DRAFT, 2024

North Carolina
Spotted Seatrout
Fishery Management Plan Amendment 1

North Carolina Division of Marine Fisheries

North Carolina Department of Environmental Quality
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Disclaimer: Data in this Fishery Management Plan may have changed since publication based on updates to source documents.

ACKNOWLEDGMENTS

Amendment 1 to the North Carolina (NC) Spotted Seatrout Fishery Management Plan (FMP) was developed by the NC Department of Environmental Quality (NCDEQ), Division of Marine Fisheries (NCDMF) under the auspices of the NC Marine Fisheries Commission (NCMFC) with the advice of the Spotted Seatrout Advisory Committee (AC). Deserving special recognition are the members of the Spotted Seatrout AC and the NCDMF Plan Development Team (PDT) who contributed their time and knowledge to this effort.

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EXECUTIVE SUMMARY

*** This section is completed prior to final approval***
This is the last section to be written and guides the reader to the main ideas and provides the simple "narrative" of the plan. Use an abstract-like approach that provides a brief history, stock status (if applicable), the goal and objectives of the plan (paraphrase), and summary of adopted management. Capture management concisely. See the Shrimp FMP Amendment 2.
This requires desk review by the DAT prior to sending to the DEQ Secretary and legislative committees.

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INTRODUCTION

This is Amendment 1 to the Spotted Seatrout Fishery Management Plan (FMP). FMPs are the ultimate product that brings all information and management considerations into one document. The NCDMF prepares FMPs for adoption by the NCMFC for all commercially and recreationally significant species or fisheries that comprise state marine or estuarine resources. The goal of these plans is to ensure long-term viability of these fisheries. By law, each FMP must be reviewed at least once every five years (G.S. 113-182.1). The N.C. Division of Marine Fisheries (NCDMF) reviews each FMP annually and a comprehensive review is undertaken approximately every five years. The last comprehensive review of the plan (Spotted Seatrout FMP) was approved by the N.C. Marine Fisheries Commission (NCMFC) in 2012. All management authority for the North Carolina spotted seatrout fishery is vested in the State of North Carolina. The NCMFC adopts rules and policies and implements management measures for the spotted seatrout fishery in Coastal Fishing Waters in accordance with 113-182.1. Until Amendment 1 is approved for management, spotted seatrout are managed under the Spotted Seatrout FMP (NCDMF, 2012).

Fishery Management Plan History

Original FMP Adoption:	February 2012
Amendments:	None
Revisions:	None
Supplements:	Supplement A to the 2012 FMP – February 2014
Information Updates:	None
Schedule Changes:	None
Comprehensive Review:	Five years after the adoption of Amendment 1

The past version of the Spotted Seatrout FMP (NCDMF 2012) and subsequent Supplement A to the 2012 FMP (NCDMF 2014) are available on the NCDMF website at: http://portal.ncdenr.org/web/mf/fmps-under-development

Management Unit

The management unit includes all spotted seatrout within the Coastal and Joint Fishing waters of North Carolina.

Goal and Objectives

The goal of this plan is to manage the Spotted Seatrout (*Cynoscion nebulosus*) fishery to maintain a self-sustaining population that provides sustainable harvest based on science-based decision-making processes. The following objectives will be used to achieve this goal.

- Implement management strategies within North Carolina that end overfishing and maintains the Spotted Seatrout spawning stock abundance and recruitment potential.
- Promote restoration, enhancement, and protection of critical habitat and environmental quality in a manner consistent with the Coastal Habitat Protection Plan, to maintain or increase growth, survival, and reproduction of the Spotted Seatrout stock.
- Monitor and manage the fishery in a manner that utilizes biological, socioeconomic, fishery, habitat, and environmental data.
- Promote outreach and interjurisdictional cooperation regarding the status and management of the Spotted Seatrout stock in North Carolina and Virginia waters, including practices that minimize bycatch and discard mortality., including practices that minimize bycatch and discard mortality.

DESCRIPTION OF THE STOCK

Biological Profile

Spotted seatrout, also known as speckled trout, are an estuarine fish species that inhabit rivers, estuaries, and shallow coastal systems. Spotted seatrout are found in coastal waters ranging from Massachusetts to southern Florida continuing throughout the Gulf of Mexico but are most abundant in the mid-Atlantic and southeastern regions of the United States. Genetic markers in North Carolina fish suggest mixing between two genetically distinct populations: one population from Georgia to the Cape Fear River, North Carolina and a another that expands north from Bogue Sound, North Carolina (Ellis et al., 2018; O'Donnell et al., 2014).

Spotted seatrout have distinct seasonal migrations. In the winter, fish migrate to shallow estuarine habitats (Ellis, 2014). As waters warm, fish will return to oyster beds, shallow bays, and grass flats (Daniel, 1988). Although spotted seatrout seasonally migrate, based on tag return studies, most individuals exhibit strong site fidelity traveling less than 50 km (Music, 1981; Ellis, 2014; Moulton et al., 2017; Loeffler et al., 2019).

Spawning occurs from April to October with peak spawning occurring in May (Burns, 1996). Spawning generally occurs near inlets or within estuaries. Because spotted seatrout are batch spawners, females are capable of spawning multiple times throughout the season. Fish mature between the ages of one and three. Younger, newly matured fish may spawn every four days while fish older than three years may spawn every two days (Roumillat & Brouwer, 2004). Estimates of the number of eggs a female can produce

in a year vary based on age and size but ranges between 3-20 million eggs per year (Nieland et al., 2002; Roumillat & Brouwer, 2004; Murphy et al., 2010). Most male spotted seatrout in North Carolina are mature at 7.9 inches total length (TL) and most females are mature at 9.9 inches TL. All males are mature at 12 inches and all females are mature at 15 inches.

North Carolina's state record is currently a 12.5 lb, 33.5-inch fish caught from the lower Neuse River in 2022. The annual average size of spotted seatrout from 1991-2021 ranged from 14.4 to 18.3 inches in North Carolina's commercial fisheries and 14.2 to 17.6 inches in the recreational fishery. Spotted seatrout can live as long as ten years old. The oldest, otolith-based age of both male and female fish reported in North Carolina is 9 years old.

Spotted seatrout are especially susceptible to cold stun events, times in which water temperatures drop below what fish can survive. The effect of cold stuns on spotted seatrout abundance depends on the severity and duration of the event. The impact can be minimal if only sub-adults are affected, if the event is localized to a few areas, or if the event is short lived. Cold stun events can have a substantial impact if all size classes are affected, if larger areas are affected, or if the event lasts for an extended period. Interannual spotted seatrout abundance can be driven by cold stun events that cause large losses to the stock, which can prompt management to suspend both recreational and commercial harvests (Hurst, 2007; NCDMF, 2012).

These fish are known to be highly opportunistic predators, feeding on a variety of prey items depending on their size and availability. Their diet mainly consists of small fish, shrimp, crabs, and other invertebrates. Spotted seatrout are ambush predators, relying on camouflage and patience to wait for prey to come within striking distance. They are most active during dusk and dawn.

Assessment Methodology

A seasonal size-structured assessment model was applied to data characterizing commercial and recreational landings and discards, fisheries-independent survey indices, and biological data collected from 1991 through 2019. A nonstationary process was assumed for natural mortality and growth in the model. The seasonal time step and nonstationary natural mortality assumption allows for capturing the cold-stun effects that have been observed for Spotted Seatrout. Both the observed data and model predictions suggest a shift in population dynamics around 2004 when the fisheries-independent survey index data became available. Lower fishing mortality and higher spawning stock biomass and recruitment with greater variation were predicted for the period after 2004. This trend was also observed in the recreational landing and discards data which exhibited higher values after 2004.

Stock Status

Reference point thresholds for the Spotted Seatrout stock were based on 20% spawner potential ratio (SPR). Due to large uncertainty in the terminal year (2019) estimates, a

weighted average of the estimates over the most recent three years (2017–2019) was used to represent the terminal year estimate for determination of stock status. The estimates of 2017–2019 from the base model were weighted by the inverse of their CV values before calculating the average. The threshold and target values for the terminal year were also averaged over 2017–2019. The estimated *F* threshold *F*20% was 0.60 per year, and the estimated terminal year (2019) *F* was 0.75 per year. Thus, the estimated *F*/*F*20% for 2019 is greater than one (1.3), suggesting the stock is currently experiencing overfishing (Figure 1). The estimated SSB threshold (SSB20%) for 2019 was 1,143 metric tons, and the estimated 2019 SSB was 2,259 metric tons. Therefore, the estimated SSB/SSB20% for 2019 is greater than one (2.0), suggesting the stock is not currently overfished (Figure 2).

