SUPPORTING STATEMENT
U.S. Department of Commerce
National Oceanic & Atmospheric Administration
Survey to Collect Economic Data from Recreational Anglers along the Atlantic Coast
OMB Control No. 0648-0783

B. Collections of Information Employing Statistical Methods

1. Describe (including a numerical estimate) the potential respondent universe and any sampling or other respondent selection method to be used. Data on the number of entities (e.g., establishments, State and local government units, households, or persons) in the universe covered by the collection and in the corresponding sample are to be provided in tabular form for the universe as a whole and for each of the strata in the proposed sample. Indicate expected response rates for the collection as a whole. If the collection had been conducted previously, include the actual response rate achieved during the last collection.

The target population for NARFS II is recreational anglers who have fished for summer flounder and/or black sea bass off the states of New Jersey and New York. Our sample frame will be drawn from 2019/2020 recreational fishing license/registry databases maintained by these states. Table 1 displays information about these databases in 2018, which represent the NARFS II respondent universe. All license holders are required to provide a mailing address. Email addresses are requested, but are not a requirement for obtaining a license. We will obtain the most recent annual state-level license databases upon approval of this ICR. The composition of the state-level databases has been relatively stable over the past five years so we don't expect the 2019 databases to differ much. However, if NARFS II is conducted in 2021 and we have access to the 2020 license registries, the respondent universe may be larger as anecdotal reports suggest an increase in license sales due to Covid-19.

Table 1. 2018 Saltwater Recreational Fishing Licenses by State

State	Total # of licensees	Mailing address	Email address
New Jersey	161,415	100%	91%
New York	825,905	100%	98%

The NARFS II will follow the same email/mail sampling methodology used for the first NARFS. The only difference is that the first NARFS focused on anglers fishing for Atlantic cod and haddock in Maine, New Hampshire, and Massachusetts. NARFSS II will focus on anglers fishing for summer flounder and black sea bass in New York and New Jersey.

The NARFS II sampling methodology involves sending mail invitations containing a web link to participate to a list of potential respondents drawn using stratified random sampling from the state license/registration databases. We expect more than three quarters of the completed responses will come from the web version of the survey, with about a quarter of the completed responses derived from the mail version of the survey. This expectation was realized in the first NARFS as 81% of the respondents that completed the survey used the web version of NARFS; the remaining 19% that completed the survey did so by filling out the mail version.

The expected response rate from the first NARFS provides the basis for that expected in NARFS II. Table 2 shows the first NARFS response rates by state. Survey invites are the total number of license-holders that the first NARFS attempted to contact. Eligible completes are sampled records from anglers that fished for cod, haddock, or pollock during the past five years in Maine, New Hampshire, or Massachusetts. NARFS II will use the same five-year eligibility definition, but will target anglers fishing for summer flounder and black sea bass in New York and New Jersey. Finally, ineligible completes shown in Table 2 refer to anglers that completed the first NARFS, but did not fish for cod, haddock, or pollock during the previous five years., These anglers were only asked to answer a subset of the total questions in the survey since they did not fish for the target species during the previous five years. NARFS II will follow this same approach. Anglers that indicate they did not fish for summer flounder or black sea bass during the past five years will only be asked the first two questions then will be directed to skip to the last section of the survey (Section C) to answer demographic questions. Please see Part A, Question 2 that explains the need for collecting a brief subset of information from anglers not targeting the species of interest. As shown in Table 2, the overall NARFS completion response rate was approximately 33% (1,326/4,000*100) with eligible respondents comprising approximately 39% (516/1,326*100) of the completed surveys.

Table 2. NARFS Survey Disposition by State

State	Survey Invites	Eligible Completes	Ineligible Completes	Eligible and Ineligible Completes
Maine	726	63	148	211
Massachusetts	2,058	256	484	740
New Hampshire	1,216	197	178	375
Total	4,000	516	810	1,326

While NARFS II will focus on anglers fishing for different species in different states, we expect a similar overall and eligible respondent survey completion rate. This is because we intend to collect virtually identical information in NARFS II using the same email/mail sampling methodology employed in the original NARFS. Additionally, the original NARFS survey targeted anglers fishing for the most commonly sought bottom fish in the Gulf of Maine: Atlantic cod and haddock. NARFS II will target anglers fishing for the most commonly sought bottom fish in New York and New Jersey: summer flounder and black sea bass. While quantitative data to compare the characteristics of anglers fishing for bottom fish in the Gulf of Maine versus New York and New Jersey are unavailable, we think any differences would be negligible. Thus, we are assuming that the overall NARFS II completion rate should be similar to the original NARFS (~33%), with eligible respondents (those that have fished for summer flounder or black sea bass within the past five years) comprising approximately 39% of the completed surveys.

