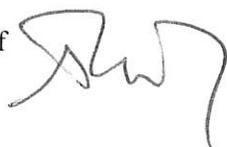




JUN 15 2018

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 Mississippi Department of Marine Resources Tails n'  
Scales

This memorandum certifies the Mississippi Department of Marine Resources (MDMR) Tails n' Scales survey 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*). The MRIP certification process is described at <https://www.st.nmfs.noaa.gov/recreational-fisheries/MRIP/making-improvement>. For MDMR Tails n' Scales, specific Terms of Reference were also adopted (see attached).

#### 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 Science 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 Mississippi Department of Marine Resources (MDMR) enacted a regulatory requirement for private and for-hire vessels to report all Red Snapper harvest regardless of waters fished and began development of an alternative survey design to accommodate required reporting of Red Snapper catches.

Goals of the survey design were: to provide Red Snapper catch estimates that were more precise than those currently available through MRIP and to facilitate improved monitoring of Red Snapper catches with respect to annual catch limits. In 2015, MDMR began development of the Tails n' Scales mobile application to facilitate required reporting and effective enforcement of reporting requirements. At MDMR's request, NMFS conducted an initial peer review of the Tails n' Scales survey design in June, 2016. MDMR has responded to the peer review comments and there have been subsequent rounds of review and response, as documented in the attachments.

#### Description of Certified Method

Tails n' Scales was specifically designed to provide estimates of Red Snapper catch that are unbiased and more precise than estimates available through MRIP. To meet this goal, MDMR introduced a regulation in 2014 that required private boat and for-hire vessel representatives to report all Red Snapper harvested and released. The Tails n' Scales survey design consists of two complimentary components: the Tails n' Scales reporting system and an access point intercept survey. Through a capture-recapture sampling approach, catch and effort information reported by anglers through the Tails n' Scales system is validated and corrected using information from the intercept survey. In using a capture-recapture approach, the assumption is made that access point intercept surveys and Tails n' Scales reporting are conducted independently. Compliance is maintained through strict enforcement of the Red Snapper reporting requirements.

- The Tails n' Scales system is the mechanism whereby required reporting of Red Snapper catch is achieved. One representative from a fishing party must register in the system and is required to prospectively declare the upcoming fishing trip to obtain a unique trip authorization number. A new trip authorization number cannot be obtained until the previous trip information has been reported using the Tails n' Scales system. Three reporting options are available to vessel representatives: Mobile app, Online, and phone.
- The dockside private boat and for hire vessel validation component is a randomized intercept survey conducted at public fishing access points based on Red Snapper fishing pressures at those sites. Sampling assignments are randomly selected by site-day and time block using probability proportional to size (PPS) protocols.

#### Certification

The MDMR 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. Critical to the validity of the capture-recapture methodology used in the Tails n' Scales survey design is maintenance of reporting compliance levels and the matching of access point intercept survey information with Tails n' Scales trip reports. The assignment of a unique trip authorization number facilitates matching of Tails n' Scales reports to access point intercepts.

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. It should be noted that any modifications of the documented survey design are not automatically deemed certified, but will require review for consistency with this determination and potential further modification for the survey to remain certified.

NMFS and MDMR'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; (4) apply the calibration 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:

Red Snapper Certification doc 7.7.17 FINAL.pdf

Review of MS Tails 'n Scales Program.pdf

TOR9\_MS\_TailsnScales.pdf

Appendix 1. MS Certification Document.pdf

Appendix 2. MS Red Snapper survey consultant report.pdf

## **Review of MS Tails 'n Scales Program Proposed for MRIP Certification**

**Jay Breidt (Colorado State University), Mike Brick (Westat), Ginny Lesser (Oregon State University),  
Jean Opsomer (Colorado State University), Lynne Stokes (Southern Methodist University)**

January 9, 2017

We received the following documents describing the MS Tails 'n Scales Program:

1. Red Snapper Certification doc 7.7.17 FINAL.docx
2. MDMR Certification Bullet Points Document\_Final.docx

Our review will be based on these materials and refer to them as needed. Below, we address each of the terms of reference.

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

The data collection consists of two components: the Tails 'n Scales trip reporting system, and the dockside intercept survey. The first consists of a required "pre-authorization" by one angler per trip, followed by reporting of trip and catch characteristics after trip completion. The reporting is greatly enhanced by enforcement mechanisms, both on-the-water interception by law enforcement and the inability to sign up for a trip unless the previous trips is closed out or canceled. From a compliance perspective, this is one of the better programs we have seen among the several self-reporting systems for recreational fisheries we have reviewed.

The second component of Tails 'n Scales consists of a validation survey, conducted through a random sample of on-site intercepts of returning trips during the relevant fishing seasons. Data from this survey are used to construct capture-recapture type estimators for the total number of trips targeting red snapper and their associated total catch. Considered in combination, these two data collection mechanisms are a valid approach to collect statistical data in this fishery.

Both Tails 'n Scales self-reporting and the intercept survey are well documented, and the latter has randomization protocols that appear appropriate. However, as the PPS sampling procedure is not described in full detail in the documentation, we are not able to fully assess it at this point. Specifically, it is not clear to us how the PPS sampling is performed across both sites and time slots (i.e. how are the site and time pressures combined) to select individual assignments. This should be clarified further to ensure that the weighting and variance estimation procedure correctly reflect the sampling design.

The PPS design as currently implemented appears statistically valid, but the very large range of pressures shown in Table 3A of (1) might lead to estimates that are highly variable. One approach to reduce this problem is to first stratify the sites into pressure categories, and then select samples using PPS within these categories. The allocation to the strata does not have to be proportional to the number of sites in a stratum nor to their total pressure, but the latter is

certainly a good place to start in considering sample allocation for this program. Depending on the sampling intensity and budget, it is also possible to have a small number of "certainty sites" for the highest-pressure ones.

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?*

Following up on the previous comment, we are not able to tell from the provided documentation how the PPS design was implemented across sites and time blocks, and hence how the weights were obtained. Information on how to improve the design through stratification would be obtained from an examination of the pressures and weight distribution. We have no reason to believe it is not done correctly, but it would still be useful for documentation purposes to more fully describe it.

On a similar topic, the documentation mentions that if a specific site/time is selected more than once, two samplers are sent to account for the expected large number of returning trips. This is certainly appropriate, but how is this assignment handled in weighting? Specifically, is it also given a double weight?

Assuming there are no weight construction issues, the capture-recapture estimator described in the documentation is indeed appropriate. Particular strengths of the Tails 'n Scales program are the high compliance rate and the fact that the issue of matching of self-reported trips and intercepted trips is mostly avoided, since it can be done based on the trip permit number. Other estimators are possible for combined self-reporting and survey intercept estimation of effort and catch, as have been recently explored in a pilot project for the charter fishery in South Carolina. In that project, an additive adjustment was found to be a better option than the capture-recapture one implemented so far for Tails 'n Scales, so it might be worthwhile to evaluate it here as well. However, given the high quality of the record matching and the high compliance rate in Tails 'n Scales compared to those encountered in South Carolina, we expect these different estimators may lead to similar estimates. It would be of interest to conduct this comparison in order to examine the usefulness of the additive adjustment with this design.

On p.14 of (1), an adjustment for sites with zero intercepts is mentioned but not fully described. If the number of sites with zero intercepts is small, no adjustment is likely to be needed in the general estimation procedure. If this occurs at a non-trivial number of sites, then an adjustment might indeed be warranted and using some type of larger-area average is reasonable. It might again be worthwhile to document this in more detail, so that it can be more fully assessed.

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

By construction, the combination of mandatory self-reporting and randomized intercepts is designed to correct for undercoverage and self-reporting errors. Especially with high participation in the self-reporting component, this should lead to high quality estimates for the MS recreational red snapper fishery. Other issues, such as angler nonresponse in the intercept survey, possible differences between private and public sites, are present in most other MRIP surveys, so acknowledging them is sufficient at this stage.

As noted in the documentation, there are a number of additional auxiliary data sources that are unique to MS and, while not necessary as part of the basic estimation procedure, can provide further insights in some of the sources of non-sampling errors. These include the home visits to a random sample of anglers returning to private sites, the on-the-water law enforcement intercepts, and the flight counts of angler vessels.

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?*

The undercoverage due to vessels returning to private sites is inherent in this intercept survey, as it is in the APAIS, even though at an estimated 30% of the trips, it might represent a larger fraction in MS than in many other states. If these trips are different in either their catch characteristics or in their compliance behavior, then this might indeed lead to bias. However, the combination of mandatory pre-approval for trips and on-the-water enforcement makes it likely that the latter factor will have at most a minor impact. Regarding possible differential catch reporting, the home visits mentioned above will provide some information on this issue even if it is unlikely to allow for estimation of the magnitude of biasing effects.

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?*

Because trip matching will be done based on individually issued authorization numbers, matching errors, often a major source of non-sampling errors, is not present in MS. Requiring that these numbers be issued prior to going on a trip also greatly reduces the potential dependence between the "capture" (self-reporting) and the "recapture" (intercept) events. Overall, the Tails 'n Scales program appears to be a very good way to avoid several of the key complications present in implementing survey-based capture-recapture surveys.

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

In most survey programs, careful and accurate implementation of the stated procedures is an essential underpinning of the quality of the resulting estimates and associated measures of precision. Because this program includes two separate components that require matching at the individual trip level, this is certainly the case here. But the mandatory pre-authorization, the high level of enforcement and issuing of penalties, the public relations campaigns are all aspects of the program that greatly improve its overall quality. As already noted, trip matching by authorization numbers bypasses one of the major hurdles in implementing capture-recapture surveys. In addition, the high level of compliance ensures that the resulting estimators are expected to be efficient.

The main aspect we were not able to fully evaluate is whether the PPS design and its associated weighting procedures are properly implemented, because the documentation was incomplete in this area.

7. *How does the survey design compare to the survey design it would replace or supplement? 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 Tails 'n Scales Program is intended to provide more data on red snapper catch and to do so in a more timely manner than the general-purpose APAIS and CHTS (or FES). All indications are that this program can indeed achieve these purposes. The statistical methodology underlying the combined estimators is not in doubt, because it can be explained using standard design-based theory. It might be useful to evaluate alternative forms of the combined estimator, but this can be done at a later time and does not change the data collection and survey design aspects of this program.

8. *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 intercept component of the Tails 'n Scales is very similar to the APAIS, which has been used as the standard MRIP catch data collection approach. The self-reporting component is not yet part of any certified programs, although a similar program in AL is currently undergoing review. Matching and estimation procedures have been pilot-tested in South Carolina and are also being implemented in AL. We recommend that these various programs coordinate future efforts in implementation of their statistical methods and try to harmonize their approaches, to facilitate data integration and comparisons across states and regions.