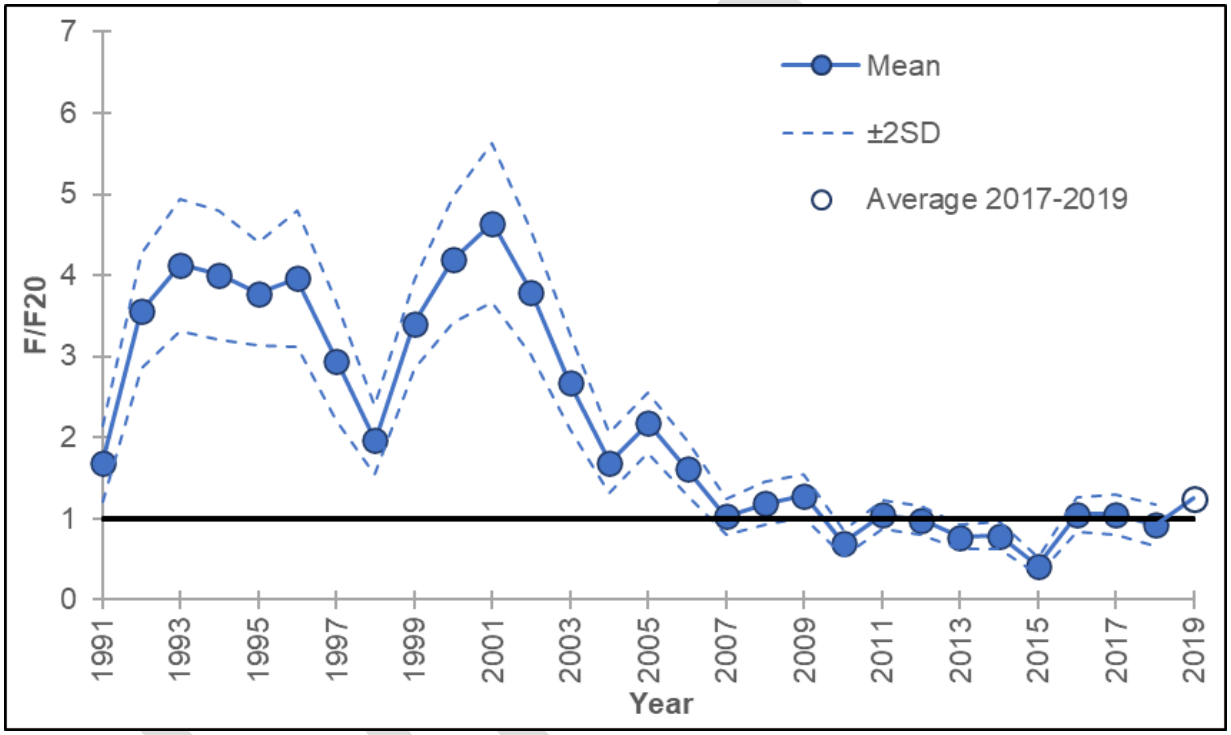

Figure 1. Annual predicted fishing mortality relative to the fishing mortality threshold (F/F_{20}) from the base model of the stock assessment, 1991–2019. The horizontal black line shows a ratio of one. The terminal-year estimate is an average of the most recent three years weighted by the inverse CV values.

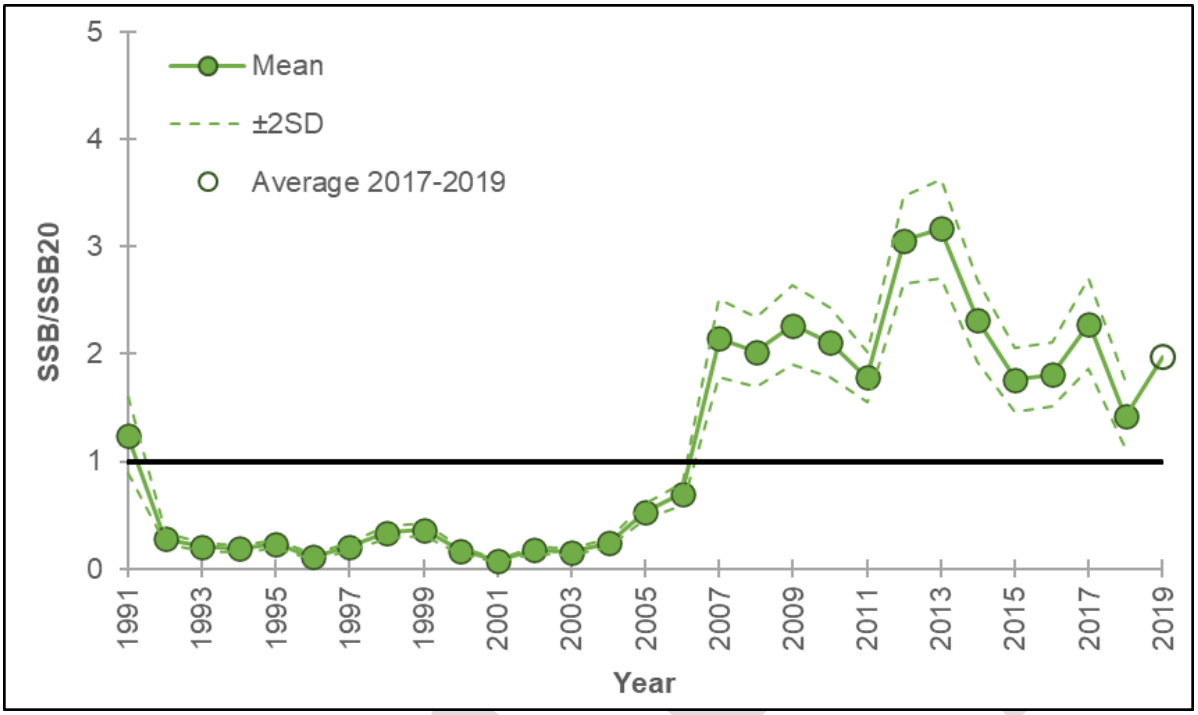

Figure 2. Annual predicted spawning stock biomass (metric tons) relative to the spawning stock biomass threshold (SSB/SSB_{20}) from the base model of the stock assessment, 1991–2019. The horizontal black line shows a ratio of one. The terminal-year estimate is an average of the most recent three years weighted by the inverse CV values.

DESCRIPTION OF THE FISHERY

Additional in-depth analyses and discussion of North Carolina's commercial and recreational spotted seatrout fisheries can be found in the original Spotted Seatrout FMP and Supplement A (NCDMF 2012 and 2014); all FMP documents are available on the DMF Fishery Management Plans website and commercial and recreational landings can be found in the License and Statistics Annual Report (NCDMF 2023) produced by the DMF which can be found on the DMF Fisheries Statistics page.

Recreational and commercial landings are typically variable from year to year and are influenced by winter weather conditions (i.e., low harvest follows severe winters) and fish availability. Confirmed cold stun events, with varying severity, occurred in 1995, 2000, 2001, 2003, 2004, 2009, 2010, 2014, 2015, 2018, and 2022 (Table 1). Since cold stuns typically occur in December and January (the end of the biological year), their impacts to recreational and commercial landings are experienced the following year.

Table 1. Confirmed spotted seatrout cold stun events and fishery closure dates, 1995-2022.

Calendar Year	Month	Biological Year	Closure	Fishery Closure Dates*

1995	December	1995	No	-
2000	January	1999	No	-
2001	January	2000	No	-
2003	January	2002	No	-
2004	December	2004	No	-
2010	January	2009	No	-
2010	December	2010	Yes	Jan. 14 - June 15, 2011
2014	January	2013	Yes	Feb. 5 - June 14, 2014
2015	February	2014	No	-
2018	January	2017	Yes	Jan. 5 - June 14, 2018
2022	December	2022	No	-

Commercial Fishery

DMF instituted a mandatory, dealer-based, trip-level, reporting system known as the North Carolina Trip Ticket Program (NCTTP) for all commercial species in 1994. All seafood landed in North Carolina and sold by licensed commercial fishermen must be reported on a trip ticket by a licensed seafood dealer. For more information about licensing requirements for purchasing and selling seafood in North Carolina and how commercial fishing data were collected prior to 1994, please refer to the DMF License and Statistics Section Annual Report (NCDMF, 2023). In 2022, 138 seafood dealers reported spotted seatrout on trip tickets, landed by 701 fishery participants during 11,756 fishing trips (Figure 3).

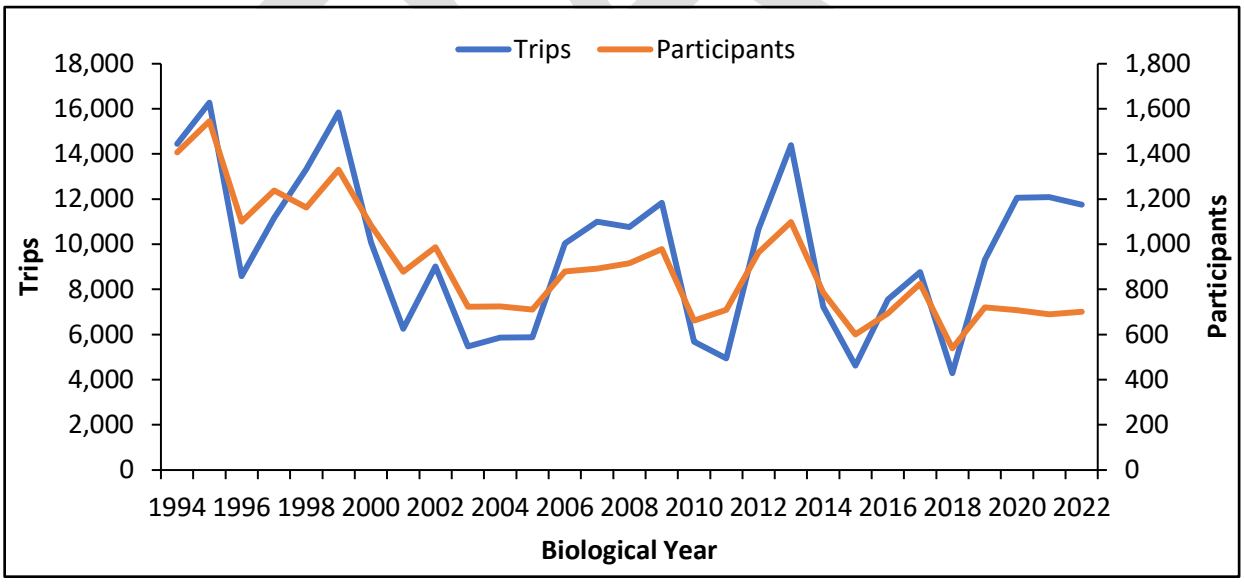

Figure 3. Annual number of trips and participants for the North Carolina spotted seatrout fishery from 1994 to 2022.

