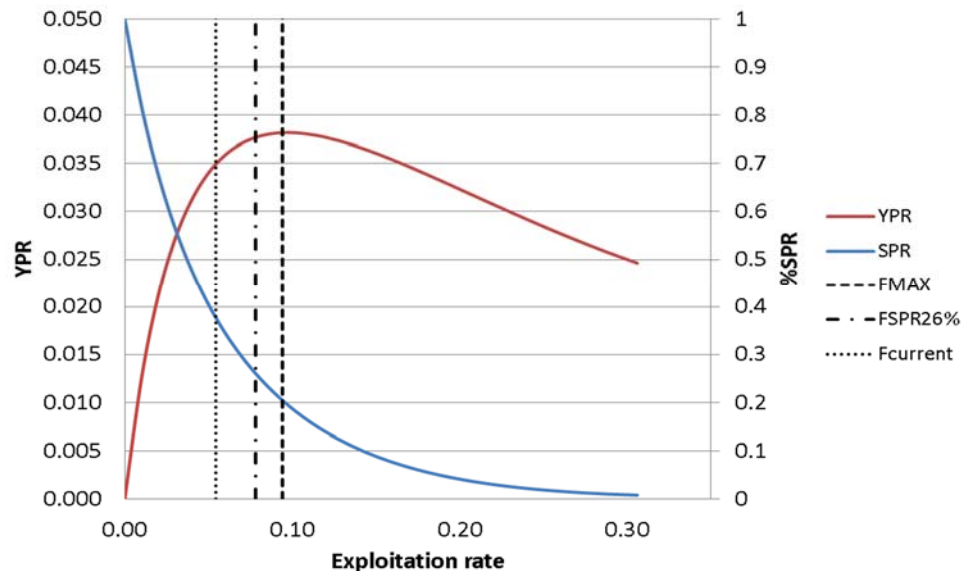


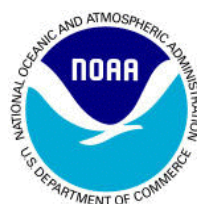
Status Determination Criteria and Optimum Yield for Reef Fish and Red Drum



Pre-Public Hearing Draft Amendment 48 to the Reef Fish Fishery Management Plan Amendment 4 to the Red Drum Fishery Management Plan

Including Environmental Assessment, Fishery Impact Statement,
Regulatory Impact Review, and Regulatory Flexibility Act Analysis

April 2018



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ENVIRONMENTAL ASSESSMENT COVER SHEET

Name of Action

Status Determination Criteria and Optimum Yield for Reef Fish and Red Drum, Amendment 48 to the Reef Fish Fishery Management Plan and Amendment 4 to the Red Drum Fishery Management Plan, including Environmental Assessment, Fishery Impact Statement, Regulatory Impact Review, and Regulatory Flexibility Act Analysis

Responsible Agencies and Contact Persons

Gulf of Mexico Fishery Management Council (Council)	813-348-1630
2203 North Lois Avenue, Suite 1100	813-348-1711 (fax)
Tampa, Florida 33607	gulfcouncil@gulfcouncil.org
Steven Atran (Steven.Atran@gulfcouncil.org)	http://www.gulfcouncil.org

National Marine Fisheries Service (Lead Agency)	727-824-5305
Southeast Regional Office	727-824-5308 (fax)
263 13 th Avenue South	http://sero.nmfs.noaa.gov
St. Petersburg, Florida 33701	
Peter Hood (Peter.Hood@noaa.gov)	

Type of Action

() Administrative
(X) Draft

() Legislative
() Final

Summary/Abstract

ABBREVIATIONS USED IN THIS DOCUMENT

ABC	Acceptable biological catch
ACL	Annual catch limit
ACT	Annual catch target
ALS	Accumulated Landings System
AM	Accountability measures
APA	Administrative Procedures Act
B	Biomass
B _{MSY}	Stock biomass level capable of producing an equilibrium yield of MSY
Council	Gulf of Mexico Fishery Management Council
DLM	Data Limited Method
EA	Environmental Assessment
EEZ	Exclusive Economic Zone
EFH	Essential fish habitat
ELMRP	Estuarine living marine resources program
ESA	Endangered Species Act
F	Instantaneous rate of fishing mortality
FL	fork length
F _{MAX}	Fishing mortality rate corresponding to maximum yield-per-recruit
F _{MSY}	Fishing mortality rate corresponding to an equilibrium yield of MSY
F _{OY}	Fishing mortality rate corresponding to an equilibrium yield of OY
F _{30% SPR}	Fishing mortality corresponding to 30% spawning potential ratio
FMP	Fishery Management Plan
FSAP	Finfish Stock Assessment Panel
GMFMC	Gulf of Mexico Fishery Management Council
M	Mortality
Magnuson-Stevens Act	Magnuson-Stevens Fishery Conservation and Management Act
MFMT	Maximum fishing mortality threshold
MMPA	Marine Mammal Protection Act
MSST	Minimum stock size threshold
MSY	Maximum sustainable yield
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOS	National Ocean Service
NS1	National Standard 1 guidelines
OFL	Overfishing level
OY	Optimum yield
RFA	Regulatory Flexibility Act of 1980
RIR	Regulatory impact review
SDC	Status determination criteria
Secretary	Secretary of Commerce
SEDAR	Southeast Data, Assessment and Review
SEFSC	Southeast Fisheries Science Center
SERO	Southeast Regional Office
SFA	Sustainable Fisheries Act

SSBR	Spawning stock biomass per recruit
SSC	Scientific and Statistical Committee
SPR	Spawning potential ratio

TABLE OF CONTENTS

ENVIRONMENTAL ASSESSMENT COVER SHEET	i
ABBREVIATIONS USED IN THIS DOCUMENT	ii
TABLE OF CONTENTS.....	iv
LIST OF TABLES	vii
LIST OF FIGURES	viii
FISHERY IMPACT STATEMENT	ix
Chapter 1. Introduction	1
1.1 Background.....	1
1.2 Purpose and Need	3
1.3 History of Management	3
Chapter 2. Management Alternatives	7
2.1 Action 1 - Maximum Sustainable Yield (MSY) Proxies	7
Sub-action 1.1. Red snapper	7
Sub-action 1.2. Assessed stocks with MSY proxies that have not been previously assigned via plan amendment	9
Sub-action 1.3. MSY proxies for stock complexes.....	11
Sub-action 1.4. Un-assessed stocks without current MSY proxies	14
2.2 Action 2 - Minimum Stock Size Threshold (MSST)	17
2.3 Action 3 - Maximum Fishing Mortality Threshold (MFMT).....	21
2.4 Action 4 - Optimum Yield (OY).....	23
Chapter 3. Affected Environment.....	26
3.1 Description of the Fishery.....	26
3.1.1 Reef Fish	26
3.1.2 Red Drum.....	31
3.2 Description of the Physical Environment	32
3.3 Description of the Biological/Ecological Environment	35
3.4 Description of the Economic Environment.....	47
3.5 Description of the Social Environment.....	47
3.5.1 Fishing Engagement and Reliance.....	47
3.5.2 Reef Fish Permits.....	51
3.5.3 Environmental Justice.....	55
3.6 Description of the Administrative Environment.....	56

3.6.1	Federal Fishery Management.....	56
3.6.2	State Fishery Management.....	57
Chapter 4.	Environmental Consequences	58
4.1	Action 1: Maximum Sustainable Yield (MSY) Proxies	58
4.1.1	Direct and Indirect Effects on the Physical Environment.....	58
4.1.2	Direct and Indirect Effects on the Biological/Ecological Environment	61
4.1.3	Direct and Indirect Effects on the Economic Environment.....	65
4.1.4	Direct and Indirect Effects on the Social Environment	67
4.1.5	Direct and Indirect Effects on the Administrative Environment	69
4.2	Action 2: Minimum Stock Size Threshold (MSST)	71
4.2.1	Direct and Indirect Effects on the Physical Environment.....	71
4.2.2	Direct and Indirect Effects on the Biological/Ecological Environment	72
4.2.3	Direct and Indirect Effects on the Economic Environment.....	73
4.2.4	Direct and Indirect Effects on the Social Environment	73
4.2.5	Direct and Indirect Effects on the Administrative Environment	75
4.3	Action 3: Maximum Fishing Mortality Threshold (MFMT)	76
4.3.1	Direct and Indirect Effects on the Physical Environment.....	76
4.3.2	Direct and Indirect Effects on the Biological/Ecological Environment	77
4.3.3	Direct and Indirect Effects on the Economic Environment.....	78
4.3.4	Direct and Indirect Effects on the Social Environment	79
4.3.5	Direct and Indirect Effects on the Administrative Environment	79
4.4	Action 4: Optimum Yield (OY).....	80
4.4.1	Direct and Indirect Effects on the Physical Environment.....	80
4.4.2	Direct and Indirect Effects on the Biological/Ecological Environment	81
4.4.3	Direct and Indirect Effects on the Economic Environment.....	82
4.4.4	Direct and Indirect Effects on the Social Environment	82
4.4.5	Direct and Indirect Effects on the Administrative Environment	82
4.5	Cumulative Effects Analysis.....	84
Chapter 5.	Regulatory Impact Review.....	87
Chapter 6.	Regulatory Flexibility ACT Analysis	88
Chapter 7.	Bycatch Practicability Analysis	Error! Bookmark not defined.
Chapter 8.	List of Preparers	89
Chapter 9.	List of Agencies, Organizations and Persons Consulted.....	90
Chapter 10.	References	91

Appendix A. Other Applicable Law	107
Appendix B. Summaries of Public Comments Received	113

LIST OF TABLES

Table 1.3.1. Stocks with SDC assigned.	5
Table 1.3.2. Stock complexes and possible indicator species	6
Table 2.1.1. MSY proxies used in recent assessments.....	9
Table 2.2.1. Reef fish species with estimates of M from stock assessments for the Gulf stocks.	19
Table 2.2.2. Reef fish species with no estimate of M in the Gulf.....	20
Table 2.4.1. Current OY definitions as implemented in plan amendments	24
Table 3.1.1.1. Number and percentage of vessels with a commercial permit for Gulf reef fish by state.	27
Table 3.1.1.2. Commercial landings for several reef fish species in pounds whole weight (2010- 2016).	28
Source: Grouper and tilefish landings from Table 17 in NMFS 2016b, except 2016, which is from SERO Commercial Quotas Catch Allowance Table. Gray triggerfish and greater amberjack landings from NMFS SERO ACL commercial monitoring webpage.....	
Table 3.1.1.3. Minimum size limits, bag limits, and seasons for reef fish species in the Gulf EEZ.	29
Table 3.1.1.4. Number and percentage of vessels with a charter/headboat permit for Gulf reef fish, including historical captain endorsements, by state.....	30
Table 3.1.1.5. Recreational landings for all reef fish (pounds whole weight) by component (2010-2016).....	30
Table 3.1.2.1. Recreational bag limit and size limits of red drum in state waters.	32
Table 3.1.2.2. Recreational landings of red drum by state (pounds whole weight) from 2010 through 2016.	32
Table 3.3.1. Reef fish stock that have assessments and accepted status determinations.	36
Table 3.3.2. Reef fish stocks deemed unsuitable by the SSC for stock status and management advice.	37
Table 3.3.3. Reef fish stocks assessed using data limited methods but without stock status determinations.....	37
Table 3.3.4. Reef fish stocks where data limited assessments were attempted but without stock status determinations.....	37
Table 3.3.5. Status of species in the Reef Fish FMP grouped by family	39
Table 3.3.6. Red drum stock status as of September 30, 2017.....	41
Table 3.3.7. Total Gulf greenhouse gas emissions estimates (tons per year) from oil platform and non-oil platform sources,	44
Table 3.5.2.1. Number of federal for-hire permits for Gulf reef fish including historical captain permits, by state and by year.....	53
Table 3.6.2.1. Gulf state marine resource agencies and Web pages.	57
Table 4.2.5.1. The estimated minimum stock size threshold	76

LIST OF FIGURES

Figure 3.2.1. Physical environment of the Gulf, including major feature names and mean annual sea surface temperature.....	34
Figure 3.3.1. Fishery closure at the height of the <i>Deepwater Horizon</i> MC252 oil spill.....	46
Figure 3.5.1.1. Distribution of reef fish landings by area fished for Gulf reef fish.	48
Figure 3.5.1.2. County commercial fishing engagement and reliance 2014.....	49
Figure 3.5.1.3. Top 20 commercial fishing communities' engagement and reliance.	49
Figure 3.5.1.4. County recreational fishing engagement and reliance 2014.....	50
Figure 3.5.1.5. Top 20 recreational fishing communities' engagement and reliance.	51
Figure 3.5.2.1. Total number of reef fish permits for both commercial and for-hire from 2006-2016.....	52
Figure 3.5.2.2. Distribution of commercially permitted reef fish vessels for Gulf States by community	53
Figure 3.5.2.3. Distribution of charter vessels with federal for-hire permits for Gulf reef fish in Gulf states by community	54
Figure 3.5.2.4. Distribution of headboats with federal for-hire permits for Gulf reef fish by community	55

FISHERY IMPACT STATEMENT

CHAPTER 1. INTRODUCTION

1.1 Background

The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) requires the National Marine Fisheries Service (NMFS) and the Regional Fishery Management Councils to end overfishing, rebuild overfished stocks, and achieve, on a continuing basis, the optimum yield from federally managed fish stocks. These mandates are intended to ensure fishery resources are managed for the greatest overall benefit to the nation, particularly with respect to providing food production, recreational opportunities, and protecting marine ecosystems.

Gulf of Mexico Fishery Management Council

- Responsible for conservation and management of fish stocks
- 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 National Marine Fisheries Service; and 4 non-voting members
- Develops fishery management plans and amendments; and recommends actions to National Marine Fisheries Service for implementation in federal waters.

National Marine Fisheries Service

- Responsible for preventing overfishing while achieving optimum yield
- Approves, disapproves, or partially approves Council recommendations
- Implements regulations in federal waters

Status Determination Criteria and Biological Reference Points

The National Standard 1 (NS1) guidelines require that stocks each have measurable values for minimum stock size threshold (MSST) and maximum fishing mortality threshold (MFMT), collectively known as status determination criteria (SDC). Stocks must also have a maximum sustainable yield (MSY) or proxy, optimum yield (OY), and annual catch limit (ACL). The Gulf of Mexico Fishery Management Council (Council) currently has these reference points defined for some, but not all, stocks (Table 1.3.1). The Generic Sustainable Fisheries Act Amendment (GMFMC 1999) established fishing mortality based reference points for all stocks, but the proposed biomass reference points were disapproved by NMFS. Reference points were subsequently adopted in plan amendments for some stocks as rebuilding plans were needed. For other stocks, stock assessment scientists adopted reference points based on their scientific

judgment, but without being formally adopted by the Council. In order to comply with the Magnuson-Stevens Act and NS1 guidelines, and to provide measurable reference points for determining overfished and overfishing status, MSY proxies, MSST, MFMT, and OY must be established for all stocks. The actions in this amendment are intended to establish reference points where they do not currently exist, and in some cases to consider modifying existing reference points. For some stocks, particularly those that are data-limited, it may be appropriate to combine stocks into a stock complex and assign the biological reference points to the stock complex or to an indicator species for the complex. Five such stock complexes were defined in the Generic Annual Catch Limits/Accountability Measures Amendment (GMFMC 2011a) and are shown in Table 1.3.2.

Maximum Sustainable Yield Proxy

Maximum sustainable yield (MSY) is the amount of fish that can be harvested from the stock each year on a continuing basis. MSY can rarely be calculated with accuracy, so a proxy that can be more readily calculated is usually used that represents a sustainable level of harvest.

Minimum Stock Size Threshold

Minimum stock size threshold (MSST) is the biomass level that a stock can decline to before being declared overfished (stock abundance is too low) and requiring a rebuilding plan. MSST is usually expressed a percentage of the biomass level at MSY or MSY proxy.

Maximum Fishing Mortality Threshold

Maximum fishing mortality threshold (MFMT) is the rate of fishing mortality above which a stock is declared to be experiencing overfishing (fish are being removed at too rapid a rate). MFMT may not exceed the rate of fishing associated with MSY or the MSY proxy.

Optimum Yield

Optimum yield (OY) is a level of harvest that is based on MSY as reduced by any relevant economic, social, or ecological factor, takes into account the protection of marine ecosystems and, in the case of an overfished fishery, provides for rebuilding to a level consistent with producing the MSY or MSY proxy.

Spawning Potential Ratio (SPR)

The spawning potential ratio assumes that a certain amount of fish must survive and spawn in order to replenish the stock.

The spawning potential ratio is calculated as the average number of eggs per fish over its lifetime when the stock is fished compared to the average number of eggs per fish over its lifetime when the stock is not fished.

1.2 Purpose and Need

The purpose of this proposed action is to establish or modify MSY proxies, MSST, MFMT, and OY that are consistent with the current NS1 guidelines for stocks in the Reef Fish and Red Drum Fishery Management Plans.

The need is to have biological reference points that can be used for setting management targets and for determining overfished and overfishing status of the stocks.

1.3 History of Management

Seven reef fish stocks have MSY proxies, MSST, and MFMT established (or proposed and under review by NMFS) as shown in Table 1.3.1. In addition, OY has been established for six of these stocks.

Amendment 1 (GMFMC 1989) established OY as a harvest level for each species which maintains, or is expected to maintain, over time a survival rate of biomass into the stock of spawning age to achieve at least a 20% spawning stock biomass per recruit (SSBR) population level, relative to the SSBR that would occur with no fishing. The SSBR terminology was later changed to spawning potential ratio (SPR). In 1996, the Sustainable Fisheries Act and subsequent National Standard guidelines provided new criteria for defining SDC and biological reference points. The Generic Sustainable Fisheries Act Amendment (GMFMC 1999) proposed new definitions of MSY proxy, MSST, MFMT, and OY for all stocks managed by the Council.

However, NMFS accepted only the fishing mortality rate reference points (MFMT). SPR-based definitions for biomass reference points (MSY proxy, MSST, OY) were rejected on the basis that SPR was not a suitable proxy for biomass (NMFS later accepted the yield when fishing at $F_x \% SPR$ as a suitable proxy where F is the fishing mortality rate). Biomass reference points were assigned on a stock-by-stock basis as stock assessments were completed and a stock was determined to be in need of rebuilding. To date, seven stocks have had acceptable biomass proxies established (Table 1.3.1).

For stocks that did not have accepted biomass reference points in the Generic Sustainable Fisheries Act Amendment or in subsequent amendments, OY remains at the Amendment 1 definition of the yield at 20% SPR. However, this definition may not be consistent with the requirements of the Sustainable Fisheries Act Amendment or current National Standard guidelines.

The terms MSST and MFMT did not exist when Amendment 1 was implemented in 1990. These criteria were added to the National Standard 1 guidelines following passage of the Sustainable Fisheries Act of 1996, which mandated that for each managed species, fisheries managers quantitatively define "overfishing" (certain specified maximum allowed rates of fishing mortality) and "overfished" (depletion below a certain population level). Therefore, stocks other than those in Table 1.3.1 do not have defined SDC. However, Amendment 1 did define overfished and overfishing as follows.

1. A reef fish stock or stock complex is overfished when it is below the level of 20% of the SSBR that would occur in the absence of fishing.
2. When a reef fish stock or stock complex is overfished, overfishing is defined as harvesting at a rate that is not consistent with a program that has been established to rebuild the stock or stock complex to the 20% SSBR level.
3. When a reef fish stock or stock complex is not overfished, overfishing is defined as a harvesting rate that if continued would lead to a state of the stock or stock complex that would not at least allow a harvest of OY on a continuing basis.

As with OY, these definitions may not be consistent with the requirements of the Sustainable Fisheries Act Amendment or current National Standard guidelines.

Table 1.3.1. Stocks with SDC assigned.

Stock	MSY	MSST*x	MFMT	OY	Source
Gag	Yield at F_{MAX}	$0.50*B_{MAX}$	F_{MAX}	Yield at 75% of F_{MAX}	Amendment 30B (GMFMC 2008a)
Red grouper	Yield at $F_{30\% SPR}$	$0.50*B_{30\% SPR}$	$F_{30\% SPR}$	Yield at 75% of F_{MSY}	Secretarial Amendment 1 (GMFMC 2004a)
Red snapper	Yield at $F_{26\% SPR}$	$0.50*B_{MSY}$	$F_{26\% SPR}$	Yield at 75% of $F_{26\% SPR}$	Amendment 22 (GMFMC 2004b) Amendment 27 (GMFMC 2007a)
Vermilion snapper	Yield at $F_{30\% SPR}$	$0.50**B_{30\% SPR}$	$F_{30\% SPR}$	Yield at 75% of $F_{30\% SPR}$	Amendment 23 (GMFMC 2004c) Amendment 47 (GMFMC 2017c)
Gray triggerfish	Yield at $F_{30\% SPR}$	$0.50**B_{30\% SPR}$	$F_{30\% SPR}$	Yield at 75% of $F_{30\% SPR}$	Amendment 30A (GMFMC 2008b)
Greater amberjack	Yield at $F_{30\% SPR}$	$0.50*B_{30\% SPR}$	$F_{30\% SPR}$	Yield at $F_{40\% SPR}$	Secretarial Amendment 2 (GMFMC 2002a)
Hogfish	Yield at $F_{30\% SPR}$	$0.50*B_{30\% SPR}$	$F_{30\% SPR}$	**	Amendment 43 (GMFMC 2016a)

* MSST was set equal to $0.50*B_{MSY proxy}$ in Amendment 44 (GMFMC 2017b).

** For hogfish and other reef fish stocks not listed above, Amendment 1 (GMFMC 1989) established OY as the yield when fishing at 20% SSBR (later, 20% SPR). However, this definition has not been evaluated for consistency with the Sustainable Fisheries Act of 1996.

Biomass may be measured either in terms of stock pounds or in terms of egg production.

Vermilion snapper MSY proxy was set at the yield corresponding to $F_{30\% SPR}$ in Amendment 47 (GMFMC 2017c).

The NS1 guidelines allow SDC and biological reference points to be established for stock complexes as well as individual stocks. Stock complexes should, where practicable, consist of stocks with similar geographic distribution, life history characteristics, and vulnerabilities to fishing pressure. The MSY proxy, MSST, MFMT, and OY can be set for either the stock complex as a whole, or for an indicator species that is part of the stock complex. The Generic ACL/Accountability Measures Amendment defined five stock complexes (Table 1.3.2). Possible indicator species are those that have had stock assessments.

Table 1.3.2. Stock complexes and possible indicator species

Stock Complex	Species	Possible Indicator Species
Tilefishes	Tilefish (Golden) Blueline Tilefish Goldface Tilefish	Tilefish (Golden)
Other Shallow-water Grouper	Black Grouper Scamp Yellowmouth Grouper Yellowfin Grouper	Black Grouper
Deep-water Grouper	Yellowedge Grouper Warsaw Grouper Snowy Grouper Speckled Hind	Yellowedge Grouper
Jacks	Lesser Amberjack Almaco Jack Banded Rudderfish	none
Mid-water Snappers	Silk Snapper Wenchman Blackfin Snapper Queen Snapper	none

The NSI guidelines state that an indicator stock is a stock with measurable SDC that can be used to help manage and evaluate unassessed stocks that are in a stock complex. Possible indicator species are those that have had stock assessments.

CHAPTER 2. MANAGEMENT ALTERNATIVES

2.1 Action 1 - Maximum Sustainable Yield Proxies

Sub-action 1.1. Red snapper

Alternative 1. No action. The MSY proxy for red snapper will remain the yield when fishing at $F_{26\% \text{ SPR}}$ where F is the fishing mortality rate.

Alternative 2. The MSY proxy for red snapper shall be

- Option 2a:** The yield when fishing at $F_{20\% \text{ SPR}}$
- Option 2b:** The yield when fishing at $F_{30\% \text{ SPR}}$
- Option 2c:** The yield when fishing at $F_{40\% \text{ SPR}}$

Discussion:

Note: There are 7 stocks that have previously been assigned MSY proxies via plan amendment (Table 1.3.1). With the exception of red snapper, those MSY proxies will not be revisited here. The Gulf of Mexico Fishery Management Council (Council) has indicated a desire to reconsider the red snapper MSY proxy. Therefore, this sub-action is specific to red snapper.

The Council currently uses a maximum sustainable yield (MSY) proxy for red snapper of the yield when fishing at $F_{26\% \text{ SPR}}$. Originally, in Amendment 1 (1989), the Council adopted overfished and overfishing criteria based on a spawning stock biomass level or a rate of fishing that would cause the stock to drop below 20% of the spawning stock biomass per recruit (SSBR) that would occur in the absence of fishing. Amendment 3 (1991) changed the terminology to 20% spawning potential ratio (SPR: which allows stock status to be measured in terms of egg production). Following passage of the Sustainable Fisheries Act (SFA) of 1996, the Council attempted to redefine MSY for reef fish in the Generic Sustainable Fisheries Act Amendment (GMFMC 1999) as 26% static SPR for red snapper, 50% static SPR for Nassau grouper and goliath grouper, and 30% static SPR for all other reef fish and red drum. A Finfish Stock Assessment Panel (FSAP 1998) had recommended 30% static SPR as the MSY proxy for red snapper. However, the 26% static SPR proxy for red snapper was based on a recommendation by the Reef Fish Stock Assessment Panel (RFSAP 1998) that 26% static SPR was an appropriate level for red snapper. Nevertheless, the National Marine Fisheries Service (NMFS) rejected biomass reference points based on SPR because it did not consider SPR to be a biomass-based reference point¹.

The current red snapper MSY proxy is the yield when fishing at $F_{26\% \text{ SPR}}$ and was formally adopted in Amendment Reef Fish 27/Shrimp 14 (GMFMC 2007), which revised the red snapper rebuilding plan. This was based on analysis conducted by the Southeast Fisheries Science Center (SEFSC) in 2005, which indicated that this SPR level would maximize yield under a

¹ Letter from NMFS to Council dated November 17, 1999

scenario known as the MSY-link, in which all sources of fishing mortality, including bycatch mortality, are linked so that they increase or decrease by the same proportions. However, this scenario is unrealistic, and the Council decided that it was necessary to revisit the MSY proxy for red snapper.

The Scientific and Statistical Committee (SSC) has recommended that the MSY proxy for red snapper be set at the yield corresponding to $F_{30\% \text{ SPR}}$. However, it recognizes that $F_{26\% \text{ SPR}}$ is very close to the recommended level. In May 2015, after evaluating several potential MSY proxies for red snapper, the SSC concluded that there is insufficient biological evidence for a better MSY proxy than what is currently used by the Council (the yield corresponding to $F_{26\% \text{ SPR}}$) for Gulf of Mexico (Gulf) red snapper (GMFMC 2015a).

Recently, the SEFSC conducted an analysis of proxies that provided the greatest probability of achieving MSY under uncertainty about the stock-recruit steepness (Harford et al. 2017). Seventeen stocks from the southeastern U.S. and Caribbean were examined, incorporating both gonochoristic (no sex change) and hermaphroditic (sex change) species. For gonochoristic species (triggerfishes, jacks, snappers, and tilefishes), the simulations indicated that a fishing mortality rate of $F_{40\% \text{ SPR}}$ had the greatest probability of achieving MSY on a long-term basis. For hermaphroditic species (groupers), $F_{50\% \text{ SPR}}$ had the greatest probability.

Alternative 1 maintains the existing MSY proxy of the yield at $F_{26\% \text{ SPR}}$ for red snapper. This proxy is supported by analysis conducted in 1998 and in 2005 as discussed above.

Alternative 2 contains three options to change the red snapper MSY proxy.

Option 2a would establish the yield when fishing at $F_{20\% \text{ SPR}}$ as the proxy. This is the least conservative proxy considered by the SSC for analysis. The SSC has stated that yield streams at conditional SPRs less than 26% provide short-term increases in acceptable biological catch (ABC), but over the longer term target SPRs of 20% to 30% tend to converge to similar ABC levels (GMFMC 2015a). However, over the long-term, fishing at target SPR levels less than 30% will result in declines in the eastern Gulf stock of red snapper, while in the west the SPR will increase at all SPR levels between 20% and 40% (GMFMC 2015a).

Option 2b would establish the yield when fishing at $F_{30\% \text{ SPR}}$ as the proxy. This is the proxy used for most finfish species by the Council. During a presentation on red snapper MSY proxies to the Council's Reef Fish Committee in June 2015, SSC Chair Dr. Luiz Barbieri stated, "30% is the value that we think is the minimum that could be used and guarantee long-term stability of the stock and resilience in terms of the ability to withstand impacts, environmental variability, or some issues." Dr. Barbieri went on to state that the SSC felt 26% SPR was close enough to 30% that the Council could continue with that proxy. However, the SSC did not feel that anything lower than 26% would be advisable. There would be an increased risk to the stock, but that risk level cannot be quantified.²

² Minutes of the June 9-10, 2015 Reef Fish Committee at the June 2015 Council meeting in Key West, Florida.

Option 2c would establish the yield when fishing at $F_{40\% SPR}$ as the proxy. As discussed above, recent analysis by the SEFSC suggests that a proxy of $F_{40\% SPR}$ provides the greatest probability of achieving MSY on a long-term basis (Harford et al. 2017).

Relative to **Alternative 1**, of the options under **Alternative 2**, **Option 2a** would result in a higher annual yield, but also a higher risk of failing to maintain MSY over the long term.

Option 2b would result in a lower annual yield, but also a lower risk of failing to maintain MSY over the long term. **Option 2c** would result in the lowest annual yield, but also the lowest risk of failing to maintain MSY over the long term.

Sub-action 1.2. Assessed stocks with MSY proxies that have not been previously assigned via plan amendment

Alternative 1. No action. The MSY proxy for assessed stocks included in this group (black grouper, yellowedge grouper, mutton snapper, yellowtail snapper, and tilefish) will remain undefined.

Alternative 2. The MSY proxy for assessed stocks included in this group (black grouper, yellowedge grouper, mutton snapper, yellowtail snapper, and tilefish) will be the MSY proxy used by the SSC in the most recent SEDAR stock assessment for stock status determination, as shown in Table 2.1.1.

Alternative 3. The MSY proxy for the hermaphroditic species black grouper and yellowedge grouper will be the yield at $F_{50\% SPR}$. The MSY proxy for the gonochoristic species will be the yield at $F_{40\% SPR}$.

Table 2.1.1. MSY proxies used in recent assessments

Stock	MSY Proxy: Assessed Yield at
Grouper, Black (IFQ)	$F_{SPR 30\%}$
Grouper, Yellowedge (IFQ)	$F_{SPR 30\%}$
Snapper, Mutton	$F_{SPR 30\%}$
Snapper, Yellowtail	$F_{SPR 30\%}$
Tilefish (IFQ)	$F_{SPR 30\%}$

Notes:

Black grouper: $F_{30\% SPR}$ was used in SEDAR 19 (2010)

Yellowedge grouper: $F_{30\% SPR}$ was used for the baseline run in SEDAR 22 (2011b), but either $F_{30\% SPR}$ or $F_{40\% SPR}$ was recommended.

Mutton snapper: $F_{30\% SPR}$ was used in SEDAR 15A Update (2015).

Yellowtail snapper: $F_{30\% SPR}$ was used in SEDAR 27A (O'Hop et al. 2012).

Tilefish: $F_{30\% SPR}$ was used for the baseline run in SEDAR 22 (2011a).

Discussion:

This sub-action includes stocks that have had Southeast Data, Assessment, and Review (SEDAR) assessments which included MSY proxies. Some of the SEDAR assessments included multiple runs under different MSY proxies. The MSY proxy assigned in this alternative is the one used by the SSC for stock status determination.