As was done for the first NARFS, we will send out 4,000 survey invites allocated across states according to the proportion of angler trips targeting the species of interest. The most recent data from the National Marine Fisheries Service's Marine Recreational Information Program (MRIP) show about 4.1 million angler trips in New Jersey and 2.8 million angler trips in New York targeted summer flounder or black sea bass in 2019. Thus, we will allocate 59% of the NARFS II sample to New Jersey license holders (4,000 x .59 = 2,360 survey invites) and 41% to New York license holders (4,000 x .41 = 1,640 survey invites). Assuming an overall completion response rate of about 33% results in 1,326 total completed surveys (4,000 x .3315 = 1,326), with 782 derived from New Jersey license holders (2,360 x .3315 = 782), and 544 from license holders in New York (1,640 x .3315 = 544). Approximately 39% of the completed surveys are expected to be from anglers targeting summer flounder or black sea bass (i.e., eligible completes). This results in 516 completed surveys by eligible anglers (1,326 x .389 = 516), with 304 completed eligible surveys from New Jersey license holders (782 x .389 = 304) and 212 from New York license holders (544 x .389 = 212). Expected survey dispositions by state are shown in Table 3.

Table 3. Expected NARFS II Survey Dispositions by State

State	Survey Invites	Eligible Completes	Ineligible Completes	Eligible and Ineligible Completes
New Jersey	2,360	304	478	782
New York	1,640	212	332	544
Total	4,000	516	810	1,326

Implementation of NARFS II will follow procedures suggested by Dillman et al. (2009). These procedures have been followed extensively in survey research to increase response rates for mail and web surveys. Repeated contacts with respondents through one or more mediums (phone, email, and mail), allow flexibility regarding how potential respondents choose to respond and serve to maximize the overall survey response rate. The implementation schedule for NARFS II is described below.

<u>Track A: Mail push-to-web invitation letter for respondents that have an email address on file.</u>
This will be the primary track as approximately 91% of the saltwater recreational license holders in New Jersey and 98% in New York provided email addresses in 2018. We expect similar percentages for the 2019 or 2020 license frames that we will use for NARFS II. The mail push-to-web letter provides an opportunity to explain the survey's purpose and elicit cooperation. The letters will introduce the survey, demonstrate its relevance, encourage web participation, and assure confidentiality. Subsequent contacts with Track A participants who do not respond after receiving the mail push-to-web letter are as follows:

- An email invitation, which reinforces the importance of the survey and reminds those who did not respond about the survey. The reminder email will contain a web link to the survey, in the hopes that that will make it easier for participants to respond online.
- A reminder email, which reinforces the importance of the survey and reminds those who did not respond about the survey. The reminder email will contain a web link to the survey.
- A reminder letter, which reinforces the importance of the survey and reminds those who did not respond about the survey. The reminder letter will contain a web address to access the survey online.
- A mail package that includes the paper version of NARFS II and a cover letter explaining the importance of the survey.

<u>Track B: Mail push-to-web invitation letter for respondents without an email address on file.</u>

Track B is very similar to Track A, with the exception that these participants will not receive email contacts. Any subsequent contact after the first mail push-to-web contact will be made by mail.

The NARFS survey instrument is included in the appendix of Supporting Statement Part A..

2. Describe the procedures for the collection of information including:

<u>Statistical methodology for stratification and sample selection</u>

A stratified random sampling strategy will be used to focus efforts on the population of interest and reduce implementation costs. As indicated in Question 1 above, participants will be drawn from each state license database (g) in proportion to that state's contribution to the total number of recreational fishing trips taken during 2019 that targeted summer flounder or black sea bass. Publicly available MRIP data (https://www.st.nmfs.noaa.gov/recreational-fisheries/data-and-documentation/queries/index) show the total number of angler trips to be 4.1 million in New Jersey and 2.8 million in New York. Thus, 59% of the sample will be drawn from New Jersey license holders and 31% from New York license holders.