Annual Landings and Value

In recent years (2012 to 2022), total landings averaged 361,656 pounds per year (Figure 4). The lowest landings during this period was 115,547 pounds in 2015 and the highest was 654,327 pounds in 2021. Spotted seatrout landings have increased in recent years, exceeding 650,000 pounds in 2020 and 2021. Annual dockside value of spotted seatrout commercial landings averaged $891,180 from 2012 to 2022. Annual dockside value was lowest in 2015 at $290,709 and reached a high of just under $1.7 million in 2021.

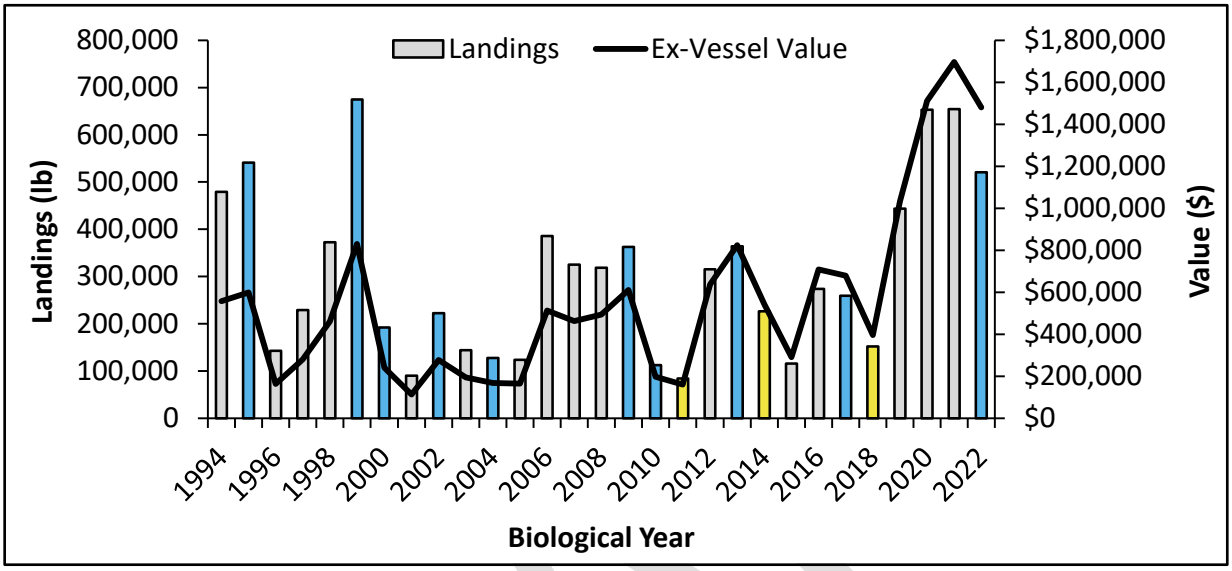

Figure 4. North Carolina annual spotted seatrout commercial landings and ex-vessel value, 1994-2022. Values include all market grades and are not adjusted for inflation. The biological year begins in March and ends in February the following year (ex.: biological year 1994 begins in March 1994 and ends in February 1995). Gray bars indicate years without a cold stun or cold stun closure, blue bars indicate years with a confirmed cold stun event, and yellow bars indicate years with a cold stun closure.

Landings by Month

Spotted seatrout are harvested year-round but there are distinct seasonal peaks (Figure 5). From 1994 through 2022, on average the largest harvest peak occurs from October through February, with a second smaller harvest plateau occurring from April through May. The fall/winter harvest season has accounted for 71% of the harvest and the shorter spring season has accounted for 12% of the harvest from 1194-2022. Harvest is typically highest in colder months as spotted seatrout aggregate in smaller waterbodies and can be caught in higher numbers. Harvest tends to taper off as waters warm and fish disperse in preparation for the summer spawning season.

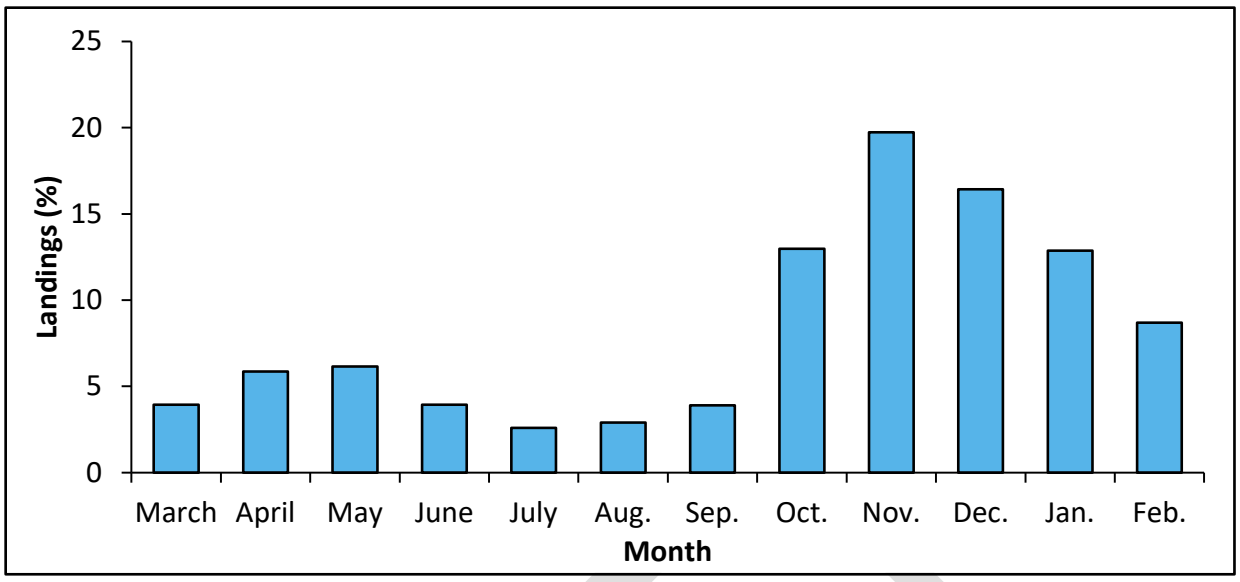

Figure 5. North Carolina spotted seatrout commercial landings proportion by month, 1994-2022. Months are ordered according to the biological year which begins in March and ends in February the following year.

Landings by Area

Spotted seatrout are harvested statewide. The main harvest areas are typically Pamlico Sound, followed by the Neuse and Bay rivers and Central Sounds area (Core, Back, and Bogue sounds; Figure 6). Pamlico Sound accounted for 28% of the harvest from 2012 through 2022. Annual harvest from Pamlico Sound during this period ranged from 11,569 lb in 2018 to 255,176 lb in 2021. During this same period, the Neuse and Bay rivers accounted for 24%, the Central Sounds and Southern area each accounted for 13%, Albemarle Sound accounted for 11%, the Pamlico and Pungo rivers accounted for 9%, and the Ocean accounted for 2% of the harvest.

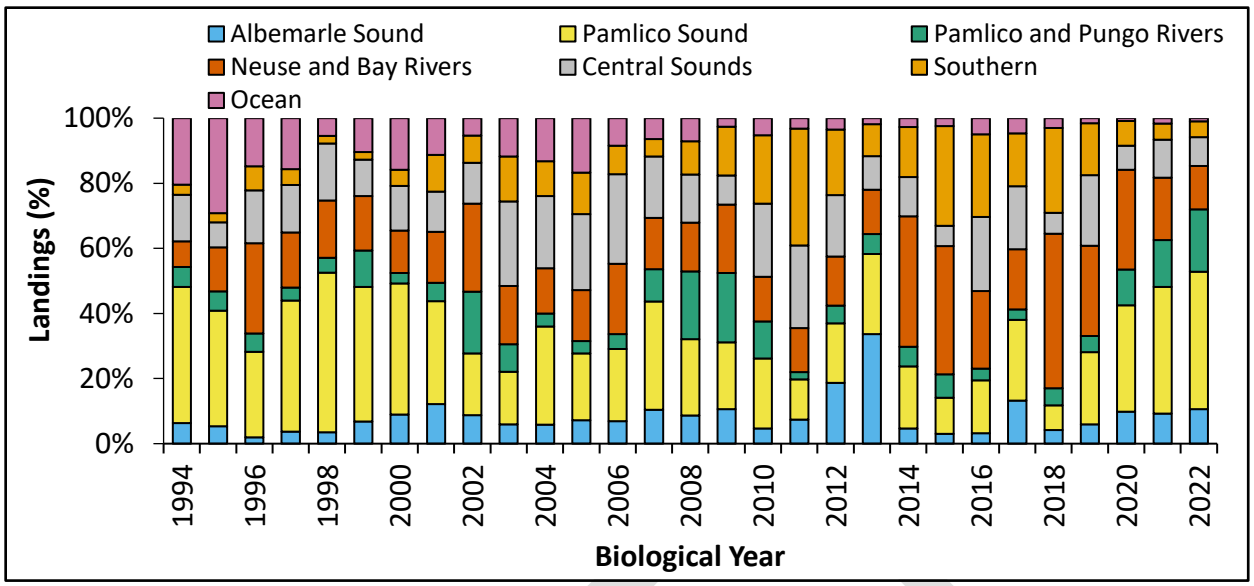

Figure 6. North Carolina annual spotted seatrout commercial landings proportion by area, 1994-2022. Albemarle Sound includes Albemarle, Currituck, Croatan, and Roanoke sounds and their tributaries. Pamlico Sound includes Pamlico Sound and its bays and tributaries. Central Sounds includes Core, Back, and Bogue Sounds and their tributaries. Southern includes the White Oak River and all waters south to the SC state line.