The five stocks in this sub-action have been assessed under SEDAR, and status determination was based on what the SEFSC and the SSC considered to be the best proxy for MSY. In each case this was the yield at $F_{30\% SPR}$. The SEDAR assessments in which this proxy was used are indicated in the notes below the table of assessed stocks. However, the Council has not formally adopted MSY proxies for these stocks.

Alternative 1 would leave the MSY proxy for these stocks undefined. In future assessments, the assessment scientists and the SSC will continue to use their judgement as to the most appropriate MSY proxy. Under the proxy currently used (yield at $F_{30\% SPR}$), none of the stocks in this sub-action are overfished or experiencing overfishing.

Alternative 2 would formally adopt the MSY proxy used by SEDAR for these five stocks of the yield at $F_{30\% SPR}$. In some cases, multiple MSY proxies were evaluated in the assessment, but $F_{30\% SPR}$ was the proxy used for status determination. This alternative represents the best available scientific information provided at the time of each SEDAR assessment.

Alternative 3 would adopt MSY proxies based on the recommendation of the analysis in Harford et al. (2017). These more recent recommendations are to set the MSY proxy for hermaphroditic species (black grouper and yellowedge grouper) at the yield at $F_{50\% SPR}$, and for gonochoristic species (mutton snapper, yellowtail snapper, and tilefish) at the yield at $F_{40\% SPR}$. These are more recent recommendations than the analysis on which $F_{30\% SPR}$ is based. However, since the Harford et al. (2017) analysis has not yet been published or peer-reviewed outside of an internal SEFSC review, it may be considered as useful management guidance at this time.

Under the no action alternative, **Alternative 1**, the yield at $F_{30\% SPR}$ is likely to continue to be used as the unofficial MSY proxy in future stock assessments. Based on this assumption, relative to **Alternative 1**, **Alternative 2** will produce identical results in terms of annual and MSY yield and risk of failing to maintain MSY yields over the long term. However, **Alternative 2** will remove uncertainty as to what proxy will be used for MSY. **Alternative 3** assigns more conservative MSY proxies, which will result in lower yields but also lower risk of failing to maintain MSY over the long term.

Sub-action 1.3. MSY proxies for stock complexes

Alternative 1. No action. Do not establish MSY proxies for stock complexes.

Alternative 2. Establish an MSY proxy for the tilefishes stock complex.

Option 2a. The tilefish (golden) MSY proxy will serve as an indicator species and proxy for the tilefishes stock complex.

Option 2b. The MSY proxy for the tilefishes complex will be the equilibrium MSY yield for tilefish (golden) plus the constant catch overfishing levels (OFL) of the remaining species determined through either Tier 3a or 3b of the ABC control rules, or through a data-limited method.

Tilefishes Stock complex (IFQ)
-Tilefish (golden) (i) - Blueline tilefish - Goldface tilefish

Alternative 3. Establish an MSY proxy for the other shallow-water grouper stock complex.

Option 3a. The black grouper MSY proxy will serve as an indicator species and proxy for the other shallow-water grouper stock complex.

Option 3b. The MSY proxy for the other shallow-water grouper complex will be the equilibrium MSY yield for black grouper plus the constant catch OFLs of the remaining species determined through either Tier 3a or 3b of the ABC control rules, or through a data-limited method.

Other Shallow-water Grouper complex (IFQ)
- Black grouper (i) - Scamp - Yellowmouth grouper - Yellowfin grouper

Alternative 4. Establish an MSY proxy for the deep-water grouper stock complex.

Option 4a. The yellowedge grouper MSY proxy will serve as an indicator species and proxy for the deep-water grouper stock complex.

Option 4b. The MSY proxy for the deep-water grouper complex will be the equilibrium MSY yield for yellowedge grouper plus the constant catch OFLs of the remaining species determined through either Tier 3a or 3b of the ABC control rules, or through a data-limited method.

Deep-water grouper complex (IFQ)
<ul style="list-style-type: none"> -Yellowedge grouper (i) -Warsaw grouper - Snowy grouper - Speckled hind

Alternative 5. Establish an MSY proxy for the jacks stock complex. The MSY proxy will be the sum of the constant catch OFLs of the species determined through either Tier 3a or 3b of the ABC control rules, or through a data-limited method.

Jacks complex
<ul style="list-style-type: none"> -Lesser amberjack -Almaco jack - Banded rudderfish

Alternative 6. Establish an MSY proxy for the mid-water snappers stock complex. The MSY proxy will be the sum of the constant catch OFLs of the species determined through either Tier 3a or 3b of the ABC control rules, or through a data-limited method.

Mid-water snappers complex
<ul style="list-style-type: none"> - Silk snapper - Wenchman - Blackfin snapper - Queen snapper

Discussion:

This sub-action includes the stock complexes defined in the Generic Annual Catch Limits/Accountability Measures (ACL/AM) Amendment (GMFMC 2011a). That amendment assigned OFL and ABC based on data-limited methods using mean catch over a specific time period (Tier 3a or 3b of the ABC control rule), but did not assign MSY proxies. This sub-action would assign MSY proxies to those complexes.

Three of the five stock complexes have a stock that has been assessed, and the stock status determined using an $F_{30\% SPR}$ based MSY proxy (tilefish for the tilefishes complex, black grouper for the other shallow-water groupers complex, and yellowedge grouper for the deep-water grouper complex). These stocks could be considered as indicator species for their respective stock complexes. However, the MSY proxy for these stocks has not yet been established in a plan amendment. **Option 2a, Option 3a, and Option 4a** in this sub-action assume that MSY proxies will be established in Sub-action 1.2. If that does not occur, these options cannot be considered. The remaining two stock complexes (jacks complex and mid-water snappers complex) do not include any assessed stocks. Therefore, only data-limited methods (i.e., Tier 3a or 3b of the ABC control rule, or a DLMTToolkit method) can be used to determine an MSY proxy.

Stocks included in any accepted stock complexes will be removed from Sub-action 1.4, except for indicator species.

Alternative 1 would not establish any group MSY proxies. All stocks would be assigned MSY proxies on an individual basis.

Alternative 2 would establish an MSY proxy for the tilefishes stock complex, consisting of golden tilefish, blueline tilefish, and goldface tilefish. Golden tilefish is an assessed species that will have an MSY proxy assigned under Sub-action 1.2 (unless the no action alternative is selected). The remaining stocks do not have stock assessments or MSY proxies. **Option 2a** would result in golden tilefish serving as a proxy for the stock complex. If golden tilefish is found to be overfished or experiencing overfishing, then that designation will apply to the entire stock complex. **Option 2b** would create an MSY proxy for the entire group by combining the MSY yield calculated for golden tilefish with the constant catch OFL calculated for each of the remaining data limited stocks by either Tier 3a or 3b of the ABC control rule, or by the methods available in the data-limited methods toolbox (DLMTtoolbox). The resulting yield would be the MSY for the group as a whole.

Alternative 3 would establish an MSY proxy for the other shallow-water grouper stock complex, consisting of black grouper, scamp, yellowmouth grouper, and yellowfin grouper. These stocks are jointly managed under an individual fishing quota (IFQ) program for the commercial sector. Black grouper is an assessed species that will have an MSY proxy assigned under Sub-action 1.2 (unless the no action alternative is selected). The remaining stocks do not have stock assessments or MSY proxies. **Option 3a** would result in black grouper serving as a proxy for the stock complex. If black grouper is found to be overfished or experiencing overfishing, then that designation will apply to the entire stock complex. **Option 3b** would create an MSY proxy for the entire group by combining the MSY yield calculated for black grouper with the constant catch OFL calculated for each of the remaining data limited stocks by either Tier 3a or 3b of the ABC control rule, or by the methods available in the DLMTtoolbox. The resulting yield would be the MSY for the group as a whole. Scamp is tentatively scheduled to have a SEDAR benchmark assessment completed by 2020. If scamp is assessed and receives its own MSY proxy, it may be removed from this stock complex and provided its own status determination.

Alternative 4 would establish an MSY proxy for the deep-water grouper stock complex, consisting of yellowedge grouper, Warsaw grouper, snowy grouper, and speckled hind. These stocks are jointly managed under an individual fishing quota (IFQ) program for the commercial sector. Yellowedge grouper is an assessed species that will have an MSY proxy assigned under Sub-action 1.2 (unless the no action alternative is selected). The remaining stocks do not have stock assessments or MSY proxies. **Option 4a** would result in yellowedge grouper serving as a proxy for the stock complex. If yellowedge grouper is found to be overfished or experiencing overfishing, then that designation will apply to the entire stock complex. **Option 4b** would create an MSY proxy for the entire group by combining the MSY yield calculated for yellowedge grouper with the constant catch OFL calculated for each of the remaining data

limited stocks by either Tier 3a or 3b of the ABC control rule, or by the methods available in the data-limited methods toolbox (DLMTtoolbox). The resulting yield would be the MSY for the group as a whole.

Alternative 5 would establish an MSY proxy for the jacks stock complex, consisting of lesser amberjack, almaco jack, and banded rudderfish. There are no assessed stocks in this group, and therefore no option to use an indicator species. An MSY proxy would be created for the entire group by combining the constant catch OFL calculated for each of the data limited stocks by either Tier 3a or 3b of the ABC control rule, or by the methods available in the data-limited methods toolbox (DLMTtoolbox). The resulting yield would be the MSY for the group as a whole.

Alternative 6 would establish an MSY proxy for the mid-water snappers stock complex, consisting of silk snapper, wenchman, blackfin snapper, and queen snapper. There are no assessed stocks in this group, and therefore no option to use an indicator species. An MSY proxy would be created for the entire group by combining the constant catch OFL calculated for each of the data limited stocks by either Tier 3a or 3b of the ABC control rule, or by the methods available in the data-limited methods toolbox (DLMTtoolbox). The resulting yield would be the MSY for the group as a whole.

Sub-action 1.4. Un-assessed stocks without current MSY proxies

Alternative 1. No action. The MSY proxy for unassessed stocks and assessed stocks that did not include an MSY proxy will remain undefined.

Alternative 2. The MSY proxy for unassessed stocks and assessed stocks that did not include an MSY proxy will be the proxy selected by the Council for each stock as shown below.

Stock	Options for MSY Proxy: Yield at				Tier 3 or DLM OFL
	FSPR 20%	FSPR 30%	FSPR 40%	FSPR 50%	
Grouper, Goliath (h)					
Snapper, Queen					
Snapper, Blackfin					
Snapper, Cubera					
Snapper, Gray					
Snapper, Lane					
Snapper, Silk					
Wenchman					
Speckled Hind (h)					
Grouper, Warsaw (h) (IFQ)					
Grouper, Snowy (h) (IFQ)					
Grouper, Yellowmouth (h) (IFQ)					
Scamp (h) (IFQ)					
Grouper, Yellowfin (h) (IFQ)					
Tilefish, Goldface (IFQ)					
Tilefish, Blueline (IFQ)					
Amberjack, Lesser					
Almaco Jack					
Banded Rudderfish					
Red Drum					

Notes:

(h) – hermaphroditic species

Goliath grouper: 50% static SPR was recommended in the Generic Sustainable Fisheries Act Amendment (1999). SPR based biomass reference points were disapproved by NMFS, but the equivalent in current terms would be the yield at F_{50% SPR}.

Discussion:

This sub-action includes stocks that are not included in the previous sub-actions. This includes stocks that either have not been assessed, or the assessment did not produce an MSY proxy.

The yield when fishing at F_{SPR} cannot be calculated without a stock assessment. If an MSY proxy based on F_{SPR} is selected for a given stock, it will be considered a placeholder until an assessment is conducted that can use the proxy. For stocks that are unlikely to have assessments in the foreseeable future, the data-limited approach is recommended.

Any data-limited stocks selected to be part of a stock complex in Sub-action 1.3 will not be included in Sub-action 4.

Alternative 1 would leave these stocks without MSY proxies. The MSY proxy is used to establish the acceptable level for a sustainable catch. Catch levels for determining overfished or overfishing status will remain undefined.

Alternative 2 would establish an MSY proxy for each stock. Stocks included in a stock complex under Sub-action 1.3 would be removed from the listing if included in a stock complex MSY proxy established in Sub-action 1.3. For each of the remaining stocks, an MSY proxy would be selected from one of the options in the table. These options are:

Option yield at $F_{20\% SPR}$. This is the least conservative proxy considered by the SSC. It may be a sustainable level, but at a higher risk level than the remaining options. Since the stock has not been assessed, this would act as a placeholder until an assessment is completed.

Option yield at $F_{30\% SPR}$. This is the proxy usually selected by the SSC for assessed stocks. It is a sustainable level, at a lower risk level than **Option yield at $F_{20\% SPR}$** . Since the stock has not been assessed, this would act as a placeholder until an assessment is completed.

Option yield at $F_{40\% SPR}$. This is the proxy recommended by Harford et al. (2017) for gonochoristic stocks. These are the stocks in the list not marked with an (h). This is a sustainable level, with less risk than **Option yield at $F_{20\% SPR}$** or **Option yield at $F_{30\% SPR}$** . Since the stock has not been assessed, this would act as a placeholder until an assessment is completed.

Option yield at $F_{50\% SPR}$. This is the proxy recommended by Harford et al. (2017) for hermaphroditic stocks. These are the stocks in the list marked with an (h). This is a sustainable level, with less risk than any of the prior options. Since the stock has not been assessed, this would act as a placeholder until an assessment is completed.

Option Tier 3 or DLM OFL. This is an MSY proxy consisting of a specific yield determined by a data-limited method. This could be either the OFL resulting from Tier 3a or 3b of the ABC control rule, or an OFL resulting from analysis using the DLMToolkit. These methods can be used to determine catch levels when a traditional assessment cannot be conducted, and a yield based on F_{SPR} cannot be determined. The yields resulting from these methods may or may not be close to actual MSY, but are considered sustainable yields. These are not placeholders, but actual constant catch levels that can serve as MSY proxies.

One stock, lane snapper, was assessed under SEDAR 49 (2016) using the DLMToolkit. Based on the results of the DLMToolkit analysis, The SSC recommended that OFL be set at the catch recommendation result of the “Itarget” analysis, which is 364,100 pounds (GMFMC 2017d). This is a long-term constant catch level which can be used as a proxy for MSY. Seven other stocks were also evaluated under SEDAR 49 (wenchman, yellowmouth grouper, snowy grouper, speckled hind, lesser amberjack, almaco jack, and red drum), but were determined to be unsuitable for DLMToolkit analysis due to missing data or issues with the available data.

2.2 Action 2 - Minimum Stock Size Threshold

Alternative 1. No action. Stocks with minimum stock size threshold (MSST) will retain the MSST. For stocks with undefined MSST, the MSST will be defined as needed for each stock by plan amendment.

Alternative 2. For stocks where MSST is currently undefined, $MSST = (1-M)*B_{MSY \text{ (or proxy)}}$.

Alternative 3. For stocks where MSST is currently undefined, $MSST = 0.75*B_{MSY \text{ (or proxy)}}$.

Alternative 4. For stocks where MSST is currently undefined, reef fish stocks $MSST = 0.50*B_{MSY \text{ (or proxy)}}$.

Discussion:

MSST is a stock biomass level set at or below the biomass level capable for producing MSY or the MSY proxy ($B_{MSY \text{ (or proxy)}}$). It is used to determine when a stock is overfished. Reef Fish Amendment 44 (GMFMC 2017b) recently revised the MSST for seven reef fish stocks where it was previously defined (gag, red grouper, red snapper, vermilion snapper, gray triggerfish, greater amberjack, and hogfish). For these seven stocks, Amendment 44 set MSST equal to $0.50*B_{MSY \text{ (or proxy)}}$. The remaining 24 reef fish stocks have not had MSST defined, nor has it been defined for red drum in the Red Drum Fishery Management Plan. The action proposes to define MSST for the remaining reef fish stocks and for red drum.

The NS1 guidelines allow MSST to be set at a level below $B_{MSY \text{ (or proxy)}}$ but no lower than $0.50*B_{MSY \text{ (or proxy)}}$. If the fishing mortality can be kept below the overfishing threshold (MFMT), stock biomass is unlikely to drop below the overfished level (MSST). However, stock biomass can fluctuate due to environmental variability, or due to management being unsuccessful in constraining fishing mortality. In such cases, there are concerns with setting MSST either too close to or too far from $B_{MSY \text{ (or proxy)}}$.

- If MSST is too close to B_{MSY}
 - It may not allow for natural fluctuations in the stock biomass
 - It may not be detectably different from B_{MSY}
- If MSST is too far from B_{MSY}
 - Stock could become in danger of recruitment collapse due to uncertainty about the 50% B_{MSY} level.
 - A stock that drops below MSST will require a more restrictive rebuilding plan.

Each of the alternatives sets MSST equal to some multiple of stock biomass corresponding to MSY or the MSY proxy ($B_{MSY \text{ (or proxy)}}$). For data-poor stocks $B_{MSY \text{ (or proxy)}}$ may not be known. If $B_{MSY \text{ (or proxy)}}$ is unknown, then MSST is also unknown. For these stocks, the MSST definition is a placeholder until $B_{MSY \text{ (or proxy)}}$ can be calculated.

Under **Alternative 1**, MSST is undefined and would need to be established on a case by case basis. This is inconsistent with the National Standard 1 guidelines, which require that managed species have quantitative definitions of the status determination criteria.

Alternative 2 sets MSST for all stocks where MSST is currently undefined at $(1-M)*B_{MSY}$ (or proxy). In the past, this has often been the de facto MSST used to determine overfished status for stocks where MSST is undefined. When MSST is defined as equal to $(1-M)*B_{MSY}$ (or proxy), stocks with a low natural mortality rate (M) can end up with an MSST that is only slightly below the B_{MSY} (or proxy) spawning stock biomass level. In such situations it can be difficult to determine if a stock is actually below MSST due to imprecision and accuracy of the data. In addition, natural fluctuations in stock biomass levels around the B_{MSY} level may temporarily drop the spawning stock biomass below MSST, although analysis from the SEFSC suggests that this is unlikely except at very low natural mortality rates (see below). Setting a wider buffer between B_{MSY} (or proxy) and MSST can avoid these issues. In addition, setting a wider buffer can allow a greater opportunity for management to end a decline in a stock that is approaching an overfished condition without the constraints imposed by a rebuilding plan that is required if the stock drops below MSST and is declared overfished. However, if a stock does drop below MSST and is declared overfished, a more restrictive rebuilding plan may be needed than if there were a narrower buffer between B_{MSY} and MSST. This formula is used for at least some stocks managed by four of the Regional Management Councils (South Atlantic, Caribbean, Pacific, Western Pacific), plus the Highly Migratory Species Decision of NMFS.

Alternative 2 requires that there be an estimate of M. Such estimates have been made through stock assessments for 14 of the 31 reef fish stocks in the Gulf (Table 2.2.1). These estimates range from a low of 0.073 (yellowedge grouper) to a high of 0.28 (greater amberjack), and the resulting MSST values using this formula range from 72% to 91% of the B_{MSY} (or proxy). An additional 14 stocks have estimates of M from other regions, either in the published literature or in SEDAR assessments done for South Atlantic stocks (Table 2.2.2). The SEFSC and the SSC would need to determine if these estimates are applicable to the Gulf stocks or if separate Gulf estimates are needed. Three stocks (goldface tilefish, lesser amberjack, almaco jack) have no published estimates of M (Table 2.2.2). Unless M can be estimated, this formula cannot be used, and those three stocks would continue to have MSST undefined.

Under **Alternative 2**, if any species are added to the management unit, or if the estimate of natural M is changed in a peer-review report or SEDAR assessment for any existing species in the management unit, the MSST will be adjusted based on the most recent estimate of M if applicable under the preferred alternative selected in this action.

Alternative 3 sets MSST for all stocks where MSST is currently undefined at $0.75*B_{MSY}$ (or proxy) for all reef fish stocks. This would set MSST at the 0.75 level for all 24 reef fish stocks for which MSST is addressed in this action and for red drum.

Alternative 4 sets MSST $0.50*B_{MSY}$ (or proxy) for all reef fish stocks. This would set MSST at the 0.50 level for all 24 reef fish stocks for which MSST is addressed in this action and for red drum, and it would match the MSST level established for seven other reef fish stocks in Amendment 44. This is the widest buffer allowed under the National Standard 1 guidelines. This buffer is

used for at least some stocks managed by three of the Regional Management Councils (New England, Mid-Atlantic, North Pacific).

Table 2.2.1. Reef fish species with estimates of M from stock assessments for the Gulf stocks.

Common Name	Scientific Name	M	Source
Snappers			
Mutton snapper	<i>Lutjanus analis</i>	0.11	SEDAR 15A (2015)
Red snapper	<i>Lutjanus campechanus</i>	0.094277	SEDAR 31 (2013)
Lane snapper*	<i>Lutjanus synagris</i>	0.30 0.11-0.24	Ault et al. (2005) Johnson et al. (1995)
Yellowtail snapper	<i>Ocyurus chrysurus</i>	0.194	O’Hop et al. (2012)
Vermilion snapper	<i>Rhomboplites aurorubens</i>	0.25	SEDAR 9 (2006a)
Groupers			
Yellowedge grouper	<i>Hyporthodus flavolimbatus</i>	0.073	SEDAR 22 (2011b)
Goliath grouper	<i>Epinephelus itajara</i>	0.12	SEDAR 23 (2011b)
Red grouper	<i>Epinephelus morio</i>	0.14	SEDAR 12 (2007)
Black grouper	<i>Mycteroperca bonaci</i>	0.136	SEDAR 19 (2010)
Gag	<i>Mycteroperca microlepis</i>	0.134	SEDAR 33 (2014a)
Tilefishes			
Tilefish	<i>Lopholatilus chamaeleonticeps</i>	0.13	SEDAR 22 (2011a)
Other Species			
Hogfish	<i>Lachnolaimus maximus</i>	0.179	Cooper et al. (2013)
Greater amberjack	<i>Seriola dumerili</i>	0.28	SEDAR 33 (2014b)
Gray triggerfish	<i>Balistes capriscus</i>	0.27	SEDAR 9 (2006b)

* Lane snapper: Ault et al. (2005) estimated M=0.30 for lane snapper in the Florida Keys. Johnson et al. (1995) reported a range of M estimates from 0.11 to 0.24 for lane snapper from the northern Gulf.

Table 2.2.2. Reef fish species with no estimate of M in the Gulf. Estimates of M, where shown, are for stocks from other regions, primarily the Florida Keys, U.S. South Atlantic, or Caribbean.

Common Name	Scientific Name	M	Source
Snappers			
Queen snapper	<i>Etelis oculatus</i>	0.843 0.33-0.76	Murray and Moore (1992) Bryan et al. (2011)
Blackfin snapper	<i>Lutjanus buccanella</i>	0.23 0.73	Ault et al. (1998) Tabash and Sierra (1996)
Cubera snapper	<i>Lutjanus cyanopterus</i>	0.15	Ault et al. (1998)
Gray (mangrove) snapper	<i>Lutjanus griseus</i>	0.25 0.18-0.43	Ault et al. (2005) Burton (2000)
Silk snapper	<i>Lutjanus vivanus</i>	0.23 0.19-0.86 0.86	Ault et al. (1998) Bryan et al. (2011) Tabash and Sierra (1996)
Wenchman	<i>Pristipomoides aquilonaris</i>	0.44	Froese and Pauly (2014a)
Groupers			
Speckled hind	<i>Epinephelus drummondhayi</i>	0.20 0.15	Ault et al. (1998) Ziskin (2008)
Warsaw grouper	<i>Hyporthodus nigrilus</i>	0.08	Ault et al. (1998)
Snowy grouper	<i>Hyporthodus niveatus</i>	0.12	SEDAR 36 (2013)
Yellowmouth grouper	<i>Mycteroperca interstitialis</i>	0.14-0.24*	Burton et al. (2014)
Scamp	<i>Mycteroperca phenax</i>	0.15 0.14	Potts and Brennan (2001) Ault et al. (2005)
Yellowfin grouper	<i>Mycteroperca venenosa</i>	0.20	Ault et al. (2005)
Tilefishes			
Goldface tilefish	<i>Caulolatilus chrysops</i>	n/a	
Blueline tilefish	<i>Caulolatilus microps</i>	0.10	SEDAR 32 (2013)
Jacks			
Lesser amberjack	<i>Seriola fasciata</i>	n/a	
Almaco jack	<i>Seriola rivoliana</i>	n/a	
Banded rudderfish	<i>Seriola zonata</i>	0.41	Froese and Pauly (2014b)

* For yellowmouth grouper, Burton et al. (2014) gave age specific natural mortality rates calculated three ways, but did not provide an average. The values in this table are the range of average values for each method for the adult age groups (ages 3 to 31).

2.3 Action 3 - Maximum Fishing Mortality Threshold

Alternative 1. No action. The current definitions for maximum fishing mortality threshold (MFMT) will be retained. These are:

- $F_{26\% \text{ SPR}}$ for red snapper
- $F_{50\% \text{ SPR}}$ for goliath grouper
- F_{MAX} for gag
- $F_{30\% \text{ SPR}}$ for all other reef fish and for red drum

Alternative 2. $\text{MFMT} = F_{\text{PROXY}}$ for all stocks, where Proxy is the MSY proxy for each stock as determined in Action 1. If the MSY proxy is expressed as a biomass yield rather than F_{proxy} , the MFMT is a harvest rate that results in the annual yield equal to the biomass MSY proxy.

Alternative 3.

- $\text{MFMT} = F_{\text{PROXY}}$ for stocks that are not in a rebuilding plan or that have exceeded the maximum time for rebuilding. If the MSY proxy is expressed as a biomass yield rather than an F_{proxy} , the MFMT is a harvest rate that results in the annual yield equal to the biomass MSY proxy.
- $\text{MFMT} = F_{\text{REBUILD}}$ for stocks that are in a rebuilding plan

Discussion:

The Generic ACL/AM Amendment (GMFMC 2011a) established two methods for determining if overfishing is occurring.

1. The NS1 guidelines define MFMT as the level of fishing mortality (i.e., F), on an annual basis, above which overfishing is occurring. The MFMT or reasonable proxy may be expressed either as a single number (a fishing mortality rate or F value), or as a function of spawning biomass or other measure of reproductive potential. Under the provisions of the Generic ACL/AM Amendment (GMFMC 2011a), in years where there is a stock assessment, overfishing is occurring if the stock assessment's estimate of the current fishing mortality rate is above MFMT.
2. The overfishing limit (OFL) is a yield that corresponds to fishing at MFMT. Under the provisions of the Generic ACL/AM Amendment (GMFMC 2011a), in years when there is not a stock assessment, or for stocks that do not have assessments that provide estimates of F , overfishing is occurring if the annual harvest exceeds the OFL.

The Generic Sustainable Fisheries Act (SFA) Amendment (GMFMC 1999) set MFMT equal to $F_{50\% \text{ SPR}}$ for Nassau grouper and goliath grouper. It set MFMT equal to $F_{30\% \text{ SPR}}$ for all other reef fish stocks except red snapper. It also set MFMT equal to $F_{30\% \text{ SPR}}$ for red drum. The gag F_{MSY} proxy and MFMT were subsequently set equal to F_{MAX} in Amendment 30B (GMFMC 2008a). Following additional analyses conducted for the 2005 benchmark assessment of red snapper (SEDAR 7 2005), Amendment 27 (GMFMC 2007) and subsequent management actions used $F_{26\% \text{ SPR}}$ as the red snapper proxy for F_{MSY} and MFMT.

Alternative 1 leaves MFMT unchanged. All reef fish stocks plus red drum have an MFMT as a result of the Generic SFA Amendment (GMFMC 1999), or subsequent amendments. However, these are specific values (e.g., $F_{30\% SPR}$ instead of F_{proxy}), and they may not match the MSY proxy if it is changed in Action 1 or in future amendments.

Alternative 2 sets MFMT equal to F_{proxy} based on the MSY proxies adopted in Action 1. In most cases, this will be the same as **Alternative 1**, but if an MSY proxy is changed in Action 1 or in a future amendment, the MFMT will also change to reflect the new proxy. For some stocks the MSY proxy may be expressed as a biomass yield rather than the yield when fishing at some F_{proxy} . This would occur with stocks where MSY is set equal to the OFL derived from Tier 3 of the ABC control rule or from a data-limited method. For these stocks, the MFMT is a harvest rate that results in the annual yield equal to the biomass MSY proxy.

If an F_{proxy} based MSY proxy is adopted for data-limited stocks where F cannot be determined, the MFMT would be a placeholder until a stock assessment can be conducted and F values estimated. Overfishing status could not be determined using F_{proxy} because the value of F_{proxy} is unknown. However, such stocks could still be determined to be undergoing overfishing if the OFL is exceeded.

Alternative 3 is the same as **Alternative 2** for stocks that are not in a rebuilding plan. However, if a stock is in a rebuilding plan, then MFMT is equal to $F_{Rebuild}$ instead of F_{MSY} . This alternative would result in an overfishing determination if the stock is harvested at a level inconsistent with the rebuilding plan, i.e., above $F_{Rebuild}$. OFL would be set at the more conservative $F_{Rebuild}$ rather than F_{MSY} . ABC would then be a reduction from the $F_{Rebuild}$ level. This is being done informally for red snapper, but **Alternative 3** would make it official.

2.4 Action 4 - Optimum Yield

Alternative 1. No action. For stocks with undefined optimum yield (OY), the reference point will be defined as needed for each stock by plan amendment.

Alternative 2. OY is the equilibrium yield that implicitly accounts for relevant economic, social, or ecological factors by fishing at

Option 2a. 50% of $F_{MSY\text{ Proxy}}$ (or 50% of MSY when F_{MSY} cannot be determined)

Option 2b. 75% of $F_{MSY\text{ Proxy}}$ (or 75% of MSY when F_{MSY} cannot be determined)

Option 2c. 90% of $F_{MSY\text{ Proxy}}$ (or 90% of MSY when F_{MSY} cannot be determined)

Alternative 3. OY is the equilibrium yield that explicitly accounts for relevant economic, social, or ecological factors by the use of a decision tool that considers such factors when reducing OY from MSY. (Factors used in the stock prioritization tool may be included in the OY decision tool.)

Discussion:

The Magnuson-Stevens Act and NS1 guidelines state that OY should be based on MSY as reduced by relevant economic, social, or ecological factors. The NS1 guidelines provide additional detail in considering such factors, including:

- (1) The benefits of food production derived from providing seafood to consumers; maintaining an economically viable fishery together with its attendant contributions to the national, regional, and local economies; and utilizing the capacity of the Nation's fishery resources to meet nutritional needs.
- (2) The benefits of recreational opportunities reflect the quality of both the recreational fishing experience and non-consumptive fishery uses such as ecotourism, fish watching, and recreational diving. Benefits also include the contribution of recreational fishing to the national, regional, and local economies and food supplies.
- (3) The benefits of protection afforded to marine ecosystems are those resulting from maintaining viable populations (including those of unexploited species), maintaining adequate forage for all components of the ecosystem, maintaining evolutionary and ecological processes (e.g., disturbance regimes, hydrological processes, nutrient cycles), maintaining productive habitat, maintaining the evolutionary potential of species and ecosystems, and accommodating human use.

The NS1 guidelines infer that the setting of OY includes a component for scientific uncertainty. The guidelines state that if the estimates of MFMT and current biomass are known with a high level of certainty and management controls can accurately limit catch, then OY could be set very close to MSY, assuming no other reductions are necessary for social, economic, or ecological factors. To the degree that such MSY estimates and management controls are lacking or unavailable, OY should be set farther from MSY.

OY presumes there is an MSY. Because OY is a reduction from MSY, if MSY cannot be determined, neither can OY. Under a purely commercial scenario, OY is the maximum yield that can be produced for the least cost. This is often very near MSY, so it is primarily ecological (and possibly some social) factors that push OY further down from MSY.