Estimation procedure

The most critical input for estimating the angler behavioral model are the data collected from Section B of NARFS II, the discrete Choice Experiment (CE). Each of the six questions in this section presents respondents with three options—two hypothetical summer flounder and black seas bass fishing trips that vary in catch levels, probabilities of keeping a given number of fish, and cost, and the option to not go recreational saltwater fishing—and asks them to indicate which of the three options would be their first if they were presented with these alternatives in the real world. We use these data to estimate a vector of parameters that represent risk and ambiguity attitudes, and marginal utilities of fishing trip attributes included in the discrete choice experiment (see Part A, Table 1 for a summary of attributes).

We will analyze the discrete choice experiment data collected by NARFS II using random utility maximization (RUM) models, which decompose utility into its observable and unobservable components (McFadden 1973). RUM models assume that when faced with multiple alternatives, individual n will select alternative i (from among other alternatives j) that maximizes utility, $U_{¿}$.

1.

1. $U_{¿} > U_{nj} \forall j \neq i$ 2.

Partitioning $U_{¿}$ into its two component parts, the choice of alternative i is such that

2. $V_{¿} + \varepsilon_{¿} > V_{nj} + \varepsilon_{nj} \forall j \neq i,$

where V_{nj} and $V_{¿}$ are indirect utilities derived from alternatives i and j, respectively. and ε_{nj} and $\varepsilon_{¿}$ are their respective error terms. Unlike standard specifications, which typically assume that V_{nj} is linear in parameters, $V_{nj} = \beta' X_{nj}$, we are interested in eliciting angler's risk and ambiguity preferences in catch space (Foster and Just, 1989, Leggett, 2002, de Palma and Picard 2004, Holzer and McConnell 2017). Thus, we assume a quasilinear specification in which risk preferences associated with the random catch are represented by a von Neumann-Morgenstern utility function with constant absolute risk aversion (CARA),

3. $$V_{¿} + \varepsilon_{¿} = \sum_{k=1}^{K} \pi_{¿}^{k} u\left(z_{¿}^{k}, X_{¿} r, \beta\right) + \lambda\left(y_n - c_{¿}\right) + \varepsilon_{¿}$$

where k indexes the possible catch outcomes $z_{¿}^{k}$, $\pi_{¿}^{k}$ is the probability that outcome k occurs, $X_{¿}$a vector of non-random site attributes, $y_n - c_{¿}$ income net of trips costs, r denotes the Arrow-Pratt coefficient of absolute risk aversion, and β and λ are parameters to be estimated. Function u is given by

$$4.\quad u\left(z_{¿}^{k}, X_{¿}; r, \beta\right) = \frac{1 - e^{-r\left(\theta z_{¿}^{k} + \beta' X_{¿}\right)}}{r}$$

and combining both expressions, we write

$$5.\quad V_{¿}\left(z_{¿}^{k}, X_{¿}; r, \beta\right) + \varepsilon_{¿} = \sum_{k=1}^{K} \pi_{¿}^{k} \left(\frac{1 - e^{-r\left(\theta z_{¿}^{k} + \beta' X_{¿}\right)}}{r} \right) + \lambda\left(y_n - c_{¿}\right) + \varepsilon_{¿}$$

that relates observed attributes to utility. In our choice experiments, while the catch is deterministic, the keep (essentially determined by whether those fish are legal size) is stochastic.

