Regulatory Amendment 35

Snapper Grouper Release Mortality Reduction and Red Snapper Catch Levels

Decision Document

June 2022

Background

Red snapper have been in a rebuilding plan since 2010, with the stock scheduled to be rebuilt by 2044. The most recent stock assessment for South Atlantic red snapper, SEDAR 73 (2021) with data through 2019, determined the stock to still be overfished and undergoing overfishing. Since initial implementation of the rebuilding plan, red snapper fishing has been limited by few days of recreational harvest allowed annually and a low annual catch limit (ACL) for the commercial sector with a season beginning each year in July until the ACL is met. These measures, combined with growing effort in the South Atlantic snapper grouper fishery, particularly from the recreational sector, have led to a drastic increase in the number of red snapper that must be released after being caught. The increase in releases has, in turn, led to an increase in the number of fish that die after being caught and released, despite efforts from management and fishermen to improve survival after release through best practices and use of descending devices. The number of dead red snapper releases far outnumbers fish removed from the population by harvest.

Large numbers of releases limit managers' ability to prevent overfishing and reduce the number of fish that can be landed by the fishery. Overfishing occurs when the number of total removals exceeds the overfishing limit. If more of these removals occur from fish dying after release, fewer fish may be landed.

In September 2021, the Scientific and Statistical Committee (SSC) recommended new acceptable biological catch (ABC) levels for red snapper based on the results of SEDAR 73 (2021). Implementation of the recommended ABCs would initially entail an approximate one third reduction from the current ABC, further limiting the fishery and not addressing the primary

source of mortality for the stock. Therefore, the Council began gathering information and analyses to inform management measures that would reduce releases of red snapper, recognizing that such a measure would necessarily affect multiple species in the snapper grouper fishery. The Council intends for this management change to also be accounted for by the SSC in reconsidering assumptions about future management conditions in projections that support their ABC recommendation.

In March 2022, the Council formally initiated Regulatory Amendment 35 and directed staff to compile analyses that could inform Council consideration of area, time, or depth-based closures for the snapper grouper fishery.

Objective for this meeting

Provide guidance to staff for further development of Regulatory Amendment 35:

- What actions should be included?
    1. Revise the OFL, ABC, OY, and ACLs for South Atlantic red snapper.
    2. Management changes to reduce dead releases?

Management Options

1. Implement red snapper ABC based on current SSC recommendation

Current total ACL: 42,510 fish
Current recreational ACL: 29,656 fish
Current commercial ACL: 124,815 lbs ww

Table 1. Acceptable biological catch levels recommended for South Atlantic red snapper by the Scientific and Statistical Committee, based on projections from SEDAR 73 (2021). Discard pounds and numbers are those of dead discards.

Year	Landings (lbs ww)	Discards (lbs ww)	Landings (numbers of fish)	Discards (numbers of fish)	Percent Landed Number Reduction from Current ACL
*2022**	*284,000*	*983,000*	*25,000*	*195,000*	--
2023	327,000	1,036,000	28,000	202,000	34.13%
2024	368,000	1,076,000	31,000	207,000	27.08%
2025	408,000	1,104,000	33,000	210,000	22.37%
2026	446,000	1,122,000	35,000	211,000	17.67%

**Given the timing of this amendment, the earliest that revised ABCs could be implemented is 2023.*

- Projections require a 34.13%-17.67% reduction in landings, which would be accomplished through a reduction of the ABC and ACL.

- Per allocation policy, allocation changes would need to be discussed. If the Council wants to consider changes to allocation, would need to be done through a plan amendment. Current allocations: 71.93% recreational; 28.07% commercial.
- Recreational season would continue to be set (beginning the second Friday in July) using catch rates from the previous years, but with a revised (lower) ACL.
- Commercial season would operate with the same timed opening (second Monday in July), but would have a revised (lower) ACL.
- **Projections assume that dead discards decrease as landings decrease.** This relationship has been highly variable for South Atlantic red snapper since 2010, including several years of low landings and very high discards. Federal waters were closed for red snapper in 2010, 2011, 2015, and 2016.
- Recent observed fishing mortality rates (F) from discards alone are greater than the F_{MSY} proxy, $F_{30\%SPR}$ (0.21; SEDAR 73) (**Table 2**), so based on recent catch, overfishing would still be occurring due to discards even if landings were 0. $F_{current}$ is the geometric mean of full F values for the 3 most recent years of the assessment (2017-2019) and equals 0.453 (SEDAR 73). **To end overfishing, the fishing mortality rate would need to be reduced to 0.21 or lower**.

Table 2. Recent estimated time series of fully selected fishing mortality rates (F) for commercial handlines, headboat, recreational (private and charter) landings and discards. Also shown is Full F, the maximum F at age summed across fleets, which may not equal the sum of fully selected F's because of dome-shaped selectivities. (SEDAR 73)

Year	Commercial Handline Landings	Headboat Landings	Recreational Landings	Commercial Handline Discards	Headboat Discards	Recreational Discards	Full F
2015	0.001	0.001	0.008	0.015	0.01	0.328	0.356
2016	0.001	0	0	0.014	0.011	0.527	0.553
2017	0.016	0.003	0.049	0.007	0.006	0.288	0.328
2018	0.02	0.005	0.06	0.004	0.007	0.599	0.646
2019	0.019	0.005	0.067	0.004	0.007	0.388	0.435

Implementation of the SSC-recommended ABCs would fulfill the National Standard 1 requirement that the Council cannot set an ABC greater than the SSC's recommendation. However, implementation of these ABCs would not fulfill the requirement to end overfishing, as the fishing mortality rate due to discards in the most recent years of the assessment ($F_{current}$) is greater than the fishing mortality rate that was projected to produce the recommended ABC levels.

2. Consider management measures for the snapper grouper fishery to reduce discards

SSC Comments (see April 2022 Meeting Report for full comments)

- To significantly reduce discard mortality, reducing encounters and effort is paramount. Long-term management strategies need to focus on these reductions in order to enable greater harvest to occur.

- The SSC emphasized that F-rebuild [0.21] is much lower than F-current [0.453] and thus dramatic reductions in overall fishery effort to reduce discards will be required. Small changes that allow only a slight reduction in effort or discard mortality rates will not be sufficient to address the challenges facing this fishery and successful rebuilding of red snapper.
- **In the short-term (for this regulatory amendment), the SSC recommends pursuing temporal/spatial reductions (possibly wave-based) in bottom fishing.** Seasonal differences among regions within the South Atlantic should be considered when developing these regulations, if possible. The bulk of recreational discards for red snapper are occurring off the East Coast of Florida; thus, spatial closures may be most effective in this area.
- Spatial reductions by depth may be less effective in the South Atlantic as compared to the West Coast, for example, where barotrauma complications account for majority of discard mortality. A smaller proportion of red snapper caught in the US South Atlantic suffer from barotrauma. Also, spatial closures based on depth would need to first identify if different species have different ecological niches, and take into account the community composition, co-occurrence of species, and fleet dynamics as functions of depth.
- Effectiveness of gear restrictions/changes to reduce discard mortality will be difficult to quantify within the short time frame of this amendment and should only be considered in the suite of longer-term solutions.

Snapper Grouper AP Comments (see April 2022 Meeting Report for full comments)

- Some localized fishery needs were noted by the AP, but much of the AP was opposed to giving up access to other species to potentially increase ability to retain red snapper.
- The AP provided the following statement:

  For Regulatory Amendment 35, the AP was asked to provide suggestions to further reduce red snapper interactions while fishing for other species. The AP was asked to consider punitive actions that may include bottom fishing closures and altered or shut seasons for other species in order to avoid red snapper interactions.

