DESCRIPTION OF THE FISHERIES

Additional in depth analyses and discussion of North Carolina's commercial and recreational southern flounder fisheries can be found in earlier versions of the Southern Flounder FMP (NCDMF 2005, 2013, 2017a, 2019a); all documents are available on the division website at: http://portal.ncdenr.org/web/mf/fmps-under-development and the License and Statistics Annual Report (NCDMF 2019b) produced by the division which can be found at: http://portal.ncdenr.org/web/mf/marine-fisheries-catch-statistics.

The socio-economic information presented is about the current fishery and is not intended to be used to predict potential impacts from management changes. However, this and other information pertaining to fishery management plans is included to help inform decision-makers regarding the long-term viability of the state's commercially and recreationally significant species or fisheries. For a detailed explanation of the methodology used to estimate the economic impacts please refer to the division's License and Statistics Section Annual Report (NCDMF 2019b) and the E-doc.

COMMERCIAL FISHERY (1)

Southern flounder supports one of the largest and most valuable commercial fisheries in North Carolina, accounting for landings of 1.39 million pounds with a dockside value of $5.66 million in 2017. Historically, North Carolina has accounted for approximately 99 percent of annual Atlantic coast southern flounder landings since 1978 (Figure 7.1). Southern flounder have been harvested commercially since the 1800s in North Carolina, with the earliest documented landings reported in 1889 (Chestnut and Davis 1975).

The average commercial fisherman participating in the southern flounder fishery is a middle-aged Caucasian male with more than 50% of their income coming from commercial fishing (Diaby 2000, 2001; Cheuvront 2002, 2003; Cheuvront and Neal 2004; Crosson 2010; Hadley 2012; Hadley and Wiegand 2014; Stemle and Wiegand 2017; Gambill and Bianchi 2019).

Landings of southern flounder increased steadily in the mid-1970s, peaking in the mid-1990s and declining to nearly 1.4 million pounds in 2017 (Figure 7.2). Historically, summer flounder accounted for most of the flounder landings in North Carolina. Summer flounder occur primarily in the ocean from North Carolina to Massachusetts. While southern flounder commercial fisheries occur almost exclusively in the estuaries, summer flounder landed in North Carolina are caught using trawlers fishing in the mid-Atlantic region of the Atlantic Ocean, most recently off of New Jersey and New York.

Several management restrictions, including a quota, were implemented for summer flounder, in the mid-1980s to early 1990s. These restrictions decreased the harvest of summer flounder, while at the same time the southern flounder fishery expanded through growth in the pound net fishery (2), and development of a fall large mesh gill net fishery in Pamlico Sound. These changes resulted in southern flounder ranking as the top commercially landed flounder species until 2014 when summer flounder regained the top spot.

Commercial Fishery Data Collection (3)

Historical landings statistics were collected on a voluntary basis and methodology varied through time until 1994 when the division implemented a mandatory trip ticket program (NCTTP) to monitor commercial landings and fishing effort. A fisherman needs to hold a Standard Commercial Fishing License (SCFL) or a Retired Standard Commercial Fishing License (RSCFL) to land southern flounder commercially in North Carolina. The total number of SCFLs and RSCFLs issued during fiscal years 2008 through 2017 ranged from 6,296 in 2017 to 6,861 in 2008 (NCDMF 2019b).

The division requires dealers purchasing finfish and/or shellfish from commercial fishermen to submit trip tickets that capture information about their catch. Commercial fishermen who sell their catch directly to consumers are required to possess a dealer's license and submit trip tickets. The number of seafood dealers reporting landings of southern flounder has ranged from 249 in 2012 to 189 in 2016.

Southern flounder commercial catches are also monitored through fishery-dependent sampling conducted by the division at fish houses (4). Fishery-dependent sampling for southern flounder has been ongoing since 1982. Data collected in this program allow the size and age distribution of southern flounder to be characterized for each of the major gears and fisheries that harvest southern flounder.

Annual Landings and Value

Flounder landings reported through the NCTTP are not tabulated by species. Sampling of the commercial harvest indicates that southern flounder make up less than one percent of the catch from ocean waters, while summer flounder and Gulf flounder account for approximately two percent or less of the flounder harvested from internal waters (NCDMF unpublished data). Therefore, it is assumed that all flounder harvested from estuarine waters are southern flounder, while all flounder taken from the ocean are summer flounder.

Unless otherwise noted, all data presented in this section are from division's trip ticket program from 2008 to 2017. Trends are shown for the dockside (ex-vessel) value and harvest volume presented in pounds.

Commercial landings of southern flounder are highly variable with a low in the time series in 2016 since the peak in 1994 (Figure 7.2). Southern flounder may be graded into five size categories: jumbo, large, medium, mixed, and small; dockside price per pound increases with larger market grades with maximum price per pound seen in the sushi and sashimi market. Over the past 10 years landings have been impacted by environmental conditions, such as hurricanes, and changes in management strategies; both have impacted the level of effort in the southern flounder fishery.

It is important to note that the price-per-pound of southern flounder has increased over time, as prices have shifted from roughly $2 per pound to $4 per pound during the course of the time

series. As the total poundage of southern flounder landings have decreased over time, ex-vessel values have been able to stay relatively consistent, with the exception of 2011 where the northern area pound net fishery was disproportionately impacted by severe weather (Table 7.1; NCDMF 2019b).

Landings by Gear (6)

Historically, southern flounder were harvested commercially using pound nets, seines, gill nets, and gigs (Chestnut and Davis 1975) and all but seines remain as primary gears (Lee et al. 2018). To use a pound net in North Carolina waters, including those used to harvest southern flounder, a Pound Net Permit needs to be obtained. The number of permits has ranged from 267 in 2012 to 304 in 2008 (Table 7.2).

As of 2015, an Estuarine Gill Net Permit is required to fish with gill net gear in North Carolina's estuaries. The permits are used to facilitate observer coverage, which is a requirement of Incidental Take Permits (ITP) [Section 10(a)(1)(B) of the Endangered Species Act (ESA)] for sea turtles and Atlantic sturgeon (78 FR 57132). The number of permits has ranged from 2,672 in license year 2017 to 2,897 in license year 2016 (Table 7.2). The use of gigs in the southern flounder fishery does not require a specific permit.

Pound nets and gill nets have been the dominant gears, with gill nets leading harvest from the early 1990s through 2013. Recent declines in the gill net landings most likely can be attributed to increased regulations on the large-mesh anchored gill net fishery. The third highest ranking gear for southern flounder in recent years is gig, with gig harvest increasing since 2008 (Table 7.3). Landings from other gears account for approximately two percent of the total landings and include crab and peeler pots, crab and shrimp trawls, hook and line, fyke nets, and haul seines (Table 7.3).

Characterization of Trips

The annual number of commercial trips reporting landings of southern flounder averaged over 20,000 during the 2008 to 2017 period with a peak in 2009 (Table 7.4). The predominate gear by number of trips and participants is the anchored large-mesh gill net fishery, followed by gigs and then pound nets (Table 7.4). Although large-mesh gill nets account for the largest volume of trips per year, the average landings per trip is 61 pounds, which is less than the average landings per trip for pound nets of 377 pounds.

The greater number of participants in the gill net and gig fisheries may be reflective of the relative lower cost of gear compared to the monetary investment required for each pound net in that fishery. Unlike the major gears, catch from other gears can have the second highest number of trips in a given year but the average pounds per trip are low (Table 7.4); unlike the major gears, catch from other gears is not targeted but incidental (for further information see below in *Discards and Bycatch of Southern Flounder*) . The number of trips taken and the number of participants in the fishery can be dependent on the weather as well as management regulations.

Landings by Season and Waterbody

Commercial southern flounder landings and average dockside value and price per pound in North Carolina vary by season. The southern flounder commercial fishery typically begins with the gig fishery in the early summer in the southern part of the state (Core Sound south) as weather allows for increased water clarity necessary for giggers to see flounder when operating at night. During the late summer months, the gill net fishery intercepts the southern flounder that overwintered in the estuaries and have grown to legal size. Gill net harvest typically begins in the western portions of the river systems in Pamlico and Albemarle sounds shifting downstream and eastward as the fish migrate (NCDMF 2019a; see *Sustainable Harvest* Issue Paper).

The gill net fishery harvest increases in the fall as the fish begin to migrate to the ocean to spawn. This migration is what starts the fall flounder pound net fishery, as the gear is passive which means the gear does not move in relation to the fish, gill nets and gigs are mobile and are able to move to follow the fish. This migration period coincides with peak harvest for gill nets and pound nets. For pound nets, harvest typically begins in Currituck Sound in late August and early September following a north to south migration pattern, with Core Sound harvesting flounder through November after the northern portion of the fishery has ended (NCDMF 2019a; see *Sustainable Harvest* Issue Paper). (7)

Commercial fishermen in North Carolina are asked to identify the waterbody in which they caught the majority of their catch during each trip. The Albemarle Sound and its tributaries (includes Albemarle, Croatan, Roanoke, and Currituck sounds as well as Alligator, Chowan, Pasquotank, Perquimans, and Roanoke rivers, and Back Bay) and the Pamlico Sound Region (includes Pamlico Sound and Neuse, Pamlico, Pungo, and Bay rivers) accounted for 76 percent of the total southern flounder harvest from 2008 to 2017 (Table 7.5). During this time period, the average real dockside value was marginally highest in the Pamlico Sound Region.

Commercial Discards and Bycatch of Southern Flounder (8)

Since 2016, the minimum size limit to harvest southern flounder in the commercial fishery is 15 inches. Any undersized southern flounder must be immediately returned to the water (regulatory discard). Discards of undersized flounder primarily occur from gill nets, pound nets, gigs, and shrimp trawls. Some fish are captured and released that are legal size but may not be marketable due to the presence of injuries or sores (unmarketable discards). Management measures, such as yardage restrictions, soak times, minimum mesh size requirements, and pound net escape panels, are used to minimize discards (NCDMF 2019a).

