



LOUISIANA SOUTHERN FLOUNDER Fishery Management Plan

Louisiana Department of Wildlife & Fisheries
Office of Fisheries

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Executive Summary



Southern Flounder (*Paralichthys lethostigma*) are the most commonly harvested flatfish on the northern coast of the Gulf of Mexico both, recreationally and commercially. Due to their life history and spawning migrations, Southern Flounder are particularly vulnerable to harvest during the fall when they leave inshore waters for offshore spawning grounds. Historically in Louisiana, much of the commercial harvest of Southern Flounder has come from incidental catch in the shrimp fishery. Between 1985 and 1995, Louisiana was the leading Gulf state for commercial harvest of Southern Flounder, peaking in 1994 with nearly 1 million pounds. After a ban on entanglement nets in Louisiana in 1995, commercial harvest significantly decreased as those nets were phased out over a period of a few years. While most recreational anglers consider Southern Flounder a secondary target to more popular species such as Spotted Seatrout (*Cynoscion nebulosus*) and Red Drum (*Sciaenops ocellatus*), they are often a welcome addition to the day's catch, as they are considered excellent table fare. Recreationally, Southern Flounder are harvested mostly by hook and line and gig; however, bowfishing has become increasingly more popular in recent years.

As Louisiana's Southern Flounder fishery developed, managers implemented a number of measures to prevent overharvesting and maintain the Southern Flounder population at sustainable levels. Biologists regularly monitor and assess the condition of this valuable resource to ensure these measures are effective and to inform future management decisions, all in an effort to protect the viability of the Southern Flounder resource for future generations.

This fishery management plan creates a centralized document that summarizes current information about the biology and status of Louisiana Southern Flounder, Louisiana's commercial and recreational fisheries for Southern Flounder, effects of Louisiana's Southern Flounder fisheries on the ecosystem, and environmental influences on Louisiana's Southern Flounder resource. In addition, this plan describes management approaches within the state and regional framework, defines long-term management goals and objectives, identifies management issues, recommends options to address these issues, and outlines future research needs.

Introduction

DEFINITION OF MANAGEMENT UNIT

The management unit consists of the population of Southern Flounder (*Paralichthys lethostigma*) residing in coastal and estuarine waters of Louisiana.

MANAGEMENT AUTHORITY AND PROCESS

The Louisiana State Legislature (Legislature), the Louisiana Wildlife and Fisheries Commission (Commission), and the Louisiana Department of Wildlife and Fisheries (LDWF) are responsible for managing Southern Flounder fisheries in Louisiana's state waters, which include inland waters and extend seaward from the shoreline to three nautical miles.

Louisiana Revised Statutes, Title 56, provides for the preparation and implementation of fishery management plans that will prevent overfishing and will achieve and maintain plentiful fish populations to ensure, on a continuing basis, the optimum yield from each fishery. Louisiana's fishery management plans are developed according to applicable principles and standards of the Food and Agriculture Organization of the United Nations' (FAO) Code of Conduct for Responsible Fisheries.

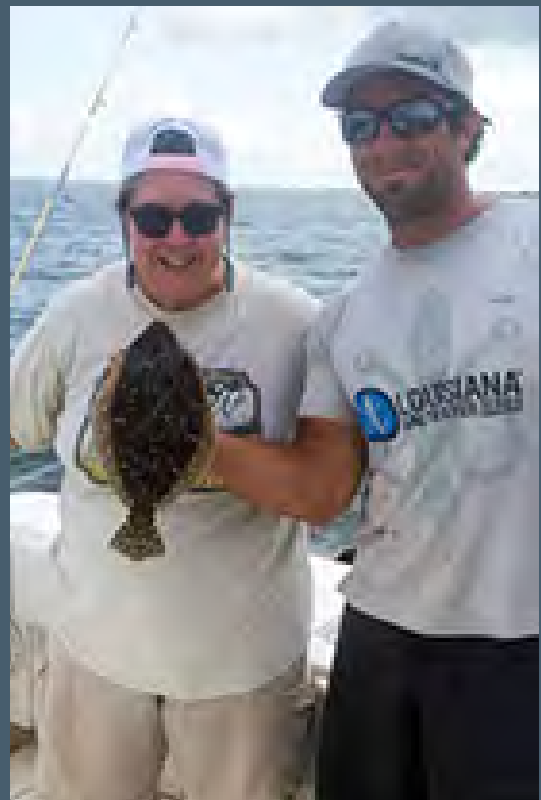
Responsible fisheries management requires an ongoing process of continual improvement, with active monitoring of fisheries resources and timely response to any observed changes. Fishery management plans are flexible and can be improved with collection and analyses of relevant data. Plan work groups will continuously review new research and monitoring information every year, document progress toward fishery management goals and objectives, and fully review and revise management plans as managers and stakeholders prioritize issues and identify and refine options.

MANAGEMENT GOALS AND OBJECTIVES

The goal of the Louisiana Southern Flounder Fishery Management Plan is to ensure long-term conservation and sustainable use of the Southern Flounder resource for the maximum environmental, social, and economic benefit to the state of Louisiana, its citizens, and visitors.

LDWF will use the following objectives to achieve this goal:

1. Prevent overfishing and ensure Southern Flounder are able to successfully reproduce and maintain the population.
2. Achieve a level of fishing capacity that provides for a sustainable harvest and allows for a profitable fishery.
3. Minimize conflicts among user groups.
4. Minimize fishery impacts on Southern Flounder while maintaining a sustainable adult spawning population.
5. Continue to produce stock assessments that establish acceptable biological reference points for fishing mortality and population abundance.
6. Promote research to better understand the impacts of environmental factors on both the Southern Flounder population and fishery as well as the impacts of Southern Flounder fisheries on the ecosystem.
7. Promote research to improve knowledge of the commercial and recreational fisheries for Southern Flounder, including harvest data and socioeconomic information to enhance social and economic benefits derived from the use of the resource.



Description of the Stock



Southern Flounder Resilience

Productivity is a function of fecundity, growth rates, natural mortality, age of maturity, and longevity and can be a reasonable proxy for resilience.

Southern Flounder are considered highly productive, and therefore highly resilient. Despite these qualities the stock is currently overfished. Management measures have been enacted to ensure future resilience.

BIOLOGICAL PROFILE

Stokes (1977) provides a life history analysis of Southern and Gulf Flounder (*Paralichthys albigutta*) from the western Gulf of Mexico (Port Aransas, TX) focusing on the biological description, reproductive strategies, and habitat needs of these two flounder species. Gilbert (1986) examines the biology, life history strategies and environmental requirements of the three commercially important flounder species in the South Atlantic and Gulf of Mexico (Southern, Gulf, and Summer Flounder). Gilbert (1986) also gives insight into the reproductive potential of these *Paralichthid* species through initial reproductive studies conducted on Summer Flounder (*Paralichthys dentatus*). The Gulf States' Management Profile of the Southern Flounder (2015) combines these works with others to give the most complete summary of this species to date. Other texts that investigate the biological, reproductive and life history of this species are mentioned in this description.

PHYSICAL DESCRIPTION

Southern Flounder are a member of the family *Paralichthyidae*, which includes 12 species native to the Gulf of Mexico (Barton 2007, GSMFC 2015). This family is located within the order of *Pleuronectiformes* (suborder *Pleuronectoidei*), which is characterized by adults lacking bilateral symmetry with extreme lateral compression, dorsal and anal fins with long fin bases (dorsal fin base can extend to cranium), six to seven branchiostegal rays, cycloid or ctenoid scales, often lacking a swim bladder (Barton 2007).

Paralichthys are further differentiated from other left-eyed flounders like *Cynoglossidae* (tonguefishes) by a pre-opercle not covered by skin (Hoese and Moore 1998, Barton 2007). During early development, eye migration occurs and side swimming behavior develops (Barton 2007). The positioning of this eye is later used to differentiate between “right-eyed” and “left-eyed” species (Barton 2007). After the eyes have completed migration, the individual will begin its benthic existence. The side which lies on the substrate (“blind-side”) normally lacks pigmentation while the upper side of the fish exhibits cryptic coloration, which facilitates ambush feeding and hiding from predators (Barton 2007). Further delineation of this family can be problematic as this family shares similar characteristics between the families *Bothidae* (to which Southern Flounder were previously designated) and *Pleuronectidae* (Hoese and Moore 1998, Barton 2007). Members of the genus *Paralichthys* are the most commercially important flounders south of Cape Hatteras, North Carolina (Hoese and Moore 1998). In particular, the Southern and Gulf Flounders are commonly harvested along the Gulf and South Atlantic coasts, while the congeneric (belonging to the same genus) Summer Flounder is harvested along the entire Atlantic Seaboard (Gilbert 1986, Hoese and Moore 1998).

Physically, Southern Flounder exhibit a “left-eyed” (head faces to the left in anatomical positioning) orientation which lacks bi-lateral symmetry and exhibits acute lateral and dorsoventral compression. The mouth is terminally oriented, contains well-developed teeth for grasping prey, and the upper jaw extends to or beyond the posterior margin of their eyes (Hoese and Moore 1998). The bases of both pelvic fins are short and symmetrical, and do not extend forward to the urohyal bone (Gilbert 1986, Hoese and Moore 1998). On both the dorsal and ventral surfaces, the lateral line is well developed and highly arched. Also, Southern Flounder and its congeners possess pectoral fins on both sides of the body which are normally oriented medially (Hoese and Moore 1998). Coloration of Southern Flounder is subject to great variation; some individuals are light all over while others can be very dark. Often, the substrate plays a significant role in influencing the coloration of the individual (Hoese and Moore 1998). Further, the spotting pattern on individuals is subject to variability, with some adults losing their spotting entirely (Hoese and Moore 1998). Pigmentation and shading intensity can vary between life and death, with irregularly sprinkled, whitish spots usually noticeable all over the body until the death of the fish (Ginsburg 1952).

Due to their similar life histories, overlapping areas of distribution, Southern Flounder can often be difficult to identify throughout their geographic distribution with related flatfishes, especially in the juvenile stages. However, examination of certain body characteristics allows for accurate identification of flatfishes within the *Paralichthys* genus. First, the dorsal fin of Southern Flounder consist of between 80-95 rays, while the Gulf Flounder and the Broad Flounder (*Paralichthys squamilentus*) possess between 71-85 and 76-85 dorsal rays respectively (Hoese and Moore 1998). Further, the Summer Flounder possesses a dorsal ray count of 80-96 fin rays, nearly identical to

the Southern Flounder (Gilbert 1986). The anal fin ray counts for Southern Flounder range between 63-74 soft rays, while the Gulf Flounder and Broad Flounder soft ray counts range between 53-63 and 59-65 soft rays respectively (Hoese and Moore 1998). Comparatively, the Summer Flounder possesses an anal fin ray similar to the Southern Flounder with a count of 61-73 anal fin rays (Gilbert 1986). Examination of the soft ray counts for the pectoral fin on the ocular side indicate that Southern Flounder possess between 11-13 soft rays in comparison to Gulf Flounder (10-12 soft rays) and Broad Flounder (11-12 soft rays) (Hoese and Moore 1998). Another key feature that differentiates these congeners is the gill raker counts in the top and ventral portions of the first gill arch. For Southern Flounder, the top gill arch contains two to three gill-rakers and the bottom arch possesses eight to 11 gill rakers (Hoese and Moore 1998). In contrast, the Gulf Flounder contains between two to four rakers on the top branch and nine to 12 rakers on the lower arch while the Broad Flounder possesses three to five gill arches on the top branch and nine to 12 branches on the lower branch (Hoese and Moore 1998). Further, the Summer Flounder possesses the highest gill-raker count on the lower limb of the first gill arch (13-18 gill rakers) in comparison to the Southern Flounder and Gulf Flounder (Gilbert 1986). Another key characteristic that helps to separate these fish is the count of lateral line scales. Southern Flounder have been documented to contain 85-100 lateral line scales while Gulf Flounder and Broad Flounder possess 78-83 and 104-117 lateral line scales, respectively (Hoese and Moore 1998). Further, Southern Flounder and Summer Flounder have differing lateral line scale counts in the straight portion of the lateral line with counts between 52-69 scales and 56-76 scales, respectively (Gilbert 1986). Finally, the body depth percentage to standard length is one of the more reliable methods to identify the members of this genus. According to literature, Southern Flounder and Gulf Flounder exhibit a body depth percentage of 39-47% of the standard length (Hoese and Moore 1998). In contrast, the Broad Flounder exhibits the greatest body depth ratio of 48-59% respectively (Hoese and Moore 1998). Although coloration is not a reliable metric for identifying these flatfish, Gulf Flounder exhibit three distinct ocellated spots set in a triangular pattern on its dorsal surface while these ocellated spots are lacking in Southern Flounder (Hoese and Moore 1998).

DISTRIBUTION

Southern Flounder have an established distribution range from Albemarle Sound, North Carolina to Laguna de Yamilahua in Northern Mexico (Ginsburg 1952, Manooch 1984, Music and Pafford 1984, Shipp 1986, Gilbert 1986, Darnell and Kleypas 1987, Hoese and Moore 1998). Southern Flounder appear to be the most common species of flounder in the northwestern Gulf of Mexico, ranging from Port Aransas, Texas to the Gulf States along the Northern Gulf of Mexico (Gilbert 1986, GSMFC 2015). Research has indicated that this species is uncommon to absent along the southeast coast of Florida beginning from the Loxahatchee River south and then along Florida Bay to the south of Tampa, FL. (Gilbert 1986, GSMFC 2015). It is presumed that this decline in abundance is attributed to the hard sand substrate which is prevalent in the region and is preferred by the Gulf

Flounder (Gilbert 1986, Hoese and Moore 1998). This area of the Florida coast does not have as large a quantity of freshwater input as other areas of the Gulf of Mexico (GSMFC 2015). As a result, the habitat found in that region tends to have lower turbidity, higher salinity, and firmer substrates, which are preferred by the Gulf Flounder (GSMFC 2015). In recent years, there has been evidence of juvenile Southern Flounder being captured as far north as the Mattaponi River in Virginia, which feeds into the Chesapeake Bay system (Lusk et al. 2014). While adults are known to appear in the lower reaches of the Chesapeake Bay system, previous recordings of juveniles were non-existent (Lusk et al. 2014). It is suspected that altered oceanic currents and increasing surface temperatures may have influenced the deposition of these juvenile specimens (Lusk et al. 2014).

HABITAT

While all members of the genus *Paralichthys* are capable of adapting to various levels of salinity across different habitat types, Southern Flounder exhibit the greatest affinity towards a euryhaline (i.e. able to tolerate wide salinity ranges) existence (Gilbert 1986). Research has indicated that Southern Flounder are able to tolerate salinities from 0-60 ppt (parts per thousand) and temperatures between 5-35°C (41-95 °F) (Gilbert 1986, GSMFC 2015). As a result of their ability to tolerate a wide range of salinities, Southern Flounder are able to utilize numerous different habitats including freshwater rivers and lakes, brackish estuaries, bayous, canals, saltwater bays, sounds, and lagoons as well as offshore areas up to 360 feet deep (Deubler 1960, Guthertz 1967, Nall 1979, Gilbert 1986, Hoese and Moore 1998). However, research has indicated that the utilization of these habitats is not uniform and often correlates with ontogenetic shifts (developmental changes that occur during an organism's life span) within the life cycle of the Southern Flounder.

During the late fall to early winter, adult Southern Flounder migrate to offshore waters near the continental shelf and undergo final maturation prior to spawning (Stokes 1977, Grieshaber et al. 2016, GSMFC 2015). It should be noted that the timing of this migration varies between regions as the South Atlantic migration tends to occur earlier (September) than Gulf Coast regions (October-November) (Stokes 1977, Flowers et al. 2019). Research from both the Atlantic and Gulf Coasts indicate that one of the main triggering factors for migration is declining water temperatures at the onset of winter (Gilbert 1986). While spawning behavior has never been witnessed in the wild for Southern Flounder, tag recaptures, in Texas, during the winter ranged up to 30 nautical miles from Port Aransas Pass give credence to the observations that Southern Flounder utilize the deep water passes along the Gulf to facilitate movement offshore (Stokes 1977). However, the author of this survey mentioned that not all re-captured flounder underwent such great movements as most were captured within a few miles of the passes within weeks of release (Stokes 1977). Once Southern Flounder complete their migration, spawning is believed to occur over the continental shelf in the Gulf of Mexico and South Atlantic regions. Data from Mississippi has indicated preferred spawning depths range between water depths of 20-60 meters (66-164 feet) (Benson 1982, Gilbert 1986).

After completion of spawning, Southern Flounder eggs remain suspended in the water column until hatching. This is facilitated through the deposition of different fatty acids such as triacylglycerol and wax esters within the oil globules of released eggs (Mejri et al. 2020). Southern Flounder larvae are then transported by currents until reaching the coast (Benson 1982, GSMFC 2015). Upon completing their metamorphosis, juveniles begin their migration into estuarine areas (Benson 1982). While there is variability as to the timing of this migration, research has indicated that environmental (abiotic and biotic) cues often influence juvenile migration. However, it should be noted that these environmental cues vary significantly by geographic region. For example, Burke et al. (1998) examined how juvenile *Paralichthys spp.* exhibited different migration strategies between high tidal flow regions (Onslow Bay, North Carolina) and lower tidal flow (Yuma Bay, Japan) regions. Juvenile flounder from North Carolina (Southern, Gulf and Summer Flounder) were found at their highest densities on the bottom during the ebb (out-going) tide in contrast to the flood stage (in-going) where the highest densities were found in the mid-water column (Burke et al. 1998). In addition to these density shifts, active movement for juvenile flounder from the North Carolina site peaked at ebb tide in contrast to the flood tide (Burke et al. 1998). A corresponding rise in overall salinity was observed during the flood tide from North Carolina (Burke et al. 1998). In contrast, juvenile Japanese Flounder (*Paralichthys olivaceus*) from Yuma Bay, Japan were found at their highest density on the bottom, regardless of tidal stage (Burke et al. 1998). This work indicated there was no discernible change in the salinity gradient with regards to tidal stage at the Japanese site (Burke et al. 1998). As such, it has been proposed that juvenile Southern Flounder and related flatfish will utilize tidal stream transport to move into estuarine areas in regions with significant tidal flow (Burke et al. 1998). In areas where tidal flow is limited, other environmental factors (i.e. seasonal changes in river discharge) may have a more significant role in the timing of the migration of juvenile Southern Flounder, regions like the Gulf of Mexico (Burke et al. 1998). In terms of suitable habitat, Southern Flounder are generalists regarding the type of habitat they will utilize, consequently, habitat selection is dependent on geographic location. Studies from bay systems in Texas have indicated that newly settled Southern Flounder will utilize sandy bottoms with vegetation when first arriving in the estuary (Nañes-James et al. 2009). Previous observations have also indicated that vegetated substrates near oligohaline (i.e. low salinity) water bodies were primary habitat areas for newly settled flounder (Gunter 1945, Deubler 1960). It is presumed that these habitats may act as ideal nursery grounds due to the abundance of cover for protection and abundant food sources (Nañes-James et al. 2009). Additional studies from this region indicated that deeper sand flats with shallow slopes were more utilized as these juveniles matured (Furey et al. 2013). In contrast, juvenile Southern Flounder collections from Louisiana beam trawl surveys indicated that juvenile Southern Flounder sought more oligohaline (i.e. areas of low salinity) regions in Louisiana estuaries due to their low abundance from mesohaline (i.e. mid-level salinity) marsh areas (Allen and Baltz 1997).

Examination of stable isotope concentrations in juvenile Southern Flounder otoliths (calcified structures in the inner ear which aid in hearing and the vestibular system, often used to age fish) indicates that a minority of the fish from the Mobile-Tensaw Delta region of Alabama area were hatched in freshwater/oligohaline regions due to low Strontium: Calcium ratios in the otolith perimeters compared to the otolith cores (Love et al. 2011). Further studies of other isotope ratios (specifically Barium: Calcium) in flounder otoliths have revealed similar habitat usage across Southern Flounder populations in Georgia and North Carolina (Nims and Walther 2014). Previous studies have also demonstrated that juvenile Southern Flounder preferred muddy or silty bottoms (Allen and Baltz 1997, GSMFC 2015). Such habitat selection patterns were similarly observed within the Mobile-Tensaw Delta during electro-fishing sampling (Lowe et al. 2011).

As juveniles age, there is a noticeable ontogenetic shift in habitat preference. For example, older juvenile Southern Flounder off the Texas coast were more prone to move to deeper, more saline areas (Nañez-James et al. 2009). Along with this shift in salinity preference, older juveniles and sub-adults begin to seek out substrates of muddy to silty composition (Ginsburg 1952, GSMFC 2015), while bottom substrates with higher organic loads held greater numbers of Southern Flounder (Burke et al. 1991).

Along with bottom substrate composition, availability in prey can also influence habitat selection for juvenile and sub-adult Southern Flounder. Acoustic telemetry from the South Atlantic coast indicates Southern Flounder associate positively to areas of high prey fish diversity and abundance (Scharf 2022). In turn, this positive correlation towards increased prey distribution and abundance supersedes other factors such as water flow dynamics and sediment organics (Scharf 2022). An exception to this general trend was observed in Alabama where a sub-population of Southern Flounder used freshwater exclusively throughout their juvenile stage. However, these individuals were found to exhibit slower growth rates, occupy a lower trophic level (i.e. level of feeding and energy consumption) and displayed reduced physical condition compared to estuarine resident conspecifics (Chrisp 2020).

Upon completion of their maturation inshore, sub-adults and adults migrate towards higher salinity open ocean water to undergo their spawning run (Stickney and White 1974). Researchers have indicated that the spawning season generally occurs between September and April, with the spawning peak occurring between November and January (Gilbert 1986, GSMFC 2015). These migrations are believed to be initiated with reductions in water temperature with the onset of winter (GSMFC 2015). Gilbert (1986) noted that these migrations often coincided with sudden drops in water temperature between 4-5 °C (39-41°F) in magnitude. Often, these drops in temperature coincided with the passage of cold fronts and the onset of winter (Gilbert 1986). Tagging studies from Texas have demonstrated that Southern Flounder will congregate near passes and inlets during these periods as a staging area prior to the start of the spawning migration (Stokes 1977). Some of these tagged individuals were later captured up to 30 nautical miles (56 km)

from their initial tagging location near the passes and inlets, indicating that migration had started (Stokes 1977). Other evidence validating the offshore spawning hypothesis include the capture of mature females in spawning condition near passes and inlets and a reduction of ripe females from inshore habitats during the winter (GSMFC 2015). It should be noted, that not all maturing Southern Flounder undergo this migration as there are over-wintering populations of adult males in nearshore waters that have been observed during the early winter. (Stokes 1977, GSMFC 2015). Once spawning is complete, the majority of Southern Flounder will return to coastal habitats as spring approaches (Stokes 1977, Gilbert 1986). However, it has been proposed that males will remain offshore after the completion of spawning (Stokes 1977, Gilbert 1986). For example, Fischer (1999) noted that observed male: female sex ratios in his study indicated that males did not return to the estuary after the spawning migration. Further, Midway et al. (2015) observed a conspicuous absence of older male flounder from inshore sampling, lending credence to the hypothesis that males remain offshore after the completion of the spawning migration.

REPRODUCTION

Southern Flounder are batch spawners (multiple spawning events during a spawning season), spawning in Louisiana from December through January (Fischer 1995), although spawning activity has been documented to begin as early as November and last into February in Mississippi (Corey et al. 2017). Gonadal development of females begins in August, continuing to November, with a sharp decline in December indicating a peak in spawning activity (Shepard 1986). There is little information available regarding spawning frequency, however, Fischer (1999) reported spawning from once every 3.6 days to once every 6.4 days in Louisiana. Along the Gulf coast, studies have indicated inshore migration of Southern Flounder recruits begins as early as January, increasing into February and March, and continuing through April (Stokes 1977, Nanez-James et al. 2009, Froeschke et al. 2011). The presence of early juveniles in estuaries coincides with elevated gonadosomatic index (GSI) values and histological evidence that indicate spawning occurs primarily during December and January (Fischer 1999, Corey et al. 2017).

Arnold (1977) found that the onset of spawning behavior occurred three weeks before spawning when the males began following females. When at rest, the males' head would be positioned 2-3 cm from the females vent. Females released eggs after swimming to the surface, which were immediately fertilized by the male with similar behavior also being observed by Smith et al. (1999). However, in that study, males were observed below females and appeared to be guiding females toward the surface. Smith et al. (1999) also documented that males would splash at the surface while releasing sperm before returning to the bottom with females subsequently releasing eggs in the same area where sperm were released. Arnold (1977) noted that spawning took place midday, with each female spawning more than three times. Alternatively, Smith et al. (1999) observed spawning to take place much later in the day, closer to artificial sunset, with spawning occurring on 64 days of a 99 day period. Several studies have used wild caught fish to suc-

cessfully produce large numbers of viable high quality eggs with photo-thermal manipulation (Smith et al. 1999, Watanabe et al. 2001). Watanabe et al. (2001) found that spawning occurred in water temperatures ranging from 13.9° C (57°F) to 24.5° C (76°F) and noted that spawning was triggered by changes in temperature, both warming and cooling.

Female flatfish can release over 100,000 eggs per spawning season, depending upon the species (White and Stickney 1973). Arnold et al. (1977) observed six female Southern Flounder spawning a total of 13 times who produced a total of 120,000 eggs with a fertilization rate of 30% - 50%. In the same study it was found that the three smaller females did not spawn and that three larger females spawned more than 3 times each. In another study, Lasswell et al. (1977) reported three spawning Southern Flounder females that produced approximately 40,000 eggs each. The fertilization percentage and hatching rate that Lasswell et al. (1977) reported was similar to that reported by Arnold et al. (1977), averaging only 26% and 50% for each, respectively. In a later study, Lasswell et al. (1978) found approximately 5,000 eggs per spawn were fertilized (a fertilization rate of approximately 80%).

Mass emigration of flounder occurs during the spawning season, with adults from bays and estuaries moving offshore in response to decreased water temperature during the fall and winter (Topp and Hoff 1972, Stokes 1977, and Benson 1982), with waters 66 to 197 feet (20-60 meters) deep most often utilized by spawning flounder (Benson 1982). Fischer (1999) suggested that males migrate offshore before females, with males beginning to move offshore in October and females waiting until November and December. He also inferred that older males may remain offshore after spawning. Stokes (1977) had similar findings in a tagging study that indicated older males did not return to the estuary. However, post spawn movement of older male fish remains relatively unknown (Midway et al. 2015). In North Carolina, a tagging study showed that Southern Flounder, which moved to offshore waters, were recovered south of the initial tagging location (Craig et al. 2015).

Southern Flounder have environmental sex determination, wherein outside factors beyond genetics can influence sex determination (Luckenbach et al. 2003). Genetic XY male flounder develop into males, but XX females can become males during early development; once the juvenile stage is passed, flounder do not change sex (Luckenbach et al. 2004). One main factor influencing sex determination in Southern Flounder is water temperature during juvenile development (Luckenbach et al. 2003, Montalvo et al. 2012, Honeycutt et al. 2019). Southern Flounder exhibit a near 1:1 proportion of males and females reared at 18° C (64 °F) in captivity and warmer temperatures substantially induce male differentiation in Texas (Montalvo et al. 2012). However, In North Carolina, exposure of fry to high (28° C; 82 °F) and low (18° C; 64 °F) temperatures showed male-biased sex ratios (>7:1), while those exposed to a midrange temperature (23° C; 73 °F) exhibited a sex ratio near 1:1, suggesting possible latitudinal differences (Luckenbach et al. 2003).

Following a winter spawn on the continental shelf, eggs and early life stages of Southern Flounder drift toward estuaries with prevailing currents. At this stage, Southern Flounder are vulnerable to environmental factors, which may inhibit recruitment into the estuary causing detrimental effects on year-class strength (Burke et al. 1998). Moustakas et al. (2004) found that early larval Southern Flounder were either neutrally or positively buoyant in full strength seawater, while they became negatively buoyant at or below 25 ppt. Larvae react to environmental conditions when moving toward inshore waters, utilizing vertical migration abilities to ride incoming tides and remain near the bottom during ebb tides (Weinstein et al. 1980). An extended recruitment period ensures survival of at least some larvae during favorable conditions (Warlen and Burke 1990). The rate of immigration of post-larval flounders (Southern Flounder inclusive) in Texas waters was found to significantly correlate with wind direction, such that immigration was greatest during onshore or southerly winds (King 1971). The same study found that rates of immigration were higher with increased salinity, current velocity, water turbidity, and tidal amplitude (King 1971). Minimum size at initial recruitment ranged from 0-5 millimeters (0-0.19 inches) standard length (SL) in January (Rogers and Herke 1985) to 51 millimeters (2 inches) total length (TL) in April (Norden 1966). In a Louisiana study, two recruitment peaks of young of the year were observed in February and March (Rogers and Herke 1985). Juveniles have also been found to recruit as early as January in an observation made near the Chandeleur Islands, Louisiana (Laska 1973).

AGE AND GROWTH

The maximum life span of Southern Flounder has been documented to 10 years of age by Nall (1979), however the methods in this study were not validated. Safrit and Schwartz (1998) found the maximum age of Southern Flounder to be 7 years, while Fischer and Thompson (2004) found age-8 female present in Louisiana. Further, supplementary stock assessments from North Carolina (2009) found one female Southern Flounder attained a calculated age of 9 years (Takade-Heumacher and Batsavage 2009). Studies from Music and Pafford (1984), Fischer and Thompson (2004), Takade-Heumacher and Batsavage (2009) indicate maximum lengths of greater than 700 millimeters (28 inches) for Southern Flounder. The current IGFA recreational record Southern Flounder was caught in Nassau Sound, Florida, weighed 20 lbs. 9 oz. (9.79 kg), and was 33 inches total length (838 millimeters).

Overall, Southern Flounder are considered to be a relatively fast growing and short-lived fish. Although there are variations in growth by regions and gender, Southern Flounder generally reach sexual maturity by age two (GSMFC 2015). Stuntz et al. (2000) stated that the maximum theoretical size for males was less than females and was reached at an earlier age. There appear to be differences in size at age between males and females, along with differences in growth rates between regions as described in *Table 1*. These differences in growth may be due to a variety of factors including genetic variance, food availability, temperature, salinity, and habitat (Enge and Mulholland 1985).

TABLE 1. Comparison of male and female size at sexual maturity in various states.

STATE	SEX	UNIT OF MEASUREMENT	AGE									AUTHOR
			0	1	2	3	4	5	6	7	8	
TX	F	TL (observed)	10-300	301-450	541-530	531-570	571-620					Stokes 1977
	M	TL (observed)	10-230	231-280	281-320	284	292					
	F	TL (mean back-calculated)		253	328	402	429					Stuntz et al. 1996
	M	TL (mean back-calculated)		194	252	284	292					
LA	F	TL (mean)	319.5	396.3	438.1	471.2	522.3	530.6	586.02	538.02	675.52	Fischer and Thompson 2004
	M	TL (mean)	256.0	271.8	317.4	302.4	374.02					
MS	F	TL (mean back-calculated)		258	366	422	474	527				Corey et al. 2017
AL/ FL	F	TL (mean back-calculated)		258	366	422	474	527				Frick 1988
	M	TL (mean back-calculated)		169	278							
GA	F	TL (mean back-calculated)		173	334	460	585	605				Music and Pafford 1984
	M	TL (mean back-calculated)		119	224	342						
SC	F	TL (mean back-calculated)		234	344	431	499	554	597	630		Wenner et al. 1990
	M	TL (mean back-calculated)		206	274	327						

Both sexes of Southern Flounder exhibit the highest growth rates during the first two years of life, with females growing faster than males (Nall 1979). Stickney and White (1974) examined growth rates of five-month-old fish in North Carolina and found a 500% increase in weight over a ten-week period. Growth rates of Southern Flounder are similar throughout the Gulf region, but have been shown to exceed growth rates of those in Atlantic states (Corey et al. 2017). The differences between male and female growth rate is more evident after one year of age.

The age and length at which Southern Flounder sexually mature varies throughout their geographic distribution. In Texas, gravid Southern Flounder were documented at age-2 with an initial spawn occurring at the same age. Etzold and Christmas (1979) found Southern Flounder became sexually mature by age-3 (approximately 338 millimeters; 13 inches standard length) in Mississippi waters, with the smallest sexually mature fish at 229 millimeters (9 inches) standard length. In a Louisiana study, the smallest female with spawning potential was 243 millimeters (10 inches), while the smallest potentially spawning male was 170 millimeters (7 inches) total length (Shepherd 1986). Reproductive activity in this study was evaluated using gonadosomatic index (GSI), a metric that compares gonad weight to the total weight of the fish. Another study found that 50% maturity (L50) of female Southern Flounder in Louisiana was around 229 millimeters (9 inches) total length (Fischer 1995). This was significantly lower than the L50 of 303 millimeters (12 inches)

total length in neighboring Mississippi (Corey et al. 2017). In South Carolina, a study found first maturity of females at 320 millimeters (13 inches) TL and all were mature by 380 millimeters (15 inches) total length, which is consistent with the faster early growth and maturity of Southern Flounder in the Gulf of Mexico (Wenner et al. 1990).

PREDATOR-PREY RELATIONSHIPS

Southern Flounder are estuarine-dependent carnivores (Wagner 1973). Southern Flounder larvae feed primarily on plankton, while late juveniles and adults feed primarily on crustaceans and fish (Darnell 1958, Stokes 1977; Etzold and Christmas 1979; Gilbert 1986). In a Texas study, 96% of the diet of Southern Flounder ranging from 10-150 millimeters (0.39-6 inches) total length was invertebrates, with mysids being of high importance (Stokes 1977). The diet of larger fish (>150 millimeters; 6 inches total length) was 70% fish including anchovies, menhaden, croaker, mullet, and other unidentified fish remains. Penaeid shrimp were the most common invertebrate prey for the larger fish (Stokes 1977). The importance of fish and shrimp for Gulf of Mexico Southern Flounder has been documented in other studies as well (Gunter 1945, Kemp 1949, Miles 1949, Knapp 1950, Reid 1955, Reid et al. 1956, Darnell 1958, Fox and White 1969, Etzold and Christmas 1979, Overstreet and Heard 1982, Matlock and Garcia 1983). Diet items documented in those studies include Pinfish (*Lagodon rhomboides*), Mojarra (*Gerresidae spp.*), Sheepshead (*Archosargus probatocephalus*), arthropods, gastropods, schizopods, polychaetes, bivalves, crabs, and

other non-penaeid shrimps (Gunter 1945, Kemp 1949, Darnell 1958, Matlock and Garcia 1983). As Southern Flounder grow they consume more prey individuals of the same size class rather than using larger food items (Fox and White 1969). When smaller, Southern Flounder can consume up to 7.6% of their live weight in prey, but as adults they eat about 4.0% of their live weight each day (Minello et al. 1989). A Texas study found that Southern Flounder fed on shrimp until prey items (i.e. shrimp) reached 33-50% of the total length of the predator (i.e. Southern Flounder) (Minello et al. 1989). Darnell (1958) stated the relative percentage of food utilized from one environment to another may be related to seasonal availability rather than prey selectivity among Southern Flounder.

Southern Flounder are known to be ambush predators, exhibiting a “lay and wait” feeding behavior; they wait for prey to come within striking distance before attacking (Music and Pafford 1984, Minello et al. 1987, Henderson-Arzapalo et al. 1988, Minello et al. 1989). Such predation tactics are assisted by the Southern Flounder’s unique morphology, cryptic coloration, and sensory systems resulting in Southern Flounder being well suited to utilize the soft bottom habitats found throughout their geographic range as camouflage. Aquarium experiments demonstrated that 79% of Southern Flounder strikes utilized the “lay and wait” tactic, while other flounder actively searched for prey (Minello and Benfield 2018). Further evidence of this behavior was seen in experiments involving Southern Flounder and Pinfish, a common prey species for Southern Flounder. When Pinfish were exposed to flounder over sandy bottoms, they tended to exhibit avoidance behaviors (i.e. staying high in the water column, gathering in tighter groups, etc.) or moved closer to structured bottom types like simulated seagrass beds (Jordan et al. 1997). In a similar manner, newly settled juvenile Southern Flounder in Texas associate with seagrass beds for both shelter and accessible food sources (Nañez-James et al. 2009).

While the ambush techniques and the unique anatomical features of the Southern Flounder allow them to be efficient predators, changes in ambient environmental conditions can also influence predation success of these fish. During research examining the effects on water clarity and bottom type on Brown Shrimp (*Farfantepenaeus aztecus*), a positive correlation was noted between Southern Flounder predation on shrimp and decreasing visibility (Minello et al. 1987). While the exact mechanisms were not determined, researchers hypothesized that there could be other sensory systems (i.e. chemo-sensory or tactile) that allow Southern Flounder to find and capture prey (Minello et al. 1987). The study further noted that decreased visibility caused Brown Shrimp to be more active and therefore have a greater probability of interacting with predators (Minello et al. 1987).

Older juvenile and adult Southern Flounder feed actively day and night with peak activity in the afternoon, While they are primarily visual feeders, night feeding suggests that other sensory mechanisms may also be used in prey detection (DeGroot 1971, Stokes 1977, Minello et al. 1987). Feeding activity has also been shown to be greatest at water temperatures of 16-

25 °C (61-77 °F), during the three-day period following a first quarter moon, and the three day period prior to a new moon (Music and Pafford 1984).

STOCK STATUS AND ASSESSMENT METHODOLOGY

STOCK UNIT DEFINITION

Southern Flounder are considered one stock in the Gulf of Mexico for management purposes, distinct from those found in the southern Atlantic as confirmed by genetics and otolith shape analysis (Blandon et al. 2001, Anderson and Karel 2012, Anderson et al. 2012, Midway et al. 2014). Within the Gulf of Mexico, there is little evidence that separate stock structures exist, however population structuring was noted when comparing flounder from northern Texas to flounder of south Texas (Blandon et al. 2001). For the purposes of this fishery management plan and to remain consistent with the current statewide management strategy, the unit stock is defined as those female Southern Flounder occurring in Louisiana waters.

ASSESSMENT FREQUENCY, REFERENCE POINTS AND CONTROL RULES

LDWF’s most recent Southern Flounder stock assessment was conducted in 2019 using data through 2018. LDWF is required to assess the Southern Flounder stock every five years (LA R.S. 56:325.4).

The Louisiana Legislature requires the LDWF, in LA R.S. 56:325.4, to monitor and evaluate the Southern Flounder stock in Louisiana waters, establish management targets to ensure a stable population, and report on the status of the stock to the Legislature no later than March first of every year (2015) and every five years thereafter. If that report indicates the Southern Flounder stock is not meeting or is likely not to meet the established targets, LDWF must provide for the Commission’s consideration management options to ensure the stock can meet the established management targets. As a result of the requirements of LA R.S. 56:325.4, the Commission promulgated Louisiana Administrative Code (LAC) 76.VII.385, establishing those rules. Both biomass and fishing mortality rate targets must be based upon a historical time series from the beginning of the assessed period through 2013. Biomass targets must be based upon the average (geometric mean) spawning stock biomass (SSB) from the stock’s historical time series.

The current biomass target and threshold for Southern Flounder are 1.24 million lbs. (562,454 kg.) and 454,000 lbs. (205,930 kg.) respectively. Fishing mortality rate targets are based upon the fishing mortality rate that corresponds to the stock’s SSB targets at equilibrium. The current annual fishing mortality rate target and threshold for Southern Flounder are 0.24 and 0.92, respectively.

STOCK STATUS

LDWF's most recent assessment of Southern Flounder in Louisiana waters estimated that the stock is currently overfished, with an estimated spawning potential ratio (SPR) of 19%, and that the stock has been overfished since 2017 and was very near the overfished condition since 2015. The stock is currently not undergoing overfishing and overfishing has not occurred during the history of the assessment (West et al. 2019).

Average fishing mortality rates have varied over the history of the assessment with an upward trend in the most recent decade. Fishing mortality generally increased from the beginning of the time-series of the assessment through 1994. After commercial gear restrictions were enacted in 1995, fishing mortality decreased to a low of 0.14 estimated in 1998. Fishing mortality began to increase after 1998, concurrent with the decline in female age-1 recruitment, to a peak of 0.50 estimated in 2001. Fishing mortality decreased again following 2001 to an all-time low of 0.13 estimated in 2008. After 2008, fishing mortality increased to record peaks of 0.74 and 0.59 estimated in 2013 and 2016, respectively. The 2018 average fishing mortality rate estimate was 0.44, which indicates the stock is not currently undergoing overfishing.

SSB estimates for Southern Flounder have varied over the time-series of the assessment with an overall downward trend. Female SSB remained above 1 million lbs. (453,592.37 kg.) from the beginning of the time-series through 2000 (mean of 1.4 million pounds). Female SSB began to decline after 2000 to a low of 0.7 million pounds (317,514.66 kg.) in 2002. After 2002, female SSB increased to a peak of 1.3 million lbs. (589,670.08 kg.) in 2009. Female SSB began another decline in 2010 to a record estimated low of 0.3 million lbs. (136,077.71 kg.) in the terminal year of the assessment (2018).

ASSESSMENT METHODS

LDWF's most recent Southern Flounder assessment uses an Age-Structured Assessment Program (ASAP 3 Version 3.0.12; NOAA Fisheries Toolbox), a statistical catch-at-age model, to describe the dynamics of the female portion of the Louisiana Southern Flounder stock from 1982 through 2018 (West et al. 2019). This model projects abundance at age from estimates of abundance in the initial year of the time series and recruitment estimates in subsequent years. Minimum data requirements for the model are fishery catch-at-age and an index of abundance. Landings were taken from LDWF's Recreational Creel Survey (LA Creel) and commercial trip ticket programs, the National Marine Fisheries Service's (NMFS) commercial statistical records, and NMFS' Marine Recreational Information Program (MRIP). Abundance indices were developed from LDWF's experimental marine gillnet survey. Age composition of fishery catches were estimated with length-at-age-keys derived from direct samples of the fishery and a growth model.

Fishery Catch-at-Age

Commercial Southern Flounder landings are taken from the LDWF Trip Ticket Program and the NMFS commercial statistical

records (NMFS 2019). It is important to note that NMFS commercial records prior to 2000 did not differentiate landings of flatfish species in Louisiana. Several flatfish species are found in LA waters, such as the Gulf Flounder and Broad Flounder, but the most common species is the Southern Flounder (GSMFC 2015). MRIP recreational landings estimates from 1985-1999 indicate Gulf Flounder comprises only 2.5% (on average as weight) of the annual recreational harvest relative to Southern Flounder harvest, and none have been reported in that survey since then. Neither Gulf nor Broad Flounder have been identified in LA Creel landings to date (2014-2019). Given these small landings, it is unlikely the inclusion of Gulf or Broad Flounder in Louisiana flatfish harvest estimates would have a major impact on Southern Flounder stock status estimation. Therefore, for purposes of the assessment, commercial landings labeled as flatfish in Louisiana were assumed as Southern Flounder.

Annual size compositions of commercial Southern Flounder harvest were developed from samples from the Trip Interview Program (TIPS; 1982-2002), the Fishery Information Network (FIN; 2002-2013), and the LDWF Biological Sampling Program (2014-2018). Due to very limited size composition samples collected in early years of the commercial fishery, the 1994 TIPS size composition data were pooled with the available size data from earlier years and used as a proxy of the 1982-1993 size compositions. Due to very limited size composition samples collected from 1997-2001, the 2002 FIN samples were pooled with the available TIPS size information from 1997-2001 and used as a proxy of the 1997-2001 size compositions. For other years where annual size composition samples were <200 (1996, 2008, 2011-2014, 2017), samples from the previous and prior years were pooled with that year's size composition samples. Due to very limited commercial size samples collected in 2018, the 2016-2018 samples were pooled and used as a proxy of the 2018 size composition.

Estimates of commercial live releases of Southern Flounder are not available. Due to no size limit regulations, commercial live releases were assumed to be insignificant relative to commercial Southern Flounder harvest and not considered further in the assessment.

Recreational Southern Flounder landings and live release estimates were taken from the LDWF recreational creel survey (LA Creel; 2014-2018) and estimates hindcast to the historic MRIP time-series (1982-2013). Consequently, the pre-2014 recreational estimates used in this assessment differ from the LA estimates currently published by MRIP (www.st.nmfs.noaa.gov/recreational-fisheries/data-and-documentation/queries/index). Furthermore, due to changes made to the MRIP Access Point Angler Intercept Survey (APAIS) in 2013 (see www.fisheries.noaa.gov/topic/recreational-fishing-data#making-improvements) and the recent transition from the MRIP Coastal Household Telephone Survey to the new Fishing Effort Survey (FES; see www.fisheries.noaa.gov/recreational-fishing-data/types-recreational-fishing-surveys#fishing-effort-survey), harvest estimates currently available from MRIP also differ from those used in the prior Louisiana Southern Flounder stock assessment (Davis et al. 2015).

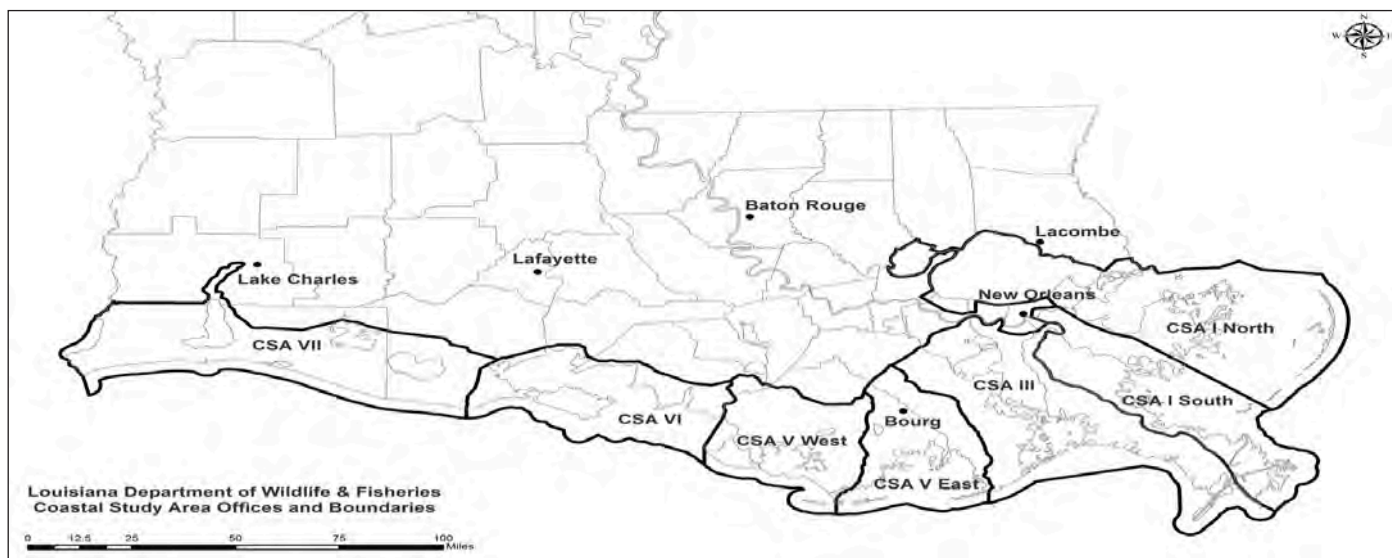


FIGURE 1. Map of Louisiana's coastal study areas (CSAs).

Annual size composition of recreational Southern Flounder harvest estimates were derived from the LDWF Biological Sampling Program (2014-2018) and MRIP (1982-2013, prior to the APAIS and FES calibration changes). Size composition estimates of recreational live releases are not available. Due to a no size limit regulation on the recreational fishery, annual size compositions of live releases were assumed equivalent to harvest. Statewide size compositions obtained from the LDWF Biological Sampling Program were derived by statistically weighting the LDWF Coastal Study Area specific size compositions by the corresponding recreational landings estimates.

Ages of recreational and commercial Southern Flounder landings were derived from a von Bertalanffy growth model (1982-2001) and otoliths collected directly from the recreational and commercial fisheries (2002-2018).

Index of Abundance

For sampling purposes, coastal Louisiana is currently divided into five Coastal Study Areas (CSAs; *Figure 1*). LDWF biologists routinely sample each CSA with standardized gear (marine gill net, trammel net, and beach seines) as part of a long-term comprehensive monitoring program to collect life history information and measure relative abundance and size distributions of recreationally and commercially important species.

Results of the inshore trawl and trammel net surveys are used in the Southern Flounder stock assessment. The inshore trawl and trammel net surveys are conducted with standardized design. The inshore trawl survey gear is a 16-foot flat otter trawl attached to a ½ inch diameter nylon or Kevlar rope, or stainless steel tow line and bridle. The length of the bridle is two to three times the trawl width. Samples are taken from 10-minute tows at a constant speed and in a weaving or circular track to allow the prop wash to pass on either side of the trawl. All captured Southern Flounder are enumerated and a maximum of 50 randomly selected Southern Flounder are collected for length measurements.

This inshore trawl survey is conducted at fixed sampling stations within each LDWF CSA. In October 2010, additional fixed stations were added to this survey allowing more spatial coverage within each CSA. Prior to July 2013, sampling was conducted weekly from March to October and semi-monthly from November to February. Beginning July 2013, sampling was reduced to monthly samples from January-March and August- November and semi-monthly samples from April-July and December.

The trammel net survey gear is a 750-foot long and 6-foot depth net, consisting of three walls constructed of nylon. The inner wall has 1 5/8-inch bar mesh wall, and the two outer walls have 6-inch bar mesh wall. All captured Southern Flounder are enumerated and a maximum of 50 randomly selected Southern Flounder are collected for length measurements, gender determination, and maturity information.

The trammel net survey was conducted from 1986 to October 2013 at fixed sampling stations within each CSA. In October 2010, additional fixed stations were added allowing for more spatial coverage within each CSA. Beginning in 2013, the survey design was modified where sampling locations are now selected randomly from the established stations within each CSA.

Biologists record water temperature, turbidity, conductivity, and salinity data along with each biological sample from all gears sampled. LDWF (2020) contains a full description of survey methodology.

Current CSAs are defined as: CSA 1 - Mississippi state line to South Pass of the Mississippi River (Pontchartrain Basin); CSA 3 - South Pass to Bayou Lafourche (Barataria Basin); CSA 5 - Bayou Lafourche to eastern shore of Atchafalaya Bay (Terrebonne Basin); CSA 6 - Atchafalaya Bay to western shore of Vermilion Bay (Vermilion/Teche/Atchafalaya Basin); and CSA 7 - western shore of Vermilion Bay to Texas state line (Mermentau/Calcasieu/Sabine Basins).

TABLE 2. FAO proposed guideline for indices of productivity for exploited aquatic species.

PARAMETER	PRODUCTIVITY			SPECIES: SOUTHERN FLOUNDER	SCORE
	Low (1)	Medium (2)	High (3)		
Natural mortality rate (M)	<0.2	0.2 - 0.5	>0.5	0.53	3
von Bertalanffy growth rate (K)	<0.15	0.15 - 0.33	>0.33	0.44	3
Age at maturity (t_{mat})	>8	3.3 - 8	<3.3	3	3
Maximum age (t_{max})	>25	14 - 25	<14	8	3
Examples	orange roughy, many sharks	cod, hake	sardine, anchovy	Southern Flounder Productivity Score = 3 (high)	

See the full assessment report in Appendix I for complete details of the current stock status and assessment methods.

REGIONAL ASSESSMENT EFFORTS

Although limited, the available information for Southern Flounder indicates that there is concern regarding stocks of Southern Flounder from the Southeast Atlantic coast through the Gulf of Mexico. There is no regional assessment of the Southern Flounder stock. Gulf wide, scientists and fisheries managers are noticing declines in populations of Southern Flounder. Texas' assessment of Southern Flounder (TPWD 2014) indicated a transitional SPR above the target of 30%, while the most recent Louisiana assessment indicates the stock is overfished with a 19% SPR. Most of the states within the Gulf of Mexico have adjusted flounder regulations to be more restrictive in recent years due to observed declines in recruitment and stock biomass. LDWF has recently (2022) enacted new regulations for a fall closed season (Oct. 15 - Nov. 30) in order to reduce harvest of mature female Southern Flounder by 50%.

STOCK RESILIENCE

LDWF's most recent Southern Flounder stock assessment evaluates factors that can be used to gauge the resilience of Southern Flounder stock (West et al. 2019). Productivity is a function of fecundity, growth rates, natural mortality, age at maturity, and longevity, which can be a reasonable proxy for resilience, i.e. 'the ability to rebound after perturbation' (Holling 1973). The assessment characterizes the relative productivity of the Louisiana Southern Flounder stock based on life-history characteristics, following SEDAR 9 (2006), with a classification scheme developed at the FAO second technical consultation on the suitability of the CITES criteria for listing commercially-exploited aquatic species (FAO 2001). Each life history characteristic (von Bertalanffy growth rate, age at maturity, longevity, and natural mortality rate) is assigned a rank (low=1, medium=2, and high=3) and then averaged to compute an overall productivity score. In this case, the overall productivity score is 3.0 for Gulf of Mexico Southern Flounder (*Table 2*) indicating high productivity.

FAO. 2001. Second Technical Consultation on the Suitability of the CITES Criteria for Listing Commercially-exploited Aquatic Species: A background analysis and framework for evaluating the status of commercially-exploited aquatic species in a CITES context. Available: www.fao.org/docrep/MEETING/003/Y1455E.htm.

Description of the Fishery



Fishery Monitoring

LDWF monitors commercial landings and fishing effort through a trip ticket program. Through this program, LDWF collects commercial landings data on a trip basis from wholesale/retail seafood dealers and commercial fishermen holding fresh products licenses.

LDWF conducts economic research pertaining to Louisiana and Gulf fisheries resources using information from the trip ticket program and surveys.

Comprehensive descriptions of the Louisiana commercial and recreational Southern Flounder fisheries prior to 2000 including development and history of exploitation, effort and harvest, economics, markets, value, and processing are available through numerous publications including Adkins et al. (1998) and GSMFC (2015).

DATA COLLECTION AND ANALYSIS

In Louisiana, commercial harvest of Southern Flounder has historically been primarily incidental catch from the shrimp fishery. Commercial Landings in Louisiana peaked in 1994 with nearly 1 million pounds landed. LDWF implemented a trip ticket program in 1999 to monitor commercial landings and fishing effort. Through this program, LDWF collects commercial landings data on a trip basis from wholesale/retail seafood dealers and fresh products license holders (commercial fishermen, or their spouses, licensed to sell their catch directly to consumers). LDWF requires dealers purchasing Southern Flounder from commercial fishermen and fresh products license holders to submit trip tickets to capture information about the catch - for example, what it is, where it was caught, how it was caught, and how much was caught. As of May 2000, dealers can submit trip tickets through a computerized electronic trip ticket program. To date, over 400 dealers are signed up to use electronic trip tickets, while in 2021, 124 dealers used electronic trip tickets to submit their data. Unless otherwise noted, the commercial data presented throughout this section are sourced from LDWF's trip ticket program. All data collected by LDWF are published in aggregate form, meaning the sum of data submitted by three or more individuals; data submitted by less than three individuals are confidential and are denoted as such in the tables below. Data are presented from 2000 (when the electronic trip ticket program was implemented) through 2020. Value is presented as real dockside value, in constant, inflation-adjusted 2020 dollars calculated from the nominal or current dollar values using the U.S. Bureau of Economic Analysis Implicit Price Deflator. Volume is presented in pounds whole-weight.

Prior to 2014, recreational landings data are available through MRFSS/MRIP. In 2014, LDWF created a recreational landings survey called LA Creel to estimate recreational harvest of salt-water finfish in Louisiana. From 2014 forward, LDWF has not participated in MRFSS/MRIP; MRFSS/MRIP landings estimates are not yet directly comparable to LA Creel landings estimates. NOAA Fisheries and LDWF are currently working together to calibrate landings estimates from the two surveys to allow for historical comparison of recreational landings; however, this methodology has not yet been fully validated. LDWF's Socioeconomic Research and Development Section conducts economic research pertaining to Louisiana and Gulf fisheries resources using information from Louisiana's trip ticket program, LA Creel, and surveys. This section publishes results in LDWF reports and peer-reviewed scientific journals, presents research findings at professional and scientific meetings, and provides information and support to LDWF and other agencies to support scientific research and resource management.

COMMERCIAL FISHERY

Commercial landings of flounder in Louisiana have been relatively modest since 2000 compared to the state's major commercial fisheries, such as shrimp, blue crabs, and oysters. Landings varied between approximately 74,000 lbs. (33,566 kg.) and 154,000 lbs. (69,853 kg.) between 2001 and 2011, respectively, except for a low in 2005 of approximately 21,576 lbs. (9,787 kg.) (Table 3). The value per pound in constant inflation-adjusted 2020 dollars was less than \$2.00 per pound for all but one year (2010) during this period.

Landings declined from approximately 97,000 lbs. (43,998 kg.) in 2012 to 47,000 lbs. (21,319 kg.) in 2017 as inflation-adjusted value rose from \$2.05 per pound to \$2.47 per pound. Landings rose to 71,000 lbs. (32,205 kg.) in 2019 but dropped to 15,000 lbs. (6,804 kg.) in 2020. Value in 2020 was \$2.25 per pound.

Louisiana has accounted for a small fraction of U.S. commercial flounder landings, approximately one-tenth of 1% of 2000-2020 average national landings by weight (Figure 2) and one-fifth of 1% by average inflation-adjusted dockside value (Figure 3).

LANDINGS BY MONTH (FOR 2000-2020)

Most flounder harvested commercially in Louisiana are landed in the autumn. Average November landings between 2000 and 2020 were 45,923 pounds, a majority (56.9%) of the annual sum of monthly landings (Table 6). Average October landings (15,174 pounds) represented approximately 19% of the annual sum of monthly landings. The average dockside value was approximately \$2.00 per pound during the peak production months of October and November as well as in April, May, and August. Average dockside value per pound was lowest in January and February, months with relatively lower average landings.

LANDINGS BY SELECTED GEAR TYPE

Louisiana's commercial fishers reported flounder landings associated with over two dozen different types of gear in trip ticket records submitted between 2000 and 2020. Over 90% of the commercial flounder landings during this period were reported as being harvested with one of five types of gear: butterfly nets,

TABLE 3. Louisiana commercial flounder landings, 2000-2020. (Inflation-Adjusted Values are given in 2020 dollars. This can be changed.)

YEAR	Landings	Nominal Dockside Value	Inflation-Adjusted Dockside Value	Inflation-Adjusted Value per Pound
2000	177,503	\$222,885	\$324,379	\$1.83
2001	91,769	\$93,917	\$133,751	\$1.46
2002	81,831	\$80,002	\$112,160	\$1.37
2003	63,649	\$68,400	\$94,146	\$1.48
2004	73,696	\$82,152	\$110,109	\$1.49
2005	21,576	\$29,916	\$38,886	\$1.80
2006	83,824	\$112,431	\$141,849	\$1.69
2007	78,828	\$109,690	\$134,770	\$1.71
2008	77,954	\$112,413	\$135,480	\$1.74
2009	131,593	\$198,243	\$237,113	\$1.80
2010	81,072	\$139,519	\$164,954	\$2.03
2011	154,268	\$254,337	\$294,551	\$1.91
2012	97,210	\$175,068	\$198,933	\$2.05
2013	89,114	\$170,625	\$190,541	\$2.14
2014	66,279	\$146,141	\$160,233	\$2.42
2015	62,843	\$140,024	\$152,080	\$2.42
2016	65,134	\$152,683	\$164,106	\$2.52
2017	47,412	\$110,837	\$116,931	\$2.47
2018	62,756	\$159,811	\$164,644	\$2.62
2019	71,419	\$178,551	\$180,725	\$2.53
2020	15,091	\$33,959	\$33,959	\$2.25

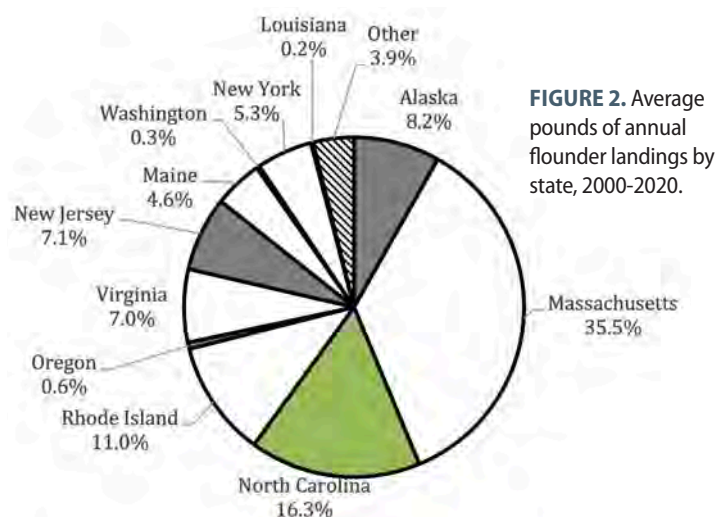


FIGURE 2. Average pounds of annual flounder landings by state, 2000-2020.

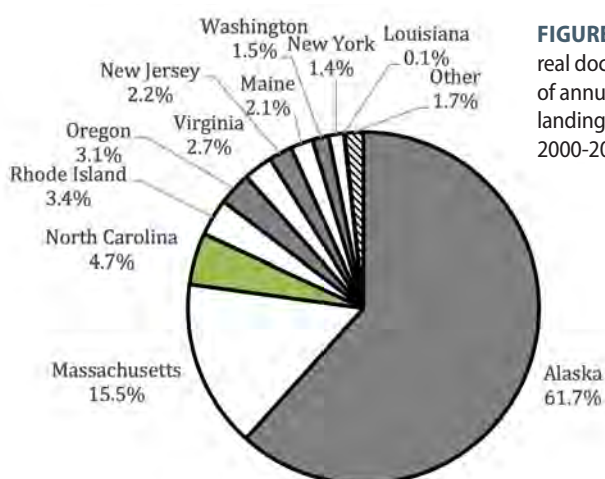


FIGURE 3. Average real dockside value of annual flounder landings by state, 2000-2020.

TABLE 4. Flounder landings by state (thousands of pounds).

State	YEAR										
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Alaska	34,296.4	26,278.8	32,148.5	38,233.2	23,184.9	42,157.9	48,807.8	44,610.8	80,559.7	81,511.4	102,016.3
California	1,753.3	1,874.1	1,378.1	1,516.7	956.1	688.9	372.6	515.7	403.9	274.5	303.1
Connecticut	1,020.1	1,001.4	627.9	560.9	634.6	579.4	452.7	340.2	302.9	304.0	332.4
Delaware	12.3	7.5	2.7	5.5	7.6	3.2	3.6	*	*	*	1.9
Florida	8.8	4.6	12.4	19.9	16.4	7.1	10.0	255.4	217.5	206.4	195.3
Louisiana	177.5	91.8	81.8	63.6	73.7	21.6	83.8	78.8	78.0	131.6	81.1
Maine	7,360.7	7,966.3	6,562.3	4,875.2	1,574.8	3,063.7	1,830.7	1,315.7	829.2	607.0	330.4
Maryland	3.9	5.3	0.0	329.5	226.4	342.9	282.8	245.9	225.1	216.5	307.8
Massachusetts	28,740.3	33,892.9	28,960.1	29,387.8	30,652.1	22,000.9	13,075.5	10,791.4	11,565.3	12,371.3	11,157.0
Mississippi	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
New Hampshire	515.2	520.3	508.2	318.4	286.1	264.4	98.7	65.1	72.5	87.1	58.0
New Jersey	2,481.4	2,398.5	2,676.1	2,910.1	3,245.7	2,793.0	2,768.4	2,098.4	1,756.3	1,857.0	2,174.8
New York	2,420.8	2,336.5	1,888.0	1,706.2	1,988.4	2,024.7	1,637.8	1,410.4	1,106.6	1,311.1	1,448.9
North Carolina	6,593.1	6,307.0	7,567.5	5,771.6	7,361.6	5,936.8	6,271.8	4,753.5	5,009.0	5,255.5	5,000.9
Oregon	2,949.4	2,533.3	1,654.1	2,063.0	2,545.9	3,173.6	3,724.0	3,891.2	4,902.4	6,681.8	5,302.8
Rhode Island	5,690.6	4,886.7	5,032.2	4,572.0	5,414.7	4,225.8	3,935.0	3,335.4	2,566.6	2,783.6	2,639.6
South Carolina	6.5	6.9	6.3	7.7	7.9	3.5	0.0	1.4	1.6	1.9	2.3
Texas	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0
Virginia	2,211.4	2,661.5	2,971.3	3,522.2	3,916.3	3,869.6	2,757.0	1,855.5	1,653.6	1,980.3	2,592.1
Washington	4,563.0	3,121.8	3,352.4	3,129.7	2,994.3	2,198.7	1,356.3	1,403.5	1,062.8	2,265.9	1,948.4

State	YEAR									
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Alaska	88,777.9	76,941.3	72,735.7	109,341.1	58,500.9	59,711.9	67,497.7	51,212.3	71,126.6	65,612.2
California	317.9	362.2	488.5	455.7	358.5	245.8	236.6	209.9	125.4	59.5
Connecticut	417.7	351.6	421.7	310.1	368.2	295.4	205.2	332.5	340.4	427.9
Delaware	0.8	*	*	1.7	1.3	2.2	1.4	0.7	1.3	0.6
Florida	364.0	342.8	253.6	224.1	169.6	185.3	168.0	125.8	160.8	125.9
Louisiana	154.3	97.2	89.1	66.3	62.8	65.1	47.4	62.8	71.4	15.1
Maine	281.0	537.4	731.8	629.6	764.6	435.2	358.0	*	551.3	184.0
Maryland	349.0	207.1	193.6	192.0	188.0	159.0	137.5	143.4	154.8	221.3
Massachusetts	13,691.8	14,242.6	11,516.6	9,018.1	8,292.9	5,970.8	7,292.1	6,099.3	5,892.5	5,928.6
Mississippi	0.0	*	0.0	16.4	29.2	26.5	8.3	13.1	30.4	6.2
New Hampshire	69.5	132.8	60.5	*	96.8	86.1	118.7	98.4	60.7	58.2
New Jersey	2,851.8	2,275.9	2,077.3	1,843.8	1,689.0	1,310.2	962.9	1,048.1	1,599.6	1,908.5
New York	1,571.8	1,296.8	1,291.9	1,072.5	1,086.3	771.6	580.7	492.0	879.7	887.5
North Carolina	4,101.6	2,736.2	2,727.9	4,583.8	4,080.5	3,020.9	2,957.3	2,558.1	2,825.2	2,256.3
Oregon	3,922.5	3,540.6	3,861.4	2,774.7	2,808.5	2,330.3	2,209.9	1,302.7	883.4	576.3
Rhode Island	3,438.1	3,072.2	3,559.6	4,213.6	2,772.5	2,071.7	1,833.8	1,237.7	1,782.8	1,803.3
South Carolina	2.7	1.4	1.8	1.4	1.7	1.9	1.9	1.7	2.9	4.8
Texas	74.6	59.6	20.5	25.4	51.1	64.3	39.8	18.3	25.7	24.5
Virginia	4,064.5	4,122.1	4,804.2	2,049.2	2,275.7	1,663.2	1,253.8	1,254.4	1,918.0	1,585.5
Washington	1,254.2	1,635.2	521.0	168.0	154.8	121.7	47.0	27.1	29.1	8.8

TABLE 5. Real dockside value of flounder landings by state (thousands of 2020 dollars).

