

Results from the first year of an exempted fishing permit (18-SERO-01) for state management of Red Snapper recreational harvest in Florida

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## **Executive Summary**

During 2018, the first year of this exempted fishing permit (EFP), Florida's Fish and Wildlife Conservation Commission (FWC) set a season that spanned 40 continuous days during June and July based on the quota allocated to Florida. Several surveys were conducted over the course of the season to monitor landings from private recreational boats and charter vessels operating in state waters without a federal permit. Monitoring harvest in-season with a high degree of certainty is not feasible due to the high number of participants in Florida's private boat fishery and the large geographic area over which red snapper landing points are dispersed. The survey that has been developed in Florida to monitor the recreational private boat fishery was designed to provide precise monthly estimates of both landings and discards for a variety of reef fish species; however, red snapper landings for 2018 were not available until after the conclusion of the harvest season. Additional landings from charter boats operating in state waters without federal permits were generated with data collected through the Marine Recreational Information Program (MRIP), and these estimates also were not available until after the end of the red snapper season.

A total estimated 2,007,049 pounds (S.E. 166,871) of red snapper were landed during the 2018 recreational season in Florida, which accounts for 112.85% of the state ACL (Table 7). The majority, 95.3%, of total landings were harvested from private boats during the June and July harvest season. Landings from non-federally permitted charter vessels operating in state waters accounted for another 4.4% of total estimated harvest, and out-of-season landings from private boats accounted for 0.3% of the total estimated pounds landed in 2018. The results from the first year of this EFP demonstrate the relative importance of data collection efforts that provide precise estimates for the private boat segment of the recreational fishery in order to effectively manage red snapper in Florida.

In response to the overage in 2018, a shorter season was set for the second year of this EFP (32 continuous days from June 11-July 12, 2019). In addition, FWC is also exploring methods this year that may be used to provide fishery managers with a mid-season projection as a way to monitor progress towards the ACL before more comprehensive survey estimates are available.

## **Introduction**

In April 2018, FWC was issued an EFP to conduct a pilot study in 2018 and 2019 to test state-run management, data collection, and quota monitoring of the private recreational angler component of the red snapper fishery off Florida's Gulf Coast. Under this EFP, Florida was allocated 1,778,515 pounds of the Gulf-wide private recreational quota for 2018. Based on this allocation, FWC set the 2018 recreational season for harvest in Gulf state and federal waters at June 11 – July 20 (40 days). This season applied to all recreational harvest in state waters (private anglers and non-federally-permitted for-hire operations, which are referred to as state charters in this report) and to private anglers fishing in federal waters and landing their harvest in Florida. Anglers fishing under this EFP were limited to two red snapper per person per day, with a minimum size limit of 16 inches total length. Anglers and state captains were encouraged to use descending devices to promote survival of released red snapper and reef fish, and voluntarily report their catches using the iAngler app. In accordance with the terms of this EFP, anglers and state charters fishing for red snapper under this EFP were required to sign up for Gulf Reef Fish Survey (GRFS) or State Gulf Reef Fish Charter designations, respectively, in addition to required fishing licenses.

Since April 2015, recreational anglers that fish from private boats on the Gulf coast of Florida have been required to sign up for the Gulf Reef Fish Survey to legally harvest red and vermilion snappers; gag, black

and red groupers; gray triggerfish; and amberjack species. The purpose for this requirement was to provide a list of known participants that could be directly surveyed to more closely monitor fishing effort for these important managed reef fish stocks. The Gulf Reef Fish Survey was designed to provide more precise estimates that may be used to closely track recreational reef fish fisheries managed with an annual catch limit (ACL).

The Gulf Reef Fish Survey is the result of years of collaboration between the state of Florida, regional and federal partners, and academic experts from across the country. The survey design was developed during a series of workshops hosted by Gulf States Marine Fisheries Commission, which brought together researchers from all five states in the Gulf region, NOAA Fisheries, and statisticians with expertise in the field of survey design. The Gulf Reef Fish Survey was peer reviewed in early 2018 by a team of statisticians retained by NOAA Fisheries who are experts in survey design. In their final report to FWC, the reviewers concluded that the approach taken to monitor recreational fishing in Florida is appropriate and that the methods are statistically sound. The reviewers also provided valuable suggestions for ways FWC may improve upon the current survey. Following the peer review, FWC developed a plan for implementing many of the recommended improvements to the Gulf Reef Fish Survey, and in December 2018, NOAA Fisheries announced that the design of the Gulf Reef Fish Survey was certified as a statistically valid data collection method. A description of the certified survey design is provided in the Methods section below, and links to a complete timeline for the development of the survey and the final report from the peer review are available online at: <https://myfwc.com/research/saltwater/fishstats/gulf-reef-fish-survey/update/>.

Recreational landings in Florida historically have been monitored through the Marine Recreational Information Program (MRIP, formerly the Marine Recreational Fisheries Statistics Survey), which provides landings estimates for all saltwater finfish species at two-month intervals (waves). The newer GRFS design includes a separate effort survey that provides a monthly estimate of private boat angler trips that specifically target or catch reef fish species. However, since the GRFS relies in part on catch data collected through the MRIP, landings estimates are not timelier. Preliminary effort estimates from the GRFS are available 45 days after the end of a month, and catch data collected through the MRIP survey are available to FWC approximately 45 days after end of each wave. Thus, preliminary GRFS catch estimates for June may be produced in mid-August (45 days after wave 3, which ends June 30), but landings that occur during the first the month of wave 4 (July) are not available until at least mid-October.

During 2018, the FWC season was allowed to run its course without interruption. Preliminary estimates from surveys conducted over this time were produced in mid-October, and indicated that Florida exceeded the state ACL by 13%. Final estimated landings reported herein do not deviate from this result.

## **Methods**

### *State Charter Boat Mode: Modifications to the MRIP For-Hire Survey*

The FWC maintains a list of active charter fishing vessels operating in the state of Florida, which is used by NOAA Office of Science and Technology (NOAA S&T) as the sample selection frame for the MRIP For-Hire Telephone Survey. This frame includes a mix of vessels that possess a federal permit to harvest red snapper in the Gulf of Mexico, and vessels without federal permits that may harvest red snapper within State Territorial Seas (up to 10 miles from shore on the Gulf coast of Florida). Each week, Gulf States

Marine Fisheries Commission (GSMFC) draws a 10% sample from the For-Hire vessel frame for each of three Gulf coast regions in Florida. Region 1 includes vessels with a home port in the northwestern panhandle, Region 2 includes vessels operating from the western peninsula, and Region 3 includes vessels located in Monroe County that may fish in the Gulf or Atlantic Ocean. Prior to running the weekly draws, the list is sorted by hull length and vessels are selected systematically from a random start point to ensure the sample is representative of the frame. Sample draws are provided to FWC, and staff attempt to contact a representative for each selected vessel via telephone within seven days after the end of the fishing week to collect information on the numbers of charter fishing trips taken, the numbers of anglers carried during each trip, and whether fishing during each trip occurred primarily in state waters or in the EEZ. The response data are delivered to GSMFC and used by NOAA S&T to expand fishing effort to all charter fishing vessels in the sample frame. Estimated effort is ultimately combined with catch-per-unit-effort data from access point intercept survey (AP AIS) to produce an MRIP estimate for the total number of red snapper landed by charter boat anglers in Florida.

Since charter vessels with a federal permit to harvest reef fishes in the EEZ are managed separately with their own red snapper allocation, their landings should not count against Florida's recreational allocation. However, charter vessels in Florida may legally harvest red snapper without a federal permit within 9 nautical miles from shore whenever the recreational season is open in state waters. Landings from non-federally permitted charter vessels counted towards Florida's recreational allocation in 2018; thus, a method was needed to track charter landings separately for non-federally permitted vessels. Florida's recreational season occurred during the same two months as the federal charter season (June 1-July 21, 2018). While MRIP landings from federal waters can all be attributed to federally permitted vessels, a mix of charter vessels may have harvested red snapper from state waters and a method was needed to partition the MRIP charter mode landing estimates for red snapper in state waters during wave 3 (May-June) and wave 4 (July-August). Staff from FWC, NOAA S&T (J. Foster), and GSMFC (G. Bray) worked together to develop new procedures that would allow for landings in state waters attributed to non-federally permitted charter boats to be extracted from the final estimates generated through MRIP. Methods described below reflect modifications to the For-Hire Survey that were agreed upon in advance of the recreational season.

