SUPPLEMENT A TO AMENDMENT 1 TO THE N.C. STRIPED MULLET FISHERY MANAGEMENT PLAN

May 2023

ISSUE

Consideration of Supplement A to Amendment 1 to the N.C. Striped Mullet Fishery Management Plan (FMP) to implement temporary management measures to immediately address overfishing of the striped mullet stock while Amendment 2 is developed.

ORIGINATION

The North Carolina Division of Marine Fisheries (DMF).

BACKGROUND

The North Carolina striped mullet stock is overfished and overfishing is occurring in 2019, the terminal year of the stock assessment (NCDMF 2022). As statutorily required, management measures will be developed through Amendment 2 to end overfishing and rebuild spawning stock biomass. Development of Amendment 2 is underway, with final adoption and implementation tentatively scheduled for 2024. Because of the timeline of FMP development, there will be four-years between the terminal year of the stock assessment and implementation of management measures to address the stock status. The supplement allows for implementation of temporary management measures to supplement Amendment 1 until Amendment 2 is adopted.

General Statute 113-182.1 provides a mechanism to supplement management under a FMP between scheduled reviews when the Secretary of the Department of Environmental Quality (DEQ) determines it is in the interest of the long-term viability of the fishery. The draft supplement contains analysis of the proposed management change, projected outcomes, and proposed rules or proclamation measures necessary to implement the management change. The North Carolina Marine Fisheries Commission (MFC) may only consider a single management issue for each draft supplement. The supplement allows for implementation of temporary management measures to supplement Amendment 1 until Amendment 2 is adopted. MFC Rule 15A NCAC 03M .0502 provides the Fisheries Director proclamation authority to implement restrictions in the taking of mullet. In accordance with the MFC FMP Guidelines, the MFC will review the draft supplement and reject (end of process), approve, or modify and approve it for public comment.

The North Carolina Striped Mullet FMP was adopted in April 2006 and established minimum and maximum commercial landings triggers of 1.3 and 3.1 million pounds (NCDMF 2006). If annual landings fall below the minimum trigger, the DMF would determine whether the decrease in landings is attributed to stock decline, decreased fishing effort, or both. If annual landings exceed the maximum trigger, DMF would determine whether harvest is sustainable and what factors are driving the increase in harvest. The Striped Mullet FMP established a daily possession limit of 200 mullets (white and striped combined) per person per day in the recreational fishery, through MFC Rule 15A NCAC 03M .0502.

The Striped Mullet FMP Amendment 1 was adopted in November 2015. The associated rules from Amendment 1 were implemented in April 2016; to resolve issues with Newport River gill net attendance and mitigate known user group conflicts. Amendment 1 also updated the management framework and

updated minimum and maximum commercial landings triggers to 1.13 and 2.76 million pounds (NCDMF 2015). Amendment 1 maintains the recreational fishery limit. Other than the recreational daily possession limit there are no management measures directly limiting harvest of striped mullet.

Stock assessments for the North Carolina striped mullet stock were conducted by the DMF in 2006 (NCDMF 2006), 2013 (NCDMF 2015), 2018 (NCDMF 2018), and 2022 (NCDMF 2022). In each assessment, a fishing mortality threshold of $F_{25\%}$ was used to determine if overfishing was occurring. The 2022 assessment also used a spawning stock biomass (SSB) threshold of $SSB_{25\%}$ to determine if the stock was overfished. Stock assessments in 2006, 2013, and 2017 determined overfishing was not occurring but could not determine whether the stock was overfished. While these assessments concluded overfishing was not occurring, each noted concerning trends, data uncertainty, and the potential impact of future poor recruitment events. Given this concern, the commercial landings triggers and adaptive management framework were approved in the Striped Mullet FMP and updated in Amendment 1.

Commercial landings in 2016 were 965,198 pounds, less than the minimum commercial landings trigger. As required under the FMP, the DMF initiated data analysis and ultimately recommended updating the 2013 stock assessment with data through 2017 prior to considering any management action. As an assessment update, there were no changes to model parameters and peer review was not required, as the configuration of the model that previously passed peer review was maintained. The 2018 stock assessment concluded overfishing was not occurring in 2017 but indicated declining spawning stock biomass, declining recruitment, and increasing fishing mortality. A major concern in the 2017 assessment was lack of contrast in commercial landings data and lack of contrast and high variability associated with fishery-independent indices including the Fishery-Independent Gill Net Survey (Program 915), the Striped Mullet Electrofishing Survey (Program 146), and the Striped Bass Independent Gill Net Survey (Program 135). Also of concern were the poor fits to survey data and length compositions.

At the August 2018 MFC business meeting, the DMF presented its recommendation along with recommendations from the Northern, Southern, and Finfish Advisory Committees that no management action be taken since the stock assessment update indicated overfishing was not occurring. The DMF would, however, continue to monitor trends in the commercial fishery and fishery-independent indices. The recommendation was approved by the MFC.

For the 2022 striped mullet stock assessment, a F threshold of $F_{25\%}$ and a target of $F_{35\%}$ were maintained from the prior assessment since the commercial fishery continues to target mature female fish during the spawning season and the ecological importance of striped mullet. Complementary reference points for stock size were adopted based on female SSB, with a threshold of $SSB_{25\%}$ and a target of $SSB_{35\%}$. The stock assessment model estimated a value of 0.37 for the $F_{25\%}$ threshold and a value of 0.26 for the $F_{35\%}$ target. In 2019, the terminal year of the assessment, F was 0.42, higher than the $F_{25\%}$ threshold, indicating overfishing is occurring (Figure 1). The model estimated a value of 1,364,895 pounds for the $SSB_{25\%}$ threshold and a value of 2,238,075 pounds for the $SSB_{35\%}$ target. Female SSB in 2019 was estimated at 579,915 pounds, smaller than the $SSB_{25\%}$ threshold, indicating the stock is overfished (Figure 2).

An external peer review workshop was held in April 2022. The panel concluded the assessment model and results are suitable for providing management advice for at least the next five years. The panel considers the current model a substantial improvement from the previous assessment, representing the best scientific information available for the stock.