Two types of OY are discussed in the NS1 guidelines, a long-term (equilibrium) OY and an annual OY. An annual OY if defined is usually the annual yield associated with fishing at F_{OY} . This may vary from year to year due to fluctuations in biomass. The annual OY cannot exceed the annual ACL, and must be consistent with achieving a long-term OY. Therefore, an annual OY cannot be set in the absence of a long-term OY. An annual OY is optional. Given that annual OY appears superfluous with the use of ACLs and ACTs, this action focuses on determining the long-term OY.

The long-term equilibrium OY is the average amount of desired yield from a stock, stock complex, or fishery on a continuing basis. Annual yields may periodically exceed the long-term OY. For example, if a stock's biomass is above target levels, ACLs may temporarily be set at levels above the long-term OY that would result in the stock biomass being reduced to the target levels. However, over the long term the average catch should equal OY.

Alternative 1 leaves OY undefined for stocks that currently have no definition, and unchanged for those stocks that have an OY definition (Table 2.4.1). Leaving stocks with OY undefined is inconsistent with the NS1 guidelines.

Table 2.4.1. Current OY definitions as implemented in plan amendments

Stock	OY	Source
Gag	Yield at 75% of F_{MAX}	Amendment 30B (GMFMC 2008a)
Red grouper	Yield at 75% of F_{MSY}	Secretarial Amendment 1 (GMFMC 2004a)
Red snapper	Yield at 75% of F_{MSY}	Amendment 22 (GMFMC 2004b)
Vermilion snapper	Yield at 75% of F_{MSY} proxy	Amendment 47 (GMFMC 2017c)
Gray triggerfish	Yield at 75% of F_{MSY} proxy	Amendment 30A (GMFMC 2008b)
Greater amberjack	Yield at $F_{40\% SPR}$	Secretarial Amendment 2 (GMFMC 2002)

Alternative 2 specifies a long-term OY for each stock. The long-term OY is an equilibrium yield around which the yield may fluctuate. Under **Alternative 2**, OY is some fixed percentage

of MSY (or the yield at some fixed percentage of F_{MSY}) that is considered to implicitly account for relevant economic, social, or ecological factors when specifying OY.

Under **Alternative 3**, a decision tool would be developed that would be used to assign a value to explicitly incorporate relevant economic, social, or ecological factors into the determination of OY. The stock prioritization tool incorporates some of these factors, and could be used in the development of a decision tool.

CHAPTER 3. AFFECTED ENVIRONMENT

3.1 Description of the Fishery

This section provides general information on the reef fish and red drum fisheries. Fishing in the Gulf of Mexico (Gulf) is divided into two broad sectors: recreational and commercial. Management of the commercial and recreational fishing sectors fishing for reef fish in federal waters of the Gulf began in 1984 with the implementation of the Fishery Management Plan for the Reef Fish Resources in the Gulf of Mexico (Reef Fish FMP). The Reef Fish FMP has been continuously amended through plan amendments and framework actions (previously known as regulatory amendments). A summary of reef fish management actions can be found on the Gulf of Mexico Fishery Management Council's (Council) webpage.³ Presently, the reef fish fishery management unit contains 31 species (see Section 3.3).

Management of the commercial and recreational fishing sectors fishing for red drum in federal waters of the Gulf began in 1986 with the implementation of the Secretarial FMP for the Red Drum Fishery of the Gulf of Mexico (Red Drum FMP). Harvest of red drum from federal waters has been prohibited since 1988, as implemented under Red Drum Amendment 2 (GMFMC 1988). There is no federal for-hire permit for red drum and there is no allowable harvest of red drum from federal waters. A summary of red drum management actions can be found on the Council's Web page.⁴

3.1.1 Reef Fish

A detailed description of the fishing gears and methods used in the reef fish fishery is provided in Amendment 1 to the Reef Fish FMP (GMFMC 1989).⁵ Additionally, Sections 3.3 and 3.4 provide information on the respective economic and social environments of the fishery.

Commercial Sector

A commercial vessel permit for Gulf reef fish is required for the commercial harvest of reef fish from the Gulf exclusive economic zone (EEZ). Commercial reef fish permits are under a moratorium and are thus limited access; no new permits are available. An expired permit may no longer be used for fishing, but is renewable for one year after it expires. Both valid and renewable permits may be transferred to another operator. As of February 20, 2018, a total of 845 vessels have the permit (770 valid and 72 renewable). Of these, 98% provide a mailing address in a Gulf state (Table 3.1.1.1). These vessels must have a vessel monitoring system onboard.

³ <http://gulfcouncil.org/fishery-management/>

⁴ <http://gulfcouncil.org/fishery-management/implemented-plans/red-drum/>

⁵ <http://www.gulfcouncil.org/Beta/GMFMCWeb/downloads/RF%20Amend-01%20Final%201989-08-rescan.pdf>

Table 3.1.1.1. Number and percentage of vessels with a commercial permit for Gulf reef fish by state.

State	Commercial Reef Fish Permits	
	Number	Percent
AL	36	4.3%
FL	669	79.2%
LA	40	4.7%
MS	7	0.8%
TX	76	9.0%
Subtotal	831	98.0%
Other	17	2.0%
Total	847	100.0%

Source: NMFS SERO.⁶

Only vessels with a valid Gulf reef fish permit can harvest reef fish in the Gulf EEZ, and those that use bottom longline gear in the Gulf EEZ east of 85°30' W. long. must also have a valid eastern Gulf longline endorsement. As of January 16, 2017, 62 of the permit holders have the longline endorsement (61 valid and one renewable/transferrable), and all but one of the endorsement holders have a mailing address in Florida. In addition to these restrictions, operators of reef fish fishing vessels who want to harvest red snapper or grouper and tilefish species must participate in the red snapper or grouper-tilefish individual fishing quota (IFQ) programs. For more information about the IFQ program and commercial reef fish management, see Amendments 26 (GMFMC 2006), 29 (GMFMC 2008c), and 36A (GMFMC 2017a). This includes the commercial harvest of shallow-water grouper (SWG), deep-water grouper (DWG), and tilefish (TF). To harvest IFQ species, a vessel permit must be linked to an IFQ account and possess sufficient allocation for the species to be harvested. IFQ shares and allocation are transferable and eligible vessels can receive allocation from other IFQ participants.

Of the 31 species in the Reef Fish FMP, 14 are managed under the IFQ programs. Not all IFQ program managed species have sector allocations, but all have a commercial quota. Of the remaining reef fish species, only two (gray triggerfish and greater amberjack) have sector allocations. Table 3.1.1.2 provides the commercial landings in recent years for IFQ managed species and those with a sector allocation. Information on recent landings for the remaining reef fish species can be found on the National Marine Fisheries Service (NMFS) annual catch limits (ACL) monitoring webpage.⁷

⁶http://sero.nmfs.noaa.gov/operations_management_information_services/constituency_services_branch/freedom_of_information_act/common_foia/RCG.htm Accessed February 21, 2018.

⁷http://sero.nmfs.noaa.gov/sustainable_fisheries/acl_monitoring/index.html

Table 3.1.1.2. Commercial landings for several reef fish species in pounds whole weight (2010-2016).

	Groupers and Tilefishes	Red snapper	Gray triggerfish	Greater amberjack
2010	4,928,955	3,392,209	55,661	534,095
2011	7,164,184	3,594,552	105,251	508,871
2012	8,277,929	4,036,398	72,778	308,334
2013	7,587,068	5,448,544	63,086	457,879
2014	8,898,807	5,567,822	42,630	486,679
2015	7,848,945	7,184,210	49,201	459,532
2016	7,839,690	6,723,823	61,122	437,390

Source: Grouper and tilefish landings from Table 17 in NMFS 2016b, except 2016, which is from SERO Commercial Quotas Catch Allowance Table.⁸ Gray triggerfish and greater amberjack landings from NMFS SERO ACL commercial monitoring webpage.⁹

Recreational Sector

Recreational fishing includes fishing from charter boats and headboats (collectively referred to as for-hire vessels), privately owned and rental vessels, and from shore. No federal permit is needed for privately owned vessels to fish for reef fish in the EEZ, but persons fishing onboard private vessels do need either a state recreational saltwater fishing permit or be registered in the federal National Saltwater Angler Registry system. To harvest reef fish from the EEZ, for-hire vessels are required to have a federal charter/headboat permit for reef fish that is specifically assigned to that vessel. As with commercial permits, charter/headboat permits for reef fish are under a moratorium and no new permits are available. Existing permits are renewable and transferable. An expired permit may no longer be used for fishing, but is renewable for one year after it expires. Both valid and renewable permits may be transferred to another operator. As a condition of the permit, operators must abide by federal fishing regulations whether in federal or state waters. Reef fish caught under recreational bag limits are not allowed to be sold.

Anglers must follow size limits, bag limits, and season openings and closings when fishing in federal waters for those species that have such regulations (Table 3.1.1.3). In some cases, state regulations are different than federal regulations, which apply for the harvest of reef fish from state waters. In those circumstances (e.g., red snapper fishing seasons), fishermen fishing from privately owned or rented vessels must obey the regulations for the waters in which they are fishing.

⁸ <https://portal.southeast.fisheries.noaa.gov/cs/documents/pdf/CommercialQuotasCatchAllowanceTable.pdf>

⁹ http://sero.nmfs.noaa.gov/sustainable_fisheries/acl_monitoring/commercial_gulf/reef_fish_historical/gulf_historic_commercial_final.pdf

Table 3.1.1.3. Minimum size limits, bag limits, and seasons for reef fish species in the Gulf EEZ.

Stock	Minimum size	Daily bag limit	Season
Red snapper	16 inches TL	2 per person	Open June 1, close when ACT is projected to be met
Gray (mangrove) snapper	12 inches TL	10 snapper aggregate bag limit**	January 1-December 31*
Mutton snapper	16 inches TL	10 snapper aggregate bag limit **	January 1-December 31*
Yellowtail snapper	12 inches TL	10 snapper aggregate bag limit **	January 1-December 31*
Cubera snapper	12 inches TL	10 snapper aggregate bag limit **	January 1-December 31*
Queen snapper, Blackfin snapper, Wenchman, Silk snapper	none	10 snapper aggregate bag limit **	January 1-December 31*
Vermilion snapper	10 inches TL	10 per person within 20 reef fish aggregate bag limit	January 1-December 31*
Lane snapper	8 inches TL	20 reef fish aggregate bag limit	January 1-December 31*
Gray triggerfish	14 inches FL	2 per person within 20 reef fish aggregate bag limit	January 1-16, March 1-December 31*
Almaco jack	none	20 reef fish aggregate bag limit	January 1-December 31*
Golden tilefish, Goldface tilefish, Blueline tilefish	none	20 reef fish aggregate bag limit	January 1-December 31*
Hogfish	14 inches FL	5 per person	January 1-December 31*
Greater amberjack	34 inches FL	1 per person	August 1-October 31, May 1-31#
Lesser amberjack, Banded rudderfish	14-22 inches FL slot limit	5 per person combined	January 1-December 31*
Gag	24 inches TL	2 per person within 4 grouper aggregate bag limit	June 1-December 31*
Red grouper	20 inches TL	2 per person within 4 grouper aggregate bag limit	January 1-December 31*^
Black grouper	24 inches TL	4 grouper aggregate bag limit	January 1-December 31*^
Scamp	16 inches TL	4 grouper aggregate bag limit	January 1-December 31*^
Yellowfin grouper	20 inches TL	4 grouper aggregate bag limit	January 1-December 31*^
Yellowmouth grouper	none	4 grouper aggregate bag limit	January 1-December 31*^
Yellowedge grouper, Snowy grouper	none	4 grouper aggregate bag limit	January 1-December 31*
Speckled hind	none	1 per vessel, included in 4 grouper aggregate bag limit	January 1-December 31*
Warsaw grouper	none	1 per vessel, included in 4 grouper aggregate bag limit	January 1-December 31*
Goliath grouper, Nassau grouper	Harvest prohibited		

*Season closures can occur prior to December 31 if a species annual catch limit is caught or is projected to be caught.

** 10 snapper aggregate bag limit includes all snappers except red, vermilion, and lane.

The greater amberjack recreational fishing year is August 1-June 30. Season closures can occur prior to June 30 if a species annual catch limit is caught or is projected to be caught (regulation pending).

^ Recreational shallow-water grouper (red, black, scamp, yellowfin, yellowmouth) season is closed February 1-March 31 when fishing beyond 20 fathom break.

Note: TL means total length; FL means fork length.

As of February 20, 2018, there were 1,310 vessels with a valid or renewable for-hire reef fish permit: 1,278 vessels with the permit and another 32 with a historical captain endorsement (Table 3.1.1.4). Approximately 58% of the permits have mailing recipients in Florida. Texas recipients hold the second highest number of permits with 17%. Collectively, approximately 97% of the permits have mailing recipients in one of the Gulf states.

Table 3.1.1.4. Number and percentage of vessels with a charter/headboat permit for Gulf reef fish, including historical captain endorsements, by state.

State	Gulf Reef Fish Permits		
	Permits	Historical Captain	Percent
AL	127	3	9.9%
FL	748	17	58.4%
LA	105	6	8.5%
MS	36	2	2.9%
TX	216	4	16.8%
Subtotal	831	32	96.5%
Other	46		3.5%
Total	847	32	100.0%

Source: NMFS SERO.¹⁰

Table 3.1.1.5 provides the recreational landings in recent years for all reef fish by component. The for-hire component includes federally permitted charter vessels and headboats, and the private component includes privately owned vessels and fishing from shore.

Table 3.1.1.5. Recreational landings for all reef fish (pounds whole weight) by component (2010-2016).

	For-hire	Private	Total
2010	3,129,423	5,240,128	8,369,551
2011	4,366,054	5,462,209	9,828,262
2012	4,881,069	8,158,138	13,039,208
2013	5,118,499	15,155,915	20,274,414
2014	3,538,404	8,699,338	12,237,743
2015	5,667,588	8,691,052	14,358,641
2016	5,488,516	11,199,073	16,687,588

Source: NMFS SEFSC Recreational ACL file, February 28, 2018.

¹⁰

http://sero.nmfs.noaa.gov/operations_management_information_services/constituency_services_branch/freedom_of_information_act/common_foia/RCG.htm Accessed February 20, 2018.

3.1.2 Red Drum

Red drum have historically been fished by both recreational and commercial fishermen. Records of commercial fishing date back to 1950, and recreational fishing records date back to the early 1980s. Commercial fishing in the EEZ was prohibited in 1987, but incidental catch was still allowed until 1988. Commercial fishing throughout the EEZ largely targeted offshore schools of larger fish, with run-around gill nets and purse seines landing the majority of those fish. Recreational fishing for red drum is conducted almost exclusively through hook-and-line gear, and retention of fish in the EEZ was prohibited in 1988 (GMFMC 1988). Thus, the remainder of this section addresses landings in state waters, only.

Commercial Sector

All states except Mississippi prohibit commercial harvest of red drum from state waters. From 1980 through 1988, when commercial harvest was allowed in the EEZ, commercial fishermen took an average of 28% of the redfish, while sport fishermen harvested 72%.¹¹ Mississippi currently allows commercial harvest with a quota of 60,000 lbs. The principal gear used for commercial harvest is trammel nets (Porch 2000). It is illegal for any vessel carrying a purse seine to have on board any quantity of red drum. Commercial harvest has been increasing from about 18,000 lbs in 2002 to slightly over 60,000 lbs in 2015 and 2016.

Recreational Sector

Red drum remains a popular directed fishery for the recreational sector in all five states. The recreational harvest of red drum is open year-round Gulf-wide in state waters. All five states manage red drum using a slot limit (i.e., a fish must be larger than the minimum and smaller than the maximum size limit). Table 3.1.2.1 provides the size and bag limits for red drum by state, and Table 3.1.2.2 provides recreational landings in recent years by state. Florida manages red drum using three management zones: the northwest zone extends from Escambia through Pasco County; the south zone begins in Pinellas County and covers the southern Florida Peninsula northeast through Volusia County; and the northeast zone covers Flagler through Nassau County. The northwest and south zone are adjacent to federal waters under the Council's jurisdiction.

¹¹ Source: https://en.wikipedia.org/wiki/Red_drum

Table 3.1.2.1. Recreational bag limit and size limits of red drum in state waters.

State	Size limit (min-max)	Bag limit (daily)	Exceptions to bag limit
Florida	18-27 inches TL	By zone: NE zone: 2 per person; S and NW: 1 per person; All zones: vessel limit of 8 fish	None
Alabama	16-26 inches TL	3 per person	1 fish may be greater than 26 inches TL
Mississippi	18-30 inches TL	3 per person	1 fish may be greater than 30 inches TL
Louisiana	16-27 inches TL	5 per person	1 fish may be greater than 27 inches TL
Texas	20-28 inches TL	3 per person	Per license year, each angler may retain 1 additional fish greater than 28 inches by affixing a Red Drum Tag, and 1 additional fish by affixing a Bonus Red Drum Tag.

Table 3.1.2.2. Recreational landings of red drum by state (pounds whole weight) from 2010 through 2016.

	AL	FL	LA	MS	TX	Total
2010	828,593	1,032,604	11,502,642	373,847	1,424,770	15,162,455
2011	768,784	1,137,160	13,040,458	588,937	1,814,163	17,349,501
2012	870,505	1,762,781	9,004,719	799,338	1,766,361	14,203,703
2013	1,999,251	1,638,902	14,113,356	1,381,350	1,374,069	20,506,928
2014	577,991	1,695,759	6,473,007	741,523	1,361,193	10,849,473
2015	1,372,207	2,065,928	9,479,472	912,376	1,302,599	15,132,581
2016	850,835	1,585,903	4,776,611	1,077,903	1,511,272	9,802,524

Source: NMFS SEFSC Recreational ACL file, February 28, 2018.

3.2 Description of the Physical Environment

General Description of the Physical Environment

The physical environment for Gulf reef fish and red drum is detailed in the Environmental Impact Statement for the Generic Essential Fish Habitat (EFH) Amendment (GMFMC 2004d), Generic Amendment 3 (GMFMC 2005a), and the Generic ACL/Accountability Measures (AM) Amendment (GMFMC 2011a), which are hereby incorporated by reference.

The Gulf has a total area of approximately 600,000 square miles (1.5 million km²), including state waters (Gore 1992). It is a semi-enclosed, oceanic basin connected to the Atlantic Ocean

by the Straits of Florida and to the Caribbean Sea by the Yucatan Channel (Figure 3.2.1). Oceanographic conditions are affected by the Loop Current, discharge of freshwater into the northern Gulf, and a semi-permanent, anti-cyclonic gyre in the western Gulf. The Gulf includes both temperate and tropical waters (McEachran and Fechtelm 2005). Gulf water temperatures range from 54° F to 84° F (12° C to 29° C) depending on time of year and depth of water. Mean annual sea surface temperatures ranged from 73 ° F through 83° F (23-28° C) including bays and bayous (Figure 3.1.1) between 1982 and 2009, according to satellite-derived measurements (NODC 2011)¹². In general, mean sea surface temperature increases from north to south with large seasonal variations in shallow waters.

Description of the Reef Fish Physical Environment

In general, reef fish are widely distributed in the Gulf, occupying both pelagic and benthic habitats during their life cycle. A planktonic larval stage lives in the water column and feeds on zooplankton and phytoplankton (GMFMC 2004d). Juvenile and adult reef fish are typically demersal and usually associated with bottom topographies on the continental shelf (less than 100 m) which have high relief, i.e., coral reefs, artificial reefs, rocky hard-bottom substrates, ledges and caves, sloping soft-bottom areas, and limestone outcroppings. However, several species are found over sand and soft-bottom substrates. For example, juvenile red snapper are common on mud bottoms in the northern Gulf, particularly off Texas through Alabama. Also, some juvenile snapper (e.g., mutton, gray, red, dog, lane, and yellowtail snappers) and grouper (e.g., goliath, red, gag, and yellowfin groupers) are associated with inshore seagrass beds, mangrove estuaries, lagoons, and larger bay systems.

¹² NODC 2011: <http://accession.nodc.noaa.gov/0072888>

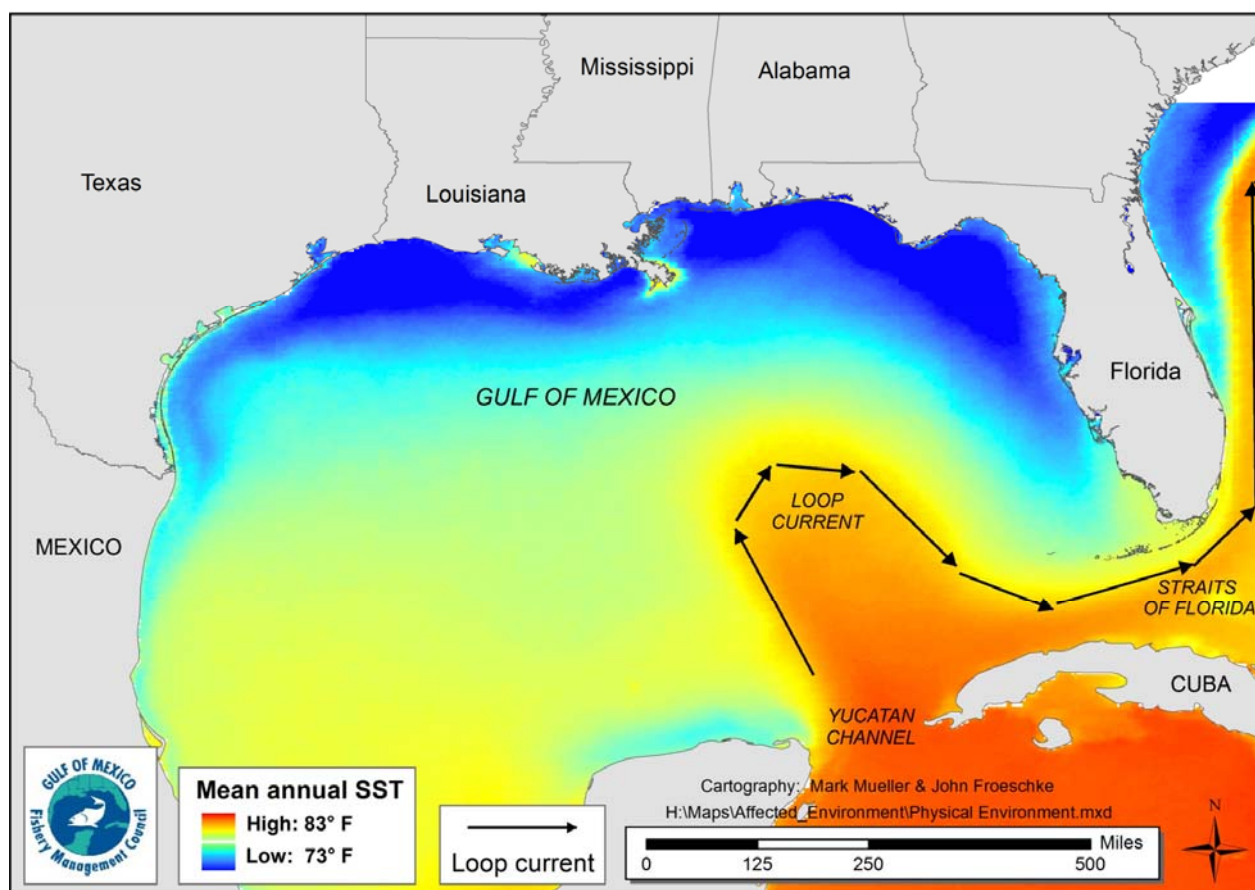


Figure 3.2.1. Physical environment of the Gulf, including major feature names and mean annual sea surface temperature as derived from the Advanced Very High Resolution Radiometer Pathfinder Version 5 sea surface temperature data set (<http://accession.nodc.noaa.gov/0072888>)

General Description of the Red Drum Physical Environment

Red drum are distributed over a geographical range from Massachusetts on the Atlantic coast to Tuxpan, Mexico (Simmons and Breuer 1962). They occur throughout the Gulf in a variety of habitats, ranging from depths of about 40 m offshore to very shallow estuarine waters. They commonly occur in virtually all of the Gulf's estuaries where they are found over a variety of substrates including seagrass, sand, mud, and oyster reefs. Red drum can tolerate salinities ranging from freshwater to highly saline, but optimum salinities for the various life stages have not been determined. Estuarine wetlands are especially important to larval, juvenile, and sub-adult red drum. Based on such a habitat suitability index model for larval and juvenile red drum developed by the Fish and Wildlife Service (Buckley 1984), shallow water (1.5 to 2.5 m deep) with 50 to 75% submerged vegetation growing on mud bottoms and fringed with emergent vegetation provided optimum red drum habitat. The model, however, needs to be further refined, and estuaries in the Gulf need to be surveyed for habitat and optimum environmental conditions available for red drum production.

The Red Drum FMP (GMFMC 1986) reported that habitat utilized by this species has generally deteriorated since approximately 1940, mostly as a result of industrial and human population

growth in existing estuarine systems. Changes have ranged from residential development in Florida to extensive dredging and channelization in Louisiana. This dredging is largely attributable to the quest for petroleum products. Gagliano (1973) stated that loss of productive habitat in Louisiana averages 16.5 square miles per year. The Corps of Engineers estimated that 13% of this amount resulted from dredging associated with oil and gas operations (Louisiana Wetlands Prospectus 1973). The entire Gulf is heavily impacted by activities in other parts of the U.S., as almost two-thirds of the natural sediments and industrial pollutants of the U.S. are dumped into the Gulf (Boykin 1971). Diminishment and degradation of coastal wetlands and estuarine habitat may be responsible to some degree for perceived declines in the inshore portion of Gulf red drum stocks.

Historic Places

With respect to the National Register of Historic Places, there is one site listed in the Gulf. This is the wreck of the *U.S.S. Hatteras*, located in federal waters off Texas. Historical research indicates that over 2,000 ships have sunk on the Federal Outer Continental Shelf in the Gulf between 1625 and 1951; thousands more have sunk closer to shore in state waters during the same period. Only a handful of these have been scientifically excavated by archaeologists for the benefit of generations to come. Further information can be found at:

<http://www.boem.gov/Environmental-Stewardship/Archaeology/Shipwrecks.aspx>.

3.3 Description of the Biological/Ecological Environment

The biological environment of the Gulf, including the species addressed in this amendment, is described in detail in the Generic EFH Amendment (GMFMC 2004d), Generic ACL/AM Amendment (GMFMC 2011a), and Reef Fish Amendments 28 (GMFMC 2015b) and 40 (GMFMC 2014a) and is incorporated here by reference and further summarized below.

General Information on Reef Fish Species

The National Ocean Service (NOS) collaborated with NMFS and the Council to develop distributions of reef fish (and other species) in the Gulf (SEA 1998). The NOS obtained fishery-independent data sets for the Gulf, including Southeast Area Monitoring and Assessment Program and state trawl surveys. Data from the Estuarine Living Marine Resources Program (ELMRP) contain information on the relative abundance of specific species (highly abundant, abundant, common, rare, not found, and no data) for a series of estuaries, by five life stages (adult, spawning, egg, larvae, and juvenile) and month for five seasonal salinity zones (0-0.5, 0.5-5, 5-15, 15-25, and greater than 25 parts per thousand). NOS staff analyzed these data to determine relative abundance of the mapped species by estuary, salinity zone, and month. For some species not in the ELMRP database, distribution was classified as only observed or not observed for adult, juvenile, and spawning stages.

Reef fish are widely distributed in the Gulf, occupying both pelagic and benthic habitats during their life cycle. Habitat types and life history stages can be found in more detail in GMFMC (2004d). In general, both eggs and larval stages are planktonic. Larvae feed on zooplankton and

phytoplankton. Exceptions to these generalizations include gray triggerfish, which lay their eggs in depressions in the sandy bottom (Simmons and Szedlmayer 2012), and gray snapper whose larvae are found around submerged aquatic vegetation. Juvenile and adult reef fish are typically demersal, and are usually associated with bottom topographies on the continental shelf (less than 328 feet; less than 100 m) which have high relief, i.e., coral reefs, artificial reefs, rocky hard-bottom substrates, ledges and caves, sloping soft-bottom areas, and limestone outcroppings. However, several species are found over sand and soft-bottom substrates. Juvenile red snapper are common on mud bottoms in the northern Gulf, particularly from Texas to Alabama. Also, some juvenile snappers (e.g., mutton, gray, red, dog, lane, and yellowtail snappers) and groupers (e.g., goliath grouper, red, gag, and yellowfin groupers) have been documented in inshore seagrass beds, mangrove estuaries, lagoons, and larger bay systems (GMFMC 1981). More detail on hard bottom substrate and coral can be found in the FMP for Corals and Coral Reefs (GMFMC and SAFMC 1982).

Status of Reef Fish and Red Drum Stocks

The Reef Fish FMP currently encompasses 31 species (Table 3.3.5). Eleven other species were removed from the FMP in 2012 through the Generic ACL/AM Amendment (GMFMC 2011a). Stock assessments and status determinations have been conducted and designated for 11 stocks and can be found on the Council (www.gulfcouncil.org) and SEDAR (www.sedarweb.org) websites.

Table 3.3.1. Reef fish stock that have assessments and accepted status determinations.

Stock	Stock Status		Most Recent SSC Determination	Most Recent Stock Assessment
	Overfishing	Overfished		
black grouper	N	N	Mar 2010	SEDAR 19 2010
yellowedge grouper	N	N	May 2011	SEDAR 22 2011b
yellowtail snapper	N	N	Oct 2012	SEDAR 27A 2012
red snapper	N	N*	Jan 2015	SEDAR 31 Update 2015
hogfish	N	N	Oct 2014	SEDAR 37 2013
mutton snapper	N	N	May 2015	SEDAR 15A Update 2015
gray triggerfish	N	N*	Jan 2016	SEDAR 43 2015
red grouper	N	N	Jan 2016	SEDAR 42 2015
vermillion snapper	N	N	Jun 2016	SEDAR 45 2016
gag	N	N	Jan 2017	SEDAR 33 Update 2016b
greater amberjack	N	Y	Mar 2017	SEDAR 33 Update 2016a

*Red snapper and gray triggerfish were re-classified from overfished to not overfished-rebuilding in the December 2017 update to the Status of U.S. Fisheries Report to Congress.

Stock assessments have been conducted for the following stocks, but upon review by the SSC, the assessments were deemed not suitable for stock status and management advice. Based on the most recent SSC determination the stocks are not experiencing overfishing based on annual harvest remaining below the OFL, but there has been no assessment-based status determination.

Table 3.3.2. Reef fish stocks deemed unsuitable by the SSC for stock status and management advice.

Stock	Stock Status		Most Recent SSC Determination	Most Recent Stock Assessment
	Overfishing	Overfished		
tilefish (golden)	N	N	May 2011	SEDAR 22 2011a
Atlantic goliath grouper	N	unknown	Sep 2016	SEDAR 47 2016

Note: OFL and ABC for the above stocks were assigned based on Tier 3a of the ABC control rule.

An assessment was conducted for the following stock using the Data Limited Methods Toolkit (DLMTToolkit). This method allows the setting of OFL and acceptable biological catch (ABC) based on limited data, but does not provide assessment-based status determinations. The stock is not experiencing overfishing based on annual harvest remaining below the OFL, but no overfished status determination has been made.

Table 3.3.3. Reef fish stocks assessed using data limited methods but without stock status determinations.

Stock	Stock Status		Most Recent SSC Determination	Most Recent Stock Assessment
	Overfishing	Overfished		
lane snapper	N	unknown	Mar 2017	SEDAR 49 2016

Data was requested for the following stocks but it was determined not enough information was available to complete an assessment even using the DLMTToolkit methods. These stocks are not experiencing overfishing based on annual harvest remaining below the OFL, but no overfished status determination has been made.