  The AP presented opinion and suggestions in the best of faith. However, the overriding opinion and feeling of the AP is that red snapper are recovered. This is based on the collective on-the-water experience of the AP members. The AP overwhelmingly feels they were asked for suggestions to solve a problem that no longer exists.

  The red snapper is highly abundant. The biomass of the species is largely assumed , by the AP as recovered and sufficient in abundance and range to begin a pathway to more liberal regulation of the species.

Table 3. Commercial and recreational percentages of South Atlantic red snapper dead releases. (SEDAR 73)

Sector Releases	2015-2019 Percentage	Average Annual % 2015-2019	1992-2019 Percentage	Average Annual % 1992-2019
Commercial	1.48%	1.64%	3.22%	10.03%
Recreational	98.52%	98.36%	96.78%	89.97%

Because most of the releases occur in the recreational sector and commercial discard data are not as readily available as data on recreational releases, further analyses investigating spatial and temporal dynamics of releases were only conducted for the recreational sector. Additionally, more recent catch data than the terminal year of the SEDAR 73 assessment (2019) are being used as these would be most relevant for predicting future releasing behavior in the fishery.

Table 4. Average percentages of red snapper recreational releases and recreational trips with red snapper catch by wave, 2019-2021. (MRIP, queried May 2022)

Wave	Average % of Annual MRIP Releases (B2)	Avg % of Annual Trips that caught red snapper
1	11.05%	5.25%
2	10.65%	10.68%
3	27.02%	20.71%
4	33.10%	48.97%
5	8.77%	9.41%
6	9.42%	4.98%

Table 5. Average percentages of red snapper recreational releases by wave and state of landing, 2019-2021. (MRIP, queried May 2022)

Wave	Average Percentage of Annual Releases	State Average Percentages of Releases Within Each Wave			
		NC	SC	GA	FL
1	11.05%	3.65%	0.00%	0.00%	96.35%
2	10.65%	0.03%	0.38%	9.34%	90.25%
3	27.02%	0.30%	2.79%	4.28%	92.64%
4	33.10%	0.92%	7.91%	1.90%	89.27%
5	8.77%	1.20%	3.41%	0.66%	94.73%
6	9.42%	1.00%	0.12%	2.71%	96.17%
State Average Percentages of Annual Releases		0.61%	4.38%	3.05%	91.96%

Committee Discussion

- SHOULD ACTION(S) TO REDUCE DEAD RELEASES OF RED SNAPPER (AND OTHER SNAPPER GROUPER SPECIES) CONTINUE TO BE DEVELOPED THROUGH REG. AMENDMENT 35?
    - IF SO, PROVIDE GUIDANCE ON WHAT ACTION(S) AND ALTERNATIVES SHOULD BE DEVELOPED.
    - ADDITIONAL REQUESTED INFORMATION IS INCLUDED IN THE APPENDIX.

Appendix

SEDAR 73 Landings and Dead Releases

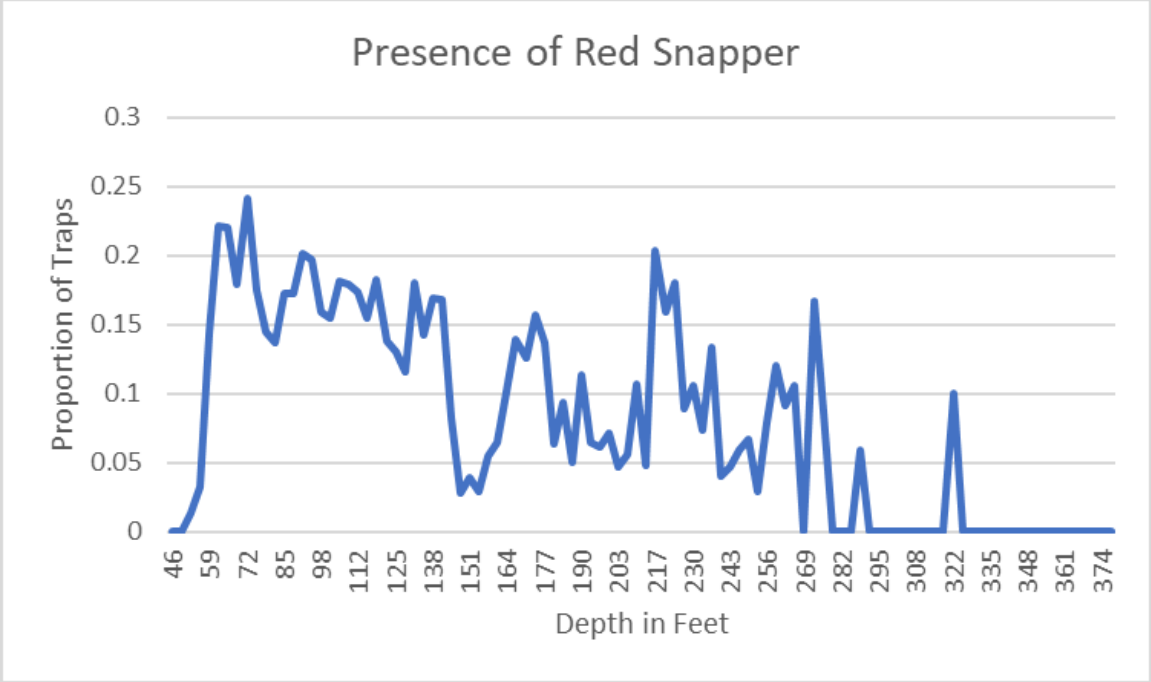
App. Table 1. SEDAR 73 (2021) landings and dead releases, numbers of fish.

Year	Com Landings	Rec Landings	Total Landings	Com Dead Releases	Rec Dead Releases	Total Dead Releases
1992	8,580	80,590	89,170	8,890	15,240	24,130
1993	21,140	37,230	58,370	7,710	66,860	74,570
1994	18,900	40,610	59,510	9,740	47,170	56,910
1995	15,950	25,980	41,930	9,720	34,020	43,740
1996	12,390	35,370	47,760	9,550	15,260	24,810
1997	9,720	22,440	32,160	10,310	7,260	17,570
1998	8,350	46,320	54,670	7,420	40,970	48,390
1999	9,360	104,180	113,540	6,260	120,780	127,040
2000	11,270	147,450	158,720	6,700	205,280	211,980
2001	21,770	145,400	167,170	6,970	198,970	205,940
2002	20,600	165,900	186,500	12,390	127,640	140,030
2003	14,460	66,460	80,920	3,970	149,730	153,700
2004	17,220	113,710	130,930	970	267,750	268,720
2005	12,490	62,500	74,990	4,780	51,840	56,620
2006	7,630	68,790	76,420	2,180	173,230	175,410
2007	11,120	66,850	77,970	5,000	379,450	384,450
2008	30,300	341,920	372,220	4,740	546,470	551,210
2009	40,250	442,130	482,380	5,380	372,950	378,330
2010	760	540	1,300	6,140	186,920	193,060
2011	60	1,420	1,480	14,680	80,320	95,000
2012	750	8,060	8,810	7,460	117,650	125,110
2013	2,930	1,580	4,510	6,260	71,360	77,620
2014	6,600	16,980	23,580	10,100	218,140	228,240
2015	550	2,780	3,330	11,410	373,190	384,600
2016	390	410	800	13,510	662,440	675,950
2017	10,750	22,080	32,830	7,560	419,790	427,350
2018	14,780	31,370	46,150	4,980	828,390	833,370
2019	13,410	34,660	48,070	4,550	519,470	524,020