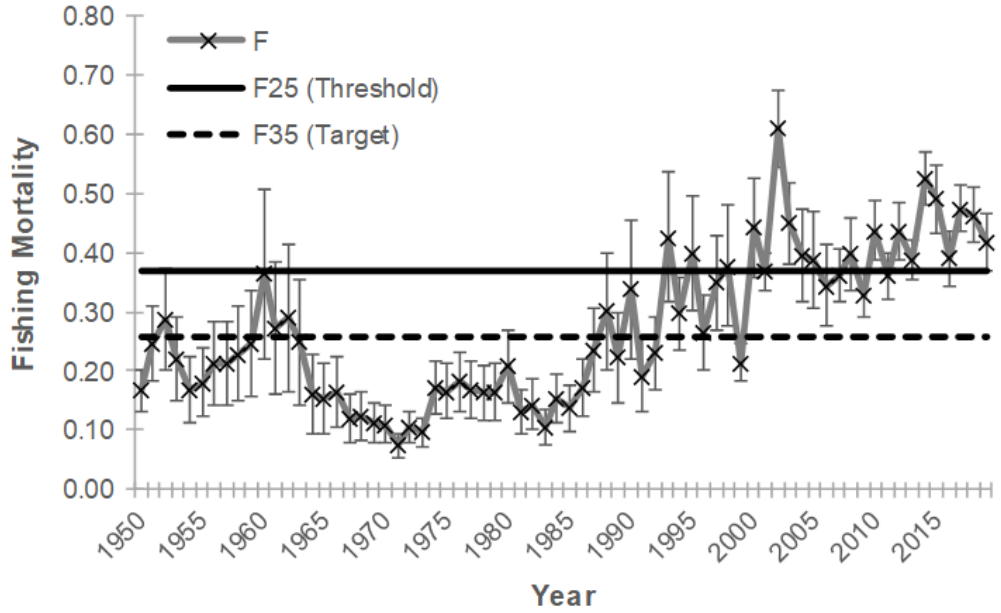

Figure 1. Comparison of annual estimates of fishing mortality (numbers weighted, ages 1-5) to the fishing mortality target (F35%) and threshold (F25%). Error bars represent ± 2 standard deviations.

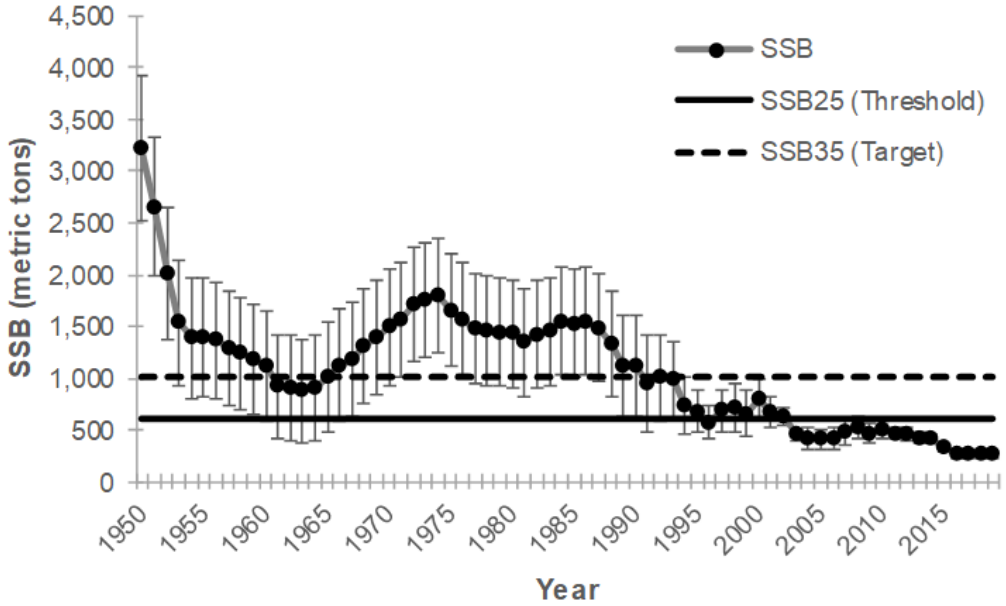

Figure 2. Comparison of annual estimates of female spawning stock biomass (SSB) to the SSB target (SSB35%) and threshold (SSB25%). Error bars represent ± 2 standard deviations.

AUTHORITY

G.S. 113-134 RULES
G.S. 113-182 REGULATION OF FISHING AND FISHERIES
G.S. 113-182.1 FISHERY MANAGEMENT PLANS
G.S. 113-221.1. PROCLAMATIONS; EMERGENCY REVIEW
G.S. 143B-289.52 MARINE FISHERIES COMMISSION-POWERS AND DUTIES
15A NCAC 03M .0502 MULLET
15A NCAC 03H .0103 PROCLAMATIONS, GENERAL

DISCUSSION

The 2022 stock assessment (NCDMF 2022) indicates recruitment has not only declined but has been below average since 2009 (Figure 3). The decline in recruitment coincides with declining spawning stock biomass while fishing mortality has increased (Figures 1-2).

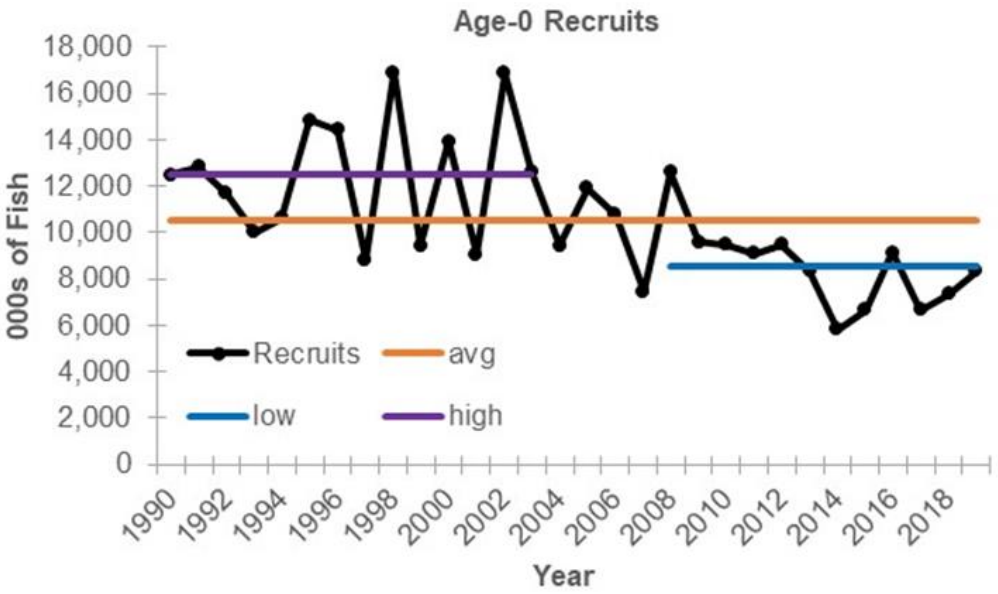

Figure 3. Estimates of striped mullet recruitment from the 2022 striped mullet stock assessment (NCDMF 2022). Average recruitment is the average number of recruits from 1990 to 2019, high recruitment is the average number of recruits from 1990 to 2003, and low recruitment is the average number of recruits from 2008 to 2019.

