SSC Draft

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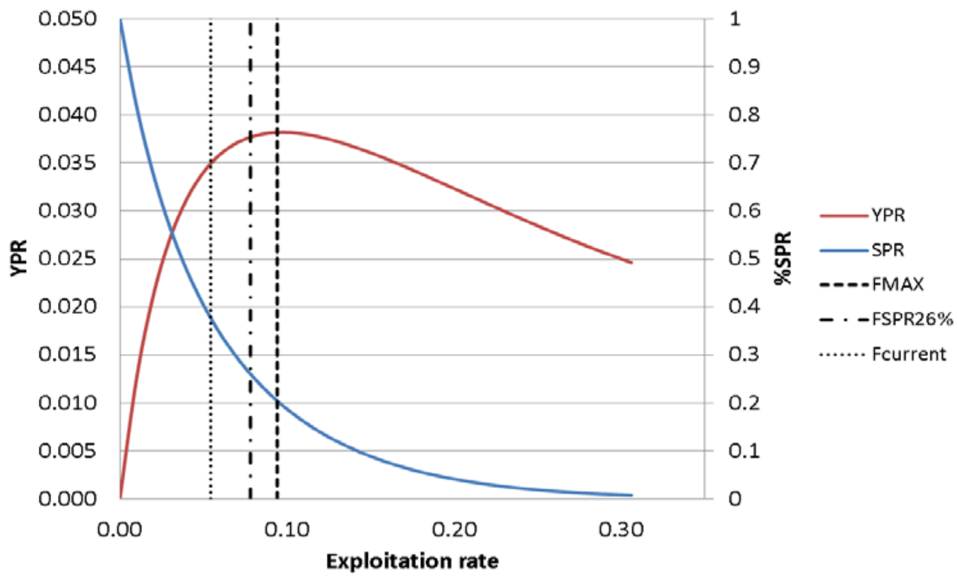
Status Determination Criteria and Optimum Yield for Reef Fish and Red Drum



Public Hearing Draft
Amendment 48 to the Reef Fish Fishery Management Plan
Amendment 5 to the Red Drum Fishery Management Plan

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

June 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 5 to the Red Drum Fishery Management Plan, including Environmental Assessment, Fishery Impact Statement, Regulatory Impact Review, and Regulatory Flexibility Act Analysis

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Type of Action

( ) Administrative ( ) Legislative
(X) Draft ( ) Final

Summary/Abstract

ABBREVIATIONS USED IN THIS DOCUMENT

ABC	Acceptable biological catch
ACL	Annual catch limit
ACT	Annual catch target
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
DLMTool	Data Limited Methods Tool
DPS	Distinct population segment
EA	Environmental Assessment
EEZ	Exclusive Economic Zone
EFH	Essential fish habitat
EIS	Environmental impact statement
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_{PROXY}	Fishing mortality rate corresponding to an MSY proxy
$F_{REBUILD}$	Fishing mortality rate corresponding to a stock rebuilding plan
$F_{x\%\ SPR}$ ratio	Fishing mortality corresponding to an x percent spawning potential
FMP	Fishery Management Plan
FSAP	Finfish Stock Assessment Panel
GMFMC	Gulf of Mexico Fishery Management Council
IFQ	Individual Fishing Quota
IRFA	Initial regulatory flexibility analysis
M	Mortality
Magnuson-Stevens Act	Magnuson-Stevens Fishery Conservation and Management Act
MFMT	Maximum fishing mortality threshold
MMPA	Marine Mammal Protection Act
MRFSS	Marine Recreational Fisheries Statistics Survey
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
RFOP	Reef Fish Observer Program
RIR	Regulatory impact review
SDC	Status determination criteria
Secretary	Secretary of Commerce
SEDAR	Southeast Data, Assessment and Review
SEFSC	Southeast Fisheries Science Center
SEIS	Supplemental environmental impact statement
SERO	Southeast Regional Office
SFA	Sustainable Fisheries Act
SSB	Spawning stock biomass
SSBR	Spawning stock biomass per recruit
SSC	Scientific and Statistical Committee
SPR	Spawning potential ratio
TAC	Total allowable catch

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FISHERY IMPACT STATEMENT

This section will be completed when all preferred alternatives have been selected.

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 (OY) 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 (SDC) and Biological Reference Points

The National Standard 1 (NS1) guidelines require that each FMP described objective and measurable criteria to determine overfishing and overfished status, such as a minimum stock size threshold (MSST), and maximum fishing mortality threshold (MFMT) or an overfishing limit (OFL), collectively known as status determination criteria (SDC). These thresholds represent the point at which a stock is determined to be overfished (MSST) or experiencing overfishing (MFMT or OFL). Stocks must also have a maximum sustainable yield (MSY) or proxy, and an OY.

Catch Level Reference Points

MSY and OY are long-term average catch levels. They are usually measured in terms of biomass (pounds) caught but could be measured in terms of numbers of fish caught. MSY is the largest average amount of fish that can be caught each year on a continuing basis. OY is a long-term average catch level that is based on MSY as reduced by any relevant economic, social, or ecological factor. Therefore, OY cannot exceed MSY. When data are insufficient to estimate MSY directly a proxy may be used. The most common proxy is a yield that will allow the stock to maintain a certain level of egg production or spawning potential ratio (SPR).

Stock Biomass Reference Points

The stock level refers to a measure of how many fish are left in the water rather than how many fish are caught. It can be measured in terms of biomass (e.g., pounds left in the water), numbers of fish, or the expected egg production from the spawning stock biomass (SSB) of the adult stock. The stock level that results from catching the MSY level is called the biomass at MSY (B_{MSY}). If the stock level falls below B_{MSY}, it can no longer sustain the MSY catch without further depletion. However, biomass can be expected to fluctuate over time, due to changes in environmental conditions, recruitment to the stock, or other variables. Because of these natural fluctuations, a stock is not considered to be overfished until it drops to some level further below B_{MSY}. This is the MSST level. The Gulf of Mexico Fishery Management Council (Council) has broad latitude in deciding how far the MSST can be set below B_{MSY}, except that is cannot go below 50% of B_{MSY}. The wider the gap between B_{MSY} and MSST, the less likely a stock is to be declared overfished, but the more difficult it may be to rebuild the stock back to $B_{MSY.}$ The narrower the gap between B_{MSY} and MSST, the more likely a stock is to be declared overfished, but the less difficult it may be to rebuild the stock. If MSST is set too close to B_{MSY}, natural fluctuations may cause the stock to enter an overfished condition even if it is well-managed.