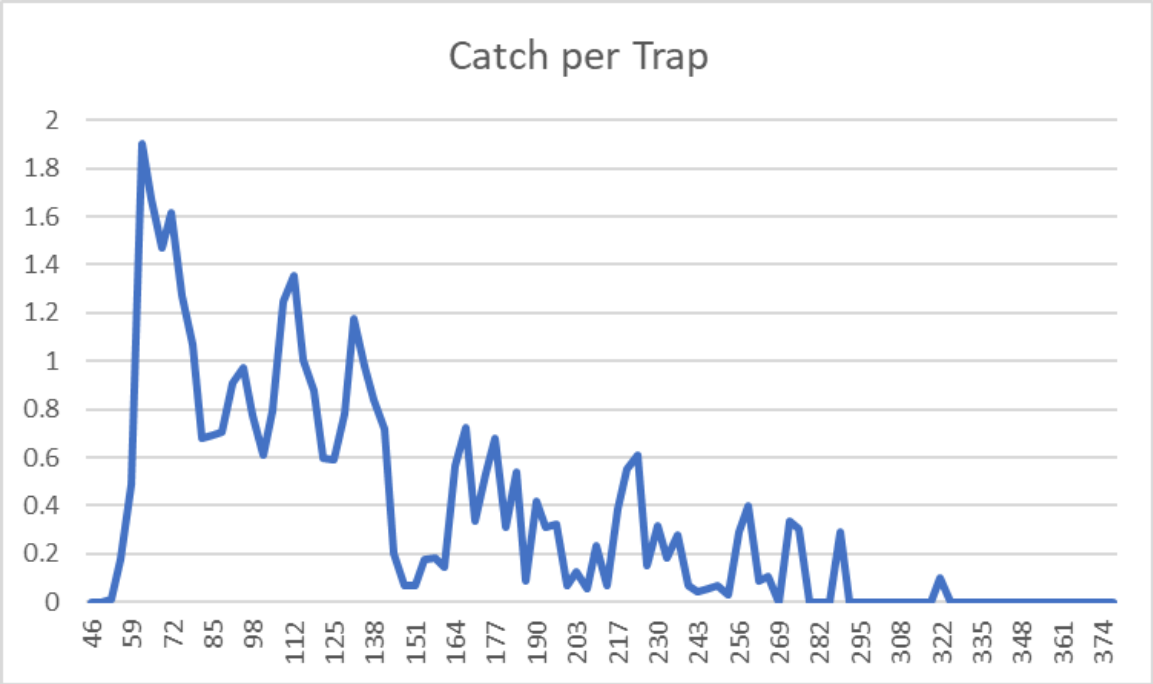
Preliminary **Fishery-Independent Depth and Spatial Data (MARMAP Chevron Trap Survey)**

The following Southeast Reef Fish Survey (SERFS) data are shown with the caveat that these data have not been treated to account for differences in sample type, depth, or sampling effort. These data should be regarded as preliminary investigation into depths where Red Snapper are most commonly observed. Fishermen have described red snapper being caught over a variety of depths. Data from the chevron trap survey observed red snapper from 50 feet to over 300 feet (**App Figure 1**). Red snapper were most common from 60 feet out to 200 feet. The average catch per trap of red snapper tended to decrease from a peak catch rate at 62 feet (**App Figure 2**). After 150 feet, there appears to be a shift to a lower catch per trap of red snapper**.**

NOTE: These data have a high number of zero catches and averages, as included here, can be biased. For example, differences in sampling effort occurs between Florida and North and South Carolina by depth and red snapper are more common and more abundant in Florida (**App Table 2** and **3**). A more thorough analysis should account for these differences in effort and abundance and will be done as the amendment is developed, if needed.



App. Figure 1. Proportions of chevron traps that caught red snapper by depth in the Southeast Reef Fish Survey (2011-2021).



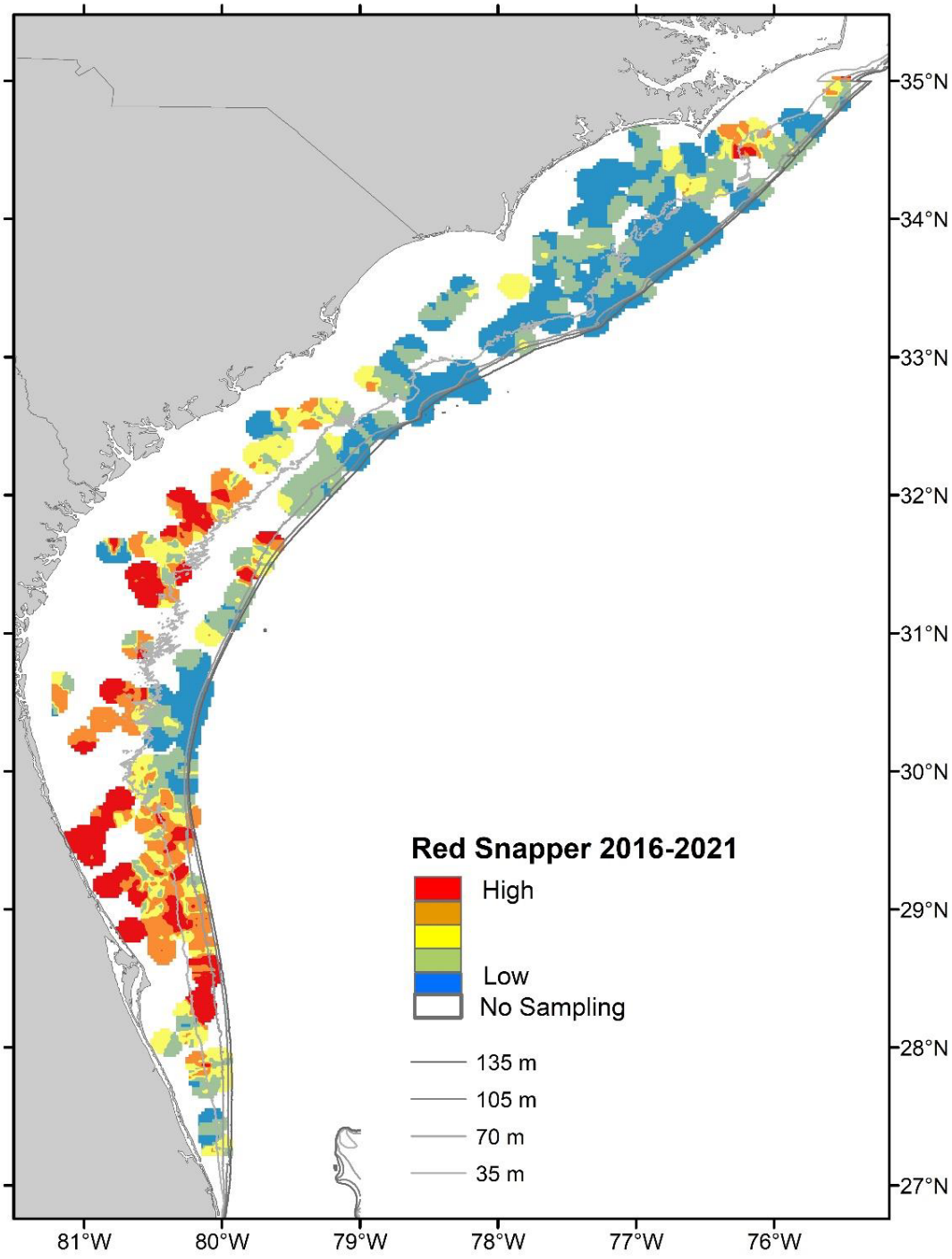
App. Figure 2. Red snapper caught per trap by depth (ft) in the Southeast Reef Fish Survey (2011-2021).