Pound Nets

Data are not available to estimate discards or post-release mortality of southern flounder from commercial pound nets; however, this fishery is known to have discards (unmarketable and regulatory). While the magnitude is unknown, post-release mortality is assumed to be relatively low. Pound nets capture fish by entrapment, as opposed to gilling or entanglement, so southern flounder discards, when culled in a timely and careful manner, can be released with a high likelihood of survival. Additionally, pound nets that are permitted as a "flounder pound net" are required to have escape panels. The escape panels consist of large mesh (a minimum of 5.75-inch stretch mesh) webbing and must be placed in all four bottom corners of the pound. The

required minimum mesh size in the panel is adequate to allow a large portion of undersized southern flounder to escape while larger legal sized flounder are retained (Brown 2014; NCDMF 2017a).

Gill Nets
Gill net bycatch of undersized and unmarketable southern flounder commonly occurs in both large-mesh and small-mesh anchored estuarine gill nets. To minimize bycatch of sub-legal southern flounder, since January 2016 gill nets landing southern flounder are required to have a minimum stretched mesh size of at least six inches. Commercial gill net discards are monitored through onboard observers in the estuarine gill net fishery.

Based on available discard data from the observer program, commercial southern flounder dead discards (fish dead at time net was fished) ranged from a low of just over 4,179 fish in 2017 to over 87,410 fish in 1994 (Figure 7.3). In addition to the dead discards encountered at the net, post-release mortality (assumed to be 23% in stock assessment) associated with the release of live discards ranged from a low of 5,003 fish in 2011 to a high of 40,441 thousand fish in 2008. Estimates of bycatch, both at-net mortality and post-release mortality, were incorporated into the most recent stock assessment (Flowers et al. 2019; http://portal.ncdenr.org/web/mf/fmps-under-development).

Gigs
Due to size limits, regulatory discards in this fishery occur and post-release mortality is assumed to be 100%. Discard estimates in the commercial gig fishery are unknown.

Other Gears (Non-Target)
Non-targeted catch of non-legal sized southern flounder from other gears such as crab and peeler pots, crab and shrimp trawls, channel nets, fyke nets, and haul seines are considered bycatch and must be returned to the water. Marketable legal southern flounder that is retained (incidental catch) from these gears makes up less than two percent of the total commercial landings and has declined over the last 10 years (Table 7.6, Figure 7.4).

From 2008 to 2017, ~55% southern flounder harvested as incidental catch came from the crab and shrimp pot fishery, with landings from the shrimp and crab trawl fishery making up the second largest portion of southern flounder sold as bycatch. Since 2014, landings from trawls have been slightly higher than pots.

The portion of bycatch that is returned to the sea (discarded catch) due to economic, legal, or personal considerations is more difficult to quantify. Discard data is not available for many of the non-targeted fisheries that catch southern flounder. However, studies indicate that flounder species are captured as bycatch in the blue crab pot fishery, with a survival rate exceeding 85% (Doxey 2000; Thorpe et al. 2005). Currently, there are no management measures requiring the use of bycatch reduction devices in crab pots; however, the use of these devices has been shown to be highly effective at excluding fish as bycatch (Morris et al. 2011).

In North Carolina's shrimp trawl fishery, southern flounder represented 1% to 33% of the regulatory discards in the estuarine otter and skimmer trawls and ocean shrimp trawl fishery

(Brown 2009, 2010a, 2010b, 2015, 2016; Brown et al. 2019). In an effort to minimize the discard of sublegal flounder in the shrimp trawl fishery, the 2006 Shrimp FMP initiated management measures limiting the total combined headrope length in the mouths of the Pamlico and Neuse Rivers and all of Bay River as well as restricting the use of otter and crab trawls above the Highway 172 Bridge in the New River (NCDMF 2015). More recently, the MFC voted to require fishermen to use one of four gear combinations tested by an industry workgroup that achieved at least a 40 percent reduction of finfish bycatch (Brown et al. 2019).

Discard data from North Carolina's shrimp trawl observer program was used to help estimate bycatch rates of southern flounder in the South Atlantic shrimp trawl fishery. Results indicate a general decline in bycatch of southern flounder as well as effort from 1989 to 2017. Discards from the shrimp trawl fishery were also found to contribute minimally to the overall catch and were not found to bias the results of the 2019 stock assessment for southern flounder in the South Atlantic (Lee et al. 2018; Flowers et al. 2019).

Summary of Economic Impact of Commercial Fishing

As one of the largest commercial fisheries in the state, southern flounder is a strong economic driver for the industry. From 2008 to 2017, the average southern flounder fishery consistently boasted over 1,000 participants (Table 7.7). Additionally, during this period the ex-vessel value of southern flounder harvest is, on average, 5% of the total value of all commercial seafood landings in the state (NCDMF 2019b).

More broadly, an economic impact assessment of the commercial southern flounder fishery helps demonstrate its influence on the state economy. Using IMPLAN modelling software along with expenditure estimates from NOAA's 2016 Fisheries Economics of the U.S. (FEUS) report, the indirect impacts of the southern flounder fishery to the state economy at-large can be estimated (IMPLAN 2013). For a detailed explanation of the methodology used to estimate the economic impacts refer to the division's License and Statistics Section Annual Report (NCDMF 2019b).

The impact estimates of the commercial southern flounder fishery from 2008 to 2017 taking into account ex-vessel revenues, participants, NOAA FEUS expenditure modifiers, and division socioeconomic survey data are shown in Table 7.7. Overall, the large economic impact of southern flounder to the state's commercial fishing industry is also reflected in its effect on the state economy. Total impacts vary slightly year-to-year, though these values remain relatively consistent from a state-impact perspective. Additionally, it should be noted that the economic activity generated by commercial southern flounder fishing supports over 1,000 additional full- and part-time jobs in the state.

Lastly, within the direct impacts that effort and production have on the value of the commercial flounder industry, there are a number of other factors that can dictate the total economic impact of this fishery at any time, both on a broader market level and individual product level. As a popular seafood across the country, the value of flounder in North Carolina is influenced by broader trends of supply and demand. There is a wide range of competitive substitutes for North Carolina flounder, including flounder caught in other states, as well as seafood products with comparatively similar properties, such as halibut or sole. Because of this, the value of flounder in

North Carolina is not just influenced by the availability of the product in-state, but also the regulations, seasons, and effort for the harvest of flounder and substitute products across the world. However, as flounder is such a popular fish with a number of available substitutes, it is difficult to accurately track how supply of other products directly influences prices in the state.

In addition to the broader dynamics of supply and demand that can influence North Carolina's flounder market, there are also a number of specific factors that can adjust product value on different time scales. Method of catch can often influence prices, as consumers will seek product caught with gears that are perceived as more environmentally friendly, or gears that produce higher-quality flounder (Asche and Guillen 2012). This can lead to increased prices on flounder caught with certain gear versus other gears. Additionally, enterprise-level marketing can often impact product value. Both fishermen and dealers have the ability to market their business and product how they wish.

When these strategies are successful, prices can be raised and value can increase, though this is on an individual level and demonstrates the volatility within the market. Such changes in value can be demonstrated by the positive effects that local product branding and direct-to-consumer strategies have produced in North Carolina (NCREDC 2013; Stoll et al. 2015). While these are just two examples of the variety of factors that can influence the value of North Carolina's flounder industry, they help demonstrate the complicated dynamics at play, as well as the fact that many of the factors driving the price of flounder are not dictated by fishery managers, but by consumers and producers within the market itself.

RECREATIONAL FISHERY (9)

Southern flounder, or flounder species in general, are one of the most sought after recreational species in North Carolina. Southern flounder are taken by recreational anglers using hook and line, gigs, and gill nets. Southern flounder are caught year-round, but most southern flounder harvest occurs during the summer and fall. Depending on the season, anglers fish for southern flounder in inland and coastal waters, including the surf, inlets, and in the nearshore waters of the Atlantic Ocean along live bottom reefs, and wrecks. It should be noted that southern, summer and Gulf flounder are currently managed as an aggregate fishery for the recreational sector. Additional discussion on species specific management and implications of management as an aggregate can be found in the *Increased Recreational Access Issue Paper*.

In North Carolina, recreational landings and effort statistics for southern flounder are obtained through three fishery dependent surveys programs; the Marine Recreational Information Program (MRIP), the Gig Mail Survey, and the Recreational Commercial Gear License Survey (RCGL). These surveys produce estimates of effort and catch with an associated measure of variability (proportional standard error; PSE). As with the commercial fishery, southern, Gulf, and summer flounder are all encountered through MRIP, the gig survey, and the RCGL survey.

Recreational Fishery Data Collection

Marine Recreational Information Program (MRIP) (10)

The MRIP is a national program through the National Oceanic and Atmospheric Administration (NOAA) Fisheries that uses several surveys to obtain catch and effort data at a regional level. The Access Point Angler Intercept Survey (APAIS) provides the catch rates and species composition from anglers fishing in estuarine or marine waters (not freshwater). Anglers who have completed a fishing trip are intercepted and interviewed to gather catch and demographic data, including fishing mode (charter boat, private/rental boat, beach/bank, and man-made structures), area fished, and wave (two-month period).

The MRIP implemented the Fishing Effort Survey (FES) in 2018, an improved methodology of the prior effort survey (Coastal Household Telephone Survey). The data from the APAIS and FES surveys are combined to provide estimates of the total number of fish caught, released, and harvested. Additionally, information is collected on the weight of the harvest, total number of trips, and the number of people participating in marine recreational fishing. For additional information on MRIP see the E-doc and https://www.fisheries.noaa.gov/topic/recreational-fishing-data.

Flounder landings reported through MRIP are available to the species level through direct observation; however, releases are not observed and so are only captured at the genus level, which includes summer, southern, and Gulf flounder. To properly estimate species level releases a ratio of flounder species is obtained from the observed catch through MRIP and applied to the unobserved releases at the corresponding time of year, wave, and fishing area. For further information on species composition and discussion see the *Increased Access for the Recreational Fishery* Issue Paper.