Prior to sampling in June and July 2018, FWC obtained a list of vessels with home ports in Florida that possess a federal Gulf of Mexico Reef Fish permit from the NMFS Southeast Regional Office (SERO). To identify vessels in the Florida For-Hire Survey sample frame with and without a federal permit to harvest red snapper, the federal permit list was merged with the Wave 3 (May-June 2018) sample frame by vessel registration number or Coast Guard documentation number (whichever was available). Prior to running the weekly sample draws, GSMFC sorted vessels in the sample frame by a new permit flag (coded as 1 for vessels matched with a federal permit, or 0 for unmatched vessels), in addition to vessel length. For each week that the recreational red snapper season was open, vessels were systematically selected from the sorted list to obtain a 15% sample (normally 10%) that was representative of the variety of vessels with each permit flag. Vessel representatives were then contacted via telephone by FWC staff to conduct the standard For-Hire Survey interview and collect information on where the majority of fishing occurred during each reported trip (state waters or EEZ), as well as the primary and secondary target species. The only modification to the interview procedure occurred when red snapper was not reported as the primary or secondary target species for a given trip. When this happened, the interviewer followed up with a question to confirm whether red snapper was targeted or caught at any

time during the trip. If so, then the secondary target species was recorded as red snapper; otherwise, the original response was recorded. Since target species is not used in effort or catch estimation, this modification had no impact on MRIP estimates.

To calculate the proportion of charter angler trips in Gulf state waters that were taken by non-federally permitted vessels, sample weights were calculated for each trip reported in the For-Hire Telephone Survey. For a given sample week and region, the sample weight was calculated for each permit category  $p$  (vessels with or without a federal permit) as:

$$w_p = \frac{N_p}{n_p}$$

Where  $N_p$  is the total number of vessels of permit type  $p$  in the sample frame, and  $n_p$  is the number of successful contacts for vessels of permit type  $p$  that were sampled. For each response, the total number of angler trips reported in state waters was multiplied by the appropriate sample weight (for the corresponding week, region, and permit type of the responding vessel) to obtain the weighted number of angler trips. For each region and month, the proportion of angler trips in state waters taken by state charter vessels without a federal permit was calculated as:

$$p = \frac{\sum_{week=24}^{29} s_i}{\sum_{week=24}^{29} s_i + \sum_{week=24}^{29} f_i}$$

Where  $s_i$  is the weighted number of angler trips reported for the  $i$ th state charter vessel response during the selected week (weeks 24 to 29), and  $f_i$  is the weighted number of angler trips reported for the  $i$ th federally permitted vessel response. This proportion was multiplied times the wave 3 (for June) or wave 4 (for July) MRIP estimate for charter mode red snapper landings in state waters. It should be noted that at the time this report was written, 2018 estimates for MRIP were still PRELIMINARY and subject to change.

#### *Private Boat Mode: Florida Gulf Reef Fish Survey*

Anglers (including spear fishers) 16 years of age and older fishing from private recreational boats off the west coast of Florida (excluding Monroe County) are required to register for the Gulf Reef Fish Survey (GRFS) to recreationally harvest certain reef fish species in the Gulf of Mexico. This requirement is in addition to all applicable state saltwater fishing license requirements, size and bag limits, state and federal harvest seasons, and other regulatory requirements. Registration is required to legally harvest red snapper, as well as a suite of other commonly targeted reef fishes. Anglers are registered for the Gulf Reef Fish Survey through the state fishing licensing system during the purchase or renewal of a saltwater fishing license for no additional fee, or as a separate and free transaction if no license is purchased (for more information: <http://myfwc.com/fishing/saltwater/recreational/gulf-reef-fish-survey/>). Registration must be renewed on an annual basis for continued participation in the fishery.

Civil penalties apply if a person is found in possession of Gulf Reef Fish species and has failed to sign up for the survey. Enforcement is conducted by FWC officers during field inspections of vessels and landed catch. Civil penalties include \$50 for the first offense and incrementally higher fines for repeat offenses within 36 months. Anglers registered for the GRFS are eligible to be contacted by mail for data collection; however, individuals selected for the mail survey may choose not to complete and return the questionnaire without penalty.

The mail survey of registered Gulf Reef Fish anglers is administered by FWC and is separate and independent of the MRIP Fishing Effort Survey (FES) conducted by NOAA Fisheries. Prior to drawing a sample for the GRFS mail survey, individual registrants are grouped into 14 separate survey groups (also referred to as strata) based on expected levels of participation in the recreational reef fish fishery. The stratification scheme for the mail survey was designed to account for variable participation rates by out-of-state residents, and state residents that reside in different regions of Florida with or without a registered recreational boat. This degree of survey stratification allows for precise estimates of fishing effort. Out-of-state residents are divided into two groups: 1) states adjacent to Florida (Georgia and Alabama), and 2) all other states. Florida residents are divided based on their county of residence into four main regions, which are sub-divided based on whether the county is directly adjacent to the Gulf coast (Table1). Within each sub-region, Florida residents are further sub-divided based on whether their physical address is matched to a recreational boat registration in Florida (Table 1).

At the beginning of each new month, approximately 7,000 registered participants are selected to receive a paper questionnaire to report their fishing activity for the prior month. The Neyman allocation method is used to determine the proportion of the total sample that is selected from each of the 14 survey strata (Table 2). This method allocates sample to achieve maximum precision by taking into account the population size in each stratum and the degree of variance associated with historic responses. Included with the questionnaire is a cover letter explaining the purpose of the survey, a fish identification guide with colored pictures of each Gulf reef fish species, and a self-addressed return envelope with postage paid upon delivery. Respondents are instructed to only report fishing activity for the previous month, and only for the person whose name is printed on the survey questionnaire. The respondent is asked to mark on a calendar the specific date for each recreational fishing trip taken from a private recreational boat in the Gulf of Mexico. A map is provided to assist with reporting the zone where each trip took place (Figure 1). For each reported trip, the respondent is asked to record the percent of time (if any) spent fishing more than 10 miles from shore (in the EEZ), and to select from a list of reef fishes that were targeted or caught (if any) during each trip. One week after questionnaires are mailed, a reminder postcard is mailed to prompt a timely response. One-and-a-half weeks after the reminder is mailed, a second questionnaire is mailed to households that have not yet returned the first survey to prompt them again for a response.

Responses received within 12 weeks (84 days) after the end of a reporting month are used to expand reporting fishing effort to the population of registered participants in the fishery (Appendix A). More than 95% (up to 99%) of responses are received in time for inclusion in final estimates. Additional data collected through intercept surveys (described below) are used to adjust the expanded effort estimate to account for anglers that are not registered for the Gulf Reef Fish Survey. Effort estimation methods are described in detail in Appendix A.

#### *Private Boat Mode: Integrated MRIP and GRFS Intercept Surveys*

The FWC is responsible for maintaining a comprehensive list of recreational fishing access points that is used by NOAA S&T as the sample frame for the MRIP Access Point Angler Intercept Survey (APAIS) in Florida. A sub-set of sites are identified as having relatively high historic proportions of private boat interviews that target or catch a key species indicative of an offshore fishing trip. The offshore site group serves two purposes: 1) a portion of sites randomly selected for APAIS assignments in Florida are allocated to this site group, and 2) additional sites from this group are randomly selected at the same

time that the APAIS sample is drawn, and this supplemental draw is used to assign additional intercept surveys as part of the GRFS. The supplemental GRFS assignments employ a more streamlined access point intercept survey methodology that allows biologists in the field to target survey efforts towards anglers returning from trips specifically targeting and/or catching Gulf reef fish species. The objective of this combined approach is to increase the numbers of offshore trips targeting reef fishes that are intercepted in the field to improve precision around estimates of catch-per-unit-effort (CPUE). Drawing assignments for the two surveys together serves two purposes: 1) to avoid overlapping survey effort at the same sites on the same days, and 2) to produce primary sample weights that are compatible and allow data collected during both surveys to be combined. Sample selection weights are provided by NOAA S&T to the state of Florida for use in calculation of combined catch-per-unit-effort (CPUE) estimates for Gulf reef fish species.

