A ratio-based method for calibrating MRIP-SRFS recreational fisheries estimates for southeastern US Mutton Snapper (*Lutjanus analis*)

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SEDAR 79 Southeastern U.S. Mutton Snapper

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SRFS Background

In response to a need for more precise estimates of recreational catch for reef fishes, particularly from private boats, the Florida Fish and Wildlife Conservation Commission developed and implemented a new survey that runs side-by-side with the historic Marine Recreational Information Program (MRIP). The MRIP is a general survey of all saltwater recreational fishing in both state and federal waters, whereas the State Reef Fish Survey (SRFS) is a supplemental, more specialized survey that directly targets participants in the reef fish fishery to collect information on effort and catch. The SRFS is the result of a decade of development and testing in Florida, in collaboration with independent statistical consultants and NOAA Fisheries scientists. The survey provides year-round, monthly estimates of fishing effort, landings, and discards for a suite of reef fish species commonly targeted by recreational anglers fishing from private boats in Florida. Initially named the Gulf Reef Fish Survey (GRFS), the methodology was implemented in May 2015 and was only conducted on the west coast of Florida, north of Monroe County (Fig. 1). In 2018, the survey design and estimation methods were peer-reviewed and subsequently certified by NOAA Fisheries as statistically valid and suitable for use (SRFS Certification Memo and design documentation, available online: https://www.fisheries.noaa.gov/recreational-fishing-data/transitioning-new-recreational-fishing-survey-designs).

Mutton Snapper (*Lutjanus analis*) are not frequently targeted by recreational anglers along the Gulf coast of Florida north of Monroe County (Fig. 2), and thus were not included in the survey when it was initially tested in Florida. However, following successful certification, the survey was expanded statewide in July 2020 to include Monroe County and the Atlantic coast of Florida, and began collecting data for three additional reef fish species targeted by recreational anglers primarily in the Keys and Southeast Florida: Hogfish (*Lachnolaimus maximus*), Yellowtail Snapper (*Ocyurus chrysurus*), and Mutton Snapper.

The SRFS continues to run concurrent with the legacy MRIP survey in Florida, which has provided vital statistics on recreational fishing effort and catch in the Gulf of Mexico and Atlantic Ocean off the coast of Florida since 1981. This overlap has facilitated the use of the newer SRFS time-series in regional stock assessments. These assessments require long-term, consistent, time-series of landings and discards and consequently a calibration method is necessary to convert the historic MRIP time-series to a common currency. The first stock assessment to incorporate SRFS estimates was SEDAR 72 for Gag in the Gulf of Mexico (https://sedarweb.org/assessments/sedar-72/). This assessment incorporated SRFS estimates from 2016 forward, and MRIP estimates prior to 2016 were converted into SRFS currency (Cross et al. 2020). The method that was developed to calibrate historic MRIP-FCAL estimates to SRFS currency for use in SEDAR 72 was peer-reviewed by NOAA OS&T statistical consultants and deemed fit for use in stock assessments (NOAA 2022). The Gulf SSC also found that the assessment was consistent with the best scientific information available (GMFMC 2022) and SRFS estimates are now used by NOAA's Southeast Regional Office (SERO) to track recreational catch for Gag in the Gulf. Additionally, the Gag calibration method is consistent with the simple ratio-based approach deemed reasonable in the Fifth Red Snapper Workshop (Cross et al. 2020; GSMFC-NOAA 2020) and is similar to the method we provide here to calibrate MRIP estimates to SRFS currency for Mutton Snapper.

Objectives

The objective of this report is to describe the development and application of simple ratio-based conversion factors that may be applied to annual, fully calibrated MRIP estimates (FCAL), and produce a historic time series in the same currency as the SRFS for use in regional assessments for Mutton Snapper stocks in the southeastern US. This report was written following Terms of Reference (TORs; Appendix A) developed by NOAA Fisheries, OS&T for the use of calibrated estimates for stock assessment and management.

Methods

This analysis used private boat mode recreational estimates of total landings (numbers and pounds of fish) and releases (numbers) derived from SRFS and MRIP from January 2021 through December 2023. Overlapping estimates from the first six months of SRFS implementation (July-December 2020) were not included in this analysis due to challenges related to the global pandemic, which coincided with initial expansion of the survey. To our knowledge there are no biases in 2021-2023 data.

The SRFS and MRIP surveys use independent methods to estimate fishing effort (angler trips); however, catch estimates derived from each method are not completely independent. To estimate catch-per-unit-effort (CPUE), both surveys use data collected in the Access Point Angler Intercept Survey (APAIS), and SRFS 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).

We did not apply calibrations at a fine scale back in time (*i.e.,* by month or area fished), as neither survey was designed to generate precise estimates at this scale. Instead, we quantified the overall differences between SRFS and FCAL estimates across the years and waves over which the two surveys overlap. This allowed for a single calibration factor to be applied to annual FCAL estimates back in time for landings and releases. Separate conversion factors are provided for landings in numbers, landings in pounds, and releases in numbers. As requested by assessment analysts for SEDAR 79, recreational estimates for Mutton Snapper were calculated and calibrated separately for two stock boundaries: all Gulf coast counties and both coasts of Monroe County, and all Atlantic coast counties excluding Monroe County. This is identical to how MRIP produces estimates, with both coasts of Monroe County included in Gulf estimates.

