Independent Peer Review Report on the Calibration Model Accounting for a Recreational Fishery Survey Design Change

Prepared for the Center for Independent Experts (CIE) Program

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1 Executive Summary

This document presents my findings on the proposed calibration model for estimating the historical recreational effort one would have estimated had the Fishing Effort Survey (FES) been conducted at some point in the past when only telephone estimates were available from the Coastal Household Telephone Survey (CHTS). The importance of developing a calibration approach that can produce reliable and comparable estimates of recreational effort for long time series (e.g. 1982 - Present) is a key task outlined in the FES transition plan [3]. To that end, data were collected and effort estimated for both the FES and CHTS (during 2015 and over five, two-month waves in 2016) and a new proposed calibration approach uses this data and the past time-series of CHTS data for judging the performance of the calibration model. In this report I find that

1. The proposed model is a reliable and scientifically defensible way to estimate (calibrate) in either FES or CHTS effort units, since
   (a) the approach employs a well-known methodology and provides estimates of model uncertainty that embodies both the prediction and sampling error associated with calibrated estimates.
   (b) the statistical properties of the model are clearly presented and follow from clear and reasonable modeling assumptions.
   (c) the model is well specified for the calibration problem for which it is used.
2. While the calibration model may be intended to predict FES estimates in the past, it can also be used to
   (a) purge the "wireless" effects that have potentially biased CHTS effort estimates during the period 2000 - Present.
   (b) predict what the CHTS would be in some point in the future.

My report also includes some specific recommendations for potentially improving the application of the model and these include:

1. Sensitivity analysis should be performed to investigate the effect of the overlapping mail and telephone specification in the model.
2. Additional covariates should be explored for better capturing the wireless effect in the model
3. The agency should consider revisiting the model once a longer time series of FES data is available so that the FES portion of the model might include time trending covariates.
4. The model results and outputs should be better presented using case studies to show the types of output it can yield (e.g. confidence intervals, effort units rather than log(effort units)) for hindcasting and forecasting.

2 Background

The Marine Recreational Information Program (MRIP) has committed to a full transition from the Coastal Household Telephone Survey (CHTS) to the Fishing Effort Survey (FES) for allowing the estimation of total effort [3] because of likely biases resulting from the random digit dial of coastal household residences sample frame. As pointed out by Andrews et al. [2], there are multiple problems associated with the CHTS that the FES attempts to overcome including

- CHTS undersamples wireless-only households and therefore there are questions about the representativeness of landline households as compared to the total population.
- More efficient sample frame for FES.
- Potential for FES to overcome some of the problems associated with gatekeeper bias.

A further issue that should be pointed out is that the CHTS does not collect socio-demographic information in sufficient detail to enable a re-weighting for possibly overcoming some of these factors. A complete review of the problems with the CHTS and the advantages associated with the FES were the motivation of the change currently ongoing with the MRIP data collection efforts.

Both pilot survey evidence and recent side-by-side sampling show that there can be large and persistent differences resulting from the two sampling methodologies due to a host of recognized factors and the transition plan for moving from CHTS to FES [3] calls for the development of a methodology to calibrate one set of estimates to another (e.g. CHTS to FES, or potentially vice-versa). The differences between Mail and Telephone estimates can be attributed to a range of causes, but the most important ones are arguably

- Mode Effects (phone versus mail)
- A change in the survey instrument
- On-going issues associated with the representativeness of the CHTS sample due to wireless telephone adoption by of U.S. households

A review of the proposed calibration method was organized to analyze the soundness of the statistical approach taken, and to investigate the suitability of the application to the MRIP FES data as outlined in the Terms of Reference (ToR) provided below. It is important to recognize that the review panel was instructed to take the survey methods and estimation methods underlying either the FES

and CHTS estimates used in the calibration model as scientifically defensible and therefore, we were tasked to focus only on the calibration methods one might employ *after data is collected and effort is estimated using either FES or CHTS methodologies*.

Three CIE reviewers, three appointed reviewers, and a Chair served on the review panel. The review was conducted during a meeting at the Sheraton Silver Spring, Maryland from June 27th - 29th 2017 and the peer review panel had a conference call for finalizing the Summary Report on July 8, 2017. Each panelist participates in the Panel review meeting and writes their own independent assessment of the approach proposed. While my report is in large measure consistent with the panel's Summary Report, it reflects my own independent findings with respect to the proposed approach.

3 Description of My Role in the Review Activities

Four pre-meeting documents ([3],[2], [11], and [4]) were available and reviewed from June 14, 2017. In addition, the panel was given access to a recorded webinar by F. Jay Breidt on June 23, 2017 for more detail on the statistical method underlying the calibration approach. During the meeting, I participated in the discussion and suggested some exploratory analysis for checking model robustness and model fit. Since the meeting I have performed some exploratory analysis based on the provided model outputs [5], and written a summary of the model and outlined key issues for enhancing my understanding of details, included in Section 5 of this report.

4 Summary of Findings

Below I discuss my findings for each ToR. In some places I reference more detailed discussions contained in my summary of the methodology (Section 5.2).

4.1 Term of Reference 1

Evaluate the suitability of the proposed model for converting historical estimates of private boat and shore fishing effort produced by the CHTS design to estimates that best represent what would have been produced had the new FES design been used prior to 2017.

In my view the proposed model is a reliable and scientifically defensible way to estimate what an FES design estimate would have been had it been conducted

at some time since 1982. The approach employs a well-known methodology that is capable of being used to predict either Mail or Telephone effort estimates and provides estimates of error that embodies both the prediction and sampling error associated with calibrated estimates. The proposed calibration method meets ToR 1 and the sub-components (a) - (e).

It is important to note that the model [4] is agnostic with respect to whether CHTS or FES estimates are "best". I believe this is a reasonable position to take given that we are dealing with self-reported data and that for most of the 1980's and 1990's there are strong arguments to be made for Telephone Surveys in general. Notwithstanding the many reasons why more recent CHTS estimates (denoted as $\hat{T}$ hereafter) might be biased downwards, the model allows for projection from Telephone to Mail "units" of effort or vice versa. The proposed approach also allows for wireless effects to be purged from the CHTS estimate to account for the hypothesized downward bias in CHTS estimates since 2000. Given that in the future, only the FES methodology will be used, the model will most likely be used to cast past Telephone estimates into predicted Mail estimates, and it is suited for that. But the model is also equipped to cast future Mail estimates (FES) into predicted Telephone estimates (see discussion in Section 5.2.1). The ability to calibrate in either direction is a strength of the proposed approach particularly if future side-by-side stock assessments or policy analysis is desired using both Mail and Telephone predicted effort.

4.1.1 Term of Reference 1a

Does the proposed model adequately account for differences observed in the estimates produced by the CHTS and FES designs when conducted side-by-side in 2015-2016?