9. *Is the survey collecting data and producing information products that will meet the needs of the primary customers (stock assessment scientists and fishery managers)? [To be addressed by NMFS staff.]*

Term of Reference #9.

SERO/SEFSC Response (01/29/2018) to request to review TOR #9.

Edited 3/08/2018 RPC from Email 01/29/2018.

- Request MS continue to collect discard information on red snapper
- The program will likely provide accurate counts of red snapper target trips and anglers, which is great.
- Trip estimates will only include red snapper information, so there will be some information loss relative to MRIP in terms of identifying other species that were targeted and/or harvested on trips that targeted red snapper. The demand for recreational angler trips may be driven by expectations of catching multiple species. Having only red snapper info reduces our ability to estimate changes in red snapper or other species effort resulting from biological or management changes across co-occurring stocks. Target species questions should be collected, both primary and secondary. While we understand most trips will say they are targeting red snapper, this additional information on secondary target species would be useful for management.
- It's not clear how the results from Tails 'N Scales could be combined with effort estimates from MRIP to get total trip estimates. Would MRIP supersede Tails 'N Scales when looking at general effort, or is there a way to link them together without double counting trips?
- Because a trip authorization number is required prior to departure, how are trips handled that encounter red snapper incidentally? Can anglers not keep such fish even if the season is open? Seems red snapper catch information on trips that aren't explicitly targeting red snapper would be lost. Does this underestimate red snapper effort and discards?
- There is no question posed to anglers about whether they were fishing in federal waters or state waters (e.g. MRIP has a distance from shore variable). Such information could be valuable information for setting federal seasons, etc.

**Mississippi Red Snapper Reporting Program review**  
**Biloxi, MS**  
**June 29-30, 2016**  
**Consultant Report**

Jay Breidt, Virginia Lesser, Jean Opsomer, Lynne Stokes

August 26, 2016

**General Comments**

The review meeting in Biloxi was informative and efficient, and we appreciate the care taken in putting together the materials and presentations for our review. We are confident that the Tails 'n Scales data collection system, with minor changes, can support a scientifically valid red snapper catch estimation system.

This report summarizes what we see as the strengths of the project plan as it is currently implemented, as well as the parts of the current system we believe could be eliminated or changed. We also present valid estimation methods in more detail, based on capture-recapture methodology.

**Strengths of Tails 'n Scales**

The Tails 'n Scales system requires that red snapper angling trips be prospectively declared by a member of the angling party. The data collection strategy proposed in Mississippi uses mark-recapture methods to estimate population totals, which are efficient and statistically valid approaches for producing estimates in difficult-to-sample populations. The pre-declaration of the intention to fish provides a well-defined "capture" for each trip that is by definition independent of any subsequent "recapture," since it occurs before the angler is aware of whether or not a recapture will occur. (This is true for estimating the count of trips; the counts of anglers and caught fish are not declared in advance of recapture. This will be discussed later in the estimation section.) We consider this to be a great strength of this implementation of the angler reporting system, since it eliminates a common assumption violation in other capture-recapture estimation systems. Another strength of the Mississippi approach is that the pre-declaration of the trips is mandatory, with significant penalties for violations (e.g., increasing fines for 1<sup>st</sup>, 2<sup>nd</sup>, and 3<sup>rd</sup> offenses resulting in revoking a license after the third offense) *and* actual enforcement on the water. This makes it likely that compliance numbers will be high, ensuring that the Tails 'n Scales database will represent close to a complete census of red snapper trips.

The survey implementation of Tails 'n Scales is well conceived and crafted, including the requirement of the trip declaration. The weather and sea forecasts and the trip log should incentivize users to access the system before and after their trips. There

are few questions and the response categories are easy to figure out. However, we do suggest that the list of landing sites is quite long which may reduce accurate responses. A person might be more likely to click the first sites on the screen rather than scroll to the bottom. We suggest rather than look over a long list of over 50 sites, the program should first list counties (Harrison, Jackson, Hancock). Once the respondent clicks on the county, the list of sites within that county are displayed. There will still be a list to look at but it will be much smaller.

Another strong point of the data collection system is that it may provide an opportunity to collect information to answer a particularly thorny problem in many recreational angler surveys: How do public and private access angling trips differ? In particular, a goal of each state is to examine whether the reporting compliance rate and catch rate differ for public and private access anglers. Two aspects of the Mississippi survey protocols provide opportunities to examine public and private estimates. First, the unique geography of Mississippi and the intense law enforcement presence on the water may provide an opportunity to collect data to discern the difference in reporting rates for the two groups of anglers. Specifically, suppose we can assume that law enforcement data can produce a reasonable estimate of reporting compliance rate of the entire population of red snapper anglers. Then this estimate can be combined with other data already available to estimate the reporting compliance rate of private access anglers. We return to a discussion of how this can be done through a combination of Tails 'n Scales reports, and law enforcement and access point intercepts. This is discussed in the section on auxiliary data collection procedures.

Second, the program of "sampling by appointment" for private access anglers provides a means for allowing validation of reported data on catch (although not on number of anglers) for those private access anglers who do report their trip. While this is not the entire universe of private access anglers, it is still a subgroup whose data are not available in other recreational angler surveys. As it is now implemented, this subgroup is not sampled according to a probability sample, as the sample is restricted to individuals who are specifically chosen by Mississippi staff. While this is a reasonable way to begin the program to test its feasibility, we recommend that it be extended to a randomly selected sample of anglers who have ever reported a private access trip. There will probably be more refusals for this group than previously, but sample analysts are accustomed to dealing with missing data and have tools for adjusting for non-response bias.

### **Validation data sources**

Estimating aspects of angling trips (number, total fish caught or number of anglers participating, or any other feature) via capture-recapture methods requires two sources of data, one of which must be randomly selected (or at least reasonably modeled as randomly selected). In this application and other similar ones using angler reports, one of the two sources is the database of angler initiated reports. These reports do not originate from a random sample of red snapper anglers, so the

other source of data must originate from a random sample. Fortunately, the access point intercept sample does produce a random sample of (public access) trips by design. It is important to note that the design does not need to give each trip an equal chance of selection, but when it does not, weights must be used in estimation to account for the unequal selection. These two sources (Tails 'n Scales reports and access point intercept samples) are all that is needed to estimate features of public access trips.

For example, to estimate the number of public access trips, the reported number of such trips in Tails 'n Scales is adjusted by dividing it by an estimate of their reporting compliance rate. This estimate is calculated from the access point intercept sample. In order to expand such estimates to include the number of private access trips, one must make the (usually unverifiable) assumption that public and private access trips are reported at the same rate. Then the compliance rate estimated from the access point intercept sample can be applied to the whole population of Tails 'n Scales reported trips. Note that if a separate estimate of reporting rate for private access trips were available, it could be used to inflate the number of reported trips in this category separately, and the estimates of total trips for the two domains summed up after separately adjusting them.

To estimate another characteristic over all trips, such as total catch, the form of the estimator is similar. In that case, the Tails 'n Scales reported number of fish caught is adjusted by dividing by an estimate of the ratio of the total reported to total true number of fish caught, where the estimate is made from the access point intercept sample only. This ratio is likely to be less than one when reporting is incomplete, thus producing an estimate that inflates the number of fish reported. However, unlike for the estimate of number of trips, it is possible for the ratio to exceed one—say if reporting were 100% and anglers exaggerated their catch in Tails n' Scales. In that case, the estimated catch would actually be smaller than the reported catch. If this estimated ratio is used to adjust all the reported catch (public and private), the estimate of total catch will only be approximately unbiased when the ratio of reported to true catch is the same for public and private access trips. As noted earlier, the auxiliary data collected in the Mississippi data collection plan may provide a way to assess this assumption.

While the presence of a trip report in Tails 'n Scales is truly independent of its possible access point intercept, the same cannot be said a priori about the trip characteristics. That is because the completion of a Tails 'n Scales trip report, which includes the catch, the number of anglers and the area fished, can occur both before (on the water) and after the intercept. That seems unavoidable given the current approach but it is good to remain aware of this potential source of bias in the estimates.

It is possible to make use of additional sources of information using a methodology known as multiple recapture, in which the data from each of the new sources must also be either randomly selected or reasonably modeled as such. In addition, the

events of capture in the various sources must be independent, and the units observed in each sample must be identifiable across samples. One or several of these conditions are violated for either of the other data collection systems that were described (telephone and on-the-water samples). Only trips present in the Tails 'n Scales list appear in the telephone sample. Thus the probability of selection for the telephone sample depends on membership on the Tails 'n Scales list, violating the independence assumption. It is not possible to match encountered trips from either the airplane or law enforcement samples with the other available samples. Therefore neither of these additional sources of data can be used for estimation under the multiple recapture framework.

There may be other uses for the data from these sources that make them worthwhile to continue to collect. The telephone sample may be used for quality control/verification of the access point intercept samplers, as is currently done in MRIP (to determine whether the interview actually took place and whether all the questions were answered). If this is the goal, then only anglers intercepted during the access point survey need to be included in the telephone sample. Currently, calls are also made to anglers who declared a trip in Tails 'n Scales and were not intercepted. However, data collected in the telephone interview of registered anglers on any trips not included in the access point intercept sample cannot be used for adjusting the compliance rate, since that by definition concerns anglers who did not register trips.

As mentioned before, making telephone contact with a random sample of anglers who report trips returning to private access points for the purpose of requesting permission for access to their private property could be useful. The data for assumption checking will not come from the calls themselves, but from the subsequent private access point encounters.

The data from the law enforcement sample might be useful for assessing the validity of the assumption of equal reporting compliance rate for public and private access. It is less clear to us that the data from the airplane sample provides any real value for either the estimation program or assessment of assumptions, since it is difficult to match individual boats with the Tails'n Scales trip numbers and that the sampling is non-random (only clear days can be flown, only a subset of the fishing sites can be reached).

### **Auxiliary data collection procedures**

As noted earlier, only the Tails 'n Scales reporting database and the access point intercepts are needed for producing the catch estimates, though some of the auxiliary data sources could be useful for checking additional characteristics of the red snapper fishery, formally or informally. In particular, we return briefly to the "by appointment" private site intercepts and the on-the-water enforcement intercepts.

If data about catch are to be obtained from the private access point trips, these trips should have a probability of selection that can be calculated. The current method of selecting anglers who are most likely to be willing to participate makes this difficult, since it is not a probability sample of anglers. A probability sample of private access trips could, however, be obtained by first selecting a probability sample of reporting private access anglers, then by selecting trips within anglers, with non-zero selection probabilities for each such trip. Either the angler sample or the trip within angler sample may have unequal probabilities, provided they are known and non-zero. The resulting sample of trips may have unequal probabilities across trips, and weights should be constructed to reflect this unequal probability design.