App. Table 2. Proportions of traps containing red snapper by region and depth in the Southeast Reef Fish Survey (2011-2019). Depths and latitudes denote lower bounds (e.g. 10 m is 10-19.9 m). Colors for all areas are relative to each other (green = greater presence; red = lesser presence).

Depth (m)	27-29 Canaveral to St Aug	30-32 St Aug to Charleston	33-35 Charleston and north
0		0	0
10	0.095455	0.015909	0.006818
20	0.085166	0.058259	0.033458
30	0.030523	0.084063	0.043282
40	0.049663	0.04335	0.015572
50	0.06552	0.025799	0.021294
60	0.003425	0.087329	0.013699
70		0.054968	0.023256
80		0.033708	0.022472
90		0	0.007246
100			0
110			0

App. Table 3. Red snapper abundance per trap including zeros in the Southeast Reef Fish Survey (2011-2019). An estimate of abundance should use a zero-inflated estimate, but this is a quick look and indicates that further north, sampling occurs over broader depths and red snapper are found at deeper depths. Depths and latitudes denote lower bounds (e.g. 10 m is 10-19.9 m). Colors for all areas are relative to each other (green = greater presence; red = lesser presence).

Depth (m)	27-29 Canaveral to St Aug	30-32 St Aug to Charleston	33-35 Charleston and north
0		0	0
10	0.611364	0.156818	0.006818
20	0.502808	0.425831	0.071128
30	0.149862	0.551414	0.152614
40	0.346801	0.147306	0.050505
50	0.307125	0.096233	0.078215
60	0.02911	0.22774	0.017123
70		0.15222	0.027484
80		0.078652	0.044944
90		0	0.007246
100			0
110			0



App. Figure 3. SERFS sampling locations and relative abundances of red snapper sampled in chevron traps (2016-2021).

Red Snapper Releases and Mortality by Depth

The following tables were excerpted from the SEDAR 73 working paper, SEDAR 73-WP15, by Vecchio et al. (2021). Release data were from angler behavior studies conducted by the Florida Fish and Wildlife Conservation Commission and Georgia Department of Natural Resources.

App. Table 4. Total numbers of Red Snapper observed caught and released in the Florida east coast recreational fishery.

Depth (m)	Charter	Headboat	Total	Total %
10-19	20	247	**267**	**3.81%**
20-29	566	4848	**5414**	**77.35%**
30-39	463	598	**1061**	**15.16%**
40-49	51	101	**152**	**2.17%**
50-59	41	44	**85**	**1.21%**
60+	16	4	**20**	**0.29%**
Totals	**1157**	**5842**	**6999**	**100.00%**

App. Table 5. Proportional mortality by depth applying varying levels of descender use within the South Atlantic Red Snapper recreational fishery. "All depths" mortality is calculated for both the Charter/Private fleet and for the headboat fleet. Each was calculated by applying proportional mortality by depth to the proportion of the catch released within each 10 m depth bin as directly observed in the Florida east coast charter boat and headboat fisheries (App. Table 4).

Depth	M (0% descend)	M (25% descend)	M (50% descend)	M (75% descend)	M (100% descend)
10-19	0.24	0.23	0.22	0.21	0.19
20-29	0.26	0.25	0.23	0.22	0.20
30-39	0.29	0.28	0.26	0.24	0.23
40-49	0.32	0.30	0.28	0.26	0.24
50-59	0.33	0.31	0.29	0.27	0.25
60+	0.40	0.37	0.34	0.31	0.28
All depths-Charter/Private	0.279	0.263	0.248	0.233	0.218
All depths-Headboats	0.263	0.249	0.235	0.221	0.207

Summary of Previous Discard-Reducing Analyses and Discussion

SG Amendment 17A

- Impacts of bathymetric closures determined % of RS within closed depths by statistical area (commercial logbook grid).
- Projected reductions in total removals were computed from baseline 2005-2007 data compiled from commercial logbook, MRFSS, and headboat logbook data.
- Used estimates of discard mortality from SEDAR 15 (2008): 40% for the recreational fishery and 90% for the commercial fishery.
- SEDAR 15 sensitivity runs indicated overfishing of red snapper would still be occurring at lower release mortality rates of 20% for the recreational sector and 70% for the commercial sector.
- Appendix E – model considered red snapper harvest reductions as a function of directed and/or targeted trips for species regulated by Amendment 13C (commercial sector only), Amendment 16 (all sectors), and Amendment 17A (all sectors). Compared projected removal rates under scenarios with/without:
    - Elimination of directed effort and/or target trips due to regs
    - Changes in overall release mortality
    - Inshore release mortality rates (to account for effort shift to shallower water)
    - Varying compliance rates
- Burns et al. (2004) estimated a red snapper release mortality of 64% following a study on headboats off Florida in the Atlantic and Gulf of Mexico. The majority of acute mortalities in this study (capture depth of 9–42 m) were attributed to hooking (49%), whereas barotrauma accounted for 13.5%. Using barometric chambers, Burns et al. (2004) estimated barometric mortality at 0% for depths of less than 20, 25, and 30 m; barotrauma-induced mortality increased to 40% at 45 m and 45% at 60 m.
- Burns et al. (2002) estimated J-hook mortality at 56% in a similar study.
- A mark-recapture study by Patterson et al. (2001b) in the Gulf of Mexico estimated a discard mortality of 9% at 21 m, 14% at 27 m, and 18% at 32 m. The mean minimum depth in the recreational (charter boat) fishery was 43 m (range 20 to 183 m). The mean maximum depth was 58 m (24 to 274 m).
- Council determined a compliance rate of less than 90% and that was input into the prediction model.
- Several proposed closure alternatives may result in commercial and recreational fishermen moving into shallower water to fish, potentially decreasing discard mortality rates by reducing barotrauma.
- Assumed noncompliance had greater proportional impact on red snapper removals than similar level of effort shifting due to expected shift of effort inshore due to proposed area closure alternatives and reduced release mortality in shallower waters.
- Projected RS reduction were extremely sensitive to changes in recreational release mortality rates and estimated compliance rate.

- Lack of fishery independent data led to basing the estimated percent of the stock protected under the various area closure alternatives on commercial logbook data, thus introducing several potential biases (e.g. commercial fishery in deeper waters, etc)
- Appendix O has econ simulation model (Jim Waters) for commercial. Did not include Am 17B as part of the baseline (effects to SWG, esp. red grouper)
- Proposed regs compared to simulated effects of Amds 13C, 15A, and 16 rather than observed historical landings
- Appendix N has economic analyses for recreational. Follows the methodology employed in NMFS (2008a and 2008b). NMFS (2008a) analyzed the expected economic effects of a recreational closure of the red snapper fishery in the Gulf of Mexico in 2008. NMFS (2008b) analyzed the expected economic effects of the interim rule to close the red snapper fishery in the South Atlantic.
- Magnitude of socio-econ effects correlated with size of proposed closures.
- Northeast Florida/ Georgia would experience the largest economic effects, followed by southeast Florida, South Carolina, and lastly by North Carolina. This generally reflects the fact that the bulk of the affected fishery is in the northeast Florida/Georgia area.
- Looked at CS and NOR (2009 dollars) for different levels of trip cancellations for each area closure alternative.