All MRIP-FCAL estimates used in this calibration were generated by the NOAA Southeast Fisheries Science Center. MRIP-FCAL estimates were generated for the Gulf of Mexico and South Atlantic as whole regions and are not separated by state. Landings and releases in Florida make up more than 99.9% of the total landings and releases in both of these regions. Therefore, in order the generate estimates for Florida for use in this calibration, the additional Mutton Snapper landed and released in states outside of Florida were subtracted from the whole estimates in each year. PSE values were used as provided. Authors, stock assessment analysts, and representatives from the Southeast Fisheries Science Center decided that removal of the data from other states would change PSE values very minimally or not at all due to the extremely small proportion of landings and releases that came from other states. Variances for use in this calibration process were back calculated using the PSE and estimates values.

To assess overall differences between SRFS and FCAL estimates the estimates ($\hat{E}$) and variances ($\hat{V}$) for each estimation method (*m: SRFS, FCAL*) were summed across years (*y*), two-month waves (*w*), and areas fished (*a*: federal or state waters) for each variable (*v*: number landed, pounds landed, number released) and region (*r*: Gulf of Mexico with Keys, Atlantic Ocean) [1, 2].

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

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

This resulted in 6 pairs of SRFS and FCAL sums (3 variables and 2 regions for Mutton Snapper; Table 1). For each of the paired sums, the ratio was calculated as the total SRFS estimate divided by the total FCAL estimate (landings and releases) [3].

$$\hat{R}_{v,r} = \frac{\hat{E}_{SRFS,v,r}}{\hat{E}_{FCAL,v,r}} \quad [3]$$

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. To calculate the variance of the ratio above, we assumed a 0% correlation as this is the most conservative approximation of variance if correlation between the two survey estimates is ignored (Cross et al. 2020). This correlation percentage was recommended by peer review (Stokes et al. 2020). A delta method approximation for the variance of two independent variables was used to calculate the variance of the ratio above ($\hat{V}\left(\hat{R}_{v,r}\right)$) because this method incorporates error associated with both the numerator (SRFS estimates) and denominator (FCAL estimates). The R statistical software package 'msm' and the function deltamethod (R Core Team 2023; Jackson 2011) were used to carry out these calculations.

Historic estimates were converted to SRFS currency by multiplying the annual FCAL estimate for each year, region, and variable type (number landed, pounds landed, number released) [4] with the corresponding ratio [3]:

$$\hat{E}_{GRFS-hind,y,v,r} = \hat{R}_{v,r}\hat{E}_{FCAL,y,v,r} \text{ [4]}$$

Variance was again approximated using the delta method and, once again, a 0% correlation was assumed.

Findings and Conclusions

For the years in which the SRFS and MRIP overlap, annual Mutton Snapper estimates derived from SRFS and FCAL and associated variances, observed ratios of summed SRFS to FCAL estimates, and approximated variance for each ratio are provided in Tables 1. Yearly and average annual estimates are shown in Figures 3. The Mutton Snapper ratios in the Gulf with the Keys were generally lower (range 0.28-0.48) than the ratios in the Atlantic (range 0.53-0.55). Also, the median PSE values for the calibrated estimates were 24%. Calibrated estimates for Mutton Snapper in the Gulf with the Keys (Fig. 4, Table 2) and in the Atlantic Ocean (Fig. 5, Table 3) are provided.

The purpose of this report was to calibrate the historic FCAL estimates to SRFS currency for use in the SEDAR 79 southeastern US mutton snapper stock assessment. Results presented in this report include data collected over 36 months. However, as the two surveys continue to run concurrently in Florida, the calibration factors may be routinely updated and shared for future assessments.

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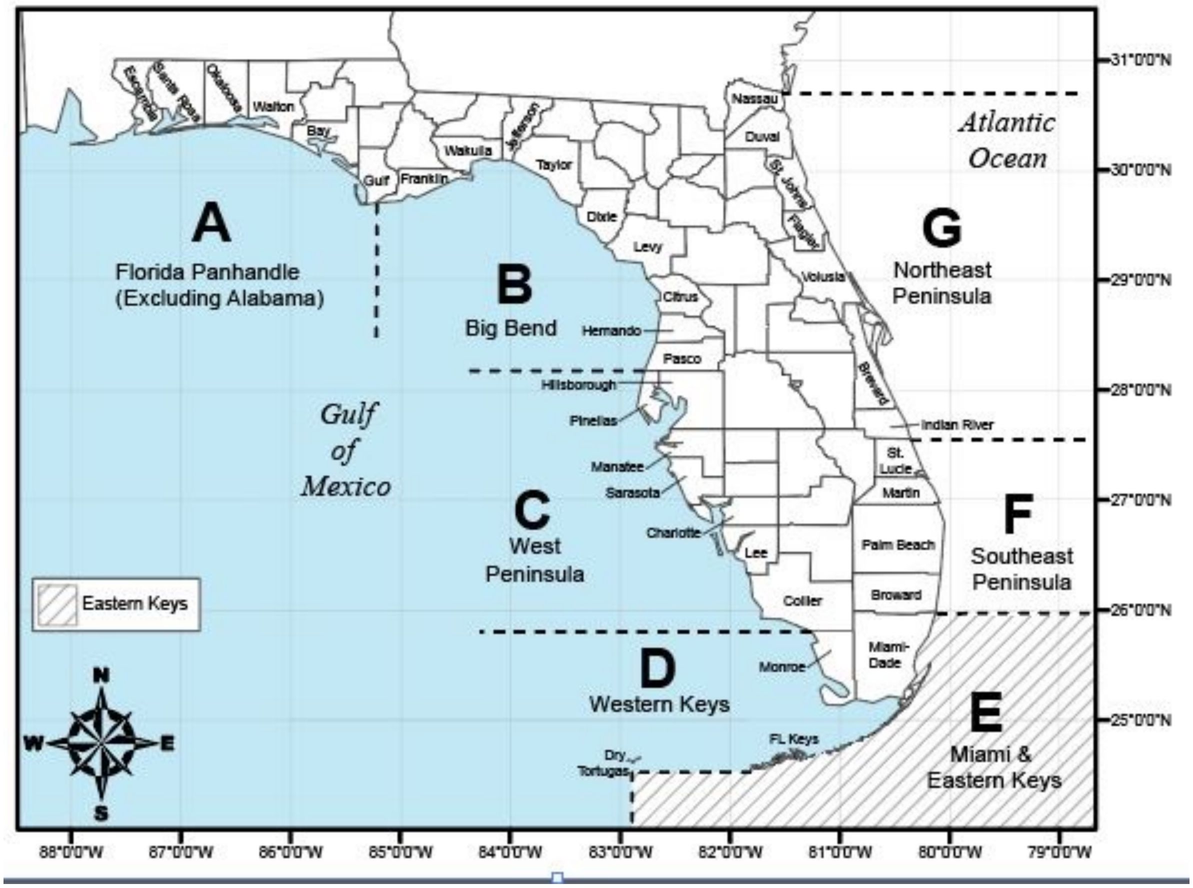