We had substantial discussion at the meeting about what data would be needed from law enforcement in order to be useful, and whether it would be possible to obtain it. The latter question is beyond our expertise. However, for the former, we believe that information only about the presence or absence of a trip number (reporting compliance information) for all red snapper anglers is enough to be useful. This can be shown by noting that the overall reporting compliance rate  $R$  can be expressed as the number of trips reported ( $n_1$ ) divided by the total number of trips taken ( $N$ ), or

$$R = \frac{n_1}{N} = \frac{n_{1,pub} + n_{1,pr}}{N_{pub} + N_{pr}},$$

which can be rearranged as

$$N_{pr} = \frac{n_{1,pub} + n_{1,pr}}{R} - N_{pub},$$

where  $n_{1,pub}$  is the number of trips reported by public access anglers and  $n_{1,pr}$  is the number of trips reported by private access anglers, and  $N_{pub}$  and  $N_{pr}$  are the total number of trips taken by public and private access anglers. Suppose we can make an estimate of  $R$ , denoted as  $\hat{R}$ , from the law enforcement data. We can also validly estimate  $N_{pub}$  from Tails 'n Scales and the access point sample as  $\hat{N}_{pub} = \frac{n_{1,pub}}{\hat{R}_{pub}}$

where  $\hat{R}_{pub}$  is the estimated public access reporting rate. Plugging the estimates  $\hat{R}$  and  $\hat{N}_{pub}$  and the number of trips reported,  $n_{1,pub} + n_{1,pr}$ , into the equation above, we then have

$$\hat{N}_{pr} = \frac{n_{1,pub} + n_{1,pr}}{\hat{R}} - \hat{N}_{pub} = \frac{n_{1,pub} + n_{1,pr}}{\hat{R}} - \frac{n_{1,pub}}{\hat{R}_{pub}}.$$

An estimate of private access reporting rate  $R_{pr} = n_{1,pr}/N_{pr}$  is then obtained as

$$\hat{R}_{pr} = \frac{n_{1,pr}}{\hat{N}_{pr}} = \frac{n_{1,pr}}{\frac{n_{1,pub} + n_{1,pr}}{\hat{R}} - \frac{n_{1,pub}}{\hat{R}_{pub}}}.$$

### Estimation under capture-recapture methodology using a complex validation sample

Before introducing the proposed estimator, we review the usual capture-recapture estimator of population size:

$$\hat{N} = \frac{n_1 n_2}{m},$$

where  $n_1$  and  $n_2$  are the sizes of the capture and recapture samples and  $m$  is the number of units in the recaptured sample that were previously captured. This estimator can be thought of as a ratio estimator. To see this, define  $y_i = 1$  for every unit in the population so that the parameter of interest is the population total

$$t_y = \sum_{i=1}^N y_i = N.$$

Next, define  $r_i = 1$  if the  $i^{\text{th}}$  unit in the population is in the captured (or reporting) sample and  $r_i = 0$  otherwise. With this notation,  $n_1 = \sum_{i=1}^N r_i$ ,  $n_2 = \sum_{i=1}^{n_2} y_i$  and  $m = \sum_{i=1}^{n_2} r_i$ . Thus, under equal-probability sampling, we can write the usual capture-recapture estimator of population size,  $\hat{N}$ , as a ratio estimator with auxiliary variable  $r$ :

$$\hat{N} = \sum_{i=1}^N r_i \frac{\sum_{i=1}^{n_2} y_i}{\sum_{i=1}^{n_2} r_i}.$$

This provides the framework for how to accommodate complex sample designs that include unequal weighting and clustering, and how to compute standard errors for  $\hat{N}$  and confidence intervals for  $N$ . This is done by replacing the unweighted sample ratio in  $\hat{N}$  by a ratio of survey-weighted estimators, with the weights determined by the sampling design of the access point intercept survey. This properly weighted version of  $\hat{N}$  is readily implemented in commercial or open-source survey software (SAS, R), which can also produce estimates of its variance and associated confidence intervals.

The estimator we propose for estimating number of fish removed is similar to the estimator of population size. First, define  $y_i$  to be the number of red snapper removed (by catch or discard) on trip  $i$ ; and define the auxiliary variable  $x_i = r_i y_i^*$ , where  $y_i^*$  is the number of removals reported on the  $i^{\text{th}}$  trip. If no electronic report was made for trip  $i$ , then  $x_i = 0$ . The total number of fish removed can be estimated consistently as a standard ratio estimator by

$$\hat{t}_y = \sum_{i=1}^N r_i y_i^* \frac{\sum_{i=1}^{n_2} y_i}{\sum_{i=1}^{n_2} r_i y_i^*} \quad .(1)$$

If the sample design is complex, weights need to be included in the sample sum to accommodate the design, and standard software can be used to compute the estimate and its standard error. We have developed two other estimators that are variations of this one that have better properties when reporting rates are low. Because they are more complicated and the reporting rate in Tails 'n Scales is expected to be high, we do not discuss these alternative estimators further here.

The estimator  $\hat{t}_y$  (and its variants) are consistent estimators of the total number of fish removed as long as the validation sample is a probability sample and identification of reported trips is accurate. Note that there is no requirement that the original reporters (in Tails 'n Scales) constitute a representative sample or report accurately for this estimator to be statistically valid, since  $r_i y_i^*$  is used only as auxiliary data to support estimation of  $t_y$ . However, a larger fraction of reporters in Tails 'n Scales and/or greater accuracy of their reports reduce the variability of  $\hat{t}_y$ .

The current sampling design of the access point intercept survey is PPS (probability proportional to size), with the size variable taken to be the observed fishing pressure in the previous year. Pressures are computed separately for 4 time intervals across all sites and for the sites-days, with weekend and weekday treated separately. The assignments are chosen by selecting PPS samples of time intervals and of site-days, which are then combined into specific site-days and times. The idea of using PPS sampling to allocate the sample proportionally to fishing activity is certainly valid, increasing the sampling "yield" in terms of number of interviews and improving the precision of survey estimators. This is also the motivation for using PPS in the Access Point Angler Intercept Survey (APAIS).

However, using observed pressures from the prior year is likely not the best way to implement PPS, for a number of reasons. First, because the pressure is based on a single year of data, it is likely that it represents a "noisy" version of the true long-term fishing pressure at those sites, so that strict proportionality to it does not actually achieve the goal of PPS with respect to the current year's fishing effort. Second, it results in a non-trivial fraction of sites being given zero pressure (and hence zero probability of being selected), which leads to an invalid design if the goal is to represent the full fishery. Third, while PPS is a good design for efficiency reasons, it can lead to sampling weights that are very different between low and high pressure site-days, which can result in estimators that are highly variable. For example, suppose a very low-pressure site-day happens to be sampled and contains an unusually high observation. This can have a large effect on the final estimate due to the very large associated sampling weight. For these reasons, we recommend implementing a PPS design that adjusts the pressures to ensure all sites with potential fishing activity are available for selection, and also sets the pressures in such a way that very extreme differences in weights are avoided. This continues to result in a fully statistically valid design, even if the resulting pressures differ from the historically observed ones.

In order to better control the distribution of the assignments over the population being surveyed, PPS is often combined with stratification. In the case of the red snapper fishery, it might make sense to stratify the site-days by weekend and weekday in addition to assigning them different pressures, and also to stratify by time intervals, to ensure a spread over both the busy and less busy times. This reduces the variance of the estimators and can also help in scheduling of interview assignments.

Regardless of whether the pressures are adjusted based on the above discussion, a sampling design that is used to select access point intercept assignments is a complex sampling design, so that the associated sampling weights need to be used in estimation to ensure statistically valid estimates. In addition, because the intercepted trips are clustered within assignments, the variance estimates need to account for that aspect of the design as well. Both of these aspects are readily handled by standard survey software including the survey-specific routines in R and SAS.

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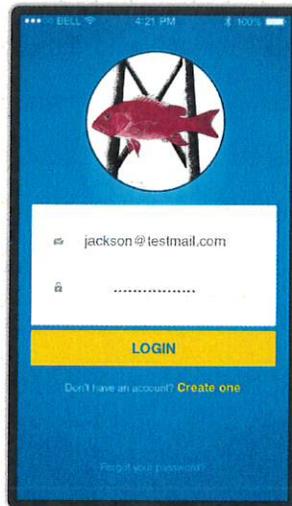
MARINE FISHERIES



**ENHANCE ★ PROTECT ★ CONSERVE**

MANDATORY RED SNAPPER REPORTING PROGRAM

2016 METHODS AND RESULTS



July 2017

## BACKGROUND

Red Snapper is currently one of the most recreationally targeted reef fishes; however, recent declines in the population have led to numerous regulation changes in the Gulf of Mexico. Currently, state and federal seasons for Red Snapper are two of the most anticipated seasons for anglers in Mississippi. With this in mind, the Mississippi Department of Marine Resources (MDMR) has created and enhanced artificial reefs south of the barrier islands in Mississippi territorial waters and adjacent federal waters over the last several years. These artificial reefs have provided important habitats for Red Snapper and ease of access and opportunity for harvest for Mississippi recreational anglers. This increase in participation has led to numerous difficulties gathering catch and effort data from anglers, which will be addressed further in this document.

Table 1: Red Snapper federal season lengths from 2010 to 2017

	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>
<b>Federal Season</b>	77 days	48 days	46 days	42 days	9 days	10 days	11 days	3 days*

\*Initial federal season began on June 1<sup>st</sup> and ended June 3<sup>rd</sup>. However, the recent federal season extension increased the number of days from three to forty-two (including those first three days). The federal extended season began again on June 16<sup>th</sup> allowing private recreational anglers to fish on Fridays, Saturdays, and Sundays only.

The NOAA implemented federal private recreational season changed from 53 days in 2010 to 3 days in 2017. The National Oceanic and Atmospheric Administration's (NOAA) data show that Red Snapper quotas have been exceeded in recent years and as a result, seasons have become shorter giving anglers less access to this fishery (Gulf of Mexico Fishery Management Council 2014, 2015; NOAA Southeast Regional Office, 2013). Historically, MDMR has set the state Red Snapper season to coincide with the federal season, but as the length of the federal fishing seasons has continued to decrease, MDMR implemented a longer state Red Snapper season in 2014. The implementation of the longer season is consistent with other gulf states that also have developed their own Red Snapper state seasons.

