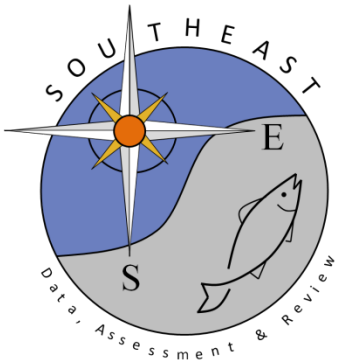
A ratio-based method for calibrating estimates of total landings (numbers and pounds of fish), releases (numbers of fish), and total trips from MRIP-FCAL to SRFS for Red Snapper (*Lutjanus campechanus*) in the Gulf of Mexico

Chloe Ramsay

SEDAR98-DW-14

26 November 2024



Please cite this document as:

Ramsay, Chloe. 2024. A ratio-based method for calibrating estimates of total landings (numbers and pounds of fish), releases (numbers of fish), and total trips from MRIP-FCAL to SRFS for Red Snapper (*Lutjanus campechanus*) in the Gulf of Mexico. SEDAR98-DW-14. SEDAR, North Charleston, SC. 24 pp.

A ratio-based method for calibrating estimates of total landings (numbers and pounds of fish), releases (numbers of fish), and total trips from MRIP-FCAL to SRFS for Red Snapper (*Lutjanus campechanus*) in the Gulf of Mexico.

Chloe Ramsay

Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, 100 Eighth Avenue SE, St. Petersburg, Florida 33701

In preparation for

SEDAR 98 Gulf of Mexico Red Snapper

November 26, 2024

Background

The Marine Recreational Information Program (MRIP) has provided vital statistics on recreational fishing effort and catch in the U.S. Gulf of Mexico since 1981. To remain useful for regional stock assessments, the time-series has undergone several calibrations to account for the effects of survey design improvements in more recent years. For example, when MRIP made the transition from the coastal household telephone survey (CHTS) to the fishing effort survey (FES) the historic estimates CHTS were calibrated into FES currency. This calibration is currently used for generating historic MRIP estimates and is termed FCAL. Stock assessments require long-term time-series of landings and discards on an annual scale that are measured consistently through time.

In response to a region-wide need for more precise and timely estimates of recreational catch, Florida's Gulf Reef Fish Survey (GRFS) was developed in May 2015 in collaboration with NOAA Fisheries alongside similar efforts in other states. The GRFS generated recreational catch estimates for the Gulf of Mexico, excluding Monroe County. Beginning July 1, 2020, the Gulf Reef Fish Survey was expanded statewide in Florida and is now known as the State Reef Fish Survey (SRFS). The SRFS runs concurrent with the MRIP survey in Florida and produces estimates that are consistently lower. Previous stock assessments of Florida-centric species such as Gag in the Gulf of Mexico (SEDAR 72) and Southeast Mutton Snapper (SEDAR 79) have incorporated a long-term time series of MRIP estimates converted to SRFS currency for historic estimates of landings and discards from recreational private boats and SRFS estimates for recent years (Cross et al. 2020; Ramsay et al. 2024a). This data is also in consideration for other ongoing stock assessments such as Gulf of Mexico Red Grouper (SEDAR 88) and Southeast Yellowtail Snapper (SEDAR 96; Ramsay et al. 2024b, Ramsay et al. 2024c). The method that was developed to calibrate historic MRIP-FCAL estimates to SRFS currency was peer-reviewed by NOAA Office of Science and Technology (OS&T) statistical consultants and approved for use (Ramsay, NOAA OS&T et al. 2024). The method is used herein to calibrate MRIP estimates to SRFS currency for Gulf Red Snapper, which will facilitate the use of SRFS estimates in this assessment.

Objectives

The objective is to develop conversion factors that may be applied to the MRIP-FCAL estimates for landings and releases of Red Snapper (*Lutjanus campechanus*) in the Gulf of Mexico, including the Keys. "The Keys" is defined as all trips taken off of mainland Monroe county and all trips taken from the Keys in the Gulf (i.e., north of U.S. 1/the island chain; Fig. 1 region D). Landings and release estimates will be calculated separately for open and closed fishing seasons and the two regions of Florida which will be assessed separately (FLwest: Peninsular Florida from Citrus County south and FLpan: the Panhandle of FL from MS to Levy County). Consistent conversion factors will be applied across all years, regions, and season status. This will produce a historic time series in the same currency as the SRFS.

Methods

Prior to producing a calibrated time series, SRFS estimates during the early years require an adjustment to account for effort and catch from the Gulf Keys (Fig. 1; region D) because this region was not included in the SRFS survey until June 2020. To do this, data from the three most recent years (2021-2023) were used to produce separate recreational catch estimates for the Gulf coast with the Gulf Keys included (Gulfk; Fig. 1 regions A-D) and excluded (Gulf; Fig. 1 regions A-C), and a ratio was calculated. Application of this ratio resulted in an increase in 2016-2020 SRFS estimates because they accounted for additional landings and discards from the Gulf Keys. Next, another ratio was calculated to calibrate MRIP estimates for the Gulf (excluding the Keys) down to the SRFS Gulfk estimates using the available overlapping years (2016-2023). MRIP estimates were provided broken down by FL region (FLwest and FLpan) and by season status (open and closed). To generate the calibration ratio, both MRIP and SRFS estimates were summed across all overlapping years, regions, and seasons. Using broader scale data reduces ratio variability that can occur when using limited data (Ramsay, NOAA OS&T et al. 2024). This ratio was then applied to the finer scale estimates to produce calibrated estimates of total landings (numbers and pounds of fish) and releases (numbers). The same general method was used to produce a calibrated time series for reef fish effort, but MRIP effort estimates were calculated by year as region/season estimates were not provided. For this calculation, effort estimates for SRFS and MRIP included trips that targeted and/or caught one or more of the following from the suite of reef fish species covered by the SRFS survey: red grouper, gag, black grouper, red snapper, vermilion snapper, gray triggerfish and amberjacks (greater, lesser, almaco and banded rudderfish). The estimated ratios for all the variables and their associated uncertainty were used to convert the historical MRIP time series (1982-2015) to a common currency with SRFS. For the years 2016-2023, SRFS Gulfk estimates are provided in place of MRIP.

To calculate the calibration ratios, SRFS estimates ($\hat{E}$) and variances ($\hat{V}$) for each estimation method (where *m = SRFS Gulf or SRFS Gulfk*) were summed across years (*y*), months (*n*), areas fished (*a*: federal or state waters), regions (*r*: FLpan or FLwest), and season (*s*: open or closed) for each combination and estimate type variable (*v*: number landed, pounds landed, number released, angler trips) [1, 2].

$$\hat{E}_{m,v} = \sum_{m,v} \hat{E}_{y,n,a,r,s,m,v} \quad [1]$$

$$\hat{V}\left(\hat{E}_{m,v}\right) = \sum_{m,v} \hat{V}\left(\hat{E}_{y,n,a,r,s,m,v}\right) \quad [2]$$

This resulted in four paired overall sums for each estimate type from SRFS Gulf and SRFS Gulfk (Table 1). For each of the paired sums, the ratio was calculated as the SRFS Gulfk estimate divided by the SRFS Gulf estimate [3].

$$\hat{R}_{Gulfk\ v} = \frac{\hat{E}_{SRFS\ Gulfk\ v}}{\hat{E}_{SRFS\ Gulf v}} \text{ [3]}$$

This first ratio was applied as a multiplier to SRFS estimates for the years that data was not collected in the Gulf Keys 2016-2020 for use in calculating the SRFS/MRIP ratio [4].

$$\hat{E}_{SRFS,y,v} = \hat{R}_{Gulfk\ v}\hat{E}_{Gulf,y,v} \text{ [4]}$$

This ratio was also applied as a multiplier to SRFS estimates for 2016-2020 at a finer scale of year, region, and season for consideration for use in the assessment [5].

$$\hat{E}_{SRFS,y,r,s,v} = \hat{R}_{Gulfk\ v}\hat{E}_{Gulf,y,r,s,v} \text{ [5]}$$

The delta method was used to approximate the variance of both the ratio ($\hat{V}(\hat{R}_{s,v})$) and the final calibrated estimates ($\hat{E}_{SRFS,y,v}$ and $\hat{E}_{SRFS,y,r,s,v}$). The delta method incorporates error associated with both the numerator (SRFS Gulfk estimates) and denominator (SRFS Gulf estimates) for the ratio calculation and the error of the ratio and the MRIP estimate in the final calibrated estimates calculations.