Minimum Stock Size Threshold (overfished)

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

A narrower buffer is more likely to trigger an overfished determination, but if triggered, less restrictive regulations would be needed during the rebuilding plan.	*Narrower buffer* ↑ 0.75^*B_{MSY} 0.50^*B_{MSY} ↓ *Wider buffer*	A wider buffer is less likely to trigger an overfished determination, but if triggered, more restrictive regulations would likely be required during the rebuilding plan.

Fishing Mortality Rate Reference Points

MSY, OY, B_{MSY}, and MSST are all considered to be biomass reference points that refer to either the amount of fish harvested (MSY and OY) or the amount of fish left in the ocean (B_{MSY} and MSST). In contrast, fishing mortality rate (F) and MFMT refer to rates of removal of fish by fishing.[1]

The fishing mortality rate that results in catching the MSY level on an annual basis is called F_{MSY}. The fishing mortality rate above which overfishing is occurring is MFMT. MFMT is also the fishing mortality rate that results in catching the OFL level on an annual basis. For this reason, exceeding the OFL is also considered overfishing. MFMT cannot be set higher than F_{MSY}, but it can be set lower. It is often set equal to F_{MSY}, but under some conditions it may be desirable to set it at a more conservative level. For example, an overfished stock that is required to be rebuilt in a certain number of years may require a maximum fishing mortality rate less than F_{MSY} in order to reach its rebuilding target.

Long-term vs. Annual Reference Points

All of the above reference points are considered long-term, or equilibrium, reference points. Once calculated, they do not change unless some new information about the productivity of the stock is found, or the Council decides by plan amendment to change the level of MSST or MFMT. On the other hand, the overfishing limit (OFL), acceptable biological catch (ABC), annual catch limit (ACL), and annual catch target (ACT) are annual catch levels that may change from year to year depending upon the stock condition. The ABC, ACL, and ACT are all based on OFL; whereas, OY, B_{MSY}, and MSST are all based on MSY.

The OFL is the catch level that results from fishing at the MFMT rate. If MFMT is set equal to F_{MSY}, then OFL is the annual catch when fishing at F_{MSY}, and can be considered an annualized MSY. If the stock biomass level is higher than B_{MSY} (which can occur if fishing pressure has been relatively light or if a strong spawning year-class has entered the fishery), then OFL will be higher than the long-term MSY, but will gradually be reduced as the stock is fished down to its B_{MSY} level. On the other hand, if the stock biomass level is below B_{MSY} (as in an overfished stock), then OFL will be less than MSY, but will gradually be increased as the stock rebuilds to its B_{MSY} level. If MFMT is set less than F_{MSY}, then this same pattern will occur, but at a lower long-term catch level.

Because MSY, B_{MSY}, MSST, and OY are long-term levels that don't fluctuate, and OFL, ABC, ACL, and ACT are annual levels that do fluctuate year-to-year, it is inappropriate to set them equal to each other. For example, you cannot set MSY equal to OFL because MSY is a constant value while OFL fluctuates annually.

[1] Think of your car's dashboard. The speedometer tells you your rate of travel (e.g. 50 miles per hour), but does not tell you how far you have travelled. An odometer tells you how far you have travelled, but not the rate of travel. The speedometer and odometer are therefore analogous to fishing mortality rates and biomass levels respectively.

The Council currently has MFMT and OFL defined for all stocks. However, MSY proxies, MSST, and OY are defined for some, but not all, reef fish stocks (Table 1.1.1), and not for red drum.

Table 1.1.1. Stocks with SDC assigned.

Stock	MSY	MSST*	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 at75% 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).
** F_{MAX} and B_{MAX} refer to the fishing mortality rate and biomass level that produce maximum yield per recruit.
*** 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 Generic Sustainable Fisheries Act Amendment (GMFMC 1999) established fishing mortality based reference points for all stocks, but the proposed biomass reference points were not approved 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. 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 ACL/Accountability Measures (AM) Amendment (GMFMC 2011a) and are shown in Table 1.1.2.

Table 1.1.2. 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 NS1 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.

Maximum Sustainable Yield Proxy

Maximum sustainable yield (MSY) is the theoretical maximum largest average amount of fish that can be caught 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.

Maximum Fishing Mortality Threshold (Overfishing)

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 is also the fishing mortality rate that results in catching the OFL level on an annual basis. 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)

Spawning potential ratio (SPR) assumes that a certain amount of fish must survive and spawn in order to replenish the stock. It 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. The optimum SPR is dependent upon life history of the species, but in general, SPRs of 20% to 40% are considered sustainable.

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

This history of management covers events pertinent to the development of status determination criteria for reef fish and red drum in the Gulf. A complete history of management for the Reef Fish FMP is available on the Council's website: http://gulfcouncil.org/fishery-management/implemented-plans/reef-fish/.

1.3.1 Reef Fish History of Management – Status Determination Criteria

The **Reef Fish FMP** (with its associated environmental impact statement [EIS]) was implemented in November 1984. The management objectives included, "Rebuild the declining reef fish stocks wherever they occur within the fishery". The FMP defined MSY as 51 millions pounds for all snappers and groupers combined, and 500,000 pounds for all sea basses combined. The OY was defined as 45 million pounds for all snappers and groupers combined, and 500,000 pounds for all sea basses combined.

Amendment 1 (with its associated environmental assessment (EA), regulatory impact review (RIR), and regulatory flexibility analysis (RFA)) to the Reef Fish FMP, implemented in 1990, had a primary objective to stabilize long-term population levels of all reef fish species by establishing a spawning age survival rate to achieve at least 20% spawning stock biomass per recruit (SSBR), relative to the SSBR that would occur with no fishing. This stock level was to be achieved for each stock in need of rebuilding by January 1, 2000. This amendment also revised the definition of OY to allow specification at the species level, and implemented a framework procedure to allow for annual management changes in the reef fish fishery.

