Tab D, No. 4
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Modifying the Shrimp Effort Threshold

Shrimp Amendment 18

to the Fishery Management Plan for the Shrimp Fishery of the Gulf of Mexico, U.S. Waters

Including Categorical Exclusion, Fishery Impact Statement, Regulatory Impact Review, and Regulatory Flexibility Act Analysis

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CATERGORICAL EXCLUSION COVER SHEET

Name of Action

Modifying the Shrimp Effort Threshold: Amendment 18 to the Shrimp Fishery Management Plan Including Fishery Impact Statement, Regulatory Impact Review, and Regulatory Flexibility Act Analysis

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( ) Administrative
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Summary/Abstract

ABBREVIATIONS USED IN THIS DOCUMENT

ABC	acceptable biological catch
BiOp	biological opinion
BP	British Petroleum
BRD	bycatch reduction device
CPUE	catch per unit effort
Council	Gulf of Mexico Fishery Management Council
DPS	distinct population segment
DWH	Deepwater Horizon MC 252
E.O.	Executive Order
EA	Environmental Assessment
EEZ	exclusive economic zone
EFH	essential fish habitat
EJ	environmental justice
EIS	Environmental Impact Statement
ESA	Endangered Species Act
FIS	Fishery Impact Statement
FMP	Fishery Management Plan
GRRS	Gulf royal red shrimp endorsement
GSS	Gulf shrimp system
Gulf	Gulf of Mexico
HAPC	habitat area of particular concern
Magnuson-Stevens Act	Magnuson-Stevens Fishery Conservation and Management Act
MMPA	Marine Mammal Protection Act
MSY	maximum sustainable yield
NMFS	National Marine Fisheries Service
OY	optimum yield
PS	producer surplus
RQ	regional quotient
SEDAR	Southeast Data, Assessment and Review
SEFSC	Southeast Fisheries Science Center
SERO	Southeast Regional Office
SPGM	federal Gulf commercial shrimp permit
SSC	Science and Statistical Committee
TED	turtle excluder device
VOOP	vessel of opportunity program

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FISHERY IMPACT STATEMENT

The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) requires that a fishery impact statement (FIS) be prepared for all amendments to fishery management plans. The FIS contains: 1) an assessment of the likely biological/conservation, economic, and social effects of the conservation and management measures on fishery participants and their communities; 2) an assessment of any effects on participants in the fisheries conducted in adjacent areas under the authority of another Fishery Management Council; and 3) the safety of human life at sea. Detailed discussion of the expected effects for all alternatives considered is provided in Chapter 4. The FIS provides a summary of these effects and will be completed for the final draft of the document.

CHAPTER 1. INTRODUCTION

1.1 Background

The Gulf of Mexico Fishery Management Council (Council) and the National Marine Fisheries Service (NMFS) began managing the shrimp fishery in the Gulf of Mexico (Gulf) in 1981. Four species are included in the fishery management plan (FMP): brown shrimp, *Penaeus aztecus*; pink shrimp, *Penaeus duorarum*; white shrimp, *Penaeus setiferus*; and royal red shrimp, *Pleoticus robustus*.

Reef Fish Amendment 22 (GMFMC 2004) established a new rebuilding plan for red snapper that is set to end in 2032. The Southeast Data, Assessment and Review (SEDAR) 7 stock assessment for Gulf red snapper indicated the species was overfished and undergoing overfishing (SEDAR 2005). Bycatch of red snapper by the Gulf shrimp fishery was identified as a primary factor affecting the recovery of Gulf red snapper, with the highest red snapper fishing mortality rate attributed to the western Gulf shrimp fishery, followed by the eastern Gulf recreational red snapper fishery and the western Gulf commercial red snapper fishery (SEDAR 2005). It was determined that bycatch levels in both the directed red snapper and shrimp fisheries were likely to jeopardize the success of the red snapper rebuilding plan implemented in 2005 (GMFMC 2007). The assessment indicated a need for a 74% reduction in the red snapper bycatch mortality attributed to shrimp trawls, compared to levels of effort and mortality experienced during the 2001-2003 period (GMFMC 2007). In order to end overfishing of red snapper and rebuild the red snapper stock, the Council took action to reduce shrimp fishing effort in statistical zones 10-21 in 10-30 fathom water depths of the western Gulf (i.e, the area monitored for juvenile red snapper bycatch) through Amendment 14 to the FMP for the Shrimp Fishery of the Gulf of Mexico, U.S. Waters (Amendment 14; GMFMC 2007) [1]. Amendment 14 established a shrimp fishing effort threshold of 74% below a baseline average of the years 2001-2003. The threshold level was reduced to 67% in 2011 as outlined in Amendment 14. Further, Amendment 14 identified that the target reduction goal should decrease (i.e. shrimp effort could increase) to 60% by 2032 (terminal year of red snapper rebuilding plan) via framework action, but the framework procedure to implement this reduction was never established.

To date, the Gulf shrimp fishery has not exceeded the allowable threshold effort level in the area monitored for juvenile red snapper since the implementation of the threshold, though it did come within two percentage points in 2014, 2016, and 2017 (Table 1.1.1). The fishery has been contracting since the establishment of the federal commercial Gulf shrimp moratorium permit in 2006, which was extended until 2026 by Amendment 17A to the FMP (GMFMC 2016). Additionally, the shrimp fishery continues to experience economic losses, primarily due to high fuel costs and reduced prices caused by competition with imports. These economic losses resulted in the exodus of vessels from the fishery, and consequently, a reduction in effort.

[1] Also Reef Fish Amendment 27

Table 1.1.1. Percent effort reductions in the shrimp fishery in the area monitored for juvenile red snapper (statistical zones 10-21 in 10-30 fathom water depths) and the threshold levels established by Amendment 14. The threshold level is the minimum reduction that the shrimp fishery should achieve (i.e. the % effort reduction must be higher).

Year	Threshold level	% Effort reduction of industry from 2001-2003 baseline
2008	74	83.6
2009	74	77.9
2010	74	80.7
2011	74*	67.8
2012	67	81.7
2013	67	73.1
2014	67	67.4
2015	67	71.7
2016	67	68.6
2017	67	67.1

Source: Southeast Fishery Science Center (SEFSC), 2018

*This is the year that Amendment 14 scheduled the threshold to reduce to 67%, and rulemaking was implemented in 2011.

In 2018, the red snapper fishery was determined to be no longer overfished nor undergoing overfishing, although the stock is still rebuilding consistent with the plan (SEDAR 2018). Also, recent research indicates that the effect of the shrimp fishery on red snapper mortality is less than previously thought (Gallaway et al., 2017). At its April 2018 meeting, the Council requested that the NMFS Southeast Fishery Science Center (SEFSC) conduct an analysis to determine if effort in the shrimp fishery could increase in the area monitored for juvenile red snapper bycatch without affecting red snapper rebuilding. The SEFSC conducted the analyses using several different scenarios of increasing shrimp effort Gulf-wide (i.e. not just the area monitored for juvenile red snapper bycatch) (Goethel and Smith 2018; Appendix A). Several of the scenarios indicate that increasing shrimp effort to a level outlined in Amendment 14 (60% below the baseline years of 2001–2003 in statistical zones 10-21 from 10-30 fathoms) is unlikely to affect the rebuilding timeline of red snapper, and it will have negligible effects on yearly red snapper annual catch limit projections. The first action in this amendment evaluates decreasing the target bycatch reduction threshold goal, which could allow shrimp fishing effort to increase in statistical zones 10-21 in 10-30 fathoms, the area monitored for juvenile red snapper bycatch.

Gulf of Mexico Fishery Management Council

- Consist of 17 voting members: 11 appointed by the Secretary of Commerce; 1 representative from each of the 5 Gulf states, the Southeast Regional Director of NOAA Fisheries Service; and 4 non-voting members
- Develops fishery management plans and amendments; and recommends actions to NOAA Fisheries Service for implementation

NOAA Fisheries Service

- Approves, disapproves, or partially approves Council recommendations
- Implements regulations

1.2 Purpose and Need

The purpose of this action is to reduce the red snapper bycatch reduction target in the federal Gulf shrimp fishery in response to the latest Gulf red snapper stock assessment.

The need for this action is to promote economic stability in the federal Gulf shrimp fishery by reducing effort constraints and to equitably distribute the benefits from rebuilding, while continuing to protect, the Gulf red snapper stock.

1.3 History of Management

The FMP for the Shrimp Fishery of the Gulf, U.S. Waters, supported by an environmental impact statement (EIS), was implemented on May 15, 1981. The FMP defined the shrimp fishery management unit to include brown shrimp, white shrimp, pink shrimp, royal red shrimp, seabobs (*Xiphopenaeus kroyeri*), and brown rock shrimp (*Sicyonia brevirostris*). Seabobs and rock shrimp were subsequently removed from the FMP. The actions implemented through the FMP and its subsequent amendments have addressed the following objectives:

1. Optimize the yield from shrimp recruited to the fishery.
2. Encourage habitat protection measures to prevent undue loss of shrimp habitat.
3. Coordinate the development of shrimp management measures with the shrimp management programs of the several states, when feasible.
4. Promote consistency with the Endangered Species Act (ESA) and the Marine Mammal Protection Act (MMPA).
5. Minimize the incidental capture of finfish by shrimpers, when appropriate.
6. Minimize conflict between shrimp and stone crab fishermen.
7. Minimize adverse effects of obstructions to shrimp trawling.
8. Provide for a statistical reporting system.

A comprehensive list of management actions and amendments to the FMP is outlined in Amendment 17B to the FMP[2]. Below are a subset of those actions specifically pertaining to the management action in this document.

Amendment 9/supplemental EIS (1997) required the use of a NMFS-certified bycatch reduction device (BRD) in shrimp trawls used in the exclusive economic zone (EEZ) from Cape San Blas, Florida to the Texas/Mexico border, and provided for the certification of BRDs and specifications for the placement and construction. The purpose of this action was to reduce the bycatch mortality of juvenile red snapper by 44% from the average mortality for the years 1984 through 1989 (the required bycatch reduction was reduced to 30% in 2008 through a framework action). This amendment exempted from the BRD requirement shrimp trawls fishing for royal red shrimp seaward of the 100-fathom contour, as well as groundfish and butterfish trawls. It also excluded small try nets and allowed no more than two ridged frame roller trawls of limited size. Amendment 9 also provided mechanisms to change the bycatch reduction criterion and to certify additional BRDs.

Amendment 10/environmental assessment (EA) (2002) required BRDs in shrimp trawls used in the Gulf east of Cape San Blas, Florida. Certified BRDs for this area are required to demonstrate a 30% reduction by weight of finfish.

Amendment 11/EA (2001) required owners and operators of all vessels harvesting shrimp from the EEZ of the Gulf to obtain a federal commercial vessel permit. This amendment also prohibited the use of traps to harvest royal red shrimp from the Gulf and prohibited the transfer of royal red shrimp at sea.

[2] http://gulfcouncil.org/wp-content/uploads/Final-Shrimp-Amendment-17B.pdf

Amendment 13/EA (2005) established an endorsement to the federal shrimp vessel permit for vessels harvesting royal red shrimp; defined the overfishing and overfished thresholds for royal red shrimp; defined maximum sustainable yield (MSY) and optimum yield (OY) for the penaeid shrimp stocks in the Gulf; established bycatch reporting methodologies and improved collection of shrimping effort data in the EEZ; required completion of a Gulf Shrimp Vessel and Gear Characterization Form by vessels with federal shrimp permits; established a moratorium on the issuance of federal commercial shrimp vessel permits; and required reporting and certification of landings during the moratorium.

August 2006 Regulatory Amendment (2006) changed the BRD certification criterion for red snapper from penaeid shrimp trawling in the EEZ. The BRD certification criterion addressed shrimp trawl bycatch more comprehensively and increased flexibility, promoted innovation, and allowed for a wider variety of BRDs which allowed fishermen to choose the most effective BRD for fishing conditions and therefore reduce overall finfish bycatch.

Amendment 14/EIS (2007) was a joint amendment with Amendment 27 to the Fishery Management Plan for the Reef Fish Resources of the Gulf of Mexico. It established a target red snapper bycatch mortality goal for the shrimp fishery in the western Gulf and defined seasonal closure restrictions that can be used to manage shrimp fishing efforts in relation to the target red snapper bycatch mortality reduction goal. It also established a framework procedure to streamline the management of shrimp fishing effort in the western Gulf.

Shrimp Electronic Logbook (ELB) Framework Action (2013) established a cost-sharing system for the ELB program, and described new equipment and procedures for the program.

Amendment 17A/EA (2016) extended the Gulf shrimp permit moratorium for another 10 years until October 26, 2026.

Amendment 17B/EA (2017) defined the aggregate MSY of 112,531,374 pounds of tails for all shrimp species and an aggregate OY of 85,761,596 pounds of tails for all shrimp species. This amendment allows for the creation of a reserve permit pool when certain conditions are met, and mandates that the Council convene a review panel to review the details of a permit pool if the number of permits reaches 1,175. This amendment also allows vessels possessing shrimp to transit through federal waters without a federal permit if their trawl doors and nets are out of the water and bag straps are removed.

1.4 Description of the Physical, Biological, and Ecological Environment

The EIS for the original Shrimp FMP and the FMP as revised in 1981 contains a description of the physical environment. The physical environment for penaeid shrimp is also detailed in the Generic Essential Fish Habitat (EFH) Amendment (GMFMC 2005b). This material is incorporated by reference and is not repeated here in detail.

The Gulf is a semi-enclosed oceanic basin of approximately 600,000 square miles (Gore 1992). It is connected to the Atlantic Ocean by the Straits of Florida and to the Caribbean Sea by the Yucatan Channel. Oceanic conditions are primarily influenced by the Loop Current, the discharge of freshwater into the northern Gulf, and a semi-permanent, anticyclonic gyre in the western Gulf. In the Gulf, adult penaeid shrimp are found nearshore and offshore on silt, mud, and sand bottoms; juveniles are found in estuaries. Primary fishing grounds for royal red shrimp are: the Desoto Canyon about 75 miles off Mobile, Alabama; offshore of Tampa Bay, Florida; and the Dry Tortugas northwest of the Florida Keys.

Several area closures, including gear restrictions, may affect targeted and incidental harvest of penaeid shrimp species in the Gulf. These are described in detail in Amendment 13 (GMFMC 2005a) and incorporated by reference. Areas such as the Flower Garden Banks and Tortugas North and South Reserves have either incorrect area measurements associated with them in the document (Flower Garden Banks) in Amendment 13 or incorporate state water closures in the total area (Tortugas North and South Reserves). The areas include:

- Cooperative Texas Shrimp Closure
- Tortugas Shrimp Sanctuary
- Southwest Florida Seasonal Closure
- Central Florida Seasonal Closure
- Longline/Buoy Gear Area Closure
- Madison-Swanson and Steamboat Lumps Marine Reserves
- The Edges Marine Reserve
- Tortugas North and South Marine Reserves
- Alabama Special Management Zone

Reef and bank areas designated as habitat areas of particular concern (HAPCs) in the northwestern Gulf include: East and West Flower Garden Banks, Stetson Bank, Sonnier Bank, MacNeil Bank, 29 Fathom, Rankin Bright Bank, Geyer Bank, McGrail Bank, Bouma Bank, Rezak Sidner Bank, Alderice Bank, and Jakkula Bank, Florida Middle Grounds HAPC and Pulley Ridge HAPC. Twenty one areas have been proposed as new or modified HAPCs in Amendment 9 to the Coral and Coral Reefs FMP, but have not yet been implemented.

Generic Amendment 3 addressed EFH requirements (GMFMC 2005b) and established that a weak link in the tickler chain is required on bottom trawls for all habitats throughout the Gulf EEZ. A weak link is defined as a length or section of the tickler chain that has a breaking strength less than the chain itself and is easily seen as such when visually inspected. The

amendment established an education program on the protection of coral reefs when using various fishing gears in coral reef areas for recreational and commercial fishermen.

