Methodology Description for a Simple Ratio Calibration of Texas Private Boat Red Snapper Annual Landings Estimates

NMFS Office of Science and Technology

SEDAR74-DW-10

15 April 2022

Please cite this document as:

NMFS Office of Science and Technology. 2022. Methodology Description for a Simple Ratio Calibration of Texas Private Boat Red Snapper Annual Landings Estimates. SEDAR74-DW-10. SEDAR, North Charleston, SC. 5 pp.

SEDAR 74-DW-10

Methodology Description for a Simple Ratio Calibration of Texas Private Boat Red Snapper Annual Landings Estimates

National Marine Fisheries Service
Office of Science and Technology
Fisheries Statistics Division

I. Background Information

Annual estimates of private boat effort and red snapper landings are available from the Texas Parks and Wildlife Department (TPWD) Coastal Creel Surveys (CCS) program from 1983 to the present. The CCS design uses a fishing access site creel survey to estimate both catch and effort for the recreational private boat sector. This design differs from the multi-component complemented designs used by MRIP and other state state surveys in the Gulf of Mexico Region. In 2016, the Marine Recreational Information Program (MRIP) conducted its Fishing Effort Survey (FES) in Texas (Papacostas and Foster, 2018; NOAA Fisheries, 2019) to produce effort estimates of private boat angler-trips for comparison purposes. The difference between the TPWD and MRIP private boat effort estimates was large and significant, encouraging the application of a calibration that could be used to create catch and effort estimates for Texas that would be more comparable to the corresponding MRIP estimates provided for the other Gulf states.

II. Available Information for Calibration

The separate 2016 annual private boat effort estimates from TPWD CCS and MRIP FES are the only directly overlapping data points available for calculating a ratio-based calibration factor. These point estimates and their associated variances are included in Table 1. below.

Table 1. 2016 Annual Private Boat Effort Estimates from Texas Parks and Wildlife Department's Coastal Creel Surveys Program and the Marine Recreational Information Program's Fishing Effort Survey

Program	Effort Point Estimate	Coefficient of Variation	Variance
TPWD CCS	1,025,114.5228	0.031	1,023,194,783.4
MRIP FES	11,172,596.5071	0.130	2,095,868,753,970.03

III. Calibration Ratio Estimation

The calibration ratio is calculated as

$$\hat{r}_{MRIP:TPWD} = \frac{\hat{E}_{MRIP}}{\hat{E}_{TPWD}} \quad (1)$$

where $\hat{r}_{MRIP:TPWD}$ is the ratio of effort estimates,
$\hat{E}_{MRIP}$ is the MRIP FES 2016 private boat annual effort estimate,
$\hat{E}_{TPWD}$ is the TPWD CCS 2016 private boat annual effort estimate.

The variance of $\hat{r}_{MRIP:TPWD}$ is approximated using a Taylor Series expansion ignoring the covariance term as the two effort point estimates are independent:

$$var(\hat{r}_{MRIP:TPWD}) = \frac{var(\hat{E}_{MRIP})}{(\hat{E}_{TPWD})^2} + \frac{(\hat{E}_{MRIP})^2 var(\hat{E}_{TPWD})}{(\hat{E}_{TPWD})^4} \quad (2)$$

Plugging the numeric values from Table 1 into Equations 1 and 2 yields

$$\hat{r}_{MRIP:TPWD} \approx \frac{11{,}172{,}596.5071}{1{,}025{,}114.5228} \approx 10.8989$$

$$var(\hat{r}_{MRIP:TPWD}) \approx \frac{2{,}095{,}868{,}753{,}970.03}{(1{,}025{,}114.5228)^2} + \frac{(11{,}172{,}596.5071)^2 * 1{,}023{,}194{,}783.4}{(1{,}025{,}114.5228)^4} \approx 2.11009$$

IV. Calibrated Landings Estimation

The available TPWD CCS private boat red snapper annual landings estimates are calibrated to MRIP as

$$\hat{C}_{y,MRIP*} = \hat{C}_{y,TPWD} * \hat{r}_{MRIP:TPWD} \quad (4)$$

where $\hat{C}_{y,MRIP*}$ is the annual landings estimate in year y calibrated to MRIP,
$\hat{C}_{y,TPWD}$ is the TPWD annual landings estimate in year y.

The covariance of $\hat{C}_{y,TPWD}$ and $\hat{E}_{y,TPWD}$ is unavailable and $\hat{r}_{MRIP:TPWD}$ is invariant with respect to y, so $var(\hat{C}_{y,MRIP*})$ is approximated using Goodman's Formula as

$$var(\hat{C}_{y,MRIP*}) = (\hat{C}_{y,TPWD})^2 * var(\hat{r}_{MRIP:TPWD}) + (\hat{r}_{MRIP:TPWD})^2 * var(\hat{C}_{y,TPWD}) - var(\hat{r}_{MRIP:TPWD}) * var(\hat{C}_{y,TPWD}) \quad (5)$$

This approximation may not be conservative, and better approximations may be available and should be used if identified.

