

**Individual Reviewer Report  
Marine Recreational Information Program (MRIP)  
Fishing Effort Survey (FES) Calibration Review**

**Calibration Model Review Meeting  
June 27-29, 2017  
Sheraton Hotel  
Silver Spring, MD**

**July 16, 2017**

**Panel Member Review from**

**Jason McNamee**

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## **1. Executive Summary**

This report summarizes the technical review from one of seven independent scientists of a calibration model to interrelate estimates of recreational fishing effort derived from the Coastal Household Telephone Survey (CHTS) with the Fishing Effort Survey (FES). A side-by-side experiment of the two methods, conducted in 2015 and 2106, served as the basis for this review.

The proposed modeling methodology uses a time series of historical recreational effort data and a set of explanatory covariates to convert the effort metric from one currency to another. This can be done in either direction, meaning FES can be converted to CHTS and vice versa. This is an attribute of this selected approach. Alternative modeling approaches were investigated by the researchers, but were not presented formally to the review panel. Despite this, the proposed method was deemed reasonable and scientifically-defensible and the authors are commended for their work on the Fay-Herriot model for this calibration application. An attribute of the approach the researchers used is that the model is implemented in R statistical software, making the model code accessible to other researchers for additional testing and future development. The proposed model is considered an elegant approach for dynamic predictions of recreational fishing effort, allowing for forward and backward estimation in different currencies of effort (i.e., can be calculated in CHTS or FES effort metrics). Differences among states and seasonal changes in effort (as represented by two-month periods referred to as waves) are accounted for in the model parameters, a very important aspect to the future use of this approach to account for recreational effort changes through time.

There were concerns on several topics, but as noted in the summary report, none of the concerns prohibit implementation of the Fay-Herriot model for the MRIP calibration. No single hypothesis (or covariate) was sufficient to explain the differences between the CHTS and FES estimates and this will make the explanation to the public difficult. This difficulty in outreach should not be underestimated by the MRIP program. When the results of the 2017 side-by-side experiment are available, it is recommended that some additional work be conducted and documented including simulation testing beyond that already done for the irregular term in the model. This testing will better answer some of the terms of reference that were not well addressed during the current workshop. Additionally, there may be an opportunity during this update to better document alternative models that are tested for the calibration exercise, allowing the researchers to better support why the Fay-Herriot method was deemed a superior method to other options available. Further refinement of some of the important covariates will be a worthwhile effort when the 2017 side-by-side data becomes available, namely, the population covariate can be filtered to better represent the population of interest (i.e. coastal communities) rather than the broad population growth of the entire state. Finally, while recognizing that resources are limited, future side-by-side comparative survey experiments should be considered to test how the model parameter estimates are holding up over time.

## **2. Introduction**

### ***2.1 Background***

For the sake of completeness, section 2 of this individual report is reproduced from the review panel summary report. The Review Panel for the MRIP-FES Calibration Model Review met from June 27 to June 29 to review a statistical model developed by F. Jay Breidt, Teng Liu and Jean D. Opsomer, of Colorado State University. The review committee was composed of three scientists appointed by the Center for Independent Experts (CIE): Robert Hicks, The College of William and Mary, Cynthia Jones, Old Dominion University and Ali Arab, Georgetown University. In addition, representatives from the New England (Patrick Sullivan) and South Atlantic (Fredric Serchuk) Scientific and Statistical Committees, and the Atlantic States Marine Fisheries Commission (Jason McNamee) served on the review panel. The meeting was chaired by Paul Rago as a member of the Mid-Atlantic Fishery Management Council Scientific and Statistical Committee.

The panel reviewed supporting documentation and presentations prepared by MRIP staff, led by Dave Van Voorhees, and their contractors from the Department of Statistics at Colorado State University. John Foster, Ryan Kitts-Jensen, and Richard Cody of MRIP acted as rapporteurs, providing valuable daily summaries for the Panel. Other staff from the Office of the Science and Technology, notably Karen Pianka, assisted in the efficient handling of documents via a web-based application. Jason Didden of the Mid Atlantic Fishery Management Council provided extensive support for the webinar. Approximately 35 people participated in the open sessions of the meeting. The meeting followed the agenda in Appendix 2 with respect to the sequence but not necessarily the timing of the events. Adjustments were made for differences in the duration of presentations and follow-up questions.