Figure 1. Regions of the state of Florida as designated by the State Reef Fish Survey (SRFS). The Gulf Reef Fish Survey (GRFS) which ran from May 2015-June 2020 covered regions A-C. The expansion to the SRFS included the remaining regions, which is also when Hogfish (*Lachnolaimus maximus*), Mutton Snapper (*Lutjanus analis*), and Yellowtail Snapper (*Ocyurus chrysurus*) were added to the survey.

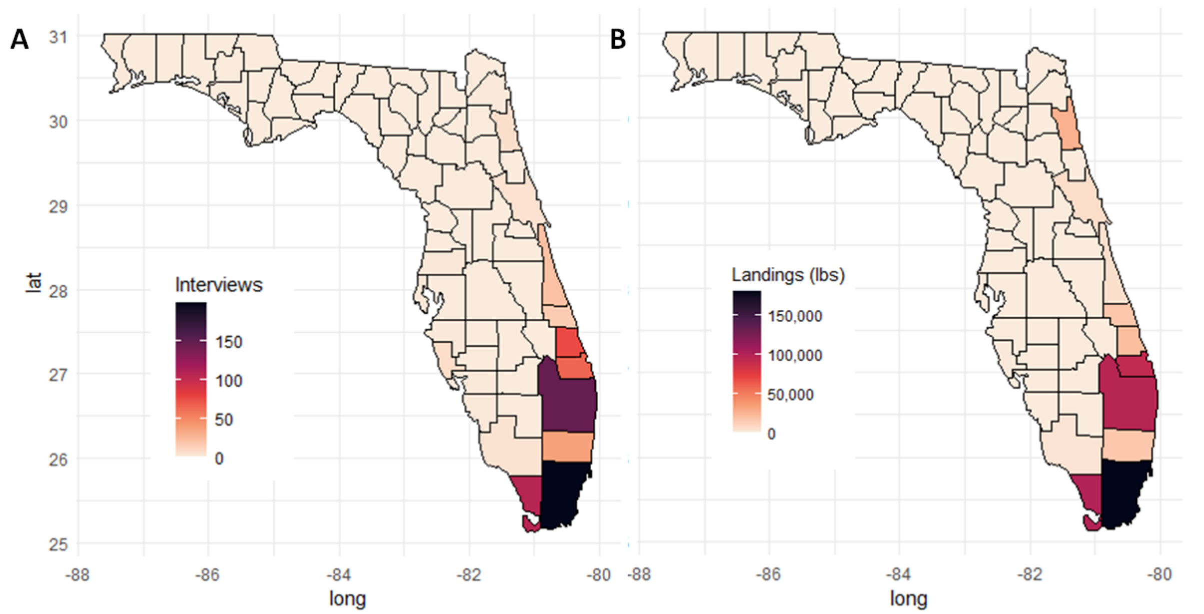

Figure 2. The spatial distribution of the number of interviews conducted where anglers caught or targeted Mutton Snapper (*Lutjanus analis*) per year (**A**) and the spatial distribution of the amount of Mutton Snapper landed per year (lbs; **B**) are shown.