In my opinion, the model accounts for differences in side-by-side Mail and Telephone estimate and based on feedback from the research team, finds that most of the differences are due to an intercept shifter that captures average differences between mail and telephone estimates that are *time invariant* rather than large changes in underlying trends. This intercept shifter would be capturing any systematic difference between the mail and telephone estimate *for each* state and wave,year and might include survey mode effects and/or effects due to differences in the survey instrument itself. While the model "accounts" for the differences, I have seen no evidence that it can explain what is driving the difference, since based on responses by the review team time-invariant mail constants are responsible for most of the differences between mail and telephone.

4.1.2 Term of Reference 1b

Is the proposed model robust enough to account for potential differences that would have been observed if the two designs had been conducted side-by-side in years prior to 2015 with regards to time trending biases?

Since this is a hypothetical comparison we are being asked about, it is difficult to answer. The model is able to adjust for the wireless bias, one of the the primary biases believed to exist with respect to the CHTS since 2000. On average, I would say the model would account for these differences.

The method includes time trends and corrections for changing composition of wireless penetration after 2000 and the bias that might impact telephone effort estimates. Consequently, it is able to predict in two types of Telephone Effort Units: one that purges telephone estimates of effort of potential biases due to the wireless effect (after 2000) and one that does not. The model, therefore, is able to explain how these biases change through time as more wireless-only and wireless-mostly household penetrate study areas, since the wireless covariate is state-specific and varies by year and are interacted with state-level population levels. Consequently, the wireless effect can influence the statistical model either by shifting the average difference between mail and telephone estimates or through time-varying trends. Unobservable factors that impact Telephone and Mail estimates in the same manner and that are not related to model covariates are captured by the model random effect. Any other systematic time-varying differences between mail and telephone estimates not included in the model specification are absorbed in the model error.

While I believe the model as it currently stands is defensible and well developed, I recommend that the model specification [4] for capturing wireless effects should investigate alternative covariates. In Section 5.2.4, I suggest some alternative specifications for the wireless portion of the model for perhaps better capturing the nuances of the wireless effects based on how we believe they are impacting our sample from a random digit dial. My suggestions center on choosing explanatory variables that focus on population for older individuals in coastal counties. Additionally, a more thorough discussion of model results as outlined in Section 5.2.5 would have been beneficial for evaluating this ToR.

4.1.3 Term of Reference 1c

How does the approach used in developing the proposed FES/CHTS calibration model compare in terms of strengths or weaknesses with other potential approaches?

While the study [4] provides no evidence, whether in the form of side-by-side comparisons or simulation experiments for determining this ToR, I am satisfied based on our discussion during the review meeting that the modeling team considered and experimented with a number of alternative approaches including the general linear model, time-series approaches, and Bayesian Heirarchical Models. They settled on this approach after experimentation with the other methods and I can't fault them for not showing the relative performance of the Small Area Estimator compared to these other approaches since they were not fully aware of the Terms of Reference. Their focus was on developing a scientifically defensible calibration methodology with known statistical properties and they have done that. Given the Small Area Estimator approach, the team did perform a number of model selection tests for the choice of final model covariates, and the review panel was given these results.

4.1.4 Term of Reference 1d

Does the proposed calibration model help to explain how different factors would have contributed to changes in differences between CHTS and FES results over time?

Given the short time-period over which Mail survey data and effort estimates exist, it is a very tough ask for the model to identify factors driving differences between the methodologies. As all time varying trends in the model impact either the base telephone portion (telephone estimate purged of wireless) or the telephone + wireless portion of the model any discussion of differences between CHTS and FES over time is being driven by the wireless effect. As an aside, I believe this is a sound modeling decision given the short time-series of Mail estimates. Unfortunately, the review panel was not presented with enough evidence on the magnitude of the wireless effect relative to other model factors to fully evaluate this ToR. I felt the presentation of results in the paper didn't highlight these types of factors enough as I outline in Section 5.2.5.

The current model could (and perhaps should) be re-estimated in the future as more Mail estimates are collected, allowing the possible inclusion of time-varying trends in the mail portion of the model. This would serve two purposes: 1) Allow for time-varying differences between CHTS and FES beyond the wireless effect and 2) provide for a larger sample size and perhaps better specification for identifying the model parameters associated with Mail. These issues are outlined in more detail in Section 5.2.3.

4.1.5 Term of Reference 1e

Is it reasonable to conclude that revised 1981-2016 private boat and shore fishing effort estimates based on the application of the proposed FES/CHTS calibration model would be more accurate than the estimates that are currently available? Does evidence provided for this determination include an assessment of model uncertainty?

I disagree with this conclusion, particularly the statement on accuracy, for several reasons:

- To gauge accuracy, one needs to know the truth. Both sources of data are designed to measure fishing effort and rely on self-reported fishing data. Furthermore, the estimates are derived from different survey instruments and survey modes. The closest we may get to the truth might be to perform a marine fishing census not relying on self-reported data, an enormous undertaking requiring near round the clock monitoring at all possible fishing sites and launch points. As no such census exists, I can't make a judgment about this ToR.

- Even if one knew the truth for gauging accuracy, there isn't strong evidence that the telephone methodology, prior to approximately 2000 and the advent of wireless phones, produced biased estimates. On the contrary, many survey experts advocated the use of telephone surveys as a reliable method for recovering population estimates of behavior during the period 1980-2000. The calibration method proposed here is agnostic as to which method is closer to the truth, and can be used to hindcast mail estimates from telephone-only time periods, or vice-versa.

- As with any prediction, calibrated estimates rely on a model and have uncertainty induced by forecasting as well as sampling error, so perhaps the pre-wireless telephone estimates are in some sense more accurate or are estimated with less uncertainty.

4.2 Term of Reference 2

Briefly describe the panel review proceedings highlighting pertinent discussions, issues, effectiveness, and recommendations.

Overall, I found the review process to be a highly effective way to assess the scientific merits of the calibration methodology. Members of the review panel were highly qualified and brought different perspectives to the review that in the

end will give the agency a broad yet penetrative look into the proposed calibration method. The deliberative process of the Panel included stimulating discussions and serendipitous feedback among the panelists during question and answer periods. For example, the afternoon session on the second day when the review panel did a deep dive into the statistical details was valuable. The chair of the panel provided invaluable guidance both in making the "trains run on time" and ensuring that diverse viewpoints were heard.

The MRIP staff are knowledgeable and I appreciated their ability to answer questions, and if necessary, get more information in a timely manner. The statisticians in MRIP are impressive and are making sure the agency asks the right questions as data collection methods evolve. Similarly the research team presenting the proposed methodology were also extremely knowledgeable and able to quickly offer clarificatory answers to questions or additional information if needed. Having access to additional information as the review progressed was vital to the review process. Important examples included access to auxiliary model information [5] and a comparison between FES and Fish and Wildlife Marine Fishing Effort Estimates [9].

