Survey Response Rate and Bias Results from a Trial of Pre-notification Letters : A Report to the Office of Management and Budget on the National Survey on Recreation and the Environment (NSRE)

The Office of Management and Budget has expressed concern that low response rates for the NSRE and other public surveys are a primary cause for non- response bias. To increase response rates, OMB required a test of prenotification letters, increased numbers of call backs to persons not reached, and a 2-question quick survey of refusing individuals to gain information for use in designing future NSRE surveys. This report provides in-depth analysis of the results of testing prenotification, more call backs and refuser questions. Response rates and apparent parameter estimate bias are the primary criteria for evaluating results.

Submitted by the US Forest Service, National Oceanic and Atmospheric Administration, University of Georgia, and University of Tennessee.

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I. INTRODUCTION: Overview of the Assessment

In the review/approval process under the Paperwork Reduction Act (PRA), the U.S. Office of Management and Budget (OMB) required several additional procedures for sampling and conducting the NSRE survey (National Survey on Recreation and the Environment). The current OMB Approval Number is 0596-0127; Expiration Date: 8/31/2007. NSRE is a national random digit dialing (RDD) telephone survey of U.S. households. Response rates for telephone surveys have been declining since the early 1990s. In a previous NSRE (1994-95), the response rate was 82 percent, while in NSRE 1999-2000 the response rate dropped to 20 percent. The Office of Management and Budget has expressed concern that low response rates increases the potential for non response bias. To increase response rates, OMB imposed the following conditions:

1. An experiment be conducted on the first three versions of the survey (each version includes approximately 5,000 completed interviews) in which RDD telephone numbers are matched to addresses and pre-notification letters be sent to 50% of those with listed numbers (i.e., those with matched mailing addresses). Survey Sampling, Inc., the firm which supplies the University of Tennessee Survey Research Center with RDD telephone numbers, takes all listed telephone numbers with addresses and does a reverse append to match addresses to RDD telephone numbers. On average, only 40% of RDD telephone numbers are listed with addresses. Note that each version of the NSRE consists of a core set of questions that take, on average, about 8 minutes and is asked of all respondents. The core questions include recreation activity participation and socioeconomic/demographic information. The total interview time per respondent is restricted to an average of 14 minutes. This leaves about six minutes, on average, for additional modules of questions. A module is a set of questions designed to achieve a specific objective or set of objectives. Different versions of the survey have different modules.
2. Increase efforts to convert refusals by increasing call-backs from 8 to 15 before dropping a number and sending letters to 50% of those refusals with addresses before calling one more time.
3. For all refusals to the full survey, conduct a two-question survey to assess non response bias from refusals. The two questions include one demographic variable related to a selected recreation activity and if the person participated in that selected activity during the past 12 month. The demographic variable was age and the selected activity was "walking for exercise or pleasure." In addition, gender of the respondent was recorded, even though not asked.
4. After completing versions one thru three, deliver a report to OMB assessing the costs/benefits of efforts to increase response rates.

The outcome of this assessment will determine whether the NSRE will be required to continue the more costly procedures of sending pre-notification letters, continuing with greater efforts to convert refusals, and administering the two-question survey to assess non-response bias due to high refusals. The following criteria were specified in the supporting statement approved by OMB:

"In addition to the marginal cost comparison, computed estimates for recreation participation rates by activity for both the sample with and without the pre-notification letter

will be examined. If there is a statistically significant difference in estimated participation rates between letter recipients and non recipients and if the average cost per additional completed response (marginal cost) with an advance letter is no greater than 5% more than the average cost per completed interview among those not receiving the advance letter (the outer limit of the budget), then the advance letter procedure will be adopted for the duration of the NSRE 2005."

NSRE has been slowed due to many factors, including the hurricanes in 2005. Consequently, only versions one and two have been completed for a total of 10,001 interviews.

To address the first three of the above four requirements, we have broken the assessment into three main assessment tasks:

(1) Assess Pre-notification Letters: Response Rates, Sample Representativeness and Non-Response Bias (Section II)
(2) Assess Letters to Refusals (Section III, Part 1)
(3) Assess Refusals and Non Response Bias (Section III, Part 2).

See Figure 1 for a summary of tasks and related sample groups used for each assessment task.

Note that in all the assessments, we have limited information about non respondents. Generally, we must extrapolate from what we learn about respondents to non respondents. The one exception is the analysis of a class of nonrespondents we label "Hard Refusals." These are eligible respondents who refused to answer even the two-question survey. For this group, we test for differences in distributions across demographic characteristics by Census Division of Residency.

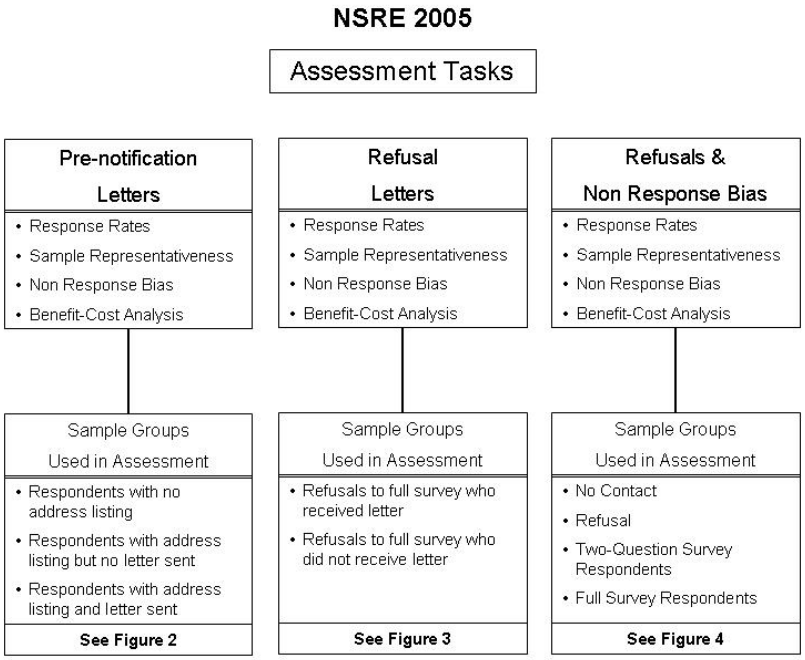

Figure 1. Assessment Efforts to Address Non Response Bias in NSRE 2005

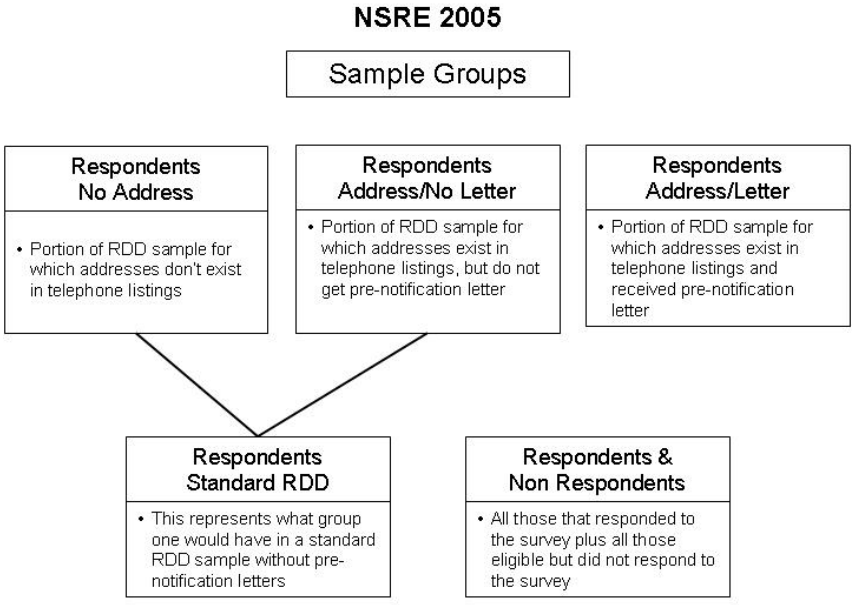

Figure 2. NSRE 2005 Sample Groups

II. Assessment of Pre-notification Letters: Response Rates, Sample Representativeness and Non Response Bias

In assessing the benefits of pre-notification letters, we address eight questions in a sequential analysis. In conducting the assessment, the sample was divided into three groups: 1) Respondents with No Matching Addresses with RDD telephone numbers, 2) Respondents with Matching Addresses, but did not receive the pre-notification letter, and 3) Respondents with Matching addresses that received the pre-notification letter (See Figure 2).

Groups one and two were also combined as they represent the sample that would have been obtained using standard RDD telephone sampling, i.e., the sample that did not receive pre-notification letters. We refer to this group as the Standard RDD Sample Group. This is an important group because it serves as the standard of comparison for the assessment of pre-notification letters.

1. Did pre-notification letters increase response rates?

   The simple answer to the above question is yes. The pre-notification letters increased response rates from 14.08% for the Standard RDD Sample Group to 28.10% for the Pre-notification Letter Sample Group, an increase of 14 percentage points. This is a much larger increase than we were led to expect by project consultants. The net increase was about 3.5 percentage points for an overall response rate of 17.62%. Again, a limitation here is that we only have information from respondents in the data we have currently received. This limits our ability to analyze the factors related to non response. See Table 1 for response rates by sample groups.

Table 1. Comparative Profiles: Census versus Samples and Response Rates by Sample Groups.

Factors	Census	No Address No Letter	Address No Letter	Address Letter	Standard RDD	Total Sample
Age (years)						
16-24	16.4	11.6	8.1	5.3	10.1	8.0
25-34	17.5	16.3	14.4	10.1	15.5	13.2
35-44	19.3	20.6	18.0	17.1	19.5	18.5
45-54	18.2	22.5	21.1	22.0	21.9	21.9
55-64	12.7	16.7	18.9	21.5	17.7	19.3
65 and older	15.9	12.2	19.5	23.9	15.4	19.1
N		3119	2454	4276	5573	9849
Chi-Square		146.8	224.7	930.6	300.5	1013.2
P-value		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Gender						
Male	48.7	44.6	45.6	48.6	45.0	46.6
Female	51.3	55.4	54.4	51.4	55.0	53.4
N		3166	2496	4332	5662	9994
Chi-Square		21.6	9.4	0.0	30.4	17.7
P-value		<0.0001	0.0022	0.9350	<0.0001	<0.0001
Race/Ethnicity						
White (not Hispanic)	70.6	79.4	86.0	90.2	82.3	85.7
Black (not Hispanic)	11.7	8.6	6.6	4.3	7.7	6.2

Factors	Census	No Address No Letter	Address No Letter	Address Letter	Standard RDD	Total Sample
Native Am./Pac.Is. (not Hispanic)	0.7	1.9	0.9	0.9	1.5	1.2
Asian (not Hispanic)	4.4	2.3	1.4	1.1	1.9	1.6
Hispanic	12.6	7.9	5.2	3.4	6.7	5.3
N		3108	2442	4252	5550	9802
Chi-Square		206.7	298.2	818.5	464.1	1202.6
P-value		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Education Attainment						
Less than High School	19.6	8.9	7.7	6.3	8.3	7.5
High School or Equivalent	28.6	23.8	25.8	26.9	24.6	25.6
Some College or College Degree	42.9	51.2	50.3	50.2	50.8	50.5
Masters, Prof. Degree, or Doctorate	8.9	16.2	16.2	16.5	16.2	16.3
N		3128	2442	4255	5570	9825
Chi-Square		448.9	361.1	714.7	806.9	1511.9
P-value		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Household Income ($)						
0-24,999	20.8	21.7	18.2	18.1	20.2	19.3
25,000-49,999	29.1	25.8	28.3	27.0	26.9	26.9
50,000-99,999	34.8	32.4	36.4	36.7	34.1	35.3
100,000 and above	15.3	20.2	17.1	18.2	18.8	18.6
N		2380	1861	3307	4241	7548
Chi-Square		51.6	11.6	38.3	43.3	73.8
P-value		<0.0001	0.0090	<0.0001	<0.0001	<0.0001
Urban/Rural Residency						
Urban	82.8	81.6	76.6	78.4	79.4	79.0
Rural	17.2	18.4	23.4	21.6	20.6	21.0
N		3169	2498	4334	5667	10001
Chi-Square		3.0	67.0	57.6	45.3	101.3
P-value		0.0821	<0.0001	<0.0001	<0.0001	<0.0001
Census Division of Residency						
New England	5.0	4.5	5.3	5.3	4.9	5.0
Middle Atlantic	13.9	12.5	12.6	12.6	12.6	12.6
South Atlantic	18.9	17.5	18.8	19.2	18.1	18.5
East South Central	6.0	5.9	7.1	8.1	6.4	7.1
West South Central	11.1	10.3	11.8	9.7	11.0	10.4
East North Central	15.7	13.2	14.7	17.9	13.8	15.6
West North Central	6.8	5.3	7.0	10.3	6.1	7.9
Mountain	6.6	8.5	7.3	6.9	8.0	7.5
Pacific	16.0	22.3	15.4	10.1	19.3	15.3
N		3169	2498	4334	5667	10001
Chi-Square		129.5	14.2	230.6	81.5	73.0
P-value		<0.0001	0.0778	<0.0001	<0.0001	<0.0001
Response Rate (%)	N/A	12.67	16.33	28.10	14.08	17.62

2. Is there a relationship between response rates and sample Representativeness?

   We answer this question in two steps.

   Step 1. Here we compared the distribution of each sample group with the Census of the noninstitutionalized population age 16 years old or older for socioeconomic/demographic factors (e.g. age, gender, race/ethnicity, educational attainment, household income, urban/rural residency and residency by Census Division). According to the U.S. Bureau of the Census, this population is the most appropriate population for extrapolating results from telephone surveys and provides the "standard of comparison" for judging representativeness of each sample group.