Table 2: Red Snapper federal and state fishing season lengths

	2010	2011	2012	2013	2014	2015	2016	2017
<b>Federal Season</b>	77 days	48 days	46 days	42 days	9 days	10 days	11 days	3 days
<b>MS State Season</b>	77 days	48 days	46 days	42 days	27 days	108 days	102 days	102 days
<b>LA State Season</b>	77 days	48 days	46 days	85 days	174 days	142 days	272 days	N/A
<b>AL State Season</b>	77 days	48 days	46 days	42 days	18 days	51 days	66 days	67 days
<b>FL State Season</b>	77 days	48 days	46 days	65 days	52 days	70 days	78 days	78 days
<b>Texas State Season</b>	365 days							

In preparation for the state season, the Commission on Marine Resources (CMR) adopted a regulatory modification to Title 22 Part 9 Rules and Regulations for Statistical Reporting and Confidentiality of Statistical Data for Marine Fisheries in the State of Mississippi, in 2014, in regards to reporting Red Snapper landings in the state of Mississippi. This regulatory modification made it mandatory, beginning in 2015, to report all recreational Red Snapper landings in the state. MDMR recognized the need for more accurate and timely reporting on Red Snapper and developed the Tails n' Scales electronic reporting system so that anglers can conveniently and easily report harvest data from each trip. The Tails n' Scales reporting system was made available online and through a mobile phone application as well as a toll-free number connected to a call center. Accurate estimation of recreational Red Snapper harvest and angler effort is crucial for MDMR and the current Gulf-wide management approach. Accurate estimation of seasonal harvest, including harvest within season, is valuable for fisheries managers to set and adjust fishing regulations. With the implementation of the Tails n' Scales reporting, MDMR is now able to collect Red Snapper data in real-time from Mississippi anglers. With the current interest in an intense regional approach to management, estimation of in-season harvest on a timely basis is of utmost importance in preventing overages and allowing each state and the Gulf entity to stay within its assigned quota.

Mississippi has a unique Red Snapper fishery that presents challenges to collecting accurate and real-time data due to numerous public boat launches and private docks. Anglers using private docks account for almost one third of Red Snapper landed in Mississippi; however, these anglers are not intercepted during routine Marine Recreational Information program (MRIP) surveys. Also, there are numerous public boat launches (coast wide) available to anglers and routine Marine Recreational Information Program (MRIP) surveys are not able to capture an adequate amount of Red Snapper data due to the short season. For instance, in 2015, no MRIP surveys encountered Red Snapper harvested by recreational anglers resulting in an estimate of zero pounds harvested for all recreational anglers in Mississippi. In this same year, Tails n' Scales data indicated that over 70,000 lbs of Red Snapper were harvested in the recreational sector. The MRIP surveys and intercepts work well with capturing data from the inshore fishery and captures some Red Snapper data, but the Tail n' Scales mandatory Red Snapper reporting system allows MDMR to collect data from the majority of recreational Red Snapper anglers in Mississippi. In addition to mandatory reporting, Marine Patrol (law enforcement) has the ability to check anglers on the water in the passes between the barrier islands. The passes create "bottlenecks" for returning vessels and allows for on-the-water intercepts to further enforce mandatory Red Snapper reporting. Marine Patrol also involves a progressive penalty for each transgression, meaning an angler who receives three citations for failing to report Red Snapper trips will result in a substantial fine and the possible suspension of the angler's saltwater fishing license for one year. These efforts, combined with the Tails n' Scales reporting system have allowed MDMR to vastly improve its database by defining a universe of anglers and allowing for an accurate number of Red Snapper landed in Mississippi to be documented. The following sections of this document outline a summary of results from the 2015 and 2016 seasons and methods used to obtain the results.

## METHODS

### A. Reporting

All recreational vessels (private and for-hire) landing Red Snapper in Mississippi are required to use the Tails n' Scales electronic reporting system regardless of harvest area (Federal waters, Mississippi state waters, adjacent states' waters, etc.). There are no exemptions. One angler per

vessel per trip is required to possess an authorization number from the reporting system when targeting Red Snapper. One unique aspect of Mississippi's reporting system is the requirement that anglers must apply for an authorization number prior to fishing for Red Snapper. Anglers can apply for the number up to five days before starting their trip; however, they can also apply for the number minutes before beginning their trip. Requiring an authorization number prior to fishing has many useful purposes including validation of the daily number of vessels fishing, as a float plan for safety purposes and assistance to law enforcement.

MDMR promoted the system, at the beginning of 2015, the first year of the mandatory Tails n' Scales reporting program, posting signs and banners next to boat ramps, in marinas, and passed out business cards detailing where and how to download the mobile application, reporting requirements, and the toll-free number. Tails n' Scales was also publicized through press releases, on the MDMR website, and on social media and Mississippi anglers were informed of the reporting requirements at local fishing meetings (Gulf Fishing Banks, Coastal Conservation Association, and Ocean Springs Fly Fishing Club). Signs and banners are replaced at the boat ramps and marinas prior to the start of each year's Red Snapper season. MDMR continues to publicize Tails n' Scales on social media and remind anglers of the reporting requirements through email notifications and various news outlets. In 2016, more attention was placed on anglers living outside the three coastal counties to disseminate information on the reporting requirements due to feedback received in 2015 from those anglers unaware of the need to report their Red Snapper harvest.

#### Reporting Options:

MDMR wanted to make the electronic reporting system as user-friendly and easily accessible as possible so that it would take only a few minutes for anglers to record their trip information. Generally, the more questions a survey has and the longer a survey takes, the less likely anglers are to report. With those two thoughts in mind, MDMR gave anglers three methods to report their trip information assuring even anglers without smartphones or access to email would have a way to report. To properly obtain a trip authorization number, one representative from each vessel must create a trip in the reporting system prior to fishing. Trip authorization numbers are valid for 24 hours from the time of trip departure and must to be closed out each time before a new trip number is issued. Trips can only be created up to five days in advance. Registration,

obtaining trip authorization numbers, and reporting harvest can be done using one of three methods: through the Tails n' Scales mobile applications, (available on both iPhone and Android devices), online at [www.tailsnscales.org](http://www.tailsnscales.org), and by phone through the toll-free number (1-844-MSSNAPP).

The toll-free number directly connects users to a call center available 24 hours a day, seven days a week. The decision was made in 2015 to use live agents rather than an interactive voice response system so that anglers would be more likely to give their trip information. Call agents have access to a special profile within the system that grants them access only to reset passwords. Otherwise, they use the angler's own profile to create and close trips. The toll-free number can be used to register, create new trips and close out trips. In the event that a user does not have an email account or does not have access to the Tails n' Scales electronic reporting system online or on a mobile device, the toll-free number is always accessible; however, MDMR encourages anglers to use the free downloadable app or visit the website to proceed through the reporting process. If any users of the Tails n' Scales program have questions or concerns regarding reporting, MDMR has created and maintained an email specifically for anglers to comment on or ask questions regarding Red Snapper reporting.

To register in the Tails n' Scales system, users are required to provide their first and last name, a valid email, phone number, home address, and either the vessel's state registration number or the U.S. Coast Guard vessel documentation number. Vessel type (private or for-hire) must be indicated and a vessel name provided if applicable. Users are not allowed to complete registration until all required fields are completed. Once registered, users are allowed to use more than one method to create and complete trips. In 2016, email verification was added to the reporting system in order to validate emails used to log in. Due to the modification, users must now register in the system then verify their account through an email that confirms the status of their email account as valid.

If a trip is created that has been rescheduled or cancelled, the user must abandon that trip and provide a reason code. Anglers cannot create a new trip number until the current trip is abandoned and a reason provided. This allows administrators to maintain a closed trip universe whereby anglers are forced to report their trip before starting a new one.

All questions pertaining to closing a trip in the system are required to be answered: the amount

of time spent fishing for Red Snapper to the nearest half hour, the number of people fishing on the vessel, the number of Red Snapper harvested, and the habitat where the majority of time is spent fishing. The addition of the number of Red Snapper discards was added as a requirement to the close trip process in 2016.

The reporting system is housed on a secured server which stores all data. These data are then exported into analyzing software for analyses. The flow of data, data access, and user interaction is restricted at each level of the process depending on user group (angler, call center staff, administrator, and Marine Patrol) (Figure 1).

There are multiple parts to the Tails n' Scales system based on the user type and purpose. MDMR project managers have administrative access and the ability to see all information about all past, present, and pending trips and update or change any personal or trip information. Marine Patrol may access only those trips that are marked as active for that day; when approached by Marine Patrol, trip numbers are checked against the reporting system database for that day. The call center connected to the 1-844-MSSNAPP number, has access to users' names and emails so that the call agent may verify the user calling before helping the user with their question. Call agents have the ability to reset passwords should the user not remember the information to log in to their account. Anglers only have access to their own personal trip information, which includes archived trip data from previous years.

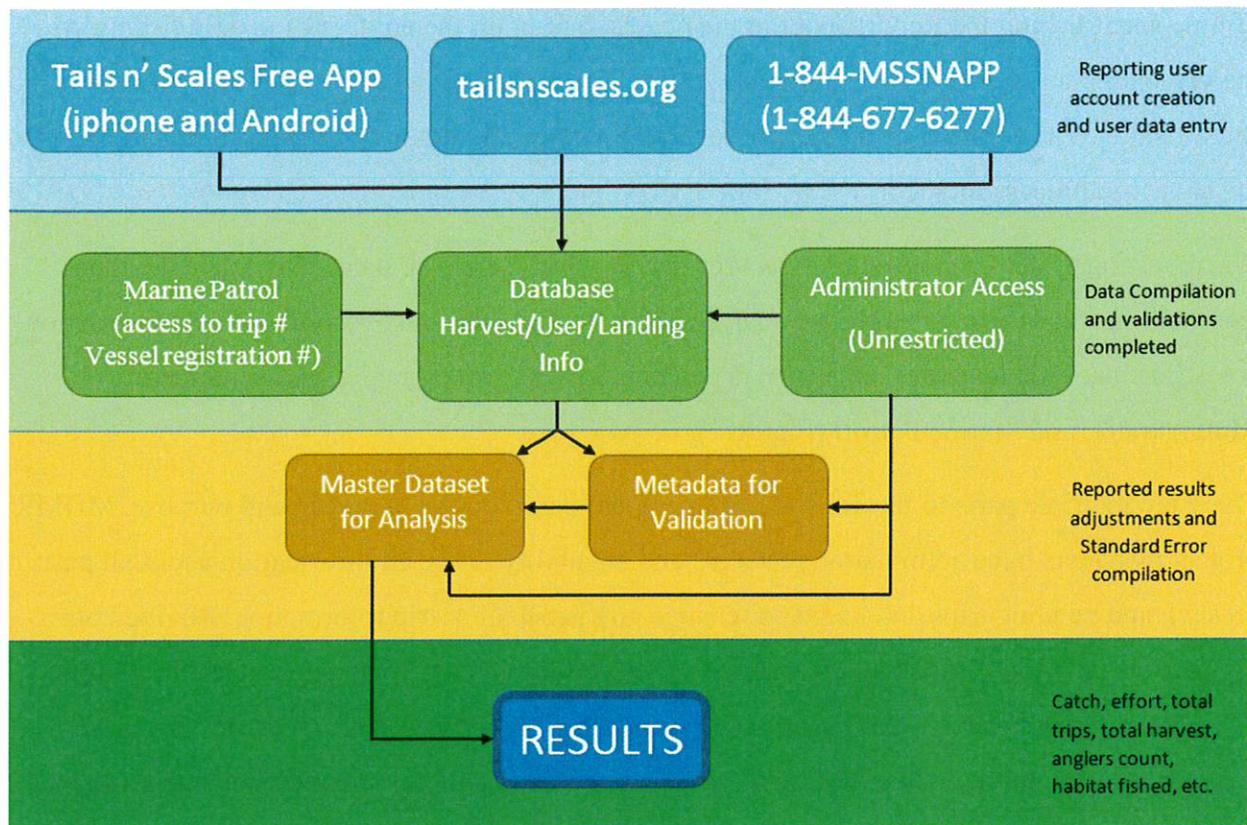


Figure 1: Flow chart illustrating user interaction and data flow through the reporting system.