State	YEAR										
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Alaska	\$1,732.8	\$670.5	\$821.4	\$1,449.9	\$2,071.0	\$4,104.3	\$4,374.7	\$3,139.3	\$9,261.2	\$8,527.5	\$11,183.2
California	\$944.6	\$1,049.5	\$743.6	\$781.9	\$507.2	\$412.7	\$226.9	\$249.4	\$195.0	\$164.3	\$150.6
Connecticut	\$1,920.9	\$1,688.3	\$1,272.6	\$1,230.8	\$1,439.7	\$1,519.1	\$1,292.7	\$1,078.4	\$1,021.9	\$877.1	\$1,053.1
Delaware	\$38.4	\$22.2	\$5.9	\$11.9	\$19.2	\$8.9	\$10.8	*	*	*	\$5.4
Florida	\$32.8	\$15.1	\$40.9	\$49.2	\$22.5	\$13.5	\$20.3	\$782.5	\$661.0	\$640.7	\$600.5
Louisiana	\$324.4	\$133.8	\$112.2	\$94.1	\$110.1	\$38.9	\$141.8	\$134.8	\$135.5	\$237.1	\$165.0
Maine	\$11,939.3	\$11,658.7	\$10,421.3	\$8,444.1	\$2,417.2	\$5,655.1	\$4,252.1	\$3,211.1	\$2,402.9	\$961.1	\$692.6
Maryland	\$13.2	\$13.4	\$0.0	\$725.3	\$530.9	\$896.2	\$784.7	\$731.5	\$760.6	\$666.5	\$745.5
Massachusetts	\$44,287.2	\$47,077.4	\$46,378.7	\$45,400.4	\$40,092.6	\$37,390.0	\$30,947.9	\$27,028.5	\$25,172.1	\$23,477.7	\$23,615.0
Mississippi	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0
New Hampshire	\$767.2	\$728.8	\$814.2	\$560.2	\$483.3	\$475.3	\$245.4	\$159.4	\$150.9	\$167.7	\$121.9
New Jersey	\$4,708.8	\$4,222.3	\$5,342.2	\$6,019.3	\$6,710.3	\$6,655.2	\$7,377.9	\$5,963.8	\$4,746.7	\$4,156.1	\$5,400.7
New York	\$5,376.5	\$4,922.2	\$4,160.3	\$4,147.4	\$5,102.0	\$5,431.6	\$5,310.9	\$4,992.6	\$4,160.3	\$3,989.5	\$4,354.0
North Carolina	\$16,958.6	\$14,443.5	\$15,799.9	\$13,311.5	\$15,496.5	\$14,239.9	\$16,781.6	\$13,927.6	\$13,133.2	\$12,107.0	\$12,895.4
Oregon	\$594.8	\$500.4	\$445.4	\$429.4	\$533.4	\$503.1	\$768.5	\$578.2	\$644.7	\$927.7	\$676.6
Rhode Island	\$11,261.7	\$9,761.2	\$10,060.2	\$9,327.9	\$9,969.1	\$9,891.7	\$10,823.9	\$9,721.5	\$7,994.3	\$7,105.1	\$7,238.8
South Carolina	\$12.3	\$16.3	\$12.6	\$15.8	\$16.1	\$5.8	\$0.0	\$2.7	\$3.4	\$5.1	\$6.9
Texas	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$69.0
Virginia	\$4,566.8	\$4,237.1	\$4,416.3	\$5,807.8	\$7,223.7	\$6,262.1	\$5,517.6	\$3,911.7	\$3,276.7	\$3,539.6	\$4,967.8
Washington	\$785.8	\$551.9	\$508.0	\$449.9	\$401.0	\$372.3	\$218.9	\$212.6	\$139.1	\$315.8	\$239.7

State	YEAR									
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Alaska	\$9,852.9	\$12,125.1	\$10,215.1	\$10,131.3	\$6,732.9	\$6,272.9	\$9,686.2	\$7,858.1	\$7,275.9	\$6,501.5
California	\$154.3	\$175.8	\$222.1	\$276.2	\$180.3	\$145.1	\$159.9	\$148.3	\$123.7	\$79.2
Connecticut	\$1,193.0	\$1,138.6	\$1,209.5	\$1,105.8	\$1,345.8	\$1,135.3	\$888.3	\$1,203.4	\$1,233.5	\$1,195.5
Delaware	\$2.3	*	*	\$5.4	\$4.5	\$7.8	\$5.0	\$2.1	\$4.0	\$1.9
Florida	\$1,056.7	\$1,029.3	\$802.3	\$702.4	\$547.9	\$602.3	\$570.1	\$458.1	\$579.8	\$446.8
Louisiana	\$294.6	\$198.9	\$190.5	\$160.2	\$152.1	\$164.1	\$116.9	\$164.6	\$180.7	\$34.0
Maine	\$543.3	\$1,033.2	\$1,536.3	\$1,359.6	\$1,605.0	\$1,260.9	\$946.7	*	\$1,020.7	\$264.2
Maryland	\$588.1	\$463.1	\$604.6	\$655.7	\$649.6	\$718.5	\$595.0	\$626.7	\$407.4	\$484.7
Massachusetts	\$25,506.9	\$28,460.9	\$23,018.0	\$19,679.4	\$18,831.7	\$18,477.8	\$18,480.4	\$14,782.6	\$12,323.4	\$10,028.7
Mississippi	\$0.0	*	\$0.0	\$48.5	\$82.7	\$80.8	\$28.7	\$46.0	\$99.7	\$19.2
New Hampshire	\$117.9	\$246.4	\$117.9	*	\$169.2	\$205.0	\$284.1	\$203.5	\$125.5	\$81.4
New Jersey	\$6,360.8	\$6,185.5	\$5,612.7	\$5,374.8	\$5,509.4	\$5,880.6	\$4,536.0	\$4,694.6	\$5,158.4	\$5,154.5
New York	\$4,399.5	\$4,220.3	\$4,012.1	\$3,765.7	\$3,838.7	\$3,132.0	\$2,756.2	\$2,339.4	\$3,555.5	\$2,991.8
North Carolina	\$10,298.9	\$8,430.0	\$7,890.5	\$14,317.1	\$13,951.0	\$12,959.0	\$12,624.8	\$11,042.9	\$10,500.1	\$4,803.4
Oregon	\$539.1	\$572.7	\$586.5	\$437.7	\$401.6	\$298.3	\$268.1	\$155.5	\$90.7	\$57.5
Rhode Island	\$8,354.1	\$9,046.3	\$9,910.6	\$11,231.0	\$8,555.7	\$7,463.9	\$6,167.1	\$5,496.5	\$6,064.8	\$4,909.2
South Carolina	\$8.7	\$5.1	\$5.9	\$4.7	\$4.9	\$6.9	\$7.1	\$6.3	\$13.0	\$24.2
Texas	\$236.7	\$199.2	\$81.4	\$108.7	\$202.8	\$256.9	\$172.5	\$74.8	\$108.1	\$112.4
Virginia	\$6,897.9	\$8,777.9	\$9,521.3	\$5,189.0	\$6,187.3	\$5,662.2	\$5,057.1	\$4,707.8	\$5,091.1	\$2,894.8
Washington	\$149.8	\$253.3	\$71.9	\$31.2	\$16.4	\$15.1	\$4.3	\$2.8	\$4.2	\$0.8

TABLE 6. Average monthly commercial flounder landings, dockside value, and dockside value per pound, 2000-2020.

Month	Average Pounds	Average Inflation-Adjusted Dockside Value	Average Inflation-Adjusted Dockside Value per Pound	Month	Average Pounds	Average Inflation-Adjusted Dockside Value	Average Inflation-Adjusted Dockside Value per Pound
January	1,287	\$1,655	\$1.29	July	1,020	\$1,932	\$1.89
February	911	\$1,347	\$1.48	August	1,577	\$3,179	\$2.02
March	789	\$1,391	\$1.76	September	2,170	\$4,192	\$1.93
April	785	\$1,572	\$2.00	October	15,174	\$30,331	\$2.00
May	971	\$1,922	\$1.98	November	45,913	\$91,051	\$1.98
June	1,576	\$2,870	\$1.82	December	8,526	\$14,939	\$1.75

TABLE 7. Commercial flounder landings by gear type, 2000-2020.

YEAR	Butterfly Nets	Skimmer Nets	Shrimp Otter Trawl	Trot Lines	Crab Pots & Traps	YEAR	Butterfly Nets	Skimmer Nets	Shrimp Otter Trawl	Trot Lines	Crab Pots & Traps
2000	37,215	13,835	62,989	17,177	4,675	2011	82,338	22,680	16,732	16,097	4,422
	21.0%	7.8%	35.5%	9.7%	2.6%		53.4%	14.7%	10.8%	10.4%	2.9%
2001	4,031	16,403	44,970	4,114	1,120	2012	56,383	9,927	11,064	8,722	2,528
	4.4%	17.9%	49.0%	4.5%	1.2%		58.0%	10.2%	11.4%	9.0%	2.6%
2002	5,463	14,635	39,721	2,636	1,655	2013	50,637	14,857	8,703	4,777	1,409
	6.7%	17.9%	48.5%	3.2%	2.0%		56.8%	16.7%	9.8%	5.4%	1.6%
2003	12,390	8,461	34,894	4,215	1,419	2014	38,122	5,262	14,622	1,951	1,194
	19.5%	13.3%	54.8%	6.6%	2.2%		57.5%	7.9%	22.1%	2.9%	1.8%
2004	26,589	11,326	25,731	3,880	2,206	2015	21,674	14,955	24,134	606	314
	36.1%	15.4%	34.9%	5.3%	3.0%		34.5%	23.8%	38.4%	1.0%	0.5%
2005	*	2,185	9,681	2,809	1,150	2016	22,880	6,273	31,908	851	771
	*	10.1%	44.9%	13.0%	5.3%		35.1%	9.6%	49.0%	1.3%	1.2%
2006	41,554	8,937	20,815	4,354	4,058	2017	26,657	7,369	8,371	903	516
	49.6%	10.7%	24.8%	5.2%	4.8%		56.2%	15.5%	17.7%	1.9%	1.1%
2007	23,911	24,880	15,521	6,292	5,193	2018	28,238	12,300	14,408	597	410
	30.3%	31.6%	19.7%	8.0%	6.6%		45.0%	19.6%	23.0%	1.0%	0.7%
2008	33,404	13,145	21,050	5,856	2,179	2019	37,852	17,927	9,996	412	599
	42.9%	16.9%	27.0%	7.5%	2.8%		53.0%	25.1%	14.0%	0.6%	0.8%
2009	34,520	14,596	52,489	15,429	5,700	2020	6,257	3,829	815	1,262	758
	26.2%	11.1%	39.9%	11.7%	4.3%		41.5%	25.4%	5.4%	8.4%	5.0%
2010	50,281	5,346	14,504	4,976	3,201	* Landings data for butterfly nets in 2005 are withheld to maintain LDWF confidentiality standards.					
	62.0%	6.6%	17.9%	6.1%	3.9%						

TABLE 8. Number of vessels with commercial flounder landings and pounds of flounder landings and landings by vessel length.

YEAR	NUMBER OF VESSELS	CUMULATIVE POUNDS OF FLOUNDER						
		20' or Under	21-30'	31-40'	41-50'	51-60'	Over 60'	Unknown
2000	254	40,174	14,428	18,567	19,092	11,450	30,617	31,389
2001	238	21,554	5,980	14,178	7,920	5,414	27,649	7,231
2002	224	17,181	7,715	16,787	5,282	2,311	25,858	4,340
2003	158	4,340	4,753	8,389	6,581	1,805	23,277	863
2004	185	23,868	10,361	8,202	8,613	1,787	15,166	3,514
2005	83	2,162	3,628	3,795	4,253	1,110	4,477	982
2006	132	19,386	3,233	15,117	16,714	9,898	4,436	14,673
2007	162	12,921	8,869	17,247	14,792	4,264	8,362	12,435
2008	148	15,611	9,703	18,472	14,913	2,446	8,328	8,414
2009	171	30,602	11,572	21,186	29,600	9,457	19,319	7,375
2010	94	15,607	7,672	11,643	16,736	7,383	14,396	4,766
2011	140	26,618	30,620	29,992	16,139	9,304	9,194	30,094
2012	133	5,426	22,943	16,082	21,890	6,829	4,546	19,025
2013	150	1,507	23,744	14,852	16,515	5,513	4,776	22,477
2014	108	3,656	15,430	8,445	16,793	5,042	4,919	8,960
2015	129	4,086	10,283	8,953	10,776	13,750	8,028	7,056
2016	116	1,959	5,924	6,711	14,854	17,917	7,124	12,443
2017	117	4,381	7,632	4,001	12,736	9,863	2,916	7,340
2018	127	5,077	7,197	7,928	21,598	8,743	1,748	12,195
2019	154	7,191	13,024	7,242	18,507	5,868	1,559	19,894
2020	57	2,600	978	1,115	4,687	*	*	2,527

* Landings data for vessels between 51' and 60' and for over 60' long are withheld to maintain LDWF confidentiality standards.

skimmer nets, shrimp otter trawls, trot lines, and crab pot and traps (*Table 7*).

In 2020, butterfly nets accounted for 41.5% of Louisiana landings by weight, skimmer nets for 25.4%, and shrimp otter trawls for 5.4%. Five percent were harvested with crab traps and 8.4% on trot lines. Landings in butterfly nets accounted for the majority of the state's commercial flounder landings in seven years between 2010 and 2020 (2010, 2011, 2012, 2013, 2014, 2017 and 2019).

Commercial Flounder Landings by Vessel Size

The number of fishing vessels reporting commercial landings exceeded 220 in the first three years of the 2000-2020 study period and ranged from 83 to 185 between 2003 and 2010 (*Table 8*). The number ranged between 108 and 154 for the years between 2011 and 2019 but dropped to 57 in 2020. In every year between 2000 and 2020, vessels of 31 feet or longer accounted for the majority of flounder landings for which vessel length data were available.

Commercial Flounder Landings by Basin

Commercial harvesters reported landings from eight basins and two offshore grids in 2020. Most of the landings (66.5% by weight) for the year were harvested in the Calcasieu River Basin in the southwestern portion of the state (*Table 9*). The Calcasieu Basin has been the reported source for the majority of commercial flounder landings in every year since 2008.

Number of Fishers with Commercial Flounder Landings

The number of fishers reporting commercial flounder landings declined from over 700 in 2000 to 324 in 2003 and 353 in 2004 (*Table 10*). The number varied widely over the next nine years and has followed a general downward trend since 2013, falling to 67 in 2020.

FISHING EFFORT

The number of commercial fishing trips with commercial flounder landings dropped from 3,370 in 2000 to 1,126 in 2003 and 1,390 in 2004 (*Table 11*). A decline in the trip count to 633 coincided with the occurrence of hurricanes Katrina and Rita in 2005. The number of trips climbed to 1,395 in 2009, dropped to 664 in 2010, the year of the *Deepwater Horizon* oil spill, rose to 1,043 in 2011, and then ranged between 600 and 700 for most of the following nine years and fell to a low of 239 in 2020.

Between 2000 and 2010, estimated pounds per trip ranged between 45 and 57 pounds per trip except for the estimate of 34.1 pounds per trip in 2005, the year of two major hurricanes. Landings per trip rose to 147.9 pounds per trip in 2011, dropped to 80.2 pounds per trip in 2017, rose to 108 pounds per trip in 2019, and then dropped to 63.1 pounds per trip in 2020.

The estimated value per trip in inflation-adjusted dollars was below \$100 per trip in each of the first six years between 2000 and 2020, ranged between \$136 and \$170 per trip over the next four years, and rose to levels of approximately \$200 or higher per trip between 2010 and 2019. The value was \$142.1 per trip in 2020.

SEAFOOD DEALERS

The number of licensed seafood dealers that reported handling or purchasing flounder from commercial fishers for later resale to other buyers dropped from 67 in 2000 to 46 in 2001 then varied between 33 and 54 for most of the remainder of the period (*Table 12*). The number of dealers stood at 23 in 2020.

DOMESTIC AND FOREIGN MARKET

Flounder are one type of fish within the broader category of flatfish. Other species included in this category include halibut and sole. Complete enumerations of U.S. landings of halibut and sole using published NMFS data since 2006 are unavailable because landings statistics for certain states have been withheld by the agency to maintain confidentiality standards. For example, in 2020, NMFS data indicate that landings of halibut were made in nine states. Data are presented for all but one state (Rhode Island). The summation of the landings for eight states for which data are available (28.0 million pounds) represents the minimum possible value for species landings (*Table 15*).

Average annual landings of halibuts in the U.S. between 2000 and 2020 were at least 56.9 million pounds (*Table 15*). The average inflation-adjusted dockside value for halibut was relatively high compared to flounder at the national level. Estimated inflation-adjusted dockside value per pound for halibuts between 2000 and 2020 in the U.S. averaged \$3.48 per pound. The estimated average inflation-adjusted value per pound for flounders during that period was \$1.99 per pound.

Average U.S. annual landings of soles between 2000 and 2020 was at least 399.0 million pounds (*Table 15*). The average inflation-adjusted dockside value per pound was \$0.21 per pound.

NOAA Fisheries provides data from the U.S. Census Bureau Foreign Trade Data Series for the imports and exports of several types of flounder and several other types of flatfish (*Table 16*). The inflation-adjusted value of the imports of all flatfish in 2020 totaled \$244.5 million, somewhat less than the average inflation-adjusted value for 2000 through 2019 (\$284.3 million).

Imports of halibut products comprised approximately 49% of the value of all flatfish imports in 2020 and exceeded the value of any other single type of flatfish in every year since 2009. Imports of sole products represented approximately 20% of the value of all flatfish imports in 2020 and average 25.6% of the value of flatfish imports from 2000 through 2019.

Imports of flounder products in 2020 were \$44.3 million or 18.1% of the value of all flatfish imports. Flounder imports averaged \$64.7 million between 2000 and 2019, an average of 23.0% of the value of flatfish imports during those years.

Data for the exports of flounder products from the U.S. are not published but statistics are available for several types of flatfish (halibut, plaice, sole, and turbot) as well as for non-specified flatfish category (*Table 17*). The total value of all flatfish exports totaled \$195.1 million in 2020 and averaged \$195.1 million between 2000 and 2019.

TABLE 9. Commercial flounder landings by gear type, 2000-2020.

YEAR	Calcasieu River	Vermilion-Teche	Terrebonne	Barataria	Lake Pontchartrain	YEAR	Calcasieu River	Vermilion-Teche	Terrebonne	Barataria	Lake Pontchartrain
2000	63,520	13,393	804	31,043	4,347	2000	105,023	5,506	2,812	5,885	26,539
	35.8%	7.5%	0.5%	17.5%	2.4%		68.1%	3.6%	1.8%	3.8%	17.2%
2001	21,178	2,783	753	14,938	10,104	2001	77,426	3,602	1,298	2,532	5,467
	23.1%	3.0%	0.8%	16.3%	11.0%		79.6%	3.7%	1.3%	2.6%	5.6%
2002	12,128	4,148	5,927	21,629	11,768	2002	73,057	2,817	948	4,550	4,543
	14.8%	5.1%	7.2%	26.4%	14.4%		82.0%	3.2%	1.1%	5.1%	5.1%
2003	16,127	294	1,151	9,771	8,506	2003	53,192	2,243	836	2,153	2,797
	25.3%	0.5%	1.8%	15.4%	13.4%		80.3%	3.4%	1.3%	3.2%	4.2%
2004	32,667	1,735	164	9,212	4,334	2004	46,750	2,488	3,226	3,401	1,500
	44.3%	2.4%	0.2%	12.5%	5.9%		74.4%	4.0%	5.1%	5.4%	2.4%
2005	8,732	2,899	229	3,362	1,148	2005	56,509	1,171	942	969	2,829
	40.5%	13.4%	1.1%	15.6%	5.3%		86.8%	1.8%	1.4%	1.5%	4.3%
2006	60,949	972	1,303	6,923	3,897	2006	42,107	1,272	377	592	1,922
	72.7%	1.2%	1.6%	8.3%	4.6%		88.8%	2.7%	0.8%	1.2%	4.1%
2007	38,686	1,967	387	11,694	18,148	2007	47,829	1,576	712	625	9,642
	49.1%	2.5%	0.5%	14.8%	23.0%		76.2%	2.5%	1.1%	1.0%	15.4%
2008	47,427	1,953	1,525	9,287	11,855	2008	58,907	1,741	1,210	5,305	2,849
	60.8%	2.5%	2.0%	11.9%	15.2%		82.5%	2.4%	1.7%	7.4%	4.0%
2009	90,040	794	2,104	9,292	11,031	2009	10,035	1,569	1,387	Confidential	990
	68.4%	0.6%	1.6%	7.1%	8.4%		66.5%	10.4%	9.2%	-	6.6%
2010	63,199	1,057	856	2,372	4,355						
	78.0%	1.3%	1.1%	2.9%	5.4%						

TABLE 10. Number of fishers reporting commercial flounder landings, 2000-2020.

YEAR	Commercial Fishers with Flounder Landings	YEAR	Commercial Fishers with Flounder Landings	YEAR	Commercial Fishers with Flounder Landings	YEAR	Commercial Fishers with Flounder Landings
2000	717	2006	258	2011	257	2016	157
2001	548	2007	288	2012	212	2017	133
2002	502	2008	250	2013	213	2018	135
2003	324	2009	314	2014	160	2019	164
2004	353	2010	199	2015	171	2020	67
2005	162						

TABLE 11. Number of trips with commercial flounder landings, pounds per trip, and inflation-adjusted dockside value per trip.

YEAR	Commercial Trips with Flounder Landings	Estimated Pounds per Trip	Estimated Dockside Value per Trip	YEAR	Commercial Trips with Flounder Landings	Estimated Pounds per Trip	Estimated Dockside Value per Trip
2000	3,370	52.7	\$96.3	2011	1,043	147.9	\$282.4
2001	2,024	45.3	\$66.1	2012	717	135.6	\$277.5
2002	1,692	48.4	\$66.3	2013	750	118.8	\$254.1
2003	1,126	56.5	\$83.6	2014	633	104.7	\$253.1
2004	1,390	53.0	\$79.2	2015	677	92.8	\$224.6
2005	633	34.1	\$61.4	2016	701	92.9	\$234.1
2006	876	95.7	\$161.9	2017	591	80.2	\$197.9
2007	921	85.6	\$146.3	2018	606	103.6	\$271.7
2008	990	78.7	\$136.8	2019	661	108.0	\$273.4
2009	1,395	94.3	\$170.0	2020	239	63.1	\$142.1
2010	664	122.1	\$248.4				

TABLE 12. Number of licensed seafood dealers that reported handling flounder, 2000-2020.

YEAR	NUMBER OF DEALERS	YEAR	NUMBER OF DEALERS	YEAR	NUMBER OF DEALERS	YEAR	NUMBER OF DEALERS
2000	67	2006	40	2011	45	2016	37
2001	46	2007	39	2012	41	2017	23
2002	54	2008	33	2013	46	2018	29
2003	50	2009	35	2014	40	2019	35
2004	47	2010	41	2015	36	2020	23
2005	33						

TABLE 13. National Marine Fisheries Service estimates of exports of seafood products for several fish species classified as flatfish (inflation-adjusted values in millions of 2020 dollars).

YEAR	Halibut	Non-Specified	Plaice	Sole	Turbot	Total
2000	\$75.2	\$44.3	\$5.4	\$54.9	\$9.9	\$189.7
2001	\$77.4	\$40.7	\$0.4	\$42.4	\$5.3	\$166.2
2002	\$86.3	\$36.0	\$0.5	\$50.3	\$2.3	\$175.4
2003	\$89.3	\$28.3	\$1.7	\$54.4	\$3.1	\$176.8
2004	\$90.7	\$34.8	\$0.1	\$75.4	\$1.0	\$202.0
2005	\$90.0	\$30.6	\$2.6	\$70.7	\$2.6	\$196.5
2006	\$101.7	\$34.2	\$0.4	\$103.2	\$3.5	\$243.0
2007	\$119.0	\$30.2	\$1.4	\$128.4	\$2.9	\$281.9
2008	\$108.1	\$40.8	\$5.6	\$130.2	\$3.4	\$288.1
2009	\$94.9	\$42.2	\$6.9	\$99.1	\$5.1	\$248.2
2010	\$111.4	\$64.5	\$5.8	\$114.6	\$6.6	\$302.9
2011	\$95.8	\$39.6	\$7.3	\$83.6	\$5.2	\$231.5
2012	\$55.4	\$31.0	\$4.6	\$97.5	\$8.7	\$197.2
2013	\$50.1	\$35.9	\$6.2	\$170.5	\$1.9	\$264.6
2014	\$40.9	\$47.4	\$7.0	\$159.4	\$2.0	\$256.7
2015	\$33.9	\$28.3	\$8.7	\$142.3	\$3.9	\$217.1
2016	\$32.3	\$37.5	\$5.9	\$160.4	\$4.8	\$240.9
2017	\$26.0	\$50.0	\$6.6	\$131.8	\$4.8	\$219.2
2018	\$26.0	\$31.2	\$9.6	\$122.7	\$5.1	\$194.6
2019	\$27.6	\$38.2	\$7.8	\$132.0	\$7.4	\$213.0
2020	\$20.2	\$39.8	\$8.3	\$123.2	\$3.6	\$195.1

TABLE 14. National Marine Fisheries Service estimates of cumulative value exports and imports of seafood products for several fish species classified as flatfish (inflation-adjusted values in millions of 2020 dollars).

YEAR	Exports of Flatfish	Imports of Flatfish	Net Exports	Trade Balance
2000	\$189.7	\$325.8	-\$136.1	Deficit
2001	\$166.2	\$267.4	-\$101.2	Deficit
2002	\$175.4	\$286.2	-\$110.8	Deficit
2003	\$176.8	\$320.6	-\$143.8	Deficit
2004	\$202.0	\$329.7	-\$127.7	Deficit
2005	\$196.5	\$302.2	-\$105.7	Deficit
2006	\$243.0	\$284.6	-\$41.6	Deficit
2007	\$281.9	\$292.1	-\$10.2	Deficit
2008	\$288.1	\$280.7	\$7.4	Surplus
2009	\$248.2	\$223.6	\$24.6	Surplus
2010	\$302.9	\$259.5	\$43.4	Surplus
2011	\$231.5	\$280.2	-\$48.7	Deficit
2012	\$197.2	\$265.1	-\$67.9	Deficit
2013	\$264.6	\$271.6	-\$7.0	Deficit
2014	\$256.7	\$258.5	-\$1.8	Deficit
2015	\$217.1	\$277.8	-\$60.7	Deficit
2016	\$240.9	\$282.3	-\$41.4	Deficit
2017	\$219.2	\$283.5	-\$64.3	Deficit
2018	\$194.6	\$319.7	-\$125.1	Deficit
2019	\$213.0	\$274.2	-\$61.2	Deficit
2020	\$195.1	\$244.5	-\$49.4	Deficit

TABLE 15. National Marine Fisheries Service's estimates of annual U.S. landings of halibuts and soles

YEAR	HALIBUTS		SOLES	
	Millions of Pounds	Dockside Value per Pound	Millions of Pounds	Dockside Value per Pound
2000	88.9	\$2.42	279.7	\$0.15
2001	87.7	\$1.94	235.1	\$0.16
2002	88.4	\$2.24	257.4	\$0.12
2003	85.3	\$2.85	256.9	\$0.10
2004	82.8	\$2.83	264.0	\$0.23
2005	81.1	\$2.82	>315.9	\$0.24
2006	>74.9	~\$3.36	>343.6	~\$0.27
2007	>72.4	~\$3.79	>393.9	~\$0.26
2008	>70.6	~\$3.70	>527.6	~\$0.23
2009	>68.1	~\$2.50	>427.3	~\$0.19
2010	>64.6	~\$3.80	>455.8	~\$0.19
2011	>50.4	~\$4.92	>515.7	~\$0.23
2012	>43.9	~\$4.00	>531.2	~\$0.24
2013	>33.0	~\$4.02	>560.7	~\$0.24
2014	>25.9	~\$4.85	>524.5	~\$0.20
2015	>28.9	~\$4.51	>429.5	~\$0.18
2016	>29.7	~\$4.63	>447.9	~\$0.18
2017	>32.4	~\$4.19	>416.8	~\$0.22
2018	>26.0	~\$3.69	>400.0	~\$0.21
2019	>31.4	~\$3.40	>398.4	~\$0.24
2020	>28.0	~\$2.71	>397.6	~\$0.22

TABLE 16. U.S. Census Bureau Foreign Trade Data Series' estimates of imports of seafood products for several fish species classified as flatfish (inflation-adjusted values in Millions of 2020 Dollars).

YEAR	Flounder	Halibut	Plaice	Sole	Turbot	Non-Specified	Total
2000	\$64.5	\$111.1	\$2.0	\$84.9	\$24.7	\$38.6	\$325.8
2001	\$67.7	\$96.4	\$2.8	\$62.2	\$19.0	\$19.3	\$267.4
2002	\$59.2	\$116.3	\$2.8	\$69.2	\$17.9	\$20.7	\$286.2
2003	\$64.3	\$135.3	\$2.3	\$85.3	\$15.3	\$18.1	\$320.6
2004	\$48.5	\$118.0	\$1.5	\$111.7	\$12.4	\$37.6	\$329.7
2005	\$57.4	\$83.8	\$1.1	\$116.1	\$13.5	\$30.4	\$302.2
2006	\$47.4	\$108.0	\$0.4	\$93.5	\$13.0	\$22.3	\$284.6
2007	\$68.6	\$97.9	\$0.1	\$91.5	\$13.8	\$20.3	\$292.1
2008	\$72.8	\$81.9	\$0.0	\$91.6	\$13.8	\$20.6	\$280.7
2009	\$66.2	\$69.7	\$0.1	\$63.0	\$10.6	\$13.9	\$223.6
2010	\$73.7	\$84.3	\$0.1	\$68.3	\$14.8	\$18.4	\$259.5
2011	\$82.3	\$99.3	\$0.9	\$69.4	\$11.5	\$16.9	\$280.2
2012	\$73.2	\$97.9	\$0.5	\$65.8	\$9.5	\$18.3	\$265.1
2013	\$81.1	\$97.0	\$1.5	\$57.6	\$10.5	\$23.9	\$271.6
2014	\$63.3	\$110.0	\$1.6	\$55.9	\$8.0	\$19.7	\$258.5
2015	\$62.3	\$127.8	\$1.7	\$52.8	\$9.8	\$23.4	\$277.8
2016	\$55.7	\$137.0	\$2.8	\$51.4	\$11.8	\$23.6	\$282.3
2017	\$63.3	\$131.4	\$2.9	\$53.6	\$7.5	\$24.7	\$283.5
2018	\$68.9	\$140.9	\$3.2	\$69.6	\$9.5	\$27.6	\$319.7
2019	\$54.0	\$134.6	\$2.9	\$48.9	\$12.0	\$21.7	\$274.2
2020	\$44.3	\$120.1	\$2.8	\$49.8	\$7.8	\$19.6	\$244.5

TABLE 17. U.S. Census Bureau Foreign Trade Data Series' estimates of exports of seafood products for several fish species classified as flatfish (inflation-adjusted values in Millions of 2020 Dollars).

YEAR	Halibut	Plaice	Sole	Turbot	Non-Specified	Total
2000	\$75.2	\$5.4	\$54.9	\$9.9	\$44.3	\$189.7
2001	\$77.4	\$0.4	\$42.4	\$5.3	\$40.7	\$166.2
2002	\$86.3	\$0.5	\$50.3	\$2.3	\$36.0	\$175.4
2003	\$89.3	\$1.7	\$54.4	\$3.1	\$28.3	\$176.8
2004	\$90.7	\$0.1	\$75.4	\$1.0	\$34.8	\$202.0
2005	\$90.0	\$2.6	\$70.7	\$2.6	\$30.6	\$196.5
2006	\$101.7	\$0.4	\$103.2	\$3.5	\$34.2	\$243.0
2007	\$119.0	\$1.4	\$128.4	\$2.9	\$30.2	\$281.9
2008	\$108.1	\$5.6	\$130.2	\$3.4	\$40.8	\$288.1
2009	\$94.9	\$6.9	\$99.1	\$5.1	\$42.2	\$248.2
2010	\$111.4	\$5.8	\$114.6	\$6.6	\$64.5	\$302.9
2011	\$95.8	\$7.3	\$83.6	\$5.2	\$39.6	\$231.5
2012	\$55.4	\$4.6	\$97.5	\$8.7	\$31.0	\$197.2
2013	\$50.1	\$6.2	\$170.5	\$1.9	\$35.9	\$264.6
2014	\$40.9	\$7.0	\$159.4	\$2.0	\$47.4	\$256.7
2015	\$33.9	\$8.7	\$142.3	\$3.9	\$28.3	\$217.1
2016	\$32.3	\$5.9	\$160.4	\$4.8	\$37.5	\$240.9
2017	\$26.0	\$6.6	\$131.8	\$4.8	\$50.0	\$219.2
2018	\$26.0	\$9.6	\$122.7	\$5.1	\$31.2	\$194.6
2019	\$27.6	\$7.8	\$132.0	\$7.4	\$38.2	\$213.0
2020	\$20.2	\$8.3	\$123.2	\$3.6	\$39.8	\$195.1

Exports of sole products totaled \$123.2 million in 2020, 63.1% of the year's total flatfish product imports. The value of sole products comprised at least 60% of the value of U.S. flatfish exports in every year between 2013 and 2020.

The value of flatfish product imports was approximately \$49 million greater than the value of flatfish product exports in 2020. By this measure, imports of flatfish have exceeded exports in all but three years (2008, 2009 and 2010) between 2000 and 2020.

RECREATIONAL FISHERY

Southern Flounder are a very popular recreational species throughout their range as they are excellent table fare and offer novel fishing challenges. Anglers can find Southern Flounder along beaches and barrier islands, inshore lakes and bays, and even in some freshwater areas. During the fall and spring, Southern Flounder may be more easily targeted in some areas due to their seasonal migration patterns. Approximately 28% of the total annual recreational flounder are landed in Louisiana during October and November according to 2017 to 2019 LA Creel data. Typically, after several cool fronts, Southern Flounder become more concentrated in areas along the migration path from inshore habitats to the Gulf of Mexico. Anglers need to study the shoreline, underwater structure, and areas of moving water based on tide to take advantage of Southern Flounder aggregations and feeding behavior.

A study in Barataria Bay, Louisiana, revealed the most productive baits included live bait, dead/cut bait, and a combination of artificial and dead/cut baits (Guillory and Hutton 1990). Small artificial grubs are commonly fished near the bottom or jigged around pilings, bulkheads, piers, and rock jetties to catch flounder. Plastic jigs can be effective over shallow, sandy

bottoms catching flounder buried in the sand waiting to ambush their prey. In turbid water, scent additives and appropriate color selection can positively affect the success of various artificial lures. In heavily vegetated areas such as grass flats, shallow running spoons and spinner baits are the best strategy when fishing with artificial baits. Often live bait such as shrimp or "cakahoe" minnows (*Fundulus spp.*) retrieved slowly along the bottom yields better results than a dead bait presentation. When fishing for flounder with rod and reel, light tackle provides the greatest sport and chance of landing. Usually, the most productive fishing times are during ebb tides, which drain shallow flats and force prey species through channels into the surf zone and along beaches.

Gigging, sometimes known as "Floundering", is a method of take using a barbless spear or multipronged barbed gig. This species is vulnerable at night when they enter shallow water to feed. Lights are used to locate the fish while an angler quietly wades through shallow water. Gigging for flounder combines the challenges of both hunting and fishing. Once a Southern Flounder is illuminated, they normally do not move, allowing an angler to use a gig to spear the fish. In recent years, an innovative night strategy has emerged, which uses high-powered LEDs mounted on flat-bottomed boats to locate flounder. This method can be much more effective than traditional floundering, especially when employing the use of a bow and arrow. This approach also covers much more area than could previously be accessed and often areas with substrate too soft for wading.

Recreational fishing efforts for Southern Flounder statewide are not as common compared to trips primarily pursuing Red Drum and Spotted Seatrout. For many anglers during most of the year, Southern Flounder are a secondary or incidental target. According to a recent study of Louisiana recreational anglers from 2016 through 2020 surveyed participants indicated, Spotted Seatrout were the primary target during 52.6% of excursions, followed by Red Drum at 31.2% (Smith et al. 2021). Comparatively, the estimated trips targeting Southern Flounder solely was 2.0% for private trips and only 0.34% during for-hire trips. (Smith 2021 et al.) These single species excursions for Southern Flounder are most likely highest during the fall spawning run than at any other time of the year.

Recreational landings, derived from NMFS' MRIP estimates from 2000 to 2013 show large variability in the amount of Southern Flounder landed in Louisiana (Table 18) Recreational landings averaged 814,355 individual Southern Flounder (1,055,410 lbs.; 478.726 kg.) annually from 2003 to 2013 (Pers. Comm. NMFS, Fisheries Statistics Division, 2022).

LA Creel landing estimates from 2014 through 2020 show wide variability in the amount of Southern Flounder landed in Louisiana (Figure 4). From 2014 through 2020, statewide landings of Southern Flounder ranged from a high of 222,071 to a low of 64,528 individual fish. LA Creel landings estimates in 2014 were 208,878 Southern Flounder. Landings increased in 2015 to 217,370 and in 2016 to 222,071. Landings declined in 2017 and 2018 to 93,667 and 64,528, respectively. Landings in 2019 and 2020 remained lower than previous highs at 102,900 and 94,077, respectively.

The total number of saltwater fishing trips taken by private recreational anglers in Louisiana between 2014 and 2020 has varied from a low of 1.94 million trips in 2019 to a high of 2.27 million trips in 2015 with an average of 2.04 million trips annually (*Table 19*). During this same time period, an average of 166,210 for-hire trips were taken in Louisiana (*Table 19*). For-hire trips varied from a high of 183,301 trips in 2018 to a low of 130,615 in 2014. The total number of recreational saltwater fishing trips, including private and for-hire, in Louisiana averaged 2.21 million trips from 2014 to 2020 (*Table 19*).

From 2014 through 2020, Southern Flounder were observed in 3.19 - 8.95% of private recreational fishing trips surveyed through LA Creel (*Table 20*). Similarly, Southern Flounder were observed in 5.94 - 16.90% of for-hire trips surveyed through LA Creel from the same time-period (2014-2020).

From 2014 through 2020, most Southern Flounder landed by private recreational fishermen were from the Calcasieu Basin (*Figure 5*). The Calcasieu Basin had an average of 94,075 Southern Flounder landed per year during the time period. Harvest from the Calcasieu Basin was highest in 2014 at 134,516 fish and lowest in 2018 at 31,385 fish. The Barataria Basin had the second highest amount of private recreational landings of Southern Flounder with an average of 15,464 fish being landed during the time period. Southern Flounder landings in the Barataria Basin peaked at 37,031 fish in 2016 and dropped to a low of 3,178 fish in 2017. The Pontchartrain Basin followed with an average of 10,041 Southern Flounder landed per year by private recreational anglers. Pontchartrain Basin landings were highest in 2016 with 15,123 flounder being landed compared to a low of 4,222 flounder in 2017. The Terrebonne/Timbalier Basin averaged 9,675 Southern Flounder landed from 2014 through 2020. Landings from the Terrebonne/Timbalier Basin were highest in 2015 with 20,083 flounder landed and lowest in 2020 with 1,149 flounder landed. The Vermillion/Teche Basin averaged 4,357 Southern Flounder landed annually with the highest landings of 8,711 flounder occurring in 2017 compared to a low of 804 in 2019. There are minimal private recreational landings of Southern Flounder in the offshore waters of Louisiana, with landings averaging 56 flounder per year during the same time period (2014-2020). Landings of flounder from offshore waters were highest in 2014 at 350 flounder with no landings being estimated from 2015 through 2018.

From 2014 through 2020, for-hire landings of Southern Flounder in Louisiana were greatest in the Calcasieu Basin at an average of 11,586 Southern Flounder landed per year. Landings from the Calcasieu Basin were highest in 2015 at 21,580 flounder and lowest in 2018 with 4,263 flounder landed (*Figure 6*). The Barataria Basin followed with the second highest average of for-hire landings during the time period (2014-2020) at 3,661 Southern Flounder per year. Landings from the Barataria Basin peaked in 2015 at 7,243 Southern Flounder compared to a low of 968 flounder in 2018. The Pontchartrain Basin followed with an average of 1,168 Southern Flounder landed per year. Highest landings in the Pontchartrain Basin occurred in 2014 with 5,184 flounder landed and the lowest landings occurred in 2018 with 0 fish landed. For-hire landings in the Terrebonne/

Timbalier Basin averaged 226 Southern Flounder annually from 2014 through 2020. Highest for-hire landings in Terrebonne/Timbalier occurred in 2016 at 435 flounder, compared to a low of 0 in 2020. Vermillion/Teche Basin for-hire landings were only recorded for two years during this period (2014-2020) with 67 Southern Flounder being landed in 2016 and 71 in 2017. Offshore for-hire landings of Southern Flounder averaged 16 per year during the time period (2014-2020), with a high of 77 Southern Flounder landed in 2020 while the years 2015 and 2017 through 2019 accounted for no for-hire landings of Southern Flounder from offshore waters.

INTERACTIONS WITH OTHER FISHERIES OR USER GROUPS

Recent restrictions on harvest of Southern Flounder in the fall will likely eliminate some historical interactions between commercial harvesters and recreational anglers that occupied the same area. Louisiana's new closed season for all commercial and recreational harvest of Southern Flounder (Oct. 15 - Nov. 30) may also reduce conflicts between recreational anglers that often utilized limited access to productive areas during the spawning run. A potential source of conflict may exist between anglers and landowners over areas that may have uncertainties regarding the distinction between navigable, public fishing grounds and private property. In areas suitable for nighttime gigging and bow-fishing, there may be potential for conflict over space as pressure is concentrated in limited areas of suitable bottom type and turbidity. Another potential interaction that could occur between bow-fishing or gigging activity and residential areas is the use of high powered lights and engines in these areas during typically quieter times of night. The bright lights on these boats may also be concerning or bothersome to members of the public seeing them late at night from roadways or walkways.

TABLE 18. Annual recreational landings of Southern Flounder in Louisiana, 2000-2013.

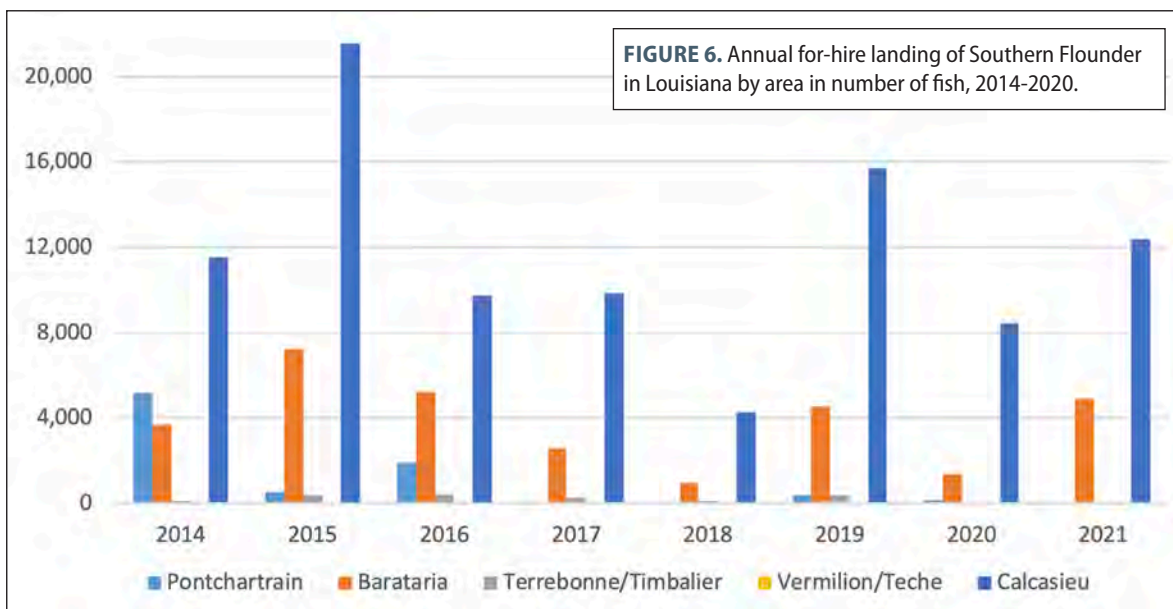
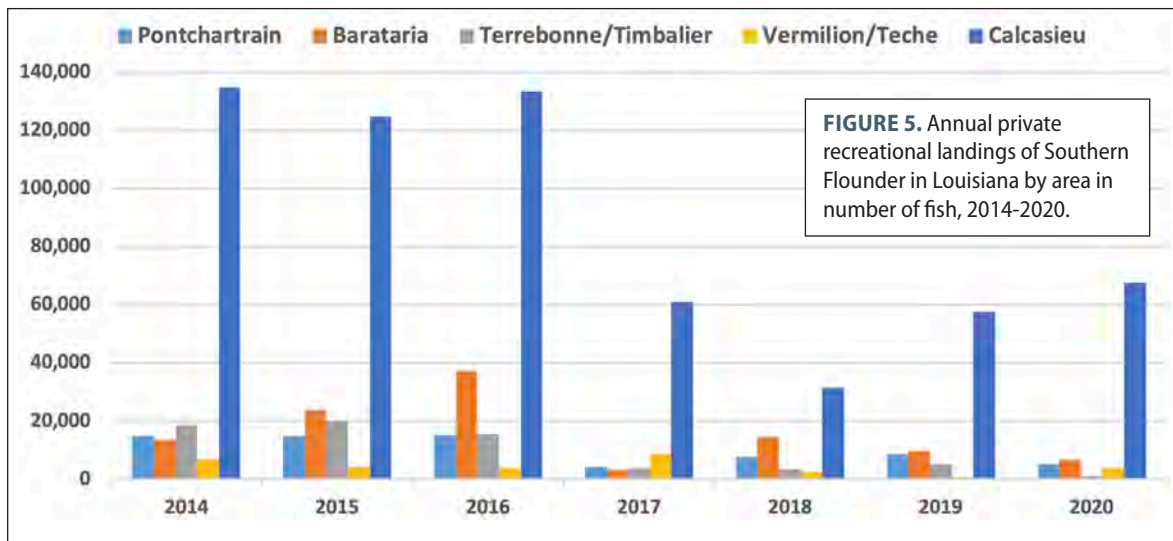
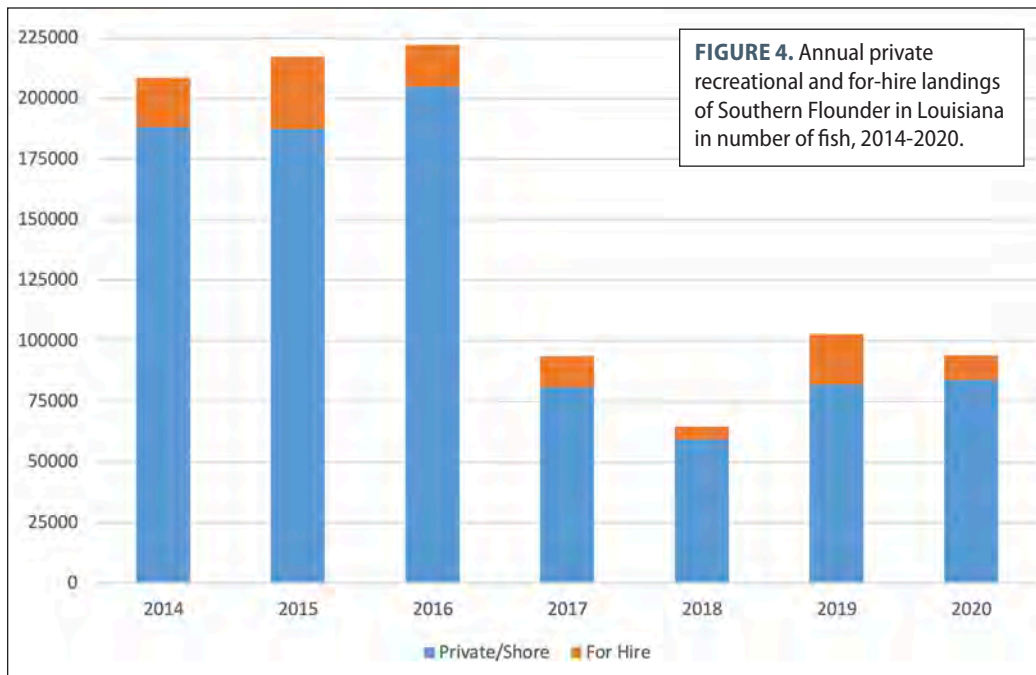
YEAR	Number of Fish	Pounds	YEAR	Number of Fish	Pounds
2000	819,318	1,264,255	2007	716,514	857,962
2001	751,343	1,091,670	2008	517,408	686,996
2002	774,508	835,864	2009	887,532	1,127,306
2003	856,122	949,852	2010	674,225	836,027
2004	812,581	874,105	2011	987,699	1,288,638
2005	741,649	753,155	2012	688,685	947,250
2006	642,871	851,525	2013	1,530,510	2,411,138

TABLE 19. Annual estimated private recreational and for-hire saltwater fishing trips, 2014-2020.

YEAR	Private Trips	For-Hire Trips	Total Trips
2014	2,096,246	130,615	2,226,861
2015	2,266,506	159,786	2,426,292
2016	2,063,347	179,239	2,242,586
2017	2,127,350	178,719	2,306,069
2018	2,092,640	183,301	2,275,941
2019	1,939,883	168,579	2,108,462
2020	1,724,626	163,233	1,887,859

TABLE 20. Annual percentage of surveyed private recreational and for-hire saltwater fishing trips that landed southern flounder, 2014-2020.

YEAR	Percent Private	Percent For-Hire
2014	3.19%	5.94%
2015	8.95%	16.90%
2016	8.11%	15.98%
2017	4.52%	11.01%
2018	3.45%	6.78%
2019	4.73%	11.48%
2020	3.71%	9.39%



Ecosystem Considerations & Environmental Factors



Addressing Potential Impacts

LDWF actively monitors the impact of the Southern Flounder fishery on the ecosystem and the impact of other fisheries to Southern Flounder population, for example, conducting research on bycatch in other fisheries that may encounter Southern Flounder such as the shrimp fishery.

ECOSYSTEMS CONSIDERATIONS

HABITAT

As of the current publication date, there has been scant research on the direct impacts of the recreational and commercial fisheries of Southern Flounder on the aquatic habitats of Louisiana. However, many of the fishing methods and gears utilized in neighboring Gulf States are used to harvest Southern Flounder in Louisiana (GSMFC 2015). Commercially, Southern Flounder are harvested primarily by trawl nets used in the shrimp fishery. While this form of fishing is effective form of harvest, the use of trawl nets may have detrimental effects on the environment. For example, trawl doors and associated ground gear (tickler chains, roller gear, etc.) are known to damage sensitive bottom habitats such as oyster reefs and marsh grasses due to their contact with the seafloor and being dragged by a motorized vessel (Barnette 1999). Also, trawling over soft bottoms such as silt can cause the resuspension of sediments affecting turbidity, which in turn can interrupt natural processes such as photosynthesis and nutrient cycling (Barnette 1999, Wells et al. 2008). Finally, trawl gear is known to be indiscriminate in the capture of both target and non-target species (including endangered and protected species) (Coale et al. 1994, Pikitch et al. 2004, Wells et al. 2008).

Other gear used for harvesting Southern Flounder are skimmer nets and “butterfly” nets. These gears are known to have a greater advantage over traditional trawl gear in that there is reduced bycatch, reduced labor, and higher quality of harvested target species (Coale et al. 1994, Hein and Meier 1995). Despite these advantages, there are concerns that these gears are as harmful to bottom substrates as traditional trawl gear and that improperly rigged skimmer nets can have impacts on shallow water habitats (Hein and Meier 1995).

In the recreational sector, the predominant harvesting methods for Southern Flounder are rod and reel and gigs. However, recreational anglers using trawl nets during the recreational shrimp season may capture Southern Flounder as bycatch while using trawl gear. In comparison to other gear types, the environmental impact from rod and reel and gig gear as methods of fishing is minimal (Barnette 1999). Rod and reel fishing can still have impacts on the environment including lost gear and post-release mortality of unwanted bycatch or target species outside the allowed size limits (Barnette 1999). The utilization of trawl gear by the recreational sector may also have similar detrimental effects on the environment in regards to habitat destruction and mortality amongst bycatch, similar to the commercial sector (Barnette 1999).

Commercial fishing is prohibited in more than 625,000 acres (252,929 hectares) of Louisiana's coastal areas, approximately 343,699 acres (139,090 hectares) of which are water bottoms, including Southern Flounder habitat. There are restrictions on recreational fishing in some of these areas as well. These coastal areas include state wildlife management areas, private sanctuaries, state and federal wildlife refuges, and areas designated by LA R.S. 56 or LAC 76.

BYCATCH AND DISCARDS

The shrimp fisheries conducted in Federal Waters (Gulf of Mexico Penaeid, South Atlantic Penaeid, and South Atlantic Rock Shrimp fisheries) utilize at sea-observers to monitor quota, assess bycatch composition and other regulations outlined in the Magnuson-Stevens Fishery Conservation and Management Act. Louisiana's inshore shrimp fishery does not have an established observer program to monitor the fishery for on the water discards, and all landings are recorded through the Trip Ticket program. A pilot study conducted by LDWF, beginning in June 2019 and running through June 2020, was conducted to help quantify and enumerate the type of bycatch captured in the Louisiana inshore trawl fishery (Cagle and West 2020). Southern Flounder data are limited to commercial landings via Trip Ticket submission and LA Creel interviews for recreational landings. While these data are limited in their scope of determining bycatch or discards, these data allow us to make reasonable estimates of the magnitude of Southern Flounder landings within the trawl fishery. As of July 20, 2022, retention of Southern Flounder between Oct. 15 - Nov. 30, for both the commercial and recreational fishing sectors, is prohibited (LAC 76: 351). Further, this closed season is aimed at reducing the overall mortality rate for female Southern Flounder by 50% in order to attempt to recover the stock to a healthy biomass by 2028. Previously, R.S. 56:492, allowed for the retention and sale of all Southern Flounder bycatch caught by a shrimping vessel on a shrimping trip (R.S. 56:492). Other commercial harvesters using legal fishing gears and valid permits were only allowed to retain 10 fish per licensed fisherman per day at sea (R.S. 56:326). Provisions were established in statute in 2021 which allow for the LWFC to regulate flounder harvest if overfishing is occurring and or the stock is overfished (R.S. 56:492). As such, the LWFC established the seasonal closure mentioned above during the peak of the Southern Flounder spawning migration.

Finfish

Over the past few decades, the Southern Flounder fishery in Louisiana has undergone changes in terms of overall landings and gear types used to harvest Southern Flounder. Historically, the majority of Southern Flounder have been harvested within Louisiana's territorial waters (less than 3 nautical miles from shore) and its interior marshes (Adkins 1998). Prior to 1995, stationary gears such as gillnets and trammel nets were utilized for commercially harvesting Southern Flounder. However, the Louisiana Legislature enacted a ban on the use of entanglement nets in 1995 with a phase out period for strike nets through 1998 (Adkins 1998). Further, Southern Flounder were categorized as a "restricted" species, meaning they could only be harvested during an open strike net season (GSMFC 2015).

After the entanglement net ban was enacted, the primary gears for harvesting Southern Flounder became otter trawls, skimmer nets, and butterfly nets in the Shrimp (Federal and Louisiana) fishery, with up to 82.5% of the overall flounder harvest coming from these gear types (GSMFC 2015). The Southern Flounder fishery had now shifted from a targeted fishery to a bycatch fishery (GSMFC 2015). While the primary target for shrimp fishery (federal and Louisiana) is penaeid shrimp (i.e. Brown, White, and Pink Shrimp) (Scott-Denton et al. 2012), Southern Flounder are caught as bycatch within this fishery (Scott-Denton et al. 2012). According to observer data over a three year period, 3,031.7 kg. (6683.7 lbs.) of Southern Flounder were landed as bycatch, making up 0.1% of the total bycatch from the federal Gulf of Mexico penaeid fishery (Scott-Denton et al. 2012). Along with Southern Flounder, various finfish species were the primary component of bycatch in the penaeid shrimp fishery, such as Atlantic Croaker (*Micropogonias undulatus*) (342,602 kg.; 755,309 lbs.)(15.9%), *Cynoscion spp.* (i.e. Sand and Silver Seatrout) (125,566.0 kg.; 276,825.6 lbs.)(5.6%), Spot (*Leiostomus xanthurus*) (972 kg.; 2,143 lbs.)(<0.1%), Pinfish (10,329 kg.; 22,771 lbs.)(0.5%), and other commercially and recreationally important species (Scott-Denton et al. 2012).

In Louisiana's inshore shrimp fishery, the primary gear utilized is the skimmer net as this allows shrimp harvesters to fish the entire water column, fish shallower areas, and fish more efficiently than otter trawls or butterfly nets (Cagle and West 2020). Observer data gathered from Louisiana's inshore shrimp fishery indicates 23 kg. (51 lbs.) of Southern Flounder were collected from 14,266 kg. (31,451 lbs.) of total bycatch (Cagle and West 2020). Of the 82 species of finfish associated with shrimp bycatch, the most numerous species included Gulf Menhaden (*Brevoortia patronus*) (2,013 kg.; 4,438 lbs.), Atlantic Croaker (768,736 kg.; 1,695 lbs.), Sand Seatrout (*Cynoscion arenarius*) (402 kg.; 887 lbs.), Hardhead Catfish (*Ariopsis felis*) (315 kg.; 694 lbs.), and Gafftopsail Catfish (*Bagre marinus*) (303 kg.; 667 lbs.) (Cagle and West 2020).

Southern Flounder are a secondary species for many recreational anglers in Louisiana when fishing for Red Drum or Spotted Seatrout, with the exception of anglers targeting flounder by gigging, bow-fishing, or with rod and reel gear. While there is a bag limit of ten fish per angler for Southern Flounder in Louisiana, no minimum length limit exists and any flounder released in favor of a larger flounder could be considered a discard.

TABLE 21. Protected sea turtles in Louisiana and Gulf waters.

Common Name	Scientific Name	ESA Status
Loggerhead sea turtle	<i>Caretta caretta</i>	Threatened
Green sea turtle	<i>Chelonia mydas</i>	Threatened
Kemp's ridley sea turtle	<i>Lepidochelys kempii</i>	Endangered
Leatherback sea turtle	<i>Dermochelys coriacea</i>	Endangered
Hawksbill sea turtle	<i>Eretmochelys imbricate</i>	Endangered

Protected Species

Five species of sea turtles share some habitat with Southern Flounder in Louisiana and Gulf waters (Table 21). All species are currently listed as threatened or endangered under the Endangered Species Act (ESA).

Federal regulations require installation of turtle excluder devices (TEDs) or the use of tow-time restrictions when trawling for shrimp. In research examining the catch composition from the three major U.S. shrimp fisheries (U.S. Gulf of Mexico Shrimp, U.S. South Atlantic Shrimp, U.S. South Atlantic Rock Shrimp) 55 sea turtles (25 Loggerhead, 21 Kemp's Ridley, four Green Sea Turtles, four unidentified sea turtles, and one Hawksbill) were captured over a three year period (Scott-Denton et al. 2012). The majority of turtle interactions were found to occur during the late spring to summer (May-August) (Scott-Denton et al. 2012) and most sea turtles were found either within trawl nets (smaller nets towed in conjunction with the main trawl nets to test shrimp abundance) (49%) or in TED-equipped main nets (44%) (Scott-Denton et al. 2012). However, it should be noted that 80% of all captured sea turtles were alive and conscious upon release (Scott-Denton et al. 2012).

Under Section 118 of the Marine Mammal Protection Act (MMPA), NOAA Fisheries is required to classify all U.S. commercial fisheries into one of three categories based on the level of incidental serious injury and mortality of marine mammals. The Gulf of Mexico Shrimp Fishery, under the MMPA, has been designated as a Category II fishery in accordance with 50 CFR part 229 due to the occasional interactions with marine mammals which may result in mortality. However, they must report to NOAA Fisheries all incidental mortalities and injuries of marine mammals that occur during commercial fishing operations, regardless of the category in which the fishery is placed (I, II, or III) within 48 hours of the end of the fishing trip. In addition, any animal that ingests fishing gear or any animal that is released with fishing gear entangling, trailing, or perforating any part of the body is considered injured regardless of the presence of any wound or other evidence of injury and must be reported.

ENVIRONMENTAL FACTORS

HYDROLOGICAL CONDITIONS (Salinity, Water Temperature, Dissolved Oxygen and Turbidity)

Salinity is one of the primary factors controlling the distribution of Southern Flounder through their life cycle. Post-larval fish generally recruit to estuaries during the late winter and early spring (February through May) (Stokes 1977). Salinity is particularly important in early life stages and salinity preferences have

been shown to vary geographically. Burke et al. (1991) indicated that flounder recruits (11-17 millimeters: 0.43-0.67 inches) initially settle in lower salinity areas (17 ppt) in North Carolina, while other studies show initial settlement to occur in waters of higher salinities (22 ppt) near tidal passes in Port Aransas, Texas. According to Burke et al. (1991), the probability of finding Southern Flounder during immigration in North Carolina was greatest in salinities of 17 to 24 ppt, with probabilities showing drastic declines in higher salinities. Burke et al. (1991) also reported the majority of older juveniles were found in low salinity areas away from the tidal inlet). Stickney and White (1974) suggest post-larvae flounder show a preference for 5-15ppt, while citing that preferences change with age. Older research on initial settlement indicated that juveniles did not remain in low salinity areas for a long duration and as juveniles matured they dispersed throughout the estuary to meet hydrological and habitat preferences (Rogers et al. 1984). More recent work examining strontium: calcium ratios in otolith cores indicate that some populations of Southern Flounder may exclusively reside in freshwater for much of their lives. Specifically, Farmer et al. (2014) established that 18% of the Southern Flounder examined in their study resided wholly within freshwater areas of the Mobile-Tensaw River Delta, Alabama. Farmer et al. (2013) also demonstrated that 55% of otoliths demonstrated a freshwater core signal, indicative of early growth in freshwater areas before the fish moved into estuarine areas permanently or transitionally. Beam trawl studies in Louisiana marshes indicated Southern Flounder were an infrequent catch in a majority of sampling areas, including higher salinity areas, and it was presumed that newly settled Southern Flounder were utilizing freshwater habitats which were excluded from their survey areas (Allen and Baltz 1997). The beam trawl survey work also presumed that any captures of Southern Flounder from that survey were individuals who were still migrating to their nursery areas and had not yet settled (Allen and Baltz 1997). Allen and Baltz (1997) also noted that the ingress of larval flounder into near-shore habitats often coincides during the winter and spring, in which freshwater discharge from rivers are at their peak.

Peters (1971) found that juvenile Southern Flounder demonstrated elevated growth rates at lower salinities due to reduced stress, while a study by Deubler (1960) found high growth rates in high salinities, but only when other environmental conditions were controlled. High salinities may be important for early larval stages, while preferences appear to shift to areas of lower salinity in post-larval stages (Deubler and White 1962). Stickney and White (1974) found juveniles to grow more rapidly at salinities between 5 and 10 ppt. Adults are highly euryhaline and salinity preferences appear to vary seasonally. Perret et al. (1971) found Southern Flounder evenly distributed in salinities ranging from 0 to >30 ppt throughout Louisiana estuaries.

While salinity plays a significant role in the distribution of Southern Flounder, temperature is an important parameter that influences many aspects of the Southern Flounder's life cycle, including the timing of spawning migrations of adult flounder and growth rates within newly settled larval flounder. Migrations offshore for spawning are triggered by a 4-5°C (7.2-9.0°F) drop in temperature magnitude (Stokes 1977), with spawning

generally occurring in waters of about 18°C (64.4 °F). In Texas, Stokes (1977) reported peak immigration into estuaries at temperatures near 16°C (60.8 °F), while Froeschke et al. (2013) noted water temperature has been shown to be an important factor in predicting recruitment of larval and juvenile Southern Flounder in Texas estuaries. Predictive modeling developed from decades of fisheries independent sampling indicated that 15°C (59 °F) was the optimal temperature for larval flounder to begin their ingress into nursery grounds and begin settlement (Froeschke et al. 2013). After settlement, increasing water temperatures through the spring and summer months were found to be positively correlated with increased growth rates of juvenile Southern Flounder in low salinity environments (Guindon and Miller 1995). Sex determination in juvenile flounder is influenced by water temperature during the developmental window (35-65 millimeters; 1-3 inches) (Honeycutt et al. 2019). As demonstrated previously, juvenile Southern Flounder from Texas reared at 18 °C (64 °F) exhibited a 1:1 male to female sex ratio while warmer ambient temperatures produced more male Southern Flounder (Montalvo et al 2012). Conversely, similar rearing experiments from North Carolina demonstrated that 23 °C ambient water temperatures produced 1:1 male to female ratios while higher (28 °C; 82 °F) and lower (18 °C; 64 °F) ambient water temperatures produced higher ratios of male Southern Flounder (Luckenbach et al 2003). Recent data appears to indicate that the last decade of higher average water temperatures in the Southern Flounder's range have been a factor in recent population declines, possibly due to masculinization of the population (Erikson et al. 2021).

Dissolved Oxygen can also influence the distribution and abundance of fish species as fluctuations in this parameter have both physiological and environmental consequences (Froeschke et al. 2013). Specifically for Southern Flounder, Nañes-James et al. 2009 demonstrated that juvenile Southern Flounder found in Texas estuaries concentrated in regions where dissolved oxygen levels ranged from 5.0-10.5 mg/L (milligrams/Liter). In comparison, juvenile Southern Flounder captured from beam trawl sampling were found in waters with an average dissolved oxygen level of 9.0 mg/L (Allen and Baltz 1997). While dissolved oxygen levels may not be an environmental cue for spawning migration or immigration timing, hypoxia is a known stressor for both the larval and adult stages of many fish species, which may influence settlement and habitat selection. Specifically, juvenile Southern Flounder actively migrated away from areas as dissolved oxygen levels fell below 3.7 mg/L (Deubler and Posner 1963, Gilbert 1986). As hypoxic events become more common in Gulf habitats, Southern Flounder could possibly begin to shift away from traditional locations to avoid low oxygen levels (Froeschke et al. 2013).

Turbidity is another environmental parameter that may influence Southern Flounder behavior and distribution. Furey and Rooker (2013) demonstrated, through predictive modeling, that juvenile Southern Flounder occurrence was positively correlated with increasing turbidity measurements within Galveston Bay. It has been hypothesized that reduced visibility within the water column may prevent predation of juvenile Southern Flounder within these nursery habitats (Furey and Rooker 2013). As a majority of estuaries that Southern Flounder reside in are

riverine influenced and low-energy, therefore higher in turbidity, such environs would likely be preferred, especially amongst newly recruited juvenile Southern Flounder (Minello et al. 1987). Along with predation avoidance, increased turbidity also appears to assist in the feeding strategies of Southern Flounder by providing cover for a predator that prefers to ambush prey. For instance, a study examining the effects of increased turbidity on the predatory success of three estuarine predators (Southern Flounder, Pinfish, Atlantic Croaker) demonstrated that Southern Flounder had increased predatory success on available prey (Brown Shrimp) in comparison to the other two species (Minello et al. 1987). It was suspected that increasing turbidity lead to Brown Shrimp to reduce burrowing into the substrate when compared to lower turbidity conditions, which in turn made these shrimp more susceptible to predation from Southern Flounder (Minello et al. 1987). Further, Brown Shrimp are also more likely to have their vision impacted with increasing turbidity, which can influence their susceptibility to predation (Minello et al. 1987). Due to the changes in behavior of prey species, ambush predators such as Southern Flounder may rely on other sensory systems in turbid conditions to increase predatory success as opposed to predators that are more reliant on visual identification of prey (i.e. Pinfish and Atlantic Croaker) (Minello et al. 1987). Further research has also demonstrated that the strike distance required for prey acquisition and prey encounter rate are also influenced by changes in turbidity and therefore could be beneficial (Minello and Benfield 2018). For example, Minello and Benfield (2018) observed that when given a choice between two different prey items (Brown Shrimp and Longnose Killifish (*Fundulus similis*)), shrimp were the preferred prey item for the majority of turbidity conditions but preferences switched to Longnose Killifish as turbidity increased. It is presumed that turbidity diminished the visual perception of the killifish similar to what occurred in Brown Shrimp in previous studies (Minello et al. 1987).

DISEASES AND PARASITES

There is no comprehensive study that identifies all possible pathogens and parasites which infect Southern Flounder, however, research involving the Summer Flounder, a congener to the Southern Flounder, demonstrates the diversity of parasites to which a host flatfish species can be susceptible. Jansen and Burreson (1990), identified over 38 species of parasites in 341 Summer Flounder collected from the Chesapeake Bay Estuary. Some of the parasites (ex. *Stephanostomum dentatum*) exhibited seasonal differences in abundance throughout the survey, mirroring the life cycle of the parasite (Jansen and Burreson 1990). Pathogens like *Trypanoplasma bullocki* were more abundant during the winter season and appeared to only be prevalent in juvenile Summer Flounder due to seasonality (Jansen and Burreson 1990). This particular parasite utilizes an intermediate host (a leech, *Calliobdella vivida*), which is only present during the winter, and adults are generally absent from nearshore waters during this period, it was deduced this was the reason for the seasonal absence of the parasite in adult Summer Flounder (Jansen and Burreson 1990). In addition to seasonal fluctuations in parasite abundance, researchers also noted that ontogenetic shifts in diet also caused different age classes of Summer Flounder to be more vulnerable to certain types of parasites, especially parasites that utilized other fish

as intermediate hosts (i.e. late juvenile to adult stages) (Jensen and Bureson 1990). Parasites such as *Davisia branchiophora*, *Bucephalopsis paralichthydis*, *Acanthochondria galerita*, and *Neoheterobothrium affine* are also known to infect other flounder like fishes, including Southern Flounder (Jansen and Bureson 1990). There has been documented evidence of juvenile Southern Flounder settling into the Chesapeake Bay system within close contact to the congeneric Summer Flounder providing a potential for cross infection of parasites that prefer flatfishes (Lusk et al. 2014). This could cause novel parasites to spread further into the Southern Flounder's range, which could lead to this species becoming a host to a parasite for which it may not mount a proper immune response.

In recent years, several studies have isolated specific pathogens and parasites to which Southern Flounder are vulnerable. For example, Goll  ty et al. (2005) established that the nematode species *Margolisianum bulbosum*, originally occurring along the Mississippi Gulf Coast, has since expanded up the East Coast of the United States. The mature female of *M. bulbosum* can often be found in the buccal cavity and amongst the gills and is the only conspicuous stage of this parasite (Goll  ty et al. 2005). Goll  ty et al. (2005) noted a discernable drop in parasite intensity as winter approached and larger flounder (450-600 millimeters; 18-24 inches) had a drop in severity of infestation compared to smaller flounders. While seasonal temperature changes did not seem to have a direct impact on parasite intensity or distribution, the shift in diet from copepods to fish in adult flounder may explain this phenomenon (Goll  ty et al. 2005).

Southern Flounder captured near Davis Bayou, Mississippi have exhibited tumors in both the gular membrane and the ventral margins of both opercles and examination of one of the tumors contained numerous trematode eggs measuring 29-35 µm (micrometers) long by 12-14 µm (Overstreet and Edwards 1976). Further examination of surrounding tissue near the tumor found parts of a trematode species from the family Didymozoidae, while philometrid nematode specimens were found in adjacent tissue sections near another tumor (Overstreet and Edwards 1976). Overstreet (1976) further observed that the ecto-parasite *Caligus praetextus* (a copepod) was often found on Southern Flounder, in addition to certain species of sea lice (*Argulus flavescens*), demonstrating a preference towards infesting Southern Flounder (GSMFC 2015).

While infection with either a pathogen or parasite may not always result in mortality of a host, certain pathogenic entities may have been the cause behind noted mortality events. A mass mortality event involving Southern Flounder occurred only in the Pamlico River estuary from December 1981 - January 1982 (McAllister et al. 1983) and was eventually linked to a virus. After tissue analysis of flounder were conducted, no specific biotic, chemical, or environmental anomalies were implicated as the root cause for the event (McAllister et al. 1983). Further analysis of brain and visceral tissue from the impacted fish against known pathogens in salmonid fishes led to the isolation of virus particles from half of the samples (7 out of 14) (McAllister et al. 1983). The virus was later identified as a strain of infectious pancreatic necrosis (IPN) virus sharing similarities to a virus detected in salmonid fishes (McAllister et al. 1983).

While the origin of particular virus is unknown, other marine fishes have exhibited similar virus infections in both wild and cultured stocks (McAllister et al. 1983).

In addition to mass mortality events in the wild, the spread of aquaculture operations, especially for Southern Flounder, in East Asia may have been the origin for pathogen and parasite outbreaks amongst native flounder species (Yoshinaga et al. 2009, Wang et al. 2011). An example of this can be seen with the introduction of an invasive flatworm (*Neoheterobothrium hirame*) in Japanese Flounder populations off Japan. This flatworm species attaches to the gill filaments and migrates to the buccal cavity of its host fish where it feeds on the blood within the capillary system of the gills (Yoshinaga et al. 2009). After genetic mapping and morphological examination of this parasite and other flatworms found in both Southern Flounder and Summer Flounder, it was noted that the *N. hirame* exhibited no substantial differences in morphology or in genetic mapping from an unknown *Neoheterobothrium spp.* collected from Southern Flounder (Yoshinaga et al. 2009). Further, *N. hirmae* was shown to infect Southern Flounder despite similar such flatworms having high host specificity (Yoshinaga et al. 2009). It was determined that the two species were in fact conspecific to each other and that it may have been introduced to Japanese waters from the Atlantic through the seafood trade via discarded fish offal (Yoshinaga et al. 2009).