   For assessing sample representativeness, we conducted several statistical tests on differences between the Census distributions and the distributions for our different sample groups for each of the socioeconomic/demographic factors. The first tests compared the total sample distribution of each factor for each sample group against the known Census distribution. This comparison was also conducted for the "Total Sample". We used the Chi-square test using the SAS Software, Inc. and PROC FREQ with the option TESTP, which specifies the known Census population distribution. The sample sizes, Chi-square values, and p-values for each of these tests (statistical significance of the difference) are reported in Table 1.

   Results of Test 1:

   - All sample groups and the Total Sample were different from the Census for Gender, except the pre-notification letter sample group.
   - All sample groups and the Total Sample were different from the Census for the following demographic factors: Age, Race/Ethnicity, Educational Attainment, and Household Income.
   - All sample groups and the Total Sample, with the exception of the sample group that had no matching addresses and received no letter, were different for Urban/Rural Residency.
   - All sample groups and the Total Sample were different from the Census for Census Division, except the Address and No Letter sample group.

   The second test we conducted was to identify where specific differences existed in a distribution that was shown earlier to be different from Census. Since a distribution for a factor had several categories, many tests could be performed to identify specific differences. To protect from finding false differences, we used a conservative approach (Bonferroni adjustment), which uses an experimentwise alpha to control for the error for the set of all tests within a distribution. In this approach, instead of using the 0.05 level on each proportion test for a factor, we divided 0.05 by the number of category proportions for a factor and used this value as the error rate for each test. Example: Race/Ethnicity has five categories: 1) White, not Hispanic, 2) Black, not Hispanic, 3) Native American, Pacific Islander, not Hispanic, 4) Asian, not Hispanic, and 5) Hispanic. We divide 0.05 by 5, which equals an error rate of 0.01 for each category comparison (Census versus sample), but 0.05 across all categories of the factor or the experimentwise error. Results are summarized in Table 2.

Results of Test 2:

Results for test 2 confirm exactly the results of test 1. That is, there was at least one category found significant in test 2 if the distribution was found significant from test 1. Similarly, if the distribution was not found significant with test 1, there were no categories found significant with test 2. This consistency was expected, especially when using the Bonferroni approach. The value of these tests is to determine what categories are under or over represented in a sample. For instance, consider age which had a significantly different distribution from Census for all samples. Table 2 shows that the younger ages (16-24 and 25-34) were significantly under represented as compared to Census for all samples. However, the older ages (45-54 and 55-64) were significantly over represented. The middle age (35-44) appears to match Census, except for the Address Letter group. This is interesting information that may be useful when analyzing the participation rates for response bias.

Step 2. We tested for differences in the distributions between sample groups for each socioeconomic/demographic factor. In this situation we are comparing two sample distributions as opposed to a sample distribution compared to a known distribution, as was previously done. We conducted three comparisons: 1) The "Address & Letter" sample groups versus the "Standard RDD" sample group, 2) The "No Address & No Letter sample group versus the "Address & No Letter" sample group and 3) "Address & Letter sample group versus the "Address & No Letter" sample group.

Two-way contingency tables were used to test for distributional differences using the Chi-Square test. Subsequent specific tests between proportions of the distribution were conducted by estimating the difference D = p1-p2 and the associated standard error and then constructing a confidence interval. Here again, we use the Bonferroni adjustment approach to control for experimentwise error. Results are summarized in Table 3.

Table 2. Differences (Sample-Census) between Census and Sample Profiles and Response Rates. An * indicates significance at the experimentwise 0.05 level.

Factors	**Census**	**No Address No Letter**	**Address No Letter**	**Address Letter**	**Standard RDD**	**Total Sample**
Age (years)						
16-24	16.4	-4.8*	-8.3*	-11.1*	-6.3*	-8.4*
25-34	17.5	-1.2	-3.1*	-7.4*	-2.0*	-4.3*
35-44	19.3	1.3	-1.3	-2.2*	0.2	-0.8
45-54	18.2	4.3*	2.9*	3.8*	3.7*	3.7*
55-64	12.7	4.0*	6.2*	8.8*	5.0*	6.6*
65 and older	15.9	-3.7*	3.6*	8.0*	-0.5	3.2*
Gender						
Male	48.7	-4.1*	-3.1*	-0.1	-3.7*	-2.1*
Female	51.3	4.1*	3.1*	0.1	3.7*	2.1*
Race/Ethnicity						
White (not Hispanic)	70.6	8.8*	15.4*	19.6*	11.7*	15.1*
Black (not Hispanic)	11.7	-3.1*	-5.1*	-7.4*	-4.0*	-5.5*
Native Am./Pac.Is. (not Hispanic)	0.7	1.2*	0.2	0.2	0.8*	0.5*

Factors	Census	No Address No Letter	Address No Letter	Address Letter	Standard RDD	Total Sample
Asian (not Hispanic)	4.4	-2.1*	-3.0*	-3.3*	-2.5*	-2.8*
Hispanic	12.6	-4.7*	-7.4*	-9.2*	-5.9*	-7.3*
Education Attainment						
Less than High School	19.6	-10.7*	-11.9*	-13.3*	-11.3*	-12.1*
High School or Equivalent	28.6	-4.8*	-2.8*	-1.7*	-4.0*	-3.0*
Some College or College Degree	42.9	8.3*	7.4*	7.3*	7.9*	7.6*
Masters, Prof. Degree or Doctorate	8.9	7.3*	7.3*	7.6*	7.3*	7.4*
Household Income ($)						
0-24,999	20.8	0.9	-2.6*	-2.7*	-0.6	-1.5*
25,000-49,999	29.1	-3.3*	-0.8	-2.1*	-2.2*	-2.2*
50,000-99,999	34.8	-2.4*	1.6	1.9	-0.7	0.5
100,000 and above	15.3	4.9*	1.8	2.9*	3.5*	3.3*
Urban/Rural Residency						
Urban	82.8	-1.2	-6.2*	-4.4*	-3.4*	-3.8*
Rural	17.2	1.2	6.2*	4.4*	3.4*	3.8*
Census Division of Residency						
New England	5.0	-0.5	0.3	0.3	-0.1	0.0
Middle Atlantic	13.9	-1.4	-1.3	-1.3	-1.3*	-1.3*
South Atlantic	18.9	-1.4	-0.1	0.3	-0.8	-0.4
East South Central	6.0	-0.1	1.1	2.1*	0.4	1.1*
West South Central	11.1	-0.8	0.7	-1.4*	-0.1	-0.7
East North Central	15.7	-2.5*	-1.0	2.2*	-1.9*	-0.1
West North Central	6.8	-1.5*	0.2	3.5*	-0.7	1.1*
Mountain	6.6	1.9*	0.7	0.3	1.4*	0.9*
Pacific	16.0	6.3*	-0.6	-5.9*	3.3*	-0.7
Response Rate (%)	N/A	12.67	16.33	28.10	14.08	17.62

Table 3. Differences between sample profiles. An * indicates significance at the experimentwise 0.05 level.

Factors	Address & Letter versus Standard RDD	No Address & No Letter versus Address & No Letter	Address & Letter Versus Address & No Letter
Age (years)			
16-24	-4.7*	3.5*	-2.8*
25-34	-5.4*	1.9	-4.3*
35-44	-2.3*	2.7	-0.8
45-54	0.1	1.5	0.9
55-64	3.8*	-2.3	2.6
65 and older	8.5*	-7.3*	4.4*
P-value	<0.0001	<0.0001	<0.0001
Gender			
Male	3.6*	-1.1	3.0*
Female	-3.6*	1.1	-3.0*
P-value	0.0003	0.4236	0.0166
Race/Ethnicity			
White (not Hispanic)	8.0*	-6.6*	4.2*
Black (not Hispanic)	-3.4*	2.1*	-2.2*

Factors	Address & Letter versus Standard RDD	No Address & No Letter versus Address & No Letter	Address & Letter Versus Address & No Letter
Native Am./Pac.Is. (not Hispanic)	-0.6*	0.9*	-0.1
Asian (not Hispanic)	-0.7*	0.9*	-0.2
Hispanic	-3.2*	2.7*	-1.7*
P-value	<0.0001	<0.0001	<0.0001
Education Attainment			
Less than High School	-2.0*	1.2	-1.4
High School or Equivalent	2.3*	-2.0	1.1
Some College or College Degree	-0.5	0.9	-0.1
Masters, Prof. Degree or Doctorate	0.3	0.0	0.3
P-value	0.0004	0.1928	0.1730
Household Income ($)			
0-24,999	-2.0	3.5*	-0.1
25,000-49,999	0.1	-2.6	-1.3
50,000-99,999	2.6	-4.0*	0.3
100,000 and above	-0.6	3.1*	1.1
P-value	0.0462	0.0003	0.6457
Urban/Rural Residency			
Urban	-1.0	5.0*	1.8
Rural	1.0	-5.0*	-1.8
P-value	0.2354	<0.0001	0.0800
Census Division of Residency			
New England	0.4	-0.8	0.0
Middle Atlantic	0.0	-0.1	-0.1
South Atlantic	1.1	-1.3	0.4
East South Central	1.7*	-1.2	1.0
West South Central	-1.3	-1.5	-2.1
East North Central	4.0*	-1.5	3.2*
West North Central	4.2*	-1.7	3.2*
Mountain	-1.0	1.1	-0.4
Pacific	-9.1*	6.9*	-5.2*
P-value	<0.0001	<0.0001	<0.0001

Results of Sample Group Comparisons:

Address & Letter versus Standard RDD:

- There were significant differences in the overall distributions for all demographic factors, except Urban/rural Residency.
- ***Age***. The Address & Letter sample group is older than the Standard RDD sample group, with significantly higher concentrations of respondents in the above 55 age groups and lower concentrations in the below age 44 groups. There was not a significant difference in the age group 45-54.
- ***Gender***. The Address & Letter sample group has a significantly higher proportion of males than the Standard RDD sample group.

- ***Race/Ethnicity***. The Address & Letter sample group has a significantly higher proportion of respondents classified as White, Not Hispanic and significantly lower proportions of respondents in all other classifications than the Standard RDD sample group.
- ***Educational Attainment***. The Address & Letter sample group has a slightly higher level of educational attainment than the Standard RDD sample group. The Address & Letter sample group had a significantly lower proportion of respondents in the "less than high school" level of education and a significantly higher proportion of respondents in the "high school or equivalent" level of education. There were no significant differences at the higher levels of education.
- ***Household Income***. There were no significant differences for any income categories, even though the overall distribution was slightly significant at $p = 0.0462$. This occasionally occurs because the Bonferroni adjustment is only approximate and was not able to find where the minor difference may have existed.
- ***Urban/Rural Residency***. There was not a significant difference for urban/rural residency.
- ***Census Division of Residency***. The Address & Letter sample group had significantly higher proportions of respondents in the East South Central, East North Central, and West North Central Census divisions of residency than the Standard RDD sample group. And, the Address & Letter sample group had a significantly lower proportion of respondents in the Pacific Census division of residency.

No Address & No Letter versus Address & No Letter:

These two sample group together compose the Standard RDD group. There are significant differences between those who have listed telephone numbers that could be matched and those who don't. Of course, this fact has long been known, and is the reason for doing RDD telephone sampling versus sampling from listings in telephone directories. The results here simply confirm this fact.

- There were significant differences in the overall sample distributions for Age, Race/Ethnicity, Household Income, Urban/rural Residency and Census Division of Residency.
- There were no significant differences in the overall sample distributions for Gender and Educational Attainment.
- ***Age***. Respondents to the No Address & No Letter sample group were younger than the Address & No Letter sample group. The No Address & No Letter sample group had a significantly higher proportion of respondents in the 16-24 age group and a significantly lower proportion of respondents in the 65 and older age group compared to the Address and No Letter sample group. There were no significant differences for any other age groups.
- ***Gender***. There was no significant difference between the two sample groups.
- ***Race/Ethnicity***. The No Address & No Letter sample group had a significantly lower proportion of respondents classified as White, Not Hispanic and a significantly higher proportion of respondents classified in all the other race/ethnicity categories.
- ***Educational Attainment***. There were no significant differences in level of education.

- ***Household Income***. The No Address & No Letter sample group had significantly higher proportions of respondents in both the lowest income category ($0 - $24,999) and the highest income category ($100,000 and above) when compared with the Address & No Letter sample group. The No Address & No Letter sample group had a significantly lower proportion of respondents in the $50,000 - $99,999 income category than the Address & No Letter sample group. The No Address & No Letter sample group had a lower proportion of respondents in the $25,000 - $49,999 income category than the Address & No Letter sample group, but this difference was not significant.
- ***Urban/Rural Residency***. The No Address & No Letter sample group had a significantly higher proportion of respondents who live in urban areas than the Address & No Letter sample group.
- ***Census Division of Residency***. The No Address & No Letter sample group had a significantly higher proportion of respondents that live in the Pacific Census division than the Address & No Letter sample group. There were no other significant differences for Census division of residency.

Address & Letter versus Address & No Letter:

This comparison controls for the treatment of samples that both have listed numbers with matching addresses and tests for differences in sample responses due to the use of the pre-notification letter. Use of the pre-notification letter does result in some significant differences in the demographic profiles of who responded to the survey.

- There were significant differences in the overall sample distributions for Age, Gender, Race/Ethnicity, and Census Division of Residency.
- There were no significant differences in the overall sample distributions for Educational Attainment, Household Income, or Urban/rural Residency.
- ***Age***. The Address & Letter sample group had a significantly lower proportion of respondents in the two age groups under 34 years old and a significantly higher proportion of respondents in the 65 and older age group than the Address & No Letter sample group. There were no significant differences for the middle age groups (35-64).
- ***Gender***. The Address & Letter sample group had a significantly higher proportion of respondents that are male compared to the Address & No Letter sample group.
- ***Race/Ethnicity***. The Address & Letter sample group had a significantly higher proportion of respondents classified as White, Not Hispanic and significantly lower proportions of respondents for those who were classified as Black or African American, Not Hispanic and those who were classified as Hispanic.
- ***Educational Attainment***. There were no significant differences for level of education.
- ***Household Income***. There were no significant differences for household income.
- ***Urban/Rural Residency***. There was no significant difference for urban/rural residency.
- ***Census Division of Residency***. The Address & Letter sample group had significantly higher proportions of respondents in the East North Central and West

North Central Census divisions and, a significantly lower proportion of respondents in the Pacific Census division versus the Address & No Letter sample group.