Table 3.3.4. Reef fish stocks where data limited assessments were attempted but without stock status determinations.

Stock	Stock Status		Most Recent SSC Determination	Most Recent SSC Workshop
	Overfishing	Overfished		
wenchman	N	unknown	Mar 2017	SEDAR 49 2016
almaco jack	N	unknown	Mar 2017	SEDAR 49 2016
lesser amberjack	N	unknown	Mar 2017	SEDAR 49 2016
speckled hind	N	unknown	Mar 2017	SEDAR 49 2016
snowy grouper	N	unknown	Mar 2017	SEDAR 49 2016
yellowmouth grouper	N	unknown	Mar 2017	SEDAR 49 2016

The NMFS Office of Sustainable Fisheries updates its Status of U.S. Fisheries Report to Congress on a quarterly basis utilizing the most current stock assessment information. Of the 11 stocks for which stock assessments have been conducted, the fourth quarter report of the 2017 Status of U.S. Fisheries¹³ classifies only one as overfished and undergoing overfishing (greater amberjack). The status of both assessed and unassessed stocks, as of the writing of this report is provided in Table 3.3.5. However, it should be noted that, although gray triggerfish and red snapper are no longer classified as overfished, those stocks along with greater amberjack are under rebuilding plans. Reef fish Amendment 44 (GMFMC 2017b), changed the minimum stock size threshold for seven species in the Reef Fish FMP including gray triggerfish, red snapper, and greater amberjack. As a result of this change, red snapper and gray triggerfish were reclassified from overfished to no longer overfished but in a rebuilding plan. Greater amberjack continued to be classified as overfished.

¹³ <https://www.fisheries.noaa.gov/national/population-assessments/fishery-stock-status-updates>

Table 3.3.5. Status of species in the Reef Fish FMP grouped by family.

Common Name	Scientific Name	Stock Status
Family Balistidae – Triggerfishes		
gray triggerfish	<i>Balistes capriscus</i>	Not overfished (rebuilding), no overfishing
Family Carangidae – Jacks		
greater amberjack	<i>Seriola dumerili</i>	Overfished, overfishing
lesser amberjack	<i>Seriola fasciata</i>	Unknown if overfished, no overfishing
almaco jack	<i>Seriola rivoliana</i>	Unknown if overfished, no overfishing
banded rudderfish	<i>Seriola zonata</i>	Unknown
Family Labridae – Wrasses		
*hogfish	<i>Lachnolaimus maximus</i>	Not overfished, no overfishing
Family Malacanthidae – Tilefishes		
tilefish (golden)	<i>Lopholatilus chamaeleonticeps</i>	Not overfished, no overfishing
blueline tilefish	<i>Caulolatilus microps</i>	Unknown
goldface tilefish	<i>Caulolatilus chrysops</i>	Unknown
Family Serranidae – Groupers		
gag	<i>Mycteroperca microlepis</i>	Not overfished, no overfishing
red grouper	<i>Epinephelus morio</i>	Not overfished, no overfishing
scamp	<i>Mycteroperca phenax</i>	Unknown
black grouper	<i>Mycteroperca bonaci</i>	Not overfished, no overfishing
yellowedge grouper	** <i>Hyporthodus flavolimbatus</i>	Unknown if overfished, no overfishing
snowy grouper	** <i>Hyporthodus niveatus</i>	Unknown if overfished, no overfishing
speckled hind	<i>Epinephelus drummondhayi</i>	Unknown if overfished, no overfishing
yellowmouth grouper	<i>Mycteroperca interstitialis</i>	Unknown if overfished, no overfishing
yellowfin grouper	<i>Mycteroperca venenosa</i>	Unknown
warsaw grouper	** <i>Hyporthodus nigrilus</i>	Unknown if overfished, no overfishing
***Atlantic goliath grouper	<i>Epinephelus itajara</i>	Unknown if overfished, no overfishing
Family Lutjanidae – Snappers		
queen snapper	<i>Etelis oculatus</i>	Unknown if overfished, no overfishing
mutton snapper	<i>Lutjanus analis</i>	Not overfished, no overfishing
blackfin snapper	<i>Lutjanus buccanella</i>	Unknown if overfished, no overfishing
red snapper	<i>Lutjanus campechanus</i>	Not overfished (rebuilding), no overfishing
cupera snapper	<i>Lutjanus cyanopterus</i>	Unknown if overfished, no overfishing
gray snapper	<i>Lutjanus griseus</i>	Unknown if overfished, no overfishing
lane snapper	<i>Lutjanus synagris</i>	Unknown if overfished, no overfishing
silk snapper	<i>Lutjanus vivanus</i>	Unknown
yellowtail snapper	<i>Ocyurus chrysurus</i>	Not overfished, no overfishing
vermillion snapper	<i>Rhomboplites aurorubens</i>	Not overfished, no overfishing
wenchman	<i>Pristipomoides aquilonaris</i>	Unknown if overfished, no overfishing

Notes: *The East Florida/Florida Keys hogfish stock is considered overfished and undergoing overfishing.

**In 2013 the genus for yellowedge grouper, snowy grouper, and warsaw grouper was changed by the American Fisheries Society from *Epinephelus* to *Hyporthodus* (American Fisheries Society 2013).

***Atlantic goliath grouper is a protected grouper and benchmarks do not reflect appropriate stock dynamics. In 2013 the common name was changed from goliath grouper to Atlantic goliath grouper by the American Fisheries Society to differentiate from the Pacific goliath grouper, a newly named species (American Fisheries Society 2013).

General Information on Red Drum

Red drum range throughout the coastal regions of the northern Gulf and southeastern United States. Several tagging studies have indicated that the movements of juvenile red drum are limited (Matlock and Weaver 1979; Osburn et al. 1982), leading some to suggest that several metapopulations may exist. Additionally, Rooker et al. (2010) found evidence of metapopulations structures in Texas bays and estuaries. On the other hand, red drum have pelagic larvae and are capable of extensive migrations as adults (Nichols 1988). Females typically breed less than 600 kilometers (km) of their natal estuary, creating a continuum of gradual genetic variations along the Gulf coast (Porch 2000).

Wilson and Nieland (1994) found that the sex ratio of the offshore spawning stock in the northern Gulf was close to 1:1. Spawning takes place primarily in nearshore waters, with occasional spawning activity observed in estuarine environments (Peters and McMichael 1987; Johnson and Funicelli 1991; Wilson and Nieland 1994; Vaughan and Carmichael 2000). Gulf red drum spawn from summer through early fall. During this time a typical female spawns every few days and produces millions of eggs (Peters and McMichael 1987; Wilson and Nieland 1994).

Red drum grow rapidly during their first few years of life, but slow thereafter. Pelagic larvae recruit to estuarine environments and are estuarine residents remain until reaching maturity (~ age 4). Once mature, individuals join offshore spawning aggregations. Mature red drum migrate in and out of estuarine habitats seasonally (Vaughan and Carmichael 2000). Larvae subsist on a diet primarily composed of copepods. Principal prey for small juveniles is comprised of mysids, amphipods, and shrimp, while larger juveniles feed more frequently on larger crustaceans and small fish (Peters and McMichael 1987). Adults have a more varied diet largely comprised of crustaceans and fish.

The most recent stock assessment determined annual natural mortality (M) by age, with an overall estimate for M of approximately $0.2y^{-1}$, with a mean generation time of 14.2 years (Porch 2000). Red drum can live for 50 years (Ross et al. 1995), with males reaching lengths in excess of 150 cm total length (TL) (Chao 1978).

Status of Red Drum

The most recent red drum stock assessment was conducted in 2000 (Porch 2000). While the assessment concluded that red drum were overfished and that overfishing was occurring, both the Council's Red Drum Stock Assessment Panel (RDSAP) and the NMFS assessment biologist noted that there was a high degree of uncertainty regarding the assessment results. The NMFS assessment biologist cited uncertainty in the stock structure, the flat stock-recruitment relationship even at very small stock sizes, the small sample size for offshore age composition, the unknown age composition of the shrimp bycatch, the unknown length composition on the inshore commercial fishery, and the unknown magnitude and composition of the inshore shrimp fleet bycatch as reasons why the results of the assessment must be regarded as uncertain (Porch 2000). Given uncertainties about the assessment's findings that red drum are overfished in the Gulf, the RDSAP chose to recommend that the ABC remain at zero in the EEZ; however, the

RDSAP chose not to estimate rebuilding schedules or MSY until the uncertainties in the assessment could be addressed with improved data.

In 2010, the SSC formed a working group to review the available information on red drum and determine if an ABC could be established. The working group reported back to the SSC in July 2010. After reviewing landings from the past 5 years for each state, the working group decided to recommend an ABC based on the sum of the highest annual landing from each state, or about 17 million pounds. However, this recommendation was based on catches under current selectivity patterns, i.e., fishing in state waters only. In order to allow data to be collected to determine the age composition of red drum on offshore waters, the working group recommended that an additional 20,000 red drum (in numbers) be allowed to be harvested from the EEZ under a scientific study that would be endorsed by the SSC. The working group further recommended that scientific studies include mercury concentrations as well as genetic characterizations of sub-stocks. The SSC accepted the working group recommendations and moved to forward the ABC recommendations to the Council. However, the Council felt that an EEZ ABC of 20,000 red drum (in numbers) for a scientific study was not workable, and chose to leave the red drum ABC at zero.

Harvest of red drum from the EEZ is currently prohibited. For this reason, NMFS has determined that overfishing is not currently occurring. However, due to the length of time since the last stock assessment, the current overfished status is considered unknown (Table 3.3.6).

Table 3.3.6. Red drum stock status as of September 30, 2017.

Stock	Stock Status		Most Recent SSC Determination	Most Recent Stock Assessment
	Overfishing	Overfished		
Red drum	N	unknown	July 2010	Porch 2000

The NMFS Office of Sustainable Fisheries updates its Status of U.S. Fisheries Report to Congress on a quarterly basis utilizing the most current stock assessment information. The most recent update can be found at: <https://www.fisheries.noaa.gov/national/population-assessments/fishery-stock-status-updates>

Bycatch of Managed Finfish Species

Many of the reef fish species co-occur with each other and can be incidentally caught when fishermen target certain species. In some cases, these fish may be discarded for regulatory reasons and thus are considered bycatch. Bycatch practicability analyses have been completed for red snapper (GMFMC 2004b, GMFMC 2007, GMFMC 2014a, GMFMC 2015b), grouper (GMFMC 2008a, GMFMC 2009, GMFMC 2010, GMFMC 2011b, GMFMC 2012a), vermilion snapper (GMFMC 2004c, GMFMC 2017c), greater amberjack (GMFMC 2008b, GMFMC 2012b, GMFMC 2017b), gray triggerfish (GMFMC 2012c), and hogfish (GMFMC 2016a). These analyses examined the effects of fishing on these species. In general, these analyses have found that reducing bycatch provides biological benefits to managed species as well as benefits to the fishery through less waste, higher yields, and less forgone yield. However, in some cases, actions are approved that can increase bycatch through regulatory discards such as increased

minimum sizes and closed seasons. Under these circumstances, there is some biological benefit to the managed species that outweigh any increases in discards from the action.

Protected Species

The Marine Mammal Protection Act (MMPA) and Endangered Species Act (ESA) provide special protections to some species that occur in the Gulf, and more information is available on the NMFS Office of Protected Resources website (<http://www.nmfs.noaa.gov/pr/laws/>). All 22 marine mammals in the Gulf are protected under the MMPA (Waring et al. 2016). Two marine mammals (sperm whales and manatees) are also protected under the ESA. Other species protected under the ESA include five sea turtle species (Kemp's ridley, loggerhead, green, leatherback, and hawksbill), five fish species (Gulf sturgeon, Nassau grouper, smalltooth sawfish, giant manta ray, and oceanic whitetip shark), and seven coral species (elkhorn, staghorn, pillar, rough cactus coral, lobed star, mountainous star, and boulder star). Critical habitat designated under the ESA for smalltooth sawfish, Gulf sturgeon, and the Northwest Atlantic Ocean distinct population segment of loggerhead sea turtles also occur in the Gulf, though only loggerhead critical habitat occurs in federal waters.

Brief overviews of the marine mammals, sea turtles, and three of the fish species that may be present in or near areas where Gulf reef fish fishing occurs and their general life history characteristics have been presented in previous actions [e.g., Amendment 36A (GMFMC 2017a), 44 (GMFMC 2017b), and 47 (GMFMC 2017c)]. Additional information on the giant manta ray and oceanic whitetip sharks can be found in the final rules listing these species (83 FR 2916 and 83 FR 4153, respectively). Because none of the listed corals or designated critical habitats in the Gulf are likely to be adversely affected by the Gulf reef fish fishery or red drum fishery, they are not discussed further.

The MMPA requires that each commercial fishery be classified by the number of marine mammals they seriously injure or kill. NMFS's List of Fisheries classifies U.S. commercial fisheries into three categories based on the number of incidental mortality or serious injury they cause to marine mammals. More information about the List of Fisheries and the classification process can be found at: <http://www.nmfs.noaa.gov/pr/interactions/fisheries/lof.html>.

NMFS classifies reef fish bottom longline/hook-and-line gear in the MMPA 2017 List of Fisheries as a Category III fishery (82 FR 3655). This classification indicates the annual mortality and serious injury of a marine mammal stock resulting from any fishery is less than or equal to 1% of the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population. Dolphins are the only species documented as interacting with these fisheries. Bottlenose dolphins are a common predator around reef fish vessels. They prey upon on the bait, catch, and/or released discards of fish from the reef fish fishery.

Under the ESA, a Section 7 consultation is required for any federal action that may affect listed species or designated critical habitat (50 CFR 402.14). Regulations at 50 CFR 402.16 require re-initiation of formal Section 7 consultation under the ESA if discretionary involvement or control over the action has been retained (or is authorized by law) and: (1) the amount or extent of the

incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not previously considered; or (4) if a new species is listed or critical habitat designated that may be affected by the identified action.

The most recent biological opinion (Opinion) for the Reef Fish FMP was completed on September 30, 2011 (NMFS 2011). The Opinion determined the continued authorization of the Gulf reef fish fishery managed under this FMP is not likely to adversely affect ESA-listed marine mammals or coral, and was not likely to jeopardize the continued existence of sea turtles (loggerhead, Kemp's ridley, green, hawksbill, and leatherback) or smalltooth sawfish. Since issuing the Opinion, in memoranda dated September 16, 2014, and October 7, 2014, NMFS concluded that the activities associated with the Reef Fish FMP is not likely to adversely affect critical habitat for the Northwest Atlantic Ocean loggerhead sea turtle distinct population segment (DPS) and four species of corals (*Mycetophyllia ferox*, *Orbicella annularis*, *O. faveolata*, and *O. franksi*). NMFS has requested a reinitiation of Section 7 consultation on the continued authorization of reef fish fishing managed by the Reef Fish FMP because new species (i.e., Nassau grouper, green sea turtle North Atlantic and South Atlantic DPSs, giant manta ray, and oceanic whitetip shark) have been listed under the ESA in memoranda dated September 29, 2016, and March 6, 2018. In these requests, it was documented that allowing the fishery to continue during the reinitiation period would not violate Section 7(a)(2) and 7(d) of the ESA .

Northern Gulf of Mexico Hypoxic Zone

Every summer in the northern Gulf, a large hypoxic zone forms. It is the result of allochthonous materials and runoff from agricultural lands by rivers to the Gulf, increasing nutrient inputs from the Mississippi River, and a seasonal layering of waters in the Gulf (see <http://www.gulfhypoxia.net/>). The layering of the water is temperature and salinity dependent and prevents the mixing of higher oxygen content surface water with oxygen-poor bottom water. For 2014, the extent of the hypoxic area was estimated to be 5,052 square miles and is similar the running average for over the past 5 years of 5,543 square miles Gulf (see <http://www.gulfhypoxia.net/>).

The hypoxic conditions in the northern Gulf directly impact less mobile benthic macroinvertebrates (e.g., polychaetes) by influencing density, species richness, and community composition (Baustian and Rabalais 2009). However, more mobile macroinvertebrates and demersal fishes (e.g., red snapper) are able to detect lower dissolved oxygen levels and move away from hypoxic conditions. Therefore, although not directly affected, these organisms are indirectly affected by limited prey availability and constrained available habitat (Baustian and Rabalais 2009; Craig 2012). For red snapper, Courtney et al. (2013) have conjectured that the hypoxic zone could have an indirect positive effect on red snapper populations in the western Gulf. They theorize that increased nutrient loading may be working in 'synergy' with abundant red snapper artificial habitats (e.g., oil platforms). Nutrient loading likely increases forage species biomass and productivity providing ample prey for red snapper residing on the oil rigs, thus increasing red snapper productivity.

Climate change

Climate change projections show increases in sea surface temperature and sea level; decreases in sea ice cover; and changes in salinity, wave climate, and ocean circulation [Intergovernmental Panel on Climate Change (IPCC) <http://www.ipcc.ch/>]. These changes are likely to affect plankton biomass and fish larvae abundance that could adversely impact fish, marine mammals, seabirds, and ocean biodiversity. Kennedy et al. (2002) and Osgood (2008) have suggested global climate change could bring about temperature changes in coastal and marine ecosystems that, in turn, can influence organism metabolism; alter ecological processes, such as productivity and species interactions; change precipitation patterns and cause a rise in sea level that could change the water balance of coastal ecosystems; alter patterns of wind and water circulation in the ocean environment; and influence the productivity of critical coastal ecosystems such as wetlands, estuaries, and coral reefs. National Oceanic and Atmospheric Administration's (NOAA) Climate Change Web Portal (<http://www.esrl.noaa.gov/psd/ipcc/ocn/>) indicates that the average sea surface temperature in the Gulf will increase by 1.2-1.4°C for 2006-2055 compared to the average over the years 1956-2005. For reef fishes, Burton (2008) speculated that climate change could cause shifts in spawning seasons, changes in migration patterns, and changes to basic life history parameters such as growth rates. The OceanAdapt model (http://oceanadapt.rutgers.edu/regional_data/) shows distributional trends both in latitude and depth over the time period 1985-1013. For some species such as the smooth puffer, there has been a distributional trend to the north in the Gulf. For other species such as red snapper and the dwarf sand perch, there has been a distributional trend towards deeper waters. Finally, for other species such as the dwarf goatfish, there has been a distributional trend both to the north and to deeper waters. These changes in distributions have been hypothesized as a response to environmental factors such as increases in temperature.

The distribution of native and exotic species may change with increased water temperature, as may the prevalence of disease in keystone animals such as corals and the occurrence and intensity of toxic algae blooms. Hollowed et al. (2013) provided a review of projected effects of climate change on the marine fisheries and dependent communities. Integrating the potential effects of climate change into the fisheries assessment is currently difficult due to the time scale differences (Hollowed et al. 2013). The fisheries stock assessments rarely project through a time span that would include detectable climate change effects.

Greenhouse gases

The IPCC (<http://www.ipcc.ch/>) has indicated that greenhouse gas emissions are one of the most important drivers of recent changes in climate. Wilson et al. (2014) inventoried the sources of greenhouse gases in the Gulf from sources associated with oil platforms and those associated with other activities such as fishing. A summary of the results of the inventory are shown in Table 3.3.7 with respect to total emissions and from fishing. Commercial fishing and recreational vessels make up a small percentage of the total estimated greenhouse gas emissions from the Gulf (1.43% and 0.59%, respectively).

Table 3.3.7. Total Gulf greenhouse gas emissions estimates (tons per year) from oil platform and non-oil platform sources, commercial fishing and recreational vessels, and percent

greenhouse gas emissions from commercial fishing and recreational vessels of the total emissions*.

Emission source	Greenhouse		Gas	Total CO _{2e} **
	CO ₂	CH ₄	N ₂ O	
Oil platform	11,882,029	271,355	167	17,632,106
Non-platform	22,703,695	2,029	2,698	23,582,684
Total	34,585,724	273,384	2,865	41,214,790
Commercial fishing	585,204	2	17	590,516
Recreational vessels	244,483	N/A	N/A	244,483
Percent commercial fishing	1.69	>0.01	0.59	1.43
Percent recreational vessels	0.71	NA	NA	0.59

*Compiled from Tables 7.9 and 7.10 in Wilson et al. (2014).

**The CO₂ equivalent (CO_{2e}) emission estimates represent the number of tons of CO₂ emissions with the same global warming potential as one ton of another greenhouse gas (e.g., CH₄ and N₂O). Conversion factors to CO_{2e} are 21 for CH₄ and 310 for N₂O.

Deepwater Horizon MC252 Oil Spill Incident

On April 20, 2010, an explosion occurred on the *Deepwater Horizon* semi-submersible oil rig approximately 36 nautical miles (41 statute miles) off the Louisiana coast. Two days later the rig sank. An uncontrolled oil leak from the damaged well continued for 87 days until the well was successfully capped by British Petroleum on July 15, 2010. The *Deepwater Horizon* MC252 oil spill affected at least one-third of the Gulf area from western Louisiana east to the Florida Panhandle and south to the Campeche Bank in Mexico. In response to the spill, NMFS closed waters in the Gulf to fishing, and at its height, closed over 88,000 square miles (Figure 3.3.1).

A final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement (PDARP), incorporated by reference, were conducted by NOAA and many cooperating agencies to assess the damage caused by the spill (DWH Trustees 2016). Key findings by NOAA with regards to the injury assessment were:

- Oil came into contact with a variety of northern Gulf habitats ranging from the deep-sea floor to coastal and nearshore areas.
- Species affected included deep-sea corals, fish and shellfish, birds, among others.
- The oil was toxic to a wide variety of organisms including fish, invertebrates, plankton, birds, deep-sea corals, sea turtles, and marine mammals.
- Toxic effects included death, disease, reduced growth, impaired reproduction, and physiological impairments that made it more difficult for organisms to survive and reproduce.
- The extent and degree of toxic levels of oil has declined substantially from 2010 to the present.

The PDARP outlines ways fish, including reef fish, were likely adversely affected. Effects include reduced recruitment, changes in trophic structure, changes in community structure, reduced growth, impaired reproduction, and adverse health effects. A more detailed description of these effects can be found in Chapter 4 of the PDARP

(<http://www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan>).

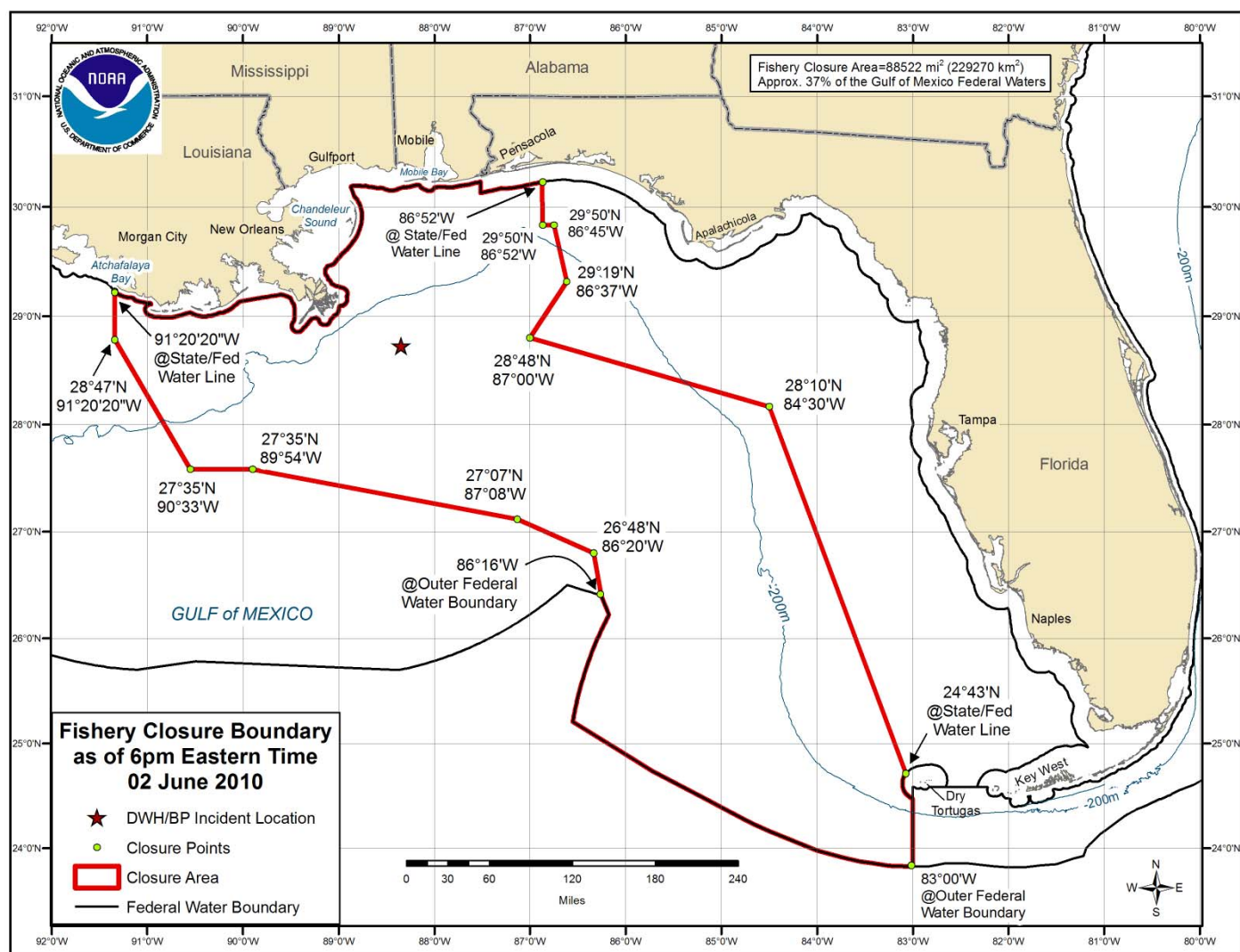


Figure 3.3.1. Fishery closure at the height of the *Deepwater Horizon* MC252 oil spill.

Deepwater Coral Communities

Deepwater corals are particularly vulnerable to episodic mortality events such as oil spills, since corals are immobile. Severe health declines have been observed in three deepwater corals in response to dispersant alone (2.3–3.4 fold) and the oil–dispersant mixtures (1.1–4.4 fold) compared to oil-only treatments (DeLeo et al. 2015). Increased dispersant concentrations appeared to exacerbate these results. As hundreds of thousands of gallons of dispersant were

applied near the wellhead during the *Deepwater Horizon MC252* oil spill, the possibility exists that deepwater corals may have been negatively impacted by the oil spill and subsequent spill remediation activities.

Several studies have documented declines in coral health or coral death in the presence of oil from the *Deepwater Horizon MC252* oil spill (White et al. 2012; Hsing et al. 2013; Fisher et al. 2014). Sites as far as 11 km southwest of the spill were documented to have greater than 45% of the coral colonies affected by oil (White et al. 2012; Hsing et al. 2013), and, though less affected, a site 22 km in 1900 m of water had coral damage caused by oil (Fisher et al. 2014). Coral colonies from several areas around the wellhead had damage to colonies that seemed to be representative of microdroplets as all colonies were not affected, and colonies that were affected had patchy distributions of damaged areas (Fisher et al. 2014). Because locations of deep-sea corals are still being discovered, it is likely that the extent of damage to deep-sea communities will remain undefined.

Outstanding Effects

As a result of the *Deepwater Horizon MC252* oil spill, a consultation pursuant to ESA Section 7(a)(2) was reinitiated. As discussed above, on September 30, 2011, the Protected Resources Division released an Opinion, which after analyzing best available data, the current status of the species, environmental baseline (including the impacts of the recent *Deepwater Horizon MC252* oil spill in the northern Gulf), effects of the proposed action, and cumulative effects, concluded that the continued operation of the Gulf reef fish fishery is not likely to jeopardize the continued existence of green, hawksbill, Kemp's ridley, leatherback, or loggerhead sea turtles, nor the continued existence of smalltooth sawfish (NMFS 2011). For additional information on the *Deepwater Horizon MC252* oil spill and associated closures, see: http://sero.nmfs.noaa.gov/deepwater_horizon_oil_spill.htm.

3.4 Description of the Economic Environment

3.5 Description of the Social Environment

Because of the nature of the amendment and the associated social effects, the description of the social environment is largely a broad look at commercial and recreational fishing in the Gulf of Mexico. A portion of the description of the social environment and pertains to total fishing effort for both commercial and recreational fishing engagement and is presented at both the county and community level. A geographical focus on reef fish permits within Gulf coast counties and communities is also included. There is little data available for the red drum fishery and it assumed that the social environment for red drum would be encompassed under the overall discussion of recreational fishing.

3.5.1 Fishing Engagement and Reliance

Commercial reef fish landings by all gear types are depicted in Figure 3.5.1.1 (Overstreet et al., 2017) and show a concentration of the largest landings in the Eastern Gulf. This is consistent with the location of many reef fish vessel homeports as seen in figures below.

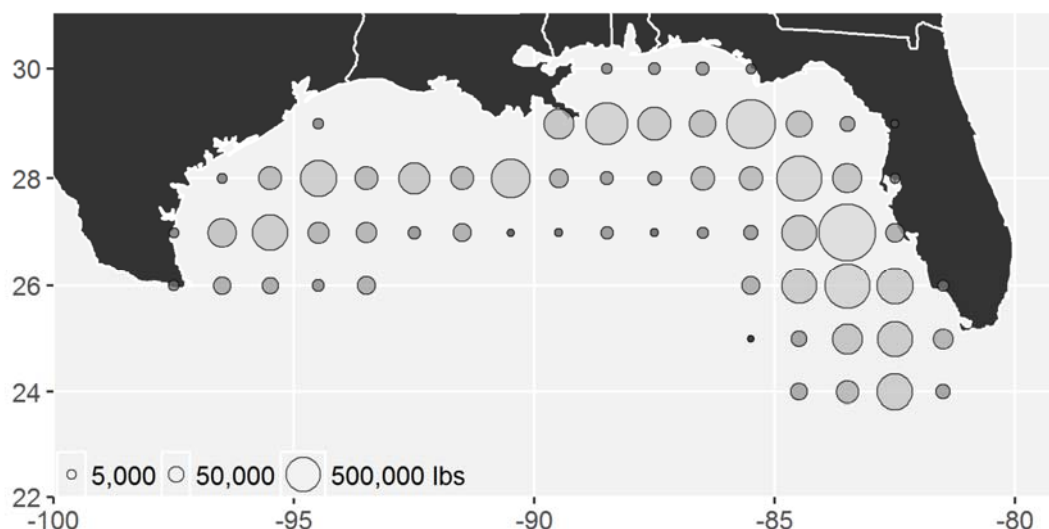


Figure 3.5.1.1. Distribution of reef fish landings by area fished for Gulf reef fish.

Source: Overstreet et al., 2017.

Commercial and recreational fishing engagement and reliance are measures of sector fishing activity at the county and community level from federal fisheries datasets (Jepson and Colburn 2013). Commercial and recreational fishing engagement are absolute measures of fishing activity as measured by the absolute numbers of that activity. For commercial fishing it is the number of commercial vessels by homeport address, number of commercial vessel by owner's address and number of dealers with landings in each county and value of those landings. For recreational engagement we used the number of recreational vessels by homeport address, number of recreational vessels by owner's address and number of recreational infrastructure (boat ramps associated with community or county). The commercial and recreational reliance indices are relative measures consisting of the same variables related to commercial or recreational fishing activity but divided by the population of the community. These variables are then placed into principal component analysis with a single factor solution. The factor score becomes the engagement or reliance score for the county or community (these are standardized and zero is the mean, they were then categorized by standard deviation: Low = ≤ 0.0 to 0.0 ; Medium = >0.0 to 0.5 ; Medium high = >0.5 to 1.0 ; High = > 1.0 , for the county level measure, while community level uses raw factor scores.