While the effects of diseases and parasites on exploited fish populations is still not fully understood, the evidence indicates these biotic factors must be taken into consideration when developing new management strategies. This is especially true as activities like aquaculture are being implemented to assist in stocking operations for Southern Flounder (Goll  ty et al. 2005, Wang et al. 2011). Further, fish that are known to inhabit polluted waterways tend to have greater parasitic infections due to suppressed immune systems in response to stressful environments (Overstreet and Howse 1977). As such, any increase in parasite prevalence could be an indicator of stress within a population.

PREDATION

Although Southern Flounder are predators within their ecosystem, research examining the diet and ecological impact of apex predators (i.e. Dolphins, Sharks, etc.) has indicated that Southern Flounder and other flatfish are a viable food source for these predators. One study examining the diet and feeding strategies of three shark species: Atlantic Sharpnose (*Rhizoprionodon terraenovae*), Blacktip (*Carcharhinus limbatus*), and Bonnethead (*Sphyrna tiburo*) demonstrated that species within the flounder family (*Paralichthyidae spp.*) comprised 8.23% by weight of total food items found within Blacktip stomachs and 0.23% of Atlantic Sharpnose stomachs that were sampled (Plumlee and Wells 2016). This same study also noted that Blacktip Sharks have significantly elevated levels of Nitrogen and Sulfur stable isotopes, indicating that their diet consisted of higher trophic level fishes, such as flounder, compared to other species in the study (Plumlee and Wells 2016). However, it should be noted, that the predominant prey items for Blacktip and Atlantic Sharpnose sharks from this study consisted primarily of the family *Sciaenidae* (drums) (31.91% and 7.96%, respectively) and members of *Paralichthyidae* (flounders) were only a minor component of

the overall diet (Plumlee and Wells 2016). Southern Flounder and other flatfish are also vulnerable to predation from marine mammals. In examinations of the diets of coastal populations of Bottlenose Dolphins (*Tursiops truncatus*) from North Carolina, members of the family *Bothidae* (family including Southern Flounder) had a 15% frequency of occurrence in the stomach contents of 146 individual dolphins (Gannon and Waples 2004). Members of the genus *Paralichthys*, the genus of Southern Flounder, were found with an 8% frequency from these examined stomach contents (Gannon and Waples 2004). Similarly to the diet analysis of sharks, flatfishes made up a smaller portion of the diets of these dolphins when compared with the drums (*Sciaenidae*), which tended to be the predominant prey items (Gannon and Waples 2004). Differences in prey occurrence in relation to season and sampling area were also noted from other studies involving Bottlenose Dolphins (Wilson et al. 2017). While Southern Flounder and other flatfishes consisted of a minor portion of the dietary intake for these apex predators, their presence in the stomach contents indicates that predators will utilize secondary food sources in order to maintain sufficient caloric intake (Plumlee and Wells 2016, Gannon and Waples 2004).

Along with aquatic apex predators, avian predators such as cormorants (*Phalacrocorax spp.*) may also rely on flatfish species as a food source. In a study examining the predation habits of Great Cormorant (*Phalacrocorax carbo*) roosts along the Wadden Sea in the Netherlands, scat studies determined that flatfish (Order: *Pleuronectiformes*) comprised of 79% of the birds' diet by mass and 73.2% of total number of fish consumed (Leopold et al 1998). Further, flounder species comprised of 22.8% of all total flatfish consumed (Leopold et al. 1998). In regards to size class, no flatfish over 14 centimeters (6 inches) were consumed, indicating these fish were age-0 recruits (Leopold et al 1998). While predation may not be the primary cause of population decline, high mortality in the young of the year recruiting class can inhibit the recovery in a stressed population.

COMPETITION FROM OTHER SPECIES

As mentioned previously, Southern Flounder are able to utilize and exploit many different salinity and habitat regimes throughout their geographic distribution. However, Southern Flounder often have to share available resources with other predatory fish species. As such, there is concern that competition for limited resources can be detrimental to both the habitat and the species that utilize it (Shaw et al 2016). A study in Bulls Bay, South Carolina examined the concentration of carbon (C13) and nitrogen (N15) stable isotopes between 10 fish species (7 cartilaginous species i.e. Sharks and rays, and three teleosts: Red Drum, Southern Flounder and Spotted Seatrout) to examine the interconnectivity of the food webs within the region (Shaw et al 2016). The variance that occurred in carbon and nitrogen stable isotopes indicated that the different fish species examined utilized different feeding regimens (Shaw et al. 2016). In particular, Southern Flounder demonstrated similar feeding regimens comparable to Red Drum and Bonnethead Sharks (Shaw et al 2016). Further, statistical modeling indicated that concentrations of stable isotopes within Bonnethead Sharks exhibited a 98.3% overlap in the dietary niche occupied by Southern Flounder (Shaw et al 2016). Further, Red Drum and Southern Flounder exhibited the closest dietary niche overlap between bony

fish (33.6% and 25.4% overlap, respectively) (Shaw et al 2016). What can be inferred here is that Southern Flounder share similar prey items between these aforementioned species and could potentially be in competition for similar food resources.

Along with sharing similar diets with other species, Southern Flounder share similar habitat regimes and life history strategies with other flatfish found in Louisiana waters. As such, there is the potential for inter-specific competition in regards to habitat, food sources, and other resources among flatfish species. However, due to the diversity of habitat types found in Louisiana, the potential adverse effects of competition may be mitigated. For instance, a beam trawl survey conducted by Allen and Baltz (1997) in Louisiana estuaries found that the pair-wise comparisons of different environmental parameters between four flatfish species were significantly different, which indicates that flatfish species have preferences for different water quality parameters and therefore were self-segregating (i.e. limiting inter-specific competition) within the available habitat (Allen and Baltz 1997).

Generally, the productivity within marshes lessens the possibility of food availability as a limiting parameter in the growth and development of Southern Flounder. Cage studies from Pamlico Sound, North Carolina demonstrated that juvenile Southern Flounder contained within cages were omnivorous in their prey selection. Fully 85-100% of sampled Southern Flounder stomachs contained prey items from different biological classifications (i.e. fish, invertebrate, polychaetes, etc.) compared to the 20% of sampled stomachs not contained within cages which contained only mysid shrimp (Kamermans et al. 1995). Further sampling from other species found within the cages indicated that diets consisted of different prey items, indicating that inter-specific competition may be limited in this habitat (Kamermans et al. 1995). Further, stable isotope examination indicates that prey item diversity counteracts limited trophic level diversity, preventing inter-specific and intra-specific competition (Shaw et al 2016).

While the intricate relationships within the marine food-web are still being researched, these experimental results indicate that the density and distribution of Southern Flounder may not be directly to inter-specific competition, but by a combination of biotic and abiotic factors.

INVASIVE SPECIES

There has been little to no research to date examining the effects of invasive species on the Southern Flounder population in Louisiana waters. However, due to the increase in aquaculture operations and the interconnectivity of world commerce, the threat of invasive species entering the Gulf of Mexico should continue to be monitored and appropriate actions taken to mitigate potential impacts. As noted previously in the "Diseases and Parasites" section, the increase in the aquaculture production of Southern Flounder has been implicated as the source of the spread of a novel flatworm (*Neoheterobothrium spp.*) into native Japanese Flounder populations (Yoshinaga et al. 2011). Outbreaks of lymphocystis disease in Southern Flounder aquaculture operations in China highlight the susceptibility of naïve hosts to indigenous diseases and that such operations could exacerbate disease outbreaks in wild populations (Wang et al. 2011).

In recent years, the documentation of non-native species in the Gulf of Mexico region has raised concerns amongst fishery management bodies and the public. The most documented of these in the marine ecosystem has been the introduction of Lionfish (*Pterois spp.*) into the Gulf of Mexico. While the direct cause of Lionfish introduction is debated, genetic analysis of captured Lionfish has indicated that releases from the Aquaria trade in Florida may have been the origin of those introductions (Fogg et al. 2013). Introduction of Lionfish into the Gulf is of particular concern due to its prodigious spawning frequency (year-round), short larval stage, and rapid spread (Fogg et al. 2013). Since the first documented specimen in 2006, this species has spread Gulf-wide, including the continental shelf waters off Louisiana (Fogg et al. 2013). The voracious appetite of these fish and their ability to inhabit shallow water habitats could potentially put native species at risk (Fogg et al. 2013).

Another species of concern has been the appearance of the Australian Spotted Jellyfish (*Phyllorhiza punctata*), a non-native jellyfish species, throughout the Northern Gulf of Mexico. This species is indigenous to the Indo-Pacific region and is believed to have been introduced into the Gulf of Mexico from vessel ballast water discharge (Graham et al. 2003). Jellyfish species have been well documented as to the extensive damage they cause to ecosystems due to their excessive feeding rates on zooplankton, especially the eggs and larvae of commercially important species (Graham et al. 2003). The Australian Spotted Jellyfish first appeared in the Gulf of Mexico in May of 2000 and spread rapidly throughout the Northern Gulf of Mexico, including Lake Borgne, Louisiana (Graham et al. 2003). During peak densities, up to 5.01 million (5,010,000) individuals within a 150km² (58 mi²) area were observed (Graham et al. 2003). The shrimping industry experienced lost earnings that reached \$10 million U.S. dollars as a result of fouled fishing gear and lost catch caused by these jellyfish (Graham et al. 2003). Despite the implications of this particular outbreak, concentrations of this jellyfish dropped off to undetectable levels after September of 2000 and have not been seen since the initial outbreak (Graham et al. 2003). This jellyfish may not impact Southern Flounder directly as the majority of larval flounder have settled into their nursery habitat when these jellyfish are prevalent.

Even with the lack of research on the impact of invasive species in the Gulf of Mexico, the threat from invasive species remains a concern. As such, continual environmental monitoring efforts remain the primary method reporting new non-native species into a given area.

HABITAT LOSS AND RESTORATION

Eighty percent of annual coastal marsh loss in the United States occurs in Louisiana. Research has estimated that the State of Louisiana loses approximately 100 km² yr⁻¹ (39 mi²yr⁻¹) and total land loss of 3900 km² (1390 mi²) (Day et al. 2000). Many factors contribute to the regional loss of marshes, including natural factors such as subsidence, sea level rise, storms, and floods, as well as anthropogenic factors such as water management, dredging for oil and gas exploration, construction of pipelines and navigation channels, saltwater intrusion, and coastal development (Chesney et al. 2000, Day et al. 2000, Day et al. 2003). Changes resulting from natural fluctuations have usually

occurred less frequently and over a longer period of time than man-induced changes (CPRA 2017). Marsh loss may affect the abundance of estuarine dependent species such as Southern Flounder and other commercially important finfish and crustaceans (Chesney et al. 2000). Most likely, overall populations have been reduced as a result of habitat alterations; loss of vegetated wetlands have the most serious impact to larval and juvenile Southern Flounder as these low salinity areas provide food and shelter during these highly sensitive early life stages (Perret et al. 1971). The loss of marsh habitat may also be one of the factors responsible for the decline in the Southern Flounder fishery in recent years (Chesney et al. 2000).

Louisiana's Coastal Protection and Restoration Authority (CPRA) monitors and measures coastal habitat loss and has proposed and/or implemented a number of coastal protection and restoration projects to help combat and slow some of these impacts through the Louisiana's Coastal Master Plan. These projects range from freshwater diversion and marsh creation to the construction of levees (CPRA 2012). These projects may have both positive and negative impacts on Southern Flounder abundance from increased marsh habitat through marsh creation to changes in salinity/temperature regimes through freshwater and sediment diversions. These projects may also impact Southern Flounder fisheries. For example, levees and other protection features could create access issues by disrupting travel to or modifying existing fishing grounds; however, they could also protect the existing fishery infrastructure as well as residences of commercial harvesters and recreational anglers. LDWF provides input into the Coastal Master Plan, but its authority is limited on project selection. However, LDWF will be directly involved in drafting operational plans for diversions and will, as feasible, provide guidance while considering conditions required for Southern Flounder and all estuarine species to thrive while also protecting Louisiana's land dwelling population. Unfortunately, both habitat loss and efforts to minimize its impacts could affect the ability of marshes to provide habitats for Southern Flounder and other estuarine dependent species. In fact, the changing coast of Louisiana would impact the fishery and Southern Flounder even if nothing were done to counteract the natural and manmade causes of coastal land loss. Increased monitoring before, during, and after construction of large-scale ecosystem restoration projects will allow LDWF to document response by species of importance and can help inform the adaptive management process, which may be relied on as Louisiana moves forward on these unprecedented steps to maintain some portion of coastal Louisiana.

2010 DEEPWATER HORIZON OIL SPILL

The Programmatic Damage Assessment and Restoration Plan (PDARP) documents the impacts to the habitat and natural resources of the Gulf caused by the *Deepwater Horizon* oil spill. According to the PDARP, approximately 65% of the total oiled shorelines and oiled wetland shorelines occurred in Louisiana, and the "heaviest and most persistent shoreline oiling occurred in salt marshes in Northern Barataria Bay" (DWH NRDA 2016). Laboratory toxicity tests have demonstrated that exposing marsh organisms to sediments contaminated with *Deepwater Horizon* oil resulted in a series of adverse effects, including mortality, reduced growth, and reduced reproductive success.

Studies analyzing DWH impacts noted damage to gill and liver tissues, reduced growth rates, and mortality in Southern Flounder. Impacts on other species include growth inhibition in juvenile Red Drum and Pacific White shrimp (*Litopenaeus vannamei*) (used as a surrogate for Brown Shrimp (*Farfantepenaeus aztecus*) and White Shrimp (*Litopenaeus setiferus*) in laboratory testing), reduced reproduction and survival in Gulf Killifish (*Fundulus grandis*), and adverse effects in all oyster life stages tested, at varying concentrations (DWH NRDA 2016). Projects to restore natural resources injured as a result of the *Deepwater Horizon* oil spill in Louisiana will focus on restoring Louisiana coastal marshes, given both the extensive impacts to Louisiana marsh habitats and species and the critical role that these habitats play across the Gulf for many injured resources and the overall productivity of the Gulf. These projects will be consistent with the Coastal Master Plan, to the extent possible. Additional details regarding completed and ongoing restoration projects can be found at www.gulfspillrestoration.noaa.gov/restoration-areas/louisiana.

Due to the commercial and recreational importance of the Southern Flounder, research has been directed at examining the potential impact that the *Deepwater Horizon* spill has had on this species. Primarily, emphasis has been placed on the physiological effects and the histopathology of petroleum and its chemical congeners on different organ systems within Southern Flounder. For example, juvenile Southern Flounder exposed to increasing concentrations of weathered oil within sediments experienced increased rates of mortality, while juvenile Southern Flounder experienced decreased somatic growth rates when exposed to sediments with heavy levels of weathered oil (Brown-Peterson 2017, Brown-Peterson 2015). Changes to avoidance behavior (i.e. constant swimming to avoid resting on sediment) and reduced feeding was also noted in Southern Flounder exposed to the highest concentrations of weathered oil (Brown Peterson 2015, Brown-Peterson 2017). Histological examination of various tissues from the respiratory, cardiovascular, and hepatic systems of fish showed the impact of petroleum and its congeners on tissue formation and function. Analysis of the gills showed an increase in the percentage of telangectasis (dilation of blood vessels which cause club like formations in secondary gill lamellae) as exposure to weathered oil increased (Brown-Peterson 2015, Brown-Peterson 2017). Other experiments have shown an increase in gill lamellae fusion and increased swelling as oiled sediment concentrations were increased (Brown-Peterson 2015). Further, epithelial proliferation in gill lamellae was shown to have a positive correlation with increasing oiled sediment concentration (Brown-Peterson 2015). Exposure to oiled sediments caused hepatic vacuolation (creation of spaces within liver cells which can inhibit proper metabolic function) within fish and it was also noted that hepatic vascular congestion along with increased lipid storage and glycogen storage occurred in the livers of flounder (Brown-Peterson 2015). Atrophy in myocardial trabeculae (series or groups of partitions crated by columns of connective tissue within the heart) and increased swelling were also found amongst individual fish that were exposed to contaminated sediment (Brown-Peterson 2015).

Additional research has been focused on examining gene expression within the organ systems of Southern Flounder to examine the shifts in biological pathways and microbiomes given that many species of fish have enzymatic systems to help with the fixation and excretion of pollutants that can be encountered in their environment as first noted by James (1987). Given that micro-fauna (bacteria, archaea, etc.) located within a host's given organ system often work as a symbiotic relationship to help accomplish a given biological task (i.e. digestion, nutrient uptake, etc.), examining such shifts in the microbiota pre and post exposure can help better document the long term health impacts from an ecological disaster on a given species (Adamovsky et al. 2018). In Southern Flounder, there were significant shifts in the microbiome communities within the gill and intestinal tissues of petroleum exposed Southern Flounder (Adamovsky et al. 2018, Brown-Peterson 2015) and some of these microbes (e.g. *Alcanivorax*, *Arcobacter*, *Donghicola*, and *Acinetobacter*) are involved with the bio-synthesis of hydrocarbons (Brown-Peterson 2015). Conversely, other microbes involved with metabolism, environmental processing, and homeostatic maintenance were documented at reduced levels of abundance in the presence of hydrocarbons (Brown-Peterson 2015). Other such shifts have been documented in other populations of flatfish exposed to different levels of contaminants (Borcier et al. 2020), and as such, it is hypothesized that the histopathological conditions mentioned previously may be the symptom of interrupted or modified biological pathways (James 1987, Brown-Peterson 2015, Adamovsky et al. 2018).

While the wellhead leak from the *Deepwater Horizon* spill has been sealed, there is clear evidence that the impacts from this disaster may be far reaching to this day and into the future, and more research is needed in order to examine the full extent of the impacts from this oil spill on Southern Flounder and other species.

Fishery Management Program



Collaborative Fishery Management

Louisiana's fishery management authorities collaborate with the other Gulf states, other aquatic resource management authorities, public health and safety authorities, industry, and other stakeholders in the management of the state's Southern Flounder resource and fisheries.

MANAGEMENT FRAMEWORK

The Constitution of Louisiana provides the foundation for the sustainable management of the state's fisheries resources, including Southern Flounder, recognizing their importance to Louisiana's environment, citizens, and economy. According to the Constitution of Louisiana, "The freedom to hunt, fish, and trap wildlife, including all aquatic life, traditionally taken by hunters, trappers and anglers, is a valued natural heritage that shall be forever preserved for the people. Hunting, fishing and trapping shall be managed by law and regulation consistent with Article IX, Section I of the Constitution of Louisiana to protect, conserve and replenish the natural resources of the state."

Louisiana's legislative statutes and administrative code provide the legal and administrative framework for the state's fishery management system. LA R.S. 56:638.1-5 define the legislative intent, findings, purposes, policy, and standards for the conservation, management, and sustainability of all species of fish in Louisiana and are similar to those found in the Magnuson-Stevens Fishery Conservation and Management Act (MSA), the law that guides U.S. federal fishery management. According to these statutes, fishery conservation and management in Louisiana should sustain:

- Louisiana's fisheries resources (fish and shellfish)
- The ecosystems in which they live (habitat and other aquatic species)
- The people that depend upon these resources (commercial and recreational fishing industries and coastal communities).

See *Appendix II* for specific details of these statutes.

AUTHORITIES

LOUISIANA

Legislature

The primary authority for managing the Southern Flounder fishery in Louisiana's state waters rests with the Legislature. The Legislature is the lawmaking body of the state and enacts Revised Statutes defining the legal framework for fishery management. The Constitution of Louisiana empowers the Legislature to enact laws to protect, conserve, and replenish the natural resources of the state, with consideration for the health, safety, and welfare of the people. The Legislature has delegated some of its authority to the Commission and the Secretary of LDWF. In general, management actions such as gear changes, licensing, and entry limitations are under the authority of the Legislature. With respect to Southern Flounder, in 1995, the Legislature eliminated the use of all set nets and provided for the use of strike nets only during specified seasons through 1997. Southern Flounder was designated as a 'restricted' species and could only be harvested during the strike net season, eliminating the gill net fishery. The Legislature also implemented requirements for a restricted species permit to harvest Southern Flounder and established several criteria to qualify for this permit. In 1997, the Legislature provided for the incidental bycatch of flounder on commercial vessels not to exceed 100 lbs. per trip. This action also reopened the flounder season at the current bag and possession limits (10 fish/licensed commercial fisherman/day) and added a reporting requirement for all transactions including flounder. In 1999, the Legislature modified the incidental bycatch regulations for flounder on commercial vessels to allow that any commercial shrimping vessel on a shrimping trip may retain and sell all Southern Flounder caught as bycatch. In 2004, the Legislature changed recreational regulations to allow for the harvest of Southern Flounder with barbed gigs. Legislative changes in 2021 gave authority to the Commission to modify flounder harvest regulations relating to bycatch from shrimp vessels on a shrimping trip if the Southern Flounder stock is determined to be overfished and/or undergoing overfishing. Subsequently, in 2022, a closed season for all recreational and commercial harvest of Southern Flounder was established from Oct. 15 - Nov. 30 of each year.

The Legislature adopts laws according to Louisiana's legislative process. LDWF, in coordination with the Louisiana Finfish Task Force, may develop proposed legislation specific to the Southern Flounder industry and assist in finding sponsors for those particular bills. Legislators also develop bills of their own.

See Appendix III for a diagram outlining Louisiana's legislative process.

Wildlife and Fisheries Commission

The Commission is charged with the control and supervision of the wildlife of the state, including all aquatic life. Part of the executive branch, the Commission consists of seven members appointed by the governor, subject to confirmation by the Senate. The Commission operates as a policy-making and budgetary control board, with no administrative function.

The Commission receives and reviews biological, socioeconomic, and other technical data and management recommendations from LDWF, gathers public input, and ultimately votes on which actions will best achieve long-term management goals. In general, the Commission is charged with setting seasons, times, places, size limits, quotas, daily take, and possession limits based upon biological data and setting fees for nonresident recreational fishing licenses, among other authorities. With respect to Southern Flounder, the Commission is granted the authority to set seasons and limits on Southern Flounder (LA R.S. 56:326.1 and 326.3).

See Appendix IV for complete details on the Commission's authorities and duties as outlined in LA R.S. 56.

The Commission adopts rules according to the process defined in Louisiana's Administrative Procedure Act (APA, LA R.S. 49:950). The APA requires that the Commission give appropriate notice of their intended action, make the proposed rule available for public review and comment, and include a Fiscal and Economic Impact Statement (FEIS), summarizing what social and economic impacts the proposed rule might have. In addition to the FEIS, a proposed rule must also include Family Impact, Poverty Impact, and Provider Impact Statements. Once the rule has gone through the process and is approved, it is published as final in the Louisiana Register and is compiled with other Commission rules in LAC 76.

Department of Wildlife and Fisheries

LDWF serves as the administrative and operational arm of the Commission. The Secretary of LDWF is appointed by the governor, subject to confirmation by the Senate. The Secretary is the executive head and chief administrative officer of LDWF. In general, LDWF monitors fishery populations and fisheries by collecting and analyzing fishery dependent and independent data; conducts scientific research; provides data and management recommendations to the Commission and Legislature; and administers and enforces laws, rules, and regulations as adopted by the Commission and Legislature.

The Legislature and Commission may grant the Secretary of LDWF additional authorities to create administrative rules. For example, the Secretary, when authorized, can make a declaration of emergency in times when public health, safety, and welfare are in jeopardy and quick and immediate action is required.

See Appendix V for complete details of the Secretary and LDWF's authorities and duties related to Southern Flounder as described in LA R.S. 56 and LAC 76.

Governor

The governor of Louisiana also has authority to issue executive orders, which are not statutes like those passed by the Legislature but do have the force of law.

Finfish Task Force

The Legislature established the Louisiana Finfish Task Force to study and monitor the finfish industry and to make recommendations to the Commission, LDWF, and other state agencies for the maximization of benefit from that industry for the state of Louisiana and its citizens.

Further description of the Finfish Task Force and its responsibilities can be found in Appendix X.

Other Aquatic Resource Management Authorities

Although not involved in marine fishery management directly, several state and local agencies are involved in managing other aquatic or coastal resources, such as protecting habitat or monitoring water quality. The Louisiana Department of Natural Resources (LDNR) is charged with regulating development activities and managing resources in Louisiana's coastal zone. Several coastal parishes have also developed their own coastal zone management programs. CPRA is responsible for developing, implementing, and enforcing the Coastal Master Plan, including monitoring and measuring coastal habitat loss and coordinating habitat restoration projects. LDWF collaborates with all of these agencies, reviewing permits, commenting on coastal zone management and habitat restoration activities, and participating in the Coastal Master Plan development process.

Public Health and Safety Authorities

All seafood produced and processed in Louisiana must meet quality and safety standards set forth in the Louisiana Sanitary Code. LDH routinely inspects the state's approximately 350 seafood processing plants using federal Hazard Analysis Critical Control Point (HACCP) requirements to ensure safe handling practices and that only safe product reaches the market. More details on these programs are available from LDH. The Louisiana Department of Environmental Quality (LDEQ) is responsible for setting pollution standards and monitoring all waters of the state, including the Gulf of Mexico, to ensure they meet water quality standards. LDH works with LDEQ to issue fish consumption advisories based on fish tissue sampling in areas of suspected contamination and assessments of risk to human health. LDH and LDEQ consult LDWF and LDAF throughout the advisory development and dissemination process.

Public Participation and Engagement

Louisiana's fishery management authorities encourage public participation throughout the management process to not only ensure stakeholders' interests are considered but also to ensure they understand the regulatory process and resulting management actions. All meetings of the Legislature's natural resources committees and the Commission are open to the public according to Louisiana's Open Meetings Law (LA R.S. 42:12-28). This law mandates that government decisions be made in an open forum, ensuring state integrity and the public's trust and awareness of its governing officials. Meetings must be announced at least 24 hours in advance, provide opportunities for public comment, allow for audience recording of the meeting, and have recorded minutes of the proceedings.

REGIONAL

Other Gulf States

The other U.S. states bordering the Gulf are responsible for the conservation and management of Southern Flounder fisheries within their respective waters. Louisiana cooperates with other Gulf States in the scientific research and management of fisheries that cross jurisdictional boundaries, including Southern Flounder, through the Gulf States Marine Fisheries Commission

(GSMFC). LA R.S. 56:71-87 establish Louisiana's authority to enter into the Gulf States Marine Fisheries Compact with other states. The GSMFC has no direct authority over the Southern Flounder fishery but is authorized to make recommendations to the governors and legislatures of the five Gulf States on programs beneficial to management of shared fisheries. The GSMFC also consults with and advises member states over fishery conservation problems, advises U.S. Congress, and testifies on legislation and marine policies affecting the Gulf States.

Specific to the Southern Flounder fishery, the GSMFC has assisted in addressing issues of importance to Southern Flounder on a regional scale. GSMFC established the Flounder Technical Task Force (TTF) which is organized with one scientific representative from each of the five Gulf States who are appointed by each state's director serving on the State-Federal Fisheries Management Committee (SFFMC). In addition, a representative from each of the GSMFC's Commercial Fisheries and Recreational Fisheries Advisory Panels, the Law Enforcement Committee, and the Habitat Subcommittee (the representative is chosen by action of the respective committees). As with all of the Commission's TTF's, the committee becomes inactive until there is a need for revision of a profile or work on specific issues related to flounder in the region. The members of the TTF may be called upon to advise the Technical Coordinating Committee (TCC), the SFFMC, or the Commission on flounder issues in the Gulf of Mexico.

See Appendices VI and VII for a table of other states' regulations for commercial and recreational Southern Flounder fisheries.

Federal Authorities

The Gulf of Mexico Fishery Management Council (Gulf Council) and NOAA Fisheries are responsible for monitoring and managing fisheries resources in Gulf federal waters (from the seaward boundary of state waters to 200 nautical miles offshore). Southern Flounder fisheries operate almost exclusively in state waters; landings in the EEZ of the Gulf of Mexico are rare. Federal agencies do not directly manage Southern Flounder, and the Gulf Council has not developed a fishery management plan for Southern Flounder. However, through their administration of laws, regulations, and policies, certain federal agencies may influence the Southern Flounder resource and fisheries and management thereof.

See Appendix VIII for a list of related federal management institutions and their authorities and jurisdictions and Appendix IX for a list of related federal laws, regulations, and policies.

EXISTING MANAGEMENT MEASURES

PLANS

LDWF's Biological and Fisheries Profile for Southern Flounder (1998) summarized relevant scientific information and studies regarding the management of Southern Flounder. This document described the biological and economic aspects of the Southern Flounder fishery, reviewed Louisiana management authorities and laws affecting Southern Flounder, described the problems and needs of the Southern Flounder fishery, and suggested management strategies and options to solve problems and meet the needs to the stock (Adkins et al. 1998)

The GSMFC's Management Profile for Gulf and Southern Flounder in the Gulf of Mexico (2015) summarized, referenced, and discussed relevant scientific information and studies regarding the management of Southern Flounder. This document describes the biological, social and economic aspects of the Southern Flounder fishery, reviewed state and federal management authorities and their jurisdictions, laws, regulations, and policies affecting Southern Flounder. It also describes the problems and needs of the Southern Flounder fishery and suggested management strategies and options to solve problems and meet the needs of the stocks.

POLICIES

LA R.S. 56:6 tasks the Commission with promulgating rules and regulations for Southern Flounder to set seasons, times, places, size limits, quotas, daily take, and possession limits based upon biological and technical data. LDWF provides the Commission with scientific and technical data, including an assessment of the Southern Flounder stock in Louisiana waters, for consideration of management to maintain the sustainability of the stock.

LA R.S. 56:325.1 gives the Commission authority to set take, possession, and size limits for saltwater finfish caught recreationally, while LA R.S. 56:325.4 requires the Commission to establish biomass and fishing mortality management targets based on a historical time series of fisheries data to ensure a sustainable Southern Flounder population. LDWF must report on the status of Southern Flounder every five years and submit that report to the Legislature no later than March 1 of that year. If data indicate, the resource or fisheries are not meeting or are likely not to meet the established targets, LDWF must provide, for the Commission's consideration, management options to ensure that the Southern Flounder resource and fisheries can remain within established management targets.

STATUTES AND RULES

Louisiana's Southern Flounder fisheries are governed by both legislative statutes (LA R.S. 56) and rules promulgated by the Commission (LAC 76). Specific regulations are described below. This summary of regulations does not retain their exact language and should be not be relied on for legal purposes. See Appendix X for detailed text of these regulations. See Appendix XI for a chronological history of major changes to Louisiana's Southern Flounder regulations.

Commercial

Licensing

Both resident and nonresident harvesters must have the appropriate commercial fishing and gear licenses to harvest Southern Flounder commercially in Louisiana waters. Gear licenses may be temporarily transferred between licensed commercial harvesters with the same residency status. Nonresidents may not purchase licenses for commercial fishing gear prohibited in the state in which they reside. Vessel owners must also have the appropriate vessel licenses. Licensed commercial harvesters may transport and sell their own catch to any licensed Louisiana wholesale/retail seafood dealer located within Louisiana. They must have a fresh products license to sell their catch directly to a consumer; they may purchase a secondary fresh products

license for any designated individual if he provides the individual's name and social security number to the department. This secondary license will allow the commercial fisherman to continue to fish while the designated individual sells the catch. Commercial harvesters that sell their catch to anyone other than a consumer or licensed dealer and anyone else that buys, acquires, handles, transports, or exports Southern Flounder for sale or resale must have the appropriate licenses.

Licenses may be suspended, denied or revoked for failure to pay child support, nonpayment of unemployment compensation overpayment, and nonpayment of individual income taxes.

Fishery Access

The Southern Flounder fishery is an open access fishery.

Legal Gear and Gear Requirements

Commercial harvesters can legally harvest Southern Flounder with rod and reel (if they possess a Spotted Seatrout commercial harvest permit), yo-yo, hand line, gig, trotline (wherein hooks are not less than 24 inches apart), trawl net, skimmer net, butterfly net, cast net, and scuba gear using standard spearing equipment. Commercial harvesters may only use trawls in waters where and when the shrimp season is open and follow all relevant requirements for the size and configuration of trawl gear. All commercial harvest of Southern Flounder may only occur when the season for Southern Flounder harvest is open. Commercial harvesters utilizing rod and reel gear may only do so if they have a rod and reel gear license, which is a limited access gear license issued only to holders of a Spotted Seatrout Permit.

Commercial harvesters may not use any of the following types of gear to harvest Southern Flounder (and other species) in state saltwater areas:

- Spears
- Stupefying substances or devices
- Guns
- Poisons
- Explosives
- Tree-topping devices
- Electric shocking instruments or devices
- Seines
- Gill, trammel and strike nets
- Snagging devices (not including bows and arrows)
- Longlines
- Bandit gear
- Elevated trotlines (except in exempt areas)

Additionally, commercial harvesters may not use any aircraft including fixed-wing aircraft, dirigibles, balloons, helicopters, or any other form of aerial surveillance to assist in harvesting Southern Flounder.

Seasons

All commercial and recreational harvest and possession of Southern Flounder is prohibited from Oct. 15 - Nov. 30 annually. During this period, all Southern Flounder caught must be released immediately.

Size and Possession Limits

Current commercial regulations allow 10 Southern Flounder for each commercially licensed harvester for each day on the water, except on commercial shrimping vessels where all Southern Flounder caught incidentally outside of the annual closed season may be kept. There is no size limit on commercially harvested Southern Flounder.

Bycatch

Commercial harvesters are permitted to retain and sell most bycatch for commercial purposes as long as they are in compliance with appropriate regulations for those species. However, they may not commercially harvest gamefish or Spotted Seatrout (unless it is captured by rod and reel gear and the harvester possesses both a Spotted Seatrout permit and a rod and reel gear license). LDWF monitors landings and sales of these species through the state's trip ticket program. Commercial harvesters may also retain bycatch for personal consumption, however, they must have applicable recreational fishing licenses and any retained fish must be within recreational minimum size and daily possession limits.

Commercial harvesters may not waste any fish of this state. Waste is defined as harvesting of any fish for commercial purposes which results in the excessive killing of such fish. Excessive killing is defined as the killing resulting from taking or attempting to take any fish in excess of what the possessor thereof can process, utilize, or transport from the fishing grounds.

Area Restrictions

Commercial harvesters may not set gear that interferes with the free passage of fish within 500 feet of the mouth of any inlet or pass or within 500 feet of any water control structures.

Gear and other restrictions may vary in state wildlife management areas, refuges, and other areas to protect important habitat and reduce conflicts with other users. Commercial fishing is prohibited in coastal national wildlife refuges.

Operational Restrictions

Commercial harvesters must land Southern Flounder whole with heads and tails attached to assist enforcement agents in easily identifying the fish. However, fish may be gilled and gutted prior to landing.

Fishing Gear Interactions

It is illegal for any person to knowingly and intentionally use or employ any net to encircle a vessel or to otherwise knowingly and intentionally use or employ any vessel or fishing gear to interfere with the legal fishing of another. It is also illegal for any person to knowingly and intentionally use or employ any vessel or recreational gear to interfere with the legal commercial fishing of another.

Packaging

The Secretary of the LDWF has the authority to adopt rules and regulations to establish standards for the packaging of seafood in Louisiana for wholesale or retail sale. These standards may govern the quality, contents, and weight of all seafood packaged in this state. The Louisiana Seafood Promotion and Marketing

Board may make recommendations to the Secretary for standards for the packaging of seafood.

Shipments containing fish shall be plainly marked, the tags or certificates to show the date and names of the consignor and the consignee, with an itemized statement of the number of pounds of fish and the names of each kind contained therein. Bills of lading issued by a common carrier for such shipments shall state the number of packages which contain fish, and the date and names of the consignor and consignee, with an itemized statement of the number of pounds of fish and the names of each kind contained therein.

Recreational***Licensing***

Residents and nonresidents 18 years of age and older must have basic and saltwater fishing licenses to harvest Southern Flounder recreationally. Wildlife Management Area (WMA) permits are required when on a WMA.

Legal Gear and Gear Requirements

Recreational anglers typically use hook and line gear or gigs to catch Southern Flounder. Recreational anglers may not use any of the following to take Southern Flounder (and other saltwater finfish):

- Crossbows
- Gill nets
- Poisons
- Stupefying substances or devices
- Explosives
- Guns
- Tree-topping devices
- Any instrument or device capable of producing electric current to shock fish
- Snagging devices.

Seasons

The recreational and commercial possession and harvest of Southern Flounder is prohibited annually from Oct. 15 - Nov. 30. Any Southern Flounder caught during this closed season must immediately be returned to the water.

Size and Possession Limits

There is no size limit for recreationally harvested Southern Flounder. Each licensed angler may keep ten Southern Flounder per day.

An angler who holds and is in possession of a valid recreational fishing license and can demonstrate to LDWF's satisfaction use of a boat launch located south of U.S. Highway 90 and that the fisherman has been actively on the water or at a remote camp that can be accessed only by water for two days or more may possess up to the possession limit of filleted Southern Flounder. The filleted fish must have sufficient skin remaining on the fillet to allow for identification of the species and must be segregated by species into plastic bags or plastic containers that are marked by species to allow for easy identification, the date caught, and the name and license number of the person who took the fish. The fish must be in possession of the person who took the fish.

However, no angler shall be actively fishing or engaged in fishing while in possession of more than the daily take limit.

Area Restrictions

Restrictions vary in state wildlife management areas, refuges, and other areas as well as coastal national wildlife refuge.

Operational Restrictions

Recreational anglers must land Southern Flounder with their head and tail fins intact to assist with fish identification for enforcement purposes, except as mentioned above when fishing south of U.S. Highway 90.

Fishing Gear Interactions

It is illegal for any person to knowingly and intentionally use or employ any vessel or recreational gear to interfere with the legal commercial fishing of another.

Other

Louisiana Seafood Promotion and Marketing Board (LSPMB)

The Louisiana Seafood Promotion and Marketing Board works to enhance the public image of commercial fisheries products, promote the consumption of these products, and assist the seafood industry, including commercial harvesters and wholesale and retail dealers, in market development to better use existing markets and help establish new markets.

Louisiana Wild Seafood Certification Program (LWSCP)

LDWF established the Louisiana Wild Seafood Certification Program to build a brand that guarantees the origin of Louisiana wild-caught seafood. Through strict chain of custody requirements, the program guarantees that all seafood products bearing the Certified Louisiana Wild Seafood logo were caught in Louisiana or Gulf waters by a licensed Louisiana harvester, landed at a Louisiana dock, and processed and packaged by a Louisiana-based company. The program provides education for participants on best seafood handling and sanitation practices to ensure the utmost safety and quality. When a buyer sees this logo, they can be confident they are buying authentic Louisiana wild-caught seafood, a premium product known for fresh flavor, consistent quality, and sustainability, and that they are supporting local Louisiana fishing communities.

By branding and showcasing Louisiana seafood, LWSCP helps suppliers increase the value of their seafood products and remain competitive in seafood marketplace. LWSCP participants benefit from free program marketing support, such as:

- Market portal linking Certified Louisiana Wild Seafood suppliers with buyers
- Promotions through the program website, social media, and events including seafood festivals and industry conventions
- Free point-of-sale materials such as window clings, apparel, brochures, stickers, and decals
- Access to program partners including the LSPMB, Audubon GULF, NOAA Fisheries, Louisiana Sea
- Grant and other in- and out-of-state partners who purchase and promote Certified Louisiana Wild Seafood.

Licensed Louisiana commercial harvesters are automatically eligible for the program; licensed Louisiana wholesale/retail seafood dealers must apply for and receive a permit to participate. They must also comply with all state and federal reporting requirements and have all legally required permits to operate their business.

Professionalism Programs

LDWF, in collaboration with Louisiana Sea Grant and the LSU Ag Center, developed Louisiana Fisheries Forward, a multi-year, multi-phase professionalism program for all sectors of Louisiana's commercial fishing industry, including harvesters, dock owners, processors, and distributors. Launched in 2014, this program provides education and training essential for the continued economic success of the industry. This program delivers training videos and corresponding fact sheets on a number of topics such as how to be a commercial harvesters and seafood business finance and management as well as hands-on workshops, training days, and demonstrations to showcase new technology for vessel refrigeration/ cooler systems, seafood freezing equipment, fuel efficiency equipment, and fishing/harvesting equipment and seafood handling and processing best practices.

Fisheries Outreach

Through outreach efforts, LDWF promotes public awareness and advises the public on stewardship and best practices in preserving the unique nature of the state's natural resources. Via a strong presence at recreational events, industry-related expos, workshops, seminars, and other state sponsored events, LDWF strives to foster a community sense of resource and habitat stewardship. At these events, LDWF distributes an assortment of printed materials which focus on fishing regulations, commercial and recreational fishing topics, as well as species profile brochures which highlight the life cycle and habitat requirements of Southern Flounder and other native Louisiana species. Through participation in events, distribution of educational materials, and other activities, LDWF reaches more than 200,000 Louisiana citizens each year.

COMPLIANCE

REPORTING METHODS AND REQUIREMENTS

Since 1999, LDWF has monitored harvest of Southern Flounder at the point of initial sale through Louisiana's trip ticket program. Under the program, wholesale/retail seafood dealers purchasing or accepting transfers of Southern Flounder from commercial harvesters must complete a commercial trip ticket at the time of purchase or transfer of the catch from the fisherman to the dealer. Fresh products license holders (commercial harvester licensed to sell their catch directly to consumers) are also required to submit trip tickets.

When a commercial harvester sells or transfers his catch to a wholesale/retail dealer, he must present his license for license verification and provide the dealer with information necessary to complete a commercial trip ticket. The dealer must record the sale or transfer on a three-part LDWF-issued trip ticket form or via the electronic reporting program and include the following information:

- Commercial harvester's name and license number

- Wholesale/retail seafood dealer's name and license number
Vessel registration or U.S. Coast Guard (USCG) documentation number
- Transaction date
- Gear used
- Primary location of where the Southern Flounder was caught (according to LDWF-issued trip ticket maps)
- Duration of the fishing trip
- Species identification
- Quantity and units of each species
- Size and condition of each species
- Unit price of each species
- Permit number for species requiring a permit to harvest

The harvester and dealer must sign each trip ticket attesting that the information is correct. The dealer retains one part of the trip ticket, provides the harvester with one part, and submits one part to LDWF. If using the electronic trip ticket program, instead of a trip ticket form, the harvester and dealer must fill out a signature log to sign the trip ticket. The signature log includes the trip ticket number, date, vessel name, harvester's signature, and dealer's initials. By signing and initialing the signature log, the harvester and dealer are attesting the information filled out electronically via the electronic trip ticket program is correct.

When a commercial harvester sells his catch under a fresh products license, he must record all information required on the commercial trip ticket, using his fresh products license number in place of the dealer license number. The commercial harvester must sign each trip ticket, as both the dealer and commercial harvester, attesting that the information provided is correct.

On or before the 10th of each month, dealers and fresh products license holders must submit to LDWF all trip tickets from the previous month. A monthly submission sheet must accompany these trip tickets, certifying that the submitted trip tickets represent all of the dealer's transactions with commercial harvester for that month. When using the electronic trip ticket program, dealers and fresh products license holders must submit the computer generated monthly submission sheet and the signature logs to LDWF on or before the 10th of the month.

Trip ticket records must be maintained for three years and are open to inspection by LDWF. Trip ticket information is confidential and is protected by both state and federal law to limit access to business-specific information. However, LDWF and approved contractors may analyze and compile individual trip information into reports to provide reliable information for monitoring harvest from locations across the state, while still protecting sensitive information. LDWF enforces the trip ticket program; violation of statutes related to the program can result in citations written by LDWF or other law enforcement officials.

RECORDKEEPING REQUIREMENTS

Wholesale/retail seafood dealers, retail seafood dealers, restaurants, and retail grocers must keep records of the following:

- The quantity and species of fish acquired, the date the fish were acquired, and the name and license number of the wholesale/retail seafood dealer or the out-of-state seller from whom the fish were acquired

- The quantity and species of fish sold, the date the fish were sold, and the name and license number of the person to whom the fish were sold. When sold to a consumer, the records must indicate the quantity, species, and date and shall state that the fish were sold to the consumer.

ENFORCEMENT

Through events, outreach materials, and other resources, LDWF informs commercial harvesters and recreational anglers about programs, projects, and most importantly, relevant regulations to prevent illegal activities. LDWF's Law Enforcement Division is responsible for ensuring compliance with all commercial and recreational licensing and harvesting regulations through regular patrols and investigations. LDWF's Law Enforcement Division is also responsible for enforcing laws as provided for in the Constitution of Louisiana; Louisiana Revised Statutes, and numerous federal laws including the Magnuson-Stevens Act (MSA), Endangered Species Act (ESA), Marine Mammal Protection Act (MMPA), and the Lacey Act.

LDWF's Law Enforcement Division partners with National Oceanic and Atmospheric Administration (NOAA) Fisheries and United States Coast Guard (USCG) enforcement agents and officers to increase their enforcement capabilities and carry out their important mission in Louisiana's waters and beyond. Local parishes also assist in enforcement, primarily through the legal functions of each parish's district attorney. Local sheriff's offices sometimes assist LDWF's Law Enforcement Division as well. Local and state sanitarians and health department employees help enforce public health and safety related regulations.

PENALTIES

Classes of violations vary by legislative statute or Commission rule. Specific penalties for violations vary with the severity of the violation and include fines, jail time, loss of fishing license, and forfeiture of property. In addition, LDWF may seize any Southern Flounder in connection with the violation. Specific penalties are listed in Appendix XII.

A person who kills, catches, takes, possesses, or injures any aquatic life in violation of an applicable state statute or regulation or a federal statute or regulation is also liable to the state for the value of each aquatic life unlawfully killed, caught, taken, possessed, or injured.

Violation of Southern Flounder regulations is punishable by a fine of \$25 per fish over the limit of 10 or in violation of such minimum size, take and possession limits, and seasons as established by the Commission. In addition to any applicable fines, violators' fishing licenses may be revoked and they may be prohibited from obtaining any new fishing licenses for a period of up to three years thereafter. Civil restitution for Southern Flounder is currently assessed at \$16.08 per individual fish.

Current Issues & Management Options



This section identifies current issues facing Louisiana's commercial and recreational Southern Flounder fisheries, provides a description of each issue, and recommends options for future action to address these issues. Before implementing any recommendation, LDWF will evaluate the feasibility and potential impacts of the action on the resource and fisheries.

ACHIEVING MANAGEMENT GOALS

Addressing current issues facing Louisiana's commercial and recreational Southern Flounder fisheries through options identified in this section or through stakeholder participation will advance these fisheries toward meeting long-term management goals.

STOCK OVERFISHED

LDWF uses Spawning Potential Ratio (SPR) as an indicator of the health of Southern Flounder population in Louisiana.

The target SPR for Southern Flounder is based on the long-term median for the population and is 54.8%, with a SPR limit of 20%. The 2019 stock assessment estimated Southern Flounder SPR at 19%, indicating the stock is currently in an overfished state. When SPR falls below a specified limit, there is a high risk that recruitment will be reduced to undesirable levels, which can lead to the stock falling to unsustainable levels with too few adult female fish to maintain the population. Given the status of the stock, management actions were needed to recover SPR levels above the established limit to recover the stock from its overfished condition.

OPTIONS

LDWF's 2019 Southern Flounder stock assessment indicated the stock is currently overfished. In accordance with LAC 76:385, LDWF presented the Louisiana Wildlife and Fisheries Commission (LWFC) with several management options which would result in a minimum of a 50% reduction in the harvest of mature female Southern Flounder. As a result, the LWFC implemented an annual closed season in the fall in order to allow mature females to escape inshore waters to offshore spawning grounds. Finalized regulations established an annual closed season for the recreational and commercial harvest of Southern Flounder from Oct. 15 - Nov. 30 of each year. The closed season attempts to recover the stock to a sustainable biomass target by 2028.

Future Research & Data Needs

Throughout the development of this fishery management plan, LDWF has identified several research needs that would provide data to address some of the issues and data gaps in the Southern Flounder fishery or species biology.

Specific research needs are listed below. These needs are not listed in order of importance. The list includes aspects of the species or fisheries that have been noted for decades in addition to relatively recently identified issues.

- Factors that influence year-class strength of Southern Flounder are poorly understood. Investigation of these factors, including inter-annual variation in seasonal factors and the influence of environmental perturbations should be a priority moving forward given the rapid decline observed in female age-1 recruitment and spawning stock biomass.
- Fishery-dependent data alone is not a reliable source of information to assess status of a fish stock. Consistent fishery-dependent and fishery-independent data sources, in a comprehensive monitoring plan, are essential to understanding the status of a fishery. Present monitoring programs should be assessed for adequacy with respect to their ability to evaluate stock status and modified if deemed necessary.
- Only limited catches of Southern Flounder occur in LDWF fishery-independent surveys. Expanding the LDWF fishery-independent surveys to a gear more effective in capturing adult Southern Flounder would allow an additional index of abundance in future modeling efforts that could help better characterize spawning stock size while also providing auxiliary life-history information.
- The GSMFC (2015) reviewed commercial and recreational GOM flatfish landings and concluded that landings were not adequately separated between Gulf and Southern Flounder to be able to assess the stocks on a gulf-wide basis. In Louisiana, Gulf Flounder are an uncommon species, but Broad Flounder inhabit the nearshore and offshore areas of the state to some degree. Better definition of the distribution and harvest of Southern Flounder

congeners will help better refine both fishery-independent and fishery-dependent inputs into future assessments.

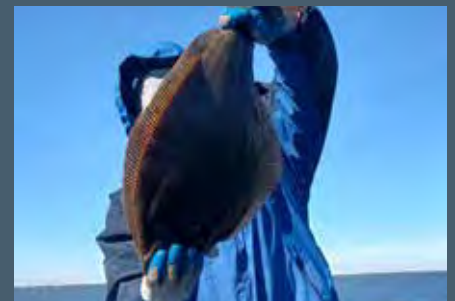
- Existing and historic creel surveys have not sampled night fishing activities and therefore recreational flounder harvest from gigging or bow fishing may not be well characterized. A specific survey to capture harvest related information for Southern Flounder harvest that occurs at night could help improve the understanding of and the significance of those fisheries.
- The relationship between wetlands losses and the continuation of fishery production within Louisiana has been discussed by numerous authors, understanding this relationship as it applies to the Louisiana Southern Flounder stock should be an ongoing priority given the rate of habitat loss being currently experienced in Louisiana.
- Female spawning stock biomass is used as a proxy of total egg production in Louisiana assessments of Southern Flounder. Spawning potential ratio estimates may be biased if egg production does not scale linearly with female body weight. Updated estimates of batch fecundity and spawning frequency as a function of age/size would better inform future assessments.
- With the recent trend toward ecosystem-based assessment models (Mace 2000; NMFS 2001), more data is needed linking Southern Flounder population dynamics to environmental conditions. The addition of meteorological and physical oceanographic data coupled with food web data may lead to a better understanding of the Southern Flounder stock and its habitat.
- Conduct research to document release mortality of Southern Flounder as bycatch from trawl gears during the newly established closed season to compare with previous bycatch studies from trawl gears.
- Further research into the masculinization of Southern Flounder and the underlying conditions that lead to masculinization may help in our understanding of how to mitigate those potential impacts to the stock.

RESEARCH PRIORITIES, FUNDING AND PUBLICATIONS

LDWF prioritizes future research according to several factors, including whether or not it:

- Fits the agency's mission
- Can be adequately funded
- Can be reasonably expected to produce answers to specific management questions
- Can be reasonably undertaken without compromising other capabilities and efforts
- Has or will have the support of stakeholders
- Has or can engender cooperation with other researchers, managers, user groups, and/or the general public.

Research is typically funded through state license fees and federal, state, or private (nongovernmental organization) grants and programs; funding is allocated based on priority as described above. While LDWF may not have funding for many of the topics listed above, outside funding sources may be available for other researchers to pursue some of these issues. Our hope is that by our including these needs here, those outside funding sources may be more inclined to support some of the research described above. LDWF analyzes research and reports results in multiple formats, as appropriate. Ultimately, all information is publicly available (other than information linked to private enterprises, e.g. confidential landings data).



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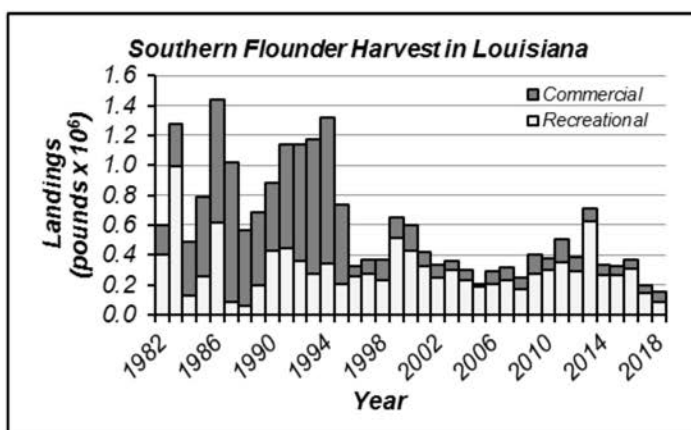
Appendices

APPENDIX I. Assessment of Southern Flounder (*Paralichthys lethostigma*) in Louisiana Waters 2020 Report

Executive Summary

Landings of southern flounder (SF) in Louisiana have averaged just under 0.4 million pounds per year in the most recent decade. The 2017 and 2018 recreational and commercial harvests are the lowest on record. The highest harvests on record (over 1 million pounds) occurred prior to 1995. After commercial gear restrictions were enacted in 1995, commercial landings declined significantly and account for less than 25% of landings in the most recent decade.

A statistical catch-at-age model is used in this assessment to describe the dynamics of female southern flounder occurring in Louisiana waters from 1982-2018. The assessment model forward calculates



abundance-at-age from estimates of abundance in the initial year of the time-series and recruitment estimates in subsequent years. The model is fit to the data with a maximum likelihood fitting criterion. Minimum data requirements are fishery catch-at-age and an index of abundance. Landings are taken from the Louisiana Department of Wildlife and Fisheries (LDWF) Recreational Creel Survey and Commercial Trip Ticket Programs, the National Marine Fisheries Service (NMFS) commercial statistical records, and the NMFS Marine Recreational Information Program (MRIP). Abundance indices are developed from the LDWF marine inshore trawl and trammel net surveys. Age composition of fishery catches are estimated with age-length-keys derived from direct samples of the fishery and a growth model.

There are currently no management thresholds established for the Louisiana southern flounder stock and no biological basis to establish management limits based on the history of the stock. Until biologically-based thresholds are established, a default limit of a 20% spawning potential ratio (SPR) is proposed. Based on results of this assessment and the proposed limit, the Louisiana southern flounder stock is currently overfished. Management actions will be needed in order to recover the stock from its current depleted condition.

There is also an alarming rapid downward trend in recruitment and spawning stock biomass. The 2017 and 2018 female recruitment and spawning stock biomass estimates are the lowest on record.

Summary of Changes from 2015 Assessment

Assessment model inputs have been updated through 2018. No changes have been made to the assessment model itself. A number of changes have been made to the data inputs of the assessment model that are described below. Because of these changes, this stock assessment is considered a benchmark assessment rather than an update of the previous assessment.

The time-series of recreational landings estimates used in this assessment has changed. In the previous assessment, recreational landing estimates were taken from the NMFS MRIP survey. In this assessment, recreational landings estimates are taken from the LDWF Recreational Creel Survey (LA Creel; 2014-2018) and estimates hindcast to the historic MRIP time-series (1982-2013; details in *Appendix 1*).

A new sampling program was established by LDWF in 2014, at the same time as the transition from MRIP to LA Creel, to provide biological information characterizing the size and age composition of LA fishery landings. In earlier assessments, size composition information of recreational landings was taken entirely from the MRIP survey. In this assessment, beginning in 2014, size composition of recreational landings was obtained from the LDWF Biological Sampling Program and from MRIP for years prior (details in 2. *Data Sources*).

The prior assessment included landings of females and males combined. To remove uncertainty associated with male migration dynamics, only the female proportion of the stock is included in this assessment.

The LDWF inshore trawl survey and trammel net survey are used to develop indices of abundance as data inputs of the assessment model. These surveys were modified in October 2010 and again in 2013 (details in 2. *Data Sources*).

The female southern flounder von Bertalanffy growth parameters used in the previous assessment to describe growth rates and develop age-length-keys for age assignments of fishery and survey catches has been replaced in this assessment with female von Bertalanffy growth parameters estimated from a larger LDWF/Louisiana State University (LSU) dataset (details in *Appendix 2*).

The female southern flounder maturity-at-age vector that was used in the previous assessment to calculate female spawning stock biomass has been replaced in this assessment with a vector developed from a logistic function fit to an LSU/Louisiana Sea Grant/LDWF dataset (details in *Appendix 2*).

The function used to assign the proportion female-at-size to fishery landings in the previous assessment has been replaced in this assessment with a logistic function fit to a larger LDWF dataset (details in 3. *Life History Information*).

A change was also made to better represent the uncertainty of recreational and commercial landings in the assessment model. In the previous assessment, variability of landings was assumed constant across each time-series. In this assessment, annual values of variability are used to control model fits of fishery yield (details in 6. *Assessment Model*).

Assessment of Southern Flounder *Paralichthys lethostigma* in Louisiana Waters 2020 Report

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1. Introduction

A statistical catch-at-age model is used in this assessment to describe the dynamics of female southern flounder *Paralichthys lethostigma* (SF) occurring in Louisiana (LA) waters from 1982-2018. The assessment model forward projects abundance-at-age from estimates of abundance in the initial year of the time-series and recruitment estimates in subsequent years. The model is fit to the data with a maximum likelihood fitting criterion. Minimum data requirements are fishery catch-at-age and an index of abundance. Commercial landings values are taken from the Louisiana Department of Wildlife and Fisheries (LDWF) Trip Ticket Program and the National Marine Fisheries Service (NMFS) commercial statistical records. Recreational harvest estimates are obtained from the LDWF Recreational Creel Program (LA Creel) and the NMFS Marine Recreational Information Program (MRIP). Indices of abundance are developed from the LDWF marine inshore trawl and trammel net surveys. Age composition of fishery catches are estimated with age-length-keys derived from samples directly of the fishery (2002-2018) and a von Bertalanffy growth function (1982-2001).

1.1 Fishery Status

A comprehensive history of the SF resource and associated fishery within LA is described in Adkins et al. (1998) and for the Gulf of Mexico (GOM) in GSMFC (2000, 2015). A current summary of the LA SF fishery is presented below.

Commercial

The LA commercial SF fishery operates primarily within state inside waters (from the coastline upward to the saltwater line) and outside territorial waters (from the coastline seaward to the state water boundary), with some harvest from federal waters of the Exclusive Economic Zone (EEZ). Entanglement net bans in the late 1990's combined with other regulation changes caused a

significant decline in commercial SF landings. Commercially harvested SF are landed primarily as incidental catch from shrimp fishers, with a smaller portion of the SF harvest from targeted activity.

Recreational

Similar to the commercial sector, the recreational SF fishery operates primarily within state inside waters and outside territorial waters. Southern flounder are infrequently targeted recreationally with less than 2% of LA anglers reporting southern flounder as their primary target in 2018 (LA Creel unpublished data).

1.2 Fishery Regulations

The LA southern flounder fishery is governed by the Louisiana State Legislature, the Louisiana Wildlife and Fisheries Commission, and the LDWF. Reviews of LA commercial and recreational SF regulations are presented below.

Commercial

Commercial SF harvest regulations changed substantially from 1995 through 1999. Commercial harvest methods were restricted on August 15, 1995, when the Marine Resources Conservation Act of 1995 (Act 1316 of 1995 Regular Legislative Session) became effective. This act prohibited the use of "set" gill nets or trammel nets in saltwater areas of Louisiana, and restricted flounder harvest by "strike" nets to the period between the third Monday in October and March 1 of the following year. A "Restricted Species Permit" issued by LDWF was also required in order to harvest SF with that gear. The Act also required annual stock assessments of southern flounder. In 1996, as a result of the first assessment of southern flounder finding the stock below a 30% SPR, and within the provisions of that Act, additional regulations became effective that outlawed the use of strike nets for SF harvest and limited possession to 10 fish per person aboard a commercial vessel. In 1997, regulations were changed by Acts 1163 and 1352 of the 1997 Regular Legislative Session in which commercial shrimping vessels were limited to 100 pounds of southern flounder per trip. In March of 1997, all flounder harvest by gill or trammel nets was banned. These regulations substantially reduced the commercial harvest of flounder. Regulations were changed in 1999 by Act 220 of the 1999 Regular Legislative Session which eliminated the 100-pound harvest limit on commercial shrimping vessels when southern flounder were harvested as incidental catch.

Current commercial regulations allow 10 fish for each licensed fisherman for each day on the water, except commercial shrimping vessels may retain all SF caught incidentally. There is no size limit on commercially harvested SF.

Recreational

Recreational regulations were first enacted in 1996 that established a creel limit of ten SF per day per licensed angler, with only a single day's limit allowed in possession. Regulations were changed in August of 2004 by Act 460 of the 2003 Regular Legislative session, which allowed recreational harvest of SF with barbed gigs (prior to 2004 only barbless gigs were allowed). Current recreational regulations allow a 10 fish daily bag and possession limit per licensed angler with no size limit.

1.3 Trends in Harvest

Time-series of recreational and commercial SF landings are presented (Table 1, Figure 1).

Commercial

Commercial landings of southern flounder in LA remained below 0.4 million pounds until the 1970's. Commercial landings peaked from the mid-1980s through the mid-1990s with nearly 1 million pounds landed in 1987 and 1994. From 1986 through 1995, commercial SF harvest averaged over 0.7 million pounds. Commercial landings beginning in 1996 substantially declined due to regulatory changes and have not exceeded 0.2 million pounds to date. The lowest commercial harvests occurred in 2005 and 2017 (0.02 and 0.05 million pounds). In 2018, the commercial sector landed 0.06 million pounds of southern flounder.

The primary gears currently used in the commercial SF fishery are bottom trawls, butterfly nets, skimmer nets, trot lines, hand lines, and traps. The majority of commercial southern flounder landings occur during the annual offshore migration (October through December). Commercial SF landings before 2006 were relatively evenly distributed among the southeastern portion of the state, offshore, and the southwestern portion of the state. After 2005, commercial landings of SF became more concentrated in the southwestern portion of the state and remain so to date.

Recreational

Recreational LA SF landings have varied from an earlier low of 0.13 million pounds harvested in 1987 to a peak of 0.62 million pounds harvested in 2013. Since 2013, recreational SF landings have declined to a record low of 0.09 million pounds harvested in 2018.

The majority of recreational harvest occurs during the annual offshore migration (October through December). The most commonly used recreational gears to harvest southern flounder are rod-and-reel and a barbed gig.

2. Data Sources

2.1 Fishery Independent

The LDWF fishery-independent (FI) marine inshore trawl and trammel net surveys are used in this assessment to develop indices of abundance as inputs of the assessment model. Below are brief descriptions of each survey's methodology. Complete details can be found in LDWF (2018).

For sampling purposes, coastal Louisiana is currently divided into five LDWF coastal study areas (CSAs). Current CSA definitions are as follows: CSA 1 – Mississippi State line to South Pass of the Mississippi River (Pontchartrain Basin); CSA 3 – South Pass of the Mississippi River to Bayou Lafourche (Barataria Basin); CSA 5 – Bayou Lafourche to eastern shore of Atchafalaya Bay (Terrebonne Basin); CSA 6 – Eastern shore of Atchafalaya Bay to western shore of Freshwater Bayou Canal (Vermillion/Teche/Atchafalaya Basins); CSA 7 – western shore of Freshwater Bayou Canal to Texas State line (Mermentau/Calcasieu/Sabine Basins).

The LDWF Marine Fisheries Section conducts routine standardized sampling within each CSA as part of a long-term comprehensive monitoring program to collect life-history information and measure relative abundance/size distributions of recreationally and commercially important species. These include the experimental marine gillnet, inshore trawl, trammel net, and bag seine surveys.

In this assessment, only the FI inshore trawl and trammel net surveys are used. The other FI gears mentioned above are excluded due to very low SF catches. The FI inshore trawl and trammel net surveys are conducted with standardized design. Hydrological and climatological measurements are taken with each biological sample, including water temperature, turbidity, conductivity and salinity.

The inshore trawl survey gear is a 16-foot flat otter trawl attached to a ½ inch diameter nylon or Kevlar rope, or stainless steel tow line and bridle. The length of the bridle is 2-3 times the trawl width. Samples are taken from ten minute tows at a constant speed and in a weaving or circular track to allow the prop wash to pass on either side of the trawl. All captured SF are enumerated and a maximum of 50 randomly selected SF are collected for length measurements.

This inshore trawl survey is conducted at fixed sampling stations within each LDWF CSA. In October 2010, additional fixed stations were added to this survey allowing more spatial coverage within each CSA. Prior to July 2013, sampling was conducted weekly from March to October and semi-monthly from November to February. Beginning July 2013, sampling was reduced to monthly samples from January-March and August- November and semi-monthly samples from April-July and December.

The trammel net survey gear is a 750-foot long and 6-foot depth net, consisting of 3 walls constructed of nylon. The inner wall has 1 5/8-inch bar mesh wall, and the two outer walls have 6-inch bar mesh wall. Samples are taken by ‘striking’ the net. All captured SF are enumerated and a maximum of 50 randomly selected SF are collected for length measurements, gender determination, and maturity information.

The trammel net survey was conducted from 1986 to October 2013 at fixed sampling stations within each CSA. In October 2010, additional fixed stations were added to allowing more spatial coverage within each CSA. Beginning in 2013, the survey design was modified where sampling locations are now selected randomly from the established stations within each CSA.

2.2 Fishery Dependent

Commercial

Commercial SF landings are taken from the LDWF Trip Ticket Program and the NMFS commercial statistical records (NMFS 2019; Figure 1). It’s important to note that NMFS commercial records prior to 2000 did not differentiate landings of flatfish species in Louisiana. Several flatfish species can be found in LA waters, such as the gulf flounder *Paralichthys albigutta* and broad flounder *Paralichthys squamilentus*, but the most common species is the southern flounder (GSMFC 2000). MRIP recreational landings estimates from 1985-1999 indicate gulf flounder comprises only 2.5% (on average as weight) of the annual recreational harvest relative to SF harvest, and none have been reported in that survey since then. Neither gulf nor broad flounder have been identified in LA Creel landings to date (2014-2019). Given these small landings, it is unlikely the inclusion of gulf or broad flounder in LA flatfish harvest estimates would have a major impact on SF stock status estimation. Therefore, for purposes of this assessment, commercial landings labeled as flatfish in LA are assumed as southern flounder.

Annual size compositions of commercial SF harvest (Table 2) are developed from samples from the Trip Interview Program (TIPS; 1982-2002), the Fishery Information Network (FIN; 2002-2013), and the LDWF Biological Sampling Program (2014-2018). Due to very limited size composition samples collected in early years of the commercial fishery, the 1994 TIPS size composition data are pooled with the available size data from earlier years and used as a proxy of the 1982-1993 size compositions. Due to very limited size composition samples collected from 1997-2001, the 2002 FIN samples are pooled with the available TIPS size information from 1997-2001 and used as a proxy of the 1997-2001 size compositions. For other years where annual size composition samples were < 200 (1996, 2008, 2011-2014, 2017), samples from the previous and prior years were pooled with that year’s size composition samples. Due to very limited commercial size samples

collected in 2018, the 2016-2018 samples are pooled and used as a proxy of the 2018 size composition.

Estimates of commercial live releases of SF are not available. Due to no size limit regulations, commercial live releases are assumed to be insignificant relative to commercial SF harvest and not considered further in this assessment.

Ages of commercial southern flounder landings are derived from a von Bertalanffy growth model (1982-2001) and otoliths collected directly from the commercial fishery (2002-2018; see 5. *Catch at Age Estimation*).

Recreational

Recreational SF landings and live release estimates are taken from the LDWF recreational creel survey (LA Creel; 2014-2018) and estimates hindcast to the historic MRIP time-series (1982-2013; details in *Appendix I*). Consequently, the pre-2014 recreational estimates used in this assessment differ from the LA estimates currently published by MRIP (<https://www.st.nmfs.noaa.gov/recreational-fisheries/data-and-documentation/queries/index>). Furthermore, due to changes made to the MRIP Access Point Angler Intercept Survey (APAIS) in 2013 (see <https://www.fisheries.noaa.gov/topic/recreational-fishing-data#making-improvements>) and the recent transition from the MRIP Coastal Household Telephone Survey to the new Fishing Effort Survey (FES; see <https://www.fisheries.noaa.gov/recreational-fishing-data/types-recreational-fishing-surveys#fishing-effort-survey>), harvest estimates currently available from MRIP also differ from those used in the prior LA SF stock assessment (Davis *et al.* 2015).

Annual size composition of recreational SF harvest estimates are derived from the LDWF Biological Sampling Program (2014-2018) and MRIP (1982-2013, prior to the APAIS and FES calibration changes; Table 3). Size composition estimates of recreational live releases are not available. Due to a no size limit regulation on the recreational fishery, annual size compositions of live releases are assumed equivalent to harvest. Statewide size compositions obtained from the LDWF Biological Sampling Program are derived by statistically weighting the CSA-specific size compositions by the corresponding recreational landings estimates.

Ages of recreational southern flounder landings are derived from a von Bertalanffy growth model (1982-2001) and otoliths collected directly from the recreational fishery (2002-2018; see 5. *Catch at Age Estimation*).

3. Life History Information

3.1 Unit Stock Definition

Genetic studies of southern flounder utilizing allozymes (Blandon et al. 2001) and sequences of mitochondrial DNA (Anderson et al. 2012) suggest SF occurring in the GOM are a distinct stock. However, for purposes of this assessment and to remain consistent with the current statewide management strategy, the unit stock is defined as those female SF occurring in LA waters.

3.2 Morphometrics

The LA SF weight-length regression reported by Fischer and Thompson (2004) is used in this assessment for length-weight conversions. Regression equation slopes comparing males and females were not significantly different. For the purpose of this assessment, the non-sex-specific formulation is used with weight calculated from size as:

$$W = 3.47 \times 10^{-6}(TL)^{3.21} \quad [1]$$

where W is whole weight in grams and TL is total length in mm.

3.3 Growth

The von Bertalanffy parameter estimates for female southern flounder used in the previous assessment reported by Fisher and Thompson (2004) are replaced in this assessment with female von Bertalanffy growth parameters estimated from a larger LDWF/LSU dataset (see *Appendix 2*). Female southern flounder total length-at-age is calculated with the von Bertalanffy growth model as:

$$TL_a = 19.96 \times (1 - e^{-0.443(a+1.14)}) \quad [2]$$

where TL_a is TL-at-age in inches and years.