## ***2.2 Review of Activities***

About ten days before the meeting the panel was given access to a comprehensive working paper summarizing the proposed statistical model. Prior the meeting, the chair met with the presenters and Marine Recreational Information Program (MRIP) staff via a conference call to discuss the scope of the contributions, presentation format and draft agenda. All supporting documents and presentations were made available to reviewers via a web-based application known as Confluence. In addition, the MRIP staff added a web page to their site that provided members of the public and other managers with access to key papers and presentations. The meetings were broadcast via webinar with the able assistance of Jason Didden of the Mid-Atlantic Fishery Management Council. Mr. Didden also managed all of the in-room computer and audio visual equipment.

The meeting opened on the morning of Tuesday June 27, 2017, with welcoming remarks and comments on the agenda by Van Voorhees and Rago. Participants and audience members introduced themselves. Following introductions, sessions on June 27 were devoted to presentation and initial discussions of five agenda topics. Robert Andrews provided an overview of the transition from the fishing effort surveys based on a Coastal Household Telephone Survey (CHTS) to the Fishing Effort Survey (FES), based on a mail survey. Richard Methot addressed the importance of properly calibrated effort for estimation of catch in stock assessments. Andy Strelcheck addressed the importance of catch information as a basis for fisheries management policies and decisions, such as allocation. Jean Opsomer provided an overview of the challenges

of applying calibration methods to historical time series. Jay Breidt led the presentation of the proposed statistical calibration model.

Each presentation was followed by a question and answer period by panel members and as appropriate, by other meeting attendees. Questions from web participants were also addressed at opportune times. A formal public comment period was reserved on each day of the meeting.

The Panel met in closed session at the end of each day to discuss the day's presentations, progress toward answering the agenda, and to make plans for the following day.

Follow-up discussions on the first day presentations were held on Wednesday June 28. The Panel requested additional data and clarification from the presenters, including greater details on the model results. Day two began with an overview of the activities of Day One and an overview of the day's work plan. Most of the Panel's efforts were devoted to questions on the statistical calibration model. Material provided by Jay Breidt and colleagues enhanced the Panel's understanding of the model and its performance. A short presentation by Paul Rago used the results of model predictions to compare results over states and fishing modes (i.e., shore vs private boat).

Day Two also included a formal public comment period and an initial summary of the Panel's findings. This was done to ensure that all participants were aware of the general outcomes of the review. The Panel stressed that this summary was not to be considered a consensus report. Instead it represented a summary of the perspectives of the Panel.

Following the initial presentation of findings, the Panel met in closed session to begin writing the Summary Report. Day Three consisted of a half day meeting for Panelists only. The purpose of the meeting was to summarize the various viewpoints herein with respect to the Terms of Reference.

The Panel completed drafting this Summary Report by correspondence, evaluating each TOR. The Chair compiled and edited the draft Panel Summary Report, which was distributed to the Panel for final review before being submitted to the MRIP. Each Panelist also provided an independent summary of their perspectives and as appropriate, with details on potential improvements to the calibration model and its application. Individual panelist reports for CIE participants were sent to the Center for Independent Experts for initial editing for completeness. Reports of Panelists supported directly by the Agency via contract were sent to the Chair. All reports were made available to MRIP staff for fact checking but were not altered for content.

The Panel agreed that scientific and statistical analyses conducted by the presenters were thorough, statistically sound, and innovative. Specific comments on the details of the analyses are provided below.

### **3. Review of MRIP FES Calibration Model**

#### ***3.1 Synopsis of Individual Panel Member Review***

As noted in the review panel summary report, the proposed methodology builds upon known properties of the existing sampling design and the extensive time series of historical data on important potential covariates that could impact effort information. The presentation given during the review on the synthesis of other attempts at calibrating survey information in other disciplines revealed no comparable attempts to adjust a historical times series backward in time in response to new information from a side-by-side comparison. Having no additional knowledge of projects conducted to calibrate surveys in this manner, the premise that this was a unique investigation was accepted, and this illustrated that the research conducted to calibrate the effort information being produced by the two survey approaches was not as simple as retrofitting some previously tested approach to the MRIP effort estimation information.

The proposed model was considered to be a well-designed approach for dynamic predictions of recreational fishing effort. It was also agreed that the property allowing for forward and backward estimation by alternate survey modes (i.e., CHTS vs FES) was an attribute of this approach. Because of the ability to switch the “currency” of the estimate between CHTS and FES, additional comparisons can be made in the future to test how well the model is able to estimate past CHTS data given new FES data, which would allow for additional judgement as to how well the model performs through time as conditions potentially change. It would be beneficial to conduct future side by side comparisons to provide new data with which to test how well the model continues to perform in to the future, but it is understood that resources are limited.

