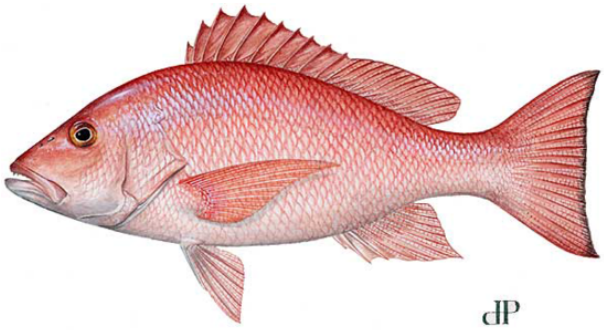

A "Traditional" Interim Assessment for Gulf of Mexico Red Snapper

Sustainable Fisheries Division
NOAA Fisheries - Southeast Fisheries Science Center

March 23, 2021

Keywords

Interim Analysis, Index of Abundance, Red Snapper, Gulf of Mexico

Abstract

An Interim Assessment (IA) was conducted for Gulf of Mexico Red Snapper following the Standard SEDAR52 stock assessment (*https://sedarweb.org/sedar-52*), ***without the influence of the Great Red Snapper Count***. Data from the NMFS BLL Survey were used to produce two candidate indices of relative abundance updated through 2019 and 2020 following the same methodology and approach described in Pollack *et al.* (2017). Trends in the various relative abundance indices were similar, and suggest a noted decrease in abundance after the relatively high abundance, terminal year of the SEDAR52 data, 2016. Considering a low tolerance for change in catch advice and a reduction in apparent Red Snapper abundance from 2017-2020, the most risk averse adjusted catch advice for 2021 would be 13.94 million pounds whole weight.

Introduction

Interim assessments (IAs) are designed to occur between regular stock assessments conducted through the Southeast Data Assessment and Review process (SEDAR) to provide the opportunity to adjust harvest recommendations based on current stock conditions. Presently, Acceptable Biological Catch (ABC) recommendations for Gulf of Mexico (GOM) Red Snapper are based on projections conducted as part of the SEDAR 52 assessment (SEDAR 2018). SEDAR 52 was the last accepted assessment for GOM Red Snapper and was conducted in 2018 with a terminal data year of 2016 (SEDAR 2018). The established Over Fishing Limit (OFL) and ABC for 2016 through 2021 were 15.5 and 15.1 million pounds whole weight assuming constant catch projections. This IA provides updated ABC advice recommendations for the SSC and Council to consider when setting catch levels for 2021, as the next assessment that will provide management advice will not take place until 2022.

Materials and Methods

Index Data Source

The traditional IA approach requires an index of abundance that is assumed to represent the stock dynamics well. Data from the National Marine Fisheries Service (NMFS) Bottom Longline (BLL) and the Dauphin Island Sea Lab (DISL) BLL surveys from 2001-2020 were used to develop relative indices of abundance for adult Red Snapper in the GOM. The NMFS Mississippi Laboratories have conducted standardized BLL surveys in the GOM, Caribbean, and Western North Atlantic since 1995. These surveys are conducted annually and provide an important source of fishery-independent information on large coastal sharks, snappers, and groupers from the GOM and Atlantic. These surveys have evolved over time, and details of their evolution are documented by Ingram *et al*. (2005). Data from the Congressional Supplemental Sampling Program (CSSP) were used to fill in gaps in the annual NMFS BLL survey due to vessel breakdowns and weather delays in 2011. The CSSP was conducted using the same gear and had a survey design similar to the NMFS BLL (Campbell *et al.* 2012). The DISL BLL survey has conducted fishery-independent shark bottom longline surveys in the north-central GOM off the coast of Alabama since 2010. The gear used during DISL surveys are similar to those of the NMFS surveys; however, the surveys utilize a different sampling design. Details concerning the DISL surveys can be obtained from Dr. Sean Powers (Pollack *et al.* 2017). Collectively, these data have been used to construct a single NMFS BLL index of relative abundance, which has been used in Red Snapper assessments since the SEDAR (SEDAR 7) Update Assessment process in 2009 (SEDAR Red Snapper Update, 2009) and continued to be utilized in SEDAR 31 (2013), the SEDAR 31 Update (2015), and the latest assessment, SEDAR 52 (2018).