A 9.3% reduction in total removals relative to landings in 2019 is needed to reduce fishing mortality to the threshold and a 33% reduction is needed to reach the target. Amendment 1 to the Striped Mullet FMP included adaptive management allowing for implementation of management measures if commercial landings exceeded or fell below commercial landings triggers. Because neither the minimum or maximum commercial landings triggers were exceeded in 2022, adaptive management cannot be used to immediately implement management measures. A supplement to Amendment 1 is the only option to immediately implement management measures to end overfishing of the striped mullet stock. Given the stock is overfished and overfishing is occurring, ending overfishing immediately is in the long-term interest of the fishery because it begins rebuilding spawning stock biomass and meets the statutory requirement to end overfishing in two years. Measures addressing sustainable harvest and stock recovery will be explored and implemented through Amendment 2.

Implementation of quotas, seasons, size limits, area closures, gear restrictions, and harvest limits were discussed in Amendment 1 (NCDMF 2015). However, because management measures implemented through a supplement are intended to address a single issue, in this case ending overfishing, size limits, area closures, and gear restrictions are not considered viable options, and are not recommended, because they are unlikely to result in necessary harvest reductions without other measures in place. A harvest quota would result in necessary harvest reductions and should be considered as a practical long-term option for management of the striped mullet fishery. However, because of the time needed to develop a quota monitoring framework and update infrastructure it is not considered a practical option through the supplement process and is not recommended. Trip limits, in conjunction with other options, could result in necessary reductions but given the high-volume nature of the striped mullet fishery may result in excessive

dead discards. Trip limits should be explored during Amendment 2 but are not recommended for the supplement.

Given the inherent seasonality of the striped mullet fishery and life history characteristics that make striped mullet more vulnerable to the fishery during certain times of year, season closures are considered the most effective and efficient method to achieve the necessary reductions that can be implemented immediately through a supplement. Striped mullet are highly fecund (upwards of 4 million eggs for a large female; Bichy 2000) and spawn in large groups near inlets and in offshore areas (Collins and Stender 1989). Spawning individuals have been reported from September to March; however, peak spawning activity occurs from October to early December (Bichy 2000). Prior to spawning, striped mullet form large schools in estuaries and can be easily spotted near the surface making them particularly vulnerable to harvest. Closing a portion of the fall season to possession of striped mullet would reduce landings in the targeted striped mullet fishery, where most effort occurs. Targeting a season closure to the period of peak striped mullet harvest minimizes the length of the closure and the numbers of discards that might occur in other fisheries.

Characterization of the Fishery

Recreational Fishery

The federal Marine Recreational Information Program (MRIP) is primarily designed to sample anglers who use rod and reel as the mode of capture. Since most striped mullet are caught with cast nets for bait, striped mullet recreational harvest data are imprecise. In addition, angler misidentification between striped mullet and white mullet is common, and bait mullet are usually released by anglers before visual verification by creel clerks is possible. As such, mullets are not identified to the species level in MRIP data (Catch Type B). Beginning in 2002, MRIP began deferring to mullet genus to classify unobserved type B1 (harvested/unavailable catch) and B2 (released/unavailable catch) catch. As a result, the magnitude of recreational mullet genus harvest far exceeds that of both striped mullet and white mullet. This methodological improvement increased the precision of mullet harvest estimates albeit without species level resolution. As such, estimates of recreational harvest for mullet prior to 2002 are considered unreliable.

The 2022 striped mullet stock assessment used the sum of recreational striped mullet harvest and a proportion of the recreational harvest of mullet genus to estimate removals by the recreational fleet (NCDMF 2022). The proportion of mullet genus assumed to be striped mullet in the recreational harvest was 29%, a value derived from a DMF striped mullet recreational cast net harvest study (NCDMF 2006).

Recreational harvest peaked in 2002 and 2003 at greater than four million fish harvested (Table 1). From 2004 to 2017 recreational harvest remained stable at around one million fish before declining in 2018, 2019 and 2020 to around 500,000 fish. This decline was likely related to decreased abundance of striped mullet and regulations that drastically shortened the recreational fishing season for southern flounder, a fishery where live mullet is a popular bait. Recreational harvest in 2021 was 1,484,850 fish.

Generally, most recreational striped mullet harvest occurs during the late summer and early fall. From 2017 to 2021 most recreational harvest occurred during September/October with some harvest during July/August (Figure 4). Based on MRIP harvest estimates very few, if any, striped mullet are harvested recreationally during the January/February or March/April waves (Table 2).

Striped mullet harvest data from the Recreational Commercial Gear License (RCGL) were collected from 2002 to 2008. The program was discontinued in 2009 due to a lack of funding and the minimal contributions from RCGL to overall harvest. From 2002 through 2008, an average of 41,512 pounds of striped mullet were harvested per year using a RCGL (Table 3).

Table 1. Recreational harvest (number of fish landed) of striped mullet and mullet genus estimated from MRIP sampling, 2002-2021. Based on results of a DMF cast net study (NCDMF 2006), 29% of the mullet genus harvested are assumed to be striped mullet.

	Striped Mullet		Mullet Genus		Striped Mullet from Mullet Genus (29%)	Striped Mullet + Mullet Genus
Year	Harvest (A+B1)	PSE	Harvest (B1)	PSE	Harvest (B1)	Striped Mullet Total Harvest
2002	4,668,427	18.0	4,480,197	36.3	1,299,257	5,967,684
2003	3,368,881	29.6	2,487,885	20.4	721,487	4,090,368
2004	5,496	101.7	4,790,382	16.1	1,389,211	1,394,707
2005	10,795	61.5	4,487,719	21.4	1,301,439	1,312,234
2006	15,706	63.5	3,599,098	21.4	1,043,738	1,059,444
2007	301,004	81.3	5,052,995	22.3	1,465,369	1,766,373
2008	3,458	65.0	4,097,156	14.4	1,188,175	1,191,633
2009	83,480	90.6	3,736,571	14.3	1,083,606	1,167,086
2010	126,250	44.7	4,113,171	14.3	1,192,820	1,319,070
2011	80,267	28.6	3,653,514	14.3	1,059,519	1,139,786
2012	351,960	79.5	3,510,395	16.3	1,018,015	1,369,975
2013	150,020	53.9	4,493,166	20.5	1,303,018	1,453,038
2014	50,381	67.0	4,490,722	26.2	1,302,309	1,352,690
2015	142,696	64.5	4,405,800	21.5	1,277,682	1,420,378
2016	29,965	50.6	5,039,891	55.6	1,461,568	1,491,533
2017	37,791	43.9	5,170,318	55.2	1,499,392	1,537,183
2018	35,565	59.3	1,564,676	31.7	453,756	489,321
2019	324,986	52.0	817,596	25.3	237,103	562,089
2020	323,102	43.2	719,908	23.2	208,773	531,875
2021	1,194,213	73.6	1,002,195	31.6	290,637	1,484,850