Amendment 3 (with its associated EA and RIR), implemented in July 1991, revised the target for stock rebuilding from 20% SSBR to 20% spawning potential ratio (SPR), a more general term that allowed the stock status to be expressed in terms of total adult fish biomass (number alive x average weight), gonad biomass (number alive x average gonad weight), or eggs produced (number alive x average number of eggs spawned) for each age-class of fish. The amendment also changed the target date for rebuilding red snapper from January 1, 2000 to January 1, 2007 because the original target date was unattainable for red snapper, and it provided additional flexibility in the annual framework procedure for specifying total allowable catch (TAC) by allowing the target date for rebuilding an overfished stock to be changed depending on changes in scientific advice, except that the rebuilding period cannot exceed 1.5 times the generation time of the species under consideration.

Amendment 11 (with its associated EA and RIR), implemented in January 1996, included revision o dealer and vessel permit requirement and to fish trap endorsements. It also included three proposed measures that were disapproved by NMFS. These included: 1) a proposed redefinition of OY; 2) use of ABC range for specification of TAC; and 3) re-specification of the Generation Time Multiplier for the Recovery periods. In April 1997, the Council resubmitted the disapproved measure for specifying OY with a proposal that OY be defined as a yield level that would result in at least 30% SPR. NMFS disapproved the resubmission on May 4, 1998 on the basis that, for the grouper species, some of which change sex or for which biological information was currently unavailable, an OY based on 40% SPR was more appropriate than one base on 30% SPR [63 FR 24522].

Amendment 22 (with its associated supplemental environmental impact statement (SEIS), RIR, and IRFA, implemented July 5, 2005 revised the red snapper rebuilding plan. It set the Sustainable Fisheries Act (SFA) parameters MSY, OY, MFMT, and MSST for red snapper, and sets bycatch reporting methodologies for the permitted reef fish fisheries.

Amendment 23 (with its associated SEIS, RIR, and RFA), implemented July 8, 2005, established a rebuilding plan for vermilion snapper, and set the SFA parameters (MSY, OY, MFMT, and MSST) for vermilion snapper. For MSY, no proxy was selected. MSY for vermilion snapper was set at the yield associated with the assessment calculation of F_{MSY} when the stock is at equilibrium, estimated to be 3.37 mp whole weight. MFMT was set equal to F_{MSY}, and MSST was set (1-M)*B_{MSY} (where M = 0.15). OY was set at the yield when fishing at 75% of F_{MSY}, which was estimated to be approximately 94 percent of MSY, except that, during rebuilding, allowable harvest for each year based on the rebuilding strategy.

Amendment 27 implemented February 28, 2008, except for reef fish bycatch reduction measures that became effective on June 1, 2008. This amendment addressed overfishing and revised the stock rebuilding for red snapper. It changed the MSY proxy for red snapper to be yield when fishing at $F_{26\%\ SPR}$. It also required the use of non-stainless steel circle hooks when using natural baits to fish for Gulf reef fish, and required the use of venting tools and dehooking devices when participating in the commercial or recreational reef fish fisheries effective June 1, 2008.

Amendment 30A (with its associated SEIS, RIR, and RFA), implemented August 2008, revised the greater amberjack rebuilding plan and established a rebuilding plan for gray triggerfish. For gray triggerfish, it set the MSY proxy as the yield associated with $F_{30\%\ SPR}$, set MFMT equal to $F_{30\%\ SPR}$, set MSST equal to (1-M)*SSB_{MSY}, and set OY as the yield associated with 75 percent of F_{MSY} when the stock is at equilibrium.

Amendment 30B (with its associated final EIS, RIR, and IRFA), implemented August 2008, contained measure to end overfishing of gag and revise red grouper management measures. For gag, it set status determination criteria based on maximum-yield-per-recruit. The MSY proxy was the yield when fishing at a rate corresponding to maximum-yield-per-recruit (F_{MAX}). MFMT was set equal to F_{MAX}, and MSST was set at (1-M)*SSB_{MAX} (where M = 0.15). The OY was set at the yield at 75 percent of F_{MAX}.

Amendment 43 (with its associated EA, RIR, and RFA), implemented August 24, 2017, defined the geographical boundaries for Gulf stock of hogfish. It set the MSY proxy for hogfish at the equilibrium yield at $F_{30\%\ SPR}$, MFMT at $F_{30\%\ SPR}$, and MSST at 75% of the spawning stock biomass when fishing at $F_{30\%\ SPR}$,

Amendment 44 (with its associated EA), was approved on December 21, 2017 (there was no rulemaking associated with this amendment, and therefore no implementation date). The amendment re-defined MSST for seven reef fish species: gag, red grouper, red snapper, vermilion snapper, gray triggerfish, greater amberjack, and hogfish. For these stocks, MSST was re-defined to be 50% of the B_{MSY} proxy.

, defined the geographical boundaries for Gulf stock of hogfish. It set the MSY proxy for hogfish at the equilibrium yield at $F_{30\%\ SPR}$, MFMT at $F_{30\%\ SPR}$, and MSST at 75% of the spawning stock biomass when fishing at $F_{30\%\ SPR}$,

Secretarial Amendments

Section 304(c)(1) and Section 304 (e)(5) of the M-FCMA provide for circumstances under which the Secretary of Commerce may prepare a fishery management plan or amendment. The following amendments have been developed as Secretarial Amendments to the Reef Fish FMP in conjunction with the Council.