Index of Relative Abundance

Abundance data for the index were restricted to depths less than 183 m in years 2001-2020. In 2020, sampling was limited to an area roughly south of 28.5° N, between 87.4° W and 88.4° W by DISL, in the Eastern GOM (EGOM) due to complications from COVID-19, weather (i.e. hurricanes), and mechanical issues (**Figure 1**).

To determine the impact of the reduced sampling in 2020 on index results, an eastern GOM (EGOM) index was developed using the reduced sampling area back in time (herein referred to as 2020 - Update Reduced). **Figure 2** is a comparison of the EGOM indices: the SEDAR 52 EGOM index (terminal year 2016), the previously described 2020 Update - Reduced, and an index herein referred to as the 2020 Update, which uses all previously available stations in the EGOM from 2001 to 2019 and the reduced samples in 2020 (adapted from Pollack 2021).

Two gulf-wide indices were utilized for this IA: a gulf-wide index excluding 2020 (terminal year 2019) and an updated 2020 index using the limited 2020 samples from the DISL in the EGOM. In both gulf-wide indices, the 2005 survey year was removed due to lack of spatial coverage by the NMFS BLL, and 2008 was removed due to zero Red Snapper captures (**Table 1 & 2**). The final 2019 and 2020 delta-lognormal indices of Red Snapper abundance retained year, area, and depth zone in the binomial sub model and year and area in the lognormal sub model. Depth zones were defined as shallow (<55 m) and mid (55-183m). Areas were defined based on shrimp grids grouped by state, with Mississippi and Alabama combined and Florida split into northern and southern regions (**Figure 3)**.

IA Methodology

The IA of Red Snapper sought to quantify a target ABC adjustment in 2021 through the use of a harvest control rule that utilizes recent trends in observed indices of abundance following the general methodology proposed by Huynh *et al.* (2020). The harvest control rule takes the form:

$$C_{y+1} = C_{ref} * (\frac{1}{3}\sum_{k=y-2}^{y} I_k)/(\frac{1}{3}\sum_{ref=y_{ref}-1}^{y_{ref}+1} I_{ref}) \quad \text{Equation (1)}$$

where:

C_{ref} = Council specified reference catch level to be adjusted.

C_{y+1} = Adjusted catch recommendation for year ($y+1$).

I_k = Observed index values in year(s) k (**Table 1-2**).

I_{ref} = Reference index values from year(s) *ref* corresponding to the reference catch.

Equation 1 was modified slightly from that presented in Huynh et al. (2020) to add an additional source of tolerance for changing the catch advice. I_{ref} was adjusted to include a moving average. The time period of the moving average for I_{ref} and I_k was either 3 or 5 years to provide results with two ranges of tolerance for changes in catch advice. When using the 2019 index, I_k represented the average of index values from either 2017-2019 or 2015-2019. Index values were averaged in a similar manner for the 2020 indices. For all versions of the IA, C_{ref} was set at either the current ABC (15.1 million pounds whole weight) or the current OFL (15.5 million pounds whole weight) (NMFS NOAA).

Splitting the adjusted catch from the IA by sector was completed by using previously established allocation fractions of 51% commercial and 49% recreational (SEDAR 2018). The recreational catches were further split by mode with 57.7% allocated to the private angling component and 42.3% to the Federal for-hire component of the recreational fishery (NMFS NOAA).

Results

Indices of Relative Abundance

The 2020 Update EGOM index and the 2020 EGOM index from the reduced area (2020 Update - Reduced) do not show any major differences in the trends of Red Snapper abundance. Both the 2020 Update and the 2020 Update - Reduced indices show a decline in relative abundance in 2020 (**Figure 2**). The similarities between the two EGOM indices indicate that although reduced, the sampled stations from the 2020 survey year accurately represent the relative abundance of Red snapper in the EGOM and therefore can be used in an gulf-wide index of Red snapper abundance. The final gulf-wide 2019 and 2020 indices both agree that the relative abundance of Red snapper has declined since 2006 (**Table 1 & 2**). The gulf-wide 2020 index shows a decrease in the terminal year as well as an increased CV for the estimate (**Table 1**).