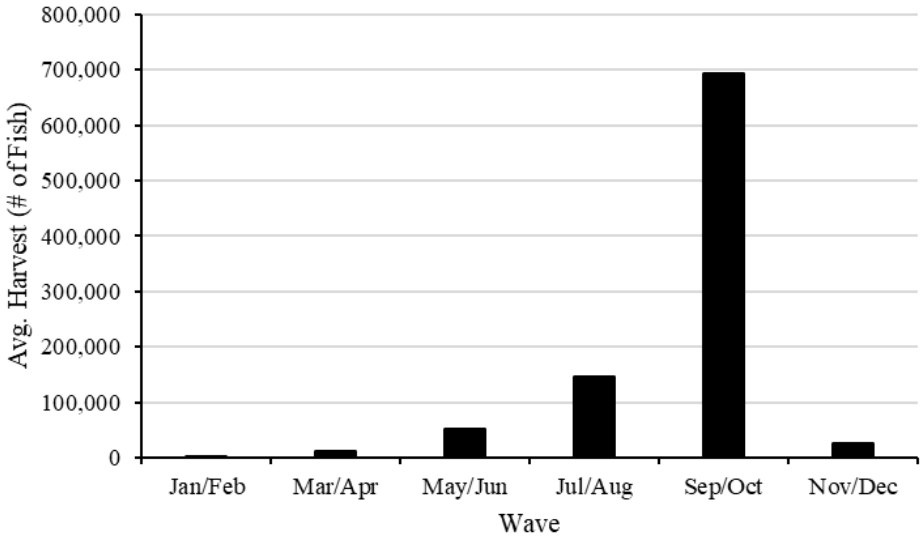

Figure 4. Average number of striped mullet harvested by the recreational fishery by wave based on MRIP estimates, 2017-2021.

Table 2. Recreational harvest (number of fish landed) of striped mullet and mullet genus by wave estimated from MRIP sampling, 2002-2021. Striped mullet assumed as 29% of mullet genus.

Year	Wave	Striped Mullet Harvest (A+B1)	Mullet Genus Harvest (B1)	Striped Mullet from Mullet Genus (29%) Harvest (B1)	Striped Mullet + Mullet Genus Striped Mullet Total Harvest
2017	January/February	.	.	.	.
2017	March/April	.	82,931	24,050	24,050
2017	May/June	27,708	284,430	82,485	110,193
2017	July/August	8,505	354,629	102,842	111,347
2017	September/October	1,579	4,432,737	1,285,494	1,287,073
2017	November/December	.	15,590	4,521	4,521
2018	January/February	.	.	.	.
2018	March/April	.	.	.	.
2018	May/June	2,239	136,595	39,613	41,852
2018	July/August	18,993	750,891	217,758	236,751
2018	September/October	13,505	457,709	132,736	146,241
2018	November/December	828	219,480	63,649	64,477
2019	January/February	.	.	.	.
2019	March/April	.	32,700	9,483	9,483
2019	May/June	11,773	86,637	25,125	36,898
2019	July/August	82,801	280,921	81,467	164,268
2019	September/October	217,317	367,020	106,436	323,753
2019	November/December	13,096	50,318	14,592	27,688
2020	January/February	1,648	1,540	447	2,095
2020	March/April	.	21,050	6,105	6,105
2020	May/June	6,308	78,303	22,708	29,016
2020	July/August	40,470	239,694	69,511	109,981
2020	September/October	274,675	370,617	107,479	382,154
2020	November/December	.	8,704	2,524	2,524
2021	January/February	.	6,340	1,839	1,839
2021	March/April	7,087	.	.	7,087
2021	May/June	1,336	144,319	41,853	43,189
2021	July/August	21,670	292,846	84,925	106,595
2021	September/October	1,164,119	558,690	162,020	1,326,139
2021	November/December	.	.	.	.

Table 3. North Carolina Recreational Commercial Gear License (RCGL) survey estimates of the number of striped mullet harvested, pounds harvested, number released, and total number caught. The survey was discontinued in 2009.

Year	Number Harvested	Pounds Harvested	Number Released	Total Number
2002	66,305	64,213	6,549	72,854
2003	28,757	24,774	3,514	32,270
2004	34,736	35,947	2,875	37,611
2005	35,888	36,314	3,492	39,380
2006	38,175	37,385	5,352	43,527
2007	35,472	40,168	7,449	42,921
2008	51,465	51,785	9,207	60,672

Commercial Fishery

Since 1972, striped mullet commercial landings have ranged from a low of 965,198 pounds in 2016 to a high of 3,063,853 pounds in 1993 (Figure 5). From 2003 to 2009, landings were stable between 1,598,617 and 1,728,607 pounds before increasing to 2,082,832 pounds in 2010. Landings fluctuated annually between 1.5 and 2.0 million pounds from 2010 to 2014 before declining in 2015 and again in 2016, dropping below the minimum commercial landings trigger established by Amendment 1. Commercial landings in 2021 increased to 2,135,952 pounds, which is 1,005,952 pounds above the minimum commercial landings trigger.

Historically, beach seines and gill nets were the two primary gear types used in the striped mullet commercial fishery, with most commercial landings prior to 1978 coming from the beach seine fishery. Gill nets (runaround, set, and drift) replaced seines as the dominant commercial gear type in 1979 and since 2017 runaround gill nets have accounted for most (>70%) striped mullet commercial landings (Figure 6).

Because the commercial fishery primarily targets striped mullet for roe, the fishery is seasonal with the highest demand and landings occurring in October and November when large schools form during their spawning migration to the ocean and females are ripe with eggs (Figures 7-8). Striped mullet are primarily targeted commercially using runaround gill nets in the estuarine and ocean waters of North Carolina. The striped mullet beach seine fishery primarily occurs in conjunction with the Bogue Banks stop net fishery. The stop net fishery has operated under fixed seasons and net and area restrictions since 1993. Currently, stop nets are limited in number (four), length (400 yards), and mesh sizes (minimum eight inches outside panels, six inches middle section). Stop nets have typically been permitted along Bogue Banks (Carteret County) in the Atlantic Ocean from October 1 to November 30. However, the stop net season was extended to include December 3 to December 17 in 2015 due to minimal landings of striped mullet (Proclamation M-28-2015). In 2020 and 2021, the stop net fishery was open from October 15 through December 31 (Proclamations M-17-2020 and M-21-2021). Due to the schooling nature of striped mullet, the beach seine fishery has the potential to be, and historically has been, a high-volume fishery with thousands of pounds landed during a single trip. In addition, the use of cast nets in the striped mullet commercial fishery has been increasing since around 2003.

