

AMENDMENT 3 DRAFT 1 – SUBJECT TO CHANGE

APPENDIX 4.1: ACHIEVING SUSTAINABLE HARVEST IN THE NORTH CAROLINA SOUTHERN FLOUNDER FISHERY

(version August 26, 2020)

I. ISSUE

Implement long-term management measures to achieve sustainable harvest in the North Carolina southern flounder fishery that end overfishing and rebuild the spawning stock.

II. ORIGINATION

The N.C. Marine Fisheries Commission (NCMFC) adopted Amendment 2 to the Southern Flounder Fishery Management Plan (FMP) in August 2019. Amendment 2 authorized the development of Amendment 3 to begin immediately in order to implement more comprehensive, long-term management measures. State law requires these management measures to achieve sustainable harvest in the southern flounder fishery. (Fisheries Reform Act, NCGS § 113-182.1).

III. BACKGROUND

The southern flounder, *Paralichthys lethostigma*, is a demersal species found in the Atlantic Ocean and Gulf of Mexico from northern Mexico to Virginia. The biological unit stock for southern flounder inhabiting U.S. South Atlantic coastal waters includes waters of North Carolina, South Carolina, Georgia, and the east coast of Florida (see the *Introduction* and *Description of the Stock* sections for more information on the management authority, distribution and unit stock definition of southern flounder).

To address the coast-wide nature of the southern flounder stock, a comprehensive stock assessment was completed to determine the status of the stock using data from North Carolina through the east coast of Florida from 1989 through 2017 (Flowers et al. 2019). The assessment model indicated the stock was overfished and overfishing was occurring (Figure 1, Figure 2). Additional analyses provided projections of reductions to fishing mortality necessary to end overfishing and to rebuild the spawning stock biomass and end the overfished status.

Fishing mortality (F) was estimated at the target of $F_{35\%}$ as 0.35 and the threshold of $F_{25\%}$ as 0.53. In 2017, fishing mortality was 0.91, which is higher than the F threshold of 0.53 and indicates overfishing is occurring (Figure 1). The probability that fishing mortality in 2017 was above the threshold value of 0.53 is 96%, whereas there is a 100% probability fishing mortality in 2017 was above the target value of 0.35.

The spawning stock biomass target ($SSB_{35\%}$) was estimated to be 5,452 metric tons (approximately 12.0 million pounds) and threshold ($SSB_{25\%}$) to be 3,900 metric tons (approximately 8.6 million pounds). In 2017, the estimated SSB was 1,031 metric tons (approximately 2.3 million pounds), which is lower than the SSB threshold of 3,900 metric tons and indicates the stock is overfished (Figure 2). The probability that SSB in 2017 was below the threshold and target values (3,900 and 5,452 metric tons, respectively) is 100%.

The General Statutes of North Carolina require that an FMP specify a time period not to exceed two years from the date of the adoption to end overfishing (NCGS 113-182.1). The statutes also

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require that an FMP specify a time period not to exceed 10 years from the date of adoption and a at least a 50% probability to achieve a sustainable harvest. In terms of the statutes, a sustainable harvest is attained when the stock is no longer overfished (NCGS 113-129). The statutes allow some exceptions to these stipulations related to biology, environmental conditions, or lack of sufficient data.

To meet statutory requirements, calculations were made to determine the reductions in total coast-wide removals (all fishery removals from each of the four states) necessary to end overfishing within two years and recover the stock from an overfished status within the 10-year period. Total removals are defined as the total pounds of landed southern flounder plus dead discards. Dead discards are comprised of fish that were dead upon retrieval of gear and not harvested and fish that were released alive that experience delayed mortality. For more information on projections and the resulting removal reductions refer to Amendment 2 or the 2019 updated stock assessment, which includes assumptions and computational details (NCDMF 2019a; Flowers et al. 2019).

The projections for rebuilding necessary to end overfishing and the overfished status are based on the conditions and restrictions such as minimum size limits for both the commercial and recreational fishery, the current gear requirements, and selected soak time and daytime restrictions in effect at the time that resulted in the annual total removals. These measures, along with recruitment strength, environmental conditions, and fishing effort, influenced the fishery during the 2017 terminal year of the stock assessment which is the base year for reduction calculations. Any changes in these past conditions will have an undetermined impact on the projections and the rebuilding schedule

As required by North Carolina law, a fishing mortality of 0.34 is needed to reach the SSB threshold by 2028 and end the overfished status (Figure 3). This will require at a minimum a 52% reduction in total removals coast wide. To increase the probability of success of rebuilding to the higher SSB target by 2028, fishing mortality would need to be lowered to 0.18 (Figure 4). This will require a 72% reduction in total removals coast wide. A fishing mortality that falls between the identified target and threshold values meets the statutory requirements (e.g., 62%; Figure 5). All projections are associated with at least a 50% probability of achieving sustainable harvest for the fishery.

The management measures implemented in North Carolina from the original Southern Flounder FMP (NCDMF 2005), Amendment 1 (NCDMF 2013), and Supplement A to Amendment 1 (NCDMF 2017a) as modified by the Aug. 17, 2017 settlement agreement have not resulted in the necessary increase in SSB to end the stock's overfished status, thus continued reductions are necessary. In developing management measures for Amendment 2 and Amendment 3, the division applied the reductions only to North Carolina's portion of total removals through the time series of this assessment. To account for North Carolina's portion of these reductions in the recreational and commercial fisheries, the identified reduction was applied to both the discards and landings, or total removals, for each sector (commercial and recreational) of the North Carolina southern flounder fishery from the terminal year of the assessment (2017). In 2017, total removals for all sectors including dead discards was 1,957,264 pounds; the commercial fishery accounted for 72.2% (including 0.9% dead discards) and the recreational fishery (hook-

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and-line and gigs) accounted for 27.9% (including 2.0% dead discards) of the total North Carolina removals (Figure 6).

In Amendment 3, the management measure proposed to meet sustainable harvest will be changed from a seasonal approach to a quota based approach. This change does not alter analyses used to calculate reductions but does adjust the terminology used to describe the individual pieces used from Total Allowable Catch (TAC) to Total Allowable Landings (TAL) as landings are the quantifiable mechanism used to manage the quota. Reductions in discards will be accounted for at the end of the fishery as discards are not part of daily quota monitoring and will be added to the annual landings to create total catch to make sure the TAC is not exceeded. This approach differs slightly from Amendment 2. In each amendment, reductions were based on TAC, but as seasons were the selected management measure implemented through Amendment 2, the seasons accounted for estimated reductions in harvest and discards. Based on a fishing mortality that falls between the identified threshold (52% reduction) and target (72% reduction), the range in annual landings of southern flounder that could occur for all sectors is 912,603 pounds to 532,352 pounds respectively (Figures 7 and 8; Table 1).

Trip Ticket Program, Marine Recreational Information Program, NCDMF Gig Mail Survey.

Management measures (seasonal closures) implemented in Amendment 2 met the statutory requirements and were critical for reducing removals and initiating the rebuilding of the southern flounder stock. Seasonal closures do not enforce a maximum removal level on the fishery and only limit the time when targeted harvest can occur. Fishing effort can be more concentrated during the open season, potentially altering fishing behaviors from previous years that were used to estimate harvest windows; that is, fishing effort may increase during the open season and lead to higher than predicted removals. Seasonal closures alone may not result in the needed increase in SSB even if maintained long term (NCDMF 2019a). Consequently, the approval of Amendment 2 specified the development of Amendment 3 to begin immediately to implement more comprehensive, long-term management measures to achieve sustainable harvest. Management strategies implemented through Amendment 3 will not restart the time requirements set in Amendment 2 that are necessary to meet the statutory mandates.

Amendment 2 required a 62% reduction in 2019 and a 72% reduction from 2020 onward, both above the minimum 52% reduction that is statutorily required. Preliminary analysis of reductions achieved in 2019 from implementation of Amendment 2 management measures indicate an overall reduction of 35% was achieved, or a 43% reduction in total removals for the commercial fishery and a 15% reduction in total removals for the recreational fishery. A level of reduction less than the required 62% was anticipated as the seasons did not begin until Sept. 4, 2019. The fisheries operated three quarters of the calendar year, as compared to estimates that were based on a closure beginning Jan. 1.

Management measures for Amendment 3 will be selected and implemented from the allowable total removals (landings and dead discards) that are calculated based on the fishing mortality estimates of the terminal year (2017) of the stock assessment. Each sector will be reduced by the identified percent reduction to meet statute. The reductions are only to North Carolina's portion of total removals through the time series of the assessment. Calculations to predict future harvest

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reductions depends on environmental parameters, recruitment, and fishing effort remaining similar to previous years, an assumption of the 2019 updated stock assessment. Any changes to these factors will impact the stock's response and whether the statutory requirement of sustainable harvest is achieved.

Building on the seasonal closures in Amendment 2, additional quantifiable and non-quantifiable management measures in Amendment 3 will serve to improve the overall southern flounder stock to reduce total removals and increase likelihood of improved southern flounder SSB and recruitment, while still providing flexibility for fishermen, when possible, in the timing of the harvest for the sectors. This issue paper evaluates management measures in addition to seasonal closures for a long-term approach in constraining harvest to the anticipated levels in the southern flounder fishery to achieve sustainable harvest in Amendment 3.

IV. AUTHORITY

North Carolina General Statutes

§ 113-134 RULES

§ 113-182 REGULATION OF FISHING AND FISHERIES

§ 113-182.1 FISHERY MANAGEMENT PLANS

§ 113-221.1 PROCLAMATIONS; EMERGENCY REVIEW

§ 143B-289.52 MARINE FISHERIES COMMISSION – POWERS AND DUTIES

North Carolina Marine Fisheries Commission Rules

15A NCAC 03H .0103 PROCLAMATIONS, GENERAL

15A NCAC 03M .0503 FLOUNDER

V. DISCUSSION

The N.C. Department of Environmental Quality and the division recognize the required reductions in the southern flounder fishery are significant but are necessary to increase the probability of successfully rebuilding this important recreational and commercial resource. For the discussion of potential management measures in Amendment 3, a 72% reduction is used based on the following:

- Amendment 2 required a 72% reduction from 2020 onward until adoption of Amendment 3.
- Projections for rebuilding are based on a minimum of a 50% probability of success. Adopting a reduction greater than the 52% minimum increases the likelihood of achieving the minimum necessary for rebuilding.
- The projections were made with the assumptions that each state that participated in the coast-wide stock assessment would implement measures for the necessary reductions required to rebuild SSB. There are uncertainties surrounding the other states with implementing cooperative management and the timing of regulations if implemented. The reductions in Amendment 3 are only to North Carolina's portion of total removals through the time series of the assessment.
- The management measures implemented in North Carolina from the original Southern Flounder FMP (NCDMF 2005), Amendment 1 (NCDMF 2013), and Supplement A to Amendment 1 (NCDMF 2017a) as modified by the Aug. 17, 2017 settlement agreement

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(2017) has not resulted in the necessary increase in SSB to end the stock's overfished status, thus further reductions are necessary.

A fishing mortality that falls between the identified threshold (52% reduction) and target (72% reduction) meets the statutory requirements (Figure 5).

There are several assumptions and limitations provided in the background section of this paper that are important to take into consideration as the potential management measures for Amendment 3 are presented. Here is a summary of the key points:

- To account for North Carolina's portion of these reductions in the recreational and commercial fisheries, the identified reduction was applied to both the discards and landings, or total removals, for each sector (commercial and recreational) of the North Carolina southern flounder fishery from the terminal year of the assessment (2017) (Figure 6).
- Reductions in discards will be accounted for at the end of the fishery as discards are not part of daily quota monitoring and will be added to the landings to adjust the value to make sure the TAC is not exceeded. This approach differs slightly from Amendment 2, in each amendment reductions were based on TAC, but as seasons were the selected management measure implemented through Amendment 2, the seasons accounted for estimated reductions in harvest and discards.
- The projections for rebuilding necessary to end overfishing and the overfished status included the minimum size limits for both the commercial and recreational fishery, the current gear requirements, and selected soak time and daytime restrictions. These measures influenced the fishery during the terminal year of the stock assessment and any consideration of changes to those values should be viewed with caution as they will have an undetermined impact on the projections and the rebuilding schedule.
- The approval of Amendment 2 specified the development of Amendment 3 to begin immediately to implement comprehensive, long-term management measures to achieve sustainable harvest. Management measures for Amendment 3 will be selected and implemented from the allowable total removals (landings and dead discards) that are calculated based on the fishing mortality estimates of the terminal year (2017) of the stock assessment.
- Additional quantifiable and non-quantifiable management measures, to augment the seasonal closures, will serve to improve the overall southern flounder stock to ensure total removals are reduced and southern flounder SSB and recruitment increase, while still providing flexibility for fishermen, when possible, in the timing of the harvest for the sectors. Quantifiable measures are calculable and count towards the requirements to end overfishing and rebuild the stock, while non-quantifiable measures serve as a buffer and help to prevent the expansion of harvest as the stock rebuilds.

MANAGEMENT CARRIED FORWARD

There are several management measures from Amendment 2 to carry forward into Amendment 3 to serve the purpose of addressing fishing behavior and potential changes in effort to minimize the possibility of catching southern flounder in a greater volume than predicted.

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Management measures from the Southern Flounder FMP Amendment 2 that will be clarified and carried forward in Amendment 3 are:

- A minimum distance (area dependent) between gill net and pound net sets, per NCMFC Rule 15A NCAC 03J .0103 (d).
- No greater than a recreational fishery four fish bag limit.
- A recreational minimum size limit of 15 inches Total Length (TL).
- A commercial minimum size limit of 15 inches TL.
- A minimum mesh size of 6.0-Inch Stretched Mesh (ISM) for anchored large mesh gill nets used in the taking of flounder.
- A minimum mesh size of 5.75-ISM for pound net escape panels. Reduced commercial anchored large-mesh gill net soak times to single overnight soaks where nets may be set no sooner than one hour before sunset and must be retrieved no later than one hour after sunrise the next morning.
- For anchored large mesh gill nets with a stretched mesh length of 4.0 inches through 6.5 inches; maintain a maximum of 1,500-yards in Management Units A, B, and C, and a maximum of 750-yards in Management Units D and E unless more restrictive yardage is specified through adaptive management through the sea turtle or sturgeon Incidental Take Permits (ITP).
- Removal of all commercial gears targeting southern flounder from the water (e.g., commercial and RCGL anchored large mesh gill nets and gigs) or make them inoperable (flounder pound nets) in areas and during times outside of an open season with exceptions for commercial large mesh gill net fisheries that target American and hickory shad and catfish species if these fisheries are only allowed to operate during times of the year and locations where bycatch of southern flounder is unlikely.
- Unlawful to use any method of retrieving live flounder from pound nets that cause injury to released fish (e.g., picks, gigs, spears, etc.).
- For the commercial fishery, during the closed commercial southern flounder season, it is unlawful to possess any species of flounder harvested from the internal waters of the state.

QUANTIFIABLE AND NON-QUANTIFIABLE MANAGEMENT MEASURES

Both quantifiable and non-quantifiable management measures are presented to meet the North Carolina harvest reduction for southern flounder based on the terminal year of the stock assessment (2017). Quantifiable management measures include a quota for the commercial fishery, which relies on daily quota monitoring, and a quota implemented by seasons for the recreational fishery, which serve to constrain the recreational fishery within a quota; these measures relate specifically to the stock assessment total removals and are calculable.

Additional types of management measures that are non-quantifiable are likely to be effective in reducing mortality, but the resulting reduction cannot be determined using existing data sources. Examples of non-quantifiable measures explored in this paper include certain management measures carried forward from Amendment 2 as described above, changes to trip limits in the commercial fisheries, changes to bag limits in the recreational fisheries, and a Recreational Commercial Gear License (RCGL) season. Such non-quantifiable measures are needed to

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prevent the expansion of harvest as the stock rebuilds, increasing the likelihood of rebuilding success; however, the magnitude of these management measures, as well as the possible response of the stock, is unknown.

QUANTIFIABLE MANAGEMENT MEASURES: QUOTA

For Amendment 3, a quota will be set so the TAL that establishes maximum fishing limits (in pounds) in a year for all participants so that landings do not exceed a pre-determined amount. A quota is a monitored, viable measure to achieve sustainable harvest that for North Carolina southern flounder fisheries is measured in pounds of fish. Once a quota is determined it can be divided (allocated) into different sectors (commercial and recreational fisheries), then further allocated among gears within sectors, including managing harvest with other tools such as seasons, areas, and trip limits; this is termed allocation. Allocation is the process or procedures dividing out a fixed amount of a resource as a portion or a share for each designated sub-group. In this paper, allocations of southern flounder harvest are explored based on the proportion of landings from the commercial and recreational fisheries in the terminal year of the stock assessment (2017) and within the total allowable landings to meet the 72% reduction. At a 72% reduction in total removals (observed harvest and dead discards), the TAL available for all participants across all fisheries to harvest is 532,352 pounds. The TAC for all fisheries is 548,034 pounds.

When using a quota to manage a fishery, decisions need to be made on how to split out or allocate the resource within each of the sectors and then also determine whether rollover of unused quota, payback of exceeded quota, or both will occur. Accountability measures implemented provide a means to manage the quota. A conservative approach benefits the resource by protecting any unharvested fish and not exceeding the total allowable catch. This benefits the resource but may have consequences to user groups by shortening seasons or limiting access in some areas during subsequent years. A more liberal approach to accountability measures benefits the user groups by allowing harvest of any remaining allocation during subsequent years and not requiring paybacks for any harvest over an allocation but may have consequences to the resource.

Commercial Fisheries

For all commercial fisheries combined, the quota is 390,493 pounds of southern flounder (Table 1). This is the commercial allocation of the overall quota. To ensure the commercial allocation is not exceeded but provides all sectors continued access to the resource under these restrictions, further refinement was necessary to allow an annual harvest of 195,105 pounds for mobile gears and 195,388 for pound nets to manage by areas and opening dates and stay within the overall quota. The division analyzed data to determine individual gear allocations for different areas and opening time frames, as well as data that combined some gears into one allocation for a given area. This analysis was undertaken with the understanding that increasing the complexity of management also increases the complexity of monitoring the quota, reducing the ability to effectively meet the targets to achieve sustainable harvest.