Mail Surveys: Gig Survey and Recreational Commercial Gear License Survey (RCGL)
Gears other than hook-and-line, such as flounder gigs and the recreational use of commercial gear are under-represented within MRIP sampling. The division implemented the Recreational Commercial Gear License (RCGL) Survey in 2002 and the Coastal Angling Program (CAP) Recreational Gigging Mail Survey in 2010. For additional information on these mail surveys see the License and Statistics Annual Report at http://portal.ncdenr.org/web/mf/marine-fisheries-catch-statistics.

The implementation of a mandatory recreational saltwater fishing license in 2007 (Coastal Recreational Fishing License, CRFL) for the harvest of all finfish provides an opportunity to survey participation in gigging at the time of license purchase. The ongoing gig mail survey began in 2010 to collect data concerning effort and catch (11). For the gig survey, no observed catch is available, thus harvest is estimated at the genus level and includes all three flounder species. As a result, when species level information is available, discussion in the recreational fishery section is focused on southern flounder; when species level information is not available, discussion is at the genus level (*Paralichthys spp.*) for flounders. For further information on species composition and discussion see the *Increased Access for the Recreational Fishery I*ssue Paper.

The division allows the use of limited amounts of commercial fishing gear in coastal fishing waters for recreational purposes through issuance of a RCGL. For eight years (2001-2008) two mail surveys of RCGL holders were conducted. Effort information such as seasonal activity, trip

number estimates, and monetary expenditures were categorized by gear type and recorded. Additionally, species-specific information such as catch (both harvested and discarded) and target species was also obtained (NCDMF 2009).

Hook and Line Fishery

Regulatory measures have strongly influenced the species composition of flounder harvested recreationally in North Carolina (12). Summer flounder dominated harvest until a size limit change from 13 to 14 inches in 2002 redistributed the species composition towards southern flounder. In 2011, a 15-inch size limit for the recreational fishery was implemented for all waters within North Carolina, which resulted in a downward trend for both southern and summer flounder (Figure 7.5). North Carolina represents the second largest proportion of recreationally harvested southern flounder in the south Atlantic using hook and line gear (Figure 7.6).

In the North Carolina recreational hook and line fishery, flounder species (13) have been the most often reported target species in 20 of the last 37 years (Figure 7.7). Many flounder are also taken during trips when anglers are targeting other species such as spotted seatrout and red drum.

Anglers catch southern flounder using an array of artificial and natural baits. Preferred artificial baits include soft bodied lures of various colors and shapes fished on the bottom. Bottom fishing using natural live baits (mullet, menhaden, mud minnows, and shrimp) continues to be popular and productive, as well. The recreational harvest of southern flounder exhibits a distinct seasonality that is concentrated between May and October (Figure 7.8).

For further information on recreational landings see the *Sustainable Harvest* and *Increased Recreational Access* Issue Papers.

Gig Fishery

The recreational gig fishery accounted for 11% of total recreational harvest in 2017. Effort estimates for 2008 through 2017 ranged from 13,524 to 25,666 trips annually while harvest estimates ranged from 24,136 to 54,419 fish. Spatially, over 87% of gigging trips originated from Carteret County and south. Like the hook and line fishery, an increase in gigging trips was observed from May through October with a peak in harvest in the summer as weather allows for increased water clarity necessary for giggers to see flounder when operating at night. For a more detailed description of the recreational gig fishery see the License and Statistics Annual Report and the *Sustainable Harvest* Issue Paper.

RCGL Fishery (14)

Data on RCGL gears are only available from 2002 to 2008 due to funding being cut for the RCGL survey. Among the allowed gears, large mesh gill nets comprised 73.7% of southern flounder harvest with small mesh gill nets (21.4%), crab pots (3.8%), and shrimp trawls (1.2%) constituting the remainder (NCDMF 2009). The number of flounder *spp*. harvested between 2002 and 2008 ranged from 18,414 to 53,785 fish. The number of licensed individuals participating in the RCGL fishery has steadily decreased from approximately 6,000 in 2000 to

1,800 in 2017 (Figure 7.9). This is the best indicator currently available of effort in the RCGL fishery. For additional information on licenses see the License and Statistics Annual Report or for RCGL survey analysis see the 2009 License and Statistics Annual Report (NCDMF 2009).

Recreational Discards and Bycatch of Southern Flounder

The minimum size limit to harvest southern flounder is 15 inches total length. Any southern flounder not legal for harvest must be immediately returned to the water. Primary gears used by recreational fishermen that capture southern flounder which are not legal for harvest include hook-and-line and gigs. These gears are also the primary gears used to capture legal size southern flounder.

Hook and line is the primary gear for taking southern flounder for recreational purposes in North Carolina. North Carolina represents the largest recreational proportion of released flounder in the South Atlantic (Figure 7.10). This is driven by the aforementioned regulatory measures. Specifically, the increase in size limit to 15 inches in 2011 resulted in a ratio of nine discarded fish for every one fish harvested in North Carolina (Figure 7.10). A 12-inch size limit in Florida has allowed the ratio of discard to harvest to remain approximately 1:1.

The stock assessment assumes a post-release mortality for hook-and-line released southern flounder of 9% (See SAR section 2.1.4 in Flowers et al. 2019, http://portal.ncdenr.org/web/mf/fmps-under-development). The post-release mortality and magnitude of discards in this fishery make these removals a major contributor to the overall fishing mortality being experienced by this stock. In recent years, post-release mortality associated with recreational releases is nearly equal to the number of removals from recreational harvest.

In the recreational gig fishery, discard estimates are available from 2010 to 2017 through a division recreational flounder gigging mail survey. This survey estimates the number of trips, as well as southern flounder harvest and discards (See SAR Section 2.1.5 in Flowers et al. 2019, http://portal.ncdenr.org/web/mf/fmps-under-development). Discard estimates ranged from 655 to 9,726 fish annually and represent only a small portion (less than 1%) of the overall removals from the recreational fishery.

Between 2002 and 2008 the number of discarded flounder *spp*. from RCGL gears ranged from approximately 15,000 to 52,000 fish. Large and small mesh gill nets contributed 58.9% of discards throughout the time series. Despite making up a small portion of the overall trips (4.8%) and harvest (1.2%), shrimp trawls disproportionately contributed to discards of southern flounder. Flounder *spp*. discards from shrimp trawls ranged from 15.1 to 51.2% and averaged 31.7% of all flounder discards from RCGL gears for the time series.

Demographic Characteristics

The average angler participating in recreational harvest of southern flounder is a male older than 47 (NCDMF unpublished data). Anglers targeting or harvesting southern flounder represented all 100 North Carolina counties, all 50 states, and the District of Columbia (Table 7.8). Anglers

harvest southern flounder by three different modes: shore; for-hire boats; and private boats. Private boat anglers harvest the largest volume of southern flounder in the recreational fishery (Figure 7.11). Due to low sample sizes and high PSE southern flounder data from the for-hire industry is unreliable. Data suggest the for-hire fleet capture flounder at a higher rate than the recreational fishery thus fewer people are having a larger impact.

Summary of Economic Impact of Recreational Fishing

The economic impact estimates presented for southern flounder recreational fishing represent the economic activity generated from trip expenditures. These estimates are a product of annual trip estimations originating from the NOAA Fisheries MRIP effort data by area and by mode (i.e., shore, for-hire, private/rental vessel, and man-made), and trip expenditures estimates from the division economics program biennial socioeconomic survey of CRFL license holders (Dumas et al. 2009; Crosson 2010; Hadley 2012; Stemle and Condon 2017). The product of these estimates gives us an annual estimate of trip expenditures made by all licensed anglers for a given year. For this analysis, a recreational flounder trip is defined as a fishing trip for which any flounder was the primary or secondary target species by the angler, or if southern flounder was caught during that trip.

Additionally, this data is used to generate state-level economic impact estimates of recreational flounder fishing in North Carolina. Using IMPLAN statistical software, these direct expenditure estimates from recreational flounder fishing produce indirect output impacts to the state economy across four categories: sales, labor income, value-added impacts, and employment (IMPLAN 2013). Additionally, all imputed expenditure estimates are adjusted for inflation based on 2016 prices, as this was the most recent year of expenditure survey data. For a detailed explanation of the methodology used to estimate the economic impacts please refer to the division's License and Statistics Section Annual Report, which can be found at: http://portal.ncdenr.org/web/mf/marine-fisheries-catch-statistics.

Table 7.9 shows the economic impacts associated with recreational southern flounder fishing in North Carolina from 2008 to 2017. Aside from a spike in 2008 and a dip in 2017 (likely due to the effects of Hurricane Florence) recreational flounder effort is relatively stable over time. With this, the economic impact from this fishery is also stable over time, but recreational flounder angling represents a sizeable contribution to the state economy. The top industries impacted by recreational southern flounder fishing in terms of output sales and employment are retail gasoline stores, retail sporting goods stores, retail food and beverage stores, real estate, and wholesale trade businesses.

It should be noted that not included in these estimates, but often presented in division overall recreational impacts models, are the durable good impacts from economic activity associated with the consumption of durable goods (e.g., rods and reels, other fishing related equipment, boats, vehicles, and second homes). Durable goods represent goods that have multi-year life spans and are not immediately consumable. Some equipment related to fishing is considered durable goods. However, we cannot estimate the durable goods expense of anglers for a given species. Durable goods expenses and impacts are estimated on an annual basis and serve to supplement angler expenditures outside of trip-based estimates.

Lastly, it should be noted that due to the size and popularity of recreational flounder fishing in North Carolina, changes in access to this fishery may lead to tangible, yet unquantifiable impacts to the value of other sport fisheries (Scheld et al. 2020). Broadly, participants target flounder more than other recreational species due to a higher individual utility gained from fishing for this species over others in North Carolina. However, it is unknown whether this benefit from flounder fishing would transfer to other fisheries if effort restrictions were put in place. In other words, there is a possibility that when faced with reduced access to flounder fishing, some anglers may choose to not fish at all, rather than seek out new target species. Alternatively, the utility of flounder fishing may not be significantly greater than other species, and anglers would target other species more frequently.

