MRIP Calibration Workshop II – Final Report

John Carmichael and Dave Van Vorhees, Editors

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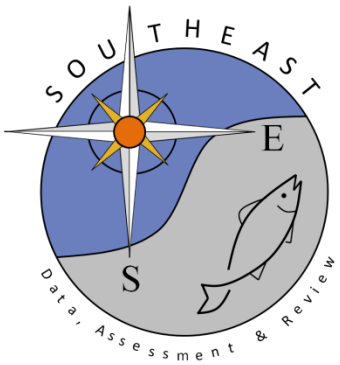


MRIP Calibration Workshop II

September 8 – 10, 2014

North Charleston SC

Final Report

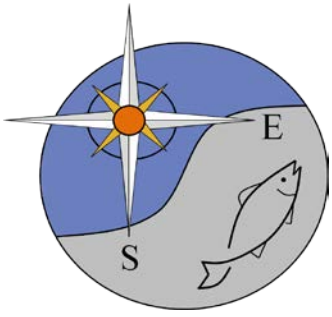
Hosted by

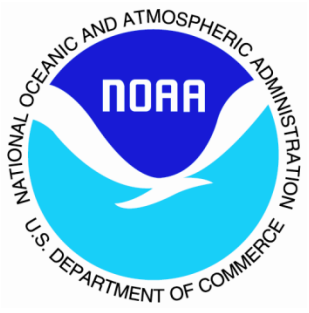
NOAA Fisheries, Office of Science and Technology, MRIP

and

SEDAR: Southeast Data, Assessment and Review

John Carmichael and Dave Van Vorhees, Editors





Introduction

The Second Marine Recreational Information Program (MRIP) Calibration workshop convened September 8 – 10, 2014, in North Charleston, SC to address potential impacts on catch resulting from changes in the Access Point Angler Intercept Survey (APAIS). Changes were implemented in the APAIS component of MRIP during 2013 and 2014 as the next step in ongoing efforts by the program to address issues raised by the 2006 National Research Council (NRC) review of recreational catch sampling.

While revised survey methods changes are believed to improve survey performance and reliability, implementing such changes results in survey outputs such as catch estimates that are now based on a different method than those same outputs from prior years. This creates a break in the time series of estimates that affects stocks assessments which rely up on long time series of data. It also creates an issue for management specifications and Accountability Measures (AMs) tied to catch levels, since the current catch estimates used to evaluate a fishery are based on a different survey method than the catch estimates used to develop those management specifications and AMs. Similar concerns were cited in the justification for the first Calibration workshop, held March 27 – 29, 2012, in Raleigh, NC, to address re-estimation 2004-2011 catch.

The goals of this workshop were to determine if changes made to the APAIS component of MRIP provide catch estimates that differ from prior values and how best to adjust survey estimates to maintain a valid time series of catch estimates.

Workshop outcomes include recommendations that calibration is necessary, that three alternative approaches should be considered and a list of steps to follow when dealing with future survey changes. Calibration alternatives are discussed in general in the workshop report, with detailed steps provided in Appendix 1. Because considerable time and effort will be required to fully develop and evaluate these alternatives, an interim approach was developed by a subset of workshop participants for application in assessments conducted while the 3 primary approaches are pursued. The interim methods is described in Appendix 2.

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Workshop Terms of Reference

1. Review the calibration approaches recommended by the MRFSS/MRIP Calibration Workshop held March 27-29, 2012, in Raleigh NC.

2. Review analyses performed to evaluate potential effects of the 2013 change in the APAIS sampling design on MRIP catch statistics.

3. Evaluate the feasibility of separating the effects of changes in the APAIS sampling design from the effects of changes in the fishery during the affected years.

    - Use red snapper as a case study and review evidence for major changes in the fishery that could account for observed changes in catch statistics.

4. Recommend appropriate calibration approaches to adjust the catch statistics (point estimates and variance) for the years prior to 2013. Discuss the key factors that the calibration approaches must take into account and how they should be modified as more years of APAIS data are collected with the new sampling design.

5. Discuss how future MRIP survey design changes should be evaluated with respect to possible needs for calibration and adjustments to past catch statistics, addressing how any APAIS design change calibration would best be integrated with any future calibrations.

6. Prepare a consensus report providing complete documentation of workshop activities and recommendations.

Proceedings and Recommendations

1. Review the calibration approaches recommended by the MRFSS/MRIP Calibration Workshop held March 27-29, 2012, in Raleigh NC.

The Workshop Panel received a presentation summarizing the approach and findings of the first Calibration workshop. The panel did not raise objections to the approaches recommended by the first calibration workshop. Discussion centered around regional implementation of recommended calibration approaches. Representatives of the Northeast and Southeast Fisheries Science Centers were asked to provide the following summaries of implementation activities in their respective areas.

Northeast Fisheries Science Center

(Bullets addressing calibration implementation: Paul/Jon)

Southeast Fisheries Science Center

(Bullets addressing calibration implementation: Steve/Vivian)

2. Review analyses performed to evaluate potential effects of the 2013 change in the APAIS sampling design on MRIP catch statistics

The second overview presentation addressed specific changes in the APAIS. Topics discussed included the need to change methods, findings of a pilot study conducted to evaluate method changes, and examples of how the change in methods may have impacted survey estimates. The panel recognized the need for a change in survey design and agreed that the updated methods are an improvement.

3. Evaluate the feasibility of separating the effects of changes in the APAIS sampling design from the effects of changes in the fishery during the affected years.

- **Use red snapper as a case study and review evidence for major changes in the fishery that could account for observed changes in catch statistics.**

Several workshop presentations addressed this Term of Reference. Collectively they provided a detailed evaluation of survey, evidence that survey changes affected catch estimates in 2013 and 2014, and alternatives for calibrating survey estimates in response to method changes. The third presentation addressed changes made in 2013, evaluation of those changes with regard to improving sampling productivity, and further changes made in 2014. This led into the fourth presentation, addressing MRIP staff efforts to describe how the changes in survey methods impacted survey estimates. These investigations centered around year effects and design change effects, with the goal

of determining whether there was evidence that design changes impacted survey estimates. Evidence that design changes have an impact on survey estimates or catch or effort provides justification to calibrate those estimates for periods prior to the design changes. The fifth workshop presentation provided information on the variation in survey change impacts on landings, details on observed changes in Gulf of Mexico red snapper estimates and introduced an approach for calibration.

Following these presentations, the Panel agreed there was evidence that survey estimates changed in response to changes in methods. Therefore, adjustment or calibration should be made to the survey estimates to ensure that estimates are comparable over time. Because the new survey methods are considered necessary and preferable to the prior survey methods, the panel agreed that calibration should be applied to the earlier estimates. There was also discussion of calibrating the more recent estimates to historical estimates to allow tracking of catches relative to ACLs established using prior survey methods, until such time that ACLs can be revised. The overall goal of calibration is to adjust the earlier values to be in line with what they would have been had the new survey methods been in place previously. If no calibration or adjustment is applied changes in catch estimates observed between years before and after method changes are applied, that are due to the survey changes, will be erroneously attributed to fishery, environmental or regulatory changes, and can lead to ACLs being met sooner or later depending on the directionality of change in landings estimates.

Recommendation: Calibration is required

- Discontinuity in time series of estimates is a concern for assessment and management efforts
- It is not appropriate to compare estimates based on the new survey design to management parameters such as Annual Catch Limits (ACL) based on old design.
- While there may be a need in the short-term to calibrate new estimates to align with existing estimates, this panel recommends that the appropriate long-term solution is to calibrate existing estimates to the new survey method estimates.
- Addressing existing management and assessment deadlines will require some interim calibrations. These should be based on the best insights and information available at the time required.

4. **Recommend appropriate calibration approaches to adjust the catch statistics (point estimates and variance) for the years prior to 2013. Discuss the key factors that the calibration approaches must take into account and how they should be modified as more years of APAIS data are collected with the new sampling design.**

Having reached agreement that survey method changes affected survey estimates, and that an adjustment in pre-change values is necessary to ensure valid comparison of results across time, the Panel began deliberations on appropriate calibration approaches. A single, most-appropriate calibration recommendation could not be reached during the workshop. Rather, the panel recognized and described three potential approaches: a simple ratio adjustment, a complex ratio adjustment, and a model-based approach. Each varies in data requirements and assumptions. In addition, while the ratio methods are fairly simple and may provide the most timely results, the model-based approach is more complex, time consuming, and may not work as theoretically envisioned. Therefore, the panel provided the following recommendations that address the methods proposed and provided guidance on their application, evaluation and final selection.

Recommendation: Pursue 3 alternative calibration approaches.

- The most appropriate calibration approach can only be determined following application and evaluation of the three proposed methods.
- The ratio methods should be applied in the short term, to address the most time sensitive management and assessment needs.
    - Apply the ratio methods to Gulf of Mexico red grouper and red snapper by October 15.
    - This is a preliminary, interim approach recommended to address the time constraints posed by upcoming assessments.
- The model based approach requires the most time and effort to implement, and is therefore unlikely to be ready in the short term for immediate management or assessment use. This option will also benefit from including additional (future) years of data in the analysis.
- All of the proposed methods key on temporal changes in survey coverage, which is considered potentially the most influential change in methods.
- Consider simulations to evaluate temporal change and sample cap effects and give some insight into the effects of each change.
- The complex ratio adjustment considers more detail of the temporal design than the simple ratio adjustment. Ratio methods vary in assumptions, and may vary by region or other factors. All assumptions for any adjustment must be checked and verified.
- Regional assistance, ideally obtained through a subset of this workshop panel, will be needed to develop and evaluate these calibration approaches.

Recommendation: Thoroughly evaluate the 3 methods before selecting the most appropriate.

- Criteria to consider when evaluating the most appropriate calibration method should be identified in advance, and include measures of variance and ability to meet assumptions.
- Calibration methods should be applied to data from the NC Pilot Study to test their performance.
- Full application of all three methods should be completed by early 2015 so that calibrated values are available for stock assessment and management use.

Recommendation: Include this workshop panel in final selection

- This workshop panel, with its broad regional representation and varied expertise, should be involved in evaluating the calibration approaches and making final recommendations.

5. Discuss how future MRIP survey design changes should be evaluated with respect to possible needs for calibration and adjustments to past catch statistics, addressing how any APAIS design change calibration would best be integrated with any future calibrations.

The workshop panel considered lessons learned through the first calibration workshop, the NC pilot study of recent APAIS changes, and the situation described in the presentations of this workshop to develop recommendations for managing future survey changes. These recommendations are offered as a series of sequential events to apply to future changes.

1. Consider calibration needs when designing survey changes.

- Ideally, apply existing and new methods side-by-side for an appropriate period of time.
  - If full side by side comparisons are not feasible due to time or budget constraints, conduct representative side by side comparisons that measure the scale and magnitude of potential biases and enables evaluating each method change before full implementation or replacement of existing methods.
  - Pilot studies should be distributed according to a valid statistical design to address known variation in survey estimates, rather than applied to a single area or year that may not be representative of the fishery
  - Use simulations (sample new data to simulate old method) to develop understanding of potential impacts from method changes.
- Consider interactions with previous changes and maintain access to original estimates, to avoid "calibrating calibrations".
- Consider impacts on stock assessment, monitoring and management activities prior to implementing changes in survey methods.

- Consider the trade-offs between making incremental changes, with increased opportunities to ascribe changes in results to changes in methods and responds to new ideas and approaches, and clustered changes, which will reduce overall calibration burdens and provide more points of consistency in survey methods.
- Preserve 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.

2. Conduct outreach and education throughout the development, implementation and evaluation of survey changes and subsequent calibration of estimates.

3. Continue reporting survey estimates based on existing methods while developing and evaluating calibration and adjustment criteria for new methods, and securing peer review of new estimates. Design new methods with sufficient components to replicate status quo methods, and maintain the ability to replicate status quo methods as long as necessary to conduct the steps described here.

4. Conduct a peer review of calibration methods and applications.

5. Finally, revise time series of survey estimates and make them available to update stock assessments and management parameters.

    - Provide both sets of estimates until all managed species have updated catch limits and assessments

6. Prepare a consensus report providing complete documentation of workshop activities and recommendations.

This report documents the workshop proceedings and panel recommendations. It also includes, through several appendices, the result of efforts following the workshop to fully document the 3 proposed calibration methods as well as the interim approach offered for short-term assessment needs.

Further development and evaluation of the proposed calibration methods will be documented through subsequent reports, thereby allowing the work of this workshop panel to conclude.

Documents and Presentations

Supporting Documents

Boreman, J. 2012. Consultant's Report: Summary of the MRFSS/MRIP Calibration Workshop. NMFS/S&T/MRIP, Silver Spring, MD.

Breidt et al. (2012) A Pilot Study of a New Sampling Design for the Access Point Angler Intercept Survey. NMFS/S&T/MRIP, Silver Spring, MD.

Breidt, F. J., H. L. Lai, J. D. Opsomer, and D. A. Van Voorhees. 2011. A report of the MRIP Sampling and Estimation Project: Improved Estimation Methods for the Access Point Angler Intercept Survey Component of the Marine Recreational Fishery Statistics Survey. NMFS/S&T/MRIP, Silver Spring, MD.

MRIP. 2014. A Descriptive Analysis of the Access Point Angler Intercept Survey 2013 Design Change. DRAFT – Not For Distribution. NMFS/S&T/MRIP, Silver Spring MD.

MRIP. 2008 . Surveys and Statistical Methods for Estimation of Catch and Effort in Marine Recreational Fisheries. Chapter 2, Access Point Angler Intercept Survey (APAIS). NMFS/S&T/MRIP, Silver Spring, MD.

Salz et al. 2012. MRFSS/MRIP Calibration Workshop ad-hoc Working Group Report. NMFS/S&T/MRIP, Silver Spring, MD.

Workshop Presentations

1. Salz, R. and D. Van Vorhees. MRIP/MRFSS Calibration Workshop #1 Key Findings and Outcomes.
2. Van Vorhees, D. A New Design for the Access Point Angler Intercept Survey. 2010 North Carolina Pilot Study.
3. Foster, J. APAIS 2013/2014 Design Changes.
4. Foster, J. Evaluation of APAIS 2013 Design Changes. Descriptive Analysis Part 1: Methods and Results for Temporal Distributions and Effort Components.
5. Foster, J. Evaluation of APAIS 2013 Design Changes. Descriptive Analysis Part 2: Results for Catch Rates, Quasi Design-based Approach for Calibration.

Workshop Participants

Name	Affiliation
Workshop Panelists	
Gregg Bray	GSMFC
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Virginia Lesser	OSU
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Julia Byrd	SEDAR
Julie Neer	SEDAR
Brad Floyd	SC DNR
Todd Phillips	Ocean Conservancy

Appendix 1. Detailed Implementation Steps for the Calibration Methods Proposed During the Workshop.

Summary Report: NOAA Calibration Methods Workshop - Charleston, SC
September 8-10, 2014
Lynne Stokes, Ken Pollock, Ginny Lesser
December 18, 2014

The new MRIP Access point survey has replaced the original MRFSS Access Point Survey. A variety of design changes have been made. One major consequence is that the new survey covers the fishing day more effectively than the original MRFSS Access Point Survey. Because the time series of recreational catch rate estimates form the basis of so many important fisheries stock assessments, there is the need to develop methods which "calibrate" the original time series of MRFSS estimates to the new time series of MRIP estimates. This is a difficult statistical estimation and prediction issue because both surveys were not run in parallel in any years (except for one pilot test in NC). The new estimates can be very different from the old estimates causing an abrupt change in the time series.

The purpose of this document is to outline the steps involved in implementing several model dependent calibration approaches to re-estimate catch that were discussed at the Charleston workshop. In addition, we discuss their assumptions. The first two methods use ideas of ratio estimation and assume that the major changes between the two surveys are due to a better temporal coverage of the fishing day in the new MRIP survey. The third method is a regression prediction modeling approach that will take longer to develop. None of these methods incorporate any analysis of spatial patterns or include time series methods, which might improve estimates. This would be worth exploring to determine if time series or small area estimation techniques for this short time series might provide improved estimates.

1. Direct Catch Ratio Adjustment
    - Steps in approach (for each subregion, state, mode, species.):
        i. Define peak period for each of the domains (excluding species). Peak period is defined using two criteria: 1) the contiguous range of hours during which weighted hourly proportions of total trips in the MRFSS years (prior to 2013) were greater than or equal to the corresponding weighted hourly proportions of total trips in 2013, and 2) the peak period accounted for at least 75% of the intercept data (trips) in the MRFSS years.
        ii. Estimate peak and total catch using the 2013 data based on the MRIP survey method where both the peak and total fishing periods were sampled adequately. Denote these by $c_{p,2013}$ and $c_{total,2013}$, respectively.

iii. Calculate the ratio $R_{2013} = c_{total,w2013}/c_{p,2013}$. This estimate and its large sample variance, based on standard Taylor series methods, can be calculated from survey sampling software packages such as SAS.

iv. Denote the estimator of catch based on the MRFSS method during the peak period in earlier year *y* (e.g., *y* = 2012, 2011, etc.) by $c_{p,y}$. Then the estimator of adjusted total catch for year *y* (i.e., a prediction of what would have been obtained if MRIP had been run) will be calculated as the product of the ratio from year 2013 and the catch for the peak period in year y; i.e.,

$$c_{tot,y} = R_{2013} * c_{p,y}.$$

iv. The variance of the adjusted catch $c_{tot,y}$ can be calculated using the expression for the variance of a product of two independent random variables introduced by Goodman (1960): .

$$var(c_{tot,y}) = var(R_{2013})(c_{p,y})^2 + var(c_{p,y})(R_{2013})^2 - var(R_{2013})var(c_{p,y})$$

By substituting estimates for each of the components in this equation, the variance can be estimated.

- Assumptions:
  i. Relative distribution of catch throughout day (i.e., between peak and total) is constant between 2013 and the year that is being adjusted for each domain

- Advantages:
  i. Simple to apply.

- Disadvantages:
  i. Information that is available for non-peak hours are not used.

- Two variations of this approach:
  i. Keep a fixed peak time the same (note this will vary by state and mode)
  ii. Use different peak times (allow this to vary by state, mode and year since this was allowed to vary in these groups)

2. Complex Ratio Method Based on Fishing Effort Distributions

- Steps in approach (for each subregion, state, mode, species etc.):
  i. The 2013 daily relative distribution of total fishing effort is obtained and also the relative distribution of total fishing effort data for the year to be compared to (for example, for y = 2012, 2011, etc.). Total fishing effort is estimated as the fishing effort estimate from separate telephone surveys (CHTS, FHS) that is subsequently expanded by coverage correction factors estimated from APAIS.

ii. The 2013 sampling weights are then adjusted (up or down weighted) so that the 2013 relative distribution matches the year y relative distribution. This is to be done by using discrete temporal bins with the exact bin widths yet to be determined. The adjustments made to the 2013 sample weights are a ratio style adjustment of the form:

$$w_{dti|y} = w_{dti} * \frac{\hat{p}_{dt,y}}{\hat{p}_{dt,2013}}$$

where w_{dti} is the unadjusted 2013 sample weight for angler-trip *i* in time bin *t* in subregion, state, mode domain *d*,
$\hat{p}_{dt,2013}$ is the original 2013 weighted proportion for time bin *t* of total trips in domain *d*,
$\hat{p}_{dt,y}$ is the year *y* weighted proportion for time bin *t* of total trips in domain *d*, and
$w_{dti|y}$ is the 2013 sample weight for angler-trip *i* in time bin *t* in domain *d* adjusted to year *y*.

From initial evaluations of bin width, it appears that a 3-hour bin is the smallest bin that results in no data gaps or mismatches in 2013 (data present in a bin in a prior year but not in 2013) for all state by mode domains. However, additional work could be done to fine tune bin widths for each domain cell.

iii. Use the MRIP survey method to estimate catch for the complete 2013 data and denote it by c_{2013}. Also calculate catch for the 2013 data weighted to match the truncated distribution of effort for year y data (step ii above), and denote this estimator by $c_{tr,2013}$
iv. Calculate the ratio of 2013 complete to truncated catch based on the MRIP survey; i.e., $R_{c/tr,2013} = c_{2013}/c_{tr,2013}$.
v. Multiply this ratio by the year y estimate of catch c_y to obtain the adjusted year y catch estimate (i.e. what would have been obtained if MRIP survey had been run) $c_{y,adj} = R_{c/tr,2013} * c_y$.
vi. A similar approach can be used to adjust all other years one by one or alternately down weight 2013 compared to the pooled temporal distribution of all other years and get one overall ratio which can be used to adjust all the years.
vii. Explore computation of the variances of the calibrated estimates by either using a bootstrap or delta method.

- Assumptions:
  i. Assumptions for this approach, such as constant relative distribution of trip/catch characteristics between years in the comparison/adjustment, must be investigated to determine if assumptions are met and will lead to consistent estimators.

- Advantages:
    i. Information that is available for non-peak hours are used unlike in the previous method.

- Disadvantages:
    i. Information from non-peak hours will be limited and may be highly variable or impacted by incomplete coverage compared to information from peak hours.
    ii. The assumptions under which this estimator will be consistent (that is, will provide an unbiased estimate for a sufficiently large sample size) are unknown at this time. For example, if the (strong) assumption needed for Method 1 is assumed, the estimator will still not necessarily be consistent.

- Other ideas to consider as variations of above
    i. Recalculate catch after effort has been readjusted. Therefore, both catch and effort are readjusted. The calibration methods make use of the MRIP public-use or micro datasets. The records included in these datasets come from APAIS. However, the sample weights in these datasets include a post-stratification adjustment such that the sum of the sample weights equals the MRIP estimate of total effort in domain cells defined by year, subregion, state, wave, mode, and area. To more fully approximate the effect of temporal coverage changes on catch, the MRIP estimates of total effort must be recalculated since they also include coverage correction factors estimated from APAIS. Once total effort has been recalculated, sample weights may be post-stratified to the new effort totals, and then revised catch estimates may be calculated as weighted sums using sample weights that have been adjusted to both a prior year daily distribution of effort as well as the resultant new effort total.
    ii. Apply temporal distribution either year-by-year or as an average across a range of years (say 2004-2012). Then multiply this ratio by MRFSS estimates of catch in previous years. NOTE: If use each year separately, then there is no assumption that the relative distribution of catch is constant throughout the day across years, only the two years that are compared. So if only one year violates this assumption, then conducting an aggregate analysis could bias the estimator for the other years, while if it was done separately, only it would be biased by that assumption violation. Conversely, using a multi-year average distribution may work to smooth results in cases where annual level distributions may be more variable.

3. Regression Model-Based Approach
    - Steps in approach:
        i. Develop a regression model using 2013 intercept data (perhaps other years as well) to predict and classify trips into either morning, peak, or evening as predicted from

their characteristics, such as type of catch and other demographic and behavior characteristics of the anglers that are available from the intercept questionnaire. Cross-validation could be used to check the model. For example, one could use approximately 75% of the data to develop the model. Then Bayes' Information Criterion (or other model fit statistic) could be used to develop the best fitting model. Once the model is built, the remaining 25% of the data could be used to predict the response variable. A statistic, such as the Press statistic, could be calculated to document how well the model is predicting the response categories. A replication approach might also be considered to look at model robustness or stability.

ii. Use the model to predict Morning, Peak and Evening trips for 2012, 2011, etc. These classifications won't be "true" morning, peak, and evening categories, since they won't be aiming to identify when the trip took place. Rather, they will be trying to predict when a trip is similar, based on catch and demographic and behavior characteristics of anglers, to trips in 2013 in those categories.

iii. Determine the proportion of Morning, Peak, and Evening trips in 2013. Adjust the 2012, 2011, data so that the Morning, Peak, Evening proportions are identical to the 2013 data. These are adjusted proportions. In addition to 2013 data, control proportions for prior years may be developed using trip time data from the CHTS and FHS effort surveys, which would be available for a range of years prior to 2013.

iv. This new weight, the inverse of the 'adjusted proportions', is multiplied by the existing weights for 2012, 2011, etc. to create the adjusted weight.

v. Data are now analyzed using the adjusted weights.

vi. A bootstrap method could be used to calculate variances.

- Assumptions:
  i. Reasonable predictive model can be developed using 2013 data to reasonably predict catch period type (i.e., Morning, Peak, and Evening).
  ii. The demographic characteristics of the angler/catch predict the characteristics of the catch through a "label" we are assigning about time of day.
  iii. Assumes that true time and latent time are identical in 2013 (see below for definition of latent.)

- Disadvantages:
  i. More work is required to develop the prediction model.
  The model is not designed to predict the observable characteristic (time of day), but is rather predicting whether the trip "resembles" a trip made during that time of day, which is a latent variable. Because of this, the model checking done on the 2013 data to see how well the model works is not like the target years, since we can't observe the latent variable even for 2013. It may be that some of the trips

made in the morning in 2013 do not resemble morning trips, and yet the model will be examined for its accuracy in predicting true time. If we were really interested in predicting true time, we would simply use the true time as a predictor in previous years!

- Advantages
    i. A number of important explanatory variables can be incorporated in the model to better predict trips.
    ii. Approach incorporates the calibration into the sample weights, which maintains the current usability of MRIP public-use datasets for analysts.

- Other comments:
    i. As more data is collected using the MRIP design, the model development should be repeated to improve prediction.

Catch can also be added to model, but need to be careful of applying 2013 year affects to previous years.

References:
Goodman, Leo A., "On the exact variance of products," *Journal of the American Statistical Association*, December 1960, 708–713.

Appendix 2. Recommended Interim Calibration Approach, suggested for use in Assessments Conducted in Winter 2014/15.

October 30, 2014
Summary Report: Recommended NOAA Calibration Method
Lynne Stokes, Ken Pollock, Ginny Lesser

Introduction

The new MRIP Access Point Angler Intercept Survey (APAIS) has replaced the original MRFSS Access Point Survey. A variety of design changes have been made. One major consequence is that the new survey covers the fishing day more effectively than the original MRFSS Access Point Survey. Because the time series of recreational catch rate estimates form the basis of so many important fisheries stock assessments, there is the need to develop methods which "calibrate" the original time series of MRFSS estimates to the new time series of MRIP estimates. This is a difficult statistical estimation and prediction issue because the two surveys were not run in parallel in any years (except for one pilot test in NC). The new estimates can be very different from the old estimates causing an abrupt change in the time series. Three methods of producing a calibration were suggested at the workshop in Charleston, SC held in September. Since that time, the statistical consultants have worked on investigating the properties of the three methods, and John Foster has implemented two of the three methods for some areas/species, in order to see how they perform. The purpose of this document is to describe our recommended method and to explain our choice.

Our recommendation

Our recommendation at this time is to use the method that was referred to as "Method 1" at the workshop. Our decision is based on two main factors. One is that the method is the easiest to explain and to understand of the three methods. It is based on an assumption that the ratio of catch in the peak period to total catch is stable over time. The method referred to as "Method 2" at the workshop is also a ratio method, but it is more complex (a negative feature) and uses the data from prior years more fully (a positive feature). Our reluctance to recommend Method 2 at this time is that we have not yet been able to determine the assumptions under which this estimator is consistent. For example, the strong assumptions required for consistency of the method 1 estimator are not sufficient to ensure consistency

of the method 2 estimator. It is also clear that the method 2 estimator requires estimation of more parameters than Method 1. As a result, we are not confident that the one year of new MRIP APAIS estimates available at this time will be sufficient. Finally, Method 3 considered at the conference is a regression prediction modeling approach that will take longer to develop and also need more data. (It is the one method not yet applied to any of the data by John Foster.)

Description of the method

Here we describe the basic assumption used to justify Method 1, and then outline the steps required for implementation. First, the justification of the method requires the assumption that in years previous to 2013, there is a period of the day that can be considered to have been fully covered by the MRFSS survey, and that the bias in its estimates occurs due to undercoverage in the non-peak periods. This is a very strong, but necessary assumption for this method. Second, the method requires the assumption that the ratio of peak catch to total catch stays constant across years for subregion, state, mode, and species. So for each of these domains, the calibrated total catch for year *y* is made as

$$\hat{C}_{tot,y} = \hat{R}_{2013}\hat{C}_{p,y} \quad (1)$$

where $\hat{C}_{p,y}$ is the estimated peak-period catch for year *y* calculated from reweighted MRFSS data and $\hat{R}_{2013} = \hat{C}_{tot,2013} / \hat{C}_{p,2013}$ is the ratio of the total to peak catch for year 2013, which is calculated from MRIP data. $\hat{C}_{tot,y}$ is thus our estimate of the catch total for the domain that would have been estimated if MRIP had been conducted in year *y*.

The steps in producing this estimate are outlined below.

Step 1. Define peak period for each of the domains (subregion, state, mode). In the pilot implementation by John Foster, peak period was defined using two criteria: 1) the contiguous range of hours during which weighted hourly proportions of total trips in the MRFSS years (prior to 2013) were greater than or equal to the corresponding weighted hourly proportions of total trips in 2013, and 2) the peak period accounted for at least 75% of the intercept data (trips) in the MRFSS years.

Step 2. Calculate $\hat{C}_{p,y}$, the catch in the peak period for all years *y* < 2013 for which calibration is needed.

Step 3. Estimate peak and total catch using the 2013 data based on the MRIP survey method where both the peak and total fishing periods were sampled adequately. Calculate its ratio $\hat{R}_{2013}$.

Step 4. Calculate the estimator $\hat{C}_{tot,y}$ shown in (1).

The variance of this estimator can be calculated using standard statistical methods.

Discussion

There are at least three substantial criticisms possible for this method. First is that the method uses none of the data collected outside the peak period in years prior to 2013. The second is that the method requires an assumption that the ratio of catch in the peak period to total catch is constant across years. We are not sure if this is defensible from a scientific point of view. Third, the method assumes that the estimate of total catch for the peak period made from the reweighted MRFSS data in years prior to 2013 is unbiased. On the other hand, some type of unverifiable assumption will be necessary in order to carry out any calibration because of the lack of side-by-side data collection for the MRIP and MRFSS APAIS sampling designs.

Some variations on Method 1 are possible. For example, the choice of how the peak period is defined will affect the estimates. Peak can be determined individually for each year or based on an aggregation of years and/or domains. We believe that this definition will be difficult to specify in advance, and must be based on characteristics of the data.

We recommend that investigation continue on the remaining two methods. It is possible that one of them will be determined to be better at some future date.