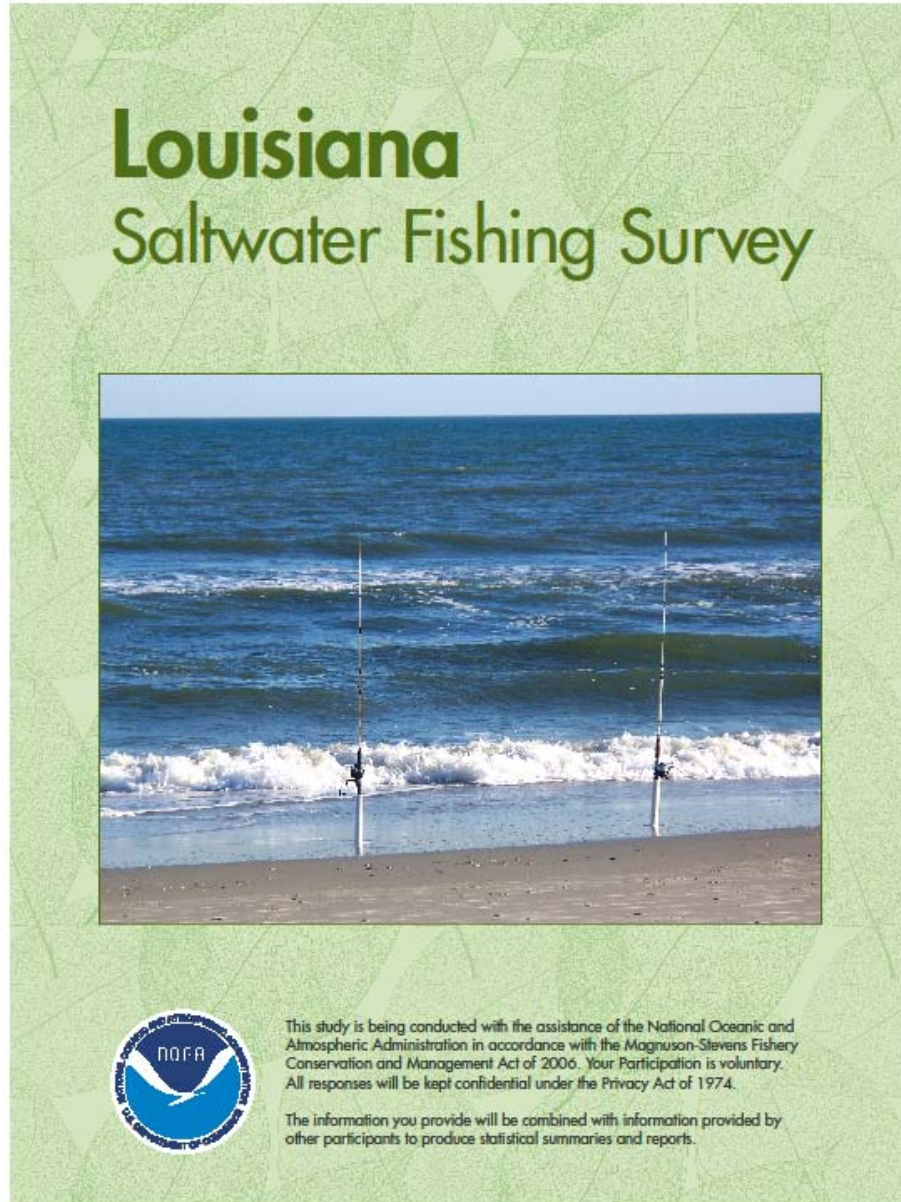
COMMONLY ASKED QUESTIONS

Why did I get this survey?

You were selected from a list of anglers who are licensed to fish in saltwater in Louisiana. Surveys from license lists are an important way of understanding uses of marine resources in Louisiana.

Who is sponsoring the survey?

This study is sponsored by the National Oceanic and Atmospheric Administration (NOAA). NOAA's mission is to understand and predict changes in the Earth's environment and conserve and manage coastal and marine resources to meet our Nation's economic, social and environmental needs.

I have not fished in the last few months. Should I still respond to the survey?