Interim Assessment

Acceptable Biological Catch

Adjustments to the SEDAR 52-based ABC (15.1 million pounds whole weight) were made using an array of reference index values, recent index values, and calculated index ratios (**Table 3**). These values varied based on the index used (terminal year 2019 or 2020) and the length of the moving average time period (3 or 5 years). The magnitude of the 2020 index I_{ref} and I_k were relatively similar to the 2019 index for both

the 3- and 5-year scenarios. Index ratios of recent to referenced values for the 3-year scenarios were 0.64 and 0.82 for 2020 and 2019, respectively. Index ratios of recent to referenced values for the 5-year scenarios increased, and were 0.92 for the 2020 index and 1.02 for the 2019 index. Multiplying the index ratio by the reference catch resulted in adjusted catch recommendations from 9.70 to 12.37 million pounds whole weight for 2021 using the 3-year average and 13.49 to 15.36 million pounds whole weight using the 5-year average (**Table 4**).

Overfishing Limits

The index ratios used to adjust the ABCs were used in a similar manner to adjust the OFL. The OFL is only slightly higher than the ABC (15.5 million pounds whole weight), resulting in an average of 309,790 additional pounds whole weight +/- 70,000 pounds whole weight (**Table 4**).

Discussion

This IA provides updated recommendations for the 2021 ABC for GOM Red Snapper without the influence of the Great Red Snapper Count results (Stunz et al. 2021).The NMFS BLL index has been consistently used in Red Snapper assessments since SEDAR 7, and was the only fishery-independent survey of those used in SEDAR 52 that could be used to develop abundance estimates for Red Snapper in 2020. Further analysis is needed to support the use of the NMFS BLL survey index compared to other indices. Catch advice was instead subjected to sensitivity in the variations of the NMFS BLL survey index, and varying levels of tolerance to change in the catch advice.

Many of the surveys that typically sample Red Snapper in the GOM did not occur in 2020, or suffered reduced coverage due to complications from COVID-19. The reduced sampling in 2020 limited the available survey indices for the IA to the NMFS BLL survey, since the DISL BLL survey was only able to collect samples from a limited area of the EGOM. This resulted in the index having no 2020 samples from the WGOM, where a higher abundance of Red Snapper is typically seen. The lack of coverage in the WGOM in 2020 is likely the reason for the sharp decline in relative abundance in 2020 (**Figure 4**) and the large amount of uncertainty around the estimate for 2020 in the 2020 Updated index (Pollack 2021). The 2020 Update - Reduced and the 2020-Update indices do not appear to have any major differences in the trends of Red Snapper abundance (**Figure 2**). The differences in the index values in 2011, 2012, and 2013 could be attributed to the high catch rates from the DISL survey, which began in 2010 (Pollack 2021).

Given the decrease in the NMFS BLL index in recent years compared to the reference year of 2016, implementing many of the presented IA variations will reduce the 2021 ABC from its previously set value of 15.1 million pounds whole weight. Using the index with a terminal year of 2019 and a 5-year moving average is the only variation attempted in which the ABC would increase from its previous value to 15.36 and remain lower than the current OFL, 15.5 million pounds whole weight. This increase is again due to including the relatively large index value from 2016 into the average for the recent index values.

One approach to setting catch advice would be to set 2021 ABC at 13.94 million pounds whole weight using the 2020 NMFS BLL Survey index and a 5-year moving average (**Table 5**). Allocations for the commercial sector would be 7.11 million pounds whole weight, and the recreational sector would receive 6.83 million pounds whole weight total (3.94 Private and 2.89 For-hire). This option appears risk-averse

in that it uses limited but up-to-date abundance data and attempts to take into account the uncertainty in the recent time series by averaging over years where higher abundances of Red Snapper were observed. The GOM Red Snapper stock is currently in a rebuilding plan with a target rebuilding year of 2032. As the IA does not assess stock status, it will take a full stock assessment to estimate the catch levels that maximize catch and maintain rebuilding timelines.