Because the ε's are stochastic, it is not possible to determine absolute levels of utility; however, probabilistic inference about individuals' choices can be made under the standard assumption for logit models that these terms are independently and identically distributed Type I extreme values. The probability that angler *n* selects fishing alternative *i* is

$$6.\quad \Pi_{¿}^{Risk} = Pr\left[\left(\varepsilon_{nj} - \varepsilon_{¿}\right) < V_{¿} - V_{nj}\right] \forall\, j \neq i$$

Train (2003) calculates this probability for a multinomial logit (MNL) model as

$$7.\quad \Pi_{¿}^{Risk} = \frac{e^{V_{¿}\left(z_{¿}^{k}, X_{¿}; r, \beta\right)}}{\sum_{j=1}^{J} e^{V_{nj}\left(z_{nj}^{k}, X_{nj}; r, \beta\right)}}$$

Next, to specify the contribution to the likelihood from the choices involving ambiguity, we use the *α*-Maxmin Expected Utility (*α*-MEU) model with fixed priors (Gilboa et al. 1989, Ghirardato et al. 2004). To illustrate, assume that angler *n* is presented with an hypothetical trip *i* that is characterized by three possible outcomes in terms of the number of legal-sized summer flounder kept, denoted $z_{¿}^{1}$, $z_{¿}^{2}$ and $z_{¿}^{3}$, with known probability for outcome$z_{¿}^{1}$ given by $\pi_{¿}^{1}$. If the probabilities associated with outcomes $Z_{¿}^{2}$ and $Z_{¿}^{3}$, are not specified, the angler faces uncertainty (i.e. unknown objective probabilities). In this case, we specify his/her utility as follows (Potamines and Zhang 2012, Ahn et al. 2014, Gneezy et al. 2015).

$$8.\quad V_{¿}\left(z_{¿}^{k}, X_{¿}; \alpha, r, \beta\right) + \varepsilon_{¿} = \pi_{¿}^{1}\left(\frac{1 - e^{-r\left(\theta z_{¿}^{1} + \beta' X_{¿}\right)}}{r}\right) + \alpha\left(1 - \pi_{¿}^{1}\right)\left(\frac{1 - e^{-r\left(\theta z_{¿}^{min} + \beta' X_{¿}\right)}}{r}\right) + \left(1 - \alpha\right)\left(1 - \pi_{¿}^{1}\right)\left(\frac{1 - e^{-r\left(\theta z_{¿}^{max} + \beta' X_{¿}\right)}}{r}\right) + \varepsilon_{¿}$$

where $z_{¿}^{min} = min\left\{z_{¿}^{2}, z_{¿}^{3}\right\}$ and $z_{¿}^{max} = max\left\{z_{¿}^{2}, z_{¿}^{3}\right\}$. Thus, above the unknown probabilities are skewed using weights $0 \geq \alpha \geq 1$ and $1 - \alpha$ for the low and high keep, respectively. The parameter α represents the attitude towards ambiguity: $1/2 < \alpha \leq 1$ indicates preferences that are ambiguity averse$0 \leq \alpha < 1/2$ indicates preferences that are ambiguity seeking, and if $\alpha = 1/2$ we have the standard subjective expected utility specification. The probability of choosing the trip option with unknown probabilities can be expressed as

$$9.\quad \Pi_{¿}^{Ambiguity} = \frac{e^{V_{¿}\left(z_{¿}^{k}, X_{¿}; \alpha, r, \beta\right)}}{\sum_{j=1}^{J} e^{V_{nj}\left(z_{nj}^{k}, X_{nj}; \alpha, r, \beta\right)}}$$

The probability of each individual in the sample choosing the alternative they were observed to actually choose is

$$10. L(\alpha, r, \beta, \lambda) = \prod_{n=1}^{N} \prod_{i} (\Pi_{¿}^{Risk})^{y_{¿}} \prod_{i'} (\Pi_{¿}^{Ambiguity})^{y_{¿}'},$$

where $y_{¿}=1$ if an individual *n* is observed to choose alternative *i* in the choice experiments only involving risk, and zero otherwise. Similarly, $y_{¿}'=1$ if an individual is observed to choose alternative *i* in the choice experiments involving ambiguity, and zero otherwise. We will jointly estimate, using maximum likelihood, parameters $\alpha, r, \beta, \lambda$, which maximize

$$11. L(\alpha, r, \beta, \lambda) = \sum_{n} \left\{ \sum_{i} y_{¿} \ln \left(\frac{e^{V_{¿}(z_{¿}^{k}, X_{¿}; r, \beta)}}{\sum_{j=1}^{J} e^{V_{nj}(z_{nj}^{k}, X_{nj}; r, \beta)}} \right) + \sum_{i'} y_{¿}' \ln \left(\frac{e^{V_{¿}(z_{¿}^{k}, X_{¿}; \alpha, r, \beta)}}{\sum_{j=1}^{J} e^{V_{nj}(z_{nj}^{k}, X_{nj}; \alpha, r, \beta)}} \right) \right\}$$

Degree of accuracy needed for the purpose described in the justification

The number of completed surveys needed to estimate the behavioral model parameters with adequate precision is based on the experimental design of the CE. We evaluated the minimum sample size required for the ensuing CE economic model using the most widely accepted approach described by Orme (2010).

