

## **Gulf Reef Fish Survey, Intercept Survey Methods**

**Beverly Sauls**

In addition to the mail survey to estimate effort by Gulf Reef Fish Survey subscribers, complementary angler intercept surveys are used to measure catch-per-unit-effort (CPUE) from recreational fishing trips made by private boat anglers off the west coast of Florida. Catch data comes from two sources: 1) the Access Point Angler Intercept Survey (APAIS) portion of the Marine Recreational Information Program (MRIP) survey, and 2) a supplemental intercept survey designed specifically to target private boat angler parties fishing for Gulf reef fish species. The Gulf Reef Fish Intercept Survey is also used to measure the proportion of reef fish trips that were made by anglers not registered for the Gulf Reef Fish Survey that are not eligible to be surveyed for fishing effort through the mail survey. This measure is needed to adjust fishing effort upwards to account for trips not reported through the mail survey. Adjusted fishing effort may then be multiplied times CPUE for a given species to estimate the total numbers of fish harvested or released.

### *Sample Frame and Site Selection*

The state of Florida maintains a statewide list of sites used by the NOAA Office of Science and Technology (S&T) as the sample frame for the MRIP Access Point Intercept Survey (APAIS) in Florida. During 2015, FWC worked collaboratively with NOAA S&T to identify a sub-set of sites with relatively high historic proportions of private boat interviews that targeted or caught key species indicative of an offshore fishing trip. The subset of offshore sites is used for two purposes: 1) a portion of sites randomly selected for APAIS assignments in Florida are allocated to the new offshore site group, and 2) additional site/day/time combinations are randomly sampled from the offshore site group at the same time that the APAIS sample is drawn, and this supplemental draw is used to assign Gulf Reef Fish intercept surveys. The supplemental assignments utilized a more streamlined access point intercept survey methodology that allowed 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 trips targeting reef fishes that are intercepted in the field and improve precision around estimates of catch-per-unit-effort (CPUE) used to calculate total landings and discards. 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 from 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.

### *Intercept Survey Procedures*

During APAIS and supplemental Gulf Reef Fish Survey assignments, FWC staff arrive on site at the beginning of the selected time period and remained 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 Gulf Reef Fish Survey assignments, FWC staff confirm what species an intercepted boat party fished for, and the biologist continues with a more detailed trip interview only if they targeted and/or caught any Gulf reef fish species. This procedure allows biologists to focus sampling efforts 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. The number of anglers in the party that are under 16 years of age is also recorded. Each angler 16 years of age and older is asked to report whether they were registered for the Gulf Reef Fish Survey. Numbers of youth under 16 years of age, registered adults, and adults not registered for the Gulf Reef Fish Survey are tallied for each boat party. The boat operator is asked to identify on a gridded chart the area(s) where fishing took place. Catch data is collected at the angler level for discarded fish, and retained catch was consolidated at the boat level (similar to the APAIS).

Supplemental materials to document the intercept survey portion of the Gulf Reef Fish Survey include:

- Appendix A: Intercept Survey Procedures Manual
- Appendix B: Assignment Summary Form
- Appendix C: Trip Interview Form
- Appendix D: Catch Interview Form (Panhandle region)
- Appendix E: Sample Fishing Area Map

#### *Catch-per-Unit Effort (CPUE)*

Intercept data collected from private boat parties that targeted and/or caught Gulf reef fish in the two surveys (APAIS and Gulf Reef Fish Survey) are combined and used to calculate monthly estimates of CPUE (catch per angler trip) for each reef fish species by area fished (STS and EEZ). The overall mean number of harvested fish per angler is calculated as:

$$\overline{cpue} = \frac{\sum_{i=1}^t W * w * f_i}{\sum_{i=1}^t W * w * a_i}, \quad (9)$$

where  $W$  is the primary sample weight for the assignment (provided by NMFS S&T) that is calculated when the assignment is initially drawn,  $w$  is the secondary sample weight calculated after the assignment is completed,  $f_i$  is the number of fish harvested by boat party  $i$ , and  $a_i$  is the number of anglers in boat party  $i$ . The secondary sample weight accounts for boat parties that could not be intercepted and interviewed during the selected assignment, and is calculated as:

$$w = \frac{r + \left(\frac{r}{r+o} * u\right)}{r} \quad (10)$$

where  $r$  is the number of boat parties intercepted during the assignment that were confirmed to be fishing for reef fish,  $o$  is the number of boat parties intercepted that were confirmed to be fishing for species other than reef fish, and  $u$  is the number of unconfirmed boat parties that were not intercepted and their targeted species could not be determined.

Standard error for  $\overline{cpue}$  is calculated as:

$$se = \frac{1}{\sqrt{n}} \sqrt{\frac{\sum_{i=1}^n (cpue_i - \overline{cpue})^2}{n-1}}, \quad (11)$$

where  $cpue_i$  is the number of harvested fish per angler in party  $i$ , and  $n$  is the number of angler parties intercepted.

#### *Adjustment for Off-Frame Effort*

The ratio of total reef fish anglers intercepted to anglers that were registered for the Gulf Reef Fish Survey was calculated from data collected during supplemental Gulf Reef Fish intercept survey assignments each month during 2016. This ratio was calculated separately for intercepted trips that took place in state and federal waters, and may be used to adjust the effort estimate generated from the mail survey to account for additional Gulf reef fish trips taken by off-frame anglers in each area.

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

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

where:

$\hat{Y}$  = estimated effort from the Gulf Reef Fish mail survey, unadjusted for off-frame effort by non-registered Gulf reef fish anglers;

$\hat{R}$  = ratio of total Gulf reef fish anglers to registered anglers intercepted during Gulf Reef Fish intercept survey assignments;

$\overline{cpue}$  = weighted mean catch-per-unit-effort (catch per angler trip) estimated from combined data collected through the APAIS and supplemental Gulf Reef Fish intercept survey.

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. Anglers whose GRFS subscription status could not be determined are excluded from this calculation. 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 (primary*secondary);
domain domvars;        *domain=year||month||area_fished;
ratio anglers / registered;
*ratio( $\hat{R}$ )=sum anglers verified for GRFS status / sum verified GRFS subscribers;
run;
```

### *Artificial Reef Human Use Survey Add-On*

In the panhandle region, an additional question was included in the GRFS catch interview during 2016 for a separate human use analysis to evaluate the portion of boat parties that utilize artificial reefs during recreational angling trips for reef fish. During 2017 from the months of May through July a separate survey of the three major inlets in the panhandle region is being conducted to estimate the total number of recreational boats that enter into the Gulf of Mexico and utilize artificial reefs. To complement the inlet boat count surveys each month, the GRFS trip interview form was modified to include the time that each private recreational boat party was intercepted (regardless of whether they saltwater fished), the time each boat exited through an inlet (if applicable), and the percent of time during the trip that was spent using artificial reefs. Data from inlet boat count surveys and the GRFS intercept survey may be used in combination to estimate the total number of private recreational trips that used artificial reefs during three peak summer months in 2017. These data may also be used to generate an independent estimates of monthly fishing effort for Gulf reef fish in the region for direct comparison with effort estimates from the mail survey portion of the GRFS. Preliminary estimates from the two side-by-side surveys may be available in fall 2017.