Commercial Engagement and Reliance

Each Gulf state in Figure 3.5.1.1 has a county with either medium high or high engagement in commercial fishing. These are counties that have a substantial amount of socio-economic activity devoted to commercial fishing and will likely have a number of communities with infrastructure to facilitate landing and processing of commercial catch and docks for commercial vessels. The states of Alabama and Mississippi are the only states that do not have a county that scores high or medium high for commercial fishing reliance. Florida's Panhandle and Louisiana's Delta region have several counties with high or medium high scores for reliance.

For those counties with high reliance, that same infrastructure will exist, but smaller populations of people are associated with it and it may play a larger role in the county economy.

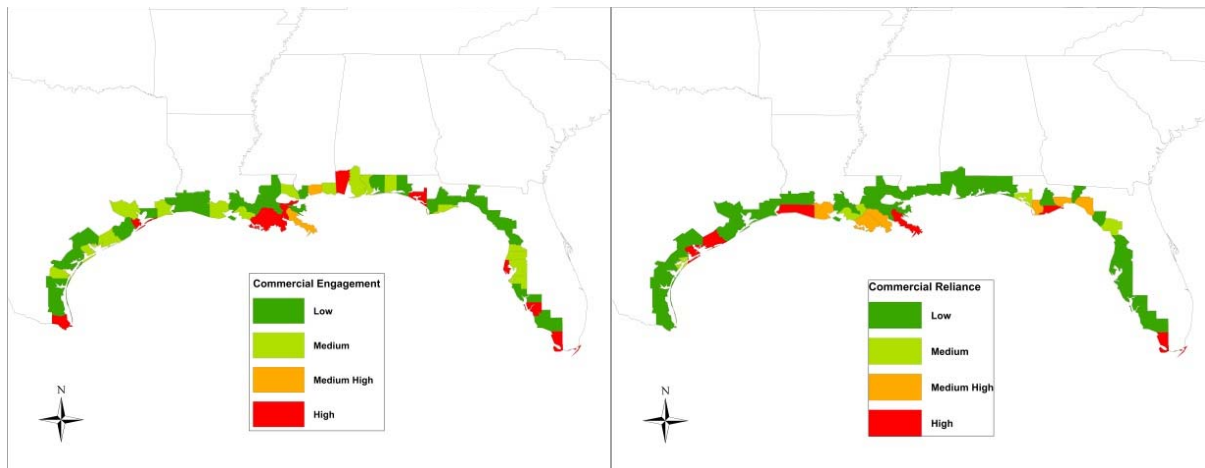


Figure 3.5.1.2. County commercial fishing engagement and reliance 2014.

Source: SERO Community ALS 2014

To further understand the importance of commercial fishing to Gulf coast communities, a list of top 20 commercial fishing communities is included by using their rank on commercial fishing engagement. All 20 included communities demonstrate high levels of commercial fishing engagement, although this is not specific to fishing for reef fish. Factor scores of both engagement and reliance were plotted together in Figure 3.5.1.3 to provide some indication of the importance of commercial fishing when compared to another community.

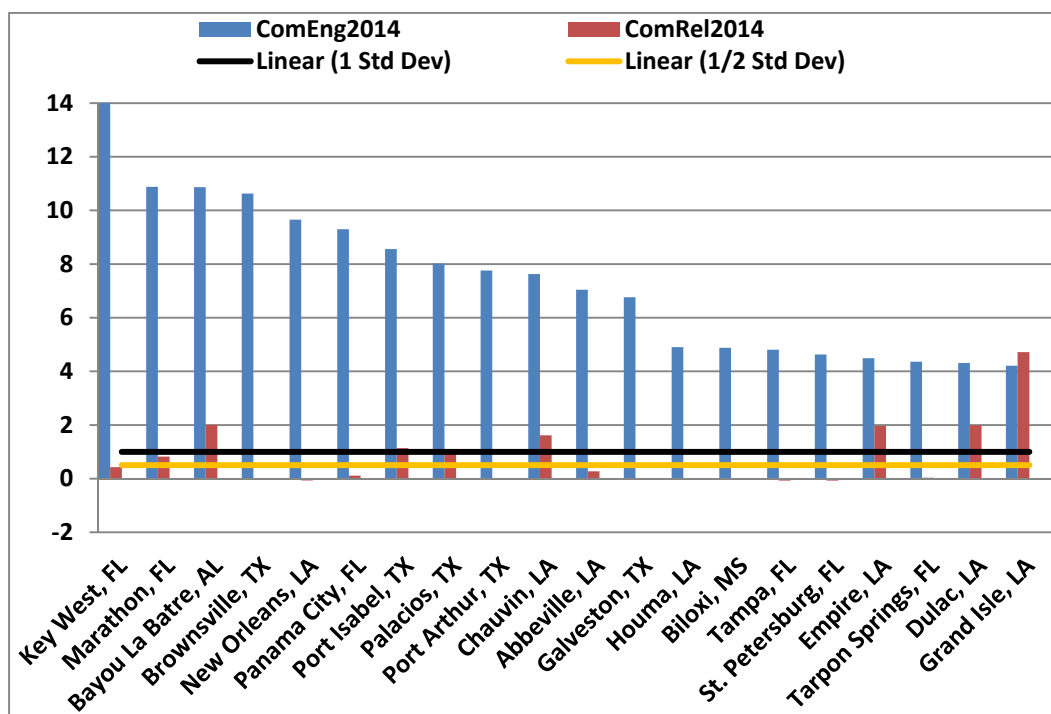


Figure 3.5.1.3. Top 20 commercial fishing communities' engagement and reliance.

Source: SERO, Community Social Vulnerability Indicators Database 2014.

In Figure 3.5.1.3 two thresholds of one and one-half standard deviation above the mean were plotted to help determine a threshold for significance. All states are represented within the top 20 commercially engaged fishing communities in the Gulf. Alabama and Mississippi each have one community in the top 20, while Florida, Louisiana and Texas have several. The most reliant communities within the top 20 engaged communities are located in Louisiana. Many of the top 20 commercial fishing communities are likely ranked where they are because of the shrimp fishery. However, several communities, including some of those that are highly reliant are also communities with large concentrations of commercial reef fish permit holders.

Recreational Engagement and Reliance

Most Gulf States in Figure 3.5.1.4 have a county with either medium high or high engagement in recreational fishing, except Louisiana. These are counties that have a substantial amount of socio-economic activity devoted to recreational fishing and will likely have a number of communities with infrastructure to facilitate landing recreational catch, boat ramps and docks for recreational vessels. Mississippi is the only state that does not have a county that scores high or medium high for recreational fishing reliance. Florida's Panhandle and west coast have several counties with high or medium high scores for both recreational engagement and reliance. For those counties with high reliance, that same infrastructure will exist, but smaller populations of people are associated with it and it may play a larger role in the county economy.

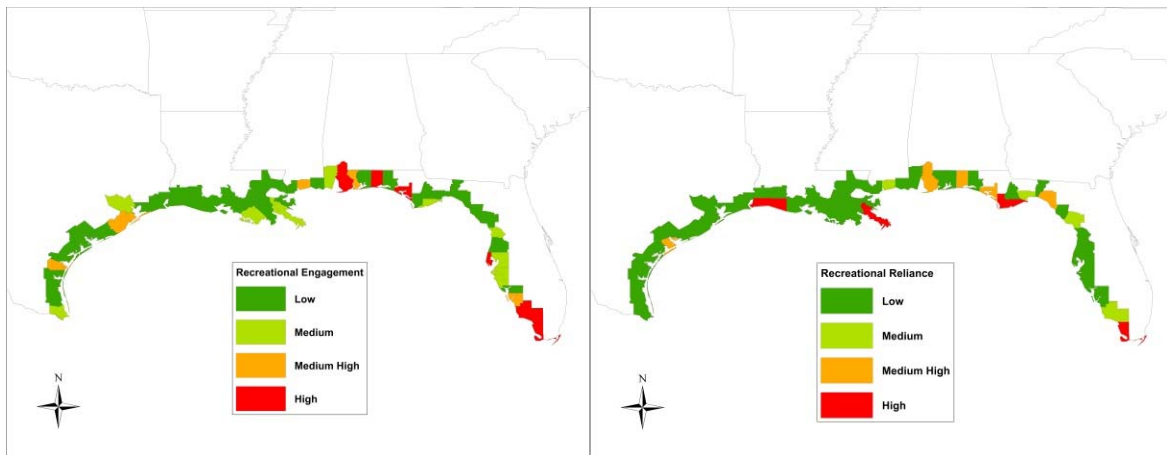


Figure 3.5.1.4. County recreational fishing engagement and reliance 2014.

Source: SERO Community ALS 2014

Reef fish landings for the recreational sector are not available at the community level, making it difficult to identify communities as dependent on recreational fishing for reef fish. Because limited data are available concerning how recreational fishing communities are engaged and reliant on specific species or species groups, indices were created using secondary data from permit and infrastructure information for the southeast recreational fishing sector at the community level as described above.

Figure 3.5.1.5 identifies the top Gulf communities that are engaged and reliant upon recreational fishing in general. Two thresholds of one and one-half standard deviation above the mean were

plotted to help determine a threshold for significance. Communities are presented in ranked order by fishing engagement and all 20 included communities demonstrate high levels of recreational engagement, although this is not specific to fishing for reef fish. Because the analysis used discrete geo-political boundaries, Panama City and Panama City Beach, Florida had separate values for the associated variables. Calculated independently, each still ranked high enough to appear in the top 20 list suggesting a greater importance for recreational fishing in that area. Grand Isle, Louisiana demonstrates a high reliance upon recreational fishing as the community's population is smaller than most of the highly engaged communities. With both a high engagement and reliance, Grand Isle may depend upon recreational fishing as a strong component of its local economy.

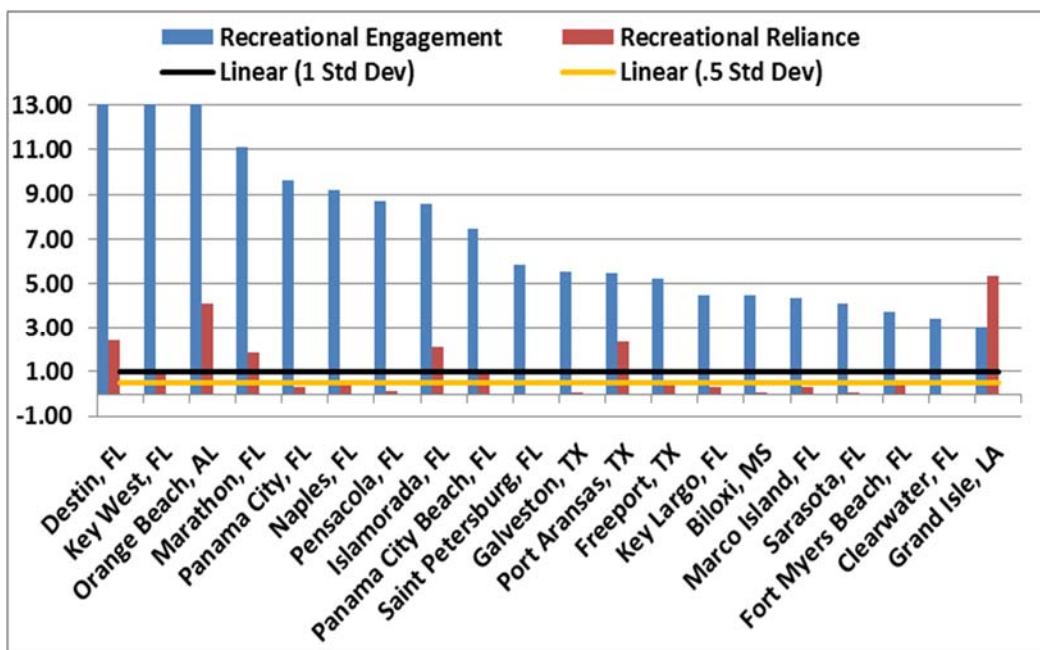


Figure 3.5.1.5. Top 20 recreational fishing communities' engagement and reliance.
Source: SERO, Community Social Vulnerability Indicators Database 2014.

3.5.2 Reef Fish Permits

The general trend for both commercial and for-hire reef fish permits has been downward from 2006 through 2016 (Fig. 3.5.2.1).

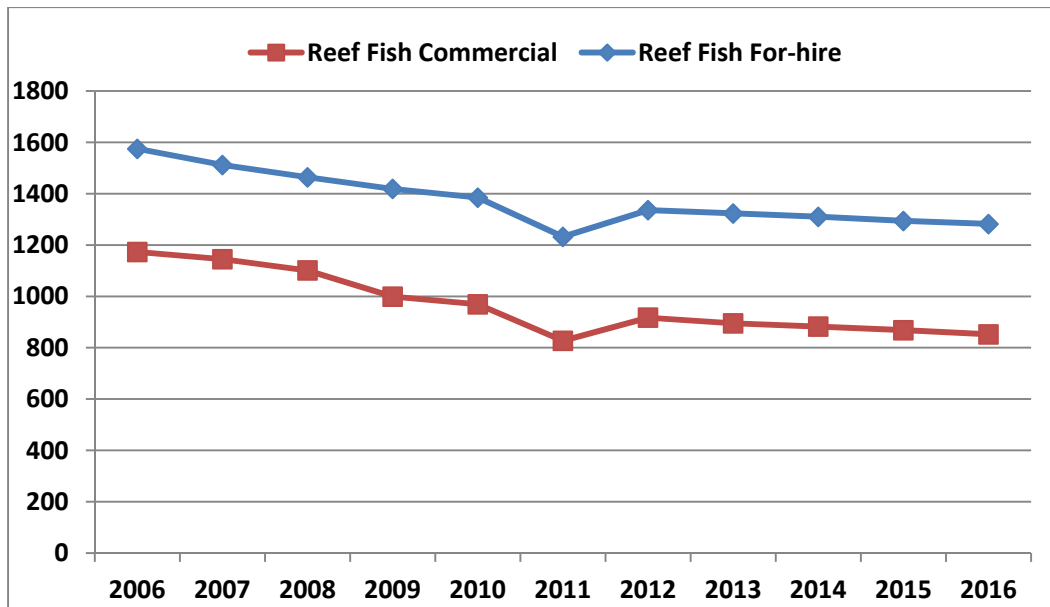


Figure 3.5.2.1. Total number of reef fish permits for both commercial and for-hire from 2006-2016.

Source: SERO Permits 2018

Reef Fish Permitted Commercial Vessels by Community

The distribution of reef fish commercial permits is provided in Fig. 3.5.2.2. Again the largest concentration is along Florida's Central west coast and Panhandle area. Alabama has large clusters in the Orange Beach and Dauphin Island areas. Mississippi also has a concentration of vessels in the Pascagoula area while the largest group of vessels in Louisiana is located near the Venice/Empire and Buras/Triumph region. Texas has its largest concentration of vessels in the Galveston area with a few smaller concentrations near Freeport and Corpus Christi.

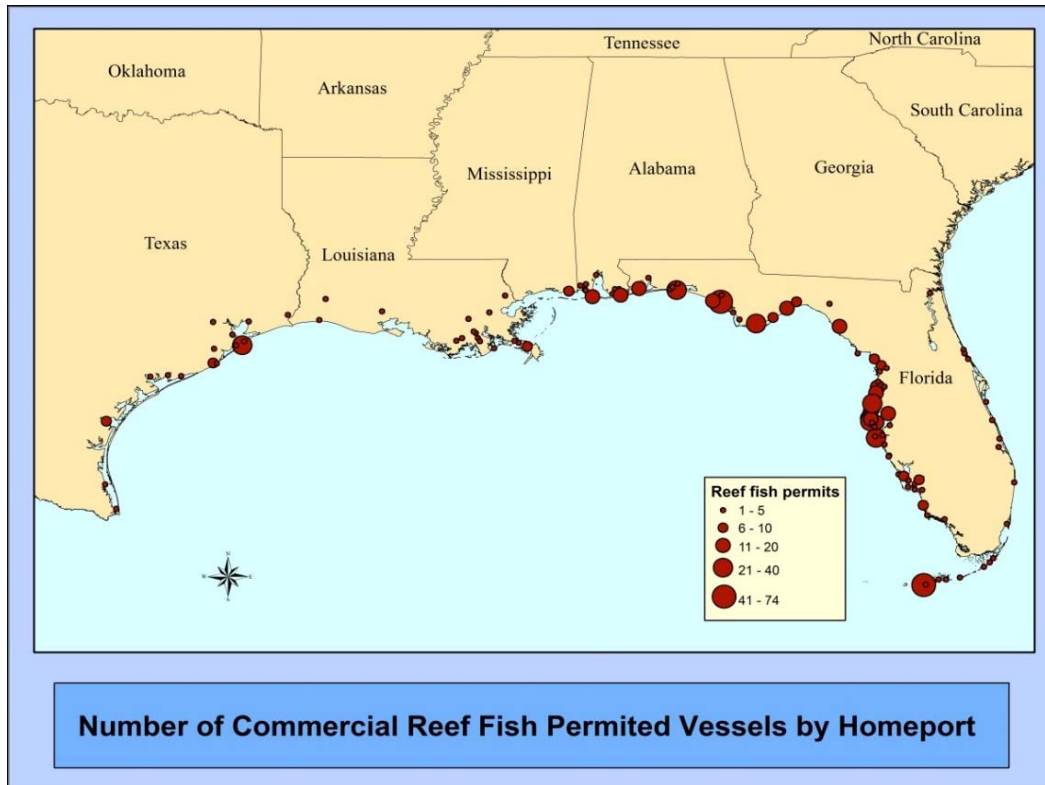


Figure 3.5.2.2. Distribution of commercially permitted reef fish vessels for Gulf States by community.

Source: NMFS Southeast Regional Office permits office, September 20, 2016.

Reef Fish Permitted Charter Vessels and Headboats by Community

In order to present information about the charter vessels and headboats that are engaged in the recreational reef fish fishery, all vessels with a federal for-hire permit for reef fish, including historical captain permits, are included in the following analysis.

The majority of federal for-hire permits for reef fish are held by operators in Florida (59% in 2016), followed by Texas (17.6%), Alabama (10.2%), Louisiana (9%), Mississippi (2.7%), and other states (1.4%; Table 3.5.2.1). The distribution of permits by state has followed a similar pattern throughout the last five years. These data may deviate from the numbers included elsewhere in the document because of the date on which data were gathered. Data included in Table 3.5.2.1 are based on the number of permits throughout the year, rather than from a specific date, and include permits that were valid or renewable sometime during the year. However, if the permit was sold, then only the most current permit has been counted. Federal for-hire permits are held by those with mailing addresses in a total of 348 communities, located in 21 states (Southeast Regional Office permit office, October 25, 2017).

Table 3.5.2.1. Number of federal for-hire permits for Gulf reef fish including historical captain permits, by state and by year.

State	2012	2013	2014	2015	2016
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AL	157	159	153	143	134
FL	812	803	787	778	776
LA	123	120	117	121	119
MS	48	47	42	38	35
TX	221	219	230	232	232
Other	17	15	16	16	19
Total	1378	1363	1345	1328	1315

Source: NMFS Southeast Regional Office permit office, SERO Access database. Includes valid and renewable permits.

When Gulf reef fish for-hire vessels are separated into charter vessels or headboats, the majority of vessels are charter vessels (95% of for-hire vessels as of September 20, 2016) and a smaller proportion are headboats (approximately 5%, NMFS Southeast Regional Office permit office). Figure 3.5.2.3 shows the spatial distribution of charter vessels with federal for-hire permits around the Gulf as of September 20, 2016.

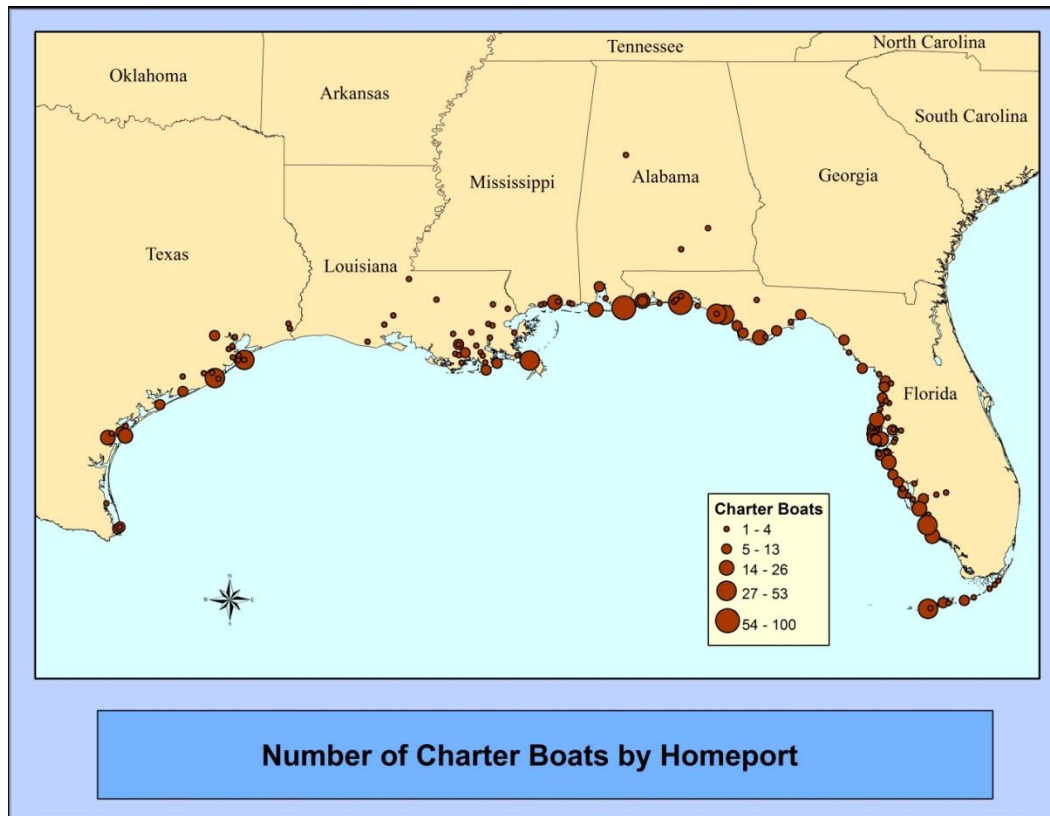


Figure 3.5.2.3. Distribution of charter vessels with federal for-hire permits for Gulf reef fish in Gulf states by community.

Source: NMFS Southeast Regional Office permits office, September 20, 2016.

Charter vessels are distributed throughout the Gulf coast with large clusters in Florida communities along the Panhandle, along the mid-Florida and southwest Florida coast, and in the Keys; in Alabama (Orange Beach and Dauphin Island); in Texas (Galveston, Freeport, Corpus

Christi, Port Aransas, Port O'Connor, and Matagorda); Mississippi (Biloxi); and in Louisiana (Venice, Chauvin, and Grand Isle) as depicted in Figure 3.5.2.3.

Figure 3.5.2.4 shows the spatial distribution of headboats with federal for-hire reef fish permits throughout the Gulf. While far fewer than charter vessels, headboats are homeported in some of the same communities where there are a considerable number of charter vessels. Only in the Florida Keys do you not see a strong presence of headboats. This may be a factor linked to how vessels are characterized within the permit system when asked how the vessel is best described. In some cases, vessels are best described by the permit holder as one category, but may also be appropriate in another.

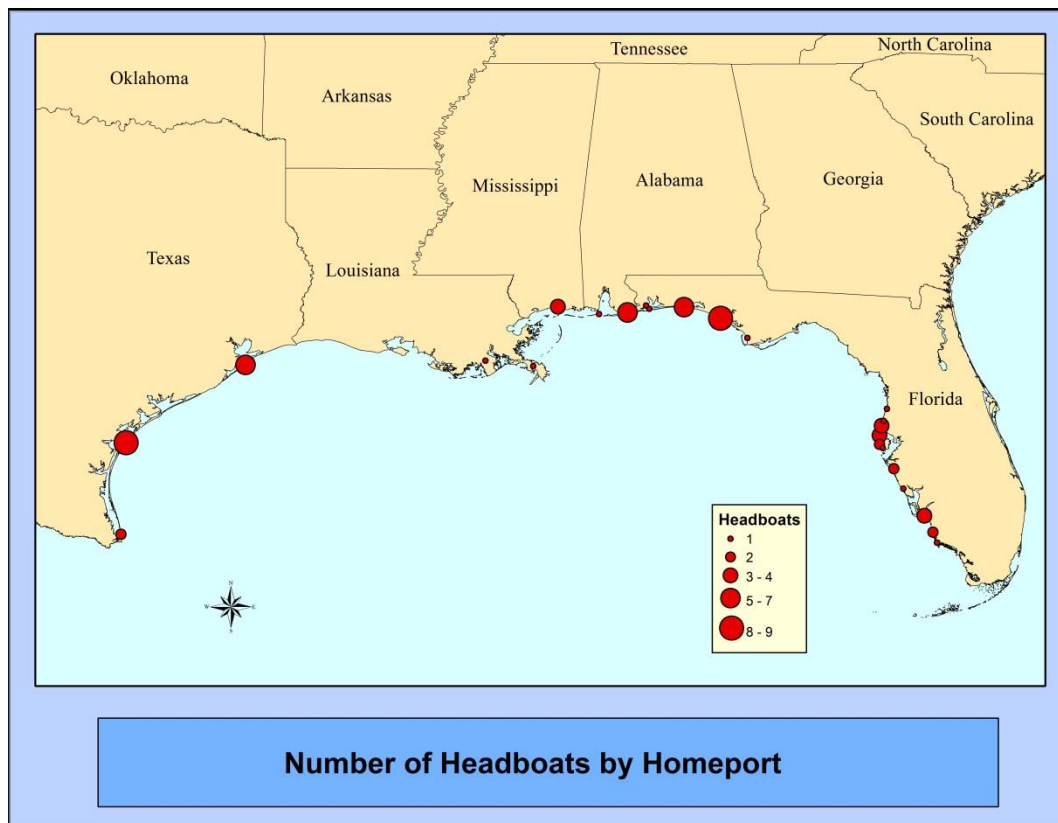


Figure 3.5.2.4. Distribution of headboats with federal for-hire permits for Gulf reef fish by community.

Source: NMFS Southeast Regional Office permits office, September 20, 2016.

3.5.3 Environmental Justice

Executive Order 12898 requires 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. The main focus of Executive Order 12898 is to consider “the disproportionately high and adverse human health or

environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States and its territories...” This executive order is generally referred to as environmental justice.

Because the nature of this amendment does not readily translate into actions that may have an impact on any particular population, it is unlikely that there are any environmental justice issues related to any anticipated effects (see section 4.1.4). These actions will be applied to particular stocks and it would be difficult to discern whether or not these actions were disproportionately having an impact on any particular population because any impacts will be further in the future. Therefore, environmental justice issues concerning this amendment do not seem to be apparent at this time and although there may be impacts in the future, there should not be any disproportionate effects to any population at this time.

3.6 Description of the Administrative Environment

3.6.1 Federal Fishery Management

Federal fishery management is conducted under the authority of the Magnuson-Stevens Act (16 U.S.C. 1801 *et seq.*). It was originally enacted in 1976 as the Fishery Conservation and Management Act. The Magnuson-Stevens Act claims sovereign rights and exclusive fishery management authority over most fishery resources within the EEZ, an area extending 200 nautical miles from the seaward boundary of each of the coastal states, and authority over U.S. anadromous species and continental shelf resources that occur beyond the EEZ.

Responsibility for federal fishery management is shared by the Secretary of Commerce (Secretary) and eight regional fishery management councils that represent the expertise and interests of constituent states. Regional councils are responsible for preparing, monitoring, and revising management plans for fisheries needing management within their jurisdiction. The Secretary is responsible for promulgating regulations to implement proposed plans and amendments after ensuring management measures are consistent with the Magnuson-Stevens Act and with other applicable laws summarized in Appendix A. In most cases, the Secretary has delegated this authority to NMFS.

The Council is responsible for fishery resources in federal waters of the Gulf. These waters extend to 200 nautical miles offshore from the seaward boundaries of the Gulf States of Alabama, Florida, Louisiana, Mississippi, and Texas, as those boundaries have been defined by law. The length of the Gulf coastline is approximately 1,631 miles. Florida has the longest coastline of 770 miles along its Gulf coast, followed by Louisiana (397 miles), Texas (361 miles), Alabama (53 miles), and Mississippi (44 miles).

The Council consists of seventeen voting members: 11 public members appointed by the Secretary; one each from the fishery agencies of Texas, Louisiana, Mississippi, Alabama, and Florida; and one from NMFS. The public is also involved in the fishery management process through participation on advisory panels and through Council meetings that, with few exceptions for discussing personnel matters, are open to the public. The regulatory process is also in

accordance with the Administrative Procedures Act, in the form of “notice and comment” rulemaking, which provides extensive opportunity for public scrutiny and comment, and requires consideration of and response to those comments.

Regulations contained within FMPs are enforced through actions of NOAA’s Office of Law Enforcement, the United States Coast Guard, and various state authorities. To better coordinate enforcement activities, federal and state enforcement agencies have developed cooperative agreements to enforce the Magnuson-Stevens Act. These activities are being coordinated by the Council’s Law Enforcement Technical Committee and the Gulf States Marine Fisheries Commission’s Law Enforcement Committee, which have developed joint enforcement agreements and cooperative enforcement programs (www.gsmfc.org).

Reef fish stocks are assessed through the SEDAR process. As species are assessed, stock condition and acceptable biological catch levels are evaluated. As a result, periodic adjustments to stock ACLs and other management measures are deemed needed to prevent overfishing. Management measures are implemented through plan or regulatory amendments.

3.6.2 State Fishery Management

The purpose of state representation at the Council level is to ensure state participation in federal fishery management decision-making and to promote the development of compatible regulations in state and federal waters. The state governments of Texas, Louisiana, Mississippi, Alabama, and Florida have the authority to manage their respective state fisheries. Each of the five Gulf States exercises legislative and regulatory authority over their respective state’s natural resources through discrete administrative units. Although each agency is the primary administrative body with respect to the states’ natural resources, all states cooperate with numerous state and federal regulatory agencies when managing marine resources. A more detailed description of each state’s primary regulatory agency for marine resources is provided on their respective web pages (Table 3.6.2.1).

Table 3.6.2.1. Gulf state marine resource agencies and Web pages.

State marine resource agency	Web page
Alabama Marine Resources Division	http://www.outdooralabama.com/
Florida Fish and Wildlife Conservation Commission	http://myfwc.com/
Louisiana Department of Wildlife and Fisheries	http://www.wlf.louisiana.gov/
Mississippi Department of Marine Resources	http://www.dmr.ms.gov/
Texas Parks and Wildlife Department	http://tpwd.texas.gov/

CHAPTER 4. ENVIRONMENTAL CONSEQUENCES

4.1 Action 1: Maximum Sustainable Yield (MSY) Proxies

4.1.1 Direct and Indirect Effects on the Physical Environment

The alternatives in this action establish a proxy for MSY. This is an administrative action that has no direct impact on the physical environment. However, the MSY proxy is used in establishing the catch levels for the overfishing limit (OFL), acceptable biological catch (ABC), and annual catch limit (ACL). Proxies that allow larger catch levels may result in greater fishing activity, which would increase the potential effects.