## B. Validations

Validations have been conducted using two different methods; however, only the first method is currently used to validate trips before applying the estimator. The second method is simply supplemental now and used to maintain expired trips at less than five percent of total trips each year. Access point intercept survey validations were completed to gather bio-sampling data (fish lengths, weights and otoliths), and phone validations were used to determine non-reporting, under- and over-reporting as well. The access point intercept survey information provided the inputs for validation and adjustment analyses (correction factors) for all user groups (private and for-hire) and seasons (federal and state) involving Red Snapper. Similar to MRIP surveys, validations and adjustment analyses for all user groups and seasons were split into six waves, each wave being a period of two months.

### 1. Access Point Intercept Survey Validations

To conduct access point intercept survey validations, a site pressure analysis was performed to select assignment times and locations accounting for pressures (high or low

vessel traffic) at public boat ramps along the Mississippi coast. For 2016, all sites with the potential to have boats launch that may fish for Red Snapper were included in the site list. Trip data from 2015 and 2016 were combined to determine each site's pressure value. Four, six-hour time blocks were created for survey time assignments (2 a.m.-8 a.m., 8 a.m.-2 p.m., 2 p.m.-8 p.m., and 8 p.m.-2 a.m.). Weekday and weekend assignment locations and times were randomly assigned from a pressure frequency distribution acquired from the created trips in the Tails n' Scales database (Figure 2A and B). Overall, assignment selection was performed for both site locations and time blocks by calculating the cumulative combined pressures and multiplying by 100.

The number of trips per site were totaled for each site to get a combined value of total trips. These values were calculated separately for weekday and weekends and were the beginning values for each site's pressure. For sites with no fishing pressure, meaning no trips were recorded as leaving from that site, they were given an initial pressure value of 0.5. A percent abundance was calculated by dividing each site pressure value by the total number of site pressure values and multiplying by 100. Then each site's pressure became the product produced for the site pressure value and added to the previous site's combined pressure (Table 3A and B). Numbers created using a random number generator in R<sup>®</sup> statistical software (setRNG package) were then used for assignment selection. During the first year of the program (2015), the reported pressure values were created using the distributions of launch locations and ramp arrival times reported from the first weekday and first weekend day of the season. The combination of values from years 2015 and 2016 provided a larger data pool of weekday and weekend distributions to assign pressure values for both location and time. If a time block or site was randomly selected twice, it was assumed a high-pressure instance and two surveyors were assigned to that particular assignment time.

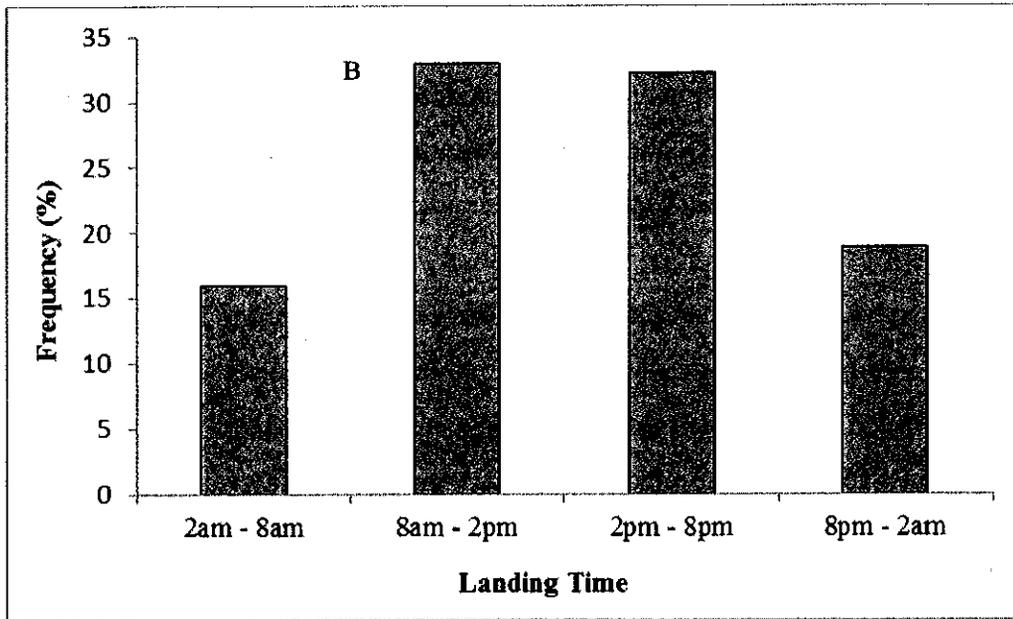
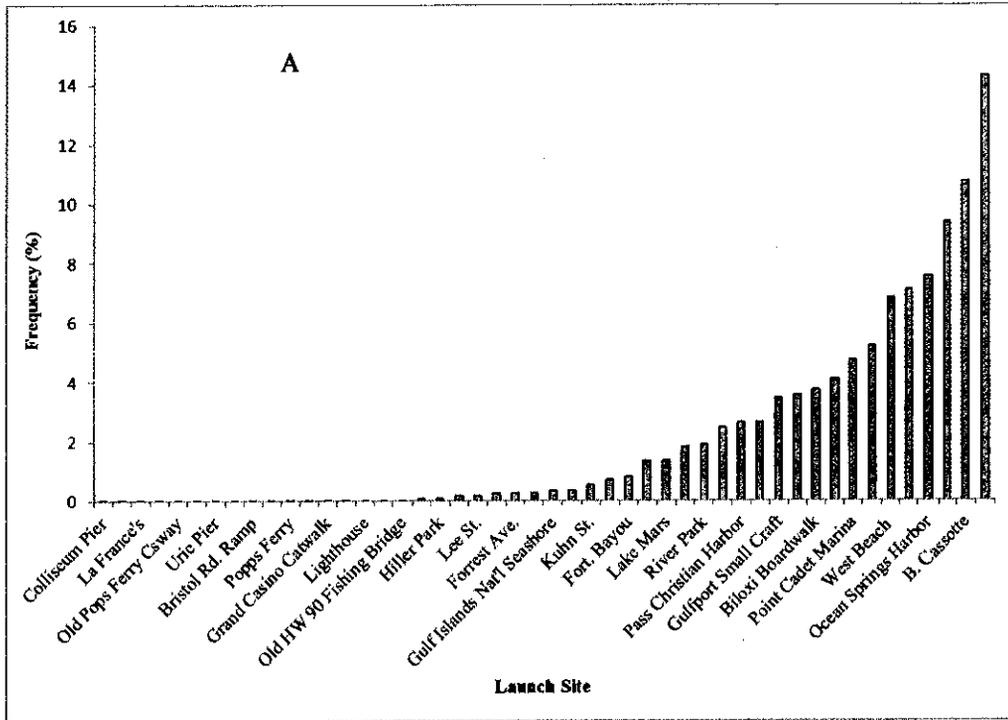


Figure 2: (A) Site pressure values using 2015 and 2016 weekday reported data. (B) Time pressure values using 2015 and 2016 weekday reported data. Site and time pressure values for weekend days were calculated using the same method. Subsequent years will use all past reported pressure values split by ramp and day type.

Table 3A: Site pressure summary value ranges for the combined federal and state Red Snapper seasons using 2015 and 2016 weekday reported data. Weekend site pressure values were calculated the same way using only trip data reported from weekend days.

Site	Pressure Value	Cumulative Combined Pressure	Pressure Range
Coliseum Pier	0.5	5	1-5
Kremer Marine	0.5	10	6-10
La France's	0.5	14	11-14
Little Joe's	0.5	19	15-19
Old Pops Ferry Causeway	0.5	23	20-23
Pearlington Ramp	0.5	28	23-28
Urie Pier	0.5	32	29-32
Cedar Point	0.5	37	33-37
Bristol Rd. Ramp	0.5	42	39-42
GCRL	0.5	46	43-46
Popp's Ferry	0.5	51	47-51
Washington Street Ramp	0.5	55	52-55
Grand Casino Catwalk	0.5	60	56-60
8-Mile	0.5	64	57-64
Lighthouse	0.5	69	65-69
Broadwater Beach Marina	0.5	73	70-73
Old Hwy 90 Fishing Bridge	0.5	78	74-78
Parkers Creek Ramp	1	87	79-87
Hiller Park	1	96	88-96
Choctaw Marina	2	114	97-114
Lee St.	2	133	115-133
Bayou. Caddy	3	160	134-160
Forrest Ave.	3	187	161-187
Gulfport Lake	3	215	188-215
Gulf Islands Nat'l Seashore	4	251	216-251
Bay St. Louis Harbor	4	288	252-288
Kuhn St.	6	342	289-342
Courthouse Rd Ramp	8	415	343-415
Fort. Bayou	9	498	416-498
Gautier City Park	15	634	499-634
Lake Mars	15	771	635-771
Keesler Marina	20	954	772-954
River Park	21	1145	955-1145
Brittany Ave.	27	1391	1146-1391
Pass Christian Harbor	29	1656	1392-1656
Long Beach Harbor	29	1920	1657-1920
Gulfport Small Craft	38	2267	1921-2267

D'Iberville Ramp	39	2622	2268-2622
Biloxi Boardwalk	41	2996	2623-2996
Graveline	45	3407	2997-3407
Point Cadet Marina	52	3881	3408-3881
Hwy 90 Pascagoula	57	4401	3882-4401
West Beach	75	5085	4402-5085
Mary Walker Marina	78	5796	5086-5796
Ocean Springs Harbor	83	6553	5797-6553
Pascagoula Lighthouse	103	7493	6554-7493
Bayou Cassotte	118	8569	7494-8569
Biloxi Small Craft	157	10000	8570-10000

Table 3B: Time pressure summary value ranges for the combined federal and state Red Snapper seasons using 2015 and 2016 reported data. Weekend time pressure values were calculated the same way using only trip data reported from weekend days.