During APAIS and supplemental GRFS assignments, FWC staff arrive on site at the beginning of the selected time period and remain until the end of the period. During APAIS assignments, FWC staff interview all saltwater anglers following standard field interview procedures established for the MRIP survey (<http://www.st.nmfs.noaa.gov/recreational-fisheries/Surveys/survey-details>). During supplemental Gulf Reef Fish Survey assignments, staff conduct a screening interview to focus reef fish trips. For each intercepted party, interviewers confirm whether anglers targeted and/or caught any Gulf reef fish species and if so, the biologist continues with a more detailed trip interview. This procedure allows biologists to hone in on reef fish trips and maximize the number of trip interviews and biological samples for Gulf reef fish species. The expanded trip interview for Gulf reef fish trips includes details about the species targeted, percent of time fished in the EEZ, hours fished, and primary gear used, which is recorded at the boat level. Similar to the APAIS, catch information is collected at the angler level for discarded fish and retained catch is consolidated at the boat level. Data collected through the two intercept surveys are combined to estimated catch-per-unit-effort (CPUE), which is multiplied times total estimated fishing effort to calculate total estimated landings (see Appendix A for detailed estimation procedures).

During the expanded trip interview for supplemental intercept surveys, each angler in a fishing party is asked whether they are registered in Florida for the Gulf Reef Fish Survey and, if they are not certain, to confirm this designation on their saltwater fishing license. For each reef fish trip intercepted, the number of anglers in the party that are either subscribed to the GRFS, not registered, or their registration status could not be verified is tallied. This information is used account for fishing effort attributed to anglers that participate in the fishery without subscribing to the Gulf Reef Fish Survey (either illegally or by legal exemption), and adjust effort estimated from the mail survey accordingly (described in Appendix A).

### *iAngler Reporting App*

Although not mandatory, anglers and state charters were encouraged to electronically report trip information using the iAngler app within 24 hours of completing their trip. Two red snapper-specific versions of this app were developed in partnership with the Angler Action Foundation: one for private anglers to report their individual catch, called iAngler Gulf Red Snapper, and one for charter captains to report on behalf of all customers aboard their vessel, called iAngler Gulf Red Snapper Charter. Information collected in the iAngler app includes:

- Date of fishing trip
- Time fished
- General location of fishing trip
- Number and size of red snapper harvested
- Number and size of red snapper released
- Number of red snapper released using a descending device, and
- Number of red snapper vented before release.

Prior to and during the 2018 red snapper season, FWC and the Angler Action Foundation encouraged anglers and state charters to download and use the app via press releases, social media, targeted emails, and a YouTube video.

The self-reported data collected from the iAngler app were not used to estimate harvest. Rather, the app was included in this pilot program to test its feasibility for use as a future recreational fisheries data collection method, and to potentially provide supplemental information about angler behavior and fish interactions from the private angler and state charter components of the Gulf red snapper fishery in Florida.

## Results

### *State Charter Boat Mode*

The number of charter boats in the For-Hire Survey vessel list that were either matched or unmatched to a federal Gulf of Mexico reef fish permit is provided in Table 3. During June and July 2018, response rates in the MRIP For-Hire Telephone Survey were higher for federally permitted charter vessels versus those that were not matched with a federal permit (Figure 2). Variable response rates were accounted for in final estimated landings with the sample weights that were calculated for each vessel type. In the northwest panhandle (region 1), the mean weekly proportion of selected vessels that were successfully contacted in the For-Hire Survey was 0.808 (s.d. 0.078) for federally permitted charter boats, versus 0.661 (0.067) for charter boats without a federal permit. In the western peninsula (Region 2), the response rate was 0.587 (0.088) for federally permitted vessels, versus 0.467 (0.044) for state charters. In the Keys (region 3), mean weekly response rates were low for both vessel types ( $p=0.308$  s.d.=0.257 for vessels with a federal Gulf of Mexico reef fish permit, and  $p=0.383$  s.d.=0.024 for vessels without).

Operators of vessels both with and without a federal permit reported fishing for red snapper in state waters in the northwest panhandle; whereas, no trips targeting red snapper were reported in state waters in the western peninsula and the Keys. The proportion of total estimated charter angler trips that targeted red snapper in state waters in the northwest panhandle that were attributed to vessels that were not matched with a federal permit was 0.657 during June, and 0.740 in July. When these proportions were multiplied times final MRIP estimates for charter mode in state waters, an estimated 40,190 lbs. (s.e. 17,007) of red snapper were landed from vessels without federal permits during wave 3, and 47,572 lbs. (s.e. 33,161) were landed during wave 4 (Table 4).

### *Private Boat Mode*

A combined total of 609 anglers that targeted or caught reef fish were interviewed during APAIS and supplemental GRFS intercept assignments conducted in June and July 2018 (Table 6). Each month, GRFS fishing effort questionnaires were mailed to more than 6,000 anglers registered for the Gulf Reef Fish Survey, with a total of 1,202 and 1,155 completed questionnaires returned for the months of June and July, respectively (Table 2).

The ratio of reef fish anglers intercepted during supplemental GRFS assignments to those signed up for the Gulf Reef Fish Survey ranged from 1.492 to 1.538 during June and July (Table 5). When effort estimated from the GRFS mail survey was adjusted for this under-coverage, a total of 419,000 (s.e. 33,977, c.v. 0.081) private boat angler trips targeting reef fishes from the Gulf coast of Florida were estimated to have been taken during the months of June and July 2018 (Table 5). Fishing effort was highest during June in the EEZ and declined in July (Figure 3). The pulse in effort in the EEZ was largely attributed to higher numbers of trips reported by Florida residents that live directly adjacent to the Gulf coast, particularly from households with a registered boat (Figure 4, panels a, b and c). Anglers that travel to the Gulf coast also appear to be an important component of the red snapper fishery in Florida. Residents of Georgia and Alabama reported taking a high frequency of trips in the EEZ during both June and July, as did residents from non-coastal counties in northern Florida that live in a household with a registered boat (Figure 4, panels b and d). Decreased effort in July was explained largely by a drop in the numbers of trips reported in the EEZ by Gulf coast residents in the northern panhandle and peninsula (Figure 4, panels a and c). The large spike in reef fish trips during June did not occur in state waters, but estimated fishing effort in this area was moderately high across both months when the red snapper season was open (Figure 3).

The red snapper season during 2018 included a total of 34 weekend days (including the July 4<sup>th</sup> holiday) and 26 regular weekdays. The highest percentage of estimated fishing effort occurred during the weekends. During June and July, respectively, 62% and 67% of private boat recreational trips targeting reef fish species took place on weekends (Figure 5). Catch per unit effort (CPUE) was not higher on weekends and averaged 0.76 and 0.70 fish per angler trip during June and July, respectively, compared to 1.52 and 1.01 fish per angler trip during weekdays (Figure 5). Across all days that the red snapper season was open, CPUE was two times higher in the EEZ (~1.2 fish per angler trip in the EEZ, versus ~0.6 in state waters; Figure 6).

### *Final estimated landings*

Preliminary landings for the months of June and July were provided to the NMFS Southeast Regional Office (SERO) in October 2018. As a standard procedure, final estimates include data received from the mail survey of fishing effort up to 84 days (12 weeks) after the end of a fishing month, thus estimates reported here are slightly different than what was reported in October. Final estimates for June and July are provided in Tables 7 (landings in pounds) and 8 (numbers). Additional out-of-season landings from private boat anglers were also estimated for the months of August, September, and December (Tables 7 and 8). The August estimate is attributed to one angler intercepted in northwest Florida during an APAIS assignment that reported discarding one dead red snapper. During one intercept in September, an interviewer during a GRFS assignment in northwest Florida intercepted 10 juvenile red snapper (that still retained the black spot) harvested by an angler who mistakenly thought the fish were lane snapper. Lastly, in December, one angler intercepted during a GRFS assignment in the Big Bend retained one red

snapper that had been bitten in half by a shark during retrieval to the surface. The expanded out-of-season landings from these three out-of-season intercepts represent 0.3% of the total estimated pounds of fish landed in Florida during 2018. Final landings from non-federally permitted charter vessels operating in state waters accounted for another 4.4% of total estimated harvest. The majority, 95.3%, of total landings were harvested from private boats during the June and July harvest season (Table 7 and 8). In all, a total estimated 2,007,049 pounds (S.E. 166,871) were landed in Florida during 2018, which accounts for 112.85% of the state ACL.