Through this complicated dynamic, the value and economic impact of other recreational species may increase or decrease based on this concept of per-species utility. However, while it is important to acknowledge how flounder management may economically impact other fisheries, this interaction is not fully understood, and therefore it cannot be determined how the value of other recreational species would shift with changes in access to flounder.

SUMMARY OF FISHERIES CONCLUSION

Both the commercial and recreational fisheries combine to create a very dynamic southern flounder fishery in North Carolina with a combined economic value of over 600 million dollars to the state of North Carolina. The commercial fishery has seen continuous declines in harvest and effort from nearly 42,475 trips in 1994 to 17,963 trips in 2017 and landings from over 4.8 million pounds down to roughly 1.4 million pounds (Figure 7.12). The recreational sector has seen an increase in both effort and harvest and a major increase in releases since 1994, with trips remaining relatively steady from 1.31 million trips in 1994 to 1.25 million trips in 2017 and harvest increasing from three-hundred thousand pounds in 1994 to four-hundred thousand pounds in 2017 with over one-million pounds harvested in 2010 (Figure 7.12). Recreational releases have also increased through the years from five-hundred thousand fish to over 1.9 million fish released in 2017. Additional information describing discards is in the Stock Assessment of Southern Flounder (*Paralichthys lethostigma*) in the South Atlantic, 1989-2017, available at http://portal.ncdenr.org/web/mf/fmps-under-development.

A more in depth analysis and discussion of North Carolina's commercial and recreational southern flounder fisheries can be found in earlier versions of the Southern Flounder FMP (NCDMF 2005, 2013, 2019a); and 2018 and 2019 Southern Flounder Stock Assessments (Lee et al. 2018; Flowers et al. 2019); all documents are available on the division website at: http://portal.ncdenr.org/web/mf/fmps-under-development, the *Sustainable Harvest* Issue Paper, or the License and Statistics Annual Report produced by the division which can be found at: http://portal.ncdenr.org/web/mf/marine-fisheries-catch-statistics.

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Table 7.1. North Carolina commercial southern flounder landings in pounds and value, 2008-2017. Source: North Carolina Trip Ticket Program.

Year	Harvest	Reported Dockside Value	Reported Dockside Price Per Pound	Inflation Adjusted Dockside Value	Inflation Adjusted Dockside Price per Pound
2008	2,602,390	$5,650,295	$2.17	$6,500,664	$2.50
2009	2,396,240	$4,609,932	$1.92	$5,350,287	$2.23
2010	1,689,557	$3,695,889	$2.19	$4,086,544	$2.42
2011	1,247,450	$2,753,128	$2.21	$2,832,693	$2.27
2012	1,646,137	$4,451,482	$2.70	$4,600,162	$2.79
2013	2,186,391	$5,673,190	$2.59	$5,921,675	$2.71
2014	1,673,511	$4,839,672	$2.89	$4,833,380	$2.89
2015	1,202,885	$3,823,567	$3.18	$3,908,832	$3.25
2016	897,765	$3,610,533	$4.02	$3,731,125	$4.16
2017	1,394,617	$5,655,751	$4.06	$5,655,751	$4.06
Average	1,693,694	$4,476,344	$2.64	$4,742,111	$2.80

Table 7.2. Number of pound net permits by year of expiration and estuarine gill net permits by license year (July 1 to June 30). Source: North Carolina Trip Ticket Program.

Year (Expiration Year or License Year)	Pound Net Permits Issued	Estuarine Gill Net Permits Issued
2008	304	
2009	299	
2010	296	
2011	293	
2012	267	
2013	271	
2014	285	
2015	271	2,674
2016	283	2,897
2017	278	2,672
Average	285	2,748

Table 7.3. Annual southern flounder landings in pounds by gear type, 2008-2017. Numbers in parentheses are the percent of the total landings for each gear for a given year. Source: North Carolina Trip Ticket Program.

Year	Gill Net	Pound Net	Gigs	Other	Total
2008	1,770,204 (68%)	685,546 (26%)	82,846 (3%)	63,793 (2%)	2,602,390
2009	1,658,074 (69%)	591,534 (25%)	84,303 (4%)	62,329 (3%)	2,396,240
2010	958,271 (57%)	571,151 (34%)	128,081 (8%)	32,054 (2%)	1,689,557
2011	652,810 (52%)	464,546 (37%)	113,414 (9%)	16,680 (1%)	1,247,450
2012	879,373 (53%)	569,388 (35%)	149,387 (9%)	47,989 (3%)	1,646,137
2013	1,096,060 (50%)	924,887 (42%)	118,489 (5%)	46,955 (2%)	2,186,391
2014	659,394 (39%)	860,216 (51%)	135,273 (8%)	18,628 (1%)	1,673,511
2015	392,339 (33%)	667,847 (56%)	130,277 (11%)	12,422 (1%)	1,202,885
2016	361,570 (40%)	398,258 (44%)	126,983 (14%)	10,953 (1%)	897,765
2017	552,292 (40%)	697,814 (50%)	136,094 (10%)	8,416 (1%)	1,394,617
Average	898,039 (53%)	643,119 (38%)	120,515 (7%)	32,022 (2%)	1,693,694

*Percentages may not total 100% due to rounding.

Table 7.4. Annual trips, average landings per trip (APT), and number of participants (#PAR) by gear type in the southern flounder fishery, 2008-2017. Source: North Carolina Trip Ticket Program.

Year	Trips[1] / APT / #PAR[2]	Gill Net Trips/ APT/ #PAR	Pound Net Trips / APT / #PAR	Gig Trips / APT / #PAR	Other Trips / APT / #PAR
2008	28,966 / 90 / 1,235	23,493/ 75 / 924	1,508 / 455 / 83	1,459 / 57 / 140	2,510 / 25 / 413
2009	29,395 / 82 / 1,299	23,691 / 70 / 992	1,746 / 339 / 85	1,450 / 58 / 143	2,510 / 25 / 426
2010	20,408 / 83 / 1,182	15,134 / 63 / 837	1,610 / 355 / 84	2,283 / 56 / 226	1,384 / 23 / 329
2011	15,810 / 79 / 1,039	11,403 / 57 / 759	1,370 / 339 / 63	2,076 / 55 / 212	963 / 17 / 250
2012	20,926 / 79 / 1,202	14,713 / 60 / 855	1,754 / 325 / 84	3,000 / 50 / 288	1,462 / 33 / 291
2013	23,579 / 93/ 1,286	16,968 / 65 / 933	2,111 / 438 / 82	2,408 / 49 / 270	2,094 / 22 / 343
2014	18,121 / 92 / 1,222	11,778 / 56 / 799	1,806 / 476 / 88	2,655 / 51 / 316	1,887 / 10 / 373
2015	13,880 / 87 / 1,029	8,465 / 46 / 674	1,803 / 370 / 81	2,616 / 50 / 307	1,002 / 12 / 249
2016	13,336 / 67 / 945	8,422 / 43 / 591	1,423 / 280 / 77	2,657 / 48 / 323	838 / 13 / 227
2017	17,963 / 78 / 1,048	12,363 / 45 / 713	1,908 / 366 / 88	2,752 / 49 / 310	943 / 9 / 237
Average	20,238 / 84 / 1,149	14,643 / 61 / 808	1,704 / 377/ 82	2,336 / 52 / 254	1,559 / 21 / 314

1 The number of trips, average landings per trip, and number of participants is from all trips that recorded southern flounder across all gear types including pound nets, gill nets, gigs, and other.
2 The annual number of participants cannot be summed by gear as many individuals fish multiple gears per trip.

Table 7.5. Southern flounder landings (millions of pounds) and average dockside price per pound by area, 2008-2017. Numbers in parentheses are the percent of the total landings for each area for a given year. Source: North Carolina Trip Ticket Program.

Year	Albemarle Sound Region	Pamlico Sound Region	Core Sound and South	Statewide
2008	1.2 (44%) / $2.15	0.8 (31%) / $2.23	0.6 (25%) / $2.13	2.7 / $2.17
2009	1.1 (44%) / $1.91	0.9 (37%) / $1.95	0.5 (20%) / $1.90	2.5 / $1.92
2010	0.4 (27%) / $2.14	0.9 (51%) / $2.23	0.4 (23%) / $2.14	1.7 / $2.19
2011	0.1 (7%) / $2.15	0.8 (63%) / $2.20	0.4 (30%) / $2.23	1.3 / $2.21
2012	0.7 (40%) / $2.68	0.6 (37%) / $2.77	0.4 (23%) / $2.64	1.7 / $2.70
2013	0.9 (40%)/ $2.48	0.9 (43%) / $2.69	0.4 (17%) / $2.62	2.2 / $2.59
2014	0.5 (32%) / $2.84	0.8 (48%) / $2.90	0.3 (20%) / $2.97	1.6 / $2.89
2015	0.3 (28%) / $3.15	0.5 (44%) / $3.17	0.3 (28%) / $3.21	1.1 / $3.18
2016	0.2 (20%) / $3.99	0.4 (50%) / $4.04	0.3 (30%) / $4.02	0.9 / $4.02
2017	0.3 (23%) / $4.02	0.7 (50%) / $4.08	0.4 (27%) / $2.23	1.4 / $4.06
Average	0.6 (33%) / $2.75	0.7 (44%) / $2.89	0.4 (23%) / $2.79	1.7 / $2.79

*Percentages may not total 100% due to rounding.

Table 7.6. Pounds of southern flounder landed as bycatch in other gears, 2008-2017.

