# Center for Independent Experts (CIE) Independent Peer Review Report on the Marine Recreational Information Program (MRIP APAIS) Access Point Angler Interview Survey (APAIS) Calibration Peer Review

## Calibration Peer Review Workshop
## March 20-22, 2018
## Sheraton Hotel
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*Mary C. Christman*
*MCC Statistical Consulting, Gainesville, FL 32605*
*marycchristman@gmail.com*

# Contents

## Executive Summary

A workshop was held in March 2018 in Silver Spring, Maryland, to review a proposed method for calibrating estimates of population parameters, such as CPUE for selected species or total effort (in angler-trips), collected in years prior to 2013 under the Access Point Angler Intercept Survey (APAIS) performed under either the Marine Recreational Fisheries Statistics Survey (MRFSS) Program and its replacement, the Marine Recreational Information Program (MRIP), to those which would have been obtained had the currently (since the second quarter of 2013) implemented version of the MRIP APAIS sampling design been in place. Such calibrations are critical to effective management of recreational fisheries since decisions rely on accurate and precise time series of the results of recreational activities. Changes to sampling designs that alter the sampling frame or population, such as sampling over all 24hrs in day versus only a subset of the 24hrs, can have a major effect on the estimates derived from the collected data and so calibration to account for such change is critical.

The current sampling design for MRIP APAIS is a statistically valid sampling design that provides unbiased estimates of various parameters describing the recreational fishery along the east coast of the US and in the Gulf of Mexico. It was initiated in 2013 after a pilot study in NC in 2010, and after in-depth review by the National Academy of Sciences. It replaced the original APAIS survey design, known as the Marine Recreational Fishery Statistics Survey (MRFSS) APAIS, which was an opportunistic sampling design that did not follow statistical sampling principles sufficiently closely to allow unbiased estimation of the desired parameters. In 2006, the National Research Council of the National Academies reviewed the methodology and concluded that the sampling strategies, collection methods and estimation approaches of MRFSS APAIS did not provide adequate information for management and policy decisions. As a result, NOAA modified the design of MRFSS APAIS to be more statistically sound and the changes were implemented in 2004 and continued until 2012 although the temporal coverage (time of day) was still limited.

At issue is how to use the entire time series back to 1981 to obtain indices that can be used in stock assessments given the changes that have occurred in the sampling design, temporal coverage, and estimation methods over time. Statisticians from Colorado State University with NOAA scientists developed an approach to calibrate the past data collected prior to the second wave of 2013 with the data collected under MRIP APAIS since then. This workshop was to review the recommended approach and determine its adequacy and statistical soundness for use in index development in future. The results are described herein.

There were three issues that the statisticians needed to address when determining if and how to combine the data collected under the different sampling approaches. First was the lack of valid sampling weights that could even be approximated for the early years (1981 – 2004). Second, the sampling frame changed with MRIP APAIS APAIS implementation, where the sampling frame was increased to include sampling around the clock, i.e. sampling over all 24 hrs. Third, there was no formal calibration experiment where both sampling designs were

performed simultaneously for some period of time, such as was done for the conversion from CHTS to FES.

As a result, a classical calibration approach which compares two different sampling efforts on the same population could not be used. Instead, the statisticians recommended a method that has been used extensively in social science surveys: raking (Deming & Stephan 1940). Raking (or raking ratio estimation) is a method for adjusting the sampling weights of the sample data based on known population characteristics. By adjusting these weights, the survey sample is essentially forced to resemble (i.e. be more representative of) the population, thereby making unbiased inference to the entire population possible. This approach requires though that 1) there be initial sampling weights that can be adjusted, and 2) the important population characteristics used in the adjustments be correctly identified and quantified.

The approach that was recommended was innovative and addressed many of the issues associated with the lack of statistical rigor for the MRFSS APAIS data collection effort. The method adjusts the initial weights for each of several periods within the time series using information from the later periods. The adjusted weights are then used to calibrate data from the years prior to the implementation of MRIP APAIS APAIS. This is accomplished by using the adjusted sampling weights in design-based estimation of a multi-stage cluster sampling design (e.g. the Horvitz-Thompson estimator of mean CPUE).

This approach was applied to the MRFSS and MRIP APAIS data collected between 1981 and 2016 to obtain estimates of annual mean CPUE for specific combinations of state, wave, mode and possibly additional strata such as were used in the raking algorithm. In addition, during the workshop several diagnostics and fit metrics were reviewed to determine the adequacy of the approach.

Earlier efforts have been made to calibrate or adjust data collected in years prior to implementation of MRIP APAIS. These were ratio adjustment methods applied to the estimates of desired parameters, for example, adjusting the CPUE for a selected species for a given year, rather than adjustments to sampling weights that would not rely on the estimates. As a result, the proposed calibration method is an advance over the earlier approaches.

The proposed approach is a complex and sophisticated method for adjusting initial sampling weights so that estimates of desired parameters are believed to be relatively unbiased over the entire time series, and similar to that expected had MRIP APAIS been in place in earlier years. An advantage of the new approach is that the adjustments to the initial weights are species independent and allow for utilization of all the data collected in MRFSS APAIS, not just those during specific time periods. As a result, every record in the APAIS dataset will have a sampling weight that can be utilized in estimation of parameters over desired domains or within strata.