3.4 Sex Ratio

Southern flounder exhibit large differences in growth between males and females, with larger flounder being predominantly female (Fischer and Thompson 2004; see *Appendix 2*). The function used in the previous assessment to estimate the probability of being female at a particular size is replaced in this assessment with a logistic function fit to a larger LDWF dataset (Table 4). The probability of being female at a specific size is calculated from:

$$P_{fem,TL} = \frac{1}{[1 + e^{[-0.516(TL - 9.63)]}]} \quad [3]$$

where TL is in units of inches. The minimum sex ratio-at-size is assumed as 50:50. Equation [3] is used to estimate the proportion female-at -size for all years without sex composition records and for instances where $n < 10$ for year/size bins with sex composition records (Table 4).

3.5 Fecundity / Maturity

Total egg production is currently not estimable for LA southern flounder (see 8. *Research and Data Needs*). For purposes of this assessment, female spawning stock biomass (SSB) is used as a proxy for total egg production. This may introduce bias if fecundity does not scale linearly with body weight (Rothschild and Fogarty 1989).

The age-specific female maturity vector used in the previous assessment (Fisher 2000) is replaced in this assessment with a vector developed from an age-specific logistic function fit to a LSU/Louisiana Sea Grant/LDWF dataset (see *Appendix 2*) where 21% of age-1 females spawn, 60% of age-2 females spawn, 90% of age-3 females spawn, and 100% of age-4 and greater females spawn.

3.6 Natural Mortality

Southern flounder can live to at least eight years of age (Fisher and Thompson 2004). For purposes of this assessment, a value of constant M is assumed (0.53) based on longevity of the species, but is allowed to vary with weight-at-age to calculate a declining natural mortality rate with age. This value of M is consistent with a stock where approximately 1.5% of the stock remains alive to 8 years of age (Quinn and Deriso 1999, Hewitt and Hoenig 2005). Following SEDAR 12 (SEDAR 2006), the value of M is rescaled where the average mortality rate over ages vulnerable to the fishery is equivalent to the constant rate over ages as:

$$M_a = M \frac{nL(a)}{\sum_{a_c}^{a_{max}} L(a)} \quad [4]$$

where M is the constant natural mortality rates over exploitable ages a , a_{max} is the oldest age-class (age-8 in this case), a_c is the first fully-exploited age-class, n is the number of exploitable ages, and $L(a)$ is the Lorenzen curve as a function of age. The Lorenzen curve as a function of age is calculated from:

$$L(a) = W_a^{-0.288} \quad [5]$$

where -0.288 is the allometric exponent estimated for natural ecosystems (Lorenzen 1996) and W_a is weight-at-age.

3.7 Relative Productivity and Resilience

The key parameter in age-structured population dynamics models is the steepness parameter (h) of the stock-recruitment relationship. Steepness is defined as the ratio of recruitment levels when the

spawning stock is reduced to 20% of its unexploited level relative to the unexploited level and determines the degree of compensation in the population (Mace and Doonan 1988). Populations with higher steepness values are more resilient to perturbation and if the spawning stock is reduced to levels where recruitment is impaired are more likely to recover sooner once overfishing has ended. Generally, this parameter is difficult to estimate due to a lack of contrast in spawning stock size (*i.e.*, data not available at both high and low levels of stock size) and is typically fixed or constrained during the model fitting process. Estimates of steepness are not available for southern flounder.

Productivity is a function of fecundity, growth rates, natural mortality, age of maturity, and longevity and can be a reasonable proxy for resilience. We characterize the relative productivity of LA southern flounder based on life-history characteristics, following SEDAR 9 (2006a), with a classification scheme developed at the FAO second technical consultation on the suitability of the CITES criteria for listing commercially-exploited aquatic species (FAO 2001). Each life history characteristic (von Bertalanffy growth rate, age at maturity, longevity, and natural mortality rate) is assigned a rank (low=1, medium=2, and high=3) and then averaged to compute an overall productivity score. In this case, the overall productivity score is 3.0 for GOM southern flounder (Table 5) indicating high productivity.

4. Abundance Index Development

Southern flounder indices of abundance (IOA) are developed from the LDWF FI inshore trawl and trammel net surveys.

The IOA developed from the inshore trawl survey represents young-of the year (age-0) SF catches only. Catches greater than age-0 are excluded based on size and date of capture and all age-0 catches are assumed as female. Only samples collected during the months of April through September are included in IOA development and samples from stations not sampled regularly through time are excluded. Catch-per-unit effort (CPUE) is defined as the number of age-0 female southern flounder caught per trawl tow.

The IOA developed from the trammel net survey uses October through December samples only. All female SF catches are included in this index, including age-0 catches. Catch-per-unit-effort is defined as the number of female SF caught per trammel net sample. To reduce unexplained variability in catch rates unrelated to changes in abundance, each IOA was standardized using methods described below.

A delta lognormal approach (Lo *et al.* 1992; Ingram *et al.* 2010) is used to standardize catch-rates in each year as:

$$I_y = c_y p_y \quad [6]$$

where c_y are estimated annual mean CPUEs of non-zero SF catches assumed as lognormal distributions and p_y are estimated annual mean probabilities of SF capture assumed as binomial distributions. The lognormal and binomial means and their standard errors are estimated with generalized linear models as least squares means and back transformed. The lognormal model considers only samples in which SF are captured; the binomial model considers all samples. The IOAs are then computed from equation [6] using the estimated least-squares means with variances calculated from:

$$V(I_y) \approx V(c_y)p_y^2 + c_y^2V(p_y) + 2c_y p_y \text{Cov}(c, p) \quad [7]$$

where $\text{Cov}(c, p) \approx \rho_{c,p} [SE(c_y)SE(p_y)]$ and $\rho_{c,p}$ represents the correlation of c and p among years.

Because of the designed nature of the FI surveys, model development was rather straightforward. Variables considered in model inclusion were year, CSA, and sampling location. Because only seasonal samples are included (*i.e.*, April-September and October-December respectively), time of year was not considered in model inclusion. To determine the most appropriate models, we began the model selection process with a fully-reduced model that included only year as a fixed effect. More complex models were then developed including interactions and random effects and compared using AIC and log-likelihood values. All sub-models were estimated with the SAS generalized linear mixed modeling procedure (PROC GLIMMIX; SAS 2008). In the final sub-models, year was considered a fixed effect, CSA was considered a random block effect, and sampling locations within CSAs were considered random subsampling block effects.

Sample sizes, proportion positive samples, nominal CPUE (of non-zero catches), standardized indices of abundance, and coefficients of variation of the standardized indices are presented (Table 6). Standardized and nominal CPUEs, normalized to 1 for comparison, are also presented graphically (Figure 2). Both indices depict similar trends, but unlike the trawl survey where both nominal CPUE and the probability of capture trend together, nominal CPUE of the trammel net survey is relatively flat through time but with a downward probability of capture.

For modeling purposes, where age-0 catches are not included in the assessment model but represent the majority of the survey catches, each IOA time-series is advanced forward a year to

allow age-0 CPUE to become a proxy of age-1 CPUE (see 5. *Catch at Age Estimation*). Survey timing is then set to the beginning of the year for each survey in the assessment model (see 6. *Assessment Model*).

5. Catch at Age Estimation

Age-length-keys (ALKs) are developed to estimate the annual age composition/catch-at-age of fishery and survey catches as described below.

Southern flounder typically spawn December-January (GSMFC 2000). Ages of southern flounder in this assessment are assigned based on a biological January 1st birthday, where southern flounder become age-1 on January 1st and remain age-1 until the beginning of the following year.

5.1 Fishery

1982-2001 Probabilities of age a given length l for recreational and commercial female SF landings are computed from:

$$P(a|l) = \frac{P(l|a)}{\sum_a P(l|a)} \quad [8]$$

with probabilities of length given age estimated from normal probability densities as:

$$P(l|a) = \frac{1}{\sigma_a \sqrt{2\pi}} \int_{l-d}^{l+d} \exp \left[-\frac{(l-l_a)^2}{2\sigma_a^2} \right] dl \quad [8b]$$

where length bins are 1 inch TL intervals with midpoint l , maximum $l + d$, and minimum $l - d$ lengths. Mean total length-at-age l_a is estimated from Equation [2]. The standard deviation in length-at-age is approximated from $\sigma_a = l_a CV_l$, where the coefficient of variation in length-at-age is assumed constant (in this case approximated as 0.05). To approximate changes in growth and vulnerability to the fishery through the year, mean l_a is calculated at the mid-point of the calendar/model year. The resulting $P(a|l)$ matrix (Table 7) is used in age assignments of 1982-2001 recreational and commercial landings and also for instances discussed below.

2002-2018 Fishery-specific f (i.e., recreational and commercial) probabilities of age given length are computed from:

$$P(a|l)_{yf} = \frac{n_{layf}}{\sum_a n_{layf}} \quad [9]$$

where n_{layf} are annual fishery-specific southern flounder samples occurring in each length/age bin. For year/length bins with $n < 10$, the $P(a|l)$ for that length interval is taken from equation [8] (Tables 8 and 9).

Annual fishery-specific catch-at-age is then calculated as:

$$C_{ayf} = \sum_l P_{fem,ly} C_{lyf} P(a|l)_{yf} \quad [10]$$

where C_{lyf} are annual fishery-specific catch-at-size in TL, $P_{fem,ly}$ are taken from Table 4, and $P(a|l)_{yf}$ are taken from Equations [8 or 9]. Recreational discard mortalities are incorporated directly into the recreational catch-at-age by applying a 10% discard mortality rate to the estimated live releases-at-size and combining them with the harvest-at-size estimates.

For modeling purposes, catches $\geq$ age-4 are summed into a plus group. Resulting annual fleet-specific catch-at-age and corresponding mean weights-at-age are presented (Tables 10 and 11).

5.2 Survey

Probabilities of age given length for female SF catches of the LDWF marine trammel net survey are computed from equation [8]. Mean total length-at-age is estimated from equation [2]. Variance in length-at-age is approximated as $\sigma_{as} = l_{as} CV_l$, where the coefficient of variation in length-at-age CV_l is assumed constant (0.05). To approximate survey timing, mean total length-at-age is calculated at the end of the calendar/model year. The resulting $P(l|a)$ matrix for female SF catches of the marine trammel net survey is presented (Table 12). Annual survey female catch-at-age is then taken from Equation [10] with annual survey female catch-at-size substituted (Table 13). Resulting annual age compositions of female SF catches of the LDWF marine trammel net survey are presented (Table 14).

6. Assessment Model

The Age-Structured Assessment Program (ASAP3 Version 3.0.12; NOAA Fisheries Toolbox) is used in this assessment to describe the dynamics of female SF occurring in LA waters. ASAP is a statistical catch-at-age model that allows internal estimation of a Beverton-Holt stock recruitment relationship and MSY-related reference points. Minimum data requirements are fishery catch-at-age, corresponding mean weights-at-age, and an index of abundance. ASAP projects abundance-at-age from estimates of abundance in the initial year of the time-series and recruitment estimates in subsequent years. The model is fit to the data with a maximum likelihood fitting criterion. An overview of the basic model configuration, equations, and their estimation, as applied in this assessment, are provided below. Specific details and full capabilities of ASAP can be found in the technical documentation (ASAP3; NOAA Fisheries Toolbox).

6.1 Model Configuration

Mortality

Fishing mortality is assumed separable by age a , year y , and fishery f as:

$$F_{ayf} = v_{af} Fmult_{yf} \quad [11]$$

where v_{af} are age and fishery-specific selectivities and $Fmult_{yf}$ are annual fishery-specific apical fishing mortality rates. Apical fishing mortalities are estimated in the initial year and as deviations from the initial estimates in subsequent years.

Commercial age-specific selectivities are modeled with double logistic functions as:

$$v_{af} = \left(\frac{1}{1 + e^{-(a - \alpha_f)/\beta_f}} \right) \left(1 - \frac{1}{1 + e^{-(a - \alpha_{2f})/\beta_{2f}}} \right) \quad [12]$$

Recreational age-specific selectivities are modeled with a single logistic function as:

$$v_{af} = \frac{1}{1 + e^{-(a - \alpha_f)/\beta_f}} \quad [13]$$

Total mortality for each age and year is calculated from the annual age-specific natural mortality rates and estimated annual fleet-specific fishing mortalities as:

$$Z_{ay} = M_{ay} + \sum_f F_{ayf} \quad [14]$$

For reporting purposes, annual age-specific fishing mortalities are averaged by weighting by population numbers at age as:

$$F_y = \frac{\sum_a F_{ay} N_{ay}}{\sum_a N_{ay}} \quad [15]$$

Population Abundance

Abundance-at-age in the initial year of the time series and recruitment in subsequent years are estimated and used to forward calculate the remaining numbers at age from the age and year-specific total mortality rates as:

$$N_{ay} = N_{a-1,y-1} e^{-Z_{a-1,y-1}} \quad [16]$$

Numbers in the 4-plus group A are calculated from:

$$N_{Ay} = N_{A-1,y-1} e^{-Z_{A-1,y-1}} + N_{A,y-1} e^{-Z_{A,y-1}} \quad [17]$$

Spawning Stock Biomass

Annual female spawning stock biomass is calculated from:

$$SSB_y = \sum_{i=1}^A N_{ay} W_{SSB,a} p_{mat,a} e^{-Z_{ay}(0)} \quad [18]$$

where $W_{SSB,a}$ are female spawning stock biomass weights-at-age (i.e., on January 1st), $p_{mat,a}$ are the proportion of mature females-at-age, and $-Z_{ay}(0)$ is the proportion of total mortality occurring prior to spawning on January 1st.

Stock Recruitment

Expected recruitment is calculated from the Beverton-Holt stock recruitment relationship, reparametrized by Mace and Doonan (1988), with annual lognormal deviations as:

$$\hat{R}_{y+1} = \frac{\alpha SSB_y}{\beta + SSB_y} + e^{\delta_{y+1}} \quad [19]$$

$$\alpha = \frac{4\tau(SSB_0/SPR_0)}{5\tau-1} \quad \text{and} \quad \beta = \frac{SSB_0(1-\tau)}{5\tau-1}$$

where SSB_0 is unexploited female spawning stock biomass, SPR_0 is unexploited female spawning stock biomass per recruit, τ is steepness, and $e^{\delta_{y+1}}$ are annual lognormal recruitment deviations.

Expected Catch

Expected fishery catches are estimated from the Baranov catch equation as:

$$\hat{C}_{ayf} = N_{ay} F_{ayf} \frac{(1 - e^{-Z_{ay}})}{Z_{ay}} \quad [20]$$

Expected fishery age compositions are then calculated from $\frac{\hat{C}_{ayf}}{\sum_a \hat{C}_{ayf}}$. Expected fishery yields are computed as $\sum_a \hat{C}_{ayf} \bar{W}_{ayf}$, where $\bar{W}_{ayf}$ are observed mean catch weights.

Survey Catch-rates

Expected annual survey catch-rates of age-1 female southern flounder catches of the trawl survey are computed from:

$$\hat{I}_{a=1,y} = q N_{a=1,y} (1 - e^{-Z_{a=1,y}(0)}) \quad [21]$$

where q is the estimated catchability coefficient of the marine trawl survey, and $-Z_{a=1,y}(0)$ is the proportion of the total mortality occurring on age-1 individuals prior to the time of the survey (January 1st).

Expected annual survey catch-rates of female southern flounder catches of the trammel net survey are computed from:

$$\hat{I}_{ay} = q \sum_a N_{ay} (1 - e^{-Z_{ay}(0)}) v_a \quad [22]$$

where v_a is the survey selectivity, q is the estimated catchability coefficient of the trammel net survey, and $-Z_{ay}(0)$ is the proportion of the total mortality occurring prior to the time of the survey (January 1st). Survey selectivity is modeled with a double logistic function (Equation [12]). Expected survey age composition is then calculated from $\frac{\hat{I}_{ay}}{\sum_a \hat{I}_{ay}}$.

Parameter Estimation

The number of parameters estimated is dependent on the length of the time-series, number of fleets and selectivity blocks modeled, and number of tuning indices modeled. Parameters are estimated in log-space and then back transformed. In this assessment, 131 parameters are estimated:

1. 14 selectivity parameters (2 commercial selectivity blocks with 4 parameters per block, 1 recreational block with two parameters, and 1 survey selectivity block with 4 parameters).
2. 74 apical fishing mortality rates (F_{mult} in the initial year and 36 deviations in subsequent years for 2 fleets)
3. 37 recruitment deviations (1982-2018)
4. 3 initial population abundance deviations (age-2 through 4-plus)
5. 2 survey catchability coefficients
6. 1 stock-recruitment parameter (unexploited SSB)

The model is fit to the data by minimizing the objective function:

$$-\ln(L) = \sum_i \lambda_i (-\ln L_i) + \sum_j (-\ln L_j) \quad [23]$$

where $-\ln(L)$ is the entire negative log-likelihood, $\ln L_i$ are log-likelihoods of lognormal estimations, λ_i are user-defined weights applied to lognormal estimations, and $\ln L_j$ are log-likelihoods of multinomial estimations.

Negative log-likelihoods with assumed lognormal error are derived (ignoring constants) as:

$$-\ln(L_i) = 0.5 \sum_i \frac{[\ln(obs_i) - \ln(pred_i)]^2}{\sigma^2} \quad [24]$$

where obs_i and $pred_i$ are observed and predicted values; standard deviations σ are user-defined CVs as $\sqrt{\ln(CV^2 + 1)}$.

Negative log-likelihoods with assumed multinomial error are derived (ignoring constants) as:

$$-\ln(L_j) = -ESS \sum_{i=1}^A p_i \ln(\hat{p}_i) \quad [25]$$

where p_i and $\hat{p}_i$ are observed and predicted age compositions. Effective sample-sizes ESS are used to create the expected numbers $\hat{n}_a$ in each age bin and act as multinomial weighting factors.

6.2 Model Assumptions/Inputs

Model assumptions include: 1) the unit stock is adequately defined and closed to migration, 2) observations are unbiased, 3) errors are independent and their structures are adequately specified, 4) fishery vulnerabilities are dome-shaped, 5) abundance indices are proportional to absolute abundance, and 6) natural mortality, fecundity, and growth do not vary significantly with time. Lognormal error is assumed for catches, abundance indices, the stock-recruitment relationship, apical fishing mortality, selectivity parameters, initial abundance deviations, and catchability. Multinomial error is assumed for fishery and survey age compositions.

A base model was defined with an age-4 plus group, the steepness parameter fixed at 1.0, two commercial fishery selectivity blocks, one recreational selectivity block, and input levels of error and weighting factors as described below.

For the commercial fleet, two selectivity blocks are modeled that correspond to the following time-periods of consistent regulation: 1) 1982-1995 (no regulations), 2) 1996-2018 (entanglement nets banned). Within the recreational fleet, only one selectivity block is modeled due to no major regulation changes over the time-period modeled.

Input levels of error for commercial fishery landings were specified with CV's of 0.1 for years where landings were obtained from NMFS commercial records (1982-1998) and CV's of 0.05 for years where landings were obtained from the LDWF Trip Ticket Program (1999-2018; Table 10). Input levels of error for recreational fishery landings estimates were specified with the corresponding CV's estimated from the LDWF LA Creel survey (2014-2018) and estimates hindcast to the historic MRIP time-series (1982-2013; Table 11). Input levels of error for survey catch-rates were specified with CV's of 0.2 for all years of each time-series. Annual recruitment deviations were specified with CV's of 0.4 for all years of the time-series. To allow reasonable estimates of population size in the first year of the time-series (*i.e.*, $SSB_{1982} < SSB_0$), the initial population abundance deviations were constrained with a CV of 0.1 to estimates from an exponential decline.

Lognormal components included in the objective function were equally weighted (all lambdas=1). Input effective sample sizes (ESS) for estimation of fishery age compositions were specified with ESS=50 for years where annual ALKs were available (2002-2018) and down weighted to ESS=10 for prior years. Input effective sample sizes (ESS) for estimation of survey age compositions were specified equally for all years of the time-series (all ESS=10).

6.3 Model Results

Objective function components, weighting factors, and likelihood values of the base model are summarized in Table 15.

Model Fit

The base model provides an overall reasonable fit to the data. Fits to the commercial and recreational landings are adequate, but are generally underestimated in the first half of each time-series and overestimated in the later half (Figures 3 and 4). Model estimated survey catch-rates provide reasonable fits to the data with little patterning observed in the residuals (Figures 5 and 6). Model estimated fishery and survey age compositions provide reasonable fits to the input age proportions (Figures 7-9).

Selectivities

Estimated fishery and survey selectivities are presented in Figure 10. Fishery estimates indicate full-vulnerability to the commercial fishery at age-4 during the 1982-1995 regulation block and age-3 for the 1996-2018 regulation blocks. Recreational estimates indicate full-vulnerability to the fishery at age-2 with over 97% vulnerability at age-1. Survey estimates indicate full vulnerability to the trammel net gear at age-1.

Abundance, Spawning Stock, and Recruitment

Total female stock size and abundance-at-age estimates are presented in Table 16. Female stock numbers have varied over the time-series with an overall downward trend. From 1982 through 1998 stock size remained relatively flat (mean of 2.2 million female fish). Stock size declined after 1998 from 1.8 million females in 1999 to 1.0 million females in 2001. Stock size increased after 2001 to a peak of 1.7 female fish in 2004 and remained relatively flat through 2011 (mean of 1.5 million female fish). Stock size began to decrease after 2011 to an all-time low of 0.3 million females in 2018.

Female spawning stock biomass (SSB) estimates are presented in Figure 12. As with (and related to) female stock size, female SSB has varied over the time-series with an overall downward trend. Female SSB remained above 1 million pounds from the beginning of the time-series through 2000 (mean of 1.4 million pounds). Female SSB began to decline after 2000 to a low of 0.7 million pounds in 2002. After 2002, female SSB increased to a peak of 1.3 million pounds in 2009. Female SSB began another decline in 2010 to a record low of 0.3 million pounds estimated in 2018.

Female age-1 recruitment has also varied over the time-series with an overall downward trend (Figure 11). The trend in female recruitment was relatively flat from the beginning of time-series until 1996. After 1996, female recruitment began to decline to a low of 0.7 million females estimated in 2001. Female recruitment increased after 2001 to a peak of 1.2 million females estimated in 2005. Female recruitment began another decline after 2005 to all-time lows estimated in 2017 and 2018 (0.2 and 0.1 million females respectively). Mean (geometric) recruitment of the entire time-series is 0.9 million females. Mean recruitment in the first and most recent decades of the time-series are 1.4 and 0.5 million females respectively. It's important to point out here the consequence of this decline on management reference point estimation. Because equilibrium conditions (i.e., average recruitment) are assumed in reference point estimation (see *6.4 Management Benchmarks*), management benchmarks will generally be biased when below average conditions persist for extended time periods.

Fishing Mortality

Estimated fishing mortality rates are presented in Table 17 (total apical, average, and age-specific) and Figure 13 (average only). Average rates are weighted by estimated stock numbers-at-age. Fishing mortality rates have varied over the time-series with an upward trend in the most recent decade. Fishing mortality generally increased from the beginning of the time-series through 1994. After commercial gear restrictions were enacted in 1995, fishing mortality decreased to a low of 0.14 yr⁻¹ estimated in 1998. Fishing mortality began to increase after 1998, concurrent with the decline in female age-1 recruitment, to a peak of 0.50 yr⁻¹ estimated in 2001. Fishing mortality decreased again following 2001 to an all-time low of 0.13 yr⁻¹ estimated in 2008. After 2008, fishing mortality generally increased to record peaks of 0.74 yr⁻¹ and 0.59 yr⁻¹ estimated in 2013 and 2016. The 2018 average fishing mortality rate estimate is 0.44 yr⁻¹.

Stock-Recruitment

A downward relationship is observed between female SSB and subsequent age-1 female recruitment (Figure 14). The most recent data pairs are the lowest on record. The ASAP base model was run with steepness fixed at 1.0. The estimated unexploited female recruitment and unexploited female SSB was 0.9 million females and 2.1 million pounds. Alternate model runs with steepness values fixed at 0.9, 0.8, and 0.7 are discussed in the *Model Diagnostics* Section below.

Parameter Uncertainty

In the ASAP base model, 131 parameters were estimated. Asymptotic standard errors for the age-1 female recruitment time-series are presented in Figure 11. Markov Chain Monte Carlo (MCMC) derived 95% confidence intervals (CI) for the median female SSB and average fishing mortality rate time-series are presented in Figures 12 and 13.

6.4 Management Benchmarks

There are currently no management thresholds established for the Louisiana southern flounder stock and no biological basis to establish limits based on the history of the stock. Until biologically based thresholds are established, a default precautionary limit of a 20% spawning potential ratio (SPR; Goodyear 1993) is proposed. The method for calculating the SPR_{limit} and the corresponding spawning stock biomass and fishing mortality rate limit reference points is presented below.

When the stock is in equilibrium, equation [18] can be solved, excluding the year index, for any given exploitation rate as:

$$\frac{SSB}{R}(F) = \sum_{i=1}^A N_a W_{SSB,a} p_{mat,a} e^{-Z_a(0,0)} [26]$$

where total mortality-at-age Z_a is computed as $M_a + v_a \times F_{mult}$; fishery vulnerability at age v_a is calculated by rescaling the current F-at-age estimate (geometric mean 2016-2018) to the maximum. Per recruit abundance-at-age is estimated as $N_a = S_a$, where survivorship at age is calculated recursively from $S_a = S_{a-1}e^{-Z_a}$, $S_1 = 1$. Per recruit catch-at-age is then calculated with the Baranov catch equation [20], excluding the year index. Yield per recruit (Y/R) is calculated as $\sum_a C_a \bar{W}_a$ where $\bar{W}_a$ are current mean fishery weights-at-age (arithmetic mean 2016-2018). Fishing mortality is averaged by weighting by relative numbers at age.

Equilibrium spawning stock biomass SSB_{eq} is calculated by substituting SSB/R estimated from Equation [24] into the Beverton-Holt stock recruitment relationship as $\alpha \times SSB/R - \beta$. Equilibrium recruitment R_{eq} and yield Y_{eq} are then taken as $SSB_{eq} \div SSB/R$ and $Y/R \times R_{eq}$. Equilibrium SPR (e.g., SPR_{limit}) is then computed as the ratio of SSB/R when $F > 0$ to SSB/R when $F = 0$.

As reference points to guide management, we estimate the equilibrium female spawning stock biomass and average fishing mortality rate that lead to a 20% SPR (SPR_{limit} , SSB_{limit} , and F_{limit}). Management targets for southern flounder were established by LAC 76: VII.385. The biomass target (SSB_{target}) is calculated as the average SSB (geometric mean) from the beginning of the assessed period through 2013. The average fishing mortality rate target (F_{target}) that corresponds to SSB_{target} when the stock is in equilibrium is then estimated from Equation [24].

The proposed limits and established targets of fishing are presented in Figure 15 relative to each time-series. Limit and target reference points are also presented in Table 18. Current estimates are taken as the geometric mean of the 2016-2018 estimates.

Also presented are a plot of the stock-recruitment data, equilibrium recruitment, and diagonals from the origin intersecting R_{eq} at the SSB_{target} , and the minimum and maximum SSB estimates of the time-series, corresponding with a SPR_{target} of 55%, and a minimum and maximum SPR of 14% and 82% (Figure 16).

6.5 Model Diagnostics

Sensitivity Analysis

In addition to the base model run, a series of sensitivity runs were used to explore uncertainty in the base model's configuration.

The ASAP base model was run with steepness fixed at 1.0. Alternate runs were conducted examining reference point estimates with steepness fixed at 0.9, 0.8, and 0.70 (Models 1-3).

Additional sensitivity runs were conducted by separately up-weighting the contributions of fishery yield and the IOA components within the base models objective function (lambdas increased from 1 to 10; Models 4 and 5).

Additional sensitivity runs were conducted using the maturity-at-age vector from the previous LDWF southern flounder stock assessment (Model 6) and only using the age-1 IOA developed from the marine inshore trawl survey as a data input of the assessment model (Model 7).

Another sensitivity run was conducted by increasing the discard mortality rate from 10% to 20% (Model 8).

An additional sensitivity run was conducted where the ALK developed from the von Bertalanffy growth model (Table 7) was used to assign ages to the entire time-series of fishery landings (Model 9).

Another sensitivity run was conducted using the MRIP ACAL time-series (see <https://www.fisheries.noaa.gov/recreational-fishing-data/recreational-fishing-data-glossary#calibrated-data>), rather than the FCAL time-series, to hindcast LA Creel estimates to the historic MRIP time-series (Model 10). This time-series was developed using the same approach described in *Appendix 1* with the ACAL estimates substituted for the FCAL estimates.

A final sensitivity run was conducted using the MRIP size distributions with the FES and APAIS calibrations applied (Model 11).

Results of each sensitivity run relative to the proposed limit reference points are presented in Table 19. Current estimates of female SSB and average F are taken as the geometric mean of the 2016-2018 estimates. Estimates from all sensitivity runs with the exceptions of Models 3, 4, 7, and 9 indicate the stock is currently below SSB_{limit} . All sensitivity runs with the exception of Model 5 indicate the fishery is currently operating below F_{limit} .

Also presented are estimates of maximum sustainable yield (MSY) and associated reference points for those sensitivity runs with the steepness parameter not fixed at 1 (Table 20). Results of the run with steepness fixed at 0.9 indicate that the fishery is currently operating under MSY and the stock is above SSB_{MSY} , where ratios of current F and SSB to F_{MSY} and SSB_{MSY} are below and above 1 respectively. Results of the run with steepness fixed at 0.8 indicate the fishery is currently operating under MSY but the stock is below SSB_{MSY} . The final run with steepness fixed at 0.7 indicates the fishery is operating above MSY and the stock is below SSB_{MSY} .

Retrospective Analysis

A retrospective analysis is conducted by sequentially truncating the base model by a year (terminal years 2015-2018). Retrospective estimates differed only marginally from the base run (Figure 17). Retrospective estimates of age-1 recruits and female SSB tend to decrease as additional years are added to the model. Retrospective estimates of the average fishing mortality rate tend to increase as additional years are modeled.

7. Stock Status

The history of the LA southern flounder stock relative to F/F_{limit} and SSB/SSB_{limit} is presented in Figure 18. Fishing mortality rates exceeding F_{limit} ($F/F_{\text{limit}} > 1.0$) are defined as overfishing; spawning stock sizes below SSB_{limit} ($SSB/SSB_{\text{limit}} < 1.0$) are defined as the overfished condition.

Overfishing Status

The current estimate of F/F_{limit} is < 1.0 (0.50), indicating the stock is not currently undergoing overfishing. The current assessment model also indicates that no overfishing occurred during the time-series examined.

Overfished Status

The current estimate of SSB/SSB_{limit} is < 1.0 (0.94), indicating the stock is currently in an overfished state. The current SPR estimate is 19%.

Control Rules

There is currently no harvest control rule established for the LA southern flounder stock.

8. Research and Data Needs

As with any analysis, the accuracy of this assessment is dependent on the accuracy of the information of which it is based. Below we list recommendations to improve future stock assessments of southern flounder in Louisiana.

Factors that influence year-class strength of southern flounder are poorly understood. Investigation of these factors, including inter-annual variation in seasonal factors and the influence of environmental perturbations such as the Deepwater Horizon oil spill, should be a priority moving forward given the rapid decline observed in female age-1 recruitment and spawning stock biomass.

Fishery-dependent data alone is not a reliable source of information to assess status of a fish stock. Consistent fishery-dependent and fishery-independent data sources, in a comprehensive monitoring plan, are essential to understanding the status of fishery. Present monitoring programs should be assessed for adequacy with respect to their ability to evaluate stock status, and modified if deemed necessary.

Only limited catches of southern flounder occur in LDWF FI surveys. Expanding the LDWF FI surveys to a gear more effective in capturing adult southern flounder would allow an additional index of abundance in future modeling efforts that could help better characterize spawning stock size and also provide auxiliary life-history information.

The Southeast Area Monitoring and Assessment Program (SEAMAP) conducts fishery-independent monitoring surveys in the GOM. These surveys may provide useful information on adult southern flounder abundance in nearshore waters. Future efforts should explore these datasets and assess their potential for use in future stock assessments.

The GSMFC (2015) reviewed commercial and recreational GOM flatfish landings and came to the conclusion that landings were not adequately separated between Gulf and Southern flounder to be able to assess the stocks on a gulf-wide basis. In Louisiana, gulf flounder are an uncommon species, but broad flounder inhabit the nearshore and offshore areas of the state to some degree. Better definition of the distribution and harvest of southern flounder congeners will help better refine both fishery-independent and fishery-dependent inputs into future assessments.

Because existing and historic creel surveys have not sampled night fishing activities, recreational flounder harvest from gigging or bow fishing is not well-characterized. A specific survey to capture information on the scale of recreational flounder harvest that occurs at night could help improve the understanding of and the significance of those fisheries (note: commercial harvest of southern flounder from gigging is collected through the LDWF Trip Ticket Program).

The relationship between wetlands losses and the continuation of fishery production within Louisiana has been discussed by numerous authors. Understanding this relationship as it applies to the LA Southern Flounder stock should be an ongoing priority.

Female spawning stock biomass is used as a proxy of total egg production in this assessment. Spawning potential ratio estimates may be biased if egg production does not scale linearly with female body weight. Estimates of batch fecundity and spawning frequency as a function of age/size are needed.

With the recent trend toward ecosystem-based assessment models (Mace 2000; NMFS 2001), more data is needed linking southern flounder population dynamics to environmental conditions. The addition of meteorological and physical oceanographic data coupled with food web data may lead to a better understanding of the southern flounder stock and its habitat.

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10. Tables

Table 1: Louisiana annual commercial and recreational southern flounder landings (pounds x 10⁶; harvest only) derived from NMFS statistical records, LDWF Trip Ticket Program, MRIP, and LA Creel.

Year	Harvest		%Commercial	%Recreational
	Commercial	Recreational		
1992	0.200	0.400	33.3%	66.7%
1993	0.276	0.997	21.7%	78.3%
1994	0.353	0.132	72.9%	27.1%
1995	0.530	0.261	67.0%	33.0%
1996	0.625	0.614	57.3%	42.7%
1997	0.938	0.053	91.9%	8.1%
1998	0.510	0.058	89.8%	10.2%
1999	0.492	0.193	71.8%	28.2%
1990	0.456	0.427	51.6%	48.4%
1991	0.692	0.443	61.0%	39.0%
1992	0.785	0.356	68.8%	31.2%
1993	0.699	0.270	76.9%	23.1%
1994	0.975	0.346	73.8%	26.2%
1995	0.533	0.204	72.3%	27.7%
1996	0.062	0.260	19.2%	80.8%
1997	0.095	0.276	25.6%	74.4%
1998	0.140	0.227	38.1%	61.9%
1999	0.141	0.510	21.7%	78.3%
2000	0.177	0.425	29.5%	70.5%
2001	0.092	0.325	22.0%	78.0%
2002	0.082	0.250	24.7%	75.3%
2003	0.064	0.300	17.5%	82.5%
2004	0.074	0.229	24.3%	75.7%
2005	0.022	0.186	10.4%	89.6%
2006	0.064	0.203	29.2%	70.8%
2007	0.079	0.235	25.1%	74.9%
2008	0.078	0.172	31.2%	68.8%
2009	0.132	0.274	32.5%	67.5%
2010	0.061	0.297	21.5%	78.5%
2011	0.154	0.348	30.7%	69.3%
2012	0.097	0.292	25.0%	75.0%
2013	0.089	0.624	12.5%	87.5%
2014	0.066	0.270	19.7%	80.3%
2015	0.063	0.263	19.3%	80.7%
2016	0.065	0.304	17.6%	82.4%
2017	0.047	0.148	24.2%	75.8%
2018	0.063	0.090	41.1%	58.9%

Table 2: Annual size composition samples of Louisiana commercial southern flounder landings derived from the Trip Interview Program (TIPS; 1981-1992), the Fishery Information Network (FIN; 2002-2013), and the LDWF Biological Sampling Program (2014-2018). Cumulative size distributions are presented for years where only limited size composition data were available.

TL in	Commercial, 1982-2018																					
	1982-1993	1994	1995	1996	1997-2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
6								1	1			2	2									
7								6		2		5	5									
8					1	1	2															
9	7	6	3	3	15	15	10	41	2	17	16	28	12	16	24	9	8	1				
10	3	2	13	15	39	37	26	75	5	25	24	52	27	35	40	5	2				1	1
11	18	17	43	48	85	76	63	76	5	25	12	94	77	120	135	15	2	2	1	1	1	1
12	38	26	42	52	75	59	65	45	35	32	17	68	20	55	83	29	8	13	10	9	12	12
13	115	67	106	117	68	41	43	51	79	64	35	77	3	8	29	26	34	91	71	41	54	54
14	133	97	196	219	84	49	80	67	37	74	45	94	7	17	24	20	45	176	136	60	74	74
15	158	132	222	242	68	41	56	56	25	56	65	113	11	3	15	52	72	152	89	43	59	59
16	113	98	138	151	50	37	33	33	10	47	39	81	16	1	11	29	47	109	65	30	43	43
17	76	66	74	84	46	34	32	14	21	29	30	47	12	1	11	29	35	74	41	26	32	32
18	54	49	35	40	63	54	11	7	6	12	14	24	10	1	4	7	22	46	26	21	26	26
19	41	37	19	21	66	64	1	2	1	15	5	18	13			5	17	24	7	6	10	10
20	17	17	21	22	26	25	3	1	4	12	2	11	9			2	4	7	3	9	11	11
21	9	9	8	11	9	6		1	1	3		4	4					1	1			
22	11	9	2	3	3	2	2			1	2	4	2			1	2	3	1	2	2	2
23	8	6		2	10	8	1					1	1					1	1	2	2	2
24	3	1	1	1	1	1														1	1	1
25	2	2																				
26	1	1																				
27																						
Totals	807	642	923	1031	709	550	428	476	232	414	306	723	231	257	376	229	298	700	452	251	328	328

Table 3: Annual size frequency distributions of Louisiana recreational southern flounder harvest taken from MRIP (1982-2013) and the LDWF Biological Sampling Program (2014-2018).

Recreational, 1982-2018																			
TL in	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
4																			
5	0.004						0.004			0.006								0.003	
6	0.006	0.004																	
7	0.030	0.015			0.001	0.007			0.007			0.003	0.003	0.018				0.003	
8	0.108	0.010	0.026		0.009		0.006	0.006	0.007	0.004	0.007	0.010	0.007	0.019	0.004	0.012			0.016
9	0.137	0.013	0.003	0.033	0.019	0.021	0.015	0.003	0.038	0.031	0.038	0.025	0.020	0.053	0.017	0.036	0.021		0.004
10	0.057	0.017	0.018	0.057	0.075	0.102	0.021	0.008	0.112	0.069	0.055	0.057	0.048	0.140	0.046	0.056	0.060	0.039	0.036
11	0.125	0.046	0.043	0.033	0.174	0.170	0.100	0.129	0.185	0.119	0.103	0.108	0.084	0.087	0.088	0.077	0.124	0.093	0.042
12	0.151	0.020	0.279	0.110	0.233	0.248	0.132	0.066	0.114	0.159	0.139	0.159	0.139	0.170	0.186	0.158	0.183	0.143	0.152
13	0.077	0.180	0.073	0.168	0.092	0.092	0.151	0.108	0.099	0.166	0.109	0.132	0.234	0.096	0.153	0.165	0.196	0.203	0.130
14	0.057	0.008	0.222	0.201	0.220	0.122	0.187	0.201	0.176	0.184	0.138	0.129	0.157	0.069	0.153	0.204	0.169	0.156	0.162
15	0.090	0.337	0.170	0.256	0.085	0.093	0.139	0.157	0.158	0.118	0.176	0.112	0.121	0.130	0.137	0.081	0.109	0.140	0.177
16	0.061	0.169	0.078	0.024	0.063	0.072	0.114	0.101	0.069	0.060	0.101	0.117	0.090	0.103	0.073	0.093	0.051	0.101	0.089
17	0.011	0.006		0.070	0.020	0.038	0.053	0.092	0.052	0.041	0.047	0.087	0.061	0.044	0.046	0.066	0.053	0.057	0.110
18	0.043	0.176	0.083	0.018	0.006	0.028	0.043	0.040	0.024	0.011	0.045	0.048	0.034	0.037	0.044	0.025	0.019	0.043	0.042
19	0.011		0.006	0.014	0.001	0.000	0.039	0.020		0.016	0.019	0.009	0.003	0.017	0.026	0.016	0.006	0.017	0.027
20	0.013			0.007	0.002		0.035		0.007	0.010	0.012		0.010		0.011	0.004	0.004	0.003	
21	0.016			0.006	0.000		0.003	0.008	0.012	0.006	0.009		0.003	0.001	0.012	0.007			0.009
22	0.003			0.003	0.000						0.000	0.004	0.003	0.005			0.003		0.007
23							0.001												
24																			
25																0.001			
26																			
27																			

TL in	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
4																		
5																		
6																		
7			0.003									0.002		0.000				0.007
8	0.010	0.020	0.006	0.006			0.008	0.008	0.023	0.001	0.008	0.013	0.001	0.002	0.005	0.004		0.026
9		0.037	0.026	0.036	0.002		0.009	0.042	0.013	0.003	0.026	0.006	0.008	0.009	0.037	0.008	0.006	0.033
10	0.020	0.138	0.075	0.099	0.016	0.031	0.027	0.026	0.038	0.041	0.076	0.071	0.016	0.047	0.103	0.019	0.029	0.067
11	0.049	0.102	0.093	0.103	0.162	0.070	0.175	0.072	0.055	0.081	0.089	0.067	0.047	0.098	0.191	0.109	0.069	0.110
12	0.105	0.114	0.160	0.147	0.177	0.175	0.140	0.192	0.142	0.159	0.108	0.100	0.071	0.197	0.162	0.198	0.127	0.133
13	0.119	0.103	0.225	0.170	0.155	0.173	0.127	0.137	0.162	0.173	0.154	0.228	0.091	0.178	0.231	0.240	0.223	0.143
14	0.220	0.151	0.155	0.164	0.213	0.170	0.173	0.149	0.150	0.179	0.144	0.108	0.186	0.157	0.108	0.188	0.259	0.231
15	0.160	0.174	0.114	0.125	0.113	0.149	0.148	0.160	0.152	0.182	0.128	0.114	0.229	0.098	0.070	0.096	0.170	0.116
16	0.129	0.100	0.086	0.084	0.098	0.128	0.063	0.064	0.188	0.073	0.124	0.113	0.202	0.131	0.048	0.076	0.054	0.053
17	0.095	0.043	0.018	0.029	0.042	0.052	0.073	0.073	0.081	0.045	0.090	0.093	0.081	0.053	0.013	0.035	0.043	0.036
18	0.057	0.014	0.020	0.014	0.007	0.021	0.028	0.047	0.021	0.038	0.023	0.045	0.048	0.024	0.000	0.013	0.006	0.026
19	0.007	0.004	0.003	0.016	0.001	0.020	0.028	0.012	0.017	0.021	0.014	0.027	0.020	0.001	0.004	0.011	0.012	
20	0.035		0.011	0.001		0.008	0.000	0.005	0.004	0.004	0.001	0.015		0.003	0.008	0.004		0.019
21	0.005		0.004	0.007	0.006		0.004	0.008			0.004	0.000			0.000	0.000	0.000	
22						0.009		0.010	0.018		0.012	0.000						
23					0.007	0.001							0.001					
24																		
25																		
26																		
27																		

Table 4: Southern flounder proportion female-at-size. Top Table depicts LDWF biological samples from the commercial and recreational fisheries combined (2002-2018), the observed and expected proportion of female southern flounder-at-size, and the corresponding logistic function parameter estimates and standard errors. Shaded cells represent size bins excluded from model fitting ($n_{\text{total}} < 10$). Lower Tables depict the annual proportion female-at-size for the commercial and recreational fisheries. The 1982-2001 proportions are expected values; the 2002-2018 proportions are observations but with expected values substituted where $n_{\text{total}} < 10$ for that size/year bin.

Slope	0.516	(0.0527)		
TL 50%	9.63	(0.223)		
TL, in	n female	n total	obs. p. fem	exp. p. fem
6	1	1	—	0.50
7	2	8	—	0.50
8	31	66	0.47	0.50
9	140	316	0.44	0.50
10	486	918	0.53	0.61
11	1069	1645	0.64	0.72
12	2018	2326	0.87	0.81
13	2528	2673	0.95	0.88
14	2745	2825	0.97	0.93
15	2195	2234	0.98	0.95
16	1526	1548	0.99	0.97
17	977	990	0.99	0.98
18	545	555	0.98	0.99
19	277	278	1.00	0.99
20	171	171	1.00	1.00
21	61	62	0.98	1.00
22	32	32	1.00	1.00
23	23	23	1.00	1.00
24	4	4	—	1.00
25	1	1	—	1.00
26	1	1	—	1.00

TL, in/Year	Commercial																	
	1982-2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
5	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
6	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
7	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
8	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
9	0.50	0.53	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
10	0.61	0.50	0.57	0.50	0.61	0.50	0.50	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61
11	0.72	0.50	0.58	0.56	0.72	0.50	0.73	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72
12	0.81	0.82	0.82	0.93	0.80	0.81	0.88	0.87	0.81	0.50	0.50	0.81	0.81	0.81	0.80	0.81	0.81	0.81
13	0.88	0.88	0.88	0.91	0.96	0.97	0.94	0.92	0.88	0.88	0.88	0.88	0.88	0.93	0.86	0.93	0.87	0.88
14	0.93	0.89	0.92	0.98	1.00	0.97	1.00	1.00	0.93	1.00	0.93	0.93	0.92	0.96	0.99	0.98	0.85	0.93
15	0.95	0.97	0.91	0.98	1.00	1.00	1.00	1.00	1.00	0.95	0.95	0.95	1.00	0.95	1.00	1.00	0.93	0.95
16	0.97	0.94	0.97	1.00	1.00	1.00	1.00	1.00	1.00	0.97	0.97	0.97	1.00	1.00	1.00	1.00	1.00	0.97
17	0.98	0.86	0.88	1.00	1.00	1.00	1.00	0.98	1.00	0.98	0.98	0.98	1.00	1.00	0.98	1.00	0.98	0.98
18	0.99	1.00	0.73	0.99	0.99	1.00	1.00	0.99	1.00	0.99	0.99	0.99	0.99	1.00	1.00	1.00	0.99	0.99
19	0.99	1.00	0.99	0.99	0.99	1.00	0.99	0.99	1.00	0.99	0.99	0.99	0.99	1.00	0.99	0.99	0.99	0.99
20+	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

TL, in/Year	Recreational																	
	1982-2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
5	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
6	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
7	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
8	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
9	0.50	0.52	0.66	0.57	0.60	0.64	0.69	0.54	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
10	0.61	0.63	0.70	0.70	0.72	0.63	0.67	0.62	0.60	0.79	0.55	0.55	0.59	0.57	0.66	0.50	0.61	0.50
11	0.72	0.66	0.78	0.75	0.81	0.85	0.59	0.77	0.84	0.65	0.68	0.80	0.86	0.74	0.82	0.55	0.50	0.50
12	0.81	0.89	0.91	0.97	0.91	0.96	0.88	0.95	0.89	0.94	0.90	0.90	0.80	0.53	0.91	0.85	0.78	0.71
13	0.88	0.95	0.98	0.99	0.98	0.99	0.97	0.96	0.87	0.98	0.97	0.96	0.97	0.61	0.91	0.92	0.90	0.80
14	0.93	0.98	0.96	0.99	0.99	0.99	0.98	0.97	0.98	1.00	1.00	0.93	0.92	0.80	0.93	0.96	0.97	1.00
15	0.95	0.99	0.98	0.99	0.95	0.99	0.98	1.00	1.00	0.99	0.98	0.89	0.97	0.98	0.97	0.99	0.97	0.96
16	0.97	0.95	0.98	0.98	0.99	1.00	1.00	1.00	0.99	1.00	0.98	0.97	0.97	0.98	0.95	0.98	1.00	1.00
17	0.98	0.98	0.98	0.98	1.00	1.00	1.00	0.98	1.00	1.00	1.00	1.00	1.00	1.00	0.86	1.00	1.00	1.00
18	0.99	0.93	1.00	1.00	1.00	1.00	1.00	0.95	1.00	0.99	0.95	1.00	0.94	1.00	0.85	1.00	1.00	1.00
19	0.99	1.00	1.00	0.99	1.00	1.00	1.00	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	1.00	0.99	0.99
20+	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Table 5: FAO proposed guideline for indices of productivity for exploited fish species.

Parameter	Productivity			Species	Score
	Low	Medium	High	Southern Flounder	
<i>M</i>	<0.2	0.2 - 0.5	>0.5	0.53	3
<i>K</i>	<0.15	0.15 - 0.33	>0.33	0.44	3
<i>t_{mat}</i>	>8	3.3 - 8	<3.3	3	3
<i>t_{max}</i>	>25	14 - 25	<14	8	3
Examples	orange roughy, many sharks	cod, hake	sardine, anchovy	Southern Flounder Productivity Score = 3.0 (high)	

Table 6: Annual sample sizes, percent positive samples, nominal CPUEs, standardized indices of abundance, and corresponding coefficients of variation derived from the LDWF fishery-independent marine trawl and trammel net surveys. Nominal CPUEs and standardized indices of abundance have been normalized to their individual long-term means for comparison.

Year	Trawl					Year	Trammel				
	<i>n</i>	%Pos	CPUE	IOA	CV		<i>n</i>	%Pos	CPUE	IOA	CV
1981	363	15%	1.92	1.93	0.41	1981	---	---	---	---	---
1982	459	15%	1.83	1.91	0.40	1982	---	---	---	---	---
1983	489	12%	1.04	1.19	0.41	1983	---	---	---	---	---
1984	475	5%	0.52	0.56	0.48	1984	---	---	---	---	---
1985	530	8%	0.59	0.64	0.44	1985	---	---	---	---	---
1986	447	14%	1.40	1.53	0.40	1986	85	26%	1.01	2.10	0.39
1987	556	10%	0.83	0.87	0.42	1987	86	20%	0.59	0.99	0.43
1988	542	9%	1.17	0.93	0.43	1988	76	18%	0.91	1.08	0.46
1989	535	12%	1.91	1.54	0.41	1989	97	12%	0.73	0.63	0.48
1990	600	13%	2.35	1.46	0.40	1990	94	14%	0.98	0.90	0.47
1991	580	5%	0.40	0.43	0.46	1991	99	20%	1.49	1.70	0.43
1992	547	9%	0.74	0.77	0.43	1992	107	16%	0.68	0.80	0.44
1993	579	12%	1.07	1.14	0.41	1993	109	23%	0.99	1.76	0.39
1994	564	8%	0.92	0.83	0.43	1994	112	26%	0.93	1.90	0.37
1995	604	13%	1.16	1.27	0.40	1995	106	26%	0.94	1.90	0.37
1996	628	15%	1.32	1.43	0.38	1996	108	19%	1.01	1.45	0.41
1997	657	12%	1.32	1.34	0.40	1997	111	16%	0.89	1.17	0.44
1998	642	8%	0.70	0.77	0.42	1998	111	19%	0.95	1.36	0.42
1999	655	8%	0.59	0.64	0.43	1999	106	17%	0.95	1.21	0.43
2000	647	4%	0.33	0.34	0.48	2000	98	12%	0.98	0.90	0.49
2001	636	9%	1.50	1.01	0.42	2001	108	11%	1.18	0.89	0.49
2002	640	11%	1.19	1.18	0.41	2002	107	9%	1.34	0.62	0.51
2003	644	15%	1.75	1.69	0.39	2003	111	14%	1.18	1.06	0.46
2004	638	8%	0.98	0.76	0.42	2004	111	13%	1.34	1.25	0.47
2005	590	12%	1.24	1.24	0.40	2005	104	16%	1.27	1.25	0.44
2006	648	10%	0.80	0.90	0.41	2006	106	10%	1.22	0.95	0.50
2007	626	12%	0.96	1.08	0.40	2007	115	14%	0.82	0.83	0.45
2008	672	9%	0.80	0.93	0.42	2008	111	14%	1.07	0.96	0.46
2009	661	10%	0.90	0.91	0.41	2009	111	11%	0.80	0.67	0.49
2010	588	12%	0.96	1.08	0.40	2010	242	16%	1.18	1.11	0.40
2011	557	16%	1.51	1.77	0.38	2011	271	12%	1.00	0.70	0.41
2012	580	8%	0.57	0.68	0.44	2012	266	11%	0.95	0.67	0.42
2013	478	3%	0.23	0.26	0.54	2013	137	7%	0.84	0.40	0.52
2014	298	11%	1.17	1.33	0.44	2014	135	12%	0.76	0.64	0.46
2015	279	9%	0.62	0.76	0.47	2015	135	8%	1.36	0.57	0.50
2016	285	2%	0.13	0.15	0.74	2016	135	7%	0.67	0.33	0.52
2017	297	1%	0.04	0.05	1.06	2017	135	1%	0.75	0.07	0.87
2018	282	9%	0.55	0.70	0.47	2018	135	3%	1.23	0.18	0.68

Table 7: Probabilities of age given length used in age assignments of female southern flounder fishery landings 1982-2001.

Fishery 1982-2001					
TL in	Age 0	Age 1	Age 2	Age 3	Age 4+
5	1.00	0.00	0.00	0.00	0.00
6	1.00	0.00	0.00	0.00	0.00
7	1.00	0.00	0.00	0.00	0.00
8	1.00	0.00	0.00	0.00	0.00
9	1.00	0.00	0.00	0.00	0.00
10	1.00	0.00	0.00	0.00	0.00
11	0.95	0.05	0.00	0.00	0.00
12	0.00	1.00	0.00	0.00	0.00
13	0.00	0.99	0.01	0.00	0.00
14	0.00	0.78	0.21	0.00	0.00
15	0.00	0.05	0.86	0.09	0.01
16	0.00	0.00	0.53	0.35	0.12
17	0.00	0.00	0.07	0.40	0.52
18	0.00	0.00	0.00	0.12	0.88
19	0.00	0.00	0.00	0.01	0.99
20	0.00	0.00	0.00	0.00	1.00
21	0.00	0.00	0.00	0.00	1.00
22	0.00	0.00	0.00	0.00	1.00
23	0.00	0.00	0.00	0.00	1.00
24	0.00	0.00	0.00	0.00	1.00
25	0.00	0.00	0.00	0.00	1.00
26	0.00	0.00	0.00	0.00	1.00

Table 8: Annual probabilities of age given length used in age assignments of commercial female southern flounder landings 2002-2018. Shaded cells represent rows where probabilities of age given length from Table 7 are substituted ($\sum_a n_{lay} < 10$).

2002						
TL / n	Age 0	Age 1	Age 2	Age 3	Age 4+	Total l
8	1.00	0.00	0.00	0.00	0.00	2
9	1.00	0.00	0.00	0.00	0.00	
10	1.00	0.00	0.00	0.00	0.00	3
11	0.54	0.46				13
12	0.26	0.65	0.04	0.04		23
13		0.88	0.08	0.04		24
14	0.08	0.44	0.40	0.08		25
15		0.67	0.33			24
16		0.67	0.29	0.05		21
17		0.44	0.55			16
18		0.64	0.16			19
19		0.69	0.11			27
20	0.00	0.00	0.00	0.00	1.00	7
21	0.00	0.00	0.00	0.00	1.00	4
22	0.00	0.00	0.00	0.00	1.00	1
23	0.00	0.00	0.00	0.00	1.00	3
24	0.00	0.00	0.00	0.00	1.00	1
25	0.00	0.00	0.00	0.00	1.00	
26	0.00	0.00	0.00	0.00	1.00	

2003						
TL / n	Age 0	Age 1	Age 2	Age 3	Age 4+	Total l
8	1.00	0.00	0.00	0.00	0.00	1
9	1.00	0.00	0.00	0.00	0.00	
10	0.20	0.80				10
11		1.00				20
12	0.09	0.76	0.12	0.03		34
13		0.90	0.10			21
14		0.79	0.21			53
15		0.72	0.28			39
16		0.74	0.26			19
17		0.45	0.30	0.20	0.05	20
18	0.00	0.00	0.00	0.12	0.88	5
19	0.00	0.00	0.00	0.01	0.99	1
20	0.00	0.00	0.00	0.00	1.00	3
21	0.00	0.00	0.00	0.00	1.00	
22	0.00	0.00	0.00	0.00	1.00	2
23	0.00	0.00	0.00	0.00	1.00	1
24	0.00	0.00	0.00	0.00	1.00	
25	0.00	0.00	0.00	0.00	1.00	
26	0.00	0.00	0.00	0.00	1.00	

Table 8 (continued):

2004						
TL _i n	Age 0	Age 1	Age 2	Age 3	Age 4+	Total I
8	1.00	0.00	0.00	0.00	0.00	
9	1.00	0.00	0.00	0.00	0.00	2
10	1.00	0.00	0.00	0.00	0.00	7
11		1.00				16
12	0.03	0.94	0.03			36
13	0.03	0.69	0.28			32
14	0.06	0.43	0.46	0.03	0.03	35
15		0.71	0.23	0.06		31
16		0.38	0.31	0.25	0.06	16
17	0.00	0.00	0.07	0.40	0.52	9
18	0.00	0.00	0.00	0.12	0.88	4
19	0.00	0.00	0.00	0.01	0.99	2
20	0.00	0.00	0.00	0.00	1.00	1
21	0.00	0.00	0.00	0.00	1.00	1
22	0.00	0.00	0.00	0.00	1.00	
23	0.00	0.00	0.00	0.00	1.00	
24	0.00	0.00	0.00	0.00	1.00	
25	0.00	0.00	0.00	0.00	1.00	
26	0.00	0.00	0.00	0.00	1.00	

2005						
TL _i n	Age 0	Age 1	Age 2	Age 3	Age 4+	Total I
8	1.00	0.00	0.00	0.00	0.00	
9	1.00	0.00	0.00	0.00	0.00	
10	1.00	0.00	0.00	0.00	0.00	
11	0.95	0.05	0.00	0.00	0.00	2
12		0.33	0.61	0.06		18
13		0.29	0.69	0.02		51
14		0.07	0.93			29
15		0.29	0.62	0.10		21
16	0.00	0.00	0.53	0.35	0.12	9
17		0.70	0.15	0.10	0.05	20
18	0.00	0.00	0.00	0.12	0.88	6
19	0.00	0.00	0.00	0.01	0.99	1
20	0.00	0.00	0.00	0.00	1.00	3
21	0.00	0.00	0.00	0.00	1.00	1
22	0.00	0.00	0.00	0.00	1.00	
23	0.00	0.00	0.00	0.00	1.00	
24	0.00	0.00	0.00	0.00	1.00	
25	0.00	0.00	0.00	0.00	1.00	
26	0.00	0.00	0.00	0.00	1.00	

2006						
TL _i n	Age 0	Age 1	Age 2	Age 3	Age 4+	Total I
8	1.00	0.00	0.00	0.00	0.00	
9	1.00	0.00	0.00	0.00	0.00	4
10	1.00	0.00	0.00	0.00	0.00	2
11	0.95	0.05	0.00	0.00	0.00	6
12	0.04	0.96				26
13	0.03	0.93	0.03			58
14	0.04	0.86	0.10			71
15	0.04	0.71	0.18	0.07		55
16		0.57	0.33	0.11		46
17		0.43	0.50	0.07		28
18		0.33	0.50	0.17		12
19		0.13	0.67	0.20		15
20		0.17	0.50	0.25	0.08	12
21	0.00	0.00	0.00	0.00	1.00	3
22	0.00	0.00	0.00	0.00	1.00	1
23	0.00	0.00	0.00	0.00	1.00	
24	0.00	0.00	0.00	0.00	1.00	
25	0.00	0.00	0.00	0.00	1.00	
26	0.00	0.00	0.00	0.00	1.00	

2007						
TL _i n	Age 0	Age 1	Age 2	Age 3	Age 4+	Total I
8	1.00	0.00	0.00	0.00	0.00	
9	1.00	0.00	0.00	0.00	0.00	
10	1.00	0.00	0.00	0.00	0.00	2
11	0.95	0.05	0.00	0.00	0.00	8
12	0.43	0.43	0.14			14
13	0.06	0.69	0.25			32
14	0.02	0.74	0.24			42
15		0.75	0.25			51
16		0.70	0.30			27
17		0.77	0.23			22
18	0.00	0.00	0.00	0.12	0.88	7
19	0.00	0.00	0.00	0.01	0.99	1
20	0.00	0.00	0.00	0.00	1.00	
21	0.00	0.00	0.00	0.00	1.00	
22	0.00	0.00	0.00	0.00	1.00	
23	0.00	0.00	0.00	0.00	1.00	
24	0.00	0.00	0.00	0.00	1.00	
25	0.00	0.00	0.00	0.00	1.00	
26	0.00	0.00	0.00	0.00	1.00	

2008						
TL _i n	Age 0	Age 1	Age 2	Age 3	Age 4+	Total I
8	1.00	0.00	0.00	0.00	0.00	
9	1.00	0.00	0.00	0.00	0.00	
10	1.00	0.00	0.00	0.00	0.00	1
11	0.95	0.05	0.00	0.00	0.00	5
12		0.74	0.19	0.07		27
13		0.76	0.24			33
14		0.71	0.26	0.02		42
15		0.65	0.35			37
16		0.58	0.35	0.08		26
17	0.00	0.00	0.07	0.40	0.52	5
18	0.00	0.00	0.00	0.12	0.88	
19	0.00	0.00	0.00	0.01	0.99	
20	0.00	0.00	0.00	0.00	1.00	
21	0.00	0.00	0.00	0.00	1.00	
22	0.00	0.00	0.00	0.00	1.00	
23	0.00	0.00	0.00	0.00	1.00	
24	0.00	0.00	0.00	0.00	1.00	
25	0.00	0.00	0.00	0.00	1.00	
26	0.00	0.00	0.00	0.00	1.00	

2009						
TL _i n	Age 0	Age 1	Age 2	Age 3	Age 4+	Total I
8	1.00	0.00	0.00	0.00	0.00	
9	1.00	0.00	0.00	0.00	0.00	
10	1.00	0.00	0.00	0.00	0.00	
11	0.95	0.05	0.00	0.00	0.00	
12	0.00	1.00	0.00	0.00	0.00	
13	0.00	0.99	0.01	0.00	0.00	
14	0.00	0.78	0.21	0.00	0.00	4
15	0.00	0.05	0.86	0.09	0.01	5
16	0.00	0.00	0.53	0.35	0.12	6
17	0.00	0.00	0.07	0.40	0.52	5
18	0.00	0.00	0.00	0.12	0.88	6
19	0.00	0.00	0.00	0.01	0.99	8
20	0.00	0.00	0.00	0.00	1.00	5
21	0.00	0.00	0.00	0.00	1.00	2
22	0.00	0.00	0.00	0.00	1.00	2
23	0.00	0.00	0.00	0.00	1.00	1
24	0.00	0.00	0.00	0.00	1.00	
25	0.00	0.00	0.00	0.00	1.00	
26	0.00	0.00	0.00	0.00	1.00	

Table 8 (continued):

2010						
TL_i n	Age 0	Age 1	Age 2	Age 3	Age 4+	Tota l
8	1.00	0.00	0.00	0.00	0.00	2
9	1.00	0.00	0.00	0.00	0.00	
10	1.00	0.00	0.00	0.00	0.00	
11	0.95	0.05	0.00	0.00	0.00	
12	0.00	1.00	0.00	0.00	0.00	
13	0.00	0.99	0.01	0.00	0.00	8
14		1.00				17
15	0.00	0.05	0.86	0.09	0.01	2
16	0.00	0.00	0.53	0.35	0.12	1
17	0.00	0.00	0.07	0.40	0.52	1
18	0.00	0.00	0.00	0.12	0.88	1
19	0.00	0.00	0.00	0.01	0.99	
20	0.00	0.00	0.00	0.00	1.00	
21	0.00	0.00	0.00	0.00	1.00	
22	0.00	0.00	0.00	0.00	1.00	
23	0.00	0.00	0.00	0.00	1.00	
24	0.00	0.00	0.00	0.00	1.00	
25	0.00	0.00	0.00	0.00	1.00	
26	0.00	0.00	0.00	0.00	1.00	

2011						
TL_i n	Age 0	Age 1	Age 2	Age 3	Age 4+	Tota l
8	1.00	0.00	0.00	0.00	0.00	1
9	1.00	0.00	0.00	0.00	0.00	
10	1.00	0.00	0.00	0.00	0.00	
11	0.95	0.05	0.00	0.00	0.00	
12	0.00	1.00	0.00	0.00	0.00	
13	0.00	0.99	0.01	0.00	0.00	3
14	0.00	0.78	0.21	0.00	0.00	2
15	0.00	0.05	0.86	0.09	0.01	3
16	0.00	0.00	0.53	0.35	0.12	7
17	0.00	0.00	0.07	0.40	0.52	8
18	0.00	0.00	0.00	0.12	0.88	1
19	0.00	0.00	0.00	0.01	0.99	
20	0.00	0.00	0.00	0.00	1.00	
21	0.00	0.00	0.00	0.00	1.00	
22	0.00	0.00	0.00	0.00	1.00	
23	0.00	0.00	0.00	0.00	1.00	
24	0.00	0.00	0.00	0.00	1.00	
25	0.00	0.00	0.00	0.00	1.00	
26	0.00	0.00	0.00	0.00	1.00	

2012						
TL_i n	Age 0	Age 1	Age 2	Age 3	Age 4+	Tota l
8	1.00	0.00	0.00	0.00	0.00	1
9	1.00	0.00	0.00	0.00	0.00	
10	1.00	0.00	0.00	0.00	0.00	
11	0.95	0.05	0.00	0.00	0.00	
12	0.00	1.00	0.00	0.00	0.00	
13	0.00	0.99	0.01	0.00	0.00	8
14	0.00	0.78	0.21	0.00	0.00	1
15	0.00	0.05	0.86	0.09	0.01	5
16	0.00	0.00	0.53	0.35	0.12	
17	0.00	0.00	0.07	0.40	0.52	
18	0.00	0.00	0.00	0.12	0.88	1
19	0.00	0.00	0.00	0.01	0.99	
20	0.00	0.00	0.00	0.00	1.00	
21	0.00	0.00	0.00	0.00	1.00	
22	0.00	0.00	0.00	0.00	1.00	
23	0.00	0.00	0.00	0.00	1.00	
24	0.00	0.00	0.00	0.00	1.00	
25	0.00	0.00	0.00	0.00	1.00	
26	0.00	0.00	0.00	0.00	1.00	

2013						
TL_i n	Age 0	Age 1	Age 2	Age 3	Age 4+	Tota l
8	1.00	0.00	0.00	0.00	0.00	1
9	1.00	0.00	0.00	0.00	0.00	
10	1.00	0.00	0.00	0.00	0.00	
11	0.95	0.05	0.00	0.00	0.00	
12	0.00	1.00	0.00	0.00	0.00	
13	0.00	0.99	0.01	0.00	0.00	4
14		0.75	0.25			12
15		0.70	0.25	0.05		40
16		0.37	0.53	0.11		19
17		0.44	0.50		0.06	16
18	0.00	0.00	0.00	0.12	0.88	3
19	0.00	0.00	0.00	0.01	0.99	5
20	0.00	0.00	0.00	0.00	1.00	2
21	0.00	0.00	0.00	0.00	1.00	
22	0.00	0.00	0.00	0.00	1.00	1
23	0.00	0.00	0.00	0.00	1.00	
24	0.00	0.00	0.00	0.00	1.00	
25	0.00	0.00	0.00	0.00	1.00	
26	0.00	0.00	0.00	0.00	1.00	

2014						
TL_i n	Age 0	Age 1	Age 2	Age 3	Age 4+	Tota l
8	1.00	0.00	0.00	0.00	0.00	1
9	1.00	0.00	0.00	0.00	0.00	
10	1.00	0.00	0.00	0.00	0.00	
11	0.95	0.05	0.00	0.00	0.00	
12	0.00	1.00	0.00	0.00	0.00	
13		0.93		0.07		14
14		0.88	0.12			25
15		0.81	0.14	0.05		21
16		0.64	0.32	0.04		25
17		0.57	0.29	0.14		14
18		0.67	0.20	0.13		15
19		0.91	0.09			11
20	0.00	0.00	0.00	0.00	1.00	2
21	0.00	0.00	0.00	0.00	1.00	
22	0.00	0.00	0.00	0.00	1.00	1
23	0.00	0.00	0.00	0.00	1.00	
24	0.00	0.00	0.00	0.00	1.00	
25	0.00	0.00	0.00	0.00	1.00	
26	0.00	0.00	0.00	0.00	1.00	

2015						
TL_i n	Age 0	Age 1	Age 2	Age 3	Age 4+	Tota l
8	1.00	0.00	0.00	0.00	0.00	9
9	1.00	0.00	0.00	0.00	0.00	
10	1.00	0.00	0.00	0.00	0.00	
11	0.95	0.05	0.00	0.00	0.00	
12	0.00	1.00	0.00	0.00	0.00	
13		0.98	0.02			61
14		0.99	0.01			134
15		0.84	0.15	0.01		88
16		0.82	0.18			65
17		0.77	0.21	0.03		39
18		0.68	0.32			25
19	0.00	0.00	0.00	0.01	0.99	7
20	0.00	0.00	0.00	0.00	1.00	3
21	0.00	0.00	0.00	0.00	1.00	1
22	0.00	0.00	0.00	0.00	1.00	1
23	0.00	0.00	0.00	0.00	1.00	1
24	0.00	0.00	0.00	0.00	1.00	
25	0.00	0.00	0.00	0.00	1.00	
26	0.00	0.00	0.00	0.00	1.00	

Table 8 (continued):

2016						
TL_i n	Age 0	Age 1	Age 2	Age 3	Age 4+	Total l
8	1.00	0.00	0.00	0.00	0.00	
9	1.00	0.00	0.00	0.00	0.00	
10	1.00	0.00	0.00	0.00	0.00	
11	0.95	0.05	0.00	0.00	0.00	1
12	0.00	1.00	0.00	0.00	0.00	6
13	0.03	0.55	0.39	0.03		38
14	0.02	0.41	0.58			59
15		0.35	0.63	0.02		43
16		0.27	0.73			30
17		0.24	0.68	0.08		25
18		0.24	0.62	0.14		21
19	0.00	0.00	0.00	0.01	0.99	6
20	0.00	0.00	0.00	0.00	1.00	8
21	0.00	0.00	0.00	0.00	1.00	
22	0.00	0.00	0.00	0.00	1.00	2
23	0.00	0.00	0.00	0.00	1.00	2
24	0.00	0.00	0.00	0.00	1.00	1
25	0.00	0.00	0.00	0.00	1.00	
26	0.00	0.00	0.00	0.00	1.00	

2017						
TL_i n	Age 0	Age 1	Age 2	Age 3	Age 4+	Total l
8	1.00	0.00	0.00	0.00	0.00	
9	1.00	0.00	0.00	0.00	0.00	
10	1.00	0.00	0.00	0.00	0.00	1
11	0.95	0.05	0.00	0.00	0.00	
12	0.00	1.00	0.00	0.00	0.00	1
13	0.00	0.99	0.01	0.00	0.00	8
14		0.64	0.36			11
15		0.54	0.38	0.08		13
16		0.42	0.42	0.08	0.08	12
17	0.00	0.00	0.07	0.40	0.52	6
18	0.00	0.00	0.00	0.12	0.88	5
19	0.00	0.00	0.00	0.01	0.99	4
20	0.00	0.00	0.00	0.00	1.00	2
21	0.00	0.00	0.00	0.00	1.00	
22	0.00	0.00	0.00	0.00	1.00	
23	0.00	0.00	0.00	0.00	1.00	
24	0.00	0.00	0.00	0.00	1.00	
25	0.00	0.00	0.00	0.00	1.00	
26	0.00	0.00	0.00	0.00	1.00	

2018						
TL_i n	Age 0	Age 1	Age 2	Age 3	Age 4+	Total l
8	1.00	0.00	0.00	0.00	0.00	
9	1.00	0.00	0.00	0.00	0.00	
10	1.00	0.00	0.00	0.00	0.00	
11	0.95	0.05	0.00	0.00	0.00	
12	0.00	1.00	0.00	0.00	0.00	
13	0.00	0.99	0.01	0.00	0.00	1
14	0.00	0.78	0.21	0.00	0.00	1
15	0.00	0.05	0.86	0.09	0.01	1
16	0.00	0.00	0.53	0.35	0.12	1
17	0.00	0.00	0.07	0.40	0.52	
18	0.00	0.00	0.00	0.12	0.88	
19	0.00	0.00	0.00	0.01	0.99	
20	0.00	0.00	0.00	0.00	1.00	
21	0.00	0.00	0.00	0.00	1.00	
22	0.00	0.00	0.00	0.00	1.00	
23	0.00	0.00	0.00	0.00	1.00	
24	0.00	0.00	0.00	0.00	1.00	
25	0.00	0.00	0.00	0.00	1.00	
26	0.00	0.00	0.00	0.00	1.00	

Table 9: Annual probabilities of age given length used in age assignments of recreational female southern flounder landings 2002-2018. Shaded cells represent rows where probabilities of age given length from Table 7 are substituted ($\sum_a n_{lay} < 10$).

