The Safina Center
at Stony Brook University

Monterey Bay Aquarium Seafood Watch®

Southern Flounder

Paralichthys lethostigma

Gulf of Mexico

Handlines and harpoon

September 4, 2019

Safina Center Analysts

Disclaimer

Seafood Watch and The Safina Center strive to ensure that all our Seafood Reports and recommendations contained therein are accurate and reflect the most up-to-date evidence available at the time of publication. All our reports are peer-reviewed for accuracy and completeness by external scientists with expertise in ecology, fisheries science or aquaculture.Scientific review, however, does not constitute an endorsement of the Seafood Watch program or of The Safina Center or their recommendations on the part of the reviewing scientists.Seafood Watch and The Safina Center are solely responsible for the conclusions reached in this report. We always welcome additional or updated data that can be used for the next revision. Seafood Watch and Seafood Reports are made possible through a grant from the David and Lucile Packard Foundation and other funders.

Seafood Watch Standard used in this assessment: Standard for Fisheries vF3

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About The Safina Center

The Safina Center (formerly Blue Ocean Institute) translates scientific information into language people can understand and serves as a unique voice of hope, guidance, and encouragement. The Safina Center (TSC) works through science, art, and literature to inspire solutions and a deeper connection with nature, especially the sea. Our mission is to inspire more people to actively engage as well-informed and highly motivated constituents for conservation.

Led by conservation pioneer and MacArthur fellow, Dr. Carl Safina, we show how nature, community, the economy and prospects for peace are all intertwined. Through Safina's books, essays, public speaking, PBS television series, our Fellows program and Sustainable Seafood program, we seek to inspire people to make better choices.

The Safina Center was founded in 2003 by Dr. Carl Safina and was built on three decades of research, writing and policy work by Dr. Safina.

The Safina Center's Sustainable Seafood Program
The Center's founders created the first seafood guide in 1998. Our online seafood guide now encompasses over 160-wild-caught species. All peer-reviewed seafood reports are transparent, authoritative, easy to understand and use. Seafood ratings and full reports are available on our website under Seafood choices. tsc's sustainable seafood program helps consumers, retailers, chefs and health professionals discover the connection between human health, a healthy ocean, fishing and sustainable seafood.

- Our online guide to sustainable seafood is based on scientific ratings for more than 160 wild-caught seafood species and provides simple guidelines. Through our expanded partnership with the Monterey Bay Aquarium, our guide now includes seafood ratings from both The Safina Center and the Seafood Watch® program.
- We partner with Whole Foods Market (WFM) to help educate their seafood suppliers and staff, and provide our scientific seafood ratings for WFM stores in the US and UK.
- Through our partnership with Chefs Collaborative, we created Green Chefs/Blue Ocean, a free, interactive, online sustainable seafood course for chefs and culinary professionals.
- Our website features tutorials, videos, blogs, links and discussions of the key issues such as mercury in seafood, bycatch, overfishing, etc.

Check out our Fellows Program, learn more about our Sustainable Seafood Program and Carl Safina's current work at www.safinacenter.org .

The Safina Center is a 501 (c) (3) nonprofit organization based in the School of Marine & Atmospheric Sciences at Stony Brook University, Long Island, NY. www.safinacenter.org admin@safinacenter.org | 631.632.3763

About Seafood Watch

Monterey Bay Aquarium's Seafood Watch program evaluates the ecological sustainability of wild-caught and farmed seafood commonly found in the United States marketplace. Seafood Watch defines sustainable seafood as originating from sources, whether wild-caught or farmed, which can maintain or increase production in the long-term without jeopardizing the structure or function of affected ecosystems. Seafood Watch makes its science-based recommendations available to the public in the form of regional pocket guides that can be downloaded from www.seafoodwatch.org. The program's goals are to raise awareness of important ocean conservation issues and empower seafood consumers and businesses to make choices for healthy oceans.

Each sustainability recommendation on the regional pocket guides is supported by a Seafood Watch Assessment. Each assessment synthesizes and analyzes the most current ecological, fisheries and ecosystem science on a species, then evaluates this information against the program's conservation ethic to arrive at a recommendation of "Best Choices," "Good Alternatives" or "Avoid." This ethic is operationalized in the Seafood Watch standards, available on our website here. In producing the assessments, Seafood Watch seeks out research published in academic, peer-reviewed journals whenever possible. Other sources of information include government technical publications, fishery management plans and supporting documents, and other scientific reviews of ecological sustainability. Seafood Watch Research Analysts also communicate regularly with ecologists, fisheries and aquaculture scientists, and members of industry and conservation organizations when evaluating fisheries and aquaculture practices. Capture fisheries and aquaculture practices are highly dynamic; as the scientific information on each species changes, Seafood Watch's sustainability recommendations and the underlying assessments will be updated to reflect these changes.

Parties interested in capture fisheries, aquaculture practices and the sustainability of ocean ecosystems are welcome to use Seafood Watch assessments in any way they find useful.

Guiding Principles

The Safina Center and Seafood Watch define sustainable seafood as originating from sources, whether fished[1] or farmed, that can maintain or increase production in the long-term without jeopardizing the structure or function of affected ecosystems.

Based on this principle, Seafood Watch and the Safina Center have developed four sustainability **criteria** for evaluating wild-catch fisheries for consumers and businesses. These criteria are:

- How does fishing affect the species under assessment?
- How does the fishing affect other, target and non-target species?
- How effective is the fishery's management?
- How does the fishing affect habitats and the stability of the ecosystem?

Each criterion includes:

- Factors to evaluate and score
- Guidelines for integrating these factors to produce a numerical score and **rating**

Once a rating has been assigned to each criterion, we develop an overall recommendation. Criteria ratings and the overall recommendation are color-coded to correspond to the categories on the Seafood Watch pocket guide and the Safina Center's online guide:

Best Choice/Green: Are well managed and caught in ways that cause little harm to habitats or other wildlife.

Good Alternative/Yellow: Buy, but be aware there are concerns with how they're caught.

Avoid/Red Take a pass on these for now. These items are overfished or caught in ways that harm other marine life or the environment.

[1] "Fish" is used throughout this document to refer to finfish, shellfish and other invertebrates

Summary

This report provides a recommendation for southern flounder (*Paralichthys lethostigma*) caught off the coast of Texas (US) in the Gulf of Mexico. The primary fishing methods for southern flounder in this area are handlines, hand-operated pole-and-lines, and gig (a single- or multi-pronged spear used for fishing). Gig is being grouped under harpoons as a spear-like implement used in fishing.

The southern flounder is distributed in the Western Central Atlantic off the US coast from North Carolina to Florida, absent along Florida's southern peninsula, and throughout the Gulf of Mexico. Southern flounder is a demersal species generally found on muddy or silty substrate in estuary or nearshore waters most of the year, with sexually-mature individuals migrating to open waters to spawn when water temperatures drop in the fall (October to December). Juvenile and small southern flounder feed primarily on invertebrates while adults and larger individuals prefer fish. Fishery-dependent and independent information is collected yearly on the southern flounder in Texas.

The restriction of gear to handlines, hand-operated pole-and-lines, and gig, imposed by the Texas Parks and Wildlife Department, produce little, if any, negative impacts to the environment. Also, these fishing methods lead to very limited by-catch. Sheepshead and black drum are targeted and retained in the gig fishery along with southern flounder, but neither are overfished or experiencing overfishing.

The Texas Parks and Wildlife Department (TPWD), through the Texas Parks and Wildlife Commission, is the direct managing entity of the southern flounder commercial and recreational fishery up to nine nautical miles (nm) off the coast of Texas. The TPWD has implemented very strict regulations in the southern flounder fishery including size limits, fishing methods, and seasonal restrictions. There is also a regional management plan in place through the Gulf States Marine Fisheries Commission (GSMFC).

The southern flounder fishery off the Texas coast in the Gulf of Mexico is rated "Yellow" or "Good Alternative."

Final Seafood Recommendations

SPECIES/FISHERY	CRITERION 1: IMPACTS ON THE SPECIES	CRITERION 2: IMPACTS ON OTHER SPECIES	CRITERION 3: MANAGEMENT EFFECTIVENESS	CRITERION 4: HABITAT AND ECOSYSTEM	OVERALL RECOMMENDATION
Southern flounder Gulf of Mexico, Handlines and hand-operated pole-and-lines	Yellow (2.644)	Green (5.000)	Yellow (3.000)	Green (3.464)	**Good Alternative (3.423)**
Southern flounder Gulf of Mexico, Harpoons	Yellow (2.644)	Green (3.318)	Yellow (3.000)	Green (3.464)	**Good Alternative (3.090)**

Summary

The southern flounder (*Paralichthys lethostigma*) is a demersal flatfish distributed in the Western Central Atlantic off the coast of the US from North Carolina to Florida, absent along Florida's southern peninsula, and throughout the Gulf of Mexico. This report covers the Texas southern flounder handline, hand-operated pole-and-line, and gig fisheries, which account for all southern flounder landings in Texas.

The "Good Alternative" rank for southern flounder from Texas is driven by the relatively "low" conservation concern for stock status, management, and habitat impacts, and "low" concern for impacts on other species.

Scoring Guide

Scores range from zero to five where zero indicates very poor performance and five indicates the fishing operations have no significant impact.

Final Score = geometric mean of the four Scores (Criterion 1, Criterion 2, Criterion 3, Criterion 4).

- **Best Choice/Green** = Final Score >3.2, and either Criterion 1 or Criterion 3 (or both) is Green, and no Red Criteria, and no Critical scores
- **Good Alternative/Yellow** = Final score >2.2-3.2, and neither Harvest Strategy (Factor 3.1) nor Bycatch Management Strategy (Factor 3.2) are Very High Concern2, and no more than one Red Criterion, and no Critical scores
- **Avoid/Red** = Final Score ≤2.2, or either Harvest Strategy (Factor 3.1) or Bycatch Management Strategy (Factor 3.2) is Very High Concern or two or more Red Criteria, or one or more Critical scores.

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[2] Because effective management is an essential component of sustainable fisheries, Seafood Watch issues an Avoid recommendation for any fishery scored as a Very High Concern for either factor under Management (Criterion 3).

Introduction

Scope of the analysis and ensuing recommendation

This report provides recommendations for southern flounder (*Paralichthys lethostigma*) caught off the Texas coast, US, in the Gulf of Mexico. Southern flounder are typically caught using hand-lines, hand-operated pole-and-lines, and gig (a single- or multi-pronged spear used for fishing).

Species Overview

Southern flounder are demersal flatfish found in the estuaries, bays, and coastal waters of the southwest Atlantic Ocean from the coast of North Carolina to northern Mexico; however, the species is absent from southern Florida between the Loxahatchee River and the Caloosahatchee River (Enge and Mulholland 1985). Adult southern flounder typically live in estuaries and bays most of the year but migrate into open water when water temperatures decrease in the fall to spawn (October to December) (Stokes 1977). Female southern flounder spawn as many as 13 times during the winter, releasing around 120,000 eggs total (Arnold et al. 1977). The eggs are fertilized by a male flounder that follows closely behind the female as she releases the eggs (Arnold et al. 1977) (Stokes 1977). Larvae are transported to bays and estuaries by ocean currents, where they stay until reaching sexual maturity between 1 and 3 years of age (GSMFC 2000) (Midway and Scharf 2012). Southern flounder are sexually dimorphic, meaning males and females grow to different sizes, with females being larger and living longer in the case of southern flounder (Stunz et al. 2000) (Midway and Scharf 2012).