A disadvantage of this approach is that it is not a true calibration since the two sampling designs could not be simultaneously implemented, and so unbiasedness of the weighted

estimators is difficult to assess. The approach also generates estimates of the desired parameters with large estimated variances, but this is to be expected given the multi-stage cluster sampling design. Even with these caveats, the proposed method is a more thoughtful and appropriate calibration approach for the APAIS dataset.

Overall, this approach is recommended as the method for calibrating past data collected under MRFSS APAIS with MRIP APAIS. There are a few recommendations related to assessing sensitivity of the approach to some choices associated with the proposed method, namely the choice of initial weights for the years prior to 2004, and the effect of the choices of domains used in the raking algorithm.

## Background

NOAA fisheries has been conducting Access Point Angler Intercept Survey (APAIS) of recreational fishermen/women since 1981 to estimate recreational effort and removals (both landed and discarded) of important fish species in the private boat, charter boat and shore fisheries. The original survey design, known as the Marine Recreational Fishery Statistics Survey APAIS (MRFSS APAIS), was an opportunistic sampling design that did not follow statistical sampling principles sufficiently closely. In 2006, the National Research Council of the National Academies reviewed the methodology and concluded that the sampling strategies, collection methods and estimation approaches of MRFSS did not provide adequate information for management and policy decisions. As a result, NOAA modified the estimation methods of MRFSS APAIS to be more statistically sound and the changes were implemented in years 2004 to 2012 although the temporal coverage (time of day) was still limited.

More recently, NOAA Fisheries' Marine Recreational Information Program developed a new statistically valid sampling strategy with more complete time of day coverage known as the Marine Recreational Information Program (MRIP APAIS). MRIP APAIS was implemented in 2013 and later evaluated by the National Academy of Sciences (NAS) in 2017. The design and estimation methods were found to be statistically sound.

Both MRFSS APAIS and MRIP APAIS are based on a multi-stage cluster sampling strategy which requires the use of sampling weights to obtain an unbiased estimate of the desired parameters (e.g. mean CPUE of an angler-trip). Intuitively, the weights, when based on selection probabilities can be though of as the number of sampling units in the population that the observations (e.g. an individual angler-trip) represents, where those with a small selection probability represent more of the population and those with larger selection probabilities represent fewer units. In the years between 1981 and 2004, MRFSS was implemented such that the required sampling weights were not estimable[1]. As a result, the estimates obtained from those data were calculated assuming observations were collected via simple random sampling (SRS).

In the later periods of the time frame, the changes made to MRFSS APAIS allowed derivation of approximate weights that could be used in estimation for data collected between 2004 and 2012. The temporal coverage, namely time of day, though was still limited.

The MRIP APAIS implementation has full temporal coverage and is statistically sound sampling. Hence, sampling weights can be calculated, and unbiased estimates derived.

[1] In the years 1993-2003, NOAA actually had copies of the site sampling frame, knew the inclusion probabilities for the sites selected in the first stage of sampling, and recorded data needed to calculate the sampling fractions at later stages. Unfortunately, the data files with that information were not saved. This prevented NOAA from applying the new weighted estimation method for the MRFSS APAIS data to revise estimates back into the mid-90's.

At issue is how to use the entire time series back to 1981 to obtain indices that can be used in stock assessments given the changes that have occurred in the sampling design, temporal coverage, and estimation methods over time. Statisticians from Colorado State University with NOAA scientists developed an approach to calibrate the past data collected prior to the second wave of 2013 with the data collected under MRIP APAIS since then. The workshop convened in March 2018 was to review the recommended approach and determine its adequacy and statistical soundness for use in index development in future. The results are described herein.

There were three issues that the statisticians needed to address when determining if and how to combine the data collected under the different sampling approaches. First was the lack of valid sampling weights that could even be approximated for the early years (1981 – 2004). Second, the sampling frame changed with MRIP APAIS implementation, where the sampling frame was increased to include sampling around the clock, i.e. sampling over all 24 hrs. Third, there was no formal calibration experiment where both sampling designs were performed simultaneously for some period of time, such as was done for the conversion from CHTS to FES.

MRFSS APAIS was stopped in early 2013 and MRIP APAIS implemented subsequently. As a result, a classical calibration approach which compares two different sampling efforts on the same population could not be used. Instead, the statisticians recommended a method that has been used extensively in social science surveys: raking (Deming & Stephan 1940). Raking (or raking ratio estimation) is a method for adjusting the sampling weights of the sample data based on known population characteristics. By adjusting these weights, the survey sample is essentially forced to resemble (i.e. be more representative of) the population, thereby making unbiased inference to the entire population possible. This approach requires though that 1) there be initial sampling weights that can be adjusted, and 2) the important population characteristics used in the adjustments be correctly identified and quantified.