Secretarial Amendment 1, including an EA, RIR, and FRFA, implemented in July 2004, established biological reference points and stock status determination criteria for the red grouper stock in U.S. waters of the Gulf of Mexico as follows:

Biological Reference Points and Status Determination Criteria:

MSY	7.560 million pounds (MP)
F_{MSY}	0.306
SS_{MSY}	840 metric tons mature female gonad weight
MSST	80% (1-M where M=0.2) of SS_{MSY} (currently estimated by proxy to be 672 metric tons mature female gonad weight)
MFMT	F_{MSY} (currently estimated at 0.306), or the F consistent with recovery to the MSY level in no more than 10 years.
OY	The yield obtained from a fishing mortality rate equal to 75% of F_{MSY} (currently estimated to be 7.385 MP gutted weight at equilibrium)

Secretarial Amendment 2, including EA, RIR, and RFA, was submitted to NMFS in November 2002, and implemented on June 17, 2003. It specified MSY, OY, MFMT, and MSST levels for greater amberjack in compliance with the Magnuson-Stevens Act, and established a rebuilding plan for greater amberjack based on 3-year intervals. The MSY proxy was the yield associated with $F_{30\%\ SPR}$. OY was set at the yield associated with an $F_{40\%\ SPR}$ when the stock is at equilibrium. MFMT was set at $F_{30\%\ SPR}$, and MSST was set at (1-M)*B_{MSY} (where M = 0.25).

1.3.1 Red Drum History of Management – Status Determination Criteria

A **Secretarial FMP for the Red Drum Fishery of the Gulf of Mexico** (with its associated EA and RIR) was implemented December 19, 1986. It prohibited directed commercial harvest of red drum from the EEZ for 1987. The FMP provided for a recreational bag limit of one fish per person per trip, and an incidental catch allowance for commercial net and shrimp fishermen. It established an escapement goal of 20% of juvenile red drum to the offshore spawning stock.

MSY was defined as the combination of inshore and offshore fishing mortality rates which maximizes the yield-per-recruit times present inshore recruitment subject to the constraint that spawning stock biomass per recruit is no smaller than 30% of what it would be if there were no exploitation. Inshore equilibrium yield was estimated to be 10.2 million pounds, but the overall range of MSY estimates was between 6.1 million pounds and 63.2 million pounds.

Amendment 2, implemented in 1988, prohibited retention and possession of red drum from the EEZ. Overfishing was defined as a fishing mortality that prohibits attaining the spawning stock goal or threshold which is currently set at a 20 percent SSBR ratio. OY was defined as all red drum recreationally and commercially harvested from state waters landed consistent with state laws and regulations, under a goal of allowing 30 percent escapement of the juvenile population. In addition, all red drum commercially or recreationally harvested from the Primary Area of the EEZ under the TAC level and allocations specified under the provisions of the FMP, and a zero retention level from the Secondary Areas of the EEZ. A 1989 SEFSC Stock Assessment report (Goodyear) indicated the SSBR would likely decline to 13 percent. The 1989 Stock Assessment Panel report recommended ABC for the EEZ be maintained at zero, and that the states increase escapement to 30 percent.

1.3.1 Generic Amendments – Status Determination Criteria

Generic Sustainable Fisheries Act Amendment (with its associated EA, RIR, and IRFA), partially approved and implemented in November 1999, set the MFMT) for most reef fish stocks at $F_{30\%\ SPR}$. Estimates of MSY, MSST), and OY were disapproved because they were based on SPR proxies rather than biomass based estimates.

CHAPTER 2. MANAGEMENT ALTERNATIVES

2.1 Action 1 - Maximum Sustainable Yield (MSY) Proxies

Sub-action 1.1. 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 Scientific and Statistical Committee (SSC) in the most recent stock assessment for stock status determination, which is the yield corresponding to a fishing mortality at spawning potential ratio of 30% ($F_{30\%\ SPR}$) 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 corresponding to a fishing mortality at spawning potential ratio of 50% ($F_{50\%\ SPR}$). The MSY proxy for the gonochoristic species will be the yield corresponding to a fishing mortality at spawning potential ratio of 40% ($F_{40\%\ SPR}$).

Table 2.1.1. MSY proxies used in recent assessments

Stock	MSY Proxy: Assessed Yield at	Source
Grouper, Black (IFQ)	$F_{30\%\ SPR}$	SEDAR 19 (2010)
Grouper, Yellowedge (IFQ)	$F_{30\%\ SPR}$	SEDAR 22 (2011b) $F_{30\%\ SPR}$ was used for the baseline run, but either $F_{30\%\ SPR}$ or $F_{40\%\ SPR}$ was recommended.
Snapper, Mutton	$F_{30\%\ SPR}$	SEDAR 15A Update (2015).
Snapper, Yellowtail	$F_{30\%\ SPR}$	SEDAR 27A (O'Hop et al. 2012)
Snapper, Gray	$F_{30\%\ SPR}$	SEDAR 51 (2018)
Tilefish (IFQ)	$F_{30\%\ SPR}$	SEDAR 22 (2011a)

<u>**Discussion**</u>:

This sub-action includes stocks that have had Southeast Data, Assessment, and Review (SEDAR) assessments which included maximum sustainable yield (MSY) proxies. Some of the SEDAR assessments included multiple runs under different MSY proxies as shown in the notes under Table 2.1.1. In those situations, the MSY proxy assigned in **Alternative 2** is the one used by the SSC for stock status determination.

The six stocks in this sub-action have been assessed under SEDAR, and status determination was based on what the Southeast Fisheries Science Center (SEFSC) and the Gulf of Mexico Fishery

Management Council's (Council) Scientific and Statistical Committee (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.

Spawning Potential Ratio (SPR)

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

The SPR 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.

The optimum SPR is dependent upon life history of the species, but in general, SPRs of 20% to 40% are considered sustainable.

More conservative

A more conservative SPR results in a lower ACL in the short-term, but would help ensure stable catch levels over the long-term.	$F_{40\%SPR}$ ↕ $F_{20\%SPR}$	A less conservative SPR results in a higher ACL in the short-term, but could result in less stable or lower catch levels over the long-term.

Less conservative

Alternative 1 would leave the MSY proxy for these stocks undefined. In future assessments, the assessment scientists and the SSC would 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 six 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. (In Review). 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, gray snapper, and tilefish) at the yield at $F_{40\% \text{ SPR}}$. These are more recent recommendations than the analysis on which $F_{30\% \text{ SPR}}$ is based. However, since the Harford et al. (In Review) analysis has not yet been published or peer-reviewed outside of an internal SEFSC review, it may be considered as not useful management guidance at this time.

