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

SUPPORTING STATEMENT PART B

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 the NARFS IV is recreational anglers who have fished for summer flounder, black sea bass, or scup along the North Atlantic coast from Massachusetts to North Carolina. Our sample frame will be drawn from 2024 recreational fishing license/registry databases maintained by these states. Table 1 displays information about these databases in 2022. Note that the composition of the 2024 database is unlikely to differ much from that of the 2022 database.

Given their lower per-unit cost relative to mail surveys and results of the NARFS II survey, web surveys will likely account for approximately 90% of the total number of surveys distributed.

Table 1. 2022 saltwater recreational fishing licensees by state and contact information availability

State	Total # of licensees	Mailing address	Email address	Mailing and email address
Massachusetts	186,468	186,439	139,405	139,396
Rhode Island	50,336	50,327	37,399	37,397
Connecticut	97,409	97,401	45,372	45,369
New York	766,604	766,604	647,330	647,330
New Jersey	146,144	146,144	136,629	136,629
Delaware	101,006	101,005	16,963	16,963
Maryland	455,341	455,341	242,057	242,057
Virginia	433,555	433,555	292,450	292,450
North Carolina	513,002	513,002	359,101	359,101
Total	2,749,865	2,749,818	1,916,706	1,916,692

As discussed in our response to question A1, the NARFS IV will follow the same email/mail sampling methodology used for all of the previous NARFS surveys. The NARFS IV 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 about 90% of the completed responses will come from the web version of the survey, with about 10% of the completed responses derived from the mail version of the survey. This expectation was realized in the NARFS II as 90% of the respondents that completed the survey used the web version; the remaining 10% that completed the survey did so by filling out the mail version.

The expected response rates from the NARFS II provides the basis for that expected in NARFS IV.[1] Table 2 shows the NARFS II response rates. Survey invites are the total number of license-holders that the NARFS II attempted to contact. Eligible completes are sampled records from anglers that fished for summer flounder, black sea bass, or scup during the previous five years. NARFS IV will use the same five-year eligibility definition. Finally, ineligible completes shown in Table 2 refer to anglers that completed the NARFS II, but did not fish for summer flounder, black sea bass, or scup 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 IV will follow this same approach. Anglers that indicate they did not fish for black sea bass or summer flounder during the past five years will only be asked the first question, then will be directed to skip to the last section of the survey (Section D) 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 II completion response rate was approximately 39% with eligible respondents comprising about 76% (1,172/1,544*100) of the completed surveys.

Table 2. NARFS II Survey Disposition

	Survey Invites	Eligible Completes	Ineligible Completes	Eligible and Ineligible Completes
Total	4,000	1,172	372	1,544
% of total invites		29.3%	9.3%	38.6%

As the NARFS IV will be designed as an update to the NARFS II, focused on the same species, using the same sampling methodology, we are expecting a similar overall and eligible respondent survey completion rate. Thus, we are expecting a completion rate of approximately 39%, with eligible respondents (those that have fished for summer flounder, black sea bass, or scup in the previous five years) comprising about 76% of the completed surveys.

Identical to the previous NARFS surveys, we intend to send out 4,000 survey invites allocated across states according to the proportion of angler trips targeting/catching the species of interest.

[1] The NARFS III survey has yet to be conducted at the time of this writing. The NARFS III survey is scheduled to take place during the final months of 2024. Thus, we use the realized response times/rates from NARFS II as a proxy for the NARFS IV survey.

Overall, we are expecting 1,544 completed surveys. Approximately 39% (515) of the completed surveys are expected to be from anglers targeting and/or catching summer flounder, black sea bass, or scup.

Implementation of NARFS IV 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, or mail), allow flexibility regarding how potential respondents choose to respond and serve to maximize the overall survey response rate. As stated above, for NARFS IV we plan to use email and mail surveys. The implementation schedule for NARFS IV 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 initial invitation track for those with email addresses. Approximately 70% of the saltwater recreational license holders from Massachusetts to North Carolina provided email addresses in 2022 (Table 1). We expect similar percentages for the 2024 license frames that we will use for NARFS IV. 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 IIV 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.

A version of the NARFS IV survey instrument and associated cover letters are included as an attachment.

2. **Describe the procedures for the collection, including: the statistical methodology for stratification and sample selection; the estimation procedure; the degree of accuracy needed for the purpose described in the justification; any unusual problems requiring specialized sampling procedures; and any use of periodic (less frequent than annual) data collection cycles to reduce burden.**

Statistical methodology for stratification and sample selection

A stratified random sampling strategy will be used to focus efforts on the population of interest and reduce implementation costs. 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 2024 that caught or targeted summer flounder or black sea bass.

