Pilot Test of a Dual Frame Two-Phase Mail Survey of Anglers in North Carolina

Final Report

November, 2010

This report was prepared for the National Marine Fisheries Service, National Oceanic and Atmospheric Administration by William R. Andrews (NOAA), J. Michael Brick (Westat), Nancy Mathiowetz (University of Wisconsin-Milwaukee) and Lynne Stokes (Southern Methodist University) with the assistance of Dong Lin (Southern Methodist University). Data collection for the project was completed by ICF/Macro, Seth Muzzy, Project Director.

Introduction and Study Objectives

The National Marine Fisheries Service of the National Oceanic and Atmospheric Administration (NOAA Fisheries) administers several ongoing data collection efforts designed to estimate saltwater fishing participation (number of people who went marine recreational fishing at least once within the calendar year), fishing effort (number of angler trips), and catch (numbers of finfish caught, harvested, and released) in the U.S. The Marine Recreational Fisheries Statistics Survey (MRFSS) is a nationwide program with two independent components, a Coastal Household Telephone Survey (CHTS) to assess fishing effort, and an access-point intercept survey to assess catch per unit effort. Data from the two surveys are combined to estimate total fishing effort, participation, and catch by species.

In a review of the MRFSS conducted by the National Research Council (NRC, 2006), panel members suggested major revisions of the methods used in data collection. In particular, the CHTS, a random digit dial (RDD) survey of households, was criticized because of its under-coverage and inefficiency. 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 its sampling only coastal county residences and landline-based telephone numbers. The NRC report endorsed mandatory registration of all saltwater anglers. In the absence of a complete registry, the NRC recommended dual-frame procedures, and suggested sampling from incomplete lists of saltwater anglers (e.g. state saltwater license databases) and state resident or household frames (e.g. RDD frames or address-based sample frames).

The three major sources of under-coverage in the current CHTS are (1) households that do not reside in the coastal counties, (2) coastal county households without landline telephone service

(Blumberg and Luke (2010) estimate this at 26.5% of U.S. households at the end of 2009), and (3) coastal county households with landline numbers that are excluded in standard RDD list-assisted samples (Fahimi, Kulp, and Brick (2008) estimate about 20% of all landline telephone households are not in the standard RDD frame). The current survey approach accounts for under-coverage of the CHTS sample frame by adjusting estimates upward using expansion factors derived through the independent access-point intercept survey. The NRC (2006) indicated that these expansion factors are susceptible to a variety of errors.

Besides its potential coverage error, the CHTS is inefficient, as a small percentage of households participate in marine recreational fishing. As noted by the NRC report:

> Random digit dialing, even limited to coastal county residences, is not the most efficient way to gather angler effort information. In urban areas, less than 1 in 20 of the telephone intercepts reaches an angler. Improving the process whereby anglers are identified and contacted would not only improve the quality of the estimates but should also reduce costs. Remedies exist for other inefficiencies as well. For example, under the current sampling regime, identifying an angler costs more than the taking of information once the angler has been identified. (NRC, 2006, p. 30)

To compensate for the shortcomings of the CHTS, NOAA Fisheries has developed a dual-frame telephone survey approach that integrates the CHTS with surveys that sample from lists of licensed anglers. These angler license directory surveys (ALDS) are more efficient than the CHTS in terms of identifying saltwater anglers, but are susceptible to coverage error since state licensing programs exempt anglers in certain categories (for example minors or disabled) from licensing requirements

The dual-frame telephone survey approach provides better coverage than either the CHTS or ALDS alone. However, the methodology is limited by the quantity and quality of telephone numbers included in ALDS sample frames. During the most recent waves of fielding, nearly 25% of cases in the study area resulted in non-contacts due to "bad telephone numbers" (Not in Service, Business Phone, Wrong Number or Missing Number). In addition, determination of the overlap of the frames (households that could be selected from both sample frames) is difficult in telephone surveys due to the occurrence of bad numbers and cell phone numbers on the license frames. Knowing whether a unit is in the overlap is essential for calculating selection probabilities of sampled units. The dual-frame telephone survey attempts to overcome this shortcoming by asking respondents questions aimed at determining whether they are in the overlap. An inability or unwillingness to answer these questions accurately is a potential source of measurement error that could result in biased estimates. A final concern with the dual-frame telephone survey approach is the decline in response rates to telephone surveys in general, and the CHTS in particular. Since 2003, CHTS response rates in NC have decreased from 39% to 25%[1]. Response rates for the ALDS have not been much better, hovering around 30% over the past two years.

Given these concerns, an alternative dual-frame survey using mail rather than telephone was proposed. The pilot study of this alternative is the focus of this paper. Mail surveys have several potential benefits over telephone surveys in a dual-frame approach, including, 1) cost reductions, 2) greater coverage, and 3) an increased likelihood of identifying overlapping frame units through address matching. Recent evidence also suggests that mail self-administered surveys have the potential to improve response rates over comparable telephone surveys (e.g., Link, et al, 2008).

[1] During the same time period, response rates for the CHTS sample for all states along the Atlantic and Gulf coasts have decreased from 31% to 18%.

Recent Use of Address Based Samples

Increased interest in the use of address-based sampling (ABS) in the U.S. for surveys of the general population has been spurred by decline in response rates for telephone surveys (a trend that began in the 1980s) coupled with the increasing cost of attempts to convert non-respondents. In addition, an increasing percentage of households that are "cell phone only" --and thus excluded from standard RDD samples -- have resulted in a downward trend in coverage for standard RDD telephone surveys. At the same time, improvements to databases of U.S. household addresses have facilitated their use for sampling households. A number of studies have examined the feasibility of using address-based sampling in place of listing households in sampled segments prior to sampling for in-person surveys (Iannacchione, Staab, and Redden, 2003; Kennel and Li, 2009). These studies have generally concluded that ABS is a viable alternative for sampling households in the U.S.

Even more recently, several surveys have explored using the ABS to sample households for both mail and telephone data collections. One approach has been to replace RDD samples with an ABS sample, recruit households by telephone (for those that can be matched using commercial lists) or mail, and then conduct data collection in the mode used regularly in the survey. This approach has been used in the U.S. Nielsen TV Ratings Diary Survey (Link, et al, 2009) and by Knowledge Networks (DiSogra, Callegaro, and Hendarwan, 2009). According to internal analyses conducted by Nielson, the ABS method improved coverage from 70% using an RDD design to 98% with the ABS design, and representation of younger adults increased from a penetration rate of 8.8% to 13.5%. The change to the mixed mode approach did not result in any change in the overall response rate to the extended diary survey.

Another approach uses the ABS frame with an all mail mode of data collection. Link et al. (2008) used this method as an alternative to the traditional RDD method for the Behavioral Risk Factor Surveillance Survey. The National Household Education Survey (Montaquila et al. 2010) and the National Survey of Veterans (Han et al. 2010) use a two-phase mail survey to interview subgroups of the population, as does the current study, which follows a first-phase mail screener to identify eligible households by a second-phase mail survey to interview a sample of those that are eligible.

Study Objectives

The pilot test is intended to examine the feasibility of conducting an angler effort survey incorporating an ABS mail approach, with special interest in the dual frame components of the methodology. It uses a mail survey with samples selected from the general household frame (the ABS) and from a license frame. One goal is to assess the response rates that can be achieved using a mail survey for screening and identifying anglers in the general population, and for conducting an extended interview with these anglers. The dual frame nature of the design allows for exploration of potential nonresponse error resulting from households with avid anglers responding at a higher rate than other households.

A second goal is related to the combining of the samples from the two frames to produce efficient estimates. Accuracy of methods to determine if sampled households are on both frames are investigated. The pilot study also provides data about the amount of undercoverage of the CHTS, albeit limited to a small sample in only one state.

Sample and Study Design

Sample Design

The target population for the survey is North Carolina (NC) saltwater anglers, both those living in households in NC as well as those living outside the state. The current CHTS attempts to survey this population by means of an RDD sample of households that live in counties along the coast, while the ALDS attempts to survey this population by means of a telephone survey of licensed saltwater anglers. The address frame used for this pilot is derived from the USPS Delivery Sequence Files (DSF). One of the advantages of using the ABS is the relatively cost efficient sampling from all households in NC, not just coastal county households.[2]

The dual frame approach used in the pilot study samples households that are in the union of the address frame and the license frame, neither of which is limited to coastal counties. The union of the frames consists of three domains: households in the address frame but not in the license frame (S_1), households in the license frame but not the address frame (S_2), and households in both frames (S_{12}). If the address frame were complete, then S_2 would be empty except for licensed anglers who reside outside of NC.

Samples were selected independently from the two frames, and estimates of the total numbers of participants and fishing effort (number of trips) were made for each of the three domains. From the address frame, estimates are made for domains S_1 and S_{12}; from the license frame estimates are made for S_2 and S_{12}. Since both frames estimate the characteristics for the overlap domain (S_{12}), these two are averaged to produce a more precise estimate for S_{12}. The three estimates are then

[2] The CHTS could include non-coastal county households; however, the efficiency of such an RDD design, in which the yield is less than 10% of households with an active angler, results in an extremely cost inefficient design. The use of a mail screening survey offers a cost-efficient means to reach the elusive angler sample in the non-coastal counties.

summed to produce estimates for the total population. In this study, we investigate the similarity of the estimates from the two frames for S_{12}, but do not produce combined estimates.

The Address Frame

A stratified sample was selected from the address frame, with different sampling rates in the strata. Addresses in the coastal counties were in the first stratum, and addresses in the remaining counties were in the second stratum. A total of 900 addresses of the 774,652 on the frame were selected in the coastal stratum, and 900 of the 3,055,903 addresses were sampled in the second stratum. The selected addresses constitute the first-phase sample from the ABS.

The second phase sample included adult anglers (saltwater fished in the previous year) in households that responded to the mail screener. One angler was sampled from each household that reported saltwater fishing by an adult during the previous 12 months. A supplemental sample of anglers was selected by sampling another adult angler in a subset of households that reported saltwater fishing by more than one adult in the previous year.

The License Frame

The license frame, which the state maintains as a part of its administrative records system, is a list of individuals who were licensed to participate in saltwater fishing in NC during the reference period (November – December, 2009). A database containing 551,060 registered anglers was provided by NC's Division of Marine Fisheries. While anyone on this file was licensed for saltwater fishing in NC, some of them may never have fished but held licenses for other types of activities that also bestowed the license for fishing. The types of licenses are discussed later.

Before samples were selected from the license file, it was processed to make it suitable as a sampling frame. The following steps were followed:

- Duplicates (records with the same core data: name, date of birth, and mailing address) were deleted.
- Records without core data were deleted.
- Persons under the age of 18 were deleted.
- Addresses were "normalized" to be in the standard formats used by the postal service.
- Records were stratified by county (coastal, non-costal, or out-of-state strata), and unique household identifiers were assigned to anglers with a common mailing address or telephone number

Frame processing resulted in a total of 456,474 unique angler records, distributed among coastal (184,593), non-coastal (239,450) and non-resident (32,431) strata.

The file was sorted by address and a systematic sample of 450 anglers was selected in each stratum. The ordering was done to minimize the possibility of including unidentified duplicated household listings. As in the ABS, a supplemental sample of anglers was selected. A second angler was selected in every sampled household identified as having more than one licensed angler.

Data Collection Procedures

A screening survey was mailed to all 1800 ABS sample addresses in the fall of 2009[3]. Consistent with the methods suggested in Dillman, Smyth, and Christian (2008), the household was mailed an instrument that included a cover letter and a $1 cash incentive. The household was asked to complete the questionnaire and mail it back in the envelope provided.

Mailing of the screener was split into two batches, with 900 addresses in each batch. The first batch was mailed November 10, 2009 and the second on November 20, 2009. The batches were mailed at different times to examine the effect of delay between the screener and the angler interview in the two phase mail survey. This is an issue that only arises in two phase mail samples and is discussed later in the analysis. Sample units in both batches were exposed to the same treatment: (1) an initial mailing of the screener questionnaire; (2) a reminder postcard mailed 1 week after the initial mailing; and (3) a second mailing of the screener questionnaire to non-respondents two weeks after the mailing of the postcard, accompanied by a non-response conversion letter.

[3] All data collection instruments are included in the attached methodology report.

Randomly selected anglers from each fishing household identified in the ABS screener as well as anglers sampled from the license frame were mailed an Angler Survey, beginning January 4, 2010. Similar to the screening data collection protocol, the Angler Survey data collection consisted of (1) the original mailing of the survey instrument (different letters for the ABS and License frame sample units), including a $1 incentive for participation; (2) a reminder postcard (one week later); (3) a second mailing of the survey two weeks following the postcard reminder (that included a modified cover letter, but no additional incentive); (4) and a final questionnaire, delivered by Federal Express 2-day delivery.

Appendix A shows the sample disposition for the ABS sample screener (Table A-1), the ABS angler survey (Table A-2), and the License sample (Table A-3) by stratum. A detailed report of the methodology used in the study, including detailed information concerning the de-duplication of the sampling frames, is included as an attachment to this report.

Findings

Matching and Domain Identification

A critical issue in the development of estimates from dual frame designs is the accurate identification of elements in each frame as well as those units which appear in both frames (overlap). Often, the identification of overlap between frames relies on data reported by the respondents. This approach is currently being explored in tests estimating fishing effort from telephone dual frame surveys. In the case of the present study, we were able to identify the overlap via matching of ABS addresses to addresses in the license frame. Both methods of identifying overlapping units are subject to errors that affect the quality of the dual frame estimators. We begin by looking at the matching of addresses and then discuss the accuracy of the self-identification of domain membership by respondents.

One way to assess the quality of the matching as a method of identifying overlap is to compare the estimate of the total number of licensed anglers from the ABS sample, both overall and by stratum, to the known number of licensed anglers in NC. A complication is that the matching is done by address, while the units of the license frame are the individuals holding licenses. To compare the number of ABS sampled addresses that are matched to the number from the license frame, we first convert the person-level license frame size to a household level size. To do this, we estimated the average number of adult licensed anglers per household from the license frame by stratum (in the coastal stratum the average was 1.19 and in the non-coastal stratum it was 1.16). The number of anglers in the stratum was divided by this average to estimate the number of angler households in each stratum.

Table 1 shows the estimated number of households with licensed anglers in each stratum for the first phase ABS sample, along with the NC license frame counts, where the license frame estimate is adjusted to be at the household level. The table shows that overall the matching was very close to unity, with the ABS sample estimate of licensed addresses being just 1.06 times the adjusted number from the license frame. This suggests the approach is effective (the 1.06 estimate is not significantly different from unity). The ratio in the coastal stratum is estimated to be 0.88 and is statistically different from unity, while the non-coastal stratum estimate is 1.19. We expected the matching error to be primarily one-directional, with some addresses not matching due to errors in the license frame and vagaries in matching. However, the tabulation suggests that the matching is either of very high quality or the matching error goes in both directions. This result supports the initial rationale of matching addresses and is consistent with the premise that the dual frame domain membership is accurately obtained from this procedure.

Table 1. Estimated number of addresses in the overlap from the ABS first phase sample and from the license frame

Stratum	ABS sample	License frame	Ratio of ABS to license	95% CI lower limit	95% CI upper limit
Total	381,326	360,610	1.06	0.90	1.21
Coastal	136,854	154,975	0.88	0.79	0.98
Non-coastal	244,472	205,635	1.19	0.93	1.45

Response Rates

We begin the analysis by examining weighted response rates[4] for the two frames and across the strata. The response rates are shown in Table 2. The study achieved an overall response to the screener of 45.6% and an extended interview response rate of 72.5% for an overall response rate for the ABS sample of 33.1%. This rate exceeds the comparable CHTS telephone response rate for Wave 6 in NC of 25.4%. Among those sampled from the license frame, we achieved a response rate of 58.2%, also exceeding the ALDS response rate for NC during the same wave of 30.1%[5].

[4] Weighted by the base weight and using AAPOR response rate RR3 (AAPOR, 2009).
[5] Note that the ABS mail survey and the CHTS are limited to NC residents whereas the license mail survey and the ALDS include anglers from out of state who have a NC saltwater fishing license.

These response rates are encouraging. They suggest that the angler population can be reached via a self-administered mail survey, that coverage of the population is possible via an ABS with a self-administered mail questionnaire, and that response rates may improve, especially for the license frame, over those of a telephone survey.

Table 2. Response Rates by Frame and Stratum. Geo-coding, Batch, License Match and Number of Anglers Sampled (all response rates weighted by base weight)

<table>
<tr><th></th><th colspan="3">ABS Frame</th><th rowspan="2">License Frame</th></tr>
<tr><th></th><th>Screener</th><th>Angler Survey</th><th>Overall</th></tr>
<tr><td>Overall</td><td>45.6%</td><td>72.5%</td><td>33.1%</td><td>58.2%</td></tr>
<tr><td>Stratum</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Coastal</td><td>48.4%</td><td>70.1%</td><td>34.0%</td><td>57.3%</td></tr>
<tr><td>Non-Coastal</td><td>44.9%</td><td>73.9%</td><td>33.2%</td><td>57.6%</td></tr>
<tr><td>Out of State</td><td>NA</td><td>NA</td><td>NA</td><td>67.7%</td></tr>
<tr><td>Geo-coding</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Borders Ocean</td><td>48.9%</td><td>73.8%</td><td>36.0%</td><td>53.7%</td></tr>
<tr><td>Coastal, not border</td><td>48.1%</td><td>67.0%</td><td>32.3%</td><td>59.9%</td></tr>
<tr><td>Other</td><td>44.9%</td><td>73.9%</td><td>33.2%</td><td>58.8%</td></tr>
<tr><td>Batch</td><td></td><td></td><td></td><td></td></tr>
<tr><td>First</td><td>46.4%</td><td>75.1%</td><td>34.9%</td><td>NA</td></tr>
<tr><td>Second</td><td>44.8%</td><td>70.1%</td><td>31.4%</td><td>NA</td></tr>
<tr><td>License Match</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Match</td><td>65.5%</td><td>70.1%</td><td>45.9%</td><td>NA</td></tr>
<tr><td>No Match</td><td>43.2%</td><td>73.4%</td><td>31.7%</td><td>NA</td></tr>
<tr><td>Number of Sampled Anglers</td><td></td><td></td><td></td><td></td></tr>
<tr><td>1 Angler HH</td><td>NA</td><td>68.4%</td><td rowspan="2">31.2%</td><td>66.5%</td></tr>
<tr><td>1 Angler/2+ HH</td><td>NA</td><td>74.8%</td><td>NA</td></tr>
<tr><td>2 Anglers/2+HH</td><td>NA</td><td>74.3%</td><td>34.0%</td><td>56.5%</td></tr>
</table>

Response rates from the mail surveys did not vary by stratum for either frame, with the exception of higher rates among anglers from out of state within the license frame. We also examined response rates by a three category geo-code, examining those who live in a county that directly borders the ocean, those in the coastal stratum, but not directly adjacent to the ocean, and all others. These geo-code categories also showed no significant differences in response rates.

As noted, the screening interview for the ABS sample was conducted in two batches, with the initial batch mailed about 10 days before the second. The second phase mailing for both batches was done at the same time, so the first batch respondents had a longer time period between the first and second phase mailings. As expected, the first phase response rates were not significantly different between the two batches (46.4% and 44.8%, respectively). Differences between the second phase response rates were also not significant, perhaps because of the small sample sizes. The direction of the difference, with a higher angler survey response rate for Batch 1 as compared to Batch 2 (75.1% and 70.1%) suggests that a longer lag time between the screening interview and the extended interview may be beneficial with respect to increasing the second phase response rate. This finding warrants further study as we explore the use of ABS for two phase designs.

In households with more than one adult angler, we sometimes sampled two anglers for participation in the second phase angler survey[6]. There was no difference in response rates among anglers in the ABS second phase sample as a function of number of anglers sampled in the household. However, when more than one angler was sampled from a household in the license frame, the response rate was 10 percentage points lower than for the anglers who were the sole recipients of the angler survey request (56.5% vs. 66.5%).

[6]For the ABS we sometimes sampled one and other times sampled two anglers, while in the license frame we always sampled two anglers when there were two present.