Under the no action alternative, **Alternative 1**, the yield at $F_{30\% \text{ SPR}}$ would 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** would 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** would remove uncertainty as to what proxy would be used for MSY. **Alternative 3** assigns more conservative MSY proxies, which would result in lower yields but also lower risk of failing to maintain MSY over the long term.

Sub-action 1.2. 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. Based on the tilefish OFL recommendation of the SSC in May 2011, this will be 533,425 lbs gw.

Option 2b. The MSY proxy for the tilefishes complex will be the equilibrium MSY yield for tilefish (golden) 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. Based on Tier 3a analysis used for the Generic ACL/AM Amendment (GMFMC 2011a), MSY = 747,000 lbs gw for the complex.

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. Based on the black grouper OFL recommendation of the SSC in March 2010, this will be 615,801 lbs ww.

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. Based on Tier 3a analysis used for the Generic ACL/AM Amendment (GMFMC 2011a), MSY = 710,000 lbs gw for the complex.

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. Based on the yellowedge grouper OFL recommendation of the SSC in May 2011, this will be 788,000 lbs gw.

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. Based on Tier 3a analysis used for the Generic ACL/AM Amendment (GMFMC 2011a), MSY = 1,110,000 lbs gw for the complex.

Deep-water grouper complex (IFQ)
-Yellowedge grouper (i)
-Warsaw grouper
- Snowy grouper
- Speckled hind

Alternative 5. Establish an MSY proxy for the jacks stock complex. The MSY proxy will 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. Based on Tier 3a analysis used for the Generic ACL/AM Amendment (GMFMC 2011a), MSY = 372,000 lbs ww for the complex.

Jacks complex
-Lesser amberjack
-Almaco jack
- Banded rudderfish

Alternative 6. Establish an MSY proxy for the mid-water snappers stock complex. The MSY proxy will 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. Based on Tier 3a analysis used for the Generic ACL/AM Amendment (GMFMC 2011a), MSY = 209,000 lbs ww for the complex.

Mid-water snappers complex
- 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 the overfishing limit (OFL) and acceptable biological catch (ABC) based on data-limited methods using mean catch over a specific time period (Tier 3a or 3b of the ABC control rule[2]), 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 4 a** in this sub-action assume that MSY proxies would be established in Sub-action 1.1. 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 Data Limited Methods Tool [DLMTool] method) can be used to determine an MSY proxy.

Stocks included in any accepted stock complexes will be removed from Sub-action 1.3, 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 would have an MSY proxy assigned under Sub-action 1.1 (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 would 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 ether Tier 3a or 3b of the ABC control rule, or by the methods available in the DLMTool. 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 would have an MSY proxy assigned under Sub-action 1.1 (unless the no action **Alternative 1** 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 would 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

[2] For example, for Cubera snapper the mean annual catch for the period 1999-2008 was 3,125 pounds, with a standard deviation of 1,940 pounds. Under Tier 3a, the OFL was set at the mean plus 2 standard deviations (3,125 + 2*1,940 = 7,005 pounds). The ABC was set at the mean plus 1 standard deviation (3,125 + 1,940 = 5,065 pounds).

stocks by ether Tier 3a or 3b of the ABC control rule, or by the methods available in the DLMTool. The resulting yield would be the MSY for the group as a whole. Scamp is tentatively scheduled to have a Southeast Data, Assessment, and Review (SEDAR) research track 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 IFQ program for the commercial sector. Yellowedge grouper is an assessed species that would have an MSY proxy assigned under Sub-action 1.1 (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 would 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 ether Tier 3a or 3b of the ABC control rule, or by the methods available in the DLMTool. 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 ether Tier 3a or 3b of the ABC control rule, or by the methods available in the DLMTool. 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 ether Tier 3a or 3b of the ABC control rule, or by the methods available in the DLMTool. The resulting yield would be the MSY for the group as a whole.

The methodology used to establish the stock complexes in the Generic ACL/AM Amendment (GMFMC 2011a) was described in Farmer et al. 2010, and is summarized in Appendix D.

Stock complexes may be comprised of: one or more indicator stocks, each of which has SDC and ACLs, and several other stocks; several stocks without an indicator stock, with SDC and an ACL for the complex as a whole; or one of more indicator stocks, each of which has SDC and management objectives, with an ACL for the complex as a whole.

Sub-action 1.3. Un-assessed stocks without current MSY proxies

The alternatives in this sub-action address MSY proxies for stocks not included in the previous sub-actions or previously assigned proxies in earlier amendments. These are stocks that have not been assessed, or if assessed, the assessment did not recommend an MSY proxy.

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.

Note: where landings are shown for Tier 3 or DLM OFL, values are OFL pounds whole weight from data used in the Generic ACL/Am Amendment except for lane snapper, where value is based on the SSC's OFL recommendation from SEDAR 49.

Stock	Options for MSY Proxy: Yield at				
	$F_{SPR\ 20\%}$	$F_{SPR\ 30\%}$	$F_{SPR\ 40\%}$	$F_{SPR\ 50\%}$	Tier 3 or DLM OFL
Included in Tilefish complex					
Tilefish, Blueline (IFQ)					157,215 lbs
Tilefish, Goldface (IFQ)					62,364 lbs
Included in Other Shallow-water Grouper complex					
Scamp (h) (IFQ)					443,983 lbs
Grouper, Yellowmouth (h) (IFQ)					2.278 lbs
Grouper, Yellowfin (h) (IFQ)					17,018 lbs
Included in Deep-water Grouper complex					
Grouper, Warsaw (h) (IFQ)					237,579 lbs
Grouper, Snowy (h) (IFQ)					212,571 lbs
Speckled Hind (h)					90,047 lbs
Included in Jacks complex					
Amberjack, Lesser					114,825 lbs
Almaco Jack					151,514 lbs
Banded Rudderfish					198,304 lbs
Included in Mid-water Snappers complex					
Snapper, Silk					112,647 lbs
Wenchman					99,668 lbs
Snapper, Blackfin					8,143 lbs
Snapper, Queen					23,809 lbs
Not included in any complex					
Grouper, Goliath					
Snapper, Cubera					7,005 lbs
Snapper, Lane					357,844 lbs
Red Drum					

Notes:
Stocks included in a complex selected in Action 1.2 will be removed from this table and not assigned an individual MSY proxy
(h) – hermaphroditic species
IFQ – Individual fishing quota 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 $F_{50\%\ SPR}$.