	Gear						
Year	Pots (crab & shrimp)	Trawls (crab & shrimp)	Fyke Nets	Channel Nets	Misc.	Total Bycatch Landings	Total Commercial Landings
2008	34,158	21,379	903	463	5,385	62,288	2,602,390
2009	29,091	28,874	654	32	2,046	60,697	2,396,240
2010	17,493	10,073	179	853	1,045	29,643	1,689,557
2011	5,275	8,963	38	162	795	15,232	1,247,450
2012	39,602	4,647	66	783	513	45,611	1,646,137
2013	30,080	13,549	292	395	331	44,646	2,186,391
2014	5,883	9,425	389	309	552	16,556	1,673,511
2015	2,256	3,451	4,538	215	207	10,666	1,202,885
2016	2,265	5,138	1,128	155	441	9,127	897,765
2017	2,492	3,429	80	161	552	6,714	1,394,617
Total	168,595	108,929	8,267	3,525	11,864	301,180	16,936,944
Percentage of Bycatch Only Landings	56%	36%	3%	1%	4%	100%	
Percentage of Total Commercial Landings	1%	1%	0%	0%	0%	2%	100%

Table 7.7. Economic impacts associated with commercial southern flounder fishing in North Carolina from 2008-2017. Data below represents the actual effort data from southern flounder harvest, along with the estimated economic impacts to the state of North Carolina using IMPLAN statistical software. Data from the 2016 NOAA Fisheries Economics of the U.S. report, along with internal division survey data, are also used to generate estimates. Note: impact estimates across categories are not additive.

Year	Pounds Landed	Ex-vessel Value	Participants	Estimated Sales Impact	Estimated Income Impacts	Estimated Employment Impact	Estimated Value Added Impact
2008	2,602,390	$ 5,650,295	1,235	$ 25,473,137	$ 10,483,954	1,544	$ 19,654,727
2009	2,396,240	$ 4,609,932	1,299	$ 20,547,716	$ 8,550,927	1,545	$ 16,161,407
2010	1,689,557	$ 3,695,889	1,182	$ 15,743,327	$ 6,531,811	1,380	$ 12,223,365
2011	1,247,450	$ 2,753,128	1,039	$ 11,771,643	$ 4,884,958	1,186	$ 9,140,235
2012	1,646,137	$ 4,451,482	1,202	$ 18,795,084	$ 7,827,308	1,440	$ 14,613,360
2013	2,186,391	$ 5,673,190	1,286	$ 23,172,478	$ 9,654,261	1,591	$ 17,977,144
2014	1,673,511	$ 4,839,672	1,222	$ 19,547,618	$ 8,134,986	1,482	$ 15,109,459
2015	1,202,885	$ 3,823,567	1,029	$ 15,852,258	$ 6,621,987	1,235	$ 12,379,619
2016	897,765	$ 3,610,533	945	$ 10,724,064	$ 6,301,409	1,129	$ 11,716,727
2017	1,394,617	$ 5,655,751	1,048	$ 20,489,984	$ 9,494,322	1,335	$ 17,676,161
Average	1,693,694	$ 4,476,342	1,149	$ 18,211,731	$ 7,848,592	1,387	$ 14,665,220

Table 7.8. Contribution of North Carolina counties and other states to flounder fisheries.

	APAIS		RCGL		Gigging Survey	
Categories	**Counties/States**	**%**	**Counties/States**	**%**	**Counties/States**	%
Top 10 Counties	New Hanover	11.3	Craven	9.3	Wake	7.61
	Dare	6.4	Carteret	7.4	New Hanover	6.94
	Brunswick	6.1	New Hanover	6.9	Carteret	5.56
	Carteret	4.5	Beaufort	6.1	Onslow	4.64
	Wake	3.8	Brunswick	5.9	Brunswick	3.98
	Onslow	3.2	Wake	5.2	Johnston	3.08
	Pitt	2.2	Pitt	4.8	Pender	3.07
	Craven	2.1	Onslow	4.3	Craven	2.99
	Pender	2.1	Pamlico	4.1	Guilford	2.63
	Guilford	1.8	Dare	3.7	Dare	2.58
Top 5 Other States	Virginia	10.3	Florida	0.2	Virginia	2.39
	Pennsylvania	2.9	Pennsylvania	0.2	South Carolina	1.06
	Maryland	2.3	Tennessee	0.2	Pennsylvania	0.48
	South Carolina	1.0	California	0.2	Maryland	0.34
	New Jersey	0.9			Georgia	0.20

Table 7.9. Economic impacts associated with recreational southern flounder fishing in North Carolina from 2008-2017. Impacts are generated using IMPLAN statistical software and division recreational survey data. Trips are defined as a fishing trip for which any flounder is the primary or secondary target, or southern flounder was caught during that trip. All job impacts represent both part- and full-time jobs. Note: Impact estimates across categories are not additive.

Year	Estimated Total Flounder Trips	Trip Expenditures	Estimated Sales Impact	Estimated Income Impact	Estimated Employment Impact	Estimated Value-Added Impact
2008	2,701,930	$ 403,612,123	$ 376,417,686	$ 135,957,566	3,292	$ 205,722,681
2009	1,482,500	$ 215,695,683	$ 200,699,372	$ 72,448,738	1,770	$ 109,870,023
2010	1,877,504	$ 280,546,465	$ 262,481,379	$ 95,039,325	2,312	$ 143,569,612
2011	1,796,204	$ 283,056,149	$ 250,861,698	$ 90,609,485	2,212	$ 137,255,698
2012	1,744,458	$ 277,772,559	$ 244,156,371	$ 88,393,860	2,159	$ 133,589,470
2013	1,707,904	$ 273,226,860	$ 238,202,597	$ 86,449,024	2,105	$ 130,332,132
2014	1,639,593	$ 269,763,604	$ 229,373,566	$ 83,466,334	2,027	$ 125,444,042
2015	1,708,499	$ 279,669,886	$ 228,724,518	$ 83,228,735	2,037	$ 125,250,995
2016	1,714,200	$ 279,905,674	$ 232,116,853	$ 84,789,195	2,079	$ 127,093,283
2017	1,250,216	$ 210,976,279	$ 171,358,430	$ 62,652,077	1,532	$ 93,793,106
Average	1,762,301	$ 77,422,528	$ 243,439,247	$ 88,303,434	2,153	$ 133,192,104

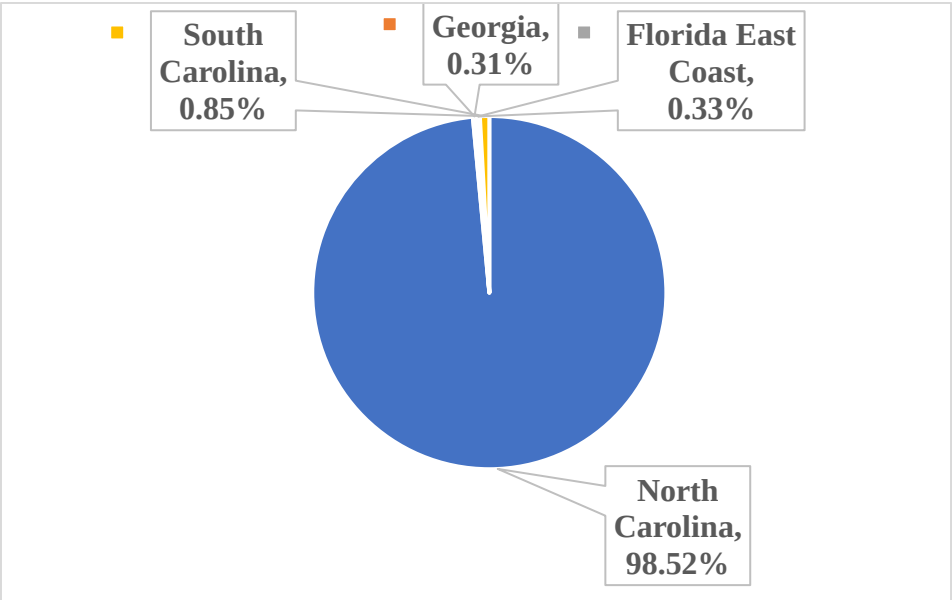

Figure 7.1. Average contribution to U.S. South Atlantic coast southern flounder commercial landings by state, 1978-2017. Source: NOAA Fisheries Annual Commercial Landing Statistics and North Carolina Trip Ticket Program.

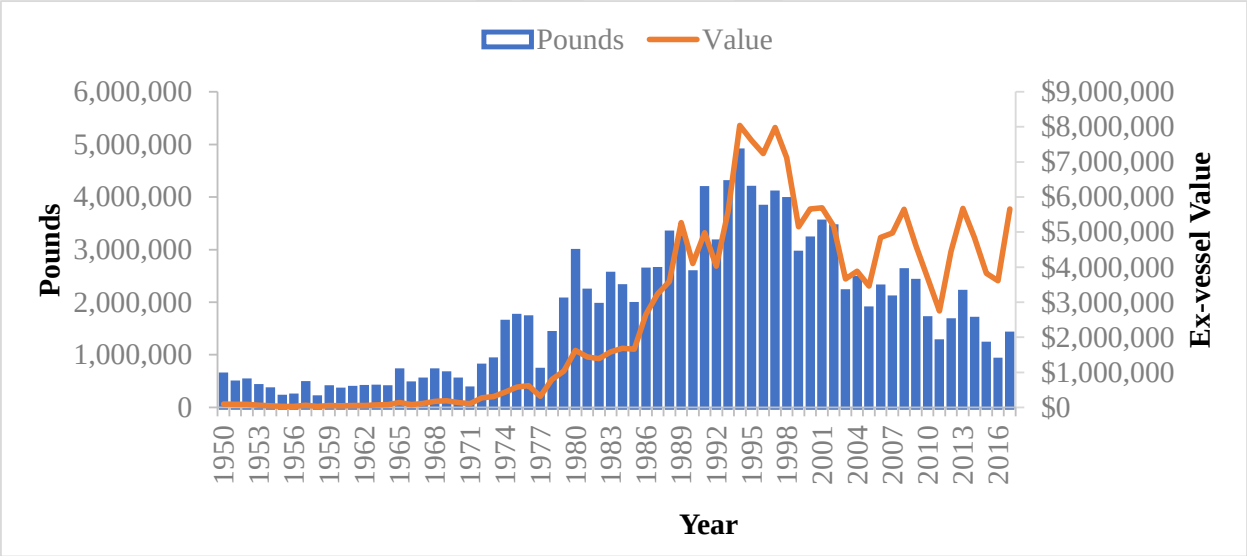

Figure 7.2. North Carolina annual southern flounder commercial landings and value, 1950-2017. Source: North Carolina Trip Ticket Program.