In the future and where possible, IAs will base index selection and harvest control rule parameterization decisions on output obtained from a Management Strategy Evaluation (MSE). In the southeast, these MSEs will be conducted using an extension to the Stock Synthesis (SS) assessment software being developed by the SSMSE research program (https://github.com/nmfs-fish-tools/SSMSE). The SSMSE tool is still under active development, which creates an opportunity for stakeholders to suggest specific performance metrics (e.g., probability of overfishing, average yield, catch stability, etc.) that would facilitate the process of selecting the index/harvest control rule combination that best achieves the desired management outcome for any species in the fisheries management plan. Many MSE tradeoffs are fundamentally about balancing varied and sometimes competing management goals while sustaining the natural resource, and thus necessitate the involvement of management stakeholders. In these situations, the fundamental tradeoff is usually between total yield and interannual stability of yield (Miller et al. 2019). Often, stakeholders prefer management procedures that result in greater stability (usually less than a 20% change in quota from one period to the next) over the management procedures that give the highest potential yield due to preferring market stability and predictability. While we have not conducted a full stakeholder-inclusive MSE, as this requires an extended period of time, preferences for stability are generally universal.

References

Campbell, MD, Pollack, AG, Henwood, T, Provaznik J, Cook M. 2012. Summary report of the red snapper (Lutjanus campechanus) catch during the 2011 congressional supplemental sampling program (CSSP). SEDAR31-DW17. 27 pp.

National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA). Fisheries of the Caribbean, Gulf of Mexico, and South Atlantic; Reef Fish Fishery of the Gulf of Mexico Red Snapper and Hogfish Management Measures. 84 FR 7828.7828-7831

Huynh, QC, Hordyk, AR, Forrest, RE, Porch, CE, Anderson, SC, Carruthers, TR.2020.The interim management procedure approach for assessed stocks: Responsive management advice and lower assessment frequency. *Fish Fish*; 21: 663– 679.

Ingram, WG, Henwood, T, Grace, M, Jones, L, Driggers, WB, Mitchell, K. 2005. Catch rates, distribution and size composition of large coastal sharks collected during NOAA Fisheries Bottom Longline Surveys from the U.S. Gulf of Mexico and U.S. Atlantic Ocean. LCS05/06-DW-27

Miller SK, Anganuzzi A, Butterworth DS, Davies CR, Donovan GP, Nickson A, et al. 2019. Improving communication: the key to more effective MSE processes. Can. J. Fish. Aquat. Sci. 76(4): 643-656

Pollack, AG. 2021. Additional Analyses of Relative Abundance of Red Snapper Captured During Fishery Independent Bottom Longline Surveys in the Northern Gulf of Mexico. 11 pp.

Pollack, AG, Hanisko DS, Ingram WG. 2017. Red Snapper Abundance Indices from Bottom Longline Surveys in the Northern Gulf of Mexico. SEDAR52-WP-16. SEDAR, North Charleston, SC. 38 pp.

SEDAR (Southeast Data, Assessment, and Review). 2009. SEDAR 7 - Stock assessment of Red Snapper in the Gulf of Mexico.448 pp. Available online at:
https://sedarweb.org/sedar-7-sar1-red-snapper-stock-assessment-report.

SEDAR. 2013. SEDAR 31 – Gulf of Mexico Red Snapper Stock Assessment Report. SEDAR, North Charleston SC. 1103 pp. Available online at:
http://sedarweb.org/sedar-31-stockassessment-report-gulfmexico-red-snapper.

SEDAR. 2015. SEDAR 31 Update Stock Assessment Report: Stock Assessment of Red Snapper in the Gulf of Mexico 1872-2013 with Provisional 2014 Landings. SEDAR, North Charleston, SC. 242p. Available online at:
http://sedarweb.org/docs/suar/SEDARUpdateRedSnapper2014_FINAL_9.15.2015.pdf.