Commercial Gear Allocation

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Given the large reduction needed to achieve sustainable harvest and the importance of each allocation staying within its allowed landings, it is most practical to separate the gears into two categories: pound nets and mobile gears (including gears that target southern flounder, primarily gigs and gill nets, and “other” gears that do not target southern flounder such as shrimp trawls, crab pots, and fyke nets). Using these two categories of mobile gears and pound nets also provides flexibility by allowing fishermen to use multiple gears in a trip without having to separate catches unless a pound net is involved. Combining mobile gears into a single category prevents users from switching between the two categories or altering their behavior that may increase harvest. For example, if there is a closure for gill nets due to protected species interactions, the remaining allocation would be available for harvest using non-gill net gears within the mobile gear category.

All mobile gears have the capability to be used to harvest southern flounder throughout the year, although there is variability in their use among the individual gears. Combining mobile gears into one allocation makes monitoring the daily harvest more efficient with less risk of exceeding the annual allocation. Looking at the seasonality and movement of southern flounder, commercial gig and “other” gears could have the ability to open in the late spring or early summer to maximize the economic benefit of the market at that time. Consequences of the southern flounder gill net fishery operating in the early spring or summer include at-net mortality, creates discards of non-marketable fish, as well as post release mortality of under sized flounder. The gig fishery could open in early summer and any remaining allocation would be available for harvest by gill nets and other gears at a specific opening date later in the fall.

The commercial southern flounder pound net fishery only has the capability to operate during the fall months, beginning in late August in Albemarle Sound and ending in late November in Core Sound. Allocating harvest to the pound net fishery outside of the fall migration would not be appropriate. Flounder pound nets are stationary gears and are only actively fishing when southern flounder are migrating to the ocean. The pound net gear is most susceptible to changes in average price per pound, as the market typically drops in value October 1 due to the opening of the winter trawl summer flounder fishery.

Commercial Areas and Seasons Allocation

Because of the migratory nature of southern flounder, areas were investigated by the North Carolina Trip Ticket Program (NCTTP) waterbody locations to allow more equitable access to fishermen across the state with seasonal opening varying by area. As the weather begins to change during the fall, southern flounder migrate to estuarine waters in the south and east before moving into the ocean (Craig et al. 2015). The migration begins in the northern and western sounds and tributaries before it begins in the southern areas. As previously stated, increasing the complexity of management also increases the complexity of monitoring the quota, reducing the ability to effectively meet the targets. However, the benefit of this type of flexibility is the potential for staggered opening dates that will be determined by the director after consultation with user groups (more information on how the division will determine opening dates is available in the *Adaptive Management Issue Paper*). Staggering opening dates minimizes the chances of a “derby fishery” which forces all participants to fish at the same time ultimately

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leading to a flooded market and lower prices. Altering opening dates allows for specific areas and gears to target southern flounder when they are accessible and most valuable to fishermen with the expectation that harvest is tracked daily so the total allowable landings are not exceeded.

Analysis indicates that gear and area combinations with no more than three areas statewide would provide the best chance of success of achieving sustainable harvest through daily quota monitoring. And for some gear and area combinations two areas would allow some flexibility to the sectors and make accountability even more manageable.

Landings data for the southern flounder commercial fishery were reviewed using waterbody locations and gear type identified by the NCTTP to determine if natural breaks by area and gear occurred (NCDMF 2017b). Identification of natural breaks by waterbody and gear determines how finely the areas can be managed within each gear category. A natural break in commercial effort and landings occurs in several areas across the state, but for ease of enforcement and knowledge of existing areas by fishermen, it is beneficial to use regulatory boundaries already in place.

Dividing mobile gears into **two** areas using current boundaries would result in a northern area from the North Carolina/Virginia border south to the B-D Incidental Take Permit (ITP) boundary line in Core Sound (34° 48.2700' N latitude which runs approximately from the Club House on Core Banks westerly to a point on the shore at Davis near Marker "1") and a southern area from the 34° 48.2700' N latitude south to the North Carolina/South Carolina Border (Figure 9). Splitting mobile gears into three areas may best be approached with a northern area encompassing the Albemarle Sound and its tributaries including the Croatan and Roanoke sounds, a central area encompassing the Pamlico Sound and its tributaries, and a southern area encompassing all waters from Core Sound south (Figure 9).

Dividing the state's pound net fishery into **two** areas may best be approached with a northern area from the North Carolina/Virginia border south to the 35° 46.3000' N latitude which runs approximately from the north end of Pea Island (old Coast Guard station) westerly to a point on the shore at Point Peter Canal and a southern area from 35° 46.3000' N latitude south to the North Carolina/South Carolina border is a good break (Figure 10). Three areas for the pound net fishery would be consistent with areas already in place under Amendment 2 for this fishery and would be the same boundaries described just above for mobile gears (Figure 10).

The division determined the annual commercial quota allocations for mobile gears statewide to be 195,105 pounds and for pound nets statewide to be 195,388 pounds. The allocations are based on the 72% reduction through Amendment 2 for 2020 forward and on landings for each gear category from the terminal year of 2017 minus the 72% (Table 2). Commercial landings for mobile gears from the terminal year of 2017 (696,803 pounds) were combined and allocated by waterbody, with the exception of landings from Core Sound. Due to Core Sound being in two areas, 50% of the landings from Core Sound were counted towards the northern area and 50% were counted towards the southern area (Table 2). Commercial pound net landings from the terminal year of 2017 (697,814 pounds) were allocated to each waterbody within the areas and then reduced by 72%.

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Landings data for the southern flounder commercial fisheries were evaluated to determine how landings and price per pound fluctuated during the year. This helped to identify what time frames would allow for the most productive fishery, while minimizing discard mortality and meeting the necessary reductions. Commercial landings remain low through the majority of the first half of the year and begin to increase in late summer and peak in October and early November (Figure 11).

Southern flounder landings vary by location, month, and gear but typically increase in the Albemarle Sound area (northern) in early September, Pamlico Sound (central) in mid-to-late September, and Core Sound and south (southern) by October. Due to these variations in seasonal landings by gear and area, landings were analyzed to show the weekly rate of harvest as a percent to the total average landings from 2008 to 2017 (Figures 12 and 13). This analysis shows harvest rates through the year for each gear category statewide and by area as identified in Figures 9 and 10. One exception is in the southern portion of the state where the commercial gig fishery harvests flounder beginning in early summer (Figure 12). What this analysis shows is in the estimates for mobile gears the gig fishery drives the harvest in the summer for the southern area. Combining all mobile gears into a single group would allow for flexibility in determining opening dates for gears within the larger category, possibly allowing a gig fishery to operate during these summer months when the fish are available. In addition to seasonal information, effort data, environmental changes, ITP constraints, and quota monitoring requirements all provided information for the division to select management areas, opening dates, and gear combinations.

Combining all mobile commercial gears into one category split between two areas of the state, with each area having its own mobile gear allocation will provide the most flexibility to accommodate opening dates within an area based on southern flounder movements. Dividing the pound net fishery into three areas will allow the timing of the openings to this gear to be more relevant to their geographic locations. Since pound nets are a stationary gear, areas to further split the allocation will accommodate some flexibility on opening dates based on southern flounder movements. But there will be consequences of impacting individual areas and gears disproportionately that should be noted within all these added layers to the allocation of the quota.

Commercial Accountability Measures

For the commercial fishery, paybacks due to overages of an allocation for a particular year from landings and dead discards would be applied to the responsible gear and area combination, meaning overages would be subtracted from the following year's allocation for that gear and area combination. These overages will be applied on a pound for pound basis. Any unused allocation or rollover would not be added to the subsequent year's allocation and would serve as a benefit to the resource and potentially decrease the time for rebuilding. The final total of pounds landed (including bycatch estimates for the gill net fishery) from a year's harvest will be determined through verification of the quota monitoring forms and NCTTP landings data. It is important to restate that it is not the individual gear and area allocations that are driving management, rather it is the overall quota. NCDMF will do what is necessary to maintain landings to meet the needs of rebuilding of the stock. Flexibility in managing each gear and area combination is necessary for the overall success of a quota system; see *Adaptive Management Issue Paper* for further flexibility in developing long-term management measures.

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Division staff will monitor the quota on a daily basis in order to prevent landings becoming so large that the quota will be exceeded and the stock will continue to be overfished. When the sum of the daily reporting for an area and gear combination approaches approximately 80% of the allocated landings, the division will issue a proclamation immediately closing the gear and area combination to the harvest of southern flounder. The mechanism for closing the southern flounder commercial fishery is through NCGS 113-221.1 (b) and rule 15A NCAC 03M .0503 that provide the director proclamation authority to immediately close a fishery that is monitored by a quota. Closure under this rule does not require a 48-hour notice and can be issued effective immediately. This may be necessary to prevent additional overfishing as certain gear area combinations can harvest a large percentage of the commercial quota if left unchecked.

Daily quota monitoring of the commercial fisheries will be key in maintaining a long-term sustainable harvest of the southern flounder stock. A quota in combination with area, season openings, and trip limits for some gears will also provide access to the fish as they migrate through the sounds and into the ocean and maintain some buffer to reduce the potential for overages in the quota.

If remaining allocation is available the division may reopen the gear and area combination for a short window to provide opportunity to harvest the remaining allocation; however, if the remaining allocation is not practical to manage while ensuring an overage will not occur, the fishery in question will not be reopened. This reopening may include trip limits, for gears where this type of management would not increase dead discards, as an additional regulation to prevent any overage of the allocation.

For gears where trip limits are not a viable option, like gill nets, the division may open the fishery daily. Daily openings may prove futile in keeping landings within an allocation and may not be a good option to use; the remaining allocation could be made available for other gears within the mobile gears category in this case; however, if the remaining allocation is not practical to manage while ensuring an overage will not occur, the fishery in question will not be reopened.

Recreational Fisheries

For the recreational fisheries, hook and line and gigs, the quota is 141,859 pounds of flounder. This is the recreational allocation of the quota. To ensure the recreational allocation is not exceeded but provides both sectors continued access to the resource under these restrictions, the allocation will be further refined to allow an annual harvest of 126,315 pounds for the hook-and-line fishery and 15,544 pounds for the recreational gig fishery, or 141,859 pounds total for all recreational fisheries (Table 1). The ability to monitor a recreational quota in real time is possible with a well-designed creel survey specific to the species and covering the geographic range of harvest and gears. The division relies on the MRIP, in which southern flounder is a species encountered regularly in the hook and line recreational fishery. The survey design of MRIP does not allow for results on a daily or weekly basis as it is not specific to southern flounder. Instead, results are available by two-month waves, months after the data are collected. As a result, historical catch data must be used to predict future catch rates. Once the level of harvest for each reduction value was identified, catch from the MRIP was analyzed by two-week increments (the

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finest level of detail available) and summed to determine seasonal dates the fishery could operate while meeting the necessary reduction (Table 3).

While the recreational hook and line fishery is monitored through the MRIP this program does not collect necessary information to provide estimates for the recreational gig fishery. Due to this, the division conducts an annual mail survey for gig fishery effort and harvest estimates (see the *Description of the Fishery* section for additional details on MRIP and the Recreational Gig survey).

Recreational use of limited commercial fishing gears is allowed in North Carolina and is subject to the same reductions as the other recreational and commercial fisheries. RCGL holders primarily use large mesh gill nets to harvest southern flounder but may occasionally harvest flounder from shrimp trawls and crab pots. The collection of RCGL harvest data has not occurred since 2008 and is not reliable for estimating reductions due to multiple management changes since the survey ended. See the section on the Description of the Fisheries for trends in the RCGL fishery.

The use RCGL gear is only allowed when both the recreational and commercial fisheries are open for the particular gear, and the user can only harvest recreational limits. Due to these requirements, the only measures available for harvest of flounder using a RCGL is during a period of time when the commercial and recreational fisheries are open simultaneously or prohibiting their use.

The limitations in monitoring for the recreational southern flounder fisheries allows for less flexibility in management measures to ensure the recreational allocation of 141,859 pounds is not exceeded. Final estimates of recreational harvest are not available until the season ends, so it is unknown how real time accounting of catch cannot be determined for underage or overage to the sector allocation. To complement a seasonal approach to the allocations, further non-quantifiable measures such as bag limits and allowable RCGL harvest are considered, as maintaining the four fish daily bag limit allows for harvest just above the maximum required under the current season. These additional management tools are needed to increase the likelihood of meeting required reductions in the recreational fisheries and are discussed below.

Further discussion on species-specific management measures are considered and presented in the *Increased Recreational Access Issue Paper*.

Recreational Season Allocation

With the 72% reduction, the recreational hook and line fishery is allocated 126,315 pounds of southern flounder annually (Table 1 and 3). With the current four fish bag limit the identified season of August 16 through September 30 does not meet the reductions when combined with the inability to provide estimates of gig harvest and discards at reduced bag levels and the potential additional harvest from an ocellated season (See *Increased Recreational Access Issue Paper*). As a result, a reduction in bag limit is discussed in detail later. Seasonal allocation results in a quota that is validated using MRIP landings only after the season has closed. In North Carolina, the previous years' MRIP landings are available by mid-April of the following year.

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Gig harvest accounted for 11% of the recreational landings in 2017. The recreational gig fishery under the 72% reduction is allocated 15,544 pounds of landings (Table 1). It is necessary to maintain concurrent seasons for the recreational hook and line and gig fisheries to keep from undermining the success of achieving necessary reductions (Table 4). Allowing a gig fishery to operate longer than the recreational hook and line fishery would allow excess harvest from the gig fishery that would exceed the gig allocation. In addition, if the gig fishery and the hook and line fishery operated during independent seasons it would allow anglers to alter normal behavior by taking advantage of each of the seasons increasing effort and thus harvest on an already limited allocation.

When the recreational fishery is closed, recreational harvest of flounder in both internal and ocean waters will be unlawful as all flounder species (southern, summer, Gulf) are managed collectively in North Carolina. Other measures may be available to allow for species specific management (see *Increased Recreational Access Issue Paper*).

Recreational Accountability Measures

Accountability measures will also be necessary for the recreational hook and line and gig fisheries. The final recreational total catch will be determined by adding the total landings from the MRIP and GIG surveys to the estimates of dead discards. To account for overages from landings and dead discards by adjusting the following year's recreational quota and season, based on the results of the MRIP and gig mail surveys from the previous year. Using the conservative approach described in the commercial accountability measures, any remaining allocation will not be rolled over to subsequent years. These data are typically available by mid-April for the previous calendar year, can be calculated quickly, and are expected to be finalized prior the usual recreational season, assuming the season does not open prior to June 1. For the recreational fishery, final total of pounds harvested from a year's harvest, discard estimates, and estimates of number of trips will be determined through verification of the final MRIP and gig mail survey.

A set annual quota is also the most appropriate tool for the recreational fisheries to maintain sustainable harvest but is more challenging to track for every single trip and harvest data is only available in two-month intervals with delays in verification. Instead, a season for the recreational fisheries that will maintain the allocation within its bounds may be the most reasonable approach. Due to a high level of discards in the recreational hook and line fishery, there is concern that the volume of discards can have a large direct impact on subsequent seasons if anglers continue to target and release southern flounder during closed seasons. As recreational hook and line discards are not monitored through a quota and are not available until after the season is complete. It is important to restate that it is not the individual gear allocations that are driving management, rather it is the overall quota. Additional measures can be implemented in concert to further refine harvest management to limit impacts due to overages while the fishery is recovering. This approach does limit angler access during periods of no harvest, but it does not stop the unintended consequences of large volumes of discards through indirect hooking while targeting other species. Unintended discards are a major source of removals in the southern flounder recreational fishery (NCDMF 2019a; Flowers et al. 2019).

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OTHER NON-QUANTIFIABLE MANAGEMENT MEASURES

Non-quantifiable measures are those that are not directly part of the stock assessment model and there is no way to measure the impact to the modelled fishing mortality. This does not mean that these non-quantifiable measures are not important to consider in management, they merely are not able to be included in the percent reduction needed to end overfishing/overfished status as statutorily required. If non-quantifiable measures are implemented, future stock assessments will indirectly reflect their effect on the fishery status. The non-quantifiable management measures under consideration include trip limits in the commercial fisheries and bag limits in the recreational fisheries as a means to control effort in the fishery. Since specific impacts on recruitment and overfishing cannot be calculated, relevant empirical data for the various measures are presented herein. Earlier in the discussion section, the management carried forward was described. In addition to those non-quantifiable management measures carried forward, there are other non-quantifiable management measures to consider.

Commercial Fisheries Trip Limits

In the southern flounder commercial fishery, the use of a trip limit may be useful to maintain the quota allocation in the gig and pound net fisheries, but is not ideal for the gill net fishery due to the potential for increased dead discards. Unlike gigs or pound nets where commercial fishermen can selectively harvest flounder or release captured flounder with a high rate of survival, gill nets although selective for sizes of fish they cannot select for volume of fish entangled. Due to this, any fish entangled in a gill net that is over a trip limit would be released with a higher rate of discard mortality increasing the pounds of removals and impacting the overall quota. To calculate trip limits for the gig and pound net fisheries, average landings for the past 10 years by proposed areas were reviewed in conjunction with the numbers of trips with landings in varying poundage increments for each area based on the 10-year average for that fishery. For the gig fishery, a trip limit in numbers of fish, not pounds, is needed for the trip limit to be enforceable. To calculate this, the pounds harvested were converted to numbers of fish based on an average of 2.56 pounds per gilled fish as determined from commercial fish house sampling.

Trip limits for the commercial pound net and gig fisheries cannot be determined at this time, because trip limits may change depending on the fishery and how many pounds are available to harvest. The director will determine the trip limit amounts dependent upon how close the fishery is to their allocation and what the overall daily harvest amounts have occurred already in the season. Information is available to identify the volume of trips that remove southern flounder based on various intervals to provide some guidance (Table 5; Table 6). There are concerns with a trip limit for the pound net fishery, particularly if set too low. Because southern flounder can be held in pound nets, it is possible for fishermen to hold southern flounder until they can be landed. Multiple people can harvest from a single operation in order to land the fish available. If the pound net trip limit is set too low, safety becomes a consideration as well and fishermen may be forced to fish their sets in unfavorable weather conditions; currently, sets are fished on good weather days, not every day. Understanding these short comings in the pound net fishery, a trip limit would allow harvest of southern flounder while minimizing dead discards as discards from pounds nets are assumed to have a high survival rate. Allowing the gig fishery additional landings within the allocation using trip limits on the remaining quota will allow harvest and

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minimize discards as the gig fisherman can stop harvesting fish when the daily limit is reached. A trip limit for the gill net fishery creates additional discards, as once their trip limit has been reached, remaining gear soaking will capture fish in excess of the specified trip limit and be released with an estimated mortality of 23%. Additional information on trip limits can be found in the *Adaptive Management Issue Paper*.