SG Amendment 17B

- Used simulation model for econ effects (see above)
- Bio analysis done with species trip composition on trips that caught at least 1 pound of DWC species
- Minority report opposing the closure cites severe and disproportionate socio economic impacts given the uncertainty of data on SH and WG. Also opposed BLT not being exempted from closure.

Snapper Grouper Spawning Literature Review

Introduction

In March 2021, following the most recent stock assessment of red snapper, the Council began the development of Regulatory Amendment 35. In December of 2021 the Council directed staff to investigate management options to reduce release mortality of red snapper and other snapper grouper species, including potential seasonal and depth closures, and gear restrictions.

A literature review was conducted to gather evidence on the spawning months of different species within the Snapper Grouper Fishery Management Unit and analyze which months may be most important to the greatest number of snapper grouper species. When considering seasonal closures to reduce fishing mortality, closing months when most species are spawning could provide the benefit of allowing mature individuals an increased opportunity to spawn, and decreased fishing pressure on spawning aggregates.

Assessment reports and peer reviewed articles were gathered that analyzed the spawning seasons of several snapper grouper species. Two of the articles examined stocks within the Gulf of Mexico but were included because the stocks are noted to have similar spawning behavior between the Caribbean, Gulf of Mexico and South Atlantic; however spawning season focused on papers from the Gulf of Mexico and South Atlantic based on similar seasonal trends in temperature. Information from the Caribbean was used to describe spawning season if no other information was available.

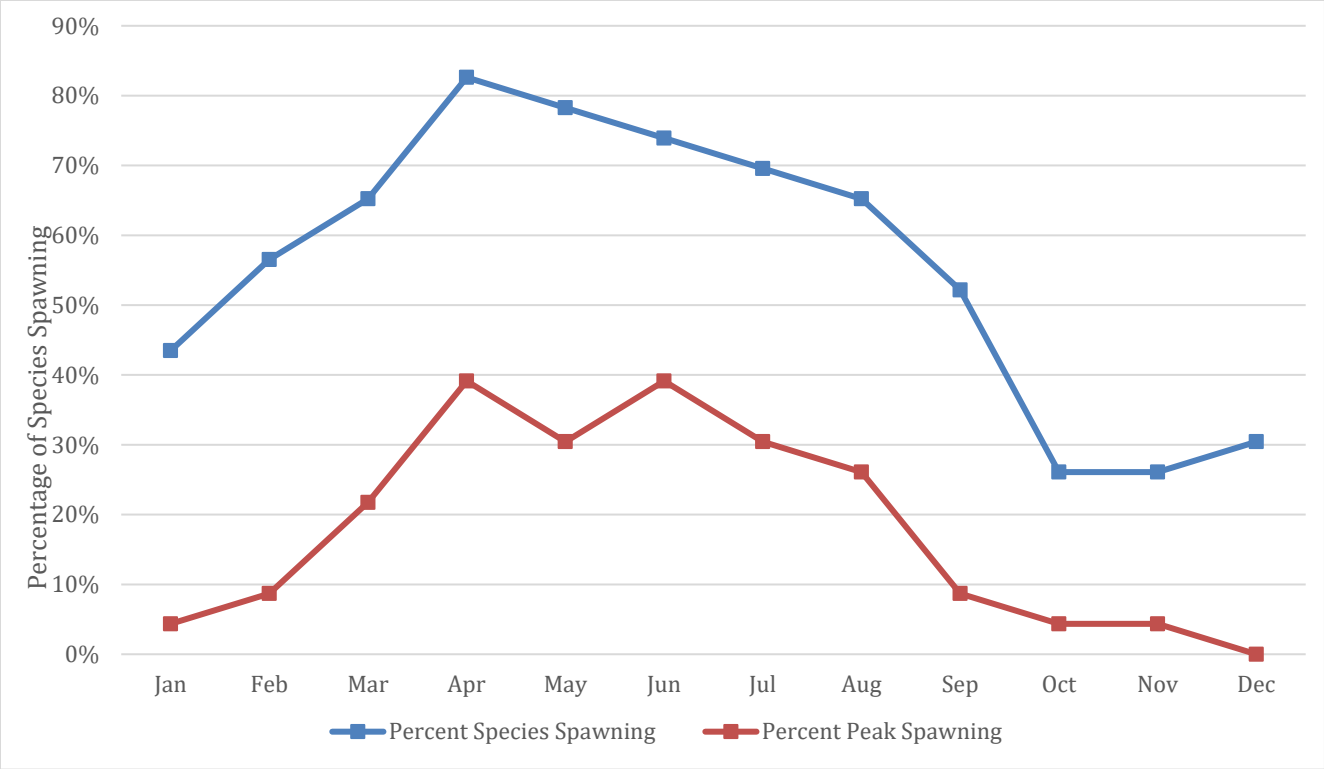
SEDAR Assessment Report Review

The Southeast Data Assessment and Review (SEDAR) assessment process provides peer reviewed stock assessments. These assessments are used by the Scientific and Statistical Committee (SSC) to determine catch levels for many snapper grouper species.

Some stock assessment reports included life history information. Of the Gulf, Caribbean, and South Atlantic assessed snapper grouper species (n=28), 23 of the reports described spawning season (**App. Table 6)**. Over 80% of assessed species were spawning in April, and 40% of assessed species were in peak spawning during April and June according to the SEDAR assessment reports (**App. Figure 4**). Less than 50% of the species were in spawning condition from October through January.

App. Table 6. A list of the assessed Snapper Grouper Fishery Management Unit species and the spawning season as indicated by the assessment report. Gray cells indicate spawning is occurring. Black cells indicate peak spawning, red rows indicate assessment lacked spawning season. SA indicates a South Altantic assessment, GM indicates a Gulf of Mexico assessment, C indicates a Caribbean assessment. Bold species are aggregate spawners.

Species	SEDAR #	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Almaco jack	GM49												
Black grouper	SA48												
Black sea bass	SA25												
Blueline tilefish	SA32												
Gag	SA10												
Goliath grouper	SA6												
Gray snapper	GM51												
Gray trigger	SA41												
Greater amberjack	SA15												
Hogfish	GM/SA37												
Lane snapper	GM49												
Lesser amberjack	GM49												
Mutton snapper	GM/SA15A												
Queen snapper	C26												
Red grouper	SA19												
Red hind	C35												
Red porgy	SA1												
Red snapper	SA41												
Scamp	SA68												
Silk snapper	C26												
Snowy grouper	SA36												
Speckled hind	GM49												
Tilefish	SA25												
Vermilion snapper	SA17												
Yellowedge grouper	GM22												
Yellowfin grouper	C14												
Yellowmouth grouper	GM49												
Yellowtail snapper	GM/SA27A												



App. Figure 4. The percentage of assessed species in the Snapper Grouper Fishery Management Unit in spawning condition based on SEDAR assessment reports (blue) and the percentage of species in peak spawning condition based on SEDAR assessment reports (orange).