The EIS for the original Shrimp FMP and the FMP as revised in 1981 contains a description of the biology of the shrimp species. In its appendix, the EIS of February 1981 includes the habitats, distribution, and incidental capture of sea turtles. Amendment 9 (GMFMC 1997) updated this information, which has essentially remained unchanged, except with respect to protected species as discussed below. This material is incorporated by reference and is not repeated here in detail.

1.4.1 Target Species

Brown, white, and pink shrimp use a variety of habitats as they grow from planktonic larvae to spawning adults (GMFMC 1981). Brown shrimp eggs are demersal and occur offshore. Post-larvae migrate to estuaries through passes on flood tides at night mainly from February until April; there is another minor peak in the fall. Post-larvae and juveniles are common in all U.S. estuaries from Apalachicola Bay, Florida to the Mexican border. Brown shrimp post-larvae and juveniles are associated with shallow, vegetated, estuarine habitats, but may occur on silt, sand, and non-vegetated mud bottoms. Adult brown shrimp occur in marine waters extending from mean low tide to the edge of the continental shelf and are associated with silt, muddy sand, and sandy substrates. More detailed discussion on habitat associations of brown shrimp is provided in Nelson (1992) and Pattillo et al. (1997).

White shrimp eggs are demersal and larval stages are planktonic in nearshore marine waters. Post-larvae migrate through passes mainly from May until November with peaks in June and September. Juveniles are common in all Gulf estuaries from Texas to the Suwannee River in Florida. Post-larvae and juveniles commonly occur on bottoms with large quantities of decaying organic matter or vegetative cover such as mud or peat. Juvenile migration from estuaries occurs in late August and September and is related to juvenile size and environmental conditions (e.g., sharp temperature drops in fall and winter). Adult white shrimp are demersal and inhabit nearshore Gulf waters to depths of 16 fathoms (96 feet) on soft bottoms. More detailed information on habitat associations of white shrimp is available from Nelson (1992) and Pattillo et al. (1997).

Pink shrimp eggs are demersal, early larvae are planktonic, and post-larvae are demersal in marine waters. Juveniles inhabit almost every U.S. estuary in the Gulf but are most abundant in Florida. Juveniles are commonly found in estuarine areas with seagrass where they burrow into the substrate by day and emerge at night. Adults inhabit offshore marine waters, with the highest concentrations in depths of 5 to 25 fathoms (30 to 150 feet).

The life history of royal red shrimp is poorly known. Royal red shrimp occur exclusively in the EEZ, live longer than penaeid shrimp, and many year classes may be present on fishing grounds at one time. Royal red shrimp become mature at three years, do not fully recruit to the fishery until they are 2-3 years old, and many year classes may occur in the same location (Reed and Farrington 2010). Royal red shrimp decrease in size with depth; juveniles likely occur in deeper

habitats (Paramo and Saint-Paul 2011), and females are larger than males (Tavares 2002; Paramo and Saint-Paul 2011).

1.4.2 Bycatch

Between 2007 and 2010, 185 species were observed as bycatch in the shrimp fishery (Scott-Denton et al. 2012). By weight, approximately 57% of the catch was finfish, 29% was commercial shrimp, and 12% was invertebrates. The species composition is spatially and bathymetrically dependent, but overall, for the Gulf, Atlantic croaker, sea trout, and longspine porgy are the dominant finfish species taken in trawls (approximately 26% of the total catch by weight). Other commonly occurring species include: portunid crabs, mantis shrimp, spot, inshore lizardfish, sea robins, and Gulf butterfish. Although red snapper comprise a very small percentage (0.3% by weight) of overall bycatch, the mortality associated with this bycatch affects the recruitment of older fish (age 2 and above) to the directed fishery and ultimately the recovery of the red snapper stock.

To address finfish bycatch issues, especially bycatch of red snapper, the Council initially established regulations requiring BRDs specifically to reduce the bycatch of juvenile red snapper. In 1998, all shrimp trawlers operating in the EEZ, inshore of the 100-fathom contour, west of Cape San Blas, Florida were required to use BRDs; later BRDs were required in the eastern Gulf (GMFMC 2002). Only three Gulf states (Florida, Louisiana, and Texas) require the use of BRDs in state waters. Shrimp trawls fishing for royal red shrimp seaward of the 100-fathom (600 feet) contour are exempt from the requirement for BRDs. The shrimp fishery is also a source of bycatch mortality on sea turtles. Bycatch is currently considered to be reduced to the extent practicable in the Gulf shrimp fishery.

1.4.3 Protected Species

Species in the Gulf protected under the ESA include: marine mammal species (sei, fin, humpback, sperm whales, and manatees); sea turtles (Kemp's ridley, loggerhead (North Atlantic distinct population segment (DPS)), green (North Atlantic and South Atlantic DPSs), leatherback, and hawksbill); fish species (Gulf sturgeon, smalltooth sawfish, and Nassau grouper); and coral species (elkhorn coral, lobed star coral, boulder star coral, and mountainous star coral). Seven species of fish and invertebrates in the Gulf are currently listed as species of concern.

Otter trawls may directly affect smalltooth sawfish that are foraging within or moving through an active trawling location via direct contact with the gear. The long toothed rostrum of the smalltooth sawfish causes this species to be particularly vulnerable to entanglement in any type of netting gear, including the netting used in shrimp trawls.

Green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles are all highly migratory and are known to occur in areas subject to shrimp trawling. Bycatch of the species by commercial fisheries is a major contributor to past declines and a potential threat to future recovery (NMFS and USFWS 1991, 1992a, 1992b, 2008; NMFS 2011). Historically, southeastern U.S. shrimp fisheries (both Gulf and South Atlantic) have been the largest threat to

benthic sea turtles. Regulations requiring turtle excluder devices (TEDs) have reduced mortalities from trawl fisheries on sea turtles. During a four year study period, 55 sea turtles were captured in shrimp trawls; 80% were released alive and conscious (Scott-Denton et al. 2012).

The impacts of the Gulf shrimp fishery on ESA-listed species were evaluated in the most recent biological opinion (bi op) on the continued implementation of the sea turtle conservation regulations under the ESA and the continued authorization of the southeast U.S. shrimp fisheries in federal waters (NMFS 2014). The bi op, which was based on the best available commercial and scientific data, concluded the continued authorization of the southeast U.S. shrimp fisheries in federal waters (including the Gulf shrimp fishery) is not likely to jeopardize the continued existence of threatened or endangered species (NMFS 2014). The bi op implemented measures to minimize the impacts of incidental take to sea turtle or smalltooth sawfish. After the completion of the bi op, NMFS designated new critical habitat for the Northwestern Atlantic distinct population segment of loggerhead sea turtles defined by five specific habitat types. Two of those habitat types (nearshore reproductive and *Sargassum)* occur within the Council's jurisdiction. NMFS determined that all federal Gulf fisheries operate outside the nearshore reproductive habitat and will not affect it. Gulf fisheries (including the shrimp fishery) could overlap with the *Sargassum* habitat. However, NMFS determined any effects from those fisheries would be insignificant and, therefore, were not likely to adversely affect the *Sargassum* habitat unit. NMFS has also listed new species since the completion of the opinion (the North Atlantic and South Atlantic green sea turtle DPSs and Nassau grouper) and has proposed listing another species (the Bryde's whale). On July, 1, 2016, NMFS requested re-initiation of consultation.

The shrimp fishery is classified in the 2015 List of Fisheries as a Category II fishery (79 FR 77919; January 28, 2015). This classification indicates the annual mortality and serious injury of a marine mammal stock is greater than 1% but less than 50 % of the stocks potential biological removal, not including natural mortalities, which may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population. This fishery was elevated to Category II from Category III (mortality or serious injury to less than 1% of the potential biological removal) in 2011 based on increased interactions reported by observers, strandings, and fisheries research data.[3]

1.4.4 Status of the Shrimp Stocks

The three species of penaeid shrimp harvested by the shrimp fishery are short-lived and provide annual crops; royal red shrimp live longer (2-5 years) and multiple year classes can be found on the same fishing grounds. The condition of each shrimp stock is monitored annually, and none has been classified as overfished or undergoing overfishing (Hart 2016a, 2016b, 2016c).

[3] http://www.nmfs.noaa.gov/pr/pdfs/fisheries/lof2012/southeastern_us_atlantic_gulf_shrimp_trawl.pdf

1.5 Description of the Economic Environment

Descriptions of the Gulf shrimp fisheries are contained in previous amendments, and are incorporated herein by reference (see Shrimp Amendment 13 (GMFMC 2005a); Shrimp Amendment 14/Reef Fish Amendment 27 (GMFMC 2007); Framework Action to Establish Funding Responsibilities for the Electronic Logbook Program in the Shrimp Fishery of the Gulf of Mexico (GMFMC 2013); Shrimp Amendment 16 (GMFMC 2014); Shrimp Amendment 15 (GMFMC 2015); Shrimp Amendment 17A (GMFMC 2016); and Shrimp Amendment 17B (GMFMC 2017). The following discusses certain key characteristics of the Gulf shrimp fisheries.

The Gulf shrimp fisheries consist of three major sectors: harvesting sector, dealer/wholesaler sector, and processing sector. The following discussion provides summary statistics and selected characteristics for these sectors. Imports are also presented.

The harvesting sector is composed of two fleets: 1) a small vessel fleet that is predominantly active in inshore and state offshore waters and very diverse with respect to gear and other operating characteristics; and 2) a large vessel fleet predominantly active in offshore waters, particularly the EEZ, and almost always using otter trawl gear. In 2003, a federal shrimp permit was instituted requiring vessels to possess the permit when fishing for penaeid shrimp in the Gulf EEZ. A moratorium on the issuance of new federal shrimp permits became effective in March 2007. Currently, vessels must possess a federal Gulf commercial shrimp permit (SPGM) when fishing for penaeid shrimp in the Gulf EEZ. In addition, a royal red shrimp endorsement (GRRS), which is an open-access permit for those holding a SPGM, is required for harvesting royal red shrimp in the Gulf EEZ.

1.5.1 Selected Characteristics of Participating Vessels in the Shrimp Fishery

Selected characteristics of participation in the Gulf shrimp fisheries from 2007 through 2014 are summarized in Table 1.5.1.1. Estimates of the total number of active shrimp vessels are based on the number of unique vessels landing shrimp as recorded in the Gulf Shrimp System (GSS) database. The number of active vessels is likely an overestimate because of vessel identification errors in the GSS database, specifically with respect to state registered boats that mostly operate in inshore waters. The number of active permitted vessels was generated by cross referencing GSS landings data with the Southeast Regional Office's (SERO) permit database. The number of active permitted vessels is likely an underestimate of the "actual" number of active permitted vessels based on other research (Travis 2010). However, this method for estimating active participation in the Gulf shrimp fisheries allows standardized estimates to be generated over a longer time frame compared to other methods.

The number of permitted and non-permitted active vessels (i.e., vessels reporting landings in the Gulf shrimp fisheries) has been above 4,000 and generally around 5,000 in the last 4 years (Table 1.5.1.1). There were an estimated 8,401 vessels active in the Gulf food shrimp fisheries in one or more years between 2011 and 2014. Although approximately one-third of the active vessels were federally permitted (vessels with SPGM) at the beginning of the moratorium, less than 25% of active vessels had federal permits in each of the last 4 years (i.e., vessels without a permit are

representing an increasing percentage of active vessels in the fisheries over time). Despite being fewer in number, federally-permitted vessels generally accounted for about 67% of shrimp landings and 76% of shrimp revenues in the fisheries between 2007 and 2011. However, the permitted vessels' shares of the fisheries' landings and revenues have declined noticeably in the last 3 years, to only 56% and 68%, respectively. Thus, vessels without permits have been accounting for an increasing percentage of the fisheries' production and revenues in recent years.

Table 1.5.1.1. Selected characteristics of participation in the Gulf food shrimp fishery, 2007-2014.

	2007	2008	2009	2010	2011	2012	2013	2014
Number of active vessels[1]	4,717	4,152	4,640	4,510	5,285	5,191	4,669	4,916
Percent of active vessels with a federal permit	33	30	27	25	22	22	24	23
Number of active vessels with a federal permit	1,553	1,237	1,232	1,132	1,187	1,148	1,110	1,116
Percent of active vessels without a federal permit	67	70	73	75	78	78	76	77
Number of active vessels without a federal permit	3,164	2,915	3,408	3,378	4,098	4,043	3,559	3,800
Number of federally permitted vessels	2,514	1,930	1,764	1,685	1,641	1,587	1,544	1,515
Percent active	62	64	70	67	72	72	72	74
Percent inactive	38	36	30	33	28	28	28	26
Food shrimp landings (million lbs, heads-off)	140	120	155	111	137	134	128	131
Gross revenues (2017 dollars, millions)	414	405	334	369	459	405	525	580
Percent of food shrimp landings by federally-permitted vessels	68	66	69	63	67	63	60	56
Percent of food shrimp gross revenues by federally-permitted vessels	78	77	76	74	78	72	72	68

[1] Active means a vessel had at least 1 lb of Gulf of Mexico shrimp landings in a year based on GSS data (R. Hart, NMFS, pers. comm., April 25, 2016). These are likely overestimates of the actual number of active vessels because of vessel identification errors in the GSS data.

The royal red shrimp sector is a relatively small segment of the Gulf shrimp fisheries. As of November 30, 2018, there were 1,419 valid or renewable SPGM permits and 308 GRRS endorsements. On average (2007-2014), royal red shrimp accounted for less than 1% of total Gulf shrimp landings and ex-vessel revenues. The deep-water nature of the fishery, the limited geographic location of known fishing grounds, and the equipment needed to fish for royal red shrimp may have contributed to the relatively low share of the royal red shrimp landings and revenues to the overall shrimp landings and revenues in the Gulf. More detailed discussions of vessels participating in the royal red shrimp fishery are provided in Shrimp Amendment 16 (GMFMC 2014) and Shrimp Amendment 17A (GMFMC 2016).

1.5.2 Key Economic and Financial Characteristics of Federally-Permitted Gulf of Mexico Shrimp Vessels

The following descriptions are based on a series of annual reports on the economics of the federal Gulf shrimp fishery for the years 2006 through 2014 (Liese 2011, 2013a, 2013b, 2014, 2016, 2018; Liese and Travis 2010; Liese et al. 2009a, 2009b). These reports present the results of the Annual Economic Survey of Federal Gulf Shrimp Permit Holders. The first survey, which was administered in 2007, collected data for the 2006 fishing year.

The type of economic data the survey collects is based on an accounting framework of money flows and values associated with the productive activity of commercial shrimping. With these data, three financial statements (the balance sheet, the cash flow statement, and the income statement) are prepared to give a comprehensive overview of the financial and economic situation of the offshore shrimp fishery.[4] Table 1.5.2.1 shows a summary of these financial statements. In this table, financial statements for 2010 and onward include costs and revenues related to the Deepwater Horizon oil spill (DWH). Dollar values are averages in 2017 dollars. The year 2010 was unique for the operations of many shrimp vessels in the Gulf because of the DWH oil spill. This oil spill and British Petroleum's (BP) responses had a confounding effect on the economics of the Gulf of Mexico shrimp fisheries in 2010 and onward.

In 2010, the majority of vessels (66%) reported receiving oil spill-related revenues. The two primary sources of this revenue were damage claims (passive income) and revenue generated by participation in BP's vessel of opportunity program (VOOP) where vessels were hired to clean up oil. Of the surveyed vessels in 2010, 28% participated in the VOOP. Both sources provided substantial revenue for participating vessels, thereby obscuring the economics of the Gulf shrimp fishery. Further, vessels participating in the VOOP incurred non-negligible costs unrelated to commercial fishing. For more details on DWH-related revenues, see Liese (2011, 2013a, 2013b, and 2014). Some shrimp vessels continued to receive DWH-related revenues after 2010, but the amounts in these later years were small relative to that received in 2010.