SEDAR. 2018. SEDAR 52 - Stock Assessment of Red Snapper in the Gulf of Mexico. SEDAR, North Charleston, SC. 242p. Available online at:
https://sedarweb.org/sedar-52-gulf-mexico-red-snapper-final-stock-assessment-report.

Stunz, G. W., W. F. Patterson III, S. P. Powers, J. H. Cowan, Jr., J. R. Rooker, R. A. Ahrens, K. Boswell, L. Carleton, M. Catalano, J. M. Drymon, J. Hoenig, R. Leaf, V. Lecours, S. Murawski, D. Portnoy, E. Saillant, L. S. Stokes., and R. J. D. Wells. 2021. Estimating the Absolute Abundance of Age-2+ Red Snapper (Lutjanus campechanus) in the U.S. Gulf of Mexico. Mississippi-Alabama Sea Grant Consortium, NOAA Sea Grant. 303 pages.

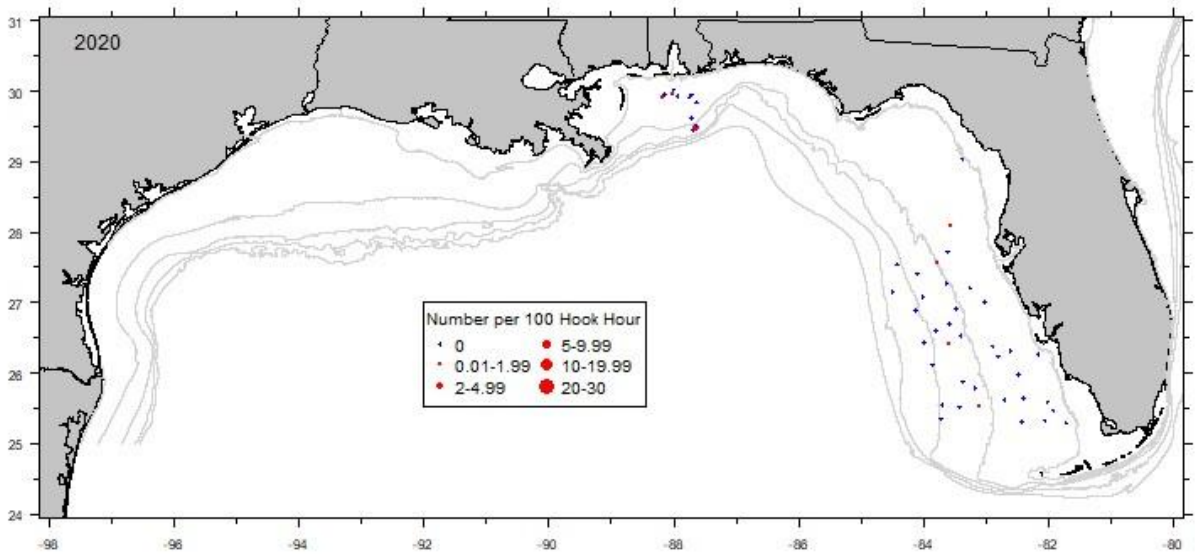

Figure 1. The reduced stations sampled in the Eastern Gulf of Mexico (EGOM) in 2020 during the DISL BLL survey with the Catch Per Unit Effort for Red Snapper in number per 100 hooks per hour (Pollack 2021).