Once the full SRFS time series was calibrated to Gulf with the Keys currency, estimates and variances for each estimation method (where *m = SRFS or FCAL*) were summed, using equation 1 above, across years (*y*), months (*n*), areas fished (*a*: federal or state waters), regions (*r*: FLpan or FLwest), and season (*s*: open or closed) for each estimate type variable (*v*: number landed, pounds landed, number released, angler trips). This resulted in four paired overall sums for SRFS Gulfk and FCAL estimates (Table 2). For this calibration, the SRFS sum was divided by the MRIP-FCAL sum to produce a second ratio that could be applied to MRIP-FCAL estimates prior to 2016, before SRFS estimates were available.

$$\hat{R}_{v} = \frac{\hat{E}_{SRFS,v}}{\hat{E}_{FCAL,v}} \text{ [6]}$$

Historic MRIP FES estimates were converted to SRFS currency by multiplying the annual FCAL estimate for each year, region, season, and variable type (number landed, pounds landed, number released, number of trips) with the corresponding ratio [6]:

$$\hat{E}_{SRFS-hind,y,r,s,v} = \hat{R}_{v}\hat{E}_{FCAL,y,r,s,v} \text{ [6]}$$

The delta method was once again used to approximate the variance of the ratios and the final calibrated estimates. The R statistical software package ‘msm’ (R Core Team 2023; Jackson 2011) was used to carry out variance calculations.

MRIP and SRFS use separate methods to calculate fishing effort (angler trips); however, catch estimates from the two surveys are not completely independent. To estimate catch-per-unit-effort (CPUE), the MRIP survey uses data from the Access Point Angler Intercept Survey (APAIS), whereas the GRFS uses a combination of data from the APAIS and supplemental reef fish angler

intercepts. Assignments for both intercept surveys are drawn together so that sample weights are compatible (Foster, 2018). Although SRFS and MRIP estimates are derived from survey data that are not completely independent, the strength of correlation between estimates from the two surveys is unknown. Additionally, SRFS Gulf and SRFS Gulfk estimates are correlated as both are generated by the same survey and generate estimates for a highly overlapped spatial distribution. For both calibrations we assumed a 0% correlation. This approximation of variance is the most conservative as it provides the highest error estimate and this method was recommended by peer review (Cross et al. 2020, Ramsay, NOAA OS&T et al. 2024).

Findings and Conclusions

Figures 2-5 show the different time-series of estimates that are discussed throughout this document.

For the years in which SRFS estimates included the Gulf Keys, the ratios of Red Snapper estimates with and without the Gulf Keys are provided in Table 1. When converting SRFS Gulf to SRFS Gulfk currency to account for additional trips, landings, and releases from the Gulf Keys, estimates were increased by 0.5% for the estimates of landings, 0.2% for estimates of releases, and 4.5% for the estimates of effort (Table 2). The average PSE value for this calibration was 53% for landings and releases and 6% for effort (Table 2).

For the years in which the SRFS and MRIP overlap, ratios of summed SRFS and FCAL estimates, and approximated variance for each ratio are provided in Table 3. When converting MRIP FES estimates to SRFS currency, estimates decreased by 62% for landings, 61% for releases, and 56% for effort. The average PSE value for this calibration was 52% for landings and releases and 9% for effort (Table 4 and 5). The average PSE values for this calibration are higher than those traditionally provided by either the SRFS or MRIP survey due to breaking the landings and releases estimates into finer annual/region/season scales. The SRFS and MRIP surveys traditionally provide estimates at an annual scale.

The purpose of this report was to document the method used to convert FCAL estimates to SRFS estimates for use in the SEDAR 98 Red Snapper stock assessment in the Gulf of Mexico. Results presented in this report include data collected over 96 months (2016-2023). The two surveys continue to run concurrently in Florida. Calibration factors that include the complete available time-series of overlapping data may be routinely updated and shared as needed.

References

Cross, T. A., C.P. Shea, and B. Sauls. 2020. A ratio-based method for calibrating GRFS and MRIP-FCAL estimates of total landings (numbers and pounds of fish), and releases (numbers of fish). Florida Fish and Wildlife Conservation Commission. Report prepared for the Gulf of Mexico Fishery Management Council Scientific and Statistical Committee, August 11-12, 2020.

Foster, J. 2018. Integration of GRFS Intercept and APAIS. Presentation given at the Florida Gulf Reef Fish Survey Review Workshop. February 6, 2018, St. Petersburg, FL. Available on request.

Jackson, C. H. 2011. Multi-State Models for Panel Data: The msm Package for R. Journal of Statistical Software 38(8): 1-29. http://www.jstatsoft.org/v38/i08/ See also: https://cran.r-project.org/web/packages/msm/msm.pdf

R Core Team. 2023. R: A language and environment for statistical computing. R Foundation for Statistical Computing. Vienna, Austria. http://www.R-project.org/

Ramsay, Chloe, Tiffanie A. Cross, Colin P. Shea, and Beverly Sauls. 2024a. A ratio-based method for calibrating MRIP-SRFS recreational fisheries estimates for southeastern US Mutton Snapper (Lutjanus analis). SEDAR79-AP02. SEDAR, North Charleston, SC. 17 pp.

Ramsay, Chloe, Tiffanie A. Cross, Colin P. Shea, and Beverly Sauls. 2024b. A ratio-based method for calibrating estimates of total landings (numbers and pounds of fish), releases (numbers of fish), and total trips from MRIP-FCAL to SRFS for Red Grouper (Epinephelus morio) in the Gulf of Mexico. SEDAR88-WP-17. SEDAR, North Charleston, SC. 14 pp.

Ramsay, Chloe, Tiffanie A. Cross, Colin P. Shea, and Beverly Sauls. 2024c. A ratio-based method for calibrating MRIP-SRFS recreational fisheries estimates for southeastern US Yellowtail Snapper (Ocyurus chrysurus). SEDAR96-WP-05. SEDAR, North Charleston, SC. 14 pp.

Ramsay, Chloe, Tiffanie A. Cross, Colin P. Shea, Beverly Sauls, Lynn Stokes, Robert Ahrens, Evan Howell, Clay Porch, Andy Strelcheck. 2024. (Ramsay, NOAA OS&T 2024). Certification Review of Florida's Proposed MRIP-SRFS Calibration Methodology for Mutton and Yellowtail Snapper. SEDAR79-RD-09, 50pp. https://sedarweb.org/documents/sedar-rd09-certification-review-of-floridas-proposed-mrip-srfs-calibration-methodology-for-mutton-and-yellowtail-snapper/

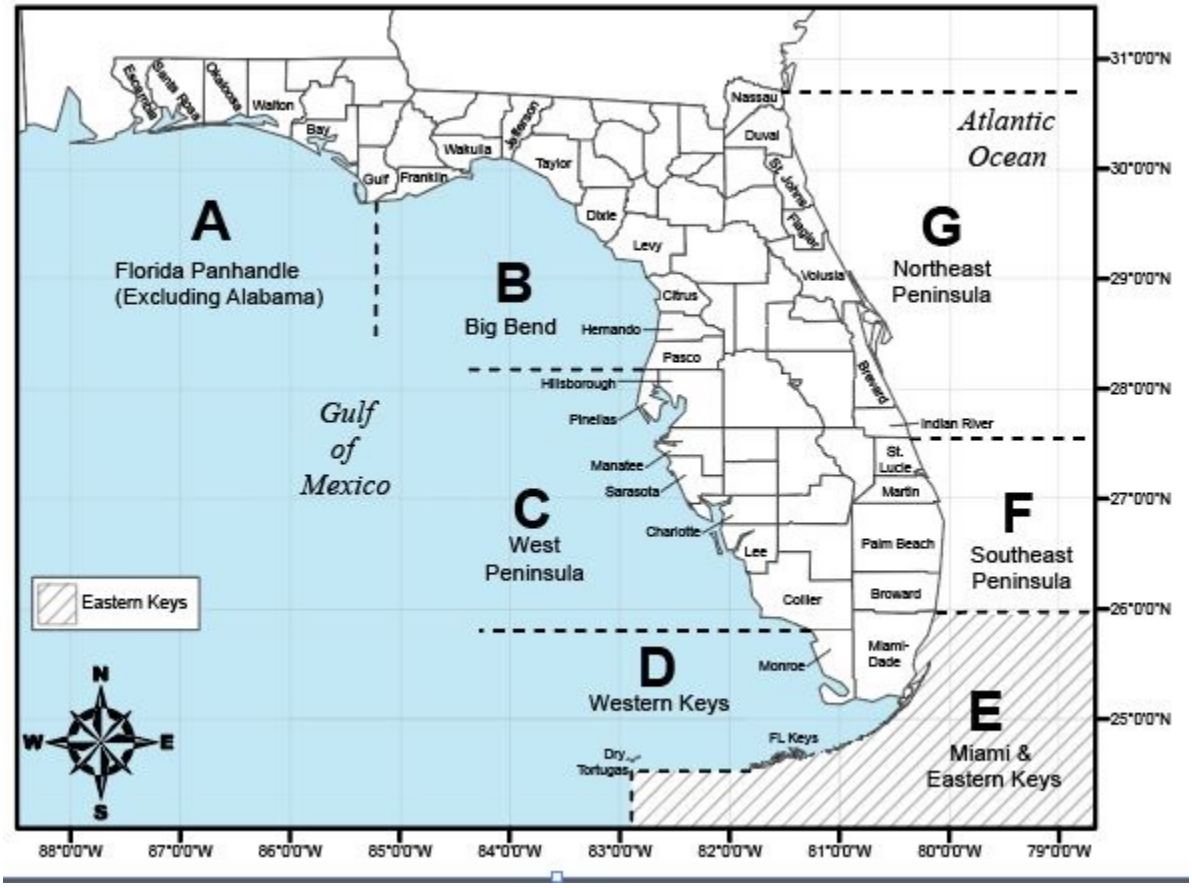


Figure 1. Regions of the state of Florida as designated by the State Reef Fish Survey (SRFS). For the purposes of this calibration, the Gulf with the Keys is defined as regions A-D.