Except for a dip in asset value in 2008, the average vessel shows a fair amount of equity that rose through the years (Table 1.5.2.2). This resulted from a combination of an increasing market value of the assets (vessel and permits being the main assets) and declining liabilities (mainly loans). Because of vastly improved economic conditions in the Gulf shrimp and other fisheries these vessels participate in, asset value increased by 23% and, in turn, equity increased even more (34%) in 2014 relative to 2013.

Except for 2007, the average vessel shows positive net cash flows. The absolute amounts of net cash flow were relatively low in 2008 and 2009, but it does indicate a certain level of solvency for continued operation in the federal shrimp fishery, at least in the short term. Since the moratorium was put in place, and cognizant of the importance of the DWH-related revenues in 2010, the years after the DWH oil spill recorded much higher net cash flows. Revenues from shrimp were the major source of cash inflows while fuel and labor (crew and hired captain) costs were the top sources of cash outflows.

[4] For more detailed descriptions of these three financial statements, see Liese et al. 2009a.

The income statement generally reflects the relatively fragile financial condition of an average permitted shrimp vessel between 2007 and 2013. Before the occurrence of DWH-related activities, net revenues from fishing operations were generally negative, except for 2009. As is true of most averages, many shrimp vessels deviated from the average and were profitable. A very different financial scenario characterized the average shrimp vessel between 2010 and 2013 when including DWH-related activities. These activities materially affected the cash flow and income statement of the average vessel. Net cash flows were significantly positive for these years relative to those of the previous years. In addition, the bottom line profits (net revenue before tax) were also relatively high for these years. In 2014, even in the absence of cash flows from DWH-related activities, economic conditions in the Gulf shrimp fisheries improved significantly as reflected by the significant increase in net revenues from fishing operations.

Table 1.5.2.1. provides a summary of the financial statements for active vessels. Active vessels are defined as vessels with at least one pound of Gulf shrimp landings in a year based on GSS data (R. Hart, NMFS, pers. comm., April 25, 2016). Similar to averages for all federally-permitted vessels, average equity for active vessels has been increasing, particularly in 2014 when it increased by 19%. However, averages focusing on active vessels highlight the fragile economic state of shrimp harvesters between 2007 and 2013, as illustrated by average net revenue from operations and economic returns for active vessels (Table 1.5.2.1).

However, economic conditions for vessels active in the fishery improved dramatically in 2014. Ex-vessel shrimp prices increased significantly, most likely due to a decrease in shrimp imports caused by diseases (early mortality syndrome) that affected cultured shrimp in some major exporting countries (e.g., Thailand). In addition, fuel prices, a major cost item for shrimp vessel operation, decreased in 2014. In fact, the difference between the average ex-vessel shrimp price and the average fuel price for active, federally permitted vessels in the Gulf was greater in 2014 by far than in any other year during the moratorium (Liese 2011, 2013a, 2013b, 2014, pers. comm., September 12, 2016; Liese and Travis 2010; Liese et al. 2009a, 2009b), and likely since the early 2000s. Between 2007 and 2012, the difference varied from a low of $0.17 in 2012 (with similarly low differences in 2008 and 2009) to $0.96 in 2010. The difference increased to $1.27 in 2013 and $1.97 in 2014. According to data sources other than the Annual Economic Survey, fuel prices paid by commercial shrimpers likely continued to decline and then stabilized in 2015 and 2016,[5] while preliminary data suggests shrimp prices initially reverted to their lower levels in 2015 but subsequently began to rebound in 2016.[6] Thus, economic conditions in 2014 may reflect a "best case" scenario for the harvesting sector, with future economic conditions in the short term being similar to those experienced on average between 2011 and 2014.

[5] See recent trends in diesel fuel prices according to the Energy Information Administration (EIA) at: https://www.eia.gov/outlooks/steo/report/ Diesel fuel prices actually paid by commercial fishers, including commercial shrimpers, however, are less than the prices reported by the EIA as they do not pay federal or state excise taxes on fuel.

[6] See archives of Gulf of Mexico monthly shrimp statistics for preliminary shrimp price estimates at: http://www.st.nmfs.noaa.gov/commercial-fisheries/market-news/related-links/market-news-archives/index.

Table 1.5.2.1. Economic and financial characteristics of an average vessel with a federal Gulf commercial shrimp permit, 2007-2014. Dollar values are averages in 2017 dollars.

Year	2007	2008	2009	2010*	2011	2012	2013	2014**
Number of observations	505	497	427	429	456	442	380	396
Balance Sheet								
Assets	$232,924	$232,552	$235,908	$256,373	$319,078	$310,851	$300,431	$232,924
Liabilities	$98,824	$80,787	$69,001	$55,526	$44,969	$53,177	$44,568	$98,824
Equity	$134,100	$151,766	$166,908	$200,846	$274,109	$257,674	$255,862	$134,100
Cash Flow								
Inflow	$226,770	$243,814	$239,106	$374,435	$345,217	$401,621	$383,283	$226,770
Outflow	$233,464	$238,890	$229,786	$268,110	$306,728	$327,334	$325,347	$233,464
Net cash flow	-$6,695	$4,923	$9,319	$106,326	$38,490	$74,287	$57,936	-$6,695
Income Statement								
Revenue (commercial fishing operations)	$218,917	$240,837	$234,197	*	$328,866	$333,189	$334,577	$218,917
Expenses	$239,123	$246,327	$233,382	$269,101	$313,805	$328,979	$328,432	$239,123
Variable costs – Non-labor	49.5%	53.7%	50.1%	42.4%	47.8%	52.0%	48.0%	47.4%
Variable costs – Labor	25.2%	25.3%	27.1%	32.6%	32.0%	28.2%	30.5%	33.7%
Fixed costs	25.4%	21.0%	22.8%	25.0%	20.2%	19.8%	21.5%	18.9%
Net revenue from operations	-$20,206	-$5,489	$815	*	$15,061	$4,210	$6,145	-$20,206
Net receipts from non-operating activities	$918	-$2,309	$515	*	$13,547	$65,210	$45,181	$918
Net revenue before tax (profit or loss)	-$19,288	-$7,797	$1,330	$101,769	$28,609	$69,420	$51,328	-$19,288
Returns								
Economic return	-8.7%	-2.4%	0.3%	*	4.7%	1.4%	2.0%	11.6%
Return on equity	-14.4%)	-5.1%	0.8%	50.7%	10.4%	26.9%	20.1%	12.7%

Source: Liese et al. various years. The Annual Economic Survey of Federal Gulf Shrimp Permit Holders, NMFS-SEFSC. *In 2010, many sampled vessels (28%) participated in BP's VOOP cleaning up oil. As a result, business operations and resulting cost (as reported on the survey and here) reflect both fishing and VOOP activities. In other years, operations were strictly commercial fishing. The survey did not ask respondents to separate revenue from participation in VOOP and damage claims (passive income), hence we cannot determine "Revenue from Operations" and calculate "Net Revenue from Operations" or "Economic Return." **2014 numbers are preliminary.

Table 1.5.2.2. Economic and financial characteristics of an average active vessel with a federal Gulf commercial shrimp permit, 2007-2014. Dollar values are averages in 2017 dollars.

Year	2007	2008	2009	2010***	2011	2012	2013	2014*
Number of observations	388	383	348	332	368	370	293	333
Balance Sheet								
Assets	$215,401	$208,537	$219,227	$233,270	$244,657	$254,952	$259,623	$283,353
Liabilities	$108,823	$78,124	$74,170	$56,484	$44,699	$53,351	$38,616	$20,638
Equity	$106,578	$130,413	$145,057	$176,786	$199,957	$201,601	$221,007	$262,715
Cash Flow								
Inflow	$257,935	$272,521	$260,004	$261,279	$344,201	$416,215	$434,753	$392,034
Outflow	$264,845	$268,505	$253,292	$262,123	$316,009	$346,206	$368,154	$334,987
Net cash flow	-$6,910	$4,017	$6,712	-$844	$28,192	$70,008	$66,599	$57,048
Income Statement								
Revenue (commercial fishing operations)	$248,618	$268,896	$254,079	$258,952	$324,939	$337,864	$376,039	$388,803
Expenses	$271,351	$278,737	$257,879	$263,874	$323,441	$348,436	$374,408	$346,980
Variable costs – Non-labor	53.0%	56.6%	52.4%	50.8%	52.4%	55.6%	49.8%	49.7%
Variable costs – Labor	23.9%	24.2%	25.4%	27.2%	27.7%	25.1%	29.2%	32.2%
Fixed costs	23.0%	19.2%	22.2%	21.9%	19.9%	19.2%	20.9%	18.1%
Net revenue from operations	-$22,733	-$9,842	-$3,800	-$4,922	$1,498	-$10,571	$1,631	$41,823
Net receipts from non-operating activities	$1,338	-$1,553	$1,157	-$760	$16,482	$74,943	$55,132	$1,271
Net revenue before tax (profit or loss)	-$21,396	-$11,394	-$2,643	-$5,682	$17,981	$64,371	$56,764	$43,094
Returns								
Economic return	-10.6%	-4.7%	-1.7%	-2.1%	0.6%	-4.1%	0.6%	14.8%
Return on equity	-20.1%	-8.7%	-1.8%	-3.2%	9.0%	31.9%	25.7%	16.4%

"Active" in this table means a permitted vessel landed at least 1 lb of shrimp from offshore or inshore waters in the Gulf at a Gulf port in a given year based on GSS or Annual Landings Form data. Source: Liese et al. Various years. The Annual Economic Survey of Federal Gulf Shrimp Permit Holders, NMFS-SEFSC. *2014 numbers are preliminary. ***2010 numbers are adjusted to remove payments and costs (cleanup activities) related to DWH.

Because of the difference in economic conditions and performance in the years before and after the DWH oil spill, as well as the year to year differences in the years after the oil spill, Table 1.5.2.3 provides an average of financial and economic conditions for active permitted vessels between 2011 and 2014. Most importantly, average gross revenue from fishing operations was approximately $356,000, but net revenue from operations was only about $8,600. These estimates best approximate expected financial and economic conditions for these vessels in the foreseeable future.

Table 1.5.2.3. Average economic and financial characteristics for active vessels with a federal Gulf commercial shrimp permit, 2011-2014. Dollar values are averages in 2017 dollars.

Number of Observations	**1,364**
Balance sheets	
Assets	$260,647
Liabilities	$39,326
Equity	$221,321
Cash Flow	
Inflow	$396,800
From shrimp (any)	91.1%
Outflow	$341,339
Net cash flow	$55,461
Income Statement	
Revenue (Commercial Fishing Operations)	$356,911
Expenses	$348,315
Variable costs: non-labor	51.9%
Variable costs: labor	28.6%
Fixed costs	19.5%
Net revenue from operations	$8,596
Net receipts from non-operating activities	$36,957
Net revenue before tax (profit or loss)	$45,552
Returns	
Economic return	3.0%
Return on equity	20.8%

1.5.3 Key Economic and Financial Characteristics of Non-Federally Permitted Shrimp Vessels

Some aggregate information regarding the non-federally-permitted vessel component of the fisheries is in Table 1.5.3.1. Detailed information regarding the financial and economic performance of non-federally-permitted vessels is not available on an annual basis. However, economic surveys that collected such information from this fleet were conducted in 2008 (Miller and Isaacs 2011) and 2012 (Miller and Isaacs 2014). Given the aforementioned changes in the economic conditions for the harvesting sector as a whole and the federally-permitted fleet, particularly after the DWH oil spill, the 2008 estimates are outdated. So, the estimates from the 2012 survey are the most current and thus best available information regarding these vessels' financial and economic performance. The following is a summary of the report's more important findings regarding these vessels' financial and economic performance in 2012. All monetary estimates are in 2017 dollars.

About 92% of these vessels are owner-operated. The average vessel was about 37 ft long, 24 years old, and had a current market value of almost $65,000. Because only 7.7% of respondents had loan balances in 2012, average debt was relatively low ($2,354), and average equity was relatively high at approximately $62,000. The average non-federally-permitted vessel took about 53 trips and spent an average of 97 days at sea in 2012. Most non-federally-permitted shrimpers (approximately 72%) harvested only shrimp and no other types of seafood. Most of their shrimp was sold to dealers or processors. About 85% sold no shrimp to retailers and 60% claimed to have sold no shrimp directly to the public. Average cash inflows were about $91,300, considerably less than federally-permitted vessels, while average cash outflows were approximately $63,600, about two-thirds of which was related to fuel, repairs and maintenance, and overhead. Average net cash flows were about $27,700, but median cash inflows were only $6,500. Net cash flows were zero or negative for about 40% of these vessels. When non-cash expenses like depreciation and owner's vessel time (opportunity cost) are included, and revenues unrelated to commercial fishing operations are excluded, average net income from operations falls to about -$5,200. Net income before taxes, which considers all sources of revenue, averaged approximately $17,600. Net income before taxes was negative for the majority of these vessels.

In general, economic performance varies considerably among non-federally-permitted shrimp vessels in the Gulf. Although average net cash flow and net income before taxes were positive, estimates for both were negative for many vessels. Economic performance with respect to net cash flow, net revenue from operations, and other measures of profitability varied significantly across vessels based on gross revenue category (cash inflow). More specifically, measures of net revenue and profitability were directly related to vessels' gross revenue (i.e., vessels who earned greater gross revenue also had higher net revenue/profits). This is illustrated in Table 1.5.5. The gross revenue/cash inflow categories are as follows: Q1 = Cash Inflow of $14,027 or less, Q2 = Cash Inflow of $14,028 to $43,160, Q3 = Cash Inflow of $43,161 to $70,135, Q4 = Cash Inflow of $70,136 to $118,690, and Q5 = Cash Inflow of more than $118,690. Average gross revenue for vessels in each of the 5 gross revenue categories were as follows, from highest to lowest: $248,590 (Q5), $93,300 (Q4), $57,022 (Q3), $29,480 (Q2), and $5,879 (Q1). The report's estimates of net revenue from operations are not identical to those produced for the federally-permitted fleet. Further, many of these vessels only operate in the shrimp fisheries on a part-time basis, and even then only in certain years, particularly the vessels in the Q1, Q2, and Q3 categories. As such, they tend to behave more like households than businesses and, based on the following estimates, often do not attempt to maximize "profits." The following represent adjusted estimates from the 2012 report that better represent net revenues for these vessels, and more specifically reflect their "net cash flow from operations" (i.e., net cash flows minus revenues from sources other than seafood): $47,051 (Q5), $3,186 (Q4), -$8,367 (Q3), -$14,214 (Q2), and -$9,620 (Q1). These findings suggest either the available data incompletely captures the "economics" of these operations, or the decision to harvest shrimp is based on criteria other than, or in addition to, considerations of profit and loss (e.g., personal consumption of harvested shrimp and associated value, lifestyle bonus,[7] etc.).

The 2012 estimates are the best available estimates of "net revenue" for non-federally-permitted vessels. Based on these estimates, economic conditions remained challenging for many non-

[7] Lifestyle bonus represents the value some fishers place on the commercial fishing lifestyle.

federally-permitted vessels in the Gulf shrimp fisheries in 2012. However, economic conditions in 2012 were the worst for the average federally-permitted vessel during the 2011 to 2014 time period, and 2012 was the only year the average federally-permitted vessel had negative net revenue from operations. Because economic conditions for the shrimp fisheries in general are thought to have improved in 2013 and particularly 2014, as the difference between ex-vessel shrimp prices and fuel prices paid by shrimpers increased, the 2012 "net revenue" estimates for the non-federally-permitted likely understate the net revenues these vessels earned on average during these years and thus also understate the net revenue they are likely to earn in the near future.