2002						
TL_i n	Age 0	Age 1	Age 2	Age 3	Age 4+	Total l
8	1.00	0.00	0.00	0.00	0.00	2
9	1.00	0.00	0.00	0.00	0.00	7
10	0.14	0.80	0.06			35
11	0.23	0.73	0.01	0.03		78
12	0.07	0.89	0.04			132
13	0.03	0.96	0.02			120
14	0.02	0.85	0.13	0.01		136
15		0.72	0.25	0.03		97
16		0.60	0.38	0.01	0.01	84
17		0.51	0.47	0.02		45
18		0.52	0.45	0.03		31
19		0.31	0.62		0.08	13
20	0.00	0.00	0.00	0.00	1.00	7
21	0.00	0.00	0.00	0.00	1.00	5
22	0.00	0.00	0.00	0.00	1.00	
23	0.00	0.00	0.00	0.00	1.00	2
24	0.00	0.00	0.00	0.00	1.00	
25	0.00	0.00	0.00	0.00	1.00	1
26	0.00	0.00	0.00	0.00	1.00	

2003						
TL_i n	Age 0	Age 1	Age 2	Age 3	Age 4+	Total l
8	1.00	0.00	0.00	0.00	0.00	5
9	0.67	0.33				12
10	0.49	0.47	0.04			49
11	0.36	0.60	0.04			85
12	0.08	0.78	0.14			177
13	0.02	0.70	0.28			220
14	0.01	0.62	0.36		0.01	190
15		0.50	0.49	0.01		143
16		0.43	0.50	0.07		88
17		0.23	0.63	0.14		57
18		0.24	0.64	0.12		33
19		0.23	0.46	0.31		13
20			0.60	0.40		15
21	0.00	0.00	0.00	0.00	1.00	4
22	0.00	0.00	0.00	0.00	1.00	
23	0.00	0.00	0.00	0.00	1.00	2
24	0.00	0.00	0.00	0.00	1.00	
25	0.00	0.00	0.00	0.00	1.00	
26	0.00	0.00	0.00	0.00	1.00	

Table 9 (continued):

2004						
TL _i n	Age 0	Age 1	Age 2	Age 3	Age 4+	Total l
8	1.00	0.00	0.00	0.00	0.00	2
9	0.05	0.90	0.05			20
10	0.07	0.87	0.07			75
11	0.04	0.93	0.02			91
12	0.01	0.88	0.11	0.00		209
13	0.01	0.68	0.30	0.01		187
14		0.54	0.45	0.01		193
15		0.37	0.52	0.11		133
16	0.01	0.34	0.42	0.22		85
17		0.16	0.50	0.34		56
18			0.42	0.58		31
19	0.00	0.00	0.00	0.01	0.99	7
20	0.00	0.00	0.00	0.00	1.00	6
21	0.00	0.00	0.00	0.00	1.00	6
22	0.00	0.00	0.00	0.00	1.00	1
23	0.00	0.00	0.00	0.00	1.00	1
24	0.00	0.00	0.00	0.00	1.00	
25	0.00	0.00	0.00	0.00	1.00	
26	0.00	0.00	0.00	0.00	1.00	

2005						
TL _i n	Age 0	Age 1	Age 2	Age 3	Age 4+	Total l
8	1.00	0.00	0.00	0.00	0.00	
9	1.00	0.00	0.00	0.00	0.00	6
10	0.54	0.46				24
11	0.38	0.51	0.10			78
12	0.20	0.45	0.35			114
13	0.05	0.49	0.42	0.03		150
14	0.01	0.45	0.45	0.09		163
15		0.29	0.44	0.25	0.02	134
16		0.11	0.52	0.31	0.06	101
17		0.09	0.52	0.34	0.05	56
18		0.04	0.48	0.30	0.17	23
19		0.20	0.50		0.30	10
20	0.00	0.00	0.00	0.00	1.00	5
21	0.00	0.00	0.00	0.00	1.00	4
22	0.00	0.00	0.00	0.00	1.00	1
23	0.00	0.00	0.00	0.00	1.00	1
24	0.00	0.00	0.00	0.00	1.00	1
25	0.00	0.00	0.00	0.00	1.00	
26	0.00	0.00	0.00	0.00	1.00	

2006						
TL _i n	Age 0	Age 1	Age 2	Age 3	Age 4+	Total l
8	1.00	0.00	0.00	0.00	0.00	1
9	1.00	0.00	0.00	0.00	0.00	6
10	0.04	0.92		0.04		26
11	0.06	0.92	0.01			78
12	0.05	0.93	0.01	0.01		190
13	0.00	0.95	0.04	0.01		271
14	0.00	0.92	0.07	0.01		224
15	0.01	0.73	0.18	0.07	0.01	146
16		0.66	0.25	0.07	0.01	95
17		0.39	0.45	0.15	0.01	67
18		0.30	0.50	0.20		30
19		0.27	0.45	0.27		11
20	0.00	0.00	0.00	0.00	1.00	9
21	0.00	0.00	0.00	0.00	1.00	4
22	0.00	0.00	0.00	0.00	1.00	1
23	0.00	0.00	0.00	0.00	1.00	1
24	0.00	0.00	0.00	0.00	1.00	1
25	0.00	0.00	0.00	0.00	1.00	
26	0.00	0.00	0.00	0.00	1.00	

2007						
TL _i n	Age 0	Age 1	Age 2	Age 3	Age 4+	Total l
8	1.00	0.00	0.00	0.00	0.00	2
9	1.00	0.00	0.00	0.00	0.00	6
10	0.60	0.40				15
11	0.40	0.55	0.05			40
12	0.15	0.82	0.03			61
13	0.04	0.92	0.04			79
14	0.01	0.81	0.18			110
15		0.78	0.22			87
16		0.60	0.36	0.04		47
17		0.30	0.65	0.02	0.02	43
18		0.29	0.52	0.19		21
19		0.27	0.73			11
20	0.00	0.00	0.00	0.00	1.00	9
21	0.00	0.00	0.00	0.00	1.00	
22	0.00	0.00	0.00	0.00	1.00	4
23	0.00	0.00	0.00	0.00	1.00	1
24	0.00	0.00	0.00	0.00	1.00	
25	0.00	0.00	0.00	0.00	1.00	
26	0.00	0.00	0.00	0.00	1.00	

2008						
TL _i n	Age 0	Age 1	Age 2	Age 3	Age 4+	Total l
8	1.00	0.00	0.00	0.00	0.00	2
9	1.00	0.00	0.00	0.00	0.00	7
10	0.63	0.37				19
11	0.42	0.58				60
12	0.25	0.72	0.03			102
13	0.08	0.78	0.14			112
14	0.01	0.72	0.26	0.01		100
15		0.58	0.42			78
16		0.28	0.69	0.03		67
17		0.29	0.63	0.08		38
18		0.26	0.53	0.21		19
19	0.00	0.00	0.00	0.01	0.99	8
20	0.00	0.00	0.00	0.00	1.00	7
21	0.00	0.00	0.00	0.00	1.00	6
22	0.00	0.00	0.00	0.00	1.00	2
23	0.00	0.00	0.00	0.00	1.00	1
24	0.00	0.00	0.00	0.00	1.00	
25	0.00	0.00	0.00	0.00	1.00	
26	0.00	0.00	0.00	0.00	1.00	

2009						
TL _i n	Age 0	Age 1	Age 2	Age 3	Age 4+	Total l
8	1.00	0.00	0.00	0.00	0.00	1
9	1.00	0.00	0.00	0.00	0.00	3
10	0.83	0.08	0.08			12
11	0.32	0.64	0.04			28
12	0.17	0.81	0.02			63
13	0.06	0.83	0.10	0.01		83
14		0.84	0.15	0.01		85
15		0.60	0.35	0.05		78
16		0.44	0.54	0.02		63
17		0.53	0.30	0.17		30
18		0.21	0.63	0.16		19
19	0.00	0.00	0.00	0.01	0.99	8
20	0.00	0.00	0.00	0.00	1.00	4
21	0.00	0.00	0.00	0.00	1.00	1
22	0.00	0.00	0.00	0.00	1.00	1
23	0.00	0.00	0.00	0.00	1.00	
24	0.00	0.00	0.00	0.00	1.00	
25	0.00	0.00	0.00	0.00	1.00	
26	0.00	0.00	0.00	0.00	1.00	

Table 9 (continued):

2010						
TL _i n	Age 0	Age 1	Age 2	Age 3	Age 4+	Total I
8	1.00	0.00	0.00	0.00	0.00	
9	1.00	0.00	0.00	0.00	0.00	2
10	0.73	0.23	0.05			22
11	0.25	0.69	0.06			16
12	0.10	0.78	0.10	0.02		50
13	0.06	0.67	0.28			36
14		0.56	0.44			62
15		0.39	0.55	0.06		49
16		0.22	0.69	0.09		32
17		0.08	0.67	0.25		12
18	0.00	0.00	0.00	0.12	0.88	5
19	0.00	0.00	0.00	0.01	0.99	4
20	0.00	0.00	0.00	0.00	1.00	2
21	0.00	0.00	0.00	0.00	1.00	
22	0.00	0.00	0.00	0.00	1.00	
23	0.00	0.00	0.00	0.00	1.00	
24	0.00	0.00	0.00	0.00	1.00	
25	0.00	0.00	0.00	0.00	1.00	
26	0.00	0.00	0.00	0.00	1.00	

2011						
TL _i n	Age 0	Age 1	Age 2	Age 3	Age 4+	Total I
8	1.00	0.00	0.00	0.00	0.00	5
9	1.00	0.00	0.00	0.00	0.00	3
10	0.63	0.38				16
11	0.50	0.47	0.03			32
12	0.22	0.76	0.02			51
13	0.04	0.83	0.13			53
14		0.87	0.13			68
15		0.64	0.36			50
16		0.48	0.48	0.05		44
17		0.41	0.48	0.11		27
18		0.50	0.33	0.11	0.06	18
19	0.00	0.00	0.00	0.01	0.99	2
20	0.00	0.00	0.00	0.00	1.00	4
21	0.00	0.00	0.00	0.00	1.00	2
22	0.00	0.00	0.00	0.00	1.00	2
23	0.00	0.00	0.00	0.00	1.00	1
24	0.00	0.00	0.00	0.00	1.00	
25	0.00	0.00	0.00	0.00	1.00	
26	0.00	0.00	0.00	0.00	1.00	

2012						
TL _i n	Age 0	Age 1	Age 2	Age 3	Age 4+	Total I
8	1.00	0.00	0.00	0.00	0.00	1
9	1.00	0.00	0.00	0.00	0.00	1
10		1.00				10
11		1.00				21
12		0.96	0.04			46
13		0.86	0.14			44
14		0.78	0.22			46
15		0.57	0.37	0.07		30
16		0.18	0.79	0.04		28
17		0.09	0.82	0.09		22
18		0.13	0.44	0.44		16
19	0.00	0.00	0.00	0.01	0.99	8
20	0.00	0.00	0.00	0.00	1.00	8
21	0.00	0.00	0.00	0.00	1.00	1
22	0.00	0.00	0.00	0.00	1.00	1
23	0.00	0.00	0.00	0.00	1.00	
24	0.00	0.00	0.00	0.00	1.00	
25	0.00	0.00	0.00	0.00	1.00	
26	0.00	0.00	0.00	0.00	1.00	

2013						
TL _i n	Age 0	Age 1	Age 2	Age 3	Age 4+	Total I
8	1.00	0.00	0.00	0.00	0.00	1
9	1.00	0.00	0.00	0.00	0.00	2
10	0.41	0.59				17
11	0.17	0.81	0.02			53
12	0.05	0.92	0.03			37
13	0.13	0.68	0.19			31
14	0.10	0.60	0.31			42
15		0.53	0.44	0.03		36
16	0.04	0.41	0.52	0.04		27
17		0.52	0.45	0.03		33
18			0.92	0.08		13
19	0.00	0.00	0.00	0.01	0.99	
20	0.00	0.00	0.00	0.00	1.00	3
21	0.00	0.00	0.00	0.00	1.00	2
22	0.00	0.00	0.00	0.00	1.00	1
23	0.00	0.00	0.00	0.00	1.00	
24	0.00	0.00	0.00	0.00	1.00	
25	0.00	0.00	0.00	0.00	1.00	
26	0.00	0.00	0.00	0.00	1.00	

2014						
TL _i n	Age 0	Age 1	Age 2	Age 3	Age 4+	Total I
8	1.00	0.00	0.00	0.00	0.00	1
9	1.00	0.00	0.00	0.00	0.00	1
10	1.00	0.00	0.00	0.00	0.00	7
11	0.57	0.43				14
12	0.10	0.90				21
13	0.06	0.78	0.17			36
14		0.72	0.24	0.04		50
15		0.53	0.35	0.12		51
16		0.34	0.44	0.20	0.02	41
17		0.26	0.37	0.33	0.04	27
18		0.20	0.60	0.10	0.10	10
19	0.00	0.00	0.00	0.01	0.99	7
20	0.00	0.00	0.00	0.00	1.00	1
21	0.00	0.00	0.00	0.00	1.00	2
22	0.00	0.00	0.00	0.00	1.00	
23	0.00	0.00	0.00	0.00	1.00	
24	0.00	0.00	0.00	0.00	1.00	
25	0.00	0.00	0.00	0.00	1.00	
26	0.00	0.00	0.00	0.00	1.00	

2015						
TL _i n	Age 0	Age 1	Age 2	Age 3	Age 4+	Total I
8	1.00	0.00	0.00	0.00	0.00	
9	1.00	0.00	0.00	0.00	0.00	2
10		1.00				19
11	0.04	0.96				51
12	0.03	0.96	0.01			72
13		0.93	0.07			81
14		0.92	0.08			90
15		0.78	0.22			58
16		0.49	0.49		0.03	39
17		0.41	0.50	0.09		22
18		0.40	0.40	0.20		10
19	0.00	0.00	0.00	0.01	0.99	1
20	0.00	0.00	0.00	0.00	1.00	2
21	0.00	0.00	0.00	0.00	1.00	2
22	0.00	0.00	0.00	0.00	1.00	1
23	0.00	0.00	0.00	0.00	1.00	
24	0.00	0.00	0.00	0.00	1.00	
25	0.00	0.00	0.00	0.00	1.00	
26	0.00	0.00	0.00	0.00	1.00	

Table 9 (continued):

2016						
TL_i n	Age 0	Age 1	Age 2	Age 3	Age 4+	Total I
8	1.00	0.00	0.00	0.00	0.00	
9	1.00	0.00	0.00	0.00	0.00	1
10	1.00	0.00	0.00	0.00	0.00	3
11	0.06	0.65	0.29			17
12		0.54	0.46			52
13		0.46	0.53	0.01		95
14	0.01	0.44	0.54	0.01		95
15	0.01	0.49	0.50			80
16		0.27	0.68	0.05		44
17		0.19	0.68	0.13		31
18		0.13	0.67	0.20		15
19	0.00	0.00	0.00	0.01	0.99	9
20	0.00	0.00	0.00	0.00	1.00	4
21	0.00	0.00	0.00	0.00	1.00	1
22	0.00	0.00	0.00	0.00	1.00	1
23	0.00	0.00	0.00	0.00	1.00	
24	0.00	0.00	0.00	0.00	1.00	
25	0.00	0.00	0.00	0.00	1.00	
26	0.00	0.00	0.00	0.00	1.00	

2017						
TL_i n	Age 0	Age 1	Age 2	Age 3	Age 4+	Total I
8	1.00	0.00	0.00	0.00	0.00	
9	1.00	0.00	0.00	0.00	0.00	
10	1.00	0.00	0.00	0.00	0.00	2
11	0.95	0.05	0.00	0.00	0.00	8
12	0.14	0.62	0.24			21
13	0.06	0.66	0.23	0.06		35
14	0.02	0.60	0.24	0.15		55
15	0.02	0.41	0.38	0.19		63
16		0.32	0.43	0.26		47
17		0.27	0.73			26
18		0.37	0.37	0.26		19
19	0.00	0.00	0.00	0.01	0.99	3
20	0.00	0.00	0.00	0.00	1.00	4
21	0.00	0.00	0.00	0.00	1.00	
22	0.00	0.00	0.00	0.00	1.00	1
23	0.00	0.00	0.00	0.00	1.00	
24	0.00	0.00	0.00	0.00	1.00	
25	0.00	0.00	0.00	0.00	1.00	
26	0.00	0.00	0.00	0.00	1.00	

2018						
TL_i n	Age 0	Age 1	Age 2	Age 3	Age 4+	Total I
8	1.00	0.00	0.00	0.00	0.00	2
9	1.00	0.00	0.00	0.00	0.00	6
10	1.00					10
11	0.78	0.17	0.06			18
12	0.59	0.21	0.21			34
13	0.25	0.32	0.41	0.02		44
14	0.17	0.50	0.23	0.08	0.02	48
15		0.39	0.40	0.12	0.09	67
16	0.03	0.35	0.53	0.03	0.08	40
17		0.41	0.48	0.10		29
18		0.29	0.36	0.07	0.29	14
19	0.00	0.00	0.00	0.01	0.99	9
20	0.00	0.00	0.00	0.00	1.00	
21	0.00	0.00	0.00	0.00	1.00	5
22	0.00	0.00	0.00	0.00	1.00	
23	0.00	0.00	0.00	0.00	1.00	
24	0.00	0.00	0.00	0.00	1.00	
25	0.00	0.00	0.00	0.00	1.00	
26	0.00	0.00	0.00	0.00	1.00	

Table 10: Annual commercial female southern flounder catch-at-age, yield (pounds) and corresponding ASAP base model input coefficients of variation, and corresponding mean weights-at-age (pounds).

Commercial Catch-at-age							Commercial Mean Weight-at-age				
Year	Age 1	Age 2	Age 3	Age 4+	Yield (lbs)	CV	Year	Age 1	Age 2	Age 3	Age 4+
1982	29,883	27,915	11,315	24,295	190,556	0.10	1982	1.15	1.71	2.16	3.46
1983	41,314	38,593	15,644	33,589	263,451	0.10	1983	1.15	1.71	2.16	3.46
1984	52,851	49,370	20,012	42,968	337,017	0.10	1984	1.15	1.71	2.16	3.46
1985	79,289	74,066	30,023	64,462	505,606	0.10	1985	1.15	1.71	2.16	3.46
1986	123,432	115,302	46,738	100,351	787,092	0.10	1986	1.15	1.71	2.16	3.46
1987	140,344	131,100	53,142	114,100	894,936	0.10	1987	1.15	1.71	2.16	3.46
1988	76,343	71,314	28,908	62,067	486,818	0.10	1988	1.15	1.71	2.16	3.46
1989	73,614	68,765	27,874	59,849	469,419	0.10	1989	1.15	1.71	2.16	3.46
1990	68,179	63,688	25,816	55,430	434,760	0.10	1990	1.15	1.71	2.16	3.46
1991	103,579	96,757	39,221	84,210	660,499	0.10	1991	1.15	1.71	2.16	3.46
1992	117,376	109,645	44,445	95,428	748,480	0.10	1992	1.15	1.71	2.16	3.46
1993	134,479	125,621	50,921	109,332	857,536	0.10	1993	1.15	1.71	2.16	3.46
1994	117,147	136,828	57,748	127,299	932,720	0.10	1994	1.16	1.72	2.16	3.42
1995	95,577	101,428	34,056	46,658	498,496	0.10	1995	1.18	1.70	2.09	3.05
1996	11,092	11,447	3,886	5,513	57,759	0.10	1996	1.17	1.70	2.10	3.11
1997	13,840	7,531	3,667	14,663	86,242	0.10	1997	1.07	1.70	2.27	3.43
1998	20,408	11,106	5,407	21,622	127,173	0.10	1998	1.07	1.70	2.27	3.43
1999	20,603	11,212	5,459	21,828	128,387	0.05	1999	1.07	1.70	2.27	3.43
2000	25,873	14,080	6,855	27,412	161,228	0.05	2000	1.07	1.70	2.27	3.43
2001	13,383	7,283	3,546	14,179	83,398	0.05	2001	1.07	1.70	2.27	3.43
2002	21,215	6,259	701	3,361	72,839	0.05	2002	2.05	2.04	1.29	4.67
2003	29,041	6,433	933	1,754	54,341	0.05	2003	1.23	1.59	2.17	3.64
2004	28,304	9,928	2,947	3,110	60,553	0.05	2004	1.13	1.44	2.03	2.69
2005	3,868	8,742	806	903	20,724	0.05	2005	1.44	1.23	1.76	3.28
2006	30,620	9,411	2,543	659	76,749	0.05	2006	1.46	2.38	2.60	4.69
2007	27,260	9,448	292	3,572	72,640	0.05	2007	1.63	1.63	2.91	3.36
2008	21,637	9,311	2,601	6,205	69,758	0.05	2008	1.38	1.52	2.12	3.26
2009	11,156	8,321	5,277	18,852	103,080	0.05	2009	0.93	1.80	2.23	3.49
2010	24,335	1,355	482	667	29,222	0.05	2010	0.99	1.70	2.16	2.64
2011	42,215	11,183	4,684	4,972	82,855	0.05	2011	0.98	1.68	2.18	2.51
2012	17,377	17,357	7,271	8,911	88,684	0.05	2012	1.05	1.73	2.15	2.79
2013	24,298	11,447	1,836	7,101	86,529	0.05	2013	1.54	1.91	2.12	3.28
2014	27,472	5,723	1,796	631	64,724	0.05	2014	1.70	1.99	2.05	4.61
2015	31,053	3,669	176	1,054	61,539	0.05	2015	1.59	2.08	2.10	4.03
2016	11,964	17,778	991	2,740	63,875	0.05	2016	1.50	1.78	2.33	4.36
2017	10,331	5,007	1,846	5,322	43,815	0.05	2017	1.37	1.65	2.28	3.22
2018	11,656	9,034	3,678	7,236	60,034	0.05	2018	1.17	1.70	2.18	3.18

Table 11: Annual recreational female southern flounder catch-at-age, yield (pounds) and corresponding ASAP base model input coefficients of variation, and corresponding mean weights-at-age (pounds).

Recreational Catch-at-age							Recreational Mean Weight-at-age				
Year	Age_1	Age_2	Age_3	Age_4+	Yield (lbs)	CV	Year	Age_1	Age_2	Age_3	Age_4+
1982	80,836	39,960	12,905	31,903	282,832	0.22	1982	0.98	1.71	2.10	3.39
1983	129,633	241,428	71,633	118,275	1,032,921	0.59	1983	1.08	1.72	2.09	2.76
1984	42,180	20,502	4,703	8,088	109,952	0.27	1984	1.04	1.64	2.06	2.81
1985	69,832	47,377	10,653	15,317	223,192	0.27	1985	1.12	1.62	2.09	3.02
1986	228,100	76,595	19,804	13,679	438,905	0.45	1986	1.05	1.63	2.02	2.54
1987	26,242	9,676	3,524	4,167	60,974	0.22	1987	0.99	1.69	2.12	2.66
1988	51,041	30,369	11,217	22,384	201,437	0.31	1988	1.09	1.70	2.12	3.14
1989	43,013	32,084	12,657	17,458	180,361	0.26	1989	1.15	1.69	2.16	2.84
1990	85,006	58,748	18,459	23,220	297,160	0.25	1990	1.06	1.68	2.10	2.99
1991	136,067	54,634	15,767	22,702	338,260	0.17	1991	1.07	1.64	2.09	3.08
1992	77,078	54,861	17,816	27,917	296,681	0.17	1992	1.06	1.69	2.10	3.02
1993	68,215	36,448	17,709	22,439	234,139	0.17	1993	1.04	1.74	2.18	2.73
1994	108,558	45,030	17,215	23,324	298,409	0.22	1994	1.07	1.69	2.14	2.98
1995	46,691	29,434	11,351	15,106	165,774	0.17	1995	0.99	1.73	2.11	2.94
1996	74,254	33,593	11,049	21,960	225,907	0.15	1996	1.05	1.67	2.14	3.12
1997	91,486	34,494	14,719	20,152	246,984	0.15	1997	1.08	1.69	2.16	2.90
1998	82,884	28,308	9,226	12,091	188,429	0.16	1998	1.05	1.64	2.14	2.89
1999	148,276	72,300	26,558	35,135	433,814	0.15	1999	1.07	1.70	2.13	2.75
2000	100,468	63,936	26,084	40,840	395,401	0.16	2000	1.07	1.69	2.19	3.00
2001	78,987	53,884	21,953	35,258	332,879	0.17	2001	1.13	1.69	2.17	2.98
2002	140,639	30,072	2,337	321	233,867	0.19	2002	1.24	1.81	1.60	2.32
2003	153,950	77,241	5,047	1,567	316,286	0.17	2003	1.14	1.58	2.74	3.70
2004	112,957	53,945	11,075	5,185	235,849	0.17	2004	1.01	1.48	2.05	3.78
2005	55,577	54,050	14,951	3,915	177,868	0.15	2005	1.09	1.39	1.79	3.93
2006	121,319	19,219	6,485	2,165	215,458	0.13	2006	1.27	2.04	2.16	3.84
2007	108,024	32,540	1,746	1,082	216,852	0.23	2007	1.30	2.07	2.56	4.03
2008	67,276	31,487	2,418	4,397	167,904	0.14	2008	1.25	1.86	2.54	4.37
2009	115,257	41,156	5,534	7,718	275,086	0.17	2009	1.34	1.82	2.06	4.40
2010	109,410	76,395	8,684	13,649	304,277	0.17	2010	1.14	1.55	2.04	3.16
2011	141,020	50,131	4,619	8,113	330,396	0.17	2011	1.36	1.86	2.36	4.35
2012	115,594	59,134	8,474	9,037	297,807	0.16	2012	1.11	1.96	2.49	3.65
2013	197,844	141,503	7,910	8,399	602,434	0.10	2013	1.46	1.89	2.12	3.53
2014	89,507	49,443	19,686	8,704	293,932	0.09	2014	1.42	1.94	2.14	3.26
2015	167,859	25,292	1,407	3,212	256,881	0.09	2015	1.15	1.82	2.58	4.17
2016	85,588	112,465	5,794	6,215	329,094	0.12	2016	1.37	1.56	2.28	3.86
2017	40,876	29,998	13,474	1,732	143,785	0.12	2017	1.49	1.75	1.75	3.84
2018	18,677	18,477	3,400	5,596	82,860	0.10	2018	1.58	1.66	1.71	3.01

Table 12: Probabilities of age given length for age assignments of female southern flounder catches from the LDWF fishery-independent marine trammel net survey.

TL, in	Survey			
	Age 0	Age 1	Age 2	Age 3+
5	1.00	0.00	0.00	0.00
6	1.00	0.00	0.00	0.00
7	1.00	0.00	0.00	0.00
8	1.00	0.00	0.00	0.00
9	1.00	0.00	0.00	0.00
10	1.00	0.00	0.00	0.00
11	1.00	0.00	0.00	0.00
12	1.00	0.00	0.00	0.00
13	0.50	0.50	0.00	0.00
14	0.00	0.97	0.03	0.00
15	0.00	0.72	0.26	0.02
16	0.00	0.10	0.65	0.25
17	0.00	0.00	0.28	0.72
18	0.00	0.00	0.03	0.97
19	0.00	0.00	0.00	1.00
20	0.00	0.00	0.00	1.00
21	0.00	0.00	0.00	1.00
22	0.00	0.00	0.00	1.00
23	0.00	0.00	0.00	1.00
24	0.00	0.00	0.00	1.00
25	0.00	0.00	0.00	1.00
26	0.00	0.00	0.00	1.00

Table 13: Annual female southern flounder catch-at-size from the LDWF fishery-independent marine trammel net survey.

Survey, 1986-2018																	
TL in	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
4																	
5																	
6						1											
7							1	1	1	1			1				1
8	2	1	2	3	3	2	2	5	3	8	5	7	2	2		1	3
9	9	2	2	2	4	4	5	6	6	6	7	1	5	4	1	3	3
10	5	2	3		2	5	2	5	2	5	3	2	4	4	1	5	2
11	6	1	1	1	3	4	4	5	7	4	1	4	5	3	4	5	1
12		3	2	2	2	4	2	5	5	2	3	1	3	1	3	2	4
13	2	1	2	3	2	5			4	2		2	2	3	1	3	
14	1	1	2		1	2		1	2	3	3	2	2				
15			2	1		4		2	1	2	3		3	1	2		2
16	2	1	1		1	4	2	3	2		2			1	2		
17	1	1	1			2		1	1		2	1		2			2
18	1					1				1	1	1		2	2		
19						1			1		1						
20	1					1			1								1
21						1											
22														1			
23																	
24																	
Totals	30	13	18	12	18	41	18	34	36	36	30	21	27	24	16	19	19

TL in	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
4																
5																
6																
7							1	1								
8	4	2	3	2	1	2	3	5	4	7	1	1	1	1		
9	4	2	9	5	5	3		7	10	8	2	3	4	1		1
10	6	9	3	3	4	6		12	9	7	3	3	1	2		1
11	2	4	6		3	3	3	10	3	3	4	7		1		2
12	1	1	3	2	3	2	2	11	3	2		1	7	1	1	2
13	1	4	1	1	1		2	3	2	2	1		1	3		
14	2	1			2	1	1	2	2	3	1	2	2			
15	1	1	3	1		4	1	3	5	1			1		1	
16	2	1		2	1			5	3				2			
17			2	1				1	1				1			1
18	1			1	1					1						
19		1				1			1		1					
20								2		1						
21																
22																
23																
24																
Totals	24	26	30	18	18	22	13	62	43	35	13	17	20	9	2	7

Table 14: Annual female southern flounder survey age composition and sample sizes derived from the LDWF fishery-independent marine trammel net survey.

Year	n	Age_0	Age_1	Age_2	Age_3+
1986	30	0.770	0.070	0.050	0.110
1987	13	0.750	0.110	0.070	0.070
1988	17	0.610	0.240	0.080	0.060
1989	12	0.810	0.170	0.020	0.000
1990	17	0.840	0.110	0.040	0.010
1991	40	0.540	0.190	0.100	0.160
1992	16	0.870	0.010	0.080	0.030
1993	33	0.790	0.080	0.080	0.040
1994	36	0.730	0.130	0.050	0.090
1995	35	0.760	0.140	0.030	0.070
1996	28	0.610	0.190	0.090	0.110
1997	20	0.760	0.140	0.020	0.080
1998	27	0.780	0.190	0.030	0.000
1999	23	0.630	0.100	0.070	0.200
2000	16	0.590	0.140	0.120	0.160
2001	19	0.920	0.080	0.000	0.000
2002	18	0.720	0.080	0.060	0.140
2003	24	0.730	0.140	0.070	0.060
2004	25	0.770	0.140	0.040	0.050
2005	29	0.810	0.090	0.050	0.050
2006	18	0.690	0.080	0.100	0.120
2007	18	0.750	0.140	0.040	0.070
2008	22	0.730	0.170	0.050	0.050
2009	13	0.770	0.200	0.020	0.000
2010	60	0.760	0.100	0.070	0.070
2011	43	0.700	0.160	0.080	0.060
2012	35	0.810	0.130	0.010	0.060
2013	11	0.780	0.130	0.000	0.090
2014	16	0.880	0.110	0.000	0.000
2015	20	0.670	0.170	0.090	0.060
2016	9	0.830	0.170	0.000	0.000
2017	2	0.500	0.360	0.130	0.010
2018	7	0.850	0.000	0.040	0.110

Table 15: Summary of objective function components and likelihood values of the ASAP base model.

Objective function=	2445.31		
Component	Lambda	ESS	negLL
<u>Catch Recreational</u>	1	--	-46.2
<u>Catch Commercial</u>	1	--	-92.4
<u>IOA trammel</u>	1	--	-7.6
<u>IOA trawl</u>	1	--	4.1
<u>Catch agecomps</u>	--	2100	2243.3
<u>IOA agecomps</u>	--	320	279.5
<u>Selectivity parms catch</u>	10	--	5.3
<u>Selectivity parms index</u>	4	--	0.76
<u>N_year_1</u>	1	--	51.7
<u>Recruitment devs</u>	1	--	6.7

Table 16: Annual female southern flounder abundance-at-age and total female stock size estimates from the ASAP base model.

Year	Age_1	Age_2	Age_3	Age_4+	Totals
1982	1,129,640	400,938	177,528	155,317	1,863,423
1983	1,855,670	474,977	182,938	152,572	2,666,157
1984	1,589,230	719,678	197,438	137,285	2,643,631
1985	975,133	701,367	339,307	153,352	2,169,159
1986	1,127,060	400,957	299,960	196,170	2,024,147
1987	1,861,360	416,289	144,944	148,775	2,571,368
1988	1,124,060	722,623	152,683	81,722	2,081,088
1989	1,167,110	447,746	291,599	83,813	1,990,268
1990	1,416,220	469,490	183,590	139,282	2,208,582
1991	1,899,860	560,466	192,059	120,927	2,773,312
1992	957,210	721,509	213,253	103,243	1,995,215
1993	1,179,200	343,035	250,052	89,973	1,862,260
1994	1,831,900	398,698	106,040	79,150	2,415,788
1995	1,286,220	593,253	114,213	36,331	2,030,017
1996	1,315,450	487,731	219,863	47,033	2,070,077
1997	1,204,460	560,211	233,782	136,705	2,135,158
1998	1,131,560	508,626	266,123	189,842	2,096,151
1999	866,997	483,276	244,334	236,834	1,831,441
2000	654,364	317,243	197,988	213,945	1,383,540
2001	493,821	213,705	115,484	163,028	986,038
2002	859,481	149,802	72,162	102,556	1,184,001
2003	907,769	312,577	61,018	77,583	1,358,948
2004	1,178,410	323,354	124,636	60,168	1,686,568
2005	609,152	463,800	142,866	87,889	1,303,707
2006	1,045,800	253,541	217,213	116,629	1,633,183
2007	905,111	438,991	119,717	169,870	1,633,689
2008	784,679	378,300	206,367	148,389	1,517,735
2009	723,331	339,318	184,147	186,720	1,433,516
2010	853,143	277,809	146,098	173,408	1,450,458
2011	895,335	316,379	115,523	144,500	1,471,737
2012	794,608	328,549	129,992	116,316	1,369,465
2013	587,776	277,887	128,451	104,417	1,098,531
2014	398,456	138,326	72,278	65,598	674,658
2015	908,895	118,957	45,950	49,674	1,123,476
2016	423,709	328,346	48,114	42,029	842,198
2017	235,085	116,395	100,139	29,801	481,420
2018	94,153	79,929	44,191	52,849	271,122

Table 17: Annual age-specific, apical, and average fishing mortality rates for female southern flounder estimated from the ASAP base model.

Year	Age 1	Age 2	Age 3	Age 4+	Apical F	Avg. F
1982	0.15	0.19	0.25	0.29	0.29	0.18
1983	0.23	0.29	0.35	0.42	0.42	0.26
1984	0.10	0.16	0.24	0.31	0.31	0.14
1985	0.17	0.26	0.37	0.47	0.47	0.25
1986	0.28	0.43	0.62	0.80	0.80	0.41
1987	0.23	0.41	0.66	0.89	0.89	0.32
1988	0.21	0.32	0.47	0.60	0.60	0.28
1989	0.20	0.30	0.44	0.57	0.57	0.27
1990	0.21	0.30	0.42	0.53	0.53	0.27
1991	0.25	0.38	0.54	0.69	0.69	0.32
1992	0.31	0.47	0.68	0.87	0.87	0.44
1993	0.37	0.58	0.87	1.14	1.14	0.51
1994	0.41	0.66	0.99	1.30	1.30	0.51
1995	0.26	0.40	0.60	0.78	0.78	0.33
1996	0.14	0.14	0.14	0.14	0.14	0.14
1997	0.15	0.15	0.15	0.15	0.15	0.15
1998	0.14	0.14	0.14	0.14	0.14	0.14
1999	0.29	0.30	0.30	0.30	0.30	0.30
2000	0.41	0.42	0.42	0.42	0.42	0.41
2001	0.48	0.49	0.50	0.49	0.50	0.49
2002	0.30	0.31	0.31	0.31	0.31	0.30
2003	0.32	0.33	0.33	0.33	0.33	0.32
2004	0.22	0.23	0.23	0.22	0.23	0.22
2005	0.16	0.17	0.17	0.17	0.17	0.17
2006	0.15	0.16	0.16	0.16	0.16	0.16
2007	0.16	0.16	0.16	0.16	0.16	0.16
2008	0.12	0.13	0.13	0.13	0.13	0.13
2009	0.24	0.25	0.25	0.25	0.25	0.25
2010	0.28	0.29	0.29	0.29	0.29	0.28
2011	0.29	0.30	0.30	0.30	0.30	0.29
2012	0.34	0.35	0.35	0.35	0.35	0.34
2013	0.73	0.76	0.76	0.75	0.76	0.74
2014	0.49	0.51	0.51	0.51	0.51	0.50
2015	0.30	0.31	0.31	0.31	0.31	0.31
2016	0.58	0.60	0.60	0.59	0.60	0.59
2017	0.36	0.38	0.38	0.38	0.38	0.37
2018	0.43	0.45	0.45	0.44	0.45	0.44

Table 18: Limit and target reference point estimates for the Louisiana female southern flounder stock. Spawning stock biomass units are pounds $\times 10^6$. Fishing mortality units are year⁻¹.

Management Benchmarks		
Parameters	Derivation	Value
SPR_{limit}	Proposed Limit	20.0%
SSB_{limit}	Equation [26] and SPR_{limit}	0.454
F_{limit}	Equation [26] and SPR_{limit}	0.918
SSB_{target}	LAC 76: VII.385 (Geometric mean SSB 1982-2013)	1.24
SPR_{target}	Equation [26] and SSB_{target}	54.8%
F_{target}	Equation [26] and SSB_{target}	0.243

Table 19: Sensitivity analysis table of proposed limit reference points. Current estimates are taken as the geometric mean of the 2016-2018 estimates. Yield and spawning stock biomass units are millions of pounds, and fishing mortality units are years⁻¹.

Model run	$negLL$	SPR_{limit}	$Yield_{limit}$	F_{limit}	SSB_{limit}	$SPR_{current}$	$F_{current}/F_{limit}$	$SSB_{current}/SSB_{limit}$
Base Model ($h=1$)	2445.3	20.0%	0.77	0.92	0.45	18.7%	0.50	0.94
Model 1 ($h=0.9$)	2455.5	20.0%	0.65	0.90	0.39	16.0%	0.71	0.77
Model 2 ($h=0.8$)	2439.1	20.0%	0.61	0.91	0.36	19.4%	0.62	0.96
Model 3 ($h=0.7$)	2434.3	20.0%	0.48	0.91	0.28	20.8%	0.71	1.08
Model 4 (Yield $\lambda_{bas} \times 10$)	1021.4	20.0%	0.79	0.91	0.47	22.4%	0.37	1.12
Model 5 (IOA $\lambda_{bas} \times 10$)	1981.0	20.0%	0.67	0.90	0.40	11.8%	1.56	0.59
Model 6 (Maturity 2015)	2445.3	20.0%	0.77	0.92	0.45	16.7%	0.50	0.84
Model 7 (Trawl IOA only)	2169.6	20.0%	0.70	0.90	0.42	20.2%	0.46	1.01
Model 8 (Discard $M=0.2$)	2457.8	20.0%	0.72	0.90	0.43	15.5%	0.65	0.78
Model 9 (Growth Model ALKs 1982-2018)	2774.2	20.0%	1.11	0.92	0.77	35.5%	0.17	1.77
Model 10 (ACAL MRIP hindcast)	2437.2	20.0%	0.77	0.91	0.46	17.2%	0.53	0.86
Model 11 (MRIP Size with FES APAIS)	2457.5	20.0%	0.68	0.90	0.40	15.2%	0.70	0.76

Table 20: Sensitivity analysis table of MSY related reference points. Current estimates are taken as the geometric mean of 2016-2018 estimates. Yield and spawning stock biomass units are millions of pounds, and fishing mortality units are years⁻¹.

Model run	$negLL$	SPR_{MSY}	MSY	F_{MSY}	SSB_{MSY}	$SPR_{current}$	$F_{current}/F_{MSY}$	$SSB_{current}/SSB_{MSY}$
Base Model ($h=1$)	2445.3	—	—	—	—	18.7%	—	—
Model 1 ($h=0.9$)	2455.5	11.8%	0.69	1.54	0.21	16.0%	0.41	1.45
Model 2 ($h=0.8$)	2439.1	21.9%	0.61	0.83	0.41	19.4%	0.68	0.85
Model 3 ($h=0.7$)	2434.3	30.4%	0.54	0.58	0.57	20.8%	1.12	0.54

11. Figures

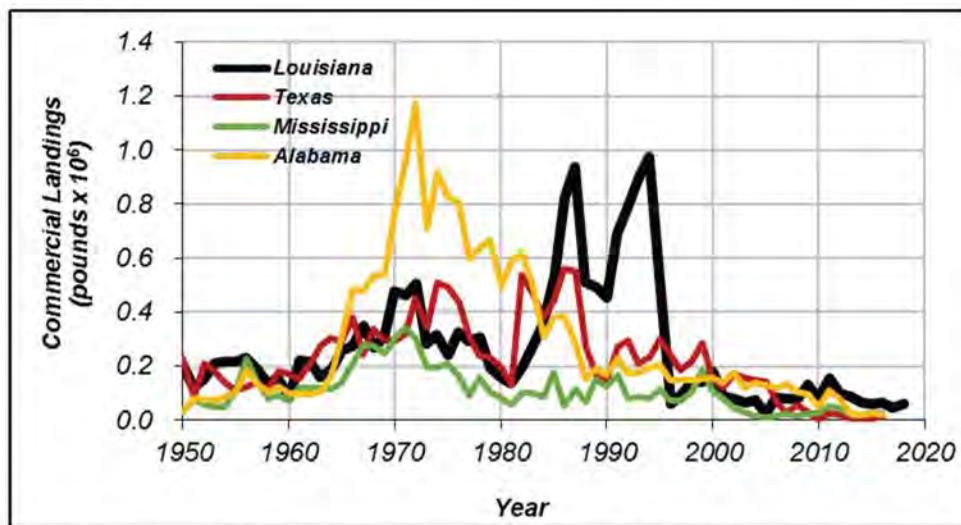


Figure 1: Reported commercial flatfish landings (pounds x 10⁶) of the northern Gulf of Mexico derived from NMFS statistical records and the LDWF Trip Ticket Program. (Note: NOAA did not distinguish between southern flounder and other flatfish species prior to 2000 in Louisiana).

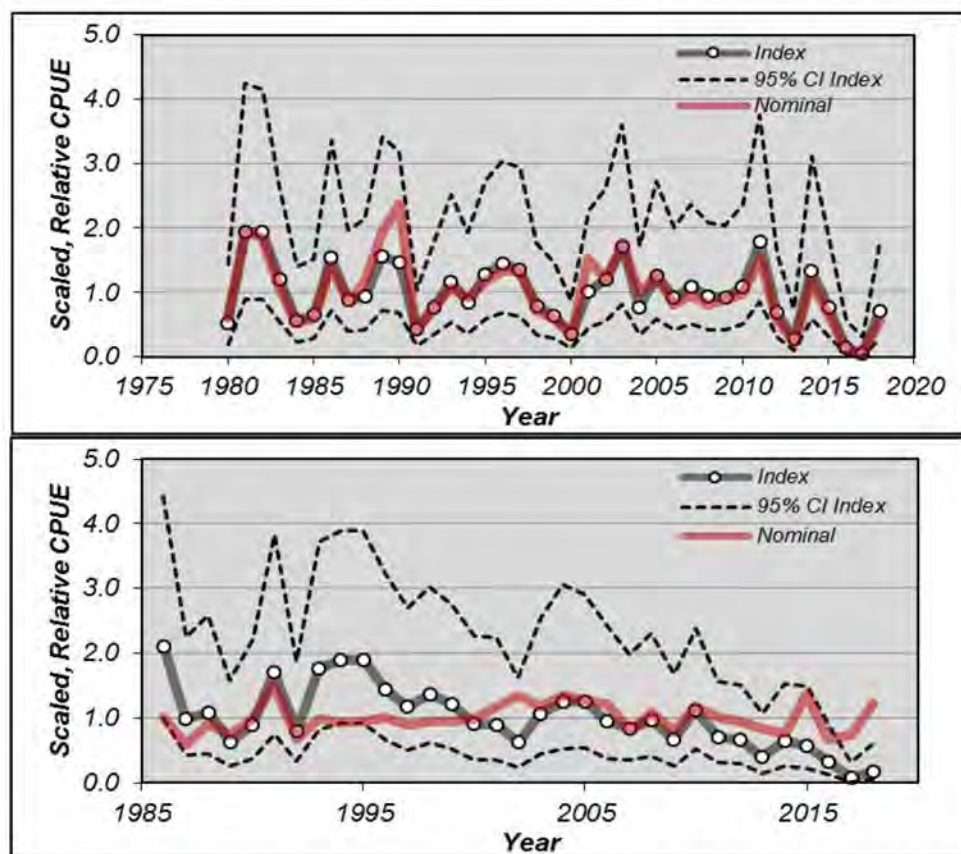


Figure 2: Standardized indices of abundance, nominal catch-per-unit-efforts, and 95% confidence intervals of the standardized indices derived from the LDWF marine inshore trawl (top) and trammel net (bottom) surveys. Each time-series has been normalized to its individual long-term mean for comparison.

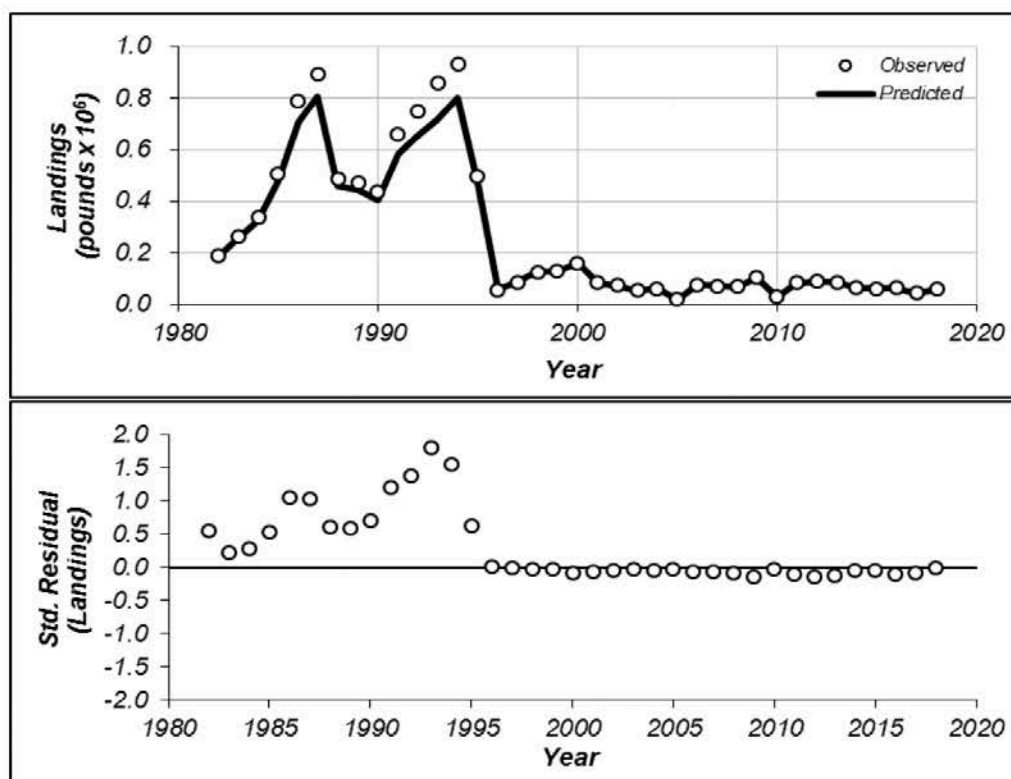


Figure 3: Observed and ASAP base model estimated commercial yield (top) and standardized residuals (bottom).

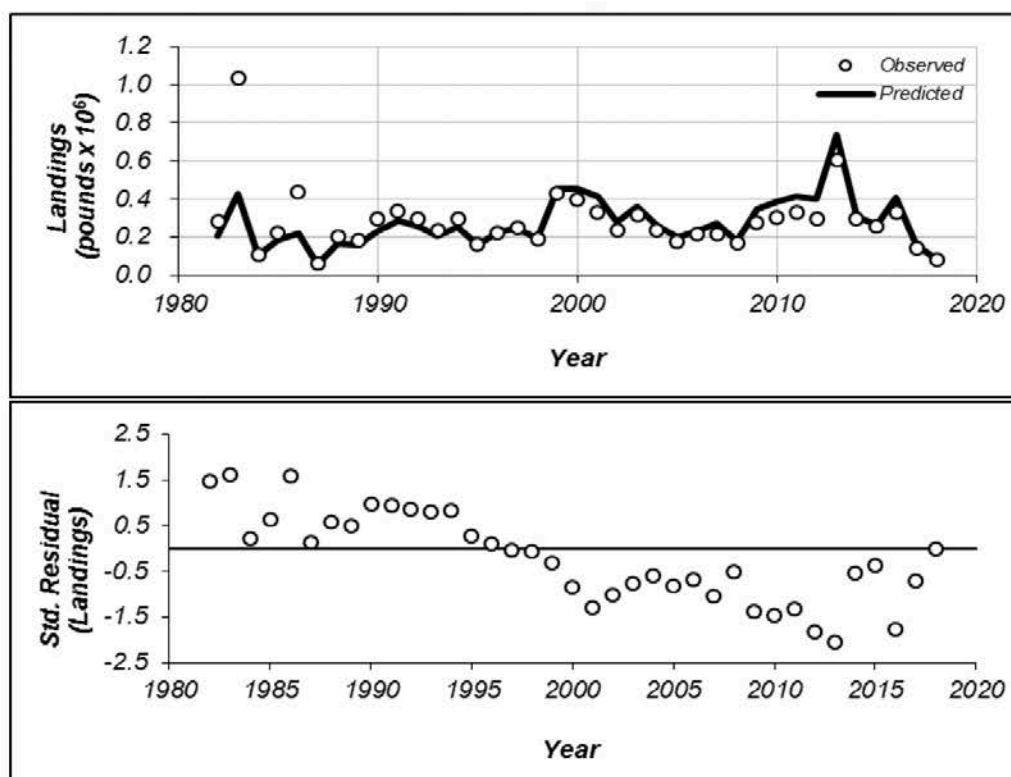


Figure 4: Observed and ASAP base model estimated recreational yield (top) and standardized residuals (bottom).

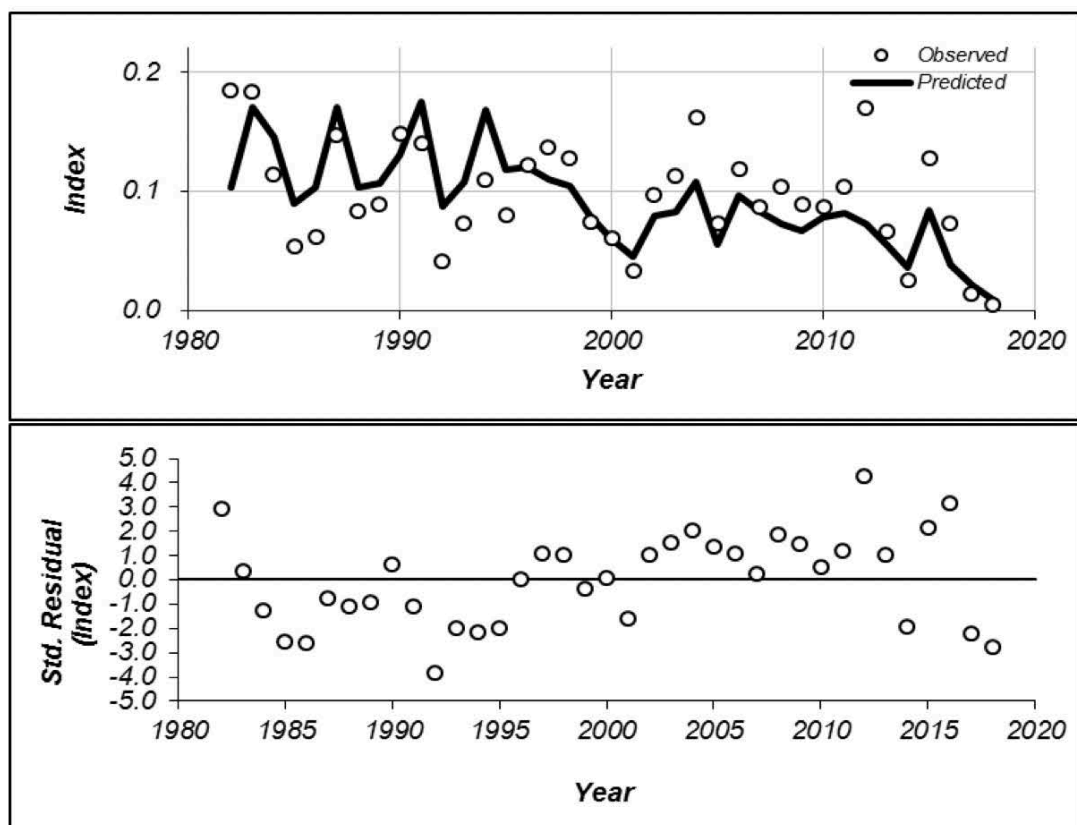


Figure 5: Observed and ASAP base model estimated age-1 trawl survey CPUE (top) and standardized residuals (bottom).

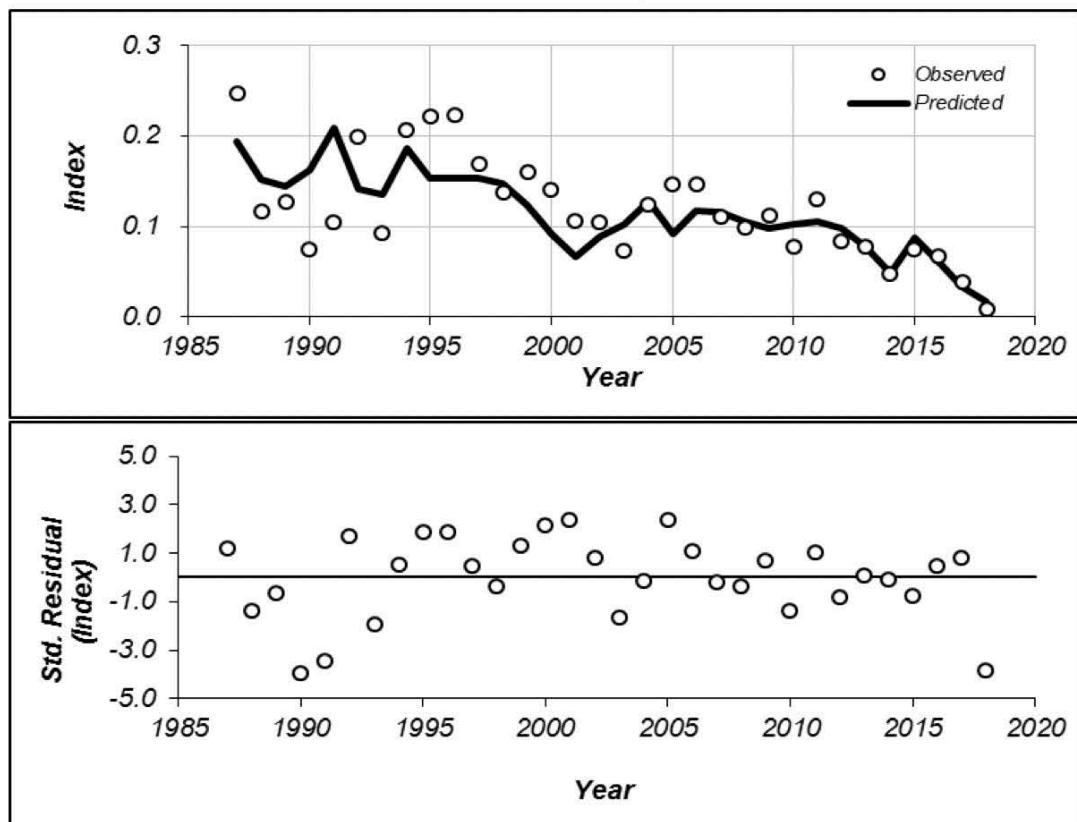


Figure 6: Observed and ASAP base model estimated trammel net survey CPUE (top) and standardized residuals (bottom).

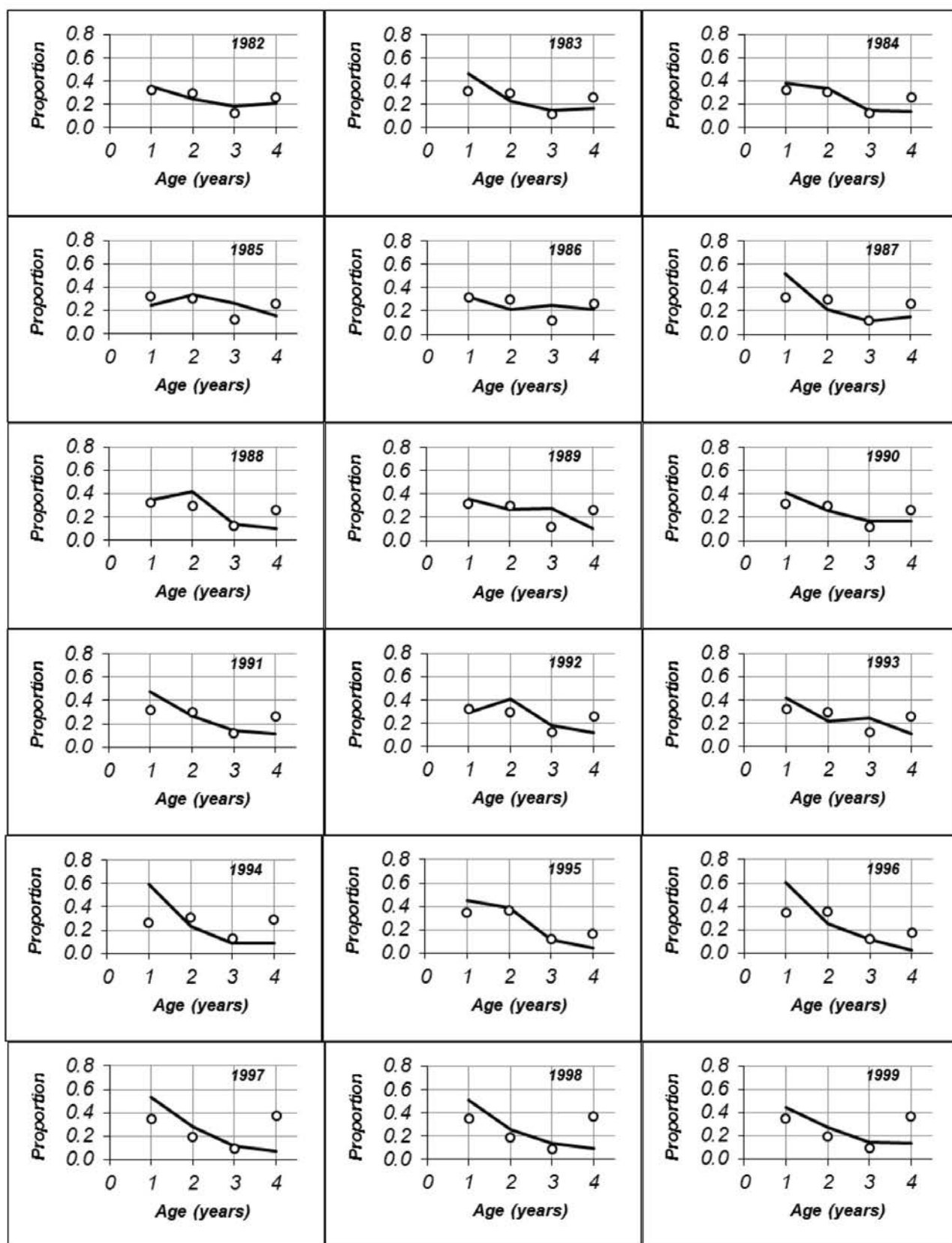


Figure 7: Annual input (open circles) and ASAP estimated (bold lines) commercial female southern flounder harvest age compositions.

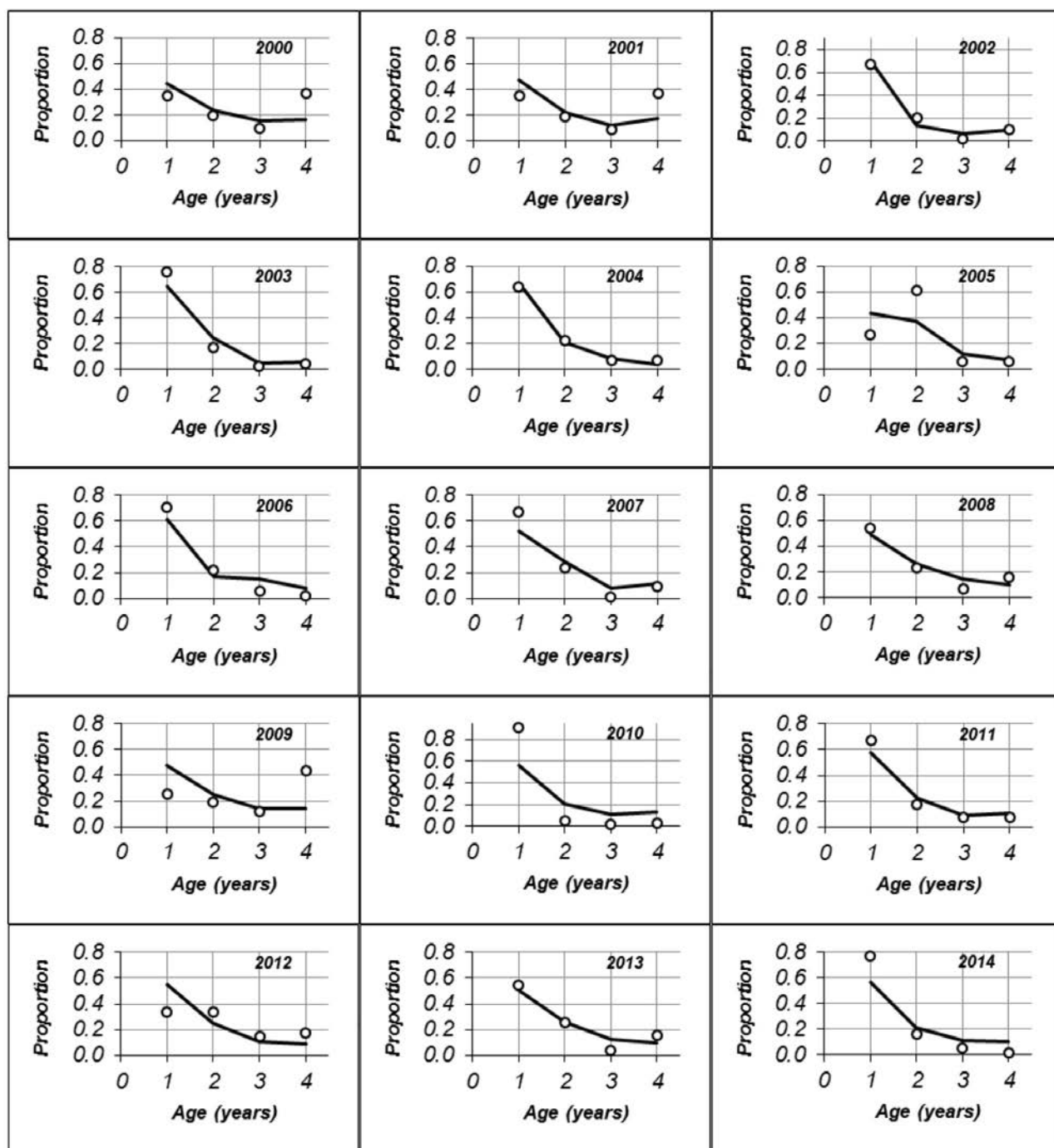


Figure 7 (continued)

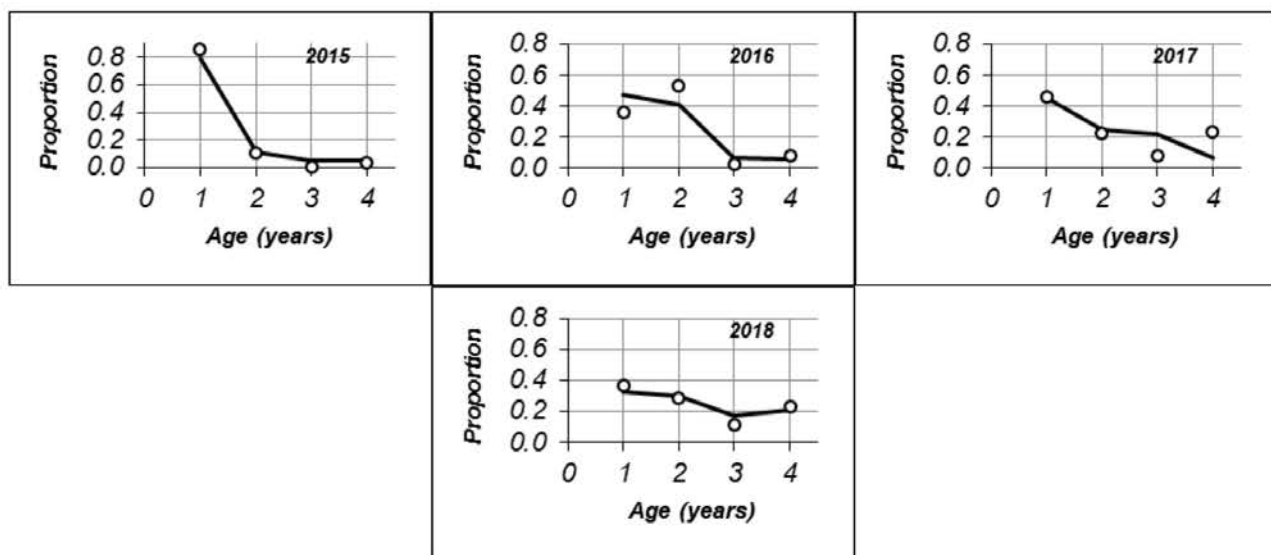


Figure 7 (continued)

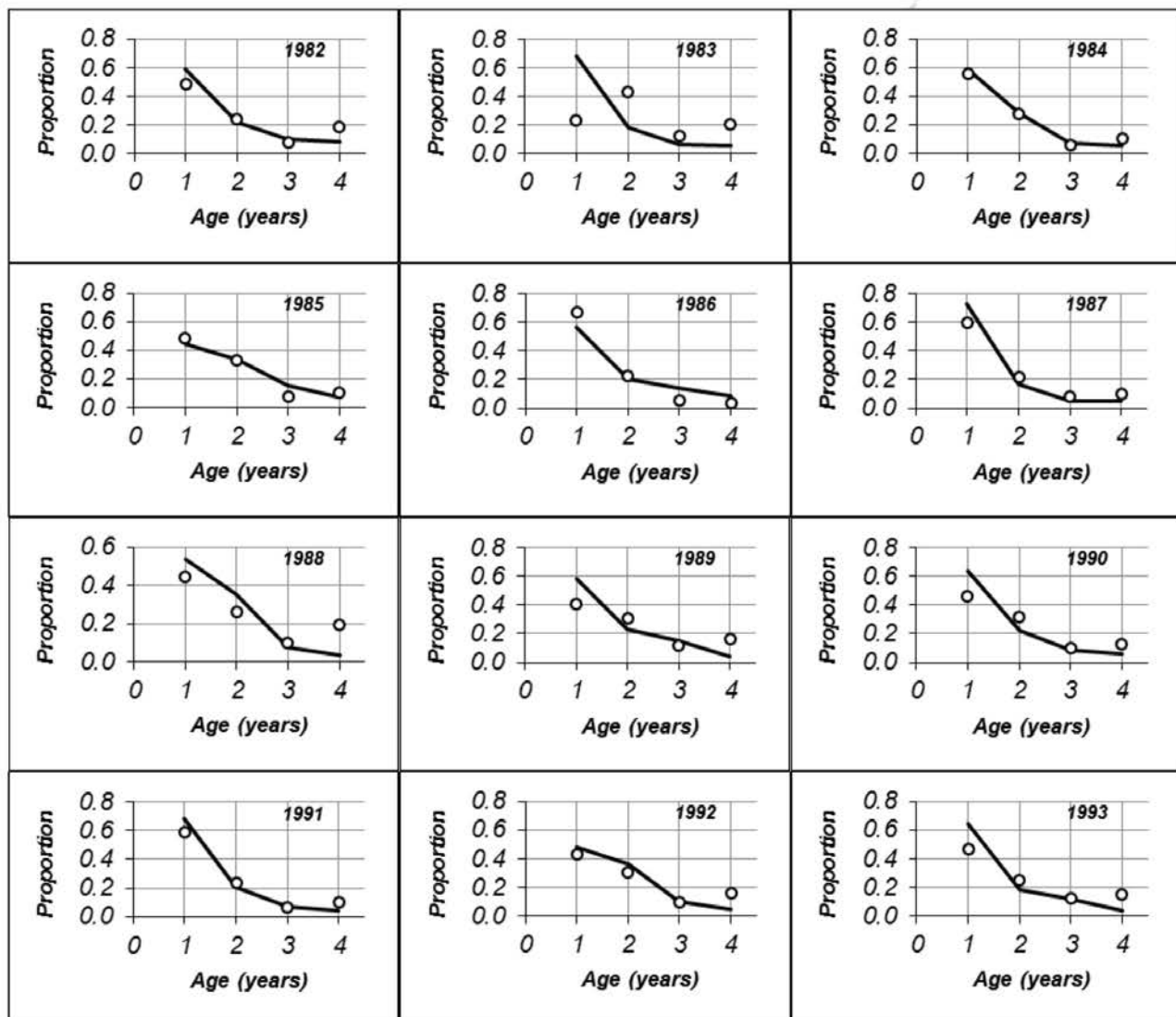


Figure 8: Annual input (open circles) and ASAP estimated (bold lines) recreational female southern flounder harvest age compositions.