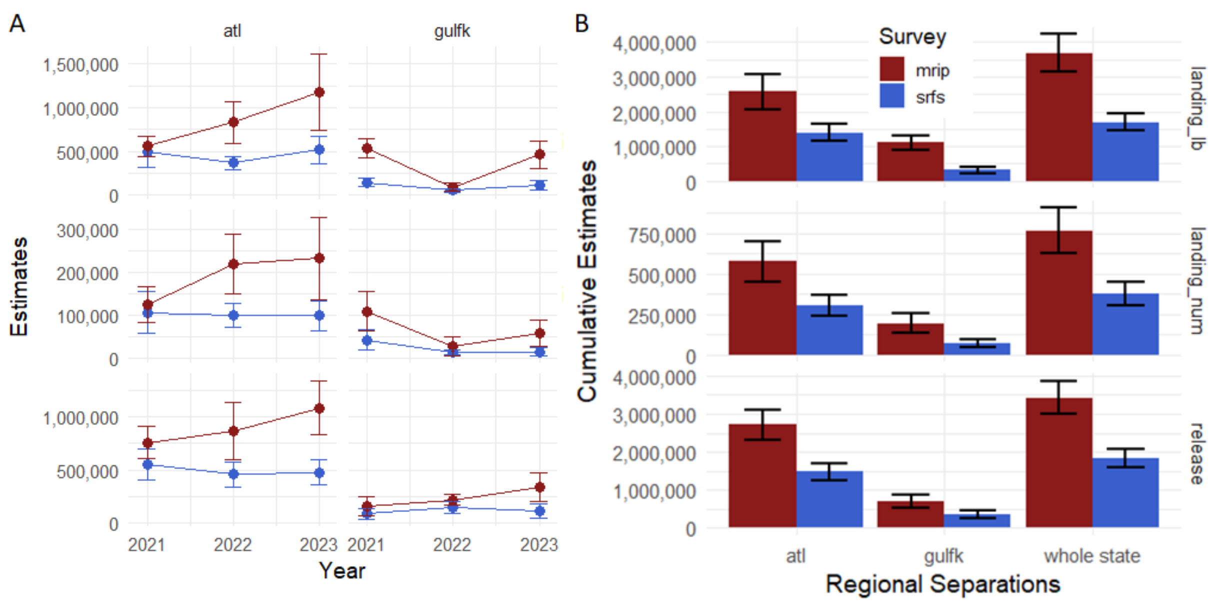

Figure 3. Estimates of landings and releases of Mutton Snapper (*Lutjanus analis*) across years (**A**) or with all the years combined (**B**; 2021-2023). The stock assessment regions are all Gulf coast counties plus both coasts of Monroe County (gulfk) and all Atlantic coast counties excluding Monroe (atl). Estimates generated by SRFS are shown in blue and estimates generated by MRIP are shown in red. Error bars depict 95% confidence limits.

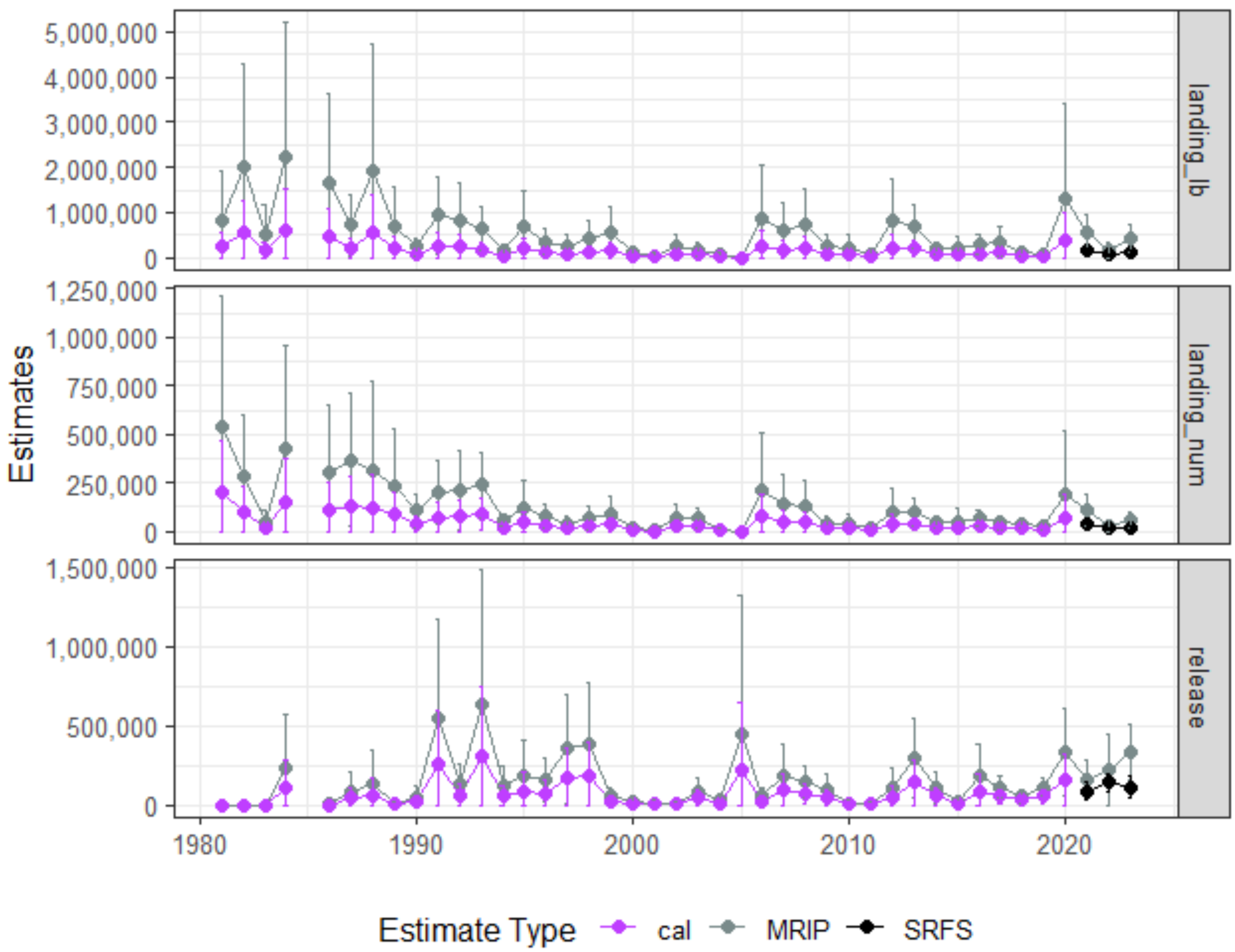

Figure 4. Mutton Snapper (*Lutjanus analis*) estimates for the Gulf of Mexico including both coasts of the Keys including: original SRFS estimates (srfs; 2021-2023), original MRIP-FCAL time-series (mrip), and MRIP-FCAL time-series calibrated to SRFS currency (cal). Landings in pounds (landing_lb), landings in numbers of fish (landing_num), and releases in numbers of fish (release) are shown. Error bars are 95% confidence limit.