Avidity Bias

With surveys that focus on a specific segment of the population, there is always concern about differential nonresponse related to participation in the behavior of interest to the study. Previous studies (e.g., Thomson, 1991; Fisher, 1996; Connelly, Brown, and Knuth, 2000) have demonstrated avidity bias in angler surveys. In this context, avidity bias would result from a higher propensity to respond by avid anglers when surveyed about fishing. To examine this, the ABS sample units were matched to the NC license frame to determine whether those with NC saltwater fishing licenses were more likely to participate in the survey than those without a license. Overall, 12.8% of the ABS sample was matched to the license file, with a higher match rate in coastal counties (17.7%) than non-coastal counties (8.0%). The quality of the matching was very good, as discussed previously.

Table 2 indicates that the screener response rate was over 20 percentage points higher for households that were matched to the license frame than those that were not (65.5% vs. 43.2%). However, the second phase response rate of adults who said they had fished in the last year did not differ significantly by whether they matched to the license frame. Because of the large first phase difference in response rates, the overall response rate did show a significant difference, 45.9% vs. 31.7%.

This is an important finding with respect to the feasibility, as well as the benefits, of using a residential address frame to estimate the total number of anglers and the total number of recreational fishing trips. If the respondents to the first phase sample are adjusted to account for nonresponse without accounting for the avidity bias, then the effect will be to overestimate the number of anglers and angler trips because the avid anglers are over-represented in the sample. Because we were able to successfully match the ABS sample to the license frame, we were able to adjust the first-phase nonresponse weights for the ABS sample to account for differential nonresponse between avid (households with at least one licensed) and non-avid (households with no licensed anglers) households. As described below, this greatly reduces the potential for avidity bias in estimates of the total number of anglers and the total number of fishing trips. However, the adjustment does not account for avid anglers who could not be matched to the license frame, or for differential avidity of licensed anglers. Research on methods to avoid this potential source of nonresponse bias is needed, for example, by examining the effect of screening focusing on a broader range of topics than just angling.

It should be noted that avidity bias may also be present in other surveys that sample from residential household frames, including the Coastal Household Telephone Survey. A research project is currently underway that will attempt to match CHTS sample units to license frames in NC and LA by telephone number and address. Successfully matching the CHTS sample to license frames will help to identify and quantify avidity bias in the CHTS, as well as allow survey managers to develop adjustments to nonresponse weights that will account for avidity bias in the survey.

We also wanted to explore differential response rates among those sampled from the license frame and those sampled from the ABS frame who matched to the license frame to determine if different types of licensure were associated with differential response rates. There are numerous saltwater license types in NC and they may be informative about avidity bias in the license frame. Some licenses are for salt water fishing only, while others are combination licenses that also permit the holder to freshwater fish or hunt. Some types provide lifetime licensure, while others are purchased annually.

Table 3 presents the response rates for the ABS screener and the License frame angler survey by strata and license type. No clear pattern overall emerges. We do see that among the license frame, the combination license holders tend to respond at a lower rate than those who hold other types of licenses. Within each of the strata of the license frame, those who held a 10-day license responded at a higher rate than other license holders. Higher response rates among these respondents with highly targeted licenses are consistent with the hypothesis that anglers who have fished recently have higher propensity to respond to the survey. These findings are evidence that not all anglers on the license frame are equally likely to respond to the survey and also have implications for nonresponse bias from the license frame. With respect to angler response rates among the ABS sample that linked to the license frame, we also see some variability in response rates by license type. However, among this sample, we see the lowest response rates among those with the 10-day license. Although the findings are mixed with respect to response rates by license type, the findings do suggest that greater reduction of nonresponse bias might be obtained by using information about license type in nonresponse adjustment.

Table3. Screener Response Rates (ABS Frame) and Angler Response Rates (License Frame) by Sample Strata and License Type

	ABS Frame: Matched			License Frame			
	Coastal Strata	Non-Coastal Strata	Overall	Coastal Strata	Non-coastal Strata	Out of State Strata	Overall
License Type							
Combo	68.0%	66.1%	66.7%	55.3%	56.6%	59.0%	56.3%
Saltwater	64.8%	57.3%	61.0%	58.7%	59.5%	69.8%	60.3%
10 day		55.2%	55.2%	100.0%	66.7%	70.4%	70.6%
Annual	68.5%	69.5%	69.0%	52.8%	61.3%	69.0%	57.6%
Lifetime	62.8%	60.6%	61.2%	63.7%	55.2%	60.3%	58.1%
Unmatched	44.1%	43.2%	43.4%				

.

Missing Data Rates

In considering a shift away from an interviewer-administered telephone survey to a self-administered mail survey, data quality, specifically missing data rates (associated with incomplete questionnaires or incorrect skip patterns) as well as inconsistent data are a concern. We examined missing data rates for several key variables. We defined missing data rates as either no response or an indication of a "don't know" response. These rates ranged from a low of less than 2% for questions concerning whether or not the respondent had participated in recreational saltwater fishing during the reference period to over 25% for questions concerning valid recreational saltwater fishing license ownership for the reference period.

Respondents were asked two summary questions concerning fishing effort during the wave: (1) whether they gone saltwater recreational fishing in North Carolina during the wave (November 1 – December 31, 2009) and (2) for those who had gone fishing during the reference period, they were asked to simply circle the dates on a calendar indicating that they had fished that day. The later information was then summarized during data processing to produce a total number of trips taken by the respondent. Instructions following the collection of this summary data requested that the respondent complete detailed trip information for the four most recent angling trips taken.

In light of this two-step process for obtaining effort information, a second form of missing data consists of those cases in which the respondent indicates multiple angling trips during the wave (indicated by circling the dates of the trips on a calendar) but then failing to complete the detailed trip information for the four most recent trips taken. We found that for 1.2% of the cases, the two pieces of information were inconsistent.[7] For 11 of the 884 anglers (0.2%) who recorded no information on the calendar, detailed information for 1 or more trips was provided. Conversely, 15 of the 270 anglers (5.6%) who circled at least one date on the calendar provided no information for the detailed trip questions, and 98 of these anglers (36%) detailed fewer than they reported on the calendar. There was a particularly serious omission rate for those anglers reporting many trips. Of the 139 anglers who reported 4 or more trips in the calendar, 71 (51%) provided detailed information for fewer than 4 trips.

Comparisons for Under-covered Populations

One of the criticisms of the current CHTS estimates is the lack of coverage of persons living in non-coastal counties and coastal residents living in households without landlines. In this section

[7] Obviously, we can only examine inconsistencies to a limited extent since avid anglers could indicate a high number of trips (> 4) on the calendar but then only report details for the most recent four trips. However, avid anglers who reported a high number of trips but then failed to complete the detailed sets of questions for the four most recent trips are classified as inconsistent.

we examine the demographic and behavioral characteristics of anglers as a function of geographic location and landline service among the ABS sample members[8].

We begin by looking at the percentage of anglers who fished during the year that would be excluded by each reason. The mail survey estimated that 64.5% of all anglers who fished during the year resided in non-coastal counties and would be excluded from the CHTS. An estimated 21.4% of anglers reported in the mail survey that they did not have a landline in their home. By examining the size of the union of these two domains, we estimated that 69.3% of anglers reported in the ABS would be excluded from the CHTS (i.e., only 30.7% of NC anglers reside in coastal households with landlines). Similarly, the mail survey provides an opportunity to assess the coverage of state license databases as sample frames. The mail survey estimated that 57% of the anglers who fished during wave 6 did not possess a saltwater fishing license. The source of this undercoverage in NC likely includes minors (<16) and anglers who fished on state fishing piers, both of which are exempted from state licensing requirements. Based on the ABS frame, we estimate that the CHTS and ALDS surveys in North Carolina exclude about 35% of anglers and approximately 38% of trips (that is, noncoastal anglers without licenses or coastal anglers without licenses or landline telephones). Clearly, the ABS mail survey has a great deal to offer to improve coverage compared to the current RDD and ALDS designs[9].

Table 4 presents the estimated demographic, angler licensure, and fishing activity characteristics for the subset of the ABS frame who fished in the last year, for NC as a whole and by stratum..

---

[8] All estimates are weighted to account for the probability of selection and for nonresponse.

[9] We can also examine the percentage of active anglers in the wave who would have been missed in the CHTS. The mail survey estimated that 44.3% of all anglers who fished during the wave resided in non-coastal counties, and 11.4% of the coastal residents who fished during the wave did not have a landline in their home. As a result 52.6% of anglers in the ABS who fished during the wave would be excluded from the CHTS.

Although demographic characteristics of the coastal and non-coastal anglers are similar, the incidence of fishing during the wave for the coastal anglers was 2.5 times the rate of non-coastal anglers (37.4% vs. 14.4%). However, among those who did fish during the wave, we find similar levels of effort; however, small sample sizes for the estimation of effort limits the power to detect differences.

Table 4. Demographic composition, Angler Participation Rates, Licensure, and Average number of days fishing from the ABS sample, by geographic location (standard errors in parentheses)

	ABS Frame: all respondents (n=152)	**Coastal Counties (n=105)**	**Non-Coastal Counties (n=47)**
Gender: Male	76.9% (4.5)	78.7% (4.6)	75.9 (6.5)
Gender: Female	16.4% (3.9)	14.9% (3.7)	17.3% (5.6)
Gender :Missing	6.7% (2.8)	6.4% (2.4)	6.8% (4.1)
Age: 18-44	16.8% (4.3)	15.8% (3.6)	17.3% (6.3)
Age:45 and older	77.2% (4.8)	79.4% (3.8)	75.9% (7.1)
Age :Missing	6.1% (2.8)	4.8% (2.0)	6.8% (4.1)
Anyone in household Salt Water Fishing in 2009? [A]	25.4% (1.9)	40.8% (2.6)	21.4% (2.2)
NC License, past 12 months?	64.2% (5.7)	76.9% (4.6)	57.1% (8.4)
NC License, past 12 months for Saltwater Fishing?	54.7% (5.8)	65.6% (5.0)	48.7% (8.4)
NC Saltwater Fishing License: Valid November, 2009?	38.9% (5.2)	59.4% (5.1)	27.5% (7.4)
Salt Water Fishing During Wave?	24.2% (4.5)	37.4% (5.4)	16.9% (6.2)
Average number of days spent fishing, during wave, per angler[B] **……by boat**	1.66 (0.27)	1.97 (0.26)	1.26 (0.49)
……by shore	1.92 (0.61)	2.66 (0.99)	0.99 (0.48)
……total trips	3.58 (0.73)	4.63 (1.03)	2.26 (0.90)

Note: All estimates limited to those who reported fishing during the 2009, except as noted.
[A] Based on information obtained in the screening interview among all screening respondents; n = 685, 357, 328 for the three columns
[B] Among those anglers who fished during the wave; n = 49, 41, 8 for the three columns

We also compared the demographic and behavioral characteristics between those with and without landlines, once again limited to the ABS sample frame. The results, reported in Table 5, show that 21.4% of those NC residents who saltwater fished in 2009 do not have a landline telephone. Anglers in NC with no landline phones are more likely to be female and younger, as compared to anglers with landline phones. The incidence of fishing during Wave 6 for those with landlines was twice that for those with no landline phones. Across all other measures of angling behavior and licensure, those without landlines are similar to those with landline phones.

The findings from Tables 4 and 5 suggest that the rate of angling among those in non-coastal counties in NC is less than those in coastal counties and that those without landline phones are less likely to have fished during the reference period than those with landline phones. Still, a majority of NC anglers do not reside in coastal county households with landline phones. Once again, small sample sizes limit our ability to draw sharp conclusions about what proportion of fishing effort takes place in households not covered by the current CHTS.

The observed differences in demographic characteristics and fishing incidence between anglers who are and who are not covered by the CHTS do not necessarily indicate that fishing effort estimates derived through the CHTS are biased. The CHTS adjusts for undercoverage by expanding estimates of fishing effort upward by correction factors derived through an access-point angler intercept survey (APAIS) of completed fishing trips. Specifically, intercepted anglers are asked for their state and county of residence, as well as whether or not their household has a landline telephone. CHTS estimates are then expanded by the inverse of the

Table 5. Demographic composition, Angler Participation Rates, Licensure, and Average number of days fishing for ABS frame by landline phone status (standard errors in parentheses)

	ABS Frame: all respondents (n=152)	Landline Phone (n=123)	No Landline Phone (n=27)
Gender: Male	76.9% (4.5)	80.9% (4.5)	65.4% (12.9)
Gender: Female	16.4% (3.9)	10.7% (2.9)	33.4% (12.9)
Gender:Missing	6.7% (2.8)	8.4% (3.6)	1.2% (1.2)
Age: 18-44	16.8% (4.3)	14.4% (4.6)	26.8% (10.74)
Age:45 and older	77.2% (4.8)	78.0% (5.4)	72.0% (10.8)
Age: Missing	6.1% (2.8)	7.6% (3.5)	1.2% (1.2)
Anyone in household Salt Water Fishing in 2009? [A]	25.4% (1.9)	26.3% (2.2)	25.8% (4.1)
NC License, past 12 months?	64.2% (5.7)	61.8% (6.4)	73.9% (13.4)
NC License, past 12 months for Saltwater Fishing?	54.7% (5.8)	50.2% (6.4)	71.2% (13.4)
NC Saltwater Fishing License: Valid November, 2009?	38.9% (5.2)	37.9% (5.8)	41.0% (12.8)
Salt Water Fishing During Wave?	24.2% (4.5)	28.0% (5.5)	13.1% (5.9)
Average number of days spent fishing, during wave, per angler [B] **……by boat**	1.66 (0.27)	1.59 (0.30)	2.19 (0.41)
……by shore	1.92 (0.61)	1.47 (0.36)	5.45 (4.13)
……total trips	3.58 (0.73)	3.06 (0.53)	7.64 (4.32)

Note: All estimates limited to those who reported fishing during the 2009, except as noted.
[A] Based on information obtained in the screening interview among all screening respondents; n = 685, 516, 149 for the three columns

[B] Among those anglers who fished during the wave; n = 49, 42, 7 for the three columns ratio of CHTS-covered trips (trips taken by anglers in coastal households with landlines) to total trips (CHTS-covered trips, as well as trips taken by anglers from non-coastal counties or households without landline phones)[10]. These expansion factors are unbiased provided the sample of angler trips derived from the APAIS is representative of all angler trips. Sampling from the ABS provides an excellent opportunity to test the assumption that APAIS samples are representative. However, sample sizes in the present pilot study were insufficient to support this analysis.

Dual Frame Considerations

The reasons for using a dual frame design are to improve coverage and reduce the cost for achieving more precise estimation of angler effort. The license frame provides a mechanism for identifying the group of interest efficiently because anglers occur in a small fraction of households. But the license frame is incomplete for saltwater recreational anglers, so it must be used together with the general population ABS to control the bias due to noncoverage.

Here, we describe some of the issues that arise in the dual frame system in the presence of nonsampling errors. The special effects of nonsampling errors on dual frame estimates have only recently been discussed in the sampling literature (see Lohr, 2009; Brick et al. forthcoming). In this section we explore the implications of certain nonsampling errors in the pilot study. In our concluding comments, we describe possible changes to the survey design and implementation that

[10] A similar approach is used to expand effort estimates derived from the ALDS; expansion factors are derived from angler-reported information about the possession of a saltwater fishing license. This approach is also potentially susceptible to reporting error based upon an inability or unwillingness to provide accurate information about license status as discussed in this report.

could alleviate some of the biases that they cause. Statistical adjustments are also being investigated, but design modifications that would eliminate or reduce the errors would be preferable.

As noted before, the overlap is the population of anglers residing in NC who have a license (more specifically, are on the license frame with sufficient information to be eligible for sampling). This assumes that all the licensed anglers in the state are in housing units that are on the ABS, a reasonable assumption based on data on coverage of households using the ABS in NC. The non-overlapping component of the ABS frame is the set of anglers residing in NC who did not have a license; the non-overlapping component of the license frame is the set of NC license holders who reside outside of the state. Our analysis begins by concentrating on the overlap component since this is relevant only in dual frame surveys.

In the pilot study, we can identify and partially quantify two sources of nonsampling errors that could bias estimates for the overlap domain. The first is nonresponse, resulting in bias due to differential response rates associated with avidity. Earlier we showed that ABS addresses matched to the license frame responded at a higher rate than those that did not. We also found that response propensity in the license frame sample depended on the type of license in a way that was consistent with avidity differences. We expand on our earlier discussion focusing on the size of avidity bias for estimates from a dual frame estimator.

A second source of bias in the dual frame estimator is error in matching the ABS sample units to the license frame. Matching is required to determine which units in the ABS are in the overlap. As discussed earlier, one of the rationales for using a self-administered mail survey is that address matching to the license frame is less error-prone than telephone number matching.

Effects of Avidity Bias

We first examine evidence about the magnitude of nonresponse bias in estimation of fishing effort in NC. Estimation of effort, defined as the number of trips, requires accurate assessment of the number of active anglers, as well as the number of trips those anglers make. If active anglers respond to the survey at a higher rate than others, or if anglers who respond take more trips than nonrespondents, then the estimate of number of trips would be biased upward. Though samples from both frames could suffer from this source of nonresponse bias, it would be expected to be more severe in the ABS frame because the variability in avidity is likely to be greater there than in the license frame.

Table 6 shows information about avidity bias in the first of those components, estimation of the number of active anglers. The first three rows of the table present independent estimates from the two frames of the number of licensed anglers who fished in the wave for the overlap, overall and by stratum. License status for both frames is based on being on the license frame rather than the response to the interview questions about license status (for the ABS this required the address match to an address on the license frame). To qualify as having fished in the wave, we also required that the angler responded that they fished during the past year (the data were not fully edited so a few cases did not meet this logical requirement).

For the ABS estimate, we produced a nonresponse adjustment by forming weighting classes that included both geographic information (proximity to the ocean) and match status, both of which should account for some avidity bias (these weights were used in previous analyses). Even with this adjustment, the ratio of the ABS estimate to the license sample estimate is about 1.35 overall and in each stratum, indicating the ABS sample estimates more anglers fished in the wave than is estimated from the license sample.

Table 6. Estimated number of licensed anglers in the overlap who fished in the wave by screener nonresponse adjustment method

	ABS sample	License sample	Ratio of ABS to license	95% CI lower limit	95% CI upper limit
ABS first phase matching adjustment					
Total	102,918	75,391	1.37	0.62	2.11
Coastal	58,801	42,571	1.38	0.60	2.16
Non-coastal	44,117	32,820	1.34	-0.04	2.73
ABS first phase geographic adjustment					
Total	135,595	75,391	1.80	0.80	2.80
Coastal	73,877	42,571	1.74	0.73	2.74
Non-coastal	61,717	32,820	1.88	-0.02	3.78
ABS first phase no cells adjustment method					
Total	138,999	75,391	1.84	0.83	2.86
Coastal	78,098	42,571	1.83	0.77	2.90
Non-coastal	60,901	32,820	1.86	-0.02	3.73

To get some idea of the potential magnitude of the avidity bias, the bottom portion of the table shows the same quantities with the ABS estimates computed using different nonresponse weighting classes; the middle three rows of estimates use cells based on geography but not match status and the last three rows uses no weighting classes at all. The ratios of the estimates that use a nonresponse adjustment based only on geography are closer to 1.80, consistent with greater overestimation of anglers when the nonresponse adjustment procedure does not account for avidity as completely. When no weighting classes are used, the ratios are slightly higher still. Because of the small sample sizes, however, the 95% confidence intervals are very wide. Since the license frame estimates are likely to be subject to some avidity bias as well, the table shows bias from differential nonresponse (as a function of fishing activity) is potentially serious.

Table 7 summarizes information about the size of the second component of potential avidity bias, the estimation of average number of trips per active angler. The table shows that ratios of the estimates of average number of trips per angler from the two frames are in the opposite direction from those shown in Table 4 (i.e., the ratios are less than unity rather than greater than unity). We also observed that the weighting cells have little effect on these estimates of average trips. The three sets of rows in the table by screener adjustment method show this result. It appears that active anglers responding in the ABS sample fish either less frequently or about the same as those from the license frame.

For estimating total trips (the product of the number of anglers and their average number of trips), the ABS and license samples are closer than either of the two components because the ratios of the components partially offset each other. A standard dual frame estimation strategy is to average the two estimates for the overlap to produce a more precise estimate of this population. Since the components of the two frames are different, averaging the two estimates could give a biased estimate of the number in the overlap. In theory, the two estimates of the overlap are assumed to both be unbiased, so a question arises about the appropriateness of simply combining the estimates from the two frames given these results. We discuss the dual frame estimators and their biases and variances below.