Southern flounder larvae look the same as many other fish—with one eye on each side of the head; it is not until the end of the larval stage that the metamorphosis of the right eye onto the left side of body begins (see figure below) (Daniels 2000). Both nostrils are on the left (or upper) side of the body as well as the mouth twisting during metamorphosis to be more towards the upper side of the body (Daniels 2000). The flounder's coloring is a light to dark brown on the upper side of the body, with the possibility of some darker spots and/or blotches (more common in smaller individuals), and the underside is white to off-white (Gutherz 1967). Although males and females are born genetically with XX and XY chromosomes, respectively, sex may be reversed in females that are exposed to water temperatures above 64.4 ^{o}F (18 ^{o}C) near the end of the larval stage (known as a temperature dependent form of genetic sex determination) (Luckenbach et al. 2003). There are varying reports on maximum age, size, and rate of growth, which could be influenced by prey availability, water temperature, and salinity (Enge and Mulholland 1985) (Corey et al. 2017); the influence of genetic population differences on growth is largely unknown (Anderson and Karel 2012). For the purposes of this report, information specific to southern flounder found in Texas waters will be used whenever possible. Maximum age reports vary from 3 to 8 years in the Gulf of Mexico, with females living longer than males (Fischer and Thompson 2004). In Texas, recent studies report a maximum age of 4 years (Stunz et al. 2000). Female southern flounder can reach lengths exceeding 630 mm in Texas, while males rarely exceed 356 mm (Stahl 2016).

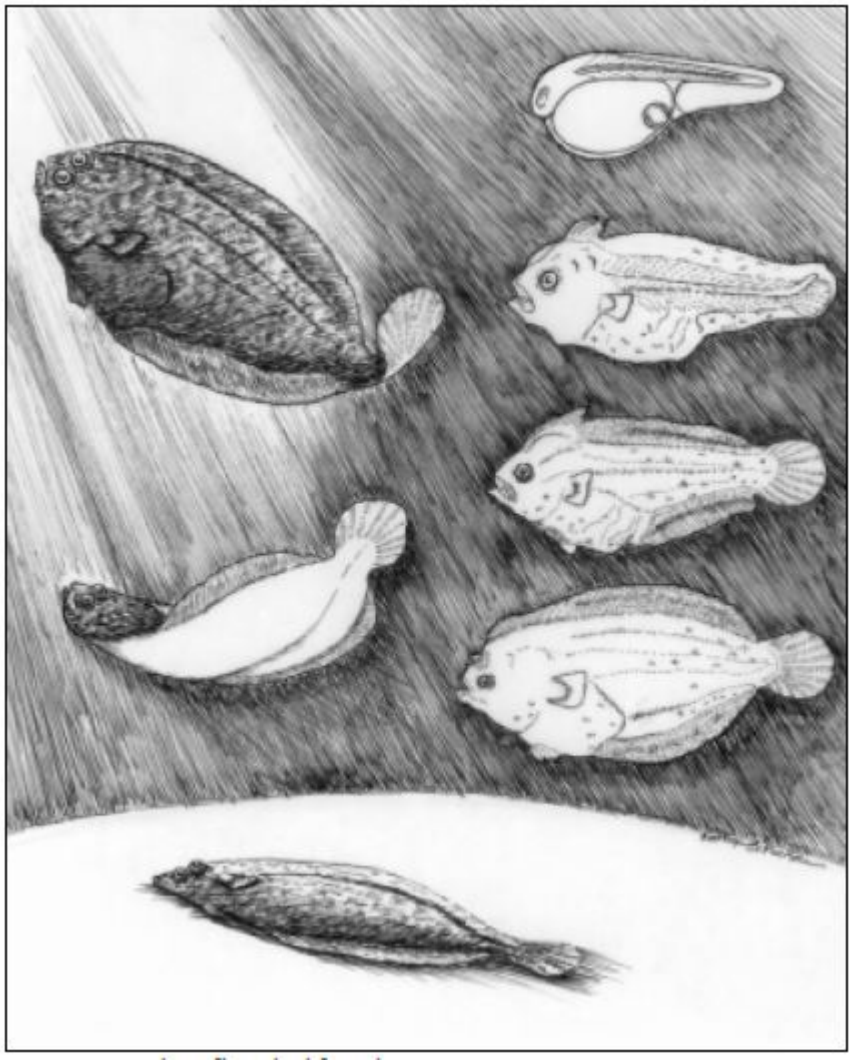

Figure 1 Southern flounder life cycle. From Daniels 2000.

Southern flounder fisheries are managed by individual states, but fish enter federal waters during offshore spawning migrations where populations mix. The Gulf States Marine Fisheries Commission (GSMFC) helps to coordinate the 5 US state agencies that border the Gulf of Mexico to ensure that monitoring and management strategies are consistent throughout the region (GSMFC 2000) (GSMFC 2015). The GSMFC recognizes the need for a gulf-wide assessment, but insufficient data has prohibited such an assessment to date. The Texas Parks and Wildlife Department (TPWD), through the Texas Parks and Wildlife Commission, is responsible for the implementation and oversight of the flounder fishery up to 9 nm off the coast of Texas (GSMFC 2000) (GSMFC 2015). A gig is the most common fishing tool used to catch southern flounder in Texas waters (J. Esslinger, personal communication 2018). Gillnets and trawls are used in other states, but catch from these gears has been steadily declining (GSMFC 2015).


Figure 2 A typical gig (https://www.pinterest.com/pin/395472411003785282/).

Production Statistics

Due to the similarities in species and equal valuation in the market place, gulf and southern flounder were not differentiated in the National Marine Fisheries Service database until 2015. However, southern flounder make up approximately 90% of the flounder caught off the coast of Texas (GSMFC 2015). The highest commercial landings since 1950 were recorded in 1986 at 560,309 lb (NOAA 2018). The lowest commercial landings occurred in 2013 at 20,426 lb (NOAA 2018). The large difference between these two numbers may be attributable to strict regulations set in place by the Texas Parks and Wildlife Department and variations in population and environmental conditions. In 2015 and 2016, southern flounder landings were 51,134 lb and 63,125 lb, respectively.

Importance to the US/North American market.

The average yearly value of commercially-caught flounder species from the coast of Texas from 1998 to 2011 was USD 257,000 (GSMFC 2015). In 2016, commercial landings of southern flounder in Texas equaled 63,125 lb valued at USD 235,742 (NOAA 2018). No flounder exports are reported in the yearly fisheries summary, leading to the assumption that all southern flounder caught off the coast of Texas are sold to US consumers (NOAA 2017).

Common and market names.

Southern flounder, flounder, doormat, mud flounder, and fluke.

Primary product forms

Southern flounder is typically purchased as whole fish or fillets, with the majority of items sold as a fresh product (GSMFC 2015).

Assessment

This section assesses the sustainability of the fishery(s) relative to the Seafood Watch Standard for Fisheries, available at www.seafoodwatch.org. The specific standard used is referenced on the title page of all Seafood Watch assessments.

Criterion 1: Impacts on the Species Under Assessment

This criterion evaluates the impact of fishing mortality on the species, given its current abundance. When abundance is unknown, abundance is scored based on the species' inherent vulnerability, which is calculated using a Productivity-Susceptibility Analysis. The final Criterion 1 score is determined by taking the geometric mean of the abundance and fishing mortality scores. The Criterion 1 rating is determined as follows:

- *Score >3.2=Green or Low Concern*
- *Score >2.2 and ≤3.2=Yellow or Moderate Concern*
- *Score ≤2.2=Red or High Concern*

Rating is Critical if Factor 1.3 (Fishing Mortality) is Critical

Criterion 1 Summary

SOUTHERN FLOUNDER			
Region | Method	**Abundance**	**Fishing Mortality**	**Score**
Gulf of Mexico | Handlines and hand-operated pole-and-lines	2.33: Moderate Concern	3.00: Moderate Concern	Yellow (2.644)
Gulf of Mexico | Harpoons	2.33: Moderate Concern	3.00: Moderate Concern	Yellow (2.644)

Criterion 1 Assessment

SCORING GUIDELINES

Factor 1.1 - Abundance

Goal: Stock abundance and size structure of native species is maintained at a level that does not impair recruitment or productivity.

- *5 (Very Low Concern) — Strong evidence exists that the population is above an appropriate target abundance level (given the species' ecological role), or near virgin biomass.*
- *3.67 (Low Concern) — Population may be below target abundance level, but is at least 75% of the target level, OR data-limited assessments suggest population is healthy and species is not highly vulnerable.*
- *2.33 (Moderate Concern) — Population is not overfished but may be below 75% of the target abundance level, OR abundance is unknown and the species is not highly vulnerable.*
- *1 (High Concern) — Population is considered overfished/depleted, a species of concern, threatened or endangered, OR abundance is unknown and species is highly vulnerable.*

Factor 1.2 - Fishing Mortality

Goal: Fishing mortality is appropriate for current state of the stock.

- *5 (Low Concern) — Probable (>50%) that fishing mortality from all sources is at or below a sustainable level, given the species ecological role, OR fishery does not target species and fishing mortality is low enough to not adversely affect its population.*
- *3 (Moderate Concern) — Fishing mortality is fluctuating around sustainable levels, OR fishing mortality relative to a sustainable level is uncertain.*
- *1 (High Concern) — Probable that fishing mortality from all source is above a sustainable level.*

SOUTHERN FLOUNDER

Factor 1.1 - Abundance

GULF OF MEXICO, HANDLINES AND HAND-OPERATED POLE-AND-LINES
GULF OF MEXICO, HARPOONS

Moderate Concern

The abundance of southern flounder in the Gulf of Mexico is uncertain, and the Texas stock may occur on the boundary between two populations (Blandon et al. 2001), though more recent genetic analyses suggest a single Gulf stock for the purposes of assessment (Anderson et al. 2012). The IUCN assessed southern flounder as "Near Threatened" in 2015, but data for Gulf populations is primarily based on studies from 2011 or earlier (Munroe 2015). In 2014 and 2015, Texas and Louisiana each assessed their respective southern flounder populations as above the spawning potential ratio (SPR) of 30% (Davis et al. 2015) (Martinez-Andrade 2014). In Texas, the fishery is considered to be in recovery (Munroe 2015) and the latest Virtual Population Analysis (VPA) suggests that the stock is not overfished, with an SPR of 46% in 2012 (Martinez-Andrade 2014). Researchers suggest interpreting the results with caution because fishery-independent catch rates decreased in 2013 (Martinez-Andrade 2014) and newer data showed a decreasing trend continuing through 2016 (Martinez-Andrade 2018). In Louisiana, the estimate for $SSB/SSB_{30\%}$ from 2011 to 2013 is 1.76 and current SPR is 50%, suggesting that the stock is also above limit reference points (Davis et al. 2015).

Due to the difference in the IUCN and state stock assessments, a Productivity-Susceptibility Assessment (PSA) was performed using data specific to the Texas coast. The Texas-specific PSA resulted in a vulnerability score of "moderate" (see below). Abundance is above limit reference points and the species is not highly vulnerable, but recent data suggests the stock may be in decline; therefore, southern flounder abundance is assessed as a "moderate" concern.