Landings by Gear Type

Spotted seatrout are harvested with a variety of gears but anchored gill nets and runaround gill nets account for most of the current harvest (Figure 7). Other gears used include haul seines, beach seines, and ocean gill nets. Since 2012, anchored gill nets have accounted for 43% of the harvest and runaround gill nets have accounted for 49% of the harvest.

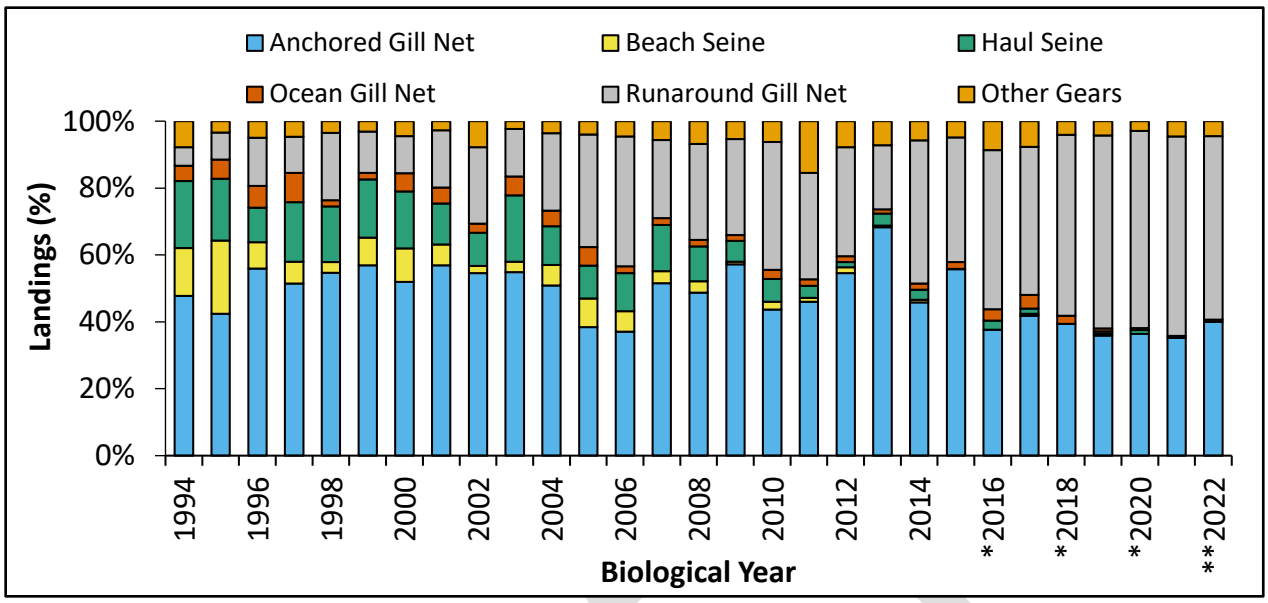

Figure 7. North Carolina annual spotted seatrout commercial landings proportion by gear type, 1994-2022. *Beach Seine landings combined with Other Gears due to data confidentiality. **Beach Seine and Haul Seine landings combined with Other Gears due to data confidentiality.

Commercial bycatch

Large mesh anchored gill nets target demersal fish such as flounder during the fall months and pelagic fish such as clupeids during the spring months. Small-mesh anchored gill-net trips occur consistently throughout the year dependent on the target species for that time of year. Spotted Seatrout are targeted primarily during fall and winter. The Spotted Seatrout small-mesh fishery would potentially interact with green sea turtles and Atlantic sturgeon. Most sea turtle interactions occur in the late summer and fall months. Sea turtle movement is typically influenced by water temperature. As soon as water temperatures start to decline within the estuaries, incidental takes significantly decline. Atlantic Sturgeon have the greatest abundance in spring but fall and winter make up for 47% of estimated discards in the small-mesh fishery. Therefore, the small mesh Spotted Seatrout fishery mostly affects Atlantic Sturgeon.

Table 2. Estimates for the number of green sea turtles, Kemp's ridley sea turtles, and Atlantic sturgeon caught incidentally in the small-mesh and large-mesh anchored gill-net fisheries from 2013-2022. A hyphen (-) represents values that could not be calculated based on the data provided.

		Green sea turtle discards		Kemp's ridley sea turtle discards		Atlantic Sturgeon discards	
Seasons	MU	Large Mesh	Small Mesh	Large Mesh	Small Mesh	Large Mesh	Small Mesh
Spring	A	17	4	19	-	1805	181

	B	66	125	13	-	18	478
	C	15	5	4	-	93	41
	Core	37	22	-	-	7	114
	D	4	1	1	-	1	1
	E	19	6	7	-	15	15
Summer	A	16	3	19	-	119	11
	B	313	62	66	-	8	64
	C	28	5	8	-	11	5
	Core	121	3	-	-	3	4
	D	21	2	4	-	1	1
	E	121	9	54	-	7	4
Fall	A	63	8	38	-	1773	88
	B	1,050	206	143	-	96	249
	C	55	14	7	-	72	31
	Core	316	81	-	-	26	134
	D	110	24	8	-	5	1
	E	194	58	43	-	37	39
Winter	A	8	3	-	-	722	131
	B	11	30	-	-	4	125
	C	1	3	-	-	3	27
	Core	1	1	-	-	1	5
	D	1	1	-	-	1	1
	E	2	4	-	-	1	9
Total		2,590	680	434	-	4,829	1,759

Recreational Fishery

The Spotted Seatrout fishery in N.C. is predominately a recreational fishery. Since 2012, recreational landings have accounted for approximately 86% of total landings. Recreational harvest, release, and trip data are estimated from the Marine Recreational Information Program (MRIP) which is a series of surveys designed to estimate total recreational catch. Recreational estimates across all years have been updated and are now based on MRIP's new Fishing Effort Survey-based calibrated estimates. For more information on MRIP see NOAA's MRIP informational page.

Annual landings and releases

Landings in 2019 increased sharply and have remained high through 2022 (

Figure *8*). In recent years (2012 to 2022) landings averaged 2,212,806 pounds, but since 2019 (2019 to 2022) landings averaged 3,339,879 pounds. Landings have been below a million pounds in only two years since 2012 (2015, 339,436 pounds and 2018, 728,411 pounds) and both years follow documented cold stuns including a fishery closure in 2018

(Table 1). Landings from 2019–2022 represent the four highest landings values in this timeframe and four of the five highest landings since 1991.

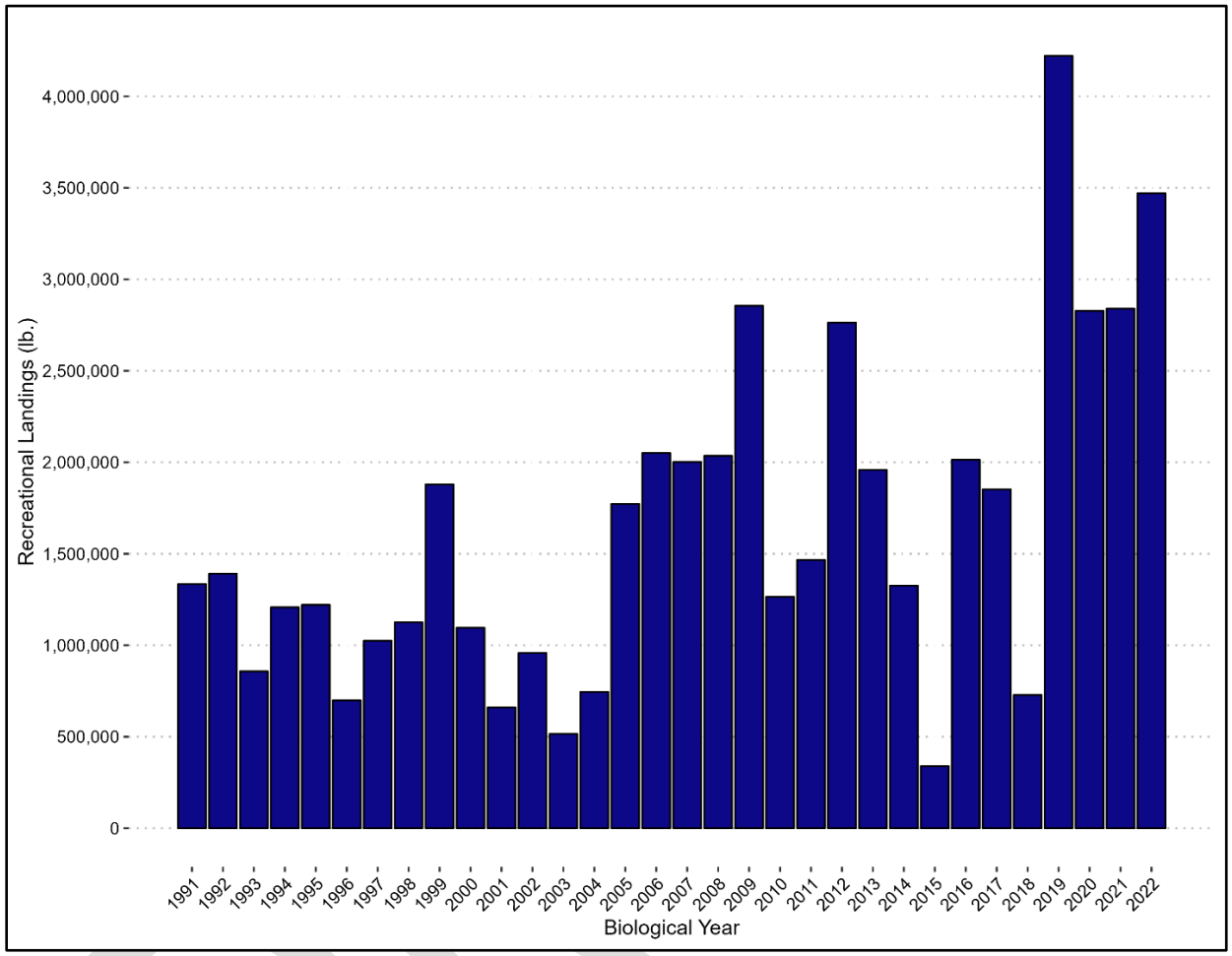

Figure 8. North Carolina Spotted Seatrout recreational landings biological years 1991–2022 (March–February).