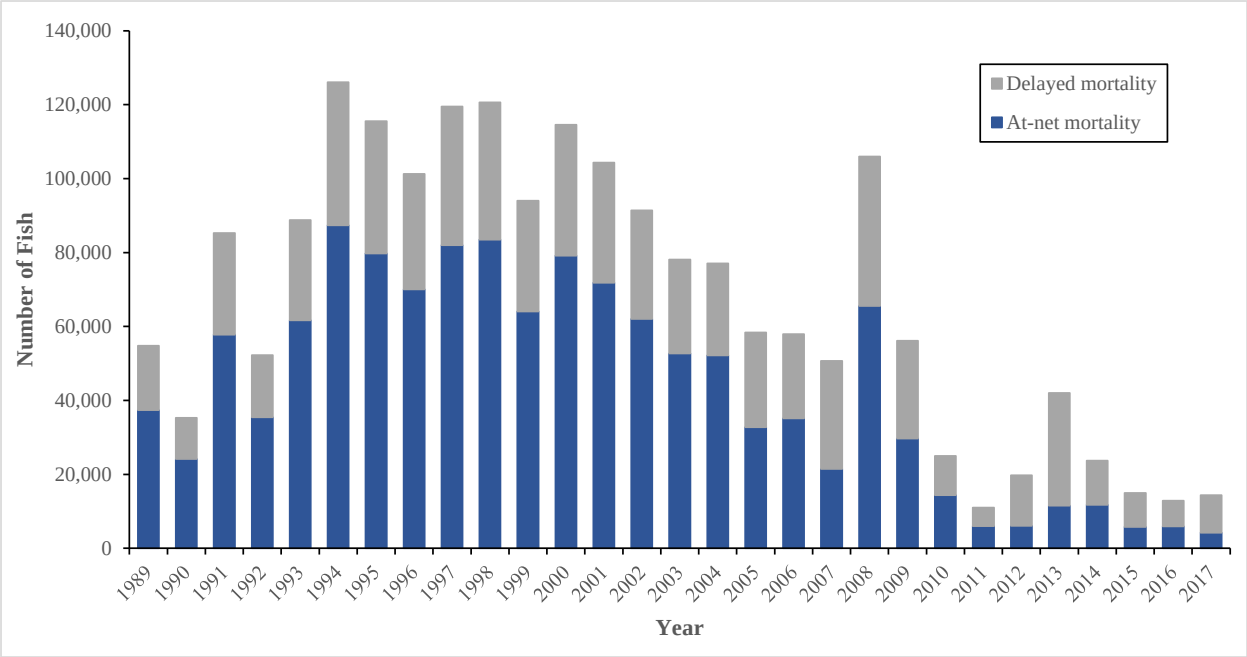

Figure 7.3. Estimated number of dead discards associated with the North Carolina estuarine gill net fishery.

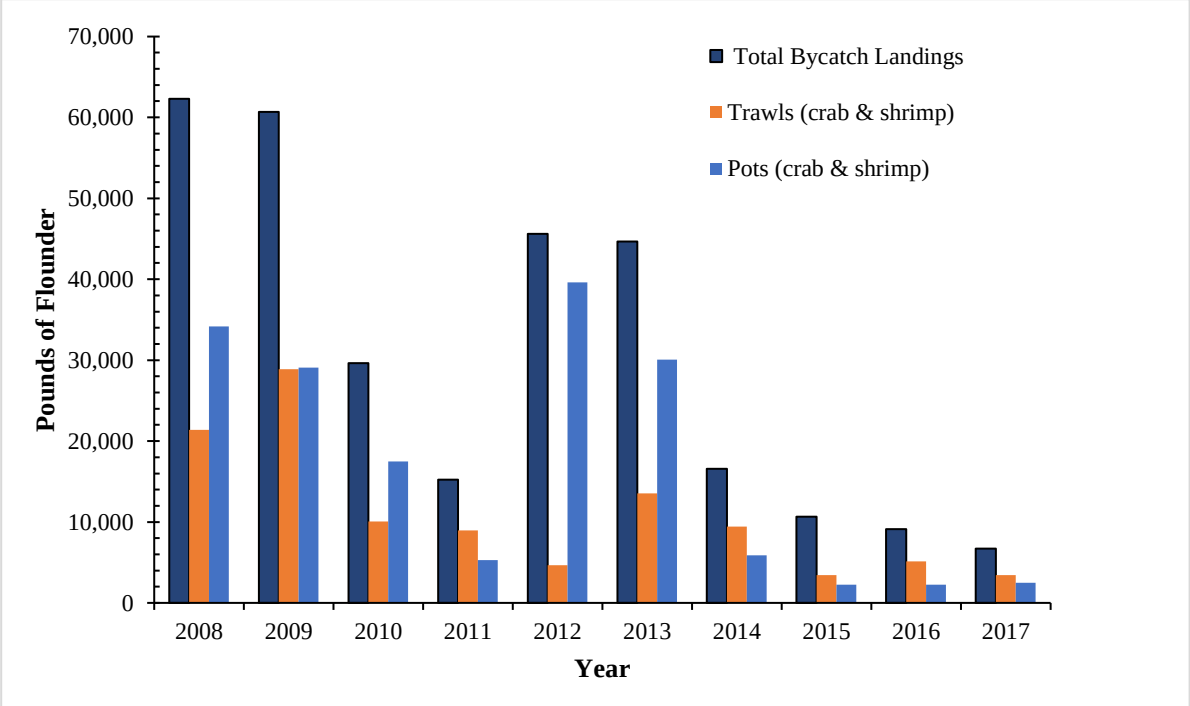

Figure 7.4. Pounds of southern flounder harvested as bycatch from other fisheries, 2008-2017. Source: North Carolina Trip Ticket Program.

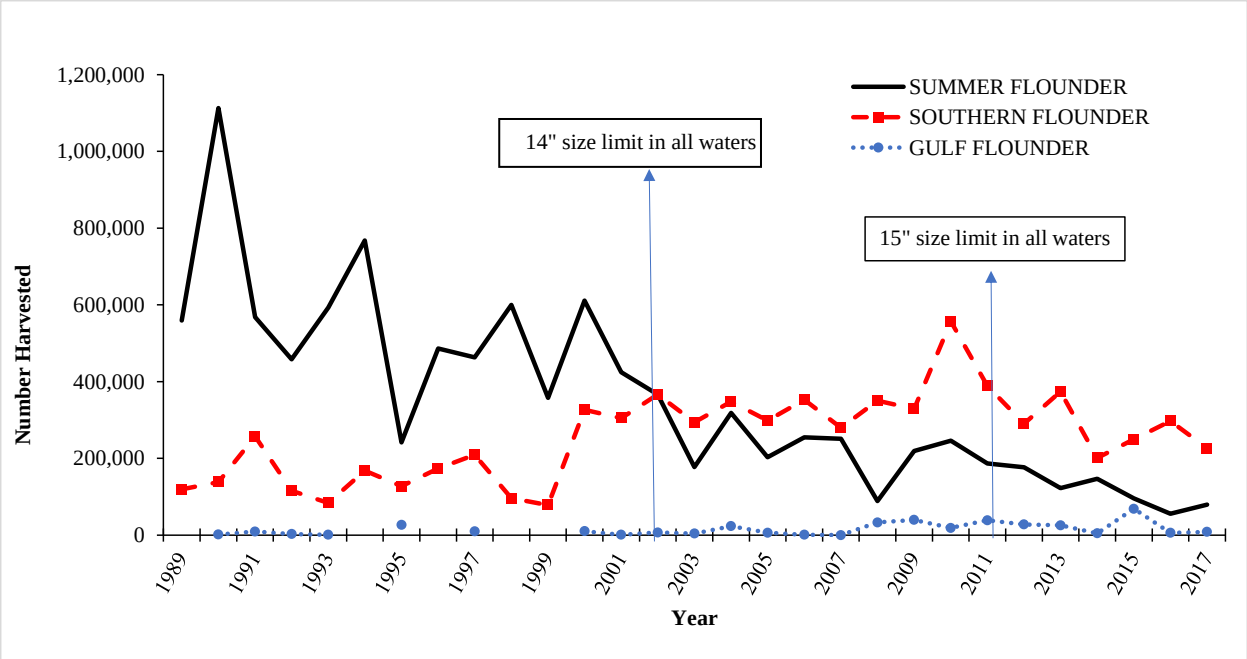

Figure 7.5. Distribution of flounder species harvested in North Carolina, 1989-2017. Source: Marine Recreational Information Program.