Justification:

Many variables have prevented a regional Gulf of Mexico population assessment including lack of and varying data on: age and growth, which is compounded by the species' sexual dimorphism and high variability in size even within year classes; sex and size composition; and catch per unit effort (CPUE) (GSMFC 2015). In addition, there has also been a lack of species differentiation between southern and gulf flounder. However, the assessments completed by Texas and Louisiana provide some insight into the current status of the Gulf of Mexico southern flounder stock.

The Louisiana assessment used a statistical catch-at-age model utilizing both fishery-dependent and fishery-independent data to describe variations in the Louisiana southern flounder population between 1981 and 2013. The model indicated that Louisiana southern flounder have not been overfished since 1987 (Davis et al. 2015). The assessment estimates the spawning potential ratio (SPR) at 50%, well above the conservation threshold of 30% (Davis et al. 2015).

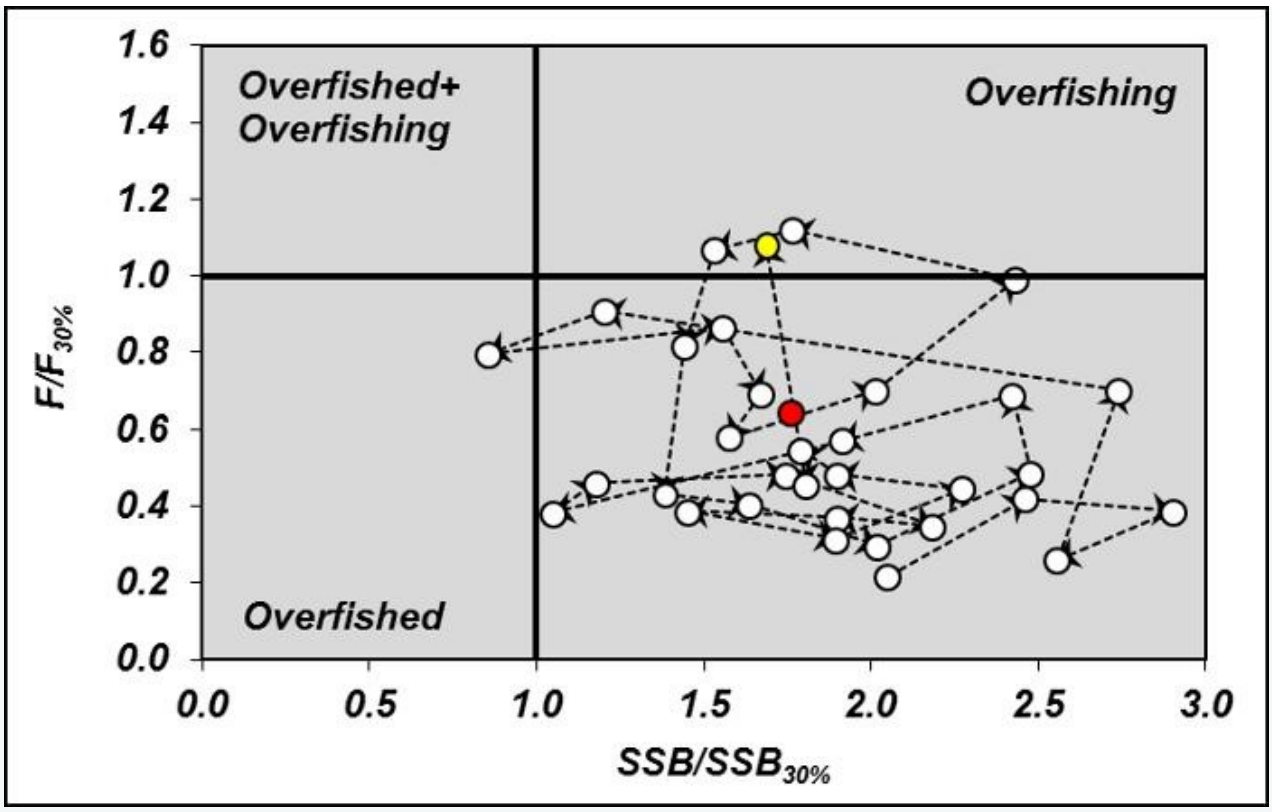

Figure 3 ASAP base model estimated ratios of annual average fishing mortality to F30% and spawning stock biomass to SSB30% for southern flounder in Louisiana. Arrows and dashed line represent direction of time-series. The yellow circle is the 2013 estimate and the red circle is current status (geometric mean of average F and female SSB 2011-2013). (Davis et al. 2015).

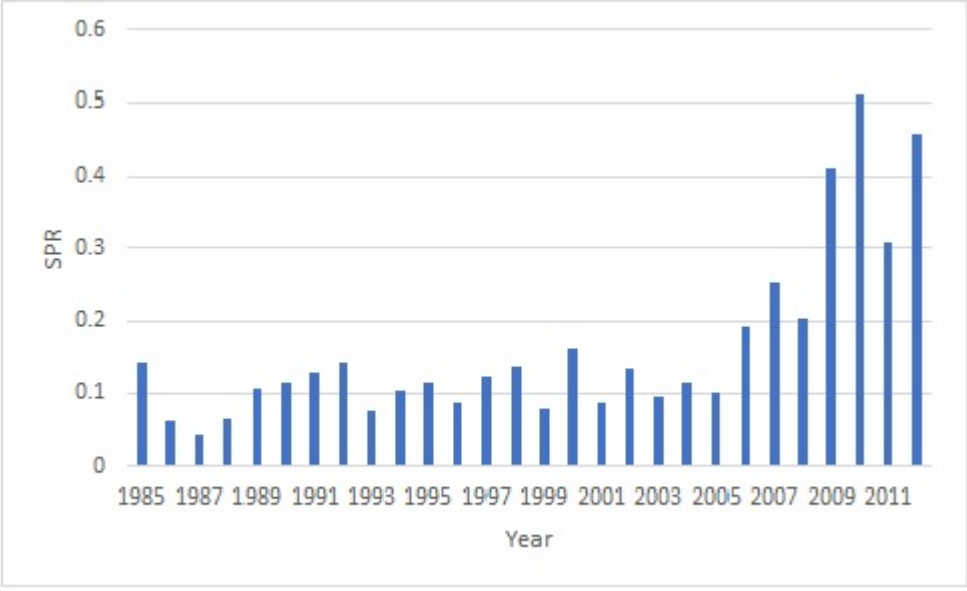

Figure 4 Texas southern flounder estimated spawning potential ratio (SPR) by year from VPA model. From Martinez-Andrade 2014.

The Texas assessment used a Virtual Population Analysis (VPA) model informed by both fishery-dependent and fishery-independent data. The VPA showed SPR levels below 20% for 1985 through 2005; however, new regulations in 2009 brought the SPR up to 46% by 2012 (Martinez-Andrade 2014).

Southern flounder, Texas Coast handline, pole-and-line, gig			
Productivity Attributes	**Value**	**Score (1 = low risk; 2 = medium risk; 3 = high risk)**	**Reference**
Average age at maturity (years)	2	1	(Midway and Scharf 2012)
Average maximum age (years)	4	1	(Stunz et al. 2000)
Fecundity (eggs/yr)	120,000	1	(Arnold et al. 1977)
Average maximum size (cm) (not to be used when scoring invertebrate species)	45–59 (sexes combined)	1	(Stunz et al. 2000) (Stahl 2016)
Average size at maturity (cm) (not to be used when scoring invertebrate species)	40–43 (sexes combined)	1	(Stunz et al. 2000)
Reproductive strategy	Broadcast spawner	1	(Arnold et al. 1977)
Trophic level	3.5	3	(Froese and Pauly 2017)
Density dependence (invertebrates only)	NA		
Quality of Habitat	Moderately altered	2	(USDA 2015)
Productivity Subscore		1.38	

Susceptibility Attribute	**Information**	**Score (1 = low risk; 2 = medium risk; 3 = high risk)**	**Reference**
Areal overlap	Southern flounder is fished throughout its entire range	3	(Munroe 2015)
Vertical overlap	Southern flounder is known to live in depths up to 62 m. Default score for target species.	3	(Stokes 1977)

Selectivity of fishery	Southern flounder is targeted, or is incidentally encountered, and is not likely to escape the gear. Conditions under "high risk" do not apply	2	(GSMFC 2015)
Post-capture mortality	Default score for retained species	3	
Susceptibility Subscore		2.325	

Productivity-Susceptibility Score	**2.70**
Vulnerability Rating (high, medium or low)	**Medium**

Factor 1.2 - Fishing Mortality

GULF OF MEXICO, HANDLINES AND HAND-OPERATED POLE-AND-LINES
GULF OF MEXICO, HARPOONS

Moderate Concern

Both Louisiana and Texas stock assessments—which considered recreational and commercial fishing—were used to score fishing mortality (F). Martinez-Andrade estimated natural mortality for southern flounder off the coast of Texas as 0.6 in 2014 (Martinez-Andrade 2014). Fishing mortality in Texas was estimated for 1985 to 2012 for female southern flounder aged 2+ (see below) to be higher than natural mortality for all but 4 years, and has averaged 0.4 in the three years following new regulations (2010 to 2012) (Martinez-Andrade 2014). Spawning potential ratio responded favorably to regulations passed in 2009 and averaged 42% in the same three years (Martinez-Andrade 2014), which is above the level deemed appropriate for moderately susceptible species (Seafood Watch 2016). In the Louisiana assessment, the 2011 to 2013 estimate for $F/F_{30\%}$ was 0.64, which is below the limit reference point for fishing mortality (F/F30% >1) (Davis et al. 2015). This indicates that on average overfishing is not occurring; however, it did occur in 2013 (Davis et al. 2015). Because the Louisiana assessment indicates that F has been consistently below F_{MSY} (but was above F_{MSY} in 2013), and the Texas assessment suggests that fishing mortality is fluctuating around a sustainable level, but total fishing mortality is uncertain (see below), southern flounder fishing mortality is assessed as a "moderate" concern.

Justification:

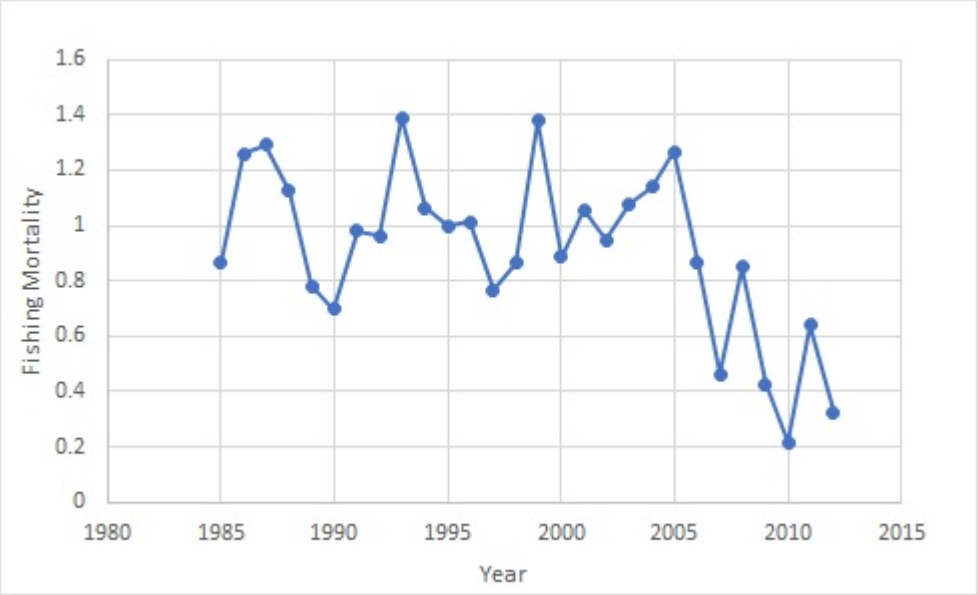

Figure 5 Estimated fishing mortality of age 2+ female Texas southern flounder. From Martinez-Andrade 2014.