The raking method is also known as the raking ratio estimation method due to the fact that the initial sample weight for any given year is adjusted by multiplication with a ratio of the true total number of angler-trips within a domain (a defined subset of the population such as state-wave-mode combination coupled with “resident of a coastal county”) to the estimated number based on the sample collected that year (slide 12 in the workshop presentation “8OpsomerCalibration APAIS.pdf”). Since the true value of the total effort within a domain for a given year cannot be known, the method was modified so that, for any given year for which an adjustment is needed, the numerator, true total number of angler-trips within a domain, was replaced by an estimate derived from data collected during a specified range of subsequent years. The denominator, the estimated number for a given year, was replaced by an estimate based on several years. Specifically, the initial estimates of the components of the raking ratio for a given year were proposed to be calculated as follows:

1) for the years 2004 to 2012, the raking algorithm was based on a ratio with a numerator based on all the MRIP APAIS data collected in 2013 – 2016 and a denominator based on averaging over 2004 to 2012;
2) for the years 1993 to 2003, the raking algorithm was based on a ratio using a numerator based on MRFSS APAIS data collected in 2004 – 2012 and a denominator based on the years 1993 to 2003;
3) for the years 1981 to 1992, the raking algorithm was based on a ratio using a numerator based on MRFSS APAIS data collected in 1993 to 2003 and a denominator based on the years 1981 to 1992.

The set of years over which the numerators of the ratio for each time segment could be further modified, namely shortened to the most recent three years subsequent to a time segment, if there was evidence that there was a linear trend in the indices over time. For specific details of how that was determined see Foster, et al. (2018) or slide 19 of the workshop presentation "8OpsomerCalibration APAIS.pdf".

For initial sampling weights, the statisticians and scientists proposed using:

1) the approximate weights previously developed and used for estimation of MRFSS APAIS data for the time period 2004 to 2013;
2) for the time period 1993 – 2003, the number of site-days sampled within each state-wave-mode-year combination standardized to the maximum value in the years 1993 to 2004 within the same state-wave-mode combination; and
3) for the time period 1981 – 1992, the number of site-days sampled within each state-wave-mode-year combination standardized to the maximum value in the years 1981 to 1992 within the same state-wave-mode combination.

The reasoning for the proposed initial weights in (2) and (3) is that these should capture the sampling variability among combinations of state-wave-mode and over years.

Once some initial weights were obtained for a particular state-wave-mode combination and the method for adjusting these weights using data from subsequent years identified, the population characteristics for which the sample weight adjustment should be performed needed to be identified. For these, the statisticians and scientists recommended the following:

1) for the time period 2004 to 2013, use the domains
    a. AF (state, wave, mode, area fished),
    b. HS (state, wave, mode, coastal/non-coastal household status),
    c. FH (state, wave, mode, for-hire boat frame status), and
    d. RE (state, wave, mode, sub-state region).
2) For the time periods 1981 to 1992 and 1993 to 2003, use the above domains plus
    a. KOD (state, wave, mode and kind-of-day),
    b. MG (state, wave, mode and month groups), and

c. AC (state, wave, mode and site activity classes).

Once these population characteristics/domains are identified, the raking algorithm is iterative. The first step is to adjust the initial weight using the estimated raking ratio for the first domain in the list. Once a modified weight is calculated within that domain, it is then used as the initial weight for the adjustment based on the second domain. The results of the adjustment for the second domain is now used as the initial weight to be multiplied by the raking ratio estimated for the third domain. This continues until all domains that identify the important population characteristics have been used to adjust the sampling weight. The procedure then repeats starting with the first listed domain again, until there are no substantive changes to the sampling weight, i.e. once convergence of the sampling weight is reached.

These adjusted weights are now used to calibrate data from the years prior to the implementation of MRIP APAIS. This is accomplished by using the adjusted sampling weights in design-based estimation of a multi-stage cluster sampling design (e.g. the Horvitz-Thompson estimator of mean CPUE).

This approach was applied to the MRFSS APAIS and MRIP APAIS data collected between 1981 and 2016 to obtain estimates of annual mean CPUE for specific combinations of state, wave, mode and possibly additional strata such as were used in the raking algorithm. In addition, several diagnostics and fit metrics were reviewed to determine the adequacy of the approach.

A review of the approach and findings is given in the section on the Terms of Reference (ToRs).

## Reviewers

Panel Members and their roles in ( ) were:

Michael D. Murphy (Chair),
John Whitehead (CIE Reviewer),
Mary Christman (CIE Reviewer),
James Chromy (CIE Reviewer),
Carolyn Belcher (NOAA Reviewer representing SAFMC),
Matthew Cieri (NOAA Reviewer representing ASMFC), and
Paul Rago (NOAA Reviewer representing MAFMC SSC).

See Appendix 3 for their affiliations.

## Summary of the Proceedings of the Workshop

A list of the attendees and the agenda for the workshop are provided in Appendix 3. During the three-day workshop (20 – 22 March 2018), Panel members were given on-line access to a broad range of background documents including the documents provided prior to the meeting (Appendix 1) and copies of the presentations made during the meetings. Before the in-person

workshop, two conference calls were arranged for NOAA staff to explain the peer review process, the terms of reference, and the availability of documents on the Wiki site and to review any questions that the panelists had before the workshop. The in-person workshop was broadcast via webinar during the open sessions.