Table 1.5.3.1. Economic and financial characteristics of an average active vessel without a federal Gulf commercial shrimp permit in 2012 (2017 dollars).

	GULF	Q1	Q2	Q3	Q4	Q5
Number of observations	246	47	51	46	47	55
Balance Sheet						
Assets: market value of vessel	$64,686	$26,747	$46,918	$61,219	$87,035	$97,385
Purchase price	$51,335	$24,866	$41,823	$42,794	$65,245	$78,521
Liabilities: loan on vessel	$2,540	$645	$2,348	$469	$8,129	$1,295
Equity: owner's equity in vessel	$62,146	$26,102	$44,569	$60,750	$78,906	$96,090
Percentage with insurance	6.1%	12.8%	3.9%	10.9%	4.3%	0.0%
Insurance coverage as a percentage of value	3.1%	11.6%	4.1%	4.6%	2.9%	0.0%
Cash Inflow						
Inflow: total	$91,303	$5,879	$29,480	$57,022	$93,300	$248,590
Revenue from shrimp	$61,566	$5,340	$20,996	$35,757	$67,692	$163,581
Revenue from other seafood	$6,881	$513	$4,934	$1,843	$6,956	$18,276
Revenue from sources other than seafood	$22,856	$27	$3,551	$19,422	$18,651	$66,734
Outflow: total	$63,583	$15,576	$40,142	$45,968	$71,463	$134,345
Fuel	$19,873	$3,833	$10,383	$14,171	$24,736	$42,995
Oil	$1,934	$241	$1,481	$498	$1,549	$5,329
Ice	$3,537	$404	$1,434	$1,877	$2,855	$10,136
Salt	$849	$120	$513	$354	$946	$2,116
Groceries	$2,596	$424	$1,891	$1,628	$3,622	$5,037
Other trip supplies	$1,819	$262	$1,339	$971	$1,863	$4,265
Labor	$7,998	$1,083	$3,616	$5,930	$10,053	$17,944
Repairs and maintenance (Regular vessel and gear)	$6,589	$2,285	$5,051	$5,988	$7,067	$11,788
Repairs and maintenance (new purchases and upgrades)	$4,578	$1,158	$1,742	$6,190	$3,299	$9,879
Insurance premiums	$90	$108	$27	$199	$138	$0
Overhead	$13,121	$5,201	$12,230	$7,739	$14,099	$24,380
Interest payments	$136	$36	$190	$17	$354	$82
Principal payments	$463	$423	$244	$405	$880	$395
Net cash flows	$27,718	-$9,697	-$10,663	$11,055	$21,837	$114,245
Non-Cash Expense Estimates						
Owner's vessel time	$12,760	$3,816	$9,338	$13,763	$17,600	$18,604
Depreciation	$2,449	$865	$1,460	$2,689	$2,722	$4,284
Income Statement (2012)						
Revenue from operations	$68,446	$5,852	$25,929	$37,600	$74,648	$181,857
Operating expenses	$73,616	$18,642	$48,765	$55,807	$87,252	$146,877
Trip-related expenditures	41.6%	28.3%	34.9%	34.9%	40.8%	47.6%
Labor expenditures	10.9%	5.8%	7.4%	10.6%	11.5%	12.2%
Fixed costs	47.6%	65.8%	57.6%	54.4%	47.7%	40.2%
Net income from operations	-$5,169	-$12,789	-$22,835	-$18,207	-$12,604	$34,979
Net income before taxes	$17,551	-$12,798	-$19,475	$1,198	$5,693	$101,631
Economic returns (2012)						
Economic return	-8.0%	-47.8%	-48.7%	-29.7%	-14.5%	35.9%
Return on equity	28.2%	-49.0%	-43.7%	2.0%	7.2%	105.8%

1.5.4 Dealers and Processors

Between 2007 and 2014, the number of food shrimp dealers ranged from 558 (2008) to 896 (2011) in a given year. [8] In 2014, there were 627 dealers. Between 2011 and 2014, there were 1,427 dealers that purchased food shrimp at some point in time in the Gulf.[9] Table 1.5.4.1 provides selected characteristics for Gulf shrimp dealers in each year. Most shrimp dealers in the Gulf are very specialized. Between 2007 and 2014, annual food shrimp purchases account for around 83% of their total annual seafood purchases. Between 2007 and 2014, annual Gulf food shrimp purchases by dealers averaged about $440 million per year (in 2017 dollars), while total seafood purchases by these dealers averaged almost $508 million. However, as in the harvesting sector, the aggregate value of these dealers' food shrimp and total seafood purchases increased significantly in 2013 and 2014 as a result of the increases in shrimp prices, with the value of shrimp purchases increasing by more than 50% between 2012 and 2014. The value of food shrimp purchases per dealer also increased by more than 50% during this time. Estimates of net revenue or profit specific to Gulf shrimp dealers are not currently available.

Although the average value of food shrimp and total seafood purchases per dealer appears relatively small, about $25,000 and $52,000 in 2014 respectively based on the median, Gulf food shrimp dealers are a very heterogeneous group. Many, if not most, "dealers" are actually vessel owners and fishers who have chosen to act as their own dealers and bypass so-called "middlemen" so they can reduce costs and retain more of their net revenue (profit). Therefore, as vessels move in and out of the fisheries, so do dealers to a large degree. A much smaller number of these dealers are also shrimp processors, and their operations generate much larger revenues on average (see below).

Selected characteristics for Gulf shrimp processors are provided in Table 1.5.4.2. Between 2007 and 2014, the number of Gulf shrimp processors was relatively stable (except for 2012), averaging 53 during this time. Thus, the consolidation seen in this sector in previous years appears to have largely abated. During the same time period, the annual value of processed shrimp averaged more than $665 million (in 2017 dollars). Like dealers, shrimp processors are also very specialized. Shrimp products accounted for more than 90% of the total value processed between 2007 and 2014. However, processors are much larger businesses on average than dealers, with the value of processed shrimp and the value of all processed products averaging $4.64 million and $5.51 million per processor, respectively, between 2007 and 2014.

Economic trends in the processing sector do not exactly mirror trends in the harvesting and dealer sectors. For example, for the sector as a whole, there were relatively minor increases in the total values of processed shrimp and all processed products by these processors in 2013 and 2014, and those values were still below the values seen in 2010. The reason for this difference is because processors process imported product as well as domestic product, whereas the dealer

[8] A Gulf of Mexico shrimp dealer is a dealer located in a Gulf of Mexico port that purchased shrimp regardless of where shrimp were harvested.

[9] This estimated number of Gulf of Mexico shrimp dealers could be slightly overestimated because the estimates are based on a compilation of unique dealer codes across the GSS and Accumulated Landings System (ALS) databases. Although most codes could be matched across the databases, there are a relatively small number of inconsistencies in the codes within and across the databases over time.

data only represents domestic production. A comparison of the dealer and processor data indicates that processors in the Gulf relied heavily on imported shrimp in 2010, and were able to increase the value of their processed products as a result. Conversely, in 2014, processors appear to have been much more dependent on domestic product. And although the aggregate value of the processed shrimp was somewhat less in 2014 relative to 2010, the average value of processed shrimp per processor was considerably greater in 2014 than in 2010, increasing by 189% from $2.89 million in 2010 to more than $8.38 million per processor in 2014. What this finding suggests is that, while imported product can and has been important for this sector as a whole, imports are important to a relatively small number of shrimp processors. Conversely, all Gulf shrimp processors are somewhat if not highly reliant on domestic production. Thus, when the value of domestic production increases, as it did in 2013 and 2014, such increases benefit all processors rather than only a relatively few.

Table 1.5.4.1. Selected characteristics of Gulf food shrimp dealers, 2007-2014. Pounds are whole weight, dollar values are in 2017 dollars.

	2007	2008	2009	2010	2011	2012	2013	2014
Number of dealers	663	558	593	726	896	808	600	627
Pounds of food shrimp purchased (millions)*	222.59	186.19	228.64	175.06	184.86	201.65	202.36	206.61
Average price per pound (mean)	$1.86	$2.18	$1.46	$2.10	$2.49	$2.01	$2.59	$2.96
Value of purchased food shrimp (millions)	$413.81	$404.88	$334.29	$368.47	$459.42	$405.42	$524.40	$609.93
Total value of all purchased by shrimp dealers (millions)	$466.90	$461.79	$391.66	$426.96	$538.57	$482.60	$603.99	$696.25
Average pounds of food shrimp purchased, per dealer (median)	3,929	5,141	4,938	4,018	3,738	4,500	4,059	6,862
Average value of food shrimp purchased, per dealer (median)	$8,822	$13,879	$10,250	$9,997	$10,538	$13,138	$11,219	$25,010
Average total value of all purchases by shrimp dealers, per dealer (median)	$13,994	$20,510	$15,428	$13,306	$19,376	$21,801	$24,487	$52,265
Average percent of purchases is food shrimp, per dealer (mean)	85	83	83	86	84	83	81	78

Source: NMFS-SERO, ALS 2007-2017. Averages are reported in terms of medians rather than means because the data distributions are highly skewed.

*Only shrimp species included in the GSS database are included in these estimates, though landings of all such species are included regardless of where they were harvested.

Table 1.5.4.2. Selected characteristics of the Gulf shrimp processing industry, 2007-2014. Pounds are whole weight, dollar values are in 2017 dollars.

	2007	2008	2009	2010	2011	2012	2013	2014
Number of processors	47	50	51	54	50	67	53	51
Pounds of shrimp processed (millions)*	273.01	260.82	335.02	271.12	294.43	355.60	282.57	322.86
Average processed price per pound (mean)	$1.82	$2.09	$1.80	$2.94	$2.04	$2.05	$2.72	$2.42
Value of processed shrimp (millions)	$496.93	$546.36	$604.21	$795.91	$601.67	$731.02	$766.30	$780.73
Total value of all products processed by shrimp processors (millions)	$503.85	$579.89	$651.24	$851.65	$648.27	$781.75	$811.36	$831.64
Average pounds of shrimp processed, per processor (median, millions)	3.98	2.56	2.87	1.87	3.06	2.35	2.02	3.18
Average value of processed shrimp, per processor (median, millions)	$4.89	$3.82	$4.10	$2.89	$4.08	$4.21	$4.76	$8.38
Average total value of all products processed by shrimp processors, per processor (median, millions)	$5.66	$4.49	$5.41	$3.45	$5.26	$4.62	$6.79	$8.43
Average percent of total processed value is shrimp, per processor (mean)	96	94	94	88	90	93	89	92
Average number of employees, per processor (median)	38	28	35	28	34	31	31	36

Source: M. Yencho, pers. comm., Office of Science and Technology, September 19, 2016.
* Includes all shrimp regardless of where harvested, but only includes shrimp processed for human consumption (i.e., shrimp processed for bait or shrimp meal are excluded). Most averages are reported in terms of medians rather than means because the data distributions are highly skewed.

1.5.5 Imports

On average, between 2007 and 2014, the United States has imported more than 1.2 billion pounds (product weight) of shrimp products annually. Imports were relatively stable between 2007 and 2011, but decreased by about 7.2% in 2012 and an additional 5% in 2013. These decreases are likely part of the reason why domestic ex-vessel shrimp prices increased in 2013 and 2014. Imports subsequently increased by almost 12% in 2014, returning to previous levels, which in turn likely caused the apparent decrease in domestic ex-vessel shrimp prices in 2015. The value of imported shrimp products averaged $5.18 billion (2017 dollars) annually between 2007 and 2014. Table 1.5.5.1 provides annual pounds and value of shrimp imports and the share of imports by country of origin.

The distribution of shrimp imports into the U.S. across exporting countries has changed significantly. Thailand was the primary country of origin for shrimp products imported into the U.S. between 2007 and 2012, and typically accounted for about one-third of all imports during that time. Vietnam and Indonesia were the next largest exporting countries to the U.S., but together they still only accounted for about 20% of shrimp imports during that time. The decrease in imports from Thailand, which was primarily driven by early mortality syndrome, led to the overall decrease in imports in 2012 and 2013. As imports of shrimp from Thailand decreased (down to just over 12% in 2014), other countries took advantage of the situation by increasing their exports of shrimp to the U.S. and, as a result, have increased their market share

in recent years. For example, India's share of the imports quadrupled from 2007 to 2014, increasing from 5% to 20.5%. Other countries that have significantly increased their market share include Indonesia, whose share increased from 11.4% to 19.7%, and Ecuador, whose share increased from 7.9% to 13.5%. Unlike earlier years when Thailand dominated the market of shrimp imports into the U.S., market share was more evenly distributed by 2014, with India, Indonesia, Vietnam, Ecuador, and Thailand each having between 12% and 20% of the market.

Table 1.5.5.1. Annual pounds and value of shrimp imports and share of imports by country, 2007-2014.

	2007	2008	2009	2010	2011	2012	2013	2014
Pounds of shrimp imports (product weight, million pounds)	1,227.8	1,243.9	1,209.3	1,231.5	1,267.9	1,176.6	1,118.6	1,251.2
Value of shrimp imports (millions, nominal)	$3,914	$4,105	$3,778	$4,296	$5,166	$4,463	$5,277	$6,696
Value of shrimp imports (millions, 2017$)	$4,532	$4,662	$4,258	$4,783	$5,636	$4,783	$5,776	$6,970
Share of Imports by Country								
Thailand	31.7	31.4	35.8	35.3	33.3	26.9	17.1	12.2
Vietnam	11.8	11.7	10.1	11.9	10.1	10.0	13.8	15.0
China*	6.0	6.1	6.2	6.4	5.6	5.1	4.5	4.1
India	5.0	3.5	4.4	7.2	10.2	12.9	19.1	20.6
Mexico	9.2	8.3	8.8	5.3	5.6	5.7	5.0	4.5
Ecuador	7.9	8.3	8.7	9.5	10.3	12.5	12.4	13.5
Indonesia	11.4	15.4	13.0	11.5	13.5	14.8	17.2	19.7
Bangladesh	3.9	3.1	2.4	2.1	1.2	0.9	1.0	.4
Malaysia	3.9	4.5	3.0	3.5	4.1	3.8	1.5	2.7
All others	9.2	7.7	7.5	7.4	6.2	7.3	8.2	7.3

Source: Pounds of Shrimp Imports (personal communication, GOM Data Management, Sept. 15, 2016 http://www.st.nmfs.noaa.gov/commercial-fisheries/market-news/related-links/market-news-archives/index). Values and market share by country (personal communication, Office of Science and Technology, Sept. 15, 2016. Does not include imports from Hong Kong, Taipei, or Macao.

1.5.6 Economic Impacts of the Gulf Shrimp Fishery

The commercial harvest and subsequent sales and consumption of shrimp generates business activity as fishers expend funds to harvest shrimp and consumers spend money on goods and services, such as shrimp purchased at a local seafood market and served during restaurant visits. These expenditures spur additional business activity in the region(s) where the harvest and purchases are made, such as jobs in local seafood markets, grocers, restaurants, and fishing supply establishments. In the absence of the availability of a given species for purchase, consumers would likely spend their money on substitute goods and services. As a result, the analysis presented below represents a distributional analysis only; that is, it only shows how economic impacts may be distributed through regional markets.

The determination of economic impacts is separate from the determination of changes in net benefits to society. Economic impacts are generally characterized in terms of the levels of employment, income, total value added, and output that accrue to local, state, regional and the national economy as a result of expenditures or gross revenues. Economic impact models are used to determine the current economic impacts of an industry or sector, as reflected by these measures, as well as changes that are expected to occur if expenditures or gross revenues change in a particular industry or sector. Estimates of the average annual business activity associated with the commercial harvest of shrimp in the Gulf were derived using the model developed for and applied in NMFS (2016). Average gross revenue from shrimp harvested in the Gulf averaged about $492.25 million between 2011 and 2014 (in 2017 dollars). Estimates of the economic impacts generated as a result of this revenue are provided in Table 1.5.6.1. According to this information, the affected fisheries generate employment, income, value-added, and output impacts of 61,750 jobs, $1.68 billion, $2.41, and $4.77 billion, respectively.