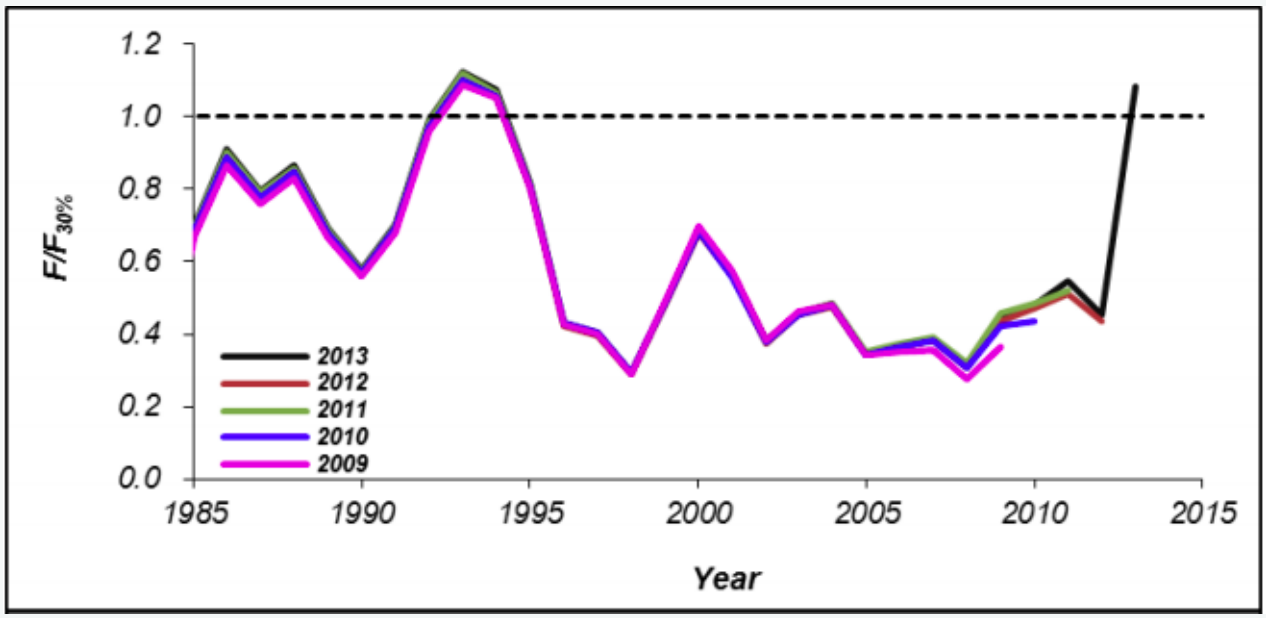

Figure 6 Model estimated ratios of annual average fishing mortality to F30% for southern flounder in Louisiana. From Davis et al. 2015.

Landings for this species have been recorded by the National Marine Fishery Service (NMFS) since 1950 (see Appendix B); however, until 2015, flounder (predominantly southern and gulf flounder in Texas) landings information was combined into one "flatfish" category (NOAA 2018). Many TPWD regulations have impacted southern flounder landings, starting in 1981 with the ban on the commercial sale of spotted sea trout and red drum (GSMFC 2015). This led commercial fishers to increase fishing pressure on the southern flounder, and the highest commercial landings were recorded in 1986 at 560,309 lb (GSMFC 2015) (NOAA 2018). Eight other regulations were passed between 1988 and 2014 that impact southern flounder landings (see Appendix C). These regulations, along with population dynamics and decreased fishing pressure, led to the lowest recorded commercial landings in 2013 of 20,426 lb (NOAA 2018).

In addition to the targeted commercial and recreational fisheries, southern flounder are also caught as bycatch in the shrimp trawl fishery. As many as 9.7 million fish/year have been reported as bycatch in the

shrimp trawl fishery (Munroe 2015), but there appears to be limited data on incidental catch in the shrimp trawl fisheries outside of Florida and Mississippi (GSMFC 2015). In Texas, approved bycatch reduction devices are required and the bag limit for southern flounder is 5 fish for each person with a shrimp boat captain's license, except from 1 November to 14 December, when the limit is 2 fish (TPWD 2017a) (TPWD 2017b). The total weight of all retained aquatic products also may not exceed 50% of the weight of shrimp on a shrimp boat (TPWD 2017b). It should be noted that stock losses from discard mortality are not taken into account in the Louisiana stock assessment (Davis et al. 2015) and the Texas assessment (Martinez-Andrade 2014) uses catch weighted F for female flounder age 2+. Total fishing mortality may not be fully captured in these assessments and results should be interpreted with caution.

Criterion 2: Impacts on Other Species

All main retained and bycatch species in the fishery are evaluated under Criterion 2. Seafood Watch defines bycatch as all fisheries-related mortality or injury to species other than the retained catch. Examples include discards, endangered or threatened species catch, and ghost fishing. Species are evaluated using the same guidelines as in Criterion 1. When information on other species caught in the fishery is unavailable, the fishery's potential impacts on other species is scored according to the Unknown Bycatch Matrices, which are based on a synthesis of peer-reviewed literature and expert opinion on the bycatch impacts of each gear type. The fishery is also scored for the amount of non-retained catch (discards) and bait use relative to the retained catch. To determine the final Criterion 2 score, the score for the lowest scoring retained/bycatch species is multiplied by the discard/bait score. The Criterion 2 rating is determined as follows:

- *Score >3.2=Green or Low Concern*
- *Score >2.2 and ≤=3.2=Yellow or Moderate Concern*
- *Score ≤=2.2=Red or High Concern*

Rating is Critical if Factor 2.3 (Fishing Mortality) is Crtitical

Guiding Principles

- *Ensure all affected stocks are healthy and abundant.*
- *Fish all affected stocks at sustainable level.*
- *Minimize bycatch.*

Criterion 2 Summary

Only the lowest scoring main species is/are listed in the table and text in this Criterion 2 section; a full list and assessment of the main species can be found in Appendix A.

SOUTHERN FLOUNDER - GULF OF MEXICO - HANDLINES AND HAND-OPERATED POLE-AND-LINES					
Subscore:	**5.000**	**Discard Rate:**	**1.00**	**C2 Rate:**	**5.000**
Species	**Abundance**	**Fishing Mortality**	**Subscore**		
No other main species caught					

SOUTHERN FLOUNDER - GULF OF MEXICO - HARPOONS					
Subscore:	**3.318**	**Discard Rate:**	**1.00**	**C2 Rate:**	**3.318**
Species	**Abundance**	**Fishing Mortality**	**Subscore**		
Black drum	3.67:Low Concern	3.00:Moderate Concern	Green (3.318)		
Sheepshead	5.00:Very Low Concern	3.00:Moderate Concern	Green (3.873)		

Handline, hand-operated pole-and-line, and gig are all highly selective gears. From 2007 to 2017, only 0.6% of commercially caught southern flounder were caught using handlines or hand-operated pole-and-lines; therefore, no bycatch species were included for these gears (J. Esslinger, personal communication 2018). Almost all of the commercially caught southern flounder in Texas are caught with gig (J. Esslinger, personal communication 2018). In this fishery, sheepshead and black drum are also targeted (M. Stahl, personal communication 2018). The International Union for the Conservation of Nature (IUCN) has assessed the

Gulf of Mexico populations of both the black drum and sheepshead as "Least Concern." Fisheries-independent data-limited assessments as well as the IUCN assessment for black drum rates the species as a "low" concern. A sheepshead assessment done by Louisiana along with the IUCN assessment rates this species as a "low" concern. Black drum is the limiting factor for the gig fishery because it is unknown whether fishing mortality is at a sustainable level.

Criterion 2 Assessment

SCORING GUIDELINES

Factor 2.1 - Abundance

(same as Factor 1.1 above)

Factor 2.2 - Fishing Mortality

(same as Factor 1.2 above)

BLACK DRUM

Factor 2.1 - Abundance

GULF OF MEXICO, HARPOONS

Low Concern

The International Union for the Conservation of Nature (IUCN) has assessed black drum (*Pogonias cromis*) in the Gulf of Mexico as "Least Concern" (Chao et al. 2015). Black drum landings have been stable over the last decade (2006 to 2016) (NOAA 2018). Texas Parks and Wildlife Department (TPWD) fisheries-independent gill net surveys in both the spring and fall show an increased catch rate over the sampling period (1975 to 2016) (see below) (Martinez-Andrade 2018). TPWD fisheries-independent bag seine surveys show a highly variable catch rate with a stable mean (see below) (Martinez-Andrade 2018). The Texas and Gulf of Mexico populations of black drum appear to be stable with two appropriate data-limited assessments; therefore, abundance is assessed as a "low" concern.

Justification:

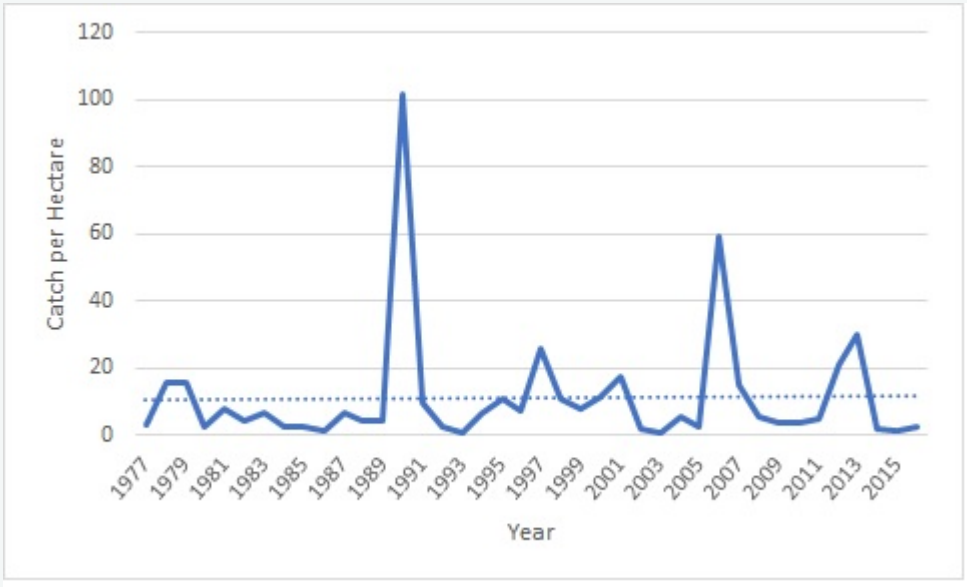

Figure 7 Texas fisheries-independent yearly bag seine survey of black drum (1977-2016). From Martinez-Andrade 2018.