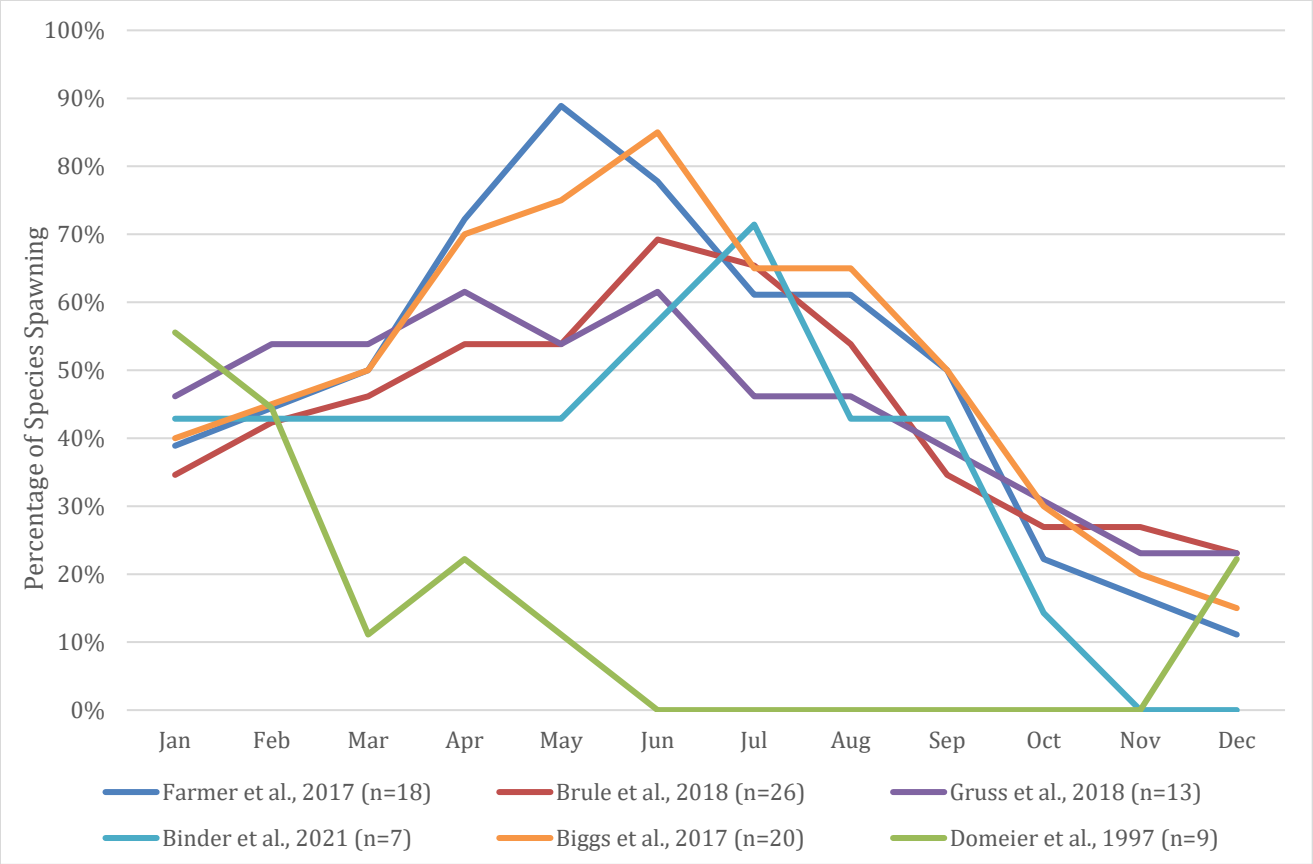
Literature Review

Complex Comparisons

The literature reviewed included many species in the Snapper Grouper Fishery Management Unit so spawning season comparisons could be made across sources. Six articles provided information on the spawning season for 41 species in the fishery management unit (**App. Table 7**). Two of the sources included data from the South Atlantic, two from the Gulf of Mexico, and two that included seasons from the eastern Gulf and Caribbean. The highest percentage of species was found to spawn from April to July (**App. Figure 5**).

App. Table 7. The list of species in the Snapper Grouper Fishery Management Unit observed in the literature reviewed and the number of articles which contained each species.

Snapper Grouper Species Included in literature	Number of Articles Observed n=6	Snapper Grouper Species Included in literature	Number of Articles Observed n=6
Gag	6	Rock hind	3
Cubera snapper	5	Black sea bass	2
Scamp	6	Red porgy	2
Mutton snapper	5	Graysby	2
Black grouper	5	Coney	2
Goliath grouper	5	Blueline tilefish	2
Snowy grouper	4	Gray snapper	2
Speckled hind	4	Almaco jack	2
Warsaw grouper	4	Red hind	2
Yellowedge grouper	4	White grunt	1
Red grouper	4	Misty grouper	1
Greater amberjack	4	Lane snapper	1
Yellowmouth grouper	4	Silk snapper	1
Red snapper	4	Blackfin snapper	1
Nassau grouper	4	Knobbed porgy	1
Yellowfin grouper	4	Yellowtail snapper	1
Tilefish (golden)	3	Tomtate	1
Gray triggerfish	3	Wreckfish	1
Vermilion snapper	3	Hogfish	1



App. Figure 5. The percentage of species in the Snapper Grouper Fishery Management Unit in spawning condition each month according to each publication examined. n=number of species within per publication.