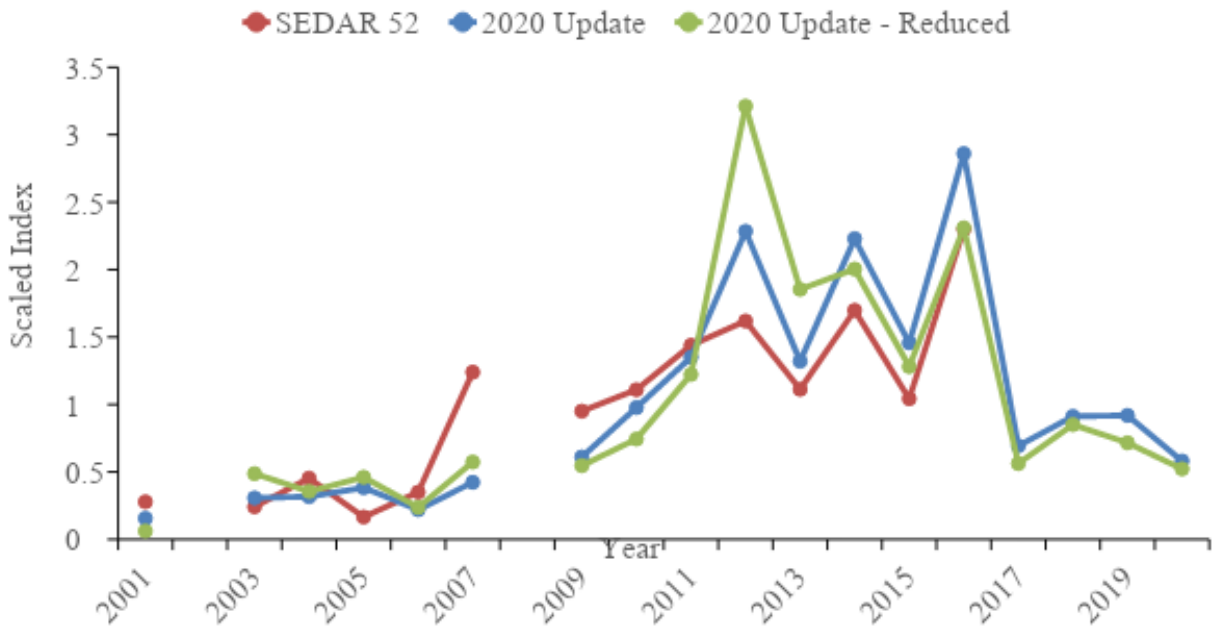

Figure 2. Comparison of relative indices of abundance for the Eastern Gulf of Mexico (EGOM) red snapper abundance using varying spatial subsets of the NMFS BLL data over time. 2020 - Update Reduced represents the abundance of Red Snapper if the reduced sampling area in 2020 was used to develop the index back in time. The 2020 Update index uses samples similar to those used in SEDAR 52 from 2001-2019, and uses the abundance from the reduced sampling area in 2020 (Pollack 2021, Figure 2).

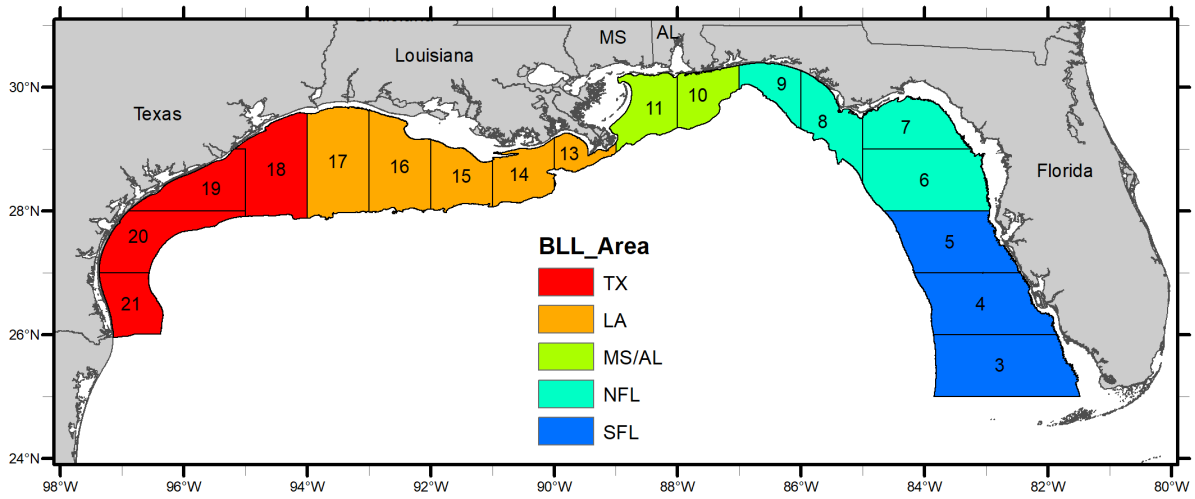

Figure 3. Area definitions for the BLL index submodels based on the grouping of Gulf of Mexico shrimp grid cells. Southern Florida (3-5), Northern Florida (6-9), Mississippi/Alabama (10-11), Louisiana (13-17), Texas (18-21).