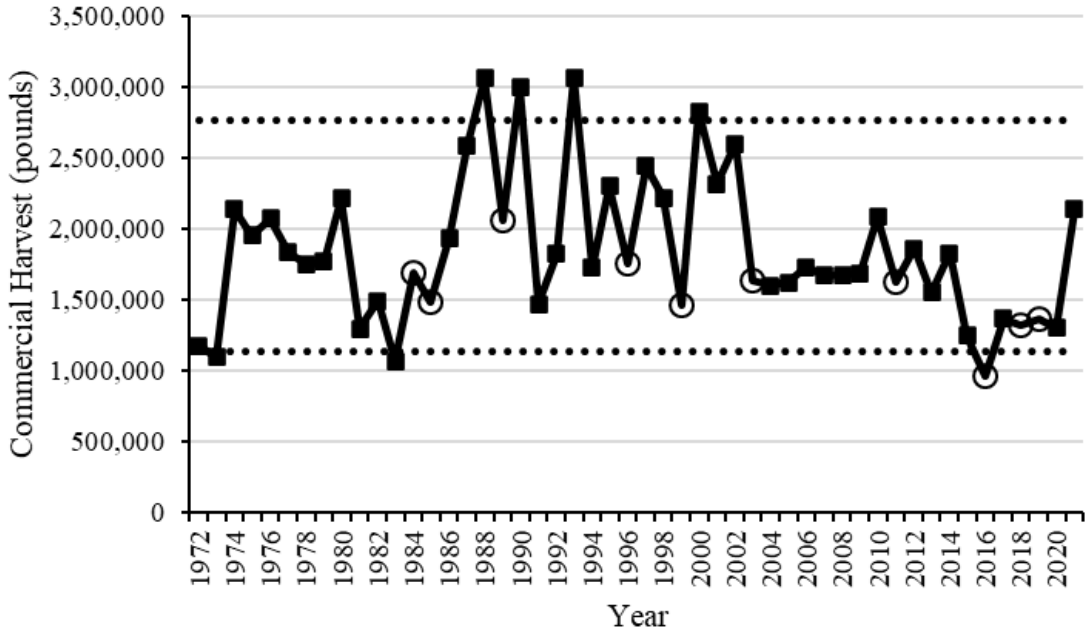

Figure 5. Striped mullet commercial landings (pounds) reported through the North Carolina Trip Ticket Program, 1972–2021 Lower dashed line (1.13 million lb.) and upper dashed line (2.76 million lb.) represent landings limits that trigger closer examination of data. Open circles represent years with significant hurricanes or storms.

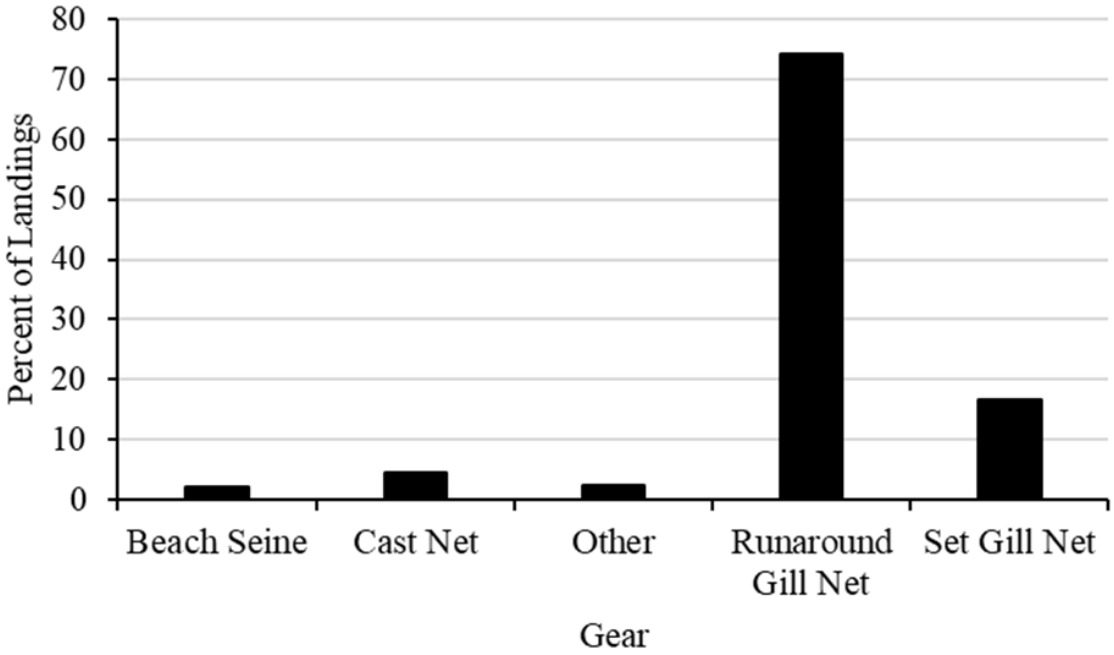

Figure 6. Percent of striped mullet commercial landings reported through the North Carolina Trip Ticket Program by gear, 2017–2021.

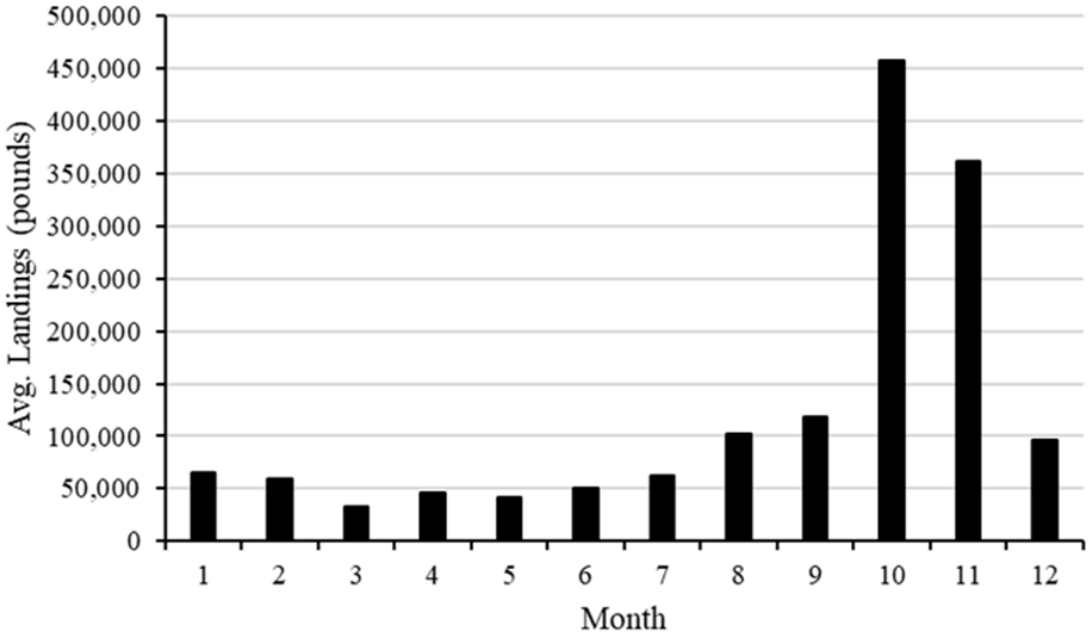

Figure 7. Average commercial landings of striped mullet by month, 2017-2021.