I feel the review process could be improved. The approach as written in [4] is not helpful beyond the statistical properties of the model. It (or a companion document) needs to focus more on model outputs rather than statistical properties. Because this type of information wasn't included, I had a difficult time addressing some ToR's adequately. A reader should reasonably expect to understand how covariates enter the model and to what degree they impact predictions. In fairness, the Colorado State research team was unaware of the ToR until approximately one week prior to the meetings. Consequently, it was impossible for them to adequately present their approach for getting at the specific concerns highlighted by the ToR's. Finally, technical reviews should include access to code and data. The panel wasn't able to fully engage on the underpinnings of the approach until the second day (after we received some auxiliary information from the research team [5]). Even with the extra information, it would have been beneficial to have access to code and data.

My primary recommendation for future statistical reviews is that they are approached more like a stock assessment review process (as it was described to me by my fellow panelists): reviewers have access to models and data, and can contribute in a give and take process for understanding the method.

5 Calibration of Effort Estimates

This is a summary of the calibration approach [4] along with additional detail for my understanding of the model.

5.1 A Strawman Calibration Model

The calibration approach used in the paper [4] does not mention the "strawman" approach outlined in this section. I include it for a) highlighting issues with more simple approaches that might have been taken and b) showing that the suggested approach overcomes a lot of these problems.

The primary requirement of the calibration approach as I understand it is to allow for the prediction of FES Mail estimates for periods when the mail survey didn't exist (e.g. 1982 - 2015) and in a way that accounts for changing trends that might be systematically driving effort estimates through time. An approach one might take is to focus on the time period where both Mail ($\hat{M}$) and Telephone ($\hat{T}$) estimates exist and estimate a model such as

$$\hat{M} = \mathbf{X}'\boldsymbol{\beta} + \hat{T}\gamma + \epsilon \tag{1}$$

where $\mathbf{X}$ is a vector of control variables (including state fixed effects, and state-wave interactions, trend variables, and controls for wireless), $\boldsymbol{\beta}$ and γ are parameters, and $\boldsymbol{\epsilon}$ is the model error which might contain random effects for each state and time period as in the proposed model.

Given an estimate of the model parameters $\hat{\boldsymbol{\beta}}$ and $\hat{\boldsymbol{\gamma}}$ one can then predict a mail estimate for state s and year,wave t as

$$\hat{\hat{M}}_{st} = \mathbf{X}'_{st}\hat{\boldsymbol{\beta}} + \hat{T}_{st}\hat{\gamma} \tag{2}$$

Using this simple model, this is the estimated Effort Estimate from a mail survey had it been conducted in year,wave t state s.

This model would provide a direct calibration from past telephone estimates into the prediction of what the mail survey would have yielded had it been undertaken. However, this approach has several shortcomings:

1. There is a very limited set of observations over which both $\hat{T}$ and $\hat{M}$ exist and therefore a reliance on short time periods for identifying time trends.

2. The above approach really only allows a *one-way* method for projecting telephone into mail units.

3. Care would need to be taken to correctly account for the fact that $\hat{T}$ is random and estimated with uncertainty, and how this uncertainty propagates into predictions ($\hat{\hat{M}}_{st}$).

4. If unobserved factors impacting the telephone estimates are also impacting mail estimates, then we have parameter bias due to endogeneity issues since it isn't likely that $E[\hat{T}'\epsilon] = 0$ which is required for unbiasedness.

While the above approach provides a direct mapping between Mail and Telephone estimates and may be a natural way to think about the problem, it does have its shortcomings as outlined above. In contrast, the approach under consideration [4] summarized below avoids these shortcomings and is a way to leverage the full time series of data available from both the CHTS and the FES for calibrating from one "effort unit" into another.

5.2 Summary and Discussion of the Proposed Method

This description of the model largely abstracts from the technical detail provided in the paper outlining the proposed calibration method [4] and focuses on model specification and predictions. From equation (1) in the paper, we have

$$\hat{T}_{st} = \mathbf{a}'_{st}\boldsymbol{\alpha} + \nu_{st} + e^T_{st} \text{ for } t < 2000 \tag{3}$$

$$= \mathbf{a}'_{st}\boldsymbol{\alpha} + w_{st}\mathbf{c}'_{st}\boldsymbol{\gamma} + \nu_{st} + e^T_{st} \text{ for } t \geq 2000 \tag{4}$$

where the variables are as described in the paper and the differences in pre and post wireless are modeled beginning for year,waves from 2000 onwards. Similarly, for mail we have

$$\hat{M} = \mathbf{a}'_{st}\boldsymbol{\alpha} + \mathbf{b}'_{st}\boldsymbol{\mu} + \nu_{st} + e^M_{st} \tag{5}$$

Compared to equation (1) from the previous section, we don't have the telephone estimate appearing as an explanatory variable. Instead the paper uses the explanatory variables outlined in Table 1.[1] Note that trends are incorporated for each state and year,wave by interacting population estimates with state fixed effects, by an overall model trend by state. Additionally, the wireless effect has similar trends specified. Consequently if the model needs to predict values in future time periods, it need not be re-estimated since no trend parameters are time-period specific (e.g. a fixed effect by year). Also, since Mail Effort isn't calibrated directly off of the Telephone estimate, the method avoids problem (4) in

[1] This table was developed from the reported parameter estimates from R given to the panel [5]. While it involved some guesswork given variable names to construct the table, I hope it captures the exact model specification in the paper.

the previous section altogether.

Table 1: Model Covariates by Variable Type for a State and Year,Wave Observation

Explanatory Variable	Included in
State,Wave Constant	$\mathbf{a}_{st}$
log(pop)$\times$ State Constant	$\mathbf{a}_{st}$
Wireless Constant (=1 for waves after 1999, else 0)	$\mathbf{c}_{st}$
Wireless Constant $\times$ Wave Constant	$\mathbf{c}_{st}$
Wireless Constant $\times$ State Constant	$\mathbf{c}_{st}$
Wireless Constant $\times$ log(pop)	$\mathbf{c}_{st}$
Wireless Constant $\times$ log(pop) $\times$ State Constant	$\mathbf{c}_{st}$
Mail Constant (=1 if Mail Estimate exists and Mail Obs., else 0)	$\mathbf{b}_{st}$
Mail Constant $\times$ Wave Constant	$\mathbf{b}_{st}$
Mail Constant $\times$ State Constants	$\mathbf{b}_{st}$

5.2.1 Predictions, Hindcasting, and Forecasting

Given model estimates, we have the following model predictions in Table 2.[2]

Table 2: Predictions of log(Effort) Estimates from the Proposed Calibration Model

Type of Prediction	Expression
Telephone	$\mathbf{a}'_{st}\hat{\boldsymbol{\alpha}} + \hat{\nu}_{st}$
Telephone + Wireless	$\mathbf{a}'_{st}\hat{\boldsymbol{\alpha}} + w_{st}\mathbf{c}'_{st}\hat{\boldsymbol{\gamma}} + \hat{\nu}_{st}$
Mail	$\mathbf{a}'_{st}\hat{\boldsymbol{\alpha}} + \mathbf{b}'_{st}\hat{\boldsymbol{\mu}} + \hat{\nu}_{st}$

Before proceeding with an analysis of some predictions we might make using the model, it is useful thinking about what comprises the differences between some of the expressions in Table 2. First, the differences between Telephone (this is purged of wireless effects) and Telephone + Wireless from Table 1 contains

1. Constants that shift Telephone away from Telephone + Wireless for each time period (i.e., Wireless Constant, Wireless Constant $\times$ Wave Constant, Wireless Constant $\times$ State Constant).