There is a dedicated catch and release segment of the recreational fishery, though how anglers participate in this segment varies. Some anglers release all fish, some anglers release all larger fish (e.g., any fish over 20”), and some anglers continue to target Spotted Seatrout for catch and release fishing after harvesting their limit. Recreational releases vary annually and 2018 represents a large outlier for the time series likely due to Hurricane Florence impacting MRIP surveys throughout most of North Carolina in late 2018 but releases have generally increased since 2009 (

Figure *9*). Recreational releases may change seasonally as well because Spotted Seatrout growth rates and life history can lead to greater numbers of sublegal fish at times. Anglers released an average of 6,150,931 fish annually from 2009–2022 with the 2018 outlier removed which is nearly five times the number of fish harvested.

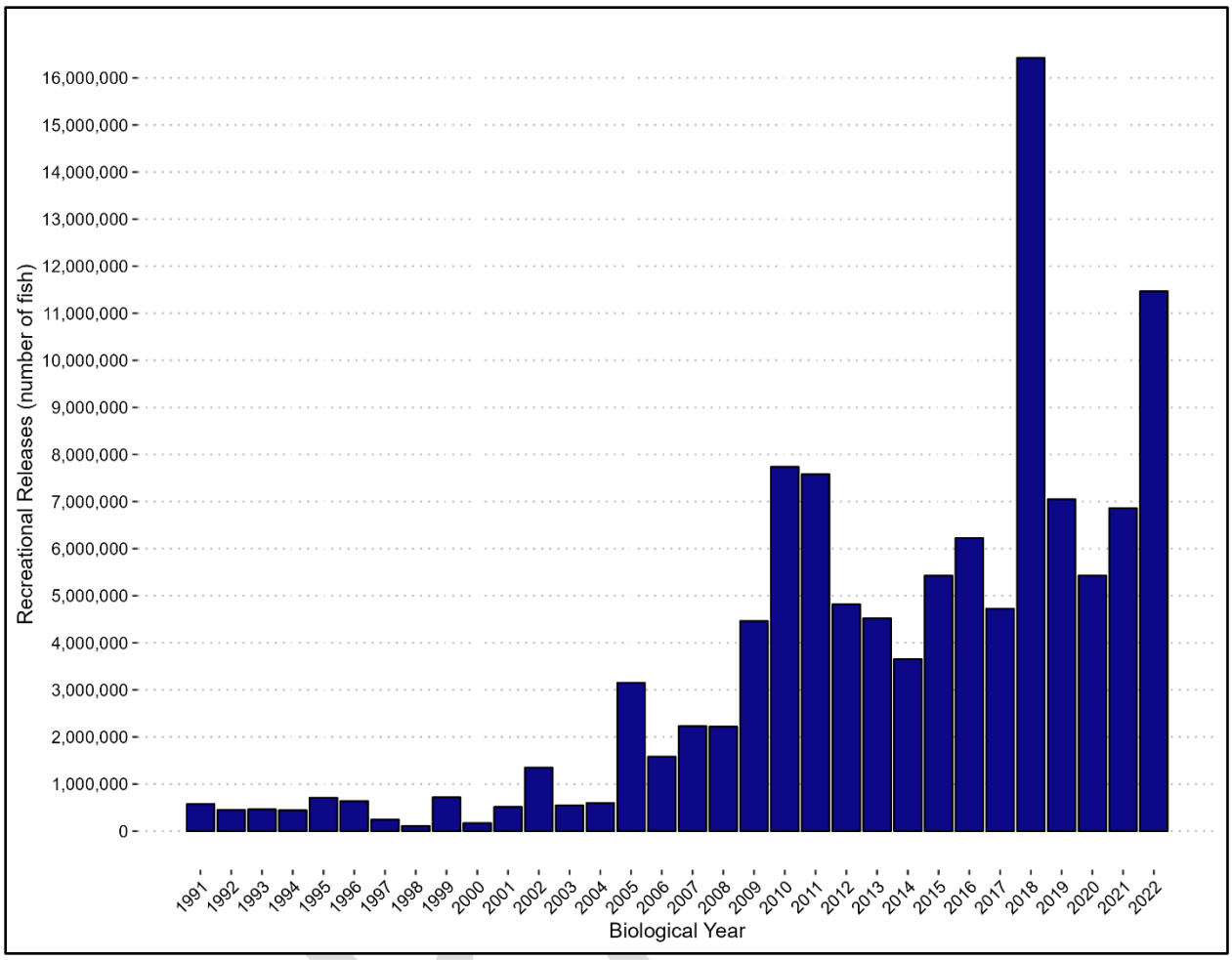

Figure 9. North Carolina Spotted Seatrout recreational releases biological years 1991–2022 (March–February). Hurricane Florence impacted MRIP sampling in most of North Carolina in late 2018. As such recreational releases from 2018 should be viewed with a high degree of caution.

Landings by month

Although recreational harvest occurs throughout the year, most harvest occurs in late fall and early winter. Harvest increases in October, peaks sharply in November, then decreases in winter but remains above average compared to the rest of the year in December, January, and February (

Figure *10*). A second, slight increase in landings occurs in June and July, likely driven by tourism. From 1991 to 2022 approximately 63% of harvest occurs during the primary harvest peak (October – February) while the slight increase in June and July encompasses about 11% of harvest. In recent years (2012–2022), the general harvest patterns remain, but winter months make up a larger proportion of harvest (

Figure *11*). Though minor regional variation in these seasonal patterns might exist, these patterns are broadly consistent across the state.

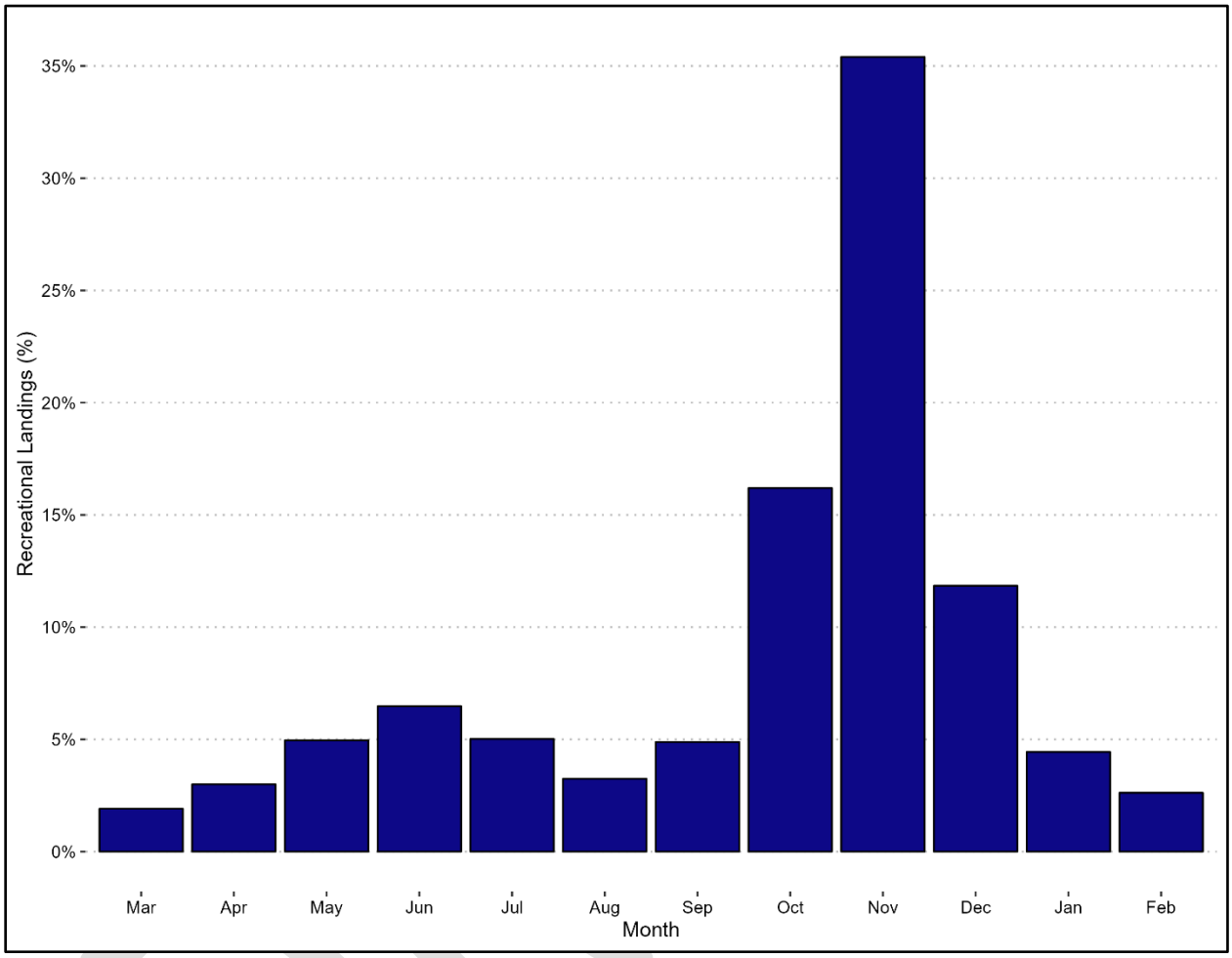

Figure 10. North Carolina average monthly Spotted Seatrout recreational landings proportion by month, 1991-2022. Months are ordered according to the biological year (March – February).