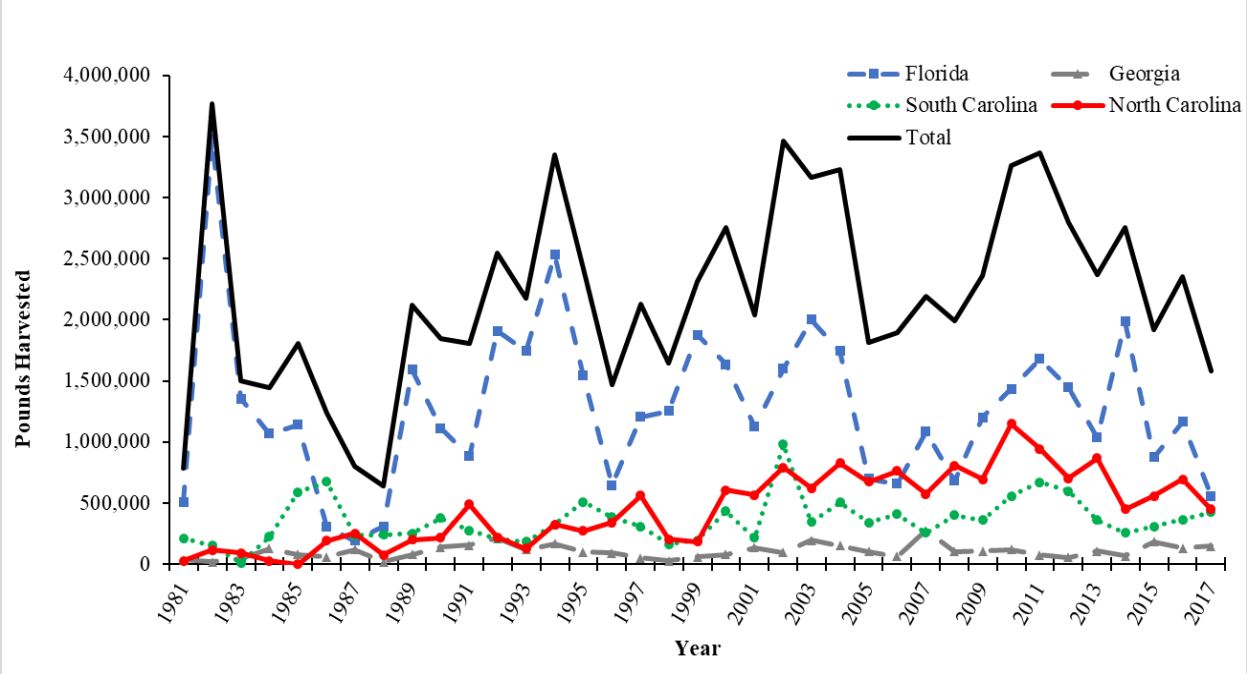

Figure 7.6. Hook-and-line harvest of southern flounder (in pounds) estimated through MRIP for North Carolina through the east coast of Florida, 1981-2017. Source: Marine Recreational Information Program.

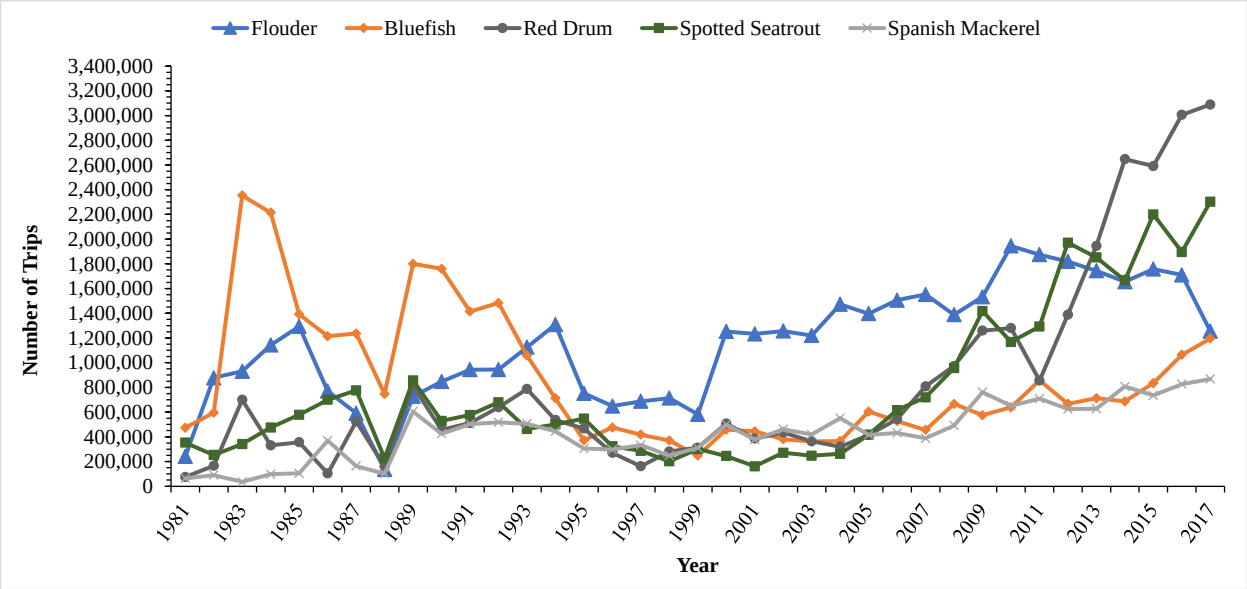

Figure 7.7. Hook and line Trips targeting five top species in North Carolina 1981-2017. Source: Marine Recreational Information Program.

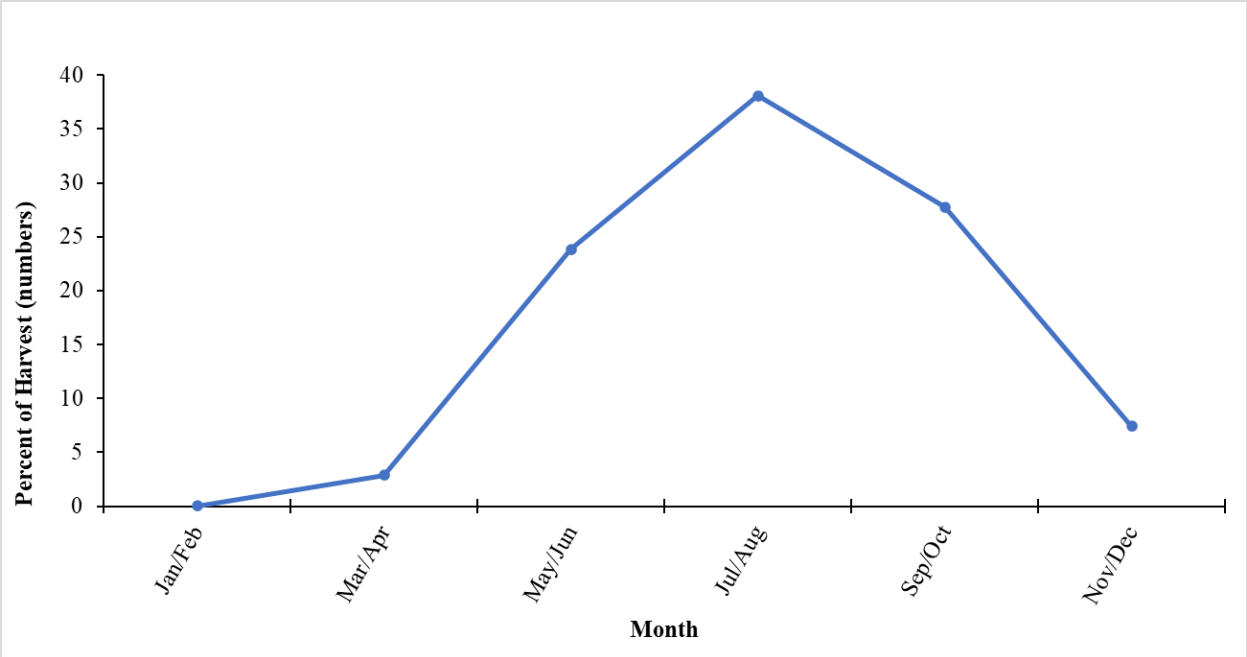

Figure 7.8. Seasonality of southern flounder harvest within North Carolina, 1981-2017. Source: Marine Recreational Information Program.

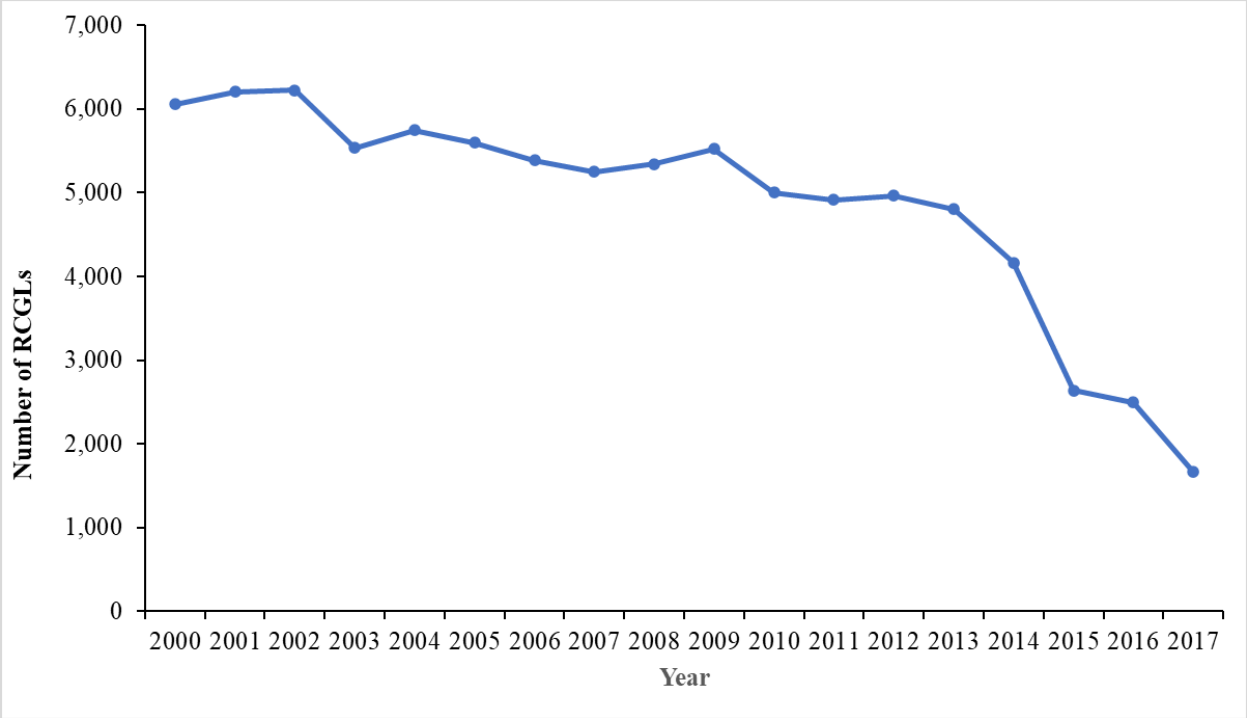

Figure 7.9. The number of Recreational Commercial Gear License's (RCGL) issued 2000-2017.