The workshop began at 9AM on March 20, 2018 with an introductory presentation by Dr. Van Voorhees. He introduced members of the transition team and gave an overview of the approach to development of the MRIP APAIS experimental design change, general APAIS survey design, effort survey changes, and proposed methods for converting early catch estimates to the modern survey's 'currency'. Subsequent presentations by Jason Didden and Katie Drew provided overviews of the importance of the calibration effort to fisheries management and stock assessments. Jason Didden emphasized the need for consistency in the time series while Katie Drew noted that estimates of catch are the primary data for estimating absolute removals by the recreational fishery. She also noted that the choice of weights in the calibration can have significant effects on the estimated inputs to stock assessments including catch-at-age, selectivity, and mortality, and, so, affects the development of quotas and ACLs from these data. After Drew's presentation, a review of the Terms of Reference of the workshop occurred. Van Voorhees explained the meaning of the term "suitable" in Term 1(a) and the panel understood 'suitability' to mean how likely the converted older survey results would reflect what would have been the estimates had the new APAIS design had been in place at those times.

Following the break, Dave Van Voorhees gave a presentation on the development of pseudo-weights that approximated the inclusion probabilities for the MRFSS APAIS design for the time period 2004-2012 when detailed sampling effort information and changes to the MRFSS implementation was available (Breidt et al. 2011). The weights were based on a multi-stage clustering design of the selected sampling locations and removed the small amount of data associated with the alternate site selection option employed by samplers during this period. Determining the inclusion probabilities also required development of a Bayesian time-slice model (Hernandez-Stumpfhauser et al., 2016) that borrowed from fishing trip time-of-day data collected in the CHTS program. One difficulty of this approach is that no actual data were collected under MRFSS APAIS during certain times of the day, and so assumptions about catch rates were unavoidable and possibly is a source of bias in the new estimate procedure.

A peer review of this new weighted estimation technique was conducted; as a result, the procedure was accepted and certified as best available science (see slide 15 of "4Weighted Estimation Methods for the MRFSS APAIS - 03-19-2018.pptx"). The Panel learned that sampling prior to 2004 was not statistically valid and often based on quota sampling or if it were statistically valid, the data for calculating the weights were lost; hence the methods could not be applied to prior years.

Simultaneous with the development of pseudo-weights for the MRFSS APAIS 2004–2012 time period, a new design (MRIP APAIS) was being developed to address on-going concerns with the MRFSS implementation. A pilot study was conducted in 2010 in North Carolina to test the

feasibility of implementing MRIP APAIS. The study “focused on developing a better understanding of how the changes to the new design would potentially affect sampling efficiency, statistical accuracy, and statistical precision going forward”. A workshop was convened which provided specific recommendations for implementing MRIP APAIS coast-wide along the Atlantic and Gulf states.

A presentation of the new MRIP APAIS design, as implemented in 2013, was given by Tom Sminkey. Several questions and a general discussion followed in order to fully understand the distinctions between the various designs and their implementations.

Once MRIP APAIS had been implemented, it was necessary to develop a calibration effort to upweight data from the MRFSS APAIS years (1981 – 2012) in order to have a consistent time series for the entire dataset. As a result, three estimation approaches were considered before the most recent approach under review in this workshop. These were 1) a simple peak-time catch rate ratio, 2) a time-specific catch rate ratio method, and 3) a regression model time-of-day classification model. The last method was never developed and was not considered further. Ryan Kitts-Jensen gave a presentation describing the two ratio methods and provided examples of their use. The proposed ratio method excluded data collected outside the time window. It also required post-stratification (aggregating across design strata) for obtaining sufficient data for rarer species. In addition, the ratios would need to be developed for each species of interest.

John Carmichael listed the findings from a calibration workshop (Carmichael and Van Voorhees 2014) that reviewed these three approaches. The tasks for the workshop were to look at the changes made from the 1981-2012 MRFSS and the fully-implemented 2013 MRIP APAIS, and evaluate these methods for converting the older estimates to reflect the new design. The recommendation from the second calibration workshop was to use the direct peak-time catch rate ratio method as it was simple to explain and it "preserve[s] the ability to calculate estimates consistent with "old" survey methods until calibration and adjustment methods are developed, peer reviewed and approved to address changes in estimates due to "new" survey methods" (pg. 9 of Carmichael & Van Voorhees, 2014).

Jean Opsomer then introduced the proposed calibration (or more accurately adjustment) method. A difficulty with the current 'calibration' is the lack of overlap between the old and new survey except for the small pilot study performed in North Carolina in 2010. For this reason, the adjustment re-weights observations at the angler-trip level to reflect the survey change and to use the expected sample weighting had those earlier data been collected under the new fully probabilistic design. See the background section of this report for more details on the proposed approach. To quickly recap, the method is first applied to the pseudo-weights of the MRFSS period of 2004-2012 using information from MRIP APAIS 2013-2016. Then, the newly derived 2004-2012 weights are used to calibrate the 1993-2003 weights. Finally, the newly derived 1993-2003 information is used as the basis for calibrating the 1981-1992 angler-trips. An important feature described later was the introduction of additional 'raking' domains as the process went back in time. These new domains were considered the most important in influencing how the choices for sample site selections were made during the earlier periods. Also, a sequence of checks for linear changes in sample effort within each time block was used to determine the lengths of the time-period that served as the basis for the calibration. A discussion of the design occurred, and members of the panel questioned the choice of when the time-period boundaries occurred. A suggestion was made that when the 2017 data become available, the analysts might consider using only the 2014-2017 period as the initial calibration basis. This presupposes a sampler-adjustment period in 2013 before implementation of the MRIP APAIS design became routine. The analysts reminded the Panel that the analyses that

they presented during the workshop were still preliminary and were subject to some revisions. Other Panel members questioned the assumptions that any trend would be linear when testing for trend. This was defended for simplicity, with no real way to evaluate non-linear effects. An additional point is that it is only applied to a sequence of 3 consecutive years, for which linearity is a reasonable assumption.