2. Trend variables that allow the difference between Telephone and Telephone + Wireless to vary across time (i.e., Wireless Constant $\times$ log(pop) and Wireless Constant $\times$ log(pop) $\times$ State Constant).

By contrast the difference between Telephone (purged of Wireless) and Mail is solely due to Constants that shift Mail away from Telephone for every time period (Mail Constant $\times$ Wave Constant and Mail Constant $\times$ State Constants). There

[2]These predictions are analogous to what the proposed method refers to as $\phi(.)$ in Section 3.2

are no trend differences between Telephone (purged of Wireless) and Mail in the Model since differences are down to estimated constants and don't include trend effects. Of course differences between Telephone + Wireless and Mail would include the wireless constants, the wireless trend variables, and the mail constants. So it is worth noting that the model implicitly assumes there are no time varying mail effects at play since no mail trend interactions are included. We note this as a technical point rather than as a point of omission in the proposed approach since with very few mail estimates available for estimation, there is no way to really model mail trends.

- **Ratios**

  The difference between a predicted telephone estimate (purged of wireless) and a predicted mail estimate is $\mathbf{b}'_{st}\hat{\boldsymbol{\mu}}$. If one wants to think of the calibration as a ratio, we have for our predictions

$$\frac{\hat{\hat{M}}_{st}}{\hat{\hat{T}}_{st}} = \frac{\mathbf{a}'_{st}\hat{\boldsymbol{\alpha}} + \mathbf{b}'_{st}\hat{\boldsymbol{\mu}} + \hat{\nu}_{st}}{\mathbf{a}'_{st}\hat{\boldsymbol{\alpha}} + \hat{\nu}_{st}} = 1 + \frac{\mathbf{b}'_{st}\hat{\boldsymbol{\mu}}}{\mathbf{a}'_{st}\hat{\boldsymbol{\alpha}} + \hat{\nu}_{st}}$$

  This ratio would vary by state and year,wave and is itself a random variable.[3] There is a high likelihood that this ratio varies substantially from state to state and wave to wave and this is evidence that a ratio-based simple calibration approach is inferior to the proposed method. Without too much effort, this could be fleshed out to show how the model predictions below outperform the ratio estimator. There may be some value in that since a ratio-based approach is perhaps the first way most people think about calibration (as we heard from the public question).

- **Hindcasting**

  For hindcasting what one would have estimated with a mail survey when one wasn't conducted, we can apply the mail predictor (from above):[4, 5]

$$\hat{\hat{M}}_{st|t<2015} = \mathbf{a}'_{st}\hat{\boldsymbol{\alpha}} + \mathbf{b}'_{st}\hat{\boldsymbol{\mu}} + \hat{\nu}_{st} \tag{6}$$

  Another useful forecast the model gives us is a re-calibration of historical

[3] Given the model specification, this is the ratio in log units.

[4] It is my understanding that this is what the research team labels as `EPLUBM` of the preferred model from provided supplementary materials [5].

[5] It is also worth mentioning that one could calibrate directly off of the existing historical telephone estimate ($\hat{T}$). The hindcast of what one would have estimated had a mail survey been done could be calculated as $\hat{T} + \mathbf{b}'_{st}\hat{\boldsymbol{\mu}} - w_{st}\mathbf{c}'_{st}\hat{\boldsymbol{\gamma}}$, but my sense is that the EPLUBM is a better estimate, and comes with a coherent estimate of variance (due to sampling and forecasting error). Figures 3 and 4 in the paper [4] shows the performance relative to the EPLUBM.

telephone estimates (post 2000) purged of the wireless effect

$$\hat{\hat{T}}_{st|t>2000} = \mathbf{a}'_{st}\hat{\boldsymbol{\alpha}} + \hat{\nu}_{st} \tag{7}$$

Both of these estimates are creating a historical time series of data using the model, and are readily calculated given model outputs since all predicted parameters are recovered.

- **Forecasting**

  The model could also be used in a forecasting context to examine what one would have estimated with the telephone survey if it was conducted after 2017. This might be useful in a future stock assessment context, for example, if the analyst wants to compare assessments using both telephone and mail units of recreational effort using the estimated model. In this case, we would use the telephone predictor (e.g., purged of wireless effects) to produce future (from the standpoint of when the calibration statistical model was last run):

  $$\hat{\hat{T}}_{st|t>2017} = \mathbf{a}'_{st}\hat{\boldsymbol{\alpha}} + \hat{\nu}_{st} \tag{8}$$

  In this case, the analyst knows $\hat{\boldsymbol{\alpha}}$, has collected data on $\mathbf{a}$ (including future time periods), but $\hat{\nu}_{st}$ is unknown. For proceeding, one might either

  - Re-estimate the new model and recover new estimates, which would include an estimate for ν_{st} for the future time period, or
  - Perhaps the model as estimated would allow you to back out an estimate for ν_{st} in a future time period, given current parameter estimates. Ideally this should also include a new estimate of variance in that time period as well. Should the method be implemented, more guidance should be given by the research team as to how this should be approached. In the paper [4], equations (14) - (16) could well be covering this but a more thorough explanation of hindcasting versus forecasting would enhance understanding of the approach.

5.2.2 Prediction Uncertainty

For quantification of prediction uncertainty, it is worth noting that:

- Confidence intervals are likely to be large for calibrated values since they embody both sampling and forecasting error, this is especially true for effort measured in levels (rather than logs), and will probably also be large *even for*

states that have high effort levels. It isn't possible to assess this completely given the current presentation of results.

- Since effort is modeled as log-normal and all modeled units are log(Effort), the confidence intervals of effort units (rather than log effort units) are no longer symmetric about the mean. Any stock assessment or policy analysis that needs to use the effort distribution (rather than only the mean) will need more information from NMFS (and possibly training on how to use that information) than the percent-standard-error approach available now.