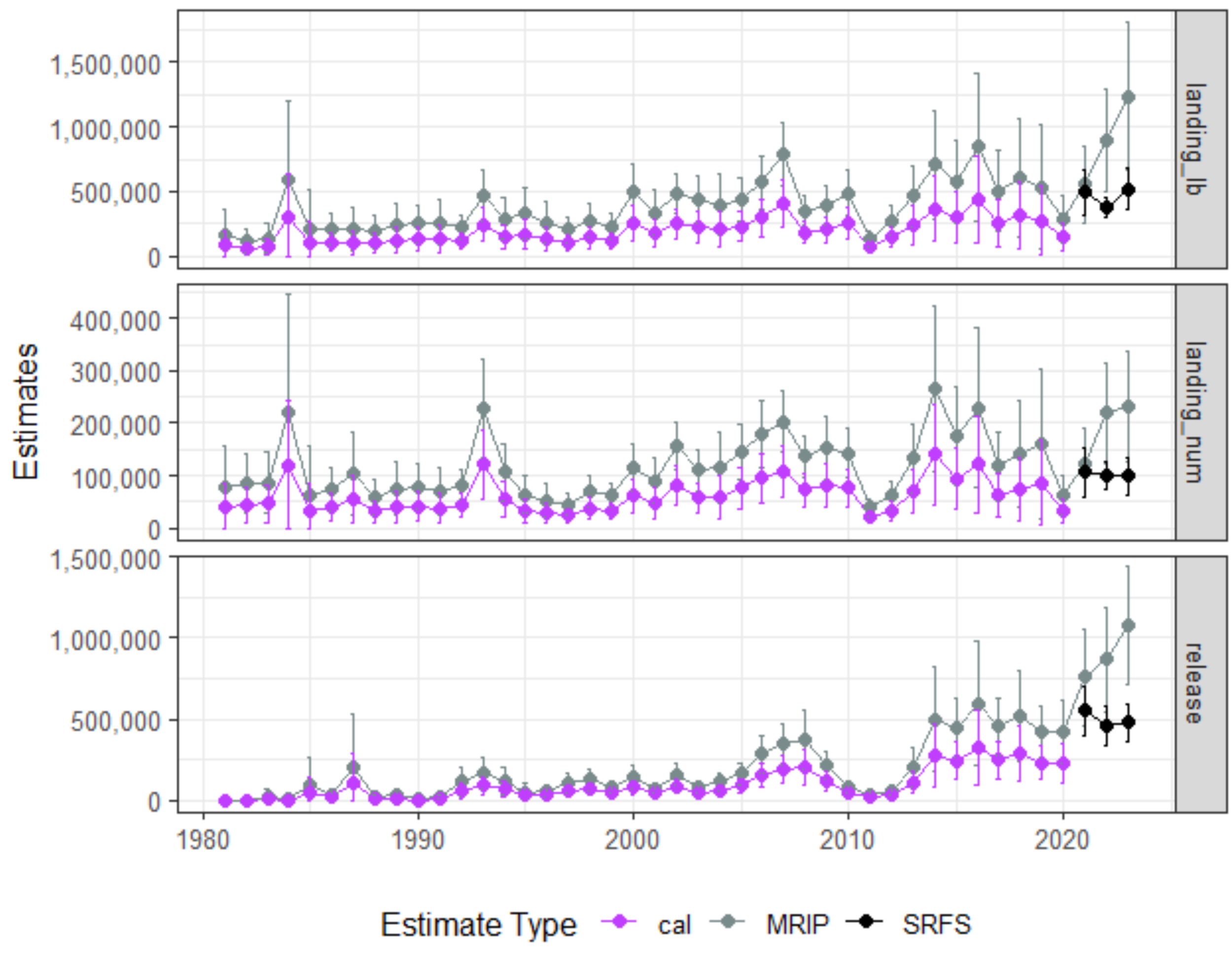

Figure 5. Mutton Snapper (*Lutjanus analis*) hindcast estimates for the Atlantic Ocean including: original SRFS estimates (srfs; 2021-2023), original MRIP-FCAL time-series (mrip), and MRIP-FCAL time-series calibrated to SRFS currency (cal). Landings in pounds (landing_lb), landings in numbers of fish (landing_num), and releases in numbers of fish (release) are shown. Error bars are 95% confidence limit.

Table 1. Annual and summed FCAL and SRFS estimates and variances and ratios of SRFS to FCAL estimates are shown for Mutton Snapper (*Lutjanus analis*) with the state broken down by assessment region. Assessment regions are all Gulf coast counties plus both coasts of Monroe County (gulfk), and all Atlantic coast counties excluding Monroe County (atl).