Table 1.5.6.1. Economic impacts of the affected Gulf shrimp fisheries. All monetary estimates are in thousands of 2017 dollars and employment is measured in full-time equivalent jobs.

INDUSTRY SECTOR	DIRECT	INDIRECT	INDUCED	TOTAL
Harvesters				
Employment impacts	8,672	1,689	1,956	12,317
Income impacts	204,715	57,826	100,769	363,310
Total value added impacts	218,216	207,218	174,019	599,452
Output impacts	492,250	478,410	334,482	1,305,143
Primary dealers/processors				
Employment impacts	2,345	936	1,626	4,907
Income impacts	86,717	79,916	75,586	242,219
Total value added impacts	92,436	101,970	142,305	336,711
Output impacts	279,106	210,227	278,169	767,502
Secondary wholesalers/distributors				
Employment impacts	592	130	574	1,296
Income impacts	28,090	8,355	29,543	65,988
Total value added impacts	29,943	14,014	50,464	94,420
Output impacts	75,240	27,433	98,139	200,812
Grocers				
Employment impacts	3,648	411	806	4,865
Income impacts	83,177	27,451	41,466	152,093
Total value added impacts	88,663	44,233	70,201	203,096
Output impacts	142,157	71,842	137,823	351,821
Restaurants				
Employment impacts	31,259	2,060	5,046	38,365
Income impacts	458,768	137,481	259,655	855,905
Total value added impacts	489,024	245,749	437,488	1,172,261
Output impacts	894,189	384,561	863,295	2,142,045
Harvesters and seafood industry				
Employment impacts	46,517	5,226	10,007	61,750
Income impacts	861,468	311,029	507,018	1,679,515
Total value added impacts	918,282	613,183	874,476	2,405,940
Output impacts	1,882,942	1,172,473	1,711,909	4,767,323

1.6 Social Environment

Description of the social environment associated with the Gulf shrimp fishery is available in Amendment 17B (GMFMC 2017) and will be incorporated herein by reference as appropriate. The shrimp fishery is one of the most economically important fisheries in the Gulf, particularly in Texas. The number of active vessels decreased following implementation of the moratorium on vessel permits for commercial shrimp in 2006 (GMFMC 2005a), and participants in the fishery are also affected by imported shrimp, fuel prices, and dockside prices (GMFMC 2017). In addition, news reports indicate that changes in national immigration policy have reduced availability of fishing crew in areas dependent on migrant workers.

The major sectors of the region's shrimp fishery—harvesting, dealer/wholesaler, and processing—are discussed at the region level in Section 1.5. The following description focuses on the fishery at the community level.

1.6.1. Regional Quotients of Shrimp Communities

The regional quotient (RQ) is a way to measure the relative importance of a given species across all shrimp fishing communities in the region and represents the proportional distribution of commercial landings of a particular species by community. The graphical representation of this proportional measure does not provide the number of pounds or the value of the catch, data which might be confidential at the community level for some locations. The RQ is calculated by dividing the total pounds (or value) of a species landed in a given community by the total pounds (or value) for that species for all communities within the Gulf region with shrimp landings.

Figure 1.6.1.1 provides the RQ for pounds and value of all food shrimp combined for the top 20 communities in the Gulf region. Most of the communities are in Texas or Louisiana, but Bayou La Batre, Alabama, has the overall highest RQ values in the region.

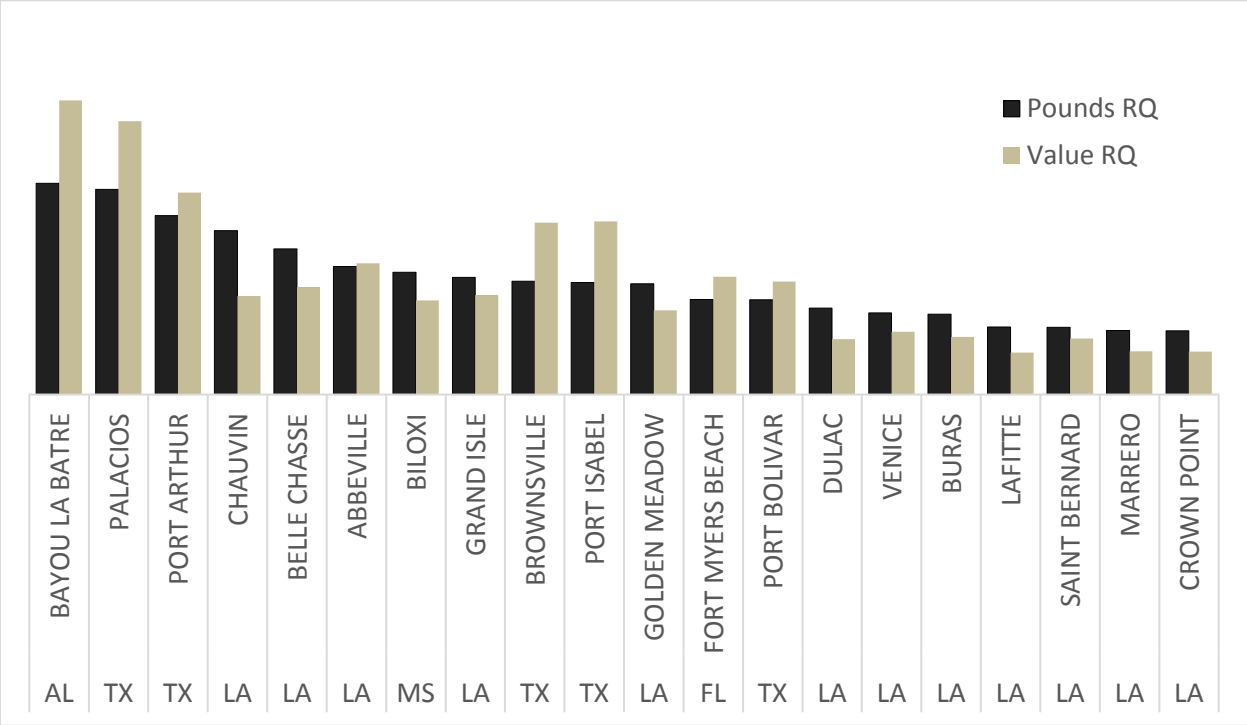

Figure 1.6.1.1. Top twenty communities' RQ of pounds and value for Gulf shrimp (all species) in 2016.
Source: SERO ALS 2016

Based on 2014 data provided in Amendment 17B (GMFMC 2017), Bayou Le Batre, Alabama, and the Texas communities of Palacios, Port Isabel and Brownsville make up a majority of brown shrimp landings and value in the Gulf and all other top brown shrimp communities are in Louisiana or Texas, except for Biloxi, Mississippi. For white shrimp, the top communities are primarily in Louisiana, with the higher RQs in the communities of Chauvin, Abbeville, Venice and Dulac. Most commercial landings of pink shrimp occur in Florida, with the largest proportion landed in Fort Myers Beach, Florida, and minimal pink shrimp landings occur in Mississippi, Alabama and Texas. Landings of royal red shrimp are primarily in Alabama and are at much lower levels that other food shrimp in the Gulf (GMFMC 2017).

1.6.2 Commercial Shrimp Fishing Engagement

The commercial fishing engagement index scores for Gulf shrimp are presented in Figure 1.6.2.1. The index is an indicator of the importance of shrimp fishing in a community relative to other communities. It is a measure of shrimp fishing through fishing activity including pounds and value of shrimp, number of shrimp permits, and number of shrimp dealers within the community. Shrimp engagement scores are standardized so that 0 is the mean.

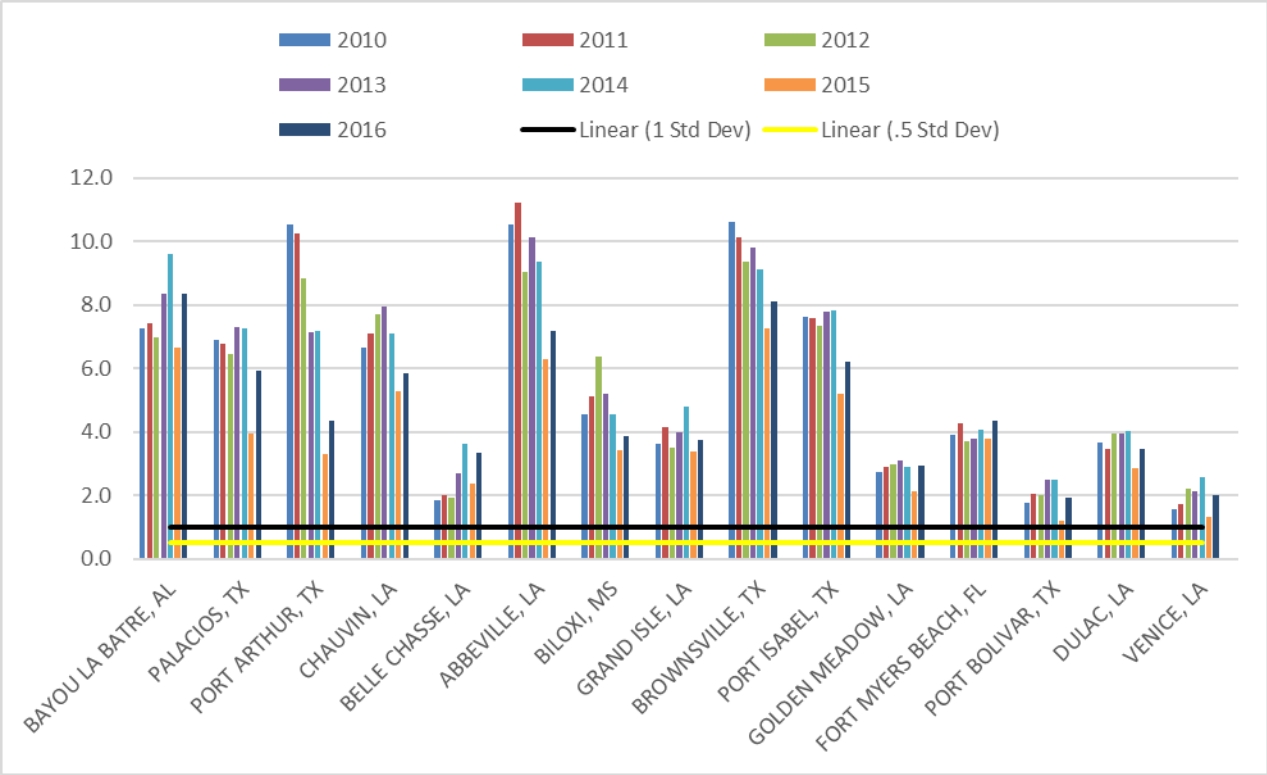

Figure 1.6.2.1. Top commercial fishing communities' engagement, 2010-2016.
Source: SERO, Community Social Vulnerability Indicators Database 2018 (American Community Survey 2012-2016).

Overall, the highest engagement with the Gulf shrimp fisheries are in Bayou La Batre (AL), Palacios (TX), Port Arthur (TX), Chauvin (LA), Abbeville (LA), Brownsville (TX) and Port Isabel (TX) (Figure 1.6.2.1). These communities would be the most likely to be affected by changes to management of the shrimp fishery.

1.6.3 Environmental Justice

Executive Order (E.O.) 12898 requires that federal agencies conduct their programs, policies, and activities in a manner to ensure individuals or populations are not excluded from participation in, or denied the benefits of, or subjected to discrimination because of their race, color, or national origin. In addition, and specifically with respect to subsistence consumption of fish and wildlife, federal agencies are required to collect, maintain, and analyze information on

the consumption patterns of populations who principally rely on fish and/or wildlife for subsistence. This executive order is generally referred to as environmental justice (EJ).

Economic and fleet information on the Gulf shrimp fishery is available (see Section 1.5), but there is little demographic information available for participants in the Gulf shrimp fishery. A review in 2003 suggested that about 30% of federally permitted shrimp vessels owners were of Southeast Asian descent (GMFMC 2017). Additionally, fishery observations indicate that there are a large number of Latino participants in the Gulf shrimp fishery, specifically in Texas working as captain and crew. There are also reports that a substantial number of Texas crew are migrant workers from Mexico and Central America.

Another measure to assess whether a community may be experiencing EJ issues has been developed using other secondary sources, a suite of indices created to examine the social vulnerability of coastal communities (Colburn and Jepson 2012; Jacob et al. 2012) is presented in Figure 1.6.3.1. The three indices used for social vulnerability are poverty, population composition, and personal disruptions. The variables included in each of these indices have been identified as important components that contribute to a community's vulnerability. Indicators such as increased poverty rates for different groups, more single female-headed households and children under the age of 5, disruptions such as higher separation rates, higher crime rates, and unemployment are all signs of vulnerable populations. These indicators are closely aligned to previously used measures of EJ which used thresholds for the number of minorities and those in poverty. For those communities that exceed the threshold, it is expected that they would exhibit vulnerabilities to sudden changes or social disruption that might accrue from regulatory change. Several of the primary shrimp communities in the Gulf region exceed the threshold, but the proposed changes are likely to improve fishing opportunities and are not expected to contribute to negative social changes in these communities.

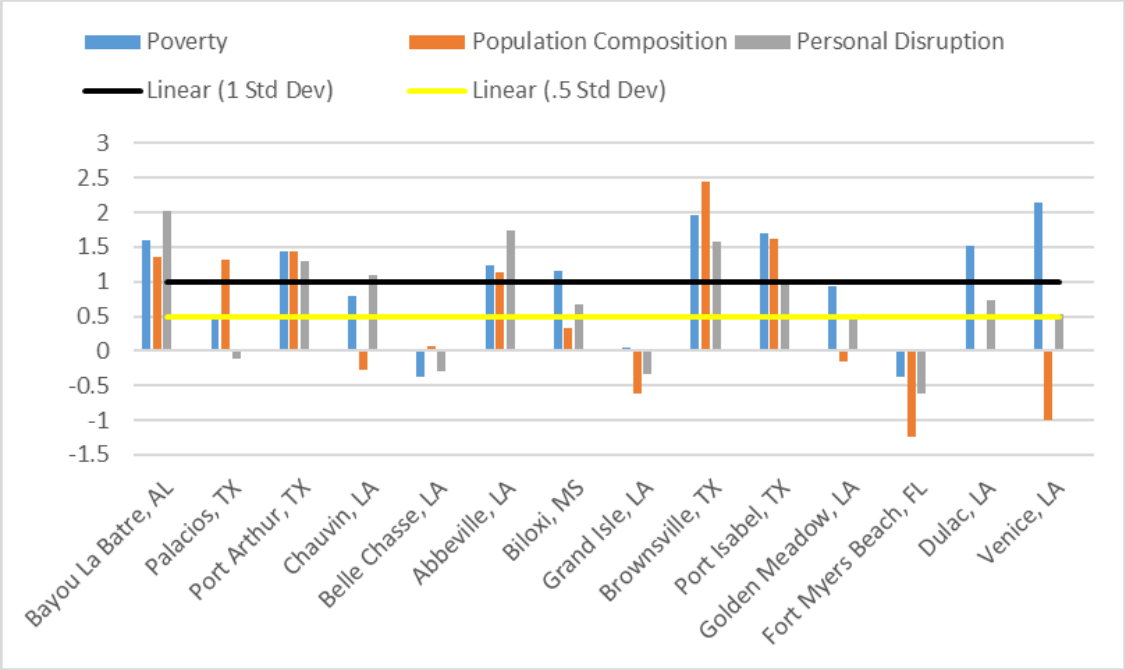

Figure 1.6.3.1. Social vulnerability indices for top commercial fishing communities.
Source: SERO, Community Social Vulnerability Indicators Database 2018 (American Community Survey 2012-2016).