5.2.3 Estimation Strategy

The calibration approach uses the well-known Fey-Herriott Small Area Method [8]. The approach has the following advantages:

- Statistical properties are known and understood.
- Can be implemented using existing software packages (e.g. R).
- Allows the mean to contain random effects that, in principle, could be spatially or temporally correlated (although that isn't implemented in the current approach).

While the approach is widely used and accepted in the statistical community, there are some downsides to using the approach for this problem:

- The mean model is estimating separately from the sampling variance model.
- The model as it is currently coded in R (and perhaps other software packages) isn't totally suited for this estimation problem, since given the overlapping data collection for the period 2015-2016, there are *two observations per state and year,wave* whereas the software packages assumes a single observation per state and year,wave. The study team creatively gets around this and I will discuss this in more detail below.
- Since in the calibration context, we have in essence a missing data problem (e.g. no observations of mail estimates until 2015) and there are other methods that could be considered for these types of problems that would have been more of a natural fit (e.g. Bayesian Heirarchical Models). The study team examined this approach and found that it wasn't fruitful.

Defining the set of year,wave time periods for which only telephone estimates are available as T^T, for which only mail estimates are available as T^M, and for

which both telephone and mail estimates are available as $T^{T,M}$, based on equation (10) in the paper, construct the design matrix by stacking these time period blocks of observations as

$$\mathbf{x} = \begin{bmatrix} \mathbf{a}_t & \mathbf{0}\mathbf{b}_t & \omega\mathbf{c}_t \\ \mathbf{a}_t & \frac{\mathbf{b}_t}{2} & \frac{\omega\mathbf{c}_t}{2} \\ \mathbf{a}_t & \mathbf{b}_t & \mathbf{0}\omega\mathbf{c}_t \end{bmatrix} \begin{matrix} \text{if t} \in T^T \\ \text{if t} \in T^M \\ \text{if t} \in T^{T,M} \end{matrix} \tag{9}$$

while the dependent variable is

$$\mathbf{y} = \begin{bmatrix} \hat{\mathbf{T}}_t \\ \frac{\hat{\mathbf{T}}_t + \hat{\mathbf{M}}_t}{2} \\ \hat{\mathbf{M}}_t \end{bmatrix} \begin{matrix} \text{if t} \in T^T \\ \text{if t} \in T^{T,M} \\ \text{if t} \in T^M \end{matrix} \tag{10}$$

Given the current state of data collection there are no observations where only the mail survey was collected. Consequently, for estimation purposes *in the current paper*, the data used in estimation looks like this

$$\mathbf{y} = \begin{bmatrix} \hat{\mathbf{T}}_t \\ \frac{\hat{\mathbf{T}}_t + \hat{\mathbf{M}}_t}{2} \end{bmatrix}, \mathbf{x} = \begin{bmatrix} \mathbf{a}_t & \mathbf{0} & \omega\mathbf{c}_t \\ \mathbf{a}_t & \frac{\mathbf{b}_t}{2} & \frac{\omega\mathbf{c}_t}{2} \end{bmatrix} \begin{matrix} \text{if t} \in T^T \\ \text{if t} \in T^{T,M} \end{matrix} \tag{11}$$

Without any "Mail Only" time periods, the mail portion of the model is estimated over just 157 state and year,wave observations (for shore mode), while the telephone only part of the model has 2810 observations. All parameters are identified, although it should be pointed out that

- The mail-specific covariates ($\mathbf{b}$) enter the model for year,waves were both the mail and telephone surveys are present and enter as the average. Consequently, the model recovers $\boldsymbol{\mu}$ by fitting an average model over the average mail and telephone survey estimates.
- Since $\mathbf{a}$, $\mathbf{b}$, and $\mathbf{c}$ contain similar covariates and all enter the model when mail and telephone estimates exist, there is likely a very high degree of colinearity between the columns of $\mathbf{x}$ for these time periods.
- Due to data constraints, there is no attempt to model trends for the mail portion of the model.

Given that the primary use of the calibration method will be to predict mail estimates in past time periods, I recommend that some sensitivity analysis be performed particularly as it relates to the assumption of averaging mail and telephone

estimates for recovering $\boldsymbol{\mu}$. Try estimating a model that drops the overlapping telephone estimates for the period 2015-2016 and run the model over the data:

$$\mathbf{y} = \begin{bmatrix} \hat{\mathbf{T}}_t \\ \hat{\mathbf{M}}_t \end{bmatrix}, \mathbf{x} = \begin{bmatrix} \mathbf{a}_t & \mathbf{0} & \omega \mathbf{c}_t \\ \mathbf{a}_t & \mathbf{b}_t & \mathbf{0} \end{bmatrix} \begin{matrix} \text{if } \ \mathrm{t} \in T^T \\ \text{if } \ \mathrm{t} \in T^{T,M} \end{matrix} \tag{12}$$

If large differences are found (in parameters and in predictions) or if mail trend effects are deemed important, then the agency might consider re-visiting specification and estimation of the calibration model once more mail data is collected and, in particular, *including mail-only time periods for estimating the model*. It is important to note that the proposed approach does not strictly require simultaneously collected mail and telephone effort estimates for a given state and year,wave for identification of parameters. In fact, the presence of both estimates has to be creatively dealt with for using existing software. From an efficiency viewpoint it would be advisable to modify the `R SAE` package (or write custom code) to overcome this problem, however custom code has to be maintained by the agency and it is my belief that any efficiency loss associated with this estimation trick is not large enough to warrant a coding extension to this project.

5.2.4 Covariates

Covariates are listed in Table 1. The choice of co-variates included in the model (and experimented with during model development) are defensible from a statistical standpoint and the study team has investigated other covariates but ruled them out using model selection criteria. Covariates are chosen so that forecasting can be done without re-estimating the model, since time trends only enter via the state's population interacted with state fixed effects. This is a reasonable choice given the requirements of the model.

Given the importance of capturing the "wireless effect" and explaining differences between mail and telephone estimates, I was surprised that no efforts were made to try to capture this more directly given what we know about landline only and mostly landline households that tend to consist of older individuals who also tend to fish less. In my view it is advisable to investigate more nuanced variables in the wireless portion of the model ($\mathbf{c}$). For example, data on the total population of coastal counties *and* the total population of older individuals in coastal counties by state should be available from the U.S. Census and could be included in the model. Many Southeastern states have had a large and increasing influx of retirees since 2000 (particularly in coastal areas) and these covariates my help explain cross-state trends that would improve the wireless correction portion of

the model.

5.2.5 Results

I found the results section of the paper the most lacking and due to that, the strength of the proposed approach isn't showcased to the degree that it should be. The methodology paper should be expanded to include

- Details on estimated results

  It is difficult to know which covariates are in the model and how "subsets" drive the difference between telephone, telephone with wireless, and the mail portions of the model. The study team should include tables outlining covariates included (with descriptions) and tables of parameter estimates.