3. Does improving response rates with pre-notification letters improve representativeness of samples compared with "standard RDD" sampling?

   In the analyses presented in Tables 1-3, we found significant differences between the Census distributions for socioeconomic/demographic factors and the distributions for the socioeconomic/demographic factors for all our sample groups. We also found that there were significant differences between the distributions for socioeconomic/demographic factors in comparisons of the Standard RDD sample group and the Pre-notification Letter sample group. Although for Gender the sample distribution of the Pre-notification Letter sample group was closer to the Census distribution, ***generally we conclude that the effect of the pre-notification letters yielded a total sample less representative than if we had just done the Standard RDD***. Below are some specific findings:

   - The Standard RDD sample group distributions were closer to the Census distributions for Age, Race/Ethnicity, Urban/rural Residency and Census Division of Residency based on the Chi-Square statistics.
   - The distributions for Education and Income were only very slightly closer to the Census for the Pre-notification Letter sample as compared to the Standard RDD.
   - The Pre-notification Letter sample group distributions were closer to the Census distribution for Gender. ***So pre-notification letters seem to correct for gender bias noted in telephone surveys, but may introduce bias related to other factors.***

4. Is there a relationship between response rates, sample representativeness and non response bias?

   In answering questions 1-3, we have established that there is no relationship between response rates and sample representativeness, and that the net effect of pre-notification letters was to reduce sample representativeness. But, we also found that all our samples are significantly different from the Census and so our sample is not (without sample weighting) representative of the population. However, sample representativeness is only a necessary, not sufficient condition for establishing the existence of non response bias. To understand non response bias, we need to establish whether there is a relationship between any of the socioeconomic/demographic factors, for which there is over or under representativeness, and activity participation rates (i.e. the measures we are seeking to estimate by use of the survey).

   For activity participation rates, we limited our analysis to nine activities: walking for exercise or pleasure (walk), bird watching (bird), hunting (hunt), fishing (fish), motor boating (mboat), swimming in natural water bodies (swim_nat), family gatherings (fam), day hiking (hike), and mountain biking (mtnbike). These activities were chosen because they capture the activities of greatest importance to the managing agencies, they span a range of activities in terms of participation rates (relatively high and low), and from past research are likely to span the range of differences in which socioeconomic/demographic variables are important for explaining participation rates.

Tables 4 and 5 show the estimated activity participation rates for each of the nine recreation activities for the total sample and each sample group for the unweighted and weighted sample data.

Table 4. Activity Participation Rates by Sample Group: Unweighted Samples

	Samples (Participation Rates)				
Activity	No Address	Address & No Letter	Address & Letter	Standard RDD[1]	Total Sample
Walking for exercise or pleasure	0.8672	0.8763	0.8738	0.8712	0.8723
Bird Watching	0.3932	0.4231	0.4384	0.4064	0.4202
Hunting	0.1123	0.1393	0.1271	0.1242	0.1255
Fishing	0.3376	0.3395	0.3459	0.3385	0.3417
Motor Boating	0.2872	0.2734	0.2970	0.2811	0.2880
Swimming in Natural Waterbodies	0.4771	0.4383	0.4442	0.4600	0.4531
Family Gatherings	0.7272	0.7103	0.7292	0.7193	0.7237
Day Hiking	0.3327	0.3731	0.3442	0.3520	0.3486
Mountain biking	0.2154	0.1951	0.1861	0.2057	0.1972

1. Standard RDD sample is equal to sample with no address listings plus sample with address listings and no letter.

Table 5. Activity Participation Rates by Sample Group: Weighted Samples

	Samples (Participation Rates)				
Activity	No Address	Address & No Letter	Address & Letter	Standard RDD[1]	Total Sample
Walking for exercise or pleasure	0.8517	0.8492	0.8523	0.8507	0.8513
Bird Watching	0.3124	0.3403	0.3777	0.3240	0.3450
Hunting	0.1039	0.1287	0.1267	0.1142	0.1191
Fishing	0.3377	0.3155	0.3527	0.3286	0.3380
Motor Boating	0.2290	0.2212	0.2640	0.2257	0.2407
Swimming in Natural Waterbodies	0.4343	0.3769	0.3923	0.4106	0.4034
Family Gatherings	0.7256	0.7061	0.7233	0.7173	0.7197
Day Hiking	0.2832	0.3142	0.3019	0.2966	0.2987
Mountain biking	0.2083	0.1896	0.1751	0.2002	0.1902

1. Standard RDD sample is equal to sample with no address listings plus sample with address listings and no letter.

To estimate the relationship between socio-demographic factors and activity participation we chose to use logit equations with the unweighted data. We chose the dummy variable approach based on previous research using NSRE 1999-2000 data for projecting participation in marine recreation (see http://marineeconomics.noaa.gov/NSRE/NSREForecast.pdf).

For socioeconomic/demographic variables, we used those variables included in the comparative profiles (See Tables 1, 2, and 3). We use the dummy variable approach for explanatory variables. For variables, age, educational attainment and household income, we chose the lowest category as the base since these variables increase in value with each category. For all other variables, we chose the base category based on previous work on activity participation in Leeworthy et al. (2005). See Table 6 for definitions of the variables in the equations.

To test for differences by sampling method, we constructed dummy variables for two sample treatments. The first sample treatment was the use of pre-notification letters versus the Standard RDD. The variable created is "stndrdd" and is equal to one when the sample group is the "Standard RDD" sample group. This will allow testing the effect of sending pre-notification letters. The second treatment was for those who received refusal letters or extra effort on refusal conversion (extra effort beyond what would have been done without the extra OMB requirements). This latter treatment will receive extensive analysis in Section III of this report. The variable for this second treatment is "Rfconv" and is equal to one if a refusal conversion.

We also deal with a problem in unit (item) non response for a certain socioeconomic factor (household income). Around 24.5 percent of our sample did not provide a response to household income. We didn't want to lose these respondents in our analyses, so in our dummy variable approach, we include those that did not provide a response as a special group.

Table 6. Definitions of Variables included in Logit Equations

Variable	Description
Age16_24	Dummy variable for age those 16 to 24. Value 1=yes 0=no. Reference in constant in initial full model estimation.
Age25_34	Dummy variable for age those 25 to 34. Value 1=yes 0=no.
Age35_44	Dummy variable for age those 35 to 44. Value 1=yes 0=no.
Age45_54	Dummy variable for age those 45 to 54. Value 1=yes 0=no.
Age55_64	Dummy variable for age those 55 to 64. Value 1=yes 0=no.
Age65p	Dummy variable for age those 65 and over. Value 1-yes 0=no.
Male	Dummy variable for gender. Value 1=male 0=female.
White	Dummy variable for Race/Ethnicity, those White-Not Hispanic. Value 1=yes 0=no.
Black	Dummy variable for Race/Ethnicity, those Black-Not Hispanic. Value 1=yes 0=no.
Asian	Dummy variable for Race/Ethnicity, those Asian-Not Hispanic. Value 1=yes 0=no.
Native	Dummy variable for Race/Ethnicity, those Native American, Native Hawaiian, or Pacific Islander & Not Hispanic. Value 1=yes 0=no. Reference in constant in initial full model estimation.
Hispan	Dummy variable for Race/Ethnicity, those who are Hispanic. Value 1=yes 0=no.
Educ11	Dummy variable for Education, less than High School. Value 1=yes 0=no. Reference in constant in initial full model estimation.
Educhs	Dummy variable for Education, High School or Equivalent. Value 1=yes 0=no.
Educcoll	Dummy Variable for Education, Some College/College Grad. Value 1=yes 0=no.
Educgrad	Dummy variable for Education, Graduate/Professional Degree. Value 1=yes 0=no.
Educoth	Dummy variable for Education, Other not specified. Value 1=yes 0=no.
Inc25	Dummy variable for Household Income, less than $25,000. Value 1=yes 0=no. Reference in constant in initial full model estimation.
Inc50	Dummy variable for Household Income, $25,000 - $49,999. Value 1=yes 0=no.
Inc100	Dummy variable for Household Income, $50,000 - $99,999. Value 1=yes 0=no.
Inc100p	Dummy variable for Household Income, $100,000 & over. Value 1=yes 0=no.
Incmiss	Dummy variable for Household Income, those who did not answer. Value 1=yes 0=no.
Urban	Dummy variable for Residence, Value 1=urban 0=rural.
Cendiv1	Dummy variable for Census Division of Residence, Northeast. Value 1=yes 0=no.
Cendiv2	Dummy variable for Census Division of Residence, Mid Atlantic. Value 1=yes 0=no.
Cendiv3	Dummy variable for Census Division of Residence, S. Atlantic. Value 1=yes 0=no.
Cendiv4	Dummy variable for Census Division of Residence, E S Central. Value 1=yes 0=no.

Variable	Description
Cendiv5	Dummy variable for Census Division of Residence, W S Central. Value 1=yes 0=no.
Cendiv6	Dummy variable for Census Division of Residence, E N Central. Value 1=yes 0=no.
Cendiv7	Dummy variable for Census Division of Residence, W N Central. Value 1=yes 0=no.
Cendiv8	Dummy variable for Census Division of Residence, Mountain. Value 1=yes 0=no. Reference in constant in initial full model estimation.
Cendiv9	Dummy variable for Census Division of Residence, Pacific, Value 1=yes 0=no.
Stndrdd	Dummy variable for sample treatment. Value 1=Standard RDD 0=Pre-notification letter.
Rfconv	Dummy variable for sample treatment. Value 1=Refusal conversion 0=not a refusal conversion.
Walk	Dummy variable for Activity Participation: Walking for Exercise or Pleasure. Value 1=yes 0=no.
Bird	Dummy variable for Activity Participation: Bird Watching. Value 1=yes 0=no.
Hunt	Dummy variable for Activity Participation: Hunting. Value 1=yes 0=no.
Fish	Dummy variable for Activity Participation: Fishing. Value 1=yes 0=no.
Mboat	Dummy variable for Activity Participation: Motor boating. Value 1=yes 0=no.
Swim_nat	Dummy variable for Activity Participation: Swimming in Natural Water bodies. Value 1-yes 0=no.
Fam	Dummy variable for Activity Participation: Family Gatherings. Value 1=yes 0=no.
Hike	Dummy variable for Activity Participation: Day Hiking. Value 1=yes 0=no.
Mtnbike	Dummy variable for Activity Participation: Mountain Biking. Value 1=yes 0=no.

We estimated the logit equations using both the SAS 9.0 software and LIMDEP 7.0. With the use of SAS we were able to test the "main effect" for each socio-demographic factor and perform pairwise comparisons. This is analogous to what is usually done in an analysis of variance. The full results are not included in this report since they are not central to the task here. However, the results are available on request.

The results of the logit equations are summarized in Tables 7 and 8. Note that we have included all the dummy variables corresponding to each category for each factor, except for Gender and Urban/rural residency. These two factors are binary variables taking on values of zero or one. A person is either male or female or lives in an urban or rural area. For all other variables (factors) we include all the category dummy variables in the table of results. A blank in the table indicates that the category is in the constant.

Results of the Logit Equations:

- Age and Household Income are significant factors in all nine (9) activities tested.
- Gender and Census Division of Residency are significant factors in 8 of 9 activities tested.
- Race/Ethnicity and Educational Attainment are significant factors in 7 of 9 activities tested. The "main effects" test indicates that race/ethnicity and education attainment were significant in 8 of the 9 activities tested. The additional activity was walking for exercise or pleasure. The significance of the "main effects" is shown in Table 8.
- Urban/rural Residency was a significant factor in 3 of 9 activities tested.
- Sample treatments of pre-notification letters and refusal conversions were not significant factors for any of the nine (9) activities tested.

Conclusion: ***There is evidence of non response bias.*** The sample contains over and under representation for all socioeconomic/demographic factors and these factors are significant factors in explaining activity participation.