Table 1. Annual and summed SRFS Gulf and SRFS Gulf with the Gulf Keys (Monroe County & the Keys north of the island chain/U.S. 1; Gulfk) estimates (sum) and variances (var) and ratios of SRFS Gulf to SRFS Gulfk estimates are shown for Red Snapper (*Lutjanus campechanus*) in Florida. Estimates for effort (number of trips) are for the whole suite of species covered by the original GRFS survey, including Red Snapper.

Estimate Type	Year	SRFS Gulfk Sum	SRFS Gulfk Var	SRFS Gulf Sum	SRFS Gulf Var	Ratio
Landings (lbs)	2021	2,798,345	324,580,849,752	2,798,345	324,580,849,752	0.0215
	2022	1,505,430	55,585,905,028	1,476,555	53,470,836,613	
	2023	2,039,418	48,022,477,951	2,039,418	48,022,477,951	
	Total	6,343,194	428,189,232,732	6,314,318	426,074,164,317	
Landings (no. fish)	2021	380,115	6,067,400,975	380,115	6,067,400,975	0.0251
	2022	242,167	1,935,724,360	237,844	1,885,453,185	
	2023	328,764	3,197,472,544	328,764	3,197,472,544	
	Total	951,045	11,200,597,879	946,723	11,150,326,704	
Releases (no. fish)	2021	1,325,034	22,292,077,176	1,325,034	22,292,077,176	0.0113
	2022	1,285,248	30,515,791,500	1,285,248	30,515,791,500	
	2023	734,225	10,254,813,426	728,739	10,211,413,501	
	Total	3,344,507	63,062,682,101	3,339,021	63,019,282,176	
Effort (no. trips): for all SRFS species	2021	1,495,099	4,036,979,055	1,441,954	3,903,127,208	0.0017
	2022	1,058,123	2,386,680,608	1,004,239	2,271,303,968	
	2023	922,297	2,556,260,952	878,852	2,455,654,146	
	Total	3,475,519	8,979,920,615	3,325,045	8,630,085,322	

Table 2. Historic SRFS Gulf estimates and estimates converted to SRFS Gulf with the Gulf Keys (Monroe County & the Keys north of the island chain/U.S. 1; Gulfk) currency (Calibrated: SRFS Gulf to SRFS Gulfk) for Red Snapper (*Lutjanus campechanus*) in Florida. Estimates are calculated by FL region (Pan: MS to Levy County or West: Citrus-Monroe Counties), season (open or closed), and year for all estimate types except effort. Estimates for effort (number of trips) are for the whole suite of species covered by the original GRFS survey, including Red Snapper and are not broken down by region and season as the final calibration is only at the annual scale. Associated standard error (PSE) is presented for the 0% correlation used to calculate variance for the calibration factor (ratio of SRFS Gulf to SRFS Gulfk).

Year	Region	Season	SRFS Gulf		SRFS Gulf - SRFS Gulfk calibration		SRFS Gulf		SRFS Gulf - SRFS Gulfk calibration	
			Landings (no.fish)	PSE	Landings (no. fish)	PSE	Landings (pounds)	PSE	Landings (pounds)	PSE
2016	Pan	open	273,041	15.5	274,288	22.1	1,282,783	9.8	1,288,650	17.6
		closed	12,844	47.3	12,903	49.9	61,734	33.3	62,017	36.4
	West	open	11,879	58.4	11,933	60.5	53,479	42.7	53,724	45.1
		closed	1,091	130.0	1,096	130.9	7,092	62.1	7,124	63.8
2017	Pan	open	481,144	12.3	483,340	20.0	2,375,789	8.5	2,386,654	16.9
		closed	11,946	58.0	12,000	60.1	85,417	38.8	85,808	41.4
	West	open	35,490	44.8	35,652	47.5	162,151	34.1	162,893	37.1
		closed	0	NA	0	NA	0	NA	0	NA
2018	Pan	open	407,557	12.1	409,418	19.8	1,879,969	8.4	1,888,566	16.9
		closed	2,141	81.3	2,151	82.8	2,402	105.2	2,413	106.2
	West	open	40,375	37.3	40,560	40.5	214,952	26.4	215,935	30.2
		closed	365	389.9	367	390.2	1,417	306.2	1,423	306.5
2019	Pan	open	231,987	21.4	233,046	26.5	1,150,816	12.6	1,156,078	19.3
		closed	808	149.0	812	149.8	3,282	119.1	3,297	119.9
	West	open	18,036	72.3	18,118	74.0	92,248	43.9	92,670	46.2
		closed	0	NA	0	NA	0	NA	0	NA
2020	Pan	open	258,576	11.9	259,756	19.7	1,259,933	8.2	1,265,695	16.7
		closed	7,730	85.7	7,765	87.1	32,161	57.8	32,308	59.6
	West	open	18,392	49.2	18,476	51.6	106,763	30.4	107,251	33.8
		closed	0	NA	0	NA	0	NA	0	NA

Table 2 cont.

Year	Region	Season	SRFS Gulf		SRFS Gulf - SRFS Gulfk calibration		SRFS Gulf		SRFS Gulf - SRFS Gulfk calibration	
			Releases (no.fish)	PSE	Releases (no. fish)	PSE	Effort (no. trips)	PSE	Effort (no. trips)	PSE
2016	Pan	open	450,420	18.6	451,160	21.4	1,173,293	5.1	1,226,390	6.4
		closed	681,683	21.4	682,803	23.9				
	West	open	27,716	71.5	27,762	72.3				
		closed	106,632	41.4	106,807	42.7				
2017	Pan	open	964,261	12.3	965,845	16.3	1,328,974	4.6	1,389,116	6.1
		closed	836,342	17.9	837,716	20.8				
	West	open	66,778	45.7	66,888	46.9				
		closed	37,361	57.1	37,422	58.1				
2018	Pan	open	797,254	14.9	798,563	18.3	1,116,802	4.4	1,167,343	5.9
		closed	711,472	20.7	712,641	23.2				
	West	open	54,633	52.7	54,722	53.7				
		closed	82,582	37.0	82,717	38.5				
2019	Pan	open	388,308	40.7	388,946	42.1	1,027,168	4.8	1,073,652	6.2
		closed	763,395	14.9	764,649	18.3				
	West	open	26,250	124.0	26,293	124.4				
		closed	106,434	26.0	106,609	28.1				
2020	Pan	open	464,235	20.4	464,998	23.0	1,223,317	3.5	1,278,678	5.3
		closed	551,020	17.8	551,925	20.8				
	West	open	21,647	56.6	21,683	57.6				
		closed	110,158	28.7	110,339	30.6				

Table 3. Annual and summed SRFS Gulf with the Keys (Monroe County) and MRIP estimates (sum) and variances (var) and ratios of MRIP to SRFS estimates are shown for Red Snapper (*Lutjanus campechanus*) in Florida. Estimates for effort (number of trips) are for the whole suite of species covered by the original GRFS survey, including Red Snapper.