### *iAngler Self-Reporting*

During the 2018 Gulf red snapper season, 361 trips with catches were voluntarily self-reported via the iAngler app. The vast majority (96%) of these trips originated in the Florida panhandle. Trips reported in the iAngler Gulf Red Snapper version of the app averaged 3.3 anglers per trip, while those reported in the charter version averaged 4.2 anglers per trip. In addition to red snapper catches, anglers reported catches of several other reef fish species, as well as cobia, dolphin, king mackerel, Gulf flounder, and red drum in the app. Reporting of non-mandatory fields (i.e., depth, location, release disposition, length) was variable. Because of the presumably low number of angler trip reports relative to the likely number of actual red snapper trips, variable reporting of non-mandatory fields, and lack of validation, these data are likely not representative of and should not be used to characterize all recreational red snapper trips. A detailed summary of results compiled by the Angler Action Foundation is provided in Appendix B.

### **Discussion**

Having a statistically robust, specialized survey of participants in the Gulf reef fish fishery is providing important new insights into the components of Florida's recreational private boat fishery and the dynamics of effort during red snapper seasons. Understanding who the various stakeholders are and their relative contributions to landings helps state managers make more informed decisions about the timing and length of recreational fishing seasons. Through this EFP and new knowledge gained through the Gulf Reef Fish Survey, the state of Florida is adapting to better manage the recreational red snapper fishery sustainably, while also providing ample opportunities for state residents and visitors alike to participate in the season.

During 2018, the first year of this EFP, FWC set a season that spanned 40 continuous days during June and July. Several surveys were conducted over the course of the season to monitor landings from private boats and charter vessels operating in state waters without a federal permit. Due to the large number of participants in Florida's private boat fishery, and the large geographic area over which red snapper landings occur off the west coast of Florida, the methods employed to monitor recreational landings rely upon a mail survey of registered participants. Estimates from this survey were not available until well after the recreational season had ended. In response to the 13% overage in 2018, daily catch was averaged over the 40-day season and used to inform the decision for a shorter 32-day season in 2019 (June 11-July 12). While it is not practical for Florida to implement in-season monitoring as the primary method for monitoring red snapper (Pollock et al. 1994), supplemental methods that can provide an early projection for final landings may be feasible as a way to inform state managers mid-season. During 2019, FWC is exploring different methods using supplemental data that may be collected in-season and modeling approaches using intercept survey data collected through the GRFS that could provide fishery managers with a mid-season check point. This early measure could serve as an advance

notice of potential risk for exceeding the ACL before final landings estimates become available so that fishery managers may take preventative measures, if necessary.

Through this EFP, some important discoveries were made about the charter sector. One result that has potential implications for the MRIP For-Hire Telephone Survey is the demonstrated need to account for variable response rates among vessels with and without federal permits. As a condition for permit renewal, vessel operators with federal charter permits in the Gulf of Mexico are required to provide data on fishing trips when requested. However, no such requirement exists for non-federally permitted charter operators. The methods developed for this pilot study could easily be implemented in the For-Hire Survey throughout the year to account for non-response bias. During the first year of this EFP, it was also revealed that approximately 60-70% of red snapper charter effort in state waters is attributed to vessels without a federal permit; however, this fleet contributed only a small percentage of total landings that counted against this year's state ACL. Thus, it is important to continue focusing data collection efforts in Florida on providing timely and precise estimates for the private boat segment of the recreational fishery in order to effectively manage red snapper.

Use of the voluntary iAngler app by anglers and state charters for electronic trip reports was relatively low, which is not surprising considering that use of this app was voluntary, and the red snapper versions of iAngler were unveiled shortly before the 2018 season began. Feedback received by the Division of Marine Fisheries Management following the 2018 season indicates that many anglers and state captains were unaware of the app or were unwilling to report some or all data fields for a number of reasons such as: the app was confusing or did not work, reporting was burdensome or takes too much time, or concerns about having to report private information such as fishing spots.

FWC will continue testing use of the iAngler app for voluntary electronic trip reporting in 2019. FWC and the Angler Action Foundation are planning coordinated angler outreach to encourage voluntary use of this app in advance of the 2019 Gulf red snapper season, while also communicating that anglers who report trip information through iAngler should also participate in dockside and mail surveys (GRFS and MRIP), as these are being used to monitor landings relative to Florida's quota. In addition, the layout of iAngler is being reviewed to ensure data entry is easy and convenient for anglers, and that essential/mandatory vs. non-mandatory fields are clearly identified. With continued outreach and app improvements, we expect that angler interest in and comfort with submitting electronic trip reports may increase in 2019, especially considering the that similar trip reporting apps are being used for red snapper in the South Atlantic and other Gulf states, and federal for-hire electronic reporting is expected to become mandatory throughout the southeastern United States later this year.

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Table 1. Mail survey strata, defined by residence of GRFS registrants.

Stratum	Region	Sub-region	Boat registration
110	NW (FL panhandle)	Coastal	No
111	NW (FL panhandle)	Coastal	Yes
200	BB (FL Big Bend)	Non-coastal	No
201	BB (FL Big Bend)	Non-coastal	Yes
210	BB (FL Big Bend)	Coastal	No
211	SW (FL peninsula)	Coastal	Yes
300	SW (FL peninsula)	Non-coastal	No
301	SW (FL peninsula)	Non-coastal	Yes
310	SW (FL peninsula)	Coastal	No
311	SW (FL peninsula)	Coastal	Yes
400	KY (Keys and SE FL)	Non-coastal	No
401	KY (Keys and SE FL)	Non-coastal	Yes
500	AL/GA (nearby states)	Non-coastal	na
600	Other states	Non-coastal	na

Table 2. Numbers of anglers and spear fishers registered for the Gulf reef Fish Survey, sample sizes for the mail survey, and mail survey responses received back during June and July, 2018. Sample sizes for each strata are based on Neyman allocation. For a description of the strata, refer to Table 1.

Stratum	June 2018			July 2018		
	Subscriptions	Sample Size	Responses	Subscriptions	Sample Size	Responses
110	46,769	1,130	165	47,249	1,058	115
111	11,882	233	91	12,094	216	73
200	76,120	798	106	79,403	722	84
201	18,507	193	55	19,313	200	60
210	32,552	508	64	34,121	622	82
211	8,700	115	30	9,067	127	35
300	47,323	445	40	50,464	647	67
301	11,008	89	26	11,615	117	27
310	83,111	1,500	219	86,197	1,409	198
311	19,776	279	79	20,507	291	99
400	23,824	76	3	26,062	81	8
401	4,642	21	1	5,052	16	3
500	57,063	689	133	59,727	761	152
600	159,751	768	190	164,463	595	152
TOTALS	601,028	6,844	1,202	625,334	6,862	1,155

Table 3. Numbers of charter vessels in 2018 For-Hire Survey sample frame with and without federal permit to harvest red snapper in the Gulf of Mexico.

Florida Region	Wave	Gulf federal reef fish permit	No Gulf federal reef fish permit	Proportion not federally permitted
Panhandle	3	194	223	0.53
	4	196	229	0.54
Peninsula	3	177	543	0.75
	4	183	552	0.75
Monroe County	3	33	405	0.92
	4	36	409	0.92

Table 4. Charter mode landings estimated by MRIP in state waters, and amounts attributed to non-federally permitted charter boats.

Wave	MRIP landings in pounds*	PSE	Proportion of effort attributed to non-federally permitted vessels	Landings attributed to non-federally permitted vessels	Landings S.E.
3	61,172	34.3	0.657	40,190	17,007
4	65,954	59.2	0.721	47,572	33,161

\* 2018 MRIP data at the time of this report were still PRELIMINARY and subject to change.