Table 7. Estimated Participation Functions by Activity: Logit Equations

	Activities (Participation Function Coefficients) [1]					
Factor	Walk	Bird	Hunt	Fish	Mboat	Swim_nat
Constant	2.0135 *	-1.7295 *	-2.4595 *	-0.1996	-2.2920 *	-0.3633
Age16_24						
Age25_34	-0.4028 *	0.2950 *	0.1484	-0.1381	-0.2859 *	-0.8554 *
Age35_44	-0.4196 *	0.6511 *	0.01750	-0.0399	-0.2073	-0.8776 *
Age45_54	-0.4822 *	0.9523 *	-0.3326 *	-0.3739 *	-0.4490 *	-1.2848 *
Age55_64	-0.6961 *	1.0253 *	-0.5556 *	-0.7318 *	-0.5743 *	-1.7689 *
Age65p	-0.8667 *	0.8795 *	-1.2766 *	-1.1430 *	-1.0778 *	-2.6188 *
Male	-0.4790 *	-0.3234 *	1.9424 *	0.8941 *	0.2605 *	-0.0838
White	0.2184	0.3193	0.3034	-0.2343	0.5561 *	0.01489
Black	0.0136	-0.5101 *	-1.1572 *	-1.0233*	-1.0292 *	-1.5114 *
Asian	-0.5876	-0.3081	-2.1376 *	-0.6259 *	-0.5952	-1.0633 *
Native						
Hispan	0.3984	-0.0717	-0.2655	-0.4910 *	-0.0695	-0.2902
Educ11						
Educhs	0.0919	0.2228 *	0.0642	0.1732	0.3356 *	0.2535 *
Educcoll	0.6621 *	0.5283 *	-0.3799 *	-0.1052	0.5563 *	0.7895 *
Educgrad	1.1007 *	0.7098 *	-0.8481 *	-0.3349 *	0.5567 *	1.0293 *
Educoth	0.5216	0.6037 *	0.3276	0.0247	0.4603	0.5477 *
Inc25						
Inc50	0.4378 *	0.1548 *	0.5207 *	0.2822 *	0.5972 *	0.4102 *
Inc100	0.5850 *	0.1602 *	0.7252 *	0.4127 *	0.9219 *	0.7177 *
Inc100p	0.8502 *	0.2737 *	0.4584 *	0.3627 *	1.1969 *	1.0508 *
Incmiss	0.1983 *	-0.04255	0.3506 *	0.1057	0.6480 *	0.3695 *
Urban	0.0056	-0.1079 *	-0.9219 *	-0.3769 *	-0.05972	0.0962
Cendiv1	-0.1376	0.4145 *	-0.8985 *	-0.1772	0.0721	1.1323 *
Cendiv2	-0.3649 *	0.0564	-0.4078 *	-0.3788 *	-0.0681	0.8177 *
Cendiv3	-0.3902 *	0.2478 *	-0.3567 *	0.2291 *	0.2390 *	0.8348 *
Cendiv4	-0.4160 *	-0.07608	-0.0617	0.1944	0.1345	0.1971
Cendiv5	-0.3848 *	-0.07841	0.4196 *	0.2287 *	0.1533	0.1306
Cendiv6	-0.3010 *	0.1329	-0.1956	-0.0907	0.3018 *	0.3401 *
Cendiv7	-0.3305 *	0.1265	0.3819 *	0.3008 *	0.6234 *	0.1505
Cendiv8						
Cendiv9	-0.0444	0.1893 *	-0.6487 *	-0.3201 *	0.0646	0.5304 *
Standrdd	-0.1161	-0.0342	0.0496	-0.0295	-0.0431	-0.0823
Rfconv	-0.0120	-0.05902	0.0952	0.0469	0.0105	0.0268

1. *=significance at .05 or less and blank means dummy category in constant.

Table 7 (Continued). Estimated Participation Functions by Activity: Logit Equations

	Activities (Participation Function Coefficients) [1]		
Factor	Fam	Hike	Mtnbike
Constant	1.4254 *	-0.1291	-0.4047
Age16_24			
Age25_34	-0.5042	-0.0015	-0.2590
Age35_44	-0.3066	0.0409	-0.5090 *

	Activities (Participation Function Coefficients) [1]		
Factor	Fam	Hike	Mtnbike
Age45_54	-0.8422 *	-0.0358	-0.8405 *
Age55_64	-1.0638 *	-0.2807	-1.3171 *
Age65p	-1.0568 *	-0.8734 *	-2.2554 *
Male	-0.1919 *	0.2922 *	0.5045 *
White	-0.0603	-0.1265	-0.4092
Black	0.5756	-1.5053 *	-0.7284 *
Asian	-0.6144	-0.7431	-1.1048 *
Native			
Hispan	-0.0736	-0.3153	-0.6593
Educ11			
Educhs	0.0311	0.0347	-0.2303
Educcoll	0.3132	0.2549	0.0179
Educgrad	0.2864	0.6239 *	0.2875
Educoth	0.5934	0.0713	0.0161
Inc25			
Inc50	0.2352	0.2692 *	0.1371
Inc100	0.5907 *	0.4858 *	0.1431
Inc100p	0.5509 *	0.5160 *	0.5205 *
Incmiss	0.1868	0.0671	-0.1510
Urban	-0.2239	-0.0160	-0.0016
Cendiv1	0.3516	-0.6420 *	0.0255
Cendiv2	0.1869	-0.7786 *	-0.0032
Cendiv3	0.0070	-0.9184 *	-0.0227
Cendiv4	0.1612	-1.0940 *	-0.3645
Cendiv5	0.2237	-1.2887 *	-0.6838 *
Cendiv6	0.1661	-0.8698 *	0.1349
Cendiv7	0.1893	-0.8318 *	0.0324
Cendiv8			
Cendiv9	0.4111	-0.3019 *	-0.0192
Standrdd	-0.1696	-0.0157	-0.0127
Rfconv	-0.1206	-0.0244	-0.0793

1. *=significance at .05 or less and blank means dummy category in constant.

Table 8. Tests (P-values) on the Main Effects in the Logit Participation Models Based on the Wald Chi-Square Test.

Factor	Walk	Bird	Hunt	Fish	Mboat	Swim	Nat	Fam	Hike	Mtnbike
Age	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001		<0.0001	<0.0001	<0.0001
Gender	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0691		0.0424	<0.0001	<0.0001
Ethrace	0.0019	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001		0.0768	<0.0001	0.0305
Educ	<0.0001	<0.0001	<0.0001	0.0006	<0.0001	<0.0001		0.1182	<0.0001	0.0026
Income	<0.0001	<0.0002	<0.0001	<0.0001	<0.0001	<0.0001		0.0012	<0.0001	<0.0001
Urban	0.9509	0.0535	<0.0001	<0.0001	0.3061	0.1067		0.0624	0.8248	0.9839
Cendiv	0.0189	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001		0.4671	<0.0001	0.0003
Standrdd	0.0818	0.4416	0.4996	0.5189	0.3851	0.0777		0.0805	0.7888	0.8585
Rfcon	0.8733	0.2180	0.2235	0.3818	0.8603	0.6294		0.2559	0.7377	0.3900

5. Is the non response bias significant?

   To answer this question, we tested whether there is a difference between unweighted and weighted data estimates of the nine activity participation rates.

   Multivariate weights were constructed for age, gender and race/ethnicity using the 2004 Census data for the noninstitutionalized population 16 years old and older and our sample data. As with the NSRE 2000, we also applied multiplicative weights for educational attainment and urban/rural residency.

   The multivariate weights included 60 cells (age=6 categories, gender=2 categories and race/ethnicity=5 categories). Sample sizes will not support extending multivariate weighting to educational attainment and urban/rural residency. Extending to educational attainment, which includes five categories, would result in a 300 cell matrix. Sample cell densities in a 300 cell matrix would most likely not support effective sample weighting. By effective, we mean that sample sizes would not be large enough to have representative samples in each cell. Effective weighting, equalizing sample to population, requires representative samples in each cell.

   For statistical tests, we used four approaches. In the first approach, we constructed 95 percent confidence intervals for the estimated activity participation rates for both the unweighted and weighted sample data. Statistically significant differences are indicated by non overlapping confidence intervals. Statistically significant differences are interpreted as indicating the existence of significant non response bias. Using this approach we conducted comparisons of unweighted and weighted estimates of activity participation for the "Full Sample" (Table 9), the "Pre-notification Letter" sample group (Table 10) and the "Standard RDD" sample group (Table 11). We also compared the weighted estimates of activity participation for the "Pre-notification Letter" sample group to the "Standard RDD" sample group.

   Results from Comparisons Using the Overlapping Confidence Interval Approach:

   - ***Full Sample***. There were significant differences between the unweighted and weighted estimates for 5 of the 9 activities tested (walk, bird, mboat, swim_nat and hike). Unweighted estimates were always higher than non weighted estimates indicating a general upward bias (Table 9).
   - ***Pre-notification Letter Sample***. There were significant differences between the unweighted and weighted estimates for 5 of the 9 activities tested (walk, bird, mboat, swim_nat and hike). All the unweighted estimates were higher, except for fishing, which was lower but not significant (Table 10).
   - ***Standard RDD Sample***. There were significant differences between the unweighted and weighted estimates for 5 of the 9 activities tested (walk, bird, mboat, swim_nat and hike). All the unweighted estimates were higher than the weighted estimates (Table 11).

Table 9. Differences in Unweighted and Weighted Estimates of Activity Participation Rates: Full Sample

Sample Group/Activity	Unweighted 95% C.I.[1]	Weighted 95% C.I.[2]	Statistically Significant Difference[3]
Walk	0.8723 (0.8658, 0.8788)	0.8513 (0.8442, 0.8584)	Yes, +
Bird	0.4203 (0.4107, 0.4299)	0.3450 (0.3358, 0.3542)	Yes, +
Hunt	0.1255 (0.1190, 0.1320)	0.1191 (0.1128, 0.1254)	No,+
Fish	0.3417 (0.3325, 0.3509)	0.3380 (0.3288, 0.3472)	No, +
Mboat	0.2880 (0.2792, 0.2968)	0.2407 (0.2323, 0.2491)	Yes, +
Swim_nat	0.4532 (0.4434, 0.4630)	0.4034 (0.3938, 0.4130)	Yes, +
Fam	0.7237 (0.7059, 0.7415)	0.7197 (0.7019, 0.7375)	No, +
Hike	0.3486 (0.3355, 0.3617)	0.2987 (0.2860, 0.3114)	Yes, +
Mtnbike	0.1972 (0.1862, 0.2082)	0.1902 (0.1794, 0.2010)	No, +

1. 95 percent confidence interval on estimated activity participation rates using unweighted data.
2. 95 percent confidence interval on estimated activity participation rates using weighted data.
3. Yes or No for statistically significant difference between unweighted and weighted estimates of activity participation rates. + or - indicating unweighted estimate of activity participation rate is greater (+) or less (-) than the weighted estimate of activity participation rate.

Table 10. Differences in Unweighted and Weighted Estimates of Activity Participation Rates: Pre-notification Letters

Activity	Unweighted 95% C.I.[1]	Weighted 95% C.I.[2]	Statistically Significant Difference[3]
Walk	0.8738 (0.8640, 0.8836)	0.8523 (0.8417, 0.8629)	Yes, +
Bird	0.4384 (0.4237, 0.4531)	0.3777 (0.3632, 0.3922)	Yes, +
Hunt	0.1271 (0.1171, 0.1371)	0.1267 (0.1169, 0.1365)	No, +
Fish	0.3459 (0.3318, 0.3600)	0.3527 (0.3384, 0.3670)	No, -
Mboat	0.2970 (0.2835, 0.3105)	0.2640 (0.2509, 0.2771)	Yes, +

Activity	Unweighted 95% C.I.[1]	Weighted 95% C.I.[2]	Statistically Significant Difference[3]
Swim_nat	0.4442 (0.4295, 0.4589)	0.3923 (0.3778, 0.4068)	Yes, +
Fam	0.7292 (0.7025, 0.7559)	0.7233 (0.6964, 0.7502)	No, +
Hike	0.3442 (0.3242, 0.3642)	0.3019 (0.2827, 0.3211)	Yes, +
Mtnbike	0.1861 (0.1698, 0.2024)	0.1751 (0.1592, 0.1910)	No, +

1. 95 percent confidence interval on estimated activity participation rates using unweighted data.
2. 95 percent confidence interval on estimated activity participation rates using weighted data.
3. Yes or No for statistically significant difference between unweighted and weighted estimates of activity participation rates. + or - indicating unweighted estimate of activity participation rate is greater (+) or less (-) than the weighted estimate of activity participation rate.

Table 11. Differences in Unweighted and Weighted Estimates of Activity Participation Rates: Standard RDD - No Pre-notification Letters

Activity	Unweighted 95% C.I.[1]	Weighted 95% C.I.[2]	Statistically Significant Difference[3]
Walk	0.8712 (0.8626, 0.8798)	0.8507 (0.8415, 0.8599)	Yes, +
Bird	0.4064 (0.3937, 0.4191)	0.3240 (0.3118, 0.3362)	Yes, +
Hunt	0.1242 (0.1156, 0.1328)	0.1141 (0.1059, 0.1223)	No, +
Fish	0.3384 (0.3261, 0.3507)	0.3286 (0.3164, 0.3408)	No, +
Mboat	0.2811 (0.2693, 0.2929)	0.2257 (0.2149, 0.2365)	Yes, +
Swim_nat	0.4600 (0.4471, 0.4729)	0.4106 (0.3979, 0.4233)	Yes, +
Fam	0.7193 (0.6956, 0.7430)	0.7173 (06934, 0.7412)	No, +
Hike	0.3520 (0.3344, 0.3696)	0.2966 (0.2797, 0.3135)	Yes, +
Mtnbike	0.2057 (0.1908, 0.2206)	0.2002 (0.1855, 0.2149)	No, +

1. 95 percent confidence interval on estimated activity participation rates using unweighted data.
2. 95 percent confidence interval on estimated activity participation rates using weighted data.
3. Yes or No for statistically significant difference between unweighted and weighted estimates of activity participation rates. + or - indicating unweighted estimate of activity participation rate is greater (+) or less (-) than the weighted estimate of activity participation rate.

Difference Approach:

An alternative approach and the one preferred here, is to estimate the difference defined as D = U – W, where U is the unweighted estimate of the participation rate and W is the weighted estimate of the participation rate. Confidence intervals on the difference are constructed as 1.96 times the square root of the variance of D (the 95 percent confidence interval) and serve as the test criterion by comparing the interval to zero. This is a more powerful test than the above over lapping paired confidence interval test.

We implemented this approach using a difference test: We considered using an analysis of variance approach using PROC MIXED in SAS, but rejected this approach because of the assumption of equal variances. Instead, we implemented the difference test by calculating unweighted and weighted means and standard errors using PROC MEANS in SAS and constructing 95 percent confidence intervals. This latter test relaxes the assumption of homogeneous or equal variances. We don't include the details of the results since they yielded the same results as the simple overlapping confidence interval results as above.

Comparison of Pre-notification Letter and Standard RDD

Here we applied both the overlapping confidence intervals and difference approach for weighted estimates of activity participation rates for the Pre-notification sample group versus the Standard RDD sample group. The differences D = P – S, where P is the weighted estimate of the participation rate for the Pre-notification sample group and S is the weighted estimate of the participation rate for the Standard RDD sample group.