Recreational Fisheries Bag Limits

Potential changes to bag limits for all recreational gear were evaluated. Reductions in recreational bag limits may increase the likelihood of meeting required reductions as the stock rebuilds. The daily bag limit for flounder currently is set at four fish, the average angler success rate for a single trip is one harvestable southern flounder (Figure 14, Figure 15). During 2017, recreational anglers released nine southern flounder for every one southern flounder that was harvested (Figure 7.10 in *Description of the Fishery Section*). Angler success rates are tied to stock size (fish availability) and minimum size limits. As stock abundance increases during the rebuilding period, it is likely angler success will increase as well. If angler success improves, any gains achieved through limited open seasons will be lessened, limiting the actual recovery of the species. Harvest must be constrained using multiple measures in the recreational fisheries while rebuilding occurs.

Reducing the southern flounder bag limit would minimize the impacts of increased angler success on the rebuilding stock. Current data shows that recreational anglers usually only harvest one fish in a daily trip although there is a four fish daily bag limit above the minimum size limit. A reduction from four fish to three fish or from four fish to two fish daily bag limit does not curtail actual harvest (Table 3). Dropping the recreational bag limit for flounder to zero fish still results in dead discards of over 50,000 pounds for all identified potential season dates by anglers who are not targeting southern flounder and happen to catch and release some (Table 3). If angler success increases during the rebuilding time period, the volume of removals could increase relative to the original reduction calculations (Figure 15). If angler success doubles, which would be a two fish daily harvest limit, paybacks from overharvest have the potential to severely curtail continued recreational angling opportunities as the stock recovers (Figure 16). Limiting the potential future harvest during times of increased abundance will allow the stock to rebuild making further bag limits necessary to constrain recreational harvest to meet the required reductions.

Additional discussion of bag limits and the potential for increased angler opportunities through species specific management of summer, southern, and Gulf flounder can be found in the *Increased Recreational Access Issue Paper*.

Recreational Commercial Gear

Recreational use of limited commercial fishing gears is allowed by law in North Carolina and is subject to the same reductions as the other recreational and commercial fisheries. Calculating reductions for the RCGL fishery is not possible because collection of RCGL harvest data has not occurred since 2008. Data collected in 2008 and prior may not be reliable for estimating

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reductions for Amendment 3 due to multiple management changes that have also occurred since the surveys ended. See *Description of the Fishery Section* for trends in the RCGL fishery

Recreational gear license holders primarily use large mesh gill nets to harvest southern flounder but may occasionally harvest flounder from shrimp trawls and crab pots. The use of commercial gears for recreational purposes is also only allowed during concurrently open recreational and commercial fishing seasons that allow the specific gear, and the user is only allowed harvest that does not exceed the recreational limits. Due to these requirements, the only measures available for harvest of flounder using a RCGL is during a period of time if and when the commercial and recreational fisheries are open simultaneously or prohibit the use of the RCGL for the harvest of southern flounder.

The volume of removals cannot be estimated for RCGL gears, but the number of license holders has continually declined from 6,055 participants in 2000 to a low of 1,662 participants in 2017 (additional information on RCGL can be found in the Description of the Fishery section). Amendment 2 provides minimal opportunity to fish RCGL gears targeting southern flounder when both the recreational and commercial seasons are open. In addition, if the bag limit for recreational harvest is reduced, the resulting change could also further limit the impacts of the RCGL fishery. If harvest of southern flounder is prohibited from RCGL gear, then an increase in discards will occur if these gears continue in targeting other non-flounder species.

CONCLUSION

Certain measures are better to attain the goal to maintain sustainable harvest at the much-reduced harvest levels than others, while other measures provide more flexibility to benefit the sectors both in access to the resource and for higher economic value. Below we expand on the key measures that are the most risk adverse in that having the most likelihood of succeeding in maintaining sustainable harvest while providing some flexibility in access to the resource for all sectors in the fisheries.

A summary of the key decision choices that are discussed as potential management measures in this paper are found in Tables 7 and 8.

VI. PROPOSED MANAGEMENT OPTIONS

Management Options

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

Below are overarching positive and negative impacts for all options, specific impacts from an option may be found below that option.

- + May increase the abundance of female southern flounder helping to rebuild the spawning stock
- + Will impact both the commercial and recreational fisheries
- + No rule changes required
- Decreased harvest and economic impacts

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1. IMPLEMENT A QUOTA FOR MOBILE GEARS AND POUND NETS

The following positive and negative impacts apply to all option 1; specific impacts are listed with each sub-option

- + Reduces potential for increased error in dealer reporting
- + Allows individuals to fish and report multiple gears per trip
- + Reduces the ability for fishermen to switch from gear to gear
- + Meets the requirements for rebuilding
- + If gill net fishing is closed due to ITP, then allocation would be available to other gears in combined category
- + Would allow fishermen to explore alternate fishing gears to reduce bycatch
- /+ Could allow for different opening dates
- Seasonal selections may impact landings from certain gears and locations more than others
- The more gears and areas are divided, the more complex monitoring becomes and we will be less likely to meet targets
- May slow rebuilding if fish are continued to be harvested

1.1A. Dividing the states mobile commercial gears into two areas using the ITP Boundary line for management units B-D.

- + Meets requirements for reductions
- + Maintains consistency for gill net ITP boundary lines
- + Allows flexibility in opening dates for each area
- Some regions may be impacted more than others
- Some gears may be impacted more than other
- More areas make monitoring the daily landings more difficult
- May shift fishing effort and alter behavior

1.1B. A single statewide mobile commercial gear allocation that includes all coastal estuarine waters.

- + Single allocation area is easiest to monitor
- + Combining mobile gears makes reporting by dealers easier
- + Equal access to commercial fishers
- + Meets requirements for reductions
- Seasonal selection may impede landings in certain locations

1.1C. Dividing the states mobile commercial gears into three areas (northern, central, and southern)The northern area would encompass the Albemarle Sound and its tributaries including the Croatan and Roanoke sounds, the central would encompass the Pamlico Sound and its tributaries, and the central would encompass all waters from Core Sound south matching the boundaries described for the pound net fishery 3 area option 2.2A.

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- + Meets requirements for reductions
- Some regions may be impacted more than others
- Some gears may be impacted more than other
- Enforcement issues through increased boundaries not consistent with current ITP lines
- More areas makes monitoring the daily landings more difficult
- More areas increase complexity for dealers daily reporting

1.2A. Dividing the state's pound net fishery into three areas maintaining consistency with areas in Amendment 2

- + Meets requirements for reductions
- + Allows flexibility for different opening dates for each area
- + Maintains consistency with Amendment 2 boundaries
- Some regions may be impacted more than others
- Some fishermen may have pound nets in multiple areas
- More areas make monitoring the daily landings more difficult

1.2B. A single statewide pound net allocation.

- + Meets requirements for reductions
- + Makes monitoring the daily landings more easy
- No flexibility in opening dates
- Availability of fish varies across the state, may impact some areas more depending on when fishery is open

1.2C. Dividing the states pound net fishery into two-areas using the 35° 46.3000' N latitude

- + Meets requirements for reductions
- Some fishermen may have pound nets in multiple areas
- Availability of fish varies across the state, may impact some areas more depending on when fishery is open

2. RECREATIONAL QUOTA

- + Meets requirements for reductions
- + Consistent with Amendment 2
- + Should limit removals and allow rebuilding of the stock
- + Allows for continued access to stock during rebuilding
- Several month delay to receive final estimates after season ends due to MRIP data availability
- Reduces access to anglers during closed seasons
- Difficult to account for angler behavior changes
- Does not stop indirect discards while targeting other species
- Does not limit future harvest during times of increased abundance from rebuilding

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- May slow rebuilding if fish are continued to be harvested

3. COMMERCIAL FISHERIES TRIP LIMITS

The following positive and negative impacts apply to all option 3; specific impacts are listed with each sub-option

- + Allows for maximizing available allocations
- + Meets requirements for reductions
- May create additional discards if the trip limits are set to low
- Pound nets will have fish in pounds that non-permit holders may access

3A. Implement trip limits for pound nets and gigs only to maximize reopening after reaching division closure threshold

- + Can be effective for gears with limited discard mortality
- Any SCFL or RSCFL holder can fish a permitted pound net with permission; a single net could distribute fish to multiple SCFL/RSCFL holders that normally would not use that gear

3B. Implement trip limits for all commercial gears

- + May limit harvest from non-targeted gears as the stock recovers
- + May alleviate concerns of a derby fishery
- Not effective for gears where discard mortality is high (gill nets)
- May force fishermen to fish in unfavorable weather

4. RECREATIONAL FISHERIES BAG LIMITS

The following positive and negative impacts apply to all option 4; specific impacts are listed with each sub-option

- + Meets requirements for reductions
- Decreases potential access to recreational anglers
- May increase discards

4A. Reduce recreational bag limit of flounder to one fish per person per day.

- + Provides the greatest chance of rebuilding and maintaining growth in the stock
- + May allow for quickest rebuilding of spawning stock biomass
- + May limit harvest during times of increased abundance from rebuilding
- May slow rebuilding if fish are continued to be harvested

4B. Reduce recreational bag limit of flounder to three fish per person per day.

- + Reduces harvest for anglers who were successful at catching three flounder per trip

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- Does not limit future harvest during times of increased abundance from rebuilding
- May delay rebuilding of spawning stock biomass

4C. Reduce recreational bag limit of flounder to two fish per person per day.

- + Reduces harvest for anglers were successful at catching two flounder per trip
- Does not limit future harvest during times of increased abundance from rebuilding
- May delay rebuilding of spawning stock biomass

5. RECREATIONAL COMMERCIAL GEAR

5A. Allow the RCGL to be used to harvest flounder only during a period of time when the commercial and recreational fisheries are both open.

- + Consistent with Amendment 2
- + Allows continued access to fishery
- Cannot account for harvest or discards from RCGL gear
- May increase discards if gear is allowed and bag limits are reduced

5B. Prohibit the use of RCGL for the harvest of southern flounder.

- + Eliminates harvest from RGCL gears
- Removes access to fishery for license holders
- May increase discards if species cannot be harvested but gear is still allowed

VII. RECOMMENDATIONS

*NCDMF Initial Recommendation**

- Set an annual harvest quota for the commercial and recreational sectors with further refinements in how the harvest will be constrained for each.

Commercial Fisheries:

- Combine mobile gears (gill nets, gigs, and “other” gears) into one gear category and maintain pound nets as their own separate commercial fishery.
- Divide mobile gears into two areas using the ITP Boundary line for the gill net management units B-D (Figure 8).
- Divide the pound net fishery into three areas maintaining consistency with areas in Amendment 2 (Figure 9).
- Implement trip limits for pound nets and gigs only to maximize reopening after reaching division closure threshold.

Recreational Fisheries:

- Implement seasons for the recreational gig and hook and line fisheries to constrain them to an annual quota.

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- Reduce the recreational bag limit of flounder to one fish per person per day.
- Allow the RCGL to be used to harvest flounder only during a period of time when the commercial and recreational fisheries are both open.

**Includes management measures and clarifications in the carried forward from Amendment 2.*

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Table 1. Southern Flounder total allowable catch (TAC) and Total Allowable Landings (TAL) in pounds to meet the necessary reductions for the overfishing threshold and SSB threshold and target of the commercial and recreational fisheries.

Percent Reduction from 2017 Terminal Year	Commercial Fisheries					Recreational Fisheries*			
	Total Catch	Dead Discards	Total Landings	Total Commercial Landings	Mobile Gears	Pound Nets	Total Recreational Landings	Hook and Line	Gigs
2017	1,957,264	56,008	1,901,256	1,394,617	696,803	697,814	506,639	451,126	55,513
52%	939,487	26,884	912,603	669,416	334,465	334,951	243,187	216,540	26,646
62%	743,760	21,283	722,477	529,954	264,785	265,169	192,523	171,428	21,095
72%	548,034	15,682	532,352	390,493	195,105	195,388	141,859	126,315	15,544

*Recreational commercial gear harvest is unknown since 2008 and could not be quantified in the reductions.

Table 2. Southern flounder commercial fishery allocations in pounds by gear and location. Corresponding maps showing the boundaries for each area by gear are identified in Figures 8 and 9.

Commercial gear	Area/Allocation (pounds)			Total allocation (pounds)
Mobile gears	Northern	Southern		195,105
	129,812	65,293		
Pound nets	Northern	Central	Southern	195,105
	49,337	68,485	77,283	
Pound nets	Northern	Southern		195,388
	41,601	153,787		
Pound nets	Northern	Central	Southern	195,388
	41,601	127,588	26,199	

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Table 3. Seasons identified to reach the SSB target of the NC recreational hook-and-line fishery quota (observed harvest) in pounds at the current four fish bag limit based on average landings from 2008-2017.

	Percent Reduction		Landings (lb)			
Terminal Year	2017		451,126			
Target (TAL)	72%		126,315			
Season	Percent Reduction 4 fish bag limit	Percent Reduction 1 fish bag limit	Landings (lb) 4 fish bag limit	Landings (lb) 3 fish bag limit	Landings (lb) 2 fish bag limit	Landings (lb) 1 fish bag limit
no closure	0%	26%	451,126	428,594	400,502	332,075
Apr 16 -Jun 30	76%	78%	109,157	107,657	105,569	100,911
May 1 -Jun 30	77%	79%	102,622	102,622	99,249	94,985
Jun 1 - Jul 15	75%	79%	110,702	109,102	106,836	102,184
Aug 16 - Sept 30	72%	74%	127,706	125,359	123,267	118,071

Table 4. Seasons identified to meet the quota (observed harvest) to reach the SSB target of the NC recreational gig fishery landings (observed harvest) at the current four fish bag limit based on average landings from 2010-2017.

	% Reduction	Landings (lb)
Terminal Year	2017	55,513
Target (TAL)	72%	15,544
Season	% Reduction	Landings (lb)
no closure	0%	85,688
Jul 1 - Sept 30	40%	33,532
Jul 16 - Sept 30	50%	28,060
Jul 1 - Sept 15	50%	27,711
Aug 1 - Sept 30	60%	22,587
Aug 16 - Sept 30	70%	17,115

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Table 5. Commercial southern flounder pound net trip limit scenarios (in pounds), including the number and cumulative of % trips, and % harvest within each trip limit bounds, September through November, 2008-2017.

Pounds Per Trip	Management Area									
	Northern					Central				
	Number of Trips	% of Trips	Cumulative Trip %	% of Harvest	Cumulative Harvest %	Number of Trips	% of Trips	Cumulative Trip %	% of Harvest	Cumulative Harvest %
<251	1,633	65%	65%	8%	8%	4,173	51%	51%	11%	11%
251-500	291	12%	77%	8%	16%	1,533	19%	70%	14%	24%
501-750	159	6%	83%	7%	24%	794	10%	80%	12%	36%
751-1,000	86	3%	87%	6%	29%	518	6%	86%	11%	47%
1,001-1,250	63	3%	89%	5%	34%	315	4%	90%	9%	56%
1,251-1,500	43	2%	91%	5%	39%	212	3%	93%	7%	63%
1,501-2,000	66	3%	93%	8%	47%	252	3%	96%	11%	74%
2,001-3,000	63	3%	96%	11%	59%	209	3%	98%	12%	86%
3,001-4,000	36	1%	97%	10%	68%	76	1%	99%	6%	92%
4,001+	66	3%	100%	32%	100%	59	1%	100%	8%	100%
Average Pounds Per Trip	539					503				
Pounds Per Trip	Management Area									
	Southern					Statewide				
	Number of Trips	% of Trips	Cumulative Trip %	% of Harvest	Cumulative Harvest %	Number of Trips	% of Trips	Cumulative Trip %	% of Harvest	Cumulative Harvest %
<251	1,850	66%	66%	18%	18%	7,656	57%	57%	11%	11%
251-500	420	15%	81%	15%	33%	2,244	17%	74%	13%	24%
501-750	197	7%	88%	13%	46%	1,150	9%	82%	11%	35%
751-1,000	123	4%	92%	12%	57%	727	5%	88%	10%	45%
1,001-1,250	63	2%	94%	7%	64%	441	3%	91%	8%	52%
1,251-1,500	40	1%	96%	6%	70%	295	2%	93%	6%	59%
1,501-2,000	48	2%	98%	9%	78%	366	3%	96%	10%	69%
2,001-3,000	40	1%	99%	10%	89%	312	2%	98%	12%	81%
3,001-4,000	20	1%	100%	7%	96%	132	1.0%	99%	7%	88%
4,001+	9	0%	100%	4%	100%	134	1.0%	100%	12%	100%
Average Pounds Per Trip	344					475				

Note: Rounding of values may cause cumulative percentages to differ slightly.

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Table 6. Commercial southern flounder gig fishery trip limit scenarios (in number of fish) for the, including the number and cumulative % of trips, and % of harvest within each trip scenario, 2008-2017.

Number of Fish	Number of Trips	% of Trips	Cumulative Trip %	% of Harvest	Cumulative Harvest %
25	17,288	74%	74%	44%	44%
50	4,504	19%	94%	33%	77%
75	941	4%	98%	12%	89%
100	324	1%	99%	6%	95%
125	92	0%	100%	2%	97%
150	32	0%	100%	1%	98%
175	19	0%	100%	1%	99%
200	23	0%	100%	1%	100%
<hr/>					
Average Pounds Per Trip	52				

Note: Rounding of values may cause cumulative percentages to differ slightly.

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Table 7. Summary of quantifiable management measures for Amendment 3.