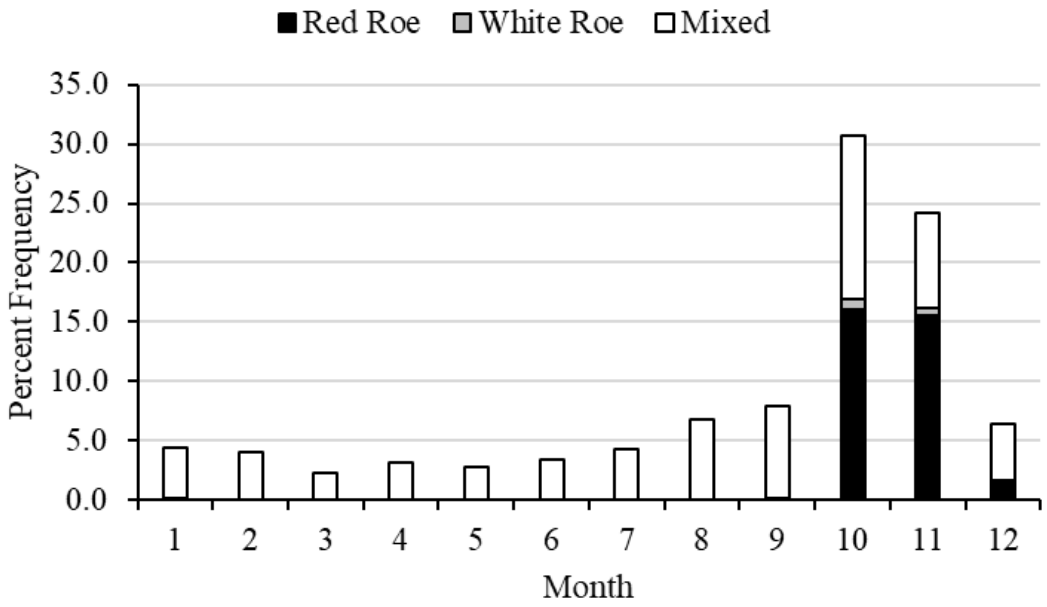

Figure 8. Percent frequency of striped mullet commercial landings by market grade and month, 2017-2021. Red Roe includes striped mullet graded as Red Roe and Roe. White Roe includes striped mullet graded as White Roe. Mixed includes striped mullet graded as Jumbo, Large, Medium, Mixed, Small, and X-Small.

PROPOSED MANAGEMENT OPTIONS

The goal of this supplement is to reduce fishing mortality and end overfishing with simple quantifiable measures as quickly as possible. A 9.3% reduction in total removals relative to landings in 2019 is needed to reduce fishing mortality to the threshold and a 33% reduction is needed to reach the target. The Division recommends harvest reductions of 20-33% to exceed the *F* threshold and either reach or approach the *F*

target. This level of reduction increases the probability of, at a minimum, ending overfishing even if there is variability in fishing effort, market demand, striped mullet availability to the fishery, or recruitment.

Non-quantifiable measures such as gear restrictions, area closures, size limits, and recreational specific measures were not considered because they may not quantifiably reduce harvest. A quota system was not considered because the infrastructure is not in place to quickly implement this type of management. Management strategies such as daily trip limits, day of the week closures, and early or mid-season closures were not considered because the risk of recouped catches would likely limit the realized reductions of these management measures. Rather than reduce harvest, measures like early season closures would likely just act to delay harvest.

End of year season closures are considered the most effective and efficient management option that can be implemented through the supplement process and be expected to successfully limit striped mullet harvest. An end of year season closure would be implemented as no possession across both commercial and recreational sectors with no additional modification or prohibition of gears. Despite the closure occurring across all sectors, reductions cannot be quantified for the recreational sector due to data limitations. Therefore, overall reduction calculations are based solely on striped mullet landings from the commercial fishery. A 9.3% overall reduction equates to a 9.9% reduction in commercial harvest, and a 20-33% overall reduction equates to a 21.3-35.4% reduction in commercial harvest. All management options are presented as percentage reductions to the commercial harvest relative to commercial landings in 2019 (terminal year of the stock assessment).

End of Year Closures

Historically, peak striped mullet roe landings have occurred in October-November, with most landings occurring from approximately October 15-November 15. An end of year season closure during this time provides the greatest reduction over the shortest period. The closure occurring at the end of the year does not allow for recoupment of catch that year, increasing the probability of successfully reducing harvest, and ending overfishing. The closure must occur during the peak fall roe harvest season, which impacts the most economically valuable segment of the striped mullet fishery. An end of year closure also creates regulatory discards associated with fisheries that do not target striped mullet during the closed period. However, much of the striped mullet harvest during this time comes from directed trips where runaround gill nets are used to capture visible, schooling striped mullet so discards in other fisheries are unlikely to be excessive. A wrap-around end of year closure extending into January was not considered because of the minimal benefit to striped mullet and to avoid creating striped mullet discards in other fisheries. A closure extending into January would not yield any significant extension to the fall striped mullet season and would likely increase pressure on other fisheries, like spotted seatrout. An end of year closure is most likely to achieve the necessary reductions because recoupment would be less significant than other management options not considered in this supplement.

Summary of Economic Impacts

Modeling software, IMPLAN, is used to estimate the economic impacts of an industry to the state at-large, accounting for revenues and participation. For a detailed explanation of the methodology used to estimate the economic impacts please refer to DMF's License and Statistics Section Annual Report on the Fisheries Statistics page (NCDMF 2021). Due to the management options being considered, this analysis focuses on the commercial industry.

Commercial landings and effort data collected through the DMF Trip Ticket Program are used to estimate the economic impact of the commercial fishing industry. For commercial fishing output, total impacts are

estimated by incorporating modifiers from NOAA's Fisheries Economics of the United States report (NMFS 2022), which account for proportional expenditures and spillover impacts from related industries. If we assume that the striped mullet fishery's impact on spending categories is the same as its impact on the total value of fish sold directly by fishermen, we can estimate the overall economic effect of striped mullet throughout the whole state.

From 2011 to 2021 striped mullet ex-vessel value has been about $1 million and impacts about 800 jobs annually (Table 4). Annual sales impacts have varied but averaged $3.6 million from 2011 to 2021. In general, these estimates demonstrate the striped mullet fishery contributes to about 1% of commercial fishing sales impact statewide.

Table 4. Annual commercial estimates of annual economic impact to the state of North Carolina from striped mullet harvest, 2011-2021. Economic impacts are reported in 2020 dollars.