The commercial sector of the reef fish fishery is conducted using vertical lines (i.e., electric reel, bandit rig, hook-and-line, and trolling) and longlines. The recreational sector (headboat, charter, and private modes) primarily uses vertical gear (hook-and-line). Reef fish are also harvested by spearfishing in both the commercial and recreational sectors. Harvest of red drum in the exclusive economic zone (EEZ) is currently prohibited. Recreational harvest occurs in state waters, primarily by hook-and-line. Commercial harvest of red drum is prohibited in most state waters, but is allowed in Mississippi state waters under quota. It is illegal for a vessel carrying a purse seine in Mississippi waters to possess any red drum.

Longline gear is deployed over hard bottom habitats using weights to keep the gear in direct contact with the bottom. The potential for this gear to adversely impact the bottom depends on the type of habitat it is set on, the presence or absence of currents and the behavior of fish after being hooked. In addition, this gear, upon retrieval, can abrade, snag, and dislodge smaller rocks, corals, and sessile invertebrates (Hamilton 2000; Barnette 2001). Direct underwater observations of longline gear in the Pacific halibut fishery by High (1998) noted that the gear could sweep across the bottom. A study that directly observed deployed longline gear (Atlantic tilefish fishery) found no evidence that the gear shifted significantly, even when set in currents (Grimes et al. 1982). Lack of gear shifting even in strong currents was attributed to setting anchors at either end of the longline to prevent movement, which is the standard in the longline component of the commercial sector of the reef fish fishery. Based on the direct observations, it is logical to assume that bottom longline gear would have a minor impact on sandy or muddy habitat areas. However, due to the vertical relief that hard bottom and coral reef habitats provide, it would be expected that bottom longline gear may become entangled, resulting in potential negative effects to habitat (Barnette 2001).

Concentrations of many managed reef fish species are higher on hard bottom areas than on sand or mud bottoms, thus vertical line gear fishing generally occurs over hard bottom areas (GMFMC 2004d). Vertical lines include multi-hook lines known as bandit gear, handlines, and rod-and-reels. Vertical line gear is less likely to contact the bottom than longlines, but still has the potential to snag and entangle bottom structures and cause attached organisms such as soft corals and sponges to tear off or be abraded (Barnette 2001). In using bandit gear, a weighted line is lowered to the bottom, and then the weighted line is raised slightly off the bottom (Siebenaler and Brady 1952). The gear is in direct contact with the bottom for only a short

period of time. Barnette (2001) suggests that physical impacts may include entanglement and minor degradation of benthic species from line abrasion and the use of weights (sinkers).

Anchor damage is also associated with vertical line fishing vessels, particularly by the recreational sector, where fishermen may repeatedly visit well marked or known fishing locations. Hamilton (2000) pointed out that “favorite” fishing areas such as reefs are targeted and revisited multiple times, particularly with the advent of GPS technology. The cumulative effects of repeated anchoring could damage the hard bottom areas where reef fish fishing occurs, as well as repeated drops of weighted fishing rigs onto the reef. Recreational and commercial vessels that use vertical line gear are typically known to anchor more frequently over the reef sites.

Spears are used by both the recreational and commercial sector to harvest reef fish, but represent a relatively minor component of both. Barnette (2001) summarized a previous study that concluded spearfishing on reef habitat may result in some coral breakage. In addition, there could be some impacts from divers touching coral with their hands or from re-suspension of sediment by fins (Barnette 2001).

Sub-action 1.1 sets the MSY proxy only for red snapper. The current proxy for red snapper is the yield at $F_{26\%}$ SPR. **Alternative 1** would leave the red snapper MSY proxy unchanged, which would result in no additional adverse impacts to the physical environment. **Alternative 2** has three options for modifying the red snapper MSY proxy. **Option 2a** would result in a less conservative MSY proxy of the yield at $F_{20\%}$ SPR. This could increase catch levels, which could result in increased fishing effort and greater adverse impacts to the physical environment. **Option 2b** would result in a slightly more conservative MSY proxy of the yield at $F_{30\%}$ SPR, which could reduce catch levels, resulting in reduced fishing effort and smaller adverse impacts to the physical environment. **Option 2c** would result in the most conservative MSY proxy of the yield at $F_{40\%}$ SPR. This could further reduce catch levels, resulting in even more reduced fishing effort and smaller adverse impacts to the physical environment. In relative terms, **Alternative 2, Option 2c** would be expected to produce the least adverse impacts, following by **Alternative 2, Option 2b, Alternative 2, Option 2a, and Alternative 1**.

Sub-action 1.2 sets the MSY proxy for 5 reef fish stocks that have had stock assessments, and produced MSY proxies that were used by the assessment scientists and the SSC to determine stock status. This includes two species of grouper, two species of snapper, and tilefish. In all cases, the assessment used an MSY proxy of the yield at $F_{30\%}$ SPR. However, the Council has not specified the MSY proxies in the FMP. **Alternative 1** would leave the MSY proxy officially undefined. It is probable, but not definite, that future assessments would continue to use this proxy. Therefore, **Alternative 1** would not result in any change to the fishing effort or effects on the physical environment. **Alternative 2** would specify the MSY proxy for these stocks as the yield at $F_{30\%}$ SPR. Since this is the same proxy as that would likely be used under **Alternative 1**, there is no difference in the impacts of **Alternative 1** vs. **Alternative 2** on the physical environment. **Alternative 3** would adopt a more conservative proxy than the yield at $F_{30\%}$ SPR. Relative to **Alternative 1** and **Alternative 2**, this could result in less fishing effort and less adverse effects on the physical environment.

Sub-action 1.3 provides for MSY proxies to be established for stock complexes. The five stock complexes presented in this sub-action were created in the Generic Annual Catch Limits/Accountability Measures Amendment (GMFMC 2011a).

Alternative 1 would result in no stock complex MSY proxies being established. Effects on the physical environment would depend on the MSY proxies established for the individual stocks through Sub-action 1.2 and Sub-action 1.4.

Alternative 2 would establish an MSY proxy for the tilefishes stock complex. **Option 2a** would use the golden tilefish as an indicator species. **Option 2b** would use a data-limited method to establish MSYs for the remaining species, and would combine those with the assessed MSY estimate from the golden tilefish to create an MSY proxy for the 3-species complex as a whole. This would be an actual harvest number (e.g., 1 million pounds whole weight) rather than the yield at some biological reference point. The relative level of MSY proxies established under these options is unknown, so the relative effects on the physical environment cannot be determined. However, if it becomes necessary to reduce fishing effort as a result of a finding of overfishing, the resulting regulations to reduce fishing effort would apply to all three stocks rather than to a single stock, and regardless of which option is selected, **Alternative 2** would therefore result in less adverse impacts to the physical environment than if this alternative is not selected, or the reductions were applied to a single stock under **Alternative 1**.

Alternative 3 would establish an MSY proxy for the other shallow-water grouper stock complex. **Option 3a** and **Option 3b** would apply as described for **Alternative 2**, except the indicator species for **Option 3a** would be black grouper. As discussed above, the relative level of MSY proxies established under these options is unknown, so the relative effects on the physical environment cannot be determined. However, if it becomes necessary to reduce fishing effort as a result of a finding of overfishing, the resulting regulations to reduce fishing effort would apply to all four stocks rather than to a single stock, and regardless of which option is selected, **Alternative 3** would therefore result in less adverse impacts to the physical environment than if this alternative is not selected, or the reductions were applied to a single stock under **Alternative 1**.

Alternative 4 would establish an MSY proxy for the deep-water grouper stock complex. **Option 4a** and **Option 4b** would apply as described for **Alternative 2**, except the indicator species for **Option 4a** would be yellowedge grouper. If it becomes necessary to reduce fishing effort as a result of a finding of overfishing, the resulting regulations to reduce fishing effort would apply to all four stocks rather than to a single stock, and regardless of which option is selected, **Alternative 4** would therefore result in less adverse impacts to the physical environment than if this alternative is not selected, or the reductions were applied to a single stock under **Alternative 1**.

Alternative 5 would establish an MSY proxy for the jacks stock complex. There is no assessed stock in this complex. Therefore, only data-limited method to establish MSYs can be applied. If it becomes necessary to reduce fishing effort as a result of a finding of overfishing, the resulting regulations to reduce fishing effort would apply to all four stocks rather than to a single stock, and regardless of which option is selected, **Alternative 5** would therefore result in less adverse

impacts to the physical environment than if this alternative is not selected, or the reductions were applied to a single stock under **Alternative 1**.

Alternative 6 would establish an MSY proxy for the mid-water snappers stock complex. There is no assessed stock in this complex. Therefore, only data-limited method to establish MSYs can be applied. If it becomes necessary to reduce fishing effort as a result of a finding of overfishing, the resulting regulations to reduce fishing effort would apply to all four stocks rather than to a single stock, and regardless of which option is selected, **Alternative 6** would therefore result in less adverse impacts to the physical environment than if this alternative is not selected, or the reductions were applied to a single stock under **Alternative 1**.

In summary, **Alternatives 2 through 6** each apply to a different stock complex, and are not directly comparable to each other, but are comparable to **Alternative 1**. In each case, because the alternative would result in management measure to reduce fishing effort being applied to the entire complex instead of a single stock, the adverse effects on the physical environment from selecting each alternative would be less than from not selecting the alternative or from selecting **Alternative 1**.

Sub-action 1.4 would establish an MSY proxy for each reef fish stock in the Reef Fish FMP that does not currently have a proxy and is not included on the previous sub-actions plus red drum. This includes between 5 and 20 stocks depending on how many stocks are selected for inclusion in stock complex MSY proxies in Sub-action 3.

Alternative 1 would leave the MSY proxy officially undefined for all stocks. Therefore, under **Alternative 1** there would be no change to the fishing effort or effects on the physical environment. **Alternative 2** would establish an MSY proxy on a stock-by-stock basis. Under **Alternative 2**, for each stock, an MSY proxy would be chosen from four F_{MSY} options ($F_{20\% SPR}$, $F_{30\% SPR}$, $F_{40\% SPR}$, or $F_{50\% SPR}$) or a proxy based on a data limited method. Because a stock assessment is required to determine the yield when fishing at F_{SPR} , and none of these stocks have been assessed, selection of one of the F_{SPR} based proxies will have no change in the effects relative to **Alternative 1**. If an assessment is eventually conducted, lower SPRs will allow higher MSY levels and possibly higher levels of fishing effort, producing potentially greater adverse effects of the physical environment. Thus $F_{20\% SPR}$ could have the greatest adverse impacts, with successively less adverse impact for $F_{30\% SPR}$, $F_{40\% SPR}$, and $F_{50\% SPR}$. This only is true if an assessment is conducted. Otherwise, the effects would be no different from **Alternative 1**. If a data-limited method is selected, this would place a limit on harvest relative to **Alternative 1**, and would therefore have less adverse impacts than **Alternative 1** even if there is no stock assessment.

4.1.2 Direct and Indirect Effects on the Biological/Ecological Environment

Direct and indirect effects from fishery management actions have been discussed in detail for a variety of reef fish species in past reef fish FMP Amendments (e.g., GMFMC 2004d, 2007, 2008a, 2008b, 2008c, 2009, 2011b, 2012b, 2012c, 2015b, 2016a, 2017c)) and are incorporated here by reference. Less has been discussed for red drum as the last amendment (Amendment 3 to the red drum FMP) occurred in 1992. Management actions that affect this environment

mostly relate to the impacts of fishing on a species' population size, life history, and the role of the species within its habitat. Removal of fish from the population through fishing reduces the overall population size. Fishing gears have different selectivity patterns which refer to a fishing method's ability to target and capture organisms by size and species. This would include the number of discards, mostly sublegal fish or fish caught during seasonal closures, and the mortality associated with releasing these fish. Potential impacts of the 2010 *Deepwater Horizon* MC252 oil spill on the biological/ecological environment are discussed in Section 3.3 of a January 2011 Framework Action (GMFMC 2011c), and the Deepwater Horizon Programmatic Damage Assessment and Restoration Plan (DWH Trustees 2016) and are also incorporated here by reference. These impacts include recruitment failure and reduced fish health.

Fishing can affect life history characteristics of reef fish such as growth and maturation rates. For example, Fischer et al. (2004) and Nieland et al. (2007) found that the average size-at-age of red snapper had declined and associated this trend with fishing pressure. Lombardi-Carlson et al. (2006) found that the mean size of gag at age was larger pre-1990 than in post-1990 years and suggested this change was also due to fishing. For red snapper, Woods (2003) found that the size at maturity for Gulf of Mexico (Gulf) red snapper had declined and speculated this change may also have been due to increases in fishing effort. Grouper reproduction may also have been impacted by fishing. Fitzhugh et al. (2006a, 2006b) reported the size at 50% maturity and 50% transition from females to males was smaller in their studies compared to earlier years. In addition, for hermaphroditic species, fishing pressure has been suggested for changes in sex ratios. The proportion of male gag in the population has decreased from historical levels of 17% (Hood and Schlieder 1992) to 2-10% in the 1990s (Coleman et al. 1996), leading to concerns by the Gulf of Mexico Fishery Management Council's (Council) Reef Fish Stock Assessment Panel that the reduction in proportion of males may have a potentially negative consequence on population reproductive potential (GMFMC 1998). It has been suggested the resulting reduction in the number of males is a consequence of males being more aggressive feeders than females. Thus, hook-and-line fishing on gag spawning aggregations tends to selectively remove males before females (Gilmore and Jones 1992; Koenig et al. 1996). A decline in the ratio of male to female gag in the Gulf has been an ongoing source of concern. Furthermore, for species that aggregate, such as gag, the species is particularly vulnerable to fishing because they are concentrated at specific locations. This problem is confounded because of the depth gag spawn (from 27-66 fathoms, but concentrated around 44 fathoms; Koenig et al. 1996). At these depths, gag are vulnerable to mortality from barotrauma through the capture process.

Less is known about how fishing affects red drum life history. As described in Sections 3.1 and 3.3, the red drum fishery primarily targets late juvenile fish caught in inshore waters (primarily 50-60 cm FL; Chih 2016). The red drum stock became overfished in the 1980's and its current status is undefined. With the prohibition of harvest in federal waters, the composition of the offshore component has become older and larger (Winner et al 2014, Powers et al. 2012) off the eastern and northern Gulf.

Bycatch does occur within the reef fish fishery. If fish are released due to catch limits, seasons, or other regulatory measures, these fish are considered bycatch. Bycatch practicability analyses have been completed for red snapper (GMFMC 2004b, GMFMC 2007, GMFMC 2014a, GMFMC 2015b), grouper (GMFMC 2008a, GMFMC 2009, GMFMC 2011b, GMFMC 2012a),

vermillion snapper (GMFMC 2004c, GMGMC 2017c), greater amberjack (GMFMC 2008b, GMFMC 2012b), gray triggerfish (GMFMC 2012c), and hogfish (GMFMC 2016a). In general, these analyses have found that reducing bycatch provides biological benefits to managed species as well as benefits to the fishery through less waste, higher yields, and less forgone yield. In some cases, actions are approved that can increase bycatch through regulatory discards such as increased minimum sizes and closed seasons. Under these circumstances, biological benefit to the managed species outweighs any increases in discards from the action.

Red drum bycatch occurs both in the state directed fisheries and non-directed fisheries – possession of red drum in federal waters is prohibited. However, information on red drum bycatch is sparse (Sagarese et al 2016). Some bycatch occurs in the menhaden fishery, but this bycatch is likely minimal (Sagarese et al 2016). SEDAR 49 (2016) indicated that red drum bycatch in the shrimp fishery and hook-and-line fishery was rare and so was considered negligible in the stock assessment.

The reef fish fishery can also affect species outside the reef fish complex. Specifically, sea turtles have been observed to be directly affected by the longline component of the Gulf reef fish fishery. These effects occur when sea turtles interact with fishing gear and result in an incidental capture injury or mortality and are summarized in GMFMC (2009). However, for sea turtles and other Endangered Species Act listed species, the most recent biological opinion (NMFS 2011) for the Reef Fish Fishery Management Plan (FMP) concluded authorization of the Gulf reef fish fishery managed in the FMP is not likely to jeopardize the continued existence of sea turtles, smalltooth sawfish, or *Acropora* species (See Section 3.3 for more information). This fishery is also not expected to adversely affect marine mammals; the primary gear types used by the commercial sector (longline and hook-and-line) were classified in the 2017 List of Fisheries (82 FR 3655) as a Category III fishery with regard to marine mammal species, indicating the gear has little effect on these populations (see Section 3.3 for more information).

Sub Action 1.1, setting the MSY proxy, is not expected to have any direct effects on the biological/ecological environment; however, management measures that would be required to maintain harvests of red snapper at or below this level would produce biological/ecological impacts. Consequently, the biological/ecological impacts of the alternatives in this sub action would be indirect. Furthermore, the impacts could be positive or negative depending on the level of risk that is acceptable when determining the MSY proxy. **Option 2a** is the most liberal of the MSY proxies (the yield at $F_{20\%SPR}$) and would have the highest fishing mortality (F) and lowest stock biomass (B) levels associated with it. Thus, it would have the highest risk of allowing the stock size to become depleted. **Option 2c** is the most precautionary with the lowest associated F value ($F_{40\%SPR}$) and the highest associated B. Maintaining this MSY proxy would be least adverse of the **Alternative 2** options. **Alternative 1** and **Option 2b** are intermediate to **Options 2a** and **2c** with the MSY proxy for **Option 2b** being more risk adverse than **Alternative 1**.

Sub Action 1.2 addresses assessed stocks where MSY proxies were developed, but never assigned through a plan amendment. This action addresses black grouper, yellowedge grouper, mutton snapper, yellowtail snapper, and tilefish. **Alternatives 1 and 2** are equivalent and only differ in that **Alternative 1** would not assign an MSY proxy and **Alternative 2** does. Therefore, these alternatives would have similar effects on the biological/ecological environment as

management measures to control harvest would be based on $F_{30\%SPR}$. **Alternative 3** is based on the recommended proxies of $F_{40\%SPR}$ for gonochoristic species (mutton snapper, yellowtail snapper, and tilefish) and $F_{50\%SPR}$ for hermaphroditic species (black grouper and yellowedge grouper) recommended by Harford et al. (in press). By using the higher SPR values as the basis for management, **Alternative 3** would produce a lower MSY proxy, lower F_{MSY} proxy, and higher B_{MSY} proxy than **Alternatives 1 and 2**, providing a greater benefit to these stocks and the biological/ecological environment on the whole.

Sub-action 1.3 would establish MSY proxies for stock complexes that were created in the Generic ACL/AM Amendment (GMFMC 2011a). **Alternative 1** would result in no assigned stock complex MSY proxies. Effects on the biological/ecological environment would depend on individual stocks in Sub-action 1.2 and Sub-action 1.4. **Alternatives 2-6** select the MSY values for the five different complexes identified in the Generic ACL/AM Amendment and are compared to **Alternative 1**.

Alternatives 2 - 4 have assessed stocks within the stock complex. These are tilefish (**Alternative 2**), other shallow-water grouper (**Alternative 3**), and deep-water grouper (**Alternative 4**). **Options 2a, 3a, and 4a** would establish the complex MSY proxy based on the MSY proxy for the assessed species – golden tilefish, black grouper, and yellowedge grouper, respectively. **Options 2b, 3b, and 4b** would use a data-limited method to establish MSYs for the remaining species, and would combine those with the assessed MSY species to create an MSY proxy for the respective complex as a whole. This would be an actual harvest number (e.g., 1 million pounds whole weight) rather than the yield at some biological reference point. The relative level of MSY proxies established under these options is unknown, so the relative effects on the biological/ecological environment cannot be determined. However, if it becomes necessary to reduce fishing effort as a result of a finding of overfishing, the resulting regulations to reduce fishing effort would apply to the species in a complex, regardless of which option is selected, **Alternatives 2-4** would therefore result in less adverse impacts to the biological/ecological environment than if any of these alternatives are not selected, or the reductions were applied to a single stock under **Alternative 1**.

Alternatives 5 and 6 would establish MSY proxies for the jacks and mid-water snapper stock complexes, respectively. For these complexes, there is no assessed stock to base MSY on. Therefore, only the data-limited method would be used to establish the MSYs. If it becomes necessary to reduce fishing effort as a result of a finding of overfishing, the resulting regulations to reduce fishing effort would apply to all stocks within the respective complex rather than to a single stock. Thus, **Alternatives 5 and 6** would result in less adverse impacts to the biological/ecological environment than if either of these alternatives are not selected, or the reductions were applied to a single stock under **Alternative 1**.

Sub-action 1.4 would establish an MSY proxy for each reef fish stock in the Reef Fish FMP that does not currently have a proxy and is not included on the previous sub-actions plus red drum. This includes between 5 and 20 stocks depending on how many stocks are selected for inclusion in stock complex MSY proxies in Sub-action 1.3.

Alternative 1 would leave the MSY proxy officially undefined for all stocks and so would not change existing conditions. **Alternative 2** would establish an MSY proxy on a stock-by-stock basis. Under **Alternative 2**, for each stock, an MSY proxy would be chosen from four F_{MSY} options ($F_{20\% SPR}$, $F_{30\% SPR}$, $F_{40\% SPR}$, or $F_{50\% SPR}$) or a proxy based on a data limited method. Because a stock assessment is required to determine the yield when fishing at F_{SPR} , and none of these stocks have been assessed, selection of one of the F_{SPR} based proxies will have no change in the direct effects relative to **Alternative 1**. If an assessment is eventually conducted, lower SPRs will allow higher MSY levels and higher levels of fishing effort, producing potentially greater adverse effects of the biological/ecological environment. Thus $F_{20\% SPR}$ would have the greatest adverse impacts, with successively less adverse impact for $F_{30\% SPR}$, $F_{40\% SPR}$, and $F_{50\% SPR}$. This only is true if an assessment is conducted. Otherwise, the effects would be no different from **Alternative 1**. If a data-limited method is selected, this would place a limit on harvest relative to **Alternative 1**, and would therefore have less adverse impacts than **Alternative 1** even if there is no stock assessment.

4.1.3 Direct and Indirect Effects on the Economic Environment

Sub-action 1.1

Alternative 1 would maintain the current MSY proxy for red snapper. Therefore, **Alternative 1** would not be expected to alter red snapper harvests and would not be expected to result in economic effects.

Alternative 2 would define the MSY proxy for red snapper as the yield when fishing at $F_{20\% SPR}$ (**Option 2a**), at $F_{30\% SPR}$ (**Option 2b**), or at $F_{40\% SPR}$ (**Option 2c**). A larger fishing mortality, i.e., a smaller SPR, corresponds to a less conservative management approach with more fishing opportunities in the short term. However, a less conservative approach in the short term would also result in greater long term risks of depleting the stock. Based on the current MSY proxy for red snapper (the yield when fishing at $F_{26\% SPR}$), **Alternative 2 - Option 2a** would be less conservative than **Alternative 1**. **Alternative 2 - Options 2b and 2c** would implement more conservative measures. As a result, **Option 2a** would be expected to result in positive economic effects in the short run. However, the increased risk of depleting the red snapper stock may result in adverse economic effects in the long term if **Option 2a** leads to the depletion of red snapper. It follows that for more conservative **Options 2b and 2c**, negative economic effects would be expected in the short term but the expected decreases in the risk of depletion would be associated with positive economic effects in the long run.

Sub-action 1.2

Under **Alternative 1**, the MSY proxy for assessed stocks in this group (black grouper, yellowedge grouper, mutton snapper, yellowtail snapper, and tilefish) will not be formally defined. However, in previous assessments, the MSY was set at the yield when fishing at $F_{30\% SPR}$ for all of these stocks. **Alternative 2** would formally define the MSY proxies for these stocks as the yield when fishing at $F_{30\% SPR}$. **Alternative 2**, which would set the same MSY

proxies for these stocks as **Alternative 1**, is not expected to alter the harvest of these reef fish species. Therefore, **Alternative 2** would not be expected to result in economic effects.

Relative to **Alternatives 1** and **2**, **Alternative 3** would be more conservative in setting MSY proxies. **Alternative 3** would set the MSY proxy for the hermaphroditic species black grouper and yellowedge grouper as the yield at $F_{50\% \text{ SPR}}$. For the gonochoristic species, **Alternative 3** would set the MSY proxy as the yield at $F_{40\% \text{ SPR}}$. Therefore, relative to **Alternatives 1** and **2**, **Alternative 3** would be expected to result in negative economic effects in the short run but the associated decreases in the risk of stock depletion would be expected to result in positive economic effects in the long run.

Sub-action 1.3

Alternative 1 (no action) would not establish MSY proxies for stock complexes. Therefore, Alternative 1 would not be expected to affect the harvest of these stock complexes and would not result in economic effects. **Alternatives 2 – 6** would establish an MSY proxy for the several stock complexes, including tilefishes (**Alternative 2**), other shallow-water grouper (**Alternative 3**), deep-water grouper (**Alternative 4**), jacks (**Alternative 5**), and mid-water snappers (**Alternative 6**). **Alternatives 2-4 (Option a)** would rely on an indicator species and proxy for the entire complex. For **Alternatives 2-4, Option b** would combine the equilibrium MSY yield for the indicator species considered in **Option a** to the constant catch OFLs of the remaining species determined through either Tier 3a or 3b of the ABC control rules, or through a data-limited method. In general, a more conservative MSY proxy would be expected to result in fewer fishing opportunities in the short run, thereby resulting in negative economic effects. However, more conservative proxies would also be expected to reduce the risk of depletion and therefore would be expected to result in positive economic effects in the long run.

Sub-action 1.4

Alternative 1 (no action) would not define the MSY proxy for unassessed stocks and assessed stocks without a MSY proxy. Therefore, **Alternative 1** would not affect the harvest of these stocks and would not be expected to result in economic effects.

For the stocks included in this action, **Alternative 2** considers MSY proxies ranging from the yield at $F_{20\% \text{ SPR}}$ to the yield at $F_{50\% \text{ SPR}}$. **Alternative 2** also considers setting a MSY proxy consisting of a specific yield determined by a data-limited method. Although the MSY proxies based on data limited methods are not known at this time, among the MSY proxies based on yields at a mortality corresponding to a given SPR, the yield at $F_{20\% \text{ SPR}}$ would be the least conservative proxy and the yield at $F_{50\% \text{ SPR}}$ the most conservative. In general, a more conservative MSY proxy would be expected to result in fewer fishing opportunities in the short run, thereby resulting in negative economic effects. However, more conservative proxies would also be expected to reduce the risk of depletion and therefore would be expected to result in positive economic effects in the long run.

4.1.4 Direct and Indirect Effects on the Social Environment

Sub-action 1.1

No additional effects would be expected from **Alternative 1** and the MSY proxy for red snapper would remain at the yield when fishing at $F_{26\% \text{ SPR}}$. Direct effects would not result from modifying the MSY proxy for red snapper, as the MSY is a biological reference point. Rather, indirect effects would be expected and, in general, short-term and long-term effects would be inversely proportional. For the short-term, indirect effects correspond to the related reference points established to determine the total allowable harvest (i.e., ACL). A more conservative proxy (e.g., **Option 2c**, $F_{40\% \text{ SPR}}$) would result in a lower ACL and associated short-term negative effects as fewer fish are allowed to be caught compared to **Alternative 1**. The greatest negative effects would be expected under **Option 2c**. A less conservative proxy (i.e., **Option 2a**, $F_{20\% \text{ SPR}}$) would allow for a larger ACL and associated social benefits as more fish are allowed to be caught. **Option 2b** would be expected to result in an ACL that is slightly more conservative than **Alternative 1**, resulting in some negative short-term effects compared to **Alternative 1** as fewer fish are allowed to be caught.

Allowing more fish to be caught in the short-term has the potential to negatively affect the long-term yields of the stock, and vice versa. Thus, constraining harvest in the short-term by adopting the most conservative MSY proxy (**Option 2c**) would be most likely to ensure that catch levels remain higher over the long-term. On the other hand, allowing larger catch limits in the short-term (**Option 2a**) would be more likely to result in the need for lower catch limits in later years, although the risk of these long-term effects is less certain than the benefits that would be realized in the short-term. In recent years, the stock has been rebuilding faster than expected despite quota overages, although it is unknown if this trend will continue. **Option 2b** would provide some additional protection to the stock in the short-term by reducing the allowable harvest, but would be more likely to maintain long-term catch levels compared to **Alternative 1**.

Sub-action 1.2

Although additional effects are not usually expected from retaining **Alternative 1**, the lack of stock status determination criteria is not consistent with NS1 guidelines and an MSY or its proxy needs to be defined. **Alternative 2** would formally adopt the same MSY proxy that was used for status determination in the stock assessments for the species covered in this action. Under this MSY proxy, none of the stocks would be overfished or experiencing overfishing. Thus, no additional social effects would be expected from **Alternative 2** when compared to **Alternative 1** for either the recreational or commercial sectors, as catch levels would not be affected by implementing this MSY proxy.

Alternative 3 would adopt more conservative MSY proxies than under **Alternative 2**. In the short term, **Alternative 3** would result in lower catch limits for the respective species compared to **Alternative 2**, and thus could entail some negative effects if fishing activity is restricted. None of the five species have a sector allocation or a specified recreational quota. Thus, for the recreational sector, these negative effects would occur if lowering the catch limits caused an in-season recreational fishing closure. Three of the species are primarily caught in south Florida

(yellowtail snapper, mutton snapper, and black grouper), and the other two (tilefish and yellowedge grouper) are caught in deep water and have low recreational landings Gulf-wide. Thus, some short-term negative impacts would be expected for the recreational sector as a whole, although these negative impacts would be concentrated for fishermen in south Florida. These negative effects would most affect those who would catch and keep black grouper, which would have a greater reduction to its catch limit than the other species (applying the MSY proxy of the yield at $F_{50\% SPR}$ compared to $F_{40\% SPR}$).

These effects would be similar for the commercial harvest of mutton snapper and yellowtail snapper, which would experience in-season closures when the quota is estimated to be met. Total landings for both species have been close to or exceeded the ACLs in recent years. While there has been no in-season closure to date on mutton snapper for either sector, there was an in-season closure on the commercial harvest of yellowtail snapper in 2015, on October 31. Thus, in-season closures are more likely under reduced catch limits (**Alternative 3**) compared to **Alternatives 1** and **2**.

For the commercial sector, black grouper, yellowedge grouper, and tilefish are managed under an IFQ program and have a commercial quota; the recreational quota remains unspecified. For the commercial species managed under an IFQ program, a reduction in the ACL would result in less allocation available for harvest. For these species, reducing the catch limits would result in a reduction to the available allocation, rather than a closed season. From 2012 through 2016, tilefish landings have ranged from 71%-89% of the quota. Thus, calculating the catch limits under the **Alternative 3** MSY proxies would not likely affect fishing activity in the short term. Yellowedge grouper and black grouper are part of the DWG and SWG multi-species share categories, respectively, meaning that any of several grouper species may be caught using allocation for the respective IFQ program share category. From 2012 through 2016, DWG landings ranged from 79%-93% of the quota and SWG landings ranged from 42%-61% of the quota. Although both of these species would see a greater quota reduction than the other species covered in this action by applying the MSY proxy of the yield at $F_{50\% SPR}$ compared to $F_{40\% SPR}$, the multi-species share categories in which each is managed would be expected to mitigate some of the negative effects.

Sub-action 1.3

Additional effects would not be expected from **Alternative 1** as the harvest of the stock complexes would not be changed and the MSY proxies established in Sub-actions 1.2 and 1.4 for individual stocks would apply. In general, a more conservative MSY proxy would be expected to result in fewer fishing opportunities in the short term, thereby resulting in negative effects. However, more conservative proxies would also be expected to reduce the risk of overharvest and therefore would be expected to result in positive effects in the long term.