A discussion of whether a finer domain structure for the raking algorithm (e.g., area fished x sub-state region in Florida) was feasible ensued, but it was considered not appropriate due to small domain estimation issues. Several advantages to this method were pointed out by Opsomer and others: the maintenance of the public-use 'micro data' with just a weighting change, re-weighting was based on the sampling unit of angler-trip and is not species dependent like the ratio adjustment methods, and, because it is not species dependent, the same adjusted weights can be used for any estimates desired from the survey.

The final presentation of the workshop, given by John Foster, began Tuesday afternoon and continued through mid-day Wednesday. This presentation provided some results of the proposed re-weightings and the distribution of preliminary changes seen across many different strata. This presentation was very detailed, partially in response to requests made by Panel members before the workshop after the initial review of the available documents. Though the effort was staggering, the Panel struggled with using this detail to review the efficacy of the proposed conversion method. The Panel was most concerned about the presence of extreme adjustments to weights and their impact on accumulated results, e.g., annual landings. However, it was unclear at the time what the cause of some of the large changes was and how significant it would be to the final survey products. For instance, was the absolute adjustment relatively small, but made to an extremely small initial weight (very small number in denominator) or is the adjustment applied to angler-trips with little to no catch or to catch of species that are not adequately sampled within the survey, e.g., cast-net caught herrings. For these reasons, the Panel turned to questions and a discussion about techniques that could be used to trim outliers and to whether this would or should be done.

The summary from the final presentation noted the comparisons between the results of conversions using the simple and complex ratio methods and the proposed weight-adjustment method were: 1) the simple ratio generally increased catch estimates and their variance, 2) the complex ratio resulted in the smallest change to catch estimates, and 3) the proposed method resulted in catch estimates that were between those for the two ratio estimators and that showed the least change in their variances.

The final presentation and general discussion and questions ended at about 1PM on Wednesday. Subsequently, the panel met in closed session for most of the remainder of the time Wednesday and throughout Thursday morning. The panel discussed the workshop presentations, resolved questions and began writing reviews. Discussions during the closed session included questions about details of the calculations for the proposed methods and the utility of judging change ratio distributions as provided by Foster. A short open session was

provided at which time questions about whether the proposed weight-adjustment method would use data from the FES or CHTS moving forward, the meaning of 'consistently' in the Terms of Reference, proposed trimming options, and the significance of the extreme values observed in the Forster presentation. During the closed session on Thursday, it was determined that the simulations and calculations presented by Foster included all species regardless of whether the MRIP APAIS program could provide reasonable data for use in estimation of mean CPUE for all species.

# Summary of Findings for Each Terms of Reference (ToRs)

## Terms of Reference

**1. Evaluate the suitability of the proposed model for converting historical estimates of mean angler catch rates obtained using the old MRFSS APAIS sampling design to estimates that best represent what would have been produced had the new MRIP APAIS sampling design been in place prior to 2013.**

**b) Is the proposed approach a suitable alternative to the calibration models that were originally developed in the 2014 MRIP APAIS Calibration Workshop and later evaluated by MRIP APAIS?**

As was described in the summary of the workshop proceedings, the two ratio methods (Method 1 using only peak time data and Method 2 using more of the daily time periods) have both flaws and advantages. These are described in detail in Appendix I of the report from the second calibration workshop (Carmichael & Van Voorhees, 2014). Method 1 is simple to apply but requires identification of peak time period for various domains and species, excludes possibly important information for other time periods, and assumes that the peak time period information is representative of the non-peak period times.

Method 2 is a more complex version of Method 1 that utilizes the distribution of catch within several 3-hour sampling windows during the day. Because of the use of finer time periods within a day, this method requires larger post-stratification in order obtain non-zero estimates for the less common species.

In both methods, the "tweaking" required to develop domains that are species-specific implies that the estimates of CPUE based on these ratios would not be additive across species. Further, when reviewing these methods, the panel found it difficult to see how the ratios could be extended to adjusting other important parameters such as catch at size or weight data.

The proposed model that was described at the March 2018 APAIS calibration workshop is an advancement on the two ratio methods. The approach is a complex and sophisticated method for adjusting initial sampling weights so that estimates of desired parameters are believed to be relatively unbiased over the entire time series, and similar to that expected had the current implementation of MRIP APAIS been in place in earlier years. An advantage of the new approach is that the adjustments to the initial weights are species independent and allow for utilization of all the data collected in MRFSS, not just those during specific time periods. As a result, every record in the APAIS dataset will have a sampling weight that can be utilized in estimation of parameters over desired domains or within strata.