CHAPTER 2. MANAGEMENT ALTERNATIVES

2.1 Action 1 – Adjust the target reduction goal for juvenile red snapper mortality in the federal Gulf of Mexico shrimp fishery in statistical zones 10-21 in the 10-30 fathom depth zone.

Options:

Option a: Modify the target reduction goal for juvenile red snapper shrimp trawl bycatch mortality on red snapper from 67% less than the benchmark years of 2001-2003 to 63%.

Option b: Modify the target reduction goal for juvenile red snapper shrimp trawl bycatch mortality on red snapper from 67% less than the benchmark years of 2001-2003 to 60%.

Option c: Modify the target reduction goal for juvenile red snapper shrimp trawl bycatch mortality on red snapper from 67% less than the benchmark years of 2001-2003 to 56%.

Discussion and Effects:

The red snapper stock is no longer overfished nor undergoing overfishing, though the stock is still in a rebuilding plan (SEDAR 2018). Also, the red snapper stock acceptable biological catch (ABC) has consistently increased under the rebuilding plan, but the shrimp fishery has not seen similar benefits to the rebuilding of the red snapper stock. In April 2018, the Gulf of Mexico Fishery Management Council (Council) requested that the National Marine Fisheries Service (NMFS) Southeast Fisheries Science Center (SEFSC) evaluate the impact of increases in shrimp fishing effort in the area monitored for juvenile red snapper bycatch (statistical zones 10-21 in 10-30 fathoms water depth). That analysis, which was based on Southeast Data, Assessment, and Review (SEDAR) 52 and new projections incorporating an increase in shrimp effort (or a reduction in the effort threshold to 60%), found that this increase in shrimp effort is unlikely to impact ABCs for Gulf of Mexico (Gulf) red snapper (Goethel and Smith 2018; Appendix A). Additionally, the analysis evaluated greater increases in shrimp effort and found that moderate changes in red snapper bycatch levels from increased shrimp effort are unlikely to alter the red snapper rebuilding schedule or ABCs. The analysis concluded that red snapper mortality due to discards in the closed recreational season is much higher than was thought at the times the shrimp effort reduction threshold was put in place, and the natural mortality values in previous assessments assumed for age 0 and age 1 fish has changed (Goethel and Smith 2018; Appendix A); the natural mortality of juvenile red snapper is higher. The SEFSC analysis was based on a reduction in the threshold being applied Gulf-wide rather than specifically to the area monitored for juvenile red snapper bycatch. The results projected negligible changes in ABCs for 60% and 56% reductions below the baseline (Table 2.1.1).

Table 2.1.1. ABC projections for red snapper based on SEDAR 52, with different scenarios decreasing the shrimp effort target reduction threshold. Values are in millions of pounds whole weight for each of the scenarios.

Year	ABC					
	SEDAR 52 Base (current 67%)	Reduce to 60%	Reduce to 56%	Reduce to 40%	Reduce to 0%	Assessment based on F in 2001-2003
2019	16.0	16.0	16.0	14.7	13.1	13.3
2020	15.0	15.0	15.0	13.9	12.5	12.7
2021	14.3	14.3	14.2	13.3	12.0	12.2
2022	13.8	13.7	13.7	12.8	11.5	11.7
2023	13.4	13.3	13.3	12.4	11.1	11.2
2024	13.2	13.1	13.0	12.2	10.7	10.9
2025	13.1	13.0	12.9	12.0	10.6	10.7
2026	13.0	13.0	12.8	12.0	10.5	10.7
2027	13.0	12.9	12.8	12.0	10.5	10.6
2028	13.0	12.9	12.8	11.9	10.5	10.6
2029	13.0	12.9	12.8	11.9	10.5	10.6
2030	13.0	12.9	12.8	11.9	10.4	10.6
2031	13.0	12.9	12.8	11.9	10.4	10.6
2032	13.0	12.9	12.8	11.9	10.4	10.6

Source: Goethel and Smith, 2018.

The primary determinants of shrimp fishing effort are environmental conditions, price of shrimp, and price of fuel. It is possible for shrimp fishing effort to increase, but there are several factors to consider. The Gulf federal shrimp fishery has been contracting since the implementation of a permit moratorium in 2006. The fleet is ageing, and the number of moratorium permits has been decreasing because of non-renewal. This, combined with the new information regarding the red snapper stock, suggests that in a year where effort may exceed the implemented threshold, the consequences of exceeding that effort threshold might be unnecessarily punitive. The shrimp effort threshold is not monitored in real time, and results indicating an excess of the target reduction one year could necessitate a closure in the following year. As the red snapper stock is rebuilding, and the ABC has been steadily increasing, it stands to reason that the shrimp fishery should also have restrictions eased for fairness.

Currently, should shrimp fishing effort in the area monitored for juvenile red snapper mortality exceed a 67% percent reduction from the baseline years of 2001-2003, the shrimp fishery would close. In Amendment 14 to the Fishery Management Plan (FMP) for the Shrimp Fishery of the Gulf of Mexico, U.S. Waters (Amendment 14), the Council determined that this shrimp effort reduction should be reduced to 60% by 2032; however, a procedure to implement such a reduction was not put in place. Therefore, the Council would need to develop a new amendment (as is the case in this document) to implement this reduction unless NMFS determines that this reduction can be made automatically in 2032. As the red snapper fishery is no longer overfished nor undergoing overfishing, and the ABC has been steadily increasing each year, perception may be that it is unfair to keep the current restrictions on the federal shrimp fishery.

The options outlined in this action would reduce the effort threshold to 63% (**Option a**), 60% (**Option b**), or 56% (**Option c**). Amendment 14 outlined a reduction to 60% by 2032. **Option a** would require a subsequent plan amendment to further reduce the threshold to 60% in the year 2032, unless NMFS determines that this reduction can be made automatically based on what is outlined in Amendment 14. The Council would need to determine if this new reduction replaces the reduction schedule outlined in Amendment 14 if it does not want to have the effort reduction threshold reduced to 60% by 2032. **Option b** would put into place a reduction to 60% below the baseline effort in the years 2001-2003 once this amendment was implemented. **Option c** would reduce the reduction to 56% below the threshold which is outside the scope of analyses produced in Amendment 14, but was included in the analysis produced by the SEFSC (Goethel and Smith 2018). **Option b** and **Option c** are both under consideration because an increase in shrimp effort consistent with these lower thresholds would not impact the ABC projections in the short term (next 3 years) more than 100,000 pounds (whole weight) and over the long term more than 200,000 pounds (whole weight) (Table 2.1.1).

Negative effects on the biological environment are not expected to increase with any of the options outlined in this action. The shrimp fishery has not yet been constrained by the threshold, and the fishery has contracted significantly since the inception of the threshold. The analysis of the red snapper bycatch indicates that the increases in shrimp effort outline in **Options a – c** are unlikely to significantly affect red snapper stocks. Though bycatch is a component of the shrimp fishery that should be considered, it is unlikely that the options outlined in this action will have effects on the biological and physical environments that exceed what is currently happening in the shrimp fishery.

For Action 1, the economic analysis examines the revenue as well as producer surplus (PS) both on the vessel level and the industry level, from **Options a-c**. The maximum effort from the shrimp industry from **Options a-c**, in terms of 24 hour days fished, is displayed in Table 2.1.2. Industry revenue is calculated by multiplying the additional effort by the catch per unit effort (CPUE) and by price. The average CPUE from 2015-2017 is 1149 (personal communication with SEFSC Galveston Laboratory, 2018), and the average ex-vessel price of Gulf food shrimp for the active Gulf shrimp permitted vessels from 2011-2014 (converted to 2017 dollars) with tails weight is $4.36 (personal communication with SERO, 2018). The vessel revenue is calculated by dividing the industry revenue by the number of active permitted vessels. The average number of active permitted vessels from 2011-2014, from Table 1.5.1, is 1140.

Table 2.1.2. Maximum effort (24 hours days fished) by option for 10-30 fathom depth zone in statistical areas.

Option	Target Reduction (%)	Maximum Effort
Option a	63%	30640.07
Option b	60%	33124.4
Option c	56%	36436.84

Source: Southeast Fishery Science Center (SEFSC) Galveston Laboratory, 2018

The industry revenue and the vessel revenue from **Options a-c** are shown in Table 2.1.3. As a result of the modifications to the target reduction, the maximum fishing effort available to the industry increases in order from **Option a** to **Option b** to **Option c**, and likewise, industry

revenue and vessel revenue increase in the same order. **Option c** has the greatest industry revenue of $182,535,451 and the greatest vessel revenue of $160,119. Revenue in Table 2.1.3 is based on the maximum effort from the industry in Table 2.1.2 and, thus, could be smaller based on industry decisions.

Table 2.1.3. Industry revenue and vessel revenue for **Options a-c**.

Option	Industry Revenue	Vessel Revenue
Option a	$153,495,720	$134,645
Option b	$165,941,319	$145,563
Option c	$182,535,451	$160,119

The vessel PS from Table 1.5.1 is calculated by multiplying the expenses ($348,315) by the percentage of expenses that are variable costs (80.5%) and then subtracting that amount from the revenue ($356,911). The percentage of vessel revenues that corresponds to vessel PS is determined by dividing the previously calculated PS by revenue ($356,911) and then multiplying it by 100. In this case, the percentage of vessel revenues that corresponds to vessel PS is 21.4%. Multiplying industry revenue and vessel revenue, respectively, by 21.4% provides the industry PS and vessel PS for **Options a-c**. Industry PS and vessel PS for **Options a-c** are shown in Table 2.1.4. Similar to industry revenue and vessel revenue, industry PS and vessel PS increase from **Option a** to **Option b** to **Option c**. **Option c** has the greatest industry PS of $39,062,587 and the greatest vessel PS of $34,265. PS in Table 2.1.4 is based on the maximum effort from the industry in Table 2.1.2 and, thus, could be smaller based on industry decisions.

Table 2.1.4. Industry PS and vessel PS for **Options a-c**.

Option	Industry PS	Vessel PS
Option a	$32,848,084	$28,814
Option b	$35,511,442	$31,150
Option c	$39,062,587	$34,265

The shrimp fishery has been constrained by regulatory and fishery changes, including the permit moratorium, imports, fuel prices, dockside prices, and crew availability, and under the current fishery conditions there may be minimal short-term effects from the proposed changes in **Options a-c**. However, the potential increase in shrimp landings that could be allowed under **Options a-c** would be expected to result in positive social effects on the commercial shrimp fishery, including increased job opportunities and increased revenue, if fishery conditions improve or landings increase in the future. Additionally, the revised threshold options would be expected to have minimal or no effects on commercial and recreational participants who fish for Gulf red snapper, as the proposed revised thresholds are not expected to negatively affect juvenile red snapper and the overall red snapper stock.

2.1 Action 2 – Revise the Shrimp FMP Management Measures Framework Procedure

Option:

Revise the Shrimp FMP Management Measures Framework Procedure to allow changes to the target effort reduction goal for juvenile red snapper mortality through the standard open framework documentation process. Modify the abbreviated documentation process to allow specification of an ABC recommended by the Council's Science and Statistical Committee (SSC) based on results of a new stock assessment and using the ABC control rule.

Discussion:

The framework procedure provides standardized procedures for implementing management changes pursuant to the provisions of the FMP. There are two basic processes, the open framework process and the closed framework process. Open frameworks address issues where there is more policy discretion in selecting among various management options developed to address an identified management issue, such as changing a size limit to reduce harvest. Closed frameworks address much more specific factual circumstances, where the FMP and implementing regulations identify specific action to be taken in the event of specific facts occurring, such as closing a sector of a fishery after their quota has been harvested.

The framework procedure was last modified in Shrimp Amendment 15. The following changes would be made to the abbreviated documentation process (blue highlight) and the standard documentation process (yellow highlight). The adoption of a framework procedure for addressing effort in the shrimp fishery would generally be expected to facilitate faster corrective action, reducing both the cost of action and pace at which benefits for the action would be received. The full Shrimp FMP Management Framework Procedure can be found in Appendix E.

1. Open framework actions may be implemented in either of two ways, abbreviated documentation, or standard documentation process.
    a. Abbreviated documentation process. Regulatory changes that may be categorized as a routine or insignificant may be proposed in the form of a letter or memo from the Council to the Regional Administrator containing the proposed action, and the relevant biological, social and economic information to support the action. If multiple actions are proposed, a finding that the actions are also routine or insignificant must also be included. If the RA concurs with the determination and approves the proposed action, the action will be implemented through publication of appropriate notification in the Federal Register. Actions that may be viewed as routine or insignificant include, among others:
        i. Reporting and monitoring requirements,
        ii. Permitting requirements,
        iii. Gear marking requirements,
        iv. Vessel marking requirements,
        v. Restrictions relating to maintaining fish in a specific condition (whole

condition, filleting, use as bait, etc.),

vi. Size limit changes of not more than 10% of the prior size limit,
vii. Vessel trip limit changes of not more than 10% of the prior trip limit,
viii. Closed seasons of not more than 10% of the overall open fishing season,
ix. Restricted areas (seasonal or year-round) affecting no more than a total of 100 square nautical miles,
x. Respecification of ACL, ACT or quotas that had been previously approved as part of a series of ACLs, ACTs or quotas,
xi. Specification of ABC, MSY, OY, and associated management parameters (such as overfished and overfishing definitions) where new values are calculated based on previously approved specifications,
xii. Gear restrictions, except those that result significant changes in the fishery, such as complete prohibitions on gear types,
xiii. Quota changes of not more than 10%, or retention of portion of an annual quota in anticipation of future regulatory changes during the same fishing year.

b. Standard documentation process. Regulatory changes that do not qualify as a routine or insignificant may be proposed in the form of a framework document with supporting analyses. Non-routine or significant actions that may be implemented under a framework action include:
   i. Specification of ACTs or sector ACTs, and modifications to ACL/ACT control rule,
   ii. Specification of acceptable biological catch (ABC) and ABC control rules,
   iii. Rebuilding plans and revisions to approved rebuilding plans,
   iv. Changes specified in section 4(a) that exceed the established thresholds,
   v. Changes to AMs including:
      In-season AMs
      1. Closures and closure procedures
      2. Trip limit changes
      3. Implementation of gear restrictions

      Post-season AMs
      4. Adjustment of season length
      5. Implementation of closed seasons/time periods
      6. Adjustment or implementation of trip or possession limits
      7. Reduction of the ACL/ACT to account for the previous year overage
      8. Revoking a scheduled increase in the ACL/ACT if the ACL was exceeded in the previous year
      9. Implementation of gear restrictions
      10. Reporting and monitoring requirements
   vi. Changes to the target effort reduction goal for juvenile red snapper mortality.

No direct physical or biological effects would be expected from modifications of the framework procedure. Changes in effort levels could change harvest levels, either increasing or decreasing the impact on the physical and biological environments. If modifications increase the ease with which regulations can be implemented as needed, long-term benefits would increase. Modifying the framework procedure offers greater management flexibility by allowing a more timely

response to new information and, therefore, are expected to offer greater long-term benefits to the physical and biological environments.

Modifying the framework procedure is not expected to result in direct economic effects to fishermen, as this is a procedural change and specific changes to the target effort reduction goal for juvenile red snapper mortality or to the ABC are not specified. Indirect effects would be anticipated in that the timelines for changing the target effort reduction goal and for specifying an ABC would be shortened, which would reduce costs to the government. However, the anticipated cost reductions to the government from a shorter timeline cannot be quantified. In addition, any economic benefits or costs to fishermen stemming from changes either to the target effort reduction goal or to the ABC would be expected to begin accruing sooner, due to an earlier implementation date.

The proposed option to revise the framework procedure would likely have minimal social effects for participants in the commercial shrimp fishery, or commercial and recreational participants targeting red snapper, in the short term. However, the revised procedure may allow for more timely revisions to the threshold in response to changes in the shrimp fishery or the red snapper fishery, which would be more beneficial to the participants in the fisheries.