To illustrate application of the calibration, Table 2 gives a partial series of the TPWD standard and MRIP calibrated estimates, with associated coefficients of variation, for recent years 2015 through 2019.

Table 2. Annual Private Boat Red Snapper Landings Estimates from Texas Parks and Wildlife Department's Coastal Creel Surveys Program with Calibration Ratio and resulting Calibrated ("MRIP") Estimates for Years 2015-2019
Note: decimal values rounded to four digits

Year	TPWD Landings	TPWD CV	Ratio	Ratio CV	MRIP Landings	MRIP CV
2015	41,937	0.1235	10.8989	0.1333	457,066.1807	0.1810
2016	22,328	0.1666	10.8989	0.1333	243,350.1129	0.2122
2017	36,389	0.1455	10.8989	0.1333	396,599.2143	0.1963
2018	42,896	0.1306	10.8989	0.1333	467,518.2032	0.1858
2019	67,643	0.1602	10.8989	0.1333	737,232.6981	0.2073

V. Context for the Texas Private Boat Red Snapper Landings Ratio Calibration

As stated earlier, the data available to inform this calibration are limited and, given the size of the calibration, concerns may arise about the reasonableness of applying it to the Texas time series of red snapper landings estimates. To provide context for the Texas calibration ratio, additional information is presented here from other states in the Gulf of Mexico region where the MRIP multi-component complemented design has been implemented for many years.

The MRIP design includes both an intercept survey component, the Access Point Angler Intercept Survey (APAIS), which provides catch-per-trip data, and off-site household and list frame surveys, including the FES, designed to provide effort data (Papacostas and Foster, 2018). While the APAIS is typically used to estimate mean catch rates, it can be used to estimate catch directly for fishing activity that is covered by its sample frame. Catch estimates calculated using only the APAIS data would be analogous and more comparable to the Texas CCS estimates as both APAIS and CCS are intercept surveys covering public-access fishing sites.

The MRIP-APAIS private boat red snapper landings estimates, those calculated using only data from APAIS, are presented in Table 3 along with the corresponding complete or standard MRIP estimates and the resulting ratios of standard MRIP to MRIP-APAIS estimates. These estimates and ratios are provided for recent years where the MRIP and State programs were conducted side-by-side.

Table 3. Annual Private Boat Red Snapper Landings Estimates (no.) as standard MRIP estimates (MRIP Landings) and estimates calculated using only data from the Access Point Angler Intercept Survey (MRIP-APAIS Landings) with corresponding ratios calculated as MRIP Landings : MRIP-APAIS Landings, 2015-2019
Note: for included years, MRIP surveys were only conducted in Louisiana in 2015

Year	State	MRIP Landings	MRIP-APAIS Landings	Ratio
2015	Florida	442,902	41,852	10.58
2016	Florida	669,649	84,632	7.91
2017	Florida	1,366,132	115,221	11.86
2018	Florida	1,008,546	93,858	10.75
2019	Florida	1,009,962	103,629	9.75
2015	Alabama	562,889	34,725	16.21
2016	Alabama	550,772	51,971	10.60
2017	Alabama	1,162,965	40,325	28.84
2018	Alabama	743,394	54,649	13.60
2019	Alabama	872,449	84,486	10.34
2015	Mississippi	19,431	1,245	15.61
2016	Mississippi	87,820	5,639	15.57
2017	Mississippi	116,426	8704	13.38
2018	Mississippi	100,414	12,095	8.30
2019	Mississippi	170,786	17,935	9.52
2015	Louisiana	275,798	38,246	7.21

Again, the ratios presented in Table 3 compare the standard complete MRIP landings estimates to those based solely on the MRIP APAIS intercept component survey. They range from 7.21 to 28.84 with a mean and median of about 12.50 and 10.67, respectively. While only based on a single year, the calibration ratio for Texas (approximately 10.90) is well centered in this distribution falling between the mean and median and, as such, does not appear atypical of similar comparisons for other states in the Gulf of Mexico Region.

VI. References

NOAA Fisheries. (2019). *Texas Fishing Effort Survey: Final Project Report*. Internal Report, NOAA Fisheries Marine Recreational Information Program.

Papacostas, K. J., & Foster, J. (2018). *Survey Design and Statistical Methods for Estimation of Recreational Fisheries Catch and Effort*. NOAA Fisheries Marine Recreational Information Program. Retrieved from Silver Spring, MD: https://www.fisheries.noaa.gov/resource/document/survey-design-and-statistical-methods-estimation-recreational-fisheries-catch-and