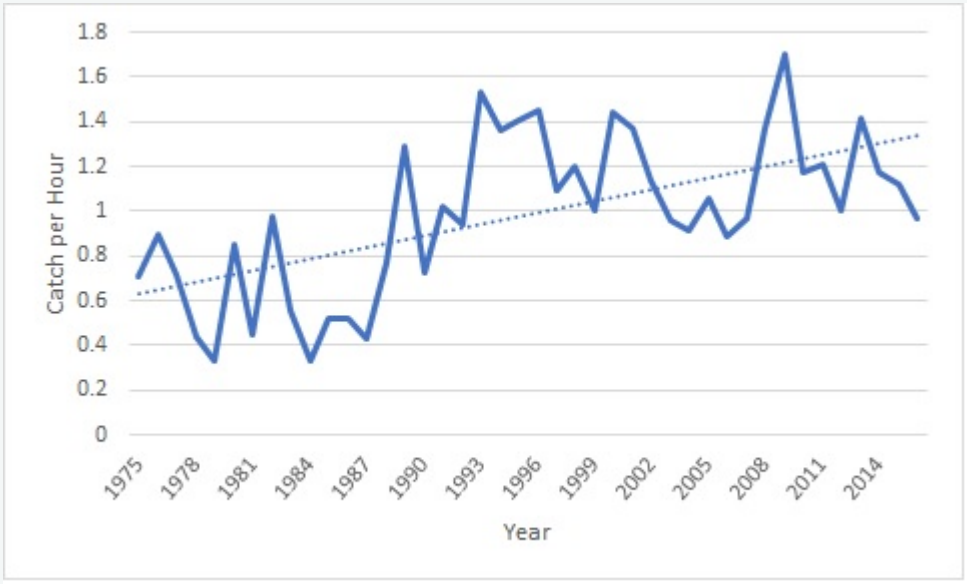

Figure 8 Texas fisheries-independent yearly fall gill net survey (1975-2016). From Martinez-Andrade 2018.

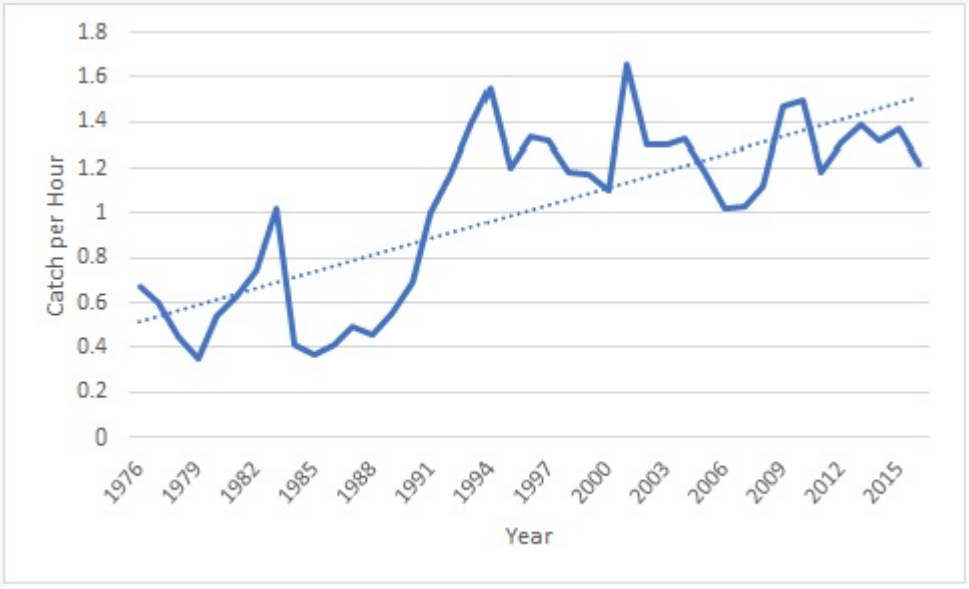

Figure 9 Texas fisheries-independent yearly spring gill net survey (1976-2016). From Martinez-Andrade 2018.

Factor 2.2 - Fishing Mortality

GULF OF MEXICO, HARPOONS

Moderate Concern

There is no data for fishing mortality at maximum sustainable yield for black drum off the coast of Texas. Due to lack of information about fishing mortality in relation to reference points, black drum fishing mortality is assessed as a "moderate" concern.

Factor 2.3 - Modifying Factor: Discards and Bait Use

Goal: Fishery optimizes the utilization of marine and freshwater resources by minimizing post-harvest loss. For fisheries that use bait, bait is used efficiently.

Scoring Guidelines: The discard rate is the sum of all dead discards (i.e. non-retained catch) plus bait use divided by the total retained catch.

RATIO OF BAIT + DISCARDS/LANDINGS	FACTOR 2.3 SCORE
<100%	1
>=100	0.75

GULF OF MEXICO, HARPOONS

< 100%

Specific discard rates are not available for southern flounder off the Texas coast; however, Kelleher estimates the weighted average discard rate for gig fisheries as 0.1% with a range of 0% to 1% (Kelleher 2005).

Criterion 3: Management Effectiveness

Five factors are evaluated in Criterion 3: Management Strategy and Implementation, Bycatch Strategy, Scientific Research/Monitoring, Enforcement of Regulations, and Inclusion of Stakeholders. Each is scored as either 'highly effective,' 'moderately effective,' 'ineffective,' or 'critical'. The final Criterion 3 score is determined as follows:

- *5 (Very Low Concern) — Meets the standards of 'highly effective' for all five factors considered.*
- *4 (Low Concern) — Meets the standards of 'highly effective' for 'management strategy and implementation' and at least 'moderately effective' for all other factors.*
- *3 (Moderate Concern) — Meets the standards for at least 'moderately effective' for all five factors.*
- *2 (High Concern) — At a minimum, meets standards for 'moderately effective' for Management Strategy and Implementation and Bycatch Strategy, but at least one other factor is rated 'ineffective.'*
- *1 (Very High Concern) — Management Strategy and Implementation and/or Bycatch Management are 'ineffective.'*
- *0 (Critical) — Management Strategy and Implementation is 'critical'.*

The Criterion 3 rating is determined as follows:

- *Score >3.2=Green or Low Concern*
- *Score >2.2 and ≤3.2=Yellow or Moderate Concern*
- *Score ≤2.2 = Red or High Concern*

Rating is Critical if Management Strategy and Implementation is Critical.

GUIDING PRINCIPLE

- The fishery is managed to sustain the long-term productivity of all impacted species.

Criterion 3 Summary

Fishery	Management Strategy	Bycatch Strategy	Research and Monitoring	Enforcement	Stakeholder Inclusion	Score
Fishery 1: Gulf of Mexico | Handlines and hand-operated pole-and-lines	Moderately Effective	Highly Effective	Highly Effective	Highly Effective	Highly Effective	Yellow (3.000)
Fishery 2: Gulf of Mexico | Harpoons	Moderately Effective	Highly Effective	Highly Effective	Highly Effective	Highly Effective	Yellow (3.000)

Criterion 3 Assessment

Factor 3.1 - Management Strategy and Implementation

Considerations: What type of management measures are in place? Are there appropriate management goals, and is there evidence that management goals are being met? Do manages follow scientific advice? To achieve a highly effective rating, there must be appropriately defined management goals, precautionary policies that are based on scientific advice, and evidence that the measures in place have been successful at maintaining/rebuilding species.

GULF OF MEXICO, HANDLINES AND HAND-OPERATED POLE-AND-LINES
GULF OF MEXICO, HARPOONS

Moderately Effective

The Texas Parks and Wildlife Department (TPWD) is the managing body over fisheries in Texas waters up to nine nautical miles (nm) from the state coast. There is also a Gulf-wide management plan for flounder in place through the Gulf States Marine Fisheries Commission (GSMFC). Texas has implemented some of the strictest regulations on the flounder fishery in the Gulf of Mexico (GSMFC 2015) (GSMFC 2000). This is a limited entry fishery and a fishing license is required for all commercial fishers; there is a minimum length of 14 inches for any harvested flounder; during the month of November, the bag and possession limit is 2 fish that may only be taken by pole-and-line; and from 1–15 December, the bag and possession limit is 2 fish that may be taken by any legal means (TPWD 2017a) (TPWD 2017b). Commercial fishers are restricted to a daily 30 fish bag/possession limit, except from 1 November to 15 December (TPWD 2017b). For black drum, there is a minimum length of 14 in and maximum length of 30 in (TPWD 2017b). For sheepshead, there is a minimum length of 15 in (TPWD 2017b). There are no bag limits or seasonal restrictions on black drum or sheepshead (TPWD 2017b).

A trip ticket program is also in place for commercial wholesale, retail and bait dealers, and commercial fishers, which requires any dealer who receives or purchases aquatic product(s) from anyone other than another dealer to record, by individual (fishing) trip, all aquatic product transactions (TPWD 2017b) (TPWD 2017c). Trip tickets must be completed when the fisher delivers the aquatic product(s) to the dealer (TPWD 2017b). A report is filed with TPWD by the 10th day of each month, of all individual trip tickets from the previous month (TPWD 2017b) (TPWD 2017c).

Management uses a "desirable spawning potential ratio (SPR) value" (target reference point) of 30% and an "accepted threshold" SPR value of 20% (limit reference point) for southern flounder. Seafood Watch considers SPR values of 35 to 40% as appropriate for moderately vulnerable species. The reference points (20% SPR and 30% SPR) may not be appropriate for this species because SPR is based on an accurate population age structure and maturity schedule (Walters and Martell 2004); such data is limited in Texas, maturation rates vary among Gulf states (Corey et al. 2017), and proxies from other regions of the Gulf may not be appropriate. Because SPR may not be conservative enough for southern flounder, and there is not a complete stock assessment with identified reference points for more than black drum, management strategy is assessed as "moderately effective."

Justification:

Each trip ticket must include:

- Name of the seller
- Type of commercial license and license number of the seller
- Date of sale
- Texas driver's license
- Number of pounds sold by species
- Unit and condition codes
- Count and/or market size
- Water body or bay system where the products were harvested
- Price paid per pound, per species
- Gear used in harvesting the product
- Trip time
- Fishing time
- Commercial fishing vessel name and license number

- Name of the dealer
- Commercial license number of the dealer

Factor 3.2 - Bycatch Strategy

Considerations: What type of management strategy/measures are in place to reduce the impacts of the fishery on bycatch species and when applicable, to minimize ghost fishing? How successful are these management measures? To achieve a Highly Effective rating, the fishery must have no or low bycatch, or if there are bycatch or ghost fishing concerns, there must be effective measures in place to minimize impacts.

GULF OF MEXICO, HANDLINES AND HAND-OPERATED POLE-AND-LINES

Highly Effective

There are very few bycatch species that are not retained in the handlines and hand-operated pole-and-lines fisheries that catch southern flounder; undersized fish or individuals that do not meet regulations are likely released with no harm to minimal harm (M. Stahl, personal communication 2018). There are very few concerns regarding bycatch in this fishery, therefore bycatch strategy is assessed as "highly effective."