Results of the Differences in Pre-notification and Standard RDD Estimates of Weighted Activity Participation Rates:

- Using the overlapping confidence interval approach, we found significant differences for only two (2) of the nine (9) activities tested (bird and mboat). In both cases the Pre-notification letter sample group estimates were higher than the Standard RDD sample group estimates (Table 12).
- Using the difference approach, we found significant differences for four (4) of the nine (9) activities tested (bird, fish, mboat and mtnbike). Of the four significant differences, the Pre-notification Letter sample group had higher estimates of activity participation rates than the Standard RDD sample group (bird, fish and mboat). For mountain biking (mtnbike), the Pre-notification Letter sample group estimates were lower than the Standard RDD sample group. See Table 13 for a summary of the results.

Conclusions: ***There is significant non response bias in some estimates of activity participation rates. Even after applying sample weighting there are significant differences between estimates of activity participation from the Pre-notification and Standard RDD sample groups.***

Table 12. Differences in Weighted Estimates of Activity Participation Rates: Comparison Pre-notification with Standard RDD - No Pre-notification Letters

Activity	Pre-notification	95% C.I.[1]	Standard RDD	95% C.I.[2]	Statistically Significant Difference[3]
Walk	0.8523	(0.8417, 0.8629)	0.8507	(0.8415, 0.8599)	No, +
Bird	0.3777	(0.3632, 0.3922)	0.3240	(0.3118, 0.3362)	Yes, +
Hunt	0.1267	(0.1169, 0.1365)	0.1141	(0.1059, 0.1223)	No, +
Fish	0.3527	(0.3383, 0.3669)	0.3286	(0.3164, 0.3408)	No, +
Mboat	0.2640	(0.2509, 0.2771)	0.2257	(0.2149, 0.2365)	Yes, +
Swim_nat	0.3923	(0.3778, 0.4068)	0.4106	(0.3979, 0.4233)	No, -
Fam	0.7233	(0.6964, 0.7502)	0.7173	(06934, 0.7412)	No, +
Hike	0.3019	(0.2827, 0.3211)	0.2966	(0.2797, 0.3135)	No, +
Mtnbike	0.1751	(0.1592, 0.1910)	0.2002	(0.1855, 0.2149)	No, -

1. 95 percent confidence interval on estimated activity participation rates using weighted data for those in the pre-notification letter sample.

2. 95 percent confidence interval on estimated activity participation rates using weighted data for those in the sample that did not receive pre-notification letters or Standard RDD.

3. Yes or No for statistically significant difference between pre-notification and Standard RDD sample group estimates of activity participation rates. + or - indicating pre-notification sample group estimate of activity participation rate is greater (+) or less (-) than the estimate of activity participation rate for the Standard RDD sample group.

Table 13. Comparison of Mean Activity Participation Rates between Pre-notification Letter Sample and the Standard RDD Sample: Weighted Data - Difference Approach[1]

Activity	Statistically Significant Difference[2,3]
Walk	No, +
Bird	Yes, +
Hunt	No, +
Fish	Yes, +
Mboat	Yes, +
Swim_nat	No, -
Fam	No, +
Hike	No, +
Mtnbike	Yes, -

1. Difference approach compares differences in weighted means for activity participation rates for two different sample groups.

2. Yes indicates a statistically significant difference at the 0.05 significance level and + indicates the mean for the pre-notification sample is greater than the mean for the Standard RDD sample. No indicates the difference is not statistically significant at the 0.05 level of significance and - indicates that the mean for the pre-notification letter sample was less than the mean for the Standard RDD sample.

3. Equal variance assumption relaxed in test.

6. Can sample weighting be used to adjust for non response bias?

We don't know the "true" activity participation rates to make definitive judgments about which estimates are better estimates. However, we can compare estimates from the NSRE 2000-2001 with our current estimates using the entire sample. Generally, our estimates for NSRE 2005 are not greatly different from those estimated in NSRE 2000-2001 (Table 14). For most of the nine activities analyzed in this assessment, the weighted estimates from NSRE 2005 are closer to the estimates from NSRE 2000-2001.

In Leeworthy et al. 2005 (see http://marineeconomics.noaa.gov/NSRE/NSREForecast.pdf), activity participation rates for marine recreation were projected to decline from 2000 to 2005 and from 2000 to 2010 based on projected changes in the same socioeconomic/demographic factors analyzed in this assessment. One of the most important factors driving the projected declines was Race/Ethnicity. The projected decreases in the proportion of the population that is White, Not Hispanic and increases in the proportions of the population that are Black or African American, Not Hispanic and Hispanic were the major drivers of the projected declines in activity participation rates. The reason for this is that those who are White, Not Hispanic had generally higher activity participation rates and those who were Black or African Americans, Not Hispanic and Hispanics had lower activity participation rates.

Given the expected declines in 2005 activity participation rates, we might expect that NSRE 2005 estimates would be slightly lower than NSRE 2000-2001 estimates. This was true for six (6) of the nine (9) activities tested here using the weighted sample estimates.

Conclusions: The sample weighting can adjust for non response bias. However, the pre-notification letters are yielding more unrepresentative samples on key variables such as race/ethnicity, which are imparting higher non response bias even with sample weighting.

Table 14. Comparison of Activity Participation Rate Estimates NSRE 2000-2001 vs. 2005

	NSRE 2000-2001	NSRE 2005	
Activity	Weighted	Weighted	Unweighted
Walking for exercise or pleasure	83.0	85.1	87.2
Bird Watching	32.4	34.5	42.0
Hunting	11.3	11.9	12.5
Fishing	34.1	33.8	34.2
Motor boating	24.4	24.1	28.8
Swimming in Natural Water bodies	41.7	40.3	45.3
Family Gatherings	73.5	71.2	72.4
Day Hiking	33.3	29.9	34.9
Mountain biking	21.4	19.0	19.7

7. What is the impact of pre-notification letters on non response bias?

The rationale behind the imposition of doing pre-notification letters is that they would increase response rates and thereby reduce non response bias. However, the basis of

RDD telephone sampling is that there is a difference between simple random sampling from listed numbers and RDD samples, with RDD samples being more representative of the population. Thus, there is a possibility that increasing the proportion of the sample with listed telephone numbers versus those with unlisted numbers could introduce bias into estimates of activity participation rates. We find support for this hypothesis.

We don't know the "true" activity participation rates, but in a Florida study where boaters used the reefs in Southeast Florida the "true" distribution of boats by size class was known (Jones et al., 2003). In this study, a stratified random sample was selected from the boat registration file, which contains the names and addresses of the boat owners, along with characteristics of the boat. Telephone numbers were not included in the boat registration files. Florida State University researchers wanted to use a computer-aided telephone instrument (CATI) system to conduct the survey. Telephone listings were used to match addresses with the boat registration files to get telephone numbers (the reverse of our problem). The result was that the sample with telephone numbers was a biased sample. The owners of boats greater than 25 foot in length occurred disproportionally among those with unlisted numbers. Given that the reefs were generally four to six miles offshore, larger boats would have a higher probability of being used to access the reefs. The telephone survey approach was abandoned and a mail survey was used.

Conclusion: ***Pre-notification letters are introducing bias. The letters are generally not correcting biases from using the Standard RDD sampling methods. Because the letters are going only to people with listed telephone numbers that can be matched to addresses and these people are different from those with unlisted numbers, increasing the proportion of these types of people is making our sample more unrepresentative and increasing bias in our estimates of activity participation.***

8. Are the benefits of pre-notification letters worth the added costs?

No. After including the costs of matching telephone numbers to addresses; stuffing/labeling letters; the printing of letters; and the postage to mail the letters, the average cost per completed interview increased 9.8%. The offsetting cost reduction of higher response rates was insignificant since the average completed interview required 3.5 calls for those who received pre-notification letters, while taking 4.0 calls for those who did not receive the letter. In addition, as demonstrated above, pre-notification letters resulted in more unrepresentative samples and biased estimates of activity participation. Therefore, according to the criteria set out at the beginning of this assessment, the increase in average costs per interview from the use of pre-notification letters exceeds the 5% threshold, while also introducing significant bias to the estimation of activity participation rates, the pre-notification letter requirement should be dropped from all further versions of NSRE 2005.

Overall Conclusions on the use of Pre-notification Letters:

- ***There is evidence of non response bias. However, there are no apparent improvements by utilization of pre-notification letters even though pre-notification letters increased response rates 14 percentage points (14.08% to 28.10%).***

- ***There is no relationship between response rates and non response bias. Non response bias comes from the mix of people responding. Pre-notification letters result in even more unrepresentative samples than simple Standard RDD samples.***

- ***Although there is evidence of non response bias in Standard RDD sampling, sample weighting seems adequate to adjust for this bias.***

- ***Given the added cost of pre-notification letters with no corresponding benefit, pre-notification letters do not pass the benefit-cost test.***

III. Assess Refusals and Non Response Bias

Currently we are making 15 calls to a telephone number before dropping the number. ***We will continue with this throughout NSRE 2005 and will not assess the benefits and costs of this requirement.***

For those who are contacted and refuse, at the end of each week's surveying a special session was set-up to call back refusals. Before these call-backs were begun, letters were sent out to 50% of the refusers with listed telephone numbers and addresses.

In call-backs to refusers, if they again refused, they were asked if they would answer two questions. If they agreed, they were asked their age and if they had participated in walking for exercise or pleasure during the past 12 months. Gender is also recorded, but not asked. We were also able to construct the variable for Census Division of Residency for each eligible telephone number.

As with pre-notification letters, we assessed whether the added efforts versus Standard RDD sampling increased response rates, whether more representative samples were obtained, whether non response bias exists, and if non response bias exists, is it significant. In addition, we addressed whether sample weighting or some other correction method be used to correct for biases. Also, do the refusal letters introduce bias? In accordance with the pre-notification letter assessment we proceed in a sequential analysis.

Part 1: Assess Letters to Refusals

To support the analysis of the refusal letter, we have two sample groups; 1) those who received a letter and 2) those who did not receive a letter (See Figure 3).

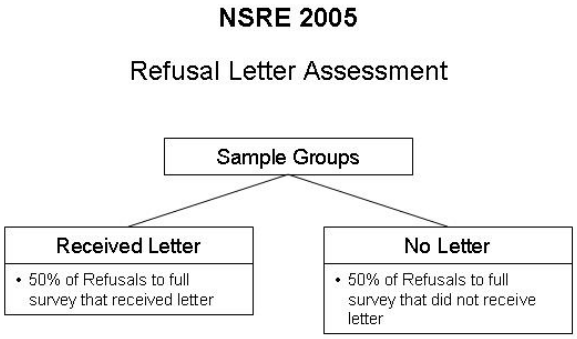

Figure 3. Sample Groups for Refusal Letter Assessment

1. Did the refusal letters increase response rates (refusal conversions)?
   Yes. Those who did not have listed telephone numbers with matching addresses and thus did not receive a refusal letter had a response rate of 7.2%. Similarly, those who had matched telephone numbers with addresses, but did not receive a refusal letter had a response rate of 7.6%. On net, all refusals that did not receive a refusal letter had a response rate of 7.4%. Those who received a refusal letter had a response rate of 14.4%. the overall response rate for refusals was 9.4% (Tables 15 and 16).

2. Is there a difference in sample representativeness as a result of increasing response rates (refusal conversions)?

   In accordance with the pre-notification letter assessment, we first compared the two sample groups and the total refusal sample to the Census distributions for all socioeconomic/demographic variables using two tests. Test 1 uses SAS PROC FREQ with the TESTP option, which specifies the known Census Distribution. A Chi-square test is conducted for differences in distributions for each factor at the 0.05 significance level. The second test uses the more conservative Bonferroni adjustment to control for experiment wise error, as described earlier.

   Results of Test 1:

   - Both refusal sample groups and the total sample of refusals were different from the Census for all socioeconomic/demographic factors, with only one exception. The exception was Gender for the refusals that received the letter. So just as with the pre-notification letter, the refusal letter seems to eliminate gender bias (See Table 15).

   Results of Test 2:

   - The results confirm the results from test 1 as expected. The real purpose of test 2 is to find out where in the distributions the differences exist (See Table 16).

Results of Sample Group Comparisons:

Here we addressed the differences between the samples obtained in the refusal conversion process by the use of the "refusal letters" by comparing the socioeconomic/demographic profiles of those who received the letters versus those who did not.

No Letter versus Letter (Table 17):

- There were significant differences for Age, Race/Ethnicity, Educational Attainment, and Census Division of Residency.
- There were not significant differences for Gender, Household Income, and Urban/rural Residency.
- ***Age***. The No Letter sample group was younger than the Letter sample group. The No Letter sample group had a significantly higher proportion of respondents in the 16-24 and 24-34 age groups and a significantly lower proportion in the 65 and older age group.
- ***Gender***. There was a lower proportion of males in the No Letter sample group, but the difference was not significant.
- ***Race/Ethnicity***. The No Letter sample group had a significantly lower proportion of respondents classified as White, Not Hispanic and a significantly higher proportion of respondents classified as Asian, Not Hispanic and Hispanic than the Letter sample group.
- ***Educational Attainment***. The No Letter sample group had a significantly lower proportion of respondents with a High School or Equivalent level of educational attainment than the Letter sample group.
- ***Household Income***. There were no significant differences.
- ***Urban/Rural Residency***. There wasn't a significant difference.
- ***Census Division of Residency***. The No Letter sample group had a significantly lower proportion of respondents in the East North Central and West North Central Census Division and a significantly higher proportion of respondents from the Pacific Census Division than the Letter sample group.

Conclusions: ***The No Letter Sample group distributions are generally closer to the Census distributions, except for Gender and Educational Attainment. Thus, the refusal letter, on balance seems to yield a more unrepresentative sample.***

Table 15. Comparative Profiles for Refusal Conversions: Census versus Samples and Response Rates by Sample Groups.