A disadvantage of this approach is that it is not a true calibration, and so unbiasedness of the weighted estimators is difficult to assess. It also generates estimates of the desired parameters with large estimated variances, but this is to be expected given the multi-stage cluster sampling

design. Another source of error is in the estimation of the calibrated weights, but the method assumes that the weights calculated from the calibration methodology are fixed and known, and not based on estimates obtained from raking. As a result, it is not possible to know the effect of the estimation of weights on the true variability of the parameter estimates such as CPUE or effort. Even with these caveats, the proposed method is a more thoughtful and appropriate calibration approach for the APAIS dataset than earlier proposed methods.

**a) Does the proposed approach adequately account for consistent differences in estimates that would have been observed if the old MRFSS APAIS had been conducted side-by-side with the new MRIP APAIS in 2013-2017?**

**c) Is it reasonable to conclude that revised 2004-2012 APAIS estimates based on the application of the proposed approach would be more comparable than the current ones to estimates produced since 2013 under the new APAIS design?**

**d) Given the limitations of the available data, is it reasonable to apply the proposed approach to revise APAIS estimates prior to 2004 (back to 1981)?**

All three of these questions are answered below since the topics overlap with respect to the proposed approach.

Overall, the answer to all three questions is a qualified yes, with more confidence for recent years than for older years. Had the 2 sampling designs been implemented simultaneously over the 2013-2017 period, the results most likely would have been very similar to that which was obtained from the proposed calibration approach. In addition, the proposed calibration approach appears to be appropriate for the 2004-2012 APAIS data given the use of the pseudo-weights as the initial weights for the raking algorithm. For earlier years, it is a bit more problematic. This is discussed below. First, though, is an overview of the concerns and discussions of the panel about the proposed method.

During discussion by the panel, several topics of concern were raised. First, was the decision regarding domain choices to be used in the raking algorithm. These varied by time period (the raking algorithm for the years 1981 to 2003 used 7 domains compared to 4 domains for later years). After much discussion it was decided that the choices of domains were reasonable given the information available to the panel. Related to this was the question of whether the order of the domains listed for the raking algorithm affected the re-weighting adjustments or convergence of the algorithm. The panel agreed that it is unlikely.

A second concern was the choice of splitting the 1991 to 2003 period into two 10-year periods, for purposes of applying the proposed calibration. Given that there are no clear alternatives, this was deemed a reasonable approach.

A third concern was the choice of initial sampling weights for the years prior to 2004, namely using the number of site-days sampled within each state-wave-mode-year combination standardized to the maximum value within each of the 2 time periods for the 1981 to 2003

years. The panel accepted this approach for obtaining initial weights. This reviewer (MCC) would recommend that the developers consider whether the calibration approach is robust to this decision. For example, annual initial weights based on treating the data as though it had been collected using a stratified random sample of primary sampling units (site-days) might be reasonable alternatives. In that case, the initial weights would the proportion of total site-days sampled in a year that were sampled within each state-wave-mode combination. It is unlikely that the proposed calibration method would be sensitive to changes in initial weights in the earlier years, but it is important that the scientists demonstrate that the method is robust to choices of the initial conditions for the raking algorithm.

A final concern of the panel was that some of the initial results shown by Foster indicated some extreme outliers in several of the comparisons of the adjusted to pre-adjustment estimates of various parameters. In most of these instances, the results were for small domains within the APAIS sampling frame. For example, in the Foster presentation ("9FosterAPAIS.Calibration.Review.pptx"), slide 42 indicates that some estimates of effort (angler-trips) change by a factor of 5 or more after adjustment for a very defined set of conditions, namely in subregion 5, specific areas fished (inshore, offshore, etc.), set of years (e.g. 1981 to 1992) and modes of fishing. The discussion among the panel was the cause of these outlying values.

A discussion ensued as to whether the "extreme" values should be trimmed from the dataset and estimates based on the trimmed data. This reviewer (MCC) disagrees with this suggestion. Trimming or truncation of high or extreme weight values is usually done to reduce their impact on the variance of the estimates, especially for subgroup estimates. If some extreme weights are removed, the remaining weights need further adjustment in order to sum to the marginal population values. Hence, a repeat of the entire re-weighting process must be performed and could result in yet more "extreme" weights. This could continue for several iterations. The entire process of trimming is subjective – the decision of how much to trim and how many iterations of trimming depends on the analysts and is not reproducible by others. The cause(s) of the extreme weight values should be thoroughly reviewed before any decision for trimming is made. This has not been done. In fact, due to the lack of sensitivity analyses (except for the choice of which MRIP APAIS years to use in the first step of the calibration, namely adjusting the pseudo-weights for the years 2004 to 2012; see later) it is difficult to assess whether these extreme values are due to the choices made for calibration (which domains to use in the raking, the initial weights for the years 1981 to 2003, the choice of dividing the 20-yr time span into two 10-yr time spans, using a period of 3 years if a linear trend was found in the 10-yr periods, the decision to look for linear trend) or because of other reasons. The panel concluded that a possible reason is that for some years, species and domains (combinations of factors that may or may not have been strata identified in the sampling design), the number of observations was so small that the adjustment would need to be large. Hence, these are years, species or domains either where MRIP APAIS should not be used for estimation even under the new statistically valid design or where sufficient (or any) data were not available in the past. In

other words, since the raking adjustments depend to some extent on the initial weights and the parameter estimates provided for some domains may not be appropriate, other aspects of the proposed calibration method should be reviewed as possible sources of these outlying values before trimming is considered.