The lack of information presented on alternative modeling approaches and other candidate covariates that might have been considered was an item of note. The proposed method was a reasonable and scientifically defensible estimation approach, but it was difficult to judge whether this approach was truly superior to other potential approaches that could have been used. For instance, one of the hypotheses of why the CHTS has become unreliable is that there is a change in behavior of anglers with regard to the use of caller ID and switching to cell phones from landline telephone systems. This effect could be a time trending effect, and there are state space modeling approaches that can estimate time trending effects (Newman et al 2014) , and there are also Bayesian hierarchical techniques (Gelman et al 2013) that can function in this same way to better account for and quantify process errors that may occur within modeling frameworks. It appeared that at least some of these types of approaches were investigated by the researchers, however this information came out during discussion so was not formally presented to the reviewers nor included in any of the pre-meeting materials, making it difficult for the reviewers to judge for themselves the logic of modeling approach used by the researchers.

The final selected calibration model chosen by the researchers is a well-founded and appropriate choice, and an additional attribute is that the researchers implemented the model using R statistical software (R core team 2016), which is free and readily available. This will allow future running and future development of the model. It would have been useful and appropriate to have had the source code provided by the researchers to the reviewers as this would have allowed for a more mechanistic understanding of the model which was somewhat difficult to fully grasp from the working paper provided on the model alone.

In accordance with the summary report from the review panel, the concerns expressed above aren't considered sufficient to preclude implementation of the model. Echoing one important concern, however, the result of the calibration increases effort by a large margin. This will have major implications on the outcome of stock assessment information, and as importantly, this result will impact many facets of management such as proportion of harvest across fishing modes (i.e. party and charter boat mode effort is not impacted by this calibration while private boat and shore angling modes are increased) and may have impacts to allocations of important recreational species amongst states. Given the magnitude and importance of the changes of the calibration results to our fisheries processes, it will be important to better define what the causative factors are for this change so that this information can be communicated out to the fisheries community at large. Without this systematic understanding of what caused the changes between the two different effort survey methodologies, it will be difficult for constituents to buy in to the information being produced by the model.

### ***3.2 Evaluation of Terms of Reference***

#### ***3.2.1 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.***

- The Individual Panel Member concurs that this TOR and its subcomponents listed below (1a,1b, 1c, 1d, 1e) were met.
- 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?

While in agreement that the model is suitable for understanding differences between the survey methodologies, similar concerns to those expressed in the summary report remain. The model converts CHTS to FES effort metrics, allowing for a retrospective recalibration of the effort levels back in time, which is critical to being able to better assess fish stocks with high recreational participation. However, the model and the investigation in to the data failed to determine any one or set of covariates that would account for why the results between the two survey estimates of effort are so different from each other in a mechanistic way. This is not a fault of the researchers, many data sources and potential covariates were investigated during model development to test various hypotheses on why the effort calculations differed between the two survey types, which was an attribute of the project, but this point is brought up to highlight the need to continue to investigate the underlying data and to seek out new data sources that may better explain in a mechanistic way why the changes occurred due simply to a change in survey method, and why the changes are so large.

- 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?

In agreement with the summary report, the main covariate investigated to test the hypothesis of a time varying trend in the performance of the CHTS was a significant effect in the model (namely, the increase in wireless-only households), however the practical effect of that covariate did not appear to be strong enough to create the differences seen in the output by itself. This finding will make it difficult for the fishing community to understand why the effect of the model is so large. Further investigation in to additional explanatory covariates should continue and their impact on the model should be tested through time. Not only is this important for the edification of the fishing community, but if and when there is a better causal mechanism identified for the changes in effort estimation, there will be more confidence that the model is not misspecified and will continue to produce reliable effort calibration calculations forward in time.

With regard to how robust the model is, the researchers focused on one area of sensitivity testing, and that had to do with the error distribution assumption around the “irregular” terms. This was a strength of the research, and the researchers proved that their model was robust to different assumptions with regard to this error distribution. This strategy could have been extended to other areas of the model, and a more comprehensive simulation testing could have been done to test the models performance to different biases in underlying data. A fuller simulation testing procedure would have more comprehensively met this term of reference, but the simulation testing that did occur was appreciated and gave confidence in the model performance to this specific assumption.