Estimate Type	Year	SRFS Sum	SRFS Var	MRIP Sum	MRIP Var	Ratio
Landings (lbs)	2016	1,411,514	59,304,189,433	3,290,551	296,181,853,646	0.3817
	2017	2,635,354	193,499,574,268	6,698,077	2,221,025,762,908	
	2018	2,108,337	123,361,715,736	4,679,191	1,949,317,541,533	
	2019	1,252,046	56,431,600,445	5,198,177	2,506,098,618,936	
	2020	1,405,254	54,201,894,194	3,288,768	786,184,946,782	
	2021	2,798,345	324,580,849,752	5,186,791	3,128,104,738,753	
	2022	1,505,430	55,585,905,028	5,248,792	1,648,313,495,520	
	2023	2,039,418	48,022,477,951	6,116,190	1,893,567,986,297	
	Total	15,155,698	914,988,206,807	39,706,537	14,428,794,944,375	
Landings (no. fish)	2016	300,220	4,138,863,272	669,649	12,753,214,916	0.3812
	2017	530,992	10,836,138,609	1,366,131	89,553,980,496	
	2018	452,495	7,756,726,665	1,008,547	89,938,715,391	
	2019	252,171	4,229,090,585	1,009,962	96,575,905,522	
	2020	285,998	3,111,001,108	689,465	33,141,269,245	
	2021	380,115	6,067,400,975	792,565	71,627,268,805	
	2022	242,167	1,935,724,360	872,739	43,920,703,368	
	2023	328,764	3,197,472,544	864,814	36,917,501,272	
	Total	2,772,922	41,272,418,118	7,273,872	474,428,559,015	
Releases (no. fish)	2016	1,268,531	49,003,533,984	3,201,978	442,875,883,815	0.3898
	2017	1,907,872	79,053,766,589	5,589,109	839,958,808,071	
	2018	1,648,645	68,212,638,167	3,844,005	416,913,824,410	
	2019	1,286,497	58,561,912,872	3,878,676	398,687,431,824	
	2020	1,148,945	34,741,117,241	2,477,918	127,677,247,171	
	2021	1,325,034	22,292,077,176	2,590,938	159,340,092,793	
	2022	1,285,248	30,515,791,500	3,732,689	369,967,258,288	
	2023	734,225	10,254,813,426	1,888,273	63,223,748,123	
	Total	10,604,996	352,635,650,955	27,203,586	2,818,644,294,494	
Effort (no. trips): for all GRFS species	2016	1,226,390	6,136,992,859	2,811,912	34,514,456,116	0.4376
	2017	1,389,116	7,111,313,893	3,211,779	93,077,396,135	
	2018	1,167,343	4,738,496,259	3,037,135	137,917,081,635	
	2019	1,073,652	4,411,682,597	2,560,975	66,489,382,954	
	2020	1,278,678	4,520,455,483	2,819,407	45,937,410,789	
	2021	1,495,099	4,036,979,055	2,227,028	31,123,556,165	
	2022	1,058,123	2,386,680,608	2,523,539	46,023,175,056	
	2023	922,297	2,556,260,952	2,769,065	31,050,194,870	
	Total	9,610,699	35,898,861,706	21,960,840	486,132,653,720	

Table 4. Original and calibrated MRIP-FCAL estimates for Red Snapper (*Lutjanus campechanus*) landings in Florida.

Year	Region	Season	MRIP-FCAL		SRFS-FCAL calibration		MRIP-FCAL		SRFS-FCAL calibration	
			Landings (no.fish)	PSE	Landings (no. fish)	PSE	Landings (pounds)	PSE	Landings (pounds)	PSE
1981	Pan	open	195,686	56	74,599	57.3	321,186	57.1	122,594	58.23
		closed	0	NA	0	NA	0	NA	0	NA
	West	open	568,244	64	216,624	65	968,168	64.4	369,543	65.43
		closed	0	NA	0	NA	0	NA	0	NA
1982	Pan	open	166,151	52	63,340	53.4	380,338	52.7	145,172	53.89
		closed	0	NA	0	NA	0	NA	0	NA
	West	open	11,959	80	4,559	80.9	29,420	86.4	11,229	87.18
		closed	0	NA	0	NA	0	NA	0	NA
1983	Pan	open	0	NA	0	NA	0	NA	0	NA
		closed	0	NA	0	NA	0	NA	0	NA
	West	open	580,760	100	221,395	101	1,294,876	100	494,245	101
		closed	0	NA	0	NA	0	NA	0	NA
1984	Pan	open	7,350	100	2,802	101	15,729	100	6,004	100.7
		closed	0	NA	0	NA	0	NA	0	NA
	West	open	21,342	72	8,136	73	45,675	74.4	17,434	75.2
		closed	0	NA	0	NA	0	NA	0	NA
1985	Pan	open	205,133	85	78,200	85.8	603,885	85.2	230,499	86.0
		closed	0	NA	0	NA	0	NA	0	NA
	West	open	157,060	71	59,874	72	445,067	71.8	169,879	72.7
		closed	0	NA	0	NA	0	NA	0	NA
1986	Pan	open	35,850	49	13,667	50.4	97,792	49.4	37,326	50.8
		closed	0	NA	0	NA	0	NA	0	NA
	West	open	181,242	50	69,092	51.4	494,520	50.3	188,755	51.6
		closed	0	NA	0	NA	0	NA	0	NA
1987	Pan	open	229,418	24	87,458	26.8	631,636	24.6	241,091	27.1
		closed	0	NA	0	NA	0	NA	0	NA
	West	open	106,125	53	40,457	54.3	314,634	53.9	120,094	55.1
		closed	0	NA	0	NA	0	NA	0	NA
1988	Pan	open	138,833	69	52,925	70	448,281	69.4	171,106	70.3
		closed	0	NA	0	NA	0	NA	0	NA
	West	open	49,105	49	18,720	50.4	167,438	51.4	63,910	52.6
		closed	0	NA	0	NA	0	NA	0	NA

Table 4 cont.

Year	Region	Season	MRIP-FCAL		SRFS-FCAL calibration		MRIP-FCAL		SRFS-FCAL calibration	
			Landings (no.fish)	PSE	Landings (no. fish)	PSE	Landings (pounds)	PSE	Landings (pounds)	PSE
1989	Pan	open	77,867	48	29,684	49.5	172,456	52.3	65,825	53.5
		closed	0	NA	0	NA	0	NA	0	NA
	West	open	142,386	69	54,280	70.0	322,181	69.5	122,974	70.4
		closed	0	NA	0	NA	0	NA	0	NA
1990	Pan	open	31,566	67	12,033	68.1	111,077	67.8	42,397	68.8
		closed	0	NA	0	NA	0	NA	0	NA
	West	open	42,071	53	16,038	54.3	148,042	56.3	56,507	57.4
		closed	0	NA	0	NA	0	NA	0	NA
1991	Pan	open	44,622	61	17,011	62.2	174,601	62.3	66,644	63.3
		closed	0	NA	0	NA	0	NA	0	NA
	West	open	17,216	61	6,563	62.2	67,366	65	25,713	66.0
		closed	0	NA	0	NA	0	NA	0	NA
1992	Pan	open	87,785	77	33,465	77.9	253,082	77.2	96,600	78.1
		closed	0	NA	0	NA	0	NA	0	NA
	West	open	3,580	71	1,365	72.0	10,015	77.8	3,823	78.6
		closed	0	NA	0	NA	0	NA	0	NA
1993	Pan	open	216,753	47	82,630	48.5	612,274	47.5	233,701	48.8
		closed	0	NA	0	NA	0	NA	0	NA
	West	open	0	NA	0	NA	0	NA	0	NA
		closed	0	NA	0	NA	0	NA	0	NA
1994	Pan	open	228,282	78	87,025	78.9	1,526,807	78.5	582,771	79.4
		closed	0	NA	0	NA	0	NA	0	NA
	West	open	0	NA	0	NA	0	NA	0	NA
		closed	0	NA	0	NA	0	NA	0	NA
1995	Pan	open	71,247	92	27,161	92.8	333,351	92.2	127,238	92.9
		closed	0	NA	0	NA	0	NA	0	NA
	West	open	3,298	100	1,257	100.7	15,433	100	5,891	100.7
		closed	0	NA	0	NA	0	NA	0	NA
1996	Pan	open	45,701	52	17,422	53.4	112,099	52.5	42,787	53.7
		closed	0	NA	0	NA	0	NA	0	NA
	West	open	36,610	64	13,956	65.1	96,980	64.7	37,017	65.7
		closed	0	NA	0	NA	0	NA	0	NA

Table 4 cont.