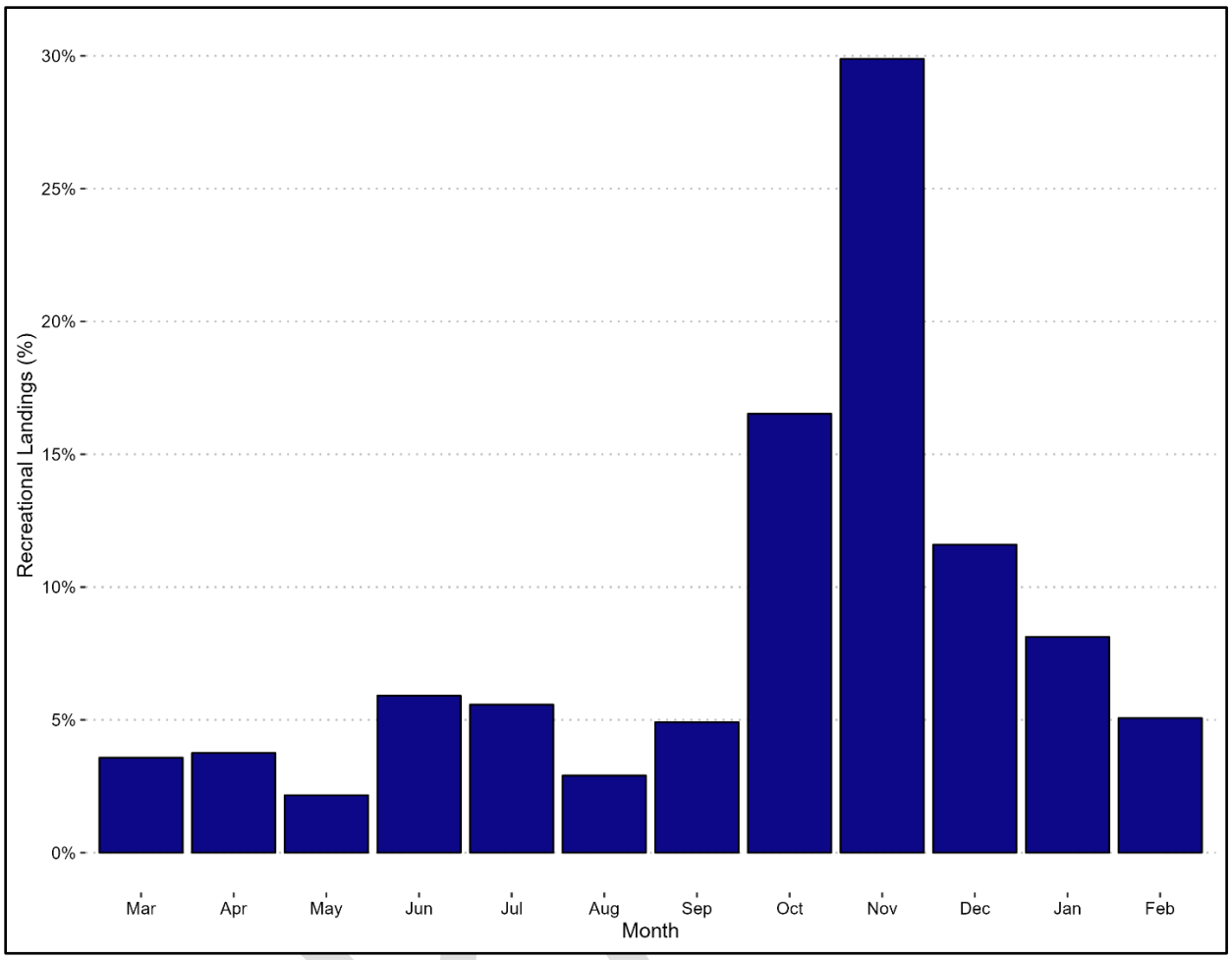

Figure 11. North Carolina average monthly Spotted Seatrout recreational landings proportion by month, 2012-2022. Months are ordered according to the biological year (March – February).

Recreational releases also occur throughout the year, however; releases are concentrated in October, November, and December. In recent years (2012–2022) a slightly larger proportion of fish are released in January compared to the rest of the year, but releases remain relatively consistent outside October, November, and December (Figure 12).

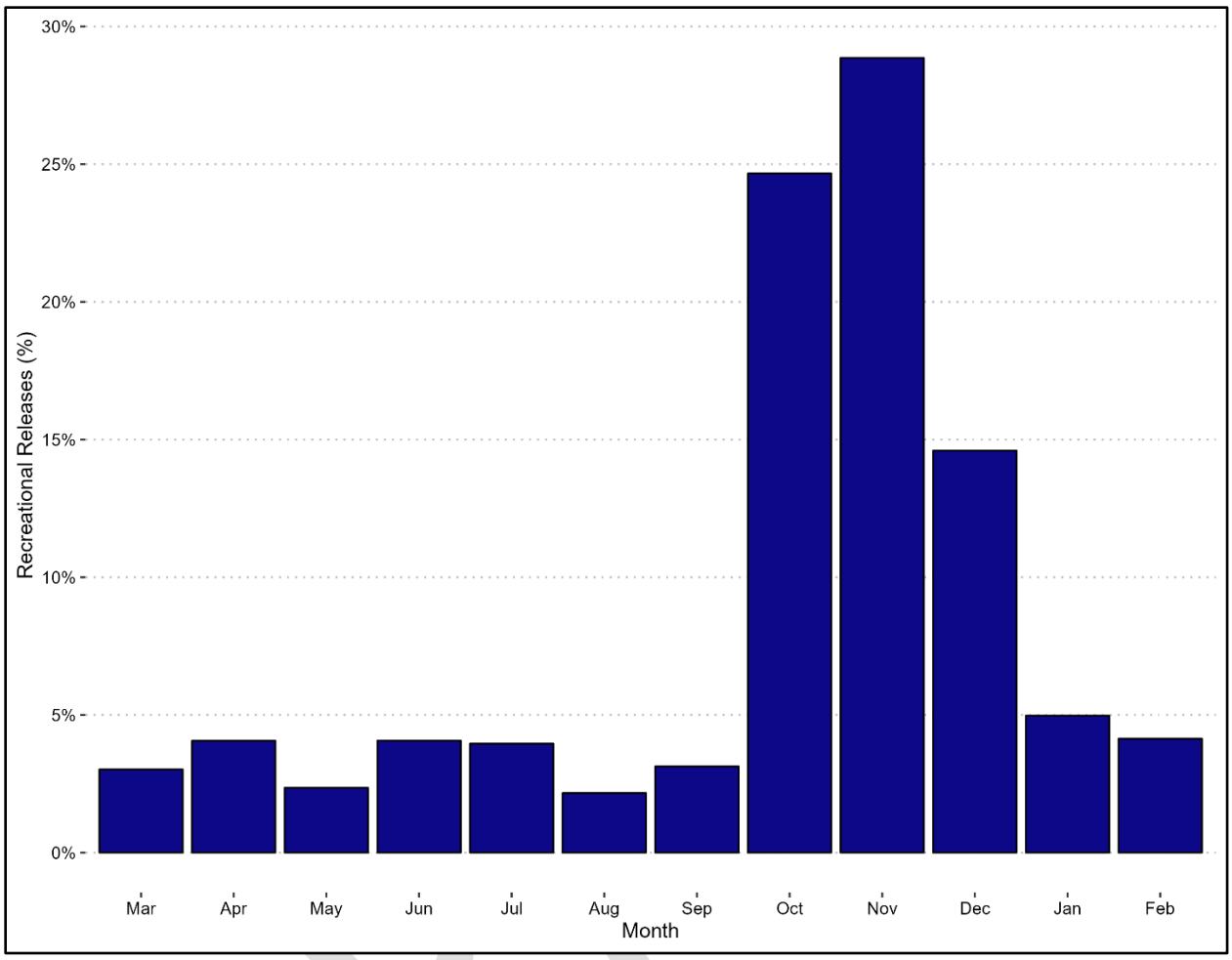

Figure 12. North Carolina average monthly Spotted Seatrout recreational releases proportion by month, 2012-2022. Months are ordered according to the biological year (March – February).

Summary of Economic Impact

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 the North Carolina Division of Marine Fisheries (DMF) License and Statistics Section Annual Report. Due to the management options being considered, this analysis includes both the recreational and commercial industries.

Commercial

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 reports from 2012-2020, which account for proportional expenditures and spillover impacts from related industries. By assuming the spotted seatrout commercial fishery's economic contribution is a proportion equal to its contribution to total commercial ex-vessel values, we can generate an estimate of the economic contribution of the commercial spotted seatrout fishery statewide.