Table 5. Estimated angler trips taken by anglers registered for the Gulf Reef Fish Survey (unadjusted angler trips), ratio of total reef fish anglers to registered anglers intercepted in the field (ratio), total estimated fishing effort (total angler trips) adjusted for unregistered angler trips, and coefficient of variation (c.v.) for total estimated effort.

Area	Year	Month	Unadjusted angler trips (S.E.)	c.v.	Ratio (S.E.)	Total angler trips (S.E.)	c.v.
EEZ	2018	June	98,302 (10,505)	0.107	1.538 (0.178)	151,210 (23,754)	0.157
		July	79,943 ( 8,945)	0.119	1.273 (0.086)	101,763 (13,280)	0.131
State	2018	June	55,069 ( 8,016)	0.146	1.528 (0.079)	84,155 (12,985)	0.154
		July	55,101 ( 9,597)	0.174	1.492 (0.117)	82,217 (15,658)	0.190
Total	2018	Jun-Jul	288,415 (18,621)	0.065		419,344 (33,977)	0.083

Table 6. Numbers of assignments and interviews for the APAIS and Gulf Reef Fish intercept surveys during June and July 2018.

Month	APAIS assignments in private boat mode	Reef fish anglers interviewed during APAIS assignments	GRFS intercept assignments	Reef fish anglers interviewed during GRFS assignments
June	76	188	74	169
July	61	98	69	154
Total	137	286	143	323

Table 7. Final estimated red snapper landings in pounds and percentage of 2018 ACL harvested.

Year	Month	Area	Mode	Pounds	Variance	C.V.	Notes
2018	June	EEZ	PR	882,954	13,054,384,397	0.1294	
		ST	PR	207,256	1,797,739,321	0.2046	
		ST	CH	40,191	289,253,449	0.4232	
	July	EEZ	PR	649,259	9,761,734,086	0.1522	
		ST	PR	172,975	1,824,075,985	0.2469	
		ST	CH	47,572	1,099,625,623	0.6971	
	Aug	ST	PR	771	255,671	0.6554	Dead discards
	Sept	ST	PR	3,740	13,714,117	0.9901	Out of season harvest
	Dec	EEZ	PR	2,330	5,290,296	0.9871	Out of season harvest
	Total			2,007,049	27,827,072,855	0.0831	%ACL landed = 112.85
ACL			1,778,515				

Table 8. Final estimated red snapper landings in numbers of fish.

Year	Month	Area	Mode	No. of Fish	Variance	C.V.	Notes
2018	June	EEZ	PR	180,307	1,200,134,815	0.1921	
		ST	PR	52,082	261,489,264	0.3105	
		St	CH	10,475	11,094,943	0.3180	
	July	EEZ	PR	122,372	635,735,419	0.2060	
		ST	PR	47,779	406,325,595	0.4219	
		ST	CH	8,893	31,685,376	0.6330	
	Aug	ST	PR	278	73,048	0.9732	Dead discards
	Sept	ST	PR	1,033	1,168,012	1.0461	Out of season harvest
	Dec	EEZ	PR	439	185,881	0.9817	Out of season harvest
	Total			423,658	2,547,892,353	0.1191	

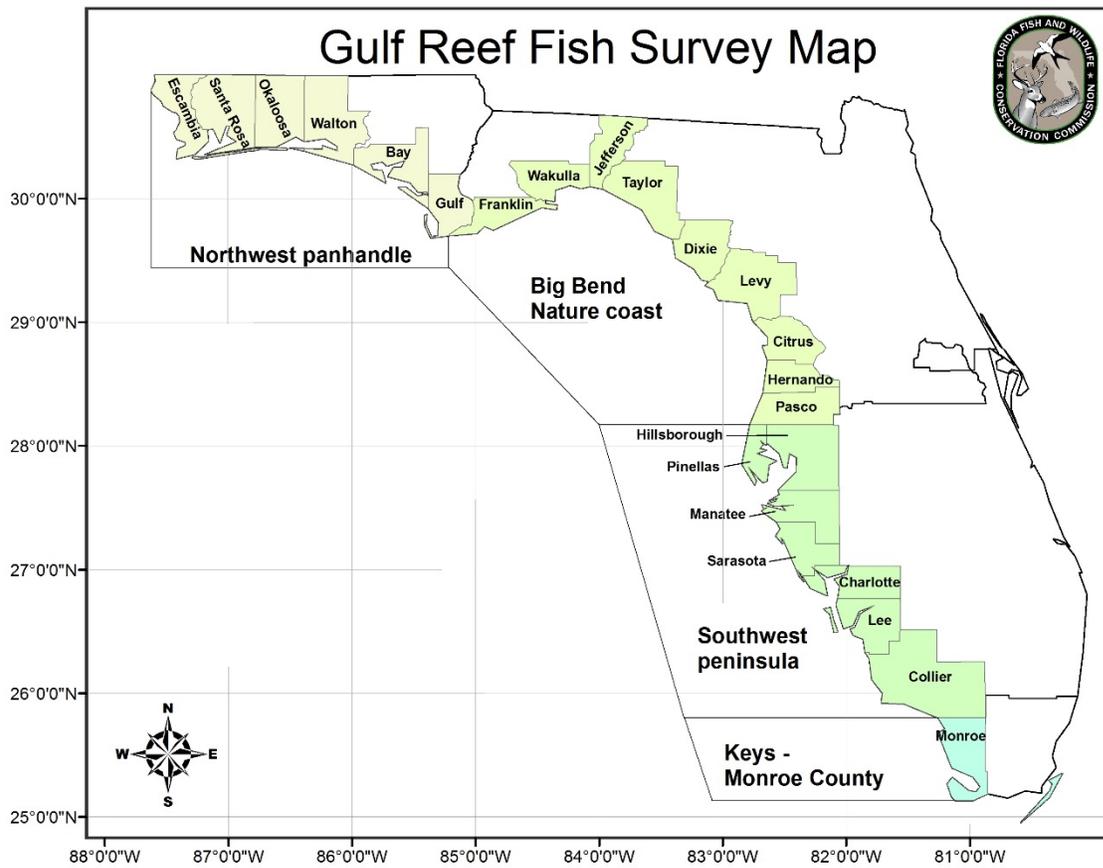


Figure 1. Map provided to survey recipients to assist in determining the region from which each fishing trip took place.

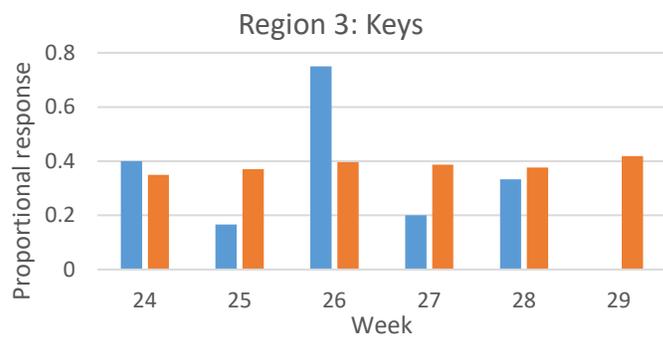
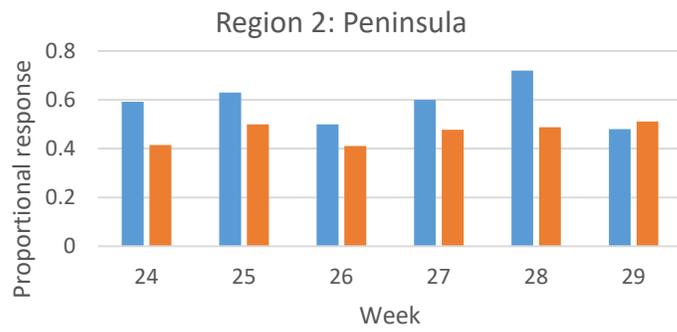
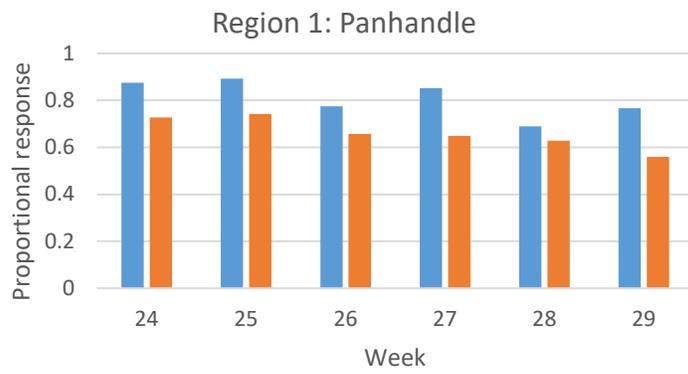


Figure 2. For-Hire Survey response rates for charter vessels with (blue) and without (orange) a federal Gulf of Mexico reef fish permit.