Year	Pounds Landed	Ex-Vessel Value	Job Impacts	Income Impacts	Value-Added Impacts	Sales Impacts
2021	2,135,952	$ 1,333,475	714	$ 1,860,564	$ 3,503,122	$ 4,004,336
2020	1,299,464	$ 651,104	658	$ 1,330,677	$ 2,257,282	$ 2,912,396
2019	1,362,212	$ 929,282	673	$ 1,502,372	$ 2,344,706	$ 3,475,378
2018	1,312,121	$ 953,667	731	$ 1,502,185	$ 2,686,226	$ 3,303,076
2017	1,366,338	$ 1,037,526	802	$ 1,571,518	$ 2,564,816	$ 3,559,251
2016	965,337	$ 669,843	716	$ 1,006,728	$ 1,739,854	$ 2,240,287
2015	1,247,044	$ 804,675	784	$ 1,203,068	$ 2,086,467	$ 2,663,251
2014	1,828,351	$ 1,112,465	912	$ 1,735,047	$ 3,293,379	$ 3,936,322
2013	1,549,157	$ 1,402,914	1,042	$ 2,318,409	$ 3,902,777	$ 5,173,187
2012	1,859,587	$ 1,041,659	948	$ 1,957,469	$ 3,167,843	$ 4,390,261
2011	1,627,894	$ 1,015,852	885	$ 1,890,316	$ 3,371,858	$ 4,175,332
Average	1,504,860	$ 995,678	806	$ 1,625,305	$ 2,810,757	$ 3,621,189

Table 5. Monthly commercial estimates of annual economic impact to the state of North Carolina from striped mullet harvest over five years, 2017-2021. Economic impacts are reported in 2020 dollars.

Month	Pounds Landed	Ex-Vessel Value	Job Impacts	Income Impacts	Value Added Impacts	Sales Impacts
1	65,170	$ 36,107.03	130	$ 53,057.71	$ 98,355.14	$ 114,549.45
2	59,618	$ 33,227.53	129	$ 49,108.96	$ 90,877.25	$ 106,053.22
3	32,731	$ 18,569.84	122	$ 28,460.61	$ 52,101.53	$ 61,568.49
4	45,885	$ 25,851.76	141	$ 39,856.46	$ 72,837.04	$ 86,245.48
5	41,826	$ 23,508.17	121	$ 35,221.68	$ 64,912.23	$ 76,114.04
6	50,157	$ 28,058.94	131	$ 43,466.77	$ 79,323.84	$ 94,077.95
7	62,675	$ 36,047.32	139	$ 54,151.74	$ 99,720.97	$ 117,036.20
8	101,967	$ 60,393.25	179	$ 91,585.84	$ 168,184.68	$ 198,027.77
9	118,860	$ 69,487.04	210	$ 103,726.30	$ 191,374.87	$ 224,109.33
10	458,246	$ 328,837.30	361	$ 485,746.18	$ 899,026.44	$ 1,048,966.80
11	362,172	$ 261,014.19	297	$ 357,945.86	$ 688,459.22	$ 766,383.96
12	95,910	$ 59,908.44	176	$ 83,266.89	$ 157,024.20	$ 179,263.56

To further understand the dynamics of the striped mullet fishery the monthly economic impacts over the last five years are reported in Table 5. The striped mullet commercial fishery is driven by seasonal changes in population availability. The estimated change in job impacts and sales impacts reflect the availability of striped mullet throughout the year. Most of the harvest and economic impacts are concentrated in October and November of each year.

Management Option Scenarios

Management options for consideration include end of year closures that end December 31 (Table 6 and 7). All options provided in Tables 6 and 7 meet the statutory requirement to end overfishing.

Table 6. Management options that satisfy the 9.9% commercial harvest reduction to end overfishing. All reductions are calculated from 2019 commercial harvest levels (terminal year of stock assessment). All closure options apply to the commercial and recreational fisheries.

Single Management Measures that Satisfy Reduction	Management Measure	Estimated Commercial Harvest Reduction (%)
	Season Closures	
1	October 29 – December 31	33.7
2	November 7 – December 31	22.1
3	November 13 - December 31	10.9

End of Year Season Closure (options 1 and 2)

(+ potential positive impact of action)
(- potential negative impact of action)

+ No additional resources required to implement
+ No additional reporting burden on fishermen or dealers
+ Reduces effort from current level
+ High likelihood of ending overfishing
+ Increases probability of ending overfishing even if stock or fishery conditions are variable
– Weather may prevent fishing during open periods
– Effort may increase during the open period reducing the effectiveness of the closure
– Reduction in fishing mortality may not be achieved
– Overfishing may still occur if recruitment is low
– May adversely impact some fisheries and fishermen more than others
– Create regulatory discards in the closed period

End of Year Season Closure (option 3)

(+ potential positive impact of action)
(- potential negative impact of action)

+ No additional resources required to implement
+ No additional reporting burden on fishermen or dealers
+ Reduces effort from current level
+ Could potentially end overfishing
− No buffer to increase probability of ending overfishing if stock or fishery conditions are variable
− Weather may prevent fishing during open periods
− Effort may increase during the open period reducing the effectiveness of the closure
− Reduction in fishing mortality may not be achieved
− Overfishing may still occur if recruitment is low
− May adversely impact some fisheries and fishermen more than others
− Create regulatory discards in the closed period

Based on public comment received prior to and during the February 2023 MFC business meeting, additional management options accommodating regional end of season closures were examined and added. Regional splits were examined using two methods:

1. Using the "waterbody fished" field from the trip ticket and assigning all trips in internal waters south of Bogue Sound and the ocean south of Cape Hatteras as "Southern Region", and everywhere else as "Northern Region.
2. Using the "county of landing" field to assign every coastal county south of Carteret (Brunswick, New Hanover, Onslow, Pender) as "Southern Region" and all other counties as "Northern Region".

Generally, the split between north and south was considered the Highway 58 Bridge to Emerald Isle. The two methods of splitting regions produced similar results for overall commercial landings. However, the method of splitting using "county of landings" was considered a more accurate representation because assigning all commercial landings south of Cape Hatteras to the "southern region", if the regional split is the Highway 58 Bridge, likely overestimates commercial landings for the Southern Region. Because of similarity between methods and concerns about waterbody assignments, the county of landing method was used to split landings between regions and calculate regional seasons. From 2017-2021 the northern region accounted for 92.8% of commercial landings and the southern region accounted for 7.2% of commercial landings. In 2019, the northern region accounted for 94.1% of commercial landings and the south accounted for 6.0%. Essentially, even if all striped mullet commercial fishing in the south was closed, the minimum 9.9% reduction needed to end overfishing would not be met.

In every month, commercial landings in the north far exceed commercial landings in the south (Figure 9). However, peak striped mullet commercial landings in the north occur in October whereas peak landings in the south occur in November (Figure 10). Despite peak commercial landings in the south occurring in November, the north landed 1,628,282 pounds compared to 182,579 pounds in the south during November form 2017-2021.

To better account for the perceived discrepancy in management impact between the two regions, options for region specific season closures were developed. Options for region specific season are shown in Table 7.