From 2012 to 2022 spotted seatrout economic sales impacts have varied from a low of approximately $360,000 in 2015 to a high of $1.5 million dollars in 2022 and supports between 575 and 1,200 jobs annually. Annual sales impacts have varied over the decade but have averaged $5.9 million from 2012 to 2022.

Table 3. Annual economic contributions from the spotted seatrout commercial fishery to the state of North Carolina from 2012-2022 reported in 2022 dollars.

Year	Pounds Landed	Ex-Vessel Value	Job Impacts	Income Impacts	Value Added Impacts	Sales Impacts
2022	520,994	$1,480,294	834	$3,413,446	$5,432,284	$7,819,923
2021	654,327	$1,833,146	846	$4,305,885	$6,767,404	$9,880,173
2020	653,093	$1,709,539	862	$4,296,534	$6,965,574	$9,646,212
2019	443,629	$1,182,385	822	$2,986,277	$4,369,883	$6,959,060
2018	151,708	$461,888	575	$1,044,323	$1,717,370	$2,371,747
2017	259,432	$810,368	898	$2,100,330	$3,132,230	$4,835,802
2016	273,848	$864,570	775	$2,281,480	$3,515,818	$5,204,455
2015	115,547	$358,921	633	$938,109	$1,450,039	$2,135,390
2014	226,394	$671,553	846	$1,631,567	$2,455,165	$3,761,647
2013	364,123	$1,035,645	1,194	$2,528,888	$3,938,648	$5,769,680
2012	315,128	$811,864	1,081	$2,858,981	$3,908,590	$6,278,522

Recreational

Recreational effort data is provided from the National Marine Fisheries Service (NMFS) as well as survey responses collected from North Carolina recreational fishing participants administered by the Fisheries Economics Program at DMF. For recreational fishing output, total impacts are estimated by incorporating modifiers from NOAA's Fisheries Economics of the United States reports from 2012-2020, which account for proportional recreational expenditures and spillover impacts from related industries. By assuming the spotted seatrout recreational fishery's contribution to expenditure categories is at a proportion equal to its contribution to total recreational trips and durable goods expenditure, we can generate an estimate of the total economic contribution of spotted seatrout in North Carolina.

From 2012 to 2022 spotted seatrout economic sales impacts have varied from a low of about $267 million in 2015 to a high of $581 million dollars in 2020. Similarly, job impacts have span from approximately 2,700 to 5,500 jobs annually. Annual sales impacts have varied over the described time horizon but have averaged $438 million from 2012 to 2022.

Table 4. Annual economic contributions of the spotted seatrout recreational fishery to the state of North Carolina from 2012-2022 reported in 2022 dollars.

Year	Trips	Expenditure	Job Impacts	Income Impacts	Value Added Impacts	Sales Impacts
2022	2952725	$610,166,244	4556	$186,974,466	$287,883,774	$508,297,606
2021	2254224	$527,895,592	4318	$167,784,164	$253,959,746	$455,899,909
2020	2719670	$680,865,862	5486	$231,035,451	$328,868,972	$580,954,157
2019	2528247	$635,730,887	5252	$195,627,253	$296,435,669	$535,753,473
2018	1773091	$439,207,323	3185	$141,032,169	$213,419,087	$380,831,319
2017	1555087	$380,456,082	3573	$117,806,629	$177,609,593	$325,543,922
2016	2091731	$522,385,203	4526	$164,680,710	$244,974,745	$443,331,488
2015	1295843	$321,730,351	2709	$98,681,487	$160,541,925	$267,200,930
2014	1510415	$384,591,773	3635	$116,796,277	$173,912,242	$309,980,126
2013	2065210	$552,161,892	4451	$390,676,333	$248,904,256	$532,736,812
2012	2112138	$587,450,277	4679	$176,846,782	$263,358,908	$473,618,472

ECOSYSTEM PROTECTION AND IMPACT

Coastal Habitat Protection Plan

The Fishery Reform Act statutes require that a Coastal Habitat Protection Plan (CHPP) be drafted by the NCDEQ and reviewed every five years (G.S. 143B-279.8). The CHPP is intended as a resource and guide compiled by NCDEQ staff to assist the Marine Fisheries, Environmental Management, and Coastal Resources commissions in developing goals and recommendations for the continued protection and enhancement of fishery habitats in North Carolina. Habitat recommendations related to fishery management can be addressed directly by the North Carolina Marine Fisheries Commission (NCMFC). The NCMFC has passed rules that provide protection for spotted seatrout habitat including the prohibition of bottom-disturbing gear in specific areas, designation of sensitive fish habitat, such as nursery areas, and SAV beds, with applicable gear restrictions. Habitat recommendations not under NCMFC authority (e.g., water quality management, shoreline development) can be addressed by the other commissions through the CHPP process. The CHPP helps to ensure consistent actions among these commissions as well as their supporting NCDEQ divisions. The CHPP also summarizes the economic and ecological value of coastal habitats to North Carolina, their status, and potential threats to their sustainability (NCDEQ, 2016).

Spotted seatrout make use of a variety of habitats during their life history with variations in habitat preference due to location, season, and ontogenetic stage. They are found most often in habitats identified in the CHPP including water column, wetlands, submerged aquatic vegetation (SAV), soft bottom, and shell bottom (NCDEQ, 2016). Spotted Seatrout are found throughout estuarine systems and can migrate offshore to deeper marine soft bottom areas and beaches in response to falling temperatures (ASMFC, 1984; Mercer, 1984). Spotted Seatrout do, however, show a strong preference for low-

flow areas with SAV or soft bottom (Tabb, 1958; Moulton et al., 2017). Growth and survival of Spotted Seatrout within the habitats they use are maximized when water quality parameters such as temperature, salinity, and dissolved oxygen are within optimal ranges. Maintenance and improvement of suitable estuarine habitat and water quality may be the most important factors in sustaining Spotted Seatrout stocks. Additional information on the habitats discussed below, threats to these habitats, water quality degradation, and how these topics relate to fisheries can be found in the CHPP (NCDEQ, 2016).

Threats and Alterations

Suitable habitat is a critical element in the ecology and productivity of estuarine systems. Degradation or improvement in one aspect of habitat may have a corresponding impact on water quality. All habitats used by Spotted Seatrout are threatened in some way.

Water Column

The water column habitat is defined as "the water covering a submerged surface and its physical, chemical, and biological characteristics" (NCDEQ, 2016). Spotted seatrout spawning is generally limited to estuarine waters in the late summer and early fall in response to temperature and salinity but can also include inlets in North Carolina (ASMFC, 1984; Mercer, 1984; Saucier & Baltz, 1992, 1993; Holt and Holt, 2003; Kupschus, 2004; Stewart & Scharf, 2008; Ricci et al., 2017). Spawning sites have been noted to include tidal passes, channels, river mouths, and waters in the vicinity of inlets (Saucier & Baltz, 1992, 1993; Roumillat et al., 1997; Luczkovich et al., 1999; Stewart & Scharf, 2008; Lowerre-Barbieri et al., 2009; Boucek et al., 2017). For the portion of the Spotted Seatrout population that spawns inshore or offshore of inlets, they are a critical component of water column habitat for Spotted Seatrout and the larvae that must pass through inlets to reach estuarine nursery areas (Churchill et al., 1997; Hare et al., 1999; Luettich et al., 1999). Due to the importance of inlets to the movement of larval Spotted Seatrout into nursery areas and of adult Spotted Seatrout out into to oceanic waters while avoiding lower estuarine temperatures, terminal groins may threaten Spotted Seatrout stocks by impeding recruitment and preventing adults from avoiding cold stuns, since they can obstruct inlet passage (Kapolnai et al., 1996; Churchill et al., 1997; Blanton et al., 1999). Inlets are hydraulically dredged on a regular basis to ensure safe passage for vessels of all sizes. Though DMF recommends an in-water-work moratorium of April 1 to July 30 to minimize impacts during peak biological activity, most projects are given moratorium relief due to public safety. Large hydraulic dredge boats are used inside the inlets and have the highest potential to draw in fishes and invertebrates of all life stages. However, this type of dredge is most impactful to eggs and larval fish, as their reduced swimming ability means they are unable to actively avoid the suction field (Todd et al., 2015).

Soft Bottom

Soft bottom habitat plays an important role in estuarine system function, acting as both a source and sink (storage) for nutrients, chemicals, and microbes. Estuarine soft bottom habitats, especially those adjacent to wetlands, act as Spotted Seatrout nursery areas, provide key food sources for all life stages, and refuge from large predators (Ross & Epperly, 1985; Noble & Monroe, 1991; Powers, 2012). Soft bottom sediments support algae and the benthic invertebrates that eat algae, which are important food sources for juvenile and adult Spotted Seatrout. Spotted Seatrout begin their lives eating primarily copepods and mysid shrimps before transitioning to penaeid and palaemonid shrimps (Peterson and Peterson 1979; Daniel 1988; McMichael and Peters 1989). Soft bottom habitat, along with SAV, are more heavily utilized by Spotted Seatrout than other habitat types (Tabb, 1958; Moulton et al., 2017). Dredging threatens soft bottom habitat, potentially affecting Spotted Seatrout food sources and water quality. Dredging removes all benthic infauna from the affected areas immediately, which reduces food availability temporarily to bottom feeding fish such as the Spotted Seatrout (NCDEQ, 2016).

In addition to estuarine soft bottom habitats, there are also surf zone and deeper marine soft bottom habitats used by adult Spotted Seatrout in North Carolina during late autumn temperature migrations (ASMFC, 1984; Mercer, 1984). The threats to ocean beaches and surf zone include beach nourishment and storm water outfalls.