Table 7. Estimated average number of trips per active angler in the overlap who fished in the wave by screener nonresponse adjustment method (standard errors in parentheses)

	ABS sample n=25	License sample n=117	Ratio of ABS to license	95% CI lower limit	95% CI upper limit
ABS first phase matching adjustment method					
Average shore trips	1.01 (0.31)	2.31 (0.28)	0.44	0.14	0.73
Average boat trips	1.83 (0.44)	2.09 0 (0.30)	0.88	0.38	1.37
Total trips	2.84 (0.59)	4.40 (0.37)	0.65	0.36	0.93
ABS first phase geographic adjustment method					
Average shore trips	0.99 (0.31)	2.31 (0.28)	0.43	0.14	0.72
Average boat trips	1.80 (0.44)	2.09 0 (0.30)	0.86	0.37	1.35
Total trips	2.79 (0.60)	4.40 (0.37)	0.63	0.34	0.93
ABS first phase no cells adjustment method					
Average shore trips	1.00 (0.31)	2.31 (0.28)	0.43	0.14	0.72
Average boat trips	1.82 (0.44)	2.09 0 (0.30)	0.87	0.38	1.36
Total trips	2.82 (0.59)	4.40 (0.37)	0.64	0.35	0.93

Before leaving this subject, it is interesting to note that by using the match status in nonresponse adjustment reduced the avidity bias in the ABS sample and made the estimates of the overlap more similar. An adjustment of this type is more difficult to implement in a dual frame telephone approach because the matching is subject to greater error. One way to do this with a telephone frame is to attempt to match the telephone numbers from the telephone sample to the telephone numbers on the license frame. The two main problems with this approach are: (1) the telephone numbers on many license frames are incomplete and out-of-date making matching difficult, and (2) many people may be reached by telephone on multiple telephone numbers (cell numbers and landline numbers) so that the telephone sampled might not be the telephone number included in the license frame. Another way of accomplishing the matching is to rely on the angler to indicate whether they have a license or not and consider this response to determine license status. As we discuss in this report, anglers may not report their license status accurately (as discussed later there are substantial errors of omission and commission).

Next we assess the accuracy of determining overlap membership from data reported by respondents. The overlap consists of licensed anglers residing in NC, and the only characteristic required from the respondent (in the absence of a method of matching) is possession of a valid saltwater license for the wave. As noted earlier, this is a method that is currently being used in dual frame telephone samples and might be more precise than matching by telephone number.

While only the quality of self-reported information about licensure among the ABS respondents is in question, the respondents in both frames were given the same questionnaire in the pilot. Thus, respondents from both frames provide information about the error rates of overlap identification. The sample from the license frame and the matched ABS frame both provide estimates of the false negative rate for the licensure question (i.e., the proportion of validly licensed respondents who claim they do not have a license). The ABS sample also provides an estimate of the false positive rate for the licensure question (i.e., the proportion of respondents who do not have a valid license but claim they do); this quantity may not be estimated as accurately as the false negative rate because of the small sample size and issues in matching addresses.

Table 8 provides estimates for three licensure questions (if the respondent has a NC fishing license, has a NC recreational saltwater fishing license, and has a NC recreational saltwater fishing license for the reference period, Wave 6, November –December 2009). First we examine the false negative rates estimated from both frames. The first column shows the estimated percentage claiming they have a valid license for the license frame respondents who reside in NC. The second column shows the same percentage for the ABS respondents who match to the license frame. All respondents in these two columns should report "yes" to all three questions. The upper half of the table shows estimates for the overlap population who saltwater fished in 2009, and the bottom half for those who fished in the wave. From the license frame, we estimate that about 15% of those who fished during the year and 10% of those who fished during the wave reported erroneously that they did not have a license to do so. The comparable estimates from the ABS frame were about 30%. This suggests that there may be a higher false negative rate from the ABS sample than from the license sample, although the sampling errors are so large that the difference is not significant.

Table 8. Percent of Respondents in from both frames reporting ownership of various NC fishing licenses (standard errors in parentheses)

	License frame: Resident licenses	ABS frame: match to license frame	ABS frame: not match to license frame
Among Respondents Who Fished during 2009:	**(n=435)**	**(n=60)**	**(n=92)**
NC Fishing License	95.5 (1.1)	85.5 (7.4)	---
NC Saltwater License	90.0 (1.6)	72.2 (4.9)	---
NC Saltwater:Wave	85.3 (1.9)	69.8 (4.3)	27.9 (6.4)
Respondents Who Fished in Wave 6, 2009:	**(n=122)**	**(n=25)**	**(n=22)**
NC Fishing License	94.4 (2.1)	70.8 (13.8)	---
NC Saltwater License	90.4 (2.8)	70.8 (13.8)	---
NC Saltwater:Wave	89.5 (2.9)	70.8 (13.8)	46.0 (17.0)

The last column of the table gives estimates from the ABS sample for those who did not match to the license frame, providing information about false positive rates. It shows that 28% of the anglers who fished during the year and 46% of the anglers who fished during the wave and did not have a license (at least they did not match by address) erroneously reported having a license. With so few respondents in these cells, the sampling errors are very large.

Given the small sample sizes, the estimates of error rates for some subpopulations are very tentative, but there are some mechanisms that might support higher error rates in the matched ABS sample than in the license frame. The data collection procedures varied somewhat between the samples in subtle ways that may have influenced responses. For example, in the license frame sample, the mail was addressed to the angler by name and there was no first phase mailing. In addition, the matching from the ABS is by address not by angler, and households with more than one angler may have both licensed and unlicensed anglers, leading to the appearance of more error. Additional studies with larger sample sizes are needed to more adequately determine the magnitude and sources of the errors. However, the pilot does show that relying on respondents to self-identify their domain membership is a source of error that can be greatly reduced by the address matching in the ABS approach. This finding suggests that the current approach used to match sample frames in the dual-frame telephone survey design is insufficient.

Because we have additional information as to the nature of the license held by respondents in the license frame, we can also examine factors that may be related to the quality of reporting about licensure. Table 9 shows estimates of false negative rate by the type of saltwater fishing license held by the individual made from the license frame. Overall, the highest rate of accurately reporting licensure was for the broad category of "NC Fishing License," with the poorest reporting for the wave specific saltwater fishing license. This is as expected, since the wave-specific reporting requires the respondent to retrieve information not only about the type of license, but the valid dates for that license. Those anglers who held licenses specific to saltwater fishing tended to be more accurate than those who held combination licenses. Once again, this is not an unexpected finding given that the question wording for holders of recreational saltwater fishing license closely matches the nature of the license they hold, making the reporting task cognitively easier than for those with combination licenses. Non-lifetime licenses must have been purchased sometime during the past 12 months, making the reporting task more salient and of higher quality for respondents with those types of licenses than for lifetime license holders. Finally, we see that among all respondents, non-resident license holders were more likely to report accurately than NC residents. We might speculate that the nature of the licenses for the non-resident groups differs (e.g., one week vs. one year) and by definition, requires travel from outside the state, once again adding to the saliency of the license.

Table 9. Estimated Percentage of saltwater license holders from the license frame who claim they do not have a valid license, by type of license (standard errors in parentheses)

	Total	**Saltwater Only**	**Combo**	**Lifetime**	**Not a Lifetime**	**Resident**	**Non-Resident**
Respondents who say they don't have a…	**Respondents Who Fished during 2009**						
	(n=718)	(n=527)	(n=191)	(n=99)	(n=619)	(n=435)	(n=383)
NC Fishing License	4.5 (1.0)	4.0 (1.1)	5.3 (1.8)	1.7 (1.7)	5.2 (1.2)	4.5 (1.1)	5.6 (1.4)
NC Saltwater License	9.9 (1.5)	6.0 (1.3)	15.8 (3.0)	12.5 (5.0)	7.1 (1.3)	10.0 (1.6)	8.6 (1.7)
NC Saltwater Wave	15.1 (1.7)	13.0 (1.9)	18.3 (3.2)	22.9 (5.0)	13.4 (1.8)	14.7 (1.9)	19.0 (2.4)
	Respondents Who Fished in Wave 6, 2009						
	(n=227)	(n=179)	(n=48)	(n=17)	(n=219)	(n=122)	(n=105)
NC Fishing License	5.3 (1.9)	5.0 (2.2)	5.8 (3.4)	0 (NA)	6.6 (2.1)	5.6 (2.1)	3.2 (1.7)
NC Saltwater License	9.1 (2.5)	6.6 (2.5)	13.5 (5.3)	22.9 (11.8)	7.2 (2.3)	9.6 (2.8)	5.3 (2.2)
NC Saltwater Wave	10.9 (2.6)	9.4 (2.8)	13.6 (5.3)	22.9 (11.8)	9.3 (2.4)	10.5 (2.9)	13.8 (3.4)

Dual Frame Estimators

Above, we explored some of the key error components for dual frame estimators, and found the domain identification (with and without a license) among the ABS to be of relatively high quality but the response patterns from the two frames to be somewhat different. In the overlap, the respondents from the ABS sample appear to be more likely to have fished in the wave but to have gone on fewer trips than the respondents from the license sample. As a result, the consequences for the bias and variance for estimating total trips from a dual frame estimator are not clear.

To better understand the consequences for the dual frame estimators we created three dual frame estimators. The estimators were all of the simple form of averaging the overlap estimates from the two frames to produce an overlap estimate, and then adding the non-overlap estimates from the separate frames. . More specifically, let $\hat{y}_{12}^{1}$ and $\hat{y}_{12}^{2}$ be the weighted estimates of the overlap domain from frame 1 (the ABS frame) and frame 2 (the license frame), respectively, then an average or composite dual frame estimator is $\hat{y}_{ave} = \hat{y}_1 + \hat{y}_2 + \lambda \hat{y}_{12}^{1} + (1-\lambda)\hat{y}_{12}^{2}$, with $0 \le \lambda \le 1$, where the subscript 1 denotes the non-overlap component from the ABS frame and 2 is the non-overlap component from the license frame. Lohr (2009) provides a good discussion of these estimators.

.

The typical assumption is that $\hat{y}_1$ and $\hat{y}_b$ $\hat{y}_2$ are unbiased for the totals in the two nonoverlapping domains, and $\hat{y}_{12}^{1}$ and $\hat{y}_{12}^{2}$ are both unbiased for the total in the overlap domain. If this set of assumptions holds, then $\hat{y}_{ave}$ is an unbiased estimator of the total. To produce estimates of characteristics using weights, the weights for units in the overlap that are sampled from frame 1 are multiplied by λ and the weights for overlap units sampled from frame 2 are multiplied by $(1-\lambda)$.

Our main concern is that the assumption that $\hat{y}_{12}^{1}$ and $\hat{y}_{12}^{2}$ are both unbiased for the total of the overlap domain may not hold, since the estimated number of anglers and average trips per angler from the overlap differ by frame. The assumption of unbiasedness for the non-overlap component estimates is also a concern, but we do not have any evidence from the survey to evaluate it.

As a simple method of evaluating the effect the choice of the compositing factor might have on the bias and standard errors of the estimates, we created three dual frame estimators with $\lambda = 0.2$, 0.5, and 0.8. The standard choice might have been to choose $\lambda = 0.2$, since about this percentage of the overlap cases were from the ABS frame (25 of the 142 who fished in the wave). Because the weights were so much larger for the ABS cases and their contribution to the variance might be large, another reasonable choice might have been closer to $\lambda = 0.5$. The choice of $\lambda = 0.8$ was used to investigate a compositing factor that was very different from these more reasonable factors.

Table 10 gives estimates of the number of anglers, the percent of anglers, the number of trips (boat, shore and total), and the mean number of trips by stratum and overall for the three estimators. The first two columns give the estimates and their standard errors computed using $\lambda =$ 0.5. All of the estimates of standard errors were computed using replication methods. The next two columns give the ratio of the estimates for $\lambda = 0.2$ and $\lambda = 0.8$ to the estimates to $\lambda = 0.5$. When these estimates equal unity, it means the choice of λ did not affect the magnitude of the estimates. Scanning over the column shows the effect on the magnitude from the choice of the λ is not very large, with only the few bolded estimates outside of the range (0.95 to 1.05). The last two columns show the effect on the precision of the estimates by taking the ratio of the standard errors of the estimators using $\lambda = 0.2$ and $\lambda = 0.8$ to the standard errors to $\lambda = 0.5$. Once again, there are few ratios outside of the range (0.95 to 1.05) and those are in bold. It appears that the standard errors for the estimators using $\lambda = 0.8$ are somewhat more affected by the choice of the compositing factor than the other estimators, as might be suspected.

In general, the estimators and standard errors seem to be fairly robust to the choice of the compositing factor, especially for the two more reasonable choices of $\lambda = 0.2$ and $\lambda = 0.5$. One explanation for this robustness is the fact that the overlap only has 37% of all the anglers who fished during the last year. (This estimated percentage varies slightly depending on the choice of the compositing factor). The non-overlap component from the license frame is about 5% of the total angler estimate while the non-overlap component from the ABS is about 58%. If the license frame were more complete, then the overlap would be a larger component of the total and the dual frame estimators and standard errors might be less robust; i.e., changes in the compositing factor might be more important to bias and standard errors of the dual frame estimators. However, under the current circumstances we can be fairly confident that the compositing factor can be chosen using standard methods without introducing large biases or inefficiencies.

Table 10. Dual Frame Estimates of Anglers and Trips By Compositing Factor.

		Computations with Composite Factor λ=0.5		Ratio of Estimates to Composite with λ=0.5		Ratio of std Error to Composite with λ=0.5	
Estimate	**Stratum**	estimate	std err	λ=0.2	λ=0.8	λ=0.2	λ=0.8
Number of Anglers	**Coastal**	122,625	18,562	0.96	1.04	**0.94**	**1.12**
	Non-Coastal	101,894	37,497	0.97	1.03	0.97	**1.06**
	Out of State	10,225	939	1.00	1.00	1.00	1.00
	Overall	234,743	42,035	0.96	1.04	0.97	**1.07**
Percent of Anglers	**Coastal**	52.24	9.82	1.00	1.00	1.01	1.03
	Non-Coastal	43.41	10.37	1.00	1.00	1.01	1.02
	Out of State	4.36	0.89	1.03	0.97	1.05	0.99
Number of Boat Trips	**Coastal**	246,294	45,182	0.97	1.03	1.00	**1.09**
	Non-Coastal	131,565	68,746	0.98	1.02	0.98	1.04
	Out of State	14,432	3,142	1.00	1.00	1.00	1.00
	Overall	392,291	83,215	0.98	1.02	1.00	1.05
Number of Shore Trips	**Coastal**	342,487	144,812	0.98	1.02	1.00	1.01
	Non-Coastal	151,760	68,235	**1.18**	**0.82**	1.01	1.00
	Out of State	35,094	4,623	1.00	1.00	1.00	1.00
	Overall	529,341	159,098	1.04	0.96	1.00	1.01
Number of Total Trips	**Coastal**	588,781	165,348	0.98	1.02	1.00	1.02
	Non-Coastal	283,325	132,638	1.09	0.91	1.00	1.02
	Out of State	49,525	6,813	1.00	1.00	1.00	1.00
	Overall	921,631	211,898	1.01	0.99	1.00	1.02
Mean Number of Boat Trips	**Coastal**	2.01	0.237	1.01	0.99	1.04	**1.09**
	Non-Coastal	1.29	0.583	1.02	0.99	1.03	0.99
	Out of State	1.41	0.246	1.00	1.00	1.00	1.00
	Overall	1.67	0.265	1.01	0.99	1.03	1.02
Mean Number of Shore Trips	**Coastal**	2.79	1.041	1.03	0.98	1.04	0.97
	Non-Coastal	1.49	0.596	**1.22**	**0.79**	**1.09**	0.97
	Out of State	3.43	0.298	1.00	1.00	1.00	1.00
	Overall	2.25	0.622	**1.08**	**0.93**	1.04	0.98
Mean Number of Total Trips	**Coastal**	4.8	1.066	1.02	0.98	1.03	0.98
	Non-Coastal	2.78	1.103	**1.12**	**0.88**	1.05	0.99
	Out of State	4.84	0.406	1.00	1.00	1.00	1.00
	Overall	3.93	0.748	1.05	0.95	1.04	0.98

Magnitude of clustering

In the pilot survey, data were collected from more than one angler in some households in both frames, when they were identified. This allowed for an investigation of the similarity between the responses obtained from two anglers in the same household. In addition, a previous study (Lin, 2009) had shown that in the CHTS, the responses for multiple anglers in the same household have such high correlation that there is some question about whether or not attempts to obtain information from multiple anglers is even worthwhile. We wanted to see if that remains true with the self-administered mail survey. We believed that the within-household correlation might be reduced in the mail survey, due to the fact that the responses for multiple anglers are often obtained from a single household respondent in the telephone survey, and in the mail survey each individual angler received his or her own questionnaire. In this section, we describe how we estimated the level of clustering for both angler and trip characteristics within a household from the mail survey. Then we compare those estimates to similar estimates for the telephone survey from the same time period.

Clustering of angler behavior within household

Because *ICC* (intra-cluster correlation) is defined only for clusters of equal size, we use a more general measure of clustering, the adjusted R^2, denoted R_a^2, to describe the effect. This parameter is defined (Lohr 2010, p. 175) as

$$R_a^2 = 1 - \frac{MSW}{S^2}, \tag{1}$$

where MSW and S^2 are defined as in an analysis of variance; i.e.,

$$MSW = SSW/(K-N) = \sum_{i=1}^{N}\sum_{j=1}^{M_i}(y_{ij}-\bar{y}_{iU})^2 \Big/ (K-N)\,, \tag{2}$$

$$S^2 = SST/(K-1) = \sum_{i=1}^{N}\sum_{j=1}^{M_i}(y_{ij}-\bar{y}_U)^2 \Big/ (K-1)\,, \tag{3}$$

$K = \sum_{i=1}^{K} M_i$ = # of secondary sampling units (anglers) in the population, N = number of psu's (households) in the population, and M_i = # of ssu's in the i^{th} psu. Because these parameters are to be estimated from a complex design, weights are needed, and each frame and variable requires its own estimator due to differences in the designs.

First we consider estimation of R_a^2 for number of shore trips, boat trips, and total trips in the license frame. In this case, we actually don't know for sure the number of licensed anglers within each household. However, the sample from the license frame was matched to the total license frame, and whenever an address match was found, the second angler was also sampled. The angler-level weighting of this sample then assumed that exactly two licensed anglers were present in every household in which a match was found. Thus we assume M_i = 1 or 2 for all households in the license frame. Note that households with only one angler make no contribution to SSW, but they do make a contribution to SST. There are two reasonable ways to estimate R_a^2 for this frame. One is that we use all households, with the one-angler households contributing only to S^2 but not MSW. This would also require estimating N, the number of households represented on the license frame.[11] A second approach is to compute R_a^2 only for that subset of the

[11] This could be done using the method in the JOS paper. That is, we could estimate the average number of licensed anglers per household for each stratum and divide the total number of anglers on the frame in each stratum by this quantity, and sum them over strata.

population that contains multiple licensed angler households; i.e., those for which $M_i = 2$. We take this approach, since it makes the results from the two frames more comparable, due to the fact that the proportion of households having multiple licensed anglers on the license frame may differ from the proportion of households having multiple anglers in the address frame. Thus we estimate

$$M\hat{S}W = S\hat{S}W / (2\hat{N}_m - \hat{N}_m) = \sum_{i=1}^{n_m} \sum_{j=1}^{2} w_{ij} (y_{ij} - \bar{y}_{iU})^2 \Big/ \hat{N}_m \quad (4)$$

and

$$\hat{S}^2 = \frac{S\hat{S}B + S\hat{S}W}{2\hat{N}_m - 1}, \quad (5)$$

(see Lohr 2010, p. 177) where n_m is the number of sampled households with 2 licensed anglers, $\hat{N}_m = \hat{K}_m / 2 = \sum_{i=1}^{n_m} \sum_{j=1}^{2} w_{ij} / 2$ is the estimate of the number of households in the population with 2 licensed anglers, and $S\hat{S}B = \sum_{i=1}^{n_m} \sum_{j=1}^{2} w_{ij} (\bar{y}_{iU} - \hat{\bar{y}}_U)^2$, where $\hat{\bar{y}}_U$ is the estimate of population mean from the complex design.[12] The first three rows of Table 11 show the components of these estimators, as well as the resulting estimateestimates of R_a^2 for the effort variables in the license frame.