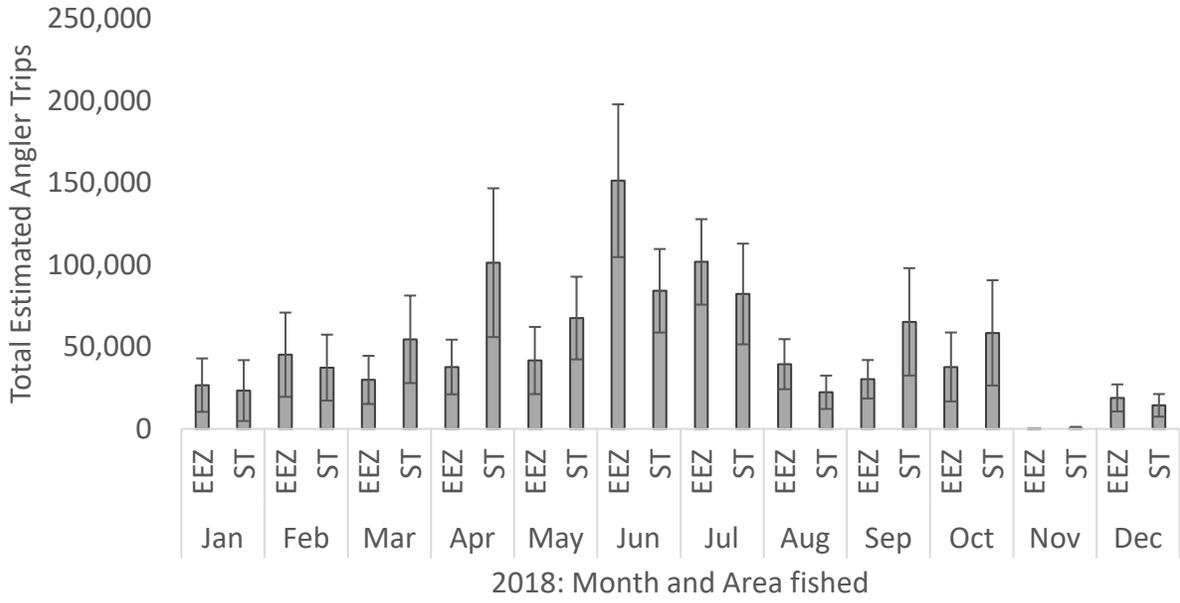


Figure 3. Total estimated angler trips during 2018 that targeted reef fishes on the Gulf coast of Florida by month and area fished (EEZ=Exclusive Economic Zone, ST=state waters up to 10 miles from shore).



Figure 4. Mean number of trips reported by mail survey respondents in various strata, by area fished and month. EEZ=Exclusive Economic Zone, ST=state waters up to 10 miles from shore.

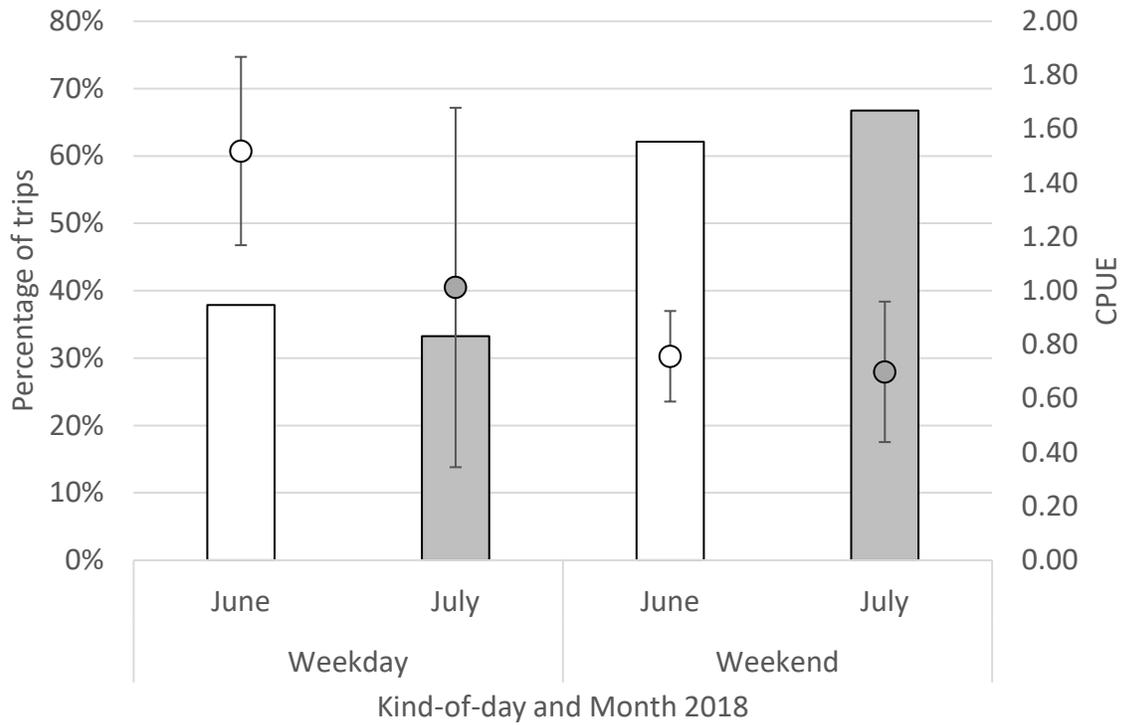


Figure 5. The percentage of estimated private boat fishing effort (reef fish angler trips in the EEZ and state waters, combined) that occurred during weekdays and weekend days (white and gray bars) during June and July 2018. Corresponding values for mean catch per unit effort (red snapper per angler trip) are also shown (white and gray circles with 95% confidence intervals).

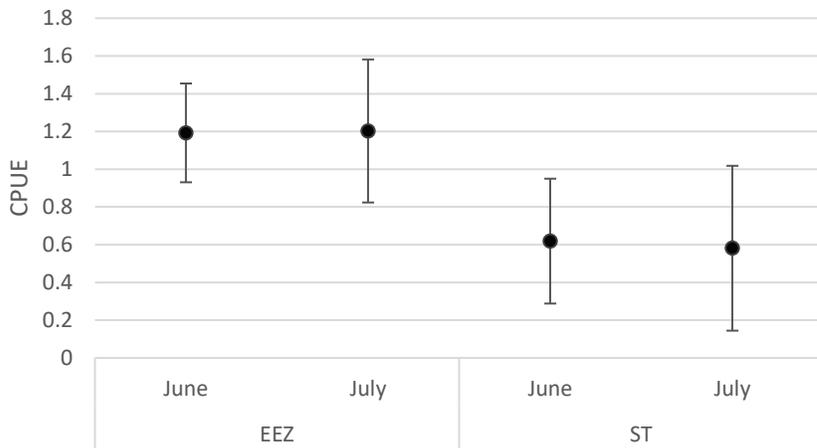


Figure 6. Estimated catch-per-unit-effort (fish per angler trip) for harvested red snapper by month and area fished during 2018 (EEZ=Exclusive Economic Zone, ST=state waters up to 10 miles from shore).