Factors	Census	No Letter	Letter	Total Sample
Age (years)				
16-24	16.4	10.7	5.3	8.5
25-34	17.5	13.9	7.7	11.4
35-44	19.3	17.2	17.1	17.1
45-54	18.2	23.6	21.2	22.6
55-64	12.7	18.1	20.2	19.0
65 and older	15.9	16.5	28.5	21.4
n		1454	1008	2462

Factors	Census	No Letter	Letter	Total Sample
Chi-Square		99.4	284.2	302.3
P-value		<0.0001	<0.0001	<0.0001
Gender				
Male	48.7	44.9	48.2	46.2
Female	51.3	55.1	51.8	53.8
n		1482	1018	2500
Chi-Square		8.7	0.1	6.1
P-value		0.0032	0.7651	0.0139
Race/Ethnicity				
White (not Hispanic)	70.6	82.4	89.4	85.3
Black (not Hispanic)	11.7	6.7	5.4	6.1
Native Am./Pac.Is. (not Hispanic)	0.7	1.7	0.9	1.4
Asian (not Hispanic)	4.4	2.7	0.9	2.0
Hispanic	12.6	6.6	3.4	5.3
n		1443	1001	2444
Chi-Square		129.9	179.9	290.8
P-value		<0.0001	<0.0001	<0.0001
Education Attainment				
Less than High School	19.6	8.6	7.0	7.9
High School or Equivalent	28.6	26.0	30.6	27.9
Some College or College Degree	42.9	48.2	48.0	48.1
Masters, Prof. Degree, or Doctorate	8.9	17.2	14.5	16.1
n		1449	1003	2452
Chi-Square		214.9	123.7	328.5
P-value		<0.0001	<0.0001	<0.0001
Household Income ($)				
0-24,999	20.8	20.0	17.2	18.8
25,000-49,999	29.1	26.2	25.8	26.0
50,000-99,999	34.8	32.8	37.4	34.7
100,000 and above	15.3	21.1	19.6	20.5
n		1082	749	1831
Chi-Square		28.4	18.1	41.6
P-value		<0.0001	0.0004	<0.0001
Urban/Rural Residency				
Urban	82.8	78.2	77.7	78.0
Rural	17.2	21.8	22.3	22.0
n		1483	1018	2501
Chi-Square		22.5	18.6	41.0
P-value		<0.0001	<0.0001	<0.0001
Census Division of Residency				
New England	5.0	4.6	5.5	5.0
Middle Atlantic	13.9	13.1	11.2	12.4
South Atlantic	18.9	15.4	18.3	16.6
East South Central	6.0	7.5	8.8	8.0
West South Central	11.1	9.5	10.8	10.0
East North Central	15.7	14.2	20.8	16.9
West North Central	6.8	6.2	9.6	7.6
Mountain	6.6	8.0	5.9	7.1
Pacific	16.0	21.6	9.0	16.5
n		1483	1018	2501
Chi-Square		55.7	80.4	37.3

Factors	Census	No Letter	Letter	Total Sample
P-value		<0.0001	<0.0001	<0.0001
Response Rate (%)	N/A	7.4%	14.4%	9.4%

Table 16. Refusal Conversion Differences (Sample-Census) between Census and Sample Profiles and Response Rates. An * indicates significance at the experimentwise 0.05 level.

Factors	Census	No Letter	Letter	Total Sample
Age (years)				
16-24	16.4	-5.7*	-11.1*	-7.9*
25-34	17.5	-3.6*	-9.8*	-6.1*
35-44	19.3	-2.1	-2.2	-2.2*
45-54	18.2	5.4*	3.0	4.4*
55-64	12.7	5.4*	7.5*	6.3*
65 and older	15.9	0.6	12.6*	5.5*
Gender				
Male	48.7	-3.8*	-0.5	-2.5*
Female	51.3	3.8*	0.5	2.5*
Race/Ethnicity				
White (not Hispanic)	70.6	11.8*	18.8*	14.7*
Black (not Hispanic)	11.7	-5.0*	-6.3*	-5.6*
Native Am./Pac.Is. (not Hispanic)	0.7	1.0*	0.2	0.7*
Asian (not Hispanic)	4.4	-1.7*	-3.5*	-2.4*
Hispanic	12.6	-6.0*	-9.2*	-7.3*
Education Attainment				
Less than High School	19.6	-11.0*	-12.6*	-11.7*
High School or Equivalent	28.6	-2.6	2.0	-0.7
Some College or College Degree	42.9	5.3*	5.1*	5.2*
Masters, Prof. Degree or Doctorate	8.9	8.3*	5.6*	7.2*
Household Income ($)				
0-24,999	20.8	-0.8	-3.6*	-2.0
25,000-49,999	29.1	-2.9	-3.3	-3.1*
50,000-99,999	34.8	-2.0	2.6	-0.1
100,000 and above	15.3	5.8*	4.3*	5.2*
Urban/Rural Residency				
Urban	82.8	-4.6*	-5.1*	-4.8*
Rural	17.2	4.6*	5.1*	4.8*
Census Division of Residency				
New England	5.0	-0.4	0.5	0.0
Middle Atlantic	13.9	-0.8	-2.7	-1.5
South Atlantic	18.9	-3.5*	-0.6	-2.3*
East South Central	6.0	1.5	2.8*	2.0*
West South Central	11.1	-1.6	-0.3	-1.1
East North Central	15.7	-1.5	5.1*	1.2
West North Central	6.8	-0.6	2.8*	0.8
Mountain	6.6	1.4	-0.7	0.5
Pacific	16.0	5.6*	-7.0*	0.5
Response Rate (%)	N/A	7.4%	14.4%	9.4%

Table 17. Refusal Conversion Differences between sample profiles. An * indicates significance at the experimentwise 0.05 level.

Factors	No Letter versus Letter
Age (years)	
16-24	5.5*
25-34	6.2*
35-44	0.1
45-54	2.4
55-64	-2.2
65 and older	-12.0*
P-value	<0.0001
Gender	
Male	-3.4
Female	3.4
P-value	0.0978
Race/Ethnicity	
White (not Hispanic)	-7.0*
Black (not Hispanic)	1.3
Native Am./Pac.Is. (not Hispanic)	0.8
Asian (not Hispanic)	1.8*
Hispanic	3.2*
P-value	<0.0001
Education Attainment	
Less than High School	1.6
High School or Equivalent	-4.6*
Some College or College Degree	0.3
Masters, Prof. Degree or Doctorate	2.7
P-value	0.0280
Household Income ($)	
0-24,999	2.7
25,000-49,999	0.4
50,000-99,999	-4.6
100,000 and above	1.4
P-value	0.1785
Urban/Rural Residency	
Urban	0.5
Rural	-0.5
P-value	0.7892
Census Division of Residency	
New England	-0.9
Middle Atlantic	2.0
South Atlantic	-2.9
East South Central	-1.4
West South Central	-1.3
East North Central	-6.7*
West North Central	-3.4*
Mountain	2.1
Pacific	12.5*
P-value	<0.0001

3. Is there a relationship between socioeconomic/demographic factors and activity participation?

   Even though in our assessment of pre-notification we already estimated logit equations for nine selected activities, we repeat this estimation for the refusal conversion sub-sample. A finding of statistically significant relationships combined with over or under representation of significant factors demonstrates non response bias. Tables 18 and 19 show the unweighted and weighted estimates of activity participation for the refusal conversion sub-sample by treatment (letter versus no letter).

Table 18. Refusal Conversion Activity Participation Rates by Sample Group: Unweighted Samples

	Samples (Participation Rates)		
Activity	No Letter	Letter	Total Sample
Walking for exercise or pleasure	0.8597	0.8821	0.8689
Bird Watching	0.4039	0.4136	0.4078
Hunting	0.1214	0.1415	0.1295
Fishing	0.3385	0.3428	0.3403
Motor Boating	0.2906	0.2790	0.2859
Swimming in Natural Waterbodies	0.4666	0.4086	0.4430
Family Gatherings	0.6835	0.7148	0.6980
Day Hiking	0.3445	0.3455	0.3450
Mountain biking	0.1996	0.1859	0.1917

1. Total sample is equal to sample with no letter plus sample with letter.

Table 19. Refusal Conversion Activity Participation Rates by Sample Group: Weighted Samples

	Samples (Participation Rates)		
Activity	No Letter	Letter	Total Sample
Walking for exercise or pleasure	0.8508	0.8693	0.8577
Bird Watching	0.3070	0.3682	0.3299
Hunting	0.1167	0.1454	0.1274
Fishing	0.3159	0.3450	0.3268
Motor Boating	0.2343	0.2466	0.2389
Swimming in Natural Waterbodies	0.4278	0.3590	0.4022
Family Gatherings	0.6642	0.6888	0.6740
Day Hiking	0.2773	0.3236	0.2961
Mountain biking	0.1790	0.1891	0.1831

1. Total sample is equal to sample with no letter plus sample with letter.

As with the pre-notification letter analysis, we found significant relationships between socioeconomic/demographic factors and activity participation. Thus, non response bias is indicated. The results are summarized in Tables 20 and 21.

4. Is there a significant difference between estimates of activity participation rates for the No Letter and Letter sample groups?

   As with the pre-notification assessment, we want to determine what the effect of letters were on our estimates of activity participation. First, we used the logit equations and tested for the treatment effect by including the dummy variable for receiving a refusal letter, with 1=received letter and 0=did not receive the letter (See Table 20). This test found only one significant difference. That was for the activity walking. In the second test, we constructed 95% confidence intervals and used the overlapping confidence intervals by comparing the unweighted and weighted estimates of participation rates for "all refusal conversions" (See Table 22), for refusal conversions that received no letters (See Table 23) and for "refusal conversions that received the letter" (See Table 24). The second test is a within sample group test for differences to test the efficacy of sample weighting, whereas the logit equation approach was an across sample group test of the effect of letters. In a third test we did a comparison using weighted estimates of activity participation to test differences between the "No Letter" and "Letter" sample groups (See Table 25). A statistically significant difference here indicates that sample weighting may not fully adjust for non response bias. And as in the pre-notification letter assessment, we did a fourth test, the difference test on mean activity participation rates using weighted data (See Table 26). The fourth test is slightly more rigorous and relaxes the assumption of equal variances used in a standard analysis of variance.

   Results:

   - Logit equation found that the refusal letter resulted in only one significant difference in activity participation, holding other factors constant. This was for activity walk (See Table 20).
   - Using the confidence interval approach across all refusal conversions, unweighted estimates of activity participation were generally higher than weighted estimates of activity participation. The differences were statistically significant for four (4) of the nine (9) activities tested (Bird, Mboat, Swim_nat and Hike) (See Table 22).
   - Using the confidence interval approach for those who did not receive a refusal letter, again estimates of unweighted activity participation rates were higher than estimates of weighted activity participation rates. Statistically significant differences were found for only two (2) of the nine (9) recreation activities tested (Bird and Mboat) (See Table 23).
   - Using the confidence interval approach for those who received the refusal letter, unweighted estimates of activity participation were higher than weighted estimates of activity participation for six (6) of the nine (9) activities tested (Walk, Bird, Mboat, Swim_nat, Fam, and Hike). However, there were no statistically significant differences(See Table 24).
   - Using the confidence interval approach and weighted data, the estimates of activity participation were higher for the "Letter" sample group than the "No Letter" sample group for eight (8) of the nine (9) activities tested and lower for one activity (Swim_nat). However, only two of the differences were statistically significant (Bird and Swim_nat) (See Table 25).
   - Using the difference approach on weighted data yielded the same results as the confidence interval approach for all activities, except Hunt. The group receiving the

letter had a higher and statistically significant participation rate for Hunt than the "no Letter" sample group (See Table 26).

Table 20. Refusal Conversion Estimated Participation Functions by Activity: Logit Equations.

	Activity (Participation Function Coefficients) [1]					
	Walk	Bird	Hunt	Fish	Mboat	Swim_nat
Constant	2.1376*	-2.0601*	-1.7470*	-0.0889	-2.9940*	-0.6133
Age16_24						
Age25_34	-0.5535	0.6437*	0.0315	0.0238	-0.1801	-0.8706*
Age35_44	-0.6295	1.0025*	-0.3007	-0.1151	-0.1333	-0.9682*
Age45_54	-0.7177*	1.3049*	-0.6850*	-0.4530*	-0.4930*	-1.4775*
Age55_64	-0.9469*	1.3387*	-0.6170*	-0.4885*	-0.4297*	-1.9329*
Age65p	-1.4765*	1.2981*	-1.7358*	-1.5056*	-1.1652*	-2.7368*
Male	-0.4124*	-0.4352*	2.0994*	0.9835*	0.2371*	0.0921
White	-0.3227	0.2830	-0.3625	-0.6509	1.0784*	0.0706
Black	-0.6383	-0.3670	-2.0579*	-1.4872*	-0.4385	-1.3191*
Asian	-0.5074	-0.1795	-2.7374*	-1.1213*	0.2126	-1.2703*
Native						
Hispanic	0.1159	-0.2143	-1.0869	-0.9786*	0.2051	-0.3752
Educ11						
Educhs	0.1618	0.0248	0.0991	0.1616	0.2972	0.1128
Educcoll	0.7312*	0.3938	-0.4074	0.1604	0.5456*	0.6532*
Educgrad	1.0684*	0.7884*	-0.9096*	-0.1923	0.3561	0.9067*
Educoth	2.3689*	0.4049	-0.1092	0.1105	-0.2604	0.1296
Inc25						
Inc50	0.3279	0.2083	0.6801*	0.2379	0.6990*	0.4125*
Inc100	0.4904*	0.1902	0.7302*	0.4073*	1.1261*	0.7200*
Inc100p	1.0068*	0.3941*	0.3886	0.3448	1.4715*	1.2243*
Incmiss	0.2388	0.1375	0.3622	0.2266	0.8368*	0.4439*
Urban	0.2783	-0.2061	-0.9686*	-0.2941*	-0.1809	0.1237
Cendiv1	-0.1192	0.6813*	-1.0268*	-0.3381	0.0312	1.5163*
Cendiv2	-0.0772	0.2185	-0.0914	-0.5388*	0.1076	1.1139*
Cendiv3	-0.1842	0.2352	-0.3562	0.1730	0.3024	1.1131*
Cendiv4	-0.1577	0.0662	0.0662	0.2868	0.3512	0.3977
Cendiv5	0.1258	0.1166	0.6271*	0.2602	0.3214	0.2871
Cendiv6	-0.0655	0.2644	-0.1421	0.0968	0.4948*	0.6501*
Cendiv7	0.0674	0.4225	0.5014	0.2989	0.9442*	0.5073*
Cendiv8						
Cendiv9	-0.1071	0.1944	-0.5716	-0.3308	0.2915	0.9344*
Rfltr	0.3848*	-0.0543	0.2078	0.0464	-0.1021	-0.0268

1. *=Significance at .05 or less and blank means dummy category in constant.