Submerged Aquatic Vegetation

Submerged Aquatic Vegetation (SAV) is a fish habitat dominated by one or more species of underwater vascular plants and occurs in both subtidal and intertidal zones, sometimes over extensive areas (NCDEQ, 2016). SAV acts as a crucial structured habitat for fishes and invertebrates, providing refuge from predators and food sources such as epiphytic (living on the surface of vegetation) algae and animals. Spotted Seatrout use SAV as spawning sites, nurseries, forage areas, refuge areas, and for feeding on invertebrates on seagrasses and other structures. The Atlantic States Marine Fisheries Commission (ASMFC) lists SAV as a Habitat Area of Particular Concern (HAPC) for Spotted Seatrout (ASMFC, 1984). All life stages of Spotted Seatrout have been documented in mesohaline and polyhaline seagrass beds (Tabb, 1966; ASMFC, 1984; Mercer, 1984; Thayer, Kenworthy & Fonseca, 1984; McMichael & Peters, 1989; Rooker et al., 1998). Spotted Seatrout use SAV habitat as much, if not more, than other spawning sites (Ricci et al., 2017; Boucek et al., 2017). Juvenile Spotted Seatrout are abundant in high salinity SAV in both Pamlico and Core sounds (Purvis, 1976; Wolff, 1976) and juvenile abundances were found to be greater in SAV than soft bottom and oyster reef and were greater than or equivalent to abundances in wetland habitats (Minello, 1999; Minello et al., 2003). Seagrass beds are threatened by physical destruction from bottom disturbing fishing gear, dredging, and damage from boat use, as well as degradation of water quality. Declines in SAV, globally and in North Carolina, due to increased coastal development and decreased water quality, are also altering these ecosystems and their community structure.

Shell Bottom

Shell bottom is defined as estuarine intertidal or subtidal bottom made of surface shell concentrations of living or dead oysters, hard clams, and other shellfish (NCDEQ, 2016). This includes oyster beds and reefs and shell hash (a mixture of sediments and broken shell). Spawning aggregations of Spotted Seatrout have been documented over shell bottom areas in North Carolina including in the Neuse River (Barrios et al., 2006). Shell bottom habitats have been shown to provide an important forage base of invertebrates and small finfish for juvenile and adult Spotted Seatrout (Coen et al. 1999; ASMFC, 2007). Oyster reefs and shell hash areas can be damaged by bottom-disturbing fishing gears, disease, and overfishing.

Wetlands

Wetlands are areas that are inundated or saturated by the accumulation of surface or groundwater, enough to support a prevalence of vegetation typically adapted for life in saturated soil conditions (NCDEQ, 2016). Estuarine wetlands are tidal and are found in bays, sounds, and rivers in brackish waters. Freshwater wetlands include freshwater marshes, bottomland, hardwood forests, and swamp forests in low salinity to freshwater areas of creeks, streams, and rivers. Wetlands are particularly valuable as juvenile Spotted Seatrout appear to use estuarine wetlands, particularly the marsh edge habitat of salt/brackish marshes, as nurseries (Tabb, 1966; ASMFC, 1984; Mercer, 1984; Hettler 1989; Rakocinski et al., 1992; Baltz et al., 1993; Peterson & Turner, 1994). Abundances of juveniles in wetlands were found to be less than or equal to abundances in SAV (Minello, 1999; Minello et al., 2003). Wetlands are threatened by many human activities, including dredging for marinas and channels, filling for development, ditching and draining for agriculture, silviculture, channelization, and shoreline stabilization. Wetland loss and decreasing vegetative buffers can hasten excessive nutrient loading impacts to the surrounding water and other habitat types (NCDWQ, 2000a).

Water Quality Degradation

Good water quality is essential, both for supporting the various life stages of Spotted Seatrout and for maintaining their habitats. Naturally occurring and anthropogenic activities can alter the salinity and temperature conditions or elevate levels of toxins, nutrients, and turbidity, as well as lower dissolved oxygen levels, which can degrade water quality and impact Spotted Seatrout survival. Water quality degradation through stormwater runoff, discharges, toxic chemicals, sedimentation, and changes in turbidity can threaten Spotted Seatrout survival. Salinity particularly affects the eggs of Spotted Seatrout which rely on high spawning salinities to remain positively buoyant allowing for wind and tidally driven distribution throughout the estuary (Churchill et al., 1999; Holt & Holt, 2003); however, sudden salinity reductions cause Spotted Seatrout eggs to sink, thus reducing dispersal and survival (Holt & Holt, 2003).

More detailed information on water quality degradation, including the topics of hypoxia, toxins, and temperature in North Carolina and the effect on fish stocks can be found in the NCDWQ guides on the NCDWQ website (NCDWQ, 2000b; NCDWQ, 2008) and in the CHPP (NCDEQ, 2016). More information about the water quality requirements for

Spotted Seatrout can be found in the DESCRIPTION OF THE STOCK section of this FMP.

Gear Impacts on Habitat

Bottom disturbing fishing gear can impact ecosystem function through habitat degradation. Static (non-mobile) gears tend to have a lesser impact on habitat compared to mobile gears, as the amount of area affected by static gears tends to be insignificant when compared to that of mobile gears (Rogers et al., 1998). Both bottom disturbing and static gears can have impacts of bycatch while in operation and can have negative impacts if the gear is abandoned or lost.

The primary gears used in the Spotted Seatrout commercial fishery are estuarine gill nets (runaround, strike, or set), long haul seines, beach seines, and ocean gill nets. In the recreational fishery, rod and reel is the primary gear. Other gears that may harvest Spotted Seatrout as incidental catch include pounds nets, crab pots, drift gill nets, and fyke nets. Many gears that interact with Spotted Seatrout are considered static gear (Barnette, 2001; NCDEQ, 2016) and generally have minimal impact on habitat.

Beach seines and runaround gill nets are both mobile and may disturb local habitats. Impacts from mobile bottom-disturbing fishing gears such as seines and runaround gill nets include changes in community composition from the removal of species and physical disruption of the habitat (Barnette, 2001). Gears may damage or uproot SAV as they are dragged across the seafloor, potentially reducing productivity and destroying structures that provide feeding surfaces and shelter for Spotted Seatrout (NCDEQ, 2016). Gears that drag across the seafloor may also suspend sediments, temporarily increasing turbidity (Corbett et al., 2004) and reducing clarity, SAV growth, productivity, and survival (NCDEQ, 2016). Sediment suspended by bottom disturbing fishing gears and boat propeller wash may also bury SAV (Thayer et al., 1984), degrading habitat quality and reducing productivity.

Extreme Weather Events

Extreme weather events have always occurred, but scientists anticipate that changes to North Carolina's climate in this century will be larger than anything experienced historically (Kunkel et al., 2020). It is predicted that average annual temperatures will continue to increase, sea level will continue to rise, the intensity of hurricanes will increase, total annual precipitation from hurricanes and severe thunderstorms will increase resulting in increased flooding events, while severe droughts will also likely increase due to higher temperatures (Kunkel et al., 2020). Flood events can flush contaminated nutrient-rich runoff into estuaries causing degraded water quality. Runoff from flood events can cause eutrophication resulting in fish kills due to hypoxia, algal blooms, and alteration of the salinity regime. Flood events can also cause erosion of shorelines resulting in loss of important coastal habitats, such as SAV, soft bottom, and wetlands, that are critical to Spotted Seatrout throughout their life history. Potential

increases in extreme weather events could have an inverse effect on the recruitment and survival of Spotted Seatrout in the estuarine system.

Included in extreme weather events are winter storms. Spotted seatrout display a greater sensitivity to sharp drops in water temperatures than many other species. Throughout their range, spotted seatrout are periodically exposed to water temperatures below their thermal tolerance (i.e., below temperatures they can tolerate without experiencing stress) because of prolonged cold air temperatures or from snow and ice melt after a winter storm. For more information on how spotted seatrout are affected by winter events, please see the Cold Stun Management issue paper in this FMP.

FINAL AMENDMENT ONE MANAGEMENT STRATEGY

****Section will be completed when the MFC selects preferred management and prior to DEQ secretary and legislative committees review****
The purpose of this section is for readers to see exactly how we are managing this fishery and what constitutes a change in management. It should include an overview and statement of policies, as well as any adaptive management. Present the management strategies in a clear, concise, and precise way.

RESEARCH NEEDS

The research recommendations listed below are offered by the division to improve future management strategies of the spotted seatrout fishery. They are considered high priority as they will help to better understand the spotted seatrout fishery and meet the goal and objectives of the FMP. A more comprehensive list of research recommendations is provided in the Annual FMP Review and DMF Research Priorities documents.

- Integrate tagging data into stock assessment model so both tagging data and other data sources can work together to give a better picture of the population dynamics including estimates of survival and natural mortality.
- Conduct additional work to evaluate more fully the utility of the Program 120 survey and determine if alternative sampling methodologies or expanded sampling seasonality could provide a more robust index.
- Develop programs to incorporate information on size of recreational releases such as Citizen Science initiatives; Improve estimates of recreational discard mortality.
- Conduct a detailed analysis of the existing data (i.e. Program 915) to determine the extent to which late fall and spring provide insights into overwinter changes in abundance.
- Conduct research to generate accurate fecundity estimates for North Carolina spotted seatrout.

MANAGEMENT FROM PREVIOUS PLANS

DRAFT – SUBJECT TO CHANGE

APPENDICES

Appendix 1: Sustainable Harvest

Appendix 2: Recreational Management

Appendix 3: Commercial Management

Appendix 4: Cold Stun Management

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