Recall that differences in the design of the license and ABS sample caused differences in estimates of effort. In the ABS frame, only those anglers who fished during the past year were sampled in the second phase, which made the 2nd phase ABS anglers potentially more avid than the anglers sampled from the license frame. To make the two samples

[12] The estimates for the sums of squares for the complex design can be obtained using SAS PROC SURVEYREG's ANOVA table.

more comparable, we produced estimates of effort for the license frame that first filtered on the flag indicating whether or not the angler had fished in the last year. It seems reasonable that the same difference in design might cause different estimates of the clustering parameter as well. Therefore, we also made estimates of R_a^2 for the population of households containing two licensed anglers who have fished in the last year. These estimates were calculated from (4) and (5), but this time for the population of households containing two *active* licensed anglers. The results for these estimates are shown in rows 4 through 6 of Table 11. The differences in the correlations for the two populations are slight.

Table 11. Computation of R_a^2 for angler effort variables for License frame

Population	Variable	n_m	$\hat{K}$	$\hat{N}_m$	$S\hat{S}W$	$S\hat{S}B$	R_a^2
All licensed anglers in multiple angler hh's	Shore trips	134	82,540	41,270	82,145	158,867	0.32
	Boat trips	134	82,540	41,270	129,636	194,110	0.20
	Total trips	134	82,540	41,270	330,029	446,974	0.15
All active licensed anglers in multiple angler hh's	Shore trips	102	59,345	29,672	79,284	150,573	0.31
	Boat trips	102	59,345	29,672	129,636	186,443	0.18
	Total trips	102	59,345	29,672	327,167	418,003	0.12

Next we consider estimation of R_a^2 for the ABS frame. A different estimation method is required due to a difference in the design that was used to sample anglers within households, and the information available about the size of the household clusters. In the ABS frame, two anglers were sampled from a subset of the multiple angler households in the sample, and a single angler was sampled from the rest. In all cases, the number of anglers in the household was known. The angler weights that were calculated for the

ABS sample used the information about the number of anglers in the household, and so varied from one household to another, even within the same stratum and non-response weighting class. As with the license frame, we can use respondents in all households to estimate S^2 defined in (3), or only those respondents who contribute to estimation of MSW; i.e., those in households from which we sampled two members. As before, we chose the latter method. Thus the parameters being estimated will again be for the subset of the ABS frame residing in households with at least two adult active anglers. The estimators of the parameters in (2) and (3) are thus

$$M\hat{S}W = S\hat{S}W/(\hat{K}_m - \hat{N}_m) = \sum_{i=1}^{n_m}\sum_{j=1}^{2} w_{ij}(y_{ij} - \hat{\bar{y}}_{iU})^2 \Big/ (\hat{K}_m - \hat{N}_m) \qquad (6)$$

and

$$\hat{S}^2 = \frac{S\hat{S}B + S\hat{S}W}{\hat{K}_m - 1} \qquad (7)$$

(see Lohr 2010, p. 177) where n_m is the number of sampled households with 2 licensed anglers, $\hat{\bar{y}}_{iU}$ is the estimate of mean for household i, $\hat{K}_m = \sum_{i=1}^{n_m}\sum_{j=1}^{2} w_{ij}$, and

$\hat{N}_m = \hat{K}_m / \hat{\bar{M}}_m$, where $\hat{\bar{M}}_m = \sum_{i=1}^{n_m} w_i M_i / \sum_{i=1}^{n_m} w_i$ is an estimate of the average number of anglers in households with multiple anglers, and w_i is a household weight computed from the angler weights (w_i = (2/ # of adult anglers in hh)*w_{ij}). These estimates are used to form an estimate of R_a^2 as shown in (1). The results are shown in Table 12. Note that the sample size is much smaller in this case than the license sample; only 17 households in the sample had responses from 2 active anglers, so the estimates have high variability.

Table 12. Computation of R_a^2 for angler effort variables for ABS frame

Population	**Variable**	n_m	$\hat{K}$	$\hat{N}_m$	$S\hat{S}W$	$S\hat{S}B$	R_a^2
All active licensed anglers in multiple angler hh's	Shore trips	17	177,747	78,270	438,928	453,380	0.12
	Boat trips	17	177,747	78,270	63,512	86,729	0.24
	Total trips	17	177,747	78,270	549,682	591,967	0.14

The estimates of R_a^2 for boat trips and total trips are very similar to those for the license frame, while the estimate of R_a^2 for shore trips is slightly lower, though the small sample size for the ABS frame may be the cause of this.

Clustering of trip-level characteristics within angler

Next we consider estimation of R_a^2 for trip-level characteristics. There are two levels of clustering for trips: within angler and within household clustering. The analysis here estimates the correlation of trip characteristics within angler. As noted earlier, the respondents were asked to profile only their four most recent trips. This does provide some information about the clustering within angler on characteristics such as public/private access or time of return. However, the profiled trips are not a probability sample of trips made in the wave. Despite this, we did use the data to make estimates of R_a^2. To the extent that the four recalled trips have similar characteristics to a random sample of trips made by the angler, the estimates will be valid.

We estimated R_a^2 as shown in (1), but this time the two mean squares must be defined differently:

$$MSW = SSW/(T-K) = \sum_{i=1}^{N}\sum_{j=1}^{M_i}\sum_{k=1}^{T_{ij}} (y_{ijk} - \bar{y}_{ijU})^2 \Big/ (T-K)\,, \tag{8}$$

$$S^2 = SST/(T-1) = \sum_{i=1}^{N}\sum_{j=1}^{M_i}\sum_{k=1}^{T_{ij}} (y_{ijk} - \bar{y}_U)^2 \Big/ (T-1)\,, \tag{9}$$

where T is the total number of trips in the population, y_{ijk} is a characteristic of the k^{th} trip made by the j^{th} angler in household i (referred to henceforth as the $(i,j)^{\text{th}}$ angler), and $\bar{y}_{ijU}$ is the mean of all trips made by that angler. To estimate MSW and S^2, we used only those anglers who made at least two trips in estimation of both sums of squares. Thus

$$M\hat{S}W = S\hat{S}W/(\hat{T} - \hat{K}) = \sum_{i=1}^{n}\sum_{j=1}^{m_i}\sum_{k=1}^{t_{ij}} w_{ijk} (y_{ijk} - \hat{\bar{y}}_{ijU})^2 \Big/ (\hat{T} - \hat{K}) \tag{10}$$

and

$$\hat{S}^2 = \frac{S\hat{S}B + S\hat{S}W}{\hat{T} - 1}\,, \tag{11}$$

where n and m_i are the number of households and anglers in the subsample of anglers with multiple trips, t_{ij} is the number of trips reported by the $(i,j)^{\text{th}}$ angler, $\hat{\bar{y}}_{ijU}$ is the estimate of mean for the trips of the (i,j)$^{\text{th}}$ angler, $S\hat{S}B = \sum_{i=1}^{n}\sum_{j=1}^{m_i}\sum_{k=1}^{t_{ij}} w_{ijk} (\bar{y}_{ijs} - \hat{\bar{y}}_U)^2$,

$\hat{T} = \sum_{i=1}^{n}\sum_{j=1}^{m_i}\sum_{k=1}^{t_{ij}} w_{ijk}$, and $\hat{K} = \sum_{i=1}^{n}\sum_{j=1}^{m_i} w_{ij}$. The weight w_{ijk} was constructed by assuming that the profiled trips are a random sample of all trips made by the angler, yielding

$$w_{ijk} = w_{ij} * (\text{\# of trips made by angler } (i,j))/(\text{\# of trips profiled by angler } (i,j))\,. \tag{12}$$

We also made a second estimate of R_a^2 only for that subset of anglers who reported all their trips, to see if the (untrue) assumption that the sampled trips were a random sample of all the angler's trips made a substantial difference in the estimate.

For completeness, we present in Table 13 a summary of the four variables we will be examining for within angler correlation: the number of anglers on each trip reported (TOT), whether or not the trip was (or ended) at a public site (PUB), whether or not it ended between 6:00 p.m. and 6:00 a.m. (LATE), and whether it included an accompanying child (CHILD). The trips accessed through the two frames do appear to be quite different, with those from the license frame more likely to be at public sites and less likely to end during night hours, which suggests they are more closely aligned with the trips profiled by the intercept survey. The trips accessed through the license frame appear to be less likely to include additional family members than those encountered through the ABS frame.

Table 13. Estimates of trip characteristics for the two frames

Sample from:	**Mean # of anglers on trip (sd)**	**Proportion of trips in public site (sd)**	**Proportion of trips ending at night (sd)**	**Proportion of trips including a child (sd)**
License frame	1.6 (0.1)	0.81 (0.04)	0.21 (0.04)	0.15 (0.03)
ABS frame	3.0 (0.7)	0.67 (0.12)	0.41 (0.15)	0.50 (0.14)

Table 14 summarizes the calculations (using (1), (8) and (9)) for estimating R_a^2 for the 4 variables described in Table 13. These calculations were carried out for the samples from each frame.

Table 14. Computation of R_a^2 for angler effort variables for two frames

Sample from…	Variable	$\hat{T}$	$\hat{K}$	$\hat{SSW}$	$\hat{SSB}$	R_a^2
Trips accessed through LIC frame for domain of anglers reporting >1 trip	TOT	258,551	48,780	87,477	378,619	0.72
	PUB	258,551	48,780	16,609	26,028	0.52
	LATE	258,551	48,780	12,732	28,631	0.62
	CHILD	258,551	48,780	7,310	30,448	0.76
Trips accessed through ABS frame for domain of anglers reporting > 1 trip	TOT	828,266	216,378	35,201	3,597,963	0.99
	PUB	828,266	216,378	7,574	175,568	0.94
	LATE	828,266	216,378	11,757	189,238	0.92
	CHILD	828,266	216,378	14,085	192,896	0.91

The results show that the trips made by an angler tend to be quite similar. This is especially true for the trips taken by anglers in the ABS frame.

Comparison with Telephone Frame

Simultaneously with the mail survey experiment, a dual frame telephone survey was conducted, which collected similar data about anglers and their fishing trips. The two frames were an RDD frame (CHTS) and the license frame (ALDS). The CHTS chose telephone numbers only from coastal households, while the ALDS sample drew from all licensees whose telephone numbers could be discerned from the license frame. We used the data from that survey to make estimates of R_a^2 , for total number of trips and for two of the trip characteristic variables (whether or not the trip ended at a public site, PUB, or between 6:00 p.m. and 6:00 a.m., LATE), which we compared with those from the mail survey.

There were differences in the sample designs of mail and telephone that make the measures of correlation apply to different populations, and therefore which may not be directly comparable. In the telephone survey, information was collected about every angler in the household, so that clusters of more than two anglers were possible. Since there was no matching to the license frame, there was no way to identify who was licensed and who was not in the CHTS, so correlations were computed for all anglers in the household, whether they were licensed or not. In the collection of trip characteristics, anglers were required to recall all the trips he/she took, rather than the four most recent ones[13]. So by design, there should have been no sampling at the last stage, but rather a complete observation of trips within anglers. However, many anglers did not provide information for all trips. During Wave 6, 2009 in NC, 71.51% of trip records were imputed (i.e. not profiled).Instead, weights were created to account for the missing trips, based on the number of trips reported by the angler, and effectively the trips that were reported were treated as though they were a random sample of trips for the purpose of estimating R_a^2.

The estimator of R_a^2 that we used for angler characteristics in both frames was the same as that shown in (6) and (7), except that the upper limit of the inner sum in (6) can be larger than 2, since data was collected about all the anglers in a household. The estimator of R_a^2 that we used for trip characteristics in both frames was the same as that shown in (10) and (11). The weight associated with the $(i,j,k)^{th}$ trip is defined as in (12), though the absent profiles were due to nonresponse, rather than from the instruction to profile only the most recent trips.

Results are shown in Table 15 for the angler characteristic, total number of trips, for both frames. A comparison of Tables 9, 10, and 15 shows that the correlation of effort within household is much larger for the telephone than for the mail survey, as expected.

[13] Note that proxy reported information is accepted for the telephone surveys if the individual angler(s) can not be interviewed. In these cases, a respondent may be reporting about his or her own trips as well as those of other household members.

Table 15: Computation of R_a^2 for angler effort for the two telephone frames:

Sample From...	Variable	n_m	$\hat{K}$	$\hat{N}_m$	$S\hat{S}W$	$S\hat{S}B$	R_a^2
All anglers in multi-angler hh in ALDS	Total trips	82	93,697	41,994	53,501	1,703,411	0.945
All anglers in multi-angler hh in CHTS	Total trips	30	12,184	5423	67.99	1,284,853	0.999

For completeness, summary data for the two trip characteristic variables for the two telephone frames is shown in Table 16.

Table 16. Estimates of trip characteristics for two frames

Sample From:	Proportion of trips in public site (sd)	Proportion of trips ending at night (sd)
Anglers with > 0 trips in ALDS	0.80 (0.04)	0.11 (0.02)
Anglers with > 0 trips in CHTS	0.69 (0.07)	0.11 (0.04)

Table 17 displays the estimated R_a^2 for the trip characteristic variables for the telephone frames. They are much smaller than the correlation among anglers in the same households. Comparison with Table 14 shows that the correlations of characteristics among trips by the same angler is similar for the mail and telephone frames in the license frame, but not for the CHTS/ABS frame. The anomaly seems to be the correlation for the ABS frame, which is unusually high, and much higher than the correlation for the CHTS frame. One could imagine that tourists to the coast from non-coastal counties may take more similar trips, especially since they were instructed to report only their last 4 (consecutive) trips. The CHTS would contain no such non-coastal anglers in its sample, while the ABS does contain such anglers. Still the magnitude of this difference is hard to explain.

Table 17. Computation of R_a^2 for angler effort variables for two frames

SAMPLE FROM…	VARIABLE	$\hat{T}$	$\hat{K}$	$S\hat{S}W$	$S\hat{S}B$	R_a^2
Trips accessed through ALDS frame for domain of anglers reporting > 0 trips	LATE	132,775	20,226	5,065	8,270	0.55
	PUB	132,775	20,226	10,797	17,627	0.55
Trips accessed through CHTS frame for domain of anglers reporting >0 trips	LATE	537,895	126,644	21,578	29,947	0.45
	PUB	537,895	126,644	22,698	67,284	0.67

These findings about correlation suggest that a design which attempts to sample more than one angler from the same household is more cost effective for the mail survey than the telephone survey, for estimating effort. For trip characteristics, this does not appear to be so. However, the latter finding comes with the caveat that the method of sampling trips for an angler differed by mode. The mail survey asked respondents to describe their four most recent trips, which may explain why the trip characteristics would be more similar to each other than the characteristics of all trips made during the wave, which were requested of telephone respondents.

Discussion

The primary goal of the pilot study was to examine whether a self-administered two phase study could be successfully implemented to estimate fishing effort among NC anglers in the fall of 2009, with an eye toward improving both the coverage and the response rates currently achieved via telephone surveys. With respect to response rate and the feasibility of conducting a two-phase self administered survey among anglers, the response rates presented in Table 2 clearly indicate that such a design is feasible and offers a potential alternative to the RDD design currently used by MRIP. Both the two-phase approach used with an ABS frame as well as the single-phase approach based on a license frame yielded response rates that exceed the current response rates achieved via telephone data collection (CHTS and ALDS, respectively). But the response rates from the ABS sample also raise concerns about avidity bias, an issue in angler surveys regardless of the mode and method of data collection. We also see a pattern (albeit not significant) similar to findings from other studies (Montaquila et al., 2010) that a longer lag time between the screener survey field period and the mailing of the extended survey instrument may be beneficial with respect to response rates. The small sample for the field test limits our ability to draw additional conclusions or recommendations with respect to the details of fielding a two-phase dual frame study by mail, but does provide sufficient positive findings to motivate further research in this area.

Other indications of data quality, specifically missing data rates or data inconsistencies did not signal a red flag. We saw relatively low levels of missing data, with the exception of detailed trip reports for avid anglers. However, both the CHTS and ALDS telephone surveys are plagued with similar problems, with respondents either not providing detailed reports for each trip or opting for the response option that all trips are similar. Regardless of the mode of data collection, attempting to collect detailed trip level information for a two month recall period for avid anglers is difficult and may require a reconsideration of the data elements to be collected for these anglers.

With respect to the dual frame nature of the study, the study had two goals: to estimate the improvement in coverage the two frames provide and to examine means by which to identify the overlap among elements across the two frames. Here too we found significant gains via the use of a dual frame design consisting of a license frame and an addressed-based frame in comparison to the current CHTS and ALDS sample designs. The findings support the improvement in the identification of frame overlap via the use of addresses as compared to self-reported fishing licensure. Thus, the use of a self-administered mail survey (based on addresses from an ABS frame and a license frame) facilitates improved identification of overlapping sample members as compared to what is possible for a dual-frame telephone survey.

The findings clearly support empirical results that have been well established in the literature, namely the presence of avidity bias in surveys of recreational anglers. We are planning to test a revised household screener that allows respondents to provide information about other recreational activities besides fishing. The goal of the revised instrument is to reduce the fishing avidity bias in the ABS sample. For both the ABS and license sample, we plan to use the type of license in nonresponse adjustment to reduce nonresponse bias. We hope that both of these steps may reduce the differences in the estimates for the overlap domain.

The major limitation of the study is its small sample sizes for active anglers during the wave. This limitation makes it difficult to precisely estimate fishing effort and reduces our ability to understand differences in fishing behavior as a function of geography and ownership of landline phones. In addition, the small sample size makes it impossible to assess the degree to which the current approach to coverage adjustment in the MRIP, that is, the use expansion factors based on the APAIS, is fully representative of all fishing trips. While we see indications of differences in these population subgroups which have traditionally been under-covered in the telephone surveys, we cannot address the extent to which their actual fishing behavior differs.

As is true for many exploratory pilot studies, the goal was not to be able to provide the definitive answer with respect to a redesign of the current MRIP telephone surveys. Rather, the pilot was successful in examining the feasibility of moving away from the telephone to a self-administered two-phase survey. It also clearly demonstrated the utility of this design in the context of a dual frame sample. The success of the two-phase mail survey, especially with respect to the dual frame design, shows the substantial potential for improving future angler surveys.

Recommendations

The 2009 two phase dual frame study conducted in North Carolina was a first step toward exploring sample and design options to address coverage, efficiency, and other issues that were raised in the report of the National Research Council. As noted above, the size of the sample limits our ability to offer definitive recommendations for a full scale redesign of the MRIP program, but the findings do suggest the following:

1. This study, as with other empirical studies, clearly indicates that surveys of anglers are subject to avidity bias. As noted above, we recommend further experimental studies to reduce avidity bias (e.g. broaden the base of the screener questionnaire) and further examination of how to reduce avidity bias through the use of license type information in nonresponse adjustments.

2. We suspect that the avidity bias evident in the mail survey also exists for CHTS and ALDS. We recommend implementing studies to test for avidity bias in CHTS and ALDS.

3. Matching household sample frames to license frames, regardless of whether using a dual-frame approach or a single-frame approach is a good approach to adjust for avidity bias. We would recommend this for surveys conducted by either the telephone or mail; however, telephone surveys would need to reverse link to addresses to facilitate this matching.

4. Conduct follow-up studies with sufficient sample sizes to test the assumption that the APAIS (intercept) survey is representative of all trips (e.g. do the trips that we can cover in the APAIS (public access) adequately represent all trips?). Sufficient sample sizes would also facilitate more robust estimation of trip-level information and comparisons of the effort levels and characteristics of trips by frame and for subgroups not currently covered by the CHTS.

5. Not addressed in the present study is the need for timely data. Clearly a shift toward self-administered mail surveys comes at the potential cost of longer field periods than comparable telephone surveys. This is particularly true

when the survey involves the need to screen households (the two phase ABS frame design). Future studies should examine the relative speed of the CHTS/ALDS design compared to a mail mode (or possibly mixed mode).

References

American Association for Public Opinion Research (AAPOR) (2009). Standard Definitions: Final Dispositions of Case Codes and Outcome Rates for Surveys. http://www.aapor.org/AM/Template.cfm?Section=Standard_Definitions&Template=/CM/ContentDisplay.cfm&ContentID=1819

Blumberg, Stephen and Luke, Julian. (2010). Wireless substitution: Early release of estimates from the National Health Interview Survey, July-December 2009 *National Center for Health Statistics*. Available from: http://www.cdc.gov/nchs/nhis.htm.