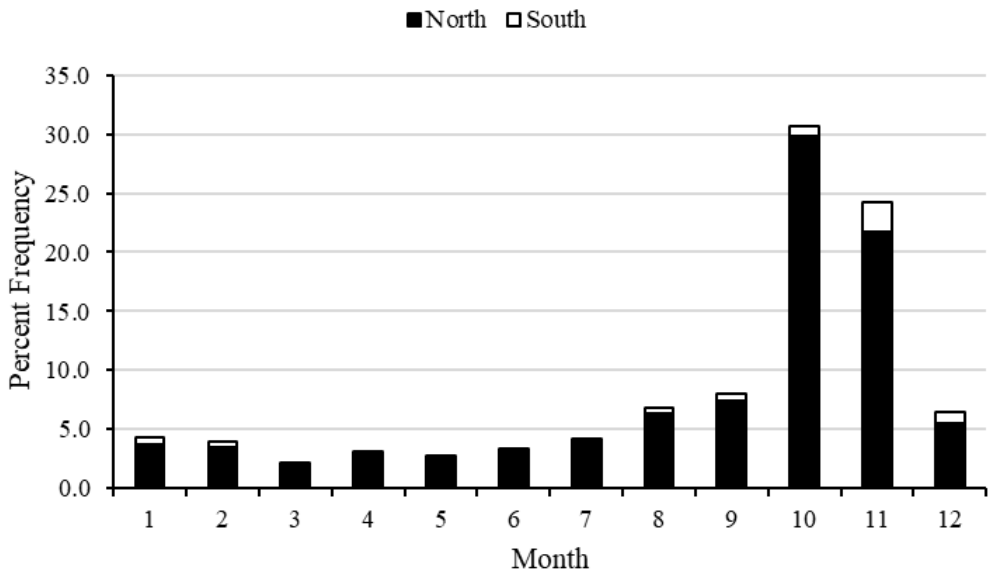

Figure 9. Percent frequency of striped mullet commercial landings by region (north and south) and month, 2017-2021.

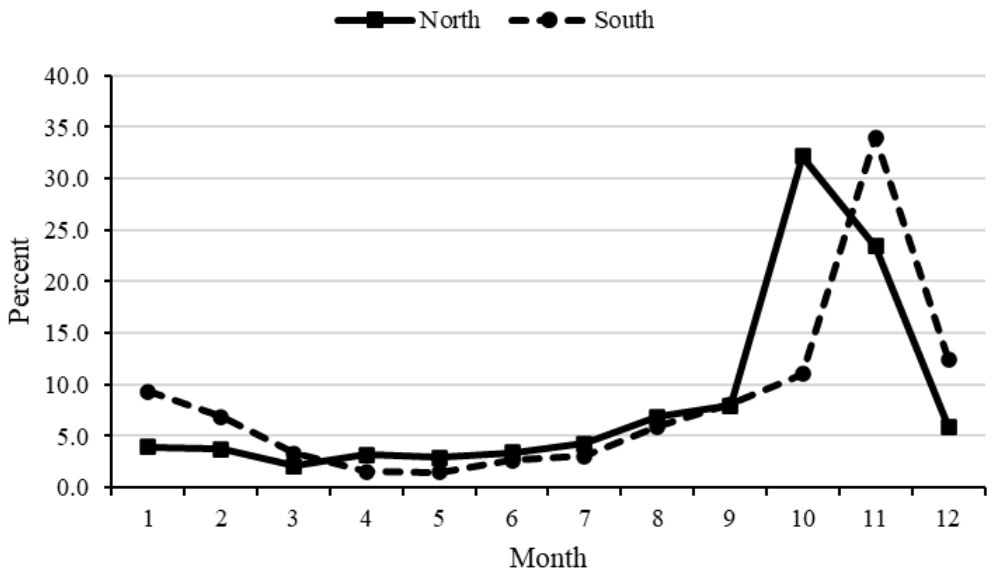

Figure 10. Percent of striped mullet commercial landings by region (north and south) and month, 2017-2021.

Participation in the two regions is strongly skewed toward the north with 269 unique participants in the north compared to 60 participants in the south during November and December 2019. There were 325 total unique participants during that time, meaning there were only four participants who landed striped mullet in both regions (Table 8). Total value lost and value lost per participant at different reduction levels is also strongly skewed toward the north.

Splitting the season regionally could allow for as many as eight additional fishing days in the south. Under a split season, effort could shift from north to south and expected harvest reductions may not be realized.

Table 7. Management options that satisfy the 9.9% commercial harvest reduction to end overfishing by splitting the seasons between north and south. All reductions are calculated from 2019 commercial harvest levels (terminal year of stock assessment). All closure options apply to the commercial and recreational fisheries.

	Season Closure		
Option	North	South	Minimum Reduction
4	October 28 – December 31	October 30 – December 31	35.6
5	November 7 – December 31	November 10 – December 31	21.7
6	November 13 – December 31	November 21 – December 31	10.1

Table 8. Striped mullet commercial fishery participants and value lost by region at various commercial reduction levels based on 2019 data.

Reduction	9.9%		21.3%		35.4%	
	North	South	North	South	North	South
Distinct Count of PID	269	60	269	60	269	60
Value lost per person	$342	$85	$742	$241	$1,278	$342
Total Value lost	$92,059	$5,125	$199,701	$14,466	$343,829	$20,491

Region Specific End of Year Season Closure (Options 1-3)

(+ potential positive impact of action)
(- potential negative impact of action)

+ No additional resources required to implement
+ No additional reporting burden on fishermen or dealers
+ Reduces effort from current level
+ High likelihood of ending overfishing
+ Increases probability of ending overfishing even if stock or fishery conditions are variable
– Weather may prevent fishing during open periods
– Effort may increase during the open period or open regions reducing the effectiveness of the closure
– Reduction in fishing mortality may not be achieved
– Overfishing may still occur if recruitment is low
– May adversely impact some fisheries and fishermen more than others
– Create regulatory discards in the closed period
– Depending on option, no buffer to increase probability of ending overfishing if stock or fishery conditions are variable

RECOMMENDATIONS

DMF Recommended Management Strategy:

The DMF recommends approval of Supplement A to implement either options 1, 2, 4, or 5. To achieve a 20-33% reduction, any statewide end of year season closure must begin no sooner than October 29 and no later than November 7 and continue through December 31. Any end of year split season closure would need to begin no sooner than October 28 in the north and October 30 in the south and no later than November 13 in the north and November 21 in the south.

The Division recommends a 20-33% reduction to exceed the threshold and either meet or approach the target. This reduction level increases the probability of, at a minimum, ending overfishing even if there is variability in fishing effort, market demand, striped mullet availability to the fishery, or recruitment fluctuations.

MFC Selected Management Strategy:

Option 5: season closure November 7 – December 31 in the North and November 10 – December 31 in the South., Supplement A to Amendment 1 will remain in place until adoption of Amendment 2 to the N.C. Striped Mullet FMP.

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