Sub-action 1.2 would establish an MSY proxy for species that could become the indicator species for the stock complexes under **Alternatives 2 – 4**: tilefish for **Alternative 2**, black grouper for **Alternative 3**, and yellowedge grouper for **Alternative 4**. If MSY proxies are established for these species in Sub-action 1.2, the effects would be the same for these species under Action 2, but applied to the respective species complexes under **Option 2a**, **Option 3a**,

and **Option 4a** of this action. Again, provided an MSY proxy is established in the previous action, **Alternatives 2 – 4, Options b** would use the selected MSY proxy for each of the three assessed species, but would use an alternate method for determining the MSY proxy for the remaining species in the complex. This alternate method would establish a MSY proxy that is more tailored to the available information for the respective species in the complex. Because the resulting MSY proxies remain unknown, it is not possible to compare the resulting indirect effects between **Alternative 2** and **3** at this time. Ultimately, the effects will relate to how aligned the MSY proxy of the indicator species is with the remaining species of each complex (**Options 2a**) compared with the use of the ABC control rule (**Options 2b**). For the complexes without an assessed species (**Alternatives 5 and 6**), the effects would be the same as **Options b** under **Alternatives 2 – 4**.

Sub-action 1.4

Additional effects would not result from **Alternative 1** as the harvest of the included species would not be changed and an MSY proxy would remain undefined. For the stocks included in this action, **Alternative 2** considers options for MSY proxies ranging from the yield at **F_{20% SPR}** (least conservative) to the yield at **F_{50% SPR}** (most conservative), as well as setting an MSY proxy consisting of a specific yield determined by a data-limited method. In general, a more conservative MSY proxy would be expected to result in fewer fishing opportunities in the short term, thereby resulting in negative effects. However, more conservative proxies would also be expected to reduce the risk of overharvest and therefore would be expected to result in positive effects in the long term. The MSY proxies based on data limited methods are not known at this time.

4.1.5 Direct and Indirect Effects on the Administrative Environment

The setting of MSY is an administrative action and will have effects on the administrative environment through additional rulemaking (direct effect), addressing overfished and overfishing conditions (indirect effect from setting other status determination criteria), and monitoring the harvest (indirect effect). Because alternatives in sub actions 1.1-1.4 would not result in added regulations, there would not be any immediate effect on the administrative environment from rulemaking.

Sub Action 1.1, setting the MSY proxy for red snapper could indirectly affect the administrative environment based on how risk averse the MSY value is. **Option 2a** is the most risk averse of the MSY proxies (the yield at **F_{20%SPR}**) and would have the highest fishing mortality (F) and lowest stock biomass (B) levels associated with it. Of the options considered in this sub action, this one is most likely to lead to stock depletion and require additional administrative action to end overfishing and rebuild the stock if necessary. **Option 2c** is the most precautionary with the lowest associated F value (**F_{40%SPR}**) and the highest associated B. Maintaining this MSY proxy would be least likely to lead to overfishing or stock depletion and likely have the lowest probability of needing additional administrative actions to ensure overfishing does not occur or the stock not become depleted. **Alternative 1** and **Option 2b** are intermediate to **Options 2a** and **2c** with the MSY proxy for **Option 2b** being more risk averse than **Alternative 1**.

Sub Action 1.2 addresses assessed stocks where MSY proxies were developed, but never assigned through a plan amendment. This action addresses black grouper, yellowedge grouper, mutton snapper, yellowtail snapper, and tilefish. **Alternatives 1 and 2** are equivalent and only differ in that **Alternative 1** would not assign an MSY proxy and **Alternative 2** does.

Alternative 2 and **Alternative 3** would ultimately reduce the administrative burden over **Alternative 1** as **Alternative 1** is inconsistent with the current NS1 guidance. Because the MSY proxies under **Alternative 3** are more risk averse than **Alternative 2**, maintaining these MSY proxies (based on $F_{40\% SPR}$ or $F_{50\% SPR}$) would be least likely to lead to overfishing or stock depletion and likely have the lowest probability of needing additional administrative actions to ensure overfishing does not occur or the stock become depleted.

Sub-action 1.3 would establish MSY proxies for stock complexes that were created in the Generic ACL/AM Amendment (GMFMC 2011a). **Alternative 1** would result in no stock complex MSY proxies being established and would be inconsistent with NS1 Guidance.

Alternatives 2-6 select the MSY values for the five different complexes identified in the Generic ACL/AM Amendment. When compared to **Alternative 1**, they are administratively advantageous because they would result in a metric assisting to assure that harvest levels are set at a level to reduce the likelihood that overfishing or stock depletion does not occur.

Sub-action 1.4 would establish an MSY proxy for each reef fish stock in the Reef Fish FMP that does not currently have a proxy and is not included on the previous sub-actions plus red drum. This includes between 5 and 20 stocks depending on how many stocks are selected for inclusion in stock complex MSY proxies in Sub-action 1.3. **Alternative 1** would leave the MSY proxy officially undefined for all stocks and not be consistent with NS1 guidance. **Alternative 2** would establish MSY proxies on a stock-by-stock basis. Under **Alternative 2**, for each stock, an MSY proxy would be chosen from four F_{MSY} options ($F_{20\% SPR}$, $F_{30\% SPR}$, $F_{40\% SPR}$, or $F_{50\% SPR}$) or a proxy based on a data limited method. Between the SPR proxies considered by the alternative, those that allow a higher MSY would likely have greater adverse effects on the administrative environment as described in the previous sub-actions. Thus $F_{20\% SPR}$ would have the greatest adverse impacts, with successively less adverse impact for $F_{30\% SPR}$, $F_{40\% SPR}$, and $F_{50\% SPR}$, respectively. If a data-limited method is selected, a workshop or meeting of experts would need to be convened to develop the appropriate methodology, adding to the administrative burden.

Overall effects - Although the different sub-actions and alternatives have different effects on the administrative environment, these effects are likely minor. Assessing stocks to determine if the stock biomass is above or below MSY and other status determination criteria are routine endeavors by NMFS. Actions to control harvest by the Council and NMFS are mostly routine and conducted through the Council system established by the Magnuson-Stevens Act. Additionally, through the use of ACLs and AMs, the Council and NMFS can determine if overfishing is occurring annually and take measures to reduce the likelihood a stock would get into an overfished condition. This minimizes the risk that harvest levels would deviate from MSY values established through this action.

4.2 Action 2: Minimum Stock Size Threshold (MSST)

4.2.1 Direct and Indirect Effects on the Physical Environment

Fishery management actions that affect the physical environment mostly relate to the interactions of fishing with bottom habitat, either through gear impacts to bottom habitat or through the incidental harvest of bottom habitat. The action does not affect the gear used and therefore has no direct impacts on the physical environment. However, changes to the minimum stock size threshold (MSST) could affect the likelihood of a stock being declared overfished, which could result in indirect effects. An “overfished” determination would require that a rebuilding plan be implemented, which would likely include restrictions that reduce fishing effort. Less fishing effort would result in less gear interaction with the physical habitat, which would be beneficial to the environment. Therefore, alternatives that allow overfishing to occur for a longer time before an overfished status is declared (i.e., larger buffers between B_{MSY} (or proxy) and MSST, would have a greater negative impact on the physical environment.

Under all of the alternatives, the seven stocks for which a definition currently exists as shown in Table 1.3.1 (gag, red grouper, red snapper, vermilion snapper, gray triggerfish, greater amberjack, and hogfish) would retain that definition. For these stocks, MSST was set equal to 50% of the B_{MSY} proxy level under Amendment 44 (GMFMC 2017b). The alternatives below would affect the remaining 24 reef fish stocks plus red drum.

Alternative 1, no action, would leave MSST undefined. Without an MSST, an overfished determination cannot be made. Therefore, there would be no control on stock biomass levels (although overfishing limits could restrict harvest). This alternative could potentially allow greater fishing effort and more adverse impacts to the physical environment than any of the alternatives that set an MSST.

Alternative 2 would apply the $(1-M) * B_{MSY}$ (or proxy) formula to all currently undefined stocks. Under this MSST proxy, the buffer between B_{MSY} and MSST depends on the average natural mortality rate of the species, as shown in Table 2.1.1 and Table 2.1.2. Long-lived stocks with a low natural mortality rate would have a narrow buffer, while shorter lived stocks with a higher natural mortality rate would have a larger buffer. The range of MSST buffers would be from 92% of B_{MSY} for Warsaw grouper ($M = 0.08$) to 50% of B_{MSY} for several stocks where there are studies indicating M greater than 0.5 (e.g., Table 2.1.2 shows queen snapper, blackfin snapper, and silk snapper have studies suggesting M may be greater than 0.50). The effect on the physical environment would be variable. Greater fishing effort and greater adverse effects could occur for stocks with a high natural mortality rate, while less fishing effort and less adverse effects could occur on stocks with a low natural mortality rate.

Alternative 3 would apply to $75\% * B_{MSY}$ (or proxy) formula to all currently undefined stocks. Relative to **Alternative 1**, this alternative would have less adverse effects on the physical environment because it would result in limits on fishing effort if the stock biomass dropped below MSST. Relative to **Alternative 2**, this alternative could have either greater adverse effects for stocks with a natural mortality rate less than 0.25 (approximately 17 stocks), and

lesser adverse impacts for stocks with a natural mortality rate greater than 0.25 (approximately 9 stocks).

Alternative 4 would set MSST at $50\% * B_{MSY}$, which is the lowest MSST allowed under the National Standard 1 guidelines. Relative to **Alternative 1**, this alternative would have less adverse effects on the physical environment because it would result in limits on fishing effort if the stock biomass dropped below MSST. Relative to **Alternative 2**, this alternative could have either greater adverse effects for stocks depending on the natural mortality of the stock. Relative to **Alternative 3**, this alternative would result in the lowest likelihood of a stock being declared overfished and the highest potential level of fishing effort, and therefore the greatest negative impact to the physical environment.

4.2.2 Direct and Indirect Effects on the Biological/Ecological Environment

Direct and indirect effects are discussed in Section 4.1.2 in detail and incorporated by reference here. In essence, alternatives that result in greater fishing effort and landings are more likely to adversely affect the biological/ecological environment than alternatives that reduce fishing effort and landings. Setting MSST should have very little effects on other reef fish stocks and other species in general. The reef fish fishery is a multispecies fishery where fishermen can target other species on trip. Thus, changing fishing practices on one stock does not generally change overall fishing effort, particularly for minor stocks within the fishery. This action should also not effect red drum as harvest of this species is prohibited in federal waters.

The closer MSST is to $B_{MSY(or proxy)}$, the time needed to rebuild the stock would likely be shorter. This is because the likelihood of larger declines in biomass from fishing is reduced and would provide more protection to the stock. **Alternative 1**, no action, would leave MSST as currently defined for the seven stocks for which a definition currently exists. This would be $50\% * B_{MSY (or proxy)}$, which is the lowest MSST allowed under the NS 1 guidelines. For the remaining stocks, no MSST would be defined leaving no metric for determining if stock is overfished or not. Therefore, **Alternative 1** would be the most adverse alternative to this environment.

For species with estimates of natural mortality (M) less than 0.25 (Tables 2.1.1 and 2.1.2), **Alternative 2** is the most conservative approach considered among the alternatives. Although this alternative results in the greatest likelihood of a stock being declared overfished if there is a decline in stock size, it would also provide the greatest positive biological/ecological effect by preventing the target stock from large declines in biomass. It would also reduce the likelihood of negative biological/ecological impacts to other species as a result of effort shifting during a rebuilding plan.

For stocks with M greater than 0.25, **Alternative 3** is the most conservative approach considered among the alternatives. This alternative would prevent the target stock from declines in biomass beyond $0.75 * B_{MSY (or proxy)}$. It would also reduce the likelihood of negative biological/ecological impacts to other species as a result of effort shifting during a rebuilding plan. However, for those stocks with M less than 0.25, there would be a wider buffer between $B_{MSY(or proxy)}$ and MSST and so overfishing could potentially occur for a longer time before the stocks are declared overfished.

Alternative 4 would set MSST at $50\% * B_{MSY}$ (or proxy), which is the lowest MSST allowed under the NS 1 guidelines. Relative to the other alternatives, this would result in the longest rebuilding time and the most restrictive management measures should a stock biomass fall below MSST, and would therefore have the greatest negative impacts on the biological/ecological environment of **Alternatives 2-4**.

4.2.3 Direct and Indirect Effects on the Economic Environment

This action considers modifications to existing MSST for reef fish species without previously defined MSSTs. **Alternative 1** (no action) would retain the existing MSSTs and let MSST be defined in future plan amendments for stocks without a defined MSST. **Alternative 1** would not be expected to alter the harvest of reef fish species and would not be expected to result in economic effects.

Alternatives 2-4 consider MSST values ranging from $0.50 * B_{MSY}$ (**Alternative 4**) to $(1-M) * B_{MSY}$ (**Alternative 2** when M is less than 0.25). The establishment of MSST values is an administrative action and would therefore not be expected to result in direct economic effects.

Alternative 4 would set the lowest MSST values and would be associated with the smallest likelihood of classifying a reef fish stock as overfished. **Alternative 4** would grant more flexibility to manage the stocks by providing a wider buffer between MSST and the biomass at MSY. Therefore, **Alternative 4** would be expected to result in indirect positive economic effects due to additional harvesting opportunities made available by the increased management flexibility. The magnitude of the potential indirect economic benefits would be determined by the additional harvests afforded to recreational anglers and commercial fishermen. However, should a particular stock be declared overfished, a smaller MSST would be expected to warrant more restrictive rebuilding measures, thereby resulting in negative indirect economic effects during the rebuilding period. Although unknown at this time, the net effects that would be expected from MSST adjustments would depend on the relative size of these benefits and adverse economic effects.

Because **Alternative 3** would set a greater MSST than **Alternative 4**, it is expected that potential benefits due to management flexibility would be lessened under **Alternative 3**. However, compared to **Alternative 4**, **Alternative 3** would require less restrictive rebuilding measures if the stock is overfished, thereby resulting in smaller negative effects during the rebuilding period. It follows that **Alternative 2**, which would set a greater MSST than **Alternative 3**, would be expected to result in smaller adverse economic effects during the rebuilding period compared to **Alternative 3**.

4.2.4 Direct and Indirect Effects on the Social Environment

This action would define the threshold at which a stock would be considered overfished for 24 reef fish stocks and red drum, which do not have a defined MSST. Direct effects would not be expected from establishing an overfished threshold. Rather, indirect effects would be tied to future determinations of whether a stock is overfished. The closer (narrower buffer) the threshold is set to MSY, the more likely for the overfished threshold to be triggered, resulting in

negative effects from the loss of harvest opportunities. A narrow buffer increases the uncertainty that a stock may enter an overfished status due to natural fluctuations in biomass. That uncertainty can have negative impacts on business planning and other aspects of both commercial and recreational fishing, as it may initiate changes in fishing behavior such as switching to other species or increased regulatory discards. On the other hand, the farther away (wider buffer) the threshold is set from MSY , the less likely the overfished threshold would be triggered. However, triggering the threshold set under a wider buffer would likely require more restrictive measures in the rebuilding plan, resulting in greater negative social effects, than if the threshold had been triggered sooner.

The management measures for a rebuilding plan that may follow a stock's determination as overfished as a result of setting or modifying the MSST are unknown. Thus, it is not possible to describe the scope and strength of any indirect effects from triggering an overfished status. Therefore, this discussion of social effects is general and qualitative in nature. Moving into an overfished status could have negative social effects if harvest levels are reduced significantly with little notice. **Alternative 1** would not define MSST for those reef fish stocks and red drum, and there would be no change in the management of these stocks, and thus, no social effects.

Alternative 2 provides a buffer related to the natural mortality rate of each species, and thus could not be used for three stocks (goldface tilefish, lesser amberjack, and almaco jack), as they have no estimates of a natural mortality rate. For these three stocks, the effects of **Alternative 2** would be the same as **Alternative 1**. For stocks with a low natural mortality rate (e.g., less than $M = 0.25$), such as mutton snapper, tilefish, and black grouper (Table 2.2.1), **Alternative 2** results in a narrow buffer. However, these stocks may be particularly susceptible to moving in and out of an overfished status due to natural fluctuations in biomass. Furthermore, given the lack of precision in the estimates of B_{MSY} , MSST, and current biomass, there is increased uncertainty with respect to whether the current biomass has actually dropped below MSST. The more stable approach to setting a wider buffer that prevents a stock from moving into an overfished status may be preferable as a more stable fishery is better for both commercial and recreational stakeholders and businesses. **Alternative 2** would provide a more stable approach biologically, but the possibility of short-term negative effects may be higher under some circumstances such as when stock biomass fluctuates below MSST due to a narrow buffer. However, there may be positive long term effects if stock status becomes more stable.

Alternative 3 would set a buffer that sets MSST at 75% of B_{MSY} , and is a narrower buffer than under **Alternative 4**. This would affect stocks with a natural mortality rate less than $M = 0.25$. Again, the social effects from defining MSST are indirect and difficult to forecast as they are determined in the future as thresholds are applied, but with more narrow buffers there may be more opportunities for short-term negative effects. Nevertheless, the social effects are difficult to anticipate until the threshold is triggered and stock status is determined.

Alternative 4 would adopt the widest buffer allowed under the NS 1 guidelines and would apply the same buffer selected for the seven stocks included in Amendment 44 (GMFMC 2017b). In that amendment, this MSST definition resulted in two stocks (red snapper and gray triggerfish) being redefined from overfished to not overfished. However, because each stock was in a rebuilding plan, that plan continues until the stock is rebuilt to B_{MSY} . By adopting the widest

buffer, the overfished threshold would be least likely to be triggered. However, in the event the threshold under **Alternative 4** is reached and a stock declared overfished, the rebuilding plan would be expected to include greater harvest restrictions than if a narrower buffer had been adopted.

In summary, the social effects from any alternative would be indirect and long term, occurring once a determination of overfished status has been made based on the selected buffer. Wider buffers may allow for current fishing activity to continue, but risk future fishing activity being curtailed more if the stock falls into an overfished status. Narrow buffers may be more likely to result in an overfished determination and the subsequent rebuilding plan could curtail existing fishing effort, but may allow for more stable fishing activity over the long term.

4.2.5 Direct and Indirect Effects on the Administrative Environment

This action would directly affect the administrative environment. Under **Alternatives 2-4**, MSST would be defined for all reef fish stocks and red drum. Thus, selecting any of these alternatives as preferred would be administratively more efficient than approving a species' MSST through multiple future actions as each species is assessed. This less efficient approach would occur under **Alternative 1** where MSSTs have only been defined for 7 stocks and would be more adverse to the administrative environment.

How MSST is determined under **Alternatives 2-4** also has indirect administrative implications. The lower the MSST value is (i.e., the greater the difference between B_{MSY} (or proxy) and MSST), the less likely a stock could be depressed below the MSST and be declared overfished. However, after a stock has been declared overfished, action must be taken to rebuild the stock to B_{MSY} (or proxy). The greater the difference between the overfished stock biomass and B_{MSY} (or proxy), the greater the harvest restrictions would need to be to allow the stock to recover to B_{MSY} (or proxy) within the rebuilding timeframe. Therefore, the lower MSST is, the greater the likelihood any rebuilding plan would require more restrictive management measures.

How the alternatives compare to one another is dependent on M and how it influences the calculation of MSST. The wider buffer would decrease the likelihood of spurious overfished determinations due to natural fluctuations. If M is less than or equal to 0.25 (at least 20 stocks; Tables 2.2.1 and 2.2.2), then the MSST from **Alternative 2** is less than the MSST in **Alternative 3** because they would be less than $0.75 \cdot B_{MSY}$. However, if M is greater than 0.25 (at least 4 stocks; Tables 2.2.1 and 2.2.2), then the MSST from **Alternative 2** is greater than the MSST from **Alternative 3** because they would be greater than $(1-M) \cdot B_{MSY}$. **Alternative 4** is the least conservative MSST of $0.5 \cdot B_{MSY}$ and would be the most adverse alternative to the administrative environment. This is illustrated in Table 4.2.5.1, which calculates MSST for each alternative using a hypothetical B_{MSY} of one million pounds and two values for M (0.15 and 0.3) that are either above or below 0.25. Under this example, if M is set at 0.15 (≤ 0.25), then the probability of the stock being declared overfished is greatest for **Alternative 2** (850,000 lbs) and least for **Alternative 4** (500,000 lbs). If M is set at 0.30 (greater than 0.25), then the probability of being declared overfished would be greatest for **Alternative 3** (870,000 lbs) and least for **Alternative 4** (500,000 lbs).

Table 4.2.5.1. The estimated minimum stock size threshold values in pounds under two natural mortality rates (M) if the stock biomass that would provide the maximum sustainable yield is assumed to be 1,000,000 lbs.

Natural Mortality	Alternative 2 (1-M)*B _{MSY}	Alternative 3 0.75*BMSY	Alternative 4 0.5*BMSY
M = 0.15	850,000 lbs	750,000 lbs	500,000 lbs
M = 0.30	700,000 lbs	750,000 lbs	500,000 lbs

Conversely, the probability of needing greater harvest restrictions to rebuild the stock should the stock size fall below MSST is also dependent on what M is as discussed above. Under the example shown in Table 4.2.5.1, if M is 0.15 (less than or equal to 0.25), then the probability of greater harvest restrictions to rebuild the stock is greatest for **Alternative 4** (500,000 lbs) and least for **Alternative 2** and **3** (850,000 lbs and 750,000 lbs, depending on M).

Although the alternatives have different effects on the administrative environment, these effects are likely minor. Assessing stocks to determine if the stock biomass is above or below MSST are routine endeavors by National Marine Fishery Service (NMFS). Actions to control harvest by the Gulf of Mexico Fishery Management Council (Council) and NMFS are mostly routine and conducted through the Council system established by the Magnuson-Stevens Fishery Conservation and Management Act. Additionally, through the use of annual catch limits (ACL) and accountability measures (AM), the Council and NMFS can determine if overfishing is occurring annually and take measures to reduce the likelihood a stock would get into an overfished condition. This minimizes the risk that the stock size would fall below MSST and be considered overfished.

4.3 Action 3: Maximum Fishing Mortality Threshold (MFMT)

4.3.1 Direct and Indirect Effects on the Physical Environment

This action does not affect the gear used and therefore has no direct impacts on the physical environment. However, changes to the maximum fishing mortality threshold (MFMT) could affect the likelihood of a stock being declared to be experiencing overfishing, which could result in indirect effects. An “overfishing” determination would require that action be taken to end overfishing immediately, which would likely include restrictions that reduce fishing effort. Less fishing effort would result in less gear interaction with the physical habitat, which would be beneficial to the environment. Therefore, alternatives that allow higher levels of fishing mortality before overfishing is declared, or which do not provide a means to determine if overfishing is occurring, would have a greater negative impact on the physical environment.

Alternative 1 leaves the existing MFMT definitions in place. All of the stocks included in this amendment have MFMT definitions which were implemented either in the Generic Sustainable Fisheries Act Amendment (GMFMC 1999) or in subsequent amendments. However, these definitions may not be based on the same MSY proxy used to determine MSST, particularly if the MSY proxy was changed in Action 1. Furthermore, all of the current MFMT definitions are

based on fishing mortality rates, i.e., F_{MFMT} . For stocks that have been assessed, this provides a cap on the level of fishing that can occur, which limits any adverse effects in the physical environment. However, for stocks that have not been assessed, there is no calculation of the fishing mortality rate, and therefore these stocks cannot be found to be experiencing overfishing regardless of the level of fishing effort. For these stocks, there is no direct limit on the level of fishing effort, and therefore no limit on the level of adverse effects that may occur to the physical environment.

Alternative 2 sets the MFMT equal to the MSY F_{PROXY} for each stock as determined in Action 1, or as established in earlier amendments. This assures that, for assessed stocks, the MFMT and MSST are both based on the same MSY proxy. For the majority of assessed stocks, there will be no change in the MFMT relative to **Alternative 1**, and therefore no change to the effects on the physical environment. For unassessed stocks, the effects of **Alternative 2** depend on the alternatives selected in Action 1. If an F_{SPR} based MSY proxy was established, then, as discussed above, there is no calculation of the fishing mortality rate, and therefore these stocks cannot be found to be experiencing overfishing regardless of the level of fishing effort. For these stocks, there is no direct limit on the level of fishing effort, and therefore no limit on the level of adverse effects that may occur to the physical environment. On the other hand, if a data-limited method was selected to establish the MSY proxy, then the MSY proxy will be a specific harvest level. In this case, exceeded that level in a fishing year will constitute overfishing. Since overfishing can be determined for unassessed stocks using the data-limited methods, there will be a cap on the level of fishing effort, and therefore less adverse impacts to the physical environment relative to **Alternative 1**.

Alternative 3 is identical to **Alternative 2** for stocks that are not in a rebuilding plan, and will have the same effects on the physical environment. For stocks that are in a rebuilding plan, MFMT will be set at $F_{REBUILD}$, which is the fishing mortality rate that will rebuild the stock in ten years or less, or within the maximum time period allowed. $F_{REBUILD}$ will never be greater than the $F_{MSY PROXY}$, and will generally be lower. Therefore, for stocks in a rebuilding program, **Alternative 3** will result in less fishing effort and less adverse effects on the physical environment than either **Alternative 1** or **Alternative 2**.

4.3.2 Direct and Indirect Effects on the Biological/Ecological Environment

Direct and indirect effects are discussed in Section 4.1.2 in detail and incorporated by reference here. In essence, alternatives that result in greater fishing effort and landings are more likely to adversely affect the biological/ecological environment than alternatives that reduce fishing effort and landings. Setting MFMT should have very little effect on other reef fish stocks, red drum, and other species in general. The reef fish fishery is a multispecies fishery where fishermen can target other species on trip. Thus, changing fishing practices on one stock does not generally change overall fishing effort, particularly for minor stocks within the fishery. This action should also not effect red drum as harvest of this species is prohibited in federal waters and managed in state waters by the respective Gulf state marine resource management agencies (see Section 3.6.2).

An “overfishing” determination would require that action be taken to end overfishing immediately, which would likely include restrictions that reduce fishing effort. Less fishing effort would result in fewer fish harvested from a stock, which would be beneficial to the biological/ecological environment. Therefore, alternatives that allow higher levels of fishing mortality before overfishing is declared, or which do not provide a means to determine if overfishing is occurring, would have a greater negative impact on the biological/ecological environment.

Alternative 1 leaves the existing MFMT definitions in place. However, these definitions may not be based on the same MSY proxy used to determine the MFMT, particularly if the MSY proxy was changed in Action 1. Furthermore, all of the current MFMT definitions are based on fishing mortality rates, i.e., F_{MFMT} . For stocks that have been assessed, this provides a cap on the level of fishing that can occur, which limits any adverse effects to the stock and biological/ecological environment. However, for stocks that have not been assessed, there is no calculation of the fishing mortality rate, and therefore these stocks cannot be found to be experiencing overfishing regardless of the level of fishing effort. Thus, there is no direct limit on the level of fishing effort, and therefore no limit on the level of adverse effects that may occur to the biological/ecological environment.

Alternative 2 sets the MFMT equal to the MSY F_{PROXY} for each stock as determined in Action 1, or as established in earlier amendments. For assessed stocks, the MFMT and MSST would both be based on the same MSY proxy. For the majority of assessed stocks, there will be no change in the MFMT relative to **Alternative 1**, and therefore no change to the effects on the biological/ecological environment. For unassessed stocks, the effects of **Alternative 2** depend on the alternatives selected in Action 1, and thus the effects would be those described in Section 4.1.2.

Alternative 3 is identical to **Alternative 2** for stocks that are not in a rebuilding plan, and will have the same effects on the biological/ecological environment. However, for stocks that are in a rebuilding plan, MFMT will be set at $F_{REBUILD}$, which is the fishing mortality rate that will rebuild the stock in 10 years or less, or within the maximum time period allowed. $F_{REBUILD}$ will never be greater than the $F_{MSY Proxy}$, and will generally be lower. Therefore, for stocks in a rebuilding program, **Alternative 3** would be more beneficial than **Alternative 2** for overfished stocks because of reduced fishing effort and subsequent harvest.

4.3.3 Direct and Indirect Effects on the Economic Environment

Alternative 1 would retain current definitions for MFMT. Therefore, **Alternative 1** would not be expected to alter the harvest of reef fish species and would not be expected to result in economic effects.

Alternative 2 would set the MFMT equal to F_{PROXY} for all stocks. **Alternative 3** would also set the MFMT equal to F_{PROXY} but only for stocks that are not under rebuilding. For stocks that are in a rebuilding plan, **Alternative 3** would set a more conservative MFMT at $F_{REBUILD}$.

Alternatives 2 and 3 are not expected to impact the harvest of reef fish species and would therefore not be expected to result in direct economic effects. However, by setting a more

conservative MFMT compared to **Alternative 2**, **Alternative 3** would increase the likelihood that a stock under rebuilding is rebuilt according the schedule set in its the rebuilding plan. In the event that MSY proxies are modified in Action 1, both **Alternatives 2** and **3** would be expected to result in indirect economic benefits relative to Alternative 1 because they would ensure consistency between the MFMT and the MSY proxies.

4.3.4 Direct and Indirect Effects on the Social Environment

Additional effects to the social environment are not expected from **Alternative 1**, as the current definitions for MFMT would remain the same and no changes to the harvest of reef fish species would occur. Direct effects would not occur under **Alternatives 2** and **3**, but indirect effects would occur if changes to the MFMT results in a change that affects fishing activity.

Alternative 2 would only affect those stocks for which the MSY proxy is changed in Action 1. Because **Alternative 2** would modify the MFMT definition such that it matches the MSY proxies selected in Action 1, the indirect effects would be similar for the respective species as discussed in Action 1.

For stocks that are not in a rebuilding plan, the effects under **Alternative 3** would be the same as **Alternative 2**. For stocks that are in a rebuilding plan (currently, red snapper, gray triggerfish, and greater amberjack), **Alternative 3** would set a more a conservative MFMT than under **Alternative 2** (at $F_{REBUILD}$). By setting a more conservative MFMT compared to **Alternative 2**, **Alternative 3** would increase the likelihood for rebuilding a stock according the schedule set in its the rebuilding plan. Thus, for rebuilding stocks, some additional negative short-term effects could result, but these would be mitigated by ensuring over the long-term by increasing the likelihood that the stock is rebuilt on schedule.

4.3.5 Direct and Indirect Effects on the Administrative Environment

This action would directly affect the administrative by defining overfishing thresholds. If these thresholds are exceeded, then action needs to be taken by the Council and NMFS to end overfishing immediately. MFMT has already been defined for all stocks under consideration either through the Generic SFA Amendment (GMFMC 1999) or under subsequent amendments for specific species that redefined MFMT as a result of a stock assessment, so these stocks are consistent with the Magnuson-Stevens Act requiring an overfishing threshold. However, if the MSY proxy is defined (or redefined for some stocks) in Action 1 and this definition is inconsistent with the MSY proxy the current MFMT is based on, an internal conflict between status determination criteria would result and require future administrative action. Should this occur, **Alternatives 2 and 3** would allow this change to occur now rather than later. This would benefit the administrative environment by creating internal stability within the status determination criteria.

If a stock is not overfished, there would be no difference in effects between **Alternatives 2 and 3** because the MFMT definition would be the same. However, if a stock were overfished, under **Alternative 2**, the MFMT would be defined as F_{PROXY} , which would be greater than $F_{REBUILD}$, the MFMT defined for overfished stocks in **Alternative 3**. **Alternative 2** would create a potential administrative inconsistency (adverse effect) where the F_{PROXY} is greater than the F

associated with the OFL or ABC determined by the Council's Scientific and Statistical Committee. By setting the MFMT for overfished stocks at $F_{REBUILD}$, **Alternative 3** would alleviate this inconsistency.