## Appendix A

### Private Boat Mode: Estimation Methods

The following methods are used to generate estimates of the number of Gulf reef fish trips made by registered participants during a given month. The sample selection weight for individuals selected to receive a survey from a given stratum (h) is calculated as:

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

Where  $N_h$  is the total number of registered Gulf reef fish anglers in the stratum, and  $n_h$  is the number of individuals selected from the stratum to receive the mail survey. To account for individuals that did not respond to a request to return the completed survey questionnaire, the survey response rate in each stratum is calculated as:

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

where  $r_i$  is the binomial variable indicating whether selected individual  $i$  responded to the survey (1=yes, 0=no). The response rate is used to calculate a secondary non-response weight as:

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

Calculations for the next three equations and associated variances are carried out using the survey means procedure in SAS. For this procedure, sample strata are identified by the survey year, survey month, and survey strata; the sample weight for each stratum is the product of the sample weight and non-response rate (described above); and the estimation domain is survey year and survey month.

The weighted mean number of Gulf reef fish trips per response in each stratum is calculated as:

$$\bar{y}_h = \frac{\sum_{j=1}^{n_{h,j}} SW_h NRW_h y_{h,j}}{\sum_{j=1}^{n_{h,j}} SW_h NRW_h} \quad (4)$$

Where  $y_{h,j}$  is the number of Gulf reef fish trips reported in state or federal waters by the  $j$ th respondent in stratum  $h$ , and  $n_{h,j}$  is the number of people in stratum  $h$  that responded to the survey out of  $n_h$  selected.

The overall mean weighted number of Gulf reef fish trips per response across all 14 strata is calculated as:

$$\bar{y} = \frac{\sum_{h=1}^{14} \sum_{j=1}^{n_{h,j}} SW_h NRW_h y_{h,j}}{\sum_{h=1}^{14} \sum_{j=1}^{n_{h,j}} SW_h NRW_h} \quad (6)$$

The total, unadjusted number of Gulf reef fish trips taken by all anglers registered for the Gulf Reef Fish Survey during a given month is calculated as:

$$\hat{Y} = N \bar{y} \quad (8)$$

where  $N$  is the total number of Gulf reef fish anglers that were registered during the survey month.

An adjustment for off-frame anglers (anglers that participated in the fishery but did not register for the Gulf Reef Fish Survey) is calculated separately using data collected from a supplemental Intercept survey of fishing parties from private recreational boats (described in the next section). The ratio is calculated as the total number of reef fish anglers from all fishing parties intercepted that could be verified as either subscribed or not subscribed to the GRFS, divided by total that were verified as subscribed. The mean weighted ratio ( $\hat{R}$ ) and variance is generated by area fished (state and federal waters) using the survey means procedure in SAS:

```
proc surveymeans data=grfs_trip mean var;
strata strat_id;      *strata=year|month|kind_of_day|time_interval;
cluster psu_id;      *cluster=assignment id;
weight w_int_grfs;   *weight=assignment sample weight;
domain domvars;     *domain=year|month|area_fished;
ratio anglers / registered;
*ratio( $\hat{R}$ )=sum anglers verified for GRFS status / sum verified GRFS subscribers;
run;
```

Total effort (expressed as reef fish angler trips) in a given domain (month and area fished) is estimated as:

$$\hat{T} = (\hat{Y} * \hat{R}) \tag{10}$$

With variance calculated using Goodman's product (Goodman, 1960):

$$s^2(\hat{T}) = \hat{Y}^2 s^2(\hat{R}) + \hat{R}^2 s^2(\hat{Y}) - s^2(\hat{Y}) s^2(\hat{R}) \tag{11}$$

Intercept data collected from private boat parties that targeted and/or caught Gulf reef fish in both the APAIS and GRFS are combined and used to calculate integrated monthly estimates of CPUE (catch per angler trip) for each reef fish species by area fished (STS and EEZ). Data from the APAIS survey includes any intercepts collected from all MRIP sites, including those that have not been identified as having historically high offshore fishing pressure. Intercept data collected from GRFS intercepts are only collected from the offshore site group. Thus, catch data collected through the GRFS may not represent all reef fish trips and serves only to supplement the APAIS. The overall mean number of harvested fish per angler is calculated as:

$$\overline{cpue} = \frac{\sum_{i=1}^t W * f_i}{\sum_{i=1}^t W * a_i} \tag{10}$$

Where W is the sample weight for the assignment,  $f_i$  is the number of fish harvested by boat party  $i$ , and  $a_i$  is the number of anglers in boat party  $i$ . The sample weight for each assignment is the product of the primary sample weight, which is based on the expected amount of fishing activity at the selected site on a given day and time, and the secondary sample weight, which accounts for anglers that are missed and not interviewed during an assignment. Primary sample weights are calculated at the time that the APAIS and GRFS intercept survey samples are drawn by NOAA S&T, and are provided to FWC for use in estimation. Since the two samples are drawn together, primary sample weights are complementary and data from the two surveys may be combined. Secondary sample weights are calculated after assignments are completed by FWC (for supplemental GRFS assignments) and NOAA S&T (for APAIS assignments).

The total number of fish harvested or released for a given species in a given domain (year, month and area fished) is estimated as:

$$\hat{C} = (\hat{T} * \overline{cpue}) \quad (12)$$

Where  $\hat{T}$  is total estimated effort from the Gulf Reef Fish mail survey, adjusted for off-frame effort by non-registered Gulf reef fish anglers. Variance is calculated using Goodman's product (described above).

## Appendix B

### **iAngler Gulf Red Snapper – 2018 EFP Season Report**

The following contains general data summaries and notes regarding information collected by the Angler Action Foundation (AAF) through an iAngler Gulf Red Snapper self-reporting campaign in the Gulf of Mexico along Florida's coast.

The summaries contained in this report were completed by the AAF and intended only to provide a general summary of data responses. It is important to note that self-reporting was completely voluntary, and within every voluntarily reported trip there are fields which are not required (voluntary field within a voluntary report) – therefore the distribution of responses is varied and must be analyzed further before any representative statistical value could be assigned.

#### **General trip data**

361 trips recorded a catch.

##### **Angler/trip origin by county:**

Western panhandle through Gulf County accounted for 75% of logged catches in iAngler.

Eastern panhandle (Franklin County) down to St. Pete accounted for 21% of logged catches.

South of St. Pete 4% of logged catches.

##### **Top 4 reported counties:**

Escambia – 426 fish

Okaloosa – 110

Bay – 110

Gulf – 101

##### **Anglers per trip:**

*iAngler Gulf Red Snapper* trips averaged 3.3 anglers per trip.

*iAngler Gulf Red Snapper Charter* trips averaged 4.2 anglers per trip.

(At the request of FWC, the Angler Action Foundation developed two separate mobile smart phone apps, one for paid charter trips and one for private recreational angler trips. The pre-season education campaign included information that steered anglers towards the correct app download.)

##### **Gross catch per trip info:**

The average catch was 5.25 fish per report. This is not a 'per trip' or 'per angler' number, as some anglers reported for just themselves on a boat of more people, and some reported for the whole boat.

**Zero Catch trips:** "Zero catch" reports accounted for 7% of the 361 trips.

This includes anglers who reported their species name as “no catch” (as opposed to default “red snapper”, as well as those (n=3) who reported the species of “red snapper” with an entered catch count of 0.