Year	Region	Season	MRIP-FCAL		SRFS-FCAL calibration		MRIP-FCAL		SRFS-FCAL calibration	
			Landings (no.fish)	PSE	Landings (no. fish)	PSE	Landings (pounds)	PSE	Landings (pounds)	PSE
1997	Pan	open	76,626	50	29,211	51.4	192,107	50.8	73,326	52.1
		closed	0	NA	0	NA	0	NA	0	NA
	West	open	0	NA	0	NA	0	NA	0	NA
		closed	0	NA	0	NA	0	NA	0	NA
1998	Pan	open	132,522	47	50,520	48.5	440,824	48.1	168,259	49.5
		closed	27,064	47	10,317	48.5	90,027	47.9	34,363	49.2
	West	open	0	NA	0	NA	0	NA	0	NA
		closed	0	NA	0	NA	0	NA	0	NA
1999	Pan	open	667,081	39	254,302	40.8	2,127,191	39.1	811,933	40.8
		closed	32,965	39	12,567	40.8	109,845	39.8	41,927	41.4
	West	open	11,548	52	4,402	53.4	39,730	52.4	15,165	53.6
		closed	0	NA	0	NA	0	NA	0	NA
2000	Pan	open	400,017	31	152,493	33.2	1,309,845	31.2	499,958	33.2
		closed	120,508	31	45,940	33.2	462,836	32.4	176661.2	34.4
	West	open	0	NA	0	NA	0	NA	0	NA
		closed	2,321	100	885	100.7	8,914	100	3,402	100.7
2001	Pan	open	743,851	29	283,568	31.4	3,666,460	29.3	1,399,461	31.4
		closed	253,108	29	96,489	31.4	1,221,068	30	466,073	32.1
	West	open	0	NA	0	NA	0	NA	0	NA
		closed	0	NA	0	NA	0	NA	0	NA
2002	Pan	open	1,094,065	28	417,076	30.5	4,260,276	28.2	1,626,117	30.4
		closed	0	NA	0	NA	0	NA	0	NA
	West	open	1,124	72	428	73.0	4,492	74.4	1,715	75.2
		closed	6,585	72	2,510	73.0	25,700	72.2	9,810	73.1
2003	Pan	open	839,863	25	320,170	27.7	2,984,184	25.2	1,139,041	27.7
		closed	20,671	25	7,880	27.7	73,784	26.7	28,163	29.0
	West	open	2,828	80	1,078	80.9	10,343	80.1	3,948	80.9
		closed	0	NA	0	NA	0	NA	0	NA
2004	Pan	open	1,200,000	35	457,460	37.0	3,845,069	35.1	1,467,635	36.9
		closed	0	NA	0	NA	0	NA	0	NA
	West	open	7,039	92	2,683	92.8	22,213	92.1	8,479	92.8
		closed	0	NA	0	NA	0	NA	0	NA

Table 4 cont.

Year	Region	Season	MRIP-FCAL		SRFS-FCAL calibration		MRIP-FCAL		SRFS-FCAL calibration	
			Landings (no.fish)	PSE	Landings (no. fish)	PSE	Landings (pounds)	PSE	Landings (pounds)	PSE
2005	Pan	open	527,106	32	200,942	34.2	2,024,749	32.3	772,832	34.3
		closed	84,519	32	32,220	34.2	286,244	33.8	109,257	35.7
	West	open	81,014	60	30,884	61.2	390,336	60.3	148,988	61.4
		closed	0	NA	0	NA	0	NA	0	NA
2006	Pan	open	803,035	23	306,130	25.9	2,539,609	23.2	969,350	25.9
		closed	49,391	23	18,829	25.9	202,998	26.8	77,483	29.1
	West	open	18,542	79	7,069	79.9	59,250	79	22,615	79.9
		closed	0	NA	0	NA	0	NA	0	NA
2007	Pan	open	1,108,577	26	422,608	28.6	3,405,913	26.1	1,300,012	28.5
		closed	175,607	26	66,944	28.6	587,490	26.8	224,241	29.1
	West	open	41,336	82	15,758	82.9	142,701	82.3	54,468	83.1
		closed	0	NA	0	NA	0	NA	0	NA
2008	Pan	open	372,348	21	141,945	24.2	1,753,285	21.3	669,216	24.2
		closed	279,505	21	106,552	24.2	1,100,088	21.3	419,896	24.1
	West	open	5,624	100	2,144	100.7	28,942	100	11,047	100.7
		closed	0	NA	0	NA	0	NA	0	NA
2009	Pan	open	782,890	26	298,451	28.6	2,901,068	26.1	1,107,317	28.5
		closed	13,354	26	5,091	28.6	49,791	36.9	19,005	38.6
	West	open	17,792	60	6,783	61.2	56,809	61.1	21,684	62.2
		closed	1,142	60	435	61.2	4,324	60	1,650	61.1
2010	Pan	open	799,003	35	304,593	37.0	3,841,335	35.1	1,466,210	36.9
		closed	0	NA	0	NA	0	0	0	NA
	West	open	1,842	72	702	73.0	12,177	75.8	4,648	76.6
		closed	1,357	72	517	73.0	7,611	73.7	2,905	74.6
2011	Pan	open	628,690	26	239,667	28.6	3,356,632	26.1	1,281,202	28.5
		closed	13,500	26	5,146	28.6	71,751	27.5	27,387	29.7
	West	open	15,121	66	5,764	67.1	75,318	66.2	28,748	67.2
		closed	1,269	66	484	67.1	6,160	66	2,351	67.0
2012	Pan	open	673,952	27	256,922	29.5	4,295,670	27.1	1,639,626	29.5
		closed	11,920	27	4,544	29.5	76,357	47.8	29,145	49.2
	West	open	13,612	72	5,189	73.0	87,519	72.9	33,405	73.7
		closed	1,028	72	392	73.0	7,269	72	2,775	72.9

Table 4 cont.

Year	Region	Season	MRIP-FCAL		SRFS-FCAL calibration		MRIP-FCAL		SRFS-FCAL calibration	
			Landings (no.fish)	PSE	Landings (no. fish)	PSE	Landings (pounds)	PSE	Landings (pounds)	PSE
2013	Pan	open	1,261,766	46	481,006	47.5	7,187,321	46.1	2,743,348	47.5
		closed	87,806	46	33,473	47.5	399,395	46.7	152,446	48.1
	West	open	908	79	346	79.9	6,442	79	2,459	79.8
		closed	2,666	`79	1,016	79.9	15,015	80	5,731	80.8
2014	Pan	open	251,116	24	95,730	26.8	1,631,719	24.2	622,815	26.8
		closed	279,219	24	106,443	26.8	1,531,198	24.2	584,447	26.8
	West	open	5,175	75	1,973	76.0	35,204	76	13,437	76.9
		closed	0	NA	0	NA	0	NA	0	NA
2015	Pan	open	75,334	27	28,719	29.5	518,495	27.3	197,906	29.6
		closed	365,667	27	139,398	29.5	1,800,691	27.3	687,311	29.6
	West	open	1,901	100	725	100.7	14,097	100	5,381	100.7
		closed	0	NA	0	NA	0	NA	0	NA

Table 5. Original and calibrated MRIP-FCAL estimates for Red Snapper (*Lutjanus campechanus*) releases and reef fish effort in Florida. Estimates for effort (number of angler trips) are for the whole suite of species covered by the original GRFS survey, including Red Snapper.

Year	Region	Season	MRIP-FCAL		SRFS-FCAL calibration		MRIP-FCAL		SRFS-FCAL calibration	
			Releases (no.fish)	PSE	Releases (no. fish)	PSE	Effort (no. trips)	PSE	Effort (no. trips)	PSE
1981	Pan	open	95,402	71	37,191	71.5	NA	NA	NA	NA
		closed	0	NA	0	NA				
	West	open	76,357	71	29,767	71.5				
		closed	0	NA	0	NA				
1982	Pan	open	7,349	100	2,865	100	1,316,720	15.6	576,235	16.0
		closed	0	NA	0	NA				
	West	open	0	NA	0	NA				
		closed	0	NA	0	NA				
1983	Pan	open	0	NA	0	NA	1,467,835	13.8	642,367	14.3
		closed	0	NA	0	NA				
	West	open	0	NA	0	NA				
		closed	0	NA	0	NA				
1984	Pan	open	0	NA	0	NA	2,383,587	6.6	1,043,127	7.6
		closed	0	NA	0	NA				
	West	open	82,405	79	32,125	79.4				
		closed	0	NA	0	NA				
1985	Pan	open	925	100	361	100	899,153	17.9	393,495	18.3
		closed	0	NA	0	NA				
	West	open	41,324	81	16,110	81.4				
		closed	0	NA	0	NA				
1986	Pan	open	0	NA	0	NA	1,250,506	10.9	547,258	11.5
		closed	0	NA	0	NA				
	West	open	11,688	71	4,556	71.5				
		closed	0	NA	0	NA				
1987	Pan	open	52,291	38	20,385	38.9	1,500,475	8.6	656,651	9.4
		closed	0	NA	0	NA				
	West	open	3,103	71	1,210	71.5				
		closed	0	NA	0	NA				
1988	Pan	open	6,710	59	2,616	59.6	1,583,456	7.9	692,966	8.7
		closed	0	NA	0	NA				
	West	open	35,687	48	13,912	48.7				
		closed	0	NA	0	NA				

Table 5 cont.