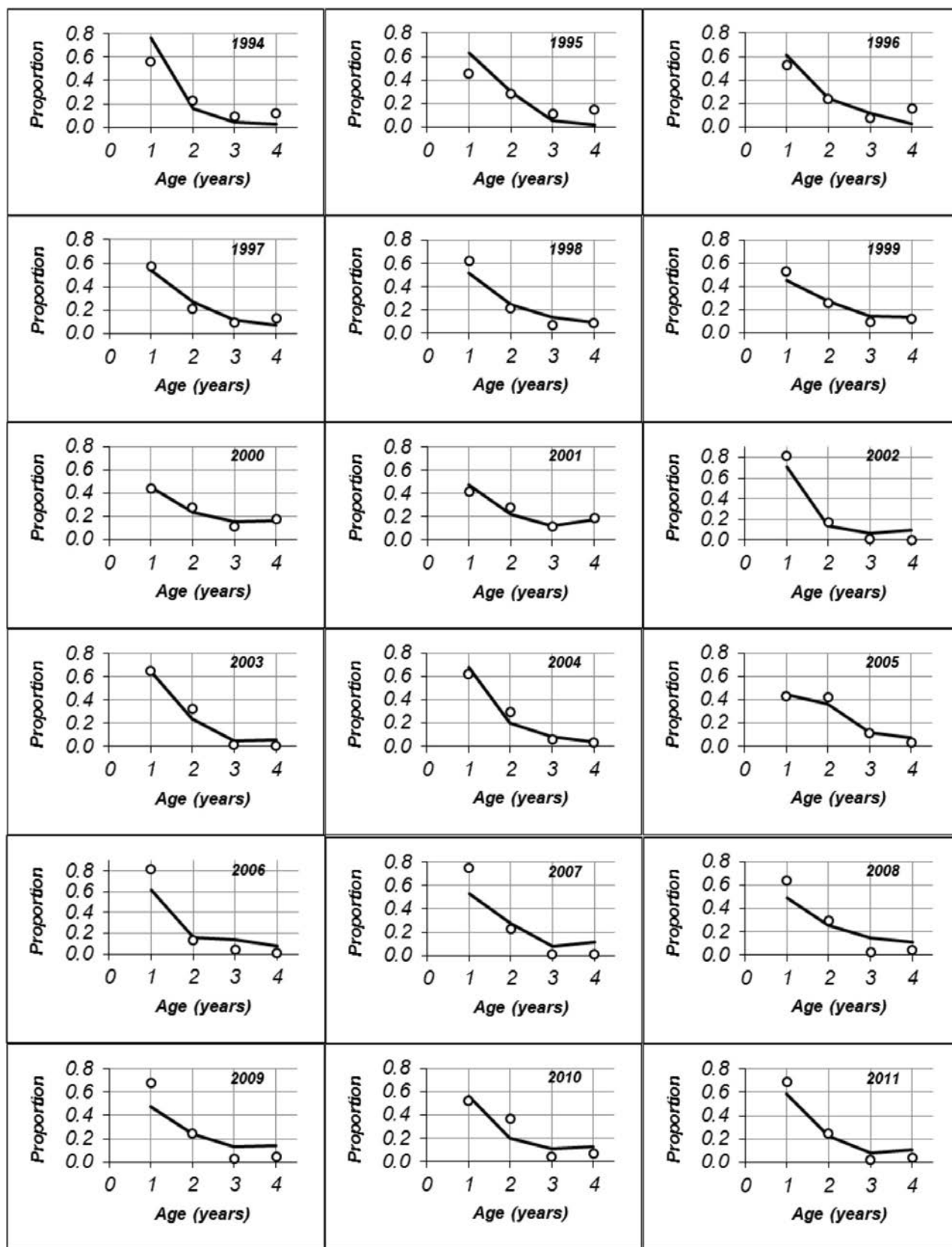


Figure 8 (continued)

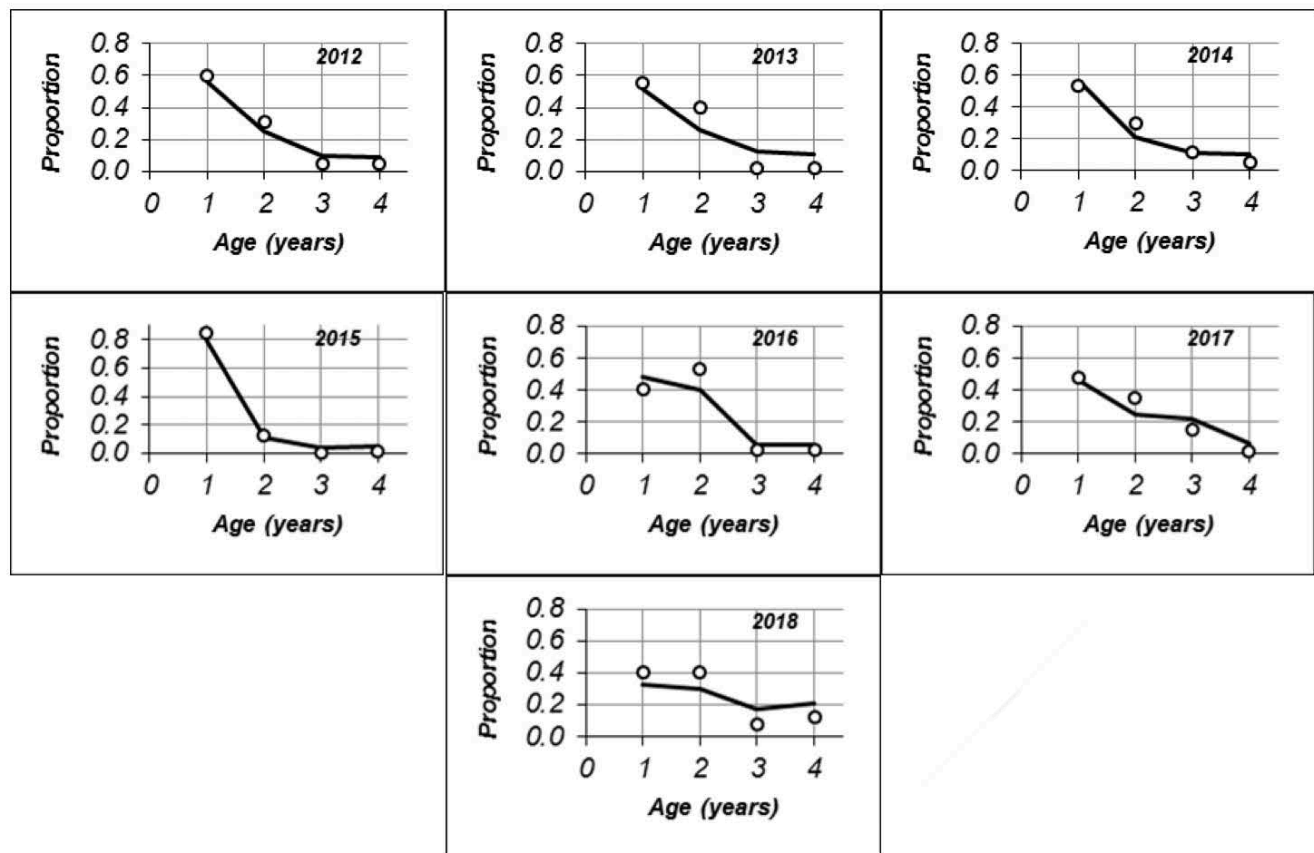


Figure 8 (continued)

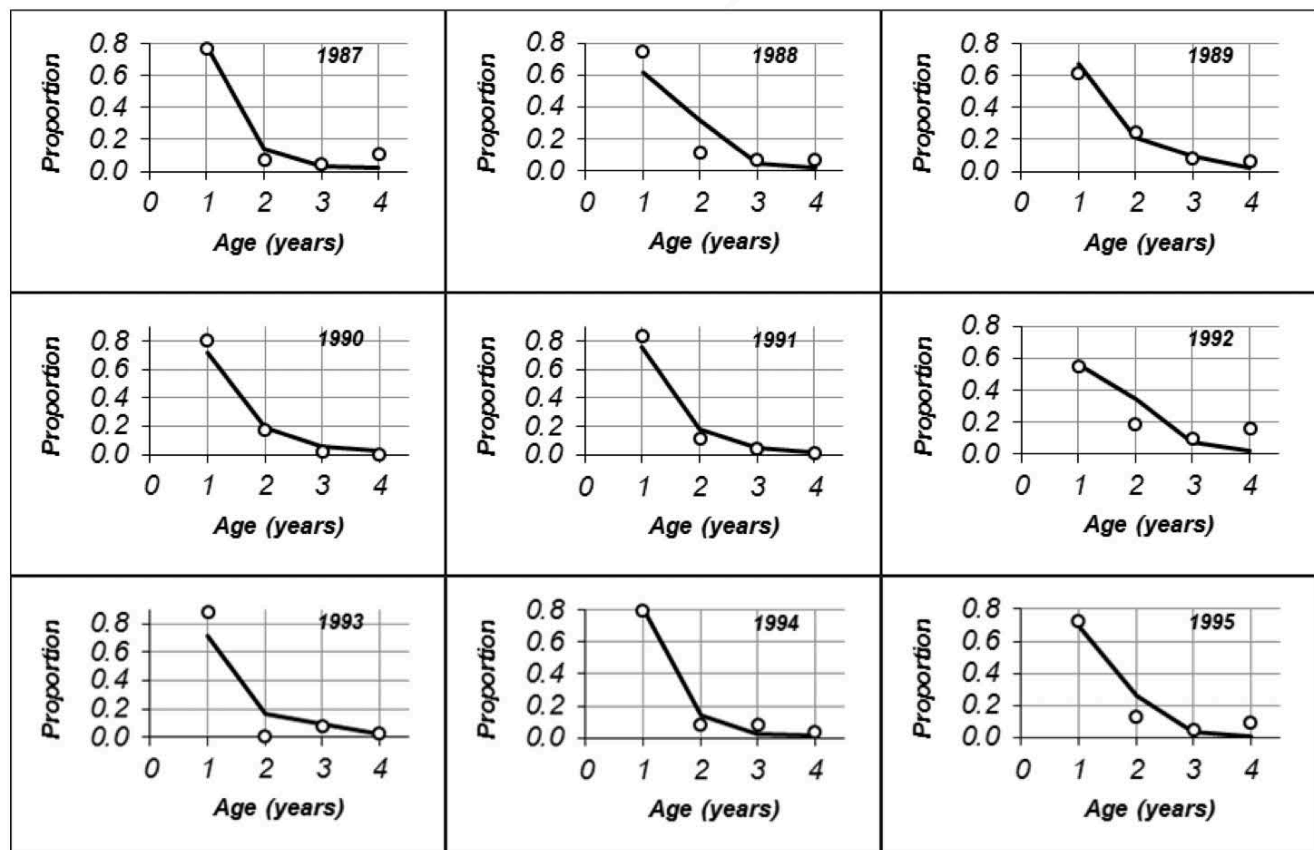


Figure 9: Annual input (open circles) and ASAP estimated (bold lines) trammel net survey female southern flounder age compositions.

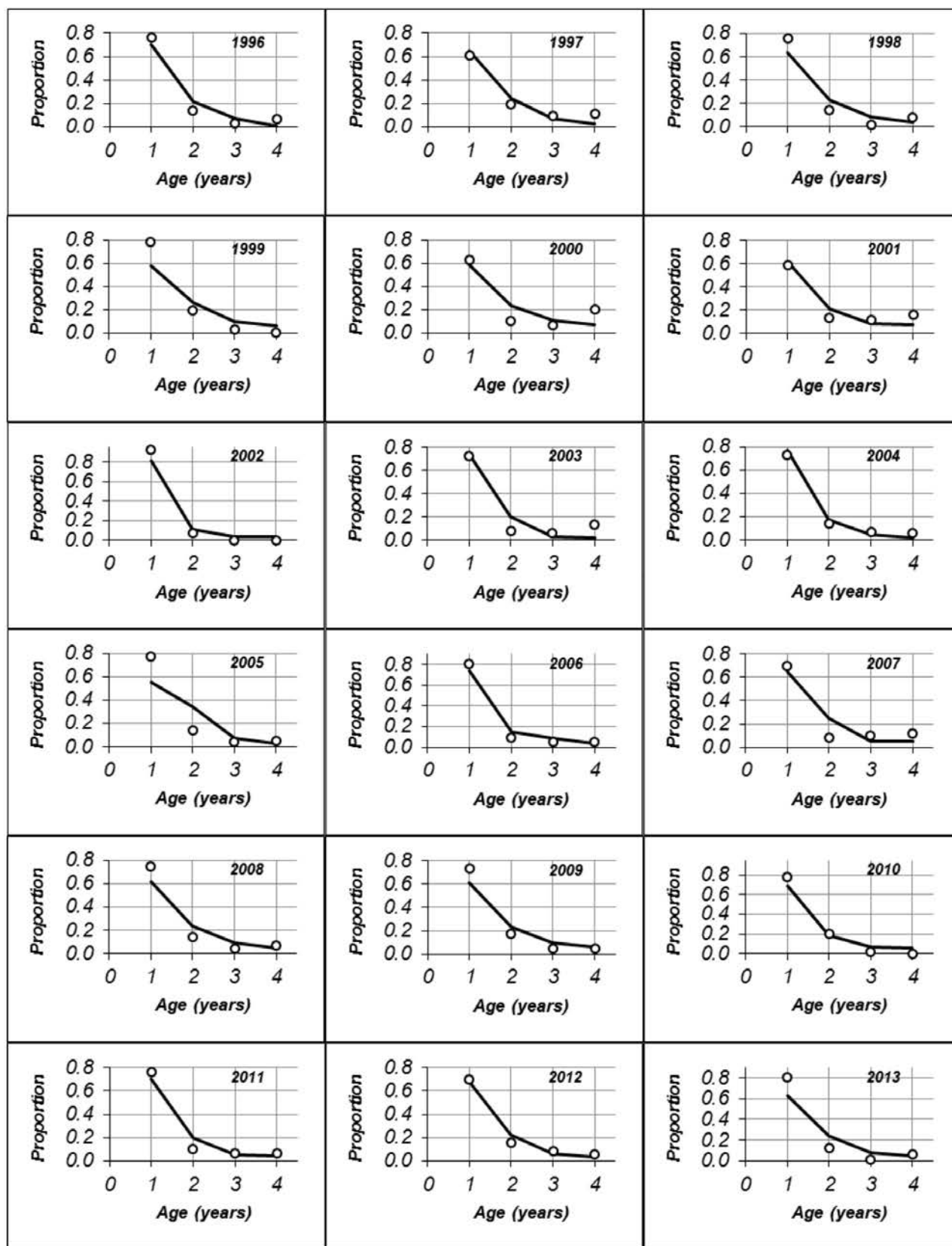


Figure 9 (continued)

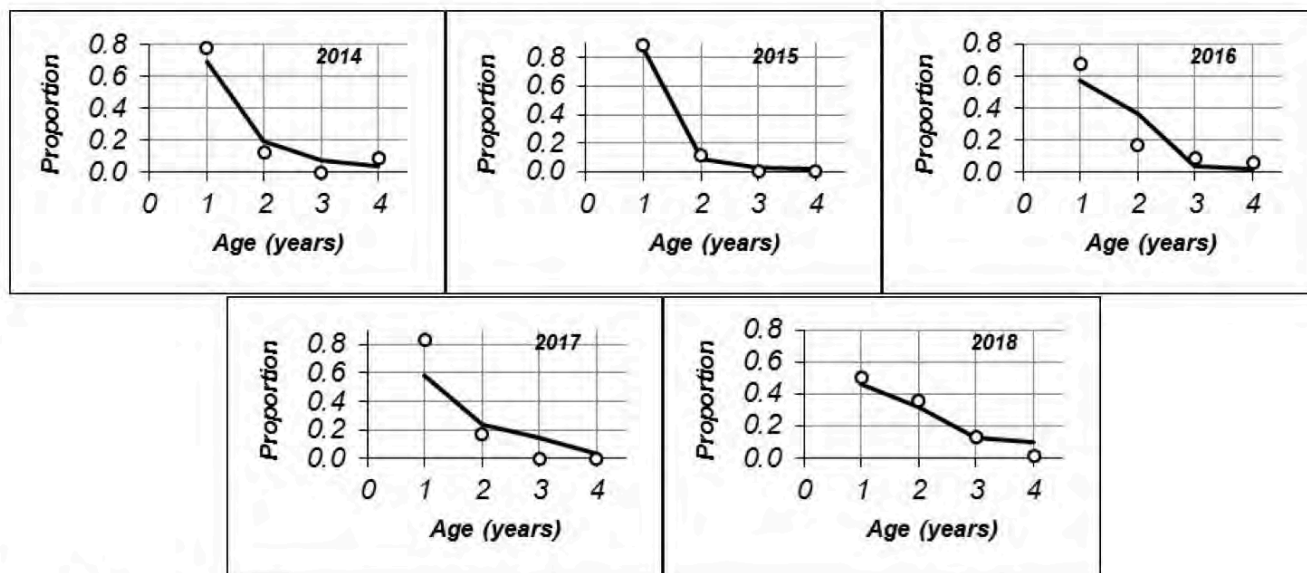


Figure 9 (continued)

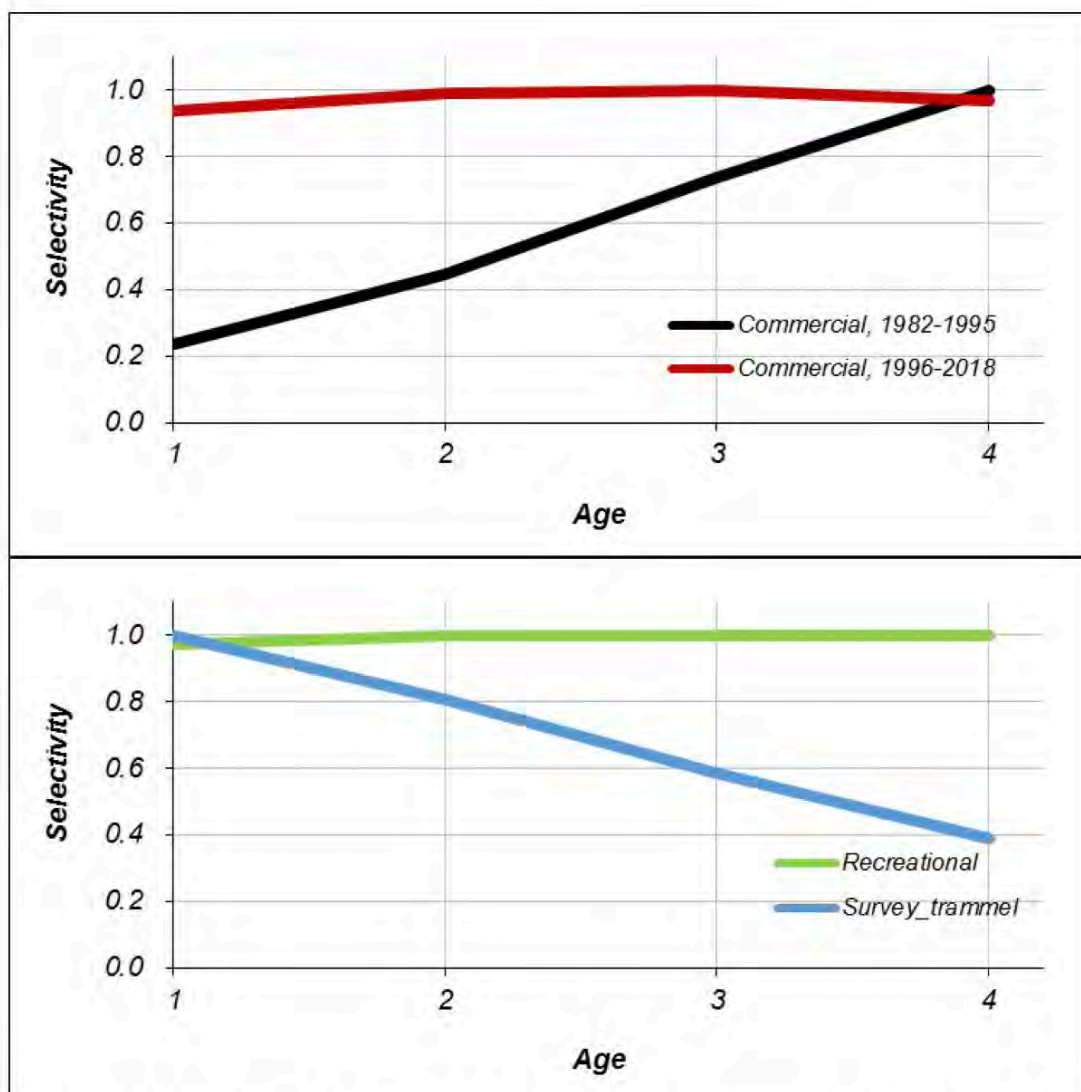


Figure 10: ASAP base model estimated commercial (top), and recreational and survey (bottom) selectivities (ages 1-4+).

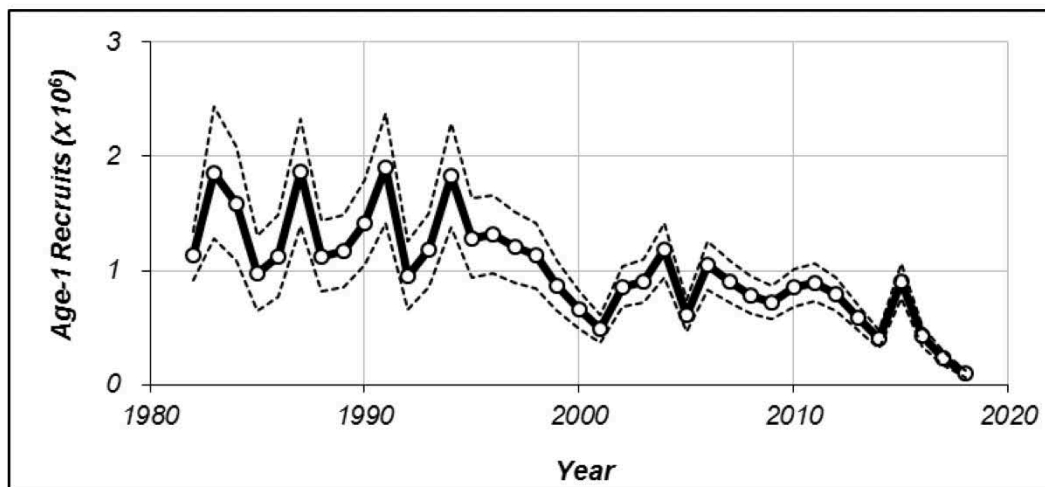


Figure 11: ASAP base model estimated age-1 female recruitment. Dashed lines represent ± 2 asymptotic standard errors.

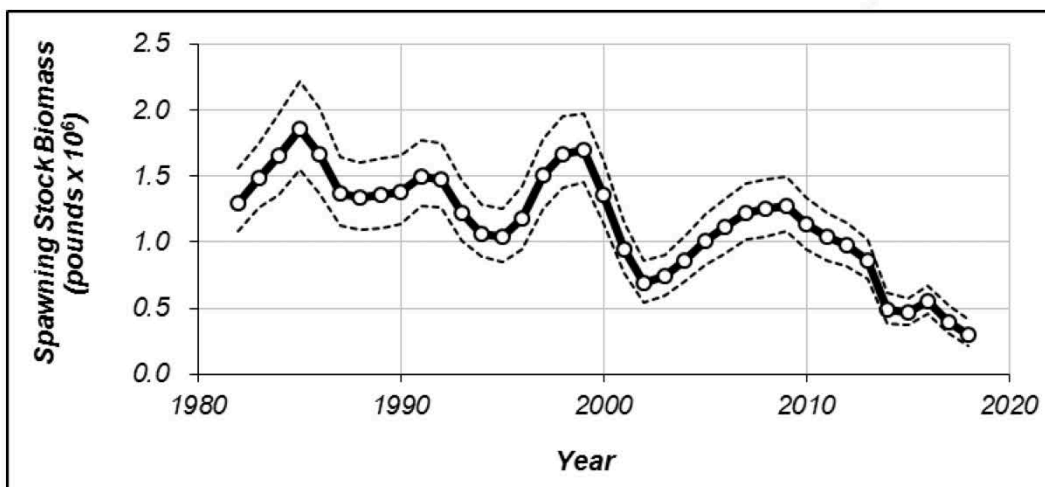


Figure 12: ASAP base model estimated female spawning stock biomass (MCMC median). Dashed lines represent 95% MCMC derived confidence intervals.

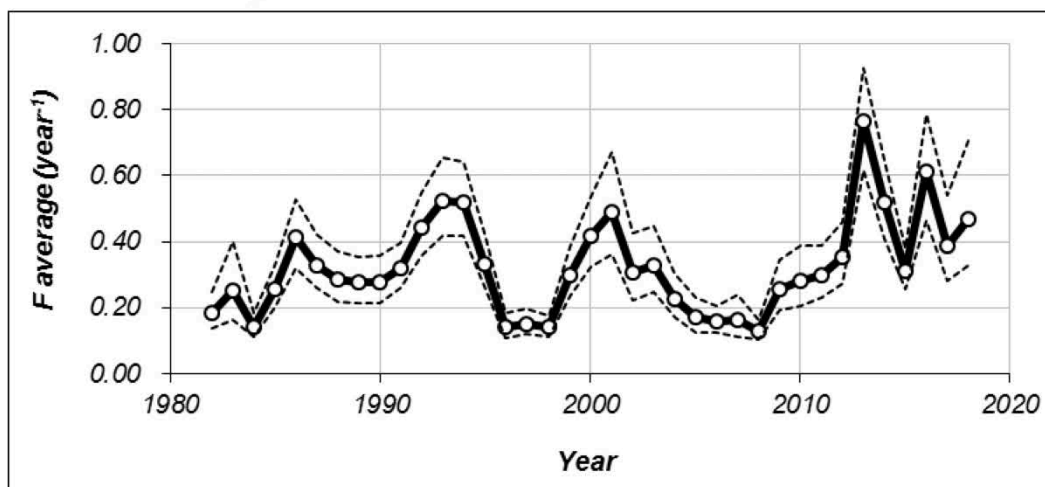


Figure 13: ASAP base model estimated average fishing mortality rates (MCMC median). Dashed lines represent 95% MCMC derived confidence intervals.

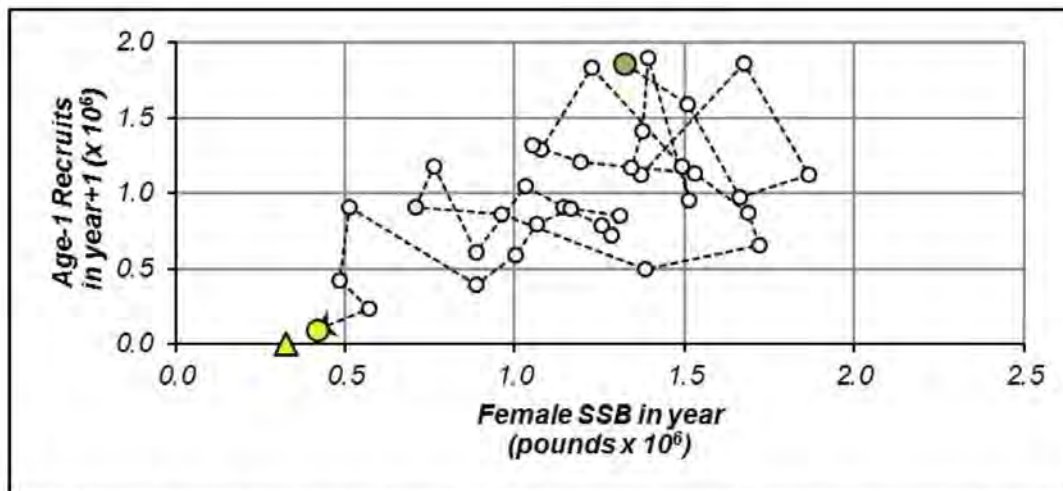


Figure 14: ASAP base model estimated age-1 female recruits and female spawning stock biomass. Arrow represents direction of the time-series. The yellow circle represents the most current data pair (2018 age-1 female recruits / 2017 female SSB) and the yellow triangle represents the 2018 SSB estimate. The green circle represents the first data pair (1983 age-1 female recruits / 1982 female SSB).

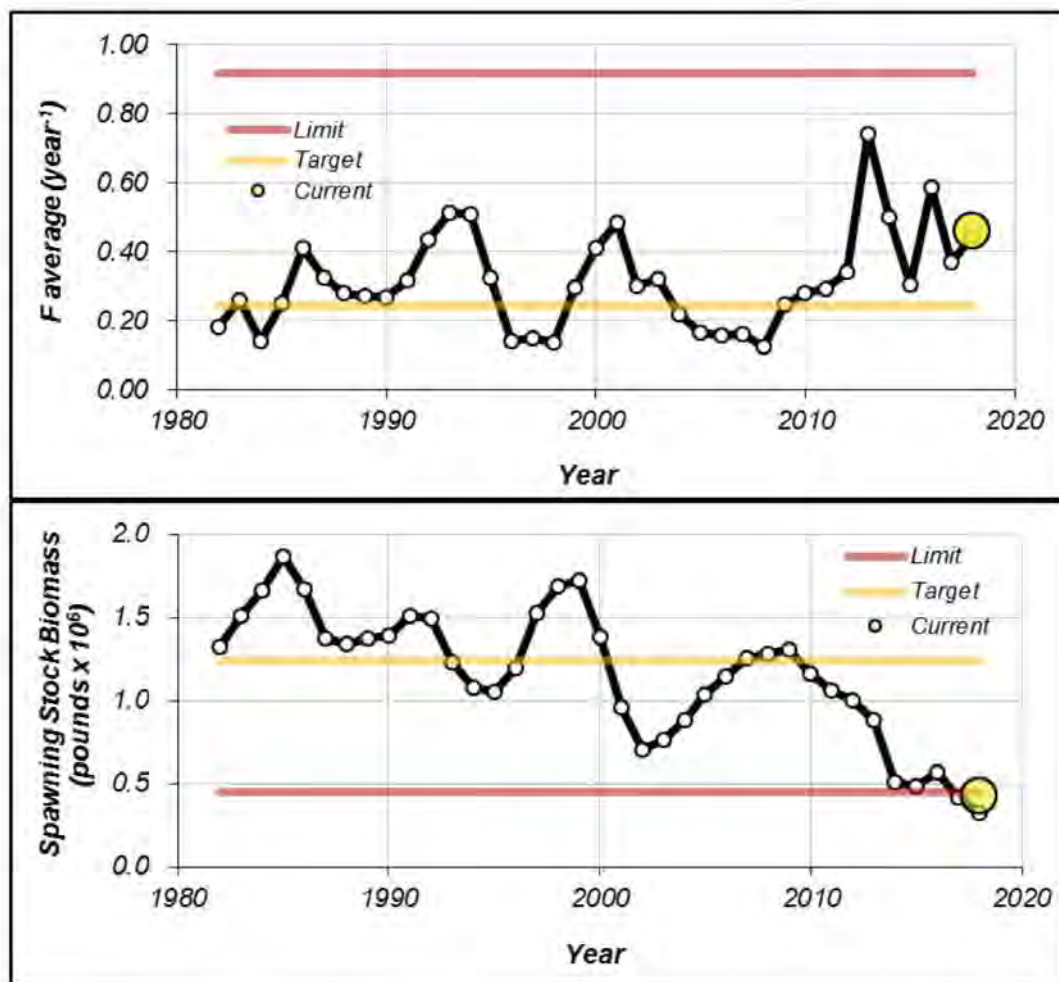


Figure 15: Time-series of ASAP base model estimated average fishing mortality rates, female spawning stock biomass, and spawning potential ratios relative to proposed limit and established target reference points. Current values represent the geometric mean of the 2016-2018 estimates.

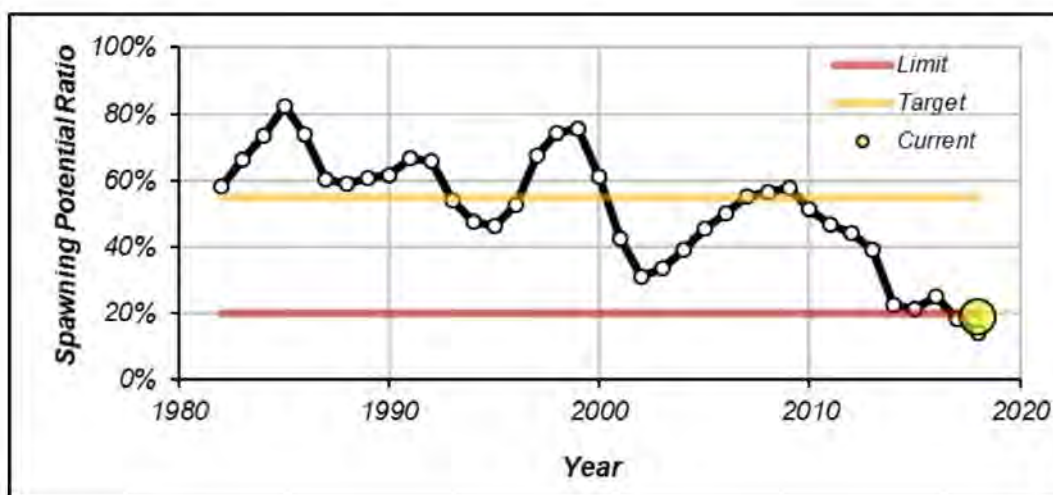


Figure 15 (continued)

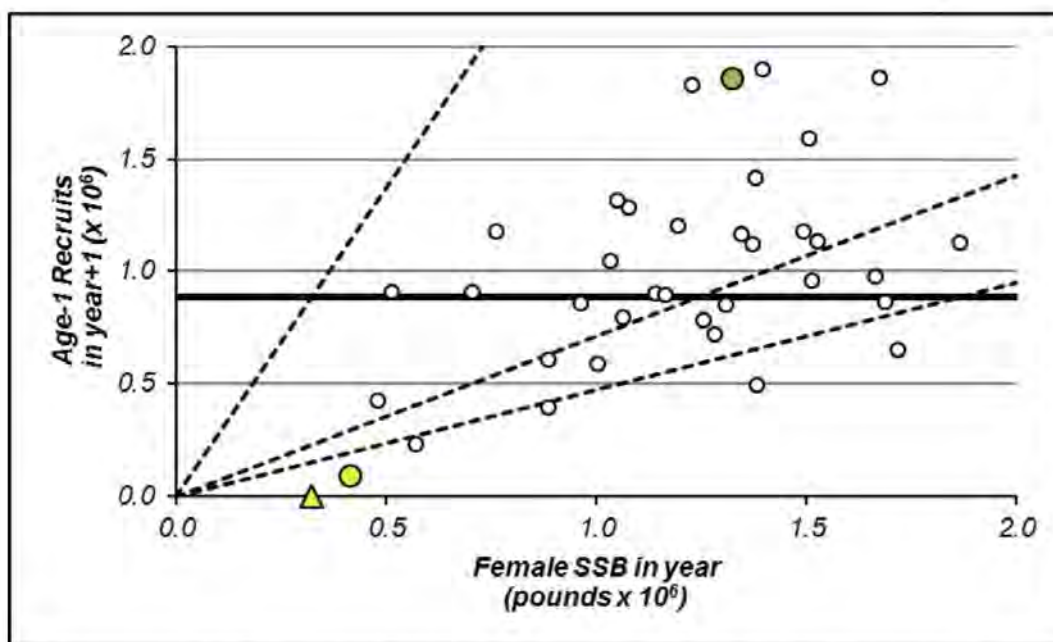


Figure 16: ASAP base model estimated age-1 female recruits and female spawning stock biomass (open circles). Equilibrium recruitment is represented by the bold horizontal. The yellow circle represents the most current data pair (2018 age-1 female recruits / 2017 female SSB) and the yellow triangle represents the 2018 SSB estimate. The green circle represents the first data pair (1983 age-1 female recruits / 1982 female SSB). Equilibrium recruitment per spawning stock biomass corresponding with the target spawning stock biomass reference point estimate and the minimum and maximum spawning stock biomass estimates are represented by the slopes of the dashed diagonals (min. SSB=14% SPR; SSB_{target}=55%; max. SSB=82% SPR).

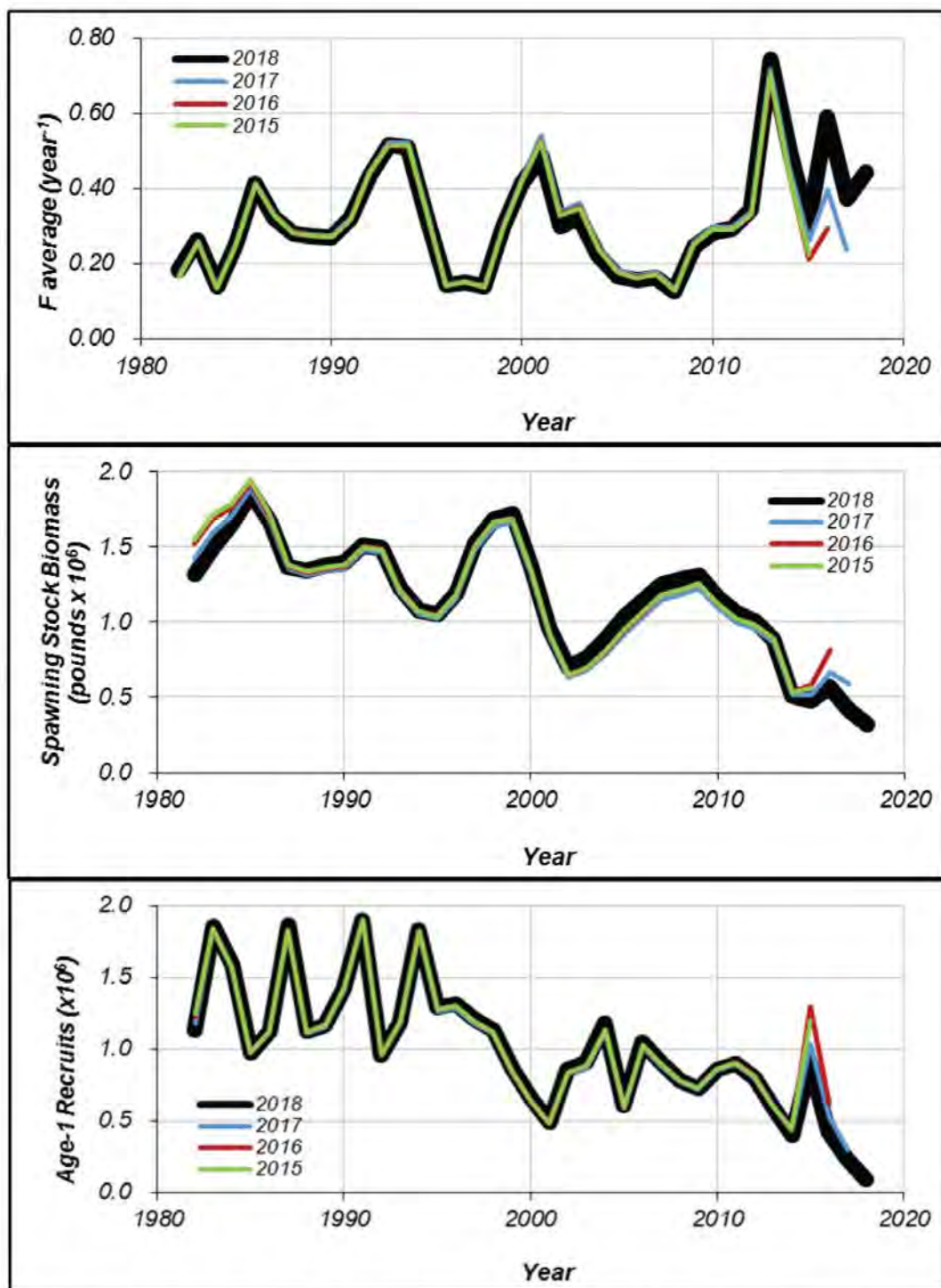


Figure 17: Retrospective analysis of ASAP base model. Top graphics depict annual average fishing mortality and female spawning stock biomass estimates. Bottom graphic depicts estimated age-1 female recruits.

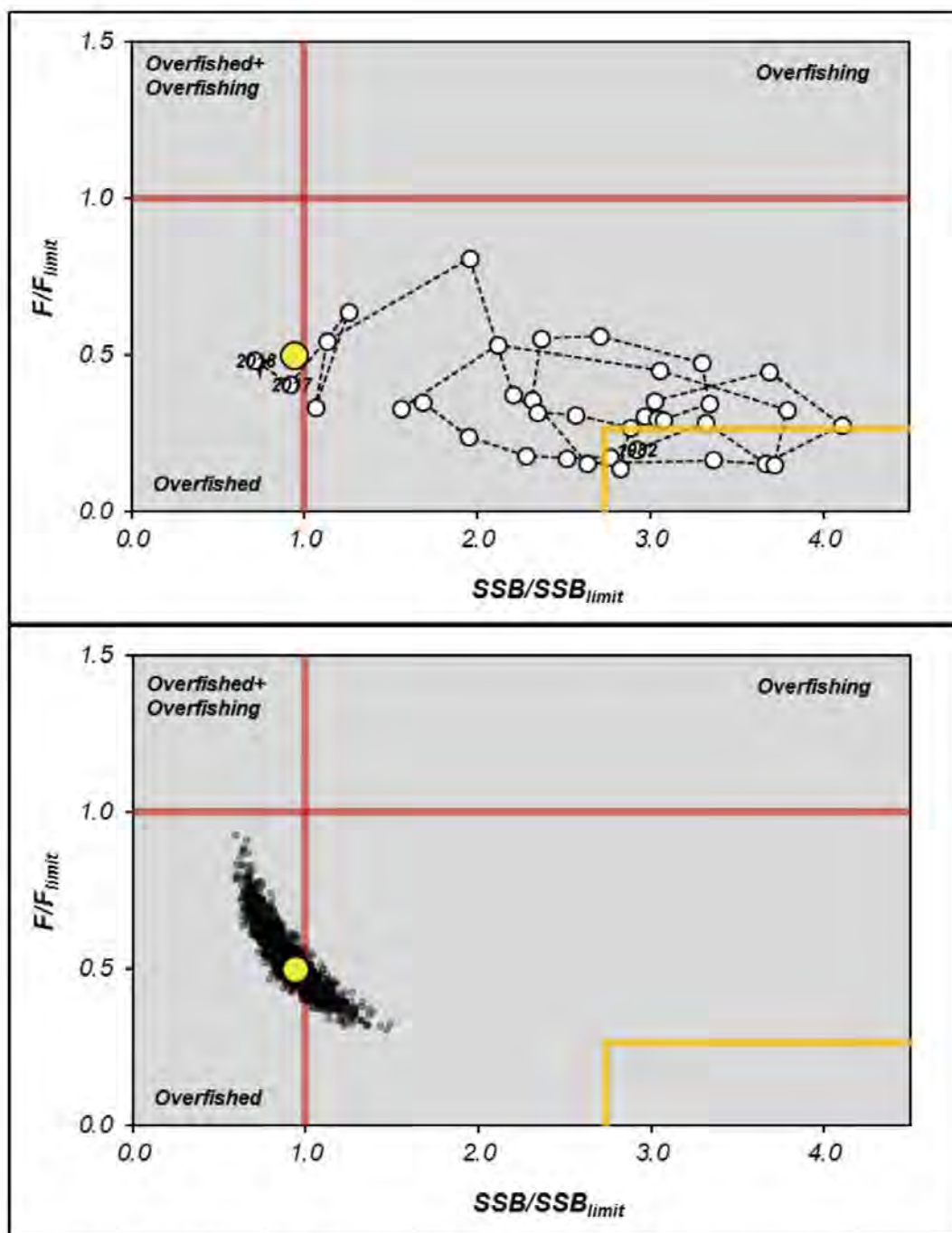


Figure 18: ASAP base model estimated ratios of annual average fishing mortality rates and female spawning stock biomass to the proposed limit reference points (F_{limit} and SSB_{limit}). Also presented are the target reference points (yellow lines). Arrow represents direction of time-series. The first and last year of the time-series are identified along with the years where the stock was considered overfished. The yellow circle represents current status (geometric mean 2016-2018). Bottom graphic depicts current status and results of 2000 MCMC simulations relative to limit and target reference points.

Appendix 1:

LA Creel/MRIP Calibration Procedure

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10/8/2018

Overview

The Louisiana Department of Wildlife and Fisheries (LDWF) conducts stock assessments on important recreationally and commercially landed species. Time-series of fishery removals are critical components of these stock assessments as they provide the level of depletion of the resource through time. Beginning in 2014, LDWF started its own creel survey (LA Creel) to provide recreational landings estimates for Louisiana-specific fishery management and stock assessment purposes. Prior to 2014 recreational landings estimates were taken from the National Marine Fisheries Service's Marine Recreational Intercept Program and the earlier Marine Recreational Fisheries Statistical Survey (MRIP/MRFSS). The MRIP and LA Creel surveys were conducted simultaneously in 2015 for benchmarking purposes. Methods are now needed to calibrate MRIP landings estimates to LA Creel landings estimates for species with upcoming LDWF stock assessments.

Calibration Methodology

A ratio estimator approach is described below allowing hind-casting of LA Creel recreational harvest estimates to 1982. The calibration procedure to hind-cast LA Creel discard estimates is presented in the Appendix of this document.

Concurrent harvest rate estimates of LA Creel and MRIP are only available for the single year (2015) both surveys were conducted simultaneously. Effort estimates, however, are available from both surveys for multiple years (2015-2017). The reliability of this calibration procedure could be greatly improved with more comparison years of the surveys. Note: MRIP private fishing effort is distributed across the various fishing modes (shore, inshore, and offshore) by applying the observed distribution of those modes from the dockside survey. In 2016 and 2017, the MRIP effort estimation process required additional estimations, as the dockside portion of that survey was not conducted in Louisiana. NOAA Fisheries applied the proportions of trips by fishing mode observed in 2015 to the effort data collected in 2016 and 2017 to obtain estimates of angler trips by fishing mode. While this method is clearly not optimal, it does allow comparison of effort over additional years.

The LA Creel survey provides estimates for four fishing modes (FM): private inshore (PI), private offshore (PO), charter inshore (CI), and charter offshore (CO). The MRIP survey provides estimates for five fishing modes: private boat (PR), shore (SH), PO, CI, and CO. For calibration purposes, LA Creel estimates are transformed into a fifth fishing mode equivalent to the MRIP surveys SH mode by separating the PI mode

Abbreviations used in this document:

E - Fishing effort
FM - Fishing mode
 C - charter
 CI - charter inshore
 CO - charter offshore
 P - private
 PI - private inshore (LA Creel)
 PO - private offshore
 PR - private boat (MRIP)
 SH - shore (MRIP)
H - Harvest
HR - Harvest rate
D - Discards
DR - Discard rate
PSE - Percent standard error
R - Ratio
V - Variance
y - Year
w - Bimonthly period
~~wk~~ - Week of year

into PR and SH modes. Additionally, the inshore/offshore fishing modes of each survey are collapsed into overall private (P) and charter (C) fishing modes for the species included in this report that support predominantly inshore fisheries.

Fishing effort (E) estimates of the two surveys are calibrated separately by collapsed fishing mode (P and SH only) and bimonthly period (w). Because the charter fishing effort frame used by the LA Creel and MRIP surveys are functionally equivalent, charter fishing effort and corresponding variance estimates of the two surveys are assumed equivalent and not adjusted. Harvest rates and corresponding variance estimates of the MRIP and LA Creel surveys for the species included in this report are also assumed equivalent and not adjusted. Calibrated effort estimates of the shore and private fishing modes are then combined with unadjusted MRIP harvest rate estimates to provide time-series of recreational harvest estimates for species with upcoming LDWF stock assessments as described below.

Fishing Effort

To allow hind-casting of LA Creel effort estimates to the historic MRIP effort time-series, fishing effort calibration factors are calculated as the ratio of mean fishing effort (2015-2017) from each survey by fishing mode (P and SH only) and bimonthly period as:

$$\hat{R}_{E,FM,w} = \frac{\bar{E}_{LAcreel,FM,w}}{\bar{E}_{MRIP,FM,w}} \quad [1]$$

Note: MRIP effort estimates in Equation [1] are based on the FES and APAIS methodologies. Survey-specific mean fishing effort (angler trips) and calibration factors for the P and SH fishing modes by bimonthly period are presented below.

FM	w	$\bar{E}_{LAcreel}$	$\bar{E}_{MRIP}$	$\hat{R}_E$
P	1	141,988	683,741	0.208
P	2	229,436	539,929	0.425
P	3	425,433	913,075	0.466
P	4	349,345	1,131,685	0.309
P	5	284,077	898,045	0.316
P	6	277,228	865,312	0.320
SH	1	50,377	692,050	0.073
SH	2	80,580	588,099	0.137
SH	3	151,142	865,279	0.175
SH	4	73,203	1,056,573	0.069
SH	5	105,286	1,115,605	0.094
SH	6	64,342	902,530	0.071

The hind-cast LA Creel fishing effort estimates (1982-2013) are then calculated by fishing mode and bimonthly period as:

$$\hat{E}_{y,w,FM,\hat{R}} = \hat{R}_{E,FM,w} \hat{E}_{y,w,FM,MRIP} \quad [2]$$

Note: MRIP effort estimates in Equation [2] have been calibrated to the FES and APAIS design changes (FCAL).

Variances of the hind-cast LA Creel fishing effort estimates from Equation [2] are approximated by fishing mode and bimonthly period as:

$$\hat{V}(\hat{E}_{y,w,FM,\hat{R}}) = \hat{E}_{y,w,FM,MRIP}^2 \hat{V}(\hat{R}_{E,FM,w}) + \hat{R}_{E,FM,w}^2 \hat{V}(\hat{E}_{y,w,FM,MRIP}) - \hat{V}(\hat{R}_{E,FM,w}) \hat{V}(\hat{E}_{y,w,FM,MRIP}) \quad [3]$$

where

$$\hat{V}(\hat{R}_{E,FM,w}) = \hat{R}_{E,FM,w}^2 \left[\frac{\hat{V}(\bar{E}_{LAcreel,FM,w})}{\bar{E}_{LAcreel,FM,w}^2} + \frac{\hat{V}(\bar{E}_{MRIP,FM,w})}{\bar{E}_{MRIP,FM,w}^2} - 2 \frac{Cov(\bar{E}_{LAcreel,FM,w}, \bar{E}_{MRIP,FM,w})}{\bar{E}_{LAcreel,FM,w} \bar{E}_{MRIP,FM,w}} \right]$$

Effort variances $\hat{V}(\hat{E}_{y,w,FM,MRIP})$ in Equation [3] are post-calibration (i.e. after applying a mean fishing effort variance ratio estimator $\frac{\hat{V}(\bar{E}_{LAcreel,FM,w})}{\hat{V}(\bar{E}_{MRIP,FM,w})}$ to the MRIP variance estimates).

Harvest

The hind-cast LA Creel harvest estimates (1982-2013) by fishing mode (P and SH only) for the species included in this report are then calculated as:

$$\hat{H}_{y,FM,\hat{R}} = \sum_w \hat{E}_{y,w,FM,\hat{R}} \hat{H}R_{y,w,FM,MRIP} \quad [4]$$

Note: MRIP harvest rate estimates in Equation [4] are FCAL estimates and represent A+ B1 landings only.

Variances of the calibrated harvest estimates are then calculated as:

$$\hat{V}(\hat{H}_{y,FM,\hat{R}}) = \sum_w \left[\hat{E}_{y,FM,w,\hat{R}}^2 \hat{V}(\hat{H}R_{y,FM,w,MRIP}) + \hat{H}R_{y,FM,w,MRIP}^2 \hat{V}(\hat{E}_{y,FM,w,\hat{R}}) - \hat{V}(\hat{E}_{y,FM,w,\hat{R}}) \hat{V}(\hat{H}R_{y,FM,w,MRIP}) \right] \quad [5]$$

Percent standard errors of the calibrated harvest estimates are then calculated as:

$$PSE(\hat{H}_{y,FM,\hat{R}}) = 100 \times \frac{\sqrt{\hat{V}(\hat{H}_{y,FM,\hat{R}})}}{\hat{H}_{y,FM,\hat{R}}} \quad [6]$$

The MRIP (FCAL) and hind-cast LA Creel harvest estimate time-series and corresponding PSEs by fishing mode for species with upcoming LDWF stock assessments are presented below.

Year	Black Drum						Red Drum						Sheepshead						Southern Flounder						Spotted Seatrout					
	MRIP			LA Creel			MRIP			LA Creel			MRIP			LA Creel			MRIP			LA Creel			MRIP			LA Creel		
	Harvest	PSE	LA Creel	Harvest	PSE	LA Creel	Harvest	PSE	LA Creel	Harvest	PSE	LA Creel	Harvest	PSE	LA Creel	Harvest	PSE	LA Creel	Harvest	PSE	LA Creel	Harvest	PSE	LA Creel	Harvest	PSE	LA Creel	Harvest	PSE	LA Creel
1982	1,106,821	27.1	426,166	31.2	3,046,664	12.0	925,323	21.4	184,011	40.4	511,387	34.3	184,011	40.4	511,387	34.3	184,011	40.4	497,263	19.5	190,801	23.4	91,600,786	16.2	3,111,188	23.8	3,111,188	23.8	3,111,188	23.8
1983	1,659,509	34.3	595,673	38.8	4,758,470	32.7	1,542,955	41.7	334,974	43.8	1,064,824	38.1	334,974	43.8	1,064,824	38.1	334,974	43.8	1,929,817	51.4	610,002	58.6	7,402,179	20.0	2,660,990	25.0	2,660,990	25.0	2,660,990	25.0
1984	362,104	26.0	138,699	29.8	2,976,458	38.9	960,611	40.8	176,510	39.5	548,364	47.5	176,510	39.5	548,364	47.5	176,510	39.5	213,064	23.0	73,394	28.5	2,503,426	29.8	790,913	33.0	790,913	33.0	790,913	33.0
1985	356,406	30.0	115,179	34.5	2,563,074	14.5	865,588	21.9	114,127	35.8	340,142	32.1	114,127	35.8	340,142	32.1	114,127	35.8	431,284	24.5	150,115	27.3	5,947,072	15.2	2,109,649	22.2	2,109,649	22.2	2,109,649	22.2
1986	918,541	24.1	317,533	28.9	2,635,843	10.0	843,830	21.1	84,282	23.6	252,644	15.5	84,282	23.6	252,644	15.5	84,282	23.6	1,464,132	48.5	483,555	47.8	14,077,720	7.8	4,947,892	16.4	4,947,892	16.4	4,947,892	16.4
1987	683,049	25.6	237,415	30.7	2,602,974	23.0	876,900	30.6	87,926	33.7	270,702	33.7	87,926	33.7	270,702	33.7	87,926	33.7	147,601	25.2	52,016	27.6	11,023,715	10.1	4,035,139	15.6	4,035,139	15.6	4,035,139	15.6
1988	344,681	15.4	115,234	22.3	1,160,955	20.2	349,965	26.3	90,608	28.5	277,793	21.3	90,608	28.5	277,793	21.3	90,608	28.5	358,099	13.2	123,628	18.1	6,890,452	14.3	2,511,864	21.3	2,511,864	21.3	2,511,864	21.3
1989	227,336	20.4	76,002	25.3	2,015,801	12.6	676,453	24.5	254,087	50.2	789,892	49.3	254,087	50.2	789,892	49.3	254,087	50.2	341,489	25.9	111,900	29.0	8,082,318	11.9	2,753,203	18.0	2,753,203	18.0	2,753,203	18.0
1990	231,168	22.9	79,940	26.9	1,469,547	16.8	481,003	25.0	104,809	31.1	270,726	27.1	104,809	31.1	270,726	27.1	104,809	31.1	805,964	23.6	264,106	26.8	4,881,711	13.7	1,640,863	21.0	1,640,863	21.0	1,640,863	21.0
1991	183,005	19.4	62,265	26.3	1,824,768	20.0	582,125	33.1	138,862	35.4	402,935	32.6	138,862	35.4	402,935	32.6	138,862	35.4	694,466	16.1	248,442	20.6	13,468,560	9.9	4,744,596	18.2	4,744,596	18.2	4,744,596	18.2
1992	333,217	23.9	119,606	28.4	2,807,145	8.7	936,586	15.5	182,360	27.9	563,816	25.3	182,360	27.9	563,816	25.3	182,360	27.9	615,928	14.6	217,218	17.6	10,680,755	9.3	3,584,240	20.0	3,584,240	20.0	3,584,240	20.0
1993	246,588	17.6	88,970	24.2	2,581,130	9.9	880,530	16.3	885,380	26.7	885,380	26.7	885,380	26.7	885,380	26.7	885,380	26.7	500,023	14.8	175,907	18.0	7,757,436	12.1	2,655,102	18.2	2,655,102	18.2	2,655,102	18.2
1994	234,272	16.9	79,717	24.5	2,311,786	9.5	778,462	16.4	170,439	24.2	508,883	17.8	170,439	24.2	508,883	17.8	170,439	24.2	578,264	21.0	216,551	26.3	10,418,883	10.5	3,481,640	17.6	3,481,640	17.6	3,481,640	17.6
1995	335,507	18.4	109,385	22.1	3,842,177	8.7	1,269,660	19.6	274,232	26.3	920,809	20.4	274,232	26.3	920,809	20.4	274,232	26.3	398,528	14.0	146,807	19.4	12,135,672	13.2	3,937,329	27.0	3,937,329	27.0	3,937,329	27.0
1996	414,798	12.9	137,386	20.9	3,197,497	9.0	1,120,688	16.0	243,914	29.8	760,607	21.7	243,914	29.8	760,607	21.7	243,914	29.8	416,737	11.4	148,322	15.5	10,306,475	11.3	3,488,899	20.1	3,488,899	20.1	3,488,899	20.1
1997	477,705	16.1	161,196	20.3	2,861,918	9.6	987,223	16.3	318,972	22.9	1,005,406	18.2	318,972	22.9	1,005,406	18.2	318,972	22.9	445,579	11.7	155,574	18.2	10,415,118	11.9	3,599,696	17.9	3,599,696	17.9	3,599,696	17.9
1998	920,933	14.6	311,906	20.5	2,762,600	8.0	955,164	15.1	358,340	25.5	1,138,280	15.6	358,340	25.5	1,138,280	15.6	358,340	25.5	393,018	13.8	148,318	18.2	10,005,379	8.7	3,578,852	18.8	3,578,852	18.8	3,578,852	18.8
1999	681,905	11.9	236,111	18.6	3,459,681	6.9	1,208,361	14.4	246,697	26.4	793,093	16.2	246,697	26.4	793,093	16.2	246,697	26.4	758,946	10.4	272,110	16.0	14,037,235	8.5	4,731,081	18.3	4,731,081	18.3	4,731,081	18.3
2000	1,017,717	12.8	352,152	18.8	4,249,272	6.9	1,474,223	16.0	246,219	34.0	769,653	28.0	246,219	34.0	769,653	28.0	246,219	34.0	670,295	13.3	246,882	18.4	15,977,551	7.7	5,264,946	19.6	5,264,946	19.6	5,264,946	19.6
2001	765,815	13.7	259,288	20.5	4,322,843	7.7	1,456,752	14.4	193,751	22.4	567,945	15.8	193,751	22.4	567,945	15.8	193,751	22.4	427,914	12.2	155,260	16.0	12,618,114	8.0	4,269,752	15.9	4,269,752	15.9	4,269,752	15.9
2002	908,616	12.6	315,701	19.5	3,445,574	8.2	1,168,322	15.9	408,449	30.9	1,249,437	18.7	408,449	30.9	1,249,437	18.7	408,449	30.9	443,758	18.8	173,052	23.0	9,816,916	10.3	3,441,381	16.8	3,441,381	16.8	3,441,381	16.8
2003	659,209	14.7	229,521	22.3	2,977,090	7.4	1,014,320	17.2	396,409	28.7	1,257,175	23.2	396,409	28.7	1,257,175	23.2	396,409	28.7	647,034	15.7	250,097	18.7	10,528,223	9.6	3,662,095	20.0	3,662,095	20.0	3,662,095	20.0
2004	546,776	12.0	183,643	18.3	2,605,118	8.1	898,352	15.2	586,483	33.7	1,722,589	24.9	586,483	33.7	1,722,589	24.9	586,483	33.7	408,006	12.6	148,846	17.3	9,728,915	10.5	3,334,545	18.8	3,334,545	18.8	3,334,545	18.8
2005	461,775	13.0	156,509	21.3	2,236,920	9.4	772,472	15.8	302,340	30.7	962,130	23.6	302,340	30.7	962,130	23.6	302,340	30.7	286,521	12.9	108,654	15.8	10,699,116	8.5	3,616,229	17.8	3,616,229	17.8	3,616,229	17.8
2006	354,910	14.3	117,386	19.2	2,385,907	10.7	812,152	16.3	125,365	32.5	430,504	25.3	125,365	32.5	430,504	25.3	125,365	32.5	285,429	11.9	98,401	15.3	13,779,620	8.7	5,016,008	16.0	5,016,008	16.0	5,016,008	16.0
2007	415,104	15.7	142,698	18.7	3,049,990	8.3	1,045,909	15.6	95,855	25.9	320,952	21.9	95,855	25.9	320,952	21.9	95,855	25.9	355,606	19.0	123,052	23.8	11,790,003	8.3	3,967,935	18.2	3,967,935	18.2	3,967,935	18.2
2008	668,820	12.8	224,335	20.6	3,336,041	7.9	1,155,421	14.9	205,809	26.8	623,988	17.6	205,809	26.8	623,988	17.6	205,809	26.8	239,893	10.9	88,186	16.8	15,551,638	9.5	5,347,885	19.1	5,347,885	19.1	5,347,885	19.1
2009	908,297	13.6	308,638	19.6	3,414,547	8.2	1,187,696	16.4	315,386	32.0	1,055,358	22.6	315,386	32.0	1,055,358	22.6	315,386	32.0	398,573	14.6	140,011	19.7	15,667,348	8.8	5,452,613	16.8	5,452,613	16.8	5,452,613	16.8
2010	697,188	14.5	231,949	19.1	5,128,842	8.0	1,797,454	14.5	261,214	29.3	753,414	22.4	261,214	29.3	753,414	22.4	261,214	29.3	571,870	14.4	214,026	18.3	14,465,717	10.7	4,974,270	23.5	4,974,270	23.5	4,974,270	23.5
2011	679,614	15.1	232,721	20.6	4,548,266	8.3	1,584,573	14.9	525,042	44.9	1,425,042	35.5	525,042	44.9	1,425,042	35.5	525,042	44.9	544,173	14.7	198,755	17.6	17,697,003	9.6	5,977,076	18.1	5,977,076	18.1	5,977,076	18.1
2012	694,257	12.8	241,481	18.1	3,458,029	8.8	1,210,182	15.5	175,722	24.4	577,843	16.7	175,722	24.4	577,843	16.7	175,722	24.4	524,259	14.8	184,915	17.5	17,938,248	8.9	6,201,433	19.0	6,201,433	19.0	6,201,433	19.0
2013	528,084	14.3	172,534	20.4	4,523,043	8.7	1,512,033	15.4	95,381	24.0	311,155	16.9	95,381	24.0	311,155	16.9	95,381	24.0	930,394	13.1	317,618	25.0	12,928,606	9.4	4,374,563	17.4	4,374,563	17.4	4,374,563	17.4

Year	Black Drum						Red Drum						Sheepshead						Southern Flounder						Spotted Seatrout					
	MRIP			LA Creel			MRIP			LA Creel			MRIP			LA Creel			MRIP			LA Creel			MRIP			LA Creel		
	Harvest	PSE		Harvest	PSE		Harvest	PSE		Harvest	PSE		Harvest	PSE		Harvest	PSE		Harvest	PSE		Harvest	PSE		Harvest	PSE		Harvest	PSE	
1982	880,444	22.8	113,540	38.2	2,388,907	23.1	293,698	36.1	293,698	36.1	676,628	29.0	66,012	30.5	834,940	21.4	103,180	36.3	2,787,818	23.5	296,866	35.0								
1983	500,922	29.9	62,566	38.0	1,351,640	25.0	123,385	34.4	123,385	34.4	2,326,172	25.9	276,981	40.7	327,205	34.7	31,100	37.4	2,927,094	47.2	258,452	45.3								
1984	536,866	34.1	51,163	46.2	660,866	35.0	173,459	34.8	173,459	34.8	987,229	41.9	85,083	40.5	112,657	45.9	9,755	45.9	331,308	40.5	32,117	42.3								
1985	181,986	27.0	16,397	32.7	618,693	30.8	46,417	33.4	46,417	33.4	656,976	30.2	51,856	35.9	284,046	29.1	23,081	33.1	500,629	27.9	43,400	33.5								
1986	469,638	52.0	39,289	48.9	243,647	45.9	18,934	47.8	18,934	47.8	782,112	81.2	57,566	79.5	189,325	42.5	18,019	48.7	1,815,727	55.4	142,905	52.4								
1987	260,971	52.0	26,358	51.9	665,407	54.3	49,467	55.0	49,467	55.0	65,880	46.2	4,878	52.4	185,090	37.3	14,954	38.7	965,130	44.3	112,992	58.7								
1988	429,974	36.6	48,607	46.1	237,418	45.6	18,170	48.4	18,170	48.4	662,260	57.5	57,664	53.5	90,283	40.5	8,305	40.6	398,803	39.6	41,221	48.1								
1989	484,955	58.2	47,183	67.1	472,062	35.4	45,444	43.7	45,444	43.7	179,471	40.2	16,156	43.5	127,388	33.6	12,077	38.8	402,794	68.4	30,056	67.0								
1990	122,352	47.4	15,821	63.4	627,617	29.6	54,607	36.3	54,607	36.3	80,673	46.7	7,631	52.3	238,834	24.9	22,144	31.2	1,178,966	28.6	120,340	42.6								
1991	80,287	38.8	7,830	45.0	497,827	35.7	39,572	39.7	39,572	39.7	109,726	43.1	8,166	45.0	617,776	26.6	69,562	37.3	1,611,329	29.8	190,451	48.5								
1992	266,722	39.0	24,559	43.7	535,731	21.7	57,486	31.8	57,486	31.8	1,470,811	61.9	111,109	64.6	197,948	31.2	17,703	32.4	1,622,752	18.8	160,534	25.9								
1993	332,409	38.4	32,083	46.0	1,058,829	26.2	102,231	30.1	102,231	30.1	438,233	37.3	34,539	38.3	152,286	34.8	14,994	35.2	1,262,891	19.3	139,848	32.3								
1994	111,090	26.4	12,000	35.3	973,065	30.5	86,198	33.8	86,198	33.8	339,821	55.8	27,751	51.7	245,182	26.2	26,246	30.4	2,585,733	32.7	225,016	34.0								
1995	122,762	40.4	10,791	37.0	747,219	23.9	61,587	28.3	61,587	28.3	338,135	43.2	33,177	41.4	56,558	30.7	5,970	40.2	1,432,447	21.4	141,769	30.2								
1996	529,054	58.3	42,278	55.7	864,227	22.6	85,059	27.2	85,059	27.2	682,583	43.1	54,497	42.0	134,402	31.1	14,417	42.1	2,327,551	27.4	272,968	42.0								
1997	123,564	39.8	14,500	55.8	347,632	21.5	33,897	27.2	33,897	27.2	283,171	25.4	28,012	31.1	307,330	23.1	31,614	33.0	1,905,584	21.5	196,046	32.0								
1998	86,575	34.3	11,850	53.2	397,083	31.2	39,546	33.4	39,546	33.4	450,254	36.2	34,658	37.6	128,645	26.4	15,533	39.9	2,415,887	30.1	316,704	52.1								
1999	385,329	39.6	34,484	42.0	492,350	25.7	58,215	38.6	58,215	38.6	202,445	35.8	17,647	34.4	641,276	32.9	57,671	36.5	3,530,688	27.9	302,816	33.9								
2000	625,217	26.3	55,444	30.4	822,698	21.3	74,515	25.1	74,515	25.1	202,744	52.7	18,710	49.9	136,953	43.0	13,647	44.9	2,697,901	36.0	235,416	36.6								
2001	675,474	30.1	74,021	37.8	621,324	23.2	56,647	29.7	56,647	29.7	399,908	49.4	46,027	53.6	305,296	67.4	40,328	72.5	2,657,545	28.5	284,780	35.3								
2002	399,178	23.6	39,488	28.7	945,520	31.8	86,759	37.0	86,759	37.0	872,663	35.4	77,666	40.1	323,826	31.2	35,596	40.3	923,988	31.5	104,622	40.0								
2003	288,546	23.4	29,030	28.5	280,366	33.2	26,439	34.2	26,439	34.2	983,844	36.8	108,655	37.5	199,400	38.3	17,629	37.0	945,730	42.3	70,559	43.3								
2004	137,240	36.0	13,664	36.9	559,991	19.0	53,877	26.8	53,877	26.8	603,693	36.9	49,237	39.0	395,552	36.1	39,848	47.2	1,303,971	45.1	186,126	62.8								
2005	138,758	28.0	13,443	36.2	704,981	30.9	57,698	36.6	57,698	36.6	563,322	29.6	52,206	36.7	450,207	38.7	35,117	45.5	632,798	30.7	54,561	34.2								
2006	261,544	30.8	25,308	39.5	389,280	25.4	35,566	35.1	35,566	35.1	593,305	31.2	44,987	35.3	335,766	29.1	34,011	31.9	788,193	22.7	75,533	29.7								
2007	286,213	35.5	28,210	37.6	187,726	25.1	17,832	35.4	17,832	35.4	257,091	36.2	27,901	42.7	348,752	28.0	38,995	36.9	771,812	27.5	84,196	35.4								
2008	247,234	25.5	22,539	32.8	374,463	27.9	30,507	30.4	30,507	30.4	1,396,084	30.3	113,710	33.3	260,865	36.4	23,363	33.9	1,140,758	33.3	131,023	47.6								
2009	100,842	26.9	10,221	33.5	123,122	28.0	12,120	33.8	12,120	33.8	523,105	46.9	62,220	56.4	470,681	44.6	39,588	45.3	611,298	25.2	62,519	33.2								
2010	184,668	41.2	16,865	42.9	531,708	32.4	50,704	34.5	50,704	34.5	561,648	40.1	46,001	39.1	94,348	29.4	8,854	31.9	584,064	43.3	45,383	43.2								
2011	380,669	21.7	36,537	27.0	983,461	22.1	96,717	27.3	96,717	27.3	1,318,064	44.8	124,632	55.1	430,717	40.0	39,973	40.9	651,281	27.8	67,792	37.1								
2012	283,508	22.6	26,638	30.9	279,299	36.1	23,109	38.3	23,109	38.3	695,553	42.6	54,144	43.8	155,170	30.6	15,176	33.3	727,577	29.5	80,824	39.4								
2013	471,823	13.0	36,871	21.6	849,762	9.3	80,731	27.2	80,731	27.2	659,450	12.4	48,095	25.1	573,922	18.3	51,029	30.3	2,682,372	11.4	241,359	21.8								

FM = Shore

Appendix (Discard Hindcast):

A ratio estimator approach is described below allowing hind-casting of LA Creel recreational discard estimates to 1982. Concurrent discard estimates of the LA Creel and MRIP surveys are not available. Analogous to the procedure to hind-cast LA Creel harvest estimates, the hind-cast LA Creel effort estimates of the shore and private fishing modes are combined with unadjusted MRIP discard rate estimates to provide time-series of recreational discard estimates for species with upcoming LDWF stock assessments as described below. Discard estimates of the charter fishing mode for the LA Creel and MRIP surveys are assumed equivalent and not adjusted.