Estimate Type	Region	Year	SRFS sum	SRFS variance	MRIP sum	MRIP variance	Ratio
Landings (lbs)	atl	2021	495,094	7,997,594,898	551,972	23,470,123,095	0.52
		2022	371,306	1,526,526,092	894,727	40,816,454,420	
		2023	519,626	6,346,192,103	1,232,812	85,344,820,083	
		Total	1,386,026	15,870,313,093	2,679,510	149,631,397,597	
	gulfk	2021	146,585	663,406,530	542,168	47,128,736,165	0.28
		2022	54,727	102,455,906	157,729	6,411,892,789	
		2023	109,041	785,055,311	411,956	25,363,632,779	
		Total	310,353	1,550,917,747	1,111,853	78,904,261,733	
Landings (no. fish)	atl	2021	106,055	596,176,848	124,009	1,121,079,661	0.53
		2022	99,519	190,692,545	218,822	2,317,546,546	
		2023	98,765	311,993,833	231,611	2,837,756,860	
		Total	304,339	1,098,863,226	574,443	6,276,383,066	
	gulfk	2021	42,227	154,072,585	108,345	1,695,044,871	0.37
		2022	13,529	10,415,543	27,709	188,133,025	
		2023	14,478	24,964,659	56,317	457,973,124	
		Total	70,234	189,452,787	192,370	2,341,151,021	
Releases (no. fish)	atl	2021	549,434	5,588,414,429	759,708	23,086,222,723	0.55
		2022	457,746	3,724,392,053	868,277	27,215,944,567	
		2023	477,399	3,492,037,554	1,077,479	33,551,802,509	
		Total	1,484,579	12,804,844,036	2,705,464	83,853,969,799	
	gulfk	2021	86,574	765,777,171	154,769	4,026,580,103	0.48
		2022	142,420	809,117,529	219,796	14,087,275,875	
		2023	111,997	1,164,325,456	332,765	8,072,414,803	
		Total	340,991	2,739,220,156	707,330	26,186,270,781	

Table 2. Historic FCAL (MRIP-FCAL) estimates and estimates converted to SRFS currency (Calibrated: FCAL to SRFS) for Mutton Snapper (*Lutjanus analis*) for the Gulf of Mexico including the Keys.

	MRIP - FCAL		Calibrated: FCAL to SRFS		MRIP - FCAL		Calibrated: FCAL to SRFS		MRIP - FCAL		Calibrated: FCAL to SRFS	
Year	Landings (lbs)	PSE	Landings (lbs)	PSE	Landings (no. fish)	PSE	Landings (no. fish)	PSE	Releases (no. fish)	PSE	Releases (no. fish)	PSE
1981	833,675	66	232,705	71.7	540,684	63	197,403	70.6	0	0	0	NA
1982	2,002,801	58	559,044	64.9	281,404	57	102,740	65.3	0	0	0	NA
1983	508,760	65	142,011	70.6	51,106	53	18,659	61.9	0	0	0	NA
1984	2,218,794	69	619,335	74.2	421,883	65	154,029	72.4	234,463	72	113,030	77.1
1985	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1986	1,640,224	62	457,838	67.8	301,662	59	110,136	67.1	3,472	100	1,674	103.7
1987	712,301	49	198,826	56.2	368,432	47	134,514	56.8	86,035	71	41,476	76.2
1988	1,933,743	74	539,768	79.4	316,635	73	115,603	79.6	133,090	83	64,160	87.5
1989	670,545	68	187,170	73.5	229,682	66	83,856	73.3	9,144	100	4,408	103.7
1990	226,994	48	63,361	55.7	106,218	43	38,780	53.5	48,581	79	23,420	83.7
1991	948,955	46	264,883	54.0	200,661	41	73,261	51.9	547,933	58	264,149	64.2
1992	815,274	52	227,568	59.5	208,097	50	75,976	59.3	129,211	50	62,290	57.1
1993	643,853	38	179,720	47.4	239,560	36	87,463	48.1	638,531	67	307,824	72.4
1994	146,517	30	40,897	41.5	55,639	27	20,314	41.8	123,183	51	59,384	58.0
1995	675,736	59	188,619	65.9	123,455	58	45,073	66.2	184,866	62	89,120	67.8
1996	341,045	43	95,196	51.2	76,529	42	27,941	52.7	158,757	45	76,534	52.8
1997	240,925	60	67,250	66.4	37,524	56	13,700	64.4	355,014	49	171,146	56.2
1998	404,534	52	112,918	59.2	67,147	49	24,515	58.5	383,505	52	184,881	58.8
1999	552,691	54	154,273	60.7	89,929	53	32,833	61.8	56,231	51	27,108	58.0
2000	102,653	79	28,654	83.5	13,573	76	4,956	82.4	17,674	100	8,520	103.7
2001	32,740	98	9,139	102.1	3,670	98	1,340	103.1	12,989	69	6,262	74.3
2002	244,823	56	68,338	62.5	66,422	53	24,250	61.9	8,657	74	4,173	79.0
2003	179,634	44	50,141	52.6	64,806	40	23,661	51.2	86,007	54	41,462	60.6
2004	60,219	58	16,809	64.7	9,818	56	3,585	64.4	31,321	49	15,099	56.2
2005	624	100	174	103.9	113	100	41	105.0	448,533	99	216,230	102.8
2006	868,381	70	242,392	75.1	214,909	69	78,463	76.0	54,773	52	26,405	58.8