Yes. We understand that all licensed anglers may not have fished during the recent months, but it is important that all licensed anglers who receive this questionnaire complete it and return it. For this survey to be scientific, we need basic information about all licensed anglers who are selected for the survey whether they fished recently or not.

How will the information I provide be used?

Your answers will help the National Oceanic and Atmospheric Administration improve its stewardship of Louisiana's marine resources. Your answers are completely confidential and will be used for this study in accordance with the Privacy Act of 1974.

How much time will this survey take?

On average, it should take less than 10 minutes to complete, including reviewing instructions and answering the questions.

Can't you ask another person instead of me?

For the results to be scientific, we need all licensed anglers who receive this questionnaire to complete the questionnaire and send it back. We greatly appreciate your efforts to help by providing important information for improving the stewardship of marine resources.

I have other questions. Who can I talk to?

Questions about completing this questionnaire can be directed to Howard King toll-free at 1-888-640-7719.

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Please use a blue or black pen.

1 During the **past 12 months**, did you do any recreational **salt water fishing**?

☐ Yes

☐ No ➡ GO TO question 8

> **Saltwater fishing:** fishing in oceans, sounds, or bays, or in brackish portions of rivers. This does not include fishing in freshwater, or for shellfish, such as crabbing.

2 Between **November 1 and December 31, 2010**, did you go recreational saltwater fishing in Louisiana from the **shore**?

☐ Yes

☐ No ➡ GO TO question 5

> **Shore** includes docks, bridges, causeways, beaches, banks or any other shore-based structure or area.

3 Between **November 1 and December 31, 2010**, on how many days did you go recreational saltwater fishing in Louisiana from the shore?

☐☐

Total days fished from shore in Louisiana

November 2010							December 2010						
S	M	T	W	T	F	S	S	M	T	W	T	F	S
	1	2	3	4	5	6				1	2	3	4
7	8	9	10	11	12	13	5	6	7	8	9	10	11
14	15	16	17	18	19	20	12	13	14	15	16	17	18
21	22	23	24	25	26	27	19	20	21	22	23	24	25
28	29	30					26	27	28	29	30	31	

4 We are interested in some details about the Louisiana shore-based fishing you did between November 1 and December 31, 2010.

For the next few questions, please answer these questions about the **most recent shore-based** fishing you did in Louisiana between November 1 and December 31, 2010.

a. Does the public have access to the place where you fished?

☐ Yes

☐ No

b. At approximately what time did you **stop** fishing?

☐ Between 2 a.m. and 8 a.m.

☐ Between 8 a.m. and 2 p.m.

☐ Between 2 p.m. and 8 p.m.

☐ Between 8 p.m. and 2 a.m.

c. Was there a child under 18 with you who also fished?

☐ Yes

☐ No

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5 Between **November 1 and December 31, 2010**, did you go recreational saltwater fishing **from a private or rental boat** that returned to shore in Louisiana? Do not include charter boat trips – charter trips have a captain or crew.

☐ Yes

☐ No ➜ GO TO question 8

6 Between **November 1 and December 31, 2010**, on how many days did you go recreational saltwater fishing from a private or rental boat that returned to shore in Louisiana?

November 2010	December 2010
S M T W T F S	S M T W T F S
1 2 3 4 5 6	1 2 3 4
7 8 9 10 11 12 13	5 6 7 8 9 10 11
14 15 16 17 18 19 20	12 13 14 15 16 17 18
21 22 23 24 25 26 27	19 20 21 22 23 24 25
28 29 30	26 27 28 29 30 31

☐☐

Total days fished from a private boat
that returned to Louisiana

7 We are interested in some details about the fishing trips you took by boat. For the next few questions, please answer about the **most recent** fishing trip you took by a boat between November 1 and December 31, 2010. We are only interested in boat trips which returned to shore in Louisiana.

a. Does the public have access to the place where the boat landed?

☐ Yes

☐ No

b. At approximately what time did you return to shore?

☐ Between 2 a.m. and 8 a.m.

☐ Between 8 a.m. and 2 p.m.

☐ Between 2 p.m. and 8 p.m.