Estimation procedure

The most critical input for estimating the angler behavioral model are the data collected from Section B of NARFS IV, the discrete Choice Experiment (CE). Each of the six questions in this section presents respondents with three options—two hypothetical summer flounder, black sea bass, and scup 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 IV 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 j and i, respectively, and ε_{nj} and $\varepsilon_{¿}$ are their respective error terms. Unlike standard specifications, which typically assume that $V_{¿}$ is linear in parameters, $V_{¿} = \beta' X_{¿}$, 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),

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

where k indexes the possible catch outcomes $z_{¿}^{k}$, $\pi_{¿}^{k}$ is the probability that outcome k occurs, $X_{¿}$ denotes a vector of non-random site attributes, $y_n-c_{¿}$ is 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 $z_{¿}^{min} = min\ \{z_{¿}^{2}, z_{¿}^{3}\}$ and $z_{¿}^{max} = max\ \{z_{¿}^{2}, z_{¿}^{3}\}$. 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

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

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

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

<u>Degree of accuracy needed for the purpose described in the justification</u>

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

$$2.\quad \frac{nta}{c} \geq 500$$

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 ($t = 6$[2], $a = 2$, $c = 6$) 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 IV should be between 250 and 500.

Given results of the Orme (2010) approach used to determine the minimum sample size required for NARFS IV, we seek to obtain at least 500 surveys completed by eligible anglers. Meeting this objective conditional on an expected 39% overall survey response completion rate, with eligible survey respondents comprising 76% of the completed surveys, requires distributing a minimum of 1,687 surveys across the three states. See Question 1 above for a description of the expected survey response rates. Distributing 4,000 surveys in the second NARFS resulted in 1,173 surveys completed by eligible anglers, which exceeds the minimum sample size range suggested by the Orme (2010) test. As we expect response rates to be similar to NARFS II, our sample size of 4,000 should be more than sufficient to provide representative population estimates.

<u>Unusual problems requiring specialized sampling procedures</u>

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

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

NARFS IV 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 the methods used to maximize response rates and to deal with nonresponse. The accuracy and reliability of the information collected must be shown to be adequate for the intended uses. For collections based on sampling, a special justification must be provided if they will not yield "reliable" data that can be generalized to the universe studied.**

As was done for the first two 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

[2]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.

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 IV will include a $2 incentive for all survey invites. By providing the $2 incentive in all survey invitations, as was done for NARFS II, we expect similar survey response rates to NARFS II.

Additionally, the survey design features implemented in the first two NARFS resulted in low unit and item non-response so will adopt these same features. In NARFS II, approximately 90% of 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 93% 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. To ensure a positive user experience, the CE questions were optimized for appearance on both desktop and mobile devices in the first two NARFS and we will follow the same design for NARFS IV. 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. Fewer than twenty of the 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 the NARFS I, we do not plan to conduct a nonresponse survey for NARFS IV. 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 NARFS II, which will help maximize survey completion rates, improve unit and item nonresponse, and promote a better respondent experience. Additionally, for the first time, we plan to use responses to the series of demographic questions contained in Section D 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 were recently collected in NOAA-sponsored nationwide angler expenditure survey.

Data collected from NARFS IV 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, black sea bass, and scup. The survey data will provide the information fisheries managers need to conduct updated 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 now rely on species-specific socio-economic studies of recreational fishing for analyses of fisheries policies. This survey addresses the need for species-specific studies of summer flounder, black sea bass, and scup.

4. **Describe any tests of procedures or methods to be undertaken. Tests are encouraged as effective means to refine collections, but if ten or more test respondents are involved OMB must give prior approval.**

We tested and refined the proposed survey instrument prior to conducting both the NARFS I and the NARFS II. This survey will use the implementation and methodological lessons learned from both of those surveys.

Prior to conducting NARFS I we conducted focus group sessions with recreational cod and haddock anglers in the study region during November of 2018. Using the license databases described in B1, we recruited focus groups participants who differed in terms of gender, age, and Atlantic cod/haddock fishing experience to obtain feedback from a diverse mix of anglers. The first two of these focus groups were held in Braintree, MA, and the second two groups were held in Portland, ME. We used feedback received from those focus groups to (a) conform survey language to regional differences in dialect and ensure consistent interpretation of survey questions across the study region, and (b) design contextually realistic and straightforward choice experiment questions.

During the focus groups conducted for NARFS II, we tested the design of the improved approach to display uncertainty in the number of fish kept (i.e. pie charts with probability labels) with undergraduate students at the University of Maryland. The respondents overwhelmingly preferred this approach to 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 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 the 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.

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