The approach suggested by Orme for determining the minimum sample size for CE modelling, is to set

$$12. \frac{nta}{c} \geq 500$$

where n is the number of respondents, t is the number of choice tasks per respondent, a is the number of alternatives per choice task excluding the opt-out alternative, and c is the largest number of levels for any one attribute for a main effects model. While the value of 500 refers to the number of times each main effect level of interest should be represented across the design to have ample stability in the ensuing parameter estimates, Orme (2010) notes that this value "was intended to be a minimum threshold when researchers cannot afford to do better. It would be better, when possible, to have 1,000 or more representations per main-effect level". When its right-hand side is set to 500, solving Equation (12) for n based on our main-effects experimental design (t = 6[1], a = 2, c = 6) yields 250; when the right-hand side of Equation (12) is set to 1,000, n = 500. Taken together, the general rule of thumb provided by Orme (2010) suggests that the minimum sample size for the NARFS II should be between 250 and 500.

[1]This was the number of choice tasks per respondent in the first NARFSS (*t* = 6). Additionally, feedback obtained from the NARFS II focus groups' indicated that participants were able to properly answer six CE questions, but a larger number of questions became burdensome.

Given results of the Orme (2010) approach used to determine the minimum sample size required for NARFS II, we seek to obtain at least 500 surveys completed by eligible anglers. Meeting this objective conditional on an expected 33% overall survey response completion rate, with eligible survey respondents comprising 39% of the completed surveys, requires distributing a minimum of 3,885 surveys across the two states. See Question 1 above for a description of the expected survey response rates. Distributing 4,000 surveys in the first NARFS resulted in 516 completed surveys, which exceeds the minimum sample size range suggested by the Orme (2010) test. As we expect the response rate for NARFS II to be at least as high as the first NARFS, our sample size of 4,000 should be more than sufficient to provide representative population estimates.

Unusual problems requiring specialized sampling procedures

The proposed stratified random sampling design of saltwater recreational license holders provided the necessary data for the first NARFS and we don't anticipate any changes for NARFS II.

Any use of periodic (less frequent than annual) data collection cycles to reduce burden

NARFS II will be a one-off data collection effort conducted at a single point in time. Respondents will be asked to respond to a single questionnaire with no follow-up data requested.

3. Describe methods to maximize response rates and to deal with issues of non-response. The accuracy and reliability of information collected must be shown to be adequate for intended uses. For collections based on sampling, a special justification must be provided for any collection that will not yield "reliable" data that can be generalized to the universe studied.

As was done for the first NARFS, we will be offering a $2 incentive and have instituted survey design features to improve unit and item non-response. The findings from the $2 incentive experiment on survey response in the first NARFS showed that sampled anglers who received the incentive were significantly more likely to respond to the questionnaire than respondents that did not receive the incentive (38.46% versus 25.31% respectively; chi-square = 56.45, $p < 0.001$). Based on these findings and other research conducted on small monetary prepaid incentives, discussed under A9, NARFS II will include a $2 incentive for all survey invites. By providing the $2 incentive in all survey invitations, rather than to a subset of the sample as was done for the first NARFS, we expect the NARFS II survey response rate should be even higher than the first NARFS.