Table 2. Continued

Year	MRIP - FCAL Landings (lbs)	PSE	Calibrated: FCAL to SRFS Landings (lbs)	PSE	MRIP - FCAL Landings (no. fish)	PSE	Calibrated: FCAL to SRFS Landings (no. fish)	PSE	MRIP - FCAL Releases (no. fish)	PSE	Calibrated: FCAL to SRFS Releases (no. fish)	PSE
2007	580,054	57	161,911	63.4	138,103	56	50,421	64.4	189,615	51	91,410	58.0
2008	717,590	57	200,302	63.2	126,763	54	46,281	62.7	142,775	36	68,829	45.3
2009	249,256	56	69,575	63.0	39,163	52	14,298	61.0	93,706	54	45,174	60.6
2010	213,310	71	59,541	76.5	39,723	68	14,503	75.1	12,613	73	6,080	78.0
2011	87,029	61	24,292	67.3	14,956	61	5,460	68.8	8,938	77	4,309	81.8
2012	804,664	60	224,607	66.2	102,479	57	37,415	65.3	104,090	61	50,180	66.9
2013	683,307	37	190,732	46.6	99,893	35	36,471	47.3	292,692	44	141,101	51.9
2014	191,680	32	53,504	42.8	45,420	30	16,583	43.7	110,564	46	53,301	53.6
2015	203,129	67	56,700	72.4	51,533	66	18,815	73.3	22,245	45	10,724	52.8
2016	298,783	36	83,400	45.7	66,425	33	24,252	45.9	182,840	55	88,144	61.5
2017	345,695	47	96,494	55.1	43,317	46	15,815	56.0	112,198	32	54,089	42.2
2018	135,388	35	37,791	44.6	37,575	32	13,719	45.1	58,114	39	28,016	47.7
2019	92,324	49	25,771	56.3	31,191	48	11,388	57.6	112,532	26	54,250	37.9
2020	1,292,255	83	360,709	87.8	195,530	83	71,388	88.9	335,333	42	161,658	50.2

Table 3. Historic FCAL (MRIP-FCAL) estimates, and estimates converted to SRFS currency (Calibrated: FCAL to SRFS) for Mutton Snapper (*Lutjanus analis*) for the Atlantic Ocean.

	MRIP - FCAL		Calibrated: FCAL to SRFS		MRIP - FCAL		Calibrated: FCAL to SRFS		MRIP - FCAL		Calibrated: FCAL to SRFS	
Year	Landings (lbs)	PSE	Landings (lbs)	PSE	Landings (no. fish)	PSE	Landings (no. fish)	PSE	Releases (no. fish)	PSE	Releases (no. fish)	PSE
1981	168,462	57	87,140	59.7	78,484	52	41,581	54.9	0	NA	0	NA
1982	115,173	38	59,575	41.8	84,113	34	44,563	38.3	0	NA	0	NA
1983	138,947	41	71,873	44.3	87,083	35	46,136	39.2	21,758	100	11,940	100.9
1984	593,048	53	306,765	55.4	222,392	51	117,823	53.9	4,386	100	2,407	100.9
1985	209,409	75	108,321	76.9	63,913	74	33,861	76.1	90,711	100	49,776	100.9
1986	203,604	31	105,318	35.1	74,203	29	39,313	33.9	31,470	49	17,268	50.7
1987	203,830	43	105,435	45.9	102,767	39	54,446	42.8	202,822	82	111,295	83.0
1988	190,400	35	98,488	38.5	58,111	29	30,787	33.9	17,872	60	9,807	61.4
1989	239,503	36	123,887	39.8	74,854	35	39,658	39.2	27,034	51	14,835	52.7
1990	252,222	30	130,466	34.1	78,442	28	41,558	33.1	4,497	78	2,468	79.1
1991	257,346	35	133,117	39.1	71,046	33	37,640	37.4	21,738	38	11,928	40.2
1992	221,890	22	114,777	27.8	82,716	18	43,823	25.2	112,941	39	61,974	41.2
1993	470,221	22	243,231	27.8	228,747	21	121,190	27.4	164,526	30	90,281	32.8
1994	289,277	28	149,634	32.4	106,252	26	56,292	31.4	120,448	36	66,094	38.3
1995	325,200	31	168,216	35.7	63,422	29	33,601	33.9	50,927	51	27,945	52.7
1996	260,417	32	134,705	36.0	52,903	30	28,028	34.8	51,349	32	28,177	34.6
1997	203,157	26	105,087	31.1	45,486	24	24,099	29.7	110,990	28	60,904	30.9
1998	270,612	24	139,979	29.8	70,169	22	37,176	28.2	125,037	27	68,612	30.0
1999	228,064	21	117,970	27.4	61,555	19	32,612	25.9	75,657	21	41,516	24.8
2000	499,449	21	258,349	27.2	115,611	20	61,250	26.6	142,047	26	77,946	29.1
2001	337,775	26	174,721	31.3	90,270	25	47,825	30.6	74,528	24	40,896	27.4
2002	485,000	16	250,875	23.3	155,797	15	82,541	23.1	157,983	21	86,691	24.8
2003	439,707	21	227,446	26.9	110,024	18	58,291	25.2	82,806	23	45,438	26.5
2004	398,964	31	206,372	35.0	114,622	30	60,726	34.8	114,550	24	62,858	27.4
2005	437,682	20	226,399	26.0	145,620	19	77,149	25.9	165,354	21	90,736	24.8
2006	567,248	19	293,419	25.2	178,895	18	94,778	25.2	283,353	20	155,485	23.9

Table 3. Continued.