GULF OF MEXICO, HARPOONS

Highly Effective

Due to the nature of gigging, specifically the fisher having to see the fish prior to impaling it, very few, if any, bycatch species or undersized individuals are caught (M. Stahl, personal communication 2018). Therefore, bycatch strategy is assessed as "highly effective."

Factor 3.3 - Scientific Research and Monitoring

Considerations: How much and what types of data are collected to evaluate the fishery's impact on the species? Is there adequate monitoring of bycatch? To achieve a Highly Effective rating, regular, robust population assessments must be conducted for target or retained species, and an adequate bycatch data collection program must be in place to ensure bycatch management goals are met.

GULF OF MEXICO, HANDLINES AND HAND-OPERATED POLE-AND-LINES
GULF OF MEXICO, HARPOONS

Highly Effective

The Texas Parks and Wildlife Department (TPWD) monitors the southern flounder population yearly by sampling bays and estuaries with seine and gill nets and by surveying recreational anglers (Stahl 2016). Commercial landing data have been collected since 1950 by the National Marine Fisheries Service (NMFS). A stock assessment was conducted by TPWD in 2014 using a virtual population analysis (VPA) of southern flounder females with a model developed by NOAA (Martinez-Andrade 2014). Fisheries-independent and fisheries-dependent data, recreational fisheries, and the impact of southern flounder as bycatch in the shrimp trawl fishery were all taken into consideration in the 2014 assessment. There is very little bycatch associated with either gear. The gig fishery also targets black drum and sheepshead. Black drum and sheepshead are monitored yearly by TPWD with fishery-independent seine and gill net surveys and fishery-dependent data has been collected by the NMFS since 1950. Observer and/or video coverage is not included due to the small scale of the fishery. Because there is a recent, scientifically valid and robust stock assessment informing TPWD management, scientific research and monitoring is assessed as "highly effective."

Factor 3.4 - Enforcement of Management Regulations

Considerations: Do fishermen comply with regulations, and how is this monitored? To achieve a Highly Effective rating, there must be regular enforcement of regulations and verification of compliance.

GULF OF MEXICO, HANDLINES AND HAND-OPERATED POLE-AND-LINES
GULF OF MEXICO, HARPOONS

Highly Effective

The Law Enforcement Division of the Texas Parks and Wildlife Department (TPWD) is responsible for the enforcement of TPWD regulations. There are 110 game wardens that enforce these regulations along the 367 miles of Texas coastline (L. Casterline, personal communication 2018). Between 1 September 2016 and 11 April 2018, there were 6 violations involving southern flounder: 3 of the violations involved the daily bag limit and 3 involved undersized southern flounder (L. Casterline, personal communication 2018). In addition to the regular patrols by game wardens and the trip ticket program, TPWD has a program called Operation Game Thief for the public to report poaching to the TPWD, with rewards of up to $1000 (OGT 2018). With regular enforcement by TPWD law enforcement and the trip ticket program, Enforcement of Management Regulations is assessed as "highly effective."

Factor 3.5 - Stakeholder Inclusion

Considerations: Are stakeholders involved/included in the decision-making process? Stakeholders are individuals/groups/organizations that have an interest in the fishery or that may be affected by the management of the fishery (e.g., fishermen, conservation groups, etc.). A Highly Effective rating is given if the management process is transparent, if high participation by all stakeholders is encouraged, and if there a mechanism to effectively address user conflicts.

GULF OF MEXICO, HANDLINES AND HAND-OPERATED POLE-AND-LINES
GULF OF MEXICO, HARPOONS

Highly Effective

The Texas Parks and Wildlife Commission (TPWC) is the agency that makes the policy decisions that are enforced by the Texas Parks and Wildlife Department (TPWD) (GSMFC 2015). The TPWC consists of nine commissioners appointed by the Governor of Texas, and confirmed by the Texas Senate, to six-year terms (GSMFC 2015) (TPWD 2018). The TPWC has an annual public hearing in August to receive input from any concerned party regarding policies, goals, programs, or responsibilities of the Department (TPWD 2018). TPWC is required, by Texas law, to notify the public of its meetings and the intended discussion topics and/or items the TPWC may take action on during the meeting; public comment is allowed on the posted topics at these meetings (TPWD 2018). In addition to oral comments at TPWC meetings, written comments may be submitted online, mailed, or delivered in person one hour prior to meetings (TPWD 2018). There are multiple ways stakeholders may comment on proposed TPWC actions, and proposed actions are posted online and in print prior to meetings; therefore, stakeholder inclusion is assessed as "highly effective."

Criterion 4: Impacts on the Habitat and Ecosystem

This Criterion assesses the impact of the fishery on seafloor habitats, and increases that base score if there are measures in place to mitigate any impacts. The fishery's overall impact on the ecosystem and food web and the use of ecosystem-based fisheries management (EBFM) principles is also evaluated. Ecosystem Based Fisheries Management aims to consider the interconnections among species and all natural and human stressors on the environment. The final score is the geometric mean of the impact of fishing gear on habitat score (factor 4.1 + factor 4.2) and the Ecosystem Based Fishery Management score. The Criterion 4 rating is determined as follows:

- *Score >3.2=Green or Low Concern*
- *Score >2.2 and ≤3.2=Yellow or Moderate Concern*
- *Score ≤2.2=Red or High Concern*

Rating cannot be Critical for Criterion 4.

Criterion 4 Summary

Region / Method	Gear Type and Substrate	Mitigation of Gear Impacts	EBFM	Score
Gulf of Mexico / Harpoons	4	0	Moderate Concern	Green (3.464)
Gulf of Mexico / Handlines and hand-operated pole-and-lines	4	0	Moderate Concern	Green (3.464)

Criterion 4 Assessment

SCORING GUIDELINES

Factor 4.1 - Physical Impact of Fishing Gear on the Habitat/Substrate

Goal: The fishery does not adversely impact the physical structure of the ocean habitat, seafloor or associated biological communities.

- *5 - Fishing gear does not contact the bottom*
- *4 - Vertical line gear*
- *3 - Gears that contacts the bottom, but is not dragged along the bottom (e.g. gillnet, bottom longline, trap) and is not fished on sensitive habitats. Or bottom seine on resilient mud/sand habitats. Or midwater trawl that is known to contact bottom occasionally. Or purse seine known to commonly contact the bottom.*
- *2 - Bottom dragging gears (dredge, trawl) fished on resilient mud/sand habitats. Or gillnet, trap, or bottom longline fished on sensitive boulder or coral reef habitat. Or bottom seine except on mud/sand. Or there is known trampling of coral reef habitat.*
- *1 - Hydraulic clam dredge. Or dredge or trawl gear fished on moderately sensitive habitats (e.g., cobble or boulder)*
- *0 - Dredge or trawl fished on biogenic habitat, (e.g., deep-sea corals, eelgrass and maerl)*
  Note: When multiple habitat types are commonly encountered, and/or the habitat classification is uncertain, the score will be based on the most sensitive, plausible habitat type.

Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts

Goal: Damage to the seafloor is mitigated through protection of sensitive or vulnerable seafloor habitats, and limits on the spatial footprint of fishing on fishing effort.

- *+1 —>50% of the habitat is protected from fishing with the gear type. Or fishing intensity is very low/limited and for trawled fisheries, expansion of fishery's footprint is prohibited. Or gear is specifically modified to reduce damage to seafloor and modifications have been shown to be effective at reducing damage. Or there is an effective combination of 'moderate' mitigation measures.*
- *+0.5 —At least 20% of all representative habitats are protected from fishing with the gear type and for trawl fisheries, expansion of the fishery's footprint is prohibited. Or gear modification measures or other measures are in place to limit fishing effort, fishing intensity, and spatial footprint of damage caused from fishing that are expected to be effective.*
- *0 —No effective measures are in place to limit gear impacts on habitats or not applicable because gear used is benign and received a score of 5 in factor 4.1*

Factor 4.3 - Ecosystem-Based Fisheries Management

Goal: All stocks are maintained at levels that allow them to fulfill their ecological role and to maintain a functioning ecosystem and food web. Fishing activities should not seriously reduce ecosystem services provided by any retained species or result in harmful changes such as trophic cascades, phase shifts or reduction of genetic diversity. Even non-native species should be considered with respect to ecosystem impacts. If a fishery is managed in order to eradicate a non-native, the potential impacts of that strategy on native species in the ecosystem should be considered and rated below.

- *5 — Policies that have been shown to be effective are in place to protect species' ecological roles and ecosystem functioning (e.g. catch limits that ensure species' abundance is maintained at sufficient levels to provide food to predators) and effective spatial management is used to protect spawning and foraging areas, and prevent localized depletion. Or it has been scientifically demonstrated that fishing practices do not have negative ecological effects.*
- *4 — Policies are in place to protect species' ecological roles and ecosystem functioning but have not proven to be effective and at least some spatial management is used.*
- *3 — Policies are not in place to protect species' ecological roles and ecosystem functioning but detrimental food web impacts are not likely or policies in place may not be sufficient to protect species' ecological roles and ecosystem functioning.*
- *2 — Policies are not in place to protect species' ecological roles and ecosystem functioning and the likelihood of detrimental food impacts are likely (e.g. trophic cascades, alternate stable states, etc.), but conclusive scientific evidence is not available for this fishery.*
- *1 — Scientifically demonstrated trophic cascades, alternate stable states or other detrimental food web impact are resulting from this fishery.*

Factor 4.1 - Physical Impact of Fishing Gear on the Habitat/Substrate

GULF OF MEXICO, HANDLINES AND HAND-OPERATED POLE-AND-LINES
GULF OF MEXICO, HARPOONS

4

Handlines, hand-operated pole-and-lines, and gig have very little contact with the seafloor, and any negative impacts are expected to be minimal.

Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts

GULF OF MEXICO, HANDLINES AND HAND-OPERATED POLE-AND-LINES
GULF OF MEXICO, HARPOONS

0

Handlines, hand-operated pole-and-lines, and gig are sufficiently benign to the seafloor; therefore, no mitigation to the gears is necessary, and no mitigation credits are added.

Factor 4.3 - Ecosystem-Based Fisheries Management

GULF OF MEXICO, HANDLINES AND HAND-OPERATED POLE-AND-LINES
GULF OF MEXICO, HARPOONS

Moderate Concern

Southern flounder are ambush predators; they feed throughout the day with the highest feeding rates occurring in the afternoon (GSMFC 2015). Typical prey varies as the flounder ages, with plankton, bottom invertebrates, and mysids being common for early life stages and juvenile fish (GSMFC 2000). As juvenile fish grow, they increasingly add small fish until it makes up a majority of their diet (GSMFC 2000). In Texas waters, common prey species are anchovy, mullet, shrimp, menhaden, and Atlantic croaker (GSMFC 2000). As large juveniles or small adults, sheepshead primarily consume hard-shelled organisms (e.g., oysters, clams, blue crabs)**;** as adults, sheepshead feed on **a variety of transition a diet of algae, seagrass**, and a variety of invertebrates (GSMFC 2006). Sheepshead may play an important role in shaping epifaunal diversity in bottom communities, including indirectly increasing motile epifauna diversity and sessile invertebrate communities (Sedberry 1987). Little is known about predation on sheepshead (GSMFC 2006). Black drum are bottom feeders, with a preference for worms and mollusks, but also consume algae and small fish (Hill 2005).