Additionally, the survey design features implemented in the first NARFS resulted in low unit and item non-response so will adopt these same features. In the first NARFS, 1,134 sampled license holders accessed the web questionnaire either by going to the survey website and entering their unique passcode or by clicking on a unique link provided in a subsequent email contact. Approximately 92% (1,039) of the sampled license holders that accessed the web questionnaire ultimately completed. The high completion percentage speaks favorably to the clarity of questions and instructions in the questionnaire as well as the screen presentation of these elements on desktop and mobile devices. It is not uncommon to see respondents breakoff when presented with CE questions given the cognitive demand required to evaluate the hypothetical scenarios. The CE questions were optimized for appearance on both desktop and mobile devices to ensure a positive user experience and we will follow the same design for NARFS

II. Measures were also taken to mitigate item non-response within the CE questions such the use of soft validations with messages tailored to each preference question. A hide/reveal of the second preference question was implemented to improve data quality such that respondents could not pick the same choice twice within a given scenario. Only 19 of the 1,039 web respondents skipped one of the CE questions, meaning 98% of web respondents fully completed the most important section of the questionnaire. The measures taken to optimize user experience, improve data quality, and minimize item nonresponse coupled with clearly and concisely written questions and instructions contributed significantly to this successful completion rate.

We statistically tested for survey nonresponse bias in the first NARFS using data collected from a telephone survey. We found that survey non-response bias had no impact on the estimation results. Given the high cost, additional burden on society, extremely low telephone contact rate achieved in the first NARFS (6.9%), and the finding that non-response bias was not a factor in NARFS, we do not plan to conduct a nonresponse survey for NARFS II. We anticipate the $2 monetary incentive will help mitigate survey nonresponse bias by attracting participation from those who otherwise might not respond to the survey. We will also adopt the same survey design features that were so successful in the first NARFS, which will help maximize survey completion rates, improve unit and item nonresponse, and promote a better respondent experience. Additionally, we will use responses to a series of demographic questions contained in Section C of the questionnaire to assess relative sample representativeness by comparing the characteristics of our sample to the characteristics of the population of recreational anglers at large, which are available in NOAA-sponsored nationwide angler expenditure reports.

Data collected from NARFS II will improve our ability to understand and predict how changes in management options and regulations may change fishing mortality and the number of trips anglers take for summer flounder and black sea bass. This data will allow fisheries managers to conduct updated and improved analysis of the socio-economic effects to recreational anglers and to coastal communities of proposed changes in fishing regulations. The recreational fishing community and regional fisheries management councils have requested more species-specific socio-economic studies of recreational fishing that can be used in the analysis of fisheries policies. This survey will address that stated need for more species-specific studies. In addition, the survey data will provide the foundation for a Management Strategy Evaluation designed to assess the added economic value to anglers associated with minimizing summer flounder discards. This work will be conducted as part of the Mid-Atlantic Fisheries Management Council's Ecosystem Approach to Fisheries Management process.

4. Describe any tests of procedures or methods to be undertaken. Testing is encouraged as an effective means of refining collections of information to minimize burden and improve utility. Tests must be approved if they call for answers to identical questions from 10 or more respondents. A proposed test or set of tests may be submitted for approval separately or in combination with the main collection of information.

The design of the approach to display uncertainty in the number of fish kept (i.e. pie charts with probability labels) was tested with undergraduate students at the University of Maryland. The respondents overwhelmingly preferred this approach over the alternative of describing probabilities using frequency bar graphs. Then, to test the efficacy of the proposed survey instrument, we conducted focus group sessions with recreational summer flounder and black sea bass anglers in the study region during March of 2019. Using 2018 license frames, we recruited focus group participants who differed in terms of gender, age, education, income level, and summer flounder/black sea bass fishing experience to obtain feedback from a diverse mix of anglers. Both focus groups were held in Cranford, New Jersey. After a brief introduction to provide context on the main purpose of the survey, focus participants were asked to answer the survey. Then, we facilitated the discussion on each of the sections in the survey, with particular emphasis on the CE questions and the pie charts describing uncertainty in the keep of summer flounder and black sea bass.

We used feedback received from these focus groups to (a) design contextually realistic choice experiment questions, (b) discuss the most intuitive design of choice experiments involving probabilistic outcomes, including the appropriate number of random outcomes, and (c) discuss the need to incorporate questions in which the probabilities are unknown a priori (i.e. hence the need to include scenario to deal with ambiguity regarding the catch).

5. Provide the name and telephone number of individuals consulted on statistical aspects of the design and the name of the agency unit, contractor(s), grantee(s), or other person(s) who will actually collect and/or analyze the information for the agency.

Design, analysis, report

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