Issues with not identifying the main causal mechanism notwithstanding, the model does appear to produce output consistent with the underlying hypothesis that the CHTS information has degraded through time, and the output when converting from CHTS to FES information shows the magnitude of the differences between the two surveys decreasing when applied to the historical time series. This gives some confidence that the model as specified is picking up and accounting for the signal in the data.

- 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?

This was an area of weakness found during the review. It was apparent that the researchers did rigorous internal model testing to find the best fitting model given the data that they investigated, which was documented during the presentation and was covered in the working paper. What was not apparent was how the researchers ended up at their preferred approach, the Fay-Herriot model. During the review the researchers did mention that they tested alternative modeling approaches including some of the approaches mentioned by the review panel in the summary report, however this was not documented in the working paper nor was it a highlight of the presentation given by the researchers. The researchers did verbally explain to the reviewers that this approach vetting did occur, however, given that this was a direct TOR for the review workshop, it would have been preferable to have had more information on this part of the research project.

It would still be worthwhile to produce some information on the approach vetting that occurred during this project in an effort to document and support the Fay-Herriot procedure for this use. Beyond the additional support for the CHTS to FES calibration, a better documentation of the approach vetting procedure will prove valuable for the other calibration efforts that the MRIP will be undergoing in the near future, such as the calibration of the new Access Point Angler Intercept Survey (APAIS) procedures to the old intercept methodology.

As a side note, it was noted that the researchers were not provided the TORs that the reviewers were working under until the week prior to the review workshop, which may have led to a number of the concerns expressed by the reviewers. For future calibration work undertaken by MRIP, an effort should be made to get the review TORs to the researchers so that they may highlight these pieces of information, which will make the review workshops run smoother and allow for easier evaluation of the research projects relative to the given TORs.

- 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?

The calibration model certainly helps to explain the differences found between the two survey methods through time. The identification of the underlying causal mechanism remains to be better defined as mentioned previously, however the existing set of covariates chosen for the model seems to account for the differences between the two survey methods, and also seems to account for the fact that these effects change through time as evidenced in Figures 3 and 4 from the Breidt et al working paper (Appendix 1).

Some of the data that was used could be better defined. Specifically, the population covariate used was a broad population metric, but filtering this metric to the population considered to be in close proximity to the coast might be a better way to investigate the population effect in the model. Different trends in population changes in coastal areas relative to the overall population of a state may be informative and could provide a better statistical fit of the model to the data.

Despite these comments, the model does show how the data sources in the model effect the output over time. This was further highlighted by work produced by Review Workshop Chairman Paul Rago during the workshop, showing how trends in the data changed depending on the years investigated.

- 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?

As noted in the summary report, there was no information provided with regard to evaluating accuracy, nor would this be possible in the context of the information available as this whole project centers around determining differences in self-

reported data. Without doing a study specific to investigate the accuracy of a self-reporting program, which would be very different from the research done for the calibration workshop, this information could not be produced by the researchers nor evaluated by the reviewers.

The only possibility that could have been investigated would have been simulation testing of the model with regard to known hypothetical data. The researchers could have produced datasets with specific known biases, and then investigated how the model performed relative to those biases. This would have produced information on the robustness of the model to various forms of bias, however not on “accuracy” in the technical sense of the term.

### 3.2.2 Term of Reference 2

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

In accordance with the review workshop summary report, the following are reviewer specific comments following the same section format used in the summary report. Some of the following is duplicative with those comments in the summary report.

#### Pre-Meeting Preparations

Background documents were provided to review panel members prior to the meeting, but additional documents and presentations were only made available during the meeting after it was realized additional information was needed to better evaluate the TORs for the workshop.

Coordination between the researchers and the MRIP with regard to the TORs would have created better flow in the workshop and less on the fly information would have been needed if the TORs had been available to the researchers with an understanding that the review panel was going to be evaluating their work relative to those TORs.

Additional background documents would have been useful for the review as well, in particular existing information of the previous comprehensive reviews of the MRIP, such as the one from the National Academy of Sciences (NAS). In this context, basic details about the surveys including similarities and differences in definitions of effort, questions in the new FES survey, etc. would have helped the reviewers to more effectively conduct the review. On the positive side, the review panel was fortunate to have had two of the participants from this previous NAS review on the panel to help with the understanding of these previous determinations.