- Evidence for each of the 3 types of predictors discussed above

  One of the great strengths of the model is that it can predict into either mail or telephone effort units, and for telephone can predict with or without wireless effects. This isn't clear enough when presenting results, as the focus is only on the Mail estimates (EPLUBM). A nice addition would be to include some calibration case studies to show model capabilities both graphically and in tabular format.

- Details about the impact of the wireless effect

  Given the sometimes large differences between the mail and telephone estimates please provide more evidence about how big the wireless effect is. What is the telephone estimate post 2000 after wireless effects are purged? To what degree does it shrink the difference between Mail and Telephone estimates? A plot like Figure 1 could easily include two plots of $EPLUBT$ one that purges and one including wireless effects. In the figure, eyeballing where the pre-2000 telephone estimator ($\hat{T}$) are on the edge of the 95% confidence interval and after 2000 they fall away, I suspect that an $EPLUBT$ purged of the wireless effect would close some of this gap. That would be evidence the model is working as we expect and provides information that informs us about problems with the telephone survey since 2000.

- Evidence about what is driving the difference between mail and telephone

  This is related to the above point, but it would be useful to quantify what is driving the biggest difference between EPLUBT (wireless purged) and EPLUBM. Given that only the Mail Constant, Wave Constant $\times$ Mail Constant, and State

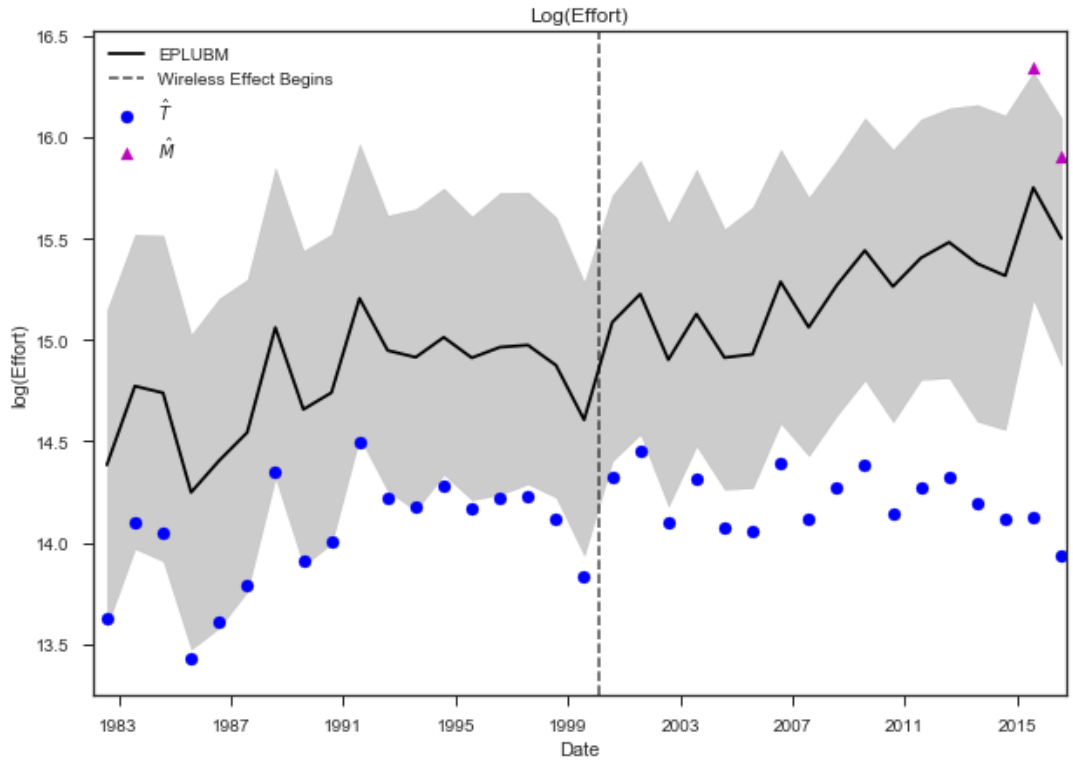

Figure 1: Florida Shore Mode Wave 4

Constant × Mail Constant are in the model, there isn't too much one can do here. One could look at the state and wave constants to see if anything systematic jumps out either spatially or temporally.

- Results in effort rather than log(effort) units

  Model outputs will be used in effort units most of the time. Please provide some figures and/or tables that show model predictions based on effort. Investigate how large prediction confidence intervals are in effort. I suspect that wireless might have relatively more important impact when examined using effort units.

6 Appendix 1: Bibliography

[1] Review of the marine recreational information program. Technical report, National Academy of Science, 2017.

[2] R. Andrews, J. M. Brick, and N. A. Mathiowetz. Development and testing of recreational fishing effort surveys testing a mail survey design: Final report.

[3] Atlantic and Gulf Subgroup of the Marine Recreational Information Program Transition Team, Marine Recreational Information Program, National Marine Fisheries Service. Transition plan for the fishing effort survey.

[4] F. J. Breidt, T. Liu, and J. D. Opsomer. A small area estimation approach for reconciling mode differences in two surveys of recreational fishing effort.

[5] F. J. Breidt, T. Liu, and J. D. Opsomer. Supporting materials. Included the files: EBLUPS.csv, EBLUPS_Variable_Names.csv, Model_Fits.txt, Mode_3_logeffort_poly_fixed.pdf, and Mode_7_logeffort_poly_fixed.pdf.

[6] CIE Review Rapporteur. Notes for day 1.

[7] CIE Review Rapporteur. Notes for day 2.

[8] R. E. Fay III and R. A. Herriot. Estimates of income for small places: an application of james-stein procedures to census data. *Journal of the American Statistical Association*, 74(366a):269–277, 1979.

[9] Marine Recreational Fisheries Program Staff. A comparison between fishing and wildlife's and mrip effort estimates.

[10] Marine Recreational Fisheries Program Staff. Sources of error and mail and chts surveys.

[11] Marine Recreational Information Program, National Marine Fisheries Service. Fishing effort survey transition progress report.

[12] National Marine Fisheries Service. Possible effects of calibration scenarios on stock assessments planned for the mrip fishing effort survey transition.

[13] Personal Correspondence: National Marine Fisheries Service. Effort survey improvements. http://www.st.nmfs.noaa.gov/recreational-fisheries/MRIP/effort-survey-improvements.

[14] Presenters at Review. Presentations. Available on Review Website.

[15] P. Rago. Eplub comparisons.