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

The review proceedings were described in an earlier section and are not repeated here. Overall, the approach used (presentations followed by discussion and question and answer periods) was very effective at informing the panel of the proposed methodology and some results from initial application. In addition, it gave the panel the opportunity to engage the developers as needed for answering concerns and allowing for adequate time to review impressions and initial conclusions for the proposed approach.

# Appendix 1

Atlantic Coastal Cooperative Statistics Program. 2018. Field Procedures Manual: Access-Point Angler Intercept Survey. 104 pp.

Boreman, J. 2012. Consultant's Report: Summary of the MRFSS/MRIP APAIS Calibration Workshop. March 27-29, 2012, Raleigh, NC. Documents and presentations are at: http://sedarweb.org/otw-01-mrfssMRIP APAIS-calibration-workshop-2012.

Breidt, F.J., H.L. Lai, J.D. Opsomer, and D.A. Van Voorhees. 2011. A Report of the MRIP APAIS Sampling and Estimation Project: Improved Estimation Methods for the Access Point Angler Intercept Survey Component of the Marine Recreational Fishery Statistics Survey. 83pp. NMFS/S&T/MRIP APAIS, Silver Spring, MD. Including comments from reviewers and responses to reviewer comments.

Breidt, F.J., et al. 2012. A Pilot Study of a New Sampling Design for the Access Point Angler Intercept Survey. Report to the Marine Recreational Information Program's (MRIP APAIS) Design and Analysis Workgroup. Including comments from reviewers and responses to reviewer comments.

Carmichael, J and D. Van Voorhees (eds.). 2014. MRIP APAIS Calibration Workshop II. Final report to of a workshop hosted by NOAA Fisheries, Office of Science and Technology, MRIP APAIS and SEDAR: Southeast Data, Assessment and Review. September 8 –10, 2014, North Charleston SC.

Demming, W.E. and F.F. Stephan. 1940. On a least squares adjustment of a sampled frequency table when the expected marginal totals are known. Annals of Mathematical Statistics, 11(4):427-444.

Foster, J., F.J. Breidt, and J.D. Opsomer. 2018. APAIS data calibration methodology report. Manuscript dated March 11, 2018.

Hernandez-Stumpfhauser, D., F.J. Breidt, and J.D. Opsomer. 2016. Hierarchical Bayesian small area estimation for circular data. Canadian Journal of Statistics 44(4):416–430.

MRIP APAIS staff. 2014. A Descriptive Analysis of the Access Point Angler Intercept Survey. 2013 Design Change. Internal Report. 48 pp., August 20, 2014, Silver Spring, MD.

National Academies of Sciences, Engineering, and Medicine. 2017. Review of the Marine Recreational Information Program. Washington, DC: The National Academies Press. doi: https://doi.org/10.17226/24640.

National Research Council. 2006. Review of Recreational Fisheries Survey Methods. Washington, DC: The National Academies Press.

Papacostas, K.J. and J. Foster. 2017. National Marine Fisheries Service's Marine Recreational Information Program Survey Design and Statistical Methods for Estimation of Recreational

Fisheries Catch and Effort, Version 1.0. Prepared for: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service.

Additional material that was provided at the meeting included the power point files from each of the presenters (see final agenda in Appendix 3).

# 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 Fisheries 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 a survey of marine recreational fishing catch rates 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 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 catch rate estimates for the shore, private/rental boat, and charter boat fishing modes that have resulted from the continued use of a legacy sampling design for the Access Point Angler Intercept Survey (APAIS). A more statistically sound sampling design for the APAIS was

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implemented in March of 2013

**Calibration Model for the APAIS Design Change**

In 2014, a Calibration Workshop was held to evaluate the potential consistent effects of implementing a new sampling design for the APAIS on the Atlantic and Gulf coasts in 2013. Workshop participants included three expert statistical consultants and representatives from NOAA Fisheries, the regional fishery management councils, the interstate marine fisheries commissions, and several state agencies. The participants determined that analyses conducted by the NOAA Fisheries Office of Science and Technology showed there was sufficient evidence that the more complete temporal coverage of the new design resulted in consistent changes in APAIS angler catch rate statistics for at least some species. They developed three different calibration models to evaluate for possible use in correcting the pre-2013 APAIS statistics. The statistical consultants concluded the simplest of the three proposed models was appropriate for use in the short term until a more complete evaluation of all three calibration models could be completed using three years of new APAIS data (2013-2015). The plan was to complete that evaluation by the end of 2016, so that one method could be selected as the best for use in 2017 to revise APAIS estimates prior to 2013.

**Requirements**

NMFS requires three (3) 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 and the evaluation of non-sampling errors (i.e., undercoverage, nonresponse, and response errors) associated with changes to survey designs over time. 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:

APAIS Design Change Calibration Workshop Report:
http://www.st.nmfs.noaa.gov/Assets/recreational/pdf/MRIPCalibrationWorkshopII_FinalReport.pdf

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NC APAIS Pilot Study Report: *A Pilot Study of a New Sampling Design for the Access Point Angler Intercept Survey.*
https://www.st.nmfs.noaa.gov/pims/main/public?method=DOWNLOAD_FR_PDF&record_id=772

Report on APAIS 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

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safeguard Personally Identifiable Information (PII).

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

**Period of Performance**
The period of performance shall be from the time of award through April 31, 2018. 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 |
| Approximately 2 weeks later | Contractor provides the pre-review documents to the reviewers |
| March 2018 | 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 $12,000.

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

**NOAA Fisheries Project Contact:**

safeguard Personally Identifiable Information (PII).

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**NOAA Fisheries Project Contact:**

Dave Van Voorhees
NOAA Fisheries
1315 East West Highway
Silver Spring, MD 20910
dave.van.voorhees@noaa.gov

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NOAA Fisheries
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dave.van.voorhees@noaa.gov

# Appendix 3

## Attendance List

| NAME | AFFILIATION |
|---|---|
| Carolyn Belcher[1] | GA Dept of Nat. Resources |
| Jim Chromy[2] | retired (RTI) |
| Mary Christman[2] | MCC Stat Consulting |
| Matt Cieri[1] | ME Dept of Mar. Resources |
| Michael Murphy[1] | retired FL-FWCC |
| Paul Rago[1] | MAFMC SSC |
| John Whitehead[2] | Appalachian State University |
| Richard Cody | NOAA support ECS |
| John Carmichael[3] | SAFMC |
| Jason Didden[3] | MAFMC |
| Laura Diederick | NOAA Fisheries support |
| Katie Drew[3] | ASMFC |
| John Foster[3] | NOAA Fisheries |
| Clifford Hutt | NOAA SF-1 (HMS) |
| Ryan Kitts-Jensen[3] | NOAA Fisheries - ST1 support |
| Yong-Woo Lee | NMFS-ST1 |
| Vivian Matter | NMFS - SEFSC |
| Jean Opsomer[3] | CSU |
| Karen Pianka | NOAA Fisheries - ST1 support |
| Thomas Sminkey[3] | NOAA Fisheries - ST1 |
| Dave VanVoorhees[3] | NOAA Fisheries |
| Chris Wright | NMFS - SF |

[1] NOAA reviewer
[2] CIE reviewer
[3] Presenter
[4] Rapporteur

## Proposed Agenda for the APAIS Calibration Review Workshop

**Tuesday, March 20:**
OPEN SESSION
9:00am – Welcome, Introductions, and Overview of Workshop
*Dave Van Voorhees, NOAA Fisheries Office of Science and Technology*
*Mike Murphy, Chair of Peer Review Panel*
9:20am – Presentation: MRIP APAIS Transition Planning and the Access Point Angler Intercept Survey
*Dave Van Voorhees, NOAA Fisheries Office of Science and Technology*
9:40am – Presentation: Importance of Calibrated Catch for Fisheries Management
*Jason Didden, Mid-Atlantic Fishery Management Council*
10:00am – Presentation: Importance of Calibrated Catch for Fishery Stock Assessments
*Katie Drew. Atlantic States Marine Fisheries Commission*
10:20am – BREAK
10:30am – Presentation: Weighted Estimation for the APAIS (and Calibration Workshop I)
*Dave Van Voorhees, NOAA Fisheries Office of Science and Technology*
11:05am – Presentation: New Design of the APAIS
*Tom Sminkey, NOAA Fisheries Office of Science and Technology*
11:40am – Presentation: Calibration Workshop II
*John Carmichael, South Atlantic Fishery Management Council & SEDAR*
12:00pm – LUNCH BREAK
1:10pm – Presentation: Considered Ratio Calibration Methods
*Ryan Kitts-Jensen, NOAA Fisheries Office of Science and Technology*
1:50pm – Presentation: APAIS Calibration Methodology
*Jean Opsomer, Westat and Colorado State University*
2:40pm – Presentation: APAIS Calibration Results
*John Foster, NOAA Fisheries Office of Science and Technology*
3:30pm – BREAK
3:40pm – Follow-Up Questions for Presenters
4:20pm – Public Comment
4:50pm – Summary of Day 1
*Mike Murphy, Chair of Peer Review Panel*
5:00pm –ADJOURN

CLOSED SESSION
5:10pm – Review Panel Coordination and Writing
6:00pm – ADJOURN

**Wednesday, March 21:**
OPEN SESSION
9:00am – Overview of Day 1 and Preview of Day 2
*Mike Murphy, Chair of Peer Review Panel*
9:10am – Follow-Up Questions for Presenters
10:15am – BREAK
10:30am – Follow-Up Questions for Presenters
12:00pm – LUNCH BREAK

CLOSED SESSION
1:00pm – Review Panel Coordination and Writing

OPEN SESSION
2:30pm – Initial Summary Findings of Review Panel
3:30pm – BREAK
3:45pm – Public Comment
4:15pm – ADJOURN

CLOSED SESSION
4:30pm – Review Panel Coordination and Writing
6:00pm - ADJOURN

**Thursday, March 22**
CLOSED SESSION
9:00am – Review Panel Coordination and Writing
12:30pm – ADJOURN