Brick J. M., Cervantes, I. F., Lee, S., and Norman, G. (forthcoming). Nonsampling Errors in Dual Frame Telephone Surveys, *Survey Methodology*.

Connelly, Nancy A., Brown, Tommy, and Knuth, Barbara (2000) Assessing the Relative Importance of Recall Bias and Non-response Bias and Adjusting for Those Biases in Statewide Angler Surveys. *Human Dimensions of Wildlife*, 5:19-29.

Dillman, Don .A., Smyth, Jolene. D., and Christian, Leah. M. (2008). *Internet, Mail, and Mixed-Mode Surveys: The Tailored Design Method*. Wiley & Sons, New York.

DiSogra, Charles, Callegaro, Mario, and Hendarwan, Erlina (2009) Recruiting Probability-Based Web Panel Members Using an Address-Based Sample Frame: Results from a Pilot Study Conducted by Knowledge Networks. *Proceedings of the Section on Survey Research Methods, American Statistical Association,* 5270- 5283.

Fahimi, M., Kulp, D., and Brick, J.M. (2009). A reassessment of list-assisted RDD methodology. *Public Opinion Quarterly*, 73, 751-760.

Fisher, Mark (1996) Estimating the Effect of Nonresponse Bias on Angler Surveys. *Transactions of the American Fisheries Society* 125: 118-126.

Han, Daifeng, Cantor, David, Brick, Pat Dean, and Aponte, Maribel. (2010). Findings from a Two-Phase Mail Survey for a Study of Veterans. *Presentation at the American Association of Public Opinion Research Meetings,* Chicago, Il.

Iannacchione, Vince, G., Stabb, Jennifer, M., and Redden, David T. (2003) Evaluating the Use of Residential Mailing Addresses in a Metropolitan Household Survey. *Public Opinion Quarterly*, 67:202-210.

Kennel,T. and Li, M. (2009). Content and coverage quality of a commercial address list as a national sampling frame for household surveys. *Proceedings of the Survey Research Methods Section, American Statistical Association,* 2364-2378.

Lin, Dong (2009) "CHTS and ALDS Data Summary." Report submitted to the National Oceanic and Atmospheric Administration.

Link, Michael W., Battaglia, Michael P., Frankel, Martin R., Osborn, Larry, and Mokdad, Ali H. (2008) A comparison of Address-Based Sampling (ABS) Versus Random Digit Dialing (RDD) for General Population Surveys. *Public Opinion Quarterly*, 72(1):6-27.

Link, Michael W., Daily, Gail, Shuttles, Charles, D., Yancey, L. Tracie, Burks, Anh Thu, and H. Christine Bourquin (2009) Building a New Foundation: Transitioning to Address Based Sampling After 30 Years of RDD. Paper presented at the 64th Annual Meeting of the American Association for Public Opinion Research, Hollywood, FL.

Lohr, S. (2009). Multiple Frame Surveys. **Chapter 4** in D. Pfeffermann and C. R. Rao. (Eds.) *Sample Surveys: Design, Methods and Applications, Vol. 29A,* (pp. 71-88) Elsevier, The Netherlands: North-Holland.

Montaquila, Jill M., Brick, J. Michael, Hagedorn, Mary, C., Williams, Douglas, W. (2010). Maximizing Response in a Two-Phase Survey with Mail as the Primary

Mode. *Presentation at the American Association of Public Opinion Research Meetings,*Chicago,Il.

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

Thomson, Cynthia (1991) Effects of the Avidity Bias on Survey Estaimtes of Fishing Effort and Economic Value. *American Fisheries Society Symposium*, 12:356-366.

Appendix A: Disposition of ABS and License Sample Units

Table A-1. Screener Disposition for ABS Sample, Both Waves, by Stratum

Disposition	Coastal Counties	Non-Coastal Counties	Total
Total Completes	357	328	685
With Anglers	154	74	228
Without Anglers	203	254	457
Refusals	14	8	22
Bad Address	78	79	157
Unknown/No Response	451	485	936
Totals	900	900	1800

Table A-2. Angler Survey Disposition for ABS Sample, by Stratum

Disposition	Coastal Counties	Non-Coastal Counties	Total
Total Completes	130	57	187
With Trips	43	8	51
Without Trips	87	49	136
Refusals	1	3	4
Bad Address	5	3	8
Unknown/No Response	47	16	63
Totals	183	79	262

Table A-3. Angler Survey Disposition of License Sample, Both Waves, by Stratum

Disposition	Coastal Counties	Non-Coastal Counties	Out of State	Total
Total Completes	316	307	343	966
With Trips	76	43	108	227
Without Trips	240	264	235	739
Refusals	5	9	5	19
Bad Address	51	41	47	139
Unknown/No Response	164	167	107	438
Totals	536	524	502	1562

Dual Frame Mail Survey of Fishing Effort: Project Documentation

Issued under Contract No. DG133F-09-RQ-0666

Conducted on behalf the National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Science and Technology

an ICF International Company

116 John Street
New York, NY 10038
Seth Muzzy, Principal
sMuzzy@icfi.com

Contents

Introduction

Since 1981, the Federal government has relied upon telephone-based general population interviews to estimate fishing effort and catch by marine recreational anglers. However, increasing issues with telephone frame coverage has caused the National Marine Fisheries Service (NMFS) to investigate alternate methodologies which may lead to increased efficiency and reduced coverage error.

As a part of this effort, the Dual-Frame Mail Survey of Fishing Effort pilot study was awarded to ICF Macro under the Blanket Purchase Agreement DG133F-09-RQ-0666.

Project Background

Historically, recreational fisheries estimates have been developed through two main components:

- An access-site intercept study (the Atlantic Coast Access Point Angler Intercept Survey, APAIS) which documents angler activity and catch; and
- Telephone surveys of fishing effort such as the Coastal Household Telephone Survey (CHTS) which primarily operate as a weighting factor to expand angler data to represent activity across all recreational fisheries.

One of the key statistics derived from the CHTS is the incidence of saltwater recreational anglers living in the coastal regions of the country. This is obtained through a relatively efficient random digit dialing (RDD) methodology targeting relevant coastal counties. However, coverage errors may weaken the integrity of resulting statistics. Specifically:

- The CHTS only incorporates traditional land–line telephone numbers in its sample frame. The National Center for Health Statistics estimated that, at the end of 2008, about one-in-seven American households received all or most calls using cellular telephones. The demographics of these households are statistically unique from those which can be contacted using a traditional landline telephone number (Blumberg & Luke, 2009).
- The CHTS limits the sample frame to areas with the highest concentrations of anglers. Specifically, non-coastal anglers and anglers active in northern states during winter months do not have a probability for selection.

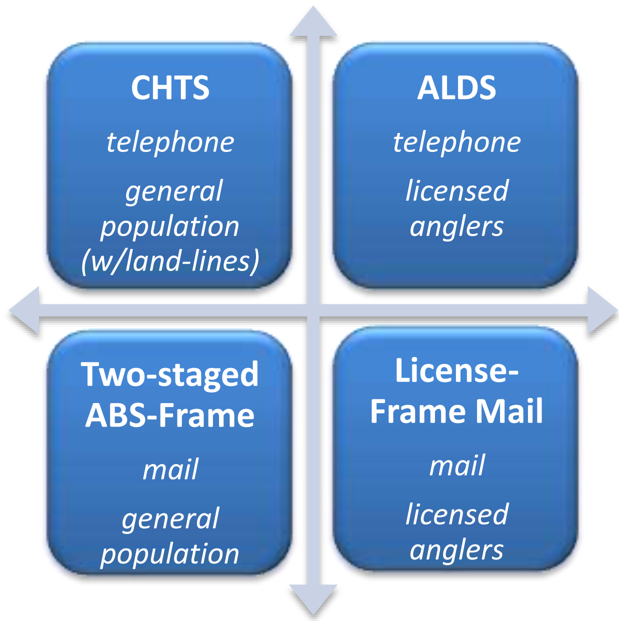
In addition, the RDD effort lacks the ability to efficiently profile adequate numbers of anglers needed to produce effective fisheries management information. A significant investment is required to produce precise figures regarding a wide variety of fishing behaviors.

License-based angler frames promise to be a primary component to resolving MRFSS' methodological issues as the program is refined as part of the Marine Recreational Information Program (MRIP) initiative. Since early 2007, the Angler Directory License

Survey has supplied data similar to the CHTS, economically providing additional details about fishing behaviors by utilizing state-based registration databases as sample frames. However, this dual-frame approach does not resolve all MRFSS coverage issues. Specifically, registration laws provide exemptions to some anglers and not all active anglers register with the state, thereby weakening state databases.

Survey Design

A dual-frame multi-stage collection methodology has been designed to mirror current CHTS and ALDS activity, adapting the current telephone methodology to a mail-based approach.



- Similar to the CHTS, a general population survey identifies households with residents recently participating in fishing activities.
- A follow-up survey sent to anglers identified in the household survey provides detail of recent activity.
- The same follow up survey sent to select registered anglers efficiently increases the amount of angler data.

During analysis, data resulting from each mail effort may be assessed in relation to the data collected via its analogous sampling frame or collection procedure.

Sample Design: Delivery Sequence File

In order to obtain an accurate estimate of the incidence of anglers in the general population, sampling was conducted using the Delivery Sequence File (DSF) from the United States Postal Service (USPS). The DSF includes addresses with both single-family style addresses and multi-unit residential property addresses such as for apartments, condominiums, and trailer properties. Non-city style addresses (i.e. post office boxes) are not included. The Census Bureau reports that in areas where city-style addresses are prominent, people who receive mail at post office boxes will often also receive postal mail at their city-style address. This assertion has been backed by other researchers who have concluded that most people who maintain a post office box also receive postal mail at their physical residence (Iannacchione, Staab, & Redden, 2003).

Records selected from the DSF were limited to households in the State of North Carolina. Addresses were stratified into Coastal/Non-Coastal classifications consistent with CHTS sampling during November and December in North Carolina. A total of 1,800 households were selected, split evenly between the two strata.

Coastal Counties		Non-Coastal Counties			
013 Beaufort	103 Jones	001 Alamance	051 Cumberland	101 Johnston	159 Rowan
015 Bertie	107 Lenoir	003 Alexander	057 Davidson	105 Lee	161 Rutherford
017 Bladen	117 Martin	005 Alleghany	059 Davie	109 Lincoln	165 Scotland
019 Brunswick	129 New Hanover	007 Anson	063 Durham	111 McDowell	167 Stanly
029 Camden	131 Northampton	009 Ashe	067 Forsyth	113 Macon	169 Stokes
031 Carteret	133 Onslow	011 Avery	069 Franklin	115 Madison	171 Surry
041 Chowan	137 Pamlico	021 Buncombe	071 Gaston	119 Mecklenburg	173 Swain
047 Columbus	139 Pasquotank	023 Burke	075 Graham	121 Mitchell	175 Transylvania
049 Craven	141 Pender	025 Cabarrus	077 Granville	123 Montgomery	179 Union
053 Currituck	143 Perquimans	027 Caldwell	081 Guilford	125 Moore	181 Vance
055 Dare	147 Pitt	033 Caswell	085 Harnett	127 Nash	183 Wake
061 Duplin	149 Polk	035 Catawba	087 Haywood	135 Orange	185 Warren
065 Edgecombe	155 Robeson	0 Chatham	089 Henderson	145 Person	189 Watauga
073 Gates	163 Sampson	039 Cherokee	093 Hoke	151 Randolph	193 Wilkes
079 Greene	177 Tyrrell	043 Clay	097 Iredell	153 Richmond	197 Yadkin
083 Halifax	187 Washington	045 Cleveland	099 Jackson	157 Rockingham	199 Yancey
091 Hertford	191 Wayne				
095 Hyde	195 Wilson				

Sample Design: Angler Registry Frame

In order to conduct the Licensed Angler Study, a database containing approximately 551,060 million registered anglers was provided by North Carolina's Division of Marine Fisheries. In order to prepare the sample file for sampling, the following steps were completed.

- Duplicate records matching on core information such as name, date of birth, and mailing address were also deleted.
- Records lacking fundamental information such as name, date of birth, and mailing address were eliminated from the file.
- Anglers under the age of 18 were excluded.
- Addresses were "normalized" using Satori Software's "Mailroom Toolkit" which is designed to correct minor deviations from standard formats used by the USPS.
- Records were classified into appropriate coastal, non-coastal, or out-of-state strata groups.

- Unique household identifiers were assigned to anglers who share a common mailing address or telephone number.

The sample draw for the license-frame survey involved an nth selection procedure for each stratum. A file listing households was sorted by address in order to minimize the possibility of including unidentified duplicate household listings. 450 records were selected from each stratum and designated as "original sample."

Supplemental sample was obtained from other anglers living in the same households as the original sample. At most one additional angler was selected for each household, with up to 100 secondary anglers permitted per stratum. Counts are listed in Table 1.

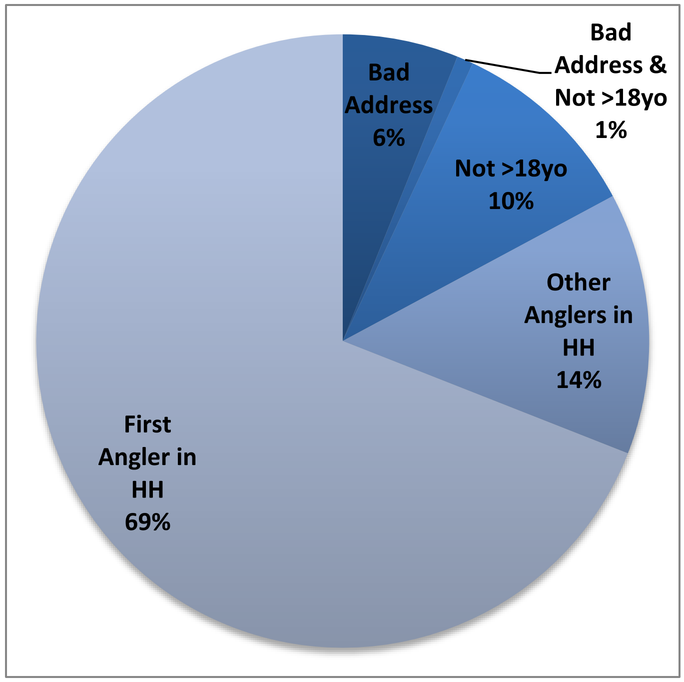


Table 1

Supplemental Records	Count
Coastal	86
Non-Coastal	74
Out-of-State	52

Questionnaire Design

Three primary data forms were designed for the study:

- An initial household screener for the ABS sample
- An angler survey for individuals identified through the household screener or using the North Carolina Angler Registry
- A trip form associated with the angler survey which captured details regarding up to four recent outings.

Questions in the mail survey were selected from key measures in the CHTS instrument. Wording modifications were required to adapt an interviewer guided telephone survey script to a self administered paper form.

Design of the initial household screener and the angler survey involved:

- Printing on 11" x 17" white paper later folded into a four page 8.5" x 11" booklet.
- A front cover incorporating the study name, NOAA logo, OMB approval number and expiration date, and informed consent information including an assurance of confidentiality. The front cover was printed in color.

- A back cover printed in color listing commonly asked questions including items involving sampling procedures, study purpose, anticipated time burden, and contact information for the survey sponsor.
- An interior spread clustering questions on the right-hand page. Major question groups were presented in shaded text boxes with response areas appearing in white. The booklet's control number appeared vertically as a form number along the crease of the booklet where it was protected from mutilation.
- The only design element appearing on the obverse of the front cover was a bar code of the respondent control number. The bar code was overlaid with a stencil of a fish, transforming it into a graphical element unlikely to be tampered with by a respondent.

A supplemental form for recording details of up to four recent trips was included with the angler questionnaire. The 11" x 17" page was printed on tan paper with black ink and folded so that all questions about each of the trips appeared independently on one 8.5" x 11" page.

Other designed components of the survey efforts included:

- A 10" x 13" white outbound envelope. The return address referenced "A Study of Fishing in NC" with the ICF Macro office location listed in the return address. NOAA's logo was prominently displayed next to the return address. The envelope was clearly marked with a "Return Service Requested" stamp to facilitate accurate classification of undeliverable pieces. Adhesive labels showing the respondent's address incorporated a unique numeric identifier to help ensure survey materials were properly matched to envelopes.
- A 9" x 12" business reply envelope (BRE). This BRE directed returns to "A Study of Fishing in NC" at the same ICF Macro office location printed on the outbound envelope.
- Cover letters. Five different cover letters were designed to motivate:
    - Households receiving an initial survey instrument,
    - Non-responding households receiving a replacement form,
    - Anglers receiving an initial angler activity survey instrument,
    - Non-responding anglers receiving a replacement forms, and
    - Non-responding anglers receiving a third and final form.

  An electronic letterhead included the NOAA logo, address, telephone number, and web address printed in color. Each motivational message displayed the signature of the NOAA's Fisheries Statistics Division's Chief, David Van Voorhees. Letters were personalized with an inside address (including the respondent's name if known).

- Postcards. Approximately one week after receiving an initial household or angler survey packet, respondents received a postcard reiterating the importance of response. Postcards were printed on white cardstock and prominently displayed the NOAA logo.

Images of survey material can be found in the appendices.

Data Collection

Assembly protocols

Household survey packets sent to the ABS participants included a cover letter, survey booklet, and business reply envelope. Initial surveys to households also included a one dollar bill clipped to the front of the packet. Outbound envelopes were stuffed with the BRE flap at the bottom of the envelope, cradling other components to ensure their orderly removal by the respondent.

Angler survey packets were assembled in a similar manner. A personalized cover letter, angler questionnaire and trip detail form were stacked and tucked into the lip of a BRE. As with the household study, initial mailings also included a dollar bill clipped to the front of the packet.

Survey materials for each mailing were sorted and printed in order of a process control number. Pieces were batched in groups of 100 and released to assembly staff by a process supervisor. If any materials were left over after assembling a batch of 100, the cause of the discrepancy was investigated and corrected. A supervisor performed a quality assurance check on approximately one out of every 10 envelopes noting proper nesting of materials and matching of all control numbers.

After assembly, packets were sealed and metered. A first-class postage rate was used in order to generate a positive impact on response rates (Fox, Crask, & Kim, 1988) and avoid possibly delays in delivery associated with second-class, third-class, or bulk mail postage rates.

Mailing protocols (issuance)

Household Sample

In an effort to optimize the timing between the household screener and angler follow-up surveys, ABS sample was split into two equal groups. Initial surveys for the first group were sent eight weeks prior to the start of the angler effort. Fielding to the remainder of the ABS sample was completed in a compressed timeline of only six weeks.

	Group 1 Extended Fielding	Group 2 Compressed Fielding
Count	900	900
Date of initial mailing	November 10, 2009	November 20, 2009
Date of postcard mailing	November 16, 2009	November 30, 2009
Date of replacement form	November 30, 2009	December 14, 2009
Fielding Window	8 weeks	6 weeks
Number of Completes	360	351

Households selected for the ABS survey were sent packets containing a $1 incentive for participation. Approximately one week later, the same households received a postcard with a reminder to complete the survey. The status of returned questionnaires were checked into a process control system using various codes including completed interview, refusal to participate, and unable to be delivered by the Postal Service. Non respondents were sent replacement survey packets including an updated cover letter but no dollar bill.

Data from all returned surveys were entered to permit the creation of a list of identified anglers. The data file was compared to the check in system to ensure a complete file for sampling.

Angler Sample

The second stage of the project involving the sampling of anglers used the same mailing procedures for anglers identified in the ABS household survey and in the North Carolina licensed angler frame. Because multiple anglers were sampled in some households, materials were personalized to include the names of anglers. If the names of anglers were not provided in the ABS household study, name fields were hand edited to include specifications such as “male angler” or “eldest female angler”.

Initial packets were sent with a $1 incentive for participation. All sampled anglers received a postcard reminder to complete the survey approximately one week later. If a form had not been returned within 3 weeks, a replacement packet using a modified cover letter was sent without the monetary incentive. Those who did not return a survey within seven weeks were sent a second replacement form with a final request for participation. This last appeal was sent using Federal Express 2-day delivery.