Year	MRIP - FCAL Landings (lbs)	PSE	Calibrated: FCAL to SRFS Landings (lbs)	PSE	MRIP - FCAL Landings (no. fish)	PSE	Calibrated: FCAL to SRFS Landings (no. fish)	PSE	MRIP - FCAL Releases (no. fish)	PSE	Calibrated: FCAL to SRFS Releases (no. fish)	PSE
2007	787,505	16	407,352	23.5	203,607	15	107,871	23.1	343,474	19	188,476	23.1
2008	351,303	16	181,718	23.3	136,350	15	72,238	23.1	369,604	25	202,814	28.2
2009	388,505	20	200,961	26.7	152,023	20	80,542	26.6	215,635	20	118,326	23.9
2010	490,560	18	253,751	24.6	143,418	17	75,983	24.5	83,527	22	45,834	25.6
2011	133,389	24	68,998	29.4	38,768	23	20,539	28.9	36,243	32	19,888	34.6
2012	273,236	22	141,336	27.9	63,794	21	33,798	27.4	57,527	25	31,567	28.2
2013	463,220	26	239,609	31.5	133,599	25	70,781	30.6	202,726	30	111,243	32.8
2014	705,223	30	364,789	34.9	265,990	30	140,921	34.8	500,692	33	274,747	35.5
2015	576,176	28	298,038	33.2	176,941	27	93,743	32.2	445,618	21	244,526	24.8
2016	844,879	35	437,029	38.8	228,901	34	121,271	38.3	596,599	33	327,374	35.5
2017	503,714	32	260,555	35.9	117,391	28	62,194	33.1	454,010	20	249,130	23.9
2018	604,262	39	312,566	42.4	140,990	37	74,696	41.0	519,078	27	284,836	30.0
2019	532,620	46	275,507	49.5	161,708	45	85,673	48.3	418,632	19	229,718	23.1
2020	283,329	34	146,557	37.7	62,975	31	33,364	35.6	421,587	23	231,339	26.5

APPENDIX A:
TERMS OF REFERENCE

Terms of reference for the use of calibrated estimates for stock assessment and Management

May 13, 2024

The following provides guidance on species-specific simple ratio-based survey estimated calibrations for use in stock assessment and management. The Terms of Reference distinguish between review requirements for model-based approaches and other data treatments that may impact microdata as well as resulting estimates and the application of a simple ratio-based scalar to survey catch estimates. The Terms of Reference described herein pertain to the latter only.

Guidance and Procedures for the Transition Process for Modification of Recreational Fishing Catch and Effort Methods can be found in Procedural Directive 04-114-01 "Implementing Recreational Fishery Catch and Effort Survey Design Changes" which is available at: https://www.fisheries.noaa.gov/national/lawsand-policies/policy-directive-system.

The following terms of reference pertain to development and application of simple ratio-based scalars to adjust the scale of annual catch estimates produced from separate survey programs. The terms of reference provide guidance to the data provider and reviewer on documentation deemed necessary for a review of the development and application of calibrations to rescale estimates from one survey standard to the other.

1. **Provide "fit for purpose" documentation for the development of calibrations (ratio scalars), where "fit for purpose" documentation is defined as inclusive of all elements required to reproduce the calibrated time series.**
    a. Generally, documentation will include a complete description of calibration procedures, terms and time series application, datasets related to the development of calibration, source datasets (annual catch estimates) used to calculate ratios, metadata and other data sets, program code for the generation and application of calibrations.
        i. Calibrated estimates should be reproducible by a third party, using the information provided.
    b. Describe how the method is intended to be used in future years when new data become available, or how it is expected to be modified.
    c. For variance estimates, please describe the methods used, for example, Taylor's series approximation (linearization), jackknife or other replication method, other alternatives (e.g., Second or Multiple Derivative Methods, Goodman's).
    d. Evaluate whether the time series is continuous and whether the estimated variances reflect temporal variation in precision. Are there any particular biases in the time series?
2. **Identify underlying assumptions for developing and applying calibrations to the recreational catch time series of landings and discards.**

   a. Assumptions should pertain to the choice of years selected, the relationship of survey estimates (for example but not limited to temporal, geographic and other coverage considerations such as fishing mode and catch type)
   b. List justification of why the specific years were selected for adjustment and others were not selected.
   c. For the purposes of development and application of calibrations, are estimation domains aligned spatially and temporally to provide equivalent ratio terms?
   d. Describe specific assumptions related to the application of scalars to unaligned domains (e.g., assumptions related to but not limited to the application of ratio scalars to uncovered modes, catch types or effort).
3. **Identify underlying assumptions for development of variance approximations.**
   a. Assumptions should pertain to the choice and application of methods, relationship of survey estimates (dependence), the treatment of covariance terms (where applicable) in the generation of estimators
   b. Evaluate tradeoffs of the approach compared to other potential approaches with respect to the characterization of uncertainty in recreational landings in stock assessments.
4. **Is the methodology consistent with the simple ratio based approach that was presented and deemed reasonable for use in the Fifth Red Snapper Workshop (2020)?**
   a. If not, please describe modifications or deviations.
      i. The description should indicate where changes have been applied to the time series and include justification for said changes.
5. **Is the methodology broadly suitable for use in calibrating other estimate series derived from the survey program (e.g., for other species covered by the survey?)**
6. **Provide a review report summarizing the Review Panel's evaluation of the calibration methodology and documenting whether each Term of Reference was met.**