<u>Discussion</u>:

This sub-action addresses data-limited stocks. Stocks that were included in Sub-action 1.2 as part of potential stock complexes are listed here, but these stocks will be addressed in this action only if the stock complex is not selected. If a stock complex is selected in Sub-action 1.2, it is not necessary to also assign individual MSY proxies to the stocks included in the complex.

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 would 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.

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 would remain undefined.

Alternative 2 would establish an MSY proxy for each stock. Stocks included in a stock complex under Sub-action 1.2 would be removed from the listing if included in a stock complex MSY proxy established in Sub-action 1.2. 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. (In Review) 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. (In Review) 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 DLMTool. 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.

With the exception of lane snapper, values shown for this option are based on Tier 3a analysis conducted for the Generic ACL/AM Amendment (GMFMC 2011a). One stock, lane snapper, was assessed under SEDAR 49 (2016) using the DLMTool. Based on the results of the DLMTool 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 DLMTool 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. MSST = (1-M)* B_{MSY} (or proxy) where M is the natural mortality rate. This alternative applies to:

Option 2a. All reef fish stocks and red drum

Option 2b. All reef fish stock and red drum except of the 7 stocks where MSST was previously set equal to 0.50*B_{MSY} (or proxy) under Amendment 44 as listed in Table 1.1.1 (gag, red grouper, red snapper, vermilion snapper, gray triggerfish, greater amberjack, and hogfish).

Alternative 3. MSST = 0.75*B_{MSY} (or proxy). This alternative applies to:

Option 3a. All reef fish stocks and red drum

Option 3b. All reef fish stock and red drum except of the 7 stocks where MSST was previously set equal to 0.50*B_{MSY} (or proxy) under Amendment 44 as listed in Table 1.1.1 (gag, red grouper, red snapper, vermilion snapper, gray triggerfish, greater amberjack, and hogfish).

Alternative 4. MSST = 0.50*B_{MSY} (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} (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} (or proxy). The remaining 24 reef fish stocks have not had MSST defined, nor has it been defined for red drum in the Fishery Management Plan for the Red Drum Fishery of the Gulf of Mexico. 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} (or proxy) but no lower than 0.50* B_{MSY} (or proxy). If the fishing mortality can be kept below the overfishing threshold (maximum fishing mortality 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} (or proxy).

Concerns When Setting MSST

- **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} (or proxy)). For data-poor stocks B_{MSY} (or proxy) may not be known. If B_{MSY} (or proxy) is unknown, then MSST is also unknown. For these stocks, the MSST definition is a placeholder until B_{MSY} (or proxy) can be calculated.

Under **Alternative 1** (No Action), MSST is undefined and would need to be established on a case-by-case basis. This is inconsistent with the NS1 guidelines, which require that managed species have quantitative definitions of the status determination criteria.

Alternative 2 sets MSST at (1-M)*B_{MSY} (or proxy) for reef fish stocks and red drum. If the Council selects this alternatives, it should decide whether: **Option 2a** - to apply the MSST to all reef fish stock plus red drum, or **Option 2b** - to exclude the 7 stocks where MSST was previously set equal to 0.50*$B_{MSY\ proxy}$ under Amendment 44 (GMFMC 2017a) as listed in Table 1.1.1 (gag, red grouper, red snapper, vermilion snapper, gray triggerfish, greater amberjack, and hogfish). 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 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, and 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 would be adjusted based on the most recent estimate of M if applicable under the preferred alternative selected in this action.

Alternative 3 sets MSST at $0.75*B_{MSY}$ (or proxy) for all reef fish stocks and red drum. If the Council selects this alternatives, it should also decide which option to select. **Option 3a** would apply the MSST to all reef fish stocks plus red drum. **Option 3b** would exclude the seven stocks where MSST was previously set equal to $0.50*B_{MSY\ proxy}$ under Amendment 44 (GMFMC 2017a) as listed in Table 1.1.1 (gag, red grouper, red snapper, vermilion snapper, gray triggerfish, greater amberjack, and hogfish). This alternative does not require an estimate of M because it sets the MSST at a fixed percentage of the B_{MSY} (or proxy). It is halfway between the B_{MSY} (or proxy) stock level and the 50% of B_{MSY} (or proxy) level, which is the minimum MSST level allowed by the NS1 guidelines. It is; therefore, more conservative than **Alternative 4**.

Relative to **Alternative 2**, the effect of this alternative depends on the natural mortality rate of the individual species (Tables 2.2.1 and 2.2.2). For species where natural mortality is greater than M = 0.25, **Alternative 3** is more conservative than **Alternative 2** (lane snapper, greater amberjack, gray triggerfish, queen snapper, wenchman, and banded rudderfish). Where M is equal to 0.25, **Alternative 3** is equal to **Alternative 2** (vermilion snapper). Where M is less than 0.25, **Alternative 3** is less conservative than **Alternative 2**.