Year	Region	Season	MRIP-FCAL		SRFS-FCAL calibration		MRIP-FCAL		SRFS-FCAL calibration	
			Releases (no.fish)	PSE	Releases (no.fish)	PSE	Effort (no. trips)	PSE	Effort (no. trips)	PSE
1989	Pan	open	145,390	73	56,679	73.5	2,308,490	7.6	1,010,262	8.5
		closed	0	NA	0	NA				
	West	open	7,022	71	2,737	71.5				
		closed	0	NA	0	NA				
1990	Pan	open	1,907	100	743	100.3	1,442,141	9.7	631,123	10.4
		closed	0	NA	0	NA				
	West	open	21,540	100	8,397	100.3				
		closed	0	NA	0	NA				
1991	Pan	open	75,974	83	29,618	83.4	2,076,512	6.9	908,742	7.9
		closed	0	NA	0	NA				
	West	open	78,277	42	30,515	42.8				
		closed	0	NA	0	NA				
1992	Pan	open	107,224	93	41,800	93.4	1,799,317	5.5	787,433	6.7
		closed	0	NA	0	NA				
	West	open	80,073	44	31,216	44.8				
		closed	0	NA	0	NA				
1993	Pan	open	385,565	58	150,308	58.6	2,165,435	7.1	947,657	8.0
		closed	0	NA	0	NA				
	West	open	29,726	47	11,588	47.7				
		closed	0	NA	0	NA				
1994	Pan	open	141,241	65	55,061	65.5	2,134,176	6.8	933,977	7.8
		closed	0	NA	0	NA				
	West	open	38,864	59	15,151	59.6				
		closed	0	NA	0	NA				
1995	Pan	open	0	NA	0	NA	2,323,872	6.1	1,016,994	7.1
		closed	0	NA	0	NA				
	West	open	13,967	78	5,445	78.4				
		closed	0	NA	0	NA				
1996	Pan	open	151,215	51	58,949	51.7	2,080,984	6.9	910,699	7.8
		closed	0	NA	0	NA				
	West	open	35,811	49	13,960	49.7				
		closed	0	NA	0	NA				

Table 5 cont.

Year	Region	Season	MRIP-FCAL		SRFS-FCAL calibration		MRIP-FCAL		SRFS-FCAL calibration	
			Releases (no.fish)	PSE	Releases (no.fish)	PSE	Effort (no. trips)	PSE	Effort (no. trips)	PSE
1997	Pan	open	745,068	62	290,456	62.5	2,510,440	5.8	1,098,641	6.9
		closed	0	NA	0	NA				
	West	open	25,990	100	10,132	100.3				
		closed	0	NA	0	NA				
1998	Pan	open	243,275	47	94,838	47.7	2,357,915	4.8	1,031,892	6.1
		closed	159,457	47	62,162	47.7				
	West	open	12,660	59	4,935	59.6				
		closed	52,945	59	20,640	59.6				
1999	Pan	open	1,316,566	33	513,248	34.1	3,007,468	5.3	1,316,155	6.5
		closed	230,248	33	89,759	34.0				
	West	open	26,440	46	10,307	46.7				
		closed	23,419	46	9,130	46.7				
2000	Pan	open	539,885	43	210,468	43.8	2,543,838	5.0	1,113,257	6.3
		closed	594,717	43	231,843	43.8				
	West	open	66,169	69	25,795	69.5				
		closed	1,556	69	607	69.5				
2001	Pan	open	1,309,026	27	510,308	28.3	3,653,718	7.0	1,598,973	7.9
		closed	1,403,845	27	547,272	28.3				
	West	open	5,729	100	2,233	100.4				
		closed	0	NA	0	NA				
2002	Pan	open	2,319,207	33	904,115	34.0	3,415,614	6.5	1,494,771	7.5
		closed	1,533,109	33	597,664	34.0				
	West	open	6,874	100	2,680	100.3				
		closed	0	NA	0	NA				
2003	Pan	open	1,805,668	26	703,918	27.3	3,643,943	6.6	1,594,695	7.6
		closed	1,420,516	26	553,771	27.3				
	West	open	2,069	72	807	72.5				
		closed	2,920	72	1,138	72.5				
2004	Pan	open	2,554,155	25	995,707	26.4	4,933,291	7.3	2,158,951	8.2
		closed	782,954	25	305,225	26.4				
	West	open	92,594	75	36,097	75.5				
		closed	0	NA	0	NA				

Table 5 cont.

Year	Region	Season	MRIP-FCAL		SRFS-FCAL calibration		MRIP-FCAL		SRFS-FCAL calibration	
			Releases (no.fish)	PSE	Releases (no.fish)	PSE	Effort (no. trips)	PSE	Effort (no. trips)	PSE
2005	Pan	open	1,368,543	25	533,510	26.3	3,607,206	7.2	1,578,618	8.2
		closed	988,232	25	385,251	26.4				
	West	open	92,921	48	36,224	48.7				
		closed	36,258	48	14,135	48.7				
2006	Pan	open	2,423,058	20	944,601	21.7	3,140,577	8.1	1,374,407	8.9
		closed	513,133	20	200,039	21.7				
	West	open	30,938	54	12,061	54.6				
		closed	24,378	54	9,503	54.6				
2007	Pan	open	3,148,748	18	1,227,502	19.8	3,642,926	7.3	1,594,250	8.2
		closed	866,224	18	337,687	19.8				
	West	open	43,270	52	16,868	52.7				
		closed	0	NA	0	NA				
2008	Pan	open	586,863	25	228,782	26.4	4,358,518	5.5	1,907,414	6.7
		closed	2,349,764	25	916,028	26.3				
	West	open	7,229	62	2,818	62.6				
		closed	33,252	62	12,963	62.6				
2009	Pan	open	1,237,123	19	482,278	20.7	3,864,931	5.6	1,691,406	6.7
		closed	1,155,882	19	450,607	20.7				
	West	open	40,073	67	15,622	67.5				
		closed	62,761	67	24,467	67.5				
2010	Pan	open	1,427,856	25	556,633	26.3	3,597,949	6.6	1,574,567	7.6
		closed	1,687,966	25	658,034	26.3				
	West	open	24,026	56	9,366	56.6				
		closed	105,442	56	41,105	56.6				
2011	Pan	open	819,093	22	319,314	23.5	2,974,699	6.7	1,301,814	7.7
		closed	1,595,389	22	621,944	23.5				
	West	open	14,601	98	5,692	98.4				
		closed	1,485,977	98	579,291	98.3				
2012	Pan	open	930,989	18	362,935	19.8	3,484,099	7.1	1,524,742	8.1
		closed	2,534,130	18	987,901	19.8				
	West	open	14,288	100	5,570	100.3				
		closed	0	NA	0	NA				

Table 5 cont.

Year	Region	Season	MRIP-FCAL		SRFS-FCAL calibration		MRIP-FCAL		SRFS-FCAL calibration	
			Releases (no.fish)	PSE	Releases (no.fish)	PSE	Effort (no. trips)	PSE	Effort (no. trips)	PSE
2013	Pan	open	2,459,756	41	958,907	41.9	4,072,666	16.3	1,782,316	16.7
		closed	980,700	41	382,314	41.9				
	West	open	0	NA	0	NA				
		closed	8,516	49	3,320	49.7				
2014	Pan	open	216,222	27	84,292	28.3	3,079,636	5.7	1,347,738	6.8
		closed	1,626,458	27	634,055	28.3				
	West	open	13,102	59	5,108	59.6				
		closed	36,284	59	14,145	59.6				
2015	Pan	open	29,719	27	11,586	28.3	2,508,478	6.2	1,097,783	7.3
		closed	1,398,836	27	545,320	28.3				
	West	open	7,123	63	2,777	63.5				
		closed	16,878	63	6,580	63.5				