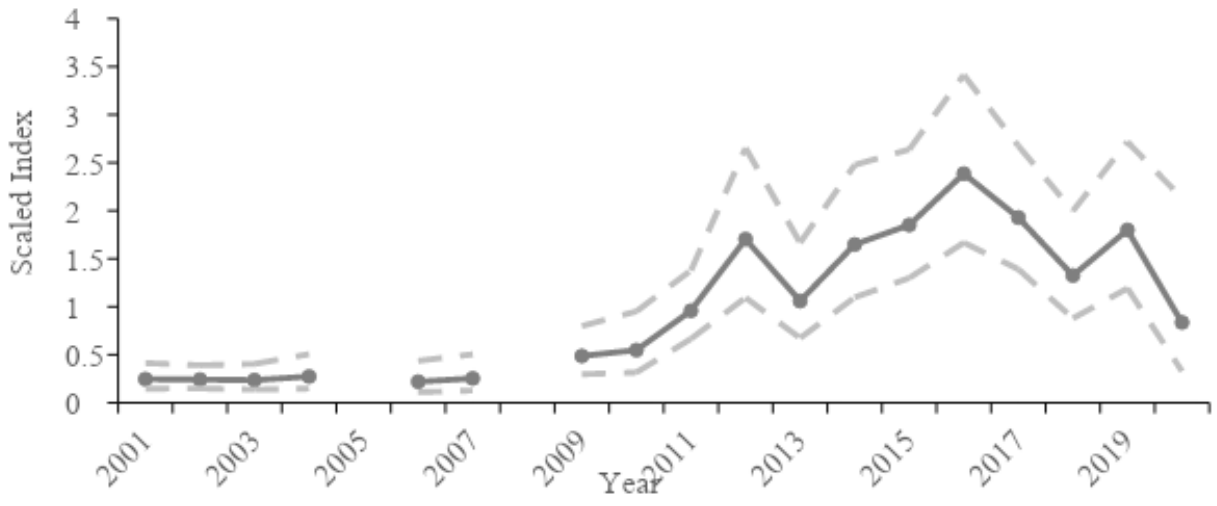

Figure 4. Annual index of abundance for the gulf-wide Gulf of Mexico Red Snapper stock from the NMFS BLL and DISL BLL surveys from 2001 – 2020 (Pollack 2021).

Table 1. Index of Red Snapper abundance developed using the delta-lognormal (DL) model for 2001-2020 for the NMFS BLL and DISL BLL surveys in the Gulf of Mexico. The nominal frequency of occurrence, the number of samples (*N*), the DL Index (number per 100 hook hour), the DL indices scaled to a mean of one for the time series, the coefficient of variation on the mean (CV), and lower and upper confidence limits (LCL and UCL) for the scaled index are listed (Pollack 2021).

Survey Year	Frequency	*N*	DL Index	Scaled Index	CV	LCL	UCL
2001	0.11245	249	0.21905	0.24589	0.26385	0.14635	0.41311
2002	0.23333	150	0.21494	0.24128	0.24452	0.14901	0.39068
2003	0.09843	254	0.20983	0.23554	0.27526	0.13719	0.40438
2004	0.09005	211	0.24363	0.27348	0.31514	0.14779	0.50606
2005							
2006	0.11719	128	0.19527	0.21919	0.35484	0.11008	0.43646
2007	0.11364	132	0.22585	0.25352	0.35453	0.12739	0.50452
2008							
2009	0.18293	164	0.43377	0.48691	0.25132	0.29682	0.79875
2010	0.16901	142	0.48835	0.54818	0.28112	0.31577	0.95163
2011	0.21600	250	0.85395	0.95857	0.18348	0.66615	1.37936
2012	0.26316	133	1.51779	1.70375	0.22407	1.09436	2.65246
2013	0.23226	155	0.94397	1.05962	0.22934	0.67375	1.66650
2014	0.32090	134	1.46822	1.64811	0.20572	1.09685	2.47640
2015	0.32934	166	1.64898	1.85102	0.17844	1.29907	2.63746
2016	0.38235	136	2.12526	2.38565	0.18065	1.66706	3.41399
2017	0.40385	156	1.71839	1.92892	0.16455	1.39104	2.67479
2018	0.29167	144	1.18060	1.32525	0.20750	0.87894	1.99818
2019	0.33065	124	1.60287	1.79925	0.20830	1.19147	2.71706
2020	0.14286	49	0.74465	0.83589	0.49416	0.32820	2.12888