Alternative 4 sets MSST $0.50*B_{MSY}$ (or proxy) for all reef fish stocks. This would set MSST at the 50% level for all 24 reef fish stocks for which MSST is currently undefined 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 NS1 guidelines and is the least conservative alternative. This buffer is used for at least some stocks managed by three of the Regional Management Councils (New England, Mid-Atlantic, and 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	*Lutjanus analis*	0.11	SEDAR 15A (2015)
Red snapper	*Lutjanus campechanus*	0.094277	SEDAR 31 (2013)
Lane snapper*	*Lutjanus synagris*	0.30 0.11-0.24	Ault et al. (2005) Johnson et al. (1995)
Yellowtail snapper	*Ocyurus chrysurus*	0.194	O'Hop et al. (2012)
Vermilion snapper	*Rhomboplites aurorubens*	0.25	SEDAR 9 (2006a)
Groupers			
Yellowedge grouper	*Hyporthodus flavolimbatus*	0.073	SEDAR 22 (2011b)
Goliath grouper	*Epinephelus itajara*	0.12	SEDAR 23 (2011b)
Red grouper	*Epinephelus morio*	0.14	SEDAR 12 (2007)
Black grouper	*Mycteroperca bonaci*	0.136	SEDAR 19 (2010)
Gag	*Mycteroperca microlepis*	0.134	SEDAR 33 (2014a)
Tilefishes			
Tilefish	*Lopholatilus chamaeleonticeps*	0.13	SEDAR 22 (2011a)
Other Species			
Hogfish	*Lachnolaimus maximus*	0.179	Cooper et al. (2013)
Greater amberjack	*Seriola dumerili*	0.28	SEDAR 33 (2014b)
Gray triggerfish	*Balistes capriscus*	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	*Etelis oculatus*	0.843 0.33-0.76	Murray and Moore (1992) Bryan et al. (2011)
Blackfin snapper	*Lutjanus buccanella*	0.23 0.73	Ault et al. (1998) Tabash and Sierra (1996)
Cubera snapper	*Lutjanus cyanopterus*	0.15	Ault et al. (1998)
Gray (mangrove) snapper	*Lutjanus griseus*	0.25 0.18-0.43	Ault et al. (2005) Burton (2000)
Silk snapper	*Lutjanus vivanus*	0.23 0.19-0.86 0.86	Ault et al. (1998) Bryan et al. (2011) Tabash and Sierra (1996)
Wenchman	*Pristipomoides aquilonaris*	0.44	Froese and Pauly (2014a)
Groupers			
Speckled hind	*Epinephelus drummondhayi*	0.20 0.15	Ault et al. (1998) Ziskin (2008)
Warsaw grouper	*Hyporthodus nigritus*	0.08	Ault et al. (1998)
Snowy grouper	*Hyporthodus niveatus*	0.12	SEDAR 36 (2013)
Yellowmouth grouper	*Mycteroperca interstitialis*	0.14-0.24*	Burton et al. (2014)
Scamp	*Mycteroperca phenax*	0.15 0.14	Potts and Brennan (2001) Ault et al. (2005)
Yellowfin grouper	*Mycteroperca venenosa*	0.20	Ault et al. (2005)
Tilefishes			
Goldface tilefish	*Caulolatilus chrysops*	n/a	
Blueline tilefish	*Caulolatilus microps*	0.10	SEDAR 32 (2013)
Jacks			
Lesser amberjack	*Seriola fasciata*	n/a	
Almaco jack	*Seriola rivoliana*	n/a	
Banded rudderfish	*Seriola zonata*	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:

- $F_{26\%\ SPR}$ for red snapper
- $F_{50\%\ SPR}$ for goliath grouper
- F_{MAX} for gag (where MAX is maximum yield per recruit)
- $F_{30\%\ SPR}$ for all other reef fish and for red drum

Alternative 2. Set the MFMT equal to the fishing mortality at the MSY or MSY proxy for each stock as determined in Action 1. If the MSY proxy is expressed as a biomass yield rather an F_{proxy}, the MFMT is a harvest rate that results in the annual yield equal to the biomass MSY proxy.

Alternative 3.

- For stock that are not in a rebuilding plan, set the MFMT equal to the fishing mortality at the MSY or MSY proxy for each stock as determined in Action 1. 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.

- For stocks that are in a rebuilding plan, set the MFMT equal to the fishing mortality rate that is projected to rebuild the stock to BMSY within the rebuilding time period ($F_{Rebuild}$).

__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 above which overfishing is occurring. The MFMT or reasonable proxy may be expressed either as a single number (a fishing mortality rate), 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 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 fishing mortality, overfishing is occurring if the annual harvest exceeds the OFL.

The Generic Sustainable Fisheries Act (SFA) Amendment (GMFMC 1999) set MFMT equal to $F_{50\%\ SPR}$ for Nassau grouper and goliath grouper. It set MFMT equal to $F_{30\%\ SPR}$ for all other reef fish stocks except red snapper. It also set MFMT equal to $F_{30\%\ SPR}$ for red drum. For gag, the fishing mortality rate proxy for maximum sustainable yield (F_{MSY} proxy) and MFMT were subsequently set equal to the fishing mortality rate corresponding to maximum yield per recruit (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 $F_{26\%\ SPR}$ as the red snapper proxy for F_{MSY} and MFMT.

Alternative 1 (No Action) would leave 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.

Alternative 2 would set MFMT equal to the fishing mortality rate based on the MSY proxies adopted in Action 1. In most cases, this would be the same as **Alternative 1**, but if an MSY proxy is changed in Action 1 or in a future amendment, the MFMT would 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 the fishing mortality rate 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 would be 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 if this amendment is implemented, **Alternative 3** would make it a requirement.

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 $F_{MSY\ Proxy}$ (or 50% of MSY when F_{MSY} cannot be determined)
>
> **Option 2b**. 75% of $F_{MSY\ Proxy}$ (or 75% of MSY when F_{MSY} cannot be determined)
>
> **Option 2c**. 90% of $F_{MSY\ Proxy}$ (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.

Discussion:

This action describes the process for determining OY for each stock. The alternatives in this section would apply to all reef fish and red drum unless the Council chooses to exclude selected species, such as those where OY has previously been defined (Table 2.4.1).