☐ Between 8 p.m. and 2 a.m.

c. Did the trip include one or more children under the age of 18 who fished?

☐ Yes

☐ No

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8 At any time during the **past 12 months**, did you have a recreational saltwater fishing license for the state of Louisiana, including a multipurpose license or a lifetime license that includes recreational saltwater fishing?

☐ Yes

☐ No ➡ GO TO question 11

9 During the past 12 months, which of the following types of Louisiana fishing licenses did you have? *Please check all that apply.*

☐ Annual Basic Fishing License (including LA disabled basic fishing license, non-resident basic fishing license, and military basic fishing license)

☐ Annual Saltwater License (including LA disabled saltwater fishing license, non-resident saltwater fishing license, and military saltwater fishing license)

☐ Annual Senior Fish/Hunt

☐ Annual LA Sportsman's Paradise License

☐ Lifetime Fishing

☐ Lifetime Hunt/Fish

☐ Lifetime Senior Hunt/Fish

☐ Charter Passenger 3-day License

☐ Charter Skiff 3-day License

☐ Non-resident Basic Fish Trip (1 day)

☐ Non-resident Saltwater Trip (1 day)

☐ Other type of license, including all fishing gear licenses

10 If you had a 1-day or 3-day license, for what dates was it valid?

Start Date: ☐☐ / ☐☐ / ☐☐
　　　　　month　　day　　year

End Date: ☐☐ / ☐☐ / ☐☐
　　　　　month　　day　　year

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11 Finally, a few questions about yourself and your household.
Are you:

☐ Male

☐ Female

12 How old are you? Are you:

☐ 18 - 24

☐ 25 - 34

☐ 35 - 44

☐ 45 - 54

☐ 55 - 64

☐ 65 or older

13 For statistical purposes, we are interested in learning about your telephone service. Which category best describes the telephone service for your household:

☐ Regular or landline phone only

☐ Cellular phone only

☐ Both landline and cellular phone

☐ No working phone service

**Thank you for completing this survey. The information you provide
will help NOAA meet its mission of stewardship of the nation's
offshore living marine resources and their habitat.**

**Please return your completed survey in the enclosed self-addressed envelope
or mail to:**
 **Louisiana Saltwater Fishing Survey
 1009 Slater Rd, Suite 110
 Durham, NC 27703**

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Thank You!

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Exhibit 1. Experimental treatments and sample sizes

Treatment	1st phase	2nd phase	Sample size
1	R,R	R,R	1250
2 (ALDS-only)	---	R,R (DSF-like)	800
3 (ALDS-only)	---	R,R (special)	800
4 (ALDS-only)	---	S,S (DSF-like)	800
5	R,R	R,S/T	1250
6	R,R	S/T,R	1250
7	R,S/T	R,R	1250
8	R,S/T	R,S/T	1250
9	R,S/T	S/T,R	1250
10	S, R/T	R,R	1250
11	S, R/T	R,S/T	1250
12	R,R	S/T,R	1250
13	R,R	R,R,S/T	1250

R is regular mail, S is special mail, T is telephone.
Comma separates contact attempts at a phase (e.g. R,R indicates two regular mailings).
Slash indicates random sample split (e.g., R/T is random split of those with a phone into the two methods).

1.2 Objectives

This project will result in an assessment of response rates and yields of completed interviews with anglers that can be expected from the dual frame survey using mail as the primary mode. These experiments will also provide direct information on the costs of the alternative methods, and the amount of time required to obtain the data using the different approaches.

1.3 Assumptions and Constraints

1. Assume response rates will be similar to those observed in dual-frame mail pilot study.
2. The ability to conduct the pilot study in states other than NC is contingent upon state participation in the planning and execution of the study.
3. The ability to conduct the pilot study in states other than NC is dependent upon the quality of angler license sample frames.

1.4 Final Deliverables

Report describing the effects of different contact alternatives on mail survey response rates. The report will provide recommended approaches for future data collections, considering the tradeoffs between response rates and cost. The report will also discuss the overall feasibility, including benefits and limitations, of mail as a data collection mode for recreational fishing surveys.