#### Proceedings

In accordance with the review panel summary report, the meeting and proceedings went well. The researchers did an excellent job producing information during the workshop to help the reviewers with their task of evaluating the calibration model, the concerns noted

above notwithstanding. Additionally, the workshop chairman did an exemplary job of keeping the researchers and reviewers on track to complete the review in the time allotted.

Given the effectiveness of the proceedings and the ability of the researchers to produce needed information during the workshop, it is believed that the proposed MRIP FES calibration model developed by Breidt *et al.* is a well-suited and statistically-appropriate approach to obtain calibrated estimates of recreational fishing effort (by state and 2-month calendar quarter for shore-based and private boat anglers) during 1982-2016.

### Utility of Presentations

The presentations on the implications of revised recreational catch estimates on stock assessments, management measures, and regulatory protocols were helpful and helped put the workshop in to context, but additional presentations, would have been very informative for more specific context of the impacts of the calibration exercise. As an example, there are previously completed stock assessment exercises conducted by the Northeast and Southeast Fisheries Science Centers that could have been presented to show what the effect of the new estimates are relative to previously assessed population information.

Similarly, as mentioned above, more comprehensive simulation exercises would have been useful in the evaluation of the TORs, and so could have been presented in addition to the specific model information that was presented.

The presentation on the Fay-Herriot model was well done and helped with the interpretation of the working paper, but more details on the model components and the model building process would have been appreciated. Also, a summary of other candidate modeling approaches that were vetted would have been useful. Such details, as provided on the second day of the review, were greatly appreciated and helped the reviewers complete their evaluation of the TORs. Further work on simulated data sets is suggested for the final year comparisons.

### Terms of Reference

The presenters did not address the TORs directly, which made it hard for the reviewers to assess the relevance of some of the information presented with regard to the TORs. Consequently, the reviewers spent a substantial portion of the discussion periods on obtaining the requisite information to address the TORs, some of which were not able to be addressed fully due to the constraint of time. Follow-up work accomplished by the researchers during the meeting gave the reviewers confidence that sufficient model scoping had been performed, though more information on this topic should be aggregated for the benefit of future review workshops on the various MRIP transitions in progress.

TOR 1e sought information concerning the accuracy of effort estimates obtained from the CHTS and the FES. Self-reported data is subject to a variety of biases that result from forgotten aspects of fishing trip. Without an external measure of fishing from an onsite survey covering the same population in space and time, angler self-reported data cannot be verified or tested for accuracy. While the review panel commented on the calibration

from CHTS to FES, there was no basis to comment on accuracy of either survey to meet that TOR.

#### Documentation for Meeting

The technical report on the Breidt et al. calibration modeling approach was difficult to understand. The researchers did a great job of enhancing understanding during the meeting, including an informative exchange on Day 2 of the workshop between the reviewers and the researchers, and this helped inform evaluation of the TORs on the model by clarifying what the modeling approach was actually doing with regard to the data examined. This should be better appreciated in the future APAIS peer review to allow that workshop to proceed in a more efficient fashion.

#### Ancillary Analyses

The presentation and documentation of the model and assumptions were well thought out, but the reviewers would have appreciated more information on the model inputs, parameter definitions, and nuances of the Fay-Herriot model. Panelists received model parameter estimates upon request but did not have time at the meeting to explore them fully. Access to more detailed model outputs and the estimation code in R would have been valuable.

Additionally, several independent data analyses existed, separate from the model, which came out during the workshop. It would have been helpful to have had a presentation and some discussion on these alternate approaches. Exploratory analyses of the pairwise calibration data was considered useful and should be considered for summarization when the analyses of the 2017 data are conducted.

#### Communication

There was a lot of discussion on the communication of the MRIP transition process to the public and other stakeholder groups, of which this calibration model is one element. While this was not a direct TOR for the review workshop, these points were believed to be important for the MRIP to consider. A detailed outline of the importance of the communication of the calibration model, and the MRIP transition process in general, is given in the review panel's summary report and is not reproduced here, but this reviewer will emphasize the importance of heeding those comments as the MRIP transition proceeds.