Table 2. Index of Red Snapper abundance developed using the delta-lognormal (DL) model for 2001-2019 for the NMFS BLL and DISL BLL surveys in the Gulf of Mexico. The nominal frequency of occurrence, the number of samples (*N*), the DL Index (number per 100 hook hour), the DL indices scaled to a mean of one for the time series, the coefficient of variation on the mean (CV), and lower and upper confidence limits (LCL and UCL) for the scaled index are listed (Pollack 2021).

Survey Year	Frequency	*N*	DL Index	Scaled Index	CV	LCL	UCL
2001	0.11245	249	0.21775	0.24270	0.26576	0.14393	0.40924
2002	0.23333	150	0.21377	0.23827	0.24624	0.14666	0.38709
2003	0.09843	254	0.20904	0.23300	0.27724	0.13520	0.40152
2004	0.09005	211	0.24290	0.27073	0.31735	0.14571	0.50304
2005							
2006	0.11719	128	0.19428	0.21653	0.35720	0.10828	0.43303
2007	0.11364	132	0.22480	0.25056	0.35693	0.12535	0.50083
2008							
2009	0.18293	164	0.43332	0.48296	0.25333	0.29328	0.79533
2010	0.16901	142	0.48724	0.54306	0.28344	0.31146	0.94689
2011	0.21600	250	0.85688	0.95505	0.18520	0.66149	1.37891
2012	0.26316	133	1.51683	1.69061	0.22601	1.08186	2.64191
2013	0.23226	155	0.93722	1.04460	0.23146	0.66149	1.64961
2014	0.32090	134	1.45975	1.62699	0.20787	1.07831	2.45487
2015	0.32934	166	1.64408	1.83244	0.18029	1.28140	2.62045
2016	0.38235	136	2.12316	2.36641	0.18253	1.64756	3.39891
2017	0.40385	156	1.71753	1.91431	0.16623	1.37597	2.66327
2018	0.29167	144	1.17669	1.31150	0.20947	0.86651	1.98501
2019	0.33065	124	1.59726	1.78026	0.21037	1.17418	2.69919

Table 3. Index reference (I_{ref}), index recent (I_k), and index ratios (I_{ratio}) for the 2020, 2019 gulfwide indices averaged over 3- and 5-year time periods. The reference value I_{ref} was the average of index values from 2015 to 2017 for all indices and time periods. The recent index value, I_k, was the average of index values for 2018-2020 for the 2020 index, during the 3-year period, and 2015-2020 during the 5-year period. For the 2019 index, the recent index value I_k was the average of values from 2017 to 2019 and 2014 to 2019 for the 3- and 5-year periods, respectively.

	Terminal Year 2020	Terminal Year 2019
	3-year average	
I_{ref}	2.06	2.04
I_k	1.32	1.67
I_{ratio}	0.64	0.82
	5-year average	
I_{ref}	1.83	1.81
I_k	1.69	1.84
I_{ratio}	0.92	1.02

Table 4. 2021 Traditional Interim Assessment (IA) Acceptable Biological Catch (ABC) and Over Fishing Limit (OFL) catch advice using variations of the gulf-wide NMFS BLL index (2020 and 2019), with a 3- or 5-year moving average for reduced tolerance to changes in catch advice. Values presented are in millions of pounds whole weight.

	Terminal Year 2020	Terminal Year 2019
	ABC	
3-year	9.70	12.37
5-year	13.94	15.36
	OFL	
3-year	9.96	12.69
5-year	14.31	15.76