Management Option	Management Sub-option	Management Measure	Gear	# Management Areas	Description	Location/Allocation (Pounds)			Quota
1	1.1A	Commercial Quota	All gear other than pound nets	2	Division at the ITP B-D Boundary Line	Northern: 129,812	Southern: 65,293		195,105
1	1.1B	Commercial Quota	All gear other than pound nets	1	Statewide	Statewide: 195,105			195,105
1	1.1C	Commercial Quota	All gear other than pound nets	3	Same areas as Amendment 2	Northern: 49,337	Central: 68,485	Southern: 77,283	195,105
1	1.2A	Commercial Quota	Pound Nets	3	Same areas as Amendment 2	Northern: 41,601	Central: 127,588	Southern: 26,199	195,388
1	1.2B	Commercial Quota	Pound Nets	1	Statewide	Statewide: 195,388			195,388
1	1.3C	Commercial Quota	Pound Nets	2	Division at approximately Pea Island	Northern: 41,601	Southern: 153,787		195,388
2	2	Recreational Quota (through season)	Hook and Line, Gigs	1	Statewide	Hook and Line: 126,315	Gig: 15,544		141,859

Table 8. Summary of Non-quantifiable management measures for Amendment 3.

Management Option	Management sub-option	Management Measure	Description
3	3A	Commercial Fishery Trip Limits	Implement trip limits for pound nets and gigs only to maximize potential opportunities for reopening a fishery to harvest remaining allocation
3	3B	Commercial Fishery Trip Limits	Implement trip limits for all gears
4	4A	Recreational Fishery Bag Limits	Reduce recreational bag limit of flounder to one fish per person per day
4	4B	Recreational Fishery Bag Limits	Reduce recreational bag limit of flounder to three fish per person per day
4	4C	Recreational Fishery Bag Limits	Reduce recreational bag limit of flounder to two fish per person per day
5	5A	Recreational Commercial Gear	Allow the RCGL to be used to harvest flounder only during a period of time when the commercial and recreational fisheries are both open
5	5B	Recreational Commercial Gear	Prohibit the use of RCGL to harvest southern flounder

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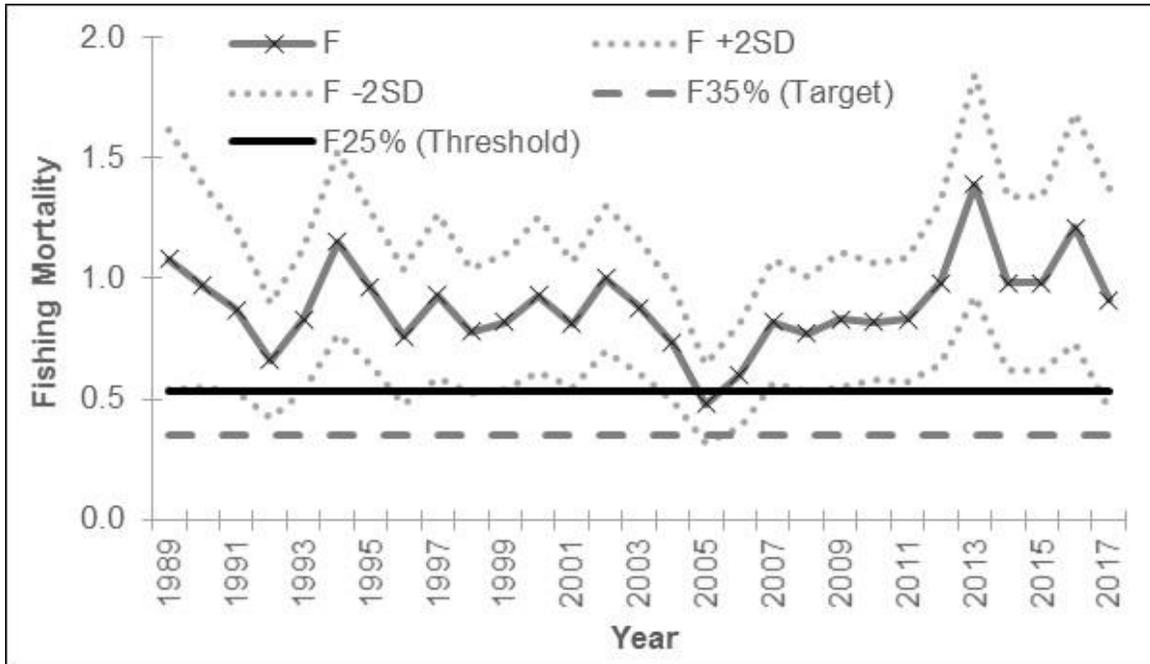


Figure 1. Estimated fishing mortality rates (numbers-weighted, ages 2–4) compared to established reference points, 1989–2017. Source: Flowers et al. 2019.

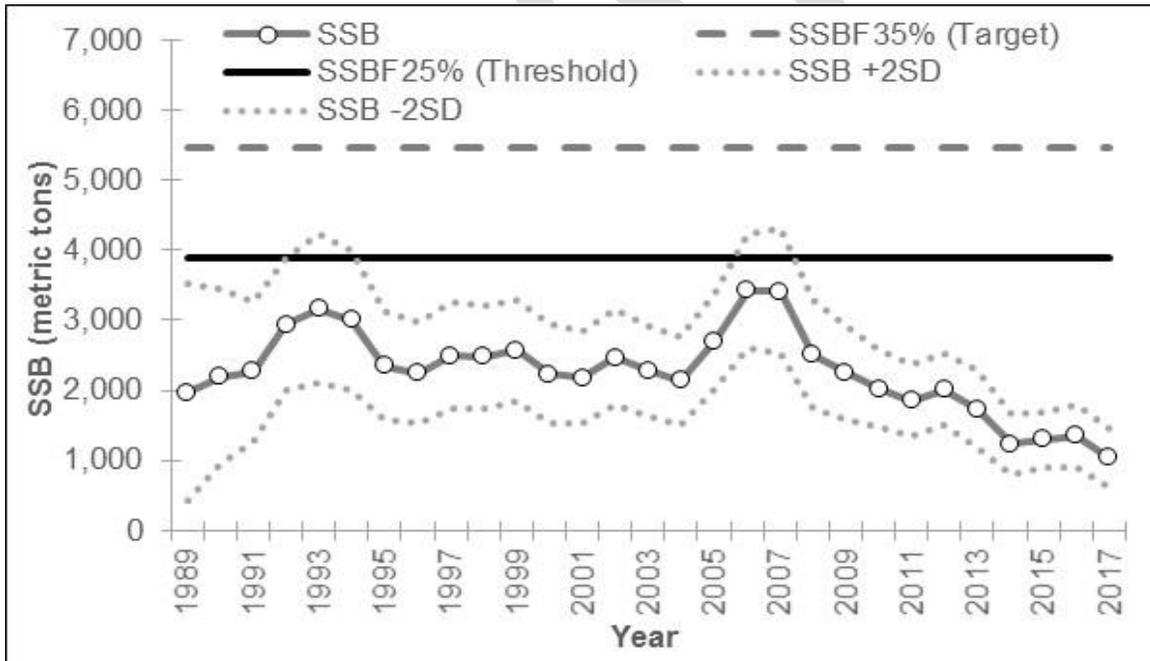


Figure 2. Estimated spawning stock biomass compared to established reference points, 1989–2017. Source: Flowers et al. 2019.

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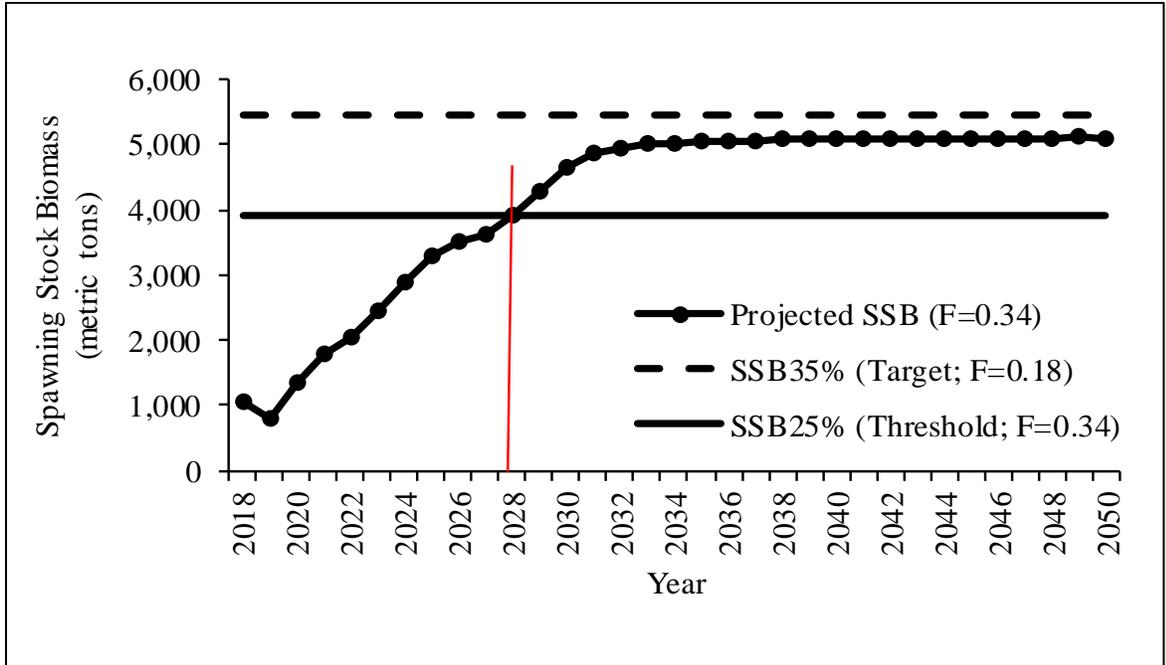


Figure 3 Predicted future spawning stock biomass (metric tons) assuming the fishing mortality value ($F_{25\%} = 0.34$; 52% reduction in total removals) necessary to end the overfished status ($SSB_{Threshold}$) by 2028 (indicated by vertical red line). Source: Flowers et al. 2019.

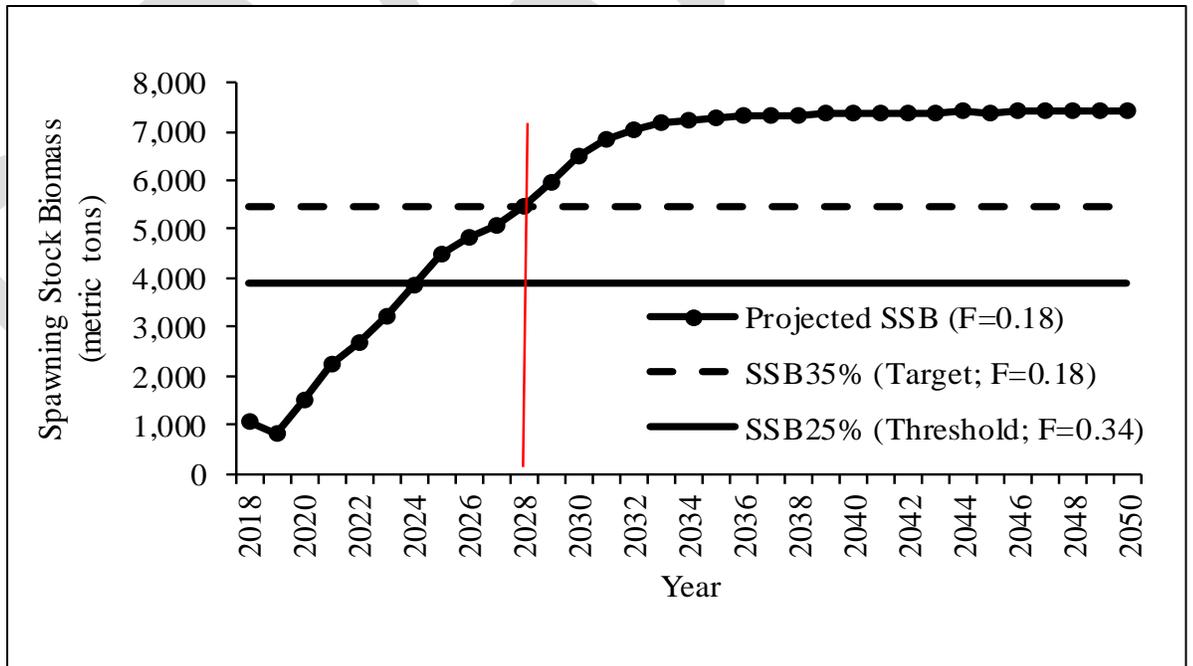


Figure 4. Predicted future spawning stock biomass (metric tons) assuming the fishing mortality value ($F_{35\%} = 0.18$; 72% reduction in total removals) necessary to reach the SSB_{Target} by 2028 (indicated by vertical red line). Source: Flowers et al. 2019.

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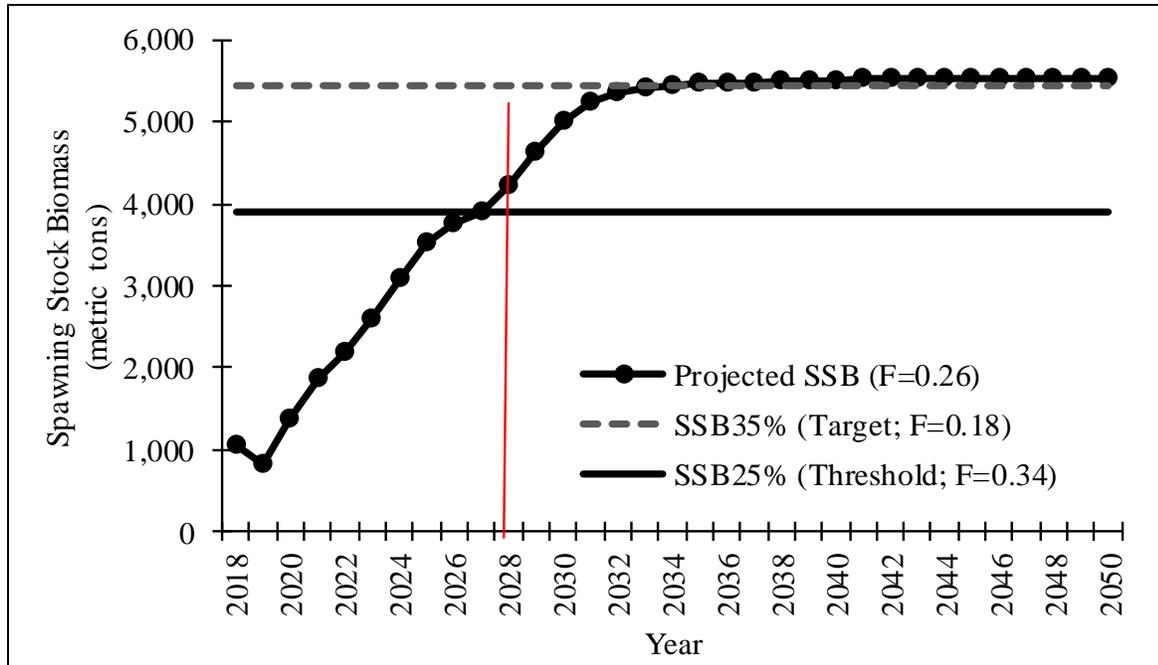


Figure 5. Predicted future spawning stock biomass (metric tons) assuming the fishing mortality value ($F=0.26$; 62% reduction in total removals) necessary to reach between the SSB_{Target} and $SSB_{Threshold}$ by 2028 (indicated by vertical red line). Source: Flowers et al. 2019.

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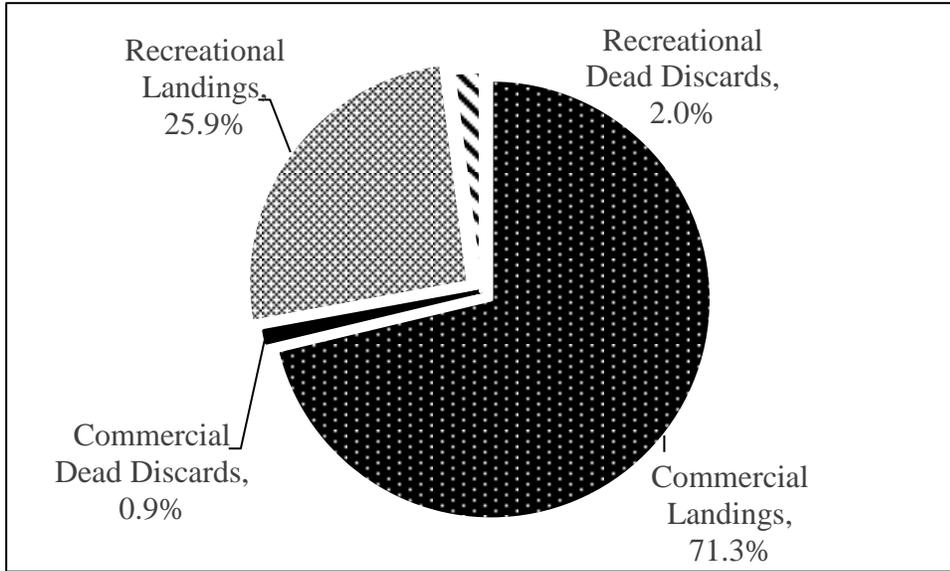


Figure 6. Contribution of the total removals (observed harvest and dead discards in percent pounds) for the commercial and recreational (hook and line and gig) fisheries in North Carolina, 2017. Source: North Carolina Trip Ticket Program, Marine Recreational Information Program, NCDMF Gig Mail Survey.

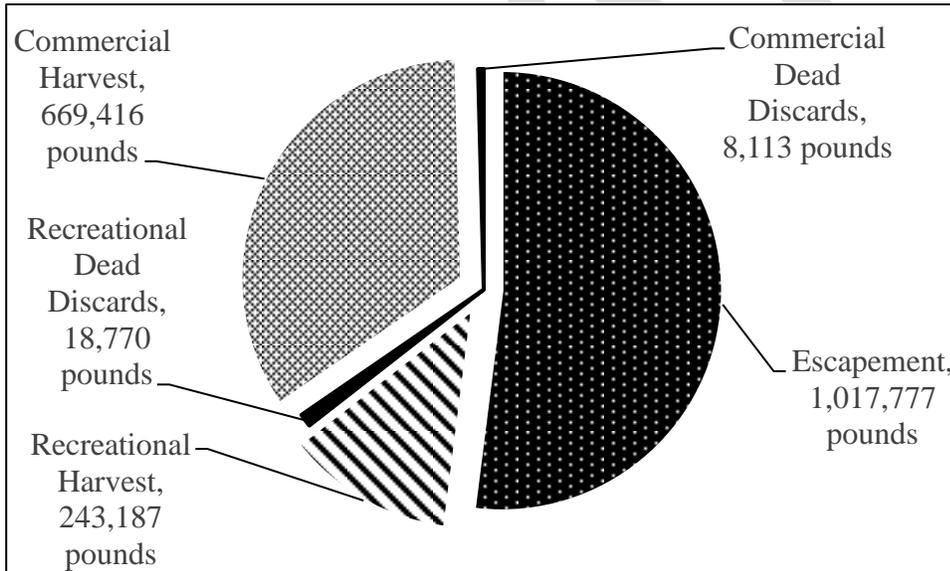


Figure 7. Contribution of the total removals for the commercial and recreational (hook and line and gig) fisheries in North Carolina, 2017, at a 52% reduction. Source: North Carolina Trip Ticket Program, Marine Recreational Information Program, NCDMF Gig Mail Survey.