## **4. Bibliography**

### **Background Papers**

Background on the MRIP Calibration Model Peer Review may be found at:  
<https://www.st.nmfs.noaa.gov/recreational-fisheries/MRIP/FES-Workshop/index.html>

The National Academies of Sciences, Engineering, and Medicine. 2016. Review of the Marine Recreational Information Program (MRIP) Washington, DC: The National Academies Press. doi: 10.17226/24640  
[https://www.st.nmfs.noaa.gov/confluence/display/FESCALIB?preview=/73074985/73728799/NAS\\_MRIP\\_review.pdf](https://www.st.nmfs.noaa.gov/confluence/display/FESCALIB?preview=/73074985/73728799/NAS_MRIP_review.pdf)

National Research Council. 2006. Review of Recreational Fisheries Survey Methods. Committee on the Review of Recreational Fisheries Survey Methods, ISBN: 0-309-66075-0, 202 pages. <http://www.nap.edu/catalog/11616.html>

### **Working Papers**

Development and Testing of Recreational Fishing Effort Surveys Testing a Mail Survey Design: Final Report. Project Team Members: Rob Andrews, NOAA Fisheries, J. Michael Brick, Westat, Nancy A. Mathiowetz, University of Wisconsin-Milwaukee. July 31, 2014. [https://www.st.nmfs.noaa.gov/recreational-fisheries/MRIP/FES-Workshop/documents/Report\\_recommending\\_FES\\_to\\_replace\\_CHTS--Finalize\\_Design\\_of\\_Fishing\\_Effort\\_Surveys.pdf](https://www.st.nmfs.noaa.gov/recreational-fisheries/MRIP/FES-Workshop/documents/Report_recommending_FES_to_replace_CHTS--Finalize_Design_of_Fishing_Effort_Surveys.pdf)

Marine Recreational Information Program Fishing Effort Survey Transition Progress Report. October 28, 2016. [https://www.st.nmfs.noaa.gov/recreational-fisheries/MRIP/FES-Workshop/documents/2015\\_benchmarking\\_progress\\_report.pdf](https://www.st.nmfs.noaa.gov/recreational-fisheries/MRIP/FES-Workshop/documents/2015_benchmarking_progress_report.pdf)

Marine Recreational Information Program Transition Plan for the Fishing Effort Survey Prepared by the Atlantic and Gulf Subgroup of the Marine Recreational Information Program Transition Team May 5, 2015 [https://www.st.nmfs.noaa.gov/recreational-fisheries/MRIP/FES-Workshop/documents/MRIP\\_FES\\_Transition-Plan\\_FINAL.pdf](https://www.st.nmfs.noaa.gov/recreational-fisheries/MRIP/FES-Workshop/documents/MRIP_FES_Transition-Plan_FINAL.pdf)

A Small Area Estimation Approach for Reconciling Mode Differences in Two Surveys of Recreational Fishing Effort draft: F. Jay Breidt, Teng Liu, Jean D. Opsomer Colorado State University June 10, 2017 [https://www.st.nmfs.noaa.gov/recreational-fisheries/MRIP/FES-Workshop/documents/DRAFT-Report\\_of\\_Calibration\\_Model.pdf](https://www.st.nmfs.noaa.gov/recreational-fisheries/MRIP/FES-Workshop/documents/DRAFT-Report_of_Calibration_Model.pdf)

### **Additional References**

Gelman, A, Carlin, JB, Stern, HS, Dunson, DB, Vehtari, A, Rubin, DB. 2013. Bayesian Data Analysis (3<sup>rd</sup> edition). Chapman and Hall, CRC. 667 p.

Newman, KB, Buckland, ST, Morgan, BT, King, R, Borchers, DL, Cole, DJ, Besbeas, P, Gimenez, O, Thomas, L. 2014. Modelling Population Dynamics: Model formulation, fitting and assessment using state-space methods. Springer. 215 p.

R Core Team (2016). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL <https://www.R-project.org/>.

## 5. Appendices

### Appendix 1. Figures referred to in this review report

From Breidt et al working paper:

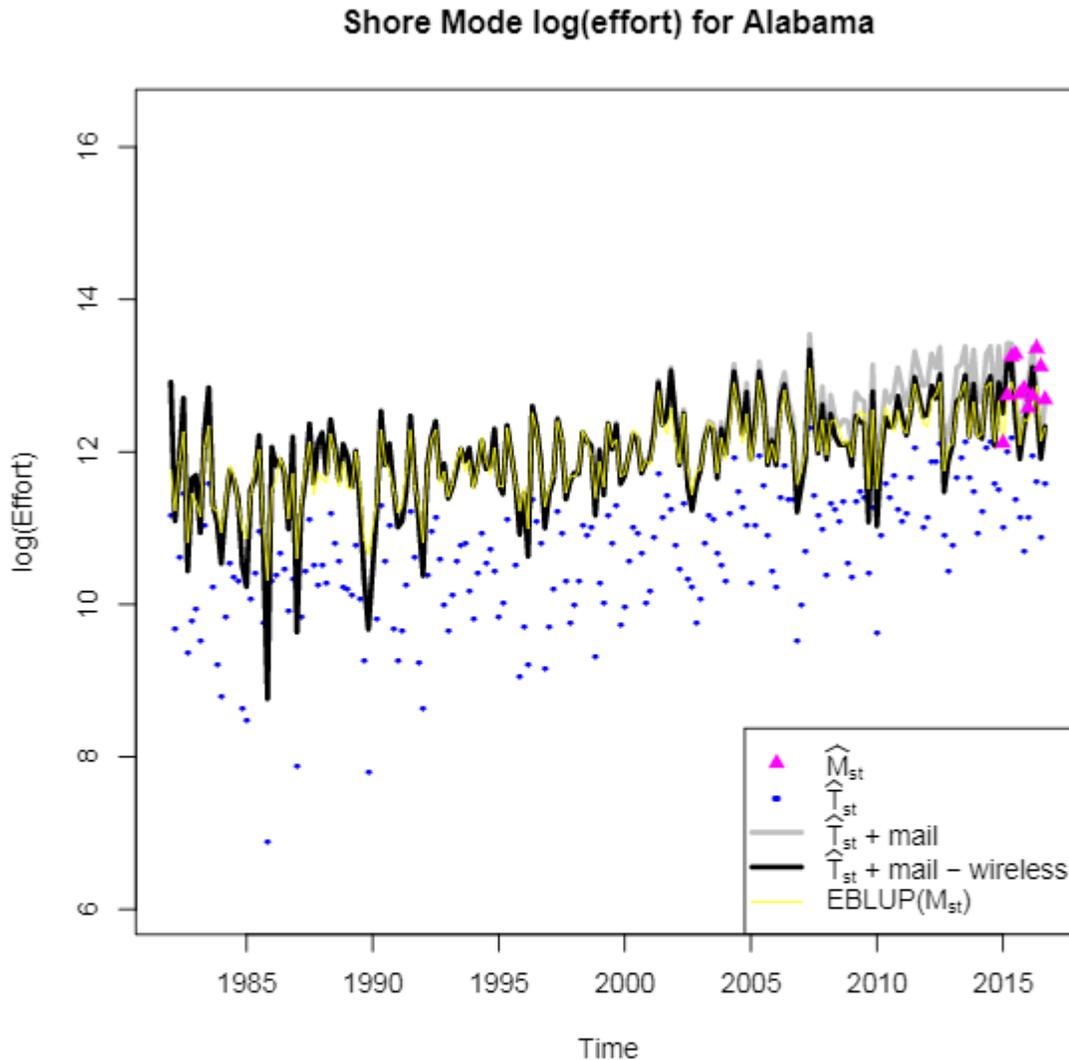


Figure 3: EBLUP's  $\{\phi_{st}(\widehat{\beta}, \widehat{\psi})\}$  (gold curve) of mail targets  $\{M_{st}\}$  for shore fishing log-effort in Alabama. Blue dots are telephone log-effort estimates  $\{\widehat{T}_{st}\}$  and pink triangles are mail log-effort estimates  $\{\widehat{M}_{st}\}$ . For comparison to EBLUP's, gray curve is the estimator  $\{\widehat{T}_{st} + \mathbf{b}'_{st}\widehat{\boldsymbol{\mu}}\}$  that adjusts only for mail methodology effects, and black curve is  $\{\widehat{T}_{st} + \mathbf{b}'_{st}\widehat{\boldsymbol{\mu}} - w_{st}\mathbf{c}'_{st}\widehat{\boldsymbol{\gamma}}\}$  that adjusts for mail and wireless.