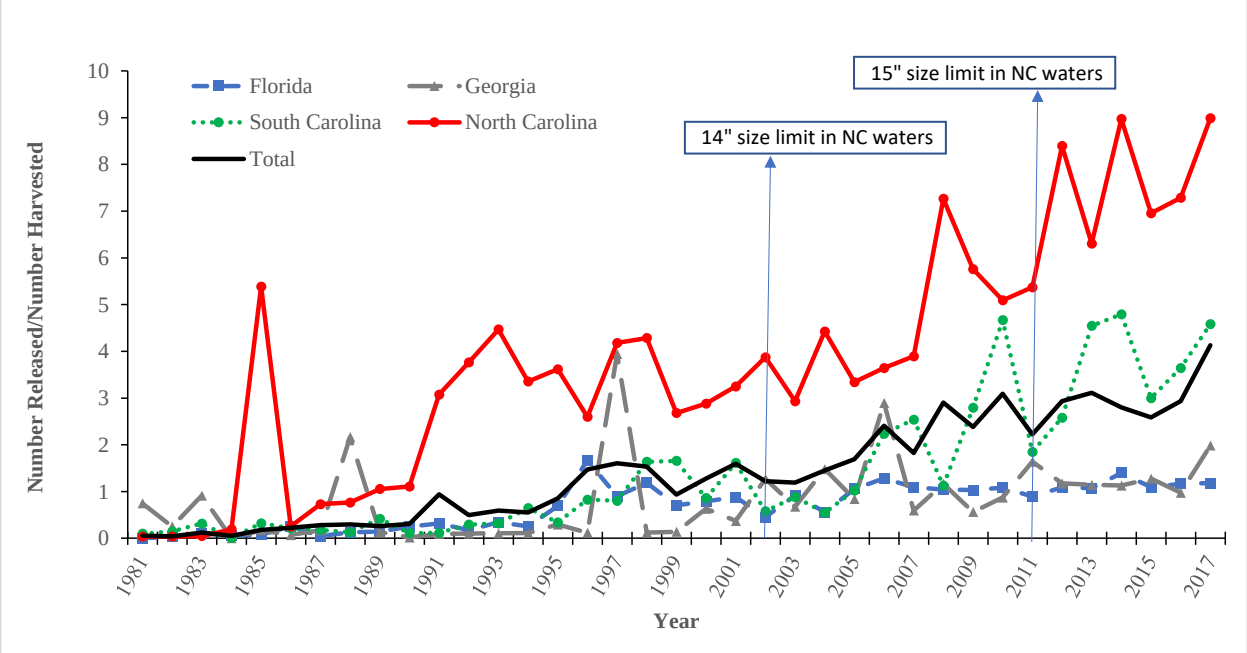

Figure 7.10. Ratio of the number of southern flounder released compared to harvested in the hook-and-line fishery as estimated through MRIP for North Carolina through the east coast of Florida, 1981-2017.

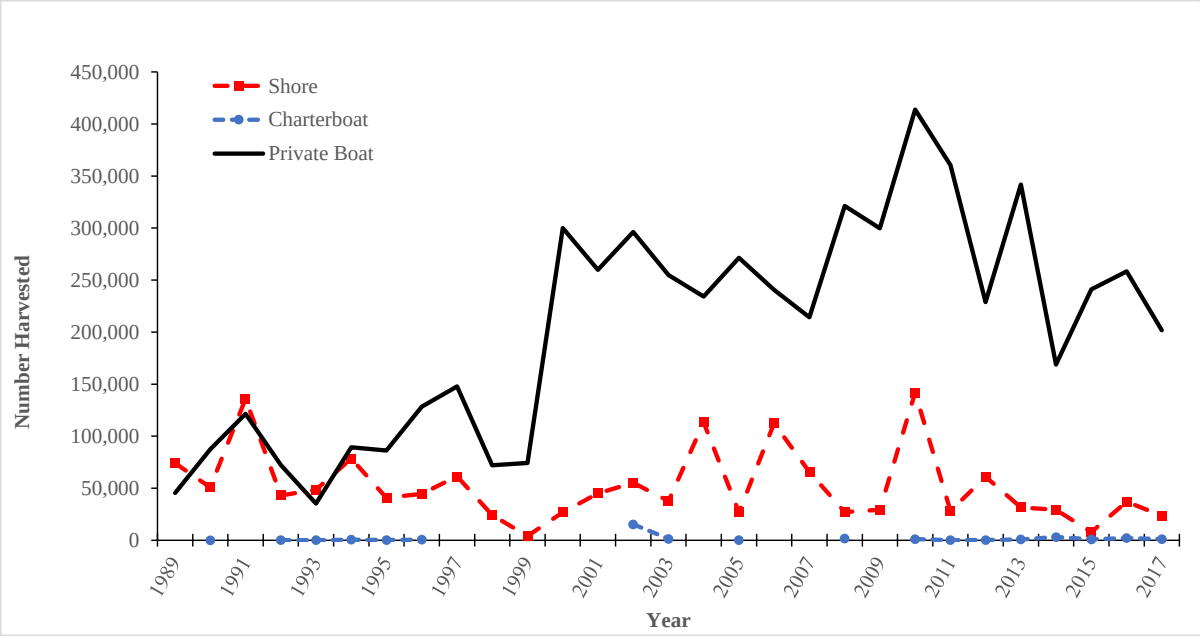

Figure 7.11. Number of southern flounder harvested by MRIP mode, 1989-2017.

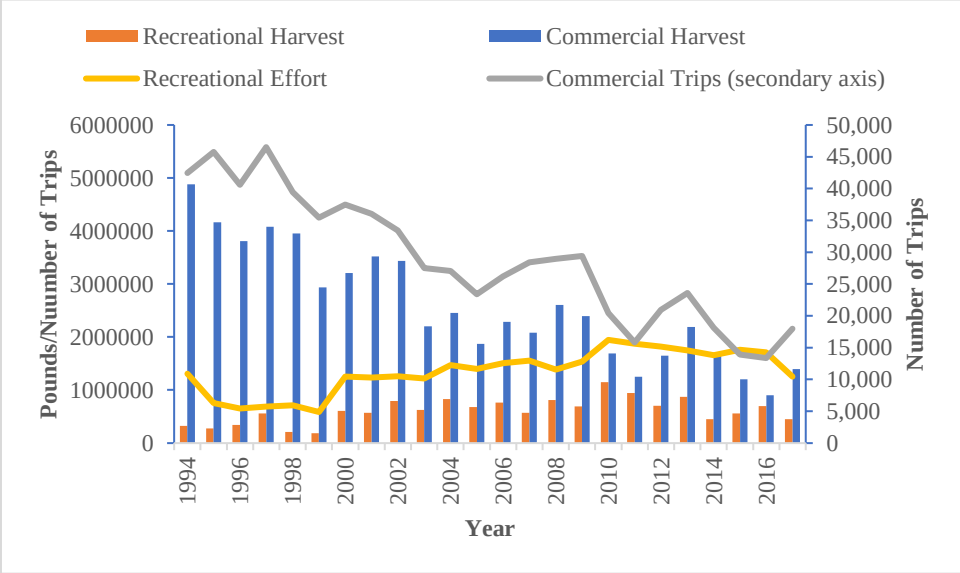

Figure 7.12. Commercial and recreational landings and trips from the N.C. Southern Flounder Fishery, 1994-2017. Recreational trips and harvest in this figure do not include recreational commercial gear or the gig fishery, as estimates are only available for small portions of this time series.

Text Boxes and Images

1) Picture of commercial fisherman fishing gill net

2) Text Box:
   Eating Fresh Raw Flounder
   Many southern flounder landed by pound nets in the fall are kept alive and sold to sushi and sashimi processors.

3) Text Box: FISHERY MONITORING
   The division monitors commercial landings and fishing effort through a trip ticket program. Through this program, the division collects information about commercial fishermen's harvest (i.e., what it is, where it was caught, how it was caught, and how much was caught) from licensed seafood dealers. The division also conducts economic research pertaining to North Carolina and Atlantic coastal fisheries resources using information from the trip ticket program and surveys.

4) Picture of fish house sampling

5) Text Box: Large and medium size grades accounted for 87 percent of landings and 85 percent of the dockside value of southern flounder harvested in North Carolina from 2008 to 2017.

   What do the commercial flounder size categories mean?
   - Jumbo: average length is 20 inches and average weight is 11 pounds
   - Large: average length is 17 inches and average weight is 5.5 pounds
   - Medium: average length is 14 inches and average weight is 3.0 pounds
   - Mixed/Small: average length is 14 inches and average weight is 3.5 pounds

6) Pictures of the primary gears (would be particularly good if have decent pound net picture)

7) Text Box: While southern flounder are harvested by gill nets and gigs coastwide, active flounder pound net sets only occur from Core Sound north.

8) Text Box: Discards and bycatch are closely related. Bycatch is the portion of the catch that is not comprised of the fishery's targeted species. Discards are the portion of the targeted catch that is thrown back into the sea

9) Picture of MRIP sampler

10) Text Box: MRIP
    Through MRIP, NOAA develops, improves, and implements surveys that measure the number of trips taken and number of fish harvested by saltwater anglers.

11) Text box: Gigs and the Coastal Recreational Fishing License

The division uses anglers who identified the use of gigs when they purchased their CRFL as the database of anglers for the ongoing gig survey.

12) Text Box:
Size Regulations
Not only do size regulations affect the species composition of the harvest and discards, but size regulations can have a significant impact on numbers of flounder harvested or discarded.

13) Text Box:
North Carolina Flounder Species
Recreational anglers in North Carolina often encounter three different species of flounder. Changes in size regulations have altered the species composition of the harvest over time. Southern flounder reach a larger size in North Carolina waters and are harvested at a higher rate than summer or Gulf flounder.

14) Text box:
RCGL Limits
While North Carolina allows limited use of commercial gears for recreational purposes anyone using RCGL gear is limited to the recreational size and creel limits.