7 Appendix 2: Statement of Work

Statement of Work
National Oceanic and Atmospheric Administration (NOAA)
National Marine Fisheries Service (NMFS)
Center for Independent Experts (CIE) Program
External Independent Peer Review

Calibration Model Accounting for a Recreational Fishery Survey Design Change

Background

The National Marine Fisheries Service (NMFS) is mandated by the Magnuson-Stevens Fishery Conservation and Management Act, Endangered Species Act, and Marine Mammal Protection Act to conserve, protect, and manage our nation's marine living resources based upon the best scientific information available (BSIA). NMFS science products, including scientific advice, are often controversial and may require timely scientific peer reviews that are strictly independent of all outside influences. A formal external process for independent expert reviews of the agency's scientific products and programs ensures their credibility. Therefore, external scientific peer reviews have been and continue to be essential to strengthening scientific quality assurance for fishery conservation and management actions.

Scientific peer review is defined as the organized review process where one or more qualified experts review scientific information to ensure quality and credibility. These expert(s) must conduct their peer review impartially, objectively, and without conflicts of interest. Each reviewer must also be independent from the development of the science, without influence from any position that the agency or constituent groups may have. Furthermore, the Office of Management and Budget (OMB), authorized by the Information Quality Act, requires all federal agencies to conduct peer reviews of highly influential and controversial science before dissemination, and that peer reviewers must be deemed qualified based on the OMB Peer Review Bulletin standards. (http://www.cio.noaa.gov/services_programs/pdfs/OMB_Peer_Review_Bulletin_m05-03.pdf). Further information on the CIE program may be obtained from www.ciereviews.org.

Scope

The Office of Science and Technology requests an independent peer review of a calibration model proposed for use in revising statistics produced by surveys of marine recreational fishing effort on the Atlantic coast and in the Gulf of Mexico. This calibration model is considered by the Marine Recreational Information Program (MRIP) to be very important to adjust historical time series of recreational effort and catch estimates in order to account for biases in past sampling and estimation methods that have become apparent with the development of a new, more statistically sound method. The calibration model is intended to account for past biases in private boat and shore fishing effort estimates that have resulted from the continued use of a legacy random-digit-dial telephone survey design that has degraded over time and will be replaced with the implementation of a new mail survey design (the "Fishing Effort Survey", or FES) in 2018.

Calibration Model for the Fishing Effort Survey

In 2015, MRIP formed a Transition Team to collaboratively plan a transition from a legacy telephone survey design to a new mail survey design for estimating private boat and shore fishing effort by marine recreational anglers. Since 2008, MRIP had conducted six pilot studies to determine the most accurate and efficient survey method for this purpose on the Atlantic and Gulf coasts. The most recent study, conducted in four states in 2012-2013, compared a new mail survey design with the Coastal Household Telephone Survey (CHTS) design that has been used since 1979. MRIP subjected the final report from the pilot project to external peer review in 2014 and certified the new survey design, called the Fishing Effort Survey (FES), in February 2015 as a suitable replacement for the CHTS. The FES is much less susceptible to potential sources of bias than the CHTS because it can reach more anglers, achieve higher response rates, and is less prone to possible recall errors. The pilot project results indicated that FES estimates were substantially higher than CHTS estimates for both private boat fishing and shore fishing.

MRIP recognized the FES should not be implemented immediately as a replacement for the CHTS, and a well thought out transition plan was needed to ensure that the phase-in of the FES is appropriately integrated into ongoing stock assessments and fisheries management actions in a way that minimizes disruptions to these processes, which are based on input from multiple data sources over lengthy time series. The Transition Plan developed by the Transition Team called for side-by-side benchmarking of the FES against the CHTS for three years (2015-2017) with the development and application of a calibration model to enable adjustment of past estimates that account for biases in historical effort and catch statistics after the second year. With this timeline, revised estimates can be incorporated into stock assessments during 2018 using a peer reviewed calibration model, and new Annual Catch Limits (ACLs) can then be set in 2019 for at least some stocks.

Requirements

NMFS requires three reviewers to conduct an impartial and independent peer review in accordance with the SoW, OMB Guidelines, and the Terms of Reference (ToRs) below. The CIE reviewers shall have working knowledge and recent experience in the design of sampling surveys, the evaluation of non-sampling errors (i.e., undercoverage, nonresponse, and response errors) associated with changes to survey designs over time, and the evaluation of differences between surveys using different modes of contact (e.g., mail *versus* telephone). In addition, they should have experience with complex, multi-stage sampling designs, time series analyses, regression estimators, and small domain estimation methods. Some recent knowledge and experience in current surveys of marine recreational fishing is desirable but not required.

NMFS will provide a Chair who has experience with U.S. fisheries stock assessments and their application to fisheries management. The Chair would ensure that reviewers understand the importance of maintaining a comparable time series of marine recreational fisheries catch statistics for use in stock assessments and their application to fisheries management. The Chair will not be selected by the contractor and will be responsible for facilitating the meeting,

developing and finalizing a summary report and working with the CIE reviewers to make sure that the ToRs are addressed in their independent reviews.

Tasks for Reviewers

Pre-review Background Documents

The following background materials and reports prior to the review meeting include:

Transition Plan for the FES:
https://www.st.nmfs.noaa.gov/Assets/recreational/pdf/MRIP%20FES%20Transition%20Plan%20FINAL.pdf

Report recommending the FES to replace the CHTS: *Finalize Design of Fishing Effort Surveys* (https://www.st.nmfs.noaa.gov/pims/main/public?method=DOWNLOAD_FR_PDF&record_id=1179)

2015 Benchmarking Progress Report:
https://www.st-test.nmfs.noaa.gov/Assets/recreational/pdf/2015_FES_Progress_Report-20161115.pdf

Report on FES/CHTS Calibration Model:
This report will be provided by the contractor (via electronic mail or make available at an FTP site) to the CIE reviewers.

Panel Review Meeting

Each CIE reviewer shall conduct the independent peer review in accordance with the SoW and ToRs, and shall not serve in any other role unless specified herein. Each CIE reviewer shall actively participate in a professional and respectful manner as a member of the meeting review panel, and their peer review tasks shall be focused on the ToRs as specified herein. The meeting will consist of presentations by NOAA and other scientists to facilitate the review, to provide any additional information required by the reviewers, and to answer any questions from reviewers.

Contract Deliverables - Independent CIE Peer Review Reports

The CIE reviewers shall complete an independent peer review report in accordance with the requirements specified in this SoW and OMB guidelines. Each CIE reviewer shall complete the independent peer review according to required format and content as described in **Annex 1**. Each CIE reviewer shall complete the independent peer review addressing each ToR as described in **Annex 2**.

Other Tasks – Contribution to Summary Report

The CIE reviewers may assist the Chair of the panel review meeting with contributions to the Summary Report, based on the terms of reference of the review. The CIE reviewers are not required to reach a consensus, and should provide a brief summary of each reviewer's views on

the summary of findings and conclusions reached by the review panel in accordance with the ToRs.