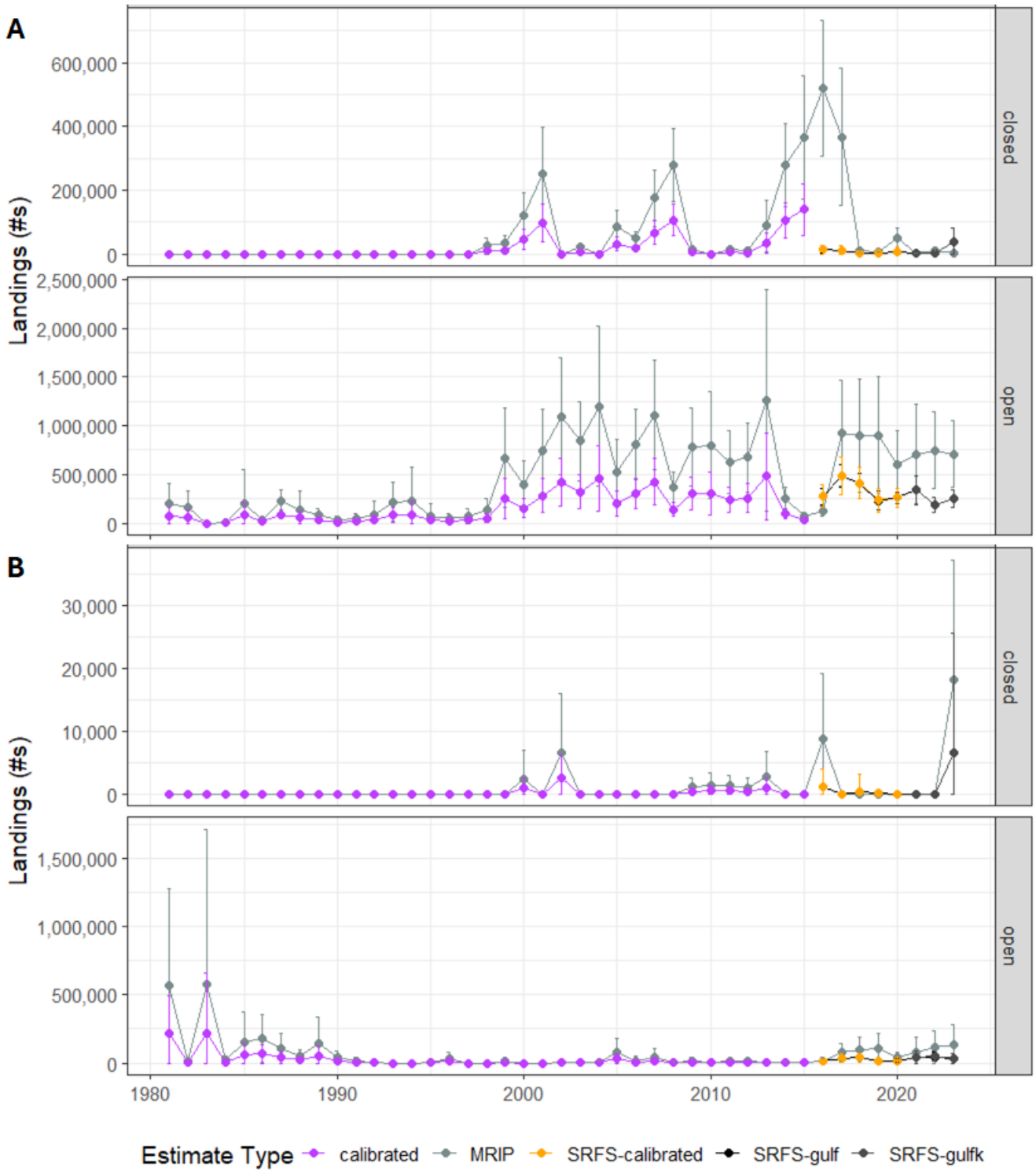


Figure 2. Red Snapper (*Lutjanus campechanus*) estimates of landings (number of fish) in the FL panhandle (**A**) and the FL peninsula (FLwest: **B**) when the season was closed or open (right panels). Estimates shown are original SRFS estimates excluding the Keys (2016-2023, SRFS-gulf), original SRFS time-series including the Keys (2021-2023, SRFS-gulfk), calibrated SRFS time-series accounting for years 2016-2020 before data were collected in the Keys (2016-2020, SRFS-calibrated), original MRIP-FCAL time-series (MRIP), and MRIP-FCAL time-series calibrated to SRFS currency (calibrated). Error bars are 95% confidence limits.

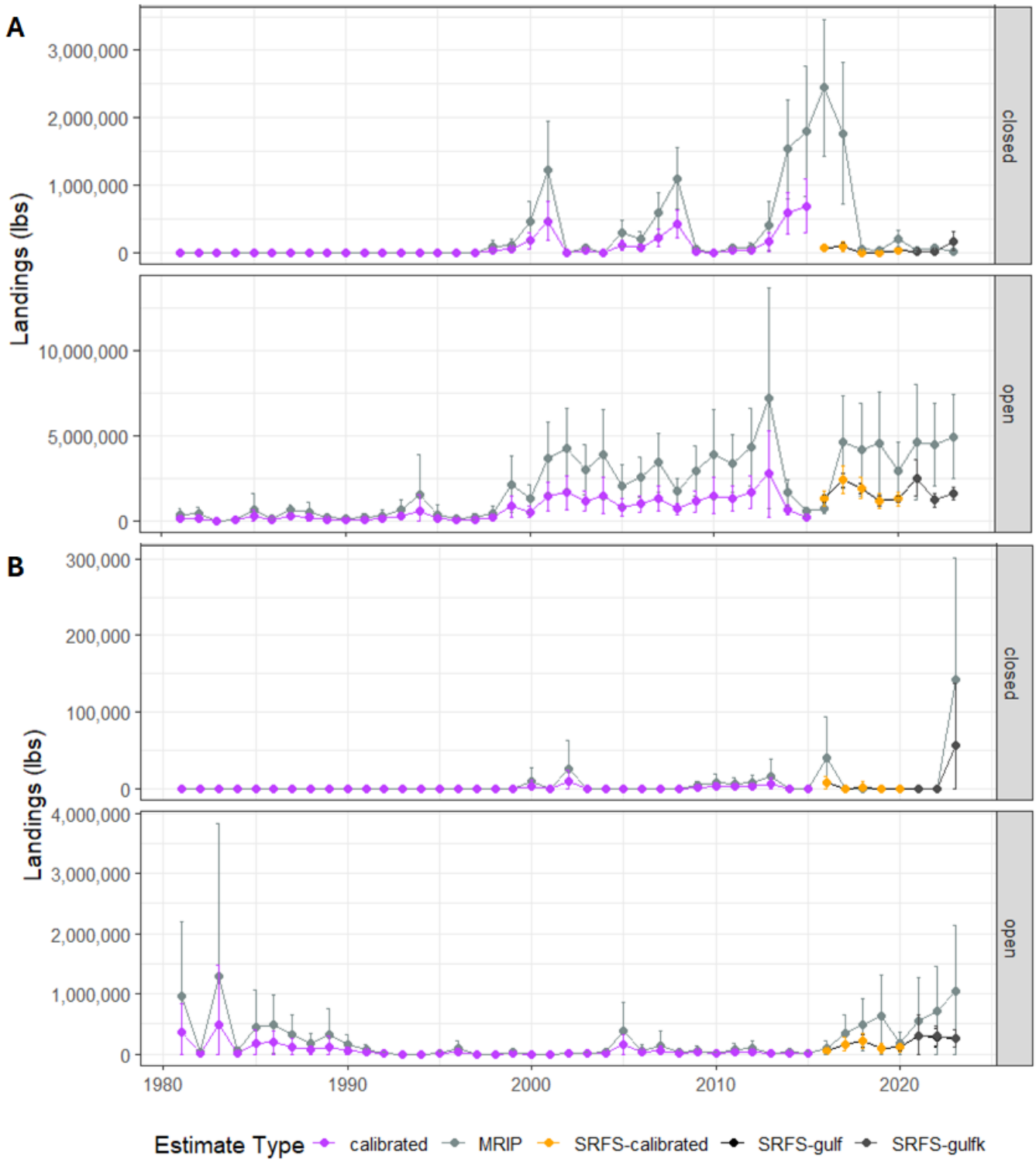


Figure 3. Red Snapper (*Lutjanus campechanus*) estimates of landings (lbs) in the FL panhandle (**A**) and the FL peninsula (FLwest: **B**) when the season was closed or open (right panels). Estimates shown are original SRFS estimates excluding the Keys (2016-2023, SRFS-gulf), original SRFS time-series including the Keys (2021-2023, SRFS-gulfk), calibrated SRFS time-series accounting for years 2016-2020 before data were collected in the Keys (2016-2020, SRFS-calibrated), original MRIP-FCAL time-series (MRIP), and MRIP-FCAL time-series calibrated to SRFS currency (calibrated). Error bars are 95% confidence limits.