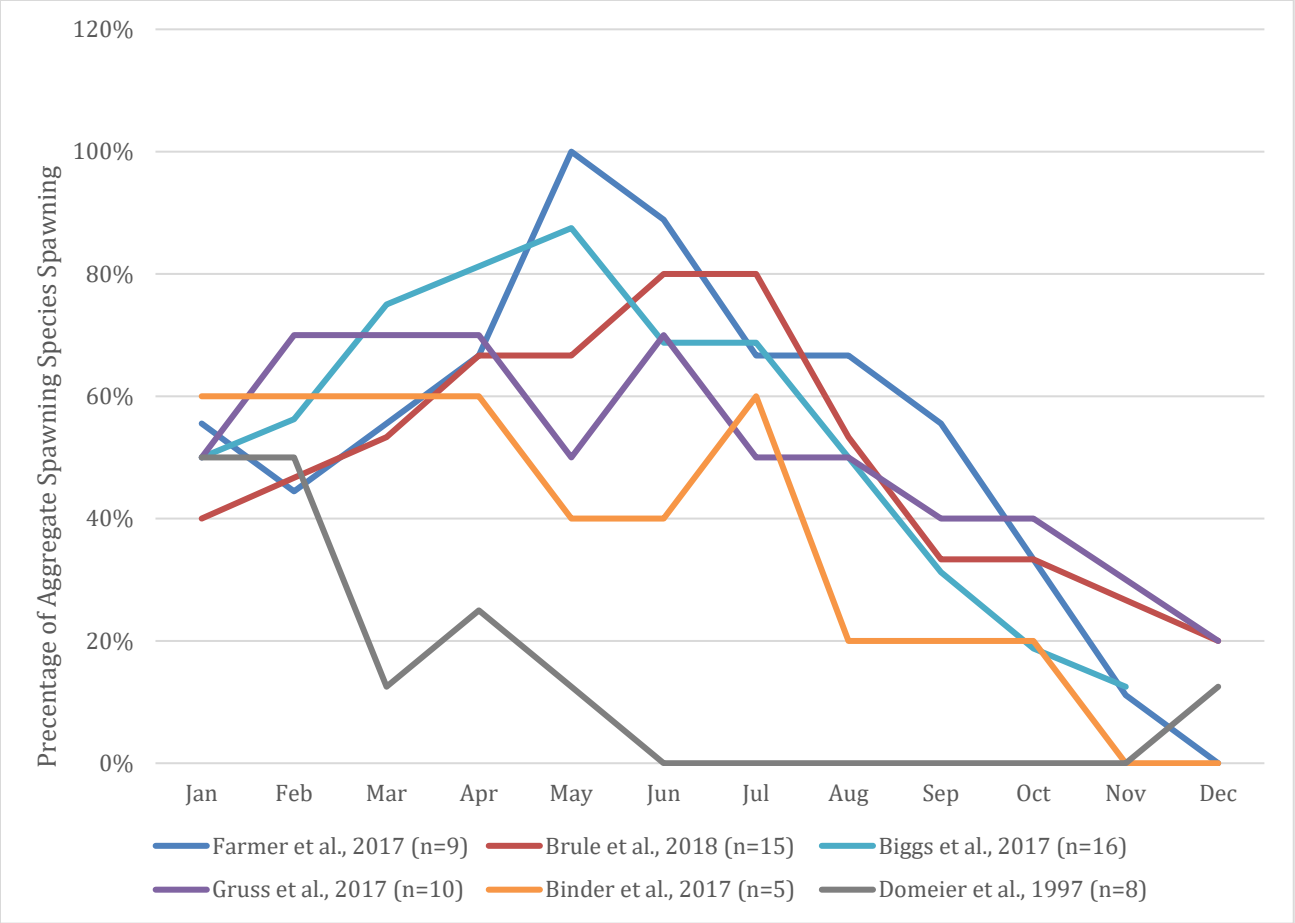
Spawning Aggregations

Some snapper grouper species form spawning aggregations, which makes them especially vulnerable to fishing pressure during aggregating events. Spawning aggregations are differentiated between typical spawning activity by the appearance of congregated groups that are notably more dense than non-spawning times (Claydon et al., 2014).

To determine which species within the complex could be considered aggregate spawners a literature review was conducted by searching Google Scholar (**App. Table 8**). The monthly ratio of total number of species and aggregate spawning species spawning was plotted for each publication (**App. Figure 6**). The highest ratio of aggregate spawning species per month occurred from March through June.

App. Table 8. A list of species in the Snapper Grouper Fishery Management Unit known or suspected to spawn in groups more dense than non-spawning times, which Claydon et al. used to describe spawning aggregate species. For each species a primary source was included that provided evidence that the species spawns in aggregates.

Species Name	Primary Source
Almaco jack	Heyman et al., 2019
Black grouper	SEDAR 48 Data Workshop Report, (2017)
Coney	Trott and Luckhurst, 2008, Luckhurst 1996*
Gag	SEDAR 10 Assessment Report (2006), Coleman et al. 1996*
Goliath grouper	SEDAR 6 Assessment Report (2004)
Gray triggerfish	Heyman et al., 2019
Graysby	Popple, 2001
Greater amberjack	Amendment 4 (1991)
Hogfish	Heyman et al., 2019
Mutton snapper	SEDAR 15A Assessment Report (2008), Domeier and Colin, 1997*
Red hind	SEDAR 35 Assessment Report (2014), Shapiro 1993a, Colin et al. 1987, Nemeth 2007, Kadison et al. 2009*
Red snapper	Binder et al., 2021
Rock hind	Ojeda et al., 2007
Scamp**	Heyman et al., 2019
Snowy grouper	Heyman et al., 2019
Speckled hind	Amendment 36 (2017), G. Gilmore, Dynamac Corporation, personal communication*
Tilefish	Heyman et al., 2019
Vermilion snapper	SEDAR 17 Assessment Report (2008)
Yellowedge grouper	Heyman et al., 2019
Yellowfin grouper	SEDAR 14 Assessment Report (2007), Shapiro 1987*
Yellowmouth grouper	Amendment 49 (2017), Bullock et al., (1994)*



App. Figure 6. The monthly percentage of aggregate spawning species in the Snapper Grouper Fishery Management Unit (**App. Table 8**) in spawning condition according to each publication examined. n= number of spawning aggregate species per publication.

Species Comparisons

The spawning seasons for five snapper grouper species (red snapper, gag, scamp, red grouper, greater amberjack) were compared across different sources. These species are all assessed through the SEDAR process.

<u>Red Snapper</u>
According to SEDAR 41, red snapper is currently overfished and experiencing overfishing. A rebuilding plan was established in 2010 and a very limited recreational and commercial season occurs during the summer months. Recently, interactions with red snapper during the closed season have increased fishing mortality from releases. For red snapper, most of the publications cited agreed that spawning occurred from May through October November with peak spawning occurring June through September October (**App. Table 9**).

App. Table 9. A comparison of the red snapper spawning season from the Gulf of Mexico and South Atlantic region reported by source. Gray squares indicate spawning and black indicate peak spawning activity.

Red Snapper												
Source	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Farmer et al., 2017												
Brule et al., 2018												
Biggs et al., 2017												
White and Palmer, 2004												
Brown-Peterson et al., 2009												
Froehlich et al. 2021												
Brown-Peterson, et al. 2019												
SEDAR 41, 2017										**		

** The LHWG recommended using a spawning season for red snapper of April - September

Gag

According to SEDAR 71, gag are currently overfished and experiencing overfishing. Because of this stock status determination, a reduction in landings will be implemented in 2023. Gag are protogynous hermaphrodites, changing sex from female to male, in addition gag spawn in spawning aggregations. Most of the sources reviewed noted that gag spawn January through May with peak spawning occurring March through April (**App. Table 10**).

App. Table 10. A comparison of the gag spawning season from the Gulf of Mexico and South Atlantic region reported by source. Gray squares indicate spawning and black indicate peak spawning activity.

Gag												
Source	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Farmer et al., 2017												
Brule et al., 2018												
Biggs et al., 2017												
Gruss et al., 2017												
Binder et al., 2017												
Coleman et al., 1996												
SEDAR 10, 2006												

Red Grouper

Red grouper are overfished and experiencing overfishing. Like gag, red grouper are protogynous hermaphrodites that change sex from female to male. The core spawning months for red grouper across six sources were February through June. Peak spawning was reported from March through May although there may be latitudinal differences throughout the South Atlantic as noted in Amendment 30 (2019) (**App. Table 11**).

App. Table 11. A comparison of the red grouper spawning season from the Gulf of Mexico and South Atlantic region reported by source. Gray squares indicate spawning and black indicate peak spawning activity.

Red Grouper												
Source	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Farmer et al., 2017												
Brule et al., 2018												
Biggs et al., 2017												
Gruss et al., 2017												
Coleman et al., 1996												
SEDAR 19, 2010												

Scamp

Scamp are not overfished or experiencing overfishing. Scamp are protogynous hermaphrodites that change sex from female to male. Scamp may spawn in aggregations (Coleman et al. 1996, Coleman et al. 2011). Scamp was one of the more variable species across the different sources obtained, with one source noting that there are regional differences between Florida and North Carolina. While the overall scamp spawning season ranged from January through August, most sources agreed that peak spawning occurred March through May (**App. Table 12**).

App. Table 12. A comparison of the scamp spawning season from the Gulf of Mexico and South Atlantic region reported by source. Gray squares indicate spawning and black indicate peak spawning activity.

Scamp												
Source	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Farmer et al., 2017*												
Brule et al., 2018												
Biggs et al., 2017												
Gruss et al., 2017												
Coleman et al., 1996												

*Combined spawning for three different regions

Greater Amberjack

Greater amberjack are not overfished or experiencing overfishing. Unlike the groupers include in this report, greater amberjack do not change sex. This species is noted to form spawning aggregations in April where fish become particularly aggressive and vulnerable to the fishery. According to the sources cited, greater amberjack having a spawning season that runs from March to June with three sources indicating additional months from January to March. Peak spawning in most sources occurs April through May with one source including March as well (**App. Table 13**).

App. Table 13. A comparison of the greater amberjack spawning season from the Gulf of Mexico and South Atlantic region reported by source. Gray squares indicate spawning and black indicate peak spawning activity.