Foreign National Security Clearance
When reviewers participate during a panel review meeting at a government facility, the NMFS Project Contact is responsible for obtaining the Foreign National Security Clearance approval for reviewers who are non-US citizens. For this reason, the reviewers shall provide requested information (e.g., first and last name, contact information, gender, birth date, passport number, country of passport, travel dates, country of citizenship, country of current residence, and home country) to the NMFS Project Contact for the purpose of their security clearance, and this information shall be submitted at least 30 days before the peer review in accordance with the NOAA Deemed Export Technology Control Program NAO 207-12 regulations available at the Deemed Exports NAO website: http://deemedexports.noaa.gov/ and http://deemedexports.noaa.gov/compliance_access_control_procedures/noaa-foreign-national-registration-system.html. The contractor is required to use all appropriate methods to safeguard Personally Identifiable Information (PII).

Place of Performance
The place of performance shall be at the contractor's facilities, and at the NMFS Headquarters in Silver Spring, Maryland.

Period of Performance
The period of performance shall be from the time of award through July 31, 2017. Each reviewer's duties shall not exceed 14 days to complete all required tasks.

Schedule of Milestones and Deliverables: The contractor shall complete the tasks and deliverables in accordance with the following schedule.

Within two weeks of award	Contractor selects and confirms reviewers
Within four weeks of award	Contractor provides the pre-review documents to the reviewers
June, 2017	each reviewer participates and conducts an independent peer review during the panel review meeting
Within two weeks of panel review meeting	Contractor receives draft reports
Within two weeks of receiving draft reports	Contractor submits final reports to the Government

Applicable Performance Standards
The acceptance of the contract deliverables shall be based on three performance standards: (1) The reports shall be completed in accordance with the required formatting and content (2) The reports shall address each ToR as specified (3) The reports shall be delivered as specified in the schedule of milestones and deliverables.

Travel
All travel expenses shall be reimbursable in accordance with Federal Travel Regulations (http://www.gsa.gov/portal/content/104790). International travel is authorized for this contract. Travel is not to exceed $15,000.

Restricted or Limited Use of Data
The contractors may be required to sign and adhere to a non-disclosure agreement.

NMFS Project Contact:
Dave Van Voorhees
National Marine Fisheries Service
1315 East West Highway
Silver Spring, MD 20910
dave.van.voorhees@noaa.gov

Annex I: Format and Contents of CIE Independent Peer Review Report

1. The report must be prefaced with an Executive Summary providing a concise summary of the findings and recommendations, and specify whether or not the science reviewed is the best scientific information available.

2. The report must contain a background section, description of the individual reviewers' roles in the review activities, summary of findings for each ToR, in which the weaknesses and strengths are described, and conclusions and recommendations in accordance with the ToRs.

   a. Reviewers must describe in their own words the review activities completed during the panel review meeting, including a brief summary of findings, of the science, conclusions, and recommendations.

   b. Reviewers should discuss their independent views on each ToR even if these were consistent with those of other panelists, but especially where there were divergent views.

   c. Reviewers should elaborate on any points raised in the summary report that they believe might require further clarification.

   d. Reviewers shall provide a critique of the NMFS review process, including suggestions for improvements of both process and products.

   e. The report shall be a stand-alone document for others to understand the weaknesses and strengths of the science reviewed, regardless of whether or not they read the summary report. The report shall represent the peer review of each ToR, and shall not simply repeat the contents of the summary report.

3. The report shall include the following appendices:

   Appendix 1: Bibliography of materials provided for review
   Appendix 2: A copy of this Statement of Work
   Appendix 3: Panel membership or other pertinent information from the panel review meeting.

Annex 2: Terms of Reference for the Peer Review

Calibration Model Accounting for a Recreational Fishery Survey Design Change

1. Evaluate the suitability of the proposed model for converting historical estimates of private boat and shore fishing effort produced by the CHTS design to estimates that best represent what would have been produced had the new FES design been used prior to 2017.

a) Does the proposed model adequately account for differences observed in the estimates produced by the CHTS and FES designs when conducted side-by-side in 2015-2016?

b) Is the proposed model robust enough to account for potential differences that would have been observed if the two designs had been conducted side-by-side in years prior to 2015 with regards to time trending biases?

c) How does the approach used in developing the proposed FES/CHTS calibration model compare in terms of strengths or weaknesses with other potential approaches?

d) Does the proposed calibration model help to explain how different factors would have contributed to changes in differences between CHTS and FES results over time?

e) Is it reasonable to conclude that revised 1981-2016 private boat and shore fishing effort estimates based on the application of the proposed FES/CHTS calibration model would be more accurate than the estimates that are currently available? Does evidence provided for this determination include an assessment of model uncertainty?

2. Briefly describe the panel review proceedings highlighting pertinent discussions, issues, effectiveness, and recommendations.

Tentative Agenda

Calibration Model Accounting for a Recreational Fishery Survey Design Change

TBD

National Marine Fisheries Service

Office of Science and Technology

1315 East-West Highway

Silver Spring, MD

June, 2017

Point of contact: Front Desk

8 Appendix 3: Panel Membership and List of Attendees

MRIP Calibration Model Peer Review Workshop
Sheraton Silver Spring Hotel
Silver Spring, MD
June 27-29, 2017

ATTENDANCE LIST

	NAME	AFFILIATION
1	Paul Rago	MAFMC SSC
2	Dave Van Voorhees	NOAA Fisheries
3	John Foster	NOAA Fisheries
4	Ali Arab	Georgetown University
5	Rob Hicks	College of William and Mary
6	Cynthia M. Jones	Old Dominion University
7	Richard Cody	NOAA support ECS
8	Teng Liu	Colorado State University
9	Thomas Sminkey	NOAA Fisheries/ST1
10	Steve Turner	NOAA Fisheries SEFSC
11	Andy Strelcheck	NOAA Fisheries - SERO
12	Richard Methot	NOAA Fisheries - HQ
13	Karen Pianka	NOAA Fisheries âĂŞ ST1
14	Lauren Dolinger Few	NMFS ST1
15	Chris Wright	NMFS - SF
16	Sabrina Lovell	NMFS ST
17	Patrick Lynch	NMFS ST
18	Melissa Karp	NMFS ST
19	Toni Kerns	ASMFC
20	Steve Ander	Gallup
21	Tommy Tran	Gallup
22	Melissa Niles	Fifth Estate/MRIP CET
23	Yong-Woo Lee	NOAA - Fisheries
24	Jay Breidt	Colorado State University
25	Jean Opsomer	Colorado State University
26	Rob Andrews	NOAA Fisheries
27	Ryan Kitts-Jensen	NOAA Fisheries
28	Fred Serchuk	SAFMC SSC
29	Jason McNamee	ASMFC
30	Patrick Sullivan	Cornell/NEFMC
31	Jason Didden	MAFMC
32	Daemian Schreiber	NMFS HQ
33	Laura Diederick	NOAA Fisheries