Table 20 (continued). Refusal Conversion Estimated Participation Functions by Activity: Logit Equations.

	Activity (Participation Function Coefficients) [1]		
	Fam	Hike	Mtnbike
Constant	0.9950	-0.5455	-0.9547
Age16_24			
Age25_34	0.3078	-0.0115	0.0334
Age35_44	0.0863	-0.0998	-0.1304
Age45_54	-0.5369	-0.0049	-0.5452
Age55_64	-0.4995	-0.4101	-1.1721*
Age65p	-1.0286*	-1.168*	-2.9934*
Male	-0.0548	0.3471*	0.6253*
White	-0.0558	-0.0226	-0.8710
Black	0.0278	-1.5900*	-2.0287*
Asian	-0.8769	0.4741	-0.7631
Native			
Hispanic	-0.0577	0.0253	-1.2529
Educ11			
Educhs	-0.1763	0.1651	-0.3171
Educcoll	0.3519	0.0401	-0.0748
Educgrad	0.1170	0.5108	0.3557
Educoth	0.4730	15.5335	2.9908*
Inc25			
Inc50	-0.2952	0.3574	-0.2051
Inc100	0.4127	0.5377*	-0.5538
Inc100p	-0.0107	0.6329*	0.0965
Incmiss	0.0024	-0.1116	-0.5754
Urban	-0.1906	0.2583	0.6136*
Cendiv1	1.0715	-0.5218	0.8767
Cendiv2	0.0826	-0.8561*	0.6015
Cendiv3	0.3401	-0.7494*	0.3076
Cendiv4	0.3308	-0.7127*	0.1418
Cendiv5	0.0984	-1.4151*	-0.3831
Cendiv6	0.3012	-0.8694*	0.8212*
Cendiv7	0.1288	-0.4442	0.8235
Cendiv8			
Cendiv9	0.2009	-0.3097	0.4429
Rfltr	0.2368	0.1454	0.2296

1. *=Significance at .05 or less and blank means dummy category in constant.

Table 21. Tests (P-values) on the Main Effects in the Refusal Conversion Logit Participation Models Based on the Wald Chi-Square Test.

	Walk	Bird	Hunt	Fish	Mboat	Swim_ Nat	Fam	Hike	Mtn bike
Age	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0046	<0.0001	<0.0001
Gender	0.0014	<0.0001	<0.0001	<0.0001	0.0139	0.3260	0.7889	0.0150	0.0004
Race	0.4180	0.0026	0.0007	0.0003	<0.0001	<0.0001	0.7893	0.0088	0.0663
Educ	<0.0001	<0.0001	0.0008	0.1270	0.0351	<0.0001	0.3087	0.2130	0.0067
Income	0.0100	0.2656	0.0235	0.1798	<0.0001	<0.0001	0.2349	0.0140	0.0369
Urban	0.0535	0.0539	<0.0001	0.0091	0.1236	0.2858	0.4721	0.1764	0.0182
Cendiv	0.9742	0.2141	<0.0001	<0.0001	0.0020	<0.0001	0.8525	0.0026	0.0497
Rfltr	0.0042	0.5501	0.1433	0.6334	0.3090	0.7841	0.2535	0.3212	0.2000

Table 22. Differences in Refusal Conversion Unweighted and Weighted Estimates of Activity Participation Rates: All Refusal Conversions

Activity	Unweighted 95% C. I.[1]	Weighted 95% C.I.[2]	Statistically Significant Difference[3]
Walk	0.8689 (0.8621, 0.8756)	0.8577 (0.8507, 0.8647)	No, +
Bird	0.4078 (0.3980, 0.4177)	0.3299 (0.3205, 0.3393)	Yes, +
Hunt	0.1295 (0.1228, 0.1363)	0.1274 (0.1207, 0.1341)	No, +
Fish	0.3403 (0.3308, 0.3497)	0.3268 (0.3174, 0.3362)	No, +
Mboat	0.2859 (0.2768, 0.2949)	0.2389 (0.2304, 0.2474)	Yes, +
Swim_nat	0.4430 (0.4331, 0.4530)	0.4022 (0.3923, 0.4120)	Yes, +
Fam	0.6980 (0.6785, 0.7176)	0.6740 (0.6541, 0.6940)	No, +
Hike	0.3450 (0.3305, 0.3594)	0.2961 (0.2823, 0.3100)	Yes, +
Mtnbike	0.1917 (0.1798, 0.2037)	0.1831 (0.1714, 0.1949)	No, +

1. 95 percent confidence interval on estimated activity participation rates using unweighted data.

2. 95 percent confidence interval on estimated activity participation rates using weighted data.

3. Yes or No for statistically significant difference between unweighted and weighted estimates of activity participation rates. + or – indicating unweighted estimate of activity participation rate is greater (+) or less (-) than the weighted estimate of activity participation rate.

Table 23. Differences in Refusal Conversion Unweighted and Weighted Estimates of Activity Participation Rates: No Letters.

Activity	Unweighted 95% C.I.[1]	Weighted 95%C.I.[2]	Statistically Significant Difference[3]
Walk	0.8597 (0.8420, 0.8774)	0.8508 (0.8326, 0.8689)	No, +
Bird	0.4039 (0.3789, 0.4289)	0.3070 (0.2835, 0.3305)	Yes, +
Hunt	0.1214 (0.1047, 0.1380)	0.1167 (0.1003, 0.1330)	No, +
Fish	0.3385 (0.3144, 0.3626)	0.3159 (0.2922, 0.3396)	No, +
Mboat	0.2906 (0.2675, 0.3138)	0.2343 (0.2127, 0.2559)	Yes, +
Swim_nat	0.4666 (0.4412, 0.4920)	0.4278 (0.4026, 0.4531)	No, +
Fam	0.6835 (0.6303, 0.7367)	0.6642 (0.6102, 0.7183)	No, +
Hike	0.3445 (0.3062, 0.3828)	0.2773 (0.2412, 0.3134)	No, +
Mtnbike	0.1996 (0.1646, 0.2287)	0.1790 (0.1482, 0.2099)	No, +

1. 95 percent confidence interval on estimated activity participation rates using unweighted data.

2. 95 percent confidence interval on estimated activity participation rates using weighted data.

3. Yes or No for statistically significant difference between unweighted and weighted estimates of activity participation rates. + or – indicating unweighted estimate of activity participation rate is greater (+) or less (-) than the weighted estimate of activity participation rate.

Table 24. Differences in Refusal Conversion Unweighted and Weighted Estimates of Activity Participation Rates: Letters.

Activity	Unweighted 95% C.I.[1]	Weighted 95%C.I.[2]	Statistically Significant Difference[3]
Walk	0.8821 (0.8623, 0.9020)	0.8693 (0.8486, 0.8901)	No, +
Bird	0.4136 (0.3833, 0.4439)	0.3682 (0.3385, 0.3979)	No, +
Hunt	0.1415 (0.1200, 0.1629)	0.1454 (0.1237, 0.1671)	No, -
Fish	0.3428 (0.3136, 0.3720)	0.3450 (0.3157, 0.3742)	No, -
Mboat	0.2790 (0.2514, 0.3066)	0.2466 (0.2200, 0.2731)	No, +
Swim_nat	0.4086 (0.3784, 0.4389)	0.3590 (0.3295, 0.3885)	No, +
Fam	0.7148 (0.6592, 0.7705)	0.6888 (0.6317, 0.7459)	No, +
Hike	0.3455 (0.3034, 0.3875)	0.3236 (0.2822, 0.3649)	No, +
Mtnbike	0.1859 (0.1515, 0.2202)	0.1891 (0.1545, 0.2237)	No, -

1. 95 percent confidence interval on estimated activity participation rates using unweighted data.

2. 95 percent confidence interval on estimated activity participation rates using weighted data.

3. Yes or No for statistically significant difference between unweighted and weighted estimates of activity participation rates. + or – indicating unweighted estimate of activity participation rate is greater (+) or less (-) than the weighted estimate of activity participation rate.

Table 25. Differences in Weighted Estimates of Activity Participation Rates: Comparison of Refusal Conversions With and Without Letters

Activity	With Letters 95% C. I.[1]	Without Letters 95% C.I.[2]	Statistically Significant Difference[3]
Walk	0.8693 (0.8486, 0.8901)	0.8508 (0.8326, 0.8689)	No, +
Bird	0.3682 (0.3385, 0.3979)	0.3070 (0.2835, 0.3305)	Yes, +
Hunt	0.1454 (0.1237, 0.1671)	0.1167 (0.1003, 0.1330)	No, +
Fish	0.3450 (0.3157, 0.3742)	0.3159 (0.3174, 0.3362)	No, +
Mboat	0.2466 (0.2200, 0.2731)	0.2343 (0.2127, 0.2559)	No, +
Swim_nat	0.3590 (0.3295, 0.3885)	0.4278 (0.4026, 0.4531)	Yes, -
Fam	0.6888 (0.6317, 0.7459)	0.6642 (0.6102, 0.7183)	No, +
Hike	0.3236 (0.2822, 0.3649)	0.2773 (0.2412, 0.3134)	No, +
Mtnbike	0.1891 (0.1545, 0.2237)	0.1790 (0.1482, 0.2099)	No, +

1. 95 percent confidence interval on estimated activity participation rates using weighted data for refusal conversions that received refusal letter.

2. 95 percent confidence interval on estimated activity participation rates using weighted data for refusal conversions that did not receive refusal letter.

3. Yes or No for statistically significant difference between weighted estimates of activity participation rates for those who received refusal letter and those who did not receive the refusal letter. + indicating estimate of activity participation rate for those who did receive the refusal letter is greater (+) or less (-) than the estimate of activity participation rate for those who did not receive the letter.

Table 26. Comparison of Mean Activity Participation Rates Between Refusal Conversions With and Without Refusal Letters: Weighted Data – Difference Approach [1]

Activity	Statistically Significant Difference [2]
Walk	No, +
Bird	Yes, +
Hunt	Yes, +
Fish	No, +
Mboat	No, +
Swim_nat	Yes, -
Fam	No, +
Hike	No, +
Mtnbike	No, +

1. Difference approach compares differences in weighted means for activity participation rates for two different sample groups. Refusal conversions for those who received a refusal letter versus those who did not receive a refusal letter.

2. Yes indicates a statistically significant difference at the 0.05 level and + indicates the mean for the group that received the letter was greater than the mean for the group that did not receive the letter. No indicates the difference is not significantly different at the 0.05 level of significance and – indicates that the mean for the group that received

the letter was less than the mean of the group that did not receive the letter. This test relaxes the assumption of equal variances.

5. Do the letters to refusals decrease non response bias?

   The tests conducted above indicate that the refusal letters are yielding more unrepresentative samples and this is having an affect on estimated participation rates. This makes non response bias worse than without use of the letters. Sample weighting doesn't appear to be successful in eliminating all the differences.

6. Are the benefits of the letters to refusals worth the added costs?

   No. Given that use of the refusal letters increases cost without any benefits, the refusal letters are not worth the costs. The letters are yielding more biased samples with effects on sample estimates of activity participation which reflect more bias than without the letters.

Part 2: Assess Refusals and Non Response Bias

Assess Refusals: Two-question Survey. A special experiment was done by asking refusals if they would answer just two questions. Those who agreed were asked their age and if they participated in walking for exercise or pleasure over the past 12 months. Gender was recorded, but not asked. We were also able to create a third variable, Census Division of Residency. This gave us three demographic variables (age, gender, and Census Division of Residency) that may be related to participation in walking for exercise or pleasure. In accordance with the previous assessments above, we tested if first there is a difference in the demographic composition of refusals and the general population using Census data. We also then tested for differences between the respondents to the two-question survey versus those who responded to the full survey.

Refusals here answered the two-question survey and they make up the first sample group for comparison. We want to compare "refusals" to those who responded to the full survey through "Standard RDD" sampling, i.e. those who completed the full survey and did not receive pre-notification letters and those who completed the full survey and received pre-notification letters. Again, following the methods used for assessing the pre-notification letters, we did a multivariate test to estimate participation rates for "walking for exercise or pleasure" using a logit equation relating participation to gender, age, Census Division of Residency, and a dummy variable for whether respondents answered the two-question survey or the full survey. As with the other assessments above, we then did univariate tests for differences in participation rates, but here we limited the tests to unweighted data.

Results:

- ***Age.*** Those who answered the Two-question Survey had a significantly different age distribution than that of the general population from the Census (See Table 28). The differences were statistically significant for all age categories using the Bonferroni adjustment for experimentwise error (See Table 29).

- ***Gender.*** Those who answered the Two-question Survey had a significantly different gender distribution than that of the general population from the Census (See Table 28). The difference was significant using the Bonferroni adjustment for experimentwise error (See Table 29).
- ***Census Division of Residency.*** Those who answered the Two-question Survey were not significantly different from the general population for Census Division of Residency (See Tables 28 and 29).
- The two-question survey estimate for walk was significantly lower than that from the full survey. The estimate from the two-question survey was 0.6451 with a 95 percent confidence interval of (0.6267, 0.6634) compared to the full survey of 0.8723 with a 95 percent confidence interval of (0.8658, 0.8788). The difference approach and the logit equation also yielded the same conclusion (See Table 27 for the logit equation results).