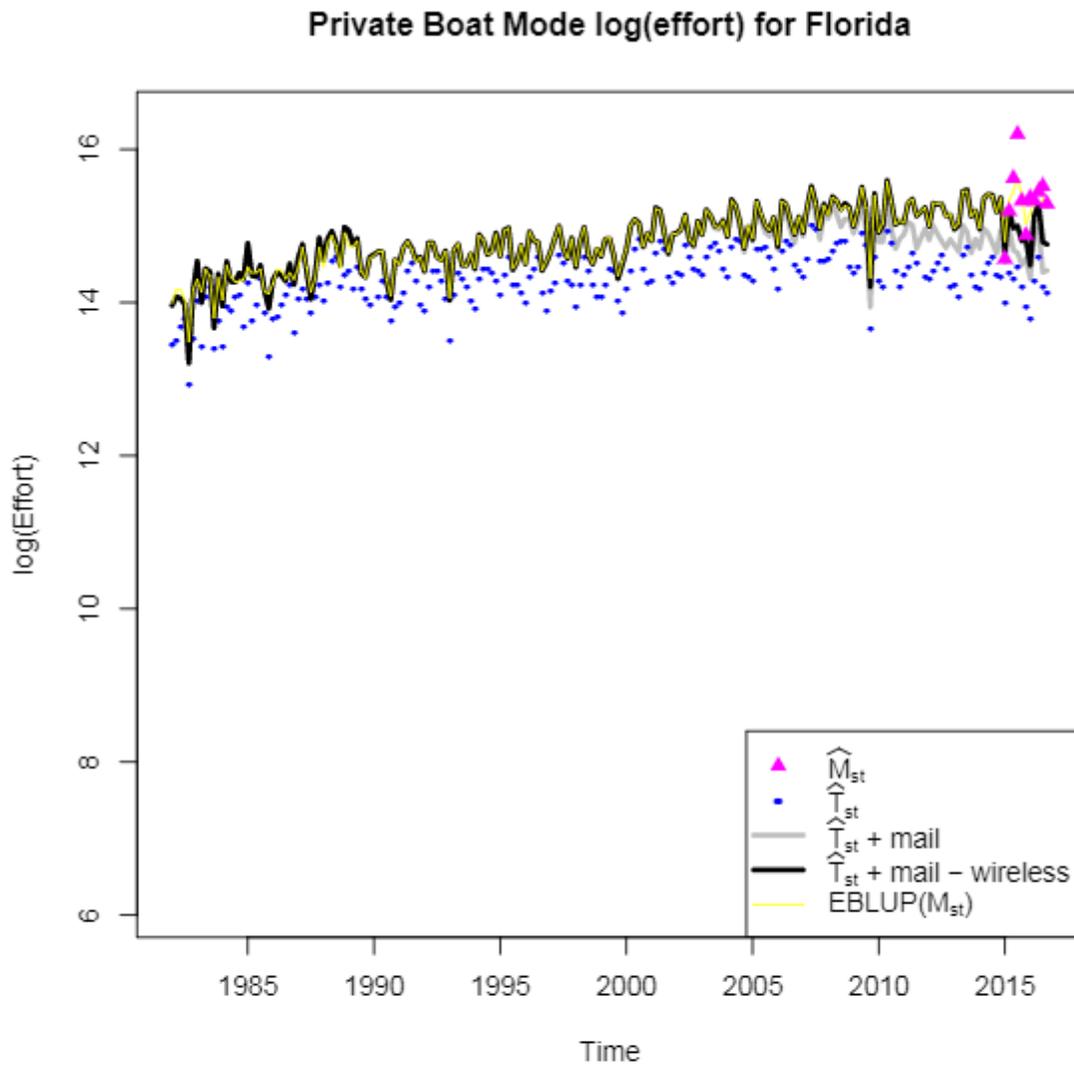


Figure 4: EBLUP's  $\{\phi_{st}(\widehat{\boldsymbol{\beta}}, \widehat{\boldsymbol{\psi}})\}$  (gold curve) of mail targets  $\{M_{st}\}$  for private boat fishing in Florida. Blue dots are telephone log-effort estimates  $\{\widehat{T}_{st}\}$  and pink triangles are mail log-effort estimates  $\{\widehat{M}_{st}\}$ . For comparison to EBLUP's, gray curve is the estimator  $\{\widehat{T}_{st} + \mathbf{b}'_{st}\widehat{\boldsymbol{\mu}}\}$  that adjusts only for mail methodology effects, and black curve is  $\{\widehat{T}_{st} + \mathbf{b}'_{st}\widehat{\boldsymbol{\mu}} - w_{st}\mathbf{c}'_{st}\widehat{\boldsymbol{\gamma}}\}$  that adjusts for mail and wireless.