	Anglers from ABS sample frame	Anglers from NC License Frame
Count	262	1562
Date of initial mailing	January 4, 2009	
Date of postcard mailing	January 12, 2009	
Date of replacement form	January 25, 2009	
Date of final replacement	February 18, 2009	
Number of Completes	191	985

Process Control Procedures

The mailing of all survey items and the receipt of all survey forms (regardless of completion status) were logged into a process tracking system. When available, bar code readers were used to automatically enter control numbers and minimize errors in documentation. Status codes included specific actions (e.g. mailing of initial survey packet) as well as outcome codes consistent with guidelines set by the American Association for Public Opinion Research (AAPOR).

All returned BREs were opened and grouped into batches corresponding to the day's receipts. An initial check of surveys ensured reasonable completeness and blank forms were logged into the tracking system as "refused interview". Each survey was scanned for errors or inconsistencies. Directive clarifications for data entry staff were written directly on the survey, initialed and dated by the reviewer in a distinguishable colored pencil.

Data Entry

A data entry program was created using specialized research software and incorporated range and logic checks. These checks can be described as hard edits, soft edits, and consistency checks:

- Hard Edits represent a finite permissible range for the response and trigger an error message if an unallowable value is entered into the program.
- Soft Edits represent response values that may be valid, but are viewed as extreme. These values trigger an "unlikely" message when entered by the data entry person. Data entry personnel review these responses for verification prior to entering them as data.
- Internal Consistency Edits represent programmed checks to ensure responses are consistent throughout the survey. Since these contradictions may reflect data

recorded on the form by the respondent, consistency checks operate like soft edits, flagging the data entry personnel to possible errors but not preventing the recording of data.

Standard codes for illegible or missing values were incorporated for each question. Each survey was entered into the system twice. Inconsistencies between data records were rectified to ensure digitized files accurately reflected the information provided by the respondent on the paper survey. In the case that coding decisions were not immediately clear to the data entry staff person, project management would clarify guidance directly on the survey form along with their initials and the date.

Data Cleaning Procedures

ICF Macro employed limited data cleaning on data files:

ABS Household Survey

- If the number of anglers with recent activity was detailed in Q2, Q1 may be coded to indicate the presence of anglers.

Angler Survey

- Given an indication of recent participation (e.g. in Q7 or Q8), Q1 may be marked to indicate 2009 recreational saltwater fishing activity
- If dates of trips were marked in the Q8 calendars, Q7 could be marked to indicate recreational saltwater fishing in North Carolina during November and/or December
- If valid trips were detailed, the following assumptions could be made:
    - Q1: Respondent participated in recreational saltwater fishing
    - Q7: Indication of recreational saltwater fishing in North Carolina during November and/or December
    - Q8a & Q8b: dates of saltwater activity

Trip Detail

- It was required that non-missing dates of trips must occur during November or December. Trips from other months were considered invalid.
- Missing trip dates may be transcribed from Q8 of the angler survey provided the angler made four or fewer trips and the mode of trips (boat, shore) were sequenced as expected.
- Fishing on a boat (Q2) could be assumed if details of a boating trip were provided in Q2a and Q2b.
- Fishing from the shore (Q3) could be assumed if details of a shore trip were provided in Q3a, Q3b, and Q3c.

- Additional household anglers for the trip (Q6) could be assumed if the additional fishers were described in Q6a and Q6b.

Production of the Data File

Data files were constructed with one record per selected piece of sample. Questionnaire variables for non-respondents appear as missing values within the data file. Final files were checked for consistency with process control databases. Values exceeding logical and reasonable tolerances were compared to original forms to ensure the fidelity of information.

Final data files were built to include all data from the dual-frame mail survey with one record for each sampled unit. In addition to data from the survey instrument, the following were provided:

- A unique record ID assigned to anglers,
- A household identification numbers,
- Angler number,
- Sample source (ABS-frame or license-frame),
- Stratum,
- AAPOR-based outcome codes,
- Original/supplemental record classification, and
- Reverse-matched telephone number.

A complete data dictionary can be found in *Appendix H: Data Dictionary* on page 36.

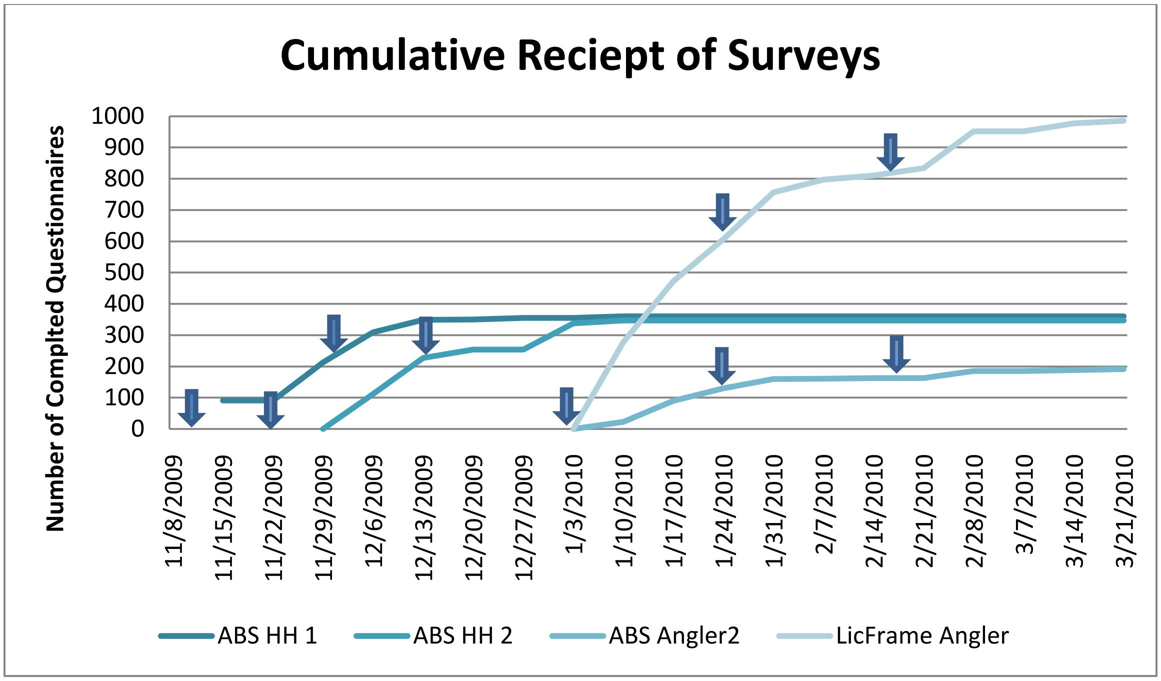
The data file will be delivered in SAS format with final content, coding, formatting, and naming conventions developed in conjunction with NMFS.

Survey Response

The survey protocol for ABS Household study resulted in a 42% response rate (measured in completes over presumably delivered surveys). The rates for the extended and compressed fielding periods were near identical. It appears that most respondents sent back forms within four weeks of the initial mailing.

A 74% response rate was achieved when contacting anglers identified in the household survey. The same survey administered to anglers identified in the license frame produced a response rate of 68%. While the majority of respondents returned forms within four to five weeks, a third mailing via Federal Express produced a swell of returns at the end of the fielding period. Approximately 10% - 15% of total returns resulted from the third mailing.

The graph below shows the cumulative receipt of surveys from each of the four efforts. Arrows mark the dates of questionnaire mailings.



Final Status of Records and Response Rates

The following tables account the final outcomes of the sample associated with each survey effort.

	ABS HH Screener	Group 1 Extended Fielding	Group 2 Compressed Fielding
Total Sent	1,800	900	900
Complete: HHs with anglers	229	113	116
Complete: HHs w/o anglers	456	235	221
Refusal	22	12	10
Undeliverable	157	77	80
Unknown outcome	936	463	473
$\frac{completed}{(total - undeliverable)}$	42%	42%	41%

	ABS Angler Study	License Frame Angler Study
Total Sent	262	1,562
Complete: Recent activity	51	227
Complete: no recent activity	137	739
Refusal	3	19
Undeliverable	8	139
Unknown outcomes	63	438
$\frac{completed}{(total - undeliverable)}$	74%	68%

Limitations of the Study

There are several inherent sources of error commonly recognized in mail-based research.

Language

According to the 2006-2008 American Community Survey 3-Year Estimates, 10% of North Carolina residents speak a language other than English at home (U.S. Census Bureau). Printed materials were in English only creating a barrier to those who cannot read the language.

Coverage

Although the ABS frame contains a comprehensive set of mailing addresses, coverage issues may result through sources such as illegal housing units or households that only receive mail through a post office box.

Because the fishing activity of households in the ABS sample frame is collected using a two stage design, the completeness of the angler data file is dependent on responses to the household screening study. Non-respondents and those who go fishing for the first time in a year after completing the household screener reduce the coverage of the angler study.

Coverage issues associated with the Licensed Angler frame come from several key sources. Minors under the age of 18 are excluded from sample through license exemptions and filtering of the sample frame. Members of the Armed Forces on temporary military leave are not required to obtain a license and therefore will not appear in the registry. Illegal activity performed by those without a fishing license cannot be captured using this sample frame. Issues with the same frame, such as incorrectly entered mailing information, may be associated with specific licensing sites and could precipitate exclusion from the sampling frame. Anglers who have recently moved may be less likely to be included in final data files.

Non-Response

As with other research studies that attempt to provide close measures of representative samples, refusal rates are of concern for this study. It is commonly cited that response rates for surveys have been dropping significantly in recent years. While weighting of data will minimize many distortions, it is commonly accepted that there will be distinct differences between the attitudes and opinions of those who complete the study verses those who refuse to do so. Therefore, any response rate less than 100% indicates some level of inaccuracy in the final data. In the same vein of reasoning, the refusal of any specific question during a survey compromises the precision of its measure.

Limited protocols

The ABS Household study received two questionnaire mailings while the Angler studies received three questionnaire mailings. The final distributions for each stage resulted in significant levels of response suggesting additional completes could be obtained through additional outreach. However, this is not to say that the cost of efforts would create a proportionate benefit.

For most respondents, fishing activity will be fully documented using the current form detailing the most recent four trips. However, earlier trips of more avid anglers may not be captured. Errors could result if undocumented trips were distinct or imputed values do not match actual activity.

Response bias

Respondents can also control the accuracy of the data depending on the level of consideration and seriousness to which they approach answering the questions. Although the questionnaire forms were designed to aid cognitive processing (e.g. through the display of a calendar to mark dates of fishing activity), ultimately the respondent controls how accurate their responses are in representing their recent activities. While the added delay between activity and reporting may cause greater immediate recall issues when compared to the telephone survey, the format of a paper self administered survey should ultimately make it easier for a respondent to verify event details (e.g. by reviewing schedules, though discussions with other members of a trip, etc.).

Other sources of error involve the design of the questions themselves. Although questions originated from the long-standing CHTS, wording needed to be adjusted to accommodate a paper-based methodology. Questions and response categories should be relatively easy for most individuals to comprehend, however some respondents could have difficulty accurately responding to some questions. Unlike the CHTS, this is a self-administered questionnaire which prohibits clarification of items.

Considerations for Future Data Collection Efforts

The following may be considered for future iterations of the project:

- Continued testing of household screener fielding schedule. The number of anglers from the ABS sample qualified to receive an angler survey may quickly change, especially during springtime months. The impact of a compressed fielding period should continue to be investigated.
- Cognitive interviewing to improve the questionnaire. Topic areas might include:
    - Methods for insuring better matches between dates on the angler survey and trip detail, possibly by listing months on the trip detail as close-ended responses.
    - Clarification for reporting in-state and out-of-state trips. Currently, Q7 in the angler survey specifies trips taken in North Carolina. Respondents may inconsistently provide information about out-of-state trips in following questions.
    - Improved ways to indicate county of trip. This may include displaying a county-level map of the state where the respondent may fill in the location of the trip.
- A non-response telephone follow-up. It is common to see over 50% of mailing addresses matched to a telephone number. A large percentage of records drawn from the licensed angler registry include a telephone number. In order to maximize response, respondents could receive a reminder call requesting that they complete the survey, allowing the respondent to complete by telephone. This option could be implemented economically given the fact that the CHTS and ALDS provide the basis for the CATI system.

Works Cited

Blumberg, S. J., & Luke, J. V. (2009, June 17). *NCHS - NHIS - Wireless Substitution, July-December 2008 (Released 5/2009)*. Retrieved September 7, 2009, from Centers for Disease Control and Prevention, National Center for Health Statistics: http://www.cdc.gov/nchs/data/nhis/earlyrelease/wireless200905.htm

Edwards, P., Roberts, I., Clarke, M., DiGuiseppi, C., Pratap, S., Wentz, R., et al. (2002). Increasing Response Rates to Postal Questionnaires: Systematic Review. *British Medical Journal* , 1183-1185.

Fox, R. J., Crask, M. R., & Kim, J. (1988). Mail Survey Response Rate: A Meta-Analysis of Selected Techniques for Inducing Response. *Public Opinion Quarterly* , 467-491.

Harrison, R. A., Holt, D., & Elton, P. J. (2002). Do Postage-Stamps Increase Response Rates to Postal Surveys? A Randomized Controlled Trial. *International Journal of Epidemiology* , 872-874.

Iannacchione, V., Staab, J., & Redden, D. (2003). Evaluating the Use of Residential Mailing Addresses in a Metropolitan Household Survey. *Public Opinion Quarterly, Vol 67* , 202-210.

U.S. Census Bureau. (n.d.). *North Carolina - Fact Sheet - American FactFinder*. Retrieved April 30, 2010, from http://factfinder.census.gov/servlet/ACSSAFFFacts?_event=Search&geo_id=&_geoContext=&_street=&_county=&_cityTown=&_state=04000US37&_zip=&_lang=en&_sse=on&pctxt=fph&pgsl=010

Yammarinio, F. J., Skinner, S. J., & Childers, T. L. (1991). Understanding Mail Survey Response Behavior. *Public Opinion Quarterly* , 613-639.

Appendix A: Key Dates (timeline)

Event	Date
ABS HH Group 1: Initial Survey Packet	November 10, 2009
ABS HH Group 1: Postcard	November 16, 2009
ABS HH Group 1: Replacement Packet	November 30, 2009
ABS HH Group 2: Initial Survey Packet	November 20 , 2009
ABS HH Group 2: Postcard	November 30, 2009
ABS HH Group 2: Replacement Packet	December 14, 2009
Angler Survey: Initial Survey Packet	January 4, 2010
Angler Survey: Postcard	January 12, 2010
Angler Survey: Replacement Packet	January 25, 2010
Angler Survey: FedEx Replacement	February 15, 2010
End of Collection	March 26, 2010

Appendix B: Disposition Report

ABS Household

Outcome	Extended Fielding	Compressed Fielding	Combined
1.1 Complete (net)	348	341	689
1.1.1: Complete with Anglers	113	117	230
1.1.2: Complete without Anglers	235	224	459
2.1 Refusals	12	10	22
3.3 Undeliverable addresses	78	82	160
TOTAL COUNT	438	433	871

Angler Survey

Outcome	ABS Sample	Licensed Based Frame	Combined
1.2 Complete (net)	188	966	1,154
1.2.1: Complete with Anglers	51	227	278
1.2.2: Complete without Anglers	137	739	876
2.1 Refusals	3	19	22
3.3 Undeliverable addresses	8	139	147
TOTAL COUNT	199	1,124	1,323

Appendix C: Material for Household Questionnaire Packets

Household questionnaire packets were comprised of:

- A customized cover letter from NOAA,
- A booklet style questionnaire, and
- A business reply envelope (BRE).

Initial mailings also included a dollar bill.

November 30, 2009

North Carolina Resident
«street»
«city», «state» «zip5»

Dear North Carolina Resident,

I am writing to ask you for your help in a study being conducted for the National Oceanic and Atmospheric Administration. This study is part of an effort to learn more about recreational fishing activities in North Carolina.

The purpose of this questionnaire is to identify people who fish. However, it *is* important for us to obtain responses from people who do fish as well as those who do not participate in recreational saltwater fishing. Your address was randomly selected from a list of all home addresses in North Carolina. Your household represents thousands of other households like yours. Only with participation by everyone selected will the findings from the study represent everyone in North Carolina. If there are people who fish in your household, we may send them a second questionnaire to learn about their recreational saltwater fishing experiences. We have enclosed a small token of appreciation as a way of saying thanks for your help.

Your answers are completely confidential and will be used for statistical purposes only in accordance with the Privacy Act of 1974. You are not required to answer any question that you feel is an intrusion of your privacy.

If you have any questions or comments about this study, we would be happy to talk with you. Please contact Rob Andrews at his number (301-713-2328) or you can write to us at the address at the bottom of this letter.

Thank you very much for your help with this important study. Please return your completed questionnaire in the postage paid envelope provided.

Sincerely,

Dave Van Voorhees,
Chief, Fisheries Statistics Division

«ID»

1315 East-West Hwy, Silver Spring, Maryland 20910
Phone: 301-713-2328 Internet: www.st.nmfs.gov

November 30, 2009

North Carolina Resident
«street»
«city», «state» «zip5»

Dear North Carolina Resident,

About three weeks ago we sent a questionnaire to your household in an effort to learn more about recreational fishing activities in North Carolina. According to our records, your household has not yet returned a completed questionnaire.

Your address was randomly selected from a list of all home addresses in North Carolina. Only with participation by everyone selected will the findings from the study represent everyone in North Carolina. Many North Carolinians have told us about their fishing behaviors. Your completed questionnaire will contribute to our understanding of the state's fishing activity.

This study being conducted for the National Oceanic and Atmospheric Administration. It is important for us to obtain information from people who do fish as well as those who do not participate in recreational saltwater fishing. If there are people who fish in your household, we may send them a second questionnaire to learn more about their recreational saltwater fishing experiences.

Your answers are completely confidential and will be used for statistical purposes only in accordance with the Privacy Act of 1974. You are not required to answer any question that you feel is an intrusion of your privacy.

If you have any questions or comments about this study, we would be happy to talk with you. Please contact Rob Andrews at his number (301-713-2328) or you can write to us at the address at the bottom of this letter.

We hope that you will take a few minutes to fill out and return the questionnaire soon. If, for any reason, you prefer not to answer it, please let us know by returning a note or blank questionnaire in the postage paid envelope provided.

Sincerely,

Dave Van Voorhees,
Chief, Fisheries Statistics Division

«ID»

1315 East-West Hwy, Silver Spring, Maryland 20910
Phone: 301-713-2328 Internet: www.st.nmfs.gov

Commonly Asked Questions

Q How did you get my address?

A *Your address was randomly selected from among all of North Carolina's addresses. It was selected using scientific sampling methods to represent other households in your part of the state.*

Q Nobody in my household fishes. Should I respond to the survey?

A *Yes. It is important that we gather information about households that do not fish as well as those who do. Once we receive your completed questionnaire, you will not be sent any additional mailings such as replacement questionnaires.*

Q Why can't you interview another household instead of mine?

A *In order to make sure final results of the study are accurate, receiving information about your household is important to us. Households selected for this study were chosen using scientific sampling methods and your responses cannot be replaced by others.*

Q How will the information I provide be used?

A *Information from this study will be used to improve the monitoring of North Carolina's fishing activity. All information will be kept confidential; It will be combined with information from other households to produce statistical summaries and reports.*

Q How much time will this survey take?

A *On average, it should take less than five minutes for you to respond, including the time for reviewing instructions, and completing and reviewing the collection of information.*

Q Who is sponsoring the survey?

A *This study is sponsored by the National Oceanic and Atmospheric Administration. Questions regarding the study can be directed to Rob Andrews at National Oceanic and Atmospheric Administration by calling 301-713-2328.*

OMB No: 0648-0052 Approval Expires 04/30/2011

A Study of Fishing In North Carolina

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.

A Study of Fishing in North Carolina

This form is for households with and without people who fish. It just takes a few minutes and your answers will be confidential.

1. In the last 12 months has anyone living in your household, including children and adults, been recreational saltwater fishing in the U.S. or a U.S. territory?

☐ Yes
☐ No ➞ *(please go to question 6)*

Recreational saltwater fishing refers to fishing primarily with hook and line for pleasure, amusement, relaxation, or home consumption in oceans, bays, inlets, canals, intra-coastal waterways, and brackish portions affected by the tides. Inland saltwater bodies includes sounds, passes, inlets, bays, estuaries, brackish portions of rivers, and other areas of salt or brackish water like bayous and canals.