Day	Time Block	Cumulative Combined Pressure	Pressure Range
Weekday	0200-0800	798	1-798
Weekday	2000-0200	1740	799-1740
Weekday	1400-2000	3352	1741-3352
Weekday	0800-1400	5000	3353-5000

MDMR staff approaches all boats landing at the designated site. After initial contact and introduction, the surveyor inquires if they have targeted Red Snapper during their trip. Anglers in vessels that have targeted Red Snapper are asked a series of questions for validation purposes; if the vessel has a valid authorization number and if so, the number is recorded by the surveyor, vessel registration number, habitat type fished (artificial reef, natural bottom, oil/gas platform), number of Red Snapper kept, number of Red Snapper released, number of anglers, hours fished, and trip type (private/for-hire).

During the 2016 state season, survey validation was the same as the federal season excluding the location and time assignments. Because of the staffing constraint of multiple projects, the Recreational Information Program's (MRIP) Access Point Angler Intercept Survey (APAIS) was used to assign times and locations (APAIS Methods and Techniques Manual 2014).

## 2. *Phone Validations*

Telephone validation interviews were performed by MDMR staff. Within the first two seasons (2015 and 2016), all expired trips were contacted by staff and verified by an MDMR employee closing out the expired trip for the angler. This violates the independence assumption of the capture/recapture method but was done only to show the functionality of the estimator equations; however, from this point forward these trips will be excluded from the estimator. Each year, no more than 5% of the expired trips remain after the season ends. Expired trips do not reset at the end of each season. Anglers with expired trips at the end of one season will not be allowed to fish the following season until their trip has been closed. All questions answered in the reporting system (listed in Section A) are verified by the staff caller.

## C. Biosampling

To acquire biological data, MDMR staff conducting the validation interviews requests permission from the angler to measure all Red Snapper landed. Data collected includes weights (g) and lengths (FL, TL in mm) as well as collection of sagittal otoliths. These data are used for calculating the mean weights, lengths and ages for landings estimations and for future stock assessment inputs. Additional methods can be found in MDMR's biological processors methodology report (NOAA-NMFS-SE Interjurisdictional Fisheries Report 2013-2003494).

#### D. Anglers, Trip, and Fish Harvest Estimator

To estimate the number of anglers, trips, and fish harvested in Mississippi, data are split into waves similar to the MRIP framework. For each wave, the data are then split into the recreational and for-hire sectors, as we assume the compliance rate may differ between the two sectors. Validations in the form of intercepts are then input along with ramp pressure into a capture-recapture estimator. The capture/recapture method was chosen as it was assumed that inputs were independent. The estimator used is ( $i$  = intercept),

$$\hat{N}_{yc} = N_{y*} \frac{\sum_{i \in S_2} w_i y_i}{\sum_{i \in S_2} w_i r_i y_i^*}$$

Where  $\hat{N}_{yc}$  is the number caught and is estimated by calculating the number reported ( $N_y$ ) and multiplying that by a correction factor which includes the sum of correct and incorrect intercepts as well as individual weights based on ramp pressure ( $\frac{\sum_{i \in S_2} w_i y_i}{\sum_{i \in S_2} w_i r_i y_i^*}$ ). Because multiple ramps contain zero intercepts, a mean correction factor calculated from wave specific data is used to estimate the total number harvested. This correction assumes that no one ramp will have a 100% compliance rate, so an estimated correction has to be used. Individual standard error, by wave, is calculated and summed to yield total standard error, as propagating uncertainty of a sum is additive. To calculate total biomass harvested, wave-specific mean total weights for each sector are calculated based on MRIP and Tails n' Scales intercept surveys to ensure the most accurate biomass estimates possible.

### RESULTS

For the purposes of this document, 2016 was the first full year with all validation methods implemented that were discussed in the Tails n' Scales program review (Breidt et al. 2016). Therefore, results presented here include 2016 data only. At the end of the 2016 recreational Red Snapper season, only waves two and three had validations available in intercept form, so the empirical data gathered in these waves were used to estimate totals for all other waves (Table 4A). The for-hire sector only had trip data available during the federal for-hire season, with the exception of one state for-hire trip during wave three (Table 4B).

Table 4. Total reported and estimated fish harvested, trips, and anglers for both the A.) Recreational and B.) For-hire sectors by wave.

A.

Wave #	Reported Fish	Estimated Fish	Reported Trips	Estimated Trips	Reported Anglers	Estimated Anglers
1	127	160	28	32	91	124
2	113	142	23	26	75	102
3	6065	8056	1121	1152	4295	4823
4	2991	3589	673	673	2387	3254
5	207	261	72	82	211	287
6	30	38	7	8	20	27

B.

Wave #	Reported Fish	Estimated Fish	Reported Trips	Estimated Trips	Reported Anglers	Estimated Anglers
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	1254	1263	112	118	728	732
4	864	930	83	89	548	602
5	16	16	2	2	8	8
6	0	0	0	0	0	0

As expected, the largest numbers of trips were observed during waves three and four, as these waves encompassed both the federal and state red snapper seasons. Minimal harvest was observed in waves one, two, and six from anglers fishing in Louisiana waters and landing their catch in Mississippi. Estimated biomass harvested was derived from the total estimated fish caught multiplied by the wave-specific average weights gathered from intercept data. The total harvest was calculated at 95,272.374 pounds of Red Snapper (Table 6). A PSE of 11.23% was estimated for the biomass harvested.

Table 6. Estimated harvested biomass of Red Snapper landed in Mississippi in 2016

Wave	Recreational	For-Hire
1	1,084.936	0
2	965.336	0
3	54,628.178	6,665.167
4	24,335.232	6,250.022
5	1,498.400	43.820
6	256.284	0
Total	82,768.365	12,959.009
<b>MS 2016 Total Harvest (lbs)</b>		<b>95,727.374 (PSE = 11.23)</b>

### 2017 SYSTEM UPDATES AND FUTURE DATA NEEDS

As described in the sections above, the data gathered in previous years were reanalyzed based upon the recommendations of NOAA staff and survey consultants who have thoroughly reviewed the program and provided helpful and informative feedback (Breidt et al. 2016). MDMR has directed staff during the 2017 Red Snapper season to gather the proper data needed to continue to increase the efficiency and validity of the Tails n' Scales program.

Prior to the 2017 season opening, Tails n' Scales developers modified the mobile application and web portal screens to reduce the number of sites in the landing sites list by first having the angler choose the county in which they will land their fish. Once the county is chosen, the reporting system lists only the landing sites within that county. Although this adds an additional question to the survey when anglers are creating their trip, the implementation of choosing the county before choosing the landing site may increase the number of accurate responses. Anglers may be less likely to choose the first few sites on the screen rather than scroll through the list of sites.

Because the estimator is based on a capture-recapture method and validations used in the estimator are data captured from intercepts, MDMR has directed staff to increase the number of dockside intercepts during the 2017 season as much as time, weather and staff availability permits. Due to the initially short federal season, Tails n' Scales intercepts were scheduled to extend throughout the state season and will now be modified to intercept recreational Red Snapper anglers on weekends until the end of the extended federal season on September 4<sup>th</sup>.

However, dockside intercept surveys are a validation method that requires ample time and staffing; therefore, due to potential staff constraints and overlap with other agency programs, supplemental data is still being gathered through on-the-water and airplane observations as they are still considered worthwhile to continue collecting.

One uncertainty that still exists within the recreational Red Snapper universe is the determination of differences between public and private access angling trips. The Tails n' Scales system provides an opportunity to collect the data necessary to lower this uncertainty. To help determine whether the reporting compliance rates and catch rates differ between public and private access sites, MDMR staff has been working closely with Marine Patrol to conduct on-the-water intercepts. Ideally, Marine Patrol will be able to gather enough intercept data to produce a reasonable estimate of compliance. Combined with data from public access point Tails n' Scales intercepts, an estimate can be made for the compliance rate of private access anglers. In addition, MDMR staff is currently acquiring information to schedule samples by appointment, allowing staff the means to validate trip information and collect biological data from private anglers' harvested Red Snapper. To test the feasibility of this portion of the reporting program, the anglers interviewed will be preselected; however, MDMR staff hopes to extend this sampling process to a randomly selected sample of private access anglers.

Considering the data collected through the Tails n' Scales reporting program and its future progression, MDMR is confident the data being collected accurately estimates recreational Red Snapper landings in Mississippi. MDMR is confident in the ability of Tails n' Scales to collect pertinent information on Mississippi recreational Red Snapper anglers and their harvest to provide accurate and timely data for future stock assessments and ensure the continuation of best fishery management practices.

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MISSISSIPPI DEPARTMENT OF MARINE RESOURCES

MARINE FISHERIES



**ENHANCE ★ PROTECT ★ CONSERVE**

MANDATORY RED SNAPPER REPORTING PROGRAM

2015 METHODS AND RESULTS



APRIL 2016

## BACKGROUND/PURPOSE

Red Snapper is currently one of the Gulf of Mexico's most important recreationally targeted fishes. Accurate and timely estimation of recreational Red Snapper harvest and angler effort is crucial for the current Gulf-wide management plan. The current management of Red Snapper includes a derby style Federal season with multiple and highly variable state seasons. Accurate estimation of seasonal harvest as well as harvest within season is valuable for fisheries managers to set and adjust fishing restrictions. With the current interest in regional management, estimation of in-season harvest on a timelier basis would be of utmost importance in preventing overages allowing each state and the Gulf as a whole stay within its allocated quota.

## METHODS

### A. Reporting

On October 21, 2014 the Commission of Marine Resources adopted a regulatory modification to Title 22 Part 9 enacting the reporting and confidentiality of Red Snapper landings in the state of Mississippi. On April 7, 2015 The Mississippi Department of Marine Resources (MDMR) partnered with a software developer to design a mobile application to record all Red Snapper landings in Mississippi. The goal of the mobile App design was to provide an easily accessible and intuitive system to enable Red Snapper private and for-hire anglers to report their Red Snapper landings in real time.