The Gulf of Mexico Marine Fishery Management Council is in the research phase of ecosystem based management (EBM) development. The most recent report identifies key indicators of the ecosystem's status including: land use change, commercial landings, bird abundance, hypoxia, artificial structures, fish stock status, sea surface temperature, Atlantic multidecadal oscillation, integrated perspectives, and sea level rise (Karnauskas et al. 2017). The bag limit is greatly reduced during the peak of spawning season (Martinez-Andrade 2014), which represents a precautionary strategy used to protect spawning individuals as they migrate offshore, but there are no closed areas or seasons (GSMFC 2015). There is no evidence that food web impacts are likely in the flounder fishery, though it is possible that removal of sheepshead could impact epifaunal diversity. Because an EBM plan is being actively sought and negative food web impacts are unlikely, ecosystem based fisheries management is assessed as a "moderate" concern.

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Scientific review does not constitute an endorsement of The Safina Center or Seafood Watch® program, or its seafood recommendations, on the part of the reviewing scientists. The Safina Center and Seafood Watch® are solely responsible for the conclusions reached in this report.

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Appendix A: Extra By Catch Species

SHEEPSHEAD

Factor 2.1 - Abundance

GULF OF MEXICO, HARPOONS

Very Low Concern

Sheepshead (*Archosargus probatocephalus*) was assessed in Louisiana waters in 2015 with a statistical catch-at-age model. Abundance was predicted using a statistical catch-at-age model and landings data from the Louisiana Department of Wildlife and Fisheries Trip Ticket Program, National Marine Fisheries Service commercial statistical records, and the NMFS Marine Recreational Information Program (West et al. 2015). The Louisiana Department of Wildlife and Fisheries fishery-independent marine trammel net survey data were used to develop an index of abundance. The assessment found that the species is not overfished ($SSB/SSB_{30\%}$ <1.0) and hasn't been overfished during the entire time-series (1981 to 2013) (West et al. 2015). The Louisiana report estimates the $SSB/SSB_{30\%}$ is 3.58 (West et al. 2015). The spawning potential ratio (SPR) is estimated at 65%, well above the conservation standard of SPR 30% (West et al. 2015). Since the Louisiana and Texas populations of sheepshead are part of a single stock, and there is evidence that the stock is above target and limit reference points, sheepshead abundance is scored as "very low" concern.

Justification:

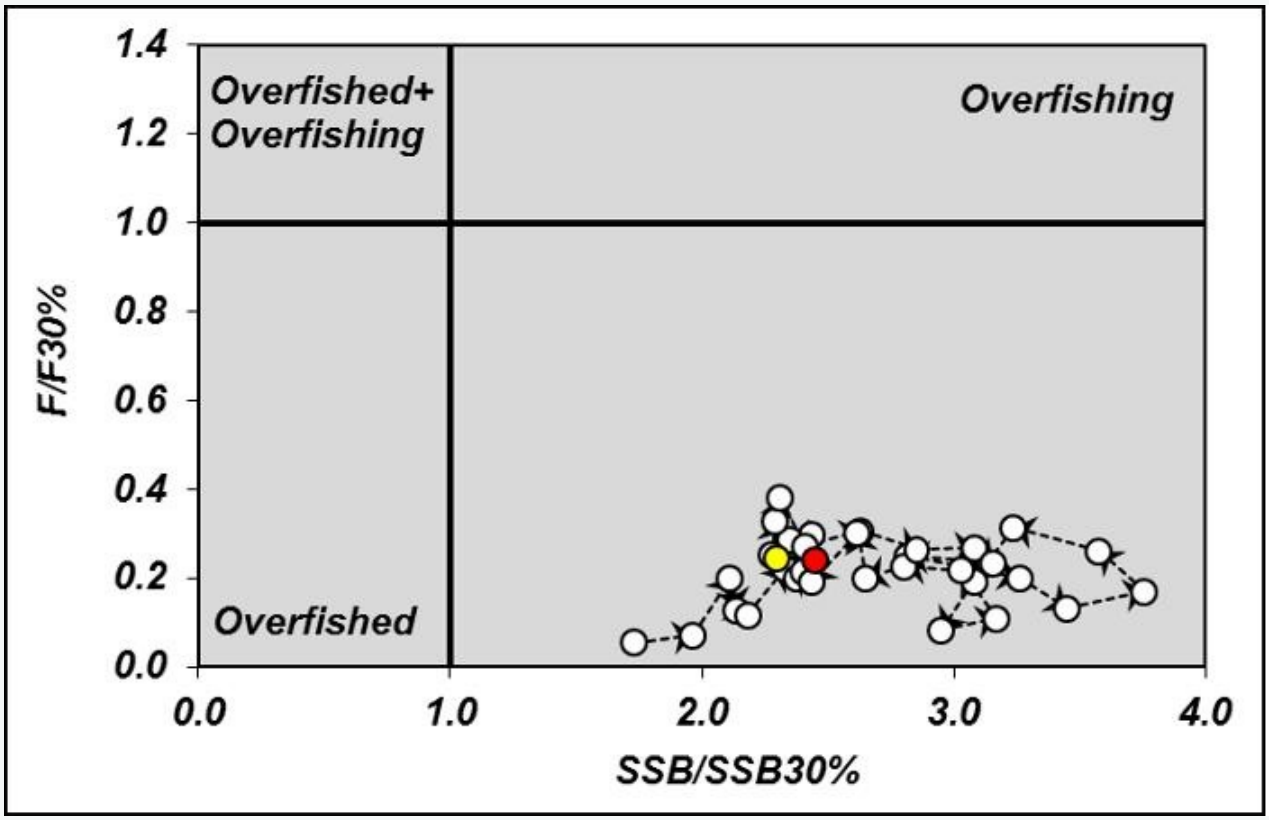

Figure 10 ASAP base model estimated ratios of annual average fishing mortality to F30% and female spawning stock biomass to SSB30%. Arrows and dashed lines represent the direction of the time-series. The yellow circle is the 2013 estimate, and the red circle is the current status (geometric mean of average F and female SSB 2011-2013). From West et al. 2015.

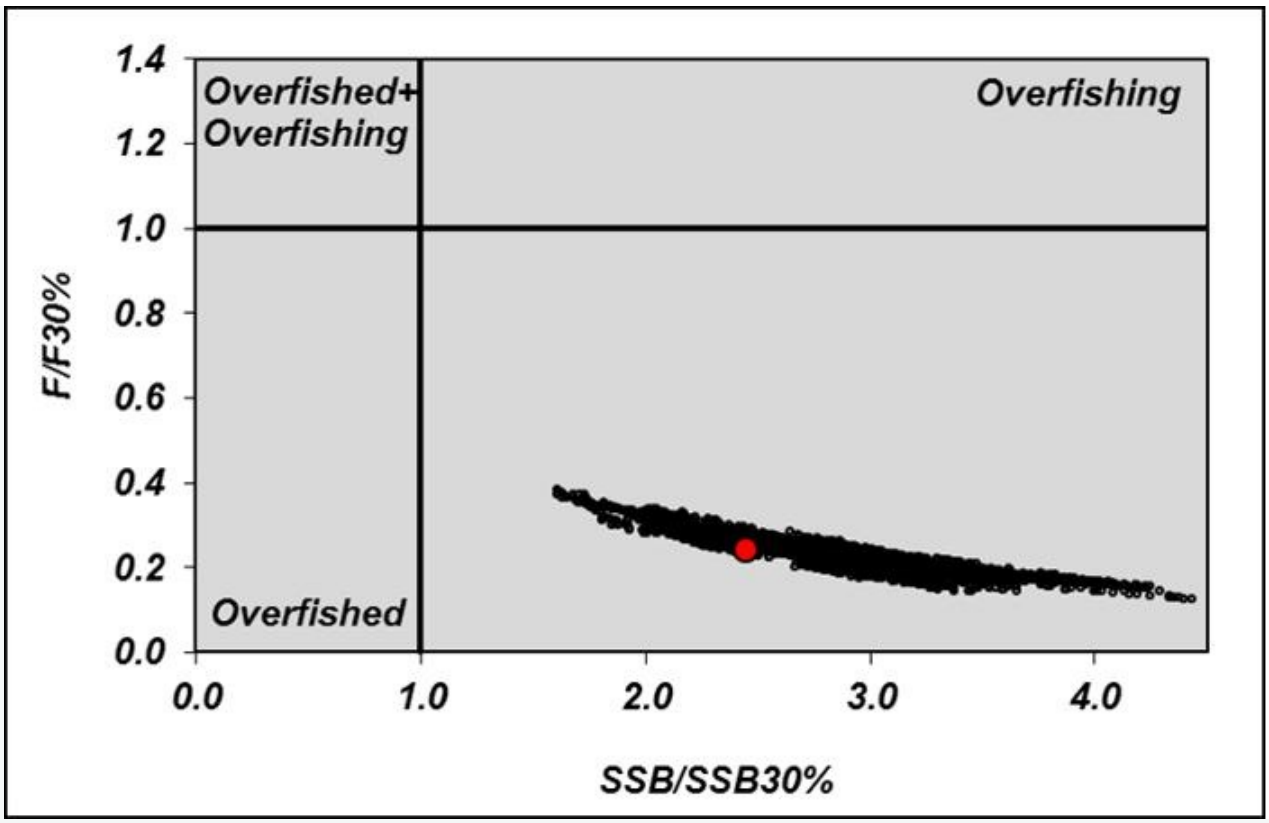

Figure 11 ASAP base model estimated ratios of annual average fishing mortality to F30% and female spawning stock biomass to SSB30%. Graphic depicts current status (red dot) and the results of 2000 Markov Chain Monte Carlo (MCMC) simulations relative to limit reference points. From West et al. 2015.

Factor 2.2 - Fishing Mortality

GULF OF MEXICO, HARPOONS

Moderate Concern

Sheepshead in the western Gulf of Mexico are considered a single stock, separate from the eastern Gulf (Florida west coast) and Atlantic stock (Munyandorero et al. 2017). There is no Gulf-wide stock assessment for this species. There is a stock assessment for sheepshead in Louisiana waters, but those authors define the unit stock as those sheepshead occurring in Louisiana waters only (West et al. 2015) and fishing mortality in Texas is excluded. In Louisiana, overfishing is not occurring. Fishing mortality for this stock is defined as overfishing when rates exceed $F_{30\%}$ ($F/F_{30\%}$ >1) and current $F/F_{30\%}$ is 0.24, well below this threshold, even including the recreational fishery, which is a significant contributor (West et al. 2015). Though fishing mortality is below a sustainable level in Louisiana, the sustainability of fishing in Texas is considered unknown. Therefore, it is assessed as a "moderate" concern.

Justification:

Figure 12 Boundaries of the three sheepshead genetic stocks; arrows indicate regions of genetic break between the western and eastern Gulf (I) and between the easter Gulf and the Atlantic (II). Figure from Munyandorero et al. 2017.

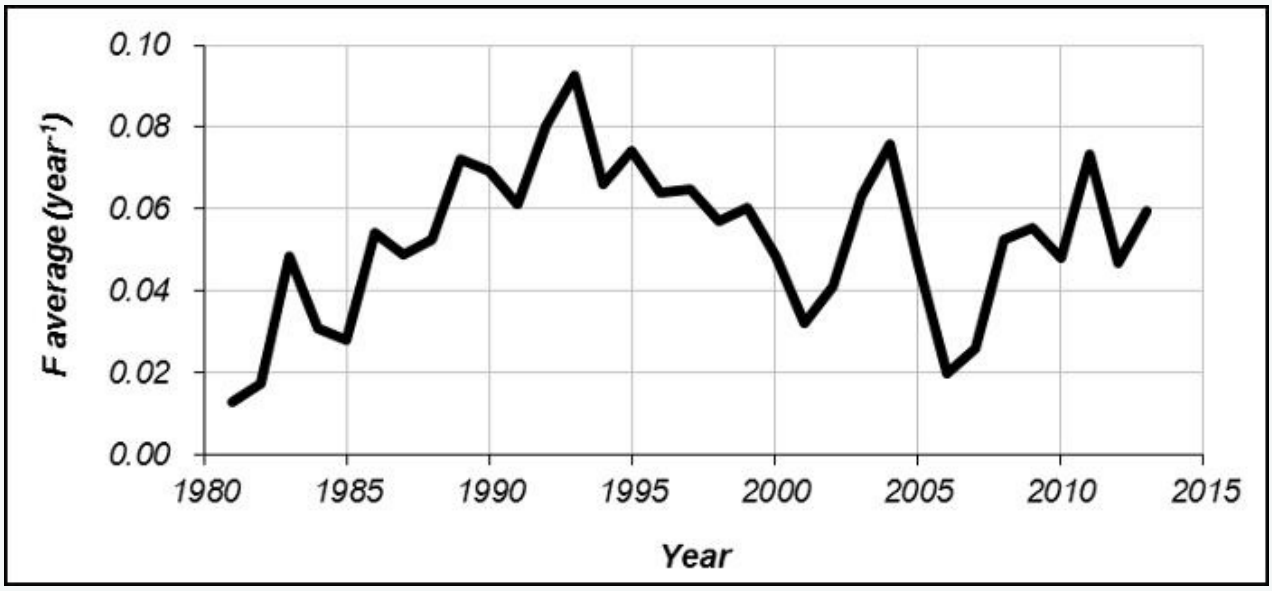

Figure 13 Model estimated average fishing mortality 1981-2013 in Louisiana. From West et al. 2015.

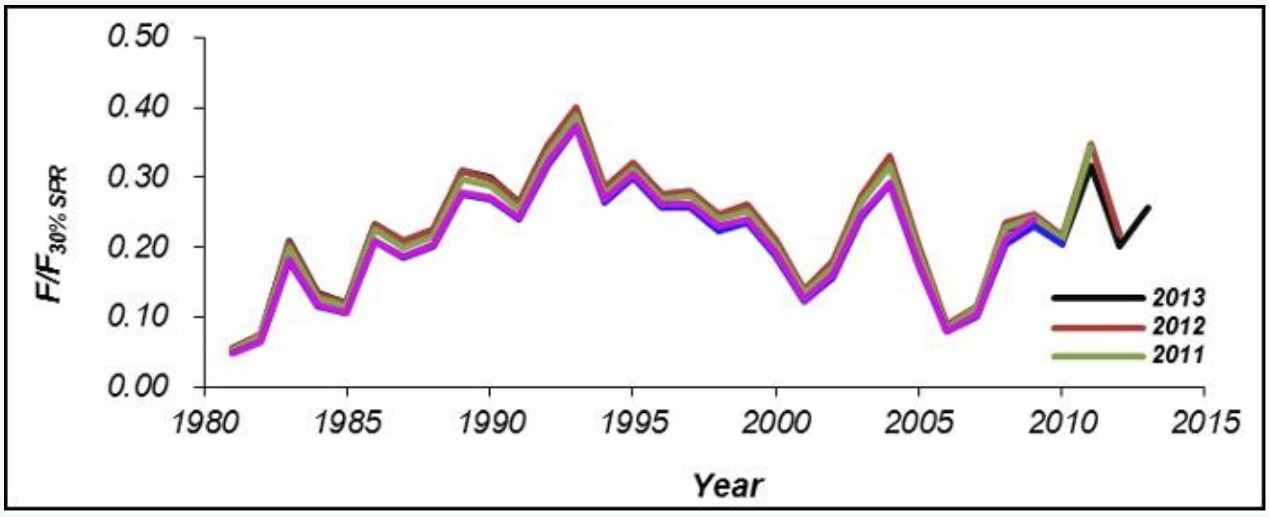

Figure 14 Retrospective analysis of ASAP base model (2009-2013). Graphic depicts estimated ratios of annual average fishing mortality to F30% in Louisiana. From West et al. 2015.

Factor 2.3 - Discard Rate

GULF OF MEXICO, HARPOONS

< 100%

Specific discard rates are not available for southern flounder off the Texas coast; however, Kelleher estimates the weighted average discard rate for gig fisheries as 0.1% with a range of 0% to 1% (Kelleher 2005).

Appendix B: Commercial Flounder Landings 1950-2016

Year	Species	Metric Tons	Pounds	$
1950	FLATFISH	104.3	229,900	56,341
1951	FLATFISH	39.4	86,900	21,925
1952	FLATFISH	94.4	208,100	45,832
1953	FLATFISH	82.1	181,100	39,745
1954	FLATFISH	62.2	137,200	31,669
1955	FLATFISH	50.4	111,200	28,548
1956	FLATFISH	57.2	126,000	29,014
1957	FLATFISH	63.8	140,700	34,955
1958	FLATFISH	52.8	116,500	24,979
1959	FLATFISH	81.6	179,900	37,251
1960	FLATFISH	78.4	172,800	45,768
1961	FLATFISH	69.6	153,500	38,787
1962	FLATFISH	95.6	210,800	51,344
1963	FLATFISH	125.2	276,100	69,007
1964	FLATFISH	138.6	305,600	77,377
1965	FLATFISH	132.7	292,500	72,783
1966	FLATFISH	172.4	380,100	94,522
1967	FLATFISH	111	244,700	62,264
1968	FLATFISH	152.5	336,200	75,438
1969	FLATFISH	133.4	294,100	63,750
1970	FLATFISH	134.8	297,200	64,844
1971	FLATFISH	144.7	319,100	75,603
1972	FLATFISH	205.8	453,800	119,735
1973	FLATFISH	155.1	341,900	105,275
1974	FLATFISH	230	507,100	149,081
1975	FLATFISH	223.4	492,600	176,032
1976	FLATFISH	198.2	437,000	181,177
1977	FLATFISH	141	310,900	171,573

1978	FLATFISH	107.6	237,150	173,202
1979	FLATFISH	105.4	232,444	190,076
1980	FLATFISH	88.2	194,448	153,239
1981	FLATFISH	58.6	129,266	136,860
1982	FLATFISH	242.9	535,487	520,915
1983	FLATFISH	214.9	473,877	444,988
1984	FLATFISH	172.4	380,000	350,758
1985	FLATFISH	201.2	443,504	444,989
1986	FLATFISH	254.2	560,309	539,973
1987	FLATFISH	249	549,050	536,195
1988	FLATFISH	124.2	273,806	337,295
1989	FLATFISH	75.6	166,688	200,543
1990	FLATFISH	65.3	143,958	180,481
1991	FLATFISH	123.9	273,088	316,101
1992	FLATFISH	135	297,646	377,647
1993	FLATFISH	96.4	212,555	328,310
1994	FLATFISH	105.2	232,004	385,123
1995	FLATFISH	135.7	299,130	517,765
1996	FLATFISH	110.1	242,833	447,235
1997	FLATFISH	85	187,378	341,866
1998	FLATFISH	98.8	217,911	422,598
1999	FLATFISH	130.5	287,768	603,057
2000	FLATFISH	72.4	159,545	321,677
2001	FLATFISH	54.7	120,682	248,776
2002	FLATFISH	78.6	173,329	371,245
2003	FLATFISH	71.9	158,512	335,891
2004	FLATFISH	68.5	151,059	324,782
2005	FLATFISH	65.3	143,984	275,764
2006	FLATFISH	30.7	67,787	164,079
2007	FLATFISH	11	24,313	62,035
2008	FLATFISH	26.3	57,910	143,502

2009	FLATFISH	14.5	31,936	90,699
2010	FLATFISH	11.8	26,042	61,651
2011	FLATFISH	33.9	74,729	205,471
2012	FLATFISH	27	59,618	175,308
2013	FLATFISH	9.3	20,426	72,545
2014	FLATFISH	11.3	24,934	97,052
2015	FLOUNDER, SOUTHERN	23.2	51,134	186,777
2016	FLOUNDER, SOUTHERN	28.6	63,125	235,742

(NOAA 2016)

Appendix C: Texas Regulations Impacting Southern Flounder

1981: Commercial sales of spotted sea trout and red drum are banned. This leads to an increase in commercial fishing pressure on southern flounder.

1988: A ban on nets and seines to catch fish and a minimum size of 12 inches is established state-wide. For recreational fishers, a bag limit of 20 fish is established with a possession limit of 40 fish. There is no bag limit for commercial fishers except for shrimp trawls, which have to follow the recreational bag limits. This decreases fishing pressure and the size limit allows the southern flounder to grow almost to sexual maturity (data on lengths at sexual maturity are varied) in order to reproduce.

1990: Shrimp trawls may only have aquatic products/bycatch that weigh up to 50% of the weight of the shrimp caught. This limits the amount of bycatch, including southern flounder, that shrimp trawls may keep.

1992: Turtle Exclusion Devices (TED) are required in all shrimp trawls in EEZ waters. This leads to less flounder bycatch since they are able to escape the trawls through the TEDs.

1995: A limited entry plan is implemented for shrimpers. This may have redistributed commercial fishing pressure.

1996: The minimum size of southern flounder is increased to 14 inches; recreational bag is decreased to 10 fish with a 20 fish possession limit; commercial bag is set at 60 fish, and shrimp trawls are confined to the recreational limits. This limits fishing pressure on the southern flounder and more likely (than the 12 inch minimum) allows them to reach sexual maturity in order to reproduce.

1998: Bycatch reduction devices (BRD) required in all trawls. This leads to a decrease in southern flounder as bycatch in trawls.

1999: A license limitation plan is implemented in the commercial finfish fishery. This leads to a decrease in fishing pressure.

2002: A shrimp vessel buy-back program is instituted along with a limited entry program for commercial shrimping licenses. This leads to a decrease in southern flounder as bycatch.

2006: The recreational possession limit is decreased from 20 fish to the bag limit of 10 fish. This may lead to a reduction in fishing mortality.

2010: The bag and possession limit for commercial fishers is decreased from 60 fish to 30 fish. The recreational bag and possession limit is decreased from 10 to 5 fish. From 1–30 November the recreational, commercial, and shrimper's bag and possession limit is 2 fish that may only be taken by pole-and-line. On a commercial shrimp boat, the limit is 5 fish per person with a current shrimp boat captain's license and is subject to the 50% bycatch rule (passed in 1990). This further decreases the fishing pressure on southern flounder, especially during November when they start migrating to spawning areas.

2014: From 1–14 December, the daily bag and possession limit for recreational, commercial, and shrimpers is decreased to 2 fish that may be taken by any legal means. This further decreases the fishing pressure on southern flounder while they are migrating to spawning areas (Reichers 2008) (TPWD 2014) (GSMFC 2015) (Stahl 2016) (TPWD 2017b).