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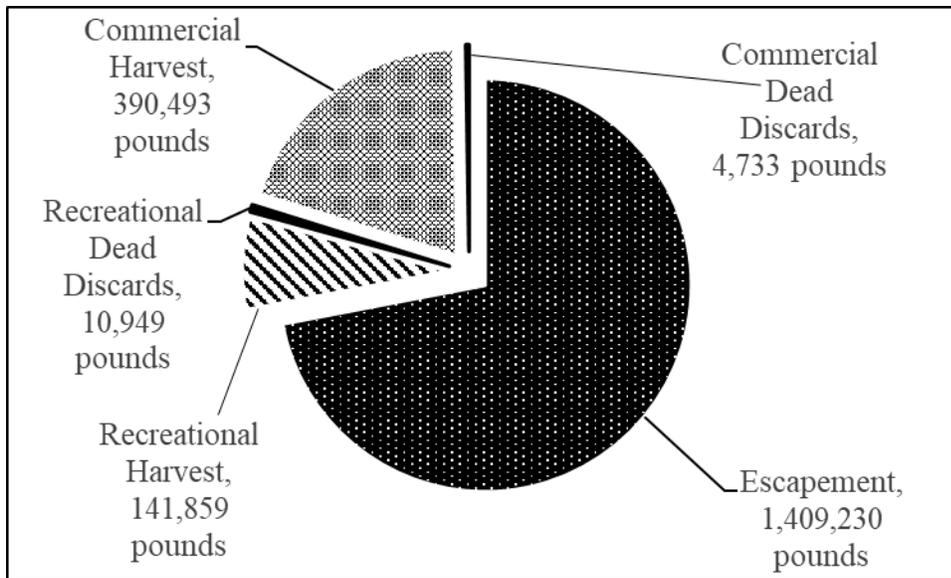


Figure 8. Contribution of the total removals for the commercial and recreational (hook and line and gig) fisheries in North Carolina, 2017, at a 72% reduction. Source: North Carolina

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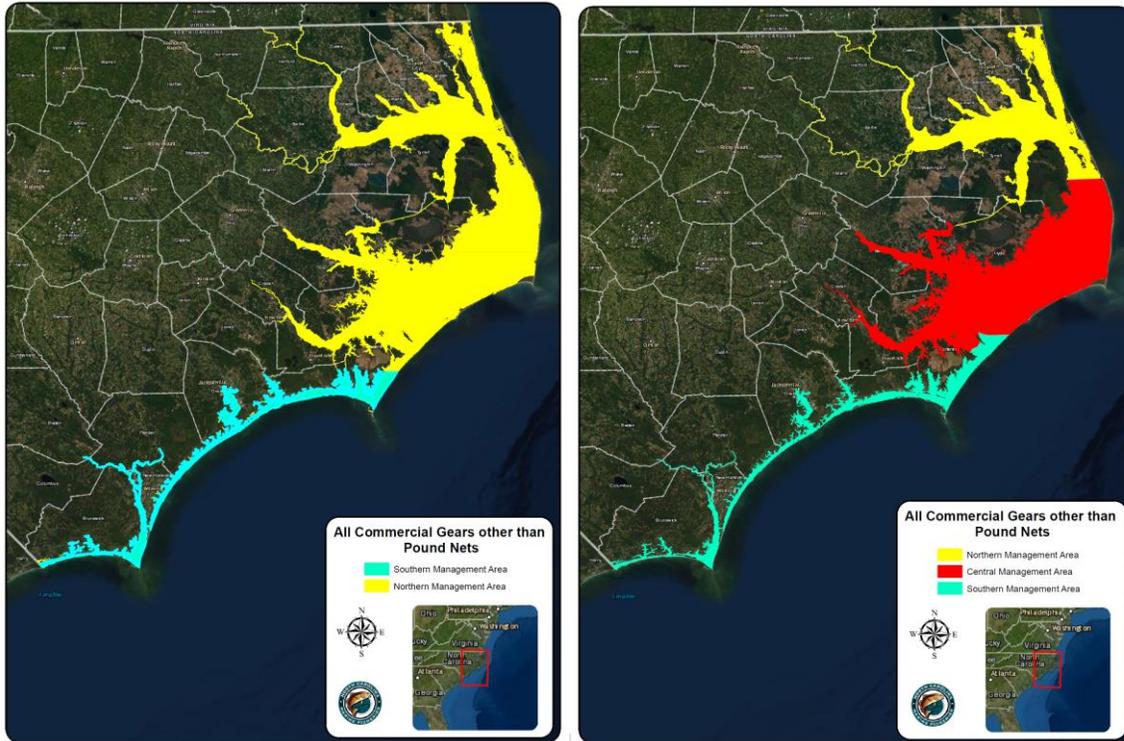


Figure 9. Boundary descriptions for two and three areas to consider for mobile gears. The three area boundaries are identical as seen for pound nets.

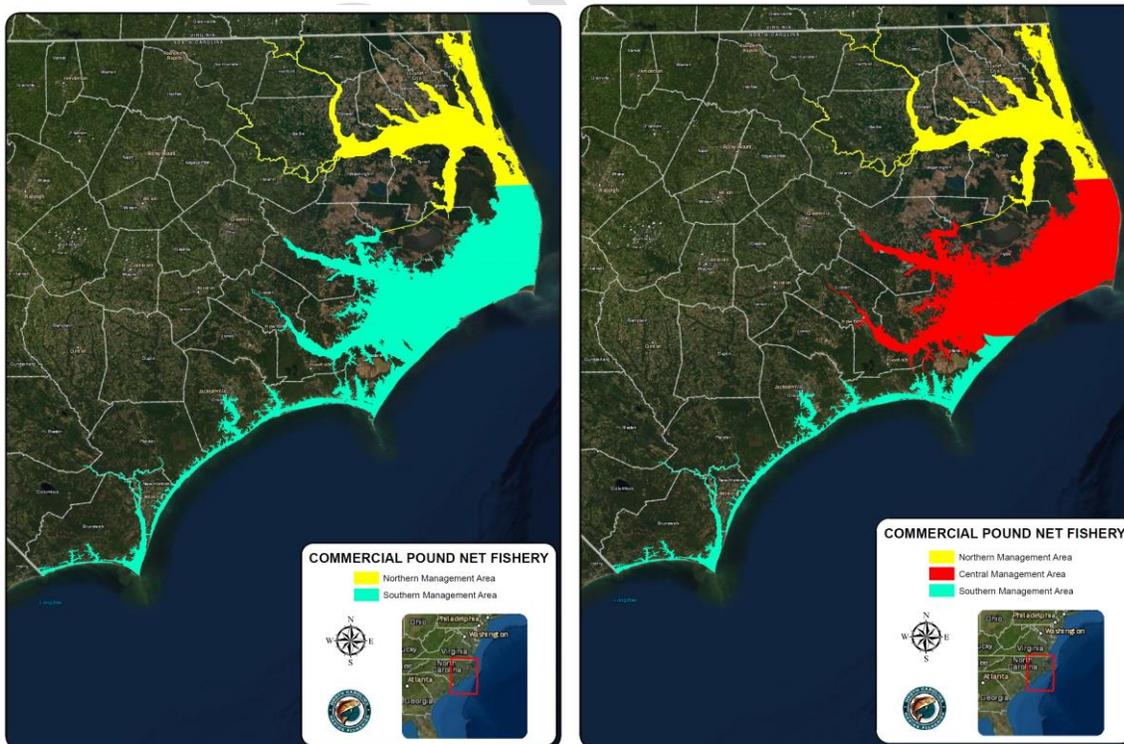


Figure 10. Boundary descriptions for two and three areas to consider for the pound net fishery. The three area boundaries are the same as mobile gears.

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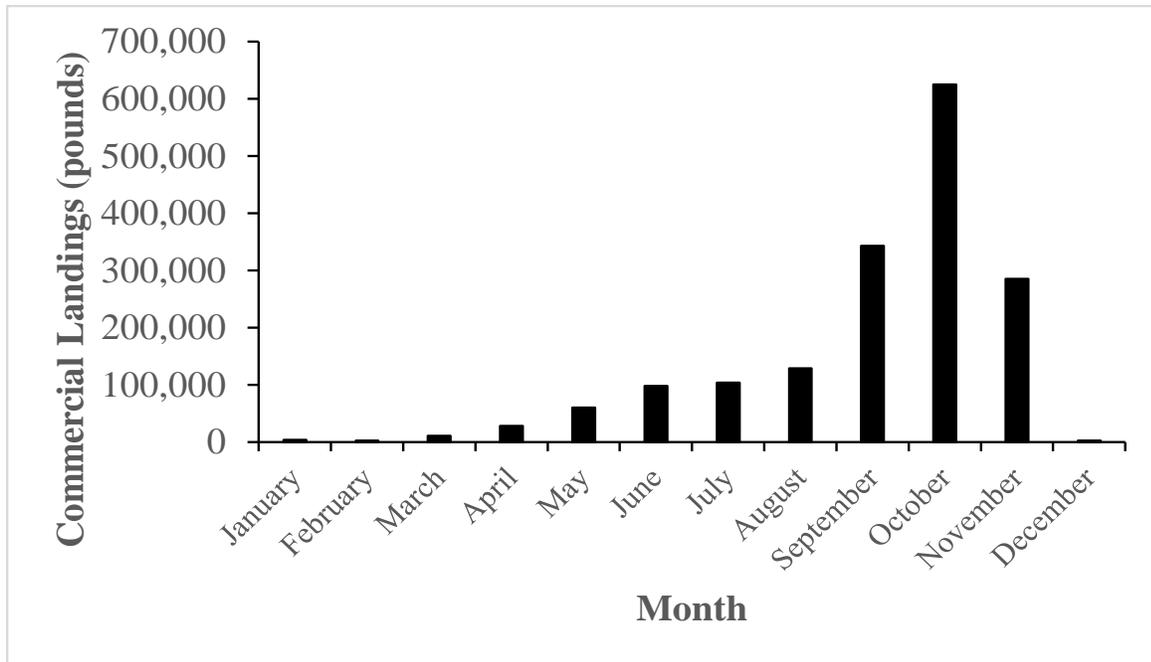


Figure 11. Average commercial southern flounder landings (pounds) by month in North Carolina, 2008-2017. Source: North Carolina Trip Ticket Program.

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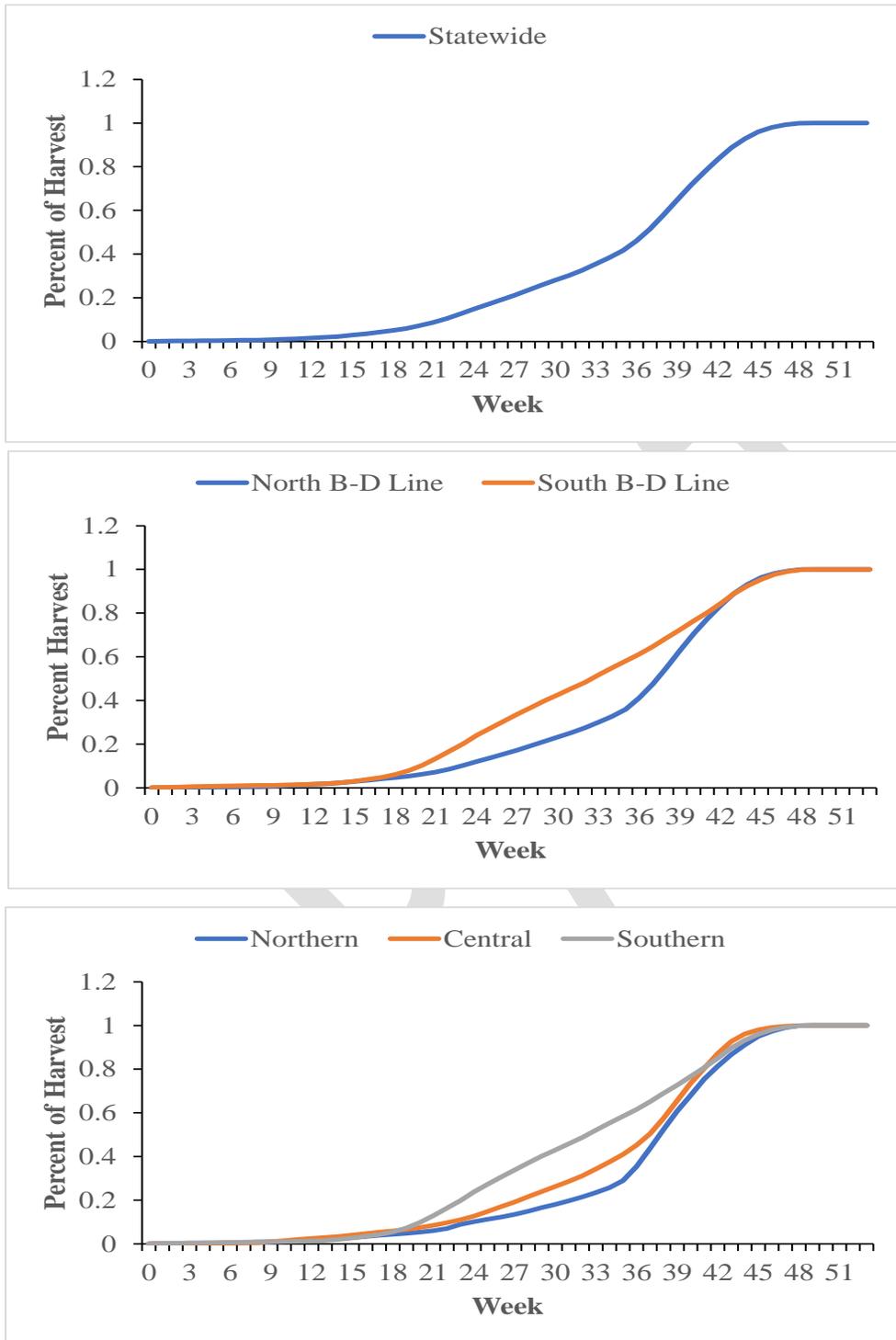


Figure 12 Average weekly harvest (in percent, 2008-2017) through the year from mobile gears statewide and for two and three areas management scenarios as identified in Figure 9.

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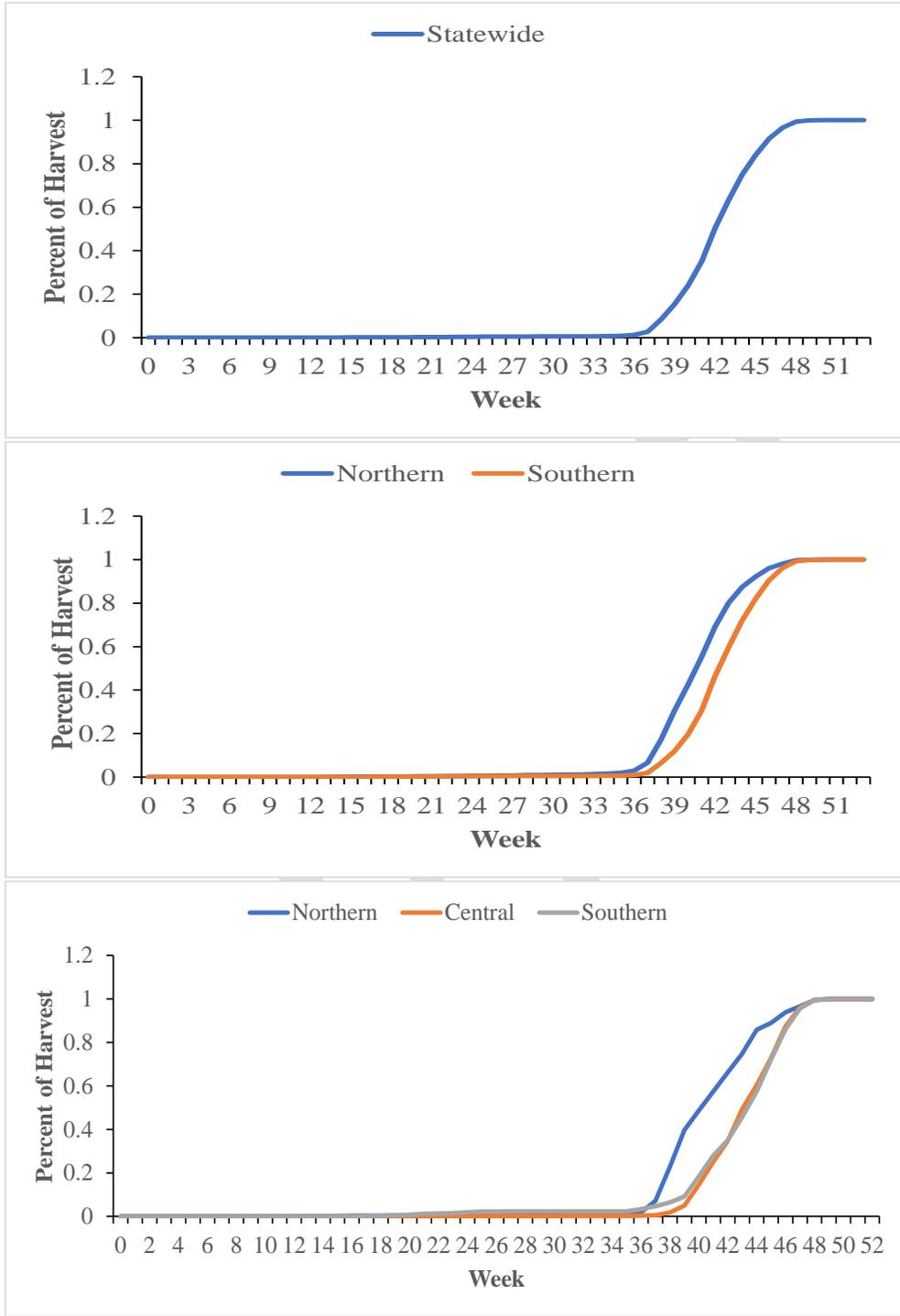


Figure 13. Average weekly harvest (in percent, 2008-2017) from the commercial pound net fishery statewide and for two and three areas management scenarios as identified in Figure 10.