CHAPTER 3. REGULATORY IMPACT REVIEW ANALYSIS

CHAPTER 4. REGULATORY FLEXIBILITY ACT ANALYSIS

CHAPTER 5. LIST OF AGENCIES AND PERSONS CONSULTED

PREPARERS

Name	Expertise	Responsibility	Agency
Morgan Kilgour	Fishery Biologist	Co-Team Lead – amendment development, introduction	GMFMC
Frank Helies	Fishery Biologist	Co-Team Lead – amendment development	SERO
Mike Travis	Economist	Economic analysis, regulatory flexibility analysis , reviewer	SERO
Matt Freeman	Economist	Economic analysis, regulatory impact review and reviewer	GMFMC
Ava Lasseter	Anthropologist	Social analyses and reviewer	GMFMC
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Joelle Godwin	Technical Writer/Editor	Regulatory writer	SERO
Rick Hart	Fisheries Biologist	Statistical analyses, reviewer	SEFSC
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-Southeast Fisheries Science Center
-Southeast Regional Office
    -Protected Resources
    -Habitat Conservation
    -Sustainable Fisheries
NOAA General Counsel
U.S. Coast Guard

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APPENDIX A. THE IMPACT OF A REDUCTION IN SHRIMP EFFORT THRESHOLDS ON SEDAR 52 GULF OF MEXICO RED SNAPPER CATCH LIMIT PROJECTIONS

Southeast Fisheries Science Center
July 11, 2018

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Executive summary

The Gulf of Mexico Fishery Management Council requested an evaluation of the impact of potential increases in shrimp effort (or shrimp days) on the red snapper resource. Results from new projections of the SEDAR 52 assessment indicate that increasing shrimp effort by 8% (i.e., reducing the shrimp effort threshold to 60% of 2001 – 2003 average levels) would be unlikely to substantially impact ABCs for Gulf of Mexico red snapper. Further increases in effort were also evaluated to determine at what threshold value a substantial impact would occur. Overall, moderate increases in shrimp effort are unlikely to alter rebuilding schedules or ABCs, while allowing effort to return to 2001 – 2003 levels would cause substantial declines in ABCs.

1. Introduction

In a memo dated April 16, 2018, the Gulf of Mexico Fishery Management Council (GMFMC) requested the Southeast Fishery Science Center (SEFSC) to perform a series of alternate projections to demonstrate the impact of an increase in shrimp effort (analogous to shrimp days) on acceptable biological catches (ABCs) for the Gulf of Mexico red snapper fishery. Due to bycatch of juvenile red snapper in the shrimp fishery, Amendment 14 to the Shrimp Fishery Management Plan required a reduction of shrimp effort in areas where red snapper bycatch was high (i.e., 10-30 fathom depth zones in statistical areas 10-21 in the Gulf of Mexico). Effort reductions of 74% from the 2001-2003 average were initially required and updated in 2011 to 67% with a long-term target of 60% by 2032 (i.e., the target rebuilding date for red snapper). Although red snapper is still in a rebuilding plan (due to its being below the SSB_{MSY} proxy of SPR 26%), it is no longer considered overfished, because it is above the minimum stock size threshold (MSST) of 0.5 * $SSB_{SPR26\%}$ (SSB_{2016} / MSST = 1.41). Therefore, the GMFMC is interested in lowering the target shrimp effort reduction thresholds in the Gulf of Mexico. Based on the request to investigate the impact of increasing shrimp effort on Gulf of Mexico red snapper rebuilding schedules and ABCs, the SEFSC performed a series of alternate ABC projections where shrimp bycatch levels were increased by various proportions compared to the 2001 – 2003 baseline levels.

2. Methods

Deterministic projections were run using the final SEDAR 52 Stock Synthesis 3 (SS3; Methot 2015; Methot and Wetzel 2013) base model accepted by the Gulf of Mexico SSC (SEDAR

2018a). Projection settings followed the methods outlines in the SEDAR 52 projections document as described in the OFL and ABC section therein (SEDAR 2018b). Projections began in 2017 using the same parameter values and population dynamics as the base model. A full description of the model settings can be found in **Table 1**. Because the base model assumes a fixed steepness of essentially 1.0, the projections assumed that forecasted recruitment would continue at recent average levels (i.e., projected recruitment was near the 'virgin' recruitment level for the recent productivity regime, 1984 – 2016, of 163 million fish) and historical average recruitment apportionment levels were assumed (i.e., 34% to the east and 66% to the west). For all years of the projections it was assumed that recent fishery dynamics would continue indefinitely including maintaining a 51% to 49% allocation of commercial to recreational catch. The selectivity for each fleet was taken from the terminal timeblock and relative harvest rates for the directed fisheries were assumed to stay in proportion to the terminal three year average (2013 – 2016) values. Similarly, discarding and retention practices were assumed to continue as they had in the three most recent years (2013 - 2016). The projected fishing mortality levels for the six bycatch fleets (shrimp bycatch, recreational closed season, and commercial closed season/no-IFQ) were assumed to be the same as in 2016 (i.e., fixed at their associated 2016 values; see **Figure 1** for terminal year relative fishing mortality rates by fleet) in the Base projections, but the fishing mortality for the shrimp bycatch fleets were varied depending on the scenario (as outlined below and in **Table 2**).

For SPR-based analyses, the harvest rate (total number killed / total abundance) that led to a gulfwide SPR of 26% (i.e., SPR = $(SSB/R)/(SSB_0/R_0)$= 0.26 which is equivalent to SSB/SSB_0 when steepness = 1.0 and recruitment is constant) was obtained by iteratively adjusting yield streams. Basically, the fishing mortality rates exerted by the directed fleets were scaled up or down by the same proportional amount (with the fishing mortality rates exerted by the bycatch and discard fleets held constant) until the fishing mortality that achieved a SPR of 26% was obtained.

Overfishing limits (OFLs) were calculated as the median (50^{th} percentile) of the probability density function (PDF) of retained yield (millions of pounds) using the projection of $F_{SPR26\%}$ (i.e., the yields that achieved a SPR of 26% in equilibrium). ABCs were obtained through rebuilding projections based on a $F_{Rebuild}$ that achieved a SPR of 26% by 2032, where the ABC was calculated assuming a probability of overfishing (P*) of 0.40 (i.e., the 40^{th} percentile of the PDF of the landings in retained yield from $F_{Rebuild}$). All projections included 2017 provisional landings (15.36 million pounds) and a fully utilized 2018 ACL (13.74 million pounds). Uncertainty in derived quantities (including retained yield) was carried through the projections from the parameter estimation phase in the stock assessment model and represented the approximate variance from the inversion of the Hessian matrix. The probability density function (PDF) and 95% confidence intervals are calculated assuming a normal distribution of the derived quantity.

A total of five sensitivity runs were carried out. Each examined different increases in the level of shrimp bycatch fishing mortality (as a proxy for an increase in effort). Runs were compared to the base model runs used for setting ABCs and OFLs through projected yield streams and associated SPR values from 2019 (the first year of catch advice set using the SEDAR 52 projections) to 2032 (the rebuilding date for Gulf of Mexico red snapper).

Although the initial GMFMC request asked for 1% decrements from the current 67% reduction in shrimp effort to 60%, initial explorations indicated that the maximum decrement in shrimp effort threshold requested (i.e., 60%) resulted in mostly negligible reductions in ABCs.

Therefore, it was determined that a more informative analysis would be to perform a handful of sensitivity runs with more extreme increases in shrimp effort ranging from the maximum reduction threshold requested (i.e., a 60% reduction from the 2001 – 2003 average effort) to a 0% reduction (including intermediate values representing 56% and 40% reductions from the 2001 – 2003 average).

A number of assumptions needed to be made to translate percent increases in shrimp effort to percent increases in associated shrimp bycatch fishing mortality (i.e., the fixed fishing mortality values used in the projections). The major assumption was that fishing mortality was directly proportional to fishing effort and that a percent increase in effort (or shrimp days) represented a matching percent increase in fishing mortality rates. Secondly, it was assumed that a percent increase in total effort corresponded to an equal increase in effort in both regions. Because the assessment model includes two regions, east and west Gulf of Mexico, each with its own shrimp bycatch fleet, it was necessary to scale the fishing mortality in each region. Unfortunately, the shrimp effort increases outlined in Amendment 14 were associated with statistical areas 10-21, which intersected the statistical areas assumed for the eastern and western Gulf of Mexico in the SEDAR 52 assessment model (i.e., east corresponded to areas 1-12 and west corresponded to areas 13-21). Therefore, without further guidance as to the relative increases in effort by area, it was necessary to assume an equal proportional increase in each area. Additionally, because of the mismatch in statistical areas for officially calculating the relative decrease in effort from the 2001 – 2003 levels compared to the effort values used in the SEDAR 52 assessment, the relative reductions varied slightly between methods. Based on statistical zones 10 – 21 (i.e., those used in Amendment 14), there has been a 69% reduction in effort. However, using areas 1-21 (i.e., the total effort used in the SEDAR 52 assessment), there has only been a 63% reduction in effort compared to the 2001 -2003 average levels.

It is important to understand that the relationship between the percent change in the threshold effort level and the change in effort needed to achieve that threshold is not linear, because the distribution of effort between regions varies among the two time periods (i.e., the eastern gulf represents 15% of the shrimp effort in 2016, whereas it represented 24% during the 2001 – 2003 baseline period). Thus, because effort changes are assumed proportional among regions, the relationship between the percent change from baseline levels (i.e., the threshold value) and the percent change in effort required to achieve those threshold values is not directly proportional (i.e., to move from a 63% threshold to a 60% threshold requires an 8% increase in gulfwide effort).

Runs were carried out representing a 60% reduction compared to the SEDAR 52 total effort levels from 2001 – 2003 (i.e., matching the maximum threshold reduction and maximum percentage increase in effort of 8% requested by the GMFMC; *Reduce_60*), a 56% reduction from the SEDAR 52 total effort levels from 2001 -2003 (*Reduce_56*), a 40% reduction from the SEDAR 52 total effort levels from 2001 -2003 (*Reduce_40*), and a 0% reduction (i.e., effort equivalent to that in 2001 – 2003, *Reduce_0*; see **Table 2** for a list of scenarios and associated fishing mortality values). Given the assumptions required to translate effort (shrimp day) increases into associated fishing mortality increases (i.e., that they are proportional), a 0% reduction does not result in fishing mortality values for the shrimp bycatch fleets that match the 2001 -2003 average estimated shrimp bycatch fishing mortalities from the SEDAR 52

assessment. An additional scenario (*Asses_F_2001_2003*) was thus carried out that utilized the estimated average shrimp bycatch fishing mortality rates for 2001 to 2003 from the SEDAR 52 assessment as an alternate approach to projecting the dynamics of the shrimp fleets during the baseline period (i.e., 2001 – 2003).

3. Results

Increasing shrimp bycatch effort within the limits proposed in the GMFMC memo (i.e., reducing the threshold to 60% or increasing effort by 8%) has relatively minimal impacts on ABCs. The *Reduce_60* and *Reduce_56* scenarios decreased catches by approximately 100,000 and 200,000 pounds per year, respectively, over the course of the red snapper rebuilding period (**Table 3**) and had almost no impact on the resulting SPR values (**Table 4**). Intermediate increases in shrimp effort (e.g., the *Reduce_40* scenario) had a stronger influence and resulted in a loss of about a million pounds per year in the ABC over the rebuilding period. Both the *Reduce_0* and the *Asses_F_2001_2003* scenarios demonstrated similar results with losses in ABC of about 2.5 million pounds per year, but with a maximum of 3 million pounds in 2019 (the first year of catch advice).

4. Discussion

Results indicate that increasing shrimp effort (or shrimp days) by the amounts proposed in the GMFMC memo would be unlikely to substantially impact ABCs for Gulf of Mexico red snapper. Allowing shrimp effort to increase back to the baseline levels from 2001 – 2003 would cause strong declines in ABC levels. Overall, moderate changes in shrimp bycatch levels are unlikely to alter rebuilding schedules or ABCs.

As described in the methods, bycatch and discard fleets are treated in a similar manner as natural mortality in the projections. This implies that retained yield by the directed fleets is maximized following the removals due to the bycatch/discard fleets. Given the way that bycatch and discard fleets are handled, resultant ABCs will typically increase when bycatch/discards decrease and vice versa. The reason for this is that total dead removals which achieve a desired SPR rebuilding target are relatively invariant, and the model can trade removals between bycatch/discard or directed fleets. In the current projections, as bycatch increased the resulting retained yield (ABCs) had to decrease to maintain the same level of dead removals in order to achieve the rebuilding target.

Although shrimp bycatch still represents one of the larger sources of mortality for red snapper (particularly in the western region), mortality due to discards from the recreational fleets during closed seasons (especially in the eastern region) is now much higher (**Figure 1**). The increase in recreational closed season discards over the last decade has acted to diminish the impact of shrimp bycatch levels on ABCs and rebuilding schedules. Additionally, compared to previous assessments and associated projections (e.g., prior to SEDAR 31), the relatively high natural mortality values assumed for age-0 and 1 fish (i.e., those ages primarily caught as bycatch in shrimp trawls) likely acts to additionally reduce the impact of shrimp bycatch on rebuilding schedules. Because a higher proportion of these juvenile fish are assumed to die from natural

causes, shrimp bycatch has a lesser impact on the resource, and moderate increases in shrimping effort is unlikely to greatly impact ABCs.

There are a number of important caveats for these projections. First, these calculations do not account for the highly variable nature of recruitment events nor the fundamental relation between adult spawners and subsequent recruits. Projections are completely deterministic and based on the assumption that future recruitment will remain constant at recent averages (i.e., steepness is approximately 1.0). The constant recruitment assumption is appropriate for short-term projections where SSB is not likely to decrease rapidly, but can lead to inappropriate long-term or equilibrium projections. Additionally, the multiple assumptions required to translate increases in shrimp effort into associated increases in shrimp bycatch fishing mortality (i.e., that they are directly proportional) along with the slight differences in how effort is tallied between the assessment model and Amendment 14 imply that these results should only be used for informational purposes. The resultant ABCs should not be used for setting management advice without more detailed analyses.

5. Acknowledgements

The SEDAR 52 assessment would not have been possible without the efforts of the numerous SEFSC, SERO, and GMFMC staff along with the many academic and research partners involved throughout the Gulf of Mexico. In particular, those who helped compile the documents and input data sets including: Julie Neer (SEDAR Coordinator); Ryan Rindone (Management History); Refik Orhun and Beth Wrege (Commercial Catch); Vivian Matter and Kelly Fitzpatrick (Recreational Catch and Discards); Kevin McCarthy (Commercial discards); Adyan Rios and Skyler Sagarese (Recreational CPUE); Robert Allman, Gary Fitzhugh, and Linda Lombardi-Carlson (Life History); Adam Pollack, Walter Ingram, Kevin Thompson, Matt Campbell, David Hanisko, Sean Powers, John Walter, and Mandy Karnauskas (Fishery Independent Indices); Rick Hart and Jeff Isely (Shrimp bycatch); Ching-Ping Chih (Size and Age composition); Matthew Campbell and Beverly Sauls (Discard mortality); Dominique Lazarre (Headboat Discard Length Frequency); and Elizabeth Scott-Denton (Shrimp Bycatch Length Frequency).

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7. Tables

Table 1. Summary of projection settings and equations. Citations to Tables and Figures refer to those in the SEDAR 52 stock assessment report (SEDAR 2018a,b).