The Magnuson-Stevens Fishery Conservation and Management 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 yield associated with fishing rate corresponding to optimum yield (F_{OY}). Unlike the long-term OY, which is constant, the yield when fishing at F_{OY} 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 annual catch targets, 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 (No Action) would leave 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 would specify 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 the yield at some fixed percentage of $F_{MSY\ Proxy}$ (or a fixed percentage of MSY when $F_{MSY\ Proxy}$ cannot be calculated) 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 85º30'W. longitude 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]

[6] http://sero.nmfs.noaa.gov/operations_management_information_services/constituency_services_branch/freedom_of_information_act/common_foia/RCG.htm Accessed February 21, 2018.
[7] http://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 annual catch target 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	**1,232**	**32**	**96.5%**
Other	46		3.5%
Total	**1,278**	**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 incudes 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 km^2), 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 Fechhelm 2005). Gulf water temperatures range from 54º F to 84º F (12º C to 29º C) depending on time of year and depth of water. Mean annual sea surface temperatures ranged from 73 º F through 83º F (23-28º 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

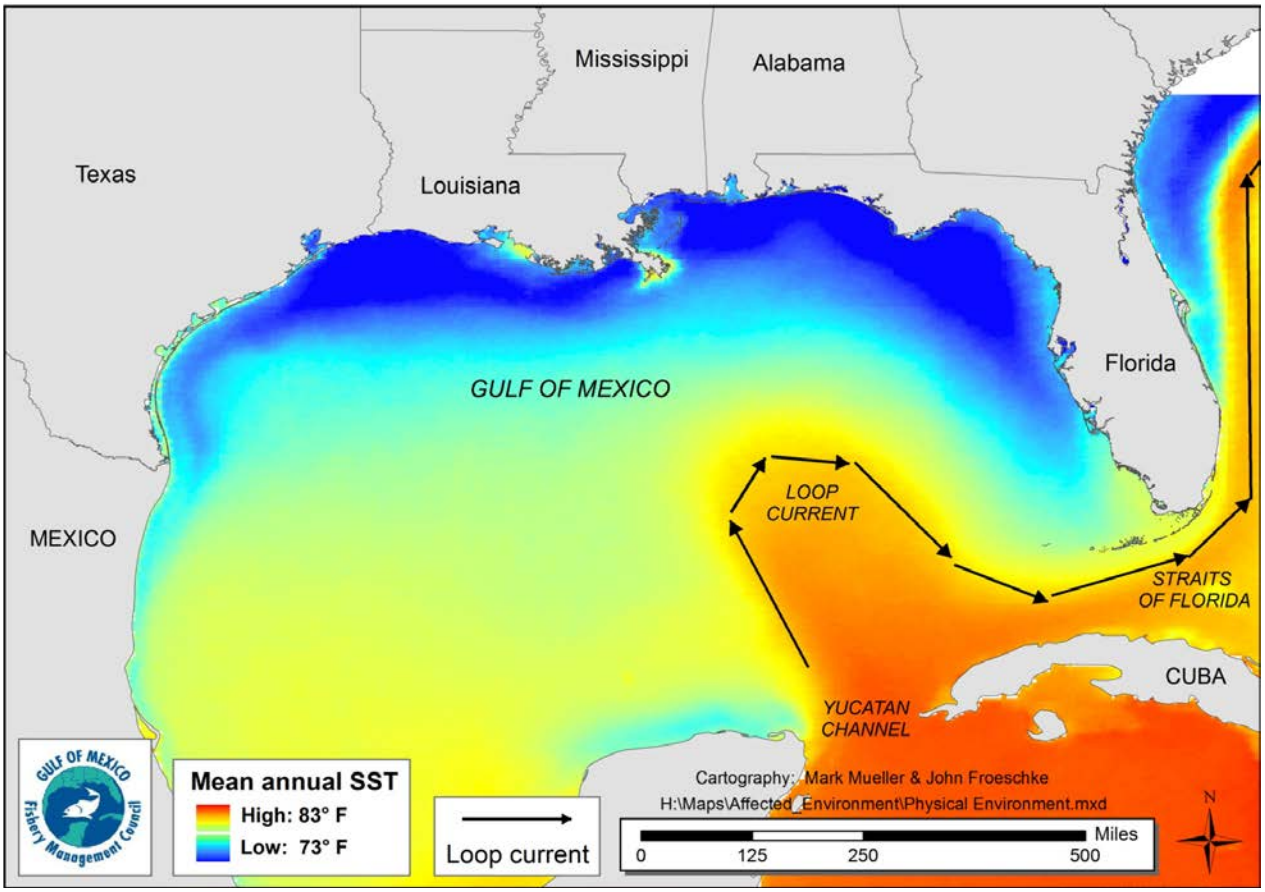


Figure 3.2.1. Physical environment of the Gulf, including major feature names and mean annual sea surface temperature as derived from the Advanced Very High Resolution Radiometer Pathfinder Version 5 sea surface temperature data set (http://accession.nodc.noaa.gov/0072888)

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 3.3.1). Eleven other species were removed from the FMP in 2012 through the Generic ACL/AM Amendment (GMFMC 2011a). The NMFS Office of Sustainable Fisheries updates its Status of U.S. Fisheries Report to Congress[13] on a quarterly basis utilizing the most current stock assessment information. Stock assessments and status determinations have been conducted and designated for 12 stocks and can be found on the Council[14] and Southeast Data, Assessment and Review (SEDAR)[15] websites. Of the 12 stocks for which stock assessments have been conducted, the fourth quarter report of the 2017 Status of U.S. Fisheries classifies only one as overfished (greater amberjack), and two stocks as undergoing overfishing (greater amberjack and gray triggerfish).

The status of both assessed and unassessed stocks, as of the writing of this report is provided in Table 3.3.1. However, it should be noted that greater amberjack, gray triggerfish, and red snapper are under rebuilding plans. Reef fish Amendment 44 (GMFMC 2017a), implemented December 2017, modified the minimum stock size threshold for seven species in the Reef Fish FMP. Red snapper and gray triggerfish are now listed as not overfished but rebuilding, because the biomass for the stock is currently estimated to be greater than 50% of B_{MSY}. The greater amberjack stock remains classified as overfished.

A stock assessment was conducted for Atlantic goliath grouper (SEDAR 47 2016). The Scientific and Statistical Committee (SSC) accepted the assessment's general findings that the stock was not overfished nor experiencing overfishing. Although the SSC determined Atlantic goliath grouper to not be experiencing overfishing based on annual harvest remaining below the OFL, the SