



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Silver Spring, MD 20910

October 5, 2018

MEMORANDUM FOR: The Record

FROM: Cisco Werner, Ph.D., Director, Scientific Programs and Chief
Science Advisor, National Marine Fisheries Service

SUBJECT: Certification of Marine Recreational Information Program (MRIP) Fishing
Survey Method for Florida Fish and Wildlife Conservation Commission's
Gulf Reef Fish Survey

This memorandum certifies the Florida Fish and Wildlife Conservation Commission's Gulf Reef Fish Survey (GRFS) design described herein as an approved method for derivation of estimates of recreational fishing catch and effort for Gulf of Mexico Red Snapper (*Lutjanus campechanus*) and other covered species as described in the survey design documentation. The MRIP certification process is described at <https://www.fisheries.noaa.gov/recreational-fishing-data/marine-recreational-information-program-certification>. For FWC GRFS, specific Terms of Reference were also adopted.

BACKGROUND

Prior to 2008, the Marine Recreational Fisheries Statistics Survey (MRFSS), initiated in 1979, was the primary source for national recreational fishery statistics in the United States. In response to a growing demand for an improved recreational fishing data collection program, NMFS commissioned the National Research Council (NRC) of the National Academies of Sciences to conduct a high-level scientific review of the existing survey methods used by NMFS and its partners to monitor catch, effort, and participation in marine recreational fisheries throughout the U.S.

The NRC's Ocean Studies Board formed a 10-member committee of experts in sampling design and statistics to conduct the requested review independent of NMFS. A final report of their findings (*Review of Recreational Fisheries Survey Methods*) was published in April 2006. The committee identified a number of potential problems with the MRFSS sampling and estimation designs, and questioned the adequacy of existing surveys in providing the statistics needed to support stock assessments and the kinds of fishery management decisions required by current law and practice. The report included recommendations to redesign current surveys to improve: their effectiveness, the appropriateness of their sampling procedures, their applicability to various kinds of management decisions, and their usefulness for social and economic analyses.



Section 401(g) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), which was added via the 2006 Magnuson-Stevens Reauthorization Act (MSRA), P.L. 109-479 (Jan. 12, 2007), includes requirements for improving recreational fisheries data collection:

- “Within 24 months after the date of enactment of the [MSRA], the Secretary, in consultation with representatives of the recreational fishing industry and experts in statistics, technology, and other appropriate fields, shall establish a program to improve the quality and accuracy of information generated by the Marine Recreational Fishery Statistics Survey, with a goal of achieving acceptable accuracy and utility for each individual fishery.” 16 U.S.C. § 1881(g)(3)(A).
- “The program shall take into consideration and, to the extent feasible, implement the recommendations of the National Research Council in its report *Review of Recreational Fishing Survey Methods* (2006), including...redesigning the survey to improve the effectiveness of sampling and estimation procedures, its applicability to various kinds of management decisions, and its usefulness for social and economic analyses...” *Id.* § 1881(g)(3)(B).
- “Unless the Secretary determines that alternative methods will achieve this goal more efficiently and effectively, the program shall, to the extent possible, include...use of surveys that target anglers registered or licensed at the State or Federal level to collect participation and effort data...collection and analysis of vessel trip report data from charter fishing vessels.” *Id.* § 1881(g)(3)(C)(ii)-(iii).

NOAA Fisheries initiated the Marine Recreational Information Program (MRIP) in 2006 to address the findings and recommendations of the NRC report and to carry out the above requirements. MRIP was formally established upon adoption of an Implementation Plan in October 2008. It is a collaborative effort among NOAA Fisheries, regional fisheries managers and stock assessment scientists, and the recreational fishing community to develop and implement an improved recreational fisheries statistics program. The new program consists of a system of regional surveys, which, after being designed, tested, and peer-reviewed, will provide recreational catch and effort statistics that fulfill the requirements of 50 CFR § 600.315 (National Standard 2 guidelines) and that will be eligible to be considered best scientific information available in the assessment and management of fisheries, taking into consideration other relevant factors.

Decisions to implement new data collection methods are informed by a technically-sound scientific process that includes testing of new or enhanced survey methods, peer reviews of survey methods and project results, reviews by stakeholder groups, and development and execution of transition plans that assure an orderly and scientifically sound process for incorporating the catch and effort estimates derived from new methods into catch history databases as necessary for fisheries stock assessments and management.

In response to the NRC findings and recommendations, and as directed and authorized by § 401(g) of the MSA, MRIP has undertaken a series of actions to establish more suitable sample frames and to develop and test survey methods, which will result in more accurate estimates of fishing effort. MRIP follows the requirements of the Information Quality Act (P.L. 106-554 § 515), which ensures the quality, objectivity, utility, and integrity of disseminated information.

Many regional partners have also initiated development of alternative and supplemental survey designs that are intended to provide catch estimates that directly address partner needs that are not fully met by

the general MRIP surveys. In order for the data generated by these surveys to be utilized by NMFS, NMFS developed a certification process under which survey designs are pilot tested, the design and pilot results peer reviewed, and NMFS certifies whether the survey and estimation methods are scientifically sound.

In 2014, the Florida Fish and Wildlife Conservation Commission (FWC) Division of Marine Fisheries Management presented to Commissioners an initial Gulf Reef Fish Proposal to develop a registry of reef fish anglers that could be used to collect information on red snapper fishing trips. In the proposal, participation by saltwater private boat anglers fishing for Gulf of Mexico red snapper was voluntary. In June 2014, the proposal received approval from Commissioners and voluntary sign up began the following month. In January 2015, voluntary sign up was extended to include reef fish anglers exempted from purchasing a saltwater license, and in April of the same year, Gulf Reef Fish Survey (GRFS) sign up was made mandatory for all private boat reef fish anglers that planned to fish for any of a suite of 10 species in the Gulf of Mexico. The requirement excluded anglers who fished on reef fish trips from Monroe County (Florida Keys) locations. In 2015, with technical support from NOAA Fisheries Office of Science and Technology, staff from FWC's Fish and Wildlife Research Institute began work on a survey design approach to utilize the GRFS angler list to collect private boat angler catch and effort data in a manner that complemented ongoing MRIP data collection through the telephone-based Coastal Household Telephone Survey (CHTS) and its replacement, the mail-based Fishing Effort Survey (FES), and the Access Point Angler Intercept Survey (APAIS). Pilot testing of the complementary GRFS catch and effort surveys has been ongoing since 2015. Prior to requesting certification for GRFS, FWC gave several presentations and prepared numerous documents summarizing the methods and results from their pilot study. As documented in the attachments, FWC has provided survey-related materials and responded to peer review comments.

Description of Certified Method

The mail and dockside survey components of the Gulf Reef Fish Survey (GRFS) were designed to support private boat catch and effort estimates for shorter harvest seasons and better facilitate in-season monitoring of private boat red snapper catch. Similar to the MRIP model for catch estimation, independently derived catch per trip and effort estimates are used to produce species-level estimates of harvested and released catch.

- GRFS Effort Survey is a mail survey of GRFS registered anglers. A weighted sampling design is used to select eligible anglers in a monthly draw. Selection is stratified based on residence status, with selection for in-state anglers further stratified by location and boat ownership.
- GRFS dockside Catch Survey assignments are drawn as part of the APAIS private boat offshore stratum in the MRIP APAIS assignment draw. GRFS assignments are conducted at a subset of public fishing access points based on private boat reef fish fishing activity. Sampling assignments are randomly selected by site-day and time blocks using probability proportional to size (PPS) sample selection protocols. Private boat fishing trip intercepts are conducted at the vessel level, with a single interview per vessel conducted to obtain trip related information on catch and effort for all anglers on the vessel.

- Integration with APAIS data is required to achieve full coverage of reef fish trips because GRFS dockside assignments are drawn for only a subset of sites eligible to be selected in the offshore stratum.

Certification

The FWC survey design described in the attached documents is certified as a design that has been appropriately developed and peer-reviewed and that is considered scientifically valid. The practical effect of this certification is that NMFS may fund use of this survey design and fund and/or provide technical support for other similar surveys proposed or used by partner organizations. NMFS supports FWC's continued attention to improving GRFS subscription and effort survey response rates. NMFS will continue to work with the FWC to address peer review recommendations and to evaluate and explain differences between MRIP and GRFS effort estimates. It should be noted that any modifications of the documented survey design will not automatically be deemed certified but will require review for consistency with this determination to remain certified.

NMFS' and FWC's next steps will be to: (1) determine how best to integrate the supplemental survey with the general MRIP surveys; (2) develop a calibration method to adjust historic estimates based solely on the MRIP general surveys to be comparable to estimates derived from the integrated approach; (3) have the new calibration method peer reviewed; and (4) apply the method to catch history time series in updated stock assessments. These steps will be undertaken through execution of a Transition Plan pursuant to NMFS Policy Directive 04-114.

Attachments:

Timeline_for_improvements.pdf

GRFS_ScanForm_20170126_APRIL_example.pdf

GRFS_DocumentationV1.1.pdf

Effort Survey docs.pdf

GRFS Dockside Intercept docs.pdf

Review of Florida Gulf Reef Fish Survey for MRIP Certification

**Jean Opsomer (Westat, Inc.), Virginia Lesser (OSU), Lynne Stokes (SMU),
Jay Breidt (CSU), Mike Brick (Westat, Inc.)**

January 10, 2019

Background

This certification review is based on a site visit to the Florida Fish and Wildlife Conservation Commission's (FWC) Fish and Wildlife Research Institute (FWRI) in St. Petersburg, FL and associated reports. The site visit took place on February 7-8, 2018 by Virginia Lesser (Oregon State University), Lynne Stokes (Southern Methodist University) and Jean Opsomer (Westat). We reviewed the survey design, methods and results from the first three years of pilot testing of the Gulf Reef Fish Survey (GRFS). Following the site visit, a consensus report (attached) was prepared by the same individuals, with additional input from Mike Brick (Westat) and Jay Breidt (Colorado State University), and delivered to FWRI on April 20, 2018. On July 9, 2018, FWRI provided a detailed response (attached) to the report, outlining measures they have already taken to improve the GRFS and additional measures that are ongoing and planned for 2019.

Certification Assessment

1. Does the survey design follow a formal probability sampling protocol with known inclusion probabilities at all stages and/or phases of sampling?

The general approach of the GRFS conducts two surveys, one to estimate effort and one to estimate CPUE, which are then combined to provide a final estimate of catch and incorporate adjustment for coverage issues of the surveys. This approach has been studied extensively by two National Academy panels and deemed appropriate for the challenging problem of estimating recreational catch. For CPUE, probabilities can be computed for the different stages of selection, based on site pressures and sampling at the sites. For effort, sampling is done from a list frame using stratified simple random sampling, so probabilities can likewise be computed.

2. Do the estimation methods appropriately weight the sample data to account for the sampling design and produce design-unbiased point estimates and variance estimates?

The formal designs for the component surveys indeed make it possible to obtain weights and produce approximately design-unbiased estimates (exactly design-unbiased estimates are almost never achievable in large-scale surveys). The effort survey is subject to substantial levels of nonresponse, so that estimation requires post-stratification adjustments and hence relies on response model

assumptions. The statistical properties of the estimates depend on these assumptions, so effort should continue to both reduce overall nonresponse and assess the validity of the modeling assumptions. This is not a major concern, since most social surveys deal with these types of issue on a regular basis, and the adjustments currently implemented appear reasonable.

3. Are appropriate methods in place to measure and/or correct for potential biases due to undercoverage, nonresponse, or response errors?

As noted above, the effort survey is subject to a substantial level of nonresponse. The consultants' consensus report lists a number of recommendations for how to reduce the nonresponse, including changes to the questionnaire and to the permit sign-up process. The response by FWRI contains an implementation plan for most of these, addressing our main concerns.

There are some issues related to undercoverage in the intercept survey, as also discussed in the consensus report. The first is that the GRFS-specific sample of access sites only covers a fraction of the total sites. This does not lead directly to undercoverage, because GRFS-eligible trips are also intercepted as part of the APAIS survey, which does sample all the sites. However, there are differences in screening protocols between the two surveys, which can lead to potential differences in trip eligibility and reporting rates. Relatedly, the frame undercoverage adjustment for the effort survey is only derived from the GRFS-specific sample, even though it is applied to all trips. Neither of these issues implies that immediate changes are needed, but possible differences between the two intercept surveys should be investigated to determine whether there are in fact non-trivial differences. Work in this direction is ongoing as stated in the FWRI response, so there are no further concerns at this time.

Another source of undercoverage concerns the private sites, which are not part of the intercept sampling frame for either APAIS or GRFS. This is a long-standing issue affecting these types of surveys, and hence not a new source of concerns for the GRFS.

4. How sensitive is the accuracy of the survey to assumptions made about segments of the target population that are not covered by the survey frame? What can be done to reduce or limit that sensitivity?

One important advantage of the separate effort and CPUE surveys is that they can be used in combination to correct their respective coverage issues. Hence, the intercept survey makes it possible to estimate the undercoverage of the license frame, while the mail survey can in principle be used to address gaps in coverage of the intercept surveys (e.g. night fishing). The latter is not currently used in GRFS, because this type of undercoverage is understood to be negligible for the target reef species. The undercoverage due to private sites is more difficult to assess directly. The CPUE characteristics for public and private are assumed the same in other states and work is being conducted in some states where data is available to test this assumption. We recommend that GRFS staff continue to discuss further developments about the validation of this assumption with NOAA staff. Overall, the GRFS

appears to be implemented in a way that makes it possible to address the most important deficiencies of both frames.

5. How sensitive is the accuracy of the survey to other potential sources of nonsampling error? What can be done to reduce or limit that sensitivity?

The main sources of nonsampling error have been identified and addressed above. An additional source, which appears to be common in recreational angling effort surveys, is mode effects, resulting in different estimates of effort depending on whether the survey uses mail or phone. The GRFS relies on mail, which is the same mode as FES. Hence, the results can be expected to be comparable between the two surveys as currently conducted.

6. How sensitive is the survey design to potential errors in implementation? What can be done to evaluate, reduce or limit that sensitivity?

The GRFS includes a rigorous QA/QC process, including manual checking and editing of a fraction of the questionnaires. In the FWRI's response, a program of evaluation and improvement of the survey is outlined. Overall, the GRFS appears to be a well-managed program, so that major errors of implementation are not expected.

7. How does the survey design compare with other survey designs previously certified by MRIP for estimating fishing effort and/or catch for the same fishing mode(s)? Is it more statistically sound and efficient, or is it at least comparable in its statistical validity and efficiency? What design features are most important in supporting this assessment?

The GRFS is similar to the current implementation of MRIP in its main characteristics. The most notable difference is that the GRFS intercept survey only covers a fraction of the fishing sites, so that estimation for the whole population requires APAIS data in addition to the GRFS data. The fact that both programs are similar makes such data pooling both feasible and cost-effective.

**Florida Gulf Reef Fish Review
St. Petersburg, FL
February 6-7, 2018**

F. J. Breidt, M. Brick, G. Lesser, J.D. Opsomer, L. Stokes

1. Introduction

We attended a presentation of the methods and results from the test implementation of the Gulf Reef Fishing Survey in Tampa on February 6 and 7, 2018. This report provides our assessment of the strengths and weaknesses of the proposed methodology for estimating catch for the 10 species. The report also contains suggestions of ways to strengthen the data collection and estimation methodology or to study these processes to find ways to improve them.

First, the general approach of using two surveys, one to estimate effort and one to estimate CPUE, which are then combined to provide a final estimate of catch, is sound. This approach has been studied extensively by two National Academy panels and deemed appropriate for the challenging problem of estimating recreational catch. The presentations that were provided were detailed and thorough and appropriately focused on the differences between the MRIP and the GRFS estimation systems. Because of the detail provided, we have quite a few suggestions for improvement, but this should not be interpreted as indicating that we see a serious problem with GRFS methods. Rather we consider most of the concerns we mention to be relatively minor problems and not disqualifying.

2. Non-response

The greatest concern that we have with the entire estimation system is the low and possibly declining response rate for the effort survey. Thus, the first set of suggestions deal with how response rates might be improved. Response rates in surveys of the general public have been declining for a while (Czajka and Beyler, 2016). However, the response rates are as low as 6% for some strata with an overall 20% response rate across all strata. Although response rates for phone surveys are generally as low as 6-10%, scientifically designed mail surveys such as this can obtain 30-40% response rates (Keeter et al, 2017; Lesser et al, 2016; Millar and Dillman, 2011). Our first recommendation is to adopt AAPOR's method of classifying responses and non-responses and to report AAPOR response rates. A description of their methods and a spreadsheet to calculate their measures can be found [here](#). A description of these is also found in Czajka and Beyler (2016).

Because it is not clear who the non-respondents are, we suggest a variety of methods to reduce their number. We do have two hypotheses about what might be causing the low response rate. The first hypothesis is that salt-water anglers who do not fish for reef fish are increasing the non-response rate, since the survey is not of interest to them. Although this group of anglers does not target reef fish, the one question that would direct the anglers to answer this only and complete the survey appears halfway down the first page. This question should appear first. The second hypothesis is that very avid reef-fish anglers are more likely to be intimidated to report on so

many trips and simply do not complete the survey. Mitigating the problem for these groups requires different approaches.

First, the frame for the effort survey consists of those who hold a GRFS permit (we realize it is not actually a permit, but for simplicity, we will refer to it this way in this document). We were told that encounters with the anglers during the intercept survey showed that many permit holders are not aware of the fact that they have a permit. Because there is no cost to the permit, it is possible that those who are acquiring their permit when they buy their salt-water fishing license at a retail outlet are not proactively requesting it or even asked if they want it. Rather, it is possible that many sales people simply check off the box without consulting the license-holder. This results in permit holders with no intention of fishing for the covered species, and thus have little interest in the survey topic. This lack of interest (or salience) in the topic of a survey is known to reduce response rates (Groves et al, 2004).

We propose measures to reduce the number of anglers on the frame who do not have interest in fishing for the species covered by the GRFS. Anglers purchasing a license may also have purchased a GRFS permit in a different month. Therefore, it is possible that active GRFS permit holders may have expired fishing licenses. Staff at the Fish and Wildlife Institute recognize this inconsistency and purge the frame of permit holders whose salt-water fishing license has expired, which is a positive step. However, if a system could be put in place to ensure simultaneous expiration of the license and permit, this would be an advantage to both your data handling and the anglers themselves, who could reduce the number of times they must renew.

Another additional suggestion is to charge a small fee when the permit is acquired, in order to eliminate the automatic inclusion of a GRFS permit when a license is purchased. Such a fee would have the advantage of increasing the salience of the experience, so that an angler would know if they have the permit. This would ease administration of the intercept survey, since those asked the coverage question (i.e. "Do you have a Gulf Reef permit?") would be more likely to provide accurate information without consulting their salt-water license. Another change that would ensure intentionality and increase salience of permit acquisition for those who purchase a salt-water license via the web is to make it harder for them to include the permit in their purchase.

As an alternative to assessing a cost, increasing the salience of registering for a GRFS permit could be accomplished by requiring that they answer a yes/no question about whether they intend to go reef fishing in the next year. After an affirmative answer, they will then access a link to a separate page or form with questions. In the case of a paper-based sign-up, having a separate page or form with questions about the intent to harvest reef fish, or possibly a separate postcard sign-up, say attached to the license form, would serve the same purpose. Neither is likely to be as noteworthy as charging a fee, but might be more acceptable to the user community.

By increasing the requirements for registering for a GRFS permit, either of the above methods could eliminate some people from the GRFS frame who should be included. Since this undercoverage is adjusted for in the estimation process by inserting an inflation factor derived from the intercept survey into the effort estimate, we believe the effect on bias of the estimator will be minimal. In contrast, the overcoverage of the anglers that do not target reef fish in the

Gulf of Mexico is most likely increasing the numbers of non-respondents. This decreases the overall quality of the survey, and in particular, introduces the possibility of bias if the non-respondents have different angling characteristics from the respondents.

Our second hypothesis for the larger than expected non-response rate is that avid anglers are dissuaded from completing the questionnaire because of the burden of enumerating up to 12 trips. There is some evidence of this from the partial response data we were provided. We discussed two ways to approach this. The first is to shorten the questionnaire. Each question should now be examined to determine if any can be dropped. For the second approach, the questionnaire would still ask anglers for the total number of trips made. However, only details of a subset of trips will be requested. Then they would be asked to provide detail for some number of “most recent” trips and then weighting up the count of trips provided by angler i by a weight of the form

$$w_i = (\# \text{ of trips reported by angler } i) / (\# \text{ of trips detailed by angler } i).$$

Before deciding on what number of trips to ask the angler to detail, we suggest examining the impact of such a change using the survey data you have. We suggest conducting the usual estimation process for effort in each stratum after capping the number of trips at K . Of most interest are $K = 3, 5$ or 6 , since these would most efficiently use the space on your questionnaire with the current layout. This will allow you to compare the resulting estimates with those from your full data, to see if there are substantial differences.

We have some concern about whether asking for the most recent trips would cause distortion of trip types, especially when the season for a particular species occurs in only part of the month. An alternative might be a rearranged questionnaire that has room for 5 trips, and which asks for all trips (up to 5) over a 2-week period. This could be implemented with two versions of the questionnaire, one asking about the first 2 weeks and the other about the last 2 weeks of the month, each randomly assigned to half the sample. Very few anglers had more than 10 trips in a month, so any remaining bias from missing trips would likely be negligible. A version of such a rearranged questionnaire that combines both shortening the questions found on the first page and reducing the number of trips where detailed information is requested is shown in Appendix A. There are some potential drawbacks to shortening the recall period to two weeks. If reef fish trips are relatively rare, the shorter time window could decrease the number of reported trips dramatically, and also potentially negatively affect data quality due to so-called telescoping bias, i.e. people will report a trip taking prior to the two week window. The rarity of trips can be investigated in the data already collected, and the telescoping bias can be assessed in an experimental survey that compares two-week and four-week recall periods.

Besides these methods for targeting special kinds of non-respondents, there are other methods that could be used that may increase response rate overall (Lesser et al., 2016). One tool is to add a pre-letter. The goal of the pre-letter is to alert the respondent of the survey that will be sent shortly. This letter is typically signed by the Director of the agency and reinforces the importance and their support of the survey. Cover letters that accompany the questionnaire should be brief, but be sure to cover the objective of the survey, explain how the person was

selected, assure confidentiality, and explain how the data will be used. Examples of these cover letters appear in Appendix B.

Other methods that have shown to improve response rates include the use of color for the questionnaire. Recent studies indicate the use of color may or may not increase response rates. Each of these approaches should be tested in a carefully designed study before the entire sample adopts these procedures. Focus groups, consisting of small groups of anglers, would be helpful to determine which approach may have more impact on improving response rates.

Staff should also consider incorporating the Internet to collect the survey data. We suggest conducting tests on the use of the Internet to assess response rates and response differences between the mail and Internet modes. See Lesser et al. (2016), Millar and Dillman (2011), and Messer and Dillman (2011) for suggestions on experiments to compare methods and approaches to improve response rates. Using a web-based survey would reduce printing and postage costs, but not all individuals have Internet access. We recommend a mixed-mode approach. In the first contact to the potential respondent, the respondent would be asked to complete the questionnaire online. This directs them to the Web first to take advantage of the postage and printing savings. Non-respondents are recontacted with a printed questionnaire and to alert them that the opportunity to complete the questionnaire online is still available. An example of the first cover letter that would be sent to the individuals in the selected sample is provided in Appendix B.

Your analysis method already incorporates poststratification weighting for mitigating the effect of non-response at the estimation stage. If the changes suggested here have the effect of reducing non-response, or even changing the nature of non-respondents, then your methods of weighting for non-response should be revisited. For example, it is possible that poststratifying by where the permit was acquired will become unnecessary.

3. Optimization of designs

a. Effort survey

The strata vary in size by a ten-fold margin, and most reach the maximum sample size of 500. We suggest that the sample sizes be allocated closer to either proportional or Neyman allocation. Note that the allocation does not need to stay constant over the months.

You can use previously collected data to investigate the allocation issue, in particular, to estimate the variance of the number of trips per individual in each stratum required to compute the Neyman allocation. While choosing a stratum allocation is somewhat subjective, we recommend investigating this by first computing the equal, Neyman and proportional allocations over all the strata in a year (so 12 x 14 strata), averaging the observed stratum variances across the years to stabilize them, and then determining a compromise allocation that ensures a minimum sample size in each estimation domain of interest. We expect that this allocation will be much closer to the Neyman or proportional allocation than to the current almost-equal allocation.

In addition to the sampling allocation itself, another issue affecting the efficiency of the effort survey is the fact that the GRFS sampling frame contains a large number of people who either do not currently have a fishing license, or who are part of the frame with no intention of fishing for Gulf reef fish. Possible approaches to reduce the magnitude of this problem were addressed above.

b. Intercept survey

On the intercept survey side, the GRFS-specific sample is deployed across a relatively small fraction of all available sites (54 out of 589), which are selected using the same overall sampling design as the APAIS sites. These GRFS-eligible sites do not cover all the possible sites from which GRFS trips take place, making it necessary to include trip intercept from APAIS to produce statistically valid estimates for the GRFS target population. This does not cause estimation issues, because methods to combine observations from multiple coordinated surveys are available. However, an additional complication arises from the fact that the interview procedures used during GRFS-specific interviews are different from those in the APAIS. We address this further below.

4. Other issues with GRFS intercept survey

During the GRFS intercept assignments, GRFS-specific questions are used to screen out ineligible trips, and only boats determined to be returning from a GRFS trip are interviewed. In contrast, the GRFS questions are not asked during APAIS interviews, so that the eligibility is only determined after the fact and is based on species targeting and harvesting questions that only approximately correspond to the GRFS eligibility criteria. Hence, there is both an issue of design efficiency (i.e. should GRFS sample be drawn from more sites at which GRFS trips take place?) and one of bias (are the same trips being identified under both sets of interview procedures?), which are difficult to separate. The most serious issue seems to be the potential bias. Fortunately, it is possible to investigate it by comparing the results of the trip screening under both the GRFS-specific and the post-hoc APAIS approach for the same set of 54 sites, because the target population and site-selection designs are the same.

Even though data from both GRFS-specific and APAIS interviews are combined to produce catch estimates, the adjustment factors for undercoverage of the GRFS frame are made only from the GRFS sites. This can again lead to bias, if the trips included in both sets of interviews are not satisfying the same eligibility criteria. The ideal solution, from the perspective of accurate estimation of GRFS-eligible trips, would be to include the GRFS screening question to the APAIS interviews. We understand this might be difficult to implement as a long-term solution. As an alternative, the GRFS survey could be expanded to sites not currently covered, either permanently or temporarily, so that differences in eligibility screening between APAIS and GRFS interviews can be assessed.

The GRFS estimation for biological data currently uses mean imputation by species for missing lengths and/or weights of individual fish. We recommend switching to a hierarchical hot-deck method, which would provide better data to users and would match the approach currently used

by MRIP. Unless there is a clear need not to do so, the imputation method implemented for APAIS data could simply be adopted for the GRFS data.

5. Saving/shifting money

In closing, we note a few areas in which it might be possible to reduce the cost of conducting this survey. The first is in QA/QC. The current level of human checking and editing of the data represented a sensible commitment of resources as this survey was being implemented. All indications are that the implementation was successful, and that very low error rates are being found. It is therefore appropriate that the amount of QA/QC now be reduced, at least until further major changes are made to the survey instruments or data collection mode.

As noted previously, providing a web option to complete the questionnaire in addition to the mail questionnaire, can help in improving the overall response rate and possibly encourage other demographic groups who are more web-savvy to participate. But another reason for introducing web forms is to reduce the on-going cost of the survey. There is, however, a start-up cost in developing the web questionnaire and associated data collection capabilities. We recommend starting a discussion with your survey contractor, to determine the overall cost and benefits of introducing web-based data collection.

Finally, we also note that the combination of increasing the response rate using some of the methods described above and re-allocating the sample across the strata should result in increased precision for the same nominal overall sample size. Hence, it might be possible to reduce that sample size in the future, depending on your desired precision targets.

REFERENCES

Czajka, J.L. and A. Beyler. 2016. Background Paper. Declining Response Rates in Federal Surveys: Trends and Implications.

<https://aspe.hhs.gov/system/files/pdf/255531/Decliningresponserates.pdf>

Groves, R. S. Presser, and S. Dipko. 2004. The Role of Topic Interest in Survey Participation Decision. *Public Opinion Quarterly*, Vol. 68 No. 1 Pp. 2–31.

Keeter, S., N. Hatley, C. Kennedy, and A. Lau. 2017. What Low Response Rates Mean for Telephone Surveys. <http://assets.pewresearch.org/wp-content/uploads/sites/12/2017/05/12154630/RDD-Non-response-Full-Report.pdf>

Lesser, V.M., L.D. Newton, D. Yang and J. Sifneos. 2016. Mixed-Mode Surveys Compared with Single Mode Surveys: Trends in Responses and Methods to Improve Completion. *Journal of Rural Social Sciences*, 31(3):7-34.

Messer, B. and D. Dillman. 2011. Surveying the General Public over the Internet Using Address-Based Sampling and Mail Contact Procedures. *Public Opinion Quarterly*, Volume 75, Issue 3, 1 September 2011, Pages 429–457, <https://doi.org/10.1093/poq/nfr021>

Millar, M. and D. Dillman. 2011. Improving Response to Web and Mixed-Mode Surveys. *Public Opinion Quarterly*, Volume 75, Issue 2, 1 January 2011, Pages 249–269, <https://doi.org/10.1093/poq/nfr003>

Pew Research Institute, Collecting Survey Data, <http://www.pewresearch.org/methodology/u-s-survey-research/collecting-survey-data/>

Appendix A. Example of revised questionnaire

See attached pages

Appendix B. Examples of cover letters

a. Pre-letter

Dear Florida Saltwater Angler:

I am writing to ask for your help with an important questionnaire we are conducting to examine levels of participation in recreational fishing for reef fish in the Gulf of Mexico. In order to maintain a healthy fishery for all recreational anglers, it is important for us to know how many recreational anglers enjoy fishing for various reef fish along the Gulf of Mexico.

Within the next week you will receive the Gulf Reef Fish Survey in the mail from the Florida Fish and Wildlife Conservation Commission. I am writing in advance because many people like to know ahead of receiving the survey packet that they will be asked to participate in a survey. We will send the questionnaire within the next week and include a prepaid return envelope for your convenience. Your feedback helps us monitor and improve the fisheries for our State. (Note that this text will change if using the web to collect data initially.)

If you have questions or comments, please direct them by email to ##### or contact Bev Sauls at #####.

Thank you ahead of time for your help. It is only with the generous help from people like you that this study will be successful.

Sincerely,

b. Cover letter for printed questionnaire.

Dear Saltwater Angler,

The Florida Fish and Wildlife Conservation Commission is interested in understanding levels of participation in recreational fishing for reef fish in the Gulf of Mexico. You have been selected as part of a random sample of Florida anglers who obtained a Florida Gulf Reef Fish Angler permit. You may recall that this permit is required for anglers who intend to harvest certain reef fish species while fishing from a privately owned boat off the west coast of Florida.

In order for us to make sure that we hear from all different types of people, **we ask that the name of the person who appears on the attached questionnaire complete the survey.** Your address is not on the survey and will not be stored with the survey data. In addition, your address will not be used for other purposes besides this survey. Only the overall results will be reported.

Your responses will help the Florida Fish and Wildlife Conservation Commission understand the health of reef fish in the Gulf of Mexico. **If you have any questions about the purpose of this survey, please call Bev Sauls or ##### at #####.**

Your cooperation is greatly appreciated.

Sincerely,

c. Cover Letter to Direct Respondents to Web Survey

Dear Saltwater Angler,

The Florida Fish and Wildlife Conservation Commission is interested in understanding levels of participation in recreational fishing for reef fish in the Gulf of Mexico. You have been selected as part of a random sample of Florida anglers who obtained a Florida Gulf Reef Fish Angler permit. You may recall that this permit is required for anglers who intend to harvest certain reef fish species while fishing from a privately owned boat off the west coast of Florida.

In order for us to make sure that we hear from all different types of people, **we ask that the name of the person who appears on the attached questionnaire complete the survey.** Your address is not on the survey and will not be stored with the survey data. In addition, your address will not be used for other purposes besides this survey. Only the overall results will be reported.

We are hoping that you can reply to the **“2018 Gulf Reef Fish Survey”** using the Internet. If people respond by using the Internet, the state saves money and obtains results quickly. To respond over the Internet, go to the main address bar in your web browser window and type

<http://myopinion.ffwcc.edu/reef>.

Note that searching for the site through a search engine like Google or Yahoo will not take you to the survey.

Once there, you will be asked to enter your password to access the survey. Your **Password is: XXXXX**. You will then be prompted to your first question. We realize that some households do not have Internet access. If this is the case for you, we will send a paper version of the questionnaire to you if we don't receive an Internet response.

Your responses will help the Florida Fish and Wildlife Conservation Commission understand the health of reef fish in the Gulf of Mexico. **If you have any questions about the purpose of this survey, please call Bev Sauls or ##### at #####.**

Your cooperation is greatly appreciated.

Sincerely

Timeline for Testing and Implementing Recommended Improvements for the Gulf Reef Fish Survey

Background

In February, 2018, a meeting was held at the Florida Fish and Wildlife Conservation Commission's (FWC) Fish and Wildlife Research Institute (FWRI) in St. Petersburg, FL, to review the survey design, methods, and results from the first three years of pilot testing of the Gulf Reef Fish Survey. Three expert consultants in the field of survey design attended the in person meeting and served as reviewers: Jean Opsomer, Colorado State University; Virginia Lesser, Oregon State University; and Lynne Stokes, Southern Methodist University. Two reviewers who did not attend the meeting also contributed to the final report: Jay Breidt, Colorado State University; and Michael Brick, Westat. Also in attendance were representatives from FWRI's Marine Fisheries Research section, FWC's Division of Marine Fisheries Management (DMFM) and Office of Licensing and Permitting (OLP), Gulf States Marine Fisheries Commission, NOAA Fisheries Office of Science and Technology, NMFS Southeast Fisheries Science Center, and NMFS Southeast Regional Office.

During the meeting, Martha Guyas (DMFM) provided background information on the requirement for anglers to sign up for the Gulf Reef Fish Survey, and Tara Gibson (OLP) described the mechanisms in place to subscribe anglers to the survey. Beverly Sauls and Tiffanie Cross (FWRI) provided background on the evolution of the survey design and detailed the methods and procedures used to administer the survey. Procedures used to combine data collected from the Gulf Reef Fish Survey with data from the MRIP Access Point Angler Intercept Survey (APAIS) and calculate statistically valid estimates of recreational landings and discards were detailed by John Foster (NOAA Fisheries). The presentations concluded with a summary of results from the first three years of pilot testing the GRFS survey methodology in Florida. Reviewers were given ample opportunity to ask questions throughout the meeting before meeting privately to discuss findings and outline their report. The completed report was received by FWRI on April 20, 2018.

In their final report, the reviewers concluded that the approach taken to monitor recreational fishing in Florida is appropriate and that the methods are statistically sound. The reviewers also provided valuable suggestions for ways FWC may improve upon the current survey. Their greatest concern was the low response rate for the mail survey. Currently, 20% of anglers that receive a Gulf Reef Fish Survey in the mail fill out the questionnaire and return it to FWC; compared to other scientifically designed mail surveys that obtain response rates as high as 30-40%. Researchers at FWRI and staff from DMFM and OLP worked jointly to review the recommendations and develop a plan for implementing improvements to the Gulf Reef Fish Survey. Below is a list of recommendations included in the final report, and FWC's response. The recommendations are organized by the amount of time needed to move forward with an improvement, test new methods to evaluate their effectiveness, or explore options before moving forward with implementation. The anticipated timeline for evaluating, testing and implementing recommendations is also summarized in Table 1.

Immediate Improvements:

The following recommendations to improve the Gulf Reef Fish Survey methods and estimation procedures were implemented immediately following the in-person review and receipt of the final report.

- Reviewers recommended that FWRI staff adopt standard codes for classifying responses and non-responses in the mail survey. We are currently converting disposition codes for past survey responses to match AAPOR codes, as recommended, and will track response rates using the new standardized codes.
- During the in person meeting, FWRI staff described the current method used to allocate sample among 14 strata. Each month, 10% of GRFS subscribers in each strata, or a maximum of 500, whichever is less, are selected to receive the mail survey questionnaire. However, as the total number of subscribers increased over time, the sample size in all but two strata has been capped at 500, thus each stratum is effectively allocated an equal portion of the total sample. Since the strata are not equal in size, and some are much larger than others, the reviewers recommended that the total sample for the mail survey be re-allocated either proportional to the size of each strata, or using a Neyman allocation. The Neyman allocation takes into account the associated error around mean trips per response in each stratum, and allocates sample to minimize variance. The reviewers also suggested allocation may need to vary throughout the year to account for seasonal changes in variance among strata.

Existing data received through the mail survey from 2015 to 2017 were used to calculate the Neyman allocation, which was also compared to an allocation proportional to the size of each strata. The Neyman allocation was chosen because of the seasonal differences in the proportional allocations among strata, which help to minimize variance throughout the year. The bi-monthly Neyman allocation for each strata is provided in Table 2 (proportions) and Table 3 (sample size). To maintain minimum sample sizes for strata 400 and 401 (residents of Keys and Southeast Florida), a constant sample size of 75 and 25, respectively, was selected. The new sample allocation was implemented starting with the April 2018 fishing month. The Neyman allocation will be revisited as necessary to evaluate whether further adjustments are needed to minimize variance as other survey improvements are implemented.

- The reviewers recommended that the cover letter for the mail survey should be as brief as possible, and also suggested that the letter be signed by a recognizable Agency head to emphasize to the public the importance of participation in the survey. This recommendation will be implemented in time for the June 2018 fishing month.
- During the design phase of the GRFS, APAIS data collected from the west coast of Florida were analyzed to identify sites in the MRIP site register where red snapper or gag grouper were frequently encountered. A sub-set of sites was selected, and a portion of APAIS assignments were allocated to this new “Offshore” site group (in addition to traditional “Shore”, “Private Boat” and “Charter” site groups) to ensure that reef fish trips are adequately represented in the sample. At the same time, NMFS S&T staff amended the APAIS draw program to select

additional site/day/time combinations from the “Offshore” site group which were used for supplemental intercept assignments for the GRFS.

During the review meeting, FWRI staff presented CPUE estimates calculated three different ways using catch data collected from: 1) supplemental GRFS intercept assignments only, 2) APAIS intercept assignments only, and 3) GRFS and APAIS intercept assignments combined. Estimates of CPUE that were calculated using methods 2 and 3, which included APAIS data collected from all MRIP sites, were similar; however, estimates using only supplemental GRFS intercept data collected only from the subset of sites in the “Offshore” site group were different, which indicates an apparent bias. This bias is accounted for when weighted GRFS and APAIS data are combined; however, the state of Florida would like to use GRFS data that are available before MRIP data are released, in order to provide preliminary monthly estimates that may inform fishery managers on progress towards catch limits mid-wave. The number of sites on the west coast of Florida that were initially included in the “Offshore” site group was 54, out of 390 total sites with private boat fishing pressure, and the reviewers recommended that the number of sites included in the “Offshore” site group should be increased to ensure that catch rates measured during GRFS intercept assignments are more representative of catch from all sites.

In response, FWRI staff re-evaluated all MRIP sites with private boat pressure using data collected in the APAIS between 2013 and 2017. For each site, we calculated the proportion of private boat intercepts that targeted and/or caught one or more of the seven species that the GRFS designation is required for (as opposed to just red snapper and gag), as well as the proportion of those intercepts where fishing occurred primarily in the EEZ. Additional sites in each county with a relatively high proportion of GRFS and EEZ intercepts were then added to the “Offshore” site group. Some sites already included in the site group were also removed if they had relatively low proportion of intercepts with GRFS species. A total of 94 sites were included in the new sub-set of MRIP sites, and this list was provided to NMFS S&T staff, a pressure rating was assigned, and Florida’s site register was updated prior to the May 2018 sample draw for APAIS and GRFS assignments. We are currently working with NMFS S&T to make the site pressures for the “Offshore” site group available on the MRIP site register web tool so that they may be routinely updated by FWC. We will continue to evaluate the need for additions and deletions to the “Offshore” site group following the 2018 fishing season. The reviewers were also concerned that intercept questions in the GRFS intercept survey pertaining to target species may illicit different responses from anglers interviewed in the APAIS, which could result in potential bias in catch-per-unit-effort (CPUE) measures. For catch estimation, data collected through either survey where one or more Gulf reef fish species are targeted, harvested, and/or released are included in CPUE calculations. Once data have accumulated following the addition of more diverse sites in the GRFS sample draws, we will compare the two data sources to evaluate whether CPUE measures differ.

Improvements in Progress

- Information on the degree of participation in the Gulf reef fish fishery by anglers that are not signed up (either intentionally or because they are exempt or unaware of the requirement) is needed to adjust effort estimates from the mail survey to account for under-coverage.

Currently, this information is only collected during supplemental intercept surveys. The reviewers recommended that a new question be added to the APAIS interview in Florida to collect additional data on under-coverage to reduce error and prevent potential bias in this correction factor. This was discussed at the March 2018 Gulf Fisheries Information Network (FIN) meeting and it was decided that FWC staff will work with Gulf States Marine Fisheries Commission staff to develop the question and add it to the form so that data collection can begin in January 2019.

- Fish weights from the intercept surveys (GRFS and APAIS) are used to estimate landings in biomass (kg or pounds). For individual fish that are not weighed in the GRFS intercept survey, the reviewers recommended that a hot deck method be used for imputation, similar to what is currently done for APAIS data. This method utilizes information from observed fish in similar cells to impute missing values, and accounts for more variability compared to applying an average weight to missing cell values. Since supplemental GRFS data are combined with APAIS data, the preferred approach would be to match the methods used in the MRIP estimation program. The Office of Science and Technology (S&T) uses the Cox-Iannacchione weighted sequential procedure and runs through multiple rounds or impute steps where cells become more aggregated in an attempt to find complete case donors for records that still contain missing values after each previous round. This procedure requires special software (SUDAAN) that can be called into SAS; however, FWRI does not currently have a license for this software. We will work with S&T in to incorporate a similar approach, and the following method will be implemented this year:
 - Step 1: merge GRFS intercept data with lengths and weights observed in APAIS (2015-current).
 - Step 2: use the combined data set to calculate log transformed linear regressions, by species, between length and weight for all observed fish across waves and years.
 - Step 3: for records with an observed length and missing weight value, use outputs from the regression models to estimate weight for individual fish.
 - Step 4: for records where both the length and weight values are missing, use the combined data set to perform a weighted hot deck procedure (stratified by year, wave, region and area fished) to impute weight for individual fish using the survey impute procedure (proc surveyimpute) in SAS. For species with low numbers of observed lengths and weights, strata may need to be collapsed.

Public use files generated from data collected since 2015 will be updated for consistency.

- During the in person meeting, FWRI staff revealed that when a questionnaire is not filled out completely by the respondent, the response is treated the same as a non-response and partial data are not used in estimates. The reviewers recommended methods that could be used to identify responses in the mail survey where enough partial data is provided that a weight could be applied to utilize the response. We will revise the effort estimation program this year to include this data processing step, and will update estimates generated from data collected since 2015 for consistency.

Improvements that will be tested and potentially implemented during 2018 and early 2019

The reviewers recommended several methods that could be tested to potentially improve response rates in the mail survey. To understand the influence each change to the mail survey has on survey response rates, we plan to take a stepwise approach to testing, with each improvement implemented incrementally only if testing results in an increased response rate. As these changes are implemented, we will continue to re-evaluate whether stratification or post-stratification needs to be revised, and also assess sample size to see if we can reduce cost/burden as a result of increase response rates.

The first change we are already testing is to switch the color of the questionnaire (originally green) to grayscale. A grayscale survey shell that is otherwise identical to the original questionnaire was developed, tested on the electronic scanner to ensure proper data capture, and randomly assigned to 50% of anglers in each strata selected to report for the April 2018 fishing month. Testing will continue for a total of three months to evaluate response rates side-by-side with the green colored survey. If response rates are improved and/or result in an ability to more effectively allocate sample, this change will be implemented across 100% of the sample during the July fishing month. If response rates decrease, then we will return to the green colored survey for 100% of the sample during the July fishing month.

The second change that will be tested is a shortened and reorganized questionnaire, including the following suggestions recommended by the reviewers: 1) move screener question to the top of the first page, 2) reformat the trip reporting section so that questions pertaining to individual trips are read in horizontal rows, rather than in vertical columns; 3) simplify the individual trip reporting by combining two questions that pertain to distance from shore into a single question; and 4) reduce the total number of trips that anglers are asked to report full details for (currently, anglers may report up to 12 trips). We are currently evaluating past survey responses to determine an appropriate number of trips to request anglers to report details for without impacting effort estimates. We anticipate testing for the new layout of the questionnaire will begin by the October 2018 fishing month.

The third change we will test in early 2019 will be to send a pre-letter to notify participants in advance that they are selected to report trips. This test will require a change in the timing for sample selection, in order to properly notify participants and prepare them to report trips after the end of a month. Currently, a license file is delivered to FWRI during the first week after the end of a fishing month, so that newly registered GRFS participants may be included in the sample. During this testing phase, we would draw samples for the 14 strata at the beginning of a new fishing month (using the Neyman allocation proportions described above); however, a portion of the total sample size will be held in reserve and not included in this initial draw. A letter will be mailed to each person to notify them of their selection. During the first week after the end of the fishing month, the survey questionnaire will be mailed to each person who received a pre-letter. At the same time, an updated license file will be used to identify new GRFS subscribers that registered or renewed during the fishing month, and the sample that was held in reserve will be used to draw an additional sample from this group using the same proportional Neyman allocation. The new group of anglers selected will not receive a pre-letter, and will receive questionnaires at the same time as the pre-selected group. During estimation, we will include a post-stratification variable to account for potential differences in response rates between the two groups. This may also improve the estimation process if subscribers are more likely to participate in a fishing trip right after purchasing or renewing their GRFS subscription. This new procedure will be

evaluated at the end of three months to determine whether response rates increased and evaluate the additional cost to implement. If response rates are notably increased, any additional cost could be offset by reducing the total sample size.

The fourth change that we are currently seeking funding for to test in early 2019 is the use of a mixed-mode survey approach, where respondents are offered the choice between electronic and paper reporting options. During the first contact, selected anglers will receive a letter in the mail that provides a unique URL address where the survey may be completed online. A paper questionnaire will also be enclosed and offered as an alternative reporting option. A reminder post-card that includes the URL will be sent to each selected angler, unless an electronic response is received immediately following the first contact. For non-respondents, the third and final contact will be a reminder letter with the URL and a second printed questionnaire. Each month, we will monitor the percentage of responses received through the web tool and evaluate whether overall response rates are increased following the addition of an electronic reporting option. We will also evaluate potential reductions in printing and mailing costs during testing of the mixed-mode approach. Data received through the electronic and paper options will also be compared to evaluate potential differences in the demographic representation of responses. The method will be permanently implemented if response rates increase, demographic representation is improved, and/or a cost savings is achieved. Post-stratification methods may also be incorporated into the effort estimation process to account for varied response rates. As this implemented change progresses, we will continue to evaluate the optimum sample allocations across strata and re-allocate accordingly.

Longer Term Improvements

The following recommendations will require changes to existing contracts with outside vendors, Agency approvals, public comment periods, and/or legislative action. Thus, addressing these issue will require the remainder of this year and potentially the better part of 2019 for the Agency to develop a preferred approach, and may not be fully implemented until October 2020.

The greatest concern brought to light during the review was the low response rates observed in the mail survey (20% overall, and <10% in some strata). Similar scientifically designed surveys achieve response rates as high as 30-40%. A primary contributing factor to the low response rate in the Gulf Reef Fish Survey is the high percentage of subscribers to the survey that are unlikely to participate in the fishery for reef fish on the west coast of Florida (over-subscribers). During the meeting with reviewers, FWRI researchers presented results of initial surveys with new or recently renewed subscribers, which found that anglers who purchase their license online and self-select which options to include on their saltwater fishing license (including the free GRFS designation) are more likely to respond to the mail survey and more likely to participate in a reef fish trip, compared to those who purchase their license through a vendor. The most likely explanation for this is sales representatives may select the free check box without specifically asking the customer whether they wish to include the Gulf Reef Fish angler designation on their license. The reviewers recommended several measures to reduce the number of anglers in the sample frame who do not have interest in fishing for the species covered by the Gulf Reef Fish Survey.

Reviewer recommendations that address the issue of oversubscription pertain primarily to the mechanism used to subscribe anglers to the survey. The reviewers recommend making the Gulf Reef Fish Angler designation less convenient to sign up for, which may force anglers or license vendors to first consider whether the designation is needed. For example, they suggested a question could be added that asks for confirmation that an angler intends to fish for reef fish in the Gulf, with a yes response taking them to a separate page or form to sign up for the GRFS. This option may be considered; however, due to the extent of change required in the state recreational licensing system to accomplish this, it may not be feasible to implement this prior to a new iteration of the licensing system, which will be available in October 2020. The reviewers' preferred option was to charge an additional fee for the Gulf Reef Angler designation as a way to eliminate the possibility of automatic inclusion by license vendors. Revenue could be used to support implementation of the survey over the long-term following certification by MRIP as an acceptable source of data for use in regional stock assessments and fisheries management. However, legislative action would be required for this option, as FWC does not have authority to charge a fee. Additional time may also be needed for gathering public input and any necessary FWC rulemaking. The Agency will evaluate these options over the coming year in order to determine the approach for reducing oversubscription that is most feasible.

The reviewers identified an issue with Gulf Reef Fish Angler designation potentially having a different expiration date than the saltwater fishing license. It is possible to purchase a license and add the Gulf Reef Fish designation in a different month. This is currently handled by purging anglers with expired saltwater fishing licenses from the GRFS sample frame. However, if a system could be put in place to ensure simultaneous expiration of the license and permit, this would benefit data handling and reduce the burden on anglers that must renew fishing privileges at different times. The state Licensing system is currently under contract through September 2020, and this improvement to the way anglers are licensed may be built into the statement of work for a new contract that will be executed in October 2020.

Table 1. Anticipated timeline for evaluating, testing, and implementing recommended improvements.

Year	Month	Intercept Survey: Implemented or in Progress	Mail Survey: Implemented or in Progress	Mail Survey: Testing and Implementation	Angler Subscription: Longer-term
2018	Mar		Evaluate sample allocation.	Test grayscale questionnaire	
	Apr	Evaluate existing APAIS data to identify additional sites to include in the Offshore Site Group for APAIS and GRFS.	Implement Neyman allocation.		
	May	Implement increased site list in Offshore Site Group.			
	Jun	Implement hot decking method for imputing missing weights.	Adopt AAPOR codes. Revise cover letter. Include partial responses in effort estimation.	Implement grayscale if successful. Use existing data to evaluate reduction in number of trips with detailed reporting.	Evaluate options and support for potential changes to subscription methods (e.g. separate website, additional questions, fee, etc.)
	Jul				
	Aug				
	Sep				
	Oct			Test modifications to layout and length of questionnaire.	
	Nov				
	Dec				
	2019	Jan	Implement new question in APAIS to increase sample size for measuring under-coverage in GRFS effort survey.		
Feb					
Mar					
Apr			Implement pre-contact letter if successful. Continue testing and evaluate mixed mode approach.		
May					
Jun-Dec					
2020	Jan-Sep				
	Oct				Execute new FWC Licensing and Permitting System contract

Table 2. Revised sample proportions using the Neyman allocation, by two-month wave.

STRATA	Wave 1	Wave 2	Wave 3	Wave 4	Wave 5	Wave 6
110	0.145	0.099	0.153	0.143	0.139	0.077
111	0.017	0.027	0.047	0.044	0.036	0.031
200	0.181	0.109	0.108	0.094	0.085	0.121
201	0.021	0.022	0.038	0.041	0.027	0.022
210	0.053	0.049	0.068	0.086	0.082	0.098
211	0.014	0.025	0.024	0.025	0.026	0.028
300	0.066	0.012	0.061	0.089	0.014	0.061
301	0.012	0.024	0.018	0.023	0.016	0.014
310	0.234	0.298	0.213	0.195	0.249	0.236
311	0.056	0.059	0.054	0.058	0.058	0.071
400						
401						
500	0.038	0.068	0.101	0.112	0.100	0.050
600	0.161	0.207	0.115	0.089	0.169	0.191

Table 3. Revised sample sizes using the Neyman allocation, by two-month wave.

STRATA	Wave 1	Wave 2	Wave 3	Wave 4	Wave 5	Wave 6
110	1003	684	1058	988	960	531
111	121	187	323	306	248	213
200	1247	755	743	649	588	838
201	148	154	264	282	183	151
210	363	340	468	591	564	674
211	99	170	167	175	177	193
300	454	86	419	612	95	418
301	86	163	127	162	111	99
310	1617	2057	1467	1346	1716	1627
311	388	410	373	400	403	487
400	75	75	75	75	75	75
401	25	25	25	25	25	25
500	264	468	697	772	691	348
600	1110	1427	793	617	1165	1320

Gulf Reef Fish Angler Designation



Gulf Reef Fish Survey Review
February 5, 2018



Florida Fish and Wildlife Conservation Commission

Implementation Timeline

- **February 2014** – Staff presented initial GRFS proposal to Commissioners following stakeholder requests for data collection improvements
- **March 2014** – Public workshops held along Florida Gulf coast
- **June 2014** – Final approval by FWC
- **July 2014** – Voluntary sign up opens to FWC license holders
 - Allowed angler sign ups during peak season for license renewals
- **January 2015** – Voluntary sign up available for GRFS becomes open to all (including anglers not required to have a saltwater fishing license)
- **April 1, 2015** – GRFS sign up mandatory for Gulf reef fish anglers



Summary of Feedback from Public Workshops – Spring 2014

- Support for improved data collection, but some felt the proposed data reporting system would be intrusive and that data could be collected other ways
- Call it a registry, not a permit
- Some felt the data reporting system should be boat-based instead of angler-based
- Concerns about fees and cost of permit after 5 years
- Concerns about how the data reporting system would be enforced



Gulf Reef Fish Angler Designation

- Mandatory for private recreational anglers (i.e., not for-hire sector) on a boat along Florida's Gulf coast intending or attempting to harvest or possess any of the following reef fish
 - Red snapper
 - Gag
 - Amberjacks/Rudderfish/Almaco jack
 - Red grouper
 - Black grouper
 - Vermilion snapper
 - Gray triggerfish
- Anglers renew annually
- No cost to anglers (funding for the first 5 years provided by NFWF Gulf restoration grant)
 - Continuation beyond June 2020 would require Commission renewal and additional funding



Gulf Reef Fish Angler Designation - Exemptions

- Children under 16 years of age
- Anglers fishing from a for-hire vessel or state-licensed recreational fishing vessel
- Harvest for scientific or educational purposes
- **Includes** anglers 65 or older
 - 18% of Floridians are 65 and older
- **Includes** others exempt from recreational saltwater fishing license requirements as well as lifetime or multi-year license holders



Outreach Approaches

- Direct communication with anglers and vendors
 - Emails/letters to licensing vendors and tackle shops
 - Bait box stickers
 - Rack cards/Postcard
 - Emails to FWC license holders
 - Outreach at fishing clubs/shows
- Targeted seniors by emailing people who have aged out of licensing system previous 9 years
- Features in many FWC publications, press releases, and website
 - <http://www.myfwc.com/fishing/saltwater/recreational/gulf-reef-fish-survey/>



Enforcement and Penalties

- Educational approach
 - Focus on customer service and being ambassadors of conservation
 - Encourage Gulf reef fish anglers on the water to report intention to fish for Gulf reef fish
- Civil penalty for violations (fines) for failure to submit report



Why Have a Free Gulf Reef Fish Survey Instead of a Fee-based Permit or Registry?

- FWC does not have authority to set fees or penalties, only the Florida Legislature can
- FWC does have authority to create (no cost) permits
 - Not supported by stakeholders
 - Could result in increased agency costs or service fees for customers
- No penalties exist in Florida Statute for failure to sign up for a registry



Gulf Reef Fish Angler Survey Subscription

Tara Gibson
Office of Licensing and Permitting



Total subscriptions

- Resident 16-64:

1,085,233

- Resident Seniors 65+:

29,540

- Non-Residents:

505,217

- First Responder/Utility:

2,096 **Implemented 09.21.2017*

Where can I sign-up?



- Online at GoOutdoorsFlorida.com
- At a retail agent location
- At a Tax Collectors office



How to sign up:

- First time sign-up, with purchase of a Saltwater fishing license
- Renewal sign-up, with the renewal of previous GRFS and Saltwater fishing license
- Sign-up outside of the purchase of Saltwater fishing license

Review of Survey Methods

Beverly Sauls and Tiffanie Cross
Fish and Wildlife Research Institute
Marine Fisheries Research
Saint Petersburg, FL



Objectives

Provide estimates for important managed reef fish stocks that:

- Improve timeliness
 - To support shorter harvest seasons
 - Facilitate in-season monitoring
- Improve precision
 - Maximize management within ACLs
 - Potentially facilitate state management
- Support stock assessments
 - Accurate catch estimates
 - Length/weight/age composition of landed catch
 - Spatial resolution



Survey Design (overview)

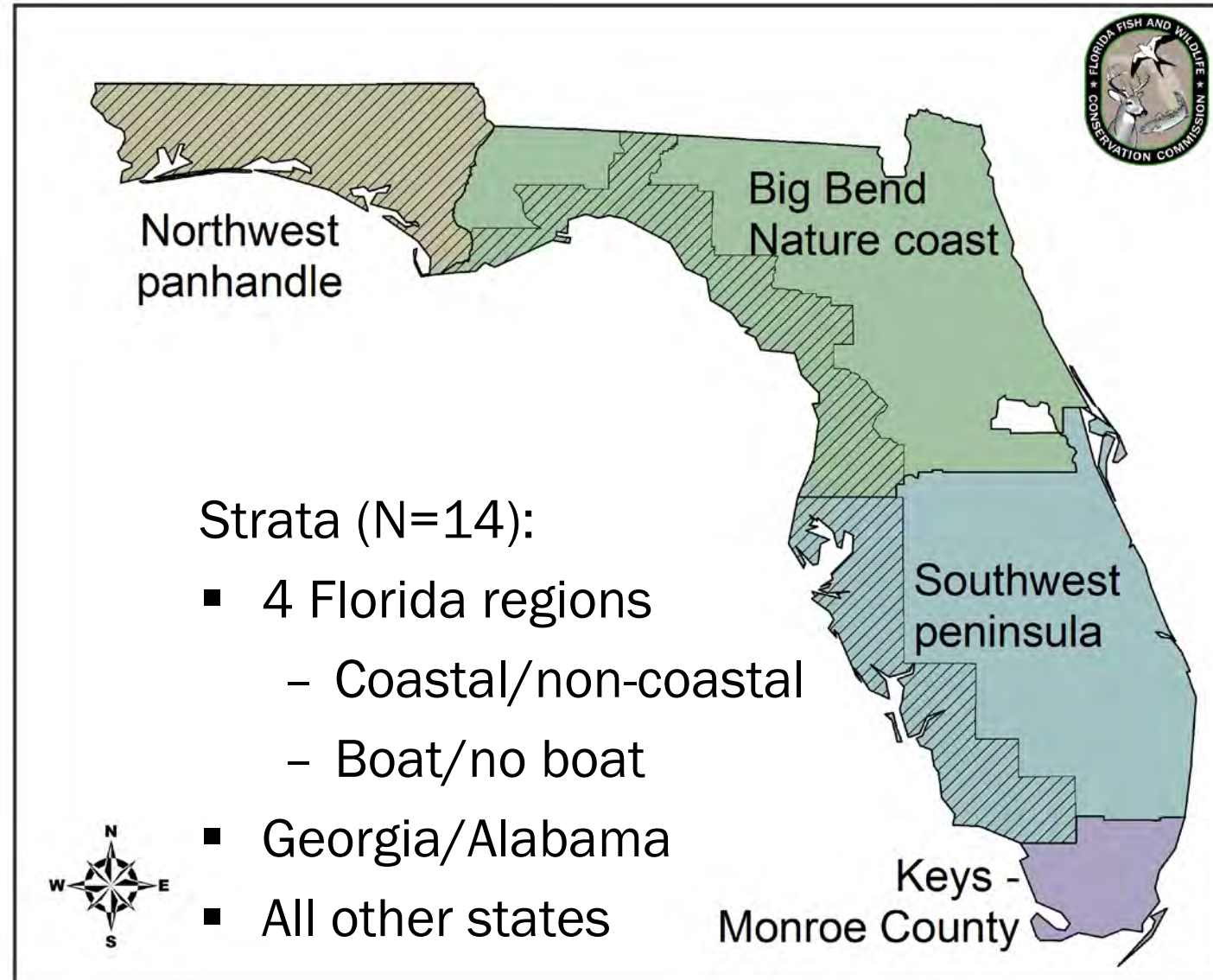
- Gulf Reef Fish Survey
 - Initiated in May 2015
 - Mail survey of registered Gulf Reef Fish Anglers
 - Monthly estimate of private boat angler trips that target reef fishes
 - Estimates state and federal waters separately
 - Supplement APAIS with specialized private boat intercept survey
 - Effort adjusted for under-coverage from supplemental intercept survey



Mail Survey



Sample Stratification



Mail Survey Sample Selection

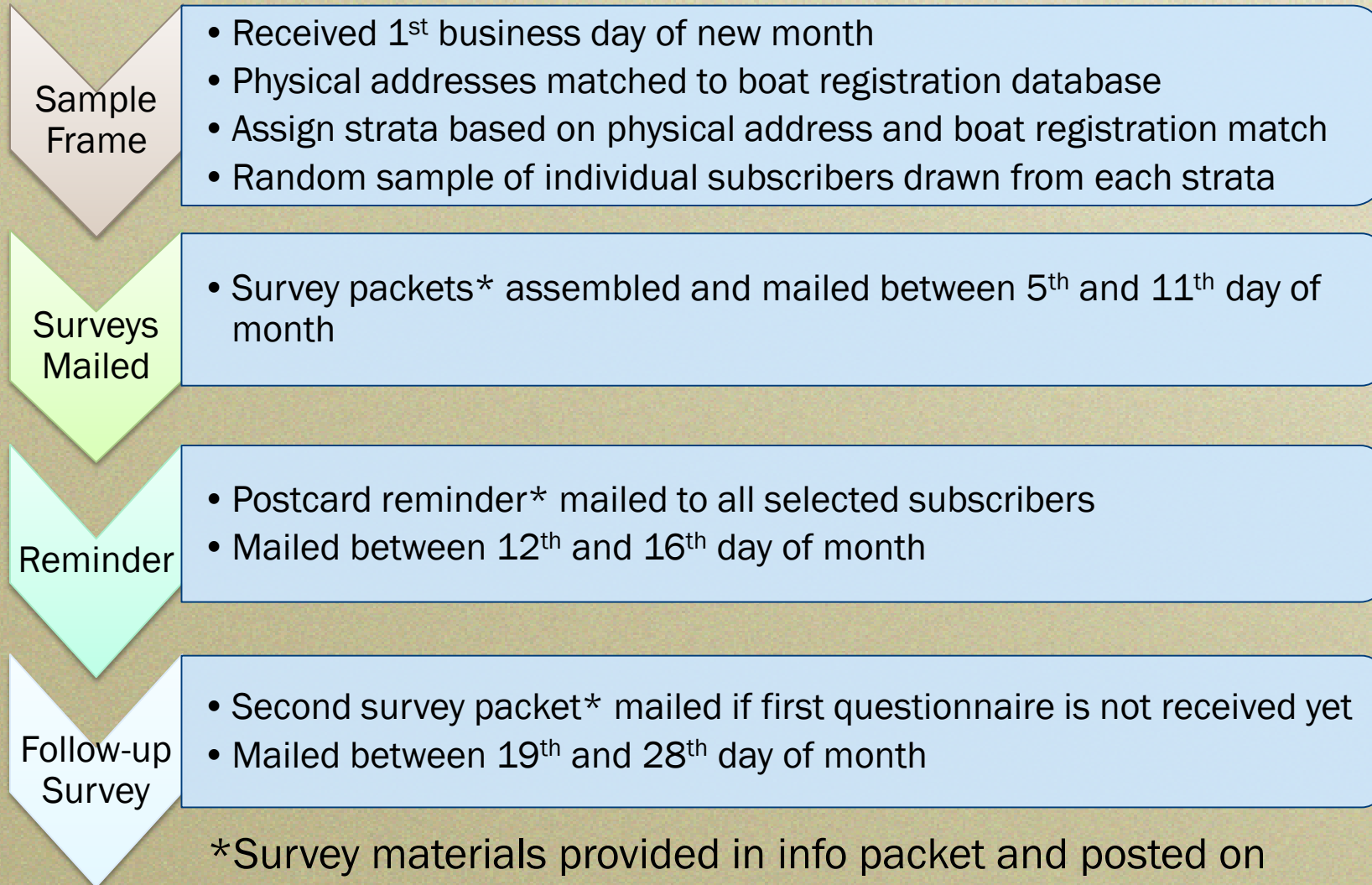
- 10% random sample from each strata
 - Capped at max of 500
 - Remove for two months following selection



The Survey Instrument...



Mail Survey Methods



*Survey materials provided in info packet and posted on website



Mail Survey Methods

- Responses scanned as they are received
- QA/QC
 - Records for review flagged by the scanning software
 - All records reviewed prior to export to the SQL database
 - 10% random audit of database records performed since survey inception
 - 0.006 error rate



Timeliness of Estimates

- Preliminary estimates:
 - Number of days after the end of a fishing month
 - 50% of responses: 33 days
 - 75% of responses: 39 days
 - 95% of responses: 60 days



Questions about mail survey methods?



Effort Estimation Methods



Unadjusted Effort

1. Weight = selection weight x non-response weight
2. Calculate mean number of trips per response in each stratum
3. Calculate overall weighted mean
4. Multiply by the total number of subscribers to obtain total unadjusted effort



1. Weight

- Sample selection weight:

$$SW_h = \frac{N_h}{n_h} \quad (1)$$

Where:

N_h = total number of registered Gulf reef fish anglers in stratum h

n_h is the number of individuals selected from stratum h

- Non-response:

$$R_h = \frac{\sum_{i=1}^{n_h} SW_h r_{h,i}}{\sum_{i=1}^{n_h} SW_h} \quad (2)$$

Where:

r_i = binomial variable indicating whether selected individual i responded to the survey (1=yes, 0=no)

- Final weight:

$$W_h = SW_h \frac{1}{R_h} \quad (3)$$



2. Sample Mean Trips per Response

Calculate separately for trips primarily fished in EEZ waters and State waters:

$$\bar{y}_h = \frac{\sum_{i=1}^n y_{h,i}}{n_h}$$
$$var(\bar{y}_h) = \frac{\sum_{i=1}^n (y_{h,i} - \bar{y}_h)^2}{n_h - 1}$$

Where:

$y_{h,i}$ = number of trips reported by the i th respondent in stratum h

n_h = number of responses in stratum h



3. Population Mean

$$\bar{y} = \sum_{h=1}^{14} W_h \bar{y}_h$$

$$var(\bar{y}) = \sum_{h=1}^{14} W_h^2 var(\bar{y}_h)$$



4. Total Unadjusted Effort

Total number of trips taken by Gulf Reef Fish survey subscribers in a given month:

$$\hat{Y} = N\bar{y}$$

$$var(\hat{Y}) = N^2 var(\bar{y})$$

Where:

N=total number of GRFS subscribers across all strata



4. Total Unadjusted Effort

```
proc surveymeans data=response_wt3
total=strata_pop_totals      *Nh subscribers in strata;
mean var sum varsum cv cvsum;
strata surveyyear surveymonth strata;
weight W;                    *from step 1;
domain surveyyear*surveymonth;
var sum_state sum_eez;       *sum trips per response;
run;
```



Questions about effort estimation?

Note: methods to adjust effort for under-coverage will be described during catch estimation



Intercept Survey Methods



Florida APAIS Stratification

- WFL APAIS Allocation:
 - 1 = 20%
 - 2 = 15%
 - 3 = 30%
 - 4 = 15%
 - 8 = 20%
- GRFS area:
 - 1, 2, 3, 4
- APAIS and GRFS assignments drawn simultaneously
 - Avoids overlapping assignments
 - Sample weights compatible



Florida APAIS Stratification

- Allocate portion of APAIS sample to first part of June
 - Ensure adequate sample coverage during short federal seasons
- Red snapper federal seasons
 - June 1-10, 2015
 - June 1-11, 2016
 - June 1-3, 2017
 - Extended to weekends only June 16 - September 4



Sample Frame

- APAIS Site Register (WFL, excluding Keys)
 - 589 sites with private boat (PR) pressure
 - 54 sites designated as offshore sites
- APAIS
 - Fixed % of assignments allocated to offshore sites
- GRFS
 - 100% of assignments allocated to offshore sites



GRFS Intercept Survey Procedures

- Documentation :
 - Field data sheets
 - Species identification guide
- On website:
 - Field Procedures Manual



GRFS Interview Procedures

- As private boats return, rapidly screen parties for:
 - Saltwater fishing
 - If yes, record: time, number of anglers, whether fished in Gulf of Mexico, % of time in EEZ
 - Gulf Reef Fish species (targeted or caught)
 - If yes, proceed to catch interview
- Record unconfirmed boats with fishing gear

		Did you fish recreationally (in saltwater) for finfish? If Yes:				Did anyone on the boat catch or try to catch any of the following species for the purpose of harvesting?							Did anyone on the boat release any of the following species?						Cont. to Catch Int.? Y/N/R	
<u>Int #</u>	Time	Confirm	# <u>angl.</u>	Gulf?	% EEZ >10 mi	RS	VS	GT	<u>AJ sp</u>	Gag	RG	BG	RS	VS	GT	<u>AJ sp</u>	Gag	RG		BG
		C U R		Y N U																
		C U R		Y N U																
		C U R		Y N U																



GRFS Status

- Needed to account for under-coverage in effort estimates
 - Currently not collected in APAIS
- Each adult in party asked to confirm “Gulf Reef Fish Angler” is printed on their SW fishing license
 - “registered” = angler can confirm and/or is sure they registered for the GRFS
 - “not registered” = angler can confirm not registered
 - “could not verify” = angler can’t confirm, and either not sure or says they have not registered for GRFS

Tally anglers in the party by registration status for GRFS:

Registered	Not Registered		Could not verify	Refused
	Youth (under 16)	Adults (over 15)		



GRFS Status

Potential Field Misclassifications:

- False positive
 - GRFS status expired but still printed on a valid license
 - Example: 5 year license
- False negative
 - GRFS status valid but not printed on valid license
 - Anglers likely remember extra effort made to sign up for survey



Discards

- Each angler asked to recall discards
 - Matches APAIS angler-based interview

Discards and bait (per angler): All anglers interviewed for discards? YES NO

If NO, how many not interviewed? _____

Angler #	For each angler, list all species caught that were either released or used for bait.	Total # released alive	Total # released dead/preyed	Total # used for bait	Of total <u>released+bait</u> , estimate how many were under size limit (if applicable)



Retained Catch

- Grouped catch for boat party
 - APAIS allows this only for observed harvest
- Biological samples (when time permits)
 - Age samples not collected in APAIS

Retained Catch (total for boat). Interview Number: _____

Office use only	Fish #	Species	# <u>Obs</u>	# <u>Rprtd</u> <u>(unobs)</u>	Length ML (mm)	Length Max TL (mm)	Weight (kg/G/C)	Otolith Y/N/R	Sex	Notes



Catch Data



Data Entry and QA/QC

- Field data sheets reviewed prior to key entry
- Electronic data entry
 - Built-in error checks
 - SQL relational database
- Error checking program
 - Run monthly
 - Flags potential errors in data entry
 - Checks length/weight against 95% CI
 - Promotes routine follow-up with field staff



Public Use Files

- GRFS intercept data formatted to match APAIS Public Use Files
- Survey design variables include:
 - Strat_id identifies the design stratum
 - Psu_id identifies the primary sampling unit (site-day)
 - Id_code identifies the angler-trip
 - Wp_int is the post-stratified sampling weight to use in weighted estimation



Public Use Files

- **SIZE_YYYYW.sas7bdat**

- Fish level length and weight data and variables required for use in estimation.
- One record per fish caught and measured or weighed by interviewer.
- Missing lengths and/or weights are imputed as needed for individual fish records.
- The lngth_imp and wgt_imp fields have values of '1' when the corresponding lngth and wgt fields have imputed values.



Weight Imputation for GRFS Intercepts

- Fish with length, no weight
 - Impute weight from length using historic data
- Fish with no length or weight
 - Combine observed lengths from APAIS and GRFS intercepts
 - Calculate mean length by wave / area / species from combined data
 - Impute weight from corresponding mean length



Public Use Files

- **CATCH_YYYYW.sas7bdat**
 - Catch level data and variables required for use in estimation.
 - Contains one record per species for every angler-trip interview.
 - GRFS: harvest totals for party grouped on first angler
 - Each record contains catch totals by major catch types (A, B1, B2) in numbers, weight (kg), and length (mm).



Public Use Files

- **TRIP_YYYYW.sas7bdat**
 - Trip level data and variables required for use in estimation.
 - Contains one record for each angler in an intercepted reef fish party with a complete catch interview
 - Leader code for first angler in a boat party
 - Primary sample weight
 - From joint APAIS/GRFS sample draw (John will talk about in next presentation)
 - Secondary sample weight (similar to APAIS)
 - Sum number of reef fish party intercepts per assignment (R)
 - Calculate proportion (p) of total intercepted fishing parties that were reef fish trips
 - Apply proportion to total unconfirmed parties (U)
 - Secondary weight = $R / pU + R$
 - Majority of values range between 1.0 - 1.9, highest=3.29



Questions?





**NOAA
FISHERIES**

A Replication Approach to Controlled Selection in an Intercept Survey of Recreational Fishing Trips

John Foster

AFS 145th Annual Meeting

Portland, Oregon
20 August 2015



Outline

- **Background**
- **Methodology**
- **Simulation**
- **Conclusions**

Background

1 of 2

- Angler intercept surveys can be difficult
 - Sample units include spatial and temporal dimensions (fishing site(s) x specific date/time)
 - Limited resources for survey operations
 - Uncontrolled selection may produce draws that exceed resource constraints
 - Available field samplers per day
- Post-hoc adjustments to sample draw may deviate from probability sampling design

Background

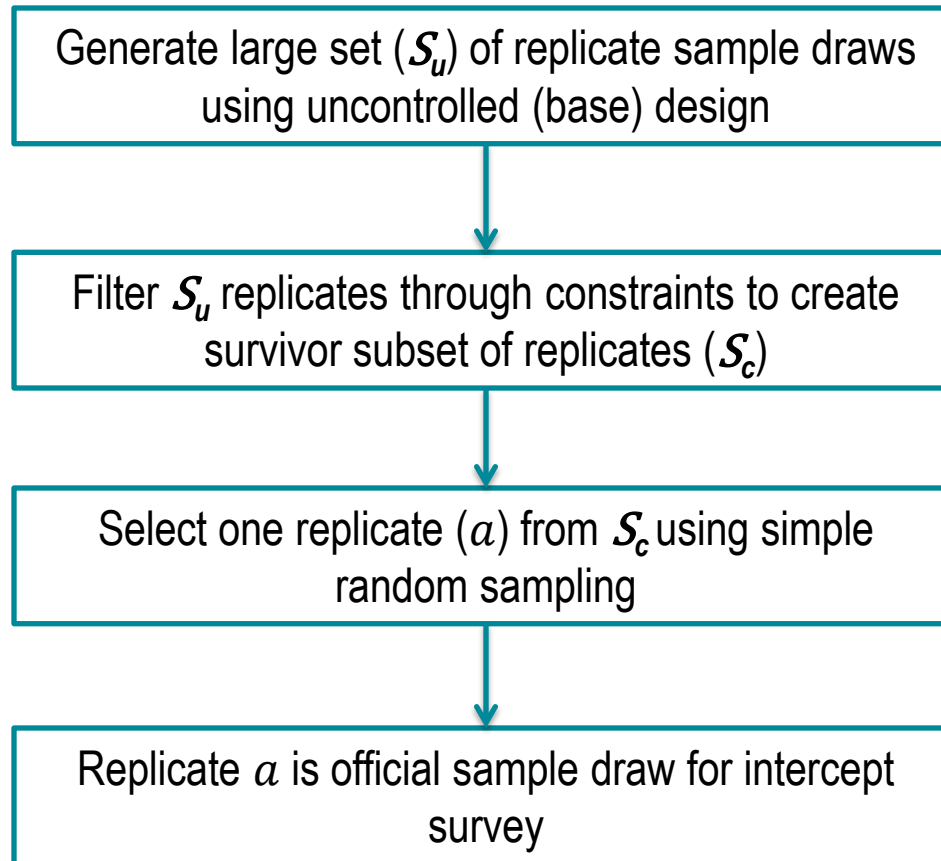
2 of 2

- Access Point Angler Intercept Survey (APAIS)
 - Conducted by US National Marine Fisheries Service (NOAA Fisheries) since 1981
 - Original procedures allowed post-hoc adjustments to sample draws to accommodate logistical constraints
 - New rigorous design implemented in 2013
 - New design uses replication-based controlled selection to incorporate logistical constraints into draw process

Methodology

1 of 4

- Overview



- Inclusion probabilities and sample weights for units in selected replicate draw a
- Reasonable number of replicate sample draws
- Adequate number of survivor sample draws
- Any potential for bias in resulting estimates

- Inclusion probabilities and sample weights for units in selected final replicate draw a
- Standard definition of inclusion probability
 - $\pi_i = P(i \in A) = \sum_{a \in A_{(i)}} p(a)$ (Fuller, 2009)
- Modify definition to condition on survivor subset \mathcal{S}_c
 - $\pi_i = P(i \in A | \mathcal{S}_c) = \sum_{a \in A_{(i)} | \mathcal{S}_c} p(a)$

- Numeric example
 - \mathcal{S}_c contains 10 surviving replicate sample draws
 - Unit i is in 3 replicates in \mathcal{S}_c
 - Final replicate, a , will be chosen using SRS
 - So $p(a)$ for any a will be $\frac{1}{10}$ and
 - $\pi_i = \sum_{a \in A_{(i)} | \mathcal{S}_c} p(a) = \frac{3}{10}$
- π_i = proportion of replicates in \mathcal{S}_c containing unit i
- $w_i = 1/\pi_i$

Simulation

1 of 11

- Population/Frame
 - Unit = site-day
 - 30 sites x 30 days = 900 units
 - 5% high activity, 35% medium, 40% low
- Design
 - Single stage, no strata
 - PPS (size: low=5, medium=10, high=20)
 - $n = 30$

- Parameter/Estimation
 - Total population catch: $Y = 100,000$
 - 3 distribution scenarios for y_i
 - Random Poisson, $\lambda = Y / N$, $y_{i,poi}$
 - Random Poisson + strong positive correlation ($\rho = +0.95$) to unit size, $y_{i,pcor}$
 - Random Poisson + strong negative correlation ($\rho = -0.95$) to unit size, $y_{i,ncor}$
- $\hat{Y} = \sum_{i=1}^n w_i y_i$

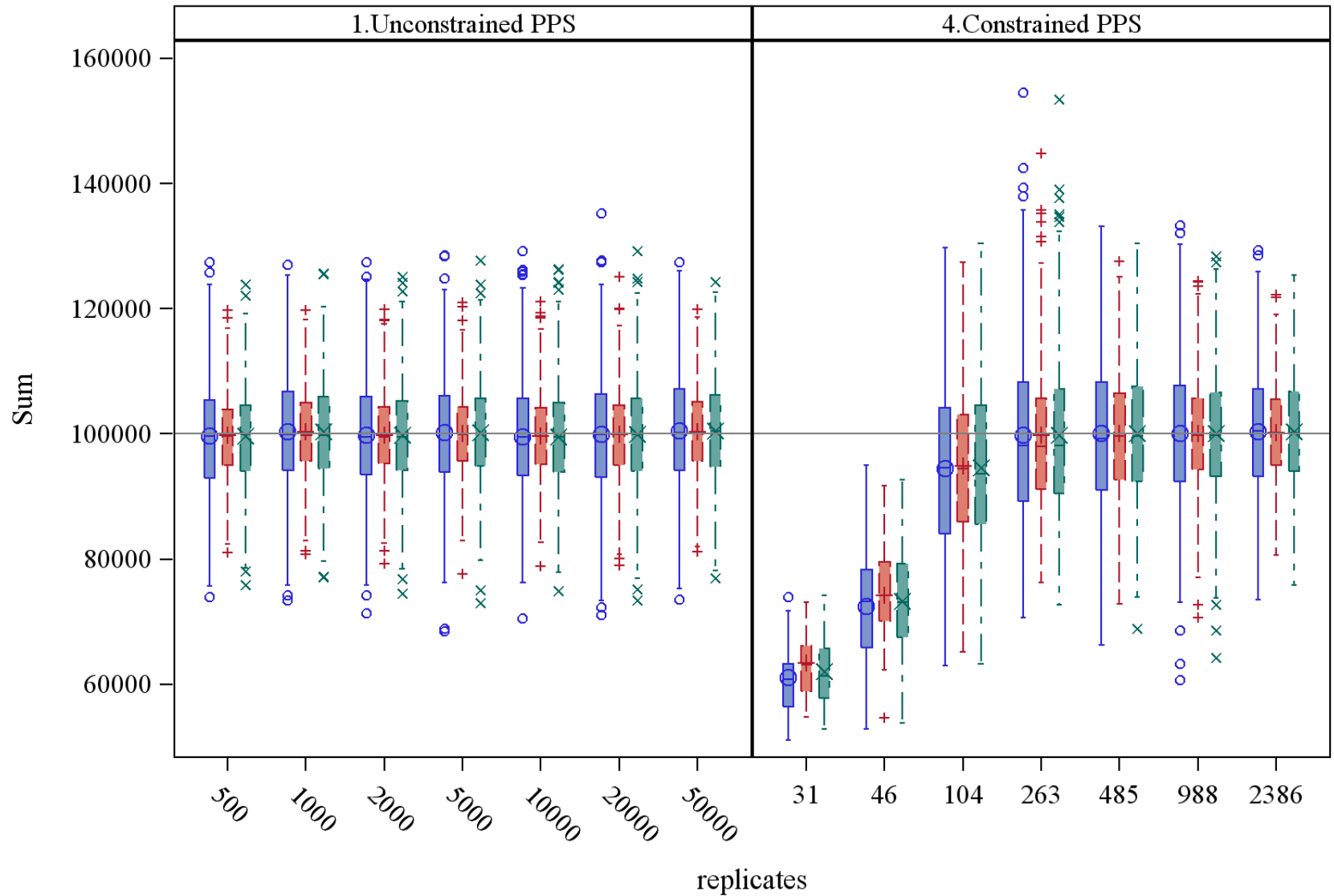
- Initial draw replication
 - 7 initial replicate sets (\mathcal{S}_u) of sizes:
 - 500, 1000, 2000, 5000, 10k, 20k, 50k
- Constraint of maximum units/day = 2
- 7 resulting \mathcal{S}_c of sizes:
 - 31, 46, 104, 263, 485, 988, 2386
 - ~5% survival rate

- Final Draw/Estimation iterations
 - Select 1 draw from each \mathcal{S}_c
 - Calculate post-stratification adjustments to sample weights
 - $w_{i,p1} = w_i \frac{N}{\sum_{i=1}^n w_i}$ same adjustment all units
 - $w_{i,p2} = w_i \frac{N_g}{\sum_{i=1}^{n_g} w_i}$ adjustment by size group
 - Estimate \hat{Y}_{poi} \hat{Y}_{pcor} \hat{Y}_{ncor} using w_i $w_{i,p1}$ $w_{i,p2}$
 - 1000 iterations

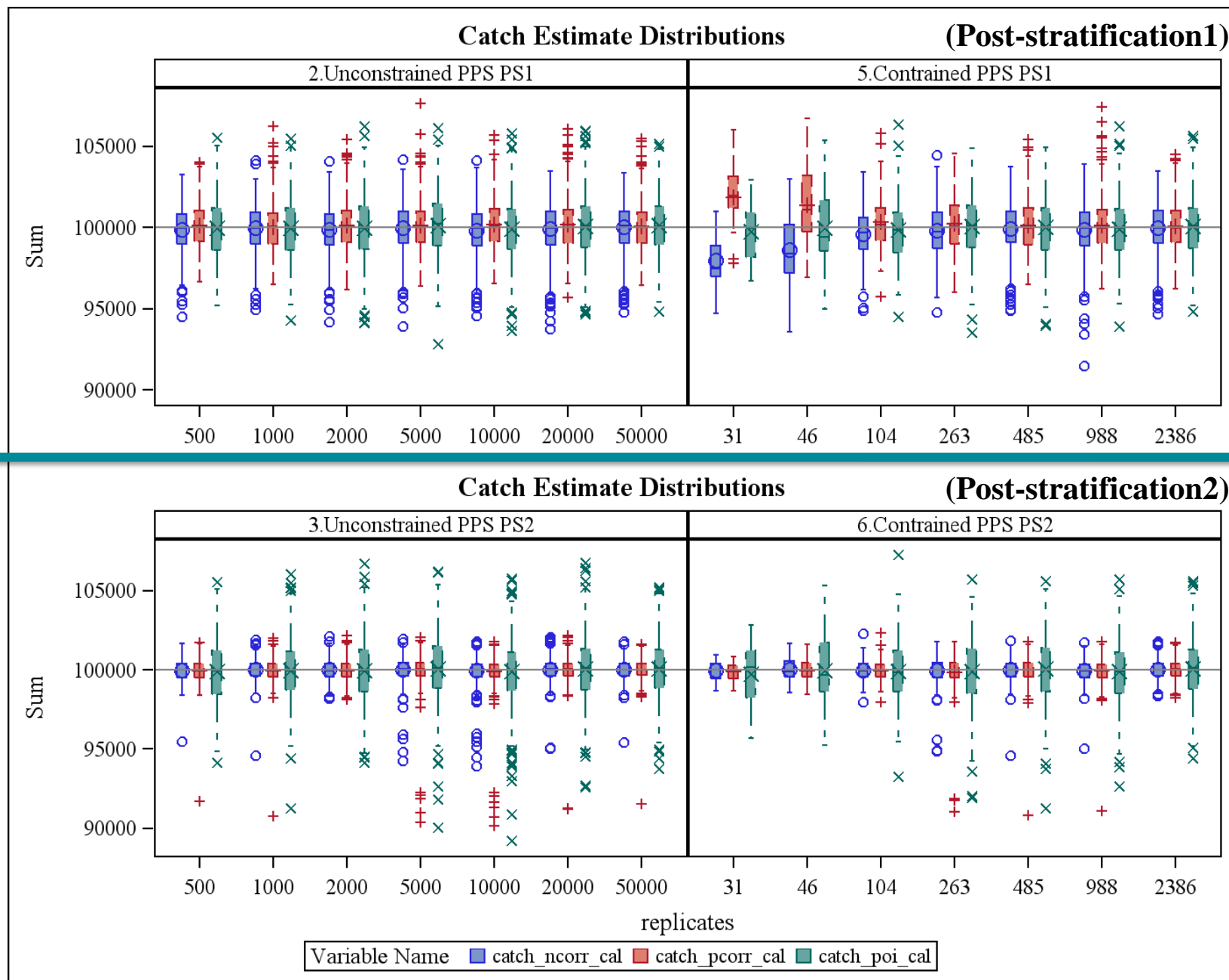
- Catch Estimate Distributions
- Relative Bias Distributions
 - $\text{RelBias}(\hat{Y}) = \frac{\hat{Y} - Y}{\hat{Y}}$
- Sample weight distributions
- Coverage

Catch Estimate Distributions

(No Post-stratification)

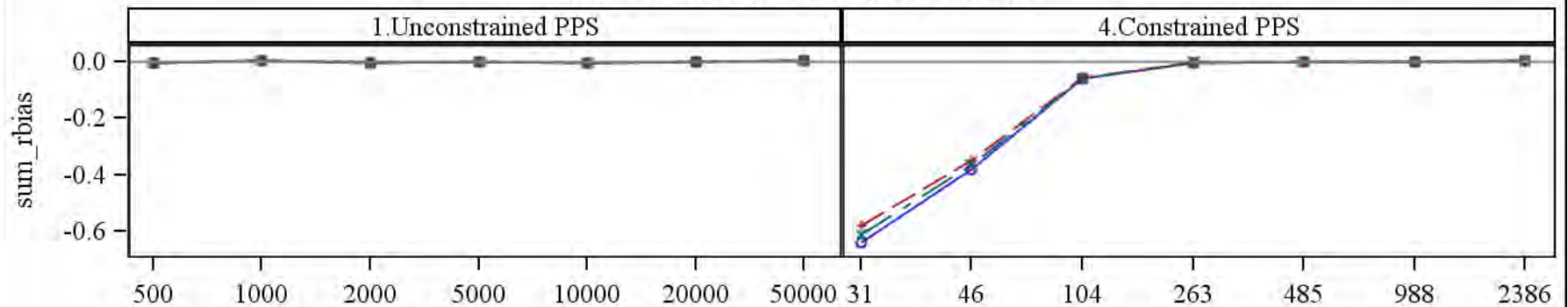


Variable Name ■ catch_ncorr_cal ■ catch_pcorr_cal ■ catch_poi_cal



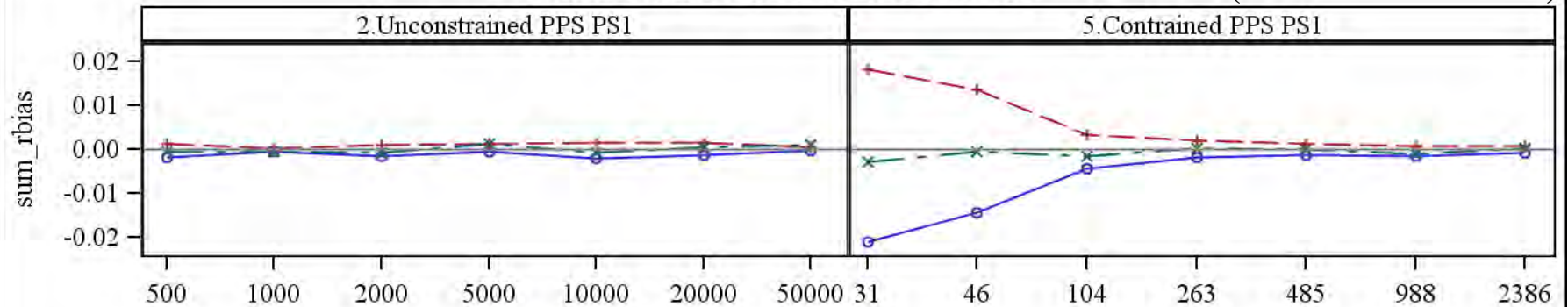
Catch Estimate RelBias Distributions

(No Post-stratification)



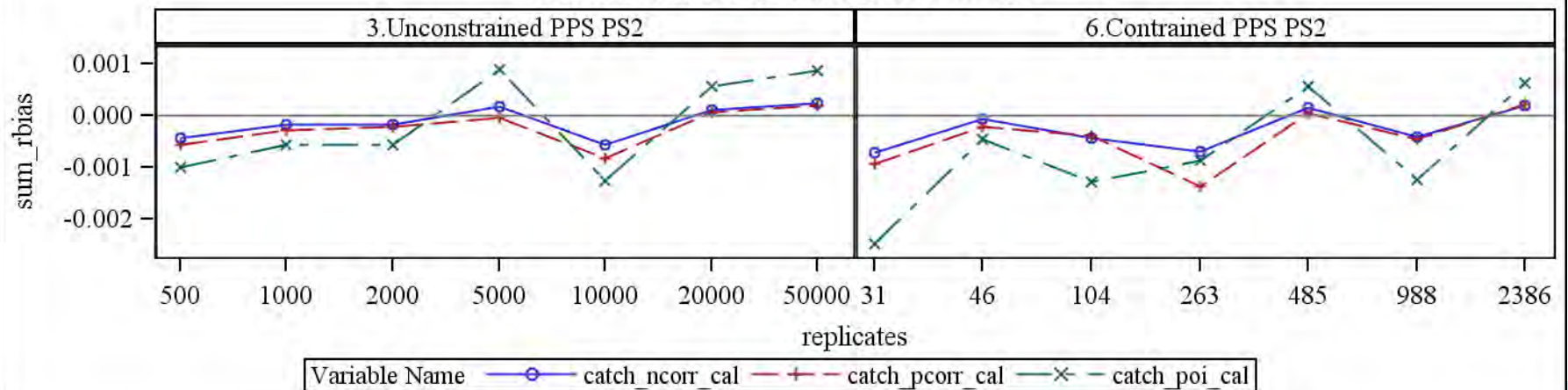
Catch Estimate RelBias Distributions

(Post-stratification1)



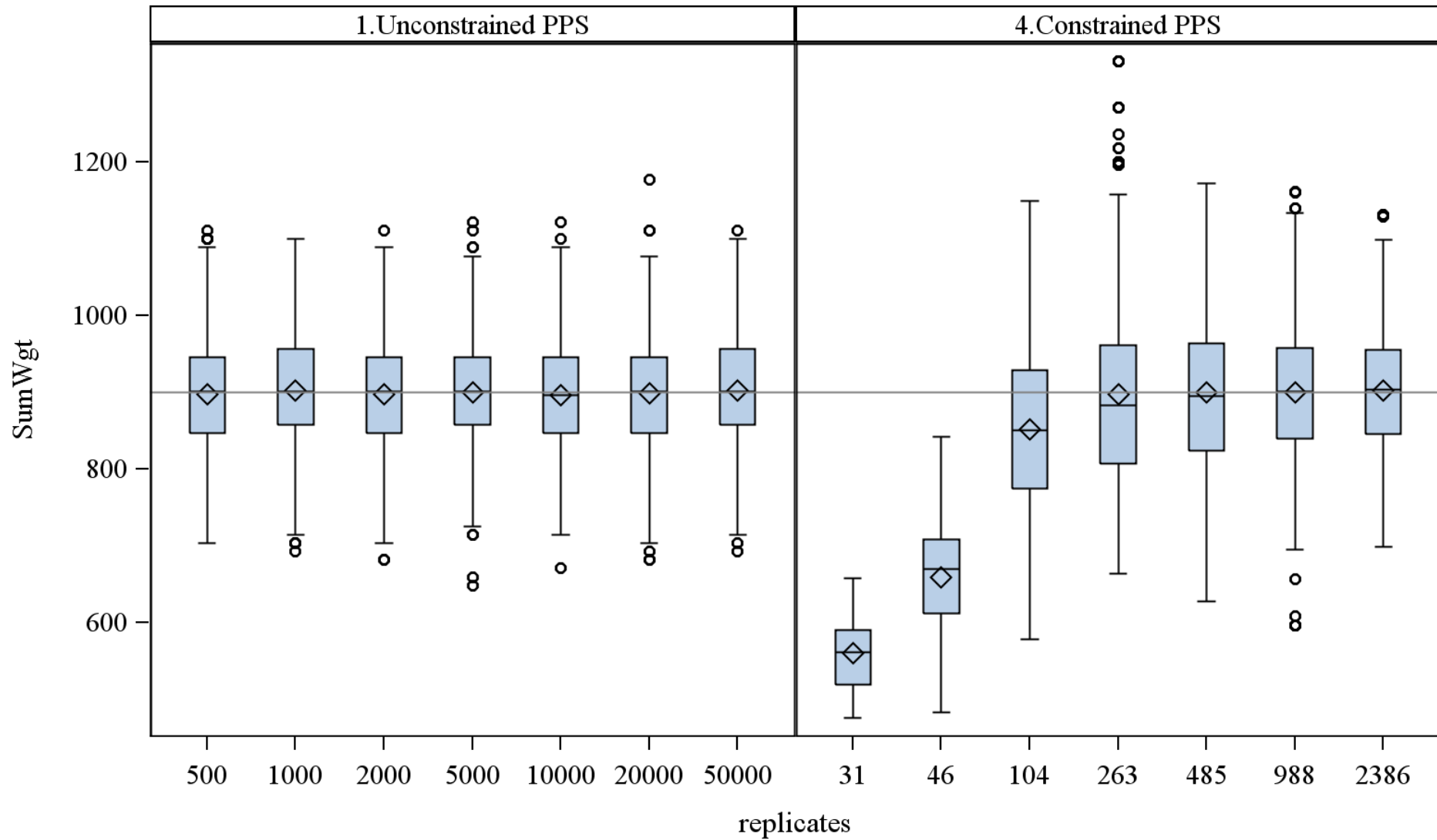
Catch Estimate RelBias Distributions

(Post-stratification2)

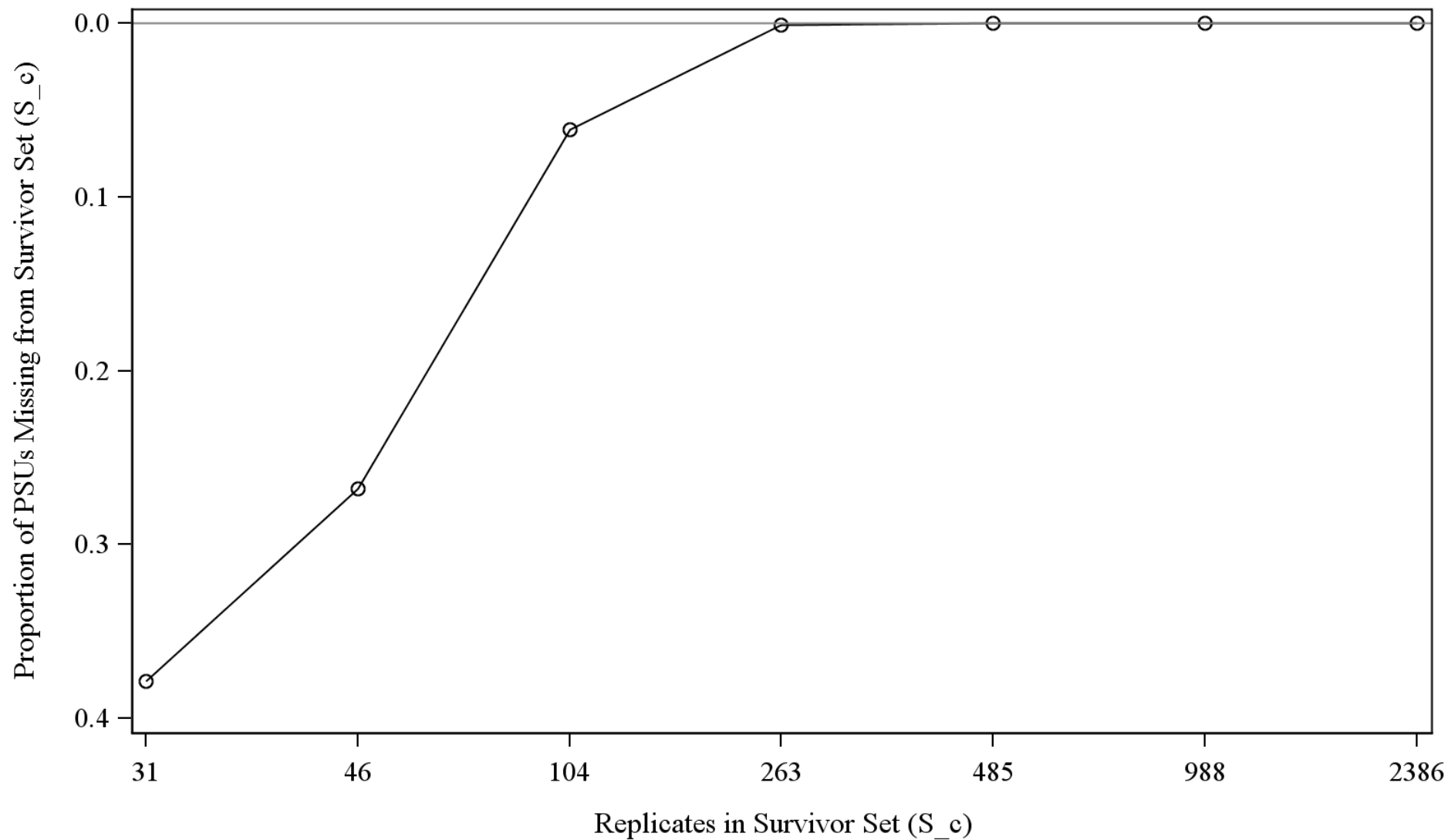


Total Sample Weight Distributions

(No Post-stratification)

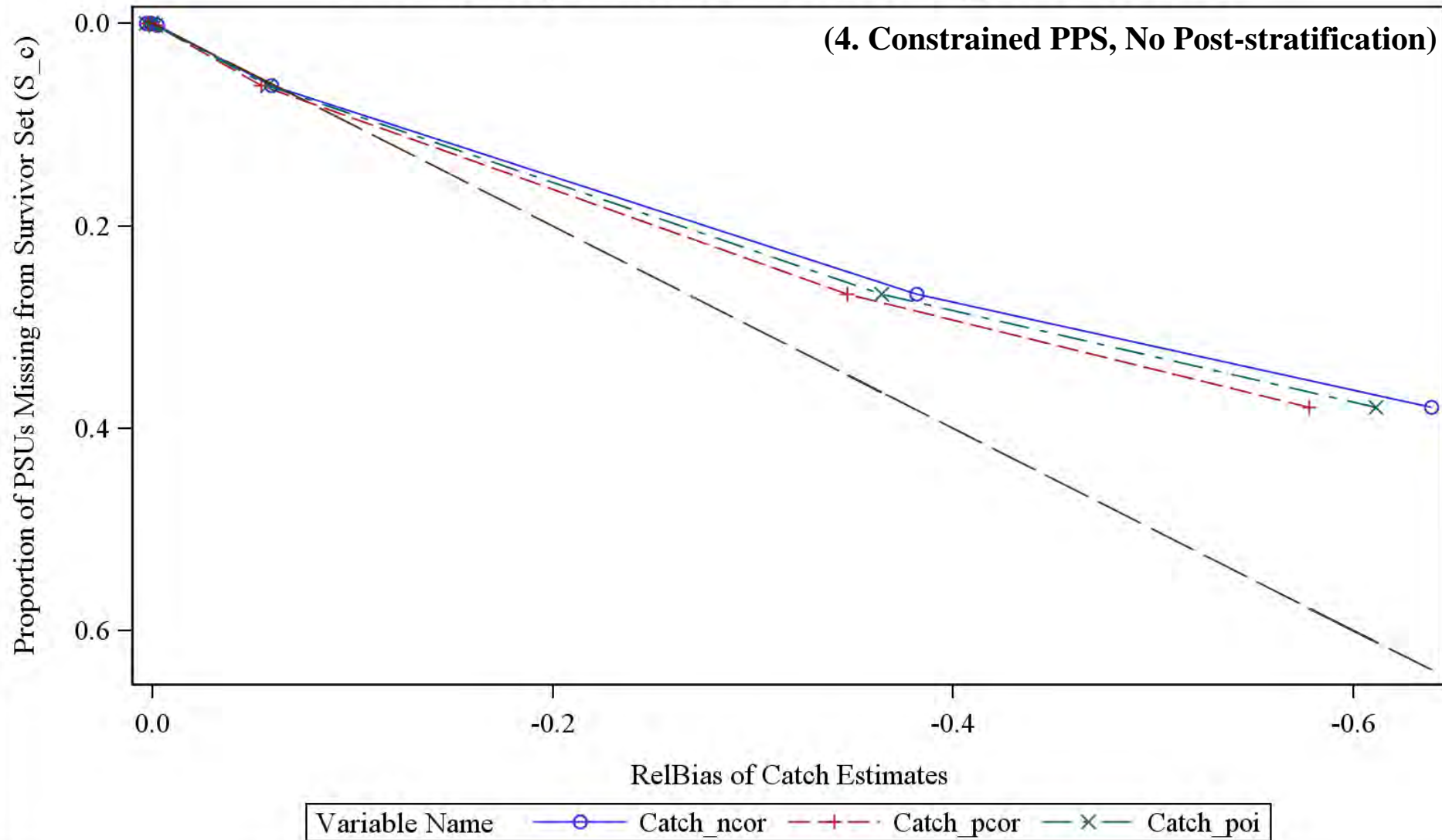


Proportion of Frame Units Missing from Survivor Set



RelBias vs Proportion of Frame Units Missing from Survivor Set

(4. Constrained PPS, No Post-stratification)



Conclusions

- Draw replication is a simple and flexible method to incorporate constraints into sample selection
- Estimates approximately unbiased so long as all frame units included in survivor set
- Post-stratification adjustments using frame control totals **may** substantially reduce bias when survivor set is missing frame units – use caution!



**NOAA
FISHERIES**

A Replication Approach to Controlled Selection in an Intercept Survey of Recreational Fishing Trips

John Foster

AFS 145th Annual Meeting

Portland, Oregon
20 August 2015





NOAA
FISHERIES

Integration of GRFS Intercept and APAIS

John Foster
Florida Gulf Reef Fish Survey
Review Workshop

February 6, 2018

Integration

- Basic approach
- Sample design
- Data considerations
- Estimation

Basic approach

- GRFS intercept sample drawn as add-on sample in select APAIS strata
- APAIS data screened for GRFS eligibility
- GRFS and eligible APAIS data used in standard design-based weighted estimation

Sample Design - APAIS

- Complex
- Frame
 - PSU: site-cluster, date, 6-hour time interval
- Stratification
 - Temporal: month, kind-of-day, time period
 - Spatial: sub-region, state, sub-state region
 - Fishing attribute: site group

Sample Design – APAIS Site Group Strata

- Defined using fishing pressures (activity levels) in different modes of fishing
 - Shore
 - Private boat
 - Charter boat
 - Offshore

Sample Design – Offshore Site Group

- Sites designated as offshore
 - General offshore fishing activity
 - Fishing activity for key regionally specific offshore species
- All offshore site group PSU's are single-site clusters
- GRFS sample units drawn from offshore site group strata

Sample Design – APAIS Sample Selection

- PSU's drawn using a form of rejective sampling
 - Basic selection: stratified probability proportional to size without replacement for PSU's
 - PSU sizes derived from expected fishing pressures estimated by State partners
 - Rejection criteria based on per-day sampler availability constraints
 - Nominal PPS inclusion probabilities adjusted to account for effects of rejective sampling

Sample Design – GRFS Samples

- Total sample sizes for offshore strata are sums of APAIS base and GRFS add-on sample sizes
- Total samples from offshore strata drawn using APAIS draw process
- GRFS samples identified at random (srswor) from all offshore strata
- Remaining samples become APAIS base samples for the offshore strata

Sample Design – GRFS Sample Weighting

- Generally follows APAIS sample weighting
- Primary stage weights calculated as inverse of inclusion probabilities for selected PSU's
- Secondary stage
 - GRFS eligible trips returning to selected PSU
 - Secondary stage weights calculated as inverse of within PSU sampling fraction of GRFS trips
- Final weights calculated as product of primary and secondary stage weights

Data Considerations

- Applying GRFS eligibility to APAIS data
- Data for GRFS effort survey coverage adjustment
- Potential for using GRFS intercept data in APAIS estimation

GRFS Eligibility in APAIS Data

- APAIS covers all marine recreational fishing trips
- Two ways to be GRFS eligible
 - GRFS species targeted on trip
 - GRFS species caught on trip
- APAIS questionnaire has primary and secondary target species questions
- APAIS catch data

GRFS Eligibility in APAIS Data

- APAIS intercepts individual angler-trips
- Angler-trips from same boat/fishing party linked in APAIS data
- GRFS eligibility for APAIS data determined at boat level
 - All angler-trips marked eligible if any angler-trips within the boat are eligible

GRFS Eligibility in APAIS Data

- APAIS data limited to GRFS eligible trips
- No adjustment made to APAIS secondary stage weights
 - Do not have separate counts of total angler-trips by eligibility status

$$\bullet \frac{N_{psu_e}}{n_{psu_e}} = \frac{N_{psu}}{n_{psu}} * \frac{n_{psu_e}/n_{psu}}{n_{psu_e}/n_{psu}} = \frac{N_{psu}}{n_{psu}}$$

GRFS effort survey coverage adjustment

- GRFS effort survey frame covers anglers with “GRFS license”
- GRFS base effort estimates adjusted to account for off-frame effort
- Data for adjustment calculation only collected on GRFS intercept assignments, would need to add question(s) to APAIS questionnaire

GRFS intercept data in APAIS estimation

- Integration works one way: APAIS data used in GRFS estimation
- Would like to incorporate GRFS intercept data into APAIS estimation
 - Ineligible trips counted on GRFS assignments
 - No full interviews for ineligible trips
- Seeking recommendations
 - Nonresponse approach?
 - Subsampling?

GRFS Total Effort and Total Catch Estimation

- Similar approach to MRIP estimation
- Estimation components from intercept survey data
 - Catch rates (GRFS intercept and APAIS data)
 - Coverage adjustment for GRFS effort survey (GRFS intercept data only)
- Total effort estimation
- Total catch estimation

GRFS Estimation – Estimation Components

- Estimation coded in SAS using proc surveymeans
- Design aspects specified (strata identifiers, PSU identifiers)
- Final stage sample weights specified
- Estimation domains, D , specified
 - Year, Month
 - GRFS area: Federal waters, State waters (territorial seas + inland)
- Linearization used for variances of estimation components

GRFS Estimation – Catch Rates

- Calculated as weighted means within domains:

$$\hat{\bar{y}}_D = \frac{\sum_{h=1}^H \sum_{i=1}^{n_h} \sum_{j=1}^{m_{hi}} w_{hij} I_D(h, i, j) y_{hij}}{\sum_{h=1}^H \sum_{i=1}^{n_h} \sum_{j=1}^{m_{hi}} w_{hij} I_D(h, i, j)}$$

- $\hat{\bar{y}}_D$ = estimated mean catch per angler-trip (element) in domain D
- H = total count of strata
- n_h = total count of PSU in stratum h
- m_{hi} = total count of sampled elements in PSU n_h
- w_{hij} = sample weight for element hij
- $I_D(h, i, j)$ = indicator variable for element hij being in D
- y_{hij} = catch for element hij
- Catch rates estimated by species and catch type (e.g., landings, releases)
- Notation adapted from SAS Documentation

GRFS Estimation – Catch Rates

- Calculations for estimated variances of weighted means within domains:

$$\text{var}(\hat{y}_D) = \sum_{h=1}^H \text{var}_h(\hat{y}_D)$$

$$\text{var}_h(\hat{y}_D)$$

$$= \frac{n_h(1 - f_h)}{n_h - 1} \sum_{i=1}^{n_h} \left(\frac{\sum_{j=1}^{m_{hi}} w_{hij} I_D(h, i, j) (y_{hij} - \hat{y}_D)}{\sum_{h=1}^H \sum_{i=1}^{n_h} \sum_{j=1}^{m_{hi}} w_{hij} I_D(h, i, j)} \right)$$

GRFS Estimation – Effort Svy Coverage Adj

- Calculated as weighted ratios within domains:

$$\hat{r}_D = \frac{\sum_{h=1}^H \sum_{i=1}^{n_h} \sum_{j=1}^{m_{hi}} w_{hij} I_D(h, i, j) t_{hij}}{\sum_{h=1}^H \sum_{i=1}^{n_h} \sum_{j=1}^{m_{hi}} w_{hij} I_D(h, i, j) o_{hij}}$$

- \hat{r}_D = estimated ratio of total GRFS trips to GRFS effort survey on-frame trips in domain D
- t_{hij} = angler-trip indicator, always equal to 1
- o_{hij} = on-frame angler-trip indicator, equal to 1 for on-frame or 0 for off-frame
- Notation adapted from SAS Documentation

GRFS Estimation – Effort Svy Coverage Adj

- Calculations for estimated variances of weighted ratios within domains :

$$\text{var}(\hat{r}_D) = \sum_{h=1}^H \text{var}_h(\hat{r}_D)$$

$$\begin{aligned} & \text{var}_h(\hat{y}_D) \\ &= \frac{n_h(1 - f_h)}{n_h - 1} \sum_{i=1}^{n_h} \left(\frac{\sum_{j=1}^{m_{hi}} w_{hij} I_D(h, i, j) (t_{hij} - o_{hij} \hat{r}_D)}{\sum_{h=1}^H \sum_{i=1}^{n_h} \sum_{j=1}^{m_{hi}} w_{hij} I_D(h, i, j) o_{hij}} \right) \end{aligned}$$

GRFS Estimation – Total Effort

- Basic calculation:

$$\hat{E}_D = \hat{G}_D * \hat{r}_D$$

- \hat{E}_D = total GRFS effort in domain D
- \hat{G}_D = base GRFS effort in D
 - Estimation details covered in separate presentation
- \hat{r}_D = coverage adjustment in D

GRFS Estimation – Total Effort

- Variance approximation uses Goodman's formula for product:

$$\text{var}(\hat{E}_D) = \text{var}(\hat{G}_D) * \hat{r}_D^2 + \hat{G}_D^2 * \text{var}(\hat{r}_D) - \text{var}(\hat{G}_D) * \text{var}(\hat{r}_D)$$

- $\text{var}(\hat{E}_D)$ = variance of total GRFS effort estimate in domain D
- $\text{var}(\hat{G}_D)$ = variance of base GRFS effort estimate in D
- $\text{var}(\hat{r}_D)$ = variance of coverage adjustment in D
- Consistent with MRIP estimation approach

GRFS Estimation – Total Catch

- Basic calculation:

$$\hat{Y}_D = \hat{y}_D * \hat{E}_D$$

- \hat{Y}_D = total GRFS catch in domain D
 - \hat{y}_D = mean catch per GRFS angler-trip in D
 - \hat{E}_D = total GRFS effort in D
- Estimation domains (D):
 - Month
 - GRFS area: Federal waters, State waters (territorial seas + inland)
 - Separate calculations by GRFS species and catch type (e.g., landings, releases)

GRFS Estimation – Total Catch

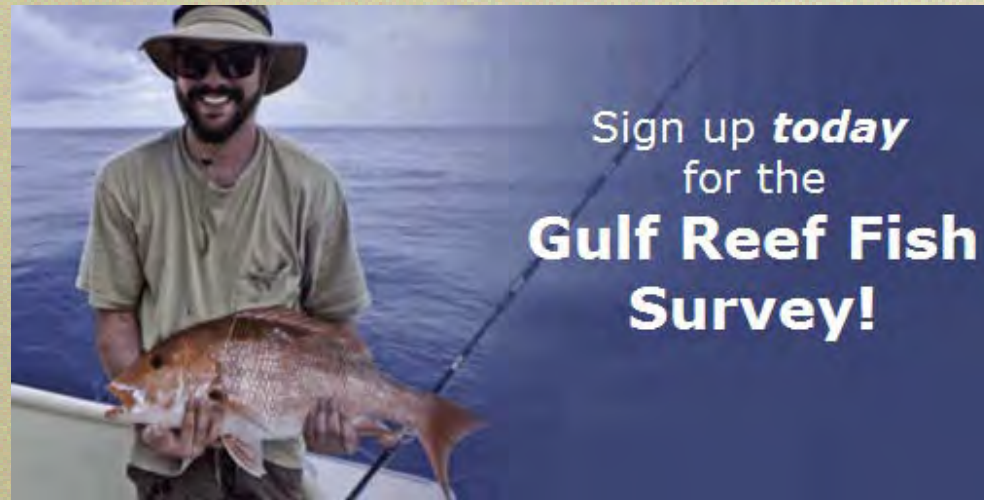
- Variance calculation uses Goodman's formula for product:

$$\text{var}(\hat{Y}_D) = \text{var}(\hat{y}_D) * \hat{E}_D^2 + \hat{y}_D^2 * \text{var}(\hat{E}_D) - \text{var}(\hat{y}_D) * \text{var}(\hat{E}_D)$$

- $\text{var}(\hat{Y}_D)$ = variance of total GRFS catch in domain D
- $\text{var}(\hat{y}_D)$ = variance of mean catch per GRFS angler-trip in D
- $\text{var}(\hat{E}_D)$ = variance of total GRFS effort in D
- Consistent with MRIP estimation approach



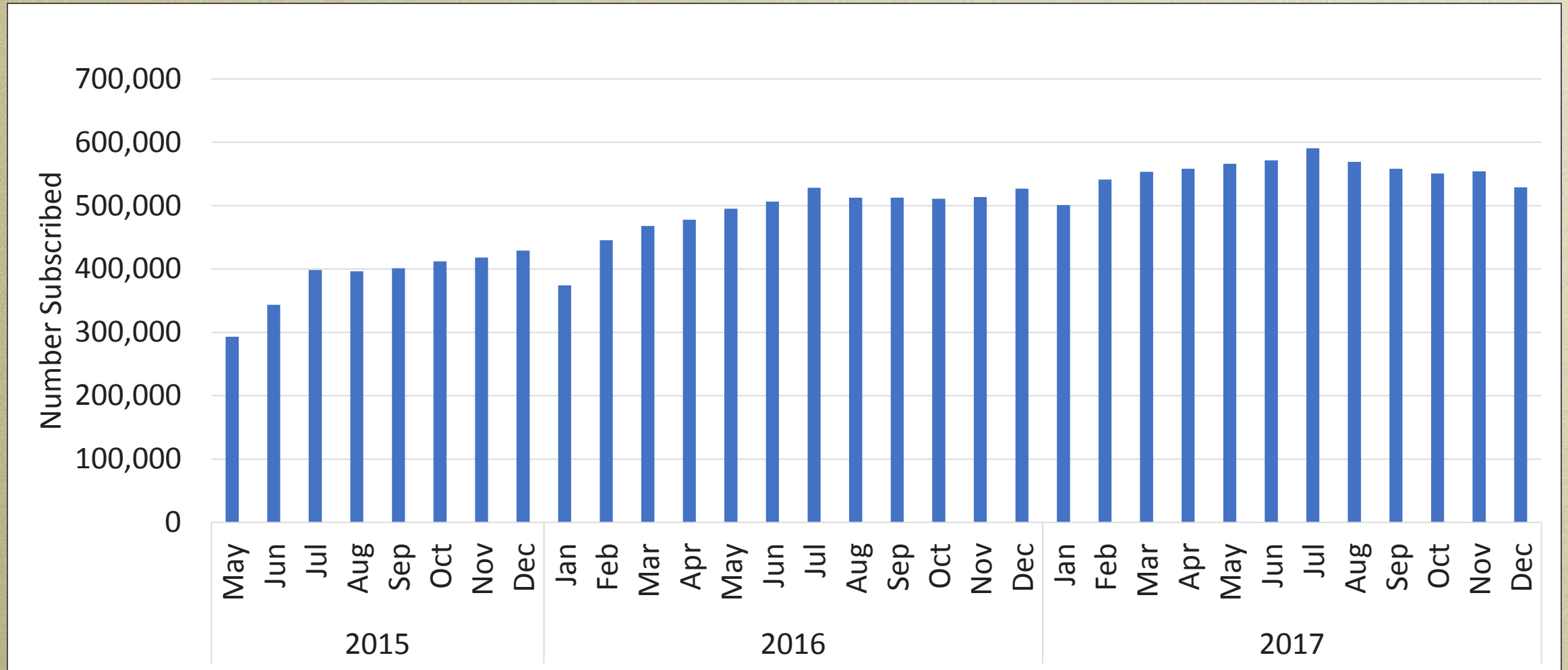
Mail Survey Results



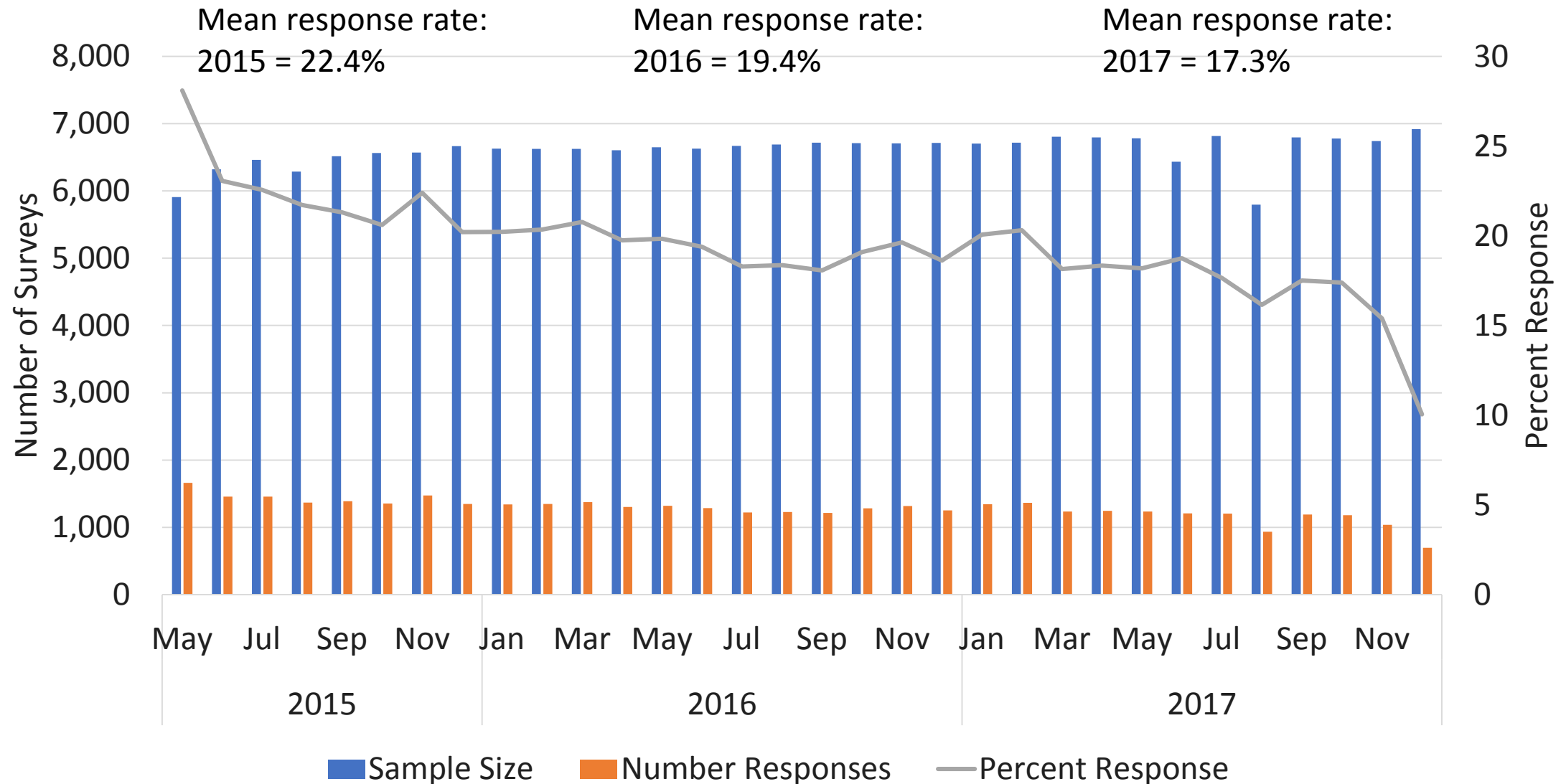
Tiffanie Cross and Beverly Sauls
Fish and Wildlife Research Institute
Marine Fisheries Research
Saint Petersburg, FL



Results - GRFS Subscribers



Results – Response Rates



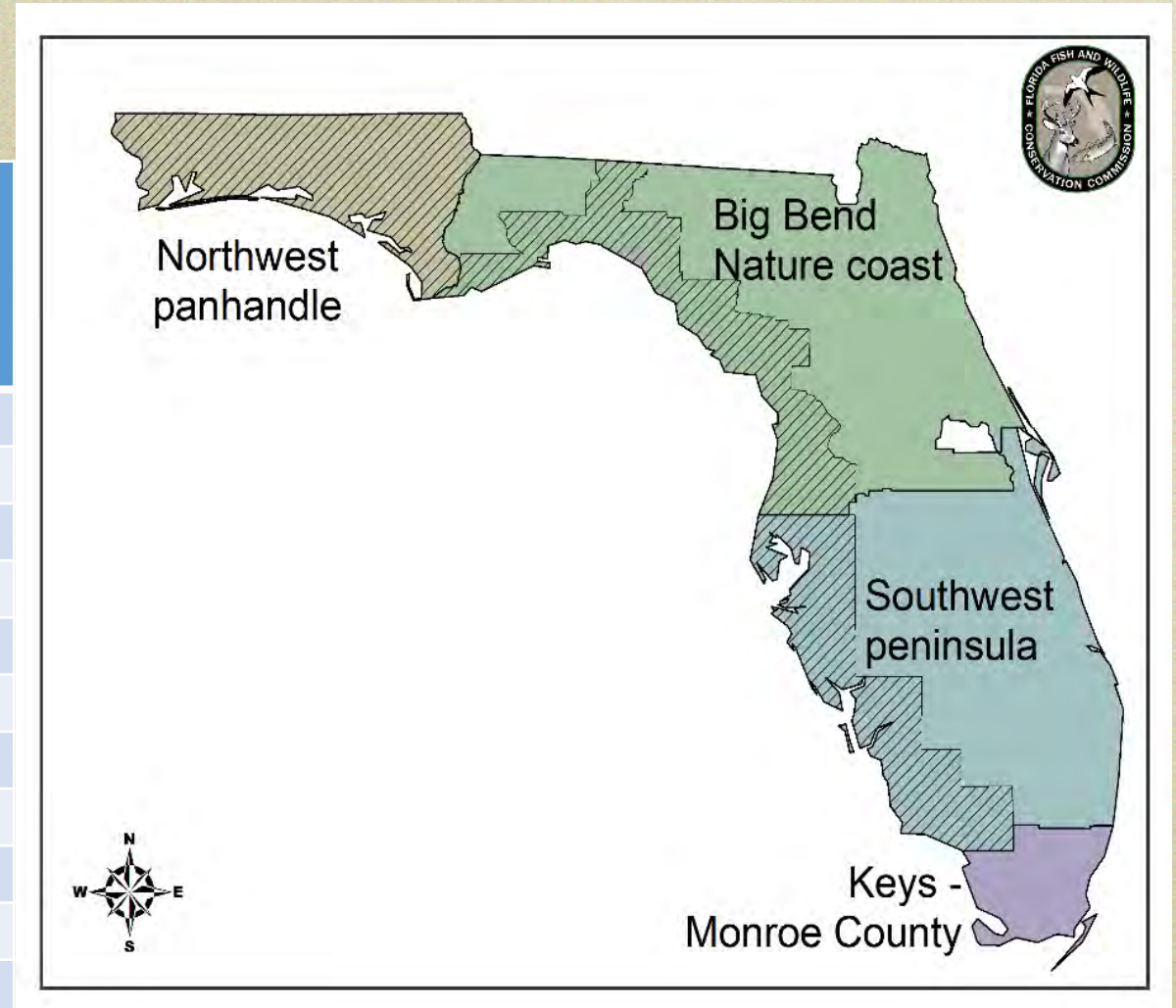
Timeliness of Estimates

- Preliminary estimates:
 - Number of days after the end of a fishing month
 - 50% of responses: 33 days
 - 75% of responses: 39 days
 - 95% of responses: 60 days

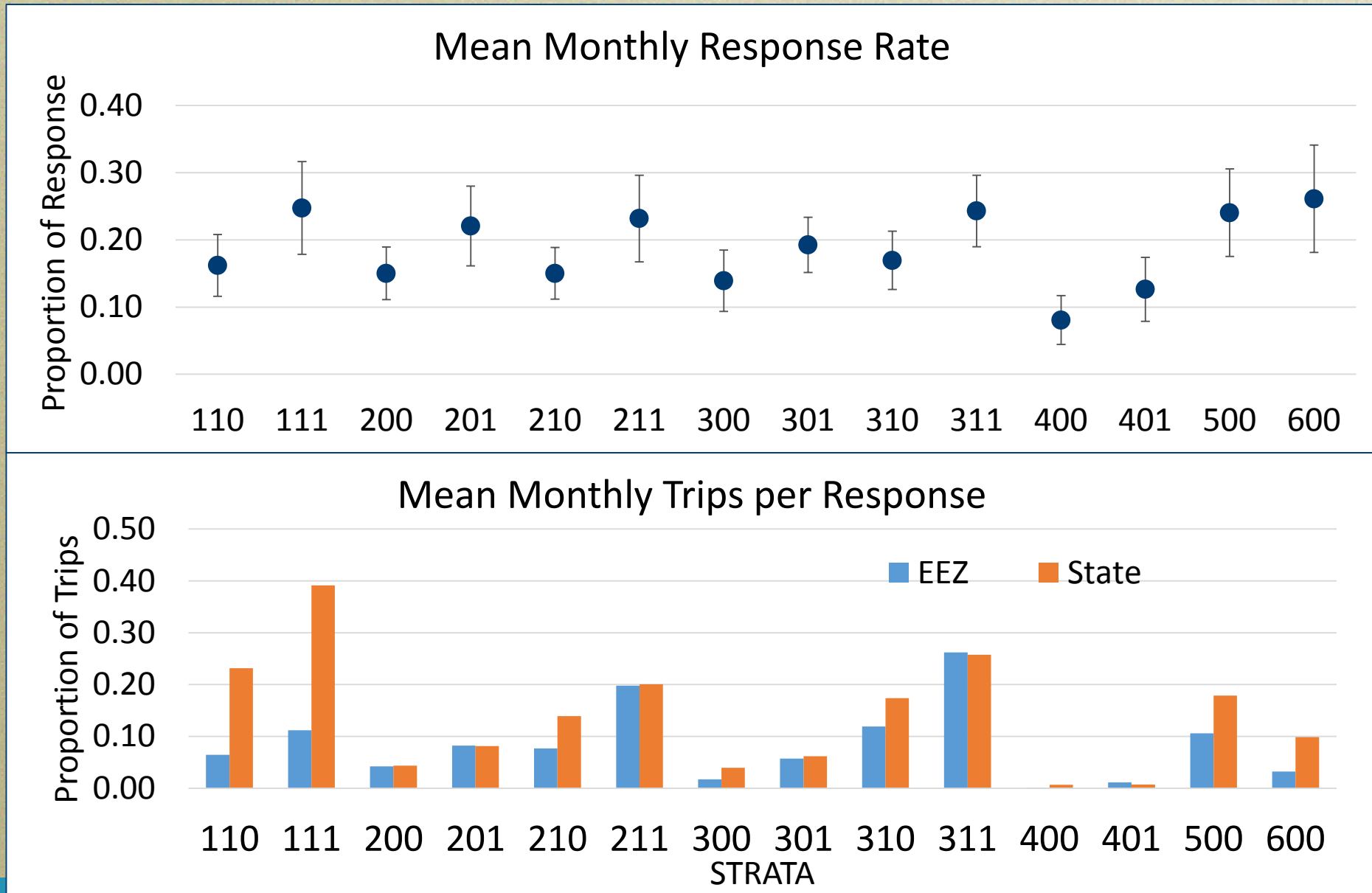


Mail Survey Strata

STRATA CODE region/coastal/ boat	REGION OF HOUSEHOLD	COASTAL (1=yes, 0=no)	REGISTERE D BOAT (1=yes, 0=no)
110	1= Northwest Panhandle	Yes	No
111		Yes	Yes
200	2 = Big Bend Nature Coast	No	No
201		No	Yes
210		Yes	No
211	3 = Southwest Peninsula	Yes	Yes
300		No	No
301		No	Yes
310		Yes	No
311		Yes	Yes
400	4 = Keys – Monroe County	No	No
401		No	Yes
500	5 = Alabama/Georgia	No	n/a
600	6 = Other states	No	n/a

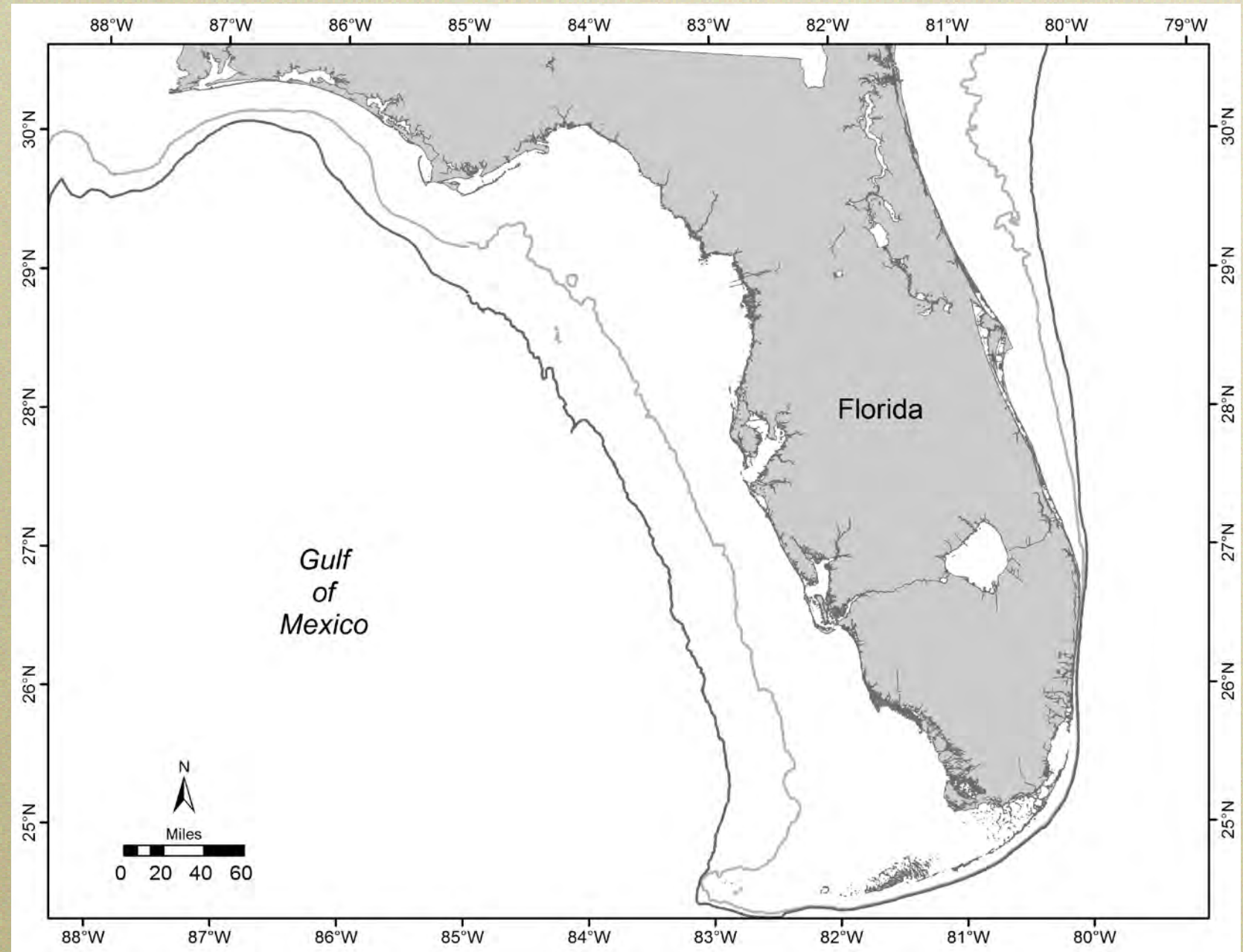


Results

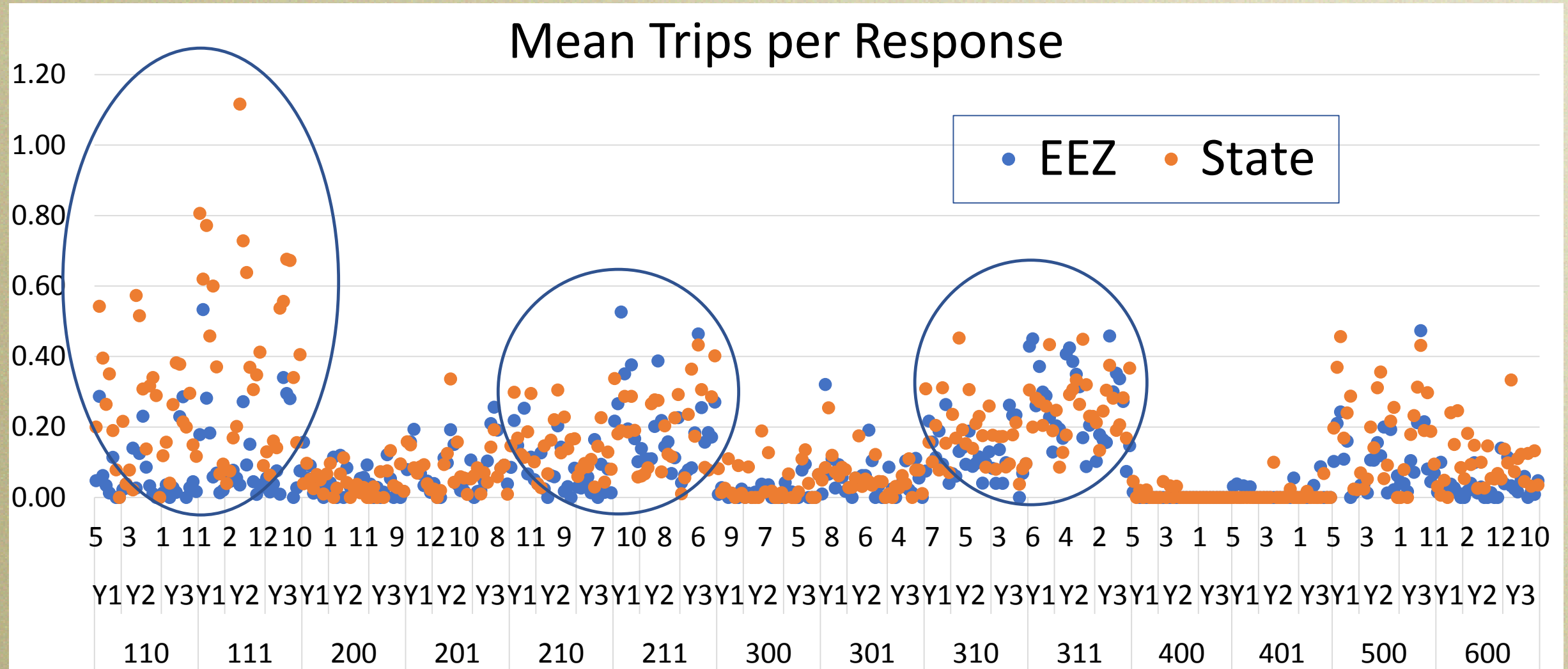


Results

- Panhandle:
access to GRFS
fishery in state
waters
- Peninsula:
GRFS fishery
further offshore
in EEZ



Results - Variability



Results – Recap

In-State:

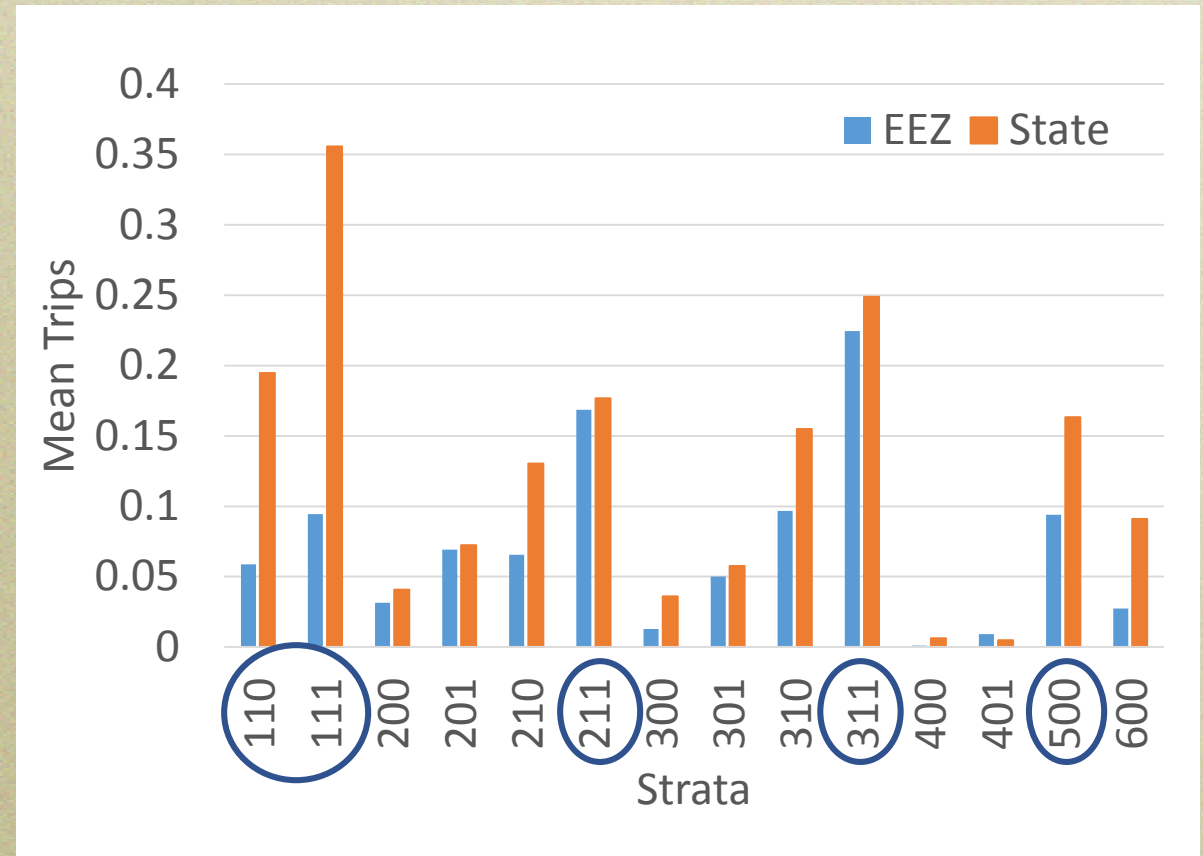
- More trips in coastal strata
- More trips in boat strata

Out-of-State:

- AL/GA strata report more

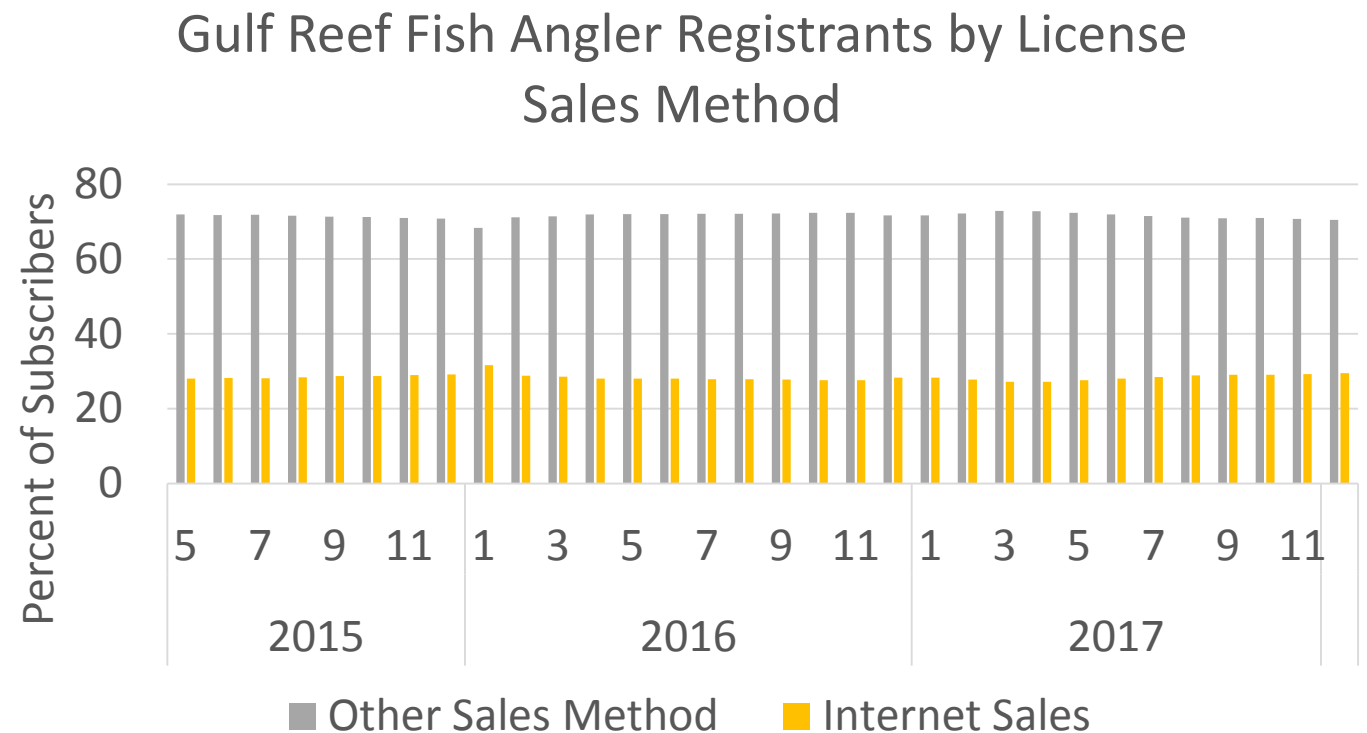
State vs. EEZ:

- More state trips in panhandle
- More EEZ trips by boat owners in Big Bend and peninsula



Challenges

- GRFS Subscriptions have increased over time
- Oversubscription
 - Non-response bias
 - Efficiency
 - Cost
 - Unnecessary reporting burden



Pre-Screen Survey of NEW Subscribers

TAXPAYER FUNDS WERE NOT USED TO PRODUCE OR MAIL THIS SURVEY



Help Us Improve Our Survey...

*In an effort to better serve Florida's recreational anglers, please answer a few questions for us. **Once complete, please tear off this portion of the mailer and return to our office to help streamline our survey efforts.***

In the past 12 months, did you recreationally fish at least once from a private boat that departed from the western (Gulf) coast of Florida (excluding Monroe County)?

☐ Yes ☐ No ☐ Not Sure/Do Not Recall

In the next 12 months, how likely are you to recreationally fish on a private boat off the western (Gulf) coast of Florida (excluding Monroe County)?

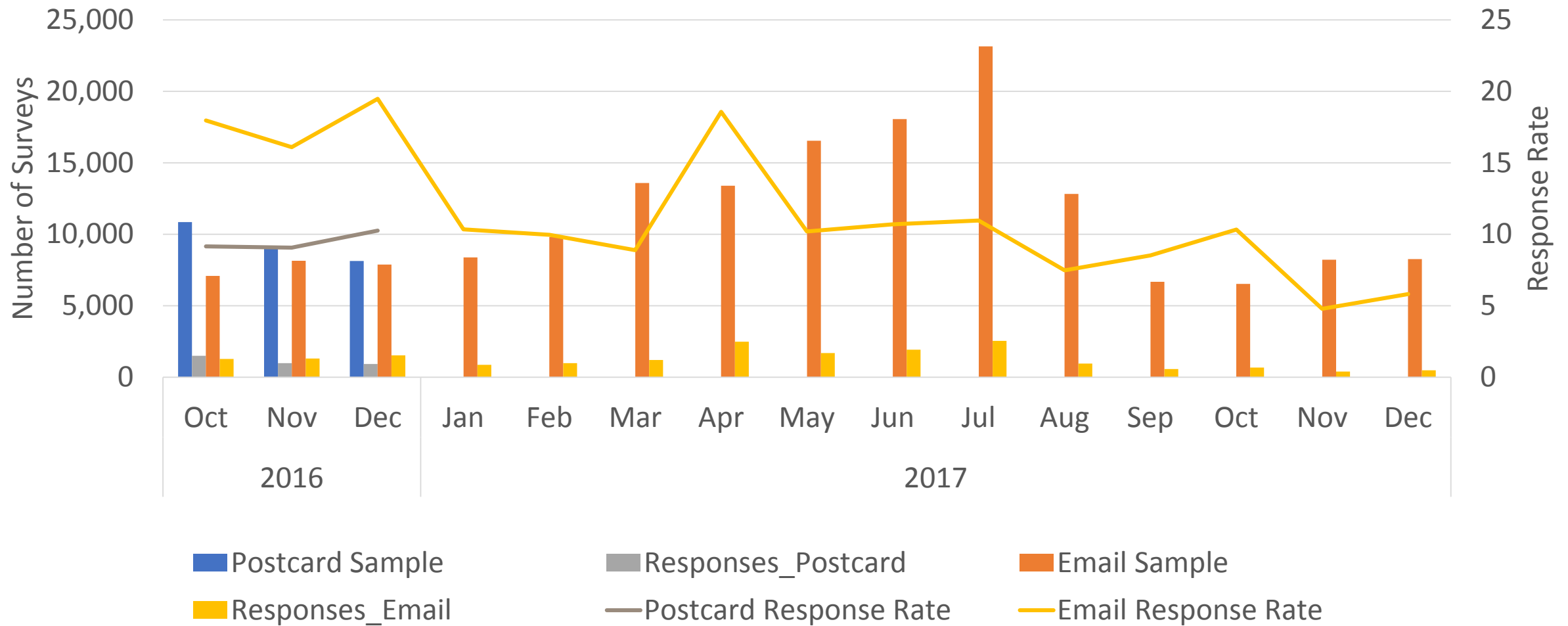
☐ Very likely ☐ Maybe/ Not Sure ☐ Very unlikely ☐ I never fish on the west coast of Florida

Whenever you recreationally fish from a private boat, do you attempt to harvest any of the following types of reef fish?

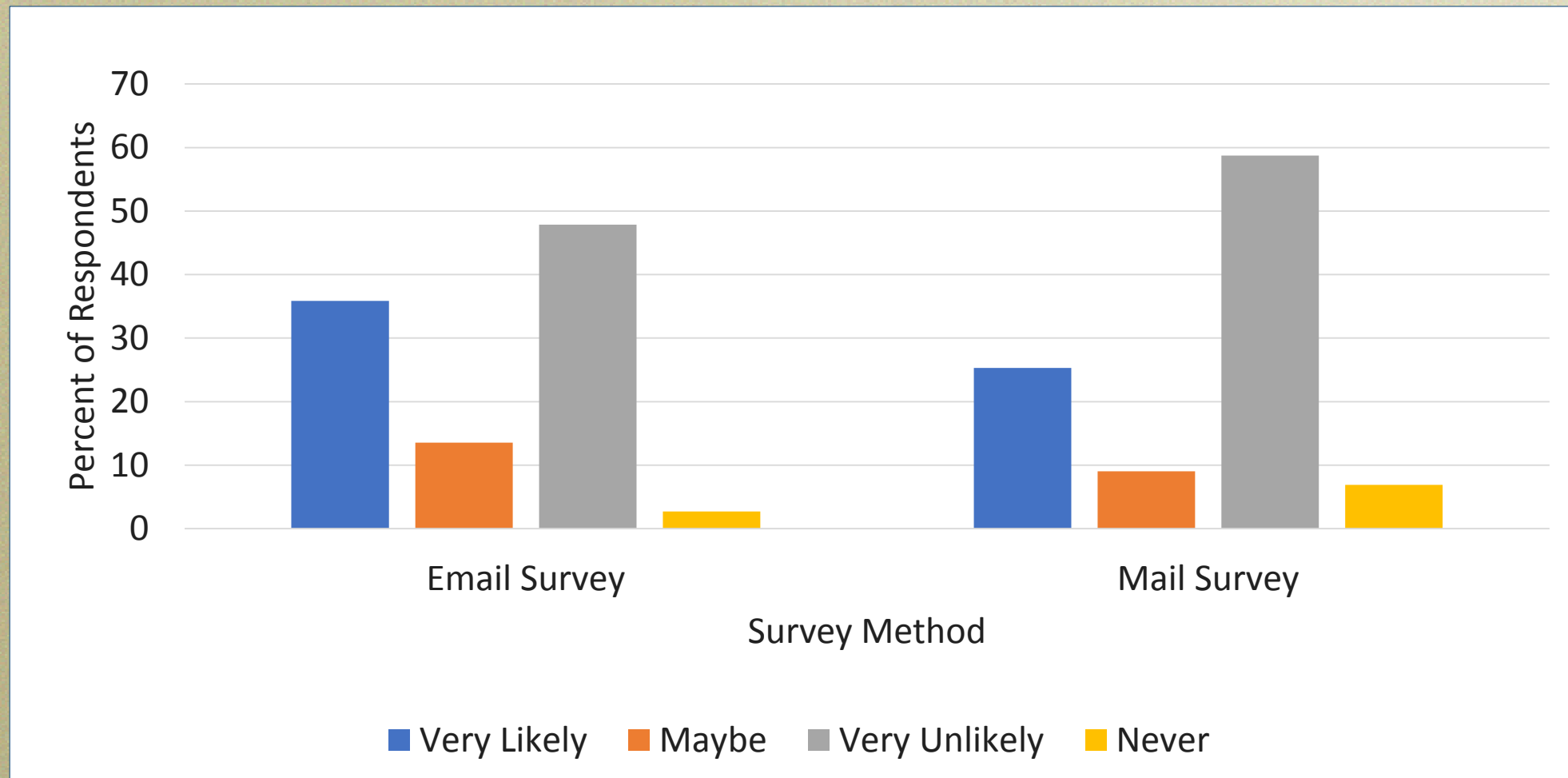
<input type="checkbox"/> Red snapper	<input type="checkbox"/> Gag grouper, red grouper, black grouper
<input type="checkbox"/> Vermilion snapper	<input type="checkbox"/> Amberjack, almaco jack, banded rudderfish
<input type="checkbox"/> Gray triggerfish	<input type="checkbox"/> I never attempt to harvest any of these species



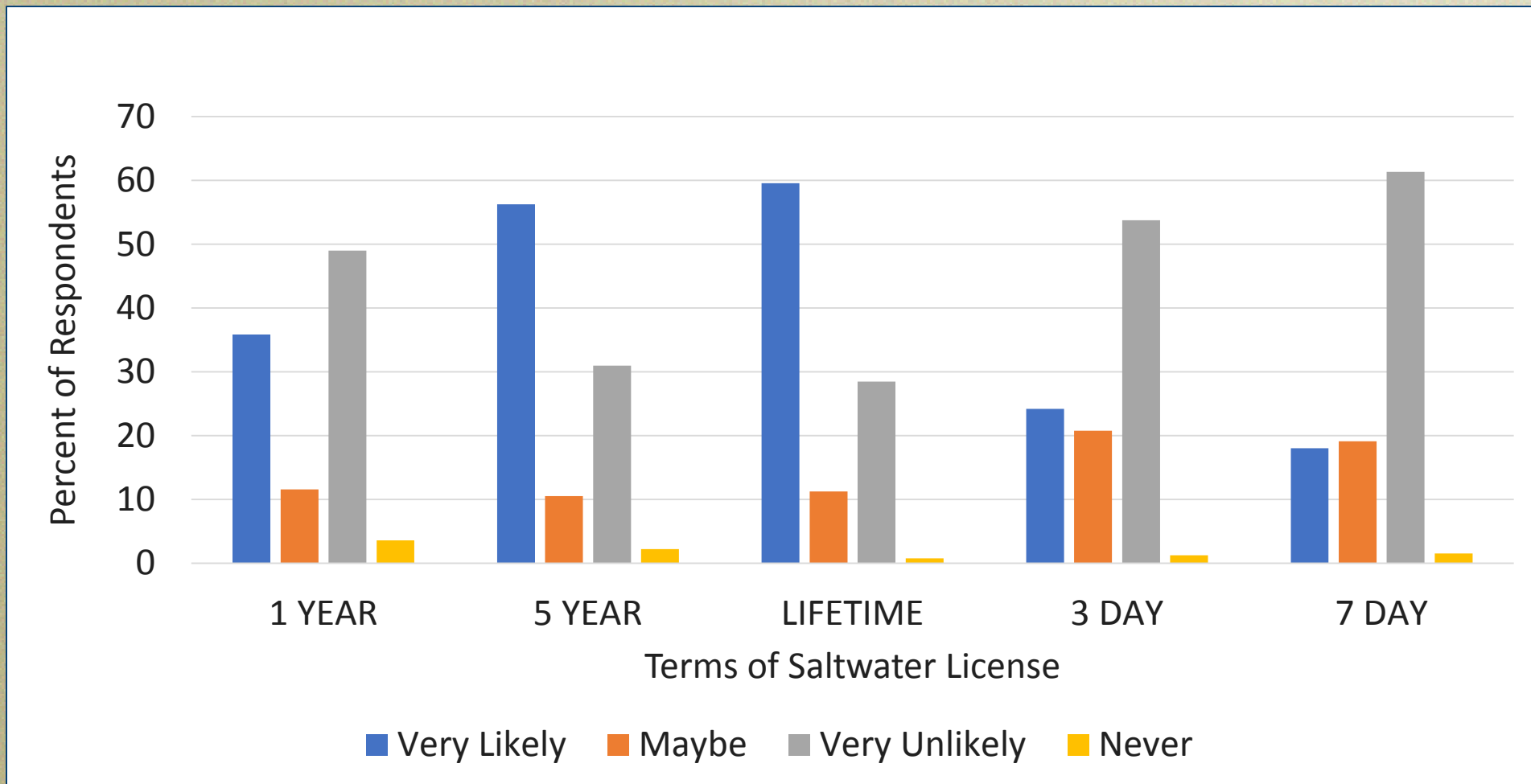
Pre-Screen - Sample Size and Response Rate



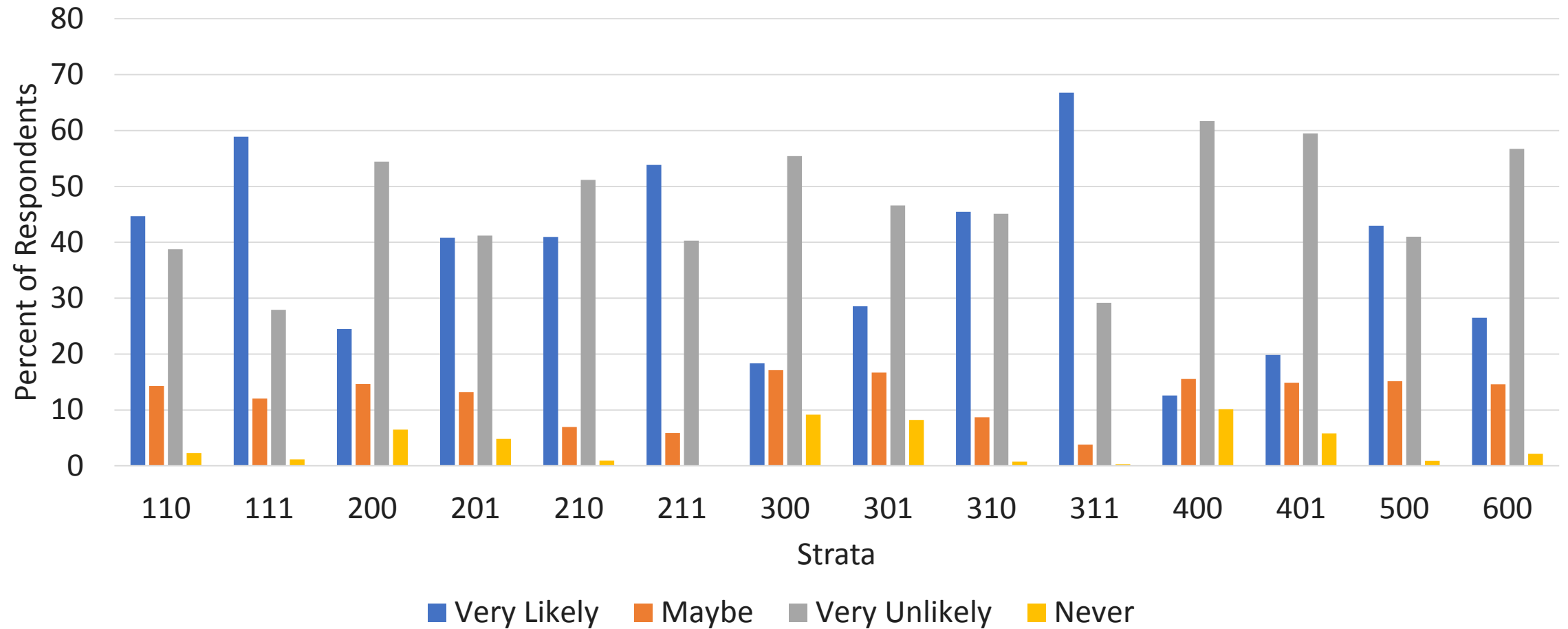
Likelihood of Participation in Gulf Reef Fishery by Survey Method



Likelihood of Participation in Gulf Reef Fishery by Terms of SW License



Likelihood of Participation in Gulf Reef Fishery by Strata

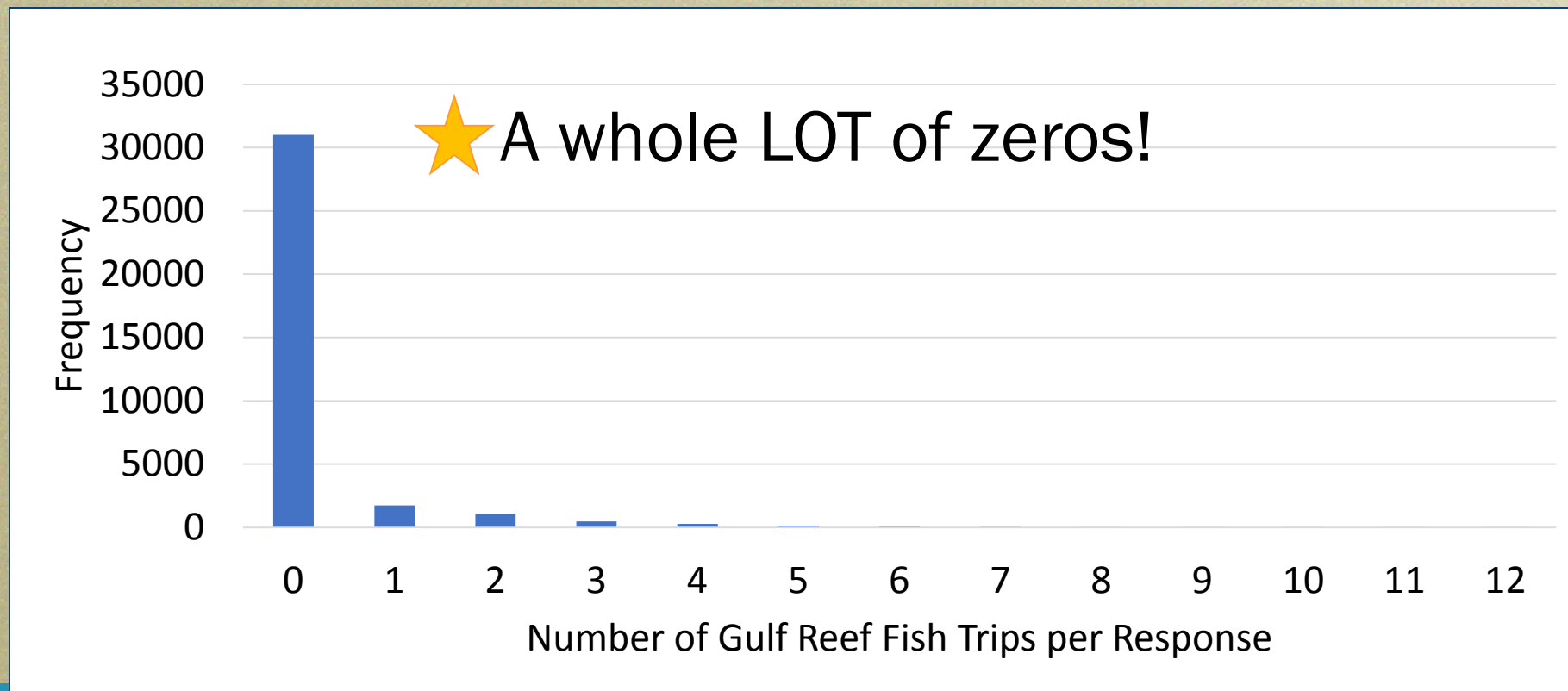


Quantify Oversubscription

- Zero-inflated Negative Binomial Model

Count model: GRFS trips/response = Month/Year + Internet

Zero model: 0 GRFS trips/response ~ Boat + Internet + RegionCoast



Results – ZINB Model

Summary of ZINB model interpretations for number of GRFS trips per response (n=34935)

Model	Description	Count	Percent
Zero-inflated	Zero GRFS trips/response due to oversubscription	27,075	77.50%
Negative Binomial	Zero GRFS trips/response due to sampling variability	3,941	11.28%
Negative Binomial	≥ 1 GRFS trips/response	3,919	11.22%



Results – ZINB Model - Count

Count model: GRFS trip/response = Month/Year + Internet

- Pearson's Goodness of Fit statistic: 1.05
- June and July were significant positive predictors of Gulf reef fish trips ($p \leq 0.02$)
- December, January, February, and March were significant negative predictors of Gulf reef fish trips ($p \leq 0.001$)

Count model coefficients (negbin with log link):				
	Estimate	Std. Error	z value	Pr(> z)
mnthyr102017	-0.308147	0.151972	-2.028	0.042595 *
mnthyr112015	-0.236402	0.143677	-1.645	0.099893 .
mnthyr112016	-0.253508	0.147693	-1.716	0.086079 .
mnthyr112017	-0.226072	0.149194	-1.515	0.129699
mnthyr12016	-0.602424	0.148610	-4.054	5.04e-05 ***
mnthyr12017	-0.799215	0.160461	-4.981	6.33e-07 ***
mnthyr122015	-0.973724	0.157433	-6.185	6.21e-10 ***
mnthyr122016	-0.267738	0.154865	-1.729	0.083838 .
mnthyr122017	-0.610743	0.213106	-2.866	0.004158 **
mnthyr22016	-0.779585	0.154885	-5.033	4.82e-07 ***
mnthyr22017	-0.847883	0.159772	-5.307	1.12e-07 ***
mnthyr32016	-0.503070	0.151904	-3.312	0.000927 ***
mnthyr32017	-0.541499	0.158141	-3.424	0.000617 ***
mnthyr42016	-0.085636	0.144716	-0.592	0.554016
mnthyr42017	-0.223351	0.152181	-1.468	0.142195
mnthyr62015	0.449486	0.128007	3.511	0.000446 ***
mnthyr62016	0.382844	0.135982	2.815	0.004872 **
mnthyr62017	0.313285	0.136982	2.287	0.022193 *
mnthyr72015	0.343652	0.128935	2.665	0.007692 **
mnthyr72016	0.197190	0.139752	1.411	0.158246
mnthyr72017	0.435316	0.137112	3.175	0.001499 **
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1				



Results – ZINB Model - Zero

Zero Model:

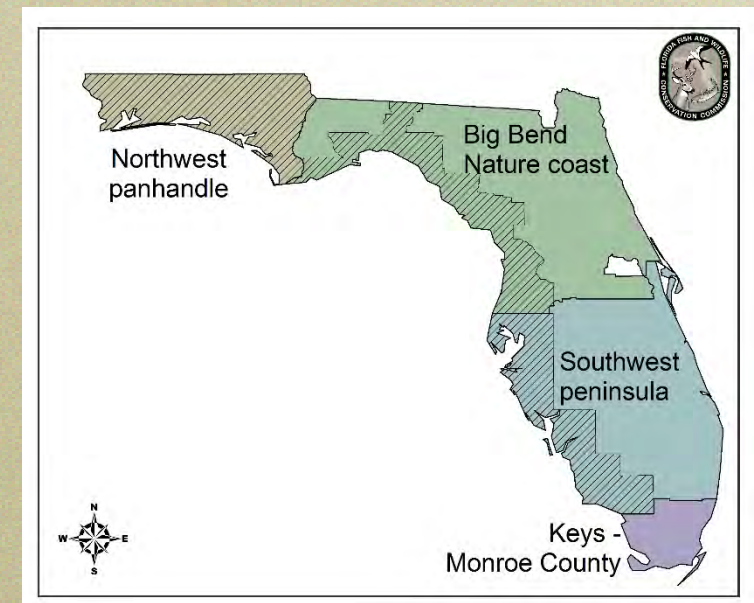
0 GRFS trips/response ~ Boat + internet + Region/Coast

- Boat and Internet were negative predictors of 0 GRFS trips per response ($p < 0.0001$)
- Non-coastal strata were strong positive predictors of zero GRFS trips per response ($p < 0.0001$)

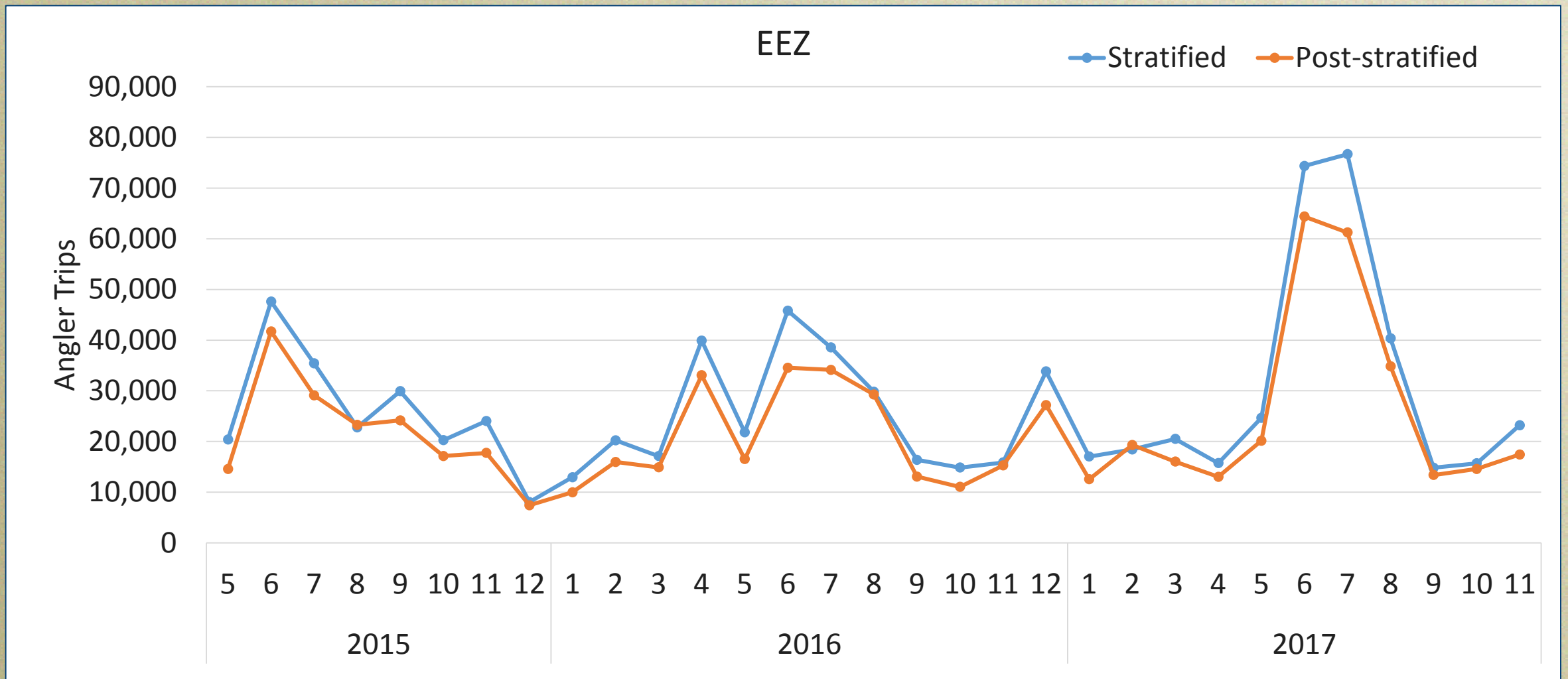
zero-inflation model coefficients (binomial with logit link):

	Estimate	Std. Error	z value	Pr(> z)	
(Intercept)	1.18957	0.08815	13.495	< 2e-16	***
Boat	-0.64958	0.05334	-12.179	< 2e-16	***
internet	-0.97012	0.05172	-18.758	< 2e-16	***
pstrata20	1.44852	0.08547	16.947	< 2e-16	***
pstrata21	0.39783	0.07387	5.386	7.22e-08	***
pstrata30	1.95164	0.09822	19.871	< 2e-16	***
pstrata31	-0.07927	0.07092	-1.118	0.263685	
pstrata40	3.62513	0.23295	15.562	< 2e-16	***
pstrata50	0.35121	0.09514	3.691	0.000223	***
pstrata60	1.23076	0.11001	11.188	< 2e-16	***

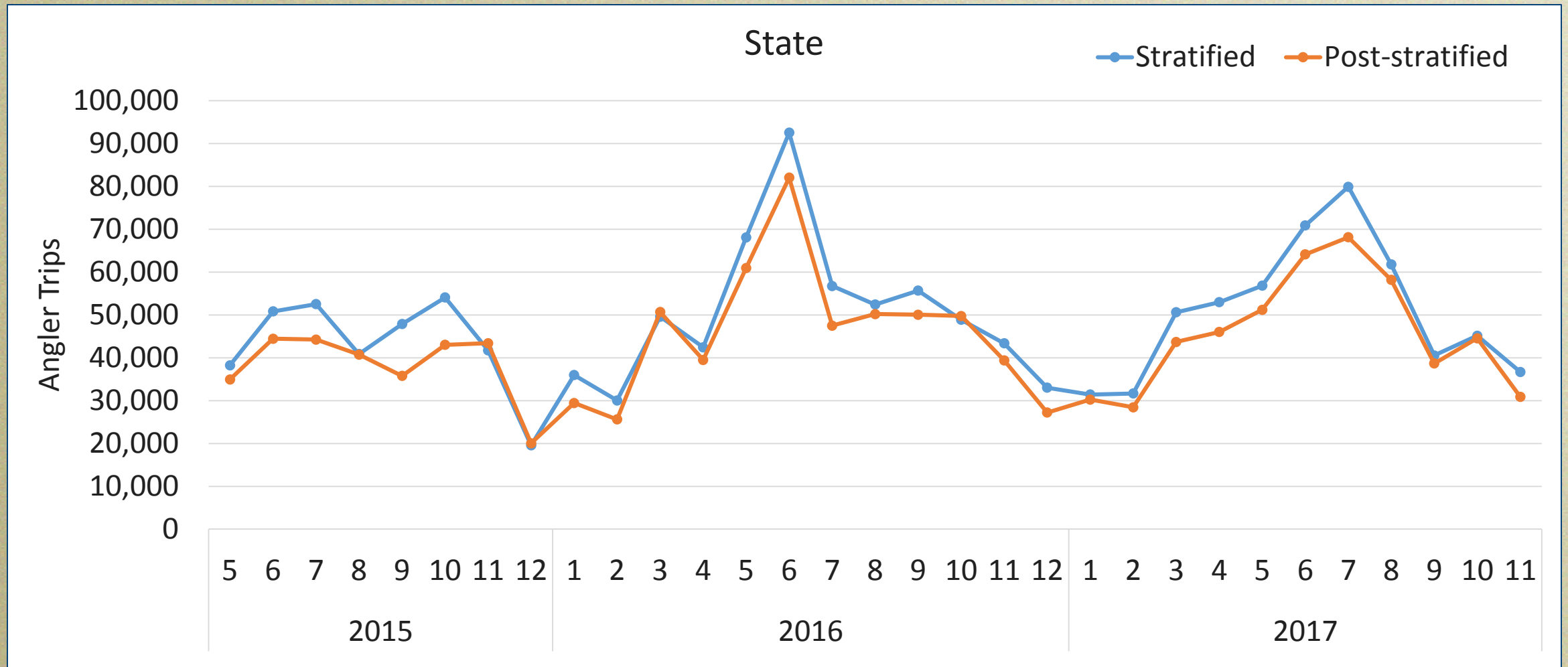
signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1



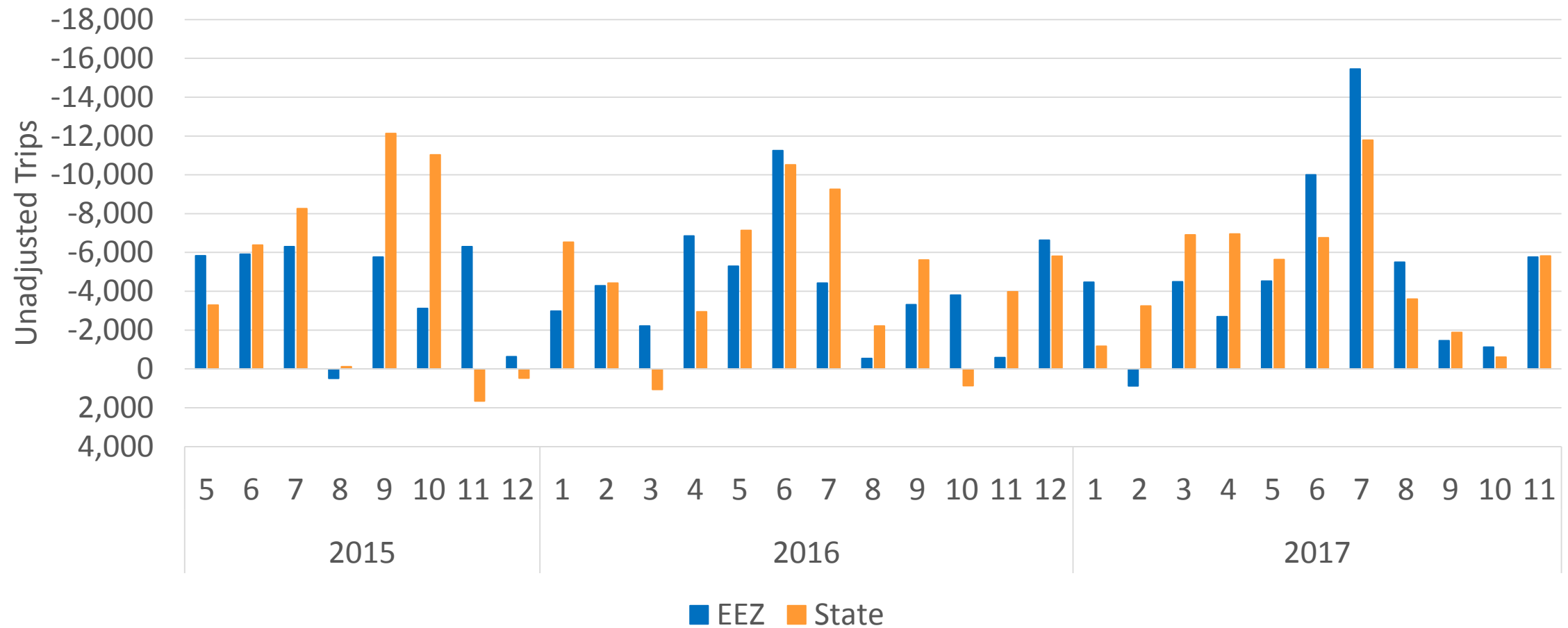
Results – Post-stratification by Internet Sales



Results – Post-stratification by Internet Sales



Results – Post-strat – Strat



What have we learned from the ZINB model?

- Our reasoning for stratification is just
 - *Region, Coast, and Boat factors were all significant*
- We can increase precision and efficiency
 - *Allocate survey sample to actual participants in GRFS fishery*
 - *5,270 surveys/month*
- Cost of oversubscription: \$89,674 annually
- Unnecessary reporting burden is realized via survey comments, letters written by respondents, and phone calls

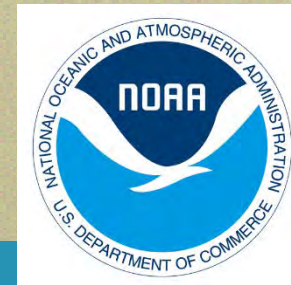


Thank you!

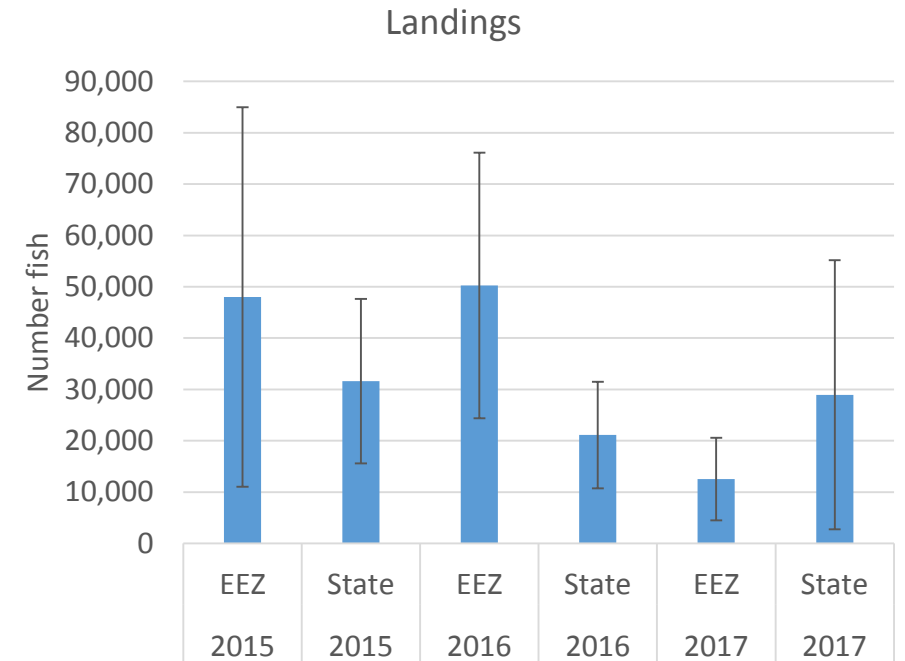
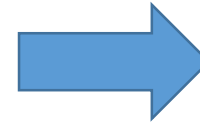


Acknowledgments

- Statistical Consultants:
 - Ginny Lesser – Oregon State University
 - Lynn Stokes – Southern Methodist University
 - Jean Opsomer – Colorado State University
 - Jay Breidt – Colorado State University
 - Mike Brick – Westat
- NOAA Office of Science and Technology
- Gregg Bray – GSMFC
- Martha Guyas – FWC Division of Marine Fisheries Management
- FWC Licensing and Permitting Office
- Florida Division of Highway Safety and Motor Vehicles for Vessel Registration data
- National Fish and Wildlife Foundation



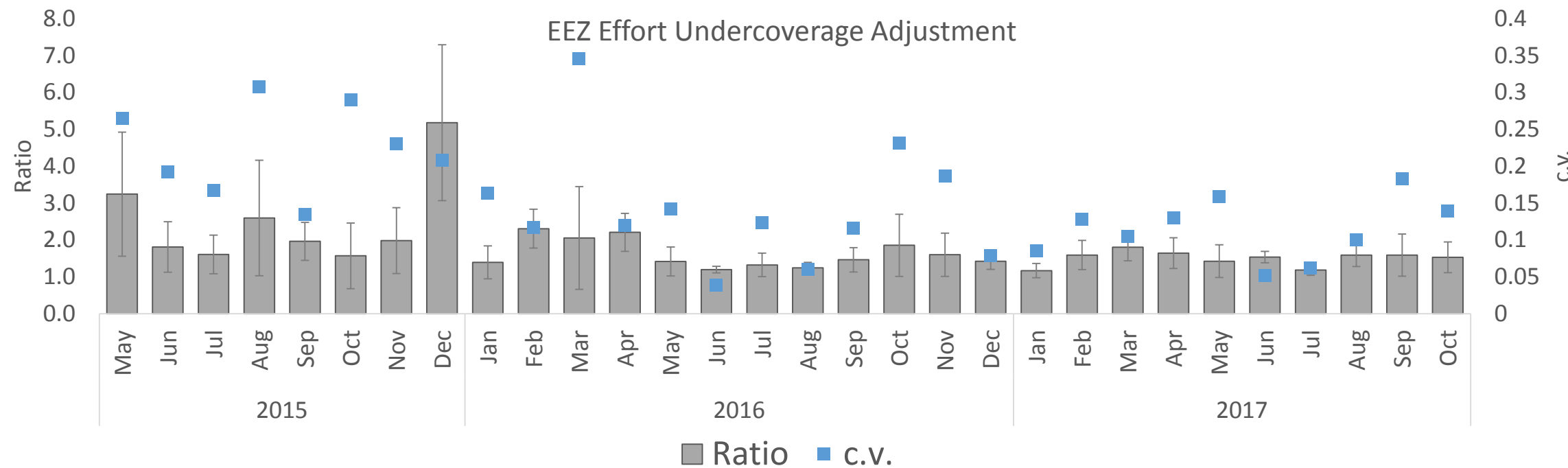
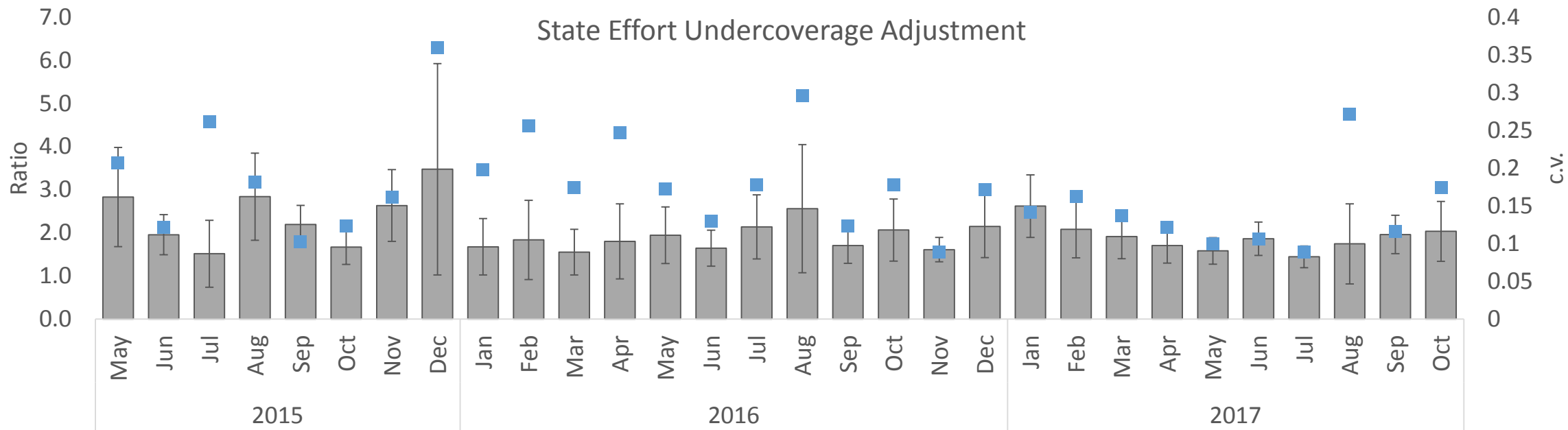
Gulf Reef Fish Survey: Overall Results



Catch and Effort Estimates

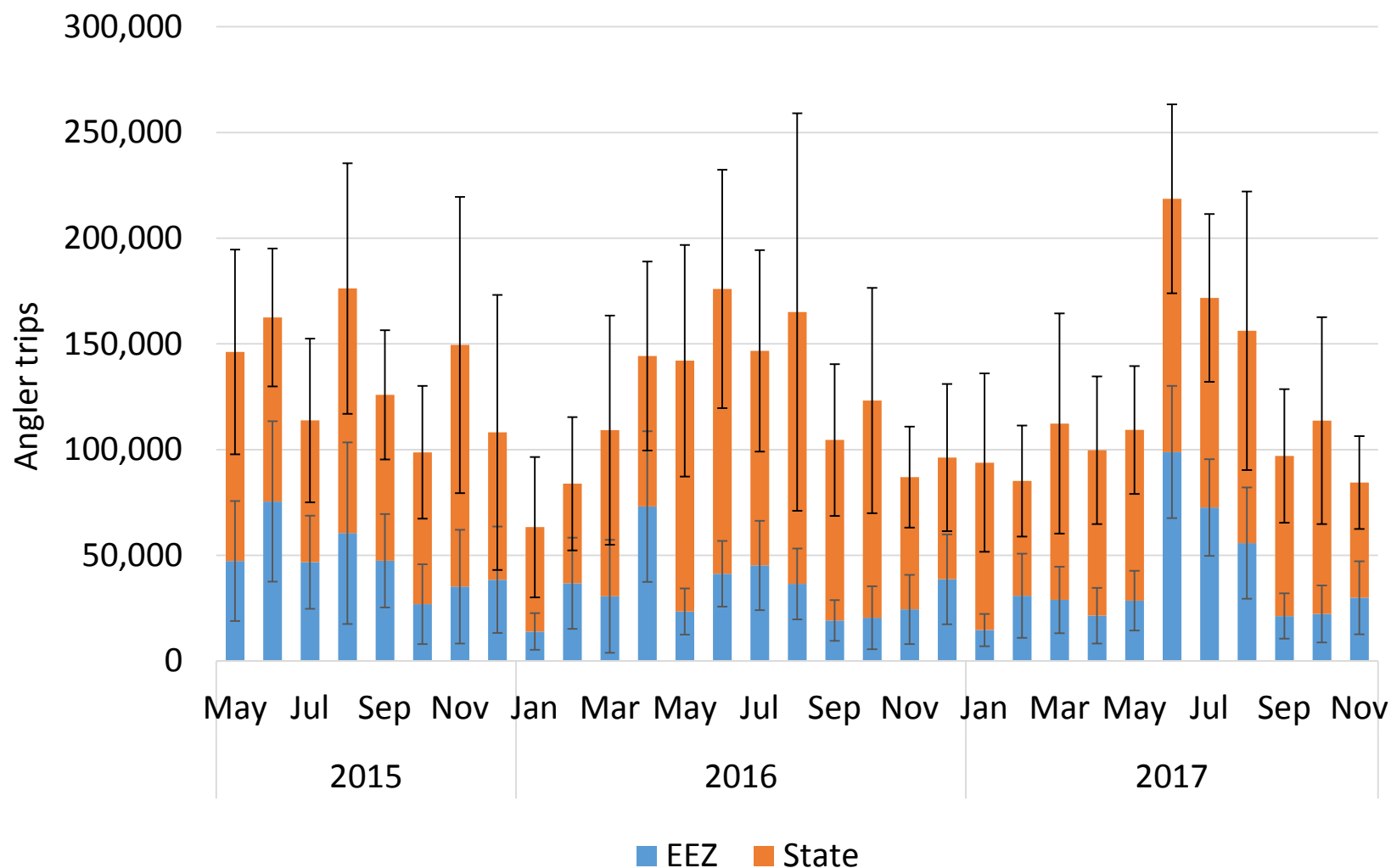
- Sources of variability
 - Seasonal
 - Regional
 - Fishing regulations
 - Episodic events (hurricanes)
- Level of precision
 - Sources of error
 - Annual, monthly level c.v.'s
 - Is precision improved?
 - Does GRFS provide reasonably precise estimates?
- How do trends and magnitude compare with current estimates?
- Timeliness

Effort Adjusted for
Under-Coverage



Adjusted Effort

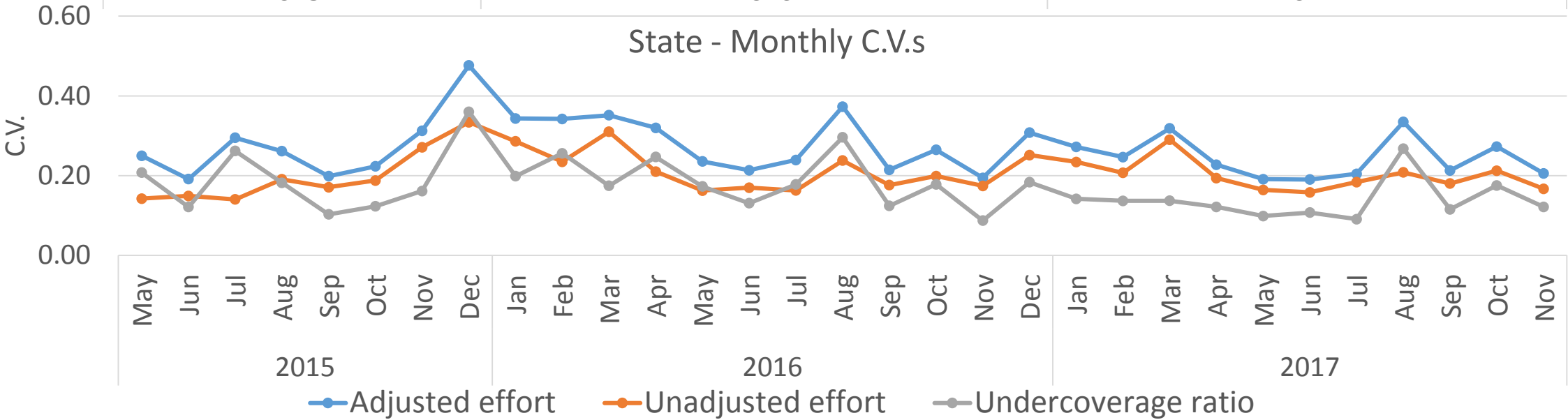
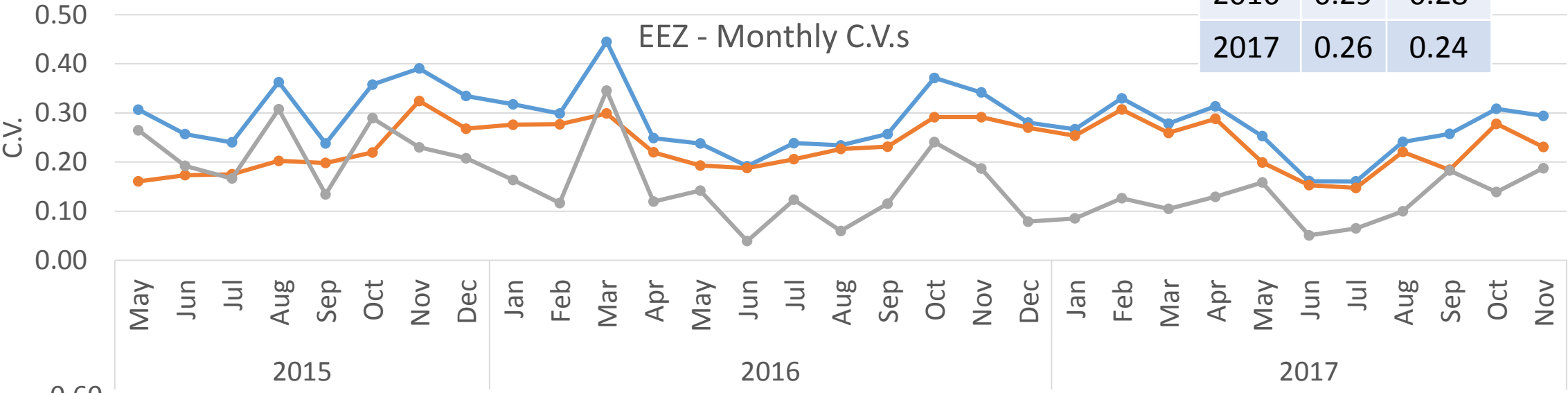
- 2015 Red Snapper
 - EEZ: June (10 days)
 - State: May-July, Sep-Nov
- 2016 Red Snapper
 - EEZ: June (11 days)
 - State: May-July, Sep-Oct
- 2017 Red Snapper
 - EEZ: June-Sep 4
 - State: May-Sep 4



Precision

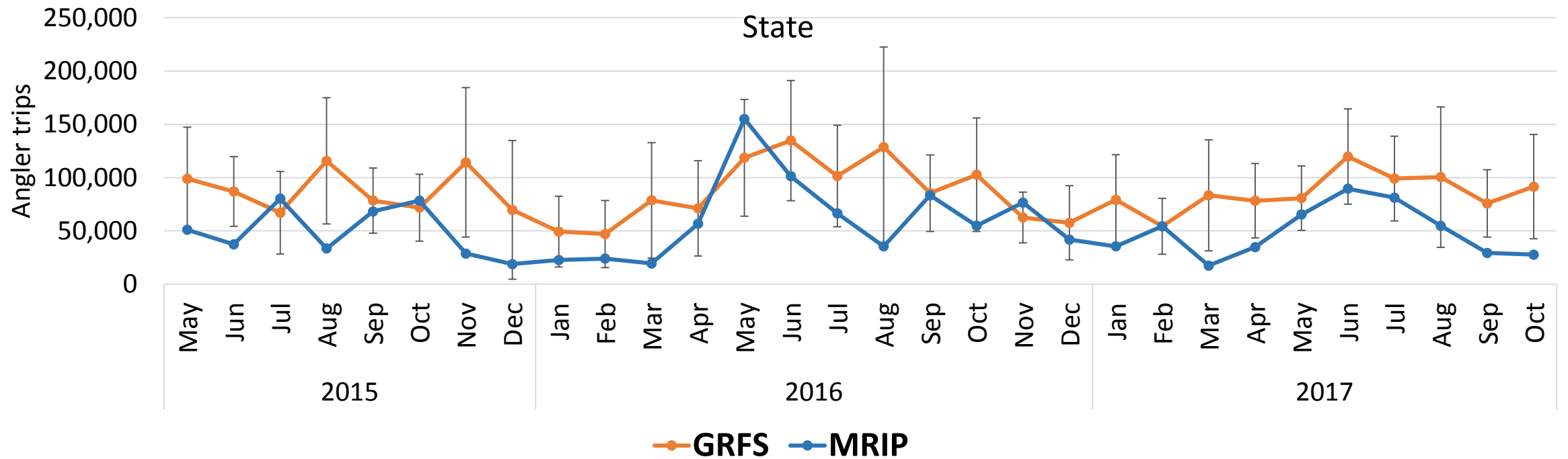
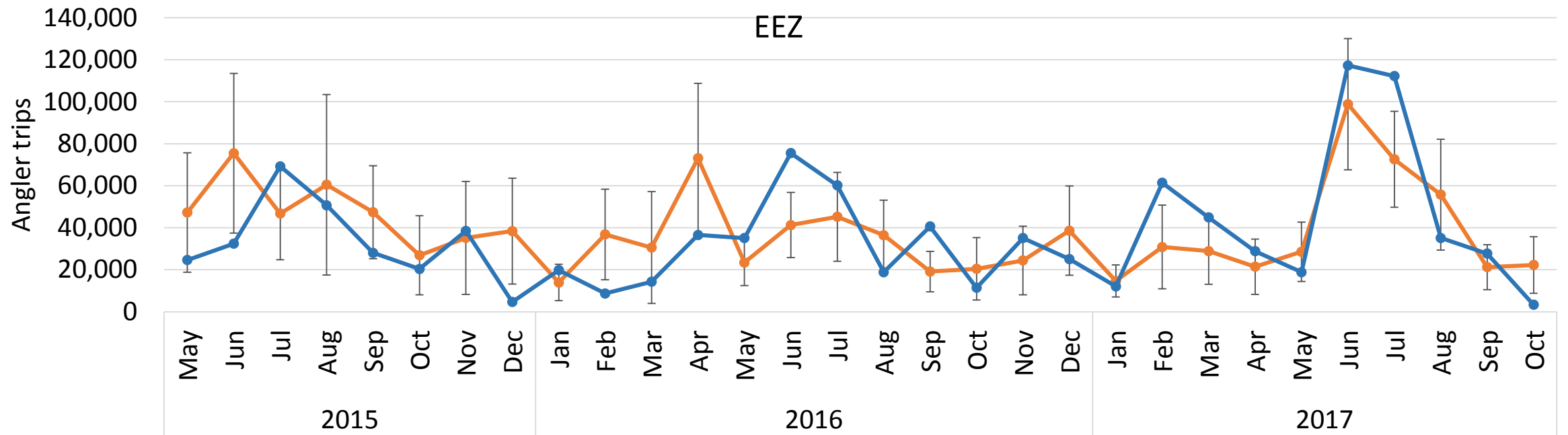
Mean monthly
adjusted effort c.v.

Year	EEZ	State
2015	0.31	0.28
2016	0.29	0.28
2017	0.26	0.24

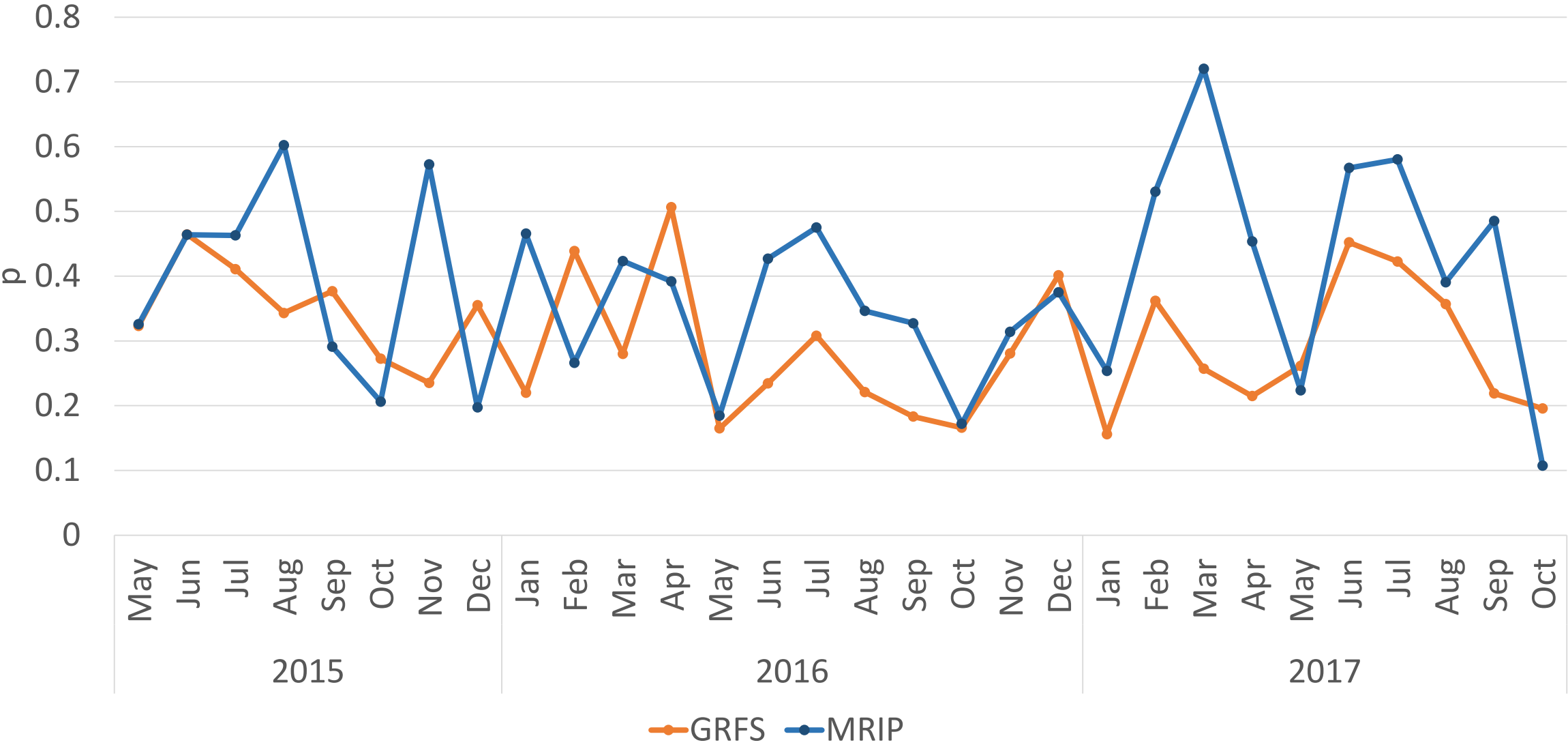


Comparison of Effort Estimates

- Different survey methods
 - MRIP is a phone survey, GRFS is a mail survey
 - MRIP is transitioning to a mail survey
- Different methods for estimating effort by area fished
 - MRIP partitions effort among EEZ and State waters based on intercept survey
 - GRFS directly estimates from mail survey
- For comparisons, monthly MRIP estimates include:
 - PR mode only
 - West Florida, excluding Monroe County
 - Trips that targeted and/or caught reef fish



Proportion of Effort in EEZ



Catch Estimates

OPEN HARVEST:

Wave 3-6 2015: 6 months

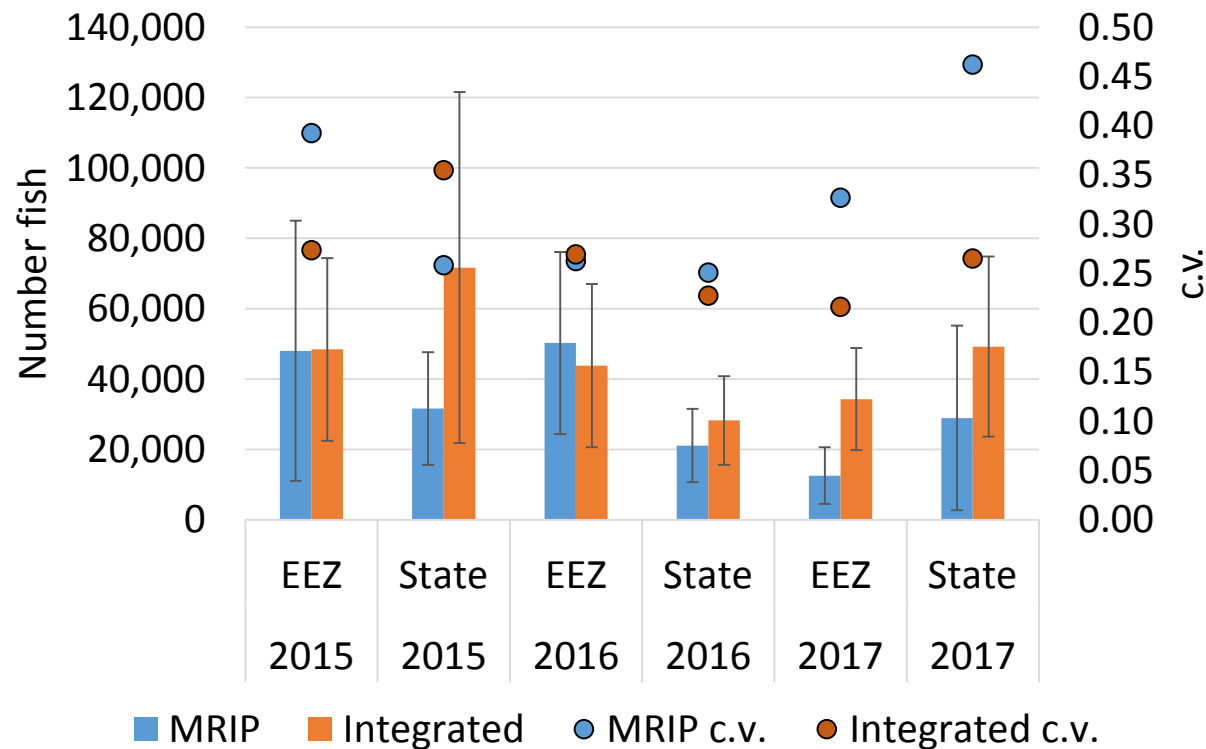
Wave 1-6 2016: 7 months

Wave 1-5 2017: 5 months

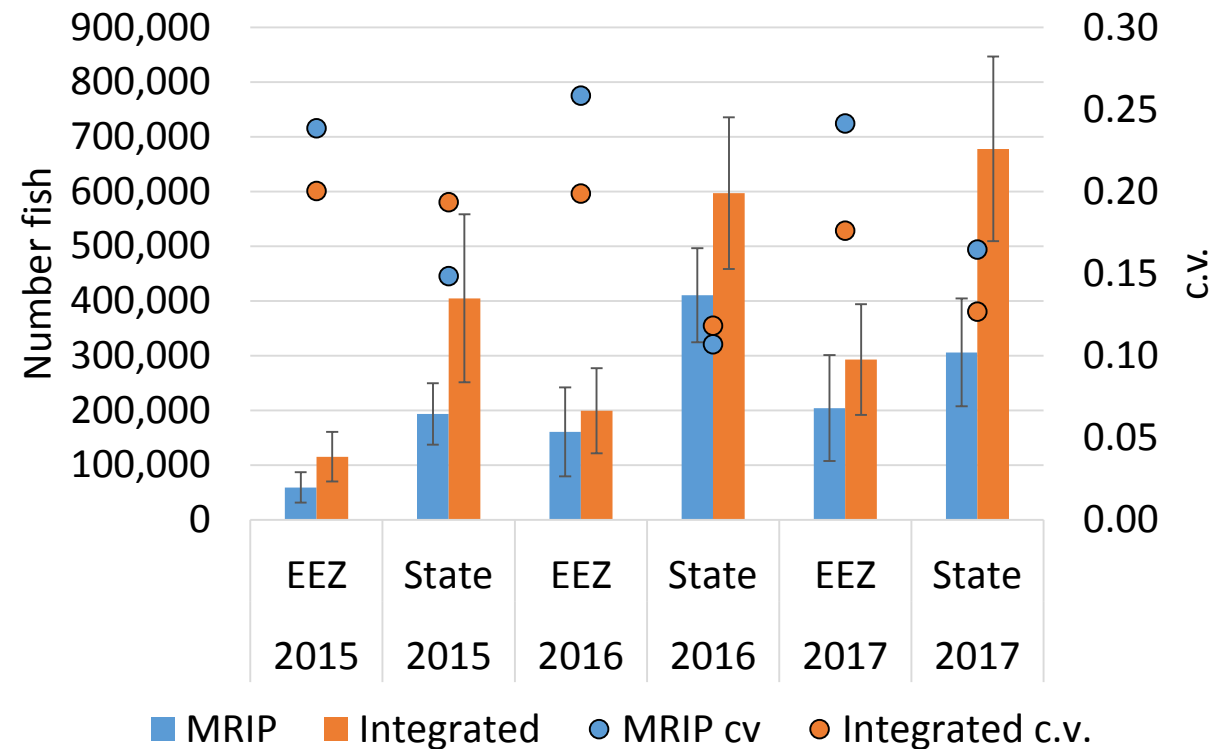


Gag Grouper

Gag Landings



Gag Discards

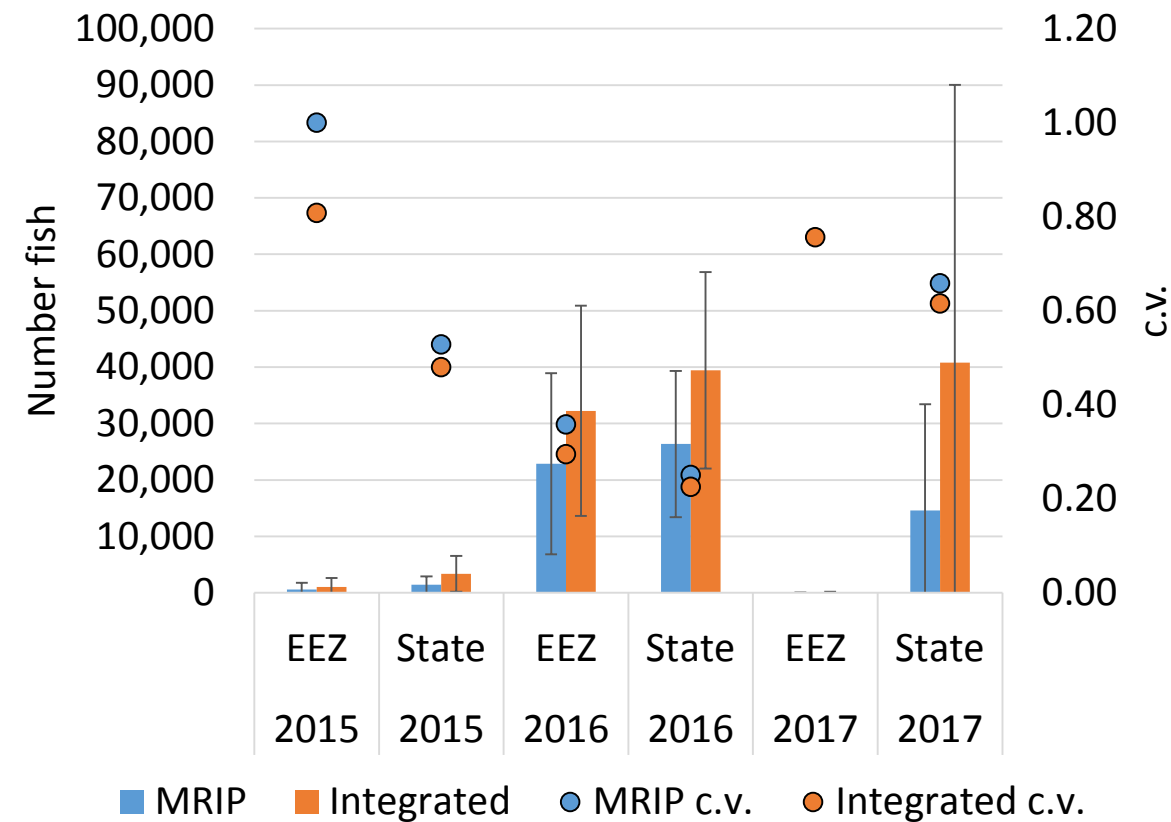


OPEN HARVEST:
Wave 3-6 2015: CLOSED
Wave 1-6 2016: 5 months
Wave 1-5 2017: 5 weekends in
state waters

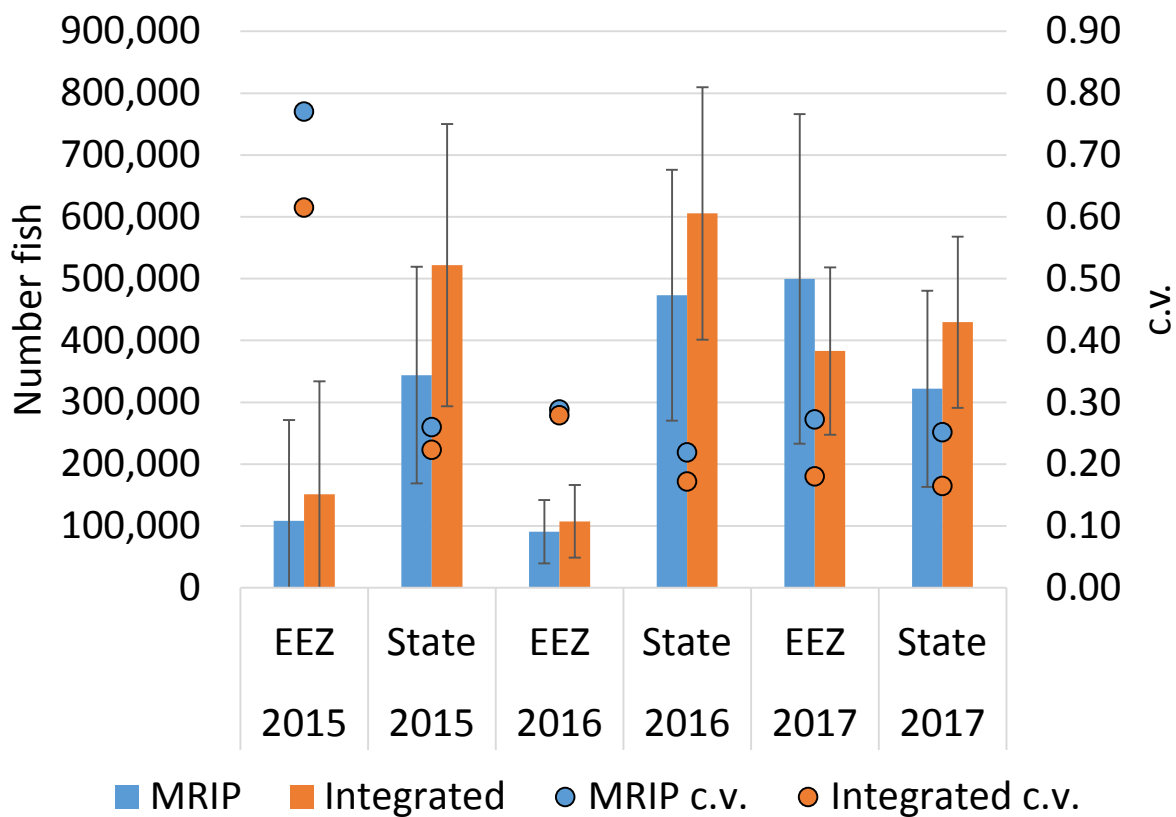


Gray Triggerfish

Gray Triggerfish Landings



Gray Triggerfish Discards

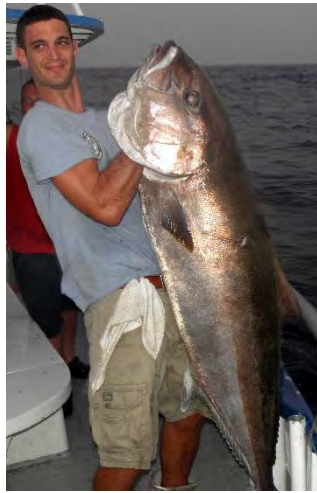


HARVEST OPEN:

Wave 3-6 2015: 4-5 months

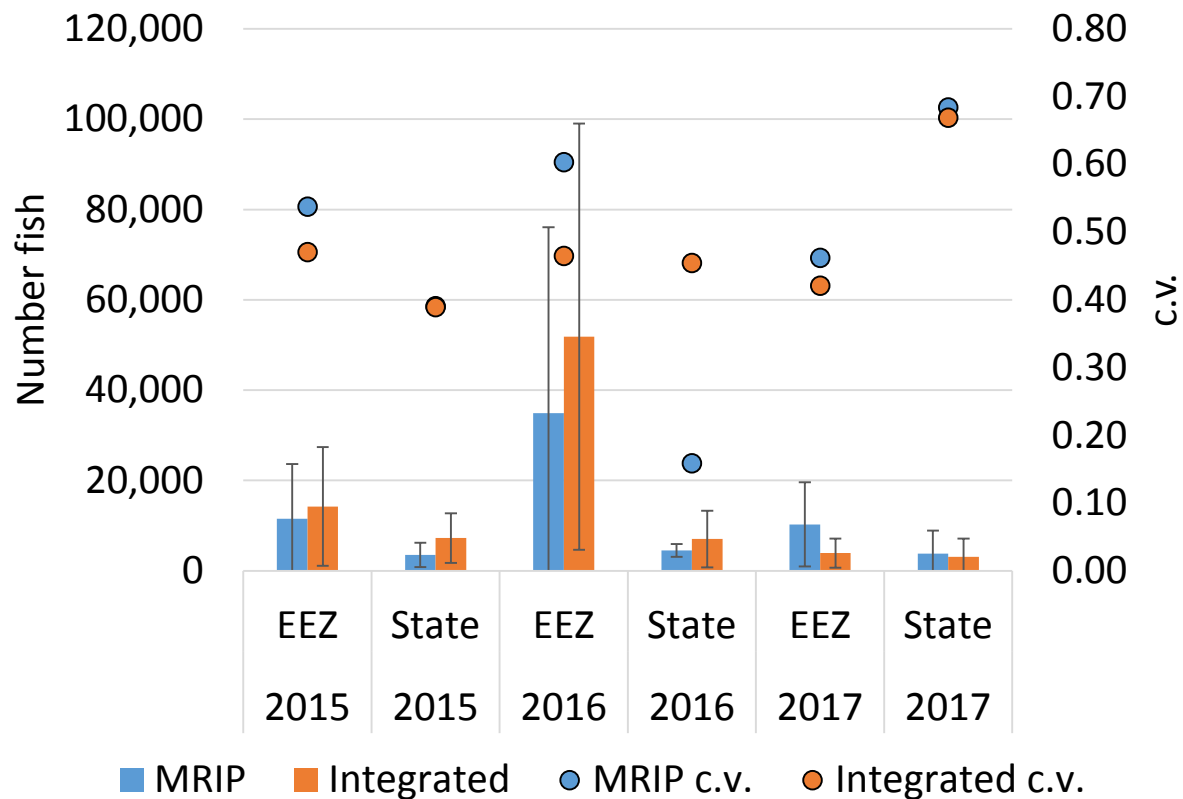
Wave 1-6 2016: 5-6 months

Wave 1-5 2017: 3-4 months

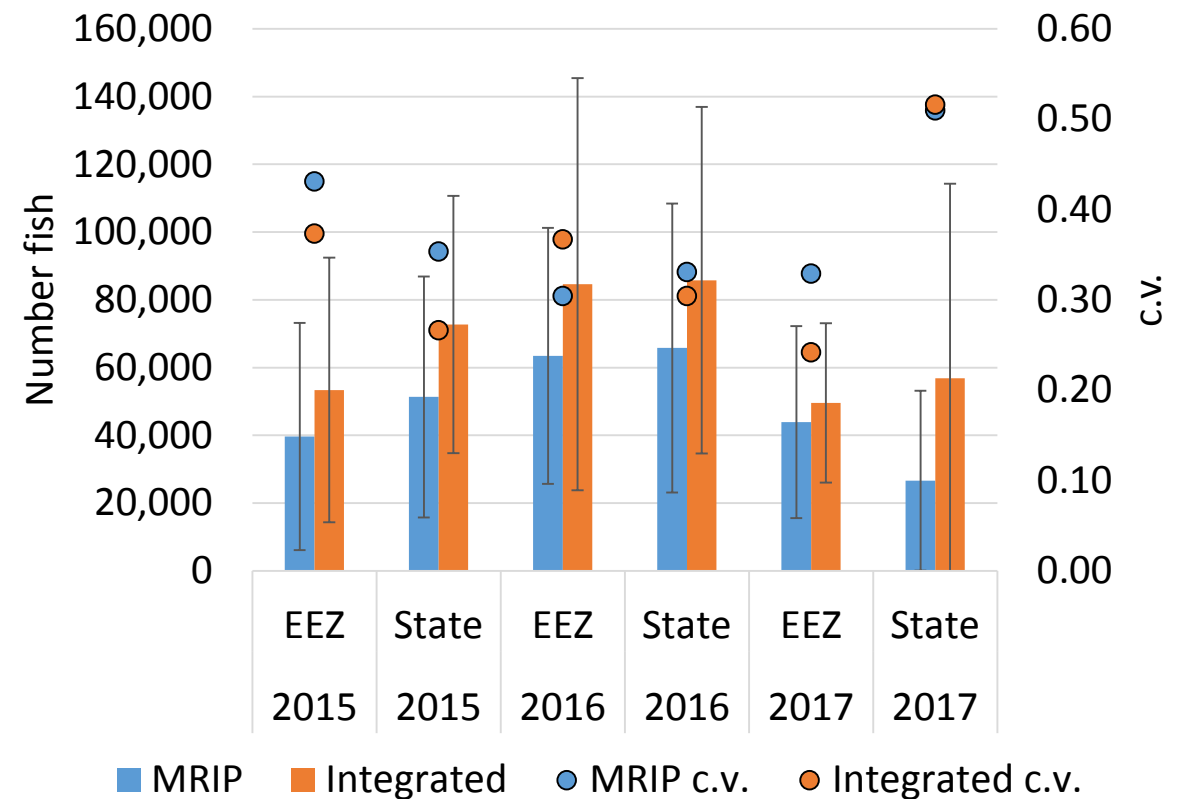


Greater Amberjack

Greater Amberjack Landings



Greater Amberjack Discards

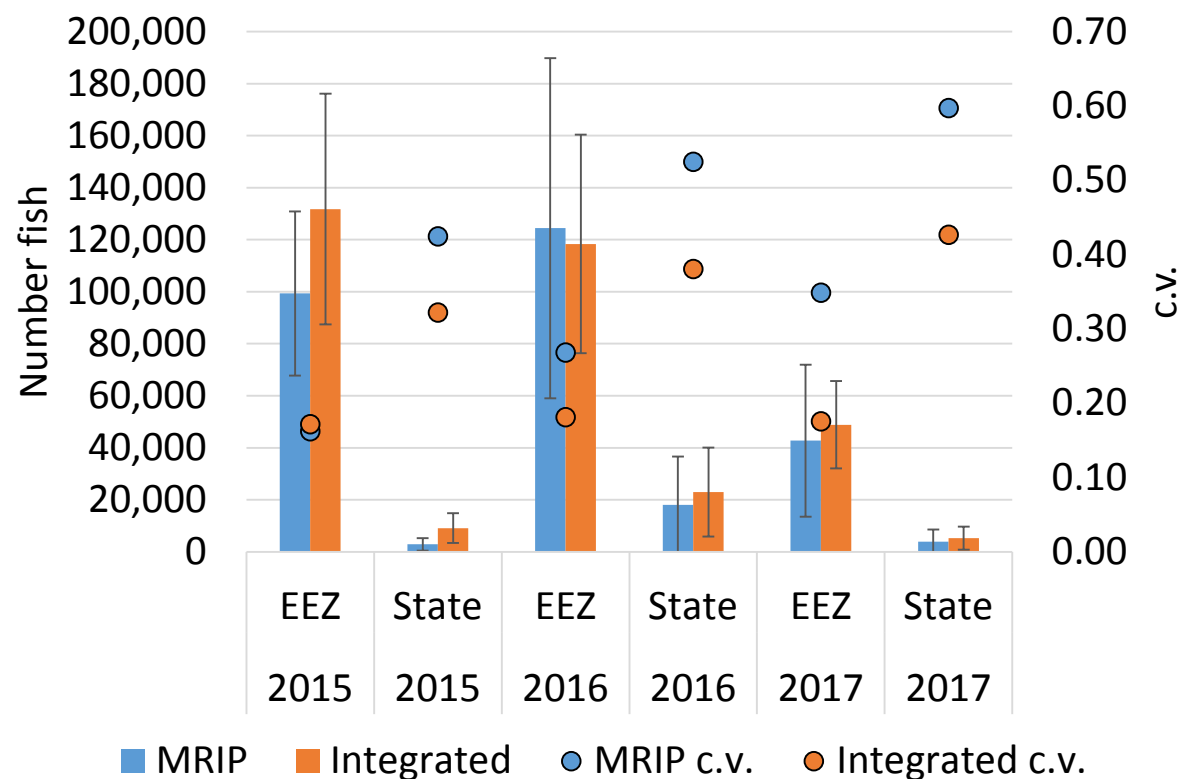


Harvest open year-round

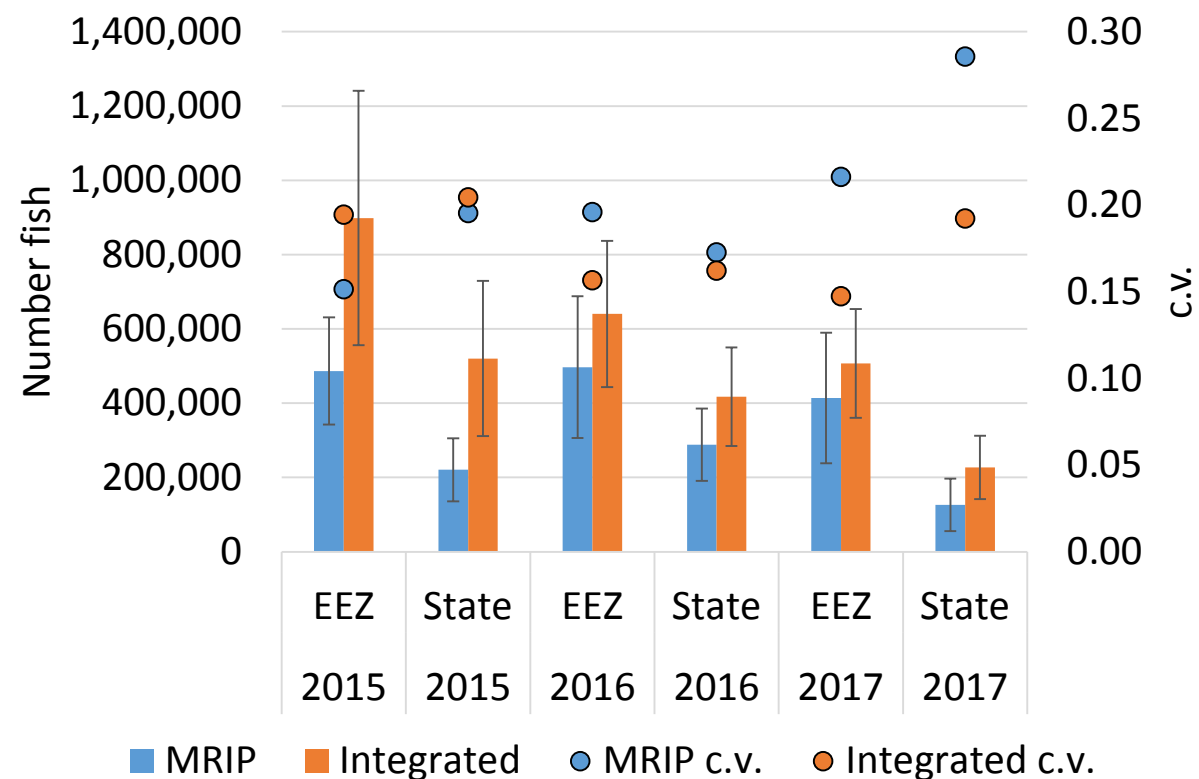


Red Grouper

Red Grouper Landings



Red Grouper Discards

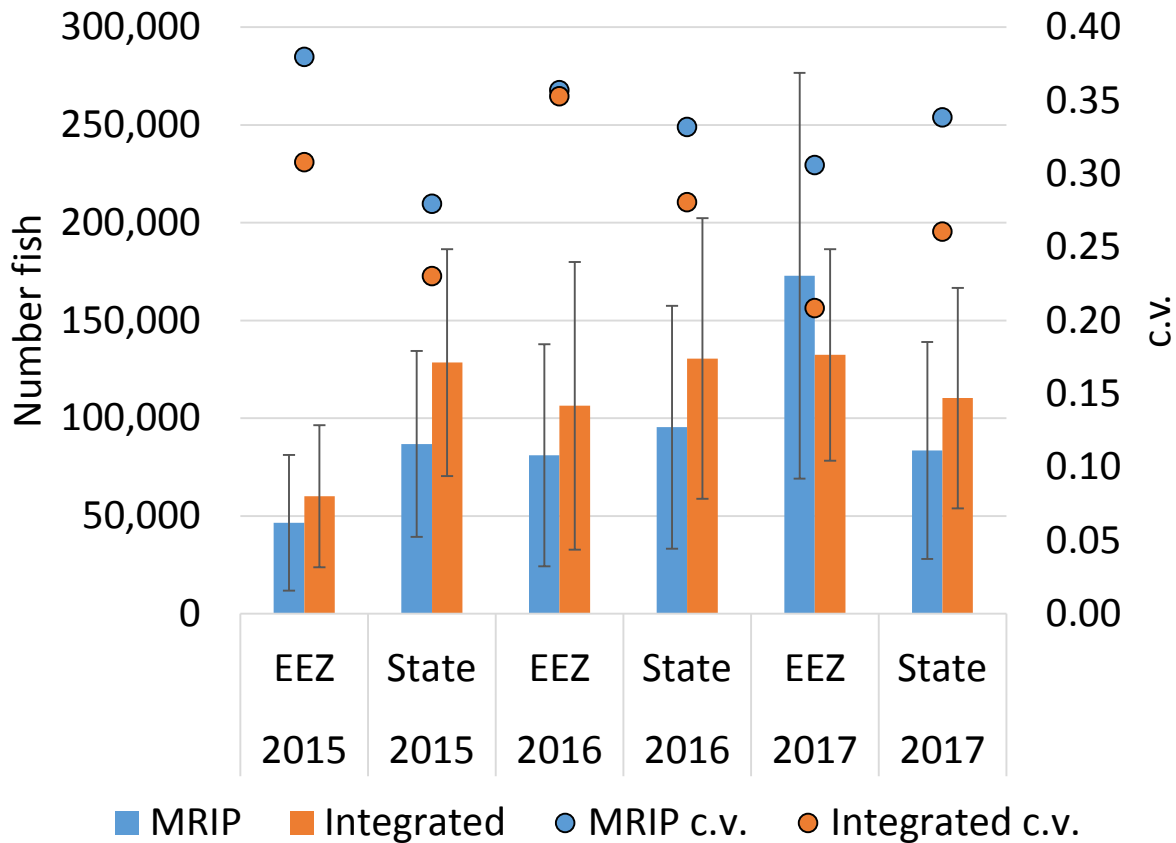


Open year-round

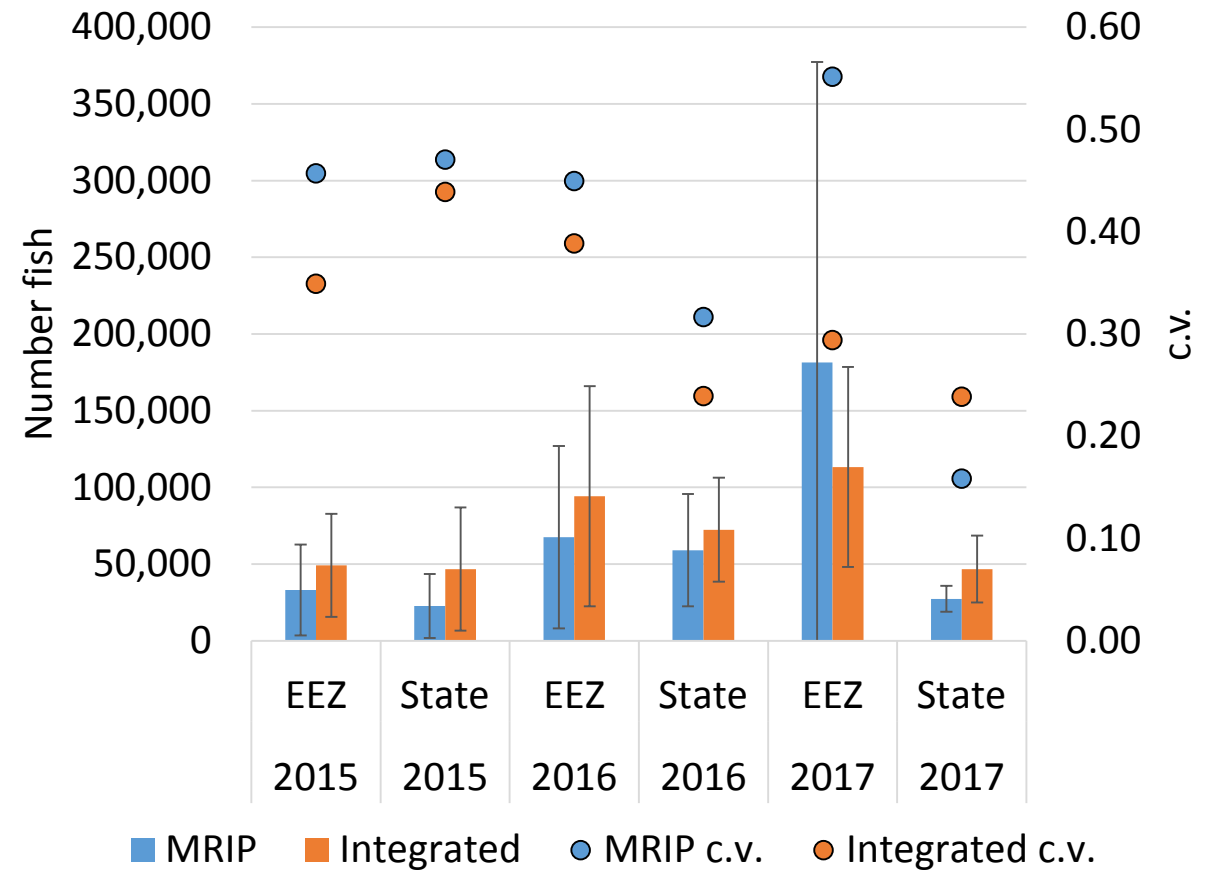


Vermilion Snapper

Vermilion Snapper Landings



Vermilion Snapper Discards

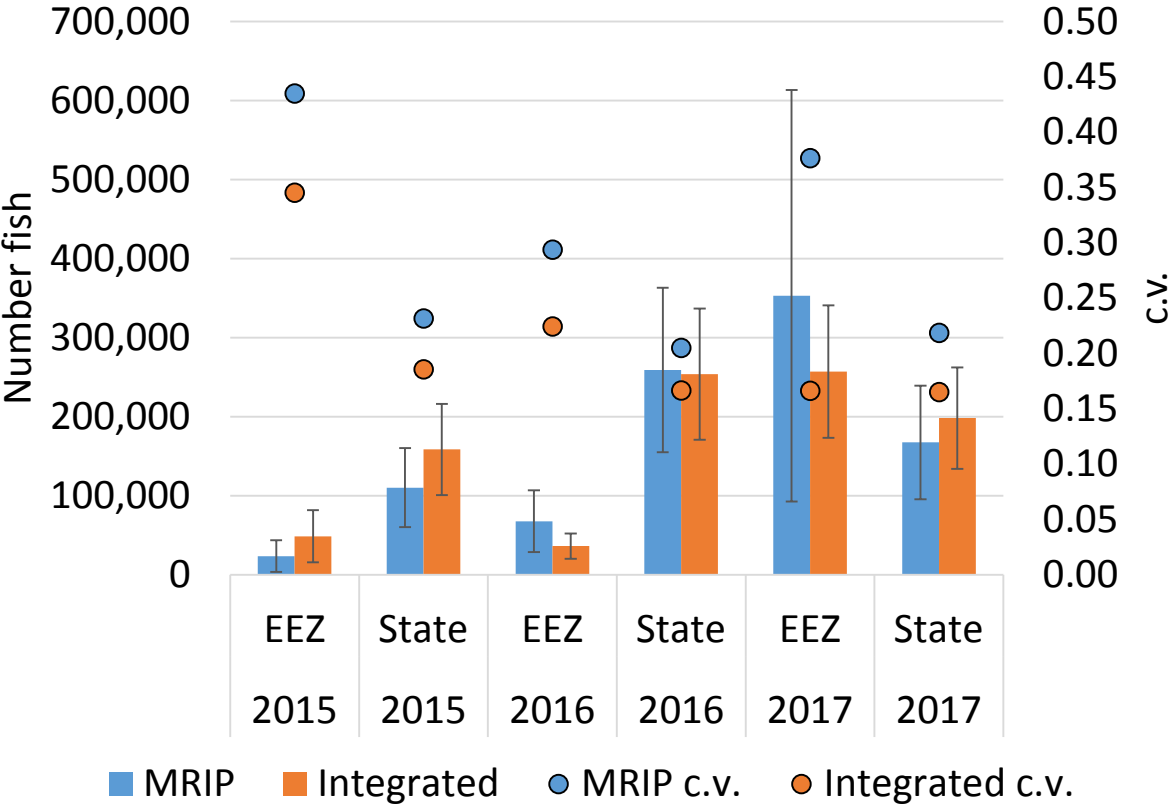


OPEN HARVEST:
Wave 3-6 2015: EEZ 10 days, State 7 months
Wave 1-6 2016: EEZ 11 days, State 5 months
Wave 1-5 2017: EEZ 3 months, State 4 months

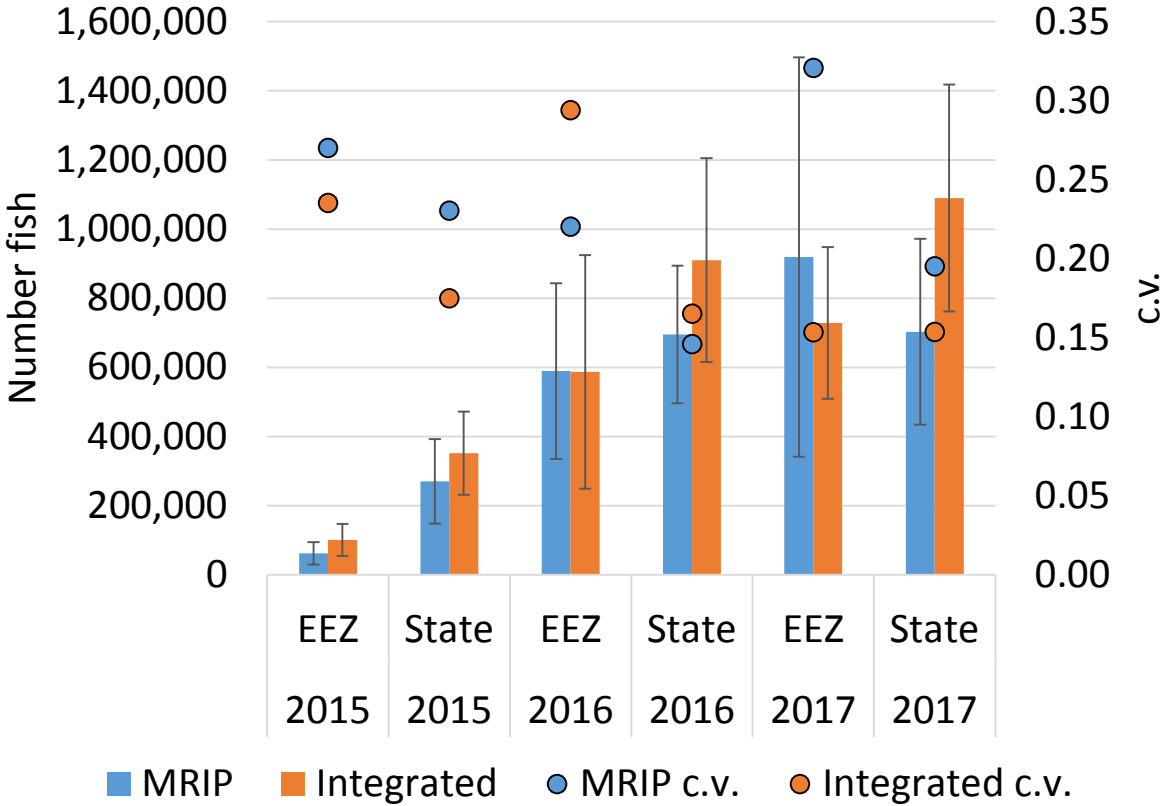


Red Snapper

Red Snapper Landings

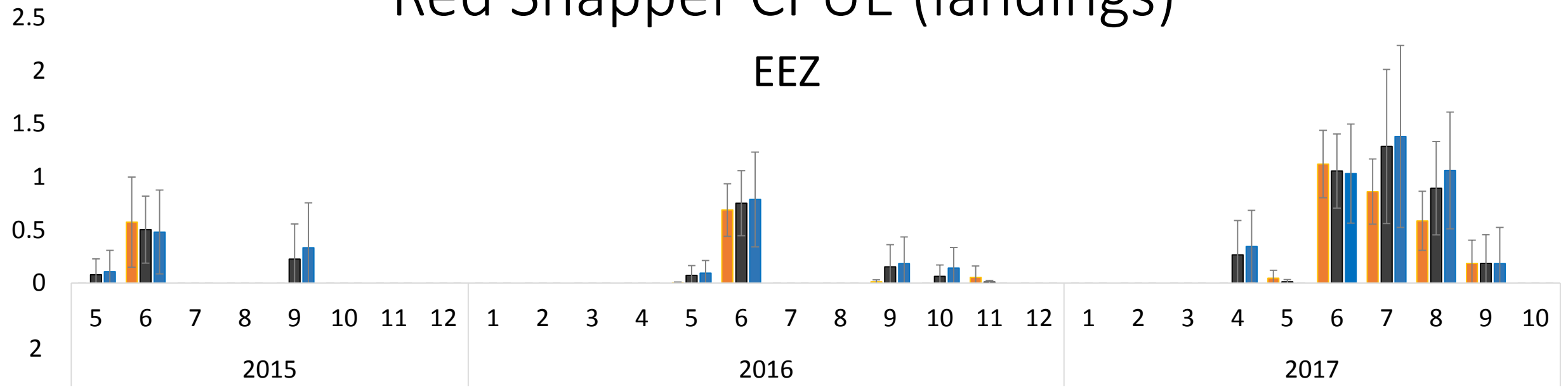


Red Snapper Discards

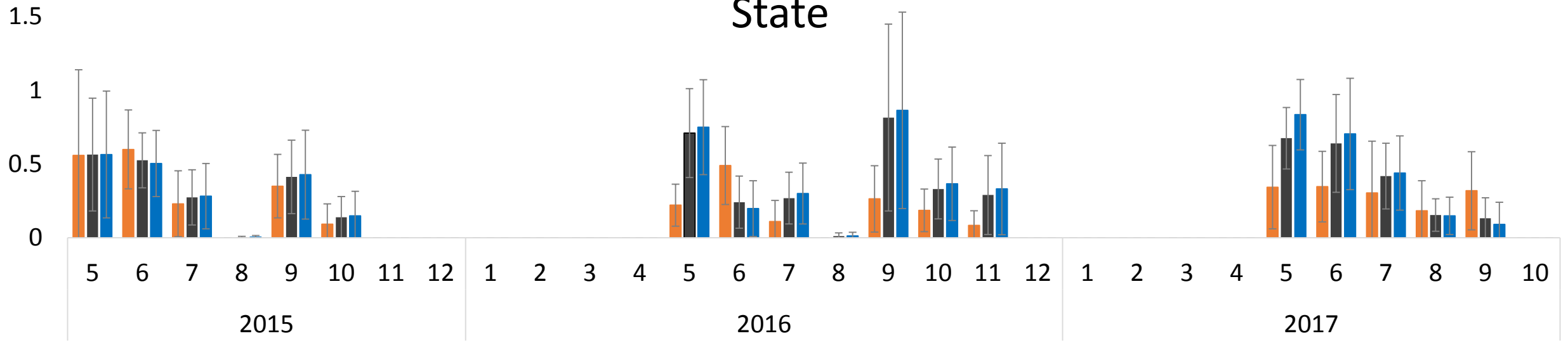


Red Snapper CPUE (landings)

EEZ



State



GRFS Integrated APAIS

Timeliness of Catch Estimates

- May (first month of Wave 3)
 - GRFS effort by July 1 (95% of responses)
 - GRFS only CPUE by mid-June
 - Integrated GRFS/APAIS CPUE after August 31
- June (second month of Wave 3)
 - GRFS effort by August 1 (95% of responses)
 - GRFS only CPUE by July 15
 - Integrated GRFS/APAIS CPUE after August 31

Acknowledgements

- Design Consultants:
 - Ginny Lesser – Oregon State University
 - Lynn Stokes – Southern Methodist University
 - Jean Opsomer – Colorado State University
 - Jay Breidt – Colorado State University
- NOAA Office of Science and Technology
 - John Foster
 - Rob Andrews
- FWC/FWRI Fisheries Dependent Monitoring
- FWC Division of Marine Fisheries Management
- FWC Licensing and Permitting Office
- Florida Division of Highway Safety and Motor Vehicles
- National Fish and Wildlife Foundation



5
CONT'D

Please continue reporting each trip in a separate column below.

TRIP 7

Please "X" ONE date the boat departed:

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

Refer to the enclosed map. Select the region the boat departed from:

☐

Northwest panhandle (excluding Alabama)

☐

Big Bend, Nature coast

☐

Southwest peninsula

☐

Keys, Monroe County

In which of the following areas did you fish? (select all that apply)

☐

0-10 miles from the shoreline

☐

More than 10 miles from shore

If you selected more than one area above, what percentage of time did you spend fishing in each of the areas?

	Less than 50%	About 50%	More than 50%
0-10 miles from shore	<div><input type="checkbox"/></div>	<div><input type="checkbox"/></div>	<div><input type="checkbox"/></div>
More than 10 miles from shore	<div><input type="checkbox"/></div>	<div><input type="checkbox"/></div>	<div><input type="checkbox"/></div>

Did you fish on an artificial reef during this trip?

	Yes	No	Not Sure
	<div><input type="checkbox"/></div>	<div><input type="checkbox"/></div>	<div><input type="checkbox"/></div>

Did anyone on the boat keep, release, or try to catch any of the following species?

☐

Red snapper

☐

Banded rudderfish

☐

Vermilion snapper

☐

Almaco jack

☐

Other snappers

☐

Amberjack

☐

Gag, black, or red grouper

☐

Other jacks

☐

Other groupers

☐

None of these

☐

Gray triggerfish

TRIP 8

Please "X" ONE date the boat departed:

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

Refer to the enclosed map. Select the region the boat departed from:

☐

Northwest panhandle (excluding Alabama)

☐

Big Bend, Nature coast

☐

Southwest peninsula

☐

Keys, Monroe County

In which of the following areas did you fish? (select all that apply)

☐

0-10 miles from the shoreline

☐

More than 10 miles from shore

If you selected more than one area above, what percentage of time did you spend fishing in each of the areas?

	Less than 50%	About 50%	More than 50%
0-10 miles from shore	<div><input type="checkbox"/></div>	<div><input type="checkbox"/></div>	<div><input type="checkbox"/></div>
More than 10 miles from shore	<div><input type="checkbox"/></div>	<div><input type="checkbox"/></div>	<div><input type="checkbox"/></div>

Did you fish on an artificial reef during this trip?

	Yes	No	Not Sure
	<div><input type="checkbox"/></div>	<div><input type="checkbox"/></div>	<div><input type="checkbox"/></div>

Did anyone on the boat keep, release, or try to catch any of the following species?

☐

Red snapper

☐

Banded rudderfish

☐

Vermilion snapper

☐

Almaco jack

☐

Other snappers

☐

Amberjack

☐

Gag, black, or red grouper

☐

Other jacks

☐

Other groupers

☐

None of these

☐

Gray triggerfish

TRIP 9

Please "X" ONE date the boat departed:

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

Refer to the enclosed map. Select the region the boat departed from:

☐

Northwest panhandle (excluding Alabama)

☐

Big Bend, Nature coast

☐

Southwest peninsula

☐

Keys, Monroe County

In which of the following areas did you fish? (select all that apply)

☐

0-10 miles from the shoreline

☐

More than 10 miles from shore

If you selected more than one area above, what percentage of time did you spend fishing in each of the areas?

	Less than 50%	About 50%	More than 50%
0-10 miles from shore	<div><input type="checkbox"/></div>	<div><input type="checkbox"/></div>	<div><input type="checkbox"/></div>
More than 10 miles from shore	<div><input type="checkbox"/></div>	<div><input type="checkbox"/></div>	<div><input type="checkbox"/></div>

Did you fish on an artificial reef during this trip?

	Yes	No	Not Sure
	<div><input type="checkbox"/></div>	<div><input type="checkbox"/></div>	<div><input type="checkbox"/></div>

Did anyone on the boat keep, release, or try to catch any of the following species?

☐

Red snapper

☐

Banded rudderfish

☐

Vermilion snapper

☐

Almaco jack

☐

Other snappers

☐

Amberjack

☐

Gag, black, or red grouper

☐

Other jacks

☐

Other groupers

☐

None of these

☐

Gray triggerfish

If you are reporting more than 9 trips and/or have comments for us, please use the additional sheet provided.

THANK YOU FOR YOUR COOPERATION!

Please return your survey in the postage-paid envelope provided.

Gulf Reef Fish Survey Questionnaire

This survey should be completed by FIRST NAME LASTNAME only.

Return this form even if you don't participate in recreational saltwater fishing.

▼START HERE

Please carefully follow these steps when completing this survey.

• Use only a blue or black ink pen that does not blot the paper

• Make solid marks inside the response boxes

• Do not make other marks on the survey

EXAMPLE

RIGHT WAY

WRONG WAY

For the purpose of this questionnaire:

• A **private boat** is defined as any boat that did not have a paid professional captain and/or crew used for recreational fishing. *Do not* report any trips taken from a paid charter or large party boat.

• Please report only those trips where the boat launched from the west coast of Florida and recreational fishing occurred in saltwater *regardless if fish were caught*.

1

In general, when you go recreational fishing, how often does the boat (or boats) that you fish on launch from the following locations: (Check the box that corresponds to your answer)

		NEVER	SOMETIMES	VERY OFTEN
1	a residential boat slip, such as a dock at a waterfront home, vacation rental, condominium or apartment complex?	<div><input type="checkbox"/></div>	<div><input type="checkbox"/></div>	<div><input type="checkbox"/></div>
2	a facility for launching boats from trailers (boat ramp)?	<div><input type="checkbox"/></div>	<div><input type="checkbox"/></div>	<div><input type="checkbox"/></div>
3	a wet slip at a commercially operated or municipal marina?	<div><input type="checkbox"/></div>	<div><input type="checkbox"/></div>	<div><input type="checkbox"/></div>
4	a dry storage facility (boat is hoisted in/out of the water)?	<div><input type="checkbox"/></div>	<div><input type="checkbox"/></div>	<div><input type="checkbox"/></div>

2

The following questions pertain to recreational fishing on artificial reefs off the Gulf coast of Florida:

		YES	NO	NOT SURE
1	Do you ever fish recreationally on artificial reefs?	<div><input type="checkbox"/></div>	<div><input type="checkbox"/></div>	<div><input type="checkbox"/></div>
2	During the month of APRIL, did you fish recreationally on an artificial reef?	<div><input type="checkbox"/></div>	<div><input type="checkbox"/></div>	<div><input type="checkbox"/></div>

3

During the month of APRIL, did you personally participate in a recreational fishing trip on a private boat that launched from the west coast of Florida? (Check the box that corresponds to your answer)

1

☐

NO, I DID NOT FISH

2

☐

YES, I FISHED

3

☐

NOT SURE, DO NOT RECALL

THANK YOU - THAT IS ALL THE INFORMATION WE NEED. PLEASE RETURN THE QUESTIONNAIRE IN THE ENCLOSED ENVELOPE.

4

On the APRIL calendar below, please "X" the box that corresponds to each day when you personally participated in a recreational fishing trip on a private boat that launched from the west coast of Florida.

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
							1 <div><input type="checkbox"/></div>
	2 <div><input type="checkbox"/></div>	3 <div><input type="checkbox"/></div>	4 <div><input type="checkbox"/></div>	5 <div><input type="checkbox"/></div>	6 <div><input type="checkbox"/></div>	7 <div><input type="checkbox"/></div>	8 <div><input type="checkbox"/></div>
	9 <div><input type="checkbox"/></div>	10 <div><input type="checkbox"/></div>	11 <div><input type="checkbox"/></div>	12 <div><input type="checkbox"/></div>	13 <div><input type="checkbox"/></div>	14 <div><input type="checkbox"/></div>	15 <div><input type="checkbox"/></div>
	16 <div><input type="checkbox"/></div>	17 <div><input type="checkbox"/></div>	18 <div><input type="checkbox"/></div>	19 <div><input type="checkbox"/></div>	20 <div><input type="checkbox"/></div>	21 <div><input type="checkbox"/></div>	22 <div><input type="checkbox"/></div>
	23 <div><input type="checkbox"/></div>	24 <div><input type="checkbox"/></div>	25 <div><input type="checkbox"/></div>	26 <div><input type="checkbox"/></div>	27 <div><input type="checkbox"/></div>	28 <div><input type="checkbox"/></div>	29 <div><input type="checkbox"/></div>
	30 <div><input type="checkbox"/></div>						

5

For each trip marked on the APRIL calendar on the previous page, please provide information about the trip in a separate column below, regardless if fish were caught.

Each trip should be a recreational fishing trip you personally participated in on a private boat that launched from the west coast of Florida.

If you took more than 12 trips, please report the 12 most recent trips. A map and a species identification guide are included in this survey packet to help with this section.

TRIP 1

Please “X” ONE date the boat departed:

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

Refer to the enclosed map. Select the region the boat departed from:

☐ Northwest panhandle (excluding Alabama)

☐ Big Bend, Nature coast

☐ Southwest peninsula

☐ Keys, Monroe County

In which of the following areas did you fish? (select all that apply)

☐ 0-10 miles from the shoreline

☐ More than 10 miles from shore

If you selected more than one area above, what percentage of time did you spend fishing in each of the areas?

	Less than 50%	About 50%	More than 50%
0-10 miles from shore	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
More than 10 miles from shore	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Did you fish on an artificial reef during this trip?

	Yes	No	Not Sure
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Did anyone on the boat keep, release, or try to catch any of the following species?

<input type="checkbox"/> Red snapper	<input type="checkbox"/> Banded rudderfish
<input type="checkbox"/> Vermilion snapper	<input type="checkbox"/> Almaco jack
<input type="checkbox"/> Other snappers	<input type="checkbox"/> Amberjack
<input type="checkbox"/> Gag, black, or red grouper	<input type="checkbox"/> Other jacks
<input type="checkbox"/> Other groupers	<input type="checkbox"/> None of these
<input type="checkbox"/> Gray triggerfish	

TRIP 2

Please “X” ONE date the boat departed:

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

Refer to the enclosed map. Select the region the boat departed from:

☐ Northwest panhandle (excluding Alabama)

☐ Big Bend, Nature coast

☐ Southwest peninsula

☐ Keys, Monroe County

In which of the following areas did you fish? (select all that apply)

☐ 0-10 miles from the shoreline

☐ More than 10 miles from shore

If you selected more than one area above, what percentage of time did you spend fishing in each of the areas?

	Less than 50%	About 50%	More than 50%
0-10 miles from shore	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
More than 10 miles from shore	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Did you fish on an artificial reef during this trip?

	Yes	No	Not Sure
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Did anyone on the boat keep, release, or try to catch any of the following species?

<input type="checkbox"/> Red snapper	<input type="checkbox"/> Banded rudderfish
<input type="checkbox"/> Vermilion snapper	<input type="checkbox"/> Almaco jack
<input type="checkbox"/> Other snappers	<input type="checkbox"/> Amberjack
<input type="checkbox"/> Gag, black, or red grouper	<input type="checkbox"/> Other jacks
<input type="checkbox"/> Other groupers	<input type="checkbox"/> None of these
<input type="checkbox"/> Gray triggerfish	

TRIP 3

Please “X” ONE date the boat departed:

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

Refer to the enclosed map. Select the region the boat departed from:

☐ Northwest panhandle (excluding Alabama)

☐ Big Bend, Nature coast

☐ Southwest peninsula

☐ Keys, Monroe County

In which of the following areas did you fish? (select all that apply)

☐ 0-10 miles from the shoreline

☐ More than 10 miles from shore

If you selected more than one area above, what percentage of time did you spend fishing in each of the areas?

	Less than 50%	About 50%	More than 50%
0-10 miles from shore	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
More than 10 miles from shore	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Did you fish on an artificial reef during this trip?

	Yes	No	Not Sure
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Did anyone on the boat keep, release, or try to catch any of the following species?

<input type="checkbox"/> Red snapper	<input type="checkbox"/> Banded rudderfish
<input type="checkbox"/> Vermilion snapper	<input type="checkbox"/> Almaco jack
<input type="checkbox"/> Other snappers	<input type="checkbox"/> Amberjack
<input type="checkbox"/> Gag, black, or red grouper	<input type="checkbox"/> Other jacks
<input type="checkbox"/> Other groupers	<input type="checkbox"/> None of these
<input type="checkbox"/> Gray triggerfish	

TRIP 4

Please “X” ONE date the boat departed:

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

Refer to the enclosed map. Select the region the boat departed from:

☐ Northwest panhandle (excluding Alabama)

☐ Big Bend, Nature coast

☐ Southwest peninsula

☐ Keys, Monroe County

In which of the following areas did you fish? (select all that apply)

☐ 0-10 miles from the shoreline

☐ More than 10 miles from shore

If you selected more than one area above, what percentage of time did you spend fishing in each of the areas?

	Less than 50%	About 50%	More than 50%
0-10 miles from shore	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
More than 10 miles from shore	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Did you fish on an artificial reef during this trip?

	Yes	No	Not Sure
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Did anyone on the boat keep, release, or try to catch any of the following species?

<input type="checkbox"/> Red snapper	<input type="checkbox"/> Banded rudderfish
<input type="checkbox"/> Vermilion snapper	<input type="checkbox"/> Almaco jack
<input type="checkbox"/> Other snappers	<input type="checkbox"/> Amberjack
<input type="checkbox"/> Gag, black, or red grouper	<input type="checkbox"/> Other jacks
<input type="checkbox"/> Other groupers	<input type="checkbox"/> None of these
<input type="checkbox"/> Gray triggerfish	

TRIP 5

Please “X” ONE date the boat departed:

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

Refer to the enclosed map. Select the region the boat departed from:

☐ Northwest panhandle (excluding Alabama)

☐ Big Bend, Nature coast

☐ Southwest peninsula

☐ Keys, Monroe County

In which of the following areas did you fish? (select all that apply)

☐ 0-10 miles from the shoreline

☐ More than 10 miles from shore

If you selected more than one area above, what percentage of time did you spend fishing in each of the areas?

	Less than 50%	About 50%	More than 50%
0-10 miles from shore	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
More than 10 miles from shore	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Did you fish on an artificial reef during this trip?

	Yes	No	Not Sure
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Did anyone on the boat keep, release, or try to catch any of the following species?

<input type="checkbox"/> Red snapper	<input type="checkbox"/> Banded rudderfish
<input type="checkbox"/> Vermilion snapper	<input type="checkbox"/> Almaco jack
<input type="checkbox"/> Other snappers	<input type="checkbox"/> Amberjack
<input type="checkbox"/> Gag, black, or red grouper	<input type="checkbox"/> Other jacks
<input type="checkbox"/> Other groupers	<input type="checkbox"/> None of these
<input type="checkbox"/> Gray triggerfish	

TRIP 6

Please “X” ONE date the boat departed:

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

Refer to the enclosed map. Select the region the boat departed from:

☐ Northwest panhandle (excluding Alabama)

☐ Big Bend, Nature coast

☐ Southwest peninsula

☐ Keys, Monroe County

In which of the following areas did you fish? (select all that apply)

☐ 0-10 miles from the shoreline

☐ More than 10 miles from shore

If you selected more than one area above, what percentage of time did you spend fishing in each of the areas?

	Less than 50%	About 50%	More than 50%
0-10 miles from shore	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
More than 10 miles from shore	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Did you fish on an artificial reef during this trip?

	Yes	No	Not Sure
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Did anyone on the boat keep, release, or try to catch any of the following species?

<input type="checkbox"/> Red snapper	<input type="checkbox"/> Banded rudderfish
<input type="checkbox"/> Vermilion snapper	<input type="checkbox"/> Almaco jack
<input type="checkbox"/> Other snappers	<input type="checkbox"/> Amberjack
<input type="checkbox"/> Gag, black, or red grouper	<input type="checkbox"/> Other jacks
<input type="checkbox"/> Other groupers	<input type="checkbox"/> None of these
<input type="checkbox"/> Gray triggerfish	

Please continue on the back page

TRIP 10

Please "X" ONE date the boat departed:

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

Refer to the enclosed map. Select the region the boat departed from:

- ☐ Northwest panhandle (excluding Alabama)
- ☐ Big Bend, Nature coast
- ☐ Southwest peninsula
- ☐ Keys, Monroe County

In which of the following areas did you fish? (select all that apply)

- ☐ 0-10 miles from the shoreline
- ☐ More than 10 miles from shore

If you selected more than one area above, what percentage of time did you spend fishing in each of the areas?

	Less than 50%	About 50%	More than 50%
0-10 miles from shore	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
More than 10 miles from shore	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Did you fish on an artificial reef during this trip?

Yes	No	Not Sure
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Did anyone on the boat keep, release, or try to catch any of the following species?

- ☐ Red snapper

☐ Vermilion snapper

☐ Other snappers

☐ Gag, black, or red grouper

☐ Other groupers

☐ Gray triggerfish
- ☐ Banded rudderfish

☐ Almaco jack

☐ Amberjack

☐ Other jacks

☐ None of these

TRIP 11

Please "X" ONE date the boat departed:

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

Refer to the enclosed map. Select the region the boat departed from:

- ☐ Northwest panhandle (excluding Alabama)
- ☐ Big Bend, Nature coast
- ☐ Southwest peninsula
- ☐ Keys, Monroe County

In which of the following areas did you fish? (select all that apply)

- ☐ 0-10 miles from the shoreline
- ☐ More than 10 miles from shore

If you selected more than one area above, what percentage of time did you spend fishing in each of the areas?

	Less than 50%	About 50%	More than 50%
0-10 miles from shore	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
More than 10 miles from shore	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Did you fish on an artificial reef during this trip?

Yes	No	Not Sure
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Did anyone on the boat keep, release, or try to catch any of the following species?

- ☐ Red snapper

☐ Vermilion snapper

☐ Other snappers

☐ Gag, black, or red grouper

☐ Other groupers

☐ Gray triggerfish
- ☐ Banded rudderfish

☐ Almaco jack

☐ Amberjack

☐ Other jacks

☐ None of these

TRIP 12

Please "X" ONE date the boat departed:

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

Refer to the enclosed map. Select the region the boat departed from:

- ☐ Northwest panhandle (excluding Alabama)
- ☐ Big Bend, Nature coast
- ☐ Southwest peninsula
- ☐ Keys, Monroe County

In which of the following areas did you fish? (select all that apply)

- ☐ 0-10 miles from the shoreline
- ☐ More than 10 miles from shore

If you selected more than one area above, what percentage of time did you spend fishing in each of the areas?

	Less than 50%	About 50%	More than 50%
0-10 miles from shore	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
More than 10 miles from shore	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Did you fish on an artificial reef during this trip?

Yes	No	Not Sure
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Did anyone on the boat keep, release, or try to catch any of the following species?

- ☐ Red snapper

☐ Vermilion snapper

☐ Other snappers

☐ Gag, black, or red grouper

☐ Other groupers

☐ Gray triggerfish
- ☐ Banded rudderfish

☐ Almaco jack

☐ Amberjack

☐ Other jacks

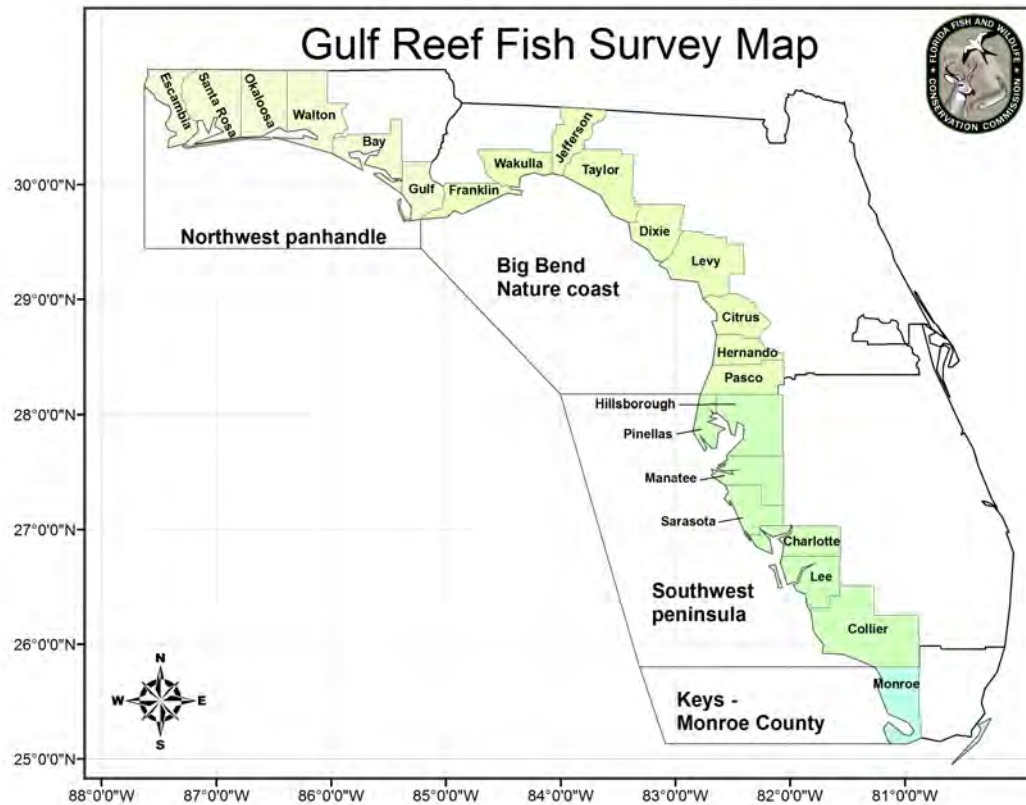
☐ None of these

If you have comments for us, please use the back of this form.

THANK YOU FOR YOUR COOPERATION!

Please return your completed questionnaire in the postage-paid envelope provided.

Please use the map below to help you complete Question 5.



Is there anything else you would like to tell us about saltwater recreational fishing in Florida?

THANK YOU FOR YOUR COOPERATION!

Please return your completed questionnaire in the postage-paid envelope provided.