**Reported depth ranges (voluntary field):**

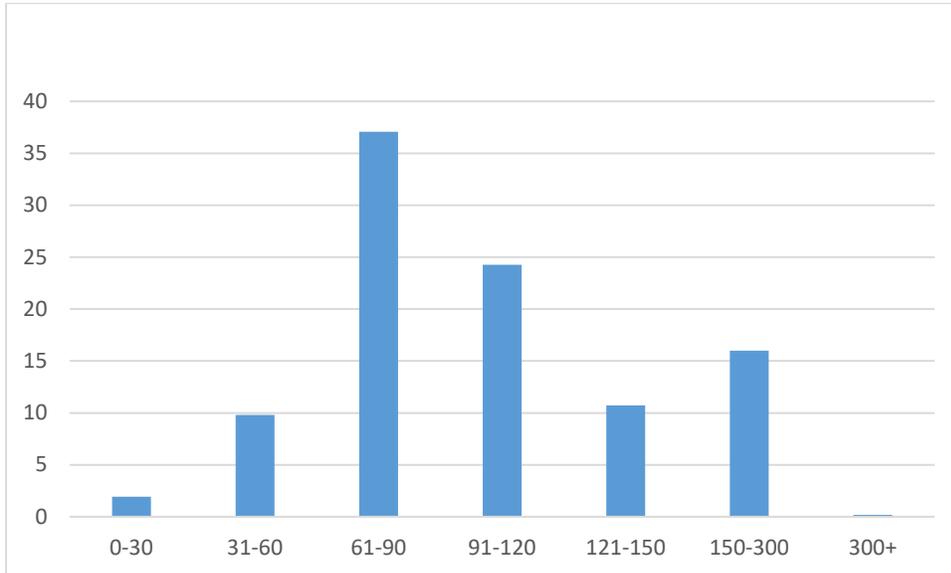


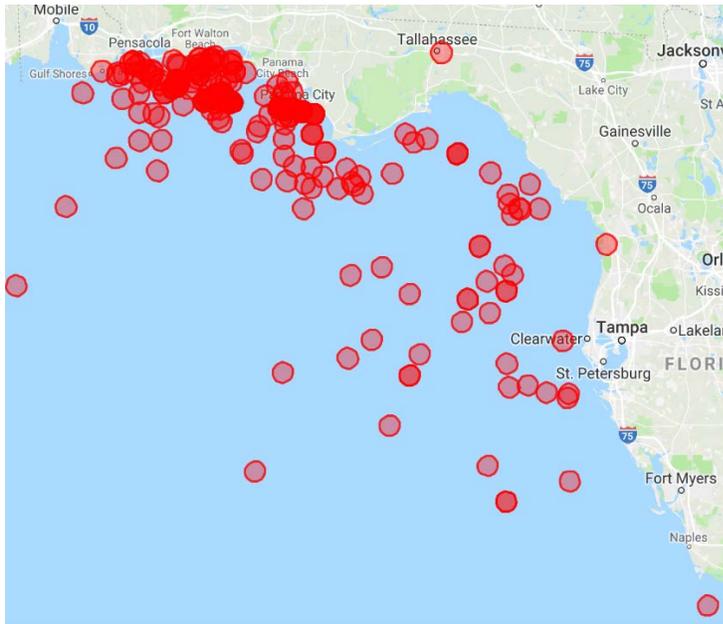
Figure 1: X-axis represents reported depth range (in feet); y-axis represents percentage of trips within each depth range. Note that each range is only 30-feet until 150 feet, where it increases.

**Notes on depth range reports:** Reported depths from whole state varied considerably. Anglers reporting from Escambia county (most reported county) reported depths of under 90-feet (76%) and very few over 150-feet (4%). At a glance, this appears to be a fair representation of the entire panhandle. Conversely, in the southern counties (Tampa Bay and south), 90% of reported catches were deeper than 90-feet, 10% were shallower.

Also, very interesting to note that nearly ALL (over 95%) of the trips from the southern section (again, Tampa Bay and south) reported depth range, an optional data field. Overall across entire Gulf coast depth reporting rate was just over 50% (meaning panhandle-only depth reports is probably under 40%).

Why this difference in the voluntary reporting rates of depth exists is unknown. Based on informal conversations with anglers who log in iAngler over the past few years, it might be because anglers in the southern range feel depth is more important to *them* so they assume it is important to FWC (these anglers have to travel much farther from shore than anglers in the western panhandle). Another possibility is that in general, until this red snapper season iAngler has been used much more in the southern counties than the panhandle, so there might be a higher percentage of experienced loggers reporting red snapper in the south, which might lead to higher percentages of completed information fields. More investigation is warranted in this area.

### Specific locations:



*Only about 25% of self-reported catches provided specific locations, which is similar to overall iAngler numbers. While the above map includes all reports (some likely reported incorrectly), the overall trend is clear: Panhandle anglers did not have to travel as far from shore, or fish as deep, as anglers from anglers originating from peninsular Florida. Anglers from the southern range were far more likely to report depth range (roughly 95%) than those from the panhandle (roughly 40%).*

### Fish data

66.9% of reported catches were logged as 'kept,' 33.1% were logged as 'released.'

#### Kept/Released fish info:

The average reported length of iAngler kept fish was 20.5 inches.

The average reported length of iAngler releases was 15.4 inches.

#### Disposition of released fish:

*Release disposition* was a voluntary category of the iAngler self-reporting system. Anglers could report the following categories (with percentage reported):

swam away straight and fast (87%)

swam slowly and lost balance (1%)

released after venting (2%)

released using decompression device (3%)

eaten by predator (6%)

floated (3%).

Thoughts on disposition reports: Due to the design of the current system, “Swam away straight and fast” was the default response to this voluntary data field, and pre-loaded in the app. This means the number is almost certainly over-represented. Other iAngler voluntary fields range in participation (e.g., specific location is only around 25%, length of fish is closer to 50%). Therefore, comparing the default response to other options is not valuable. However, subtracting the default response and comparing other options only to each other might reveal better insights to trends of angler responses. Consider the breakdown of other responses when compared only to each other (subtracting the ‘swam away straight and fast’ field from the group), we can see which options were more often reported.

Swam slowly and lost balance (6.4%)

Released after venting (12.8%)

Released using decompression device (19%)

Eaten by predator (43%)

Floated (19%)

Again, it is important to note that these elevated percentages are not of overall discard reports, but only the percentage of those which were not the default (pre-loaded) response, *swam away straight and fast*.

For consideration: The default option of *swam away straight and fast* is included because of the original design of iAngler and the original target species: snook. Future modifications to the iAngler family of apps should consider this data field and whether it should have a default value of “no report” or something similar so we can better understand data related to discard disposition, or whether there are other, better ways to capture this information in a more meaningful way. In certain fisheries such as red snapper, discard disposition is a very important data field when considering management options and can translate to millions of pounds of fish, and billions of dollars spent, etc. (our project MyFishCount in the Atlantic has a ‘no response’ option for default, which makes for better relative comparisons and might also lead to a higher percentage of voluntary reporting the field.)

#### **Release disposition related to depth fished:**

Because depth and release disposition were both voluntary fields, the number of reports that contained both was far too small to even try to recognize general trends for most data fields, especially considering the high number of default ‘*swam away straight and fast*’ which most certainly introduced an insurmountable bias. The following averages are based on very few individual reports and should be considered for future app design structure only.

Average depth of ‘floated’ releases: 115 feet

Average depth of ‘vented’ or ‘descended released’: 139 feet

#### **Other species and No Catch:**

Anglers mostly reported red snapper data, but 18 other species were reported in the designated Gulf red snapper iAngler apps (*black grouper, cobia, mahi, gag grouper, gray snapper, gray triggerfish, amberjacks, red grouper, gulf founder, king mackerel, lane snapper, vermillion snapper, and red drum*). There were a total of 22 “no catch” reports, and two “other fish” reported.

### **Disclaimers and other notes**

Data collected by the Angler Action Foundation during the Florida Gulf Red Snapper season is intended to be supplemental only at this time. Stated another way, this means when Florida assess the 2018 Florida Gulf Red Snapper season and compiles their information and estimations as directed by the Gulf Council, iAngler data is not intended to be the primary source of information. Rather, the information collected is meant to help Florida managers and scientists better understand angler behaviors, fish interactions, and how to better assess the health of our fisheries in the future using self-reporting instruments such as iAngler. It is not the intent of the Angler Action Foundation to discredit or replace Florida’s current data collecting methods. Rather, our intent is to continue to work with Florida, other states, and regional councils to help improve the overall process of data collection, recreational angler interactions and communications, and ultimately help improve overall fishery management practices. Raw data is available to Florida and other agencies upon request, and specific data fields are provided only on a ‘need to know’ basis. Personal angler data such as contact information is not shared. Raw angler data is not manipulated by AAF volunteers and staff, although some data plots might be flagged as possible errors, outliers, etc.

The information in this report is based on informal assessments and groupings of raw data. There were no statistical analyses completed to determine significance of findings, etc. It is unknown what percentage of anglers who fished reported in iAngler, although it can likely be safely assumed that the reporting percentage is very low compared to the actual fleet of anglers. Also, many of the data fields are voluntary (depth range, location, disposition of fish, length, etc.), which means even less data is collected for these areas.