2. How many people in this household (including children and adults) have participated in <u>recreational saltwater fishing</u> during the past 12 months?

☐☐ *Number of people who have <u>fished</u>*

Please tell us the following for each member of the household who has gone saltwater fishing during the past 12 months. If more than four household members have participated in recreational saltwater fishing during the past 12 months, please list the four <u>oldest</u> participants.

	Fisher 1	Fisher 2	Fisher 3	Fisher 4
3. What is the person's first name?				
4. What is the person's sex?	☐ Male ☐ Female	☐ Male ☐ Female	☐ Male ☐ Female	☐ Male ☐ Female
5. How old is the person?	☐ Less than 16 ☐ 16-18 ☐ 18-24 ☐ 25-34 ☐ 35-44 ☐ 45-54 ☐ 55-64 ☐ 65 or older	☐ Less than 16 ☐ 16-18 ☐ 18-24 ☐ 25-34 ☐ 35-44 ☐ 45-54 ☐ 55-64 ☐ 65 or older	☐ Less than 16 ☐ 16-18 ☐ 18-24 ☐ 25-34 ☐ 35-44 ☐ 45-54 ☐ 55-64 ☐ 65 or older	☐ Less than 16 ☐ 16-18 ☐ 18-24 ☐ 25-34 ☐ 35-44 ☐ 45-54 ☐ 55-64 ☐ 65 or older

6. For statistical purposes, we are interested in learning about your telephone usage. Is there at least one phone inside your home that is currently working and not a cell phone?

☐ Yes
☐ No

Thank you! Please return this form in the postage paid envelope provided or mail to:
A Study of Fishing in North Carolina
116 John Street, Suite 800
New York, NY 10038

Appendix D: Household Survey Reminder Postcard

Date

Last week a questionnaire was sent to you on behalf of the National Oceanic and Atmospheric Administration. Your household was randomly selected from a list of all households addresses in the state of North Carolina.

If you have already completed and returned the questionnaire to us, please accept our sincere thanks. If not, please do so today. Information collected in this study will be used to learn more about recreational fishing activities in North Carolina.

If you did not receive a questionnaire, or if it was misplaced, please call Rob Andrews at his number (301-713-2328).

Thank you.

Dave Van Voorhees
Chief, Fisheries Statistics Division

NORTH CAROLINA RESIDENT
Street
Town, City, #####

Appendix E: Material for Angler Questionnaire Packets

Questionnaire packets for anglers were comprised of:

- A customized cover letter from NOAA,
- A booklet style questionnaire for detailing angler activity,
- A booklet-style questionnaire for detailing up to 4 recent trips,and
- A business reply envelope (BRE).

Initial mailings also included a dollar bill.

January 6th, 2009

«NAME»
«ADDRESS»
«CITY», «ST» «ZIP»

Dear «Name__Proper»

I am writing to ask you for your help in a study being conducted for the National Oceanic and Atmospheric Administration. This study is part of an effort to learn more about recreational fishing activities in North Carolina.

Earlier this year, your address was randomly selected from among all of the home addresses in the state of North Carolina. From among those households that responded to our earlier questionnaire, we selected a random sample of recreational saltwater anglers to learn about the frequency of their fishing trips and some information about those trips, such as where and when the fishing trip occurred. Information collected in this study will be used to evaluate the impact of recreational fishing on natural fishing resources and help improve fisheries management policies. We have enclosed a small token of appreciation as a way of saying thanks for your help.

Your answers are completely confidential and will be used for statistical purposes only in accordance with the Privacy Act of 1974. You are not required to answer any question that you feel is an intrusion of your privacy.

If you have any questions or comments about this study, we would be happy to talk with you. Please contact Rob Andrews at his number (301-713-2328) or you can write to us at the address at the bottom of this letter.

Thank you very much for your help with this important study. Please return your completed questionnaire in the postage paid envelope provided.

Sincerely,

Dave Van Voorhees,
Chief, Fisheries Statistics Division

<ID>

1315 East-West Hwy, Silver Spring, Maryland 20910
Phone: 301-713-2328 Internet: www.st.nmfs.gov

January 5th, 2009

«NAME»
«ADDRESS»
«CITY», «ST» «ZIP»

Dear «Name__Proper»

I am writing to ask you for your help in a study being conducted for the National Oceanic and Atmospheric Administration. This study is part of an effort to learn more about recreational saltwater fishing activities in North Carolina.

Your name was randomly selected using scientific sampling methods from among a list of persons who has purchased a saltwater fishing license in the state of North Carolina during the past year. We are contacting a random sample of recreational saltwater anglers to learn about the frequency of their fishing trips and some information about those trips, such as where and when the fishing trip occurred. Information collected in this study will be used to evaluate the impact of recreational fishing on natural resources and help improve fisheries management policies. We have enclosed a small token of appreciation as a way of saying thanks for your help.

Your answers are completely confidential and will be used for statistical purposes only in accordance with the Privacy Act of 1974. You are not required to answer any question that you feel is an intrusion of your privacy.

If you have any questions or comments about this study, we would be happy to talk with you. Please contact Rob Andrews at his number (301-713-2328) or you can write to us at the address at the bottom of this letter.

Thank you very much for your help with this important study. Please return your completed questionnaire in the postage paid envelope provided.

Sincerely,

Dave Van Voorhees,
Chief, Fisheries Statistics Division

«ID»

1315 East-West Hwy, Silver Spring, Maryland 20910
Phone: 301-713-2328 Internet: www.st.nmfs.gov

Commonly Asked Questions

Q How did you get my address?

A *Your address was either randomly selected from a database of licensed anglers in North Carolina or you completed a similar mail survey in the past two months. Addresses were selected using scientific sampling methods to represent other households in your part of the state.*

Q Nobody in my household fished in the past few months. Should I respond to the survey?

A *Yes. It is important that we gather information about households that do not fish as well as those who do. Once we receive your completed questionnaire, you will not be sent any additional mailings such as replacement questionnaires.*

Q Why can't you interview another household instead of mine?

A *In order to make sure final results of the study are accurate, receiving information about your household is important to us. Households selected for this study were chosen using scientific sampling methods and your responses cannot be replaced by others.*

Q How will the information I provide be used?

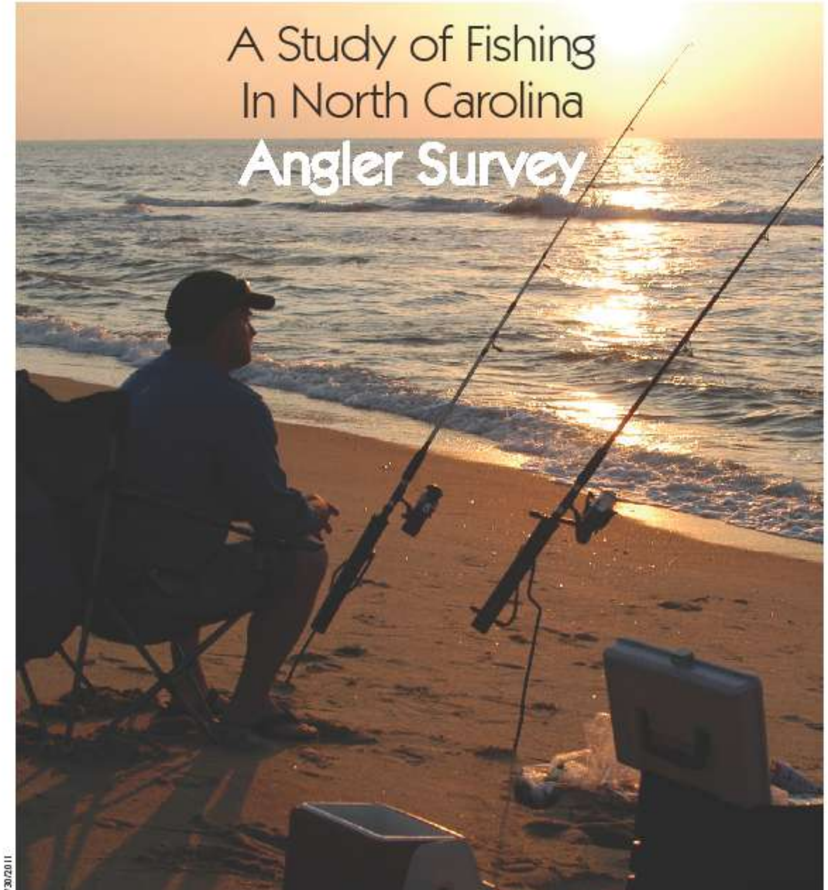
A *Information from this study will be used to improve the monitoring of North Carolina's fishing activity. All information will be kept confidential; It will be combined with information from other households to produce statistical summaries and reports.*

Q How much time will this survey take?

A *On average, it should take less than five minutes for you to respond, including the time for reviewing instructions, and completing and reviewing the collection of information.*

Q Who is sponsoring the survey?

A *This study is sponsored by the National Oceanic and Atmospheric Administration. Questions regarding the study can be directed to Rob Andrews at National Oceanic and Atmospheric Administration by calling 301-713-2328.*



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.

OMB No: 0648-0052 Approval Expires 04/30/2011

A Study of Fishing in North Carolina: Angler Survey

This form will take just a few minutes to complete and your answers will be confidential.

Thank you for completing this survey. Here are some terms we will be using:

- 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
- Private boat refers to any boat owned by an individual where no fee is paid to the individual for the use of the boat

1. During 2009, did you participate in *recreational saltwater fishing?*

☐ Yes
☐ No

2. Are you…?

☐ Male
☐ Female

3. How old are you?

☐ Less than 16
☐ 16 – 17
☐ 18 – 24
☐ 25 – 34
☐ 35 – 44
☐ 45 – 54
☐ 55 – 64
☐ 65 or older

4. During the <u>past 12 months</u>, did you have a fishing license for the state of North Carolina?

☐ Yes
☐ No → *(PLEASE GO TO QUESTION 7)*

5. Was this particular license for *recreational saltwater fishing?*

☐ Yes
☐ No → *(PLEASE GO TO QUESTION 7)*

6. Was this license valid for the month of November this year?

☐ Yes
☐ No

7. Between November 1st, 2009 and December 31st, 2009; did you go *recreational saltwater fishing* in North Carolina or from a *private boat* launched in North Carolina?

☐ Yes
☐ No

Even if you did not go saltwater fishing during November or December, it's important for us to get a response from every person selected for this study. Please return your now completed questionnaire to us in the enclosed prepaid return envelope.

8a. Please circle the day(s) when you went *recreational saltwater fishing* using a *private boat* on the calendar below.

MONTH	S	M	T	W	R	F	S
NOVEMBER	01	02	03	04	05	06	07
	08	09	10	11	12	13	14
	15	16	17	18	19	20	21
	22	23	24	25	26	27	28
	29	30					
DECEMBER			01	02	03	04	05
	06	07	08	09	10	11	12
	13	14	15	16	17	18	19
	20	21	22	23	24	25	26
	27	28	29	30	31		

8b. Please circle the day(s) when you went *recreational saltwater fishing* from the shore, pier, dock, or any other land based fishing on the calendar below.

MONTH	S	M	T	W	R	F	S
NOVEMBER	01	02	03	04	05	06	07
	08	09	10	11	12	13	14
	15	16	17	18	19	20	21
	22	23	24	25	26	27	28
	29	30					
DECEMBER			01	02	03	04	05
	06	07	08	09	10	11	12
	13	14	15	16	17	18	19
	20	21	22	23	24	25	26
	27	28	29	30	31		

Please use the enclosed tan colored booklet to provide information about fishing trips you took during November and December. The booklet contains room for reporting your most recent four trips.

4th Most Recent Trip

The following questions ask information about fishing trips taken during the previous two months. If you fished between November 1, 2009 and December 31, 2009 please fill out information for your four most recent saltwater recreational fishing trips. Once completed, please return your questionnaire to us in the enclosed prepaid return envelope.

1. Please enter the date of your most recent trip:

Month ☐☐ Day ☐☐

2. Did you fish from a boat on this date?

☐ Yes
☐ No → *(PLEASE GO TO QUESTION 3)*

2a. What state and county were you in when the boat landed and you stepped off of the boat?

State
County, Parish, Island or Municipality Name

2b. Does the public have access to the place where the boat landed?

☐ Yes, Public Access
☐ No, Private Access

3. Did you fish from the shore on this date?

☐ Yes
☐ No → *(PLEASE GO TO QUESTION 4)*

3a. Where were you fishing?

State
County, Parish, Island or Municipality Name

3b. Was that from a…?
(CHECK ALL THAT APPLY)

☐ Pier
☐ Dock
☐ Jetty or Breakwater
☐ Bridge or Causeway
☐ Other man-made structure
☐ Bank or Beach

3c. Does the public have access to this place?

☐ Yes, Public Access
☐ No, Private Access

4. Was most of your fishing effort this day in …?
(CHECK ONLY ONE)

☐ Ocean, within 3 miles from the shore
☐ Ocean, more than 3 miles from the shore
☐ Sound
☐ River
☐ Bay
☐ Inlet
☐ Someplace else

5. At approximately what time did this fishing trip end?
(CHECK ONLY ONE)

☐ Midnight – 3:00 a.m.
☐ 3:00 a.m. – 6:00 a.m.
☐ 6:00 a.m. – 9:00 a.m.
☐ 9:00 a.m. – Noon
☐ Noon – 3:00 p.m.
☐ 3:00 p.m. – 6:00 p.m.
☐ 6:00 p.m. – 9:00 p.m.
☐ 9:00 p.m. – Midnight

6. Did anyone else from your household, including children and adults, fish with you on this date?

☐ Yes
☐ No

6a. Who else from your household fished with you on this date?
(CHECK ALL THAT APPLY)

☐ Spouse/partner
☐ Child(ren)
☐ Other household member

6b. Including you, how many household members went saltwater fishing on this date?

Number of household members

☐☐

1. Please enter the date of your most recent trip:

Month ☐☐ Day ☐☐

2. Did you fish from a boat on this date?

☐ Yes
☐ No → *(PLEASE GO TO QUESTION 3)*

2a. What state and county were you in when the boat landed and you stepped off of the boat?

State
County, Parish, Island or Municipality Name

2b. Does the public have access to the place where the boat landed?

☐ Yes, Public Access
☐ No, Private Access

3. Did you fish from the shore on this date?

☐ Yes
☐ No → *(PLEASE GO TO QUESTION 4)*

3a. Where were you fishing?

State
County, Parish, Island or Municipality Name

3b. Was that from a…?
(CHECK ALL THAT APPLY)

☐ Pier
☐ Dock
☐ Jetty or Breakwater
☐ Bridge or Causeway
☐ Other man-made structure
☐ Bank or Beach

3c. Does the public have access to this place?

☐ Yes, Public Access
☐ No, Private Access

4. Was most of your fishing effort this day in …?
(CHECK ONLY ONE)

☐ Ocean, within 3 miles from the shore
☐ Ocean, more than 3 miles from the shore
☐ Sound
☐ River
☐ Bay
☐ Inlet
☐ Someplace else

5. At approximately what time did this fishing trip end?
(CHECK ONLY ONE)

☐ Midnight – 3:00 a.m.
☐ 3:00 a.m. – 6:00 a.m.
☐ 6:00 a.m. – 9:00 a.m.
☐ 9:00 a.m. – Noon
☐ Noon – 3:00 p.m.
☐ 3:00 p.m. – 6:00 p.m.
☐ 6:00 p.m. – 9:00 p.m.
☐ 9:00 p.m. – Midnight

6. Did anyone else from your household, including children and adults, fish with you on this date?

☐ Yes
☐ No → *(PLEASE CONTINUE TO YOUR NEXT MOST RECENT TRIP)*

6a. Who else from your household fished with you on this date?
(CHECK ALL THAT APPLY)

☐ Spouse/partner
☐ Child(ren)
☐ Other household member

6b. Including you, how many household members went saltwater fishing on this date?

Number of household members

☐☐ → *(PLEASE CONTINUE TO YOUR NEXT MOST RECENT TRIP)*

2nd Most Recent Trip

1. **Please enter the date of your most recent trip:**

Month [ ][ ] **Day** [ ][ ]

2. **Did you fish from a boat on this date?**
- ☐ Yes
- ☐ No → *(PLEASE GO TO QUESTION 3)*

2a. **What state and county were you in when the boat landed and you stepped off of the boat?**

State
County, Parish, Island or Municipality Name

2b. **Does the public have access to the place where the boat landed?**
- ☐ Yes, Public Access
- ☐ No, Private Access

3. **Did you fish from the shore on this date?**
- ☐ Yes
- ☐ No → *(PLEASE GO TO QUESTION 4)*

3a. **Where were you fishing?**

State
County, Parish, Island or Municipality Name

3b. **Was that from a…?**
(CHECK ALL THAT APPLY)
- ☐ Pier
- ☐ Dock
- ☐ Jetty or Breakwater
- ☐ Bridge or Causeway
- ☐ Other man-made structure
- ☐ Bank or Beach

3c. **Does the public have access to this place?**
- ☐ Yes, Public Access
- ☐ No, Private Access

4. **Was most of your fishing effort this day in …?**
(CHECK ONLY ONE)
- ☐ Ocean, within 3 miles from the shore
- ☐ Ocean, more than 3 miles from the shore
- ☐ Sound
- ☐ River
- ☐ Bay
- ☐ Inlet
- ☐ Someplace else

5. **At approximately what time did this fishing trip end?**
(CHECK ONLY ONE)
- ☐ Midnight – 3:00 a.m.
- ☐ 3:00 a.m. – 6:00 a.m.
- ☐ 6:00 a.m. – 9:00 a.m.
- ☐ 9:00 a.m. – Noon
- ☐ Noon – 3:00 p.m.
- ☐ 3:00 p.m. – 6:00 p.m.
- ☐ 6:00 p.m. – 9:00 p.m.
- ☐ 9:00 p.m. – Midnight

6. **Did anyone else from your household, including children and adults, fish with you on this date?**
- ☐ Yes
- ☐ No → *(PLEASE CONTINUE TO YOUR NEXT MOST RECENT TRIP)*

6a **Who else from your household fished with you on this date?**
(CHECK ALL THAT APPLY)
- ☐ Spouse/partner
- ☐ Child(ren)
- ☐ Other household member

6b. **Including you, how many household members went saltwater fishing on this date?**

Number of household members

[ ][ ] → *(PLEASE CONTINUE TO YOUR NEXT MOST RECENT TRIP)*

3rd Most Recent Trip

1. **Please enter the date of your most recent trip:**

Month [ ][ ] **Day** [ ][ ]

2. **Did you fish from a boat on this date?**
- ☐ Yes
- ☐ No → *(PLEASE GO TO QUESTION 3)*

2a. **What state and county were you in when the boat landed and you stepped off of the boat?**

State
County, Parish, Island or Municipality Name

2b. **Does the public have access to the place where the boat landed?**
- ☐ Yes, Public Access
- ☐ No, Private Access

3. **Did you fish from the shore on this date?**
- ☐ Yes
- ☐ No → *(PLEASE GO TO QUESTION 4)*

3a. **Where were you fishing?**

State
County, Parish, Island or Municipality Name

3b. **Was that from a…?**
(CHECK ALL THAT APPLY)
- ☐ Pier
- ☐ Dock
- ☐ Jetty or Breakwater
- ☐ Bridge or Causeway
- ☐ Other man-made structure
- ☐ Bank or Beach

3c. **Does the public have access to this place?**
- ☐ Yes, Public Access
- ☐ No, Private Access

4. **Was most of your fishing effort this day in …?**
(CHECK ONLY ONE)
- ☐ Ocean, within 3 miles from the shore
- ☐ Ocean, more than 3 miles from the shore
- ☐ Sound
- ☐ River
- ☐ Bay
- ☐ Inlet
- ☐ Someplace else

5. **At approximately what time did this fishing trip end?**
(CHECK ONLY ONE)
- ☐ Midnight – 3:00 a.m.
- ☐ 3:00 a.m. – 6:00 a.m.
- ☐ 6:00 a.m. – 9:00 a.m.
- ☐ 9:00 a.m. – Noon
- ☐ Noon – 3:00 p.m.
- ☐ 3:00 p.m. – 6:00 p.m.
- ☐ 6:00 p.m. – 9:00 p.m.
- ☐ 9:00 p.m. – Midnight

6. **Did anyone else from your household, including children and adults, fish with you on this date?**
- ☐ Yes
- ☐ No → *(PLEASE CONTINUE TO YOUR NEXT MOST RECENT TRIP)*

6a **Who else from your household fished with you on this date?**
(CHECK ALL THAT APPLY)
- ☐ Spouse/partner
- ☐ Child(ren)
- ☐ Other household member

6b. **Including you, how many household members went saltwater fishing on this date?**

Number of household members

[ ][ ] → *(PLEASE CONTINUE TO YOUR NEXT MOST RECENT TRIP)*

Appendix F: Angler Survey Reminder Postcard

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NOAA
U.S. DEPARTMENT OF COMMERCE

Date

Last week a questionnaire was sent to you on behalf of the National Oceanic and Atmospheric Administration. Your household was randomly selected from a list of all households addresses in the state of North Carolina.