Greater Amberjack												
Source	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Farmer et al., 2017												
Biggs et al., 2017												
Gruss et al., 2017												
SEDAR 15, 2008												

Additional Considerations

This paper has described the spawning season for multiple species in the Snapper Grouper Fishery Management Unit. However not all species in the management unit form spawning aggregations and the type of spawning aggregation varies. Maintaining fishing mortality at sustainable levels while achieving optimum yield for multiple species is a complex challenge that will not likely be solved with a single management measure. Management could consider other factors including:

- **Life history** – Many species in the fishery management unit have complex life history strategies (i.e. protogynous hermaphrodites, protect territories and harems);
- **Latitudinal variance –** Both the seasonality and location or type of spawning aggregation may differ latitudinally for different species;
- **Recruitment success** – Recruitment may be affected by factors outside of federal fisheries management such as the loss of nursey grounds;
- **Stock status** – Some stocks are depleted and in rebuilding plans. These stocks may need additional management strategies to keep fishing mortality low as the population rebuilds;
- **Climate change** – Changing conditions may lead to stocks shifting their ranges, which may lead to a change in spawning behavior or seasonality and in-turn change recruitment success and productivity.
- **Social and economic factors –** These factors can greatly affect fishing behavior directed towards or away from a species which in turn can have notable effects on mortality and the overall viability of a fish stock. Additionally, seasonal closures affect the portfolio of fish species available for harvest which can have social and economic implications particularly for commercial and for-hire recreational businesses.

Previously Provided Information on Management Pros/Cons and Snapper Grouper Discard Mortality Rates

In December 2021, the Council requested a compilation of information or analyses related to several potential management measures to inform whether a demonstrable change in recreational dead releases can be estimated from their implementation, such that it could be considered in re-estimation of the ABC for red snapper. Information on bycatch reduction for recreational gear types is limited in general, and further so when considering some of the unique aspects of the South Atlantic snapper grouper fishery. An initial evaluation, in the form of pros, information needs/challenges, and whether estimates of catch rate reductions would have a quantitative or qualitative basis, are shown in App. Table 4. Additionally, estimates of discard mortality for assessed species are provided in App. Table 5.

App. Table 14. Potential management measures to reduce releases and release mortality in the South Atlantic snapper grouper fishery and pros, information needs/challenges, and types of information that could potentially be used in estimates of effectiveness in reducing catch and release rates.

Type of Action	**Pros**	**Information Needs/Challenges**	**Type of information for estimating effectiveness in reducing releases**
Single Hook	• Minimal impact on fishing practices and access • Reduce effective effort	• Information on current practices (how many fishermen are using multiple vs. single hooks) and effect of the change on catch rates • Collecting information could be time-consuming	• Qualitative
Leader Length	• Pacific "long leader" has numeric support to reduce catch rates for fish closer to the bottom while maintaining ability to catch fish higher in the water column (Oregon DFW Report) • Moderate impact on fishing practices and access	• How to translate catch rate differences from Pacific groundfish species to South Atlantic snapper grouper species • Gear uncommon to the region may create implementation difficulty	• Quantitative/Qualitative
Hook Size	• Minimal impact on fishing practices and access	• Information on current practices (most common hook sizes used now) and effect of the change on catch rates • Collecting information could be time-consuming • Industry standards lacking • AP and public comments have indicated that hook size does not typically deter catch of red snapper • Effectiveness varies by species (small mouth vs. large mouth)	• Qualitative

Considered Action	**Pros**	**Information Needs/Challenges**	**Type of information for estimating effectiveness in reducing releases**
Lines per Person	• Minimal impact on fishing practices and access • Reduce effective effort	• Information on current practices and effectiveness of the gear change • Most fish one rod per person (personal observation)	• Qualitative
Prohibit electric reels	• Minimal impact on fishing practices and access • Reduce effective effort	• Information on current practices and effectiveness of the gear change	• Qualitative
Timed Openings/Seasons	• Current data allow estimation of daily catch rates • Relatively more enforceable	• May become complex if applied by species or groups • Regional differences in fishing seasons could require regional seasons • Effectiveness could be impacted by redirected effort	• Quantitative
Area Closure	• Could use heat maps to consider reducing catch in a specific, high catch area • Relatively more enforceable	• Spatial resolution lacking for current catch information • Redirected effort outside of the closed area could reduce overall effectiveness • Expect significant opposition by those currently fishing in the area	• Quantitative/Qualitative
Depth Closure	• Bottom fishing closure could potentially have similar effect as long leader gear, maintain catches of some species while reducing catches of others	• Difficult to enforce, but potentially addressed by area definitions • Redirected effort outside of the closed area could reduce overall effectiveness • Depth resolution lacking for current catch information	• Quantitative/Qualitative

Considered Action	**Pros**	**Information Needs/Challenges**	**Type of information for estimating effectiveness in reducing releases**
Weight Limit per Person	• Could potentially reduce release mortality from highgrading during the fishing season • Minimal impact on fishing practices and access	• Would not reduce out of season encounters. • No quantification of high grading available	• Qualitative

App. Table 15. Discard mortality by species and sector. Source: SG Amendment 50

Species	Fishery	Release mortality	Data Source
Black Grouper	Recreational & Commercial	20%	SEDAR 19 (2010)
Black Grouper	Commercial (Longline)	30%	SEDAR 19 (2010)
Black Sea Bass	Recreational	13.7%	SEDAR 56 (2018)
Black Sea Bass	Commercial Trap/Pot (2007- present)	48.3%	SEDAR 56 (2018)
Black Sea Bass	Commercial Vertical Line	19%	SEDAR 56 (2018)
Blueline Tilefish	Recreational	82%	SEDAR 50 (2017)
Blueline Tilefish	Commercial (H&L)	95%	SEDAR 50 (2017)
Blueline Tilefish	Commercial (Trawl)	100%	SEDAR 50 (2017)
Gag	Recreational	25%	SEDAR 10 Update (2014)
Gag	Commercial	40%	SEDAR 10 Update (2014)
Golden Tilefish	Recreational & Commercial	100%	SEDAR 25 (2011)
Gray Triggerfish	Recreational & Commercial	12.5%	SEDAR 41 (2016)
Greater Amberjack	Recreational & Commercial	20%	SEDAR 59 (2020)
Hogfish	Recreation & Commercial (H&L)	10%	SEDAR 37 (2015)
Hogfish	Recreation & Commercial (Dive)	100%	SEDAR 37 (2015)
Mutton Snapper	Recreational & Commercial	15%	SEDAR 15U (2015)
Red Grouper	Recreational & Commercial	20%	SEDAR 19 (2017)
Red Porgy	Recreational	41%	SEDAR 60 (2020)
Red Porgy	Commercial	53%	SEDAR 60 (2020)
Red Snapper	Recreational - Private	23%	SEDAR 73 (2021)
Red Snapper	Recreational - Charter & Headboat	22%	SEDAR 73 (2021)
Red Snapper	Commercial	32%	SEDAR 73 (2021)
Scamp	Recreational	26%	SEDAR 68 (2021)
Scamp	Commercial	39%	SEDAR 68 (2021)
Snowy Grouper	Recreational & Commercial	100%	SEDAR 36 (2013)
Vermilion snapper	Recreational	38%	SEDAR 55 (2018)
Vermilion snapper	Commercial	41%	SEDAR 55 (2018)
Yellowtail snapper	Recreational	15%	SEDAR 64 (2020)
Yellowtail snapper	Commercial	12.5%	SEDAR 64 (2020)

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