Discards (1982-2013)

The hind-cast LA Creel discard estimates (1982-2013) are calculated by collapsed fishing mode (P and SH only) and bimonthly period as:

$$\widehat{D}_{y,FM,\widehat{R}} = \sum_w \widehat{E}_{y,w,FM,\widehat{R}} \widehat{DR}_{y,w,FM,MRIP} \quad [1a]$$

Note: MRIP discard rate estimates in Equation [1a] are FCAL estimates and represent B2 landings only. The calibrated effort estimates are taken from Equation [2].

Variances of the calibrated discard estimates from Equation [1a] are then calculated as:

$$\widehat{V}(\widehat{D}_{y,FM,\widehat{R}}) = \sum_w \left[\widehat{E}_{y,FM,w,\widehat{R}}^2 \widehat{V}(\widehat{DR}_{y,FM,w,MRIP}) + \widehat{DR}_{y,FM,w,MRIP}^2 \widehat{V}(\widehat{E}_{y,FM,w,\widehat{R}}) - \widehat{V}(\widehat{E}_{y,FM,w,\widehat{R}}) \widehat{V}(\widehat{DR}_{y,FM,w,MRIP}) \right] \quad [2a]$$

Percent standard errors of the calibrated discard estimates are then calculated as:

$$PSE(\widehat{D}_{y,FM,\widehat{R}}) = 100 \times \frac{\sqrt{\widehat{V}(\widehat{D}_{y,FM,\widehat{R}})}}{\widehat{D}_{y,FM,\widehat{R}}} \quad [3a]$$

Discards (2014-2016)

Discard estimates of the LA Creel survey are only available from week 19 of 2016 to present. Discard estimates prior to week 19 of 2016 are imputed by fishing mode (P, SH, and C) and week of year (*wk*) by calculating discard to harvest ratios from the LA Creel estimates from week 19 of 2016 to week 18 of 2017 as:

$$\widehat{R}_{D/H,FM,wk} = \frac{\widehat{D}_{LAcreel,FM,wk}}{\widehat{H}_{LAcreel,FM,wk}} \quad [4a]$$

The imputed LA Creel discard estimates are then calculated by fishing mode from week 1 of 2014 to week 18 of 2016 as:

$$\widehat{D}_{y,wk,FM,\widehat{R}_{D/H}} = \widehat{R}_{D/H,FM,wk} \widehat{H}_{y,wk,FM,LAcreel} \quad [5a]$$

Variances of the imputed LA Creel discard estimates from Equation [5a] are approximated by fishing mode and week of year as:

$$\widehat{V}(\widehat{D}_{y,wk,FM,\widehat{R}_{D/H}}) = \widehat{H}_{y,wk,FM,LAcreel}^2 \widehat{V}(\widehat{R}_{D/H,FM,wk}) + \widehat{R}_{D/H,FM,wk}^2 \widehat{V}(\widehat{H}_{y,wk,FM,LAcreel}) - \widehat{V}(\widehat{R}_{D/H,FM,wk}) \widehat{V}(\widehat{H}_{y,wk,FM,LAcreel}) \quad [6a]$$

where

$$\widehat{V}(\widehat{R}_{D/H,FM,wk}) = \widehat{R}_{D/H,FM,wk}^2 \left[\frac{\widehat{V}(\widehat{D}_{LAcreel,FM,wk})}{\widehat{D}_{LAcreel,FM,wk}^2} + \frac{\widehat{V}(\widehat{H}_{LAcreel,FM,wk})}{\widehat{H}_{LAcreel,FM,wk}^2} \right]$$

Harvest variances $\widehat{V}(\widehat{H}_{y,wk,FM,LAcreel})$ in Equation [6a] are post-calibration (i.e. after applying a discard to harvest variance ratio estimator $\frac{\widehat{V}(\widehat{D}_{LAcreel,FM,wk})}{\widehat{V}(\widehat{H}_{LAcreel,FM,wk})}$ to the LA Creel harvest variance estimates).

The MRIP (FCAL) and hind-cast/imputed LA Creel discard estimate annual time-series and corresponding PSEs by fishing mode for species with upcoming LDWF stock assessments are presented below.

FM = Private	Black Drum			Red Drum			Sheepshead			Southern Flounder			Spotted Seatrout			
	Black Drum			Red Drum			Sheepshead			Southern Flounder			Spotted Seatrout			
	MRIP	Discards	PSE	MRIP	Discards	PSE	MRIP	Discards	PSE	MRIP	Discards	PSE	MRIP	Discards	PSE	
Year																
1982	818,734	54.5	345,860	60.5	274,870	40.0	515,459	44.8	200,681	47.1	1,083,668	45.5	1,654,868	35.7	609,681	39.2
1983	671,251	47.1	224,549	50.1	793,805	34.3	833,079	71.7	268,324	76.4	145,644	54.4	2,092,864	42.4	754,795	47.4
1984	284,254	68.2	93,240	65.6	346,317	56.3	309,986	35.6	93,467	45.2	65,411	64.9	197,040	21.8	64,439	30.9
1985	291,106	38.5	95,314	41.4	243,413	40.1	317,951	28.8	109,302	37.0	61,785	68.0	1,709,137	23.1	579,765	29.5
1986	448,236	20.4	152,135	27.7	451,777	15.3	393,569	19.8	127,427	29.5	367,830	40.1	4,745,760	10.2	1,630,190	19.8
1987	300,153	41.9	93,694	44.6	2,360,122	24.5	210,127	21.2	74,868	25.8	10,809	42.4	6,980,249	12.7	2,367,280	21.1
1988	350,541	21.1	118,251	29.1	3,062,822	16.2	398,058	25.6	135,054	32.6	375,399	58.9	5,610,284	10.4	2,077,053	16.1
1989	228,012	35.0	75,276	40.5	2,998,273	20.9	483,464	37.6	174,497	44.9	260,401	93.8	5,656,036	14.2	1,879,166	20.3
1990	653,511	28.7	214,860	36.2	1,880,922	19.7	408,363	25.1	146,133	30.3	334,821	40.3	4,750,794	18.0	1,566,570	24.0
1991	389,398	26.0	130,884	32.2	7,412,013	11.2	272,267	26.1	100,654	28.7	114,636	37.5	12,341,402	9.3	4,316,171	17.6
1992	559,417	33.2	179,758	38.0	5,753,237	9.1	440,289	16.8	142,247	23.5	42,988	21.4	8,795,484	8.4	2,994,762	16.4
1993	710,873	18.2	235,327	23.6	4,143,002	11.2	758,778	20.8	261,093	28.4	45,686	33.2	6,905,906	11.3	2,294,599	17.5
1994	440,825	29.8	144,491	33.2	4,086,816	12.5	608,190	19.3	200,928	25.0	34,050	29.6	7,780,829	9.7	2,545,253	17.4
1995	816,070	17.5	288,067	20.8	4,248,542	15.4	558,424	25.6	180,589	31.0	59,357	34.4	7,603,172	11.0	2,469,940	22.8
1996	525,560	20.4	180,919	27.4	3,312,106	11.9	878,282	23.1	280,982	30.9	80,897	23.0	8,055,743	10.2	2,790,011	17.6
1997	1,057,203	18.5	357,381	27.0	5,150,476	11.3	1,138,193	23.4	388,364	33.4	98,494	29.1	10,917,063	19.7	3,714,497	25.0
1998	1,439,547	24.7	488,061	28.2	5,753,271	10.8	1,056,926	17.9	341,063	28.4	99,007	29.1	9,977,400	9.3	3,525,435	17.2
1999	820,371	13.6	272,222	19.4	5,477,613	9.4	699,825	18.9	218,048	29.4	84,447	20.8	11,688,515	8.8	3,900,534	18.2
2000	1,833,450	16.2	636,903	21.0	6,018,948	8.2	586,993	21.9	204,594	28.9	121,790	28.3	11,091,619	7.9	3,696,143	17.1
2001	1,781,293	17.4	641,432	22.0	6,184,966	9.5	816,650	16.4	289,672	22.4	88,936	21.8	7,365,829	11.2	2,385,033	19.6
2002	1,670,431	17.1	549,754	23.8	6,266,166	10.8	854,311	17.0	278,770	22.5	90,982	26.1	6,778,238	11.5	2,325,982	18.2
2003	1,172,837	17.8	408,312	22.5	5,286,909	10.2	930,576	20.8	286,148	31.2	172,327	23.4	10,682,302	9.5	3,656,768	20.8
2004	1,155,649	17.0	384,622	24.5	3,841,642	10.1	701,938	19.9	253,961	27.9	149,844	27.6	9,847,326	11.5	3,329,014	17.7
2005	954,552	24.2	324,774	29.3	3,505,968	11.8	770,173	15.0	252,100	25.9	87,557	25.3	10,903,988	9.7	3,699,324	17.6
2006	699,933	16.3	227,542	20.8	4,124,647	11.7	616,668	30.1	179,470	34.3	41,784	27.7	11,930,250	9.1	4,253,200	16.1
2007	818,643	15.4	279,976	19.3	4,630,404	11.5	308,039	21.2	101,638	25.6	78,231	25.8	9,924,934	8.4	3,345,776	18.0
2008	1,320,182	14.8	447,658	22.4	5,074,358	8.1	609,401	23.6	193,005	30.6	50,063	26.0	13,158,192	9.4	4,628,268	17.0
2009	1,788,575	14.5	598,396	22.8	6,242,208	9.6	744,464	19.5	224,182	27.5	89,961	28.4	13,919,234	10.0	4,655,798	17.8
2010	1,813,254	14.9	636,963	18.6	7,335,948	10.2	711,836	21.9	248,894	26.2	111,912	23.5	9,190,616	12.6	3,180,901	22.2
2011	1,390,360	14.9	475,469	19.2	4,744,947	9.7	259,735	17.7	86,064	22.2	85,027	24.1	10,091,732	9.5	3,443,856	16.2
2012	1,136,427	13.3	373,501	18.6	5,374,152	8.9	422,968	13.4	136,234	19.8	152,363	24.3	13,175,745	8.7	4,524,702	18.2
2013	1,709,164	12.2	586,398	18.1	6,088,863	9.9	398,767	14.8	130,785	21.7	197,844	21.3	13,404,945	10.3	4,608,071	16.5
2014			330,955	24.0		11.8			148,454	38.3					2,316,191	11.3
2015			295,893	21.4		10.3			98,800	30.3					3,440,509	12.3
2016			161,733	21.0		6.4			47,135	25.6					3,643,636	8.6

Year	Black Drum			Red Drum			Sheepshead			Southern Flounder			Spotted Seatrout		
	Black Drum			Red Drum			Sheepshead			Southern Flounder			Spotted Seatrout		
	MRIP	LA Creel	PSE	MRIP	LA Creel	PSE	MRIP	LA Creel	PSE	MRIP	LA Creel	PSE	MRIP	LA Creel	PSE
	Discards	Discards		Discards	Discards		Discards	Discards		Discards	Discards		Discards	Discards	
1982	149,995	19,897	80.7	364,343	52,316	41.6	89,674	11,246	70.6	128,975	15,915	45.2	386,524	49,802	62.2
1983	69,276	6,493	59.5	15,283	1,470	73.4	25,959	2,914	58.8				7,794	1,361	89.1
1984	285,887	20,494	39.5	83,103	5,758	89.8	12,248	2,139	105.1	3,384	319	100.5	59,529	4,864	50.1
1985	138,851	12,304	55.2	32,336	2,913	51.6	155,985	11,628	41.9	12,292	881	80.3	603,943	47,922	44.9
1986	107,212	7,822	51.3	19,379	1,723	60.3	473,615	34,777	72.6	11,853	1,010	78.1	267,044	22,713	38.7
1987	102,949	8,596	74.4	352,180	26,897	48.2	36,133	3,410	94.8	13,517	1,198	89.8	642,898	64,120	42.0
1988	185,774	16,072	60.9	329,574	28,447	35.6	116,937	10,973	40.9	7,726	616	56.8	205,385	24,387	50.9
1989	61,484	5,723	46.1	1,080,247	128,194	83.5	115,300	11,720	45.4	49,549	3,586	66.6	311,869	27,571	40.1
1990	96,587	13,477	59.9	327,612	28,235	45.2	18,485	1,318	92.6	783,955	72,564	86.6	736,838	65,803	38.9
1991	237,878	24,906	36.8	1,544,560	124,239	43.5	207,958	14,829	39.1	91,471	10,241	47.2	1,902,261	219,559	37.7
1992	860,902	76,139	32.3	1,833,394	167,249	28.7	514,453	41,930	37.4	49,674	4,587	56.0	1,468,815	142,809	27.3
1993	1,345,395	110,604	41.5	1,630,396	171,511	31.8	1,109,224	86,564	51.4	51,220	3,860	64.5	2,544,151	323,743	45.9
1994	947,564	99,539	33.8	2,220,435	190,194	29.9	690,548	54,745	36.3	27,765	2,143	65.9	2,280,973	214,069	27.3
1995	602,888	48,383	40.0	942,643	86,408	28.5	72,571	8,839	38.7	18,216	1,309	62.8	1,617,673	162,345	29.9
1996	493,436	52,883	32.7	1,516,179	120,897	39.3	295,818	24,464	47.5	123,621	16,558	74.1	2,271,614	308,086	52.8
1997	1,032,761	90,230	49.3	1,179,933	100,418	31.4	199,864	17,257	35.4	71,388	8,442	48.4	2,076,029	207,557	32.1
1998	1,033,214	84,752	44.3	2,262,074	204,593	31.1	207,500	20,284	40.9	39,280	3,276	42.0	1,721,873	220,941	47.8
1999	532,125	45,165	42.1	1,281,413	130,179	31.6	51,091	4,474	39.5	68,459	7,292	57.3	4,103,241	371,893	29.8
2000	955,854	73,538	36.4	1,948,980	182,824	29.6	265,642	21,463	56.0	24,518	2,069	53.3	2,552,559	207,540	35.3
2001	1,404,055	143,215	44.1	1,702,671	159,705	28.0	627,865	49,516	64.4	267,359	37,792	76.1	2,252,160	187,174	32.3
2002	559,039	45,914	33.0	1,187,635	99,572	27.3	192,094	16,154	33.4	132,712	11,419	48.6	1,035,758	94,081	34.7
2003	1,024,308	104,601	38.7	744,196	73,392	36.7	114,932	11,660	47.4	299,436	31,155	65.2	1,546,106	119,188	35.8
2004	477,328	37,608	44.0	944,587	83,721	31.6	83,683	9,645	45.2	24,033	1,683	59.3	1,547,223	179,206	58.2
2005	793,236	78,009	30.6	1,986,884	197,746	37.7	322,768	27,129	33.4	127,575	10,772	59.1	895,780	88,581	36.9
2006	1,085,517	94,206	40.6	2,355,407	246,212	35.5	670,528	51,507	48.7	109,904	14,722	53.3	1,144,271	114,481	33.4
2007	464,018	53,814	41.9	1,109,367	108,758	29.6	256,654	23,186	43.8	96,680	16,221	68.5	929,550	101,536	36.6
2008	901,587	79,859	28.4	1,912,635	158,866	23.6	248,799	18,285	34.4	12,748	1,302	65.4	1,377,270	120,320	31.0
2009	417,567	39,805	30.9	1,414,008	126,475	32.2	384,706	37,443	32.7	87,082	6,332	93.7	927,737	109,736	43.9
2010	572,004	56,545	30.2	1,506,818	154,439	35.8	583,189	46,495	32.6	74,678	7,726	48.6	828,375	63,464	53.8
2011	1,434,105	134,468	28.0	1,860,121	162,394	25.3	249,435	22,119	43.9	103,717	7,384	66.2	719,286	64,218	31.8
2012	1,263,476	132,282	31.2	977,186	90,037	34.4	175,964	13,443	45.1	52,159	6,074	56.4	674,174	75,140	37.8
2013	2,271,755	195,413	19.6	3,675,890	327,093	18.3	939,354	77,379	32.1	41,427	3,162	40.7	5,525,367	504,444	24.1
2014		79,920	38.8		375,249	12.4		51,901	55.7		9,346	53.3		594,294	15.1
2015		76,780	21.4		378,245	11.5		23,835	34.1		9,300	45.9		727,719	12.3
2016		50,106	21.9		275,986	8.7		24,951	66.9		9,495	37.5		892,875	11.4

[illegible]

Appendix 2:

LSU Southern Flounder (*Paralichthys lethostigma*) Biological Parameter Appendix

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Size and Age at Maturity

Length and age at maturity were estimated for female southern flounder caught between September 2018 and January 2019 in Louisiana waters. The probability of a fish being mature was developed using a logistic regression with maturity based on the most advanced oocyte stage from histological samples. Cortical alveoli (or later) stage oocytes were assigned as mature, while fish exhibiting only primary growth were assigned immature.

Table 1. Length-at-maturity parameter estimates for fish sizes in inches and millimeters (total length; TL). Note that the same individual fish were used for both estimates. L_{50} is a ratio of the parameters and is interpreted as the size at which 50% of the population is expected to be mature. The value in the cell is the estimated parameter, with the standard error following in parentheses.

Measurement	α (intercept)	β (slope)	L_{50} ¹
Inches	-12.83201 (2.807)	0.9198007 (0.203)	13.951
Millimeters	-12.83201 (2.806)	0.03621262 (0.008)	354.352

Table 2. Age-at-maturity parameter estimates for fish using year-class ages (integer-ages). A_{50} is a ratio of the parameters and is interpreted as the age at which 50% of the population is expected to be mature. The value in the cell is the estimated parameter, with the standard error following in parentheses.

Measurement	α (intercept)	β (slope)	A_{50}
Years	-3.064 (0.611)	1.727 (0.363)	1.774

Size at Age

Length at age was estimated separately for male and female southern flounder caught between 2002 and 2019 in Louisiana waters. Length was measured as total length (TL), and ages were estimated from otolith sections that were prepared in accordance with LDWF protocols. Length at age was then estimated using the von Bertalanffy growth equation.

Table 3. Length-at-age parameter estimates by sex and measurement (inches and millimeters total length). The value in the cell is the estimated parameter, with the standard deviation following in parentheses. All parameters are estimated from a von Bertalanffy equation.

Sex and Measurement	L_{∞}	K	t_0
Female (mm)	503.92 (7.04)	0.453 (0.026)	-1.11 (0.08)
Male (mm)	441.03 (29.63)	0.312 (0.064)	-2.06 (0.33)
Female (inches)	19.96 (0.33)	0.443 (0.029)	-1.14 (0.09)
Male (inches)	17.38 (1.19)	0.312 (0.069)	-2.07 (0.35)

¹ Note that both L_{50} and A_{50} are not directly estimated parameters, but ratios of other parameters. Estimating any variance on the ratio of two parameters is not straightforward, but we can generate ratio uncertainty if needed.

Figures

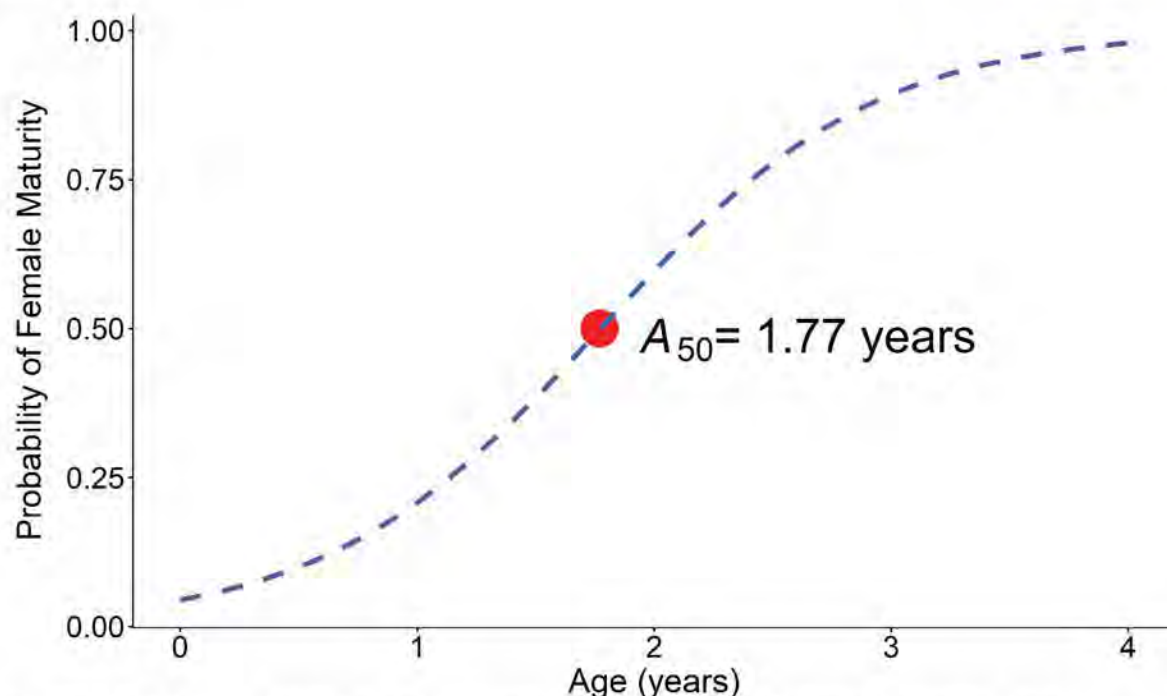


Figure 1. Probability of maturity for female southern flounder as a function of age class based on Louisiana southern flounder caught between September 2018 and January 2019 ($n = 89$). The dotted blue line represents the population-level estimate using a generalized linear model and each black dot is an individual fish. The red dot and text indicate the parameter of interest, which was the length at which 50% of females are mature (A_{50}), where $A_{50} = 1.77$ years.

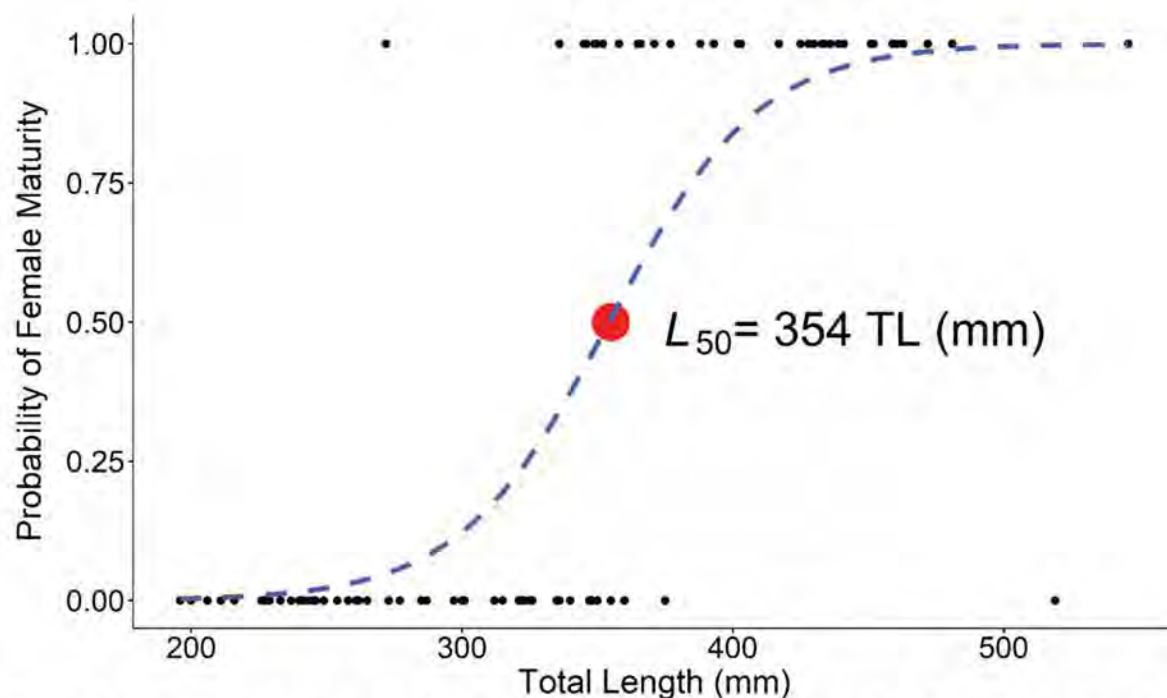


Figure 2. Probability of maturity for female southern flounder as a function of total length (mm) based on Louisiana southern flounder caught between September 2018 and January 2019 ($n = 89$). The dotted blue line represents the population-level estimate using a generalized linear model and each black dot is an individual fish. The red dot and text indicate the parameter of interest, which was the length at which 50% of females are mature (L_{50}), where $L_{50} = 354$ mm.

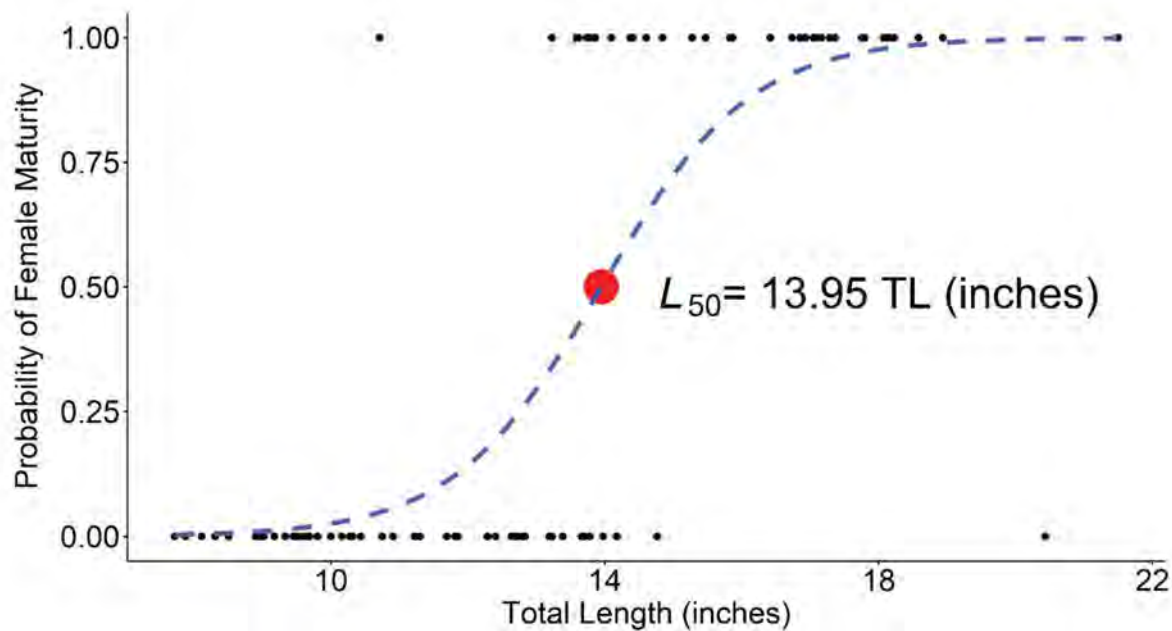


Figure 3. Probability of maturity for female southern flounder as a function of total length (inches) based on Louisiana southern flounder caught between September 2018 and January 2019 ($n = 89$). The dotted blue line represents the population-level estimate using a generalized linear model and each black dot is an individual fish. The red dot and text indicate the parameter of interest, which was the length at which 50% of females are mature (L_{50}), where $L_{50} = 13.95$ inches.

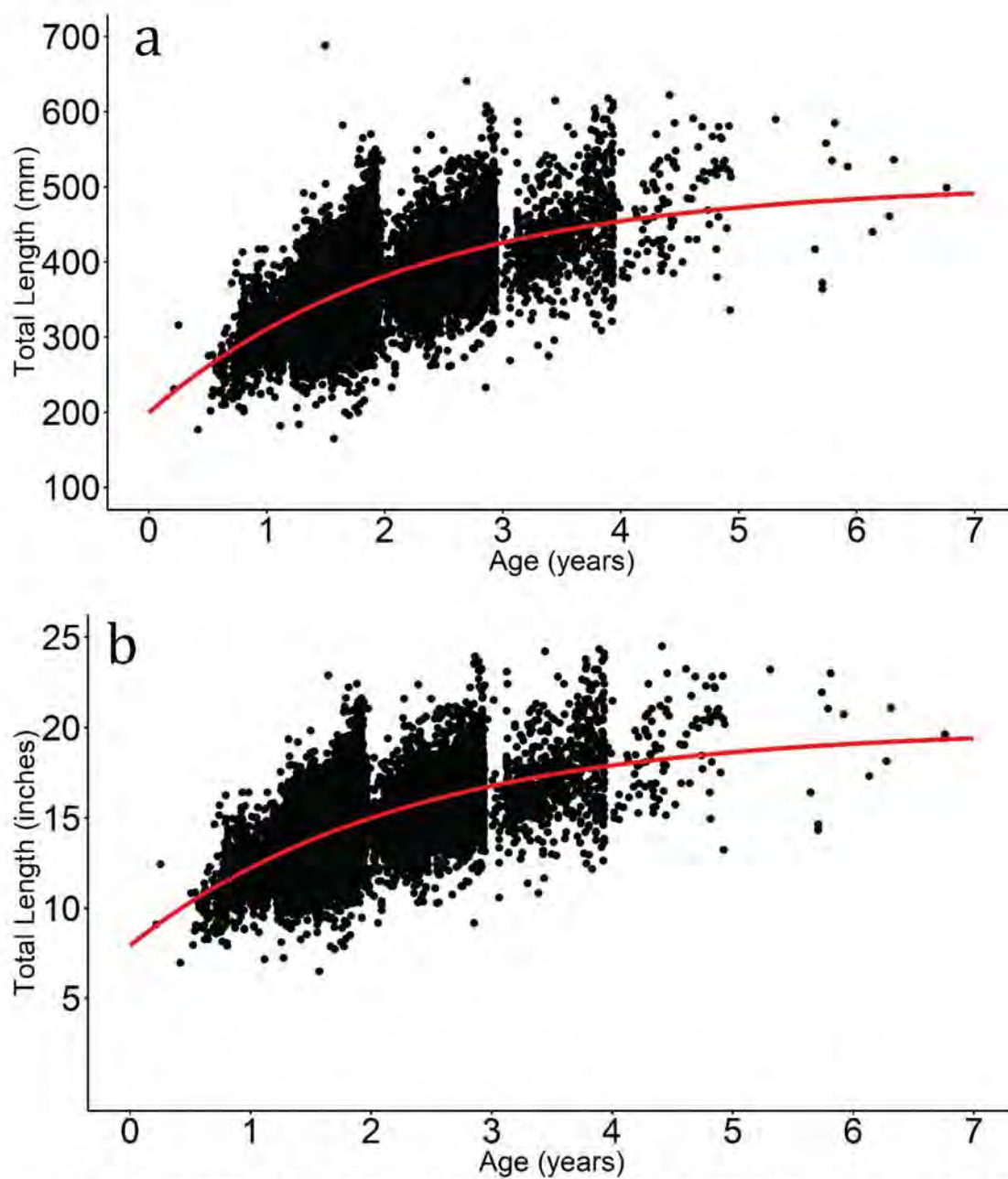


Figure 4. von Bertalanffy growth model fitted to female southern flounder ($n=12,460$) in Louisiana captured between 2002 and January 2019. The red line represents the growth equation and the black dots represent individual fish. Each fish was assigned a fractional age as a function of the number of annuli present and the month of capture (January 1 birthdate). Figure (4a) lists the total length in millimeters and Figure (4b) lists the total length in inches.

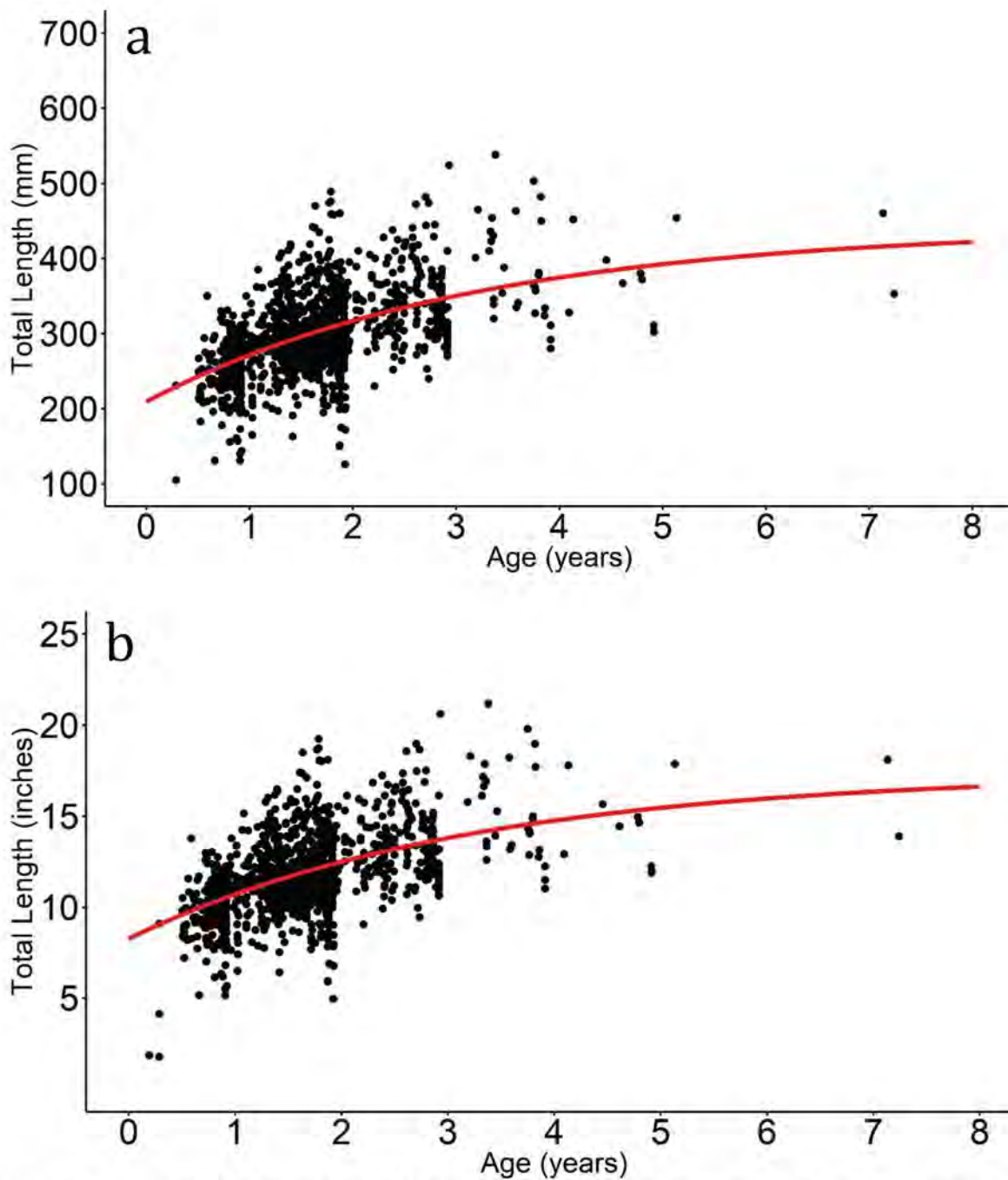


Figure 5. von Bertalanffy growth model fitted to male and indeterminate southern flounder ($n=1830$) in Louisiana captured between 2002 and January 2019. The red line represents the growth equation and the black dots represent individual fish. Each fish was assigned a fractional age as a function of the number of annuli present and the month of capture (January 1 birthdate). Figure (5a) lists the total length in millimeters and Figure (5b) lists the total length in inches.

Data Collection and Analysis

$N = 14,344$ southern flounder (*Paralichthys lethostigma*) lengths and otoliths were collected from Louisiana Department of Wildlife and Fisheries (LDWF) historical aging collection ($n = 14,184$), LDWF fishery-independent sampling in 2018 and 2019 ($n = 104$), and fishery-dependent sampling of commercial and recreational landings by Louisiana State University and Louisiana Sea Grant in 2018 and 2019 ($n = 56$). Length was measured as the total length in millimeters of the whole fish.

Aging

To determine fish age, the left sagittal otolith was first embedded in a mixture of Araldite and Aradur and allowed to cure for 24 hours. Next, three 5 mm serial sections were taken from each otolith using a Buehler Isomet 1000 saw. One section was cut just to the right of the core, the second section directly on the core, and the final section to the left of the core. In cases where the otolith was too small to section three times, as many sections were taken as possible. Sections were mounted on glass microscopy slides and set with Loctite and Shannon Mount. Finally, ages were estimated by two independent readers using a compound microscope.

Growth parameters were modeled using the three-parameter von Bertalanffy Growth Equation (VBGE). The three parameter VBGE can be expressed as:

$$L_t = L_{\infty} [1 - e^{-k(t-t_0)}] + \varepsilon$$

where L_t is the length at some age (t), L_{∞} is the asymptotic length, k is the von Bertalanffy growth constant, t_0 is the age at which a fish has a length of zero millimeters (von Bertalanffy, 1938), and ε is the error term for the model. Growth was estimated separately for males and females as flounder exhibit sexually dimorphic growth. Indeterminate sexed fish were included in the VBGE for males as they improved model performance and contributed to a more realistic estimate by anchoring the curve at smaller sizes and lowering the asymptotic length.

Maturity

To determine maturity at age and length, histological sections of gonadal tissue were prepared and analyzed. Histological analyses provided information about the specific reproductive (developmental) stage of each female, contributed to a more robust estimate of maturity, and more accurately identified the sex. A middle section of tissue from each gonad was removed, placed inside a microcassette case, and stored in 10% neutral buffered formalin. Tissues were then embedded using Leica Surgipath Paraplast tissue embedding medium and allowed to set at a low temperature in a refrigerator. From the embedded tissues, 5- μ m tissue sections were cut with a microtome (Leica RM 2125 RTS) and placed in a 36°C water bath (Leica HI 1210) before being dried onto a glass microscopy slide. Finally, each slide was stained using standard hematoxylin and eosin-y stains (Leica ST 5020). Samples were then viewed under a compound microscope by one reader and classified according to the most advanced stage. From these stages, a maturity classification (mature or immature) was generated, with anything estimated as cortical alveolus oocytes, or a more advanced stage, considered mature. One outlier was a 519mm female that showed primary growth oocytes and thus was classified as immature. While it is likely that this female would have developed mature oocytes later in the spawning season, its inclusion in the maturity estimate does not affect it by more than a few millimeters and thus it remains included in the model.

Maturity data were then used in a generalized linear model (GLM) with a binomial distribution (i.e., logistic regression), in an effort to estimate parameters for length at maturity and age at maturity. The GLM used TL (mm) as a predictor and maturity as the response. A L_{50} value was estimated for Louisiana and each CSA using the GLM parameters in the ratio $L_{50} = -\alpha/\beta$ (GLM 1). Procedures were repeated to calculate A_{50} , using a binomial GLM with age as the predictor and maturity as the response (GLM 2) and $A_{50} = -\alpha/\beta$. All data analyses were performed in the statistical computing environment R (R Core Team, 2018) and length at age data utilized a Bayesian approach with the JAGS package (Plummer, 2018).

References

- Plummer, M. (2018). *rjags*: Bayesian Graphical Models using MCMC. R package version 4-8.
- R Core Team (2018). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL <https://www.R-project.org/>.

APPENDIX II. LA Revised Statutes 56:638.1-5. Fish Conservation, Management, and Sustainability: Legislative Intent, Findings, Purposes, Policy, and Fishery Standards

The legislative intent, findings, purposes, policy and standards for the conservation and management of all species of fish in Louisiana are defined in Louisiana Revised Statutes (LA R.S.) 56:638.1, 56:638.2, 56:638.3, 56:638.4, and 56:638.5, which function similarly to those found in the federal Magnuson-Stevens Fishery and Conservation Act.

LA R.S. 56:638.1. Fish Conservation, Management, and Sustainability; Legislative Intent

Recognizing that there are ever-increasing numbers of both recreational anglers and commercial harvesters utilizing the waters of the state for recreational and commercial pursuits resulting in conflicts over limited space and competition for the same fish, and acknowledging that both the sport and commercial fishing industries are vital to the economy of the coastal region and the entire state, the fishery standards for conservation, management, and sustainability of all species of fish are hereby declared to be fair and in the best interest of the state.

LA R.S. 56:638.2. Findings

The state of Louisiana recognizes that:

1. Its fish resources are of great value and are renewable. These fish resources make many contributions to the state, including but not limited to the food supply, economy, and health of the state and recreational opportunities. With proper regulations of the harvest by commercial harvesters and recreational anglers, coupled with protection and enhancement of their freshwater, saltwater, and estuarine habitat, Louisiana's fish resources should be available to provide these benefits to the state indefinitely.
2. As a consequence of increased fishing pressure or other factors and because of the limitations of fish conservation, management, and sustainability practices, certain stocks of fish may have been or will become overfished.
3. The future productivity of renewable fish resources and their supporting habitats may be seriously jeopardized as a consequence of the continued loss of Louisiana coastal wetlands, or because of human actions affecting the functionality and value of the state's renewable fish resources and their supporting habitats.
4. Both commercial and recreational fishing constitute a major source of employment and contribute significantly to the economy of the state. Many coastal areas are dependent upon such fishing and related activities and their economies have been damaged by pollution, habitat degradation, or overfishing.
5. Fish resources are finite but renewable. If timely placed under sound management, the fisheries can be conserved and maintained so as to provide optimum and sustainable yields on a continuing basis.
6. A strong state program for the wise conservation, management, and sustainability of the fish resources of Louisiana is necessary to maintain plentiful fish populations, to prevent overfishing, to rebuild reduced stocks, to ensure conservation, and to realize their full potential.
7. The safe development or improvement of fisheries that are not fully or properly utilized by the Louisiana commercial harvesters and recreational anglers and fishing industries should help to ensure that Louisiana benefits from the employment, food supply, recreation, and social and economic benefit that could be maintained or generated thereby, if pursued in such a fashion that is socially, scientifically, economically, anthropologically, and biologically sound for the state, the species, any related species, and their supporting habitats.
8. A strong state program is necessary to advocate the importance of the functionality and value of Louisiana's waters and coastal wetlands as estuary and habitat for fish resources, the social and economic value of these resources to the state and the nation, and the need to actively seek to avoid any net loss of this functionality and value.

LA R.S. 56:638.3. Purposes

- A. In order to implement the objectives and purposes of this Subpart, the commission shall:
 1. Take timely action to conserve, manage, protect, and sustain fish species.
 2. Promote the use of sound conservation, management, and sustainability principles in the regulation of commercial and recreational fishing.
 3. Actively advocate, on behalf of the fish constituency, improvement of or no net loss of the functionality and value of the fisheries' habitat and estuary.
 4. Provide for the preparation and implementation of fish management plans, including plans for habitats, estuaries, and their supporting ecosystems, in accordance with this policy that will prevent overfishing and will achieve and maintain plentiful fish populations to ensure, on a continuing basis, the optimum yield from each fishery while ensuring its sustainability.
 5. Recognize that fish populations are subject to both natural and man-induced increases and decreases, and that changes in harvest levels may need to be recommended. If changes are required, these increases and decreases should be distributed among all recreational anglers and commercial harvesters in a fair and equitable manner that considers among other factors historical usage, ensuring that no historical user groups will be arbitrarily excluded.
- B. A sustainable fishery is one that is scientifically monitored and actively managed to be viable today and in the future, conserving fish and their environment and supporting the communities and economies that depend upon these resources.

LA R.S. 56:638.4. Policy

The policy of the state of Louisiana is hereby declared to be the following:

Stewardship of the state's renewable fish resources shall have as its utmost concern the continued health and abundance of the resource and its habitat, shall provide for optimum sustained benefits to the state, shall be responsive to the needs of interested and affected citizens, shall ensure the proper and fair utilization of these resources for the citizens of the state in present and future generations, shall preserve the state's exclusive right to manage the fisheries within or beyond its jurisdiction, shall be based on the best scientific and technical information available. In addition, such stewardship of the state's fish resources shall draw upon federal, state, and academic capabilities and promote efficiency in carrying out research, administration, management, and enforcement.

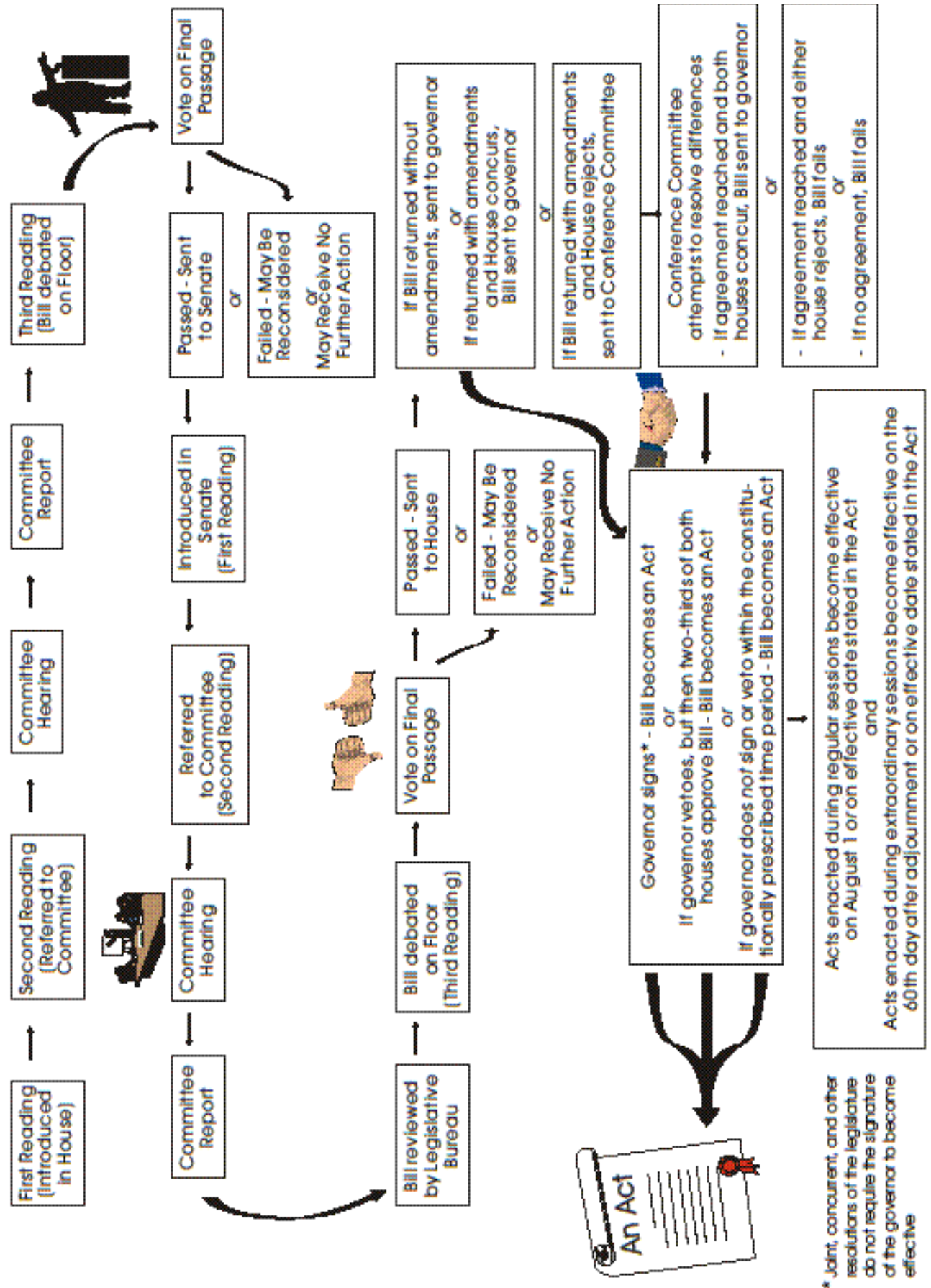
LA R.S. 56:638.5. Fishery Standards

The commission shall adopt such rules and regulations consistent with the authority granted by this Chapter and in accordance with the Administrative Procedure Act, for the harvesting, conservation, management, and sustainability of all species of fish, in accordance with the following standards:

1. Conservation, management, and sustainability measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield while maintaining healthy, plentiful stocks. In fact, every effort will be made at all times to prevent a harvest from exceeding the safe upper limit of harvests which can be taken consistently year after year without diminishing the stocks so that the stock is truly inexhaustible and perpetually renewable.
2. Conservation, management, and sustainability measures shall be based upon the best scientific, economic, biological, anthropological, and sociological information available.
3. To the extent practicable, an individual stock or unit of fish shall be managed as a unit throughout its range within the state's jurisdictional authority and interrelated stocks of fish and other renewable fish resources shall be managed in close coordination while considering their supporting habitats.
4. If it becomes necessary to allocate or assign fishing privileges among various recreational anglers and commercial harvesters, such allocations to the extent practicable shall be:
 - a. Fair and equitable to all such fishermen.
 - b. Reasonably calculated to promote conservation.
 - c. Carried out in such a manner that no particular individual, corporation, or other legal entity acquires an excessive share of such privileges.
 - d. In the best interest of the citizens of Louisiana.
5. Conservation, management, and sustainability measures shall, where practicable, promote efficiency in the conservation, management, and sustainability of fish resources; except that no such measure shall have economic allocation as its sole purpose.
6. Conservation, management, and sustainability measures shall, where practicable, minimize costs and avoid unnecessary duplication.
7. Conservation, management, and sustainability measures may take into account and allow for variations among, and contingencies in, fisheries, resources, and catches.

Acts 1991, No. 708, §1; Acts 2014, No. 553, §1.

How a Bill Becomes a Law



APPENDIX IV. Authorities and Duties of the Louisiana Wildlife and Fisheries Commission

According to LA R.S. 56, the Commission's authorities and duties related to Spotted Seatrout include:

LA R.S. 56:2 Supervision and Direction of the Commission

The Commission has general control, management, supervision, and direction of itself. The Commission is a policy-making and budgetary-control board, with no administrative functions. The Commission has sole authority to establish definite management programs and policies, approve and accept all contracts at its discretion, make studies and investigations as it thinks necessary, formulate policies, and determine the wisdom and efficacy of its policies, plans, rules, regulations and proceedings.

LA R.S. 56:3 Ownership of Fish

The ownership and title to all wild birds, and wild quadrupeds, fish, other aquatic life, the beds and bottoms of rivers, streams, bayous, lagoons, lakes, bays, sounds, and inlets bordering on or connecting with the Gulf of Mexico within the territory or jurisdiction of the state, including all oysters and other shellfish and parts thereof grown thereon, either naturally or cultivated, and all fish in the shells after they are caught or taken therefrom, are and remain the property of the state, and shall be under the exclusive control of the Wildlife and Fisheries Commission except as provided in R.S. 56:4 (Authority of Department of Natural Resources over navigable water bottoms).

LA R.S. 56:6 Special Powers and Duties

The Commission, through its secretary, shall:

- Adopt rules and regulations for the comprehensive control of finfish
- Improve, enlarge, and protect the natural oyster reefs of the state
- Enforce all law relative to the protection, propagation, and sale of all species of fish in the state
- Have full power and control over all fish within the state's waters
- Assist in protecting all lessees of private oyster bedding grounds in the enjoyment of their rights
- Promulgate rules and regulations to set seasons, times, places, size limits, quotas, daily take, and possession limits based upon biological and technical data for all fish
- Impose a fee for nonresident recreational fishing licenses
- Provide for a program of dissemination of fisheries information and education in Louisiana.

LA R.S. 56:22 Rules and Regulations

The Commission may entirely prohibit the taking of any species of fish in any part of the state for not more than a three-year period.

LA R.S. 56:25 Fish and Wildlife Restoration and Management Projects

The Commission is authorized, empowered, and directed to perform acts as may be necessary to conduct and establish cooperative fish restoration projects as defined in the Dingell-Johnson Sport Fish Restoration Act, in compliance with said act and rules and regulations promulgated by the Secretary of Interior thereunder.

LA R.S. 56:40.2 Value of Fish, Wild Birds, Wild Quadrupeds, and other Wildlife and Aquatic Life

The Commission shall adopt rules to establish guidelines for determining the value of injured or destroyed fish based upon recommendations of department staff and other relevant factors.

LA R.S. 56:301.5 Commission Rules and Regulations

The Commission may promulgate rules and regulations concerning any aspect of licensing not specifically provided for.

LA R.S. 56:313 Control of Fisheries

The Commission has exclusive control of fish having a game or commercial value in the state.

LA R.S. 56:315 Sanctuaries and Propagating Places

The Commission may operate and maintain hatcheries, sanctuaries and propagating places for the protection and propagation of fish and may restrict fishing in any manner it deems advisable.

LA R.S. 56:325.1 Size and Possession Limits for Recreational Saltwater Finfish

A (1) The Commission may set by rule daily take, possession, and size limits for saltwater finfish caught recreationally in Louisiana territorial waters, based on biological and technical data.

A (2) With respect to Red Drum, Southern Flounder, and Spotted Sea Trout specifically, and until such time as the commission establishes daily take and possession limits for these species in accordance with the Administrative Procedure Act, the following shall be the legal take, daily bag, and possession limits:

- (a) Red Drum -- five fish daily.
- (b) Spotted Sea Trout -- twenty-five fish daily.
- (c) Southern Flounder -- ten fish for each consecutive day on the water.

A (3)

(a) A fisherman who holds and is in possession of a valid recreational fishing license and can demonstrate to the department's satisfaction use of a boat launch located south of U.S. Highway 90 and that the fisherman has been actively on the water or at a remote camp that can be accessed only by water for two days or more may possess up to the possession limit of filleted Red Drum, Spotted Sea Trout, and Southern Flounder.

(b) Notwithstanding the provisions of Subparagraph (a) of this Paragraph and R.S. 56:325.2(A) and (B), a fisherman who holds

and is in possession of a valid recreational fishing license and can demonstrate to the department's satisfaction use of a boat launch located south of U.S. Highway 90 and that the fisherman has been actively on the water or at a remote camp that can be accessed only by water for two days or more may possess up to the possession limit of filleted Red Drum, Spotted Sea Trout, and Southern Flounder. The filleted fish shall have sufficient skin remaining on the fillet to allow for identification of the species and shall be segregated by species into plastic bags or plastic containers that are marked by species to allow easy identification, the date caught, and the name and license number of the person who took the fish. The Spotted Sea Trout fillets shall be no less than ten inches in length and the Red Drum shall be no less than fourteen inches in length. The fish shall be in the possession only of the person who took the fish. However, no fisherman shall be actively fishing or engaged in fishing while in possession of more than the daily take limit.

A (4) The possession limit for Red Drum and Spotted Sea Trout taken south of U.S. Highway 90 shall be three times the daily take limit when the fisherman holds and is in possession of a valid recreational fishing license and can show a landing receipt from a public boat launch located south of U.S. Highway 90 that demonstrates to the satisfaction of the department that the fisherman has been actively on the water or at a remote camp that can be accessed only by water for two days or more. The fish shall be kept whole or whole gutted in separate bags for each species of fish. The bags shall be marked with the date the fish were taken, the species, the number of fish contained in the bag, and the name and license number of the person taking the fish. The fish shall only be in the possession of the person who took the fish. However, no fisherman shall be actively fishing or engaged in fishing while in possession of more than the daily take limit.

B. No saltwater sport fisherman shall take or possess at any one time in the Louisiana territorial waters extending to the outermost boundary limit of the Federal Exclusive Economic Zone any Red Drum, Southern Flounder, or Spotted Sea Trout under the prescribed minimum size nor over the maximum prescribed size and daily bag limit. Any Red Drum, Southern Flounder, or Spotted Sea Trout under the minimum prescribed size or over the maximum prescribed size and daily bag limit shall be returned immediately to the waters from which taken without avoidable injury. Until such time as the commission establishes legal size, daily bag and possession limits for the Red Drum, Southern Flounder, and Spotted Sea Trout in accordance with the Administrative Procedure Act, the following are the legal size, daily bag and possession limits for Red Drum, Southern Flounder, and Spotted Sea Trout:

B (1) The minimum size for Red Drum is sixteen inches in total length when measured with the mouth closed.

B (2) The maximum size for Red Drum is twenty-seven inches in total length when measured with the mouth closed. However, no person shall have in possession while fishing, or while on the water, more than one Red Drum which, when whole, is or was over the prescribed maximum size of twenty-seven inches total length overall when measured with the mouth closed. Ad-

ditionally, no person shall have in his possession at any one time more than two Red Drum or parts of more than two Red Drum, which, when whole, are or were over the prescribed maximum size of twenty-seven inches total length overall when measured with the mouth closed.

B (3) The minimum size for Spotted Sea Trout is twelve inches total length when measured with the mouth closed.

LA R.S. 56:325.4 Commercial Taking of other Saltwater Finfish

B (2) The commission shall adopt rules and regulations for the entry of commercial harvesters into the commercial fishery for these species: Black Drum (also known as puppy drum), Sheepshead, and Southern Flounder.

B (3) The commercial taking of Black Drum (also known as puppy drum), Sheepshead, and Southern Flounder during the season by using a pompano strike net in excess of one thousand two hundred feet in length or by using more than one strike net from any vessel at any time is prohibited.

B (4) Each pompano strike net shall have attached to it a tag issued by the department which states the name, address, and social security number of the owner of the net and the permit number of the permit issued to commercially take Black Drum (also known as puppy drum), Sheepshead, and Southern Flounder. The department shall not issue any tag to a person who does not have a social security number.

D (1) The commission shall monitor and evaluate the condition of the Black Drum, Sheepshead, and Southern Flounder in Louisiana waters and establish management targets to ensure a sustainable population. A report of the status of each stock and an evaluation of management measures shall be submitted every five years to the legislature no later than March first of that year.

D (2) If data indicate that a fishery is not meeting or is likely not to meet the established targets, the department shall provide for the commission's consideration management options to ensure that the species can meet the management targets established for that species

LA R.S. 56:326 Size and Possession Limits; Commercial Fish

The Commission shall have the authority to set seasons, regulate the type of gear used, and set possession limits for speckled trout and other estuarine fish in Calcasieu Lake, located in Calcasieu and Cameron Parishes, where it is clearly demonstrated that intense fishing competition exists, or if pollution levels exceed accepted standards, or if biological studies indicate the need.

LA R.S. 56:326.1 Size Limits

The Commission shall have the authority to set size limits for all saltwater fish for which no limits have been set by law.

LA R.S. 56:326.3 Possession Limits; Size Limits,

Seasons, Quotas, Times, and Daily Take Limits

The Commission may set possession limits, quotas, places, seasons, times, size limits, and daily take limits based upon biological and technical data, for all saltwater finfish taken or possessed in Louisiana waters.

LA R.S. 56:326.4 Staggered and Split Seasons

The Commission may split, stagger or otherwise arrange seasons and quotas for fishing in such a manner as to maximize the availability of popular fish for serving in Louisiana restaurants throughout the year.

LA R.S. 56:327 Sale or Purchase of Freshwater or Saltwater Game Fish Prohibited; Commercial Sales and Purchases, Commercial License Required; Commercial Fingerlings and Certified Mariculture and Aquaculture Fish Excepted; Penalties

The Commission shall hold public hearings to determine areas in which the saltwater fish resources of the state must be allocated between the competing sport and commercial interests and shall promulgate rules and regulations defining such areas and the manner in which the saltwater fish resources shall be allocated.

LA R.S. 56:492 Incidental Bycatch

Any commercial shrimping vessel may retain and any commercial fisherman may sell all Southern Flounder caught as bycatch on any shrimping trip unless the Southern Flounder stock is determined by the department to be overfished or undergoing overfishing. After such a determination, the commission may adopt rules or regulations in accordance with the Administrative Procedure Act to restrict the retention of Southern Flounder caught as bycatch on any shrimping trip until such time as the department determines the stock has recovered from an overfished or overfishing status.

APPENDIX V. Authorities and Duties of the Secretary and the Louisiana Department of Wildlife and Fisheries

According to Louisiana Revised Statutes (LA R.S.) Title 56 and Louisiana Administrative Code (LAC) Title 76, the Secretary and LDWF's authorities and duties related to Southern Flounder include:

LA R.S. 56:6.1 Emergency Closures

- A. The secretary, in an emergency, may close an area to the hunting or taking of wildlife or may restrict the hunting or taking of wildlife in a designated area in any manner deemed advisable. In addition, in an emergency, the secretary may declare a closed season on any or all species of fish found or existing in the waters of the state or may restrict fishing in the closed season in any manner deemed advisable. Such closure shall be for a period of time not to extend beyond the seventh day following the next meeting of the commission.
- B. Any such closure shall be made by an order issued by the secretary in the same manner as the issuance of an emergency rule as provided in R.S. 49:953.1. The closure order authorized in this Section shall include a description of the area subject to the closure, indication of the species of fish or wildlife covered by such order, and the reasons for the closure. In addition, the order may include restrictions on hunting or fishing times, bag or creel limits, and harvest restrictions and may alter season opening and closing dates. Upon the issuance of any such order, the possession, sale, barter, trade, or exchange of, or the attempt to possess, sell, barter, trade, or exchange, any species of fish or wildlife contrary to the provisions of the order is prohibited.

LA R.S. 56:17 Permits

The director may take fish of any kind in any manner or place for the purpose of science and cultivation and distribution and may grant permits to other persons for the same purpose.

LA R.S. 56:301.4 Records; Confidentiality

The Department shall draft regulations, prescribing procedures to preserve the confidentiality of all fisheries dependent data, information, or statistics submitted or collected pursuant to the provisions of this Section (licensing), for approval by the Wildlife and Fisheries Commission and promulgation in accordance with the Administrative Procedure Act. These regulations shall provide for compliance with all procedures set forth by the United States Department of Commerce, or any of its agencies or instrumentalities, for the confidentiality of fishing statistics collected from individuals or firms by that department, its agencies, or instrumentalities.

LA R.S. 56:313 Control of Fisheries; Duty of the Department

The Department shall enforce the provisions of the law regulating fish having game or commercial value in the state. The Department through its authorized agents shall confiscate all fish taken, possessed, or transported, contrary to the provisions of LA R.S. 56:313

LA R.S. 56:318 Permits

The Department may take fish of any kind when, where, and in such manner as may be deemed necessary for scientific or educational purposes and for propagation and distribution. The Secretary may issue permits to any persons to take fish for scientific or educational purposes or for propagation or distribution.

LA R.S. 56:325.4 Commercial Taking of other Saltwater Finfish; Exceptions; Mesh Size

B (4) Each pompano strike net shall have attached to it a tag issued by the department which states the name, address, and social security number of the owner of the net and the permit number of the permit issued to commercially take Black Drum (also known as puppy drum), Sheepshead, and Southern Flounder. The department shall not issue any tag to a person who does not have a social security number.

D (1) The commission shall monitor and evaluate the condition of Black Drum, Sheepshead, and Southern Flounder in Louisiana waters and establish management targets to ensure a sustainable population. A report of the status of each stock and an evaluation of management measures shall be submitted every five years to the legislature no later than March first of that year.

LA R.S. 56:327 Sale or Purchase of Freshwater or Saltwater Game Fish Prohibited; Commercial Sales and Purchases, Commercial License Required; Commercial Fingerlings and Certified Mariculture and Aquaculture Fish Excepted; Penalties

The Secretary shall have authority to set seasons, regulate type of gear used, and set possession limits for estuarine fish where it is clearly demonstrated that intense fishing competition exists or if pollution levels exceed adopted standards or if biological studies indicate the need.

LA R.S. 56:492 Incidental Bycatch

Any commercial shrimping vessel may retain and any commercial harvester may sell all Southern Flounder caught as bycatch on any shrimping trip unless the Southern Flounder stock is determined by the department to be overfished or undergoing overfishing. After such a determination, the commission may adopt rules or regulations in accordance with the Administrative Procedure Act to restrict the retention of Southern Flounder caught as bycatch on any shrimping trip until such time as the department determines the stock has recovered from an overfished or overfishing status.

LA R.S. 56:571 Experimental Gear

The Secretary may issue permits to persons who are interested in the development of new gear and equipment to harvest fish.

LA R.S. 56:640.3 Right to Fish

The Department shall recommend the elimination or restriction of any fishing gear currently in use or which may be used in recreational or commercial fisheries in implementing its management responsibilities or in response to any emergency situation. While elimination or restriction may have uneven impacts on different groups of recreational anglers and commercial harvesters, the proposed measures should be applicable to all people of the state. In addition to acquiring the best available biological data, the Department shall use all practicable means to collect all relevant social and economic data in support of such allocation decision making efforts.

LAC 76:385 Management Targets for Selected Finfish Species

A. Policy

The stocks of Black Drum, Sheepshead, and Southern Flounder shall have management targets established within this rule. Management targets shall be established utilizing a historical time-series of fisheries data, defined for each stock, as a basis of reference. The reference time-series is developed utilizing a period of time within the most recent assessment where recruitment has not been impacted and sustainability has been demonstrated for each stock. The biomass and fishing mortality rate of each stock over this historical time-series shall be derived from the beginning of the assessed period through 2013. If data indicate that a stock is not meeting or is likely not to meet thresholds established in the assessment of the stock, the department shall provide, for the Louisiana Wildlife and Fisheries Commission's consideration, management options to ensure that a stock can remain within the management thresholds established for that particular stock.

B. Management Targets

1. Biomass targets shall be calculated as the average (geometric mean) spawning stock biomass (SSB) from each stock's historical time-series.
2. Fishing mortality rate targets shall be the fishing mortality rate that corresponds to each stock's SSB targets at equilibrium.
3. Biomass and fishing mortality rate targets shall be calculated based upon a historical time-series from the beginning of the assessed period through 2013, inclusive.