If you have already completed and returned the questionnaire to us, please accept our sincere thanks. If not, please do so today. Information collected in this study will be used to learn more about recreational fishing activities in North Carolina.

If you did not receive a questionnaire, or if it was misplaced, please call Rob Andrews at his number (301-713-2328).

Thank you.

Dave Van Voorhees
Chief, Fisheries Statistics Division

NORTH CAROLINA RESIDENT
Street
Town, City, #####

Appendix G: Coding of Text Questions

All responses to questions in the survey were pre-coded with the exception of location of fishing trip. Responses were coded to the county level using Federal Information Processing Standards (FIPS) codes. FIPS codes for North Carolina are provided below.

37001 Alamance County	37051 Cumberland County	37101 Johnston County	37151 Randolph County
37003 Alexander County	37053 Currituck County	37103 Jones County	37153 Richmond County
37005 Alleghany County	37055 Dare County	37105 Lee County	37155 Robeson County
37007 Anson County	37057 Davidson County	37107 Lenoir County	37157 Rockingham County
37009 Ashe County	37059 Davie County	37109 Lincoln County	37159 Rowan County
37011 Avery County	37061 Duplin County	37111 McDowell County	37161 Rutherford County
37013 Beaufort County	37063 Durham County	37113 Macon County	37163 Sampson County
37015 Bertie County	37065 Edgecombe County	37115 Madison County	37165 Scotland County
37017 Bladen County	37067 Forsyth County	37117 Martin County	37167 Stanly County
37019 Brunswick County	37069 Franklin County	37119 Mecklenburg County	37169 Stokes County
37021 Buncombe County	37071 Gaston County	37121 Mitchell County	37171 Surry County
37023 Burke County	37073 Gates County	37123 Montgomery County	37173 Swain County
37025 Cabarrus County	37075 Graham County	37125 Moore County	37175 Transylvania County
37027 Caldwell County	37077 Granville County	37127 Nash County	37177 Tyrrell County
37029 Camden County	37079 Greene County	37129 New Hanover County	37179 Union County
37031 Carteret County	37081 Guilford County	37131 Northampton County	37181 Vance County
37033 Caswell County	37083 Halifax County	37133 Onslow County	37183 Wake County
37035 Catawba County	37085 Harnett County	37135 Orange County	37185 Warren County
37037 Chatham County	37087 Haywood County	37137 Pamlico County	37187 Washington County
37039 Cherokee County	37089 Henderson County	37139 Pasquotank County	37189 Watauga County
37041 Chowan County	37091 Hertford County	37141 Pender County	37191 Wayne County
37043 Clay County	37093 Hoke County	37143 Perquimans County	37193 Wilkes County
37045 Cleveland County	37095 Hyde County	37145 Person County	37195 Wilson County
37047 Columbus County	37097 Iredell County	37147 Pitt County	37197 Yadkin County
37049 Craven County	37099 Jackson County	37149 Polk County	37199 Yancey County

Appendix H: Data Dictionary

ABS Household Screener

There is one record for every sampled address, regardless of the final outcome associated with the record.

Question	Field Name	Description	Coding Scheme
	HH_ID	Unique household identifier	
	MATCH_FLG	Was the household address successfully matched to the license frame? Is the household on both sample frames?	Yes=1, No=0
	STRATUM	Coastal, non-coastal, out-of-state	Coastal=1, Non-Coastal=2, Out-of-state=3
	RES_ST	State of residence	37 = North Carolina
	RES_CNTY	County of residence	
	RES_ADDRESS	Address of residence	
	HH_STATUS	Disposition of sample (complete with anglers, complete no anglers, refuse, non-contact, bad address)	1.1.1 = Household with angler 1.1.2 = Household with no angler 2.1 = Refused 3.3 = Mailing returned undelivered
Q1	FISH12_FLG	Fishing household flag. Did anyone in the household fish during previous 12 months?	Yes=1, No=0, 8 = Missing
Q2	FF12	How many people in HH fished during previous 12 months?	
Q6	HH_PHN_FLG	Does HH have a landline telephone?	Yes=1, No=0, 8 = Missing
	REC_DATE	Date questionnaire was received by contractor	
	MAIL_DATE	Date questionnaire was mailed by contractor (initial mailing)	
	SURV_YEAR	Survey year	
	SURV_WAVE	Survey wave	
	SAMP_WT	Sample weight (N/n)	
	FRM_SIZE	Number of HH units on sample frame for stratum (N)	
	BATCH	Wave 1 or Wave 2	

ABS Angler

There is one record for every angler identified in the household screener, regardless of whether or not the angler was sampled or returned a questionnaire.

Question	Field Name	Description	Coding Scheme
	HH_ID	Unique household identification number	
	ANG_ID	Unique identification for anglers within a household	
	HH_ANGLERS	Number of anglers uniquely identified in screener questionnaire (screener Q3).	
Q4	GENDER		Male=1, Female=2
Q5	AGE		Less than 16 = 1 16 -- 17 = 2 18 -- 24 = 3 25 -- 34 = 4 35 -- 44 = 5 45 -- 54 = 6 55 -- 64 = 7 65 or older = 8
	SAMP_FLG	Identifies anglers that were sampled from angler frame.	Primary angler=1, Supplemental angler=2, Not sampled=3
	ANG_STATUS	Final disposition of second-stage sample (complete with trips, complete no trips, refusal, non-contact, etc.)	1.2.1 = Trips taken in the 2 month period 1.2.2 = No trips taken in the 2 month period 2.1 = Refused 3.19 = Nothing ever returned 3.3 = Mailing returned undelivered
	REC_DATE	Date questionnaire was received by contractor	
	MAIL_DATE	Date questionnaire was mailed by contractor (initial mailing)	
Q1	FISH_YEAR_FLG	Did angler fish during 2009?	Yes=1, No=0, 88 = Missing
Q4	LICENSE_FLG	Did angler have a NC fishing license during previous 12 months (Y/N)?	Yes=1, No=0, 88 = Missing
Q5	SALT_LIC_FLG	Was license for recreational saltwater fishing? (Y/N)	Yes=1, No=0, 88 = Missing
Q6	WAVE_LIC_FLG	Was license valid during	Yes=1, No=0, 88 = Missing

		November 2009? (Y/N)	
Q7	FISH_WAVE_FLG	Did angler fish during the wave (wave 6, 2009)?	Yes=1, No=0, 88 = Missing
Q8	BOAT_TRPS	Number of private boat trips during the wave	
Q9	SHORE_TRPS	Number of shore trips during the wave	

License Angler

There is one record for every angler identified in the household screener, regardless of whether or not the angler was sampled or returned a questionnaire.

Question	Field Name	Description	Coding Scheme
	SURV_YEAR	Survey year	2009
	SURV_WAVE	Survey wave	6
	LIC_ST	License state (will be 37 (NC) in all cases for pilot study)	CRFL Infant = 1 CRFL Youth = 2 Res CRFL = 3 Res CRFL 10-Day = 4 Res CRFL Adult = 5 NonRes CRFL = 6 NonRes CRFL 10-Day = 7 NR CRFL Adult = 8 Age 65 CRFL = 9 Disabled Vet CRFL = 10 Totally Disabled CRFL = 11 Perm Disabled State Fish w CRFL = 12 Uni Adlt Care Hme Inland/CRFL = 13 Uni Blind Inland/CRFL = 14 Unified Inland/CRFL = 15 Unified Sptm/CRFL = 16 Ltime Unified Inland/CRFL = 17 Ltime Comp Inland Fish w/CRFL = 18 Subsis Inland/CRFL Waiver = 19 Disabled Combo H/F/CRFL Basic = 20 Sportsman Infant w CRFL = 21 Unified Sptm/CRFL Infant = 22 Sportsman Youth w CRFL = 23 Unified Sptm/CRFL Youth = 24 Res Sportsman Adult w CRFL = 25 Res Uni Sptm/CRFL Adult = 26 NonRes Sportsman Adult w CRFL = 27 NR Uni Sptm/CRFL Adult = 28 Unified Age 65 Sptm/CRFL = 29 Res Ltime Over 70 Sportsman w CRFL = 30 Ltime H/F/Trap/CRFL Disabled Vet = 31 Lifetime Comp Over 70 Fish w CRFL = 32 Disabled Sportsman w CRFL = 33 Uni Disabled Vet Sptm/CRFL = 34 Uni Totally Disabled Sptm/CRFL = 35
	REC_DATE	Date questionnaire received	
	MAIL_DATE	Date questionnaire was sent (initial mailing)	
	ANG_ID	Unique angler identification	

	HH_ID	Unique household identifier	
	ANG_STATUS	Final disposition of sample (complete with trips, complete no trips, refusal, non-contact, etc.)	1.2.1 = No trips taken in the 2 month period 1.2.2 = Trips taken in the 2 month period 2.1 = Refused 3.19 = Nothing ever returned 3.3 = Mailing returned undelivered
	STRATUM	Coastal, non-coastal, out-of-state	Coastal=1, Non-Coastal=2, Out-of-state=3
	RES_ST	State of residence	
	RES_CNTY	County of residence	
Q1	FISH_YEAR_FLG	Did angler fish during 2009?	Yes=1, No=0, 88 = Missing
Q2	GENDER		Male=1, Female=2
Q3	AGE		Less than 16 = 1 16 -- 17 = 2 18 -- 24 = 3 25 -- 34 = 4 35 -- 44 = 5 45 -- 54 = 6 55 -- 64 = 7 65 or older = 8
Q4	LICENSE_FLG	Did angler have a NC fishing license during previous 12 months?	Yes=1, No=0, 88 = Missing
Q5	SALT_LIC_FLG	Was license for recreational saltwater fishing?	Yes=1, No=0, 88 = Missing
Q6	WAVE_LIC_FLG	Was license valid during November 2009?	Yes=1, No=0, 88 = Missing
Q7	FISH_WAVE_FLG	Did angler fish during the wave (wave 6, 2009)?	Yes=1, No=0, 88 = Missing
Q8	BOAT_TRPS	Number of private boat trips during the wave	
Q9	SHORE_TRPS	Number of shore trips during the wave	
	SAMP_WT	Sample weight (N/n)	
	FRM_SIZE	Number of anglers on sample frame for stratum (N)	

Trip Information

Anglers provide detailed trip information for up to four recent trips. There is one record per trip.

Question	Field Name	Description	Coding Scheme
	SURV_YEAR		
	SURV_WAVE		
	HH_ID		
	ANG_ID		
	TRIP_ID	Unique identifier for each trip within an angler	
Q3B	MODE		Pier=1 Dock = 2 Jetty or Breakwater = 3 Bridge or Causeway = 4 Other man-made structure = 5 Bank or beach = 6
Q2/Q3	MODE_FX	Shore or private boat	Yes=1, No=0
Q1	TRIP_DATE	Date of trip	11/1 - 12/31
	FRAME	Is trip for an angler sampled from the license frame or the ABS frame?	ABS=1, License=2
2A/3A	TRIP_ST	State of trip	North Carolina
2A/3A	TRIP_CNTY		
2B/3B	ACCESS	Private/public	Yes, public access = 1 No, private access = 2
Q4	AREA		Ocean, within 3 miles from the shore = 1 Ocean, more than 3 miles from the shore = 2 Sound = 3 River = 4 Bay = 5 Inlet = 6 Someplace else = 7
	AREA_X		

5	RTN_TIME	Return time (time trip ended)	Midnight -- 3:00 am = 1 3:00 am -- 6:00 am = 2 6:00 am -- 9:00 am = 3 9:00 am -- Noon = 4 Noon -- 3:00 pm = 5 3:00 pm -- 6:00 pm = 6 6:00 pm -- 9:00 pm = 7 9:00 pm -- Midnight = 8
6	ADD_ANG_FLG	Did anyone else from your household fish with you (Y/N)	Yes=1, No=0
6A_1	SPOUSE_FLG	Did sampled angler fish with spouse in this trip?	6a = 1, 6a = 2,3
6A_2	CHILD_FLG	Did sampled angler fish with child on this trip?	6a = 2, 6a = 1,3
6A_3	OTHER_FLG	Did sampled angler fish with an other household member?	6a = 3, 6a = 1,2
6B	TOT_ANG	Total number of household members fishing on trip	

Household Questionnaire

Disposition of Sample		
	Frequency	Percent
Household with angler	228	12.7%
Household with no angler	457	25.4%
Refused	22	1.2%
Mailing returned undelivered	157	8.7%
No response	936	52.0%
Total	1800	100%

Did Anyone in the Household Fish During the Previous 12 Months?		
	Frequency	Percent
Yes	228	32.2%
No	457	64.6%
Missing	22	3.1%
Total	707	100.0%

Does the Household have a Landline Telephone?		
	Frequency	Percent
Yes	516	75.3%
No	149	21.8%
Missing	20	2.9%
Total	685	100.0%

How Many People in Household Fished During the Previous 12 Months?		
	Frequency	Percent
1	80	35.1%
2	89	39.0%
3	32	14.0%
4	14	6.1%
5	5	2.2%
6	4	1.8%
7	1	.4%
8	2	.9%
10	1	.4%
Missing	228	12.7%

Angler Questionnaire

Disposition of Sample				
	License		ABS	
	Frequency	Percent	Frequency	Percent
Trips taken in the 2 month period	227	14.5%	51	14.0%
No trips taken in the 2 month period	739	47.3%	137	37.6%
Refused	19	1.2%	3	.8%
Nothing ever returned	438	28.0%	63	17.3%
Mailing returned undelivered	139	8.9%	8	2.2%
No response			102	28.0%
Total	1562	100%	364	100%

Gender of the Respondent				
	License		ABS	
	Frequency	Percent	Frequency	Percent
Female	164	16.6%	34	17.8%
Male	735	74.6%	141	73.8%
Missing	86	8.7%	16	8.4%

Did the Respondent Perform in Recreational Saltwater Fishing in 2009?				
	License		ABS	
	Frequency	Percent	Frequency	Percent
Yes	718	23.4%	152	79.6%
No	230	72.9%	31	16.2%
Missing	37	3.8%	8	4.2%

License Type		
	Frequency	Percent
Residential CRFL	366	23.4
Residential CRFL 10-day	11	.7
Residential CRFL Adult	4	.3
Non-residential CRFL	282	18.1
Non-residential CRFL 10-day	115	7.4
Age 65 CRFL	87	5.6
Disabled Vet CRFL	4	.3
Totally Disabled CRFL	6	.4
Perm Disabled State Fish w CRFL	15	1.0
Uni Blind Inland / CRFL	1	.1
Unifed Inland / CRFL	40	2.6
Unified Sptm / CRFL	87	5.6
Lifetime Unifed Inland / CRFL	1	.1
Lifetime Comp Inland Fish w CRFL	15	1.0
Subsidized Inland / CRFL Waiver	35	2.2
Disabled Combo H/F/CRFL Basic	11	.7
Sportsman Infant w CRFL	39	2.5
Sportsman Youth w CRFL	29	1.9
Residential Sportsman Adult w CRFL	145	9.3
Residential Uni Sptm / CRFL Adult	6	.4
Non-residential Sportsman Adult w/ CRFL	26	1.7
Non-residential Uni Sportsman / CRFL Adult	2	.1
Unified Age 65 Sportsman / CRFL	54	3.5
Residential Lifetime Over 70 Fish w/ CRFL	122	7.8
Lifetime Comp Over 70 Fish w/ CRFL	45	2.9
Disabled Sportsman w/ CRFL	10	.6
Uni Disabled Vet Sptm / CRFL	4	.3
Total	1562	100.0

Age of the Respondent				
	License		ABS	
	Frequency	Percent	Frequency	Percent
Less than 16	2	.2%	1	.5%
16 – 17	1	.1%		
18 – 24	42	4.3%	13	6.8%
25 – 34	86	8.7%	19	9.9%
35 – 44	136	13.8%	33	17.3%
45 – 54	206	20.9%	37	19.4%
54 – 64	196	19.9%	45	23.6%
65 or older	226	22.9%	28	14.7
Missing	90	9.1%	15	7.9%

Has the Respondent Fished in NC During the Past 12 Months?				
	License		ABS	
	Frequency	Percent	Frequency	Percent
Yes	871	88.4%	132	69.1%
No	31	3.1%	43	22.5%
Missing	83	8.4%	16	8.4%

Was the License for Recreational Saltwater Fishing?				
	License		ABS	
	Frequency	Percent	Frequency	Percent
Yes	731	10.9%	106	55.5%
No	107	74.2%	22	11.5%
Missing	147	14.9%	63	33.0%

Was the License Valid During November 2009?				
	License		ABS	
	Frequency	Percent	Frequency	Percent
Yes	675	68.5%	84	44
No	51	5.2%	23	12
Missing	259	26.3%	84	44

Did the angler fish during Wave 6, 2009?				
	License		ABS	
	Frequency	Percent	Frequency	Percent
Yes	227	23%	49	25.7%
No	738	74.9%	136	71.2%
Missing	20	2.0%	6	3.1%

Trip Questionnaire

Was the Trip from the Shore or Private Boat?		
	Frequency	Percent
Shore	385	59.8%
Boat	252	39.1%
Missing	7	1.1%
Total	644	

Collapsed Mode of Fishing		
	Frequency	Percent
Ocean, less than 3 miles from the shore	306	47.5%
Ocean, more than 3 miles from the shore	48	7.5%
Inland trip	231	35.9%
Missing	8	1.2%
More than one response checked	51	7.9%

Public Access for Boat and Shore Trips				
	Boating Trips		Shore Trips	
	Frequency	Percent	Frequency	Percent
Yes, public access	179	71.0%	340	86.7%
No, private access	60	23.8%	38	9.7%
Missing	13	5.2%	14	3.6%
Total	252		392	

Mode of Shore Trip		
	Frequency	Percent
Pier	74	16.5
Dock	31	6.9
Jetty or Breakwater	18	4.0
Bridge or causeway	26	5.8
Other man-made structure	8	1.8
Bank or beach	276	61.5
Missing	16	3.6
Total	449	

Fishing Area of Trip		
	Frequency	Percent
Ocean, within 3 miles from the shore	306	47.5%
Ocean, more than 3 miles from the shore	48	7.5%
Sound	79	12.3%
River	66	10.2%
Bay	5	.8%
Inlet	59	9.2%
Someplace else	22	3.4%
Missing	8	1.2%
More than one response checked	51	7.9%

Time the Trip Ended		
	Frequency	Percent
Midnight – 3:00 am	7	1.1%
3:00 am – 6:00 am	6	.9%
6:00 am – 9:00 am	27	4.2%
9:00 am – Noon	75	11.6%
Noon – 3:00 pm	121	18.8%
3:00 pm – 6:00 pm	286	44.4%
6:00 pm – 9:00 pm	82	12.7%
9:00 pm – Midnight	11	1.7%
Missing	6	.9%
Invalid answer (multiple responses)	23	3.6%

Was Anyone in the Household who was also an Angler?		
	Frequency	Percent
Yes	332	47.0%
No	303	51.6%
Missing	9	1.4%

Did the Angler's Spouse Fish with the Respondent on this Trip?		
	Frequency	Percent
Spouse	156	45.1%
Child / Children	121	35.0%
Other	69	19.9%
Total	346	100.0%

Total Number of Household Members Fishing on the Trip		
	Frequency	Percent
1	346	53.7%
2	190	29.5%
3	57	8.9%
4	22	3.4%
5	6	.9%
7	4	.6%
8	4	.6%
10	2	.3%
12	1	.2%
Missing	12	1.9%
Total	644	100.0%