Although the alternatives have different effects on the administrative environment, these effects are likely minor. Assessing stocks to determine if the F is above or below MFMT are routine endeavors by NMFS. Actions to control harvest by the Council and NMFS are mostly routine and conducted through the Council system established by the Magnuson-Stevens Act. Additionally, through the use of ACLs and AMs the Council and NMFS can determine if overfishing is occurring annually and take measures to reduce the likelihood a stock would get into an overfished condition. This minimizes the risk that the F for a stock would increase above MFMT and be considered undergoing overfishing.

4.4 Action 4: Optimum Yield (OY)

4.4.1 Direct and Indirect Effects on the Physical Environment

This action does not affect the gear used and therefore has no direct impacts on the physical environment. However, the definition of optimum yield (OY) could affect the long-term harvest levels, which could result in indirect effects.

Alternative 1 would leave OY undefined for stocks included in this amendment. Harvest levels would continue to be determined by the ACL derived from the OFL and ABC derived from the MSY proxy selected in Action 1, or in previous amendments. There would be no change to the current impacts on the physical environment.

Alternative 2 would define OY as the yield when fishing at a fixed percentage of the MSY proxy. If the MSY proxy is based on the fishing mortality rate (F), OY would be the yield when fishing at $x\%$ of $F_{MSY\ proxy}$. If the MSY proxy is an actual harvest yield based on a data limited method, OY would be $x\%$ of that yield. Thus, OY can be defined for either an F -based MSY proxy or a yield-based proxy. The percentage applied would depend upon which option is selected. **Option 2a** would set that percentage at the lowest level, 50%, resulting in the lowest OY, the smallest amount of fishing effort, and the less adverse impacts on the physical environment than either **Option 2b** or **Option 2c**. **Option 2b** would set the percentage at 75%, resulting in an intermediate level of harvest and slightly greater adverse impacts on the physical environment than **Option 2a**, but less than **Option 2c**. **Option 2c** would set the percentage at the highest level, 90%, resulting in greater adverse impacts than either **Option 2a** or **Option 2b**. In summary, the level of adverse impacts to the physical environment for each option, from least to greatest, are **Option 2a**, **Option 2b**, and **Option 2c**. All three options would result in lower harvest and less adverse impact to the physical environment than **Alternative 1**. However, the relative effects of setting an OY harvest level depend on how the OY harvest levels and the ACL harvest levels are integrated into management. That discussion is beyond the scope of this amendment.

Alternative 3 requires the subsequent development of a decision tool that accounts for relevant economic, social, and ecological factors when setting OY. Since this decision tool has not yet been developed the specific effects of this alternative cannot be determined. However, since this alternative integrates additional factors are not explicitly accounted for in **Alternative 1** or **Alternative 2**, it can be assumed that this alternative will account for more factors than either of those alternatives. In particular, **Alternative 3** will explicitly account for ecological factors, which include the physical environment. By explicitly accounting for the physical environment, it is likely that this alternative will result in less adverse impacts than either **Alternative 1** or **Alternative 2**.

4.4.2 Direct and Indirect Effects on the Biological/Ecological Environment

Direct and indirect effects are discussed in Section 4.1.2 in detail and incorporated by reference here. In essence, alternatives that result in greater fishing effort and landings are more likely to adversely affect the biological/ecological environment than alternatives that reduce fishing effort and landings.

Setting OY is not expected to have any direct effects on the biological/ecological environment; however, the definition of OY could affect the long-term harvest levels. Management measures that would be required to maintain harvests at or below OY would produce biological/ecological impacts. Consequently, the biological/ecological impacts of the alternatives in this action would be indirect. Furthermore, the impacts could be positive or negative depending on the level of risk that is acceptable.

Alternative 1 would leave the OY values assigned to seven reef stocks as defined, and leave OY undefined for the remaining reef fish stocks and red drum. This would provide no long term harvest target for the remaining stocks, which could be detrimental should current harvest levels be too high. Thus, this alternative is least beneficial of the alternatives for the biological/ecological environment.

Alternative 2, Option 2a is the most conservative of the OY proxies (50% of MSY) and would have the lowest F and highest B levels associated with it. Thus, it would have the lowest risk of allowing the stock size becoming depleted and would be the most beneficial **Alternative 2** option. **Option 2c** is the least precautionary option with the highest associated F value and the lowest associated B. Maintaining this OY proxy would be most adverse of the **Alternative 2** options. **Option 2b** are intermediate to **Options 2a** and **2c**.

Alternative 3 is difficult to compare to **Alternative 2** because it requires the development of a decision tool that accounts for relevant economic, social, and ecological factors when setting OY. Thus the specific effects of this alternative cannot be compared to **Alternative 2** until the tool is developed. However, because this alternative integrates additional variables are not explicitly accounted for in **Alternative 1** or **Alternative 2**, it can be assumed that this alternative will account for more relevant factors than either of those alternatives. In particular, **Alternative 3** will explicitly account for ecological factors that could result in reduced (less adverse) effects on this environment than either **Alternative 1** or **Alternative 2**.

4.4.3 Direct and Indirect Effects on the Economic Environment

For stocks with undefined OY, **Alternative 1** would let the reference point be defined in future amendments when the need arises. Therefore, **Alternative 1** would not be expected to alter the harvest of reef fish species and would not be expected to result in economic effects.

Alternative 2 would define OY as a fixed percentage of $F_{MSY\text{ Proxy}}$ (or 50% of MSY when F_{MSY} cannot be determined). The percentages considered range from 50% (**Option a**) to 90% (**Option c**). **Alternative 3** considers an open-ended approach that would develop OY at a later date using a decision tool that would account for relevant economic, social, or ecological factors. Neither **Alternative 2** nor **Alternative 3** is expected to affect the harvest of reef fish species. Therefore, **Alternatives 2** and **3** would not be expected to result in direct economic effects. However, if annual catch limits (ACLs) are indirectly linked to future OY definitions, **Alternatives 2** and **3** may be expected to result in indirect effects. The direction as well as the magnitude of these potential indirect economic effects would be determined by the relationship between ACLs and OY.

4.4.4 Direct and Indirect Effects on the Social Environment

Additional effects would not be expected under **Alternative 1**, as no changes to OY would be made; for stocks without a defined OY, the reference point could be defined as needed in a plan amendment. The effects from **Alternatives 2** and **3** would be indirect and related to any changes to the total allowable harvest that results from setting OY. In general, positive effects would result in the short-term from increasing harvest levels and negative effects from a decrease in current harvest levels. However, if an increase in harvest levels jeopardizes the health of the stock, indirect long-term negative effects could result if increased catch levels trigger an overfishing or overfished status and require a rebuilding plan.

Alternative 2 specifies fixed percentages of $F_{MSY\text{ Proxy}}$ at which OY would be defined for all reef fish species. **Option 2a** would result in definitions of OY that are reduced the most from the MSY proxy for the respective species, and could result in the greatest negative effects among the options, as the least amount of fish could be caught. **Option 2c** would set OY the closest to the MSY proxy, resulting in the least short-term effects by allowing the most fish to be caught. However, as discussed above, higher catch levels in the short-term can increase the likelihood of triggering an overfished or overfishing status, resulting in stricter regulations during a rebuilding plan, if required. The effects of **Option 2b** would be intermediary between **Options 2a** and **2c**. Because the decision tool that would be used to define OY under **Alternative 3** is not yet developed, it is not possible to determine the effects. However, by using a decision tool that incorporates relevant social factors along with economic and ecological factors, it is likely that any potential negative impacts would be addressed for specific reef fish species, as appropriate.

4.4.5 Direct and Indirect Effects on the Administrative Environment

This action would directly affect the administrative environment by defining a long-term harvest goal for the stock assuming equilibrium levels. Harvest strategies level and applies to seven managed stocks that have defined overfished thresholds. Under **Alternative 1**, OY would

maintain the OY definition for seven stocks that already have an assigned OY. This would leave the other reef fish stocks without a defined OY and would be in conflict with NS 1 guidelines. Selecting either **Alternative 2 or 3** as preferred would be administratively more efficient than approving a species' OY through multiple future actions as each species is assessed. This less efficient approach would occur under **Alternative 1**, which would be more adverse to the administrative environment.

Alternative 2 would set OY as a percentage of F_{MSY} for all species. The lower OY is, the less likely the stock could end up in a depleted condition that could end up requiring a stock rebuilding plan so the stock can recover to a healthy level. Therefore, of the **Alternative 2** options, **Option 2a** would be the least adverse to the administrative environment, **Option 2c** the most adverse, and **Option 2b** would be intermediate to these options.

Alternative 3 would create an added administrative burden over **Alternative 2**. A decision tool would need to be developed across disciplines as social, economic, and biological factors would need identified and applied to the tool. Although this work could be developed off of existing methods (e.g., the stock prioritization tool), social scientists and biologists would need to be brought in by the Council to create the tool.

Although the alternatives have different effects on the administrative environment, these effects are likely minor. Assessing stocks to determine if the stock biomass is above or below OY and other status determination criteria are routine endeavors by NMFS. Actions to control harvest by the Council and NMFS are mostly routine and conducted through the Council system established by the Magnuson-Stevens Act. Additionally, through the use of ACLs and AMs, the Council and NMFS can determine if overfishing is occurring annually and take measures to reduce the likelihood a stock would get into an overfished condition. This minimizes the risk that harvest levels would deviate from OY.

4.5 Cumulative Effects Analysis

Federal agencies preparing an environmental assessment (EA) must also consider cumulative effects of a proposed action and other actions. Cumulative effects are those effects that result from incremental impacts of a proposed action when added to other past, present, and reasonably foreseeable future actions, regardless of which agency (federal or non-federal) or person undertakes such actions. Cumulative effects can result from individually minor but collectively significant actions that take place over a period of time (40 C.F.R. 1508.7). Below is our five-step cumulative effects analysis that identifies criteria that must be considered in an EA.

1. *The area in which the effects of the proposed action will occur* - The affected area of this proposed action encompasses the state and federal waters of the Gulf of Mexico (Gulf) as well as Gulf communities that are dependent on reef fish and red drum fishing. Most relevant to this proposed action are reef fish and red drum. For more information about the area in which the effects of this proposed action will occur, please see Chapter 3, Affected Environment that goes into great detail about these important resources as well as other relevant features of the human environment.

2. *The impacts that are expected in that area from the proposed action* - The proposed action would define the status determination criteria for reef fish species and red drum. The environmental consequences of the proposed status determination criteria are analyzed in detail in Sections 4.1-4.4. Setting status determination criteria and OY should have very little effect on the physical and biological/ecological environment because the action is not expected to alter the manner in which the fishery is prosecuted. These actions would not have direct effects on the social and economic environments and any indirect effects would likely be minor for the near future. The reef fish fishery is a multispecies fishery where fishermen can target other species on trip. Thus, changing fishing practices on one stock does not generally change overall fishing effort, particularly for minor stocks within the fishery. This action should also not effect red drum as harvest of this species is prohibited in federal waters.

3. *Other Past, Present and RFFAs that have or are expected to have impacts in the area* - There are literally tens of thousands of actions going on in the Gulf annually. Many of these activities are expected to have impacts associated with them. It is not possible, nor necessary to list all of them here. Below are discussed the actions expected to have the potential to combine with the effects of the proposed action to have some kind of a cumulative effects.

Other Fishery related actions - The cumulative effects from managing the reef fish fishery have been analyzed in Amendments 30A (GMFMC 2008b), 30B (GMFMC 2008a), 31 (GMFMC 2009), 32 (GMFMC 2011b), 40 (GMFMC 2014a), and 28 (GMFMC 2015b) and are incorporated here by reference. Additional pertinent past actions are summarized in the history of management (Section 1.3). Currently, there are 11 reasonably foreseeable future actions (RFFAs) that are being considered by the Council, which could affect reef fish stocks. For the Reef Fish FMP, these are: Amendment 36B, which would modify the commercial individual fish quota (IFQ) program; Amendments 41 and 42, which would address management of the charter vessel and headboat components of the reef fish fishery; Amendment 49, which addresses sea turtle release gear on federally permitted vessels; Amendment 50, which addresses state

management of red snapper; an action to revise red snapper allocations between the commercial and recreational sectors, and two framework actions that would 1) examine the red snapper annual catch target and 2) examine the commercial greater amberjack season. There are also three generic actions that include revising the ABC control rule, allow for a carry-over should an ACL not be exceeded, and address historical captain's permits.

The Council had looked into developing a plan for red drum to allow recreational fishing in Gulf EEZ waters, but that plan was postponed due to other management priorities the Council is currently working on (<http://gulfcouncil.org/>).

Non-fishery related actions - Actions affecting the reef fish fishery have been described in previous cumulative effect analyses (e.g., Amendment 40). Three important events include impacts of the *Deepwater Horizon* MC252 oil spill, the Northern Gulf Hypoxic Zone, and climate change. Reef fish species are mobile and are able to avoid hypoxic conditions, so any effects from the Northern Gulf Hypoxic Zone on reef fish species are likely minimal regardless of this action. Impacts from the *Deepwater Horizon* MC252 oil spill are still being examined; however, as indicated in Section 3.2, the oil spill had some adverse effects on fish species. However, it is unlikely that the oil spill in conjunction with setting MSST values would have any significant cumulative effect given the primarily administrative function of this action.

There is a large and growing body of literature on past, present, and future impacts of global climate change induced by human activities. Some of the likely effects commonly mentioned are sea level rise, increased frequency of severe weather events, and change in air and water temperatures. The Intergovernmental Panel on Climate Change (IPCC) has numerous reports addressing their assessments of climate change (http://www.ipcc.ch/publications_and_data/publications_and_data.shtml). Global climate changes could affect the Gulf fisheries as discussed in Section 3.3. However, the extent of these effects cannot be quantified at this time. The proposed action is not expected to significantly contribute to climate change through the increase or decrease in the carbon footprint from fishing as these actions should not change how the fishery is prosecuted. As described in Section 3.3, the contribution to greenhouse gas emissions from fishing is minor compared to other emission sources (e.g., oil platforms).

4. *The impacts or expected impacts from these other actions* - The cumulative effects from managing the reef fish fishery have been analyzed in other actions as listed in part three of this section. They include detailed analysis of the reef fish fishery, as well as other fisheries including red drum, cumulative effects on non-target species, protected species, and habitats in the Gulf.

5. *The overall impact that can be expected if the individual impacts are allowed to accumulate:* RFFAs are listed in Part 3 of this section and pertinent past actions are summarized in the history of management (Section 1.3). This action, combined with past actions and RFFAs, is not expected to have significant beneficial or adverse effects on the physical and biological/ecological environments because this action will only minimally affect current fishing practices. However, for the social and economic environments, short-term adverse effects, although minor, are likely and could result in economic losses to fishing communities. These short-term effects are expected to be compensated for by long-term management goals to

maintain the stock at healthy levels. These effects are likely minimal as proposed action, along with past and RFFAs, are not expected to alter the manner in which the fishery is prosecuted. Because it is unlikely there would be any changes in how the fishery is prosecuted, this action, combined with past actions and RFFAs, is not expected to have significant adverse effects on public health or safety.

6. *Summary:* The proposed action, if conducted in a manner consistent with specific alternatives, is not expected to have individual significant effects to the biological, physical, or socio-economic environment. The effects of the proposed action are, and will continue to be, monitored through collection of landings data by NMFS, stock assessments and stock assessment updates, life history studies, economic and social analyses, and other scientific observations. Landings data for the recreational sector in the Gulf are collected through Marine Recreational Information Program, the Southeast Region Headboat Survey, and the Texas Marine Recreational Fishing Survey, and the Louisiana Department of Wildlife and Fisheries LA Creel Program. In addition, the Alabama Department of Conservation and Natural Resources has instituted a program to collect information on reef fish, and in particular, red snapper recreational landings information. Commercial data are collected through trip ticket programs, port samplers, and logbook programs, as well as dealer reporting through the individual fishing quota program.

For the reasons outlined in this CEA and the rest of the environmental assessment, we do not expect this proposed action to have the potential to combine with other past, present and reasonably foreseeable future actions to have a significant cumulative effect on the human environment.

CHAPTER 5. REGULATORY IMPACT REVIEW

CHAPTER 6. REGULATORY FLEXIBILITY ACT ANALYSIS

CHAPTER 7. LIST OF PREPARERS

Name	Expertise	Responsibility	Agency
Steven Atran	Fishery biologist	Co-Team Lead – Amendment development and introduction	GMFMC
Peter Hood	Fishery Biologist	Co-Team Lead – Amendment development, description of the fishery, and effects analysis,	SERO
Mike Travis	Economist	Economic Environment and Regulatory Flexibility Act analysis	SERO
Assane Diagne	Economist	Economic effects analysis and Regulatory Impact Review	GMFMC
Ava Lasseter	Anthropologist	Social environment and effects analysis and Reviewer	GMFMC
Michael Jepson	Anthropologist	Reviewer	SERO
Mara Levy	Attorney	Legal compliance and Reviewer	NOAA GC
Scott Sandorf	Technical writer & editor	Regulatory writer and Reviewer	SERO
David Dale	Fishery biologist	Essential fish habitat and Reviewer	SERO
Michael Larkin	Fishery biologist	Biological analysis and Reviewer	SERO
Jennifer Lee	Protected species biologist	Reviewer	SERO
Christopher Liese	Economist	Reviewer	SEFSC
Mandy Karnauskas	Fishery biologist	Reviewer	SEFSC
Clay Porch	Fishery biologist	Reviewer	SEFSC
Ryan Rindone	Fishery biologist	Reviewer	GMFMC
Carrie Simmons	Fishery biologist	Reviewer	GMFMC

CHAPTER 8. LIST OF AGENCIES, ORGANIZATIONS AND PERSONS CONSULTED

National Marine Fisheries Service

- 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. OTHER APPLICABLE LAW

The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) (16 U.S.C. 1801 et seq.) provides the authority for fishery management in federal waters of the exclusive economic zone. However, fishery management decision-making is also affected by a number of other federal statutes designed to protect the biological and human components of U.S. fisheries, as well as the ecosystems that support those fisheries. Major laws affecting federal fishery management decision-making are summarized below.

Administrative Procedures Act

All federal rulemaking is governed under the provisions of the Administrative Procedure Act (APA) (5 U.S.C. Subchapter II), which establishes a “notice and comment” procedure to enable public participation in the rulemaking process. Under the APA, the National Marine Fisheries Service (NMFS) is required to publish notification of proposed rules in the *Federal Register* and to solicit, consider, and respond to public comment on those rules before they are finalized. The APA also establishes a 30-day waiting period from the time a final rule is published until it takes effect.

Coastal Zone Management Act

Section 307(c)(1) of the federal Coastal Zone Management Act of 1972 (CZMA), as amended, requires federal activities that affect any land or water use or natural resource of a state’s coastal zone be conducted in a manner consistent, to the maximum extent practicable, with approved state coastal management programs. The requirements for such a consistency determination are set forth in NMFS regulations at 15 C.F.R. part 930, subpart C. According to these regulations and CZMA Section 307(c)(1), when taking an action that affects any land or water use or natural resource of a state’s coastal zone, NMFS is required to provide a consistency determination to the relevant state agency at least 90 days before taking final action.

Upon submission to the Secretary, NMFS will determine if this plan amendment is consistent with the Coastal Zone Management programs of the states of Alabama, Florida, Louisiana, Mississippi, and Texas to the maximum extent possible. Their determination will then be submitted to the responsible state agencies under Section 307 of the CZMA administering approved Coastal Zone Management programs for these states.

Data Quality Act

The Data Quality Act (DQA) (Public Law 106-443) effective October 1, 2002, requires the government to set standards for the quality of scientific information and statistics used and disseminated by federal agencies. Information includes any communication or representation of knowledge such as facts or data, in any medium or form, including textual, numerical, cartographic, narrative, or audiovisual forms (includes web dissemination, but not hyperlinks to information that others disseminate; does not include clearly stated opinions).

Specifically, the DQA directs the Office of Management and Budget (OMB) to issue government wide guidelines that “provide policy and procedural guidance to federal agencies for ensuring and maximizing the quality, objectivity, utility, and integrity of information disseminated by federal agencies.” Such guidelines have been issued, directing all federal agencies to create and disseminate agency-specific standards to: 1) ensure information quality and develop a pre-dissemination review process; 2) establish administrative mechanisms allowing affected persons to seek and obtain correction of information; and 3) report periodically to Office of Management and Budget on the number and nature of complaints received.

Scientific information and data are key components of fishery management plans (FMPs) and amendments and the use of best available information is the second national standard under the Magnuson-Stevens Act. To be consistent with the Act, FMPs and amendments must be based on the best information available. They should also properly reference all supporting materials and data, and be reviewed by technically competent individuals. With respect to original data generated for FMPs and amendments, it is important to ensure that the data are collected according to documented procedures or in a manner that reflects standard practices accepted by the relevant scientific and technical communities. Data will also undergo quality control prior to being used by the agency and a pre-dissemination review.

Endangered Species Act

The Endangered Species Act (ESA) of 1973, as amended, (16 U.S.C. Section 1531 et seq.) requires federal agencies use their authorities to conserve endangered and threatened species. The ESA requires NMFS, when proposing a fishery action that “may affect” critical habitat or endangered or threatened species, to consult with the appropriate administrative agency (itself for most marine species, the U.S. Fish and Wildlife Service for all remaining species) to determine the potential impacts of the proposed action. Consultations are concluded informally when proposed actions may affect but are “not likely to adversely affect” endangered or threatened species or designated critical habitat. Formal consultations, including a biological opinion, are required when proposed actions may affect and are “likely to adversely affect” endangered or threatened species or adversely modify designated critical habitat. If jeopardy or adverse modification is found, the consulting agency is required to suggest reasonable and prudent alternatives.

On September 30, 2011, the Protected Resources Division released a biological opinion which, after analyzing best available data, the current status of the species, environmental baseline (including the impacts of the recent *Deepwater Horizon* MC 252 oil release event in the northern Gulf of Mexico), effects of the proposed action, and cumulative effects, concluded that the continued operation of the Gulf of Mexico reef fish fishery is also not likely to affect ESA-listed marine mammals or *Acropora cervicornis* or *Acropora palmate*; or to jeopardize the continued existence of green, hawksbill, Kemp’s ridley, leatherback, or loggerhead sea turtles, nor the continued existence of smalltooth sawfish; (NMFS 2011). Since issuing the biological opinion, in memoranda dated September 16, 2014, and October 7, 2014, NMFS concluded that the activities associated with the Reef Fish FMP will not adversely affect critical habitat for the Northwest Atlantic Ocean loggerhead sea turtle DPS and four species of corals (*Mycetophyllia ferox*, *Orbicella annularis*, *O. faveolata*, and *O. franksi*). In a memorandum dated September 29,

2016, NMFS indicated that several species (green sea turtle North Atlantic and South Atlantic DPSs, and Nassau grouper) have been recently listed under the ESA that may be affected by fishing managed under the Reef Fish FMP, thus triggering the need for re-initiation of consultation. Since the initial reinitiation request, NMFS has published two additional final listing rules. On January 22, 2018, NMFS listed the giant manta ray (*Manta birostris*) as threatened under the ESA, effective February 21, 2018. On January 30, 2018, NMFS listed the oceanic whitetip shark (*Carcharinus lonigmanus*) as threatened under the ESA, effective March 1, 2018. In the September 29, 2016, memorandum, followed by a March 6, 2018, memorandum revising the reinitiation request of a Section 7 consultation to include the two new listings (giant manta ray and oceanic whitetip shark), NMFS concluded that allowing continued authorization of the reef fish fishery in federal waters during the re-initiation period will not violate Section 7(a)(2) or 7(d).

Marine Mammal Protection Act

The Marine Mammal Protection Act (MMPA) established a moratorium, with certain exceptions, on the taking of marine mammals in U.S. waters and by U.S. citizens on the high seas, and on the importing of marine mammals and marine mammal products into the United States. Under the MMPA, the Secretary of Commerce (authority delegated to NMFS) is responsible for the conservation and management of cetaceans and pinnipeds (other than walruses). The Secretary of the Interior is responsible for walruses, sea and marine otters, polar bears, manatees, and dugongs.

Part of the responsibility that NMFS has under the MMPA involves monitoring populations of marine mammals to make sure that they stay at optimum levels. If a population falls below its optimum level, it is designated as “depleted,” and a conservation plan is developed to guide research and management actions to restore the population to healthy levels.

In 1994, Congress amended the MMPA, to govern the taking of marine mammals incidental to commercial fishing operations. This amendment required the preparation of stock assessments for all marine mammal stocks in waters under U.S. jurisdiction, development and implementation of take-reduction plans for stocks that may be reduced or are being maintained below their optimum sustainable population levels due to interactions with commercial fisheries, and studies of pinniped-fishery interactions.

Under Section 118 of the MMPA, NMFS must publish, at least annually, a List of Fisheries (LOF) that places all U.S. commercial fisheries into one of three categories based on the level of incidental serious injury and mortality of marine mammals that occurs in each fishery. The categorization of a fishery in the LOF determines whether participants in that fishery may be required to comply with certain provisions of the MMPA, such as registration, observer coverage, and take reduction plan requirements. The primary gear used in the Gulf of Mexico reef fish fishery are still classified in the 2018 MMPA LOF as Category III fishery (83 FR 5349, February 7, 2018). The conclusions of the most recent LOF for gear used by the reef fish fishery can be found in Section 3.3.

Paperwork Reduction Act

The Paperwork Reduction Act of 1995 (PRA) (44 U.S.C. 3501 et seq.) regulates the collection of public information by federal agencies to ensure the public is not overburdened with information requests, the federal government's information collection procedures are efficient, and federal agencies adhere to appropriate rules governing the confidentiality of such information. The PRA requires NMFS to obtain approval from the Office of Management and Budget before requesting most types of fishery information from the public. Defining the vermilion snapper maximum sustainable yield proxy and setting the annual catch limit would not likely have PRA consequences.

Executive Orders

E.O. 12630: Takings

The Executive Order on Government Actions and Interference with Constitutionally Protected Property Rights that became effective March 18, 1988, requires each federal agency prepare a Takings Implication Assessment for any of its administrative, regulatory, and legislative policies and actions that affect, or may affect, the use of any real or personal property. Clearance of a regulatory action must include a takings statement and, if appropriate, a Takings Implication Assessment. The National Oceanic and Atmospheric Administration Office of General Counsel will determine whether a Taking Implication Assessment is necessary for this amendment.

E.O. 12866: Regulatory Planning and Review

Executive Order 12866: Regulatory Planning and Review, signed in 1993, requires federal agencies to assess the costs and benefits of their proposed regulations, including distributional impacts, and to select alternatives that maximize net benefits to society. To comply with E.O. 12866, NMFS prepares a Regulatory Impact Review (RIR) for all fishery regulatory actions that either implement a new fishery management plan or significantly amend an existing plan (See Chapter 5). RIRs provide a comprehensive analysis of the costs and benefits to society of proposed regulatory actions, the problems and policy objectives prompting the regulatory proposals, and the major alternatives that could be used to solve the problems. The reviews also serve as the basis for the agency's determinations as to whether proposed regulations are a "significant regulatory action" under the criteria provided in E.O. 12866 and whether proposed regulations will have a significant economic impact on a substantial number of small entities in compliance with the Regulatory Flexibility Analysis. A regulation is significant if it a) has an annual effect on the economy of \$100 million or more or adversely affects in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or State, local, or tribal governments and communities; b) creates a serious inconsistency or otherwise interferes with an action taken or planned by another agency; c) materially alters the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of recipients thereof; or d) raises novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in this Executive Order.

E.O. 12898: Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations

This Executive Order mandates that each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States and its territories and possessions. The Executive Order is described in more detail relative to fisheries actions in Section 3.5.1.

E.O. 12962: Recreational Fisheries

This Executive Order requires federal agencies, in cooperation with states and tribes, to improve the quantity, function, sustainable productivity, and distribution of U.S. aquatic resources for increased recreational fishing opportunities through a variety of methods including, but not limited to, developing joint partnerships; promoting the restoration of recreational fishing areas that are limited by water quality and habitat degradation; fostering sound aquatic conservation and restoration endeavors; and evaluating the effects of federally-funded, permitted, or authorized actions on aquatic systems and recreational fisheries, and documenting those effects. Additionally, it establishes a seven-member National Recreational Fisheries Coordination Council (Council) responsible for, among other things, ensuring that social and economic values of healthy aquatic systems that support recreational fisheries are considered by federal agencies in the course of their actions, sharing the latest resource information and management technologies, and reducing duplicative and cost-inefficient programs among federal agencies involved in conserving or managing recreational fisheries. The Council also is responsible for developing, in cooperation with federal agencies, States and Tribes, a Recreational Fishery Resource Conservation Plan - to include a five-year agenda. Finally, the Order requires NMFS and the U.S. Fish and Wildlife Service to develop a joint agency policy for administering the ESA.

E.O. 13132: Federalism

The Executive Order on Federalism requires agencies in formulating and implementing policies, to be guided by the fundamental Federalism principles. The Order serves to guarantee the division of governmental responsibilities between the national government and the states that was intended by the framers of the Constitution. Federalism is rooted in the belief that issues not national in scope or significance are most appropriately addressed by the level of government closest to the people. This Order is relevant to FMPs and amendments given the overlapping authorities of NMFS, the states, and local authorities in managing coastal resources, including fisheries, and the need for a clear definition of responsibilities. It is important to recognize those components of the ecosystem over which fishery managers have no direct control and to develop strategies to address them in conjunction with appropriate state, tribes, and local entities (international, too).

E.O. 13158: Marine Protected Areas

This Executive Order requires federal agencies to consider whether their proposed action(s) will affect any area of the marine environment that has been reserved by federal, state, territorial, tribal, or local laws or regulations to provide lasting protection for part or all of the natural or cultural resource within the protected area. There are several marine protected areas, habitat areas of particular concern, and gear-restricted areas in the eastern and northwestern Gulf of Mexico.

Essential Fish Habitat

The amended Magnuson-Stevens Act included a new habitat conservation provision known as essential fish habitat (EFH) that requires each existing and any new FMPs to describe and identify EFH for each federally managed species, minimize to the extent practicable impacts from fishing activities on EFH that are more than minimal and not temporary in nature, and identify other actions to encourage the conservation and enhancement of that EFH. To address these requirements the Council has, under separate action, approved an Environmental Impact Statement (GMFMC 2004) to address the new EFH requirements contained within the Magnuson-Stevens Act. Section 305(b)(2) requires federal agencies to obtain a consultation for any action that may adversely affect EFH. An EFH consultation will be conducted for this action.

References

GMFMC. 2004. Final environmental impact statement for the generic essential fish habitat amendment to the following fishery management plans of the Gulf of Mexico: shrimp fishery of the Gulf of Mexico, red drum fishery of the Gulf of Mexico, reef fish fishery of the Gulf of Mexico, stone crab fishery of the Gulf of Mexico, coral and coral reef fishery of the Gulf of Mexico, spiny lobster fishery of the Gulf of Mexico and South Atlantic, coastal migratory pelagic resources of the Gulf of Mexico and South Atlantic. Gulf of Mexico Fishery Management Council. Tampa, Florida.

<http://www.gulfcouncil.org/Beta/GMFMCWeb/downloads/Final%20EFH%20EIS.pdf>

NMFS. 2011. Biological opinion on the continued authorization of Reef Fish fishing under the Gulf of Mexico Reef Fish Fishery Management Plan. September 30, 2011. Available at: http://sero.nmfs.noaa.gov/sustainable_fisheries/gulf_fisheries/reef_fish/documents/pdfs/2013/gulf_reef_fish_biop_2011.pdf

APPENDIX B. SUMMARIES OF PUBLIC COMMENTS RECEIVED

List the locations of the scoping hearings and public hearings, then list the summaries and written comments