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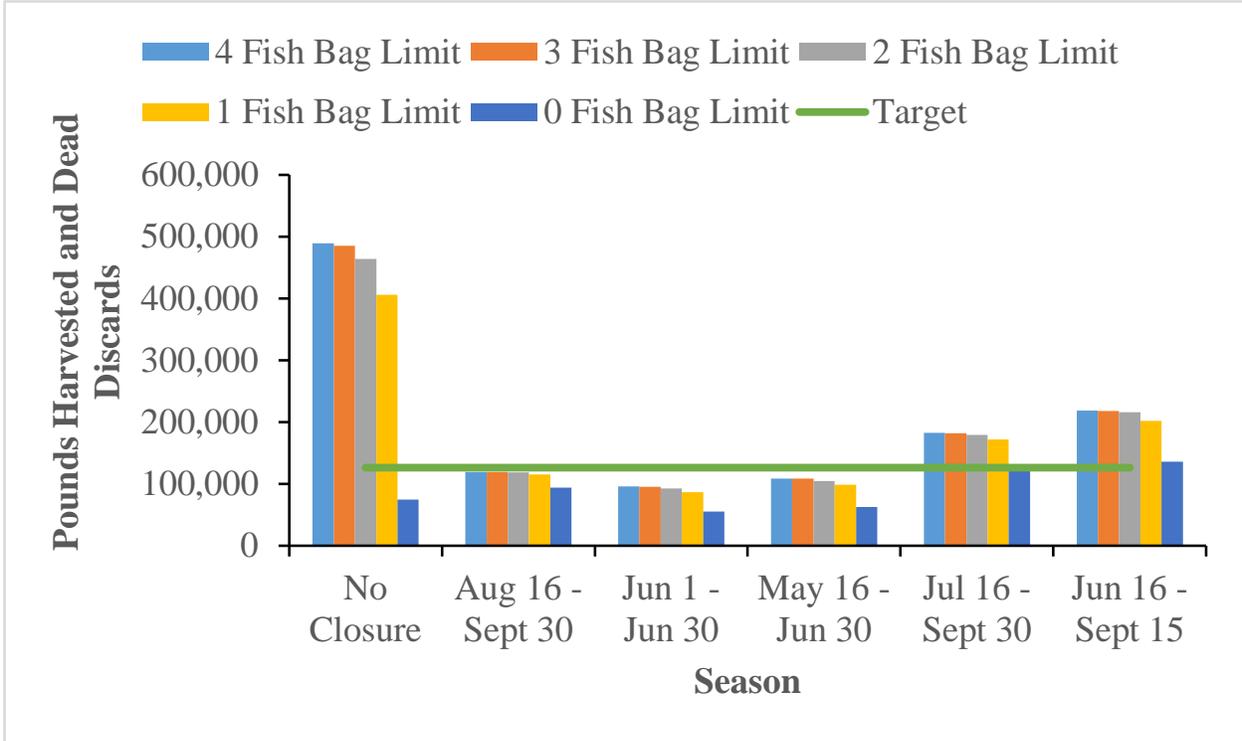


Figure 14. North Carolina southern flounder recreational fishing season relating to the 72% reduction criteria and changes to the daily bag limit.

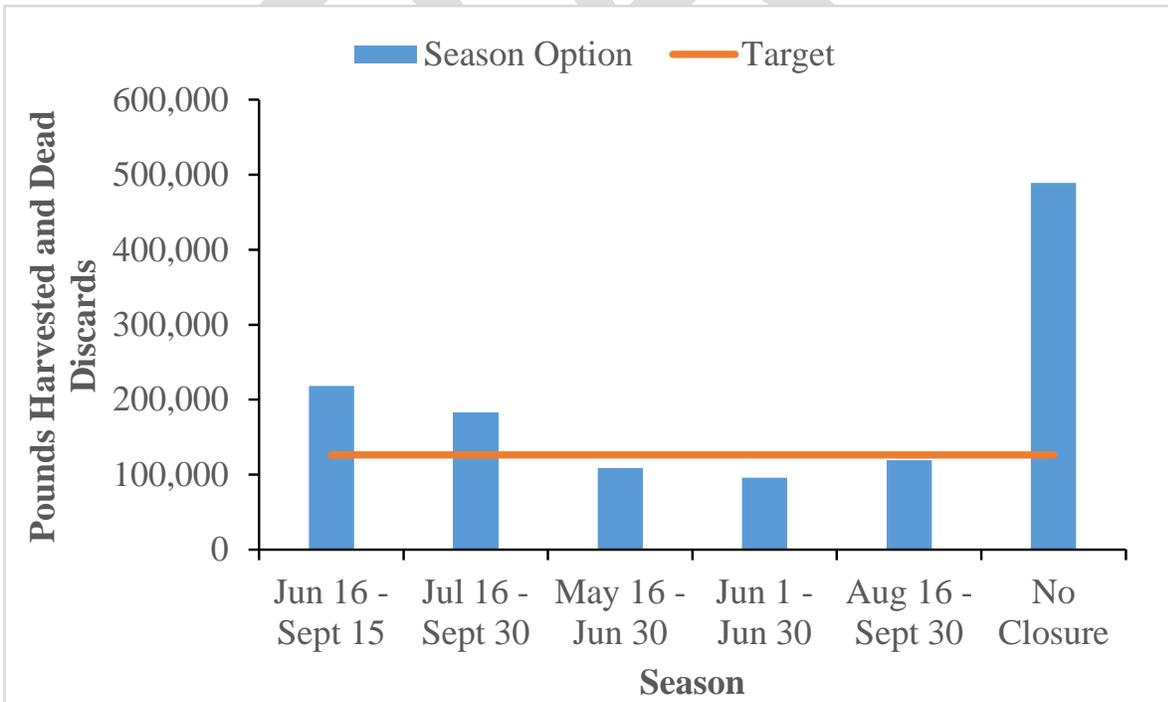


Figure 15. North Carolina southern flounder recreational fishing season relating to the 72% reduction criteria.

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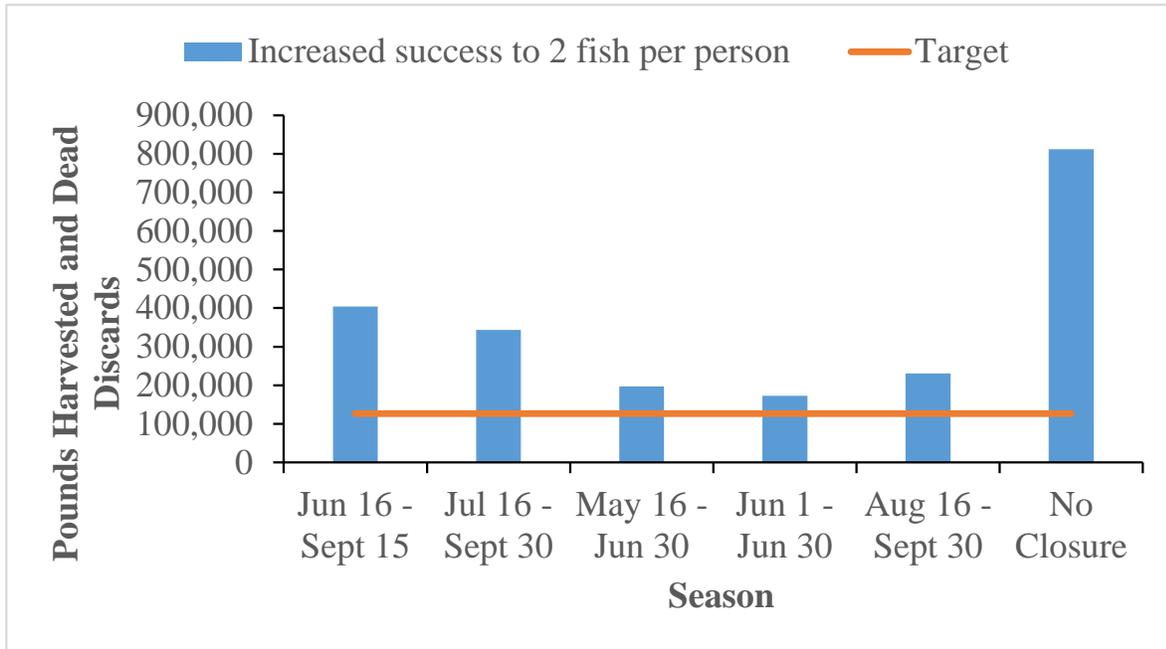


Figure 16. North Carolina southern flounder recreational fishing season relating to the 72% reduction criteria anticipating angler success increasing to two fish per trip in the future.

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APPENDIX 1. MANAGEMENT MEASURES AND STRATEGIES CONSIDERED BUT NOT DEVELOPED

Appendix 1 was developed to provide additional data analysis and discussion on management measures and strategies that have been explored. These do not have the level of data necessary to support moving forward at this time but may provide research needs so they can be considered in future updates to the southern flounder fishery management plan.

STATUS QUO

An option of “status quo”, which means continue only what is in Amendment 2, is not presented in this issue paper as final adoption of Amendment 2 to the Southern Flounder Fishery Management Plan authorized development of Amendment 3 with more comprehensive management strategies.

LIMITED ENTRY

North Carolina General Statute 113-182.1 states the NCMFC can only recommend the General Assembly limit participation in a fishery if the NCMFC determines sustainable harvest in the fishery cannot otherwise be achieved. Sustainable harvest can be achieved without the use of limited entry; therefore, limited entry is not an option at this time.

DYNAMIC QUOTA

A dynamic quota refers to a total allowable catch that fluctuates between years relative to the abundance of the resource and fishing pressure. In the case of southern flounder, the quota for a given year would be primarily driven by the strength of the year classes being subjected to fishing pressure. As with the static quota, all of the same drawbacks, including the issues with monitoring the landings on a daily basis and the high degree of variability in the daily landings, go along with implementing a dynamic quota. In addition, to adequately manage a dynamic quota, the division would need to determine if the fishery independent surveys used to estimate recruitment in the 2019 stock assessment can accurately predict year class strengths for quota management purposes. The terminal year estimates of recruitment from stock assessments tend to be the most uncertain; the use of recruitment indices to determine a dynamic quota is not a possibility. Due to limited availability of real time data that is reflective of the southern flounder stock, a dynamic quota is not a viable management option.

CHANGES TO SIZE LIMITS

Calculations necessary for developing projections based on increasing the current minimum size limit, decreasing the current minimum size limit, or developing a slot limit cannot be calculated on an individual state basis. The current format of the 2019 stock assessment does not include a spatial component, as a result the lack of this spatial component means all size limit changes would be relative to the entire stock of southern flounder. Currently, there are multiple minimum size limits in place across the unit stock, ranging from 12 to 15-inches TL. If an increase or decrease in the minimum size limit, or a slot limit, for NC waters is considered, it is necessary to note that calculations referencing reductions that affect the fishing mortality rates of spawning stock biomass are not possible. Any changes made would be based on previous years’ data for fish within North Carolina harvest estimates and may or may not have intended impacts on the

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rebuilding of the stock. It would not be possible to attribute changes to size limits as the cause of changes to stock size.

Using North Carolina harvest estimates, calculations were done to determine what additional effect size limit changes would have on the 72% reduction in harvest in North Carolina. As stated above, these calculations do not take into account the entire unit stock and are only for guidance as the effect over the entire unit stock would be nonquantifiable. Discussion below addresses these effects, as well as potential drawbacks, to decreasing the minimum size, increasing the minimum size, and implementing at slot limit.

Decrease in Minimum Size Limit

A decrease in the minimum size limit potentially would allow increased harvest on males while decreasing the pressure on the larger females. Females attain larger sizes than males do. If the minimum size limit is decreased to less than 15 inches TL, then more males could be harvested. Although it cannot be guaranteed that males will be harvested but merely available to harvest. Depending on the minimum size chosen, males could account for 25% to 40% of the fish available for harvest (Figure A1). In addition, a reduction in the minimum size limit may allow increased harvest on summer flounder. As recreational size limits have increased through regulatory changes over the years, the ratio of harvest between summer and southern flounder have changed (Figure A2). This change is because the summer flounder inhabiting North Carolina waters are typically smaller than southern flounder.

The size limit has been 15 inches TL since 2011; therefore, calculations to determine the effect of lowering the minimum size are not appropriate. Any calculations done would introduce a high level of imprecision and be based on data that may not be representative of the current fishery. There are numerous concerns with decreasing the minimum size limit, especially for the recreational sector. These concerns revolve around the large volume of recreational discards of fish that are currently under the 15-inch TL minimum size limit (approximately 1.9 million fish in 2017). Lowering the minimum size limit would make these fish available to harvest potentially turning these discards into harvest. This would in turn increase the harvest from the recreational fishery and, therefore, not meet the projected reductions necessary for rebuilding.

Increase in Minimum Size Limit

An increase in the minimum size limits is not recommended for the commercial fishery. In 2017, 80% of the fish harvested in the commercial fishery were less than 18 inches TL (Figure A3). Increasing the minimum size limit would increase the volume of releases from this fishery. In addition, continued increase in minimum size limit would place increased harvest on the largest fish in the stock, which would disproportionately be females. For the commercial fishery, an increase size limit would result in additional dead discards, particularly in the gill net fishery that has a discard mortality rate of 23%.

Public comment for increasing the minimum size limit in the recreational fishery has been received numerous times over the years, with an increase to 18-inches most often mentioned. For the recreational fishery, increasing the minimum size limit would increase the volume of releases from this fishery, many of which may be mortalities, and would decrease angler success. In 2017, 71% of the southern flounder harvested (by weight, pounds) by the recreational fishery

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were under 18-inches TL (Figure A4). If the recreational minimum size limit were to be set at 18-inches TL an additional 28,000 pounds of dead discards would be created based on 2017 data with a total harvest savings of approximately 283,352 pounds over the year. To determine what impact changing the minimum size limit to 18-inches TL would have in addition to the 72% required reduction, seasonal calculations were re-evaluated. Several seasons were identified, in addition to the season currently established (Aug. 16 to Sep. 30) in Amendment 2, that would meet the overall harvest target reduction of 126,315 pounds (Table A1). These seasons range in length from six to 10 weeks (time of year dependent). Although an increase in minimum size limit has the potential to increase the length of a season, there is increased error around these estimates. Additionally, as the stock rebuilds the seasons identified may not continue to meet the target harvest reduction due to increased angler success (Figure A5).

Slot Limit

Non-quantifiable reasons for developing a slot limit for flounder revolve around the estimated length of maturity, the potential ratio of males to females in the harvest, and that releasing all larger flounder would assist in recovery through increased spawning. However, there is no fecundity data currently available from wild individuals to indicate that larger fish are more fecund. The fecundity estimates available are from a hatchery setting and indicate flounder are capable of producing up to 18 million eggs with an average fertilization success rate of 28% (or 4.5 million fertilized eggs; Watanabe et al. 2001). However, these estimates should not be used as a proxy for wild flounder because the laboratory experiments were conducted under the most ideal conditions. In addition, the largest fish only make up 10% of the total commercial and recreational harvest, and with the poor age structure of the stock it is not likely that old fish have spawned multiple times.

To determine what impact implementing a slot limit would have in addition to the 72% required reduction, seasonal calculations were re-evaluated. Multiple slot limits were examined, and of those only three slot limits (15-16 inches, 15-17 inches, and 15-18 inches TL) indicated additional reductions. Several seasons were identified relative to these slot limits, in addition to the season currently established (Aug. 16 to Sep. 30) in Amendment 2, that would meet the overall harvest target reduction of 126,315 pounds while potentially increasing angler access (Table A2). These seasons range in length from six to 10 weeks (time of year and slot limit dependent), though the most options are seen with the narrowest slot limit. Although slot limits have the potential to increase the length of a season, there is increased error around these estimates. Additionally, as the stock rebuilds the seasons identified may not continue to meet the target harvest reduction due to increased angler success (Figure A6, Figure A7, Figure A8).

Previous analysis done by Wong (2009) for summer flounder slot limits indicated an increase in the harvest of smaller fish, while only reducing some harvest on the larger fish; non-compliance and high-grading were concerns with the implementation of a slot limit. It was recommended that narrow slot ranges be avoided due to issues related to angler satisfaction, non-compliance, and enforcement. In addition, the use of slot limits for a flounder species was not recommended until rebuilding goals and data needs for the species were met (Wong 2009).

One additional concern is the equitability of these slot limits to be applied across all gears in the recreational fishery. The identified slot limits are very narrow. It is very likely that the

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recreational gig fishery would be unable to operate under a slot limit, unless a non-lethal gear was implemented, due to the increase in dead discards that would occur due to the slot.

COMMERCIAL GEAR LIMITATIONS

Current gear configurations, including 6.0 ISM for large mesh gill nets, 5 and ¾ inch stretched mesh escape panels in pound nets combined with a 15-inch minimum size limit for flounder, have reduced the volume of discards observed. Although the only fishery with discard estimates is the large mesh gill net fishery, anecdotal evidence supports limited discards in the pound net fishery. Due to the apparent effectiveness of the current gear configurations and the current minimum size limit additional changes to gear are not recommend at this time. However, if size limits are considered for the estuarine flounder fishery, changes to gear configurations may be warranted.