Derived quantity	Equation	Parameter values
Recruitment (R)	$R_{Reg,Year} = P_{Area}\frac{4hR_0SSB_{Year}}{SSB_0(1-h)+SSB_{Year}(5h-1)}$	P_{East} = 0.23, P_{West} = 0.77, h = 0.99, R_0 = 163 million fish
Growth Curve	$L(t) = L_\infty\left[1-e^{-k(t-t_0)}\right]$	L_∞ = 85.64cm, k = 0.19yr^{-1}, t_0 = -0.39, See **Figure 2.4**
Weight-Length Relationship	$Weight = aL^b$	a = 1.7E-5, b = 3, See **Figure 2.5**
Fecundity-at-Age (Fec)	Input	See **Table 2.3**
Selectivity (S)	Input	See **Figure 4.9**
Retention (Ret)	Input	See **Figure 4.13**
Discard Mortality (DM)	Input	See **Table 2.2**
Natural Mortality (M)	Input	See **Table 2.1**
Directed Fishing Mortality (F_{Dir}) by Fleet	$F^{Fleet}_{Dir,Reg,Age,Year} = S^{Fleet}_{Dir,Reg,Age}F^{Fleet}_{Dir\_Mult,Reg,year}Ret^{Fleet}_{Dir,Reg,Age}$	Directed Fleets are HL, LL, HBT, and MRIP
Directed Discard Fishing Mortality (F_{Disc}) by Fleet	$F^{Fleet}_{Disc,Reg,Age,Year} = F^{Fleet}_{Dir\_Mult,Reg,year}(1-Ret^{Fleet}_{Dir,Reg,Age})\,DM^{Fleet}_{Dir}$	Fishing mortality due to open season discards for a directed fleet
Total Directed Fishing Mortality (F_{Tot_Dir}) by Fleet	$F^{Fleet}_{Tot\_Dir,Reg,Age,Year} = F^{Fleet}_{Dir,Reg,Age,Year} + F^{Fleet}_{Disc,Reg,Age,Year}$	Total fishing mortality for a directed fleet
Bycatch/Closed Season Discard Fishing Mortality (F_{Byc}) by Fleet	$F^{Fleet}_{Byc,Reg,Age,Year} = S^{Fleet}_{Byc,Reg,Age}F^{Fleet}_{Byc\_Mult,Reg,year}$	Bycatch and Closed Season Discard Fleets are C_No_IFQ, R_Closed, and SHR
Total Fishing Mortality (F_{Tot})	$F_{Tot,Reg,Age,Year} = \sum_{Fleet} F^{Fleet}_{Tot\_Dir,Reg,Age,Year} + F^{Fleet}_{Byc,Reg,Age,Year}$	Total Fishing Mortality Summed Across All Fleets
Total Mortality (Z)	$Z_{Reg,Age,Year} = F_{Tot,Reg,Age,Year} + M_{Age}$	Total Mortality Summed Across All Fleets
Abundance-at-Age (N)	$N_{Reg,Age+1,Year+1} = N_{Reg,Age,Year}e^{-Z_{Reg,Age,Year}}$	Total Abundance by Region
Spawning Stock Biomass (SSB)	$SSB_{Year} = \sum_{Reg}\sum_{Age=0}^{20}(Fec_{Age}N_{Reg,Age,Year}e^{-0.5Z_{Reg,Age,Year}})$	Note that Mortality is Discounted for Midyear Spawning
Retained Catch-at-Age (C) by Fleet	$C^{Fleet}_{Dir,Reg,Age,Year} = N_{Reg,Age,Year}(1-e^{-Z_{Reg,Age,Year}})\frac{F^{Fleet}_{Dir,Reg,Age,Year}}{Z_{Reg,Age,Year}}$	Retained Catch for a Directed Fleet
Retained Yield (Y) by Fleet	$Y^{Fleet}_{Dir,Reg,Year} = \sum_{Age=0}^{20}\overline{W^{Fleet}_{Age}}C^{Fleet}_{Dir,Reg,Age,Year}$	See SS3 Manual (Methot 2015) for a Complete Description of the Length Integrated Fleet-Specific Weight-at-Age (W)
Spawning Potential Ratio (SPR)	$SPR = \frac{\frac{SSB}{R}}{\frac{SSB_0}{R_0}}$	SSB_0 = 4.72E+15 eggs

Table 2. Scenarios and associated fishing mortality rates. The *Asses_F_2001_2003* scenario uses the estimated average shrimp bycatch fishing mortality rates for 2001 to 2003 from the SEDAR 52 assessment as an alternate approach to projecting the dynamics of the shrimp fleets during the baseline period. Therefore, the percent change is not in shrimp days, but the change in actual fishing mortality rates from the assessment model.

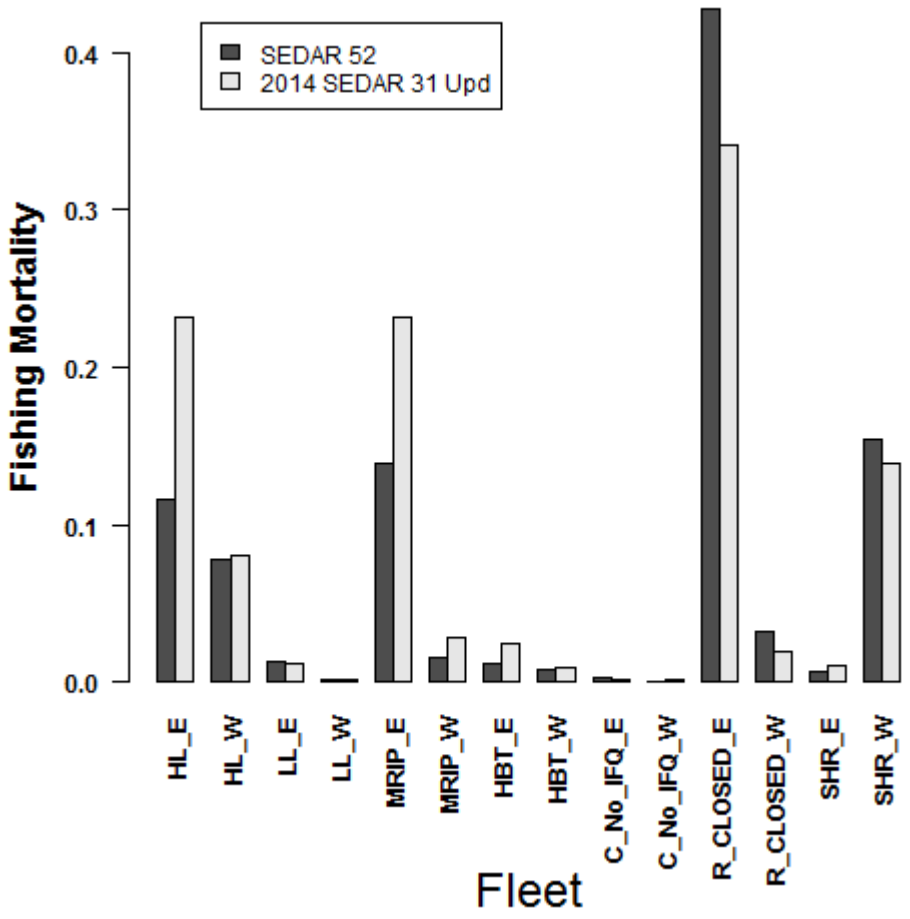
Scenario Run	SEDAR 52 Base	Reduce_60	Reduce_56	Reduce_40	Reduce_0	Assess_F_2001_2003
% Reduction In Gulfwide Shrimp Days	63%	60%	56%	40%	0%	--
% Increase in Shrimp Days Compared to 2001-2003 Average	--	8%	20%	63%	270%	447% east*, 247% west*
East Shrimp Bycatch F	0.0069	0.0075	0.0083	0.0113	0.0187	0.0310
West Shrimp Bycatch F	0.1537	0.1660	0.1844	0.2505	0.4150	0.3797

*These values represent changes in fishing mortality rates not shrimp days.

Table 3. ABCs (in millions of pounds whole weight) for each of the scenarios.

	ABC					
Year	**SEDAR 52**	**Reduce_60**	**Reduce_56**	**Reduce_40**	**Reduce_0**	**Assess_F_2001_2003**
2019	16.0	16.0	16.0	14.7	13.1	13.3
2020	15.0	15.0	15.0	13.9	12.5	12.7
2021	14.3	14.3	14.2	13.3	12.0	12.2
2022	13.8	13.7	13.7	12.8	11.5	11.7
2023	13.4	13.3	13.3	12.4	11.1	11.2
2024	13.2	13.1	13.0	12.2	10.7	10.9
2025	13.1	13.0	12.9	12.0	10.6	10.7
2026	13.0	13.0	12.8	12.0	10.5	10.7
2027	13.0	12.9	12.8	12.0	10.5	10.6
2028	13.0	12.9	12.8	11.9	10.5	10.6
2029	13.0	12.9	12.8	11.9	10.5	10.6
2030	13.0	12.9	12.8	11.9	10.4	10.6
2031	13.0	12.9	12.8	11.9	10.4	10.6
2032	13.0	12.9	12.8	11.9	10.4	10.6

	SPR					
Year	**SEDAR 52**	**Reduce_60**	**Reduce_56**	**Reduce_40**	**Reduce_0**	**Assess_F_2001_2003**
2019	0.22	0.22	0.22	0.22	0.22	0.22
2020	0.23	0.23	0.23	0.23	0.23	0.23
2021	0.24	0.24	0.24	0.24	0.24	0.24
2022	0.24	0.24	0.24	0.25	0.25	0.25
2023	0.25	0.25	0.25	0.25	0.25	0.25
2024	0.25	0.25	0.25	0.25	0.26	0.26
2025	0.25	0.25	0.25	0.25	0.26	0.26
2026	0.25	0.25	0.25	0.26	0.26	0.26
2027	0.26	0.25	0.25	0.26	0.26	0.26
2028	0.26	0.26	0.25	0.26	0.26	0.26
2029	0.26	0.26	0.25	0.26	0.26	0.26
2030	0.26	0.26	0.26	0.26	0.26	0.26
2031	0.26	0.26	0.26	0.26	0.26	0.26
2032	0.26	0.26	0.26	0.26	0.26	0.26



F**igure 1.** The terminal year fishing mortalities used in the projections for the SEDAR 52 Base Model (black bars) and the 2014 SEDAR 31 Update Assessment (grey bars). The directed fleet fishing mortalities represent three year averages from the terminal three years of the associated assessment model. The projections assume the directed fleet fishing mortalities are held in a constant proportion based on these values, whereas the bycatch and discard fleet fishing mortalities are fixed at the levels shown here for every year of the projection (except as altered for each scenario; see text and **Table 2** for scenarios and new fishing mortality rates used in each).

APPENDIX B. OTHER APPLICABLE LAW

APPENDIX C. SUMMARY OF PUBLIC COMMENTS RECEIVED

APPENDIX D. BYCATCH PRACTICABILITY ANALYSIS

APPENDIX E. EXISTING SHRIMP FMP FRAMEWORK PROCEDURE

Language for Framework Procedure

This framework procedure provides standardized procedures for implementing management changes pursuant to the provisions of the fishery management plan (FMP). There are two basic processes, the open framework process and the closed framework process. Open frameworks address issues where there is more policy discretion in selecting among various management options developed to address an identified management issue, such as changing a size limit to reduce harvest. Closed frameworks address much more specific factual circumstances, where the FMP and implementing regulations identify specific action to be taken in the event of specific facts occurring, such as closing a sector of a fishery after their quota has been harvested.

Open Framework:

2. Situations under which this framework procedure may be used to implement management changes include the following:
   a. A new stock assessment resulting in changes to the overfishing limit, acceptable biological catch, or other associated management parameters.
      In such instances the Gulf of Mexico Fishery Management Council (Council) may, as part of a proposed framework action, propose an annual catch limit (ACL) or series of ACLs and optionally an annual catch target (ACT) or series of ACTs, as well as any corresponding adjustments to maximum sustainable yield (MSY), optimum yield (OY), and related management parameters.
   b. New information or circumstances.
      The Council will, as part of a proposed framework action, identify the new information and provide rationale as to why this new information indicates that management measures should be changed.
   c. Changes are required to comply with applicable law such as Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), Endangered Species Act (ESA), Marine Mammal Protection Act, or are required as a result of a court order.
      In such instances the Regional Administrator (RA) will notify the Council in writing of the issue and that action is required. If there is a legal deadline for taking action, the deadline will be included in the notification.

3. Open framework actions may be implemented in either of two ways, abbreviated documentation, or standard documentation process.
   a. Abbreviated documentation process. Regulatory changes that may be categorized as a routine or insignificant may be proposed in the form of a letter or memo from the Council to the RA containing the proposed action, and the relevant biological, social and economic information to support the action. If multiple actions are proposed, a finding that the actions are also routine or insignificant must also be included. If the RA concurs with the determination and approves the proposed action, the action will

be implemented through publication of appropriate notification in the Federal Register. Actions that may be viewed as routine or insignificant include, among others:

i. Reporting and monitoring requirements,
ii. Permitting requirements,
iii. Gear marking requirements,
iv. Vessel marking requirements,
v. Restrictions relating to maintaining fish in a specific condition (whole condition, filleting, use as bait, etc.),
vi. Size limit changes of not more than 10% of the prior size limit,
vii. Vessel trip limit changes of not more than 10% of the prior trip limit,
viii. Closed seasons of not more than 10% of the overall open fishing season,
ix. Restricted areas (seasonal or year-round) affecting no more than a total of 100 square nautical miles,
x. Respecification of ACL, ACT or quotas that had been previously approved as part of a series of ACLs, ACTs or quotas,
xi. Specification of MSY, OY, and associated management parameters (such as overfished and overfishing definitions) where new values are calculated based on previously approved specifications,
xii. Gear restrictions, except those that result significant changes in the fishery, such as complete prohibitions on gear types,
xiii. Quota changes of not more than 10%, or retention of portion of an annual quota in anticipation of future regulatory changes during the same fishing year,

b. Standard documentation process. Regulatory changes that do not qualify as a routine or insignificant may be proposed in the form of a framework document with supporting analyses. Non-routine or significant actions that may be implemented under a framework action include:

i. Specification of ACTs or sector ACTs, and modifications to ACL/ACT control rule,
ii. Specification of acceptable biological catch (ABC) and ABC control rules,
iii. Rebuilding plans and revisions to approved rebuilding plans,
iv. Changes specified in section 4(a) that exceed the established thresholds.
v. Changes to AMs including:

In-season AMs

1. Closures and closure procedures
2. Trip limit changes
3. Implementation of gear restrictions

Post-season AMs

4. Adjustment of season length
5. Implementation of closed seasons/time periods
6. Adjustment or implementation of trip or possession limits
7. Reduction of the ACL/ACT to account for the previous year overage
8. Revoking a scheduled increase in the ACL/ACT if the ACL was exceeded in the previous year
9. Implementation of gear restrictions

10. Reporting and monitoring requirements

4. The Council will initiate the open framework process to inform the public of the issues and develop potential alternatives to address the issues. The framework process will include the development of documentation and public discussion during at least one Council meeting.

5. Prior to taking final action on the proposed framework action, the Council may convene its advisory committees and panels, as appropriate, to provide recommendations on the proposed actions.

6. For all framework actions, the Council will provide the letter, memo, or the completed framework document along with proposed regulations to the RA in a timely manner following final action by the Council.

7. For all framework action requests, the RA will review the Council's recommendations and supporting information and notify the Council of the determinations, in accordance with the Magnuson-Stevens Act and other applicable law.

Closed Framework:

1. Consistent with existing requirements in the FMP and implementing regulations, the RA is authorized to conduct the following framework actions through appropriate notification in the Federal Register:
   a. Close or adjust harvest any sector of the fishery for a species, sub-species, or species group that has a quota or sub-quota at such time as projected to be necessary to prevent the sector from exceeding its sector-quota for the remainder of the fishing year or sub-quota season,
   b. Reopen any sector of the fishery that had been prematurely closed,
   c. Implement AMs, either in-season or post-season.