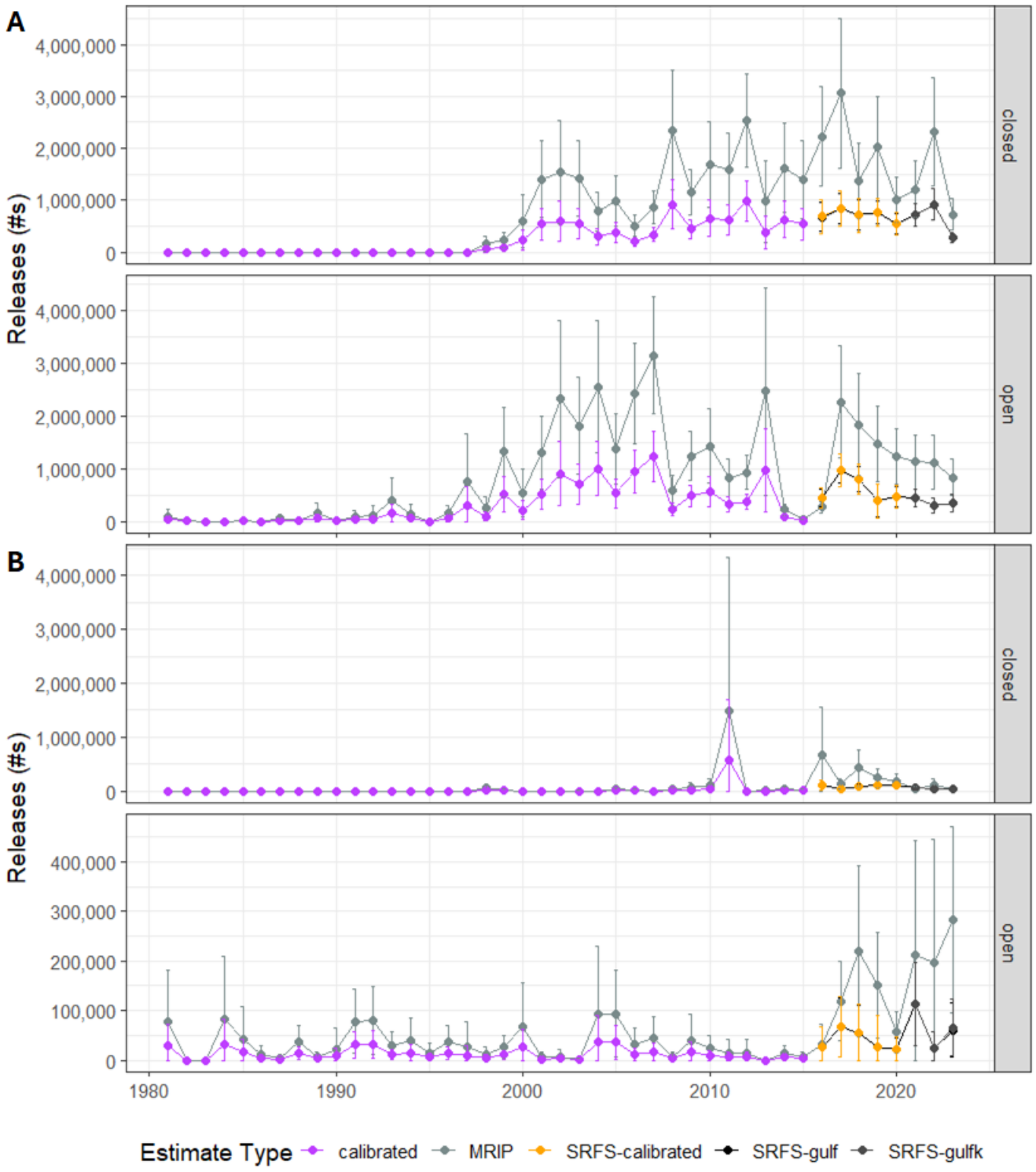


Figure 4. Red Snapper (*Lutjanus campechanus*) estimates of releases (number of fish) in the FL panhandle (**A**) and the FL peninsula (FLwest: **B**) when the season was closed or open (right panels). Estimates shown are original SRFS estimates excluding the Keys (2016-2023, SRFS-gulf), original SRFS time-series including the Keys (2021-2023, SRFS-gulfk), calibrated SRFS time-series accounting for years 2016-2020 before data were collected in the Keys (2016-2020, SRFS-calibrated), original MRIP-FCAL time-series (MRIP), and MRIP-FCAL time-series calibrated to SRFS currency (calibrated). Error bars are 95% confidence limits.

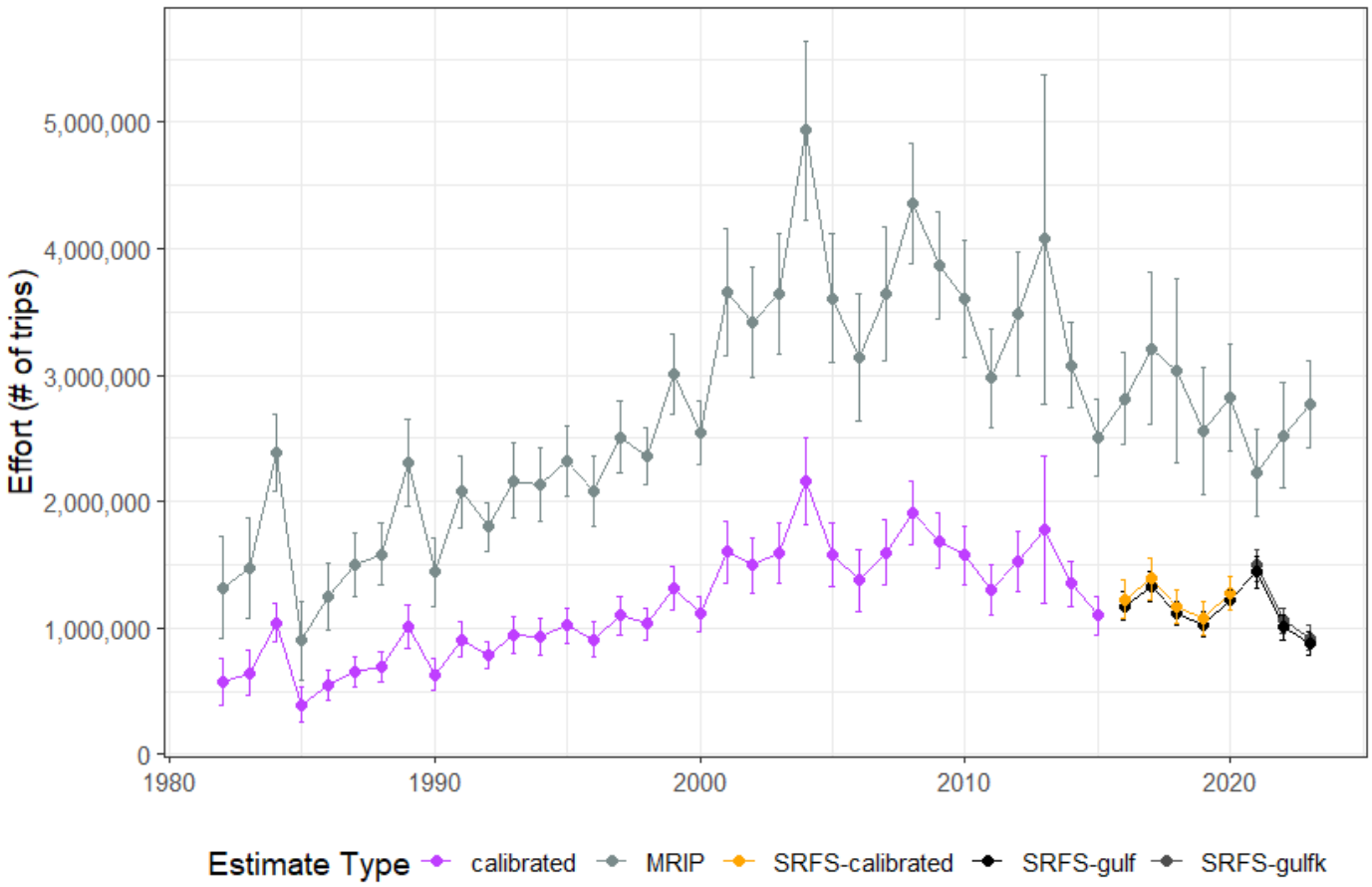


Figure 5. Private boat recreational effort estimates (in angler trips) off the Gulf coast of Florida for the original suite of GRFS species including: original SRFS time-series excluding the Keys (2016-2023, SRFS-Gulf), original SRFS time-series including the Keys (2021-2023, SRFS-Gulfk), full calibrated SRFS time-series accounting for years 2016-2020 before data were collected in the Keys (2016-2020, SRFS-calibrated), original MRIP-FCAL time-series (MRIP - Gulf), and MRIP-FCAL time-series calibrated to SRFS currency (calibrated). Error bars are 95% confidence limits.