DEVELOPMENT OF FISHING DAYS (WEEKEND/WEEKDAYS/HOLIDAYS) FOR THE RECREATIONAL FISHERY

The adoption of Southern Flounder Amendment 2 by the NCMFC mandated a 72% reduction in pounds for both the commercial and recreational sectors to achieve sustainability of the stock within 10 years. To achieve this reduction within the recreational fishery Marine Recreational Information (MRIP) data from 2008-2017 were analyzed to determine appropriate bag-limits that operate in concurrence with seasonal closures. A reduction in pounds necessitated incorporation of the discard mortality associated with existing discards as well as the mortality associated with discards generated from specific bag and season combinations. The harvest of southern flounder exhibits a distinct seasonality with the bulk of the harvest occurring during the summer months. To achieve an acceptable reduction in harvest, seasonal scenarios focused on reducing harvest during the summer months. This analysis demonstrated that the only scenario in which a 72% reduction could be achieved was through a four fish bag limit on southern flounder within a season spanning August 16th through September 30th. At the request of the NCMFC the division explored the possibility of protracting the recreational season through combinations of weekday and weekend day types. Additional input from the Southern Flounder Advisory Committee recommended a weekday specific season during the summer months with an allowance for weekend only fishing during the fall.

MRIP catch rate estimates were obtained through a variety of weightings reflective of angler avidity including location, day type (weekend vs. weekday) and time of day. MRIP produces catch estimates by applying the weighted catch rates to estimates of effort obtained through the Fishing Effort Survey (see Section 7 Description of the Fishery). Importantly, the MRIP definition of day type includes Friday as a weekend day type due to angler avidity aligning more closely with observations from Saturday and Sunday. As such, it is disproportionately weighted with expanded catch rate estimates reflecting this increased avidity. Thus, it is of particular note that Friday is included as a weekend day type when data are deconstructed for analysis. Initial analyses sought to achieve targeted reductions for particular day types as a proportion of day type specific contributions. Specifically, a weekend target of 76,000 pounds and a weekday target of 46,000 pounds to achieve the overall target reduction of 126,315 pounds. This analysis demonstrated that when individual day types were given equal consideration regarding targeted reductions there was no deviation from initial reduction projections using the combined data set. However, when individual day types were considered within the context of overall targeted

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reductions (126,315 pounds) it is possible to achieve a variety of scenarios that extend the season for over three months and still achieved desired reductions but with increased error around the produced estimates.

The scenario that most closely approaches the harvest allowance includes a summer season from July 16th through September 30th that permits harvest only during MRIP defined weekdays (Monday, Tuesday, Wednesday, and Thursday). This weekday season will provide a projected harvest of 92,354 pounds. A subsequent season consisting of MRIP defined weekend days (Friday, Saturday, Sunday) will begin on October 15th and last until November 30th. This fall weekend season will provide a projected harvest of 27,803 pounds. The combined harvest of 121,666 pounds will fall within the target reduction allowance of 126,315 pounds.

Importantly, there are similar scenarios that satisfy the 72% reduction without approaching the harvest allowance so closely (Table A3 Figure A9). Alternate management scenarios incorporate species specific harvest (i.e. Summer, Southern, Gulf) and are further evaluated in the *Increased Recreational Access by Managing Southern Flounder Separately from other Flounder Species Issue Paper*. When constituent flounder species are given consideration in establishing bag limits, the potential exists to craft additional seasons that further extend the seasonal harvest of flounder. Verifying the recreational angling community's ability to differentiate among North Carolina's three flounder species will be requisite before single species management options can be explored.

The scenarios provided will allow greater access to the resource by providing concessions for for-hire stakeholders who rely heavily on weekday clientele during the summer months while also affording anglers access to the fall flounder fishery. The primary concern with this approach is that under our initial season combining all day types provided anglers with a defined window within which to fish, thus increasing the likelihood of achieving targeted reductions. The extension of a season across multiple months between specific day types increases the opportunity for individuals to alter their behavior to capitalize on the resource, which has the potential to compromise projected reductions. It may be beneficial to consider options with a lower projected harvest to provide a buffer against temporal displacement across a protracted season. This is also suggested as the reductions are based on the terminal year of the assessment. During periods of higher abundance like 2013 weekday and weekend estimates vary greatly and are often greater than allowed at the 72% reduction level (Figure A10).

RECREATIONAL FISHERY VESSEL LIMITS

Potential implementation of vessel limits for all recreational gear were evaluated. The Private/Rental boat mode in MRIP is responsible for the largest portion of the recreational landings of southern flounder. The vessels intercepted by MRIP had an average of two anglers present from 2008 through 2017, however, the number of anglers ranged from one to 11 (Table A4). It is the trips where more than two anglers are present the cause concern. In the southern flounder recreational fishery, the use of a trip limit may be useful to maintain the quota allocation for the hook-and-line and gig fisheries. Vessel limits may have a larger impact to recreational southern flounder harvest if bag limits are not reduced from 4-fish per person per day. Much like reduction in bag limits, effects of vessel limits are not quantifiable at this time as estimates would be based on prior years which will not be reflective of the fishery moving

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forward. Due to this, implementing trip limits would serve to reduce the chances of exceeding the TAL for the recreational fishery and thus reducing the chances of significant impacts in subsequent seasons to due required accountability measures. As stock abundance increases during the rebuilding period, it is likely angler success will increase as well. If angler success improves, any gains achieved through limited open seasons will be lessened, limiting the actual recovery of the species. Harvest must be constrained using multiple measures in the recreational fisheries while rebuilding occurs. However, if the recreational bag limit is reduced to one fish then the implementation of vessel limits may not be necessary.

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Table A1. Season and total harvest for an 18-inch TL minimum size limit based on 2017 data. Bolded harvest values are options that meet the overall 126,315 pound allowable harvest.

Season	Total Harvest (pounds)
No Closure	167,774
Aug 16-Sep 30	47,401
Aug 1-Sep 30	49,149
Jul 16-Sep 30	64,576
Jul 1-Sep 30	91,376
Aug 1-Oct 15	52,914
Aug 16-Oct 15	51,167
Jul 1-Aug 31	47,493
Jul 1-Sep 15	66,396
Sep 1-Oct 31	58,760
Sep 1-Nov 15	68,808

Table A2. Season and total harvest for identified slot limits based on 2017 data. Bolded harvest values are options that meet the overall 126,315 pound allowable harvest.

Season	Slot limit (TL)		
	15 - 16 inch	15 - 17 inch	15 - 18 inch
Total harvest (pounds)			
No season	303,176	362,016	413,797
Aug 16 - Sept 30	78,038	81,505	96,623
Aug 1 - Sept 30	89,346	92,812	108,755
Jul 16 - Sept 30	120,773	132,791	148,733
Jul 1 - Sept 30	149,806	174,795	205,412
Aug 1 - Oct 15	132,133	136,779	152,721
Aug 16 - Oct 15	124,371	129,016	144,136
Jul 1 - Aug 31	91,624	113,737	130,465
Jul 1 - Sept 15	102,414	125,791	146,092
Sept 1 - Oct 31	113,402	117,458	131,847
Sept 1 - Nov 15	126,516	133,012	147,426

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Table A3. Southern flounder harvest projections from seasons using day-type specific combinations.

Day Type	Season	Pounds
Weekend	Oct 15- Nov 30	29,313
Weekday	Jul 16 - Sept 30	92,354
	Total	121,666
Weekend	Oct 1- Oct 30	33,903
Weekday	Aug 1 - Sep 30	74,953
	Total	108,856
Weekend	Oct 15- Nov 15	27,803
Weekday	Jul 16 - Sept 30	92,354
	Total	120,157
Weekend	Sep 15 -Oct 15	42,386
Weekday	Aug 1 - Sept 30	74,953
	Total	117,339
Weekend	Oct 15- Nov 30	29,313
Weekday	Aug 1 - Sept 30	74,953
	Total	104,266

Table A4. Average, minimum, and maximum anglers present in the Private/Rental Boat mode for the recreational southern flounder fishery from 2008-2017.

Year	Average	Minimum	Maximum
2008	2	1	8
2009	2	1	9
2010	2	1	11
2011	2	1	10
2012	2	1	6
2013	2	1	7
2014	2	1	6
2015	2	1	6
2016	2	1	5
2017	2	1	6
Total	2	1	11

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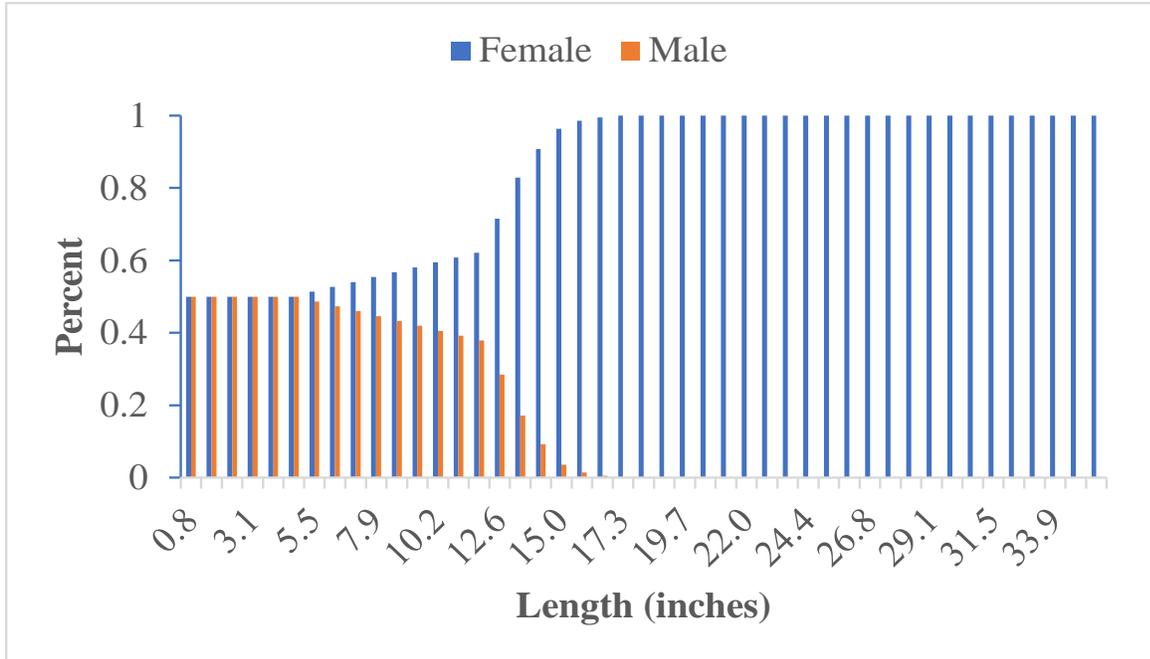


Figure A1. Sex ratios of southern flounder relative to total length.

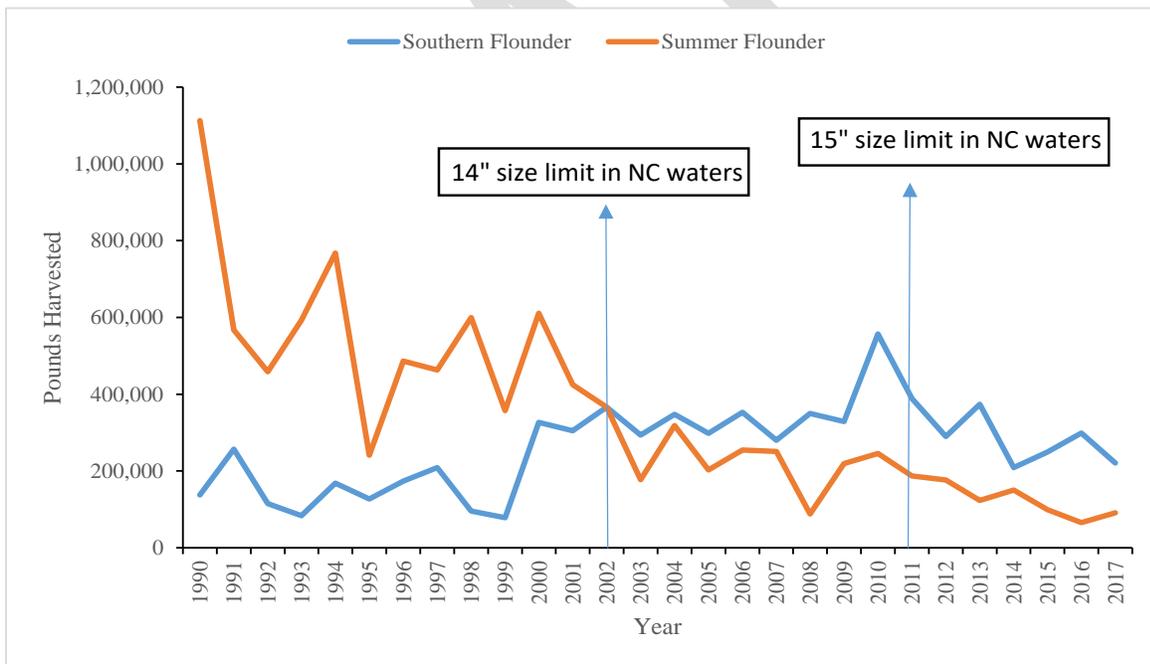


Figure A2. Impacts to summer flounder harvest due to increase in minimum size limit changes.

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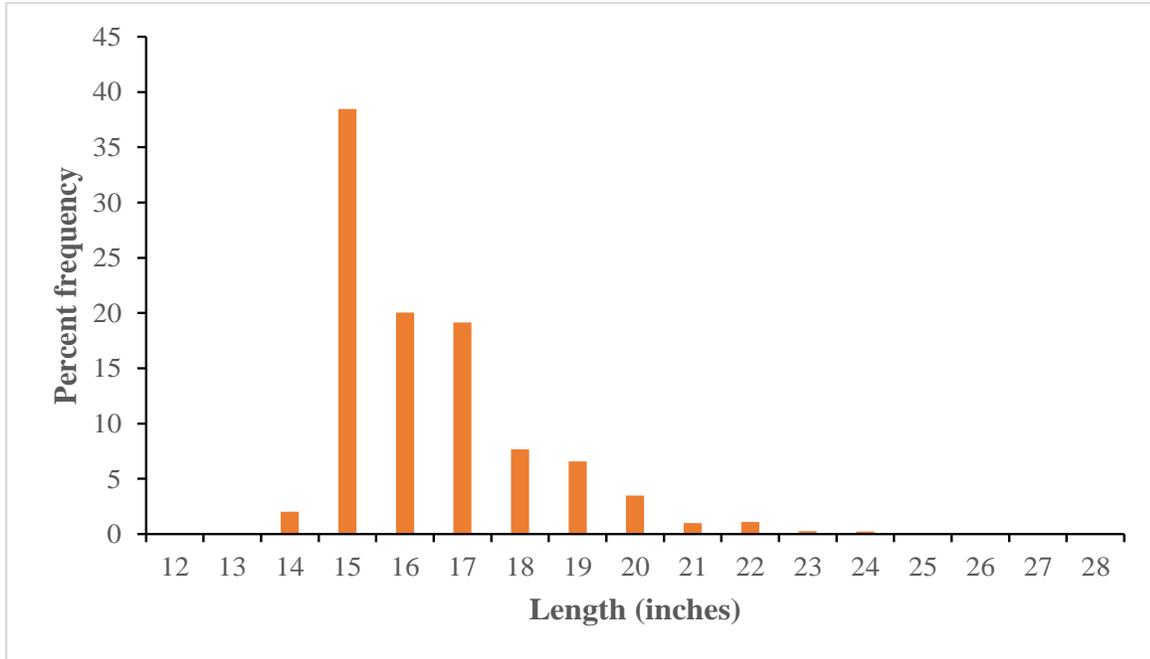


Figure A3. Percent frequency (by pound) of commercial southern flounder harvest by length, 2017. Source: North Carolina Trip Ticket Program.

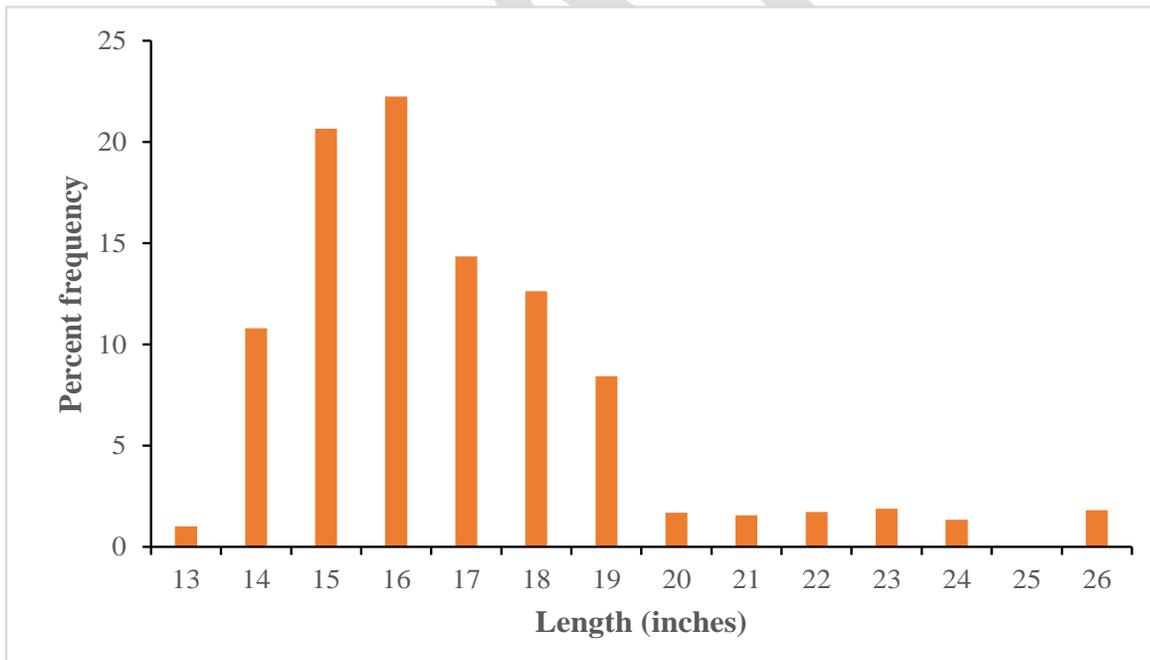


Figure A4. Percent frequency (by pound) of recreational southern flounder harvest by length, 2017. Source: MRIP

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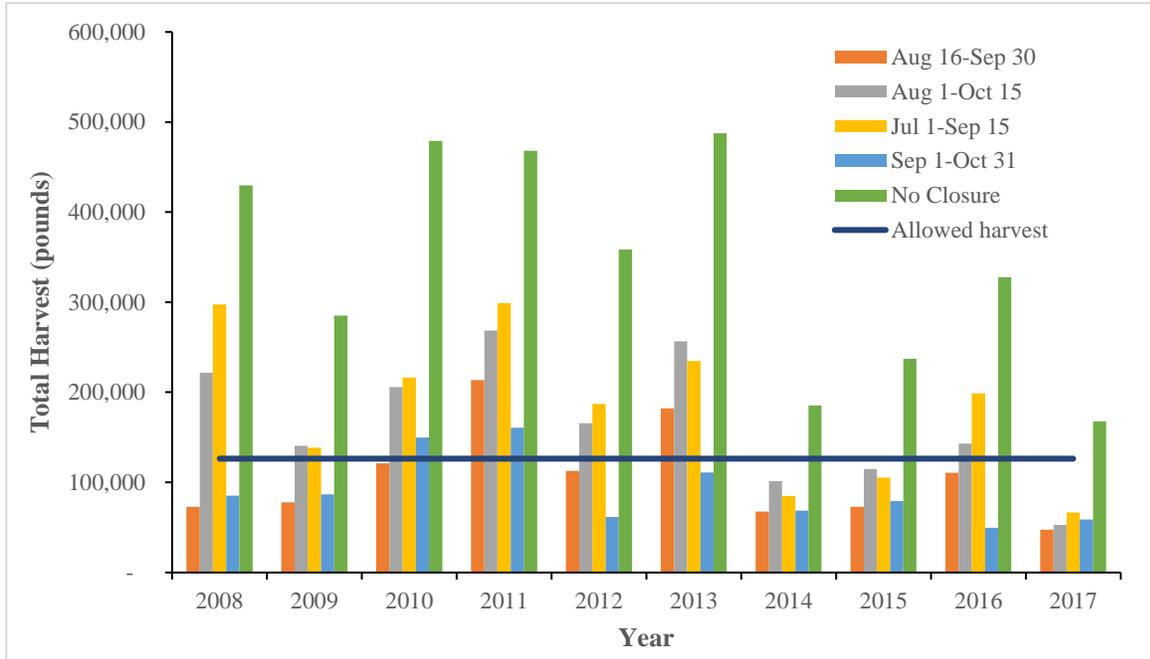


Figure A5. Total harvest for seasonal options based on data from, 2008-2017. Years 2010, 2011, and 2013 represent years of above average harvest. Total allowed harvest of 126,315 pounds is represented by the blue solid line.