APPENDIX VI. Other States' Commercial Southern Flounder Fishing Regulations

	Texas	Mississippi	Alabama	Florida	Georgia	South Carolina	North Carolina
Licensing	Commercial Finfish Fisherman's License (\$360 residential, \$1,440 nonresidential)	Commercial Saltwater License (\$100 resident, varies nonresident), additional gear licenses	Commercial Saltwater Fishing License (\$121 resident, \$241 nonresident); gear license (fee varies by type)	Saltwater Products License (\$50 resident, \$100 nonresident), Restricted Species Endorsement (\$0)	Commercial Fishing License (\$25 resident, \$200 nonresident)	Commercial Saltwater License (\$25 resident, \$300 nonresident); gear license (fee varies by type)	Standard Commercial Fishing License (\$400 resident, nonresident varies by state)
Seasons	Nov. 1-30, 2 per day pole and line only Dec. 1-14, 2 per day, any legal means	none	Closed in November	Closed from Oct. 15 - Nov. 30	none	none	Northern - Sept. 15 Central - Oct. 1 Southern - Oct. 1 *closure when near quota
Size Limits	15 inch total length minimum size limit	12 inch total length minimum size limit	14 inch total length minimum size limit	14 inch total length minimum size limit	12 inch total length minimum size limit	16 inch minimum size limit	15 inch total length minimum size limit
Harvest Limits	30 per day with seasonal exceptions	Quota: (74,000 lbs)	40 per person or 40 per vessel	Vessel limit of 150 fish from Dec. 1 to Oct. 14. Limit of 50 fish from Oct. 15 to Nov. 30 for allowable gear. Vessel limit of 50 fish (bycatch) per trip for non-allowable gear	15 per person per day	5 per day, no more than 10 per boat	372,646 lbs per season through 2024, reduced quota after that
Gear Restrictions and Requirements	Legal Gear: trot lines, archery, gig, hand fishing, perch trap, pole and line, shrimp trawl, spear gun	Legal gear: hook and line, trotline, bow, spear, gig, cast net, brill net, small mesh beach seine, trammel net or gillnet; area, size, mesh size, and material restrictions on nets and seines	Legal Gear: Hook and line, rod and reel, cast net, gig, trot line, spear, bow and arrow	Allowable gear: beach or haul seine, cast net, hook and line and spearing		Legal Gear: Hook and line, gigs, gill nets, channel nets, seines, trot lines, trawls, haul seines	Legal Gear: Rod and reel, gill nets, pound nets, trawls, seines, cast nets, trot lines, fish pots, gigs, spears
Limited Entry							
Professionalism							
Other				*all flounder species	Commercial possession restricted to recreational bag and size limits		*Southern, Summer, and Gulf Flounder

APPENDIX VII. Other States' Recreational Southern Flounder Fishing Regulations

	Texas	Mississippi	Alabama	Florida	Georgia	South Carolina	North Carolina
Licensing	Fishing License and Saltwater Fishing Endorsement (package \$35 resident, \$63 nonresident);	Saltwater Fishing License (\$10 resident, \$30 nonresident)	Saltwater Fishing License (\$23.50 resident, varies by state for nonresident)	Saltwater Fishing License (\$17 resident, \$47 nonresident)	Fishing License (\$15 resident, \$50 nonresident); SIP permit required when fishing saltwater (No fee)	Fishing License (\$10 resident, \$35 nonresident)	Fishing License (\$16 residents, \$32 nonresident) Rec Com Gear License (\$70 residents, \$500 nonresident)
Seasons	Nov. 1-30, 2 per day pole and line only Dec. 1-14, 2 per day, any legal means		Closed in November	Closed from Oct. 15 - Nov. 30	none	none	Sept. 1-30
Size Limits	15 inch total length minimum size limit	12 inch total length minimum size limit	14 inch total length minimum size limit	14 inch total length minimum size limit	12 inch total length minimum size limit	16 inch minimum size limit	15 inch total length minimum size limit
Harvest Limits	5 per person per day with seasonal exceptions	10 per person per day	5 per person per day with seasonal exceptions	5 per person per day	15 per person per day	5 per day, no more than 10 per boat	1 per person per day, total allowable catch 159,706 from 2022-2024
Gear Restrictions and Requirements	Legal Gear: hook and line, gig, hand fishing, perch traps, sail line, spear, spear gun, trot line, umbrella net	Legal gear: hook and line, trotline, bow, spear, gig, cast net, brill net, small=mesh beach seine, trammel net or gill net; area, size, mesh size, and material restrictions on nets and seines	Legal Gear: Hook and line, rod and reel, cast net, gig, trot line, spear, bow and arrow	Legal Gear: Hook and line, cast net, seines, spearing	Legal gear: hook and line and seine, gig	Legal Gear: Hook and line, gig, cast net, gill nets, seines, trot lines	Legal Gear: Rod and reel, gigs
Other	*all flounder species					*all flounder species	*total allowable catch may change due to previous overages

APPENDIX VIII. Federal Management Institutions

The following list of federal management institutions was adapted from a similar list in GSMFC 1993.

The Southern Flounder fishery operates almost exclusively in state waters; landings occasionally come from federal waters. Federal agencies do not directly manage Southern Flounder, and the Gulf Council has not developed a fishery management plan for Southern Flounder. However, through their administration of laws, regulations, and policies, certain federal agencies may influence the Southern Flounder resource and fishery and management thereof.

Regional Fishery Management Councils

Under the Magnuson-Stevens Fishery Conservation and Management Act (MSA), federal authorities are responsible for monitoring and managing fishery resources in federal waters (from the seaward boundary of state waters to 200 nautical miles off-shore). Federal management is based on fishery management plans developed by regional fishery management councils, including the Gulf of Mexico Fishery Management Council (Gulf Council). Each council prepares plans for each fishery requiring management within its geographical area of authority and amends such plans as necessary. Plans are implemented as federal regulation through the U.S. Department of Commerce. As there is no significant fishery for Southern Flounder in federal waters of the U.S. Gulf of Mexico (Gulf), the Gulf Council has not developed a management plan for Southern Flounder.

U.S. Department of Commerce

The Secretary of U.S. Department of Commerce (DOC; Secretary of Commerce), acting through the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NOAA Fisheries), has the ultimate authority to approve or disapprove all fishery management plans prepared by regional fishery management councils. Where a council fails to develop a plan, or to correct an unacceptable plan, the Secretary of Commerce may do so.

National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS)

The National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NOAA Fisheries) collects data and statistics on fisheries, recreational anglers and commercial harvesters. It performs research and conducts management authorized by international treaties. NOAA Fisheries has the authority to enforce the MSA and the Lacey Act and is the federal trustee for living and nonliving natural resources in coastal and marine areas under U.S. jurisdiction. NOAA Fisheries exercises no management jurisdiction with respect to Southern Flounder in the Gulf. It conducts some research and data collection programs and comments on all projects that affect marine fishery habitat.

National Oceanic and Atmospheric Administration's Office of Ocean and Coastal Resource Management

The National Oceanic and Atmospheric Administration's (NOAA) Office of Ocean and Coastal Resource Management (OCRM), in conjunction with coastal states, administers the National

Estuarine Research Reserve and National Marine Sanctuaries Programs as authorized under Section 315 of the Coastal Management Act of 1972. Under these programs, OCRM establishes protected areas which serve to provide suitable habitat for estuarine and marine species and serve as sites for research and education activities related to coastal management issues. These areas are managed under specific management plans that may include restrictions on harvest and use of marine and estuarine species. Such plans could directly affect harvest of Southern Flounder.

OCRM may also influence fishery management for Southern Flounder indirectly through administering the Coastal Zone Management Program and by setting standards and approving funding for state coastal zone management programs. These programs often affect estuarine habitat on which Southern Flounder depend.

Department of the Interior's National Park Service

Under the Department of the Interior (DOI), the National Park Service (NPS) may regulate fishing activities within park boundaries. Such regulations could affect Southern Flounder harvest if implemented within a given park area. For example, NPS requires commercial harvesters to have a permit to fish commercially in Jean Lafitte National Historical Park and Preserve.

Department of the Interior's U.S. Fish and Wildlife Service

The Department of the Interior's U.S. Fish and Wildlife Service (USFWS) has little direct management authority over Southern Flounder. However, commercial fishing is prohibited in USFWS's coastal National Wildlife Refuges. USFWS may also affect the management of Southern Flounder through the Fish and Wildlife Coordination Act, under which USFWS and NOAA Fisheries review and comment on proposals for projects such as dredging, filling, and marine construction that could affect Southern Flounder and their habitat.

U.S. Environmental Protection Agency

Through its administration of the Clean Water Act (CWA) and the National Pollutant Discharge Elimination System (NPDES), the U.S. Environmental Protection Agency (EPA) provides protection for Southern Flounder and their habitat. The EPA may disapprove or add conditions to applications for permits to discharge pollutants into estuarine waters to protect these marine resources.

Under Section 312 of the CWA, the EPA regulates the equipment that treats or holds sewage (marine sanitation devices) and establishes areas in which the discharge of sewage from vessels is not allowed (No Discharge Zones, or NDZs) to help protect human health and the aquatic environment from disease-causing microorganisms that may be present in sewage from vessels and boats. An individual state can petition the EPA to officially designate an NDZ to: (1) to protect aquatic habitats where pumpout facilities are available, (2) to protect special habitats or species, and/or (3) to protect human drinking water intake zones. Once a designation is official, the state and the U.S. Coast Guard, if applicable, enforce the limits of the NDZ.

This means that the discharge of untreated and treated sewage is strictly forbidden and subject to fine if violated. Also, the U.S. Coast Guard can board vessels in an NDZ to verify that they have adequate facilities. Currently, the EPA can only designate areas associated with oyster harvesting as NDZs when there are sufficient pumpout facilities in the area to service vessel traffic.

The EPA and a local sponsor jointly administer the National Estuary Program. This program evaluates estuarine resources, local protection, and development of policies, and seeks to develop future management plans. Numerous user groups including industry, environmentalists, recreational and commercial interests, and policymakers provide input on these plans. The Barataria-Terrebonne estuarine complex in Louisiana became a National Estuary in 1990.

U.S. Army Corps of Engineers

Southern Flounder populations may be influenced by the U.S. Army Corps of Engineers' (Corps) responsibilities pursuant to the CWA and Section 10 of the Rivers and Harbors Act. Under these laws, the Corps issues or denies permits to individuals and other organizations for proposals to dredge, fill, and construct in wetland areas and navigable waters. The Corps is also responsible for planning, construction, and maintenance of navigation channels and other projects in aquatic areas; these projects could affect Southern Flounder and their habitat.

U.S. Coast Guard

The U.S. Coast Guard (USCG) is responsible for enforcing fishery management regulations adopted by the DOC pursuant to management plans developed by the Gulf Council. The USCG also enforces laws regarding marine pollution and marine safety, and they assist commercial and recreational fishing vessels in times of need. Although no regulations have been promulgated for Southern Flounder in the EEZ, enforcement of laws affecting marine pollution and fishing vessels could influence Southern Flounder populations.

U.S. Food and Drug Administration

The U.S. Food and Drug Administration (FDA) directly regulates the harvest and processing of seafood through its administration of the Food, Drug, and Cosmetic Act and other regulations that prohibit the sale and transfer of contaminated, putrid, or otherwise potentially dangerous foods. The FDA reserves the right and authority to enforce the Food, Drug, and Cosmetic Act and other regulations if the states fail to do so.

APPENDIX IX. Federal Laws, Regulations and Policies

The following federal laws, regulations, and policies may directly and/or indirectly influence the quality, abundance, and ultimately the management of Southern Flounder. This list was adapted from a similar list in GSMFC 1993.

Fishery Conservation and Management Act of 1976 (later renamed the Magnuson Fishery Conservation and Management Act and then the Magnuson-Stevens Fishery Conservation Act), and subsequent reauthorizations

The Magnuson-Stevens Fishery Conservation Act (MSA) extended U.S. jurisdiction from 12 nautical miles offshore to 200 nautical miles and established regional fishery management councils. The MSA mandates the councils to prepare fishery management plans for important fishery resources within federal waters. These plans must comply with certain conservation and management requirements laid out in the MSA, including national standards for sustainable fisheries management. Congress has reauthorized the MSA twice, once in 1996 and again in 2007. The 1996 reauthorization strengthened requirements to prevent overfishing and rebuild overfished fisheries; added definitions for overfishing, overfished, and fishing communities; added three new national standards to address fishing vessel safety, fishing communities, and bycatch and also revised several existing standards; and addressed needs for improved fishery monitoring, enhanced research, greater consideration of fishing communities, identification of essential fish habitat, formation of constituent advisory panels, and analysis of fishing capacity, among other activities. The 2006 reauthorization featured a number of new requirements to prevent overfishing by establishing annual catch limits and accountability measures; promote market-based management strategies, including limited access privilege programs, such as catch shares; strengthen the role of science through peer review, the councils' Scientific and Statistical Committees, and the Marine Recreational Information Program; and enhance international fisheries sustainability by addressing illegal, unregulated, and unreported fishing and bycatch.

Interjurisdictional Fisheries Act of 1986

The Interjurisdictional Fisheries Act (IJF) established a program to promote and encourage state activities in support of management plans, to promote and encourage management of interjurisdictional fishery resources throughout their range, and to promote and encourage research in preparation for the implementation of the use of ecosystems and interspecies approaches to the conservation and management of interjurisdictional fishery resources throughout their range. The enactment of this legislation repealed the Commercial Fisheries Research and Development Act.

Federal Aid in Sport Fish Restoration Act, commonly called the Dingell-Johnson Act or the Wallop-Breaux Act

The Federal Aid in Sport Fish Restoration Act (SFRA) provides funds to states, the U.S. Fish and Wildlife Service (USFWS), and the Gulf States Marine Fisheries Commission (GSMFC) to conduct research, planning, and other programs for enhancing and restoring marine sportfish populations.

Marine Protection, Research, and Sanctuaries Act of 1972 (Titles I and III) and the Shore Protection Act of 1988

The Marine Protection, Research, and Sanctuaries Act (MPRSA) provides protection of fish habitat through establishing and maintaining marine sanctuaries. The MPRSA and the Shore Protection Act (SPA) regulate ocean transportation and dumping of dredged materials, sewage sludge, and other materials. Criteria for issuing permits for such activities include considering effects of dumping on the marine environment, ecological systems, and fishery resources.

Federal Food, Drug, and Cosmetic Act of 1938

The Federal Food, Drug, and Cosmetic Act (FDCA) prohibits the sale, transfer, or importation of "adulterated" or "misbranded" products. Adulterated products may be defective, unsafe, filthy, or produced under unsanitary conditions. Misbranded products may have false, misleading, or inadequate information on their labels. In many instances, the FDCA also requires U.S. Food and Drug Administration (FDA) approval for distribution of certain products.

Federal Water Pollution Control Act of 1948 (FWPCA), the Clean Water Act of 1972 (CWA), and amendments

The Federal Water Pollution Control Act (FWPCA) was the first major U.S. law to address water pollution. It was significantly amended in 1972 and became commonly known as the Clean Water Act (CWA). The CWA's National Pollutant Discharge Elimination System (NPDES) program regulates point sources that discharge pollutants into waters of the United States. Any facility that discharges directly into U.S. waters must have an NPDES permit issued by the U.S. Environmental Protection Agency (EPA). Discharges of pollutants into rivers and estuaries that empty into the Gulf of Mexico can harm or kill marine fishery resources and alter habitats. The EPA has authorized the State of Louisiana to implement its own NPDES program to monitor program compliance and control water pollution.

Section 404 of the CWA regulates the placement of dredged or fill material into wetlands, lakes, streams, rivers, estuaries and certain other types of waters to avoid and minimize losses to wetlands and other waters and to compensate for unavoidable loss through mitigation and restoration. The EPA and the U.S. Army Corps of Engineers (Corps) jointly administer Section 404. The Corps issues Section 404 permits and monitors compliance with the issued permits. Both the Corps and EPA are responsible for on-site investigations and enforcement of unpermitted discharges under Section 404. USFWS and the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NOAA Fisheries) evaluate impacts of federally permitted projects on fish and wildlife.

The CWA prohibits discharge of oil or hazardous substances to U.S. waters or their adjoining shorelines in quantities that may be harmful to the public health or welfare or the environment. Owners and operators of non-transportation-related oil facilities must make and implement plans to prevent oil discharges. Some oil storage facilities and vessels must also prepare and

submit plans for responding to discharges of oil and hazardous substances. If a facility or vessel discharges oil to navigable waters or adjoining shorelines, the owner/operator is required to follow certain federal reporting requirements. National and area response plans must also be developed. EPA regional personnel periodically conduct inspections to ensure compliance with these regulations.

International Convention for the Prevention of Pollution from Ships

The International Convention for the Prevention of Pollution from Ships (MARPOL) is the main international convention that covers prevention of pollution of the marine environment by ships from operational or accidental causes. MARPOL is divided into annexes, each of which regulates a particular group of ship emissions including oil and oily water, bulk noxious liquid substances, harmful substances carried by sea in packaged form, sewage, garbage, and air pollution. As a signatory to MARPOL, the United States implemented the Act to Prevent Pollution from Ships to comply with the provisions of this convention. The Marine Plastic Pollution Research and Control Act later amended the Act to Prevent Pollution from Ships.

Clean Vessel Act of 1992, as amended

Congress passed the Clean Vessel Act (CVA) to help reduce pollution from vessel sewage discharges. The CVA was created to provide a viable alternative to the overboard disposal of recreational boater sewage. All recreational vessels must have access to pumpouts funded under the CVA. The CVA made grants available to the states on a competitive basis for the construction and/or renovation, operation and maintenance of pumpout and portable toilet dump stations. States may sub-grant to public and private marinas to install pumpouts. The USFWS administers this grant program. The CVA also provides a portion of its total funding for educational outreach regarding the effects of boater sewage and how boaters can avoid improper sewage disposal.

Coastal Zone Management Act of 1972, as amended

Under the Coastal Zone Management Act (CZMA), states receive federal assistance grants to maintain federally-approved planning programs for enhancing, protecting, and using coastal resources. These are state programs, but the CZMA requires that federal activities must be consistent with the respective states' coastal zone management programs. Depending upon the individual state's program, the CZMA provides the opportunity for considerable protection and enhancement of fishery resources by regulation of activities and by planning for future development in the least environmentally damaging manner.

Endangered Species Act of 1973, as amended

The Endangered Species Act (ESA) provides for the listing of plant and animal species that are threatened or endangered. Once listed as threatened or endangered, a species may not be taken, possessed, harassed, or otherwise molested. It also provides for a review process to ensure that projects authorized, funded or carried out by federal agencies do not jeopardize the existence of these species or result in destruction or modification of habitats that are determined by the Secretary of the U.S. Department of the Interior (DOI) to be critical.

National Environmental Policy Act of 1970

The National Environmental Policy Act (NEPA) requires that all federal agencies recognize and give appropriate consideration to environmental amenities and values in the course of their decision-making. To create and maintain conditions under which man and nature can exist in productive harmony, NEPA requires that federal agencies prepare an environmental impact statement (EIS) prior to undertaking major federal actions that significantly affect the quality of the human environment. Within these statements, federal agencies must carefully assess alternatives to the proposed action that may better safeguard environmental values.

Fish and Wildlife Coordination Act of 1958

Under the Fish and Wildlife Coordination Act, USFWS and NOAA Fisheries review and comment on fish and wildlife aspects of proposals for work and activities sanctioned, permitted, assisted, or conducted by federal agencies that take place in or affect navigable waters, wetlands, or other critical fish and wildlife habitat. The review focuses on potential damage to fish, wildlife, and their habitat; therefore, it serves to provide some protection to fishery resources from activities that may alter critical habitat in nearshore waters. This Act is important because federal agencies must give due consideration to the recommendations of USFWS and NOAA Fisheries.

Fish Restoration and Management Projects Act of 1950

Under this act, DOI is authorized to provide funds to state fish and game agencies for fish restoration and management projects. Funds for protection of threatened fish communities that are located within state waters could be made available under this Act.

Lacey Act of 1981, as amended

The Lacey Act prohibits import, export, and interstate transport of illegally taken fish and wildlife. As such, the Act provides for federal prosecution for violations of state fish and wildlife laws. The potential for federal convictions under this Act has probably reduced interstate transport of illegally possessed fish and fish products.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980, commonly called Superfund

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) names NOAA Fisheries as the federal trustee for living and nonliving natural resources in coastal and marine areas under U.S. jurisdiction. It could provide funds for cleanup of fishery habitat in the event of an oil spill or other polluting event.

Fish and Wildlife Act of 1956

This Act provides assistance to states in the form of law enforcement training and cooperative law enforcement agreements. It also allows for disposal of abandoned or forfeited property with some equipment being returned to states. The Act prohibits airborne hunting and fishing activities.

APPENDIX X. Commercial and Recreational Southern Flounder Fishery Regulations - Detailed Text

In general, Southern Flounder management and conservation is covered in state law through Louisiana Revised Statutes (LA R.S.) Title 56 and rules promulgated by the Louisiana Wildlife and Fisheries Commission (Commission) within the Louisiana Administrative Code (LAC) Title 76. These regulations are listed below.

COMMERCIAL SOUTHERN FLOUNDER REGULATIONS

LICENSING

Commercial Fisherman's License

- A commercial fisherman taking fish, including bait species, from state waters or possessing fish in the state must purchase a commercial fisherman's license. LA R.S. 56:303(A)(1)
- The cost of the commercial fisherman's license is \$75.50 for residents and \$540 for nonresidents. LA R.S. 56:303(B)
- A commercial fisherman's license is valid for one year, beginning on January 1 of each calendar year and expiring on December 31 of the same calendar year. LA R.S. 56:303.1(A)
- A commercial fisherman's license may be purchased at any time of the year for the current license year and from November 15 for the immediately following license year. LA R.S. 56:303.1(B)
- The person in charge of the operation of each vessel engaged in commercial fishing must have, in his possession and in his name, a valid, original commercial fisherman's license. This person must also have in his possession a gear license indicating that the applicable gear fee has been paid and, if applicable, a vessel license. LA R.S. 56:303.2(A)
- A resident of this state who is seventy years of age or older may obtain a senior commercial fishing license for an annual fee of \$35. The senior commercial fishing license shall be valid from January 1 of each calendar year until December 31 of the same calendar year. The license may be purchased at any time for the current license year and may be purchased after November 15 for the following license year. The license shall be in lieu of a commercial fisherman's license required by this Section. LA R.S. 56:303(F)
- The holder of a commercial fisherman's license may transport and sell his own catch to any licensed Louisiana wholesale/retail seafood dealer located within the state of Louisiana. The holder of a commercial fisherman's license may transport and sell his own catch to a consumer only within the state and only when in possession of a fresh products license as provided in LA R.S. 56:303.1.1. However, if he purchases fish for resale or transports his catch out of the state of Louisiana, or if he sells fish to a retail seafood dealer, restaurant, or retail grocer, he becomes a wholesale/retail seafood dealer and must obtain a wholesale/retail seafood dealer's license and is governed by the laws, rules, and regulations concerning wholesale/retail seafood dealers. LA R.S. 56:303.7(A)
- Whenever the holder of a commercial fisherman's license sells or transfers possession of his own catch to a wholesale/retail seafood dealer, he shall present the license to the dealer for license verification. The commercial fisherman shall provide the wholesale/retail seafood dealer with all information, as determined by the commission to be necessary to properly manage the fishery resources of the state, that is required to complete the commercial receipt form, which shall include but not be limited to the fisherman's first and last name, license number, signature, gear used, vessel used, primary location of where fish were caught, duration of trip, and permit numbers for species requiring a permit to harvest. The commercial fisherman shall sign each commercial receipt form attesting that the information provided therein is correct. LA R.S. 56:303.7(B)
- A commercial fisherman selling fish under the authority of a fresh product license specified in LA R.S. 56:303.1.1 shall record all information required on the commercial receipt forms, except that the fresh product license number shall be recorded in place of the wholesaler/retailer seafood dealer's license number. The fresh product licensee shall complete monthly returns to the department as specified in LA R.S. 56:306.6 for wholesale/retail seafood dealers. The commercial fisherman shall sign each commercial receipt form attesting that the information provided therein is correct. LA R.S. 56:303.7(C)

Fresh Products License

- A commercial fisherman selling his catch directly to a consumer shall possess a fresh products license. LA R.S. 56:303(A)(2) and LA R.S. 56:303.1.1(A)
- The cost of a fresh products license shall be \$61 for residents and \$300 for nonresidents. The fresh products license shall be valid for one year, beginning on January 1 of each calendar year and expiring on December 31 of the same calendar year. LA R.S. 56:303.1.1(B)
- Anyone holding a fresh products license shall, on or before the 10th day of each month, submit to the department, on forms provided or approved by the department for that purpose, information required by the department as provided in LA R.S. 56:303.7. LA R.S. 56:303.1.1(D)
- A commercial fisherman may purchase a secondary fresh products license for any designated individual if he provides the individual's name and social security number to the department. This secondary license will allow the commercial fisherman to continue to fish while the designated individual sells the catch. The secretary of the Department of Wildlife and Fisheries shall

promulgate rules and regulations implementing the provisions of this Subsection. The department is authorized to collect a fee for issuance of the license not to exceed \$5 which, after compliance with Article VII, Section 9(B) of the Constitution of Louisiana relative to the Bond Security and Redemption Fund, shall be credited to the Conservation Fund.

- A commercial fisherman selling fish under the authority of a fresh product license specified in LA R.S. 56:303.1.1 shall record all information required on the commercial receipt forms, except that the fresh product license number shall be recorded in place of the wholesaler/retailer seafood dealer's license number. The fresh product licensee shall complete monthly returns to the department as specified in LA R.S. 56:306.6 for wholesale/retail seafood dealers. The commercial fisherman shall sign each commercial receipt form attesting that the information provided therein is correct. LA R.S. 56:303.7(C)

Vessel License

- A vessel shall be licensed whenever engaged in commercial fishing in or whenever possessing fish for sale in the saltwater areas of the state defined in LA R.S. 56:322. A vessel may be licensed whenever engaged in commercial fishing in or whenever possessing fish for sale in the freshwater areas of the state defined in LA R.S. 56:322. LA R.S. 56:304(A)
- The cost of the vessel license for a resident is \$32.50 for the first vessel, \$25 for the second vessel, and \$17.50 for the third and any subsequent vessel. The cost of the vessel license for a nonresident is \$230. LA R.S. 56:304(B)
- Vessel licenses are issued in the name of the owner of the vessel and shall list the owner's name and address, the vessel name and registration or documentation number, and any other information required by the department. LA R.S. 56:304(D)
- A vessel license is valid for one year, beginning on January 1 of each calendar year and expiring on December 31 of the same calendar year. LA R.S. 56:304.1(A)
- A vessel license may be purchased at any time of the year for the current license year and from November 15 for the immediately following license year. LA R.S. 56:304.1(B)
- It is unlawful for the owner of a commercial fishing vessel licensed under this Subpart to permit any person not holding a valid, original commercial fisherman's license to operate such licensed vessel while the vessel is engaged in commercial fishing or while the vessel is possessing fish for sale in the waters of the state. LA R.S. 56:304.2(A)
- A vessel engaged in commercial fishing and operated by a person not possessing a valid, original commercial fisherman's license subjects the vessel owner to revocation of the vessel license and seizure of the vessel and all fish and equipment thereon. LA R.S. 56:304.2(B)
- Vessel licenses are not transferable except as provided by rule or regulation of the department. LA R.S. 56:304.5(A)
- The name of a vessel for which a vessel license has been issued cannot be changed without prior notification to the department. LA R.S. 56:304.5(B)
- The person in charge of the operation of each vessel engaged in commercial fishing must have, in his possession and in his name, a valid, original commercial fisherman's license. This person must also have in his possession a gear license indicating that the applicable gear fee has been paid and, if applicable, a vessel license. LA R.S. 56:303.2(A)

Commercial Gear Licenses

- A commercial fisherman must possess a commercial gear license indicating that the applicable gear fee has been paid whenever using or possessing on the fishing grounds any gear listed in Subsection B. LA R.S. 56:305(A)
- Resident commercial gear fees are listed in LA R.S. 56:305(B)
- The commercial gear fee for nonresidents is four times the gear fee for residents. LA R.S. 56:305(C)(1)
- No commercial gear license allowing the use of specific fishing gear shall be issued to any nonresident whose domiciliary state prohibits the use of similar commercial fishing gear. LA R.S. 56:305(C)(2)
- In the event more than one gear type is in possession on the fishing grounds the gear fee for each type of gear must be paid and so indicated on the gear license. LA R.S. 56:305(D)
- A gear fee must be paid for each piece of gear or each type of gear, whichever is applicable, being used to take fish or, if the gear is not in use but is in possession on the fishing grounds, the gear fee must be paid for each piece of gear or type of gear, whichever is applicable, intended for use or which was used to take fish. LA R.S. 56:305(E)
- Any commercial fisherman who purchases a trawl, skimmer, or butterfly gear license must also pay an annual fee of \$10 (residents) or \$40 (nonresidents) for deposit into the Shrimp Marketing and Promotion Account as provided for in LA R.S. 56:10(B)(1)(b)(i). LA R.S. 56:305(G)
- A commercial gear license is valid for one year, beginning on January 1 of each calendar year and expiring on December 31 of the same calendar year. LA R.S. 56:305.1(A)
- A commercial gear license may be purchased at any time of the year for the current license year and from November 15 for the immediately following license year. LA R.S. 56:305.1(B)
- A commercial gear license can only be purchased by a person possessing a valid commercial fisherman's license. LA R.S. 56:305.2(A)
- A valid commercial gear license may be transferred for temporary use only to a person holding a valid commercial fisherman's license and having the same residency status as indicated on the license being transferred. Gear licenses that require qualification shall not be transferred and may only be used by the person to whom it was issued. LA R.S. 56:305.3(A)
- A commercial gear license used by a person not holding a valid, original commercial fisherman's license and using gear under privilege of the commercial fisherman's license is subject to revocation. LA R.S. 56:305.3(B)

- The person in charge of the operation of each vessel engaged in commercial fishing must have, in his possession and in his name, a valid, original commercial fisherman's license. This person must also have in his possession a gear license indicating that the applicable gear fee has been paid and, if applicable, a vessel license. LA R.S. 56:303.2(A)

Wholesale/Retail Seafood Dealer's License

- A commercial fisherman selling his catch to anyone other than a consumer or a licensed Louisiana wholesale/retail seafood dealer must possess a wholesale/retail seafood dealer's license as provided in R.S. 56:306 et seq. LA R.S. 56:303(A)2
- Any person buying, acquiring, or handling, from any person, by any means whatsoever, any species of fish, whether fresh, frozen, processed, or unprocessed, in Louisiana from within or outside the state, for sale or resale, including bait species, whether on a commission basis or otherwise, is a wholesale/retail seafood dealer and must purchase a wholesale/retail seafood dealer's license
- The license shall be in the name of the licensee and shall list the legal mailing address and the physical location of the place of business, and any other information required by the department. If the place of business is a vehicle, then the license shall state "vehicle" and shall list the legal mailing address and physical location of the licensee. LA R.S. 56:306(B)(1)
- If the licensee owns or operates more than one place of business, then an additional wholesale/retail seafood dealer's license must be purchased for each additional place of business or vehicle. The additional licenses shall be in the same name of the operator, list a different license number than the original license, list the legal mailing address and the location of the place of business, and any other information required by the department. LA R.S. 56:306(B)(3)
- The cost of the wholesale/retail seafood dealer's license is \$550.00 for residents and \$2,200.00 for nonresidents. LA R.S. 56:306.2(A)(1)
- A wholesale/retail seafood dealer's license is valid for one year, beginning on January 1 of each calendar year and expiring on December 31 of the same calendar year. LA R.S. 56:306.3(A)
- A wholesale/retail seafood dealer's license may be purchased at any time of the year for the current license year and from November 15 for the immediately following license year. LA R.S. 56:306.3(B)
- The department may also authorize the purchase of a wholesale/retail seafood dealer's license for a four-year period at four times the cost of the annual license fee. LA R.S. 56:306.3(C)
- Wholesale/retail seafood dealers shall buy directly from commercial harvesters validly licensed in Louisiana, and when purchasing fish for which a permit is required of the commercial harvesters, such dealers shall purchase only from those commercial harvesters possessing a valid permit. Wholesale/retail seafood dealers validly licensed in Louisiana, and in the case of wholesale/retail seafood dealers purchasing fish from out-of-state sellers and bringing the fish into Louisiana, shall purchase only from those persons from whom a wholesale/retail seafood dealer can legally purchase fish in the state of purchase, and from no one else. LA R.S. 56:306.4(A)(1)
- Each wholesale/retail seafood dealer who purchases fish from a licensed commercial fisherman shall record the sale on the three-part receipt form provided for in LA R.S. 56:303.7. The dealer shall copy the name and license number on the receipt form. The dealer, at the time of the sale, shall provide the commercial fisherman with a sales receipt which shall be one part of the three-part receipt form. All wholesale/retail seafood dealers shall comply with the records requirements contained in LA R.S. 56:306.5. LA R.S. 56:306.4(A)(2)
- Wholesale/retail seafood dealers can sell to anyone within or without the state. LA R.S. 56:306.4(B)

Retail Seafood Dealer License

- A wholesale/retail seafood dealer's license is valid for one year, beginning on January first of each calendar year and expiring on December thirty-first of the same calendar year. LA R.S. 56:306.3(A)
- A retail seafood dealer's license may be purchased at any time of the year for the current license year and from November 15 for the immediately following license year. LA R.S. 56:306.3(B)
- The department may also authorize the purchase of a retail seafood dealer's license for a four-year period at four times the cost of the annual license fee. LA R.S. 56:306.3(C)
- Restaurants and retail grocers shall buy directly only from wholesale/retail seafood dealers licensed in Louisiana. When a restaurant or retail grocer purchases fish from an out-of-state seller and brings the fish into the state, he shall buy directly from those persons from whom he can legally purchase fish in the state of purchase. When a restaurant or retail grocer buys fish from an out-of-state seller and brings the fish into the state, the restaurant or retail grocer shall be licensed in accordance with the provisions of R.S. 56:306 and shall possess a valid transport license when bringing such fish into the state. LA R.S. 56:306.4(C)(1)
- Restaurants and retail grocers who only purchase fish, whether fresh, frozen, processed, or unprocessed, from a licensed wholesale/retail seafood dealer and only sell such fish fully prepared by cooking for immediate consumption by the consumer, need not be licensed in compliance with the provisions of this Subpart. LA R.S. 56:306.4(C)(2)

Transport License

- Operators and drivers of any form of commercial transport, except common carriers, who are in the act of loading, unloading, or transporting fish shall have in their possession at least one of the following licenses:
 1. A commercial fisherman's license.
 2. A wholesale/retail dealer's license.
 3. A transport license. LA R.S. 56:307(A)

- Transport license requirements shall not apply to fish or fish products which are the result of processing as defined in LA R.S. 56:8. LA R.S. 56:307(C)
- The cost of a transport license is eighty-three per vehicle and can only be purchased by a person holding a valid Louisiana commercial fisherman's license or valid Louisiana wholesale/retail dealer's license. LA R.S. 56:307.1(A)
- The transport license shall be in the name of and bear the license number of the purchaser and shall state "transport license". LA R.S. 56:307.1(B)
- The transport license may be applied for in the same manner and is valid for the same one-year period as that of the purchaser's license. LA R.S. 56:307.1(C)
- The department may also authorize the purchase of a four-year transport license at four times the cost of the annual license fee. LA R.S. 56:307.1(D)
- A person transporting fish under privilege of a transport license is prohibited from buying or selling, by any means whatsoever, any species of fish. The provisions of this Section shall not apply to a person transporting fish under the privilege of a Louisiana transport license purchased in connection with a Louisiana wholesale/retail dealer's license when that person buys fish for or on behalf of the wholesale/retail dealer to whom such transport license was issued and only transports such fish to that wholesale/retail dealer. LA R.S. 56:307.2(A) and (B)
- A validly licensed commercial fisherman or wholesale/retail dealer may purchase any number of transport licenses. LA R.S. 56:307.3
- Transport licenses are freely transferable between vehicles, but the licensee remains responsible for all activities taking place under authority of that license. LA R.S. 56:307.5

LEGAL GEAR AND GEAR REQUIREMENTS

- "Trotline" means a line which is four hundred forty yards or less to which hoop drops are tied at various intervals or gangions and hooks are attached and which may be retrieved manually or by electric or hydraulic haulers. LA R.S. 56:8(140)
- Commercial finfish may be taken with pole, line, the device known as a yo-yo, the device known as a trigger device, handline, with any trotline wherein hooks are not less than 24 inches apart, approved slat traps, cans and minnow traps, with legal seines and nets, with bows and arrows, or by any skin diver in saltwater or freshwater, when submerged in water and using standard spearing equipment, and by no other means except as provided in Subsection C of this Section. In the saltwater areas of the state as defined in R.S. 56:322(A) and (B), commercial finfish may be taken by means of rod and reel. Violation of this Paragraph constitutes a class three violation. LA R.S. 56:320(B)(1)
- No person shall take or possess fish taken by means of spears, poisons, stupefying substances or devices, explosives, guns, tree-topping devices, lead nets, except as provided in R.S. 56:329(B), electricity, or any instrument or device capable of producing an electric current used in shocking said fish; except a barbless spear or a multi-pronged barbed gig that may be used in salt water for taking flounder. No person shall take or possess game fish taken by means of snagging devices, not including bow and arrow. It shall be unlawful to possess any of the prohibited instruments, weapons, substances, or devices set out hereinabove with the intent to take fish in violation of the provisions of this Section. LA R.S. 56:320(C)(1)
- No person shall use or deploy within the state territorial waters bandit gear or longline gear. A person may possess bandit gear or longline gear aboard a vessel within state territorial waters so long as such gear is not in use or deployed to take fish. No person shall possess fish taken within the state territorial waters using bandit gear or longline gear. LA R.S. 56:320(C)(2)
- It shall be unlawful for any person to use or employ any aircraft including fixed wing aircraft, dirigibles, balloons, helicopters, or any other form of aerial surveillance in the airspace of this state to assist in the taking of finfish except in the fisheries of menhaden and herring-like fish as defined in Title 76, Section 311 of the Louisiana Administrative Code. Any aircraft, boat, or vessel and equipment utilized in the taking of finfish and any fish taken or possessed, except in the fisheries of menhaden and other herring-like fish, contrary to the provisions of this Subsection shall be subject to confiscation. Violation of this Subsection constitutes a class 5-A violation. LA R.S. 56:320(G)
- No person shall use, possess, or have in his possession, or have aboard any vessel, a gill net, trammel net, strike net, or seine in the saltwater areas of the state as defined in LA R.S. 56:322(A) and (B), except as provided in LA R.S. 56:318 and 320.2. A violation of the provisions of this Section shall constitute a class six violation. LA R.S. 56:320.1(A) and (B)
- No person shall set, maintain, take, or attempt to take fish from any trotline of which any segment of the staging line measures in excess of four feet where any portion of any hook extends above the surface of the waters of any of the bodies of waters within the state of Louisiana. However, this Section shall not apply to White Lake in Vermilion Parish and Grand Lake and Lake Misere in Cameron Parish. Any violation of the provisions of this Section shall constitute a class two violation, LA R.S. 56:32. LA R.S. 56:321(A)
- No trawling shall be permitted in inside waters during the closed season. No vessel may pull more than the following trawl rigging in inside waters
 - a. One trawl which shall not exceed fifty feet in length along the cork-line and sixty-six feet along the lead line and in addition, one test trawl.
 - b. Two trawls which shall not exceed twenty-five feet along the cork-line, thirty-three feet along the lead line, and have trawl doors no larger than eight feet in length and forty-three inches in height and, in addition, one test trawl.

- c. Two trawls which shall not exceed twenty-five feet along the cork-line, thirty-three feet along the lead line, and have no more than two outer trawl doors no larger than eight feet in length and forty-three inches in height and no more than two inner sled doors, and in addition, one test trawl. LA R.S. 56:495.1(A)(1)
- It shall be legal for a vessel in Breton and Chandeleur Sounds to pull no more than one or two trawls, either or both of which cannot exceed sixty-five feet along the cork-line and eighty-two feet along the lead line in length, plus one test trawl. LA R.S. 56:495.1(A)(2)
- Fishing with a butterfly net or skimmer net shall be prohibited in inside waters during the closed season. LA R.S. 56:495.1(B)
- In outside waters, no vessel shall pull more than four trawls and one test trawl. LA R.S. 56:495.1(C)
- The commercial taking of Black Drum, Sheepshead, Southern Flounder and other saltwater finfish species (other than Red Drum, spotted seatrout and mullet which may not be taken with this gear, and other than pompano taken under R.S. 56:406 and LAC 76:VII.703 regulations) with a pompano strike net is prohibited except by special permit issued by the Department of Wildlife and Fisheries, hereby designated as a restricted species strike net permit. This permit is required in addition to the pompano strike net license required by law. LAC 76:349 (A)

SEASONS

- The commercial harvest of Southern Flounder (*Paralichthys lethostigma*) in Louisiana waters, by any means of take with any gear, is prohibited from October 15 through November 30 of each year. LAC 76:VII.351.A.1

SIZE & POSSESSION LIMITS

- A properly licensed commercial harvester who is using legal gear, other than shrimp gear, may possess up to a daily limit of 10 Southern Flounder. LAC 76:VII.351.B.1
- A properly licensed commercial harvester may retain and possess all Southern Flounder caught as by-catch utilizing legal shrimp gear during an open shrimp season, provided that the commercial season for Southern Flounder is open. LAC 76:VII.351.B.2
- Southern Flounder legally possessed under this rule may be purchased, bartered, traded, exchanged or sold. 76:VII.351.B.3
- Nothing shall prohibit the possession or sale of Southern Flounder legally taken prior to the closure providing that all commercial dealers possessing Southern Flounder taken legally prior to the closure shall maintain appropriate records in accordance with R.S. 56:306.4. 76:VII.351.B.4
- The possession limit for the commercial taking of Southern Flounder shall be ten fish for each licensed harvester for each consecutive day on the water. R.S. 56:326 (H)

BYCATCH

- Any commercial shrimping vessel may retain and any commercial harvester may sell all Southern Flounder caught as by-catch on any shrimping trip unless the Southern Flounder stock is determined by the department to be overfished or undergoing overfishing. After such a determination, the commission may adopt rules or regulations in accordance with the Administrative Procedure Act to restrict the retention of Southern Flounder caught as by-catch on any shrimping trip until such time as the department determines the stock has recovered from an overfished or overfishing status. LA R.S. 56:492
- A properly licensed commercial harvester may retain and possess all Southern Flounder caught as by-catch utilizing legal shrimp gear during an open shrimp season, provided that the commercial season for Southern Flounder is open. LAC 76:VII.351.B.2
- No person shall waste any fish of this state. As used in this Section, "waste" means the harvesting of any fish for commercial purposes which results in the excessive killing of such fish. LA R.S. 56:409.1(A)
- Excessive killing shall be defined as "the killing resulting from taking or attempting to take any fish in excess of what the possessor thereof can process, utilize, or transport from the fishing grounds. Shrimp and shrimping operations are excluded." LAC 76:VII.313.B
- No person shall purchase, sell, exchange, or offer for sale or exchange, or possess or import with intent to sell or exchange any game fish as defined in R.S. 56:8. LA R.S. 56:327(A)(1)
- The commercial taking or landing of Red Drum in Louisiana is prohibited. LA R.S. 56:325.3(B)
- Only a rod and reel shall be used for the commercial harvest of Spotted Sea Trout. The commercial taking or sale by a commercial fisherman of Spotted Sea Trout is prohibited except by special permit issued by the Department of Wildlife and Fisheries at a cost of \$150.00 for residents of this state and \$600.00 for those who are nonresidents. LA R.S. 56:325.3(A)(1) and (C)

AREA RESTRICTIONS

- Except as provided in Paragraph (2) of this Subsection, no obstructions including trawls, skimmer nets, butterfly nets, fyke nets, wings or leads, seines, gill nets, or trammel nets which interfere with the free passageway for fish as defined herein shall be set within five hundred feet of the mouth of any inlet or pass, or within five hundred feet of any water control structures, dams, or weirs. LA R.S. 56:329(B)(1)
- Trawling, skimming, or butterflying on White Lake in Cameron and Vermilion parishes and Grand Lake in Cameron Parish from official sunset to official sunrise is hereby prohibited. LA R.S. 56:410

- No person shall set or use any trammel net, gill net, or strike net for the taking of fish in that portion of Calcasieu Lake located in Cameron Parish including that portion of the Calcasieu Ship Channel which actually adjoins Calcasieu Lake, West and East Pass of Calcasieu River, and Turner's Bay during the hours after the official sunset on Friday and before the official sunset on Sunday of each week during the period from May first through September thirtieth of each year. LA R.S. 56:410.2 (A)
- The taking of fish, shrimp, and other seafood from the waters of the Lake Catherine and Lake Pontchartrain Sanctuary by use of trawls, skimmer nets, butterfly nets, seines, or traps or other netting, with the exception of cast nets, drop nets, or scoop nets, is hereby prohibited. LA R.S. 56:804(B)
- The areas within a 1/4-mile radius on the lake side only of the Lambert, Grand Bayou, Mangrove, and Peconi water control structures (otherwise identified as Structures No. 5, 1, 8 and 4 respectively), and the area within a 1/8-mile radius on the lake side only of the water control structure on No Name Bayou, all within the Calcasieu Lake system; the area within a 1/4-mile radius on the lake side only of the mouths of West Cove Bayou, West Cove Canal and the Sabine Refuge Headquarters Canal where they empty into Calcasieu Lake; and the area within a 1/4-mile radius on the lake side only of the mouths of Three Bayous and Willow Bayou where they empty into Sabine Lake, are fish sanctuaries and closed zones, and that all netting of fish by any means or method, including but not limited to trawls, butterfly nets, gill nets, seines, or trammel nets, is hereby prohibited, with the exception of hand cast nets, crab traps and crab drop nets. LAC 76:VII.333
- Commercial fishing is prohibited in the following areas:
 - Elmer's Island Wildlife Refuge LAC 76:III.337
 - Salvador/Timken Wildlife Management Area LAC 76:XIX.111.A
 - Pointe aux Chenes Wildlife Management Area except in Cut Off Canal and Wonder Lake LAC 76:XIX.111.A
 - Marsh Island Wildlife Refuge LAC 76:III.310.4
 - State Wildlife and Paul J. Rainey Refuges LAC 76:III.323.A.4
 - White Lake Wetlands Conservation Area LAC 76:III.335
 - Rockefeller Wildlife Refuge LAC 76:III.309.5
 - Isle Dernieres Barrier Island Refuge LAC 76:III.331

FEDERAL AREA RESTRICTIONS

Commercial fishing is prohibited in the following coastal National Wildlife Refuges:

- Big Branch Marsh National Wildlife Refuge
- Bayou Sauvage National Wildlife Refuge
- Breton National Wildlife Refuge
- Delta National Wildlife Refuge
- Mandalay National Wildlife Refuge
- Shell Keys National Wildlife Refuge
- Lacassine National Wildlife Refuge
- Cameron Prairie National Wildlife Refuge
- Sabine National Wildlife Refuge

Jean Lafitte National Historical Park and Preserve

Commercial fishing allowed by permit only.

OPERATIONAL RESTRICTIONS

- All saltwater finfish except tuna, swordfish, and sharks possessed by a commercial harvester shall have the head and caudal fin intact until set or put on shore or when sold. All saltwater finfish shall be measured in accordance with applicable law. LA R.S. 56:326(E)(1)(a)

FISHING GEAR INTERACTIONS

- It shall be unlawful for any person to knowingly and intentionally use or employ any net to encircle a vessel or to otherwise knowingly and intentionally use or employ any vessel or fishing gear to interfere with the lawful fishing of another. LA R.S. 56:320(I)(1)
- It shall be unlawful for any person to knowingly and intentionally use or employ any vessel or recreational gear to interfere with the lawful commercial fishing of another. LA R.S. 56:320(I)(2)

PACKAGING

- The secretary of the Department of Wildlife and Fisheries is authorized to adopt rules and regulations in accordance with the Administrative Procedure Act establishing standards for the packaging of seafood in Louisiana for wholesale or retail sale. Those standards may govern the quality, contents, and weight of all seafood packaged in this state. The Louisiana Seafood Promotion and Marketing Board may make recommendations to the secretary for standards for the packaging of seafood. For purposes of this Section, retail sale shall not include food service establishments which only serve food prepared for on premises or off premises consumption as defined by LA R.S. 40:5.5(E). LA R.S. 56:578.10
- Shipments containing fish shall be plainly marked, the tags or certificates to show the date and names of the consignor and the consignee, with an itemized statement of the number of pounds of fish and the names of each kind contained therein. Bills of

lading issued by a common carrier for such shipments shall state the number of packages which contain fish, and the date and names of the consignor and consignee, with an itemized statement of the number of pounds of fish and the names of each kind contained therein. Shipments of fish of any species and fish products shall be subject to inspection by enforcement agents of the department while in transit and upon leaving the state. LA R.S. 56:307.7(A)

RECORDKEEPING AND REPORTING REQUIREMENTS

- Wholesale/retail seafood dealers, restaurants, and retail grocers shall keep, in the English language the following (LA R.S. 56:306.5(A)):
 - Records of the quantity and species of fish acquired, the date the fish was acquired, and the name and license number of the wholesale/retail seafood dealer or the out-of-state seller from whom the fish was acquired. When creel limits apply to commercial species, records shall also indicate the number by head count of such species of fish. LA R.S. 56:306.5(A)(1)
 - Records of the quantity and species of fish sold, the date the fish was sold, and the name and license number of the person to whom the fish was sold. When sold to the consumer, the records shall indicate the quantity, species, and date and shall state that the fish was sold to the consumer. LA R.S. 56:306.5(A)(2)
- Wholesale/retail seafood dealers purchasing or acquiring fish from commercial fisherman shall complete a commercial receipt form. The commercial receipt form shall be a three-part form signed by both the commercial fisherman and the wholesale/retail seafood dealer or his designee, attesting to that the information required to be provided by each is correct. One part of the receipt form shall be retained by the wholesale/retail seafood dealer, one part shall be given to the commercial fisherman at the time of the transaction, and one part shall be transmitted to LDWF as provided for in R.S. 56:306.6. LA R.S. 56:306.5 (B)(1)
- Required records must be maintained for three years and shall be open to inspection by LDWF. LA R.S. 56:306.5(C)
- Each wholesale/retail seafood dealer shall, on or before the 10th of each month, make a return to the department of all commercial receipt forms representing actual transactions from every commercial fisherman during the preceding month. All commercial receipt forms submitted by a dealer shall be accompanied by a monthly submission sheet signed by the wholesale/retail seafood dealer certifying that the transactions submitted represent all of the transactions by that dealer from commercial harvesters for that particular month. LA R.S. 56:306.6(A)
- A commercial fisherman selling fish under a fresh products license shall record all information required on trip tickets, except that the fresh products license number shall be recorded in place of the wholesaler/retailer seafood dealer's license number. The fresh products licensee shall complete monthly returns to LDWF as specified for wholesale/retail seafood dealers. The commercial fisherman shall sign each commercial receipt form attesting that the information provided therein is correct. LA R.S. 56:303.7(C)
- Each restricted species strike net permit holder shall on or before the tenth of each month file a return to the department on forms provided or approved for the purpose, the pounds of Black Drum from 16 to 27 inches, the number of Black Drum over 27 inches, the pounds of Sheepshead and the pounds of flounder taken commercially during the preceding month, the gears used for harvest, and the commercial dealers to whom these were sold. Monthly reports shall be filed, even if catch or effort is zero. LAC 76:349 (B)
- Nothing shall prohibit the possession or sale of Southern Flounder legally taken prior to the closure providing that all commercial dealers possessing Southern Flounder taken legally prior to the closure shall maintain appropriate records in accordance with R.S. 56:306.4. 76:VII.351.B.4
- Commercial dealers possessing Southern Flounder legally imported into the state shall maintain appropriate records in accordance with other provisions of law. 76:VII.351.B.5

LOUISIANA FINFISH TASK FORCE

- There is hereby established the Louisiana Finfish Task Force to study and monitor the finfish industry and to make recommendations to the Wildlife and Fisheries Commission, the Department of Wildlife and Fisheries, and other state agencies for the maximization of benefit from that industry for the state of Louisiana and its citizens. LA R.S. 56:301.10(A)
- The task force shall be composed as follows:
 - The governor or his designee.
 - Three members appointed by the secretary of the Department of Wildlife and Fisheries as follows:
 - One member who is a fisheries biologist.
 - One member who is an enforcement agent.
 - One member who is an economist.
 - The commissioner of the Department of Agriculture and Forestry or his designee.
 - The secretary of the Louisiana Department of Health or his designee.
 - Three members and three alternate members appointed by the governor each of whom shall possess a commercial fisherman's license with a "certified" endorsement pursuant to LA R.S. 56:303(E), with three to be selected from a list of six nominees submitted by the Louisiana Shrimp Association and three to be selected from a list of six nominees submitted by the Delta Commercial Fisheries Association.
 - One member appointed by the governor who is an active Louisiana dock buyer of finfish.
 - Three members and three alternate members appointed by the governor each of whom shall possess recreational freshwater and saltwater fishing licenses, with four to be selected from a list of eight nominees submitted by the Coastal Conservation

Association Louisiana and two to be selected from a list of four nominees submitted by the Louisiana Chapter of the Bass Anglers Sportsman Society (B.A.S.S.).

- One member of the Senate appointed by the president of the Senate.
- One member of the House of Representatives appointed by the speaker of the House of Representatives. LA R.S. 56:301.10(B)
- The members appointed pursuant to the provisions of Paragraphs (B)(I) through (4) of this Section shall be nonvoting members. In addition, they shall not be considered members of the task force for determination of the number of members necessary for a quorum and for establishing the presence of a quorum. LA R.S. 56:301.10(C)
- The task force shall adopt bylaws under which it shall operate, and five voting members of the task force shall constitute a quorum sufficient to conduct meetings and business of the task force. The governor shall appoint the chairman of the task force for a period of one year, and thereafter the task force shall elect a chairman from its membership and may seek and receive assistance from universities within the state in the development of methods to increase production and marketability of finfish. The members of the task force shall serve without compensation; however, the task force may receive the same reimbursement of travel expenses for attending the meetings as is allowed for other state employees' travel, except all legislative members of the commission shall receive the same per diem and travel allowance for attending meetings of the task force or any meeting thereof as is normally provided for members of the legislature. LA R.S. 56:301.10(D)
- The task force is hereby charged with responsibility to do the following:
 - Coordinate efforts to increase finfish production and marketability.
 - Provide for the study of the decline in finfish marketability and market price, provide for the study of the impacts of imported finfish on the domestic market, assist in the development of a state finfish inspection program, assist in the development of a Louisiana finfish certification and branding program, and make recommendations to the Wildlife and Fisheries Commission, the Department of Wildlife and Fisheries, the Department of Natural Resources, the Department of Agriculture and Forestry, and the Louisiana Department of Health for implementation of policies to help enhance the domestic finfish industry.
 - Make recommendations with respect to issues pertaining to the finfish industry and finfish production to the various state agencies charged with responsibility for differing elements of the finfish industry in this state, including the Department of Wildlife and Fisheries, the Department of Natural Resources, the Coastal Protection and Restoration Authority, the Louisiana Department of Health, the Department of Agriculture and Forestry, and the legislature.
 - Develop markets and marketing strategies for the development and expansion of markets for finfish harvested from Louisiana waters.
 - Represent the interests of the Louisiana finfish industry before federal and state administrative and legislative bodies on issues of importance to the Louisiana finfish industry.
 - Contract for legal services to represent the interests of the Louisiana finfish industry in judicial, administrative, and legislative proceedings.
 - Perform any acts deemed necessary and proper to carry out its duties and responsibilities. LA R.S. 56:301.10(E)

LOUISIANA SEAFOOD PROMOTION AND MARKETING BOARD

- Recognizing that the commercial fishing industry in Louisiana has reached an ebb economically, creating an environment which has or could place, not only commercial harvesters, but also wholesale and retail dealers in dire economic straits, which situation could have an extreme economic impact on the state economy as a whole if nothing is done to alleviate the situation, and recognizing that there exist barriers and impediments to the economic well-being of the commercial fishery industry in Louisiana and recognizing that among these barriers and impediments, the virtual void in this state of any cohesive, coordinated and comprehensive seafood promotion and marketing effort and stratagem has a significant negative impact on the seafood industry, the Legislature of Louisiana does hereby establish the Louisiana Seafood Promotion and Marketing Board in an effort to aid the industry in two vital aspects--product promotion and marketing development. LA R.S. 56:578.1(A)
- The purpose of this Subpart, then, is to enhance the public image of commercial fishery products, thereby promoting the consumption of these products and, further, to assist the seafood industry, including commercial harvesters and wholesale and retail dealers, in market development so as to better utilize existing markets and to aid in the establishment of new marketing channels. Attention to the promotion and marketing of non-traditional and underutilized species of seafood would be inherent in the purpose of the council established herein. LA R.S. 56:578.1(B)

LOUISIANA WILD SEAFOOD CERTIFICATION PROGRAM

- A certification program for Louisiana wild fish, as defined in LA R.S. 56:8, and for Louisiana wild seafood products which are taken, harvested, or landed in Louisiana. LAC 76:I.701
- Must possess one of the following resident or nonresident Louisiana licenses: commercial fisherman's license; senior commercial fisherman's license; fresh products dealer license; seafood wholesale/retail dealer; or seafood retail dealer. LAC 76:I.701.C.1.a
- Wholesale/retail dealers must have their facility located within Louisiana. Retailers are not required to have their facility located within Louisiana. LAC 76:I.701.C.1.b
- Eligible participants not requiring an LDWF license include in-state restaurants or grocers who only sell seafood that is fully prepared by cooking for immediate consumption by the consumer, and all out-of state retailers. LAC 76:I.701.C.1.c
- Must possess and be in compliance with all other state and federal permits, licenses, and laws regarding the buying, acquiring, or handling, from any person, by any means whatsoever, any species of fish or seafood products, whether fresh, frozen, processed, or unprocessed, for sale or resale, whether on a commission basis or otherwise. LAC 76:I.701.C.1.d

- Product considered eligible to possess the LWSCP logo must meet the following criteria:
 - Eligible wild seafood includes crab, oysters, freshwater finfish, saltwater finfish, crawfish, and shrimp. Seafood must be wild-caught, taken from Louisiana waters or from the U.S. Gulf of Mexico (Gulf) and any other adjacent state waters, and landed in Louisiana. Farmed and/or aquaculture products are excluded from program participation. LAC 76:I.701.C.2.a
 - Seafood must be taken by a Louisiana licensed commercial fisherman. Seafood must be landed in Louisiana and either be sold under an LWSCP-participating fish products dealer license, or be purchased and/or physically acquired by a wholesale/retail seafood dealer participating in the LWSCP. Transfer of product throughout the supply chain must be between LWSCP participants until the product has been placed in sealed and LWSCP-labeled retail packaging. LAC 76:I.701.C.2.b
 - Seafood commingled with any other seafood that does not meet the above requirements, domestic or foreign, shall be prohibited from possessing the LWSCP label. LAC 76:I.701.C.2.c

RECREATIONAL SOUTHERN FLOUNDER REGULATIONS

LICENSING

Recreational License Requirements; Definitions

A.(1) Any person eighteen years of age or older engaged in an activity that involves hunting, fishing, or accessing property owned by the department for which a license is required shall have in their immediate possession a valid, original license, or an effective license number, together with a form of personal identification, and shall show such license and identification upon request to a duly authorized agent of the department. R.S. 56:3000(A)

Recreational Fishing Licenses; Fees

Fishing Licenses:

1. Resident licenses including bona-fide residents, active and native-born retired members of the United States Armed Forces, including the Louisiana Army National Guard or the Louisiana Air National Guard, and nonresident students:
 - Hook and line license - \$5.00/year (allows using a pole, hook and line, without a reel and without using artificial bait, dip nets, landing nets, minnow traps, crab nets, or crab lines)
 - Basic fishing license - \$17.00/year (includes all legal recreational freshwater gear)
 - Saltwater fishing license - \$15.00/year (includes all legal recreational saltwater gear)
 - Charter three-day saltwater fishing license - \$20.00
 - Charter three-day freshwater fishing license - \$10.00
2. Nonresident licenses:
 - Basic fishing license - \$68.00/year (includes all legal recreational freshwater gear)
 - Saltwater fishing license - \$60.00/year (includes all legal recreational saltwater gear)
 - Five-day basic fishing - \$30.00 (includes all legal freshwater recreational gear)
 - Five-day saltwater fishing - \$30.00 (includes all legal saltwater recreational gear)
 - Charter boat three-day saltwater fishing license - \$20.00
 - (Charter boat three-day freshwater fishing license - \$10.00)

LEGAL GEAR AND GEAR REQUIREMENTS

- Freshwater and saltwater recreational fish may be taken by means of rod, fishing pole, hook and line, trolling line, handline, bait casting, fly casting apparatus, crawfish nets, by use of devices known as yo-yos or trigger devices, bow and arrow, recreational hoop nets, recreational wire nets, recreational slat traps, standard spearing equipment used by a skin diver sport fishing in saltwater or freshwater when submerged in the water, recreational pipes, recreational buckets, recreational drums, recreational tires, and recreational cans, and by no other means except a barbless spear or a multi-pronged barbed gig that may be used in saltwater for taking flounder. Recreational wire nets and recreational hoop nets authorized for use under the provisions of this Section shall be used only in the geographical areas of the state designated as freshwater under the provisions of LA R.S. 56:322. LA R.S. 56:320(A)(1)
- No person shall take or possess fish taken by means of spears, poisons, stupefying substances or devices, explosives, guns, tree-topping devices, lead nets, except as provided in LA R.S. 56:329(B), electricity, or any instrument or device capable of producing an electric current used in shocking said fish; except a barbless spear or a multi-pronged barbed gig that may be used in salt water for taking flounder. LA R.S. 56:320(C)(1)
- No person shall use or deploy within the state territorial waters bandit gear or longline gear. A person may possess bandit gear or longline gear aboard a vessel within state territorial waters so long as such gear is not in use or deployed to take fish. No person shall possess fish taken within the state territorial waters using bandit gear or longline gear. LA R.S. 56:320(C)(2)

SEASONS

- Recreational harvest of Southern Flounder is prohibited from October 15 through November 30 of each year. LAC 76:VII.3.353.B

SIZE AND POSSESSION LIMITS

- The daily take and possession limit for the recreational taking of Southern Flounder (*Paralichthys lethostigma*) caught within or without Louisiana waters shall be 10 fish per day and in possession. LAC 76:VII.3.353.A
- Recreational harvest of Southern Flounder is prohibited from October 15 through November 30 of each year. LAC 76:VII.3.353.B
- A recreational saltwater fisherman in possession of a valid basic and saltwater license or an equivalent license that grants both basic fishing and saltwater fishing privileges may possess twice the daily bag limit of Red Drum and Spotted Sea Trout; however, no person shall be in possession of over the daily bag limit while fishing or while on the water, unless such recreational saltwater fisherman is aboard a trawler engaged in commercial fishing for a consecutive period of longer than twenty-five hours. 56:325.1(A)(3a)
- A fisherman who holds and is in possession of a valid recreational fishing license and can demonstrate to the department's satisfaction use of a boat launch located south of U.S. Highway 90 and that the fisherman has been actively on the water or at a remote camp that can be accessed only by water for two days or more may possess up to the possession limit of filleted Red Drum, Spotted Sea Trout, and Southern Flounder. The filleted fish shall have sufficient skin remaining on the fillet to allow for identification of the species and shall be segregated by species into plastic bags or plastic containers that are marked by species to allow easy identification, the date caught, and the name and license number of the person who took the fish. R.S. 56:325.1(A)(3b)
- The possession limit for Red Drum and Spotted Sea Trout taken south of U.S. Highway 90 shall be three times the daily take limit when the fisherman holds and is in possession of a valid recreational fishing license and can show a landing receipt from a public boat launch located south of U.S. Highway 90 that demonstrates to the satisfaction of the department that the fisherman has been actively on the water or at a remote camp that can be accessed only by water for two days or more. The fish shall be kept whole or whole gutted in separate bags for each species of fish. The bags shall be marked with the date the fish were taken, the species, the number of fish contained in the bag, and the name and license number of the person taking the fish. The fish shall only be in the possession of the person who took the fish. However, no fisherman shall be actively fishing or engaged in fishing while in possession of more than the daily take limit. R.S. 56:325.1(A)(4)
- No saltwater sport fisherman shall take or possess at any one time in the Louisiana territorial waters extending to the outermost boundary limit of the Federal Exclusive Economic Zone any Red Drum, Southern Flounder, or Spotted Sea Trout under the prescribed minimum size nor over the maximum prescribed size and daily bag limit. Any Red Drum, Southern Flounder, or Spotted Sea Trout under the minimum prescribed size or over the maximum prescribed size and daily bag limit shall be returned immediately to the waters from which taken without avoidable injury. R.S. 56:325.1(A)(4b)

OPERATIONAL RESTRICTIONS

- No person shall sell or barter any fish that has been taken recreationally or under the authority of any type of recreational fishing license or with any recreational gear. LA R.S. 56:302.10(A)
- All saltwater recreational finfish shall have the head and caudal fin intact until set or put on shore. All saltwater recreational finfish shall be measured in accordance with applicable law. LA R.S. 56:325.2(A)
- No person shall possess any finfish parts, such as filleted fish, while aboard a vessel on the water. For the purpose of consumption at sea aboard the harvesting vessel, a person shall have no more than two pounds of finfish parts per person on board the vessel, provided that the vessel is equipped to cook such finfish and such finfish does not exceed applicable bag limits. LA R.S. 56:325.2(B)

FISHING GEAR INTERACTIONS

- It shall be unlawful for any person to knowingly and intentionally use or employ any vessel or recreational gear to interfere with the lawful commercial fishing of another. LA R.S. 56:320(I)(2)

APPENDIX XI. Chronology of Major Changes to Louisiana's Southern Flounder Fisheries Regulations

1995

The Louisiana Legislature eliminated the use of all set nets and provided for the use of strike nets only during specified seasons through 1997. Southern Flounder was designated a 'restricted' species and could only be harvested during the strike net season, eliminating a gill net fishery. Permit criteria were established requiring that 50% of the applicant's income over two of the previous three years had to be derived from commercial fishing to qualify. In addition, possession of a saltwater gill net license and no Class 3 or greater fisheries violations were required. Net fishing was restricted to daylight, weekday hours.

1996

From May 1996 to May 1997, the commercial harvest of flounder was closed due to low SPR estimates. The closure was later modified and allowed the current daily possession limit of ten fish per person per day. The same bag limit was applied to recreational anglers. In November, the declaration of emergency closure was followed by a permanent rule which continued the original closure.

1997

The Legislature provided for the incidental bycatch of flounder on commercial vessels not to exceed 100 lbs per trip. This action also reopened the flounder season at the current bag and possession limits and added a reporting requirement for all transactions including flounder. 5-17

1999

The Legislature changed the incidental bycatch of flounder on commercial vessels to read that any commercial shrimping vessel may retain and any commercial fisherman may sell all Southern Flounder caught as bycatch.

2004

The Legislature changed recreational regulations to allow for the harvest of Southern Flounder with barbed gigs.

2018

Legislature allowed for a fisherman who holds and is in possession of a valid recreational fishing license and can demonstrate to the department's satisfaction use of a boat launch located south of U.S. Highway 90 and that the fisherman has been actively on the water or at a remote camp that can be accessed only by water for two days or more may possess up to the possession limit of filleted Red Drum, Spotted Sea Trout, and Southern Flounder.

2021

The Legislature added language to the 1999 incidental bycatch change which allowed commercial shrimping vessels and commercial harvesters to retain and sell all Southern Flounder caught as bycatch. This action provided the commission the ability to adopt rules or regulations to restrict the retention of Southern Flounder caught as bycatch if the stock is determined by the department to be overfished or undergoing overfishing until such time as the department determines the stock has recovered from an overfished or overfishing status.

2022

The Wildlife and Fisheries Commission amended two Rules (LAC 76:VII.351 and 353) by modifying existing Southern Flounder harvest regulations. Changes established a closed season for the commercial and recreational harvest of Southern Flounder from Oct. 15 through Nov. 30 of each year.

APPENDIX XII. Penalties for Regulatory Violations

Classes of violations vary by legislative statute or Commission rule. Penalties for each class of violation are below (LA R.S.56:31-37.1):

Class One: First offense - fine of \$50. The fine shall include all cost of court; second offense - fine of \$75-250; and third and subsequent offenses - fine of \$250-550.

Class Two: Class two violations shall be divided into 2-A and 2-B violations.

1. The following penalties shall be imposed for a class 2-A violation:
 - a. For the first offense, the fine shall be not less than \$100 nor more than \$350.
 - b. For the second offense, the fine shall be not less than \$300, nor more than \$500.
 - c. For the third offense and all subsequent offenses, the fine shall be not less than \$500 nor more than \$750, and forfeiture to the commission of anything seized in connection with the violation.
2. The following penalties shall be imposed for a class 2-B violation:
 - a. For the first offense, the fine shall be not less than \$250 nor more than \$500.
 - b. For the second offense, the fine shall be not less than \$500 , nor more than \$800, and forfeiture to the commission of anything seized in connection with the violation.
 - c. For the third offense and all subsequent offenses, the fine shall be not less than \$750, nor more than \$1,000, and forfeiture to the commission of anything seized in connection with the violation.
 - d. In addition to any other penalty, for a second or subsequent violation of the same provision of law, the penalty imposed may include revocation of the permit or license under which the violation occurred for the period for which it was issued and barring of the issuance of another permit or license for that same period.

Class Three: First offense - fine of \$250-500, imprisonment of no more than 90 days, or both; second offense - fine of \$500-800, imprisonment of 60-90 days, and forfeiture of anything seized in connection with the violation; third and subsequent offense - fine of \$750-1,000, imprisonment of 90-120 days, and forfeiture of anything seized in connection with the violation. In addition to any other penalty, for a second or subsequent violation of the same provision of law the penalty imposed may include revocation of the permit or license under which the violation occurred for the period for which it was issued and bar the issuance of another permit or license for that same period.

Class Four: First offense - fine of \$400-950, imprisonment of no more than 120 days, or both; second offense - fine of \$750-999 and imprisonment of 90-180 days; third and subsequent offenses - fine of \$1,000-5,000 and imprisonment of 180 days to two years. All Class Four penalties include forfeiture of anything seized in connection with the violation.

Class Five-A: First offense - fine of \$500-750 and imprisonment of 15-30 days; second offense - fine of \$750-1,000 and imprisonment of 60-90 days; third and subsequent offenses - fine of \$750-1,000 and imprisonment of 90-120 days. All Class Five penalties include forfeiture of anything seized in connection with the violation. In addition, the license under which the violation occurred shall be revoked and not reinstated at any time during the period for which it was issued and for one year thereafter.

Class Five-B: First offense - fine of \$350-500 and imprisonment of 30 days; second offense - fine of \$500-1,000 and imprisonment of 60 days; third and subsequent offenses - fine of \$1,000-2,000 and imprisonment of 90 days. All Class Five penalties include forfeiture of anything seized in connection with the violation. In addition, the license under which the violation occurred shall be revoked and not reinstated at any time during the period for which it was issued and for one year thereafter.

Class Six: For each offense, a fine of \$900-950, imprisonment of no more than 120 days, or both, as well as forfeiture of anything seized in connection with the violation.

Class Seven-A: For each offense, a fine of \$5,000-7,500, imprisonment for one year, or both, as well as forfeiture of anything seized in connection with the violation.

Class Seven-B: For each offense, a fine of \$5,000-7,500 and imprisonment for one year, as well as forfeiture of anything seized in connection with the violation.

Class Eight: For each offense, a fine of \$5,000-7,000 and imprisonment for 60 days to six months.

In addition to all other penalties, violators shall forfeit any Southern Flounder seized in connection with their violation upon conviction. LA R.S. 56:39

Anyone who kills, catches, takes, possesses, or injures any wildlife or aquatic life in violation of Title 56, regulations adopted pursuant to Title 56, or a federal statute or regulation governing fish and wildlife, or, through the violation of any other state or federal law or regulation, kills or injures any wildlife and aquatic life, is liable to the state for the value of each wildlife and aquatic life, unlawfully killed, caught, taken, possessed, or injured. LA R.S. 56:40.1.