Table 27. Refusal Estimated Participation Functions for Walking: Logit equation.

Activity (Participation Function Coefficients) [1]	
Parameter	Estimated coefficient
Constant	1.2965*
Age16_24	
Age25_34	0.0680
Age35_44	0.1956
Age45_54	0.0843
Age55_64	-0.1651
Age65p	-0.5573*
Male	-0.3529*
Cendiv1	-0.1241
Cendiv2	-0.4314*
Cendiv3	-0.4214*
Cendiv4	-0.6051*
Cendiv5	-0.4286*
Cendiv6	-0.4153*
Cendiv7	-0.3956*
Cendiv8	
Cendiv9	-0.0667
Trt[2]	1.2494*

1. *=significance at .05 or less and blank means dummy category in constant.
2. Trt=0 is the "Answer Two-Question" Group and TRT=1 is the "Answer Full survey" Group.

Non Respondents. One of the problems with even the above analysis is that for those who were either hard refusals (refused even the two-question survey) and those eligible, but never contacted, we know very little about them, and are forced to extrapolate from what we don't know to what we do know. It is the nature of all surveys. Here we conducted an analysis of all the eligible households from our RDD telephone numbers. We divided the sample of RDD telephone numbers into four sample groups: 1) No Contact, those who live in eligible households for which we received no answer to repeated calls; 2) Refusals, those who refused all follow-up efforts (Hard Refusals); 3) Two-question survey respondents; and 4) Respondents to the full survey (See Figure 4).

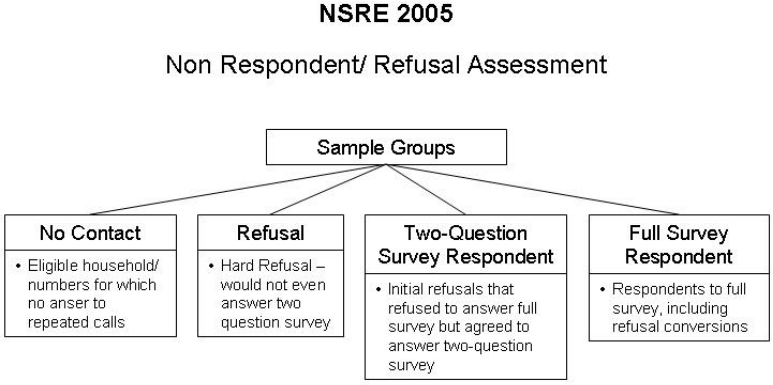

Figure 4. Sample Groups for Non Respondent/Refusal Analysis

Here we took the telephone numbers of non respondents and derived Census Division of where they live. We then tested for significant differences in the distributions of this one socioeconomic/demographic factor between the four sample groups using the Chi-square tests (See Table 28). In accordance with the previous assessments above, we then tested for where the differences existed within the distributions using the Bonferroni method which adjusts for experimentwise error (See Table 29). Then finally, we tested for differences between sample groups (See Table 30).

Results for Comparison with Census Distribution (four sample groups):

- There was no difference between Census distributions and distributions for the sample that answered the two-question survey and those who were "Hard Refusals" (See Table 28).
- There was a significant difference between Census distributions and the distributions for those who could not be contacted and for respondents to the full survey (See Table 28).

Table 28. Comparative Profiles for Refusals for Census Division.

Factor	Census	Answer	No Answer	No Contact	Total Survey
Age (years)					
16-24	16.4	4.4	-	-	8.0
25-34	17.5	6.7	-	-	13.2
35-44	19.3	11.8	-	-	18.5
45-54	18.2	12.8	-	-	21.9
55-64	12.7	16.3	-	-	19.3
65 and older	15.9	48.1	-	-	19.1
N		643			9849
Chi-Square		553.8			1013.2
P-value		<0.0001			<0.0001

Factor	Census	Answer	No Answer	No Contact	Total Survey
Gender					
Male	48.7	37.5	40.9	-	46.6
Female	51.3	62.5	59.1	-	53.4
N		674	303		9994
Chi-Square		33.6	7.3		17.7
P-value		<0.0001	0.0068		<0.0001
Census Division of Residency					
New England	5.0	4.6	5.2	5.0	5.0
Middle Atlantic	13.9	13.7	13.1	15.6	12.6
South Atlantic	18.9	17.5	17.2	14.9	18.5
East South Central	6.0	6.2	6.7	4.3	7.1
West South Central	11.1	13.7	9.9	20.5	10.4
East North Central	15.7	16.6	18.7	4.5	15.6
West North Central	6.8	7.0	7.9	10.0	7.9
Mountain	6.6	7.8	6.2	4.8	7.5
Pacific	16.0	13.1	15.1	20.4	15.3
N		681	535	8211	10001
Chi-Square		10.6	6.6	1693.5	73.0
P-value		0.2264	0.5789	<0.0001	<0.0001

Results for Comparison with Census, where differences exist (four sample groups):

- The "No Contact" sample groups had a statistically significant distribution from the Census in all Census Divisions, except New England (See Table 29).
- The "Full Survey" sample group had a statistically significant distribution from the Census in four of the nine Census Divisions (See Table 29).

Table 29. Refusal Differences (Sample-Census) between Census and Sample Profiles for Census Division. An * indicates significance at the experimentwise 0.05 level.

Factor	Census	Answer	No Answer	No Contact	Total Survey
Age (years)					
16-24	16.4	-12.0*	-	-	-8.4*
25-34	17.5	-10.8*	-	-	-4.3*
35-44	19.3	-7.5*	-	-	-0.8
45-54	18.2	-5.4*	-	-	3.7*
55-64	12.7	3.6*	-	-	6.6*
65 and older	15.9	32.2*	-	-	3.2*
Gender					
Male	48.7	-11.2*	-7.8*	-	-2.1*
Female	51.3	11.2*	7.8*	-	2.1*
Census Division of Residency					
New England	5.0	-0.4	0.2	0.0	0.0
Middle Atlantic	13.9	-0.2	-0.8	1.7*	-1.3*

Factor	Census	Answer	No Answer	No Contact	Total Survey
South Atlantic	18.9	-1.4	-1.7	-4.0*	-0.4
East South Central	6.0	0.2	0.7	-1.7*	1.1*
West South Central	11.1	2.6	-1.2	9.4*	-0.7
East North Central	15.7	0.9	3.0	-11.2*	-0.1
West North Central	6.8	0.2	1.1	3.2*	1.1*
Mountain	6.6	1.2	-0.4	-1.8*	0.9*
Pacific	16.0	-2.9	-0.9	4.4*	-0.7

Results for Sample Group Comparisons (four sample groups):

- There was no difference between those who answered the Two-question Survey and those who were Hard Refusals (See Table 30).
- There was a significant difference between those who answered the Two-question Survey and those who were in the "No Contact sample group. There were significant differences in five of the nine Census Divisions (See Table 30).
- There was no difference between those who answered the Two-question Survey and those who answered the Full Survey (Se Table 30).
- There was a significant difference between those who were "Hard Refusals" and those who were in the "No Contact" sample group. There were significant differences in three of the nine Census Divisions (See Table 30).
- There were no differences between those who were "Hard Refusals" and those who answered the Full Survey (See Table 30).
- There were significant differences between those in the "No Contact" sample group and those who answered the Full Survey. There were differences in all Census Divisions, except the New England Division (See Table 30).

Reasons given by Refusals for not participating in the Full Survey:

Refusals were asked a question before termination of the call.

"Why won't you participate in the survey?"
In our refusal database we have a total of 1,216 observations. 679 of these people answered the Two-question survey and the remaining 537 are "Hard Refusals" (wouldn't answer the Two-question Survey). Of the 1,216 in the refusal database, 1,206 answered the question of why they didn't want to participate in the full survey, while 678 of the 679 who answered the Two-question survey provided answers to the question of why they wouldn't participate in the full survey. This question yields additional information relevant to non response bias.

The answers to the question of why people did not want to participate in the full survey are summarized in Table 31. There were only a few differences between all refusals and those who answered the Two-question survey. We estimate that most likely about 20 percent of all those that refuse to participate in the full survey do not participate in any recreation activities due to either being "too old," "bad health/too sick,"

"disabled/handicapped," "homebound" or answered directly that they "don't participate in outdoor recreation."

In the 1994-95 NSRE, an analysis was conducted that tested for the effect of a screening question to allow more rapid exit of the survey for people who don't participate in any outdoor recreation and thus reduce respondent burden. Instead of going through the long list of outdoor recreation activities to determine if a person did not participate in any outdoor recreation, a screening question was employed that directly asked if they participated in any outdoor recreation activities during the past 12 months. The analysis found a significant difference in the proportion of the population that participates in outdoor recreation using the screening question indicating that people did not understand the definition of outdoor recreation until they go through the whole list of activities. So, the screener was not used in NSRE 1999-2000 or NSRE 2005.

When first contact is made in NSRE 2005, people are told that the topic of the survey is outdoor recreation, and they are given an estimate of how long the survey takes, on average, and they are told it will take less time if they do not do much outdoor recreation.

For those who don't participate in outdoor recreation, for whatever reason, they may see outdoor recreation as a low salience issue and are therefore refusing to participate. Our estimate is that 20% of all refusals are most likely not participants in any outdoor recreation (See Table 31). Of all RDD telephone numbers, 58.66% were refusals. So we estimate that 11.7% (58.66% times 20%) of all RDD telephone numbers are not participants in outdoor recreation versus 3% of the 10,001 who responded to the full survey in Versions 1 & 2 of NSRE 2005. Thus, we conclude that non response bias from refusals will lead to overestimation of activity participation rates. To correct for this we may have to apply an additional weight to account for this bias.

Conclusions from experiments on non response bias:

- There appears to be significant non response bias associated with people that will not complete the full survey. It would appear that the topic of outdoor recreation results in people that do not participate in outdoor recreation activities to not participate in the full survey. The result is a significant upward bias in the one activity we tested (walking for exercise of pleasure).
- Even though Census Division of Residency was a weak predictor of activity participation, the people we are not able to contact, even after 15 calls, are significantly different from the Census and all other sample groups.
- Reason people gave for refusing to participate in the full survey indicates that about 20% of all refusals at most likely not participants in outdoor recreation versus only 3 percent of respondents to the full survey. Thus, an additional source of non response bias that will require an additional weight to account for non response bias.

Table 30. Differences between Refusal Sample Census Division Profiles. An * indicates significance at the experimentwise 0.05 level.

Factor	Answer Versus No Answer	Answer Versus No Contact	Answer Versus Total Survey	No Answer Versus No Contact	No Answer Versus Total Survey	No Contact Versus Total Survey
Age (years)						
16-24	-	-	-3.7*	-	-	-
25-34	-	-	-6.5*	-	-	-
35-44	-	-	-6.6*	-	-	-
45-54	-	-	-9.2*	-	-	-
55-64	-	-	-3.0	-	-	-
65 and older	-	-	28.9*	-	-	-
Chi-Square			313.7			
P-value			<0.0001			
Gender						
Male	-3.4	-	-9.1*	-	-5.7*	-
Female	3.4	-	9.1*	-	5.7*	-
Chi-Square	1.0		20.9		3.8	
P-value	0.3144		<0.0001		0.0511	
Census Division						
New England	-0.7	-0.4	-0.5	0.3	0.2	-0.1
Middle Atlantic	0.6	-1.9	1.1	-2.5	0.5	3.0*
South Atlantic	0.3	2.6	-1.1	2.3	-1.3	-3.6*
East South Central	-0.6	1.9	-1.0	2.4	-0.4	-2.8*
West South Central	3.7	-6.8*	3.2	-10.6*	-0.5	10.1*
East North Central	-2.1	12.1*	1.0	14.1*	3.1	-11.0*
West North Central	-0.8	-3.0*	-0.8	-2.2	0.0	2.2*
Mountain	1.6	3.0*	0.3	1.4	-1.3	-2.7*
Pacific	-2.1	-7.3*	-2.2	-5.2*	-0.2	5.1*
Chi-Square	7.1	224.9	11.6	236.0	5.2	1093.0
P-value	0.5295	<0.0001	0.1694	<0.0001	0.7320	<0.0001

Table 31. Reasons Given by Refusals for Not Participating in Survey

Reason	All Refusals[1] (%)	Two-question Survey Respondents (%)
1. Not interested	33.00	31.42
2. Don't have time	13.18	14.60
3. Survey too long	2.90	3.98
4. Don't want to participate	15.92	17.85
5. Don't do telephone surveys	2.49	2.80
6. Too old	10.20	12.98
7. Bad health/too sick	4.06	5.16
8. Disabled/handicapped	2.57	3.39
9. Homebound	0.41	0.74
10. Hung up	9.04	0.88
11. Other	3.57	2.65
12. Don't participate in outdoor recreation	2.65	3.54
Most Likely Not Participants in Outdoor Recreation[2]	**19.89**	**25.81**

[1.] All refusals include the 1,206 of the 1,216 in the refusal database that answered the question on the reason for not participating in the survey. 679 of these people answered the Two-question Survey and the rest are "Hard Refusals" (would not answer the Two-question Survey).

[2.] Sum of responses 6, 7, 8, 9 and 12.

IV. Overall Conclusions

- Pre-notification letters and Refusal Letters increase response rates, but they yield samples that are more unrepresentative than Standard RDD. This results in significant biases in activity participation rates. Thus, at any cost, pre-notification and refusal letters do not pass a benefit-cost test if the objective is to reduce non response bias.
- There are differences between those who do and do not respond to the full survey and these differences do result in non response bias. Current sample weighting is not accounting for all of the bias. An additional sample weight will have to be constructed to account for the fact that refusals have a higher rate of non participation in outdoor recreation than those that respond to the full survey.

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