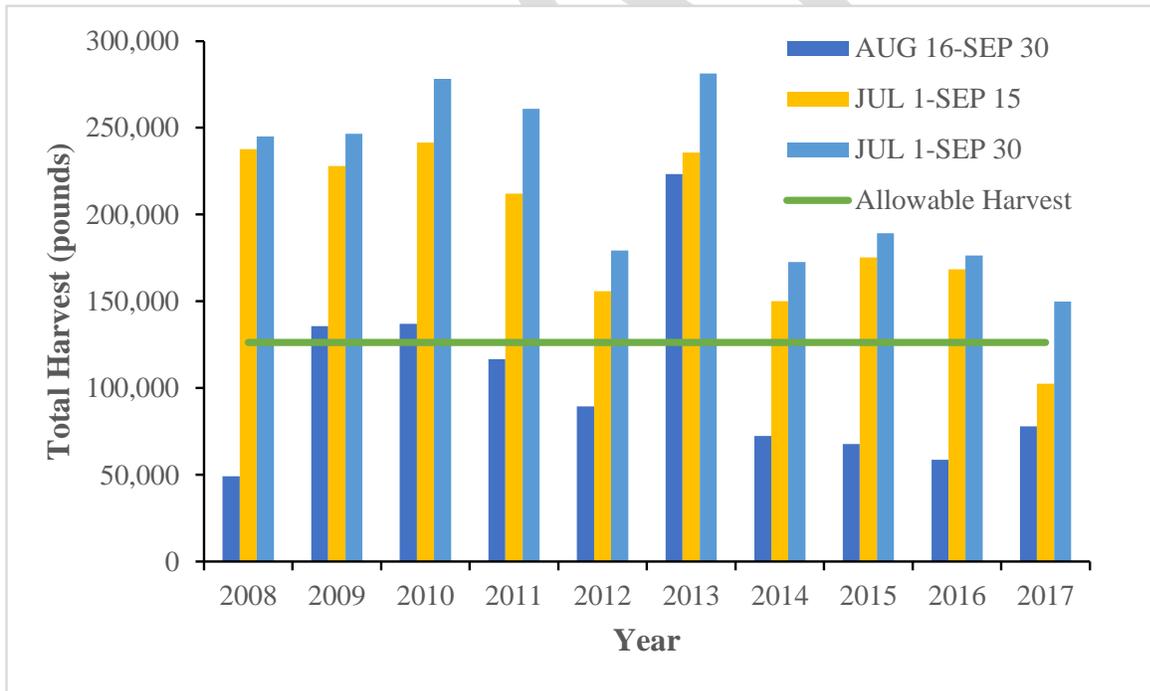


Figure A6. Total harvest for seasonal options for a 15 – 16-inch slot based on data from, 2008-2017. Years 2010, 2011, and 2013 represent years of above average harvest. Total allowed harvest of 126,315 pounds is represented by the green solid line.

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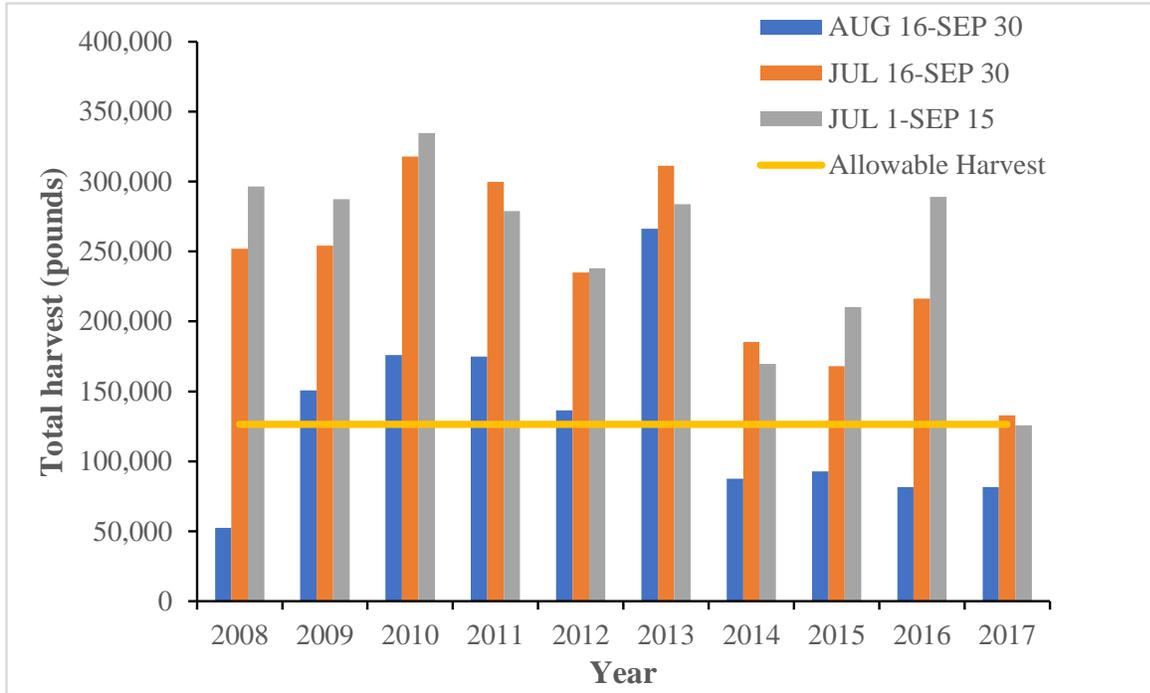


Figure A7. Total harvest for seasonal options for a 15 – 17-inch TL slot based on data from, 2008-2017. Years 2010, 2011, and 2013 represent years of above average harvest. Total allowed harvest of 126,315 pounds is represented by the yellow solid line.

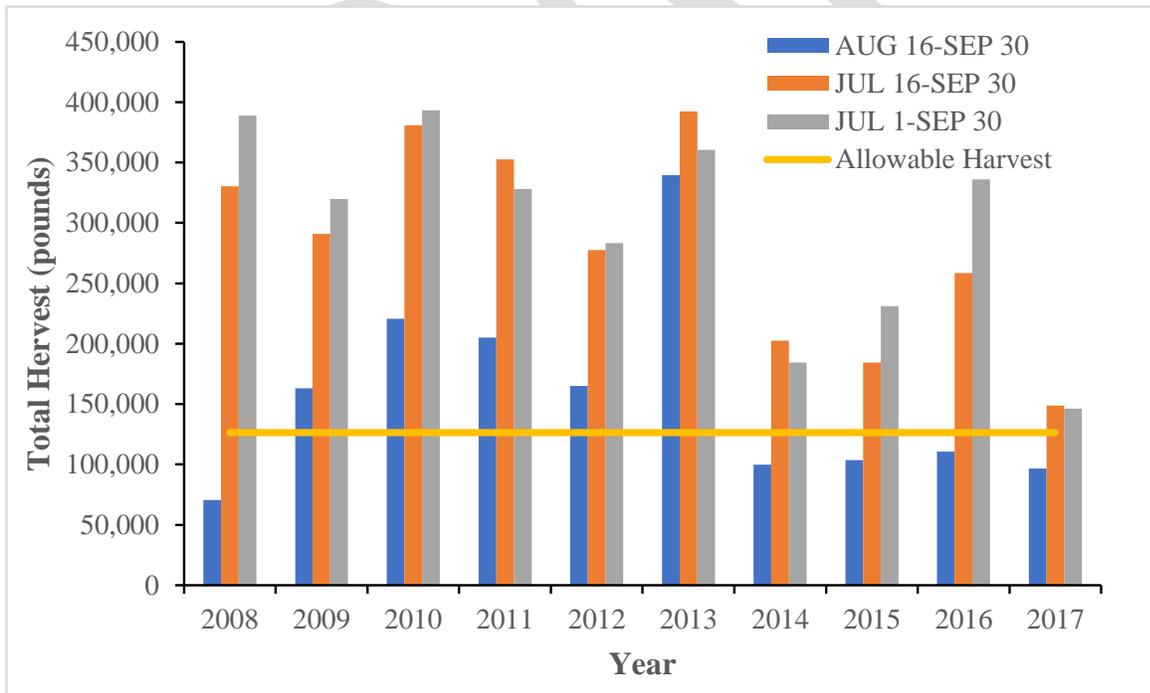


Figure A8. Total harvest for seasonal options for a 15 – 18-inch TL slot based on data from, 2008-2017. Years 2010, 2011, and 2013 represent years of above average harvest. Total allowed harvest of 126,315 pounds is represented by the yellow solid line.

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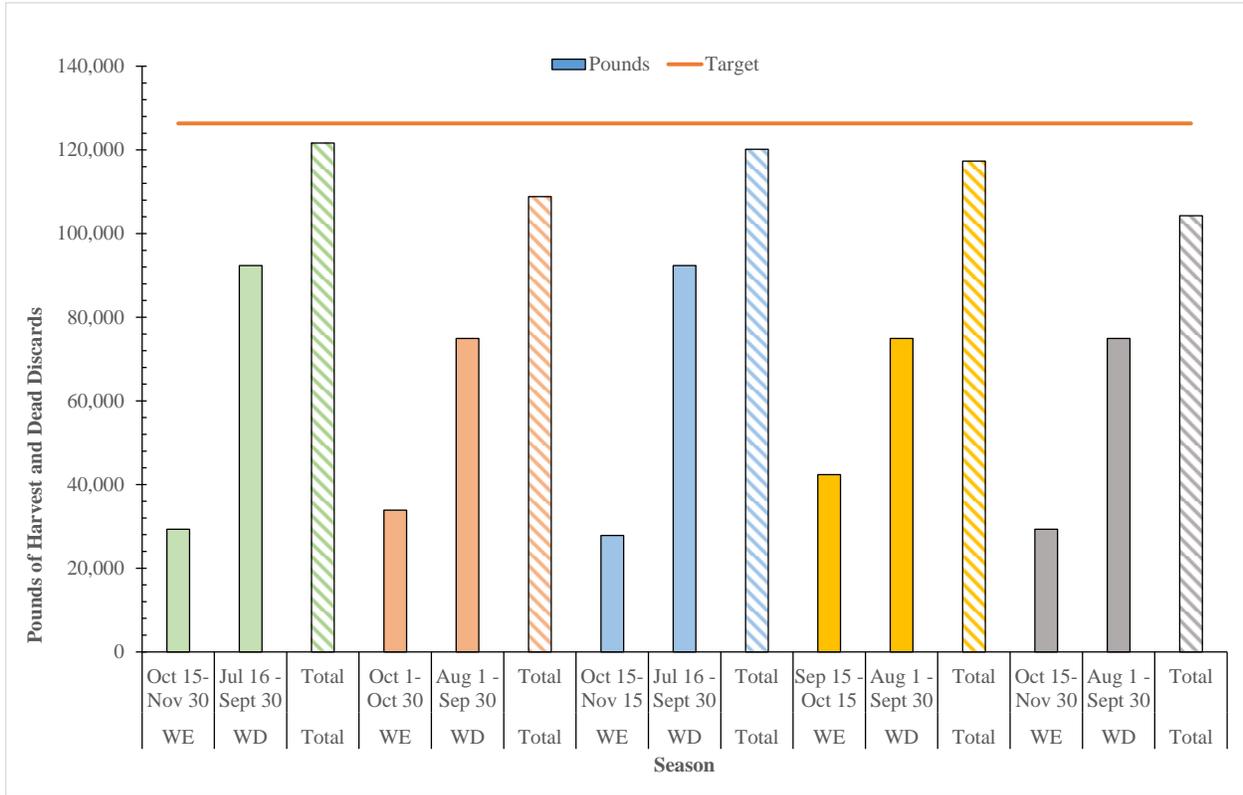


Figure A9. Southern Flounder harvest projections from seasons using day-type specific combinations. (Note – WD = Weekdays and WE = Weekends).

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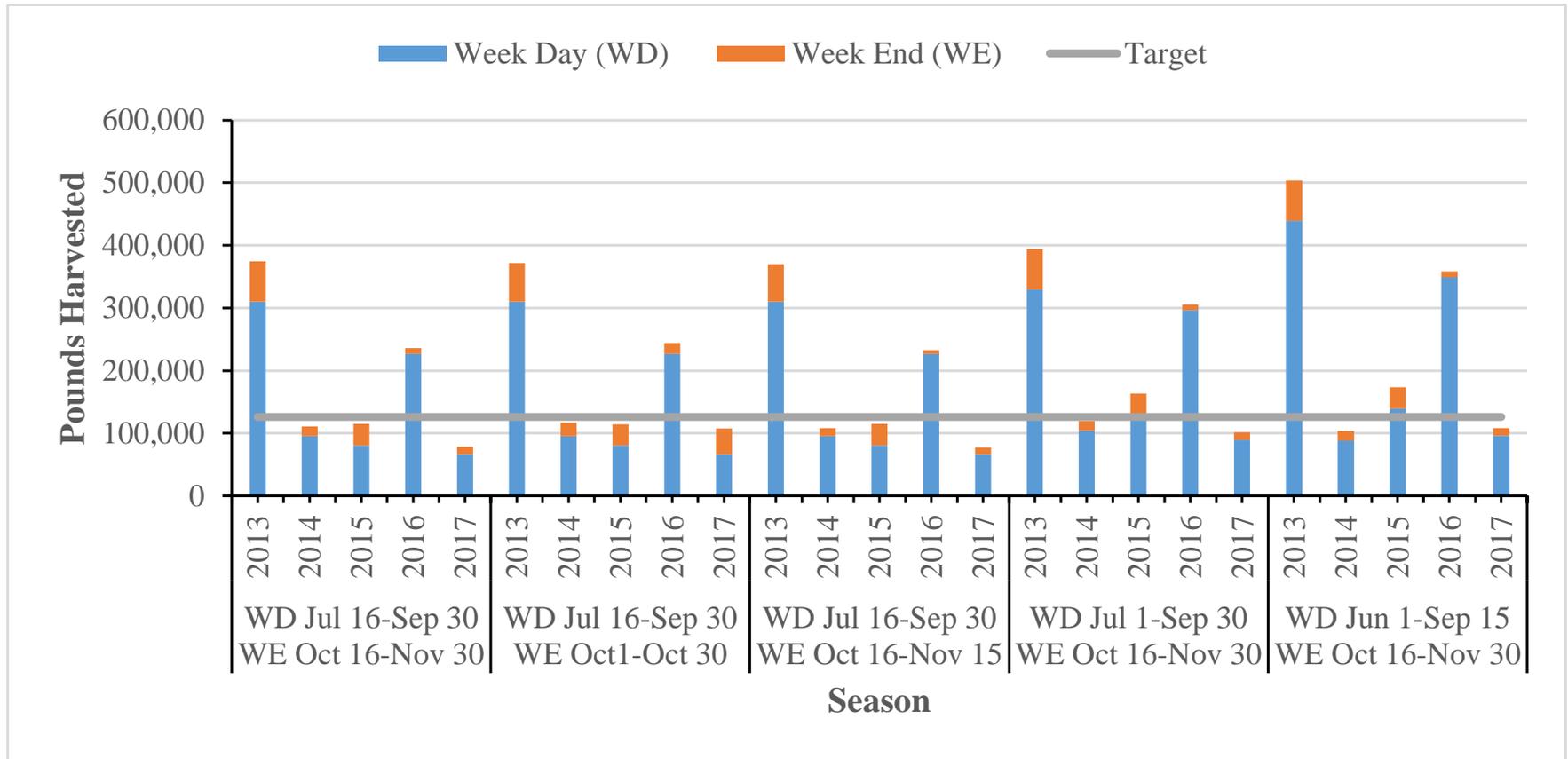


Figure A10. Annual variability in harvest of southern flounder (pounds) during identified day type combinations, 2013-2017. Note – WD = Weekdays and WE = Weekends.