All vessels (private and for-hire) landing Red Snapper in Mississippi were required to use the Tails n' Scales electronic reporting system regardless of harvest area (Federal waters, Mississippi state waters, adjacent states' waters, etc.). There were no exemptions. One angler per vessel was required to possess a trip number from the reporting system when targeting Red Snapper. When approached by law enforcement trip numbers were checked with the reporting system database for that day.

To promote the Tails n' Scales reporting system, MDMR employees posted signs and banners next to boat ramps and in marinas and passed out business cards detailing where and how to download the app, reporting requirements and the toll-free number. Tails n' Scales was also publicized on social media and Mississippi anglers were informed of the reporting requirements

at local fishing meetings (Gulf Fishing Banks, Coastal Conservation Association, and Ocean Springs Fly Fishing Club).

MDMR required one report per trip per vessel. A trip authorization number had to be obtained by a representative of each vessel prior to fishing. Trip authorization numbers were valid for 24 hours only and had to be closed out each time before a new trip number was issued. Trips could only be created up to five days in advance. Registration, obtaining trip authorization numbers, and reporting harvest could be done using one of three methods: through the Tails n' Scales mobile applications, available on both iPhone and Android devices, online at [www.tailsnscales.org](http://www.tailsnscales.org), and by phone through the toll-free number (1-844-MSSNAPP).

The toll-free number directly connected users to a call center available 24 hours a day, seven days a week. The number could be used to register, create new trips and close out trips. In the event that a user did not have an email account or did not have access to the Tails n' Scales electronic reporting system online or on a mobile device, the toll-free number was always accessible. However, MDMR highly encouraged using the free downloadable app and/or visiting the website for the reporting process. If any users of the Tails n' Scales program had questions or concerns regarding reporting, MDMR created and maintained an email specifically for Red Snapper reporting.

To register in the Tails n' Scales system, users were required to provide first and last name, a valid email, phone number and home address and either the vessel's state registration number or the U.S. Coast Guard vessel documentation number. Vessel type (private or for-hire) had to be indicated and a vessel name provided if applicable. Users were not allowed to complete registration until all required fields were completed. Once registered, users could use more than one method to create and complete trips.

If a trip was created that was rescheduled or cancelled, the user had to abandon that trip and provide a reason code. Anglers could not create new trip numbers until the current trip was abandoned and a reason provided. This allowed administrators to maintain a closed trip universe whereby anglers were forced to report their trip before starting a new one.

All questions pertaining to closing a trip in the system were required to be answered: the amount of time spent fishing to the nearest half hour, the number of people who fished on the vessel, the

number of Red Snapper harvested, and the habitat where the majority of time was spent fishing. Anglers only had access to their own account and trip information and MDMR project managers had administrative access and the ability to update or change any personal or trip information.

The reporting system was housed on a secured server which stores all data. These data were then exported into analyzing software for analyses. The flow of data, data access and user interaction was restricted at each level of the process depending on user group (angler, call center staff, administrator and law enforcement) (Figure 1).

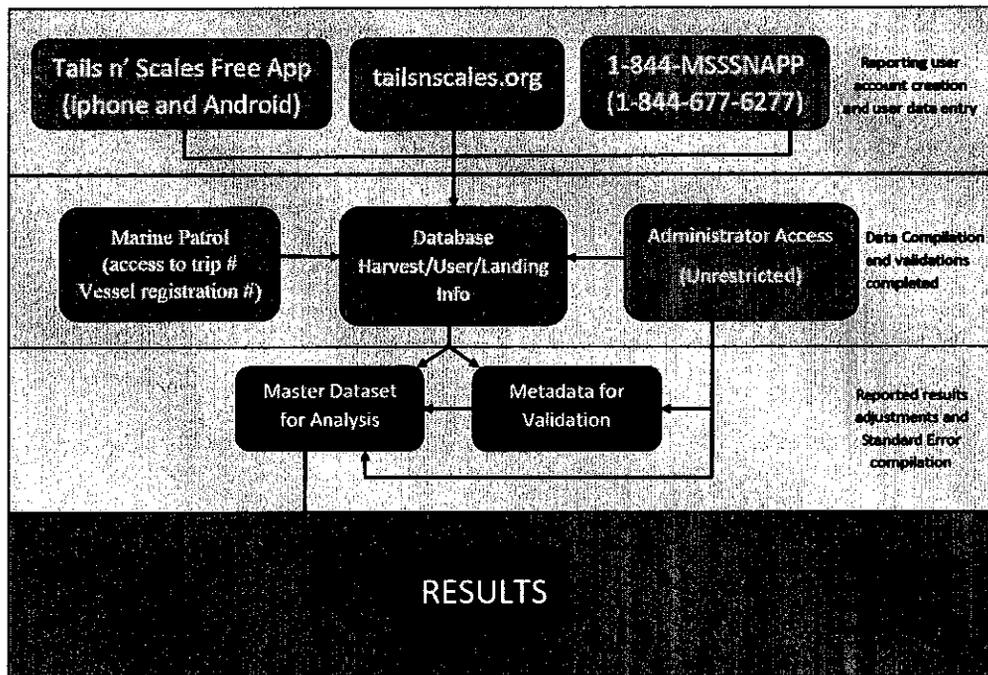


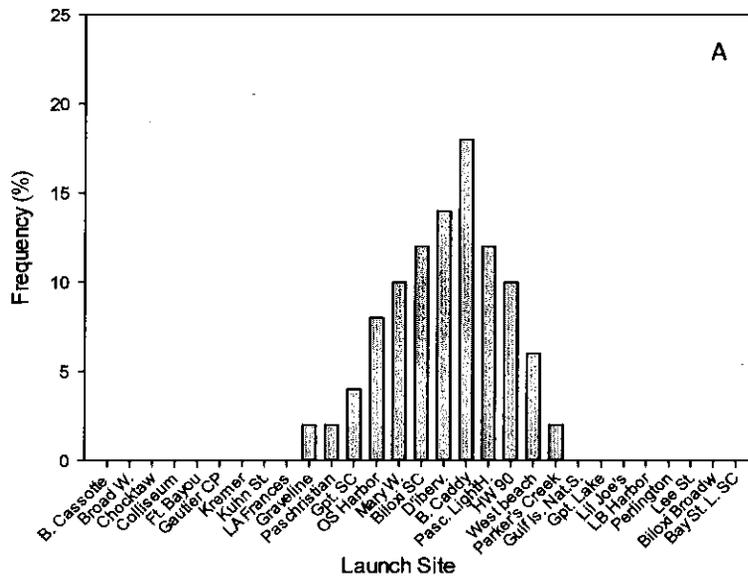
Figure 1: Flow chart illustrating user interaction and data flow through the reporting system.

### B. Validation

Validations were conducted using three different methods. (1) Access point intercept survey validations, (2) visual effort validations, and (3) phone validations were completed to determine non-reporting, under- and over-reporting as well as to gather bio-sampling data (fish lengths, weights and otoliths). This information provided the inputs for validation and adjustment analyses (correction factors) for all user groups (private and for-hire) and seasons (federal and state) involving Red Snapper.

1) Access Point Intercept Survey Validations

To conduct access point intercept survey validations a site pressure analysis was performed to select assignment times and locations accounting for pressures (high or low vessel traffic) at public boat ramps on the Mississippi coast. Four, six hour time blocks were created for survey time assignments (2 a.m.-8 a.m., 8 a.m.-2 p.m., 2 p.m.-8 p.m., 8 p.m.-2 a.m.). Weekday and weekend assignment locations and times were randomly assigned from a pressure frequency distribution acquired from the created trips in the Tails n' Scales database (Figure 2A&B). Assignment selection was performed for both site locations and time blocks by calculating the cumulative combined pressures and 100. The beginning value for each site's pressure was the product produced for the site and added to the previous site's combined pressure (Table 1A&B). Numbers created using a random number generator in R<sup>®</sup> statistical software (setRNG package) were then used for assignment selection. During the first year of the program (2015), the reported pressure values were created using the distributions of launch locations and ramp arrival times reported from the first weekday and first weekend day of the season. Subsequent years will have a larger data pool of weekday and weekend distributions to assign pressure values for both location and time. If a time block or site was randomly selected twice, it was assumed a high pressure instance and two surveyors were assigned to that particular assignment time.



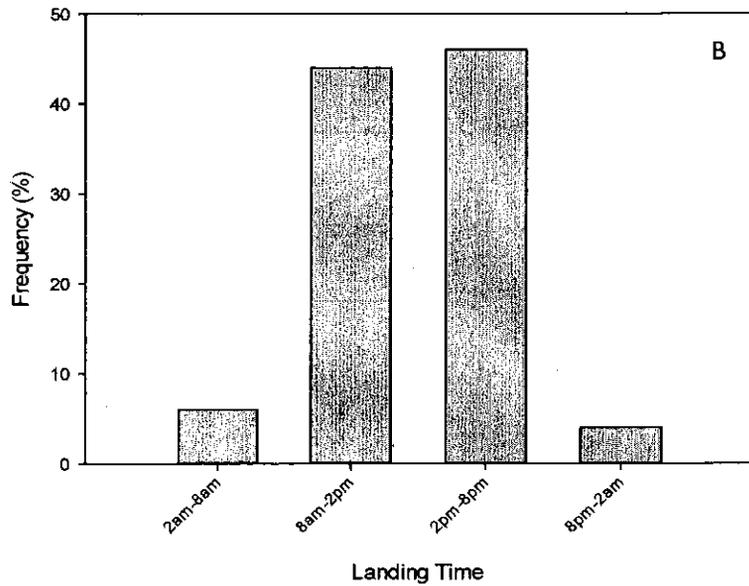


Figure 2: (A) Site pressure values using 2015 weekday reported data. (B) Time pressure values using 2015 weekday reported data. Subsequent years will use all past reported pressure values by mode.

Table 1A: Example of site pressure summary value ranges for the federal Red Snapper season using 2015 weekday reported data.

Mode	Day	Site	Pressure	Cumulative Combined Pressure	Pressure Range
Private	Weekday	B. Caddy	18	18	1-1800
Private	Weekday	B. Cassotte	0	18	
Private	Weekday	Bay St. L. S.C.	0	18	
Private	Weekday	D'iberville	14	32	1801-3200
Private	Weekday	Biloxi BroadW.	0	32	
Private	Weekday	Biloxi S.C.	12	44	3201-4400
Private	Weekday	Gpt. Lake	0	44	
Private	Weekday	Gpt. S.C.	4	48	4401-4800
Private	Weekday	Graveline	2	50	4801-5000
Private	Weekday	Gulf Is. Nat. S.	0	50	
Private	Weekday	H.W. 90	10	60	5001-6000
Private	Weekday	Kremer	0	60	
Private	Weekday	Lil Joe's	0	60	
Private	Weekday	Mary W.	10	70	6001-7000
Private	Weekday	O.S. Harbor	8	78	7001-7800
Private	Weekday	Parker's Creek	2	80	7801-8000
Private	Weekday	Pasc. Light H.	12	92	8001-9200
Private	Weekday	PasChristian	2	94	9201-9400
Private	Weekday	Pearlington	0	94	
Private	Weekday	Lee St.	0	94	
Private	Weekday	West Beach	6	100	9401-10000

Table1B: Example of time pressure summary value ranges for the federal Red Snapper season using 2015 first day reported data. Subsequent years will use all past reported pressure values by mode.

Mode	Day	Time Block	Pressure	Cumulative Combined Pressure	Pressure Range
Private	Weekday	0200-0800	3	3	1-300
Private	Weekday	0800-1400	22	25	301-2500
Private	Weekday	1400-2000	23	48	2501-4800
Private	Weekday	2000-0200	2	50	4801-5000

MDMR staff interviewers approached all boats landing at the designed site. After initial contact and introduction, the surveyor inquired if anyone on board were anglers and if they had targeted Red Snapper during their trip. Anglers in vessels that had targeted Red Snapper were asked a series of questions for report validation purposes; vessel registration number, habitat type (artificial reef, natural bottom, oil/gas platform), number of anglers, hours fished and trip type (private/for-hire).

During the state season, survey validation was the same as the federal season excluding the location and time assignments. Because of the staffing constraint of multiple projects, the Recreational Information Program's (MRIP) Access Point Angler Intercept Survey (APAIS) was used to assign times and locations (APAIS Methods and Techniques Manual 2014).

2) Visual Effort Validations

Visual validations were conducted to verify vessels offshore targeting Red Snapper. This was exclusively performed during the Federal Red Snapper season because it was assumed that Red Snapper angler effort could only be estimated from vessels present offshore during a derby style season (federal season). During additional seasons (state) the assumptions of targeting Red Snapper cannot be made because of the ability of anglers to target additional species offshore.

Visual observations were completed by two vehicles (aircraft and MDMR vessel) which were used to cover different areas to avoid overlapping vessel counts. For logistical reasons the vessel departed at approximately 0800 hrs. and returned approximately 1700 hrs. The route was subject to change because of weather conditions.

The Civil Air Patrol (CAP), a volunteer organization chartered and funded by Congress with Air Force oversight, was used to fly aircraft reconnaissance missions. This group of professionals was able to meet the MDMR's aerial request on short notice and at a low cost. Observer personnel from the MDMR were onboard the CAP aircraft for each flight. Planes left from Gulfport/Biloxi Regional Airport and maintained an altitude of 1000 feet which allowed MDMR observers to easily record the required information. The flight path covered all of Mississippi's offshore artificial reef sites within the state's territorial waters (Figure 3). The flight sight range was limited to an area no greater than 60 miles past the barrier islands. For areas south of the aircrafts range, vessel counts were completed by a MDMR offshore vessel. Personnel visually inspected off-shore artificial reefs and oil and gas production platforms within the designated area. Staff counted the number of vessels at each location, recorded the GPS coordinates, and verified the state of registration for each vessel encountered as well as the number of anglers aboard each vessel.



Figure 3: An example of a vessel/flight path during a Red Snapper Federal season visual survey (yellow dots are fishing vessels spotted by the aircraft and red dots are fishing vessels spotted by the MDMR vessel).

### 3) Phone Validations

Telephone validation interviews were performed MDMR staff. Within the first season (2015), all expired trips were contacted by staff and verified by an MDMR employee closing out the expired trip for the angler. This violates the independence assumption of the capture/recapture method but was done only to show the functionality of the estimator equations. In future seasons, 10% of the reported trips within each user group (private/for-hire/federal season/state season/weekday/weekend) will be randomly selected by using the same random number generator in R<sup>®</sup> statistical software (setRNG package) that was used in the intercept time and location selection. An extended calling list will be created for each user group and staff will be instructed to call the list in order until 10% of the entire group has been contacted and their trips verified. These contact interviews validate the reported data created by the user when the trip is closed out. All questions answered in the reporting system (listed in Section A) will be verified by the staff caller.

### C. Biosampling

To acquire biological data, MDMR staff conducting the validation interviews asked permission to measure all Red Snapper landed. Data collected included weights (g) and lengths (SL, FL, TL mm) as well as sagatille otolith collection. These data were used for calculating the mean weights, lengths and ages for landings estimations as well as for future stock assessment inputs. Additional methods can be found in MDMR's biological processors methodology report (NOAA-NMFS-SE Interjurisdictional Fisheries Report 2013-2003494).

### D. Angler Population, Trip, and Fish Harvest Estimators

Estimating angler participation, trip number and fish harvest was done through a capture/recapture method because it was assumed that both inputs were independent. This was completed using two different methods from which the first [1] is a simple estimator that takes the reported values and multiplies the sum by the quotient of the intercepted values and the correct intercepted values. The second estimator [2] was similar in structure with the summation of the three validation techniques along with the product of the weighted values for each of the three validations. The ratio estimator ( $\hat{N}$ ) was defined as the reported values multiplied by the quotient of the validated values and the correct validated values. This was identified as  $r_i=1$  if the  $i^{\text{th}}$  unit being the number of reporting and  $r_i = 0$  if not reporting, and  $y_i=1$  for every unit in the

resampled population. Within the validated groups, there were three different validation inputs described in section B ( $i$  = intercept,  $v$  = vehicle, and  $p$  = phone intercept).

$$\hat{N} = \sum_{i=1}^N ri \left( \frac{\sum_{i=1}^{n2} yi}{\sum_{i=1}^{n2} ri} \right) \quad [1]$$

$$\hat{N} = \sum_{i=1}^N ri \left( \frac{\sum_{i=1}^{n2} yi(i)(wi) + \sum_{i=1}^{n2} yi(v)(wv) + \sum_{i=1}^{n2} yi(p)(wp)}{\sum_{i=1}^{n2} ri(ci)(wi) + \sum_{i=1}^{n2} ri(cv)(wv) + \sum_{i=1}^{n2} ri(cp)(wp)} \right) \quad [2]$$

Because the three validation methods were different and independent, a weighting variable was added to each validation. Weighting values for each validation method were determined by using a quantitative value assignment to each requirement of the method (Table 2). This is done similarly to the South East Data Assessment Review (SEDAR) process of assigning  $p^*$  values to stock assessment reference points.

Table 2: Weighted value assignments for intercept, phone and visual validation methods. All requirements were assigned a 0.00 or 0.25 value based on each method's ability to validate the requirement.

Requirement (0.25)	Validation Method		
	Intercept ( $i$ )	Visual ( $v$ )	Phone ( $p$ )
Trip Occurrence	0.25	0.25	0.00
Number of Anglers	0.25	0.25	0.00
Number of Fish	0.25	0.00	0.00
Correct Trip Number	0.25	0.00	0.25
Total Weighting Value ( $w$ )	1.0	0.50	0.25

This estimator also allows standard error (SE) and an approximate 95% confidence interval for the outputs ( $\hat{N}$ ) which was conducted using R<sup>®</sup> statistical software (SURVEY package). This equation [3] was exclusively used on the landings to display the uncertainty and window of probable landings. Other management agencies may use Percent Standard Error (PSE) to present the landings and these outputs have the ability to be converted to PSE.

$$\text{Upper/Lower 95\% Confidence Limit} = X \pm \left( \frac{SD}{\sqrt{n}} * 1.96 \right) \quad [3]$$

## RESULTS

Table 3: Intercept, vehicle and phone validation totals for federal/state and private/for-hire groups (2015 data only). For visual validations (v), during the federal season both vessel and aircraft were used and during state season only the vessel was used.

Type	Season	Tails n' Scales Reported Trips	Intercept (i) Validations/Correct Validations
Private	Federal	323	14/7
Private	State	171	6/4
For-Hire	Federal	85	4/4
For-Hire	State	0	0
TOTAL		579	24/14

Table 4: Reported totals for trips, anglers, fish harvested along with weighted validation totals (estimator 2), and correction factors for federal/state, and private/for-hire groups (2015 data only).

Type	Season	Reported Trips	Reported Anglers	Reported Fish Harvested	Final CF
Private	Federal	619	3,855	5,721	2.000
Private	State	574	1,288	2,954	1.500
For-Hire	Federal	85	747	1,175	1.000
For-Hire	State	0	0	0	NA

Table 5: Mean weights of biological sampling along with estimate totals of trips, anglers, fish harvested, and total landings (estimator 2) (2015 data only).

Type	Season	Total Estimated Trips	Total Estimated Anglers	Total Estimated Fish Harvested	Mean Weight (lbs.)	Total Estimated Landings (lbs.) (SE)
Private	Federal	1238.000	7710.000	11442.000	6.087	69,647.454 (±15,805.860)
Private	State	861.000	1,932.000	4431.000	4.661	20,652.891 (±3,396.24)
For-Hire	Federal	85.000	747.000	1,175.000	6.087	7,155.750 (±572.462)
For-Hire	State	0	0	0	NA	NA
TOTAL (MS 2015)						<b>80,199.444 (±19,774.562)</b>

## FUTURE ADDITIONS

### Discards/Catch Mortality

Future Red Snapper reporting in Mississippi will estimate discards or catch mortality. By adding a few key questions to Tails n' Scales reporting system as well as to access point surveys, we can begin to build a record of fish caught and released. Multiple stock assessments on Red Snapper have quantified survivorship related to hook size and depth fished to allow additional inputs in the models.

### Private Docks

It is important to consider the large number of private access sites along the Mississippi coast line. Private docks offer a unique way to collect catch data. Groups or individuals that have access to private docks and boat launches generally own or have access to larger boats: making deeper water and bigger fish more accessible. Tidelands funds within MDMR offer the flexibility to allocate staff, target anglers and gather data from fish landed at these "private access site" locations. The access point survey methodologies for these locations remain the same as it is for public access sites. Interviewers will contact individuals prior to embarking and request permission to intercept anglers at the site upon returning from their trip. All pertinent information and Red Snapper data will be recorded.

### Addition of Season and Type

Due to Amendment 39, sector separation will require an additional user group during Federal seasons. Non-Federally permitted for-hire captains landing Red Snapper during the Federal season will be separately accounted.

### Marine Patrol Intercept Data

Another addition that will help improve the system will be collaboration with Marine Patrol. MDMR Marine Patrol had 252 intercepts during the federal season and 874 during the state season alone last year. These are data that are being validated on board the angler's vessel by marine patrol officers who will have access to trip numbers recorded in the system each day. Using this catch data and comparing it to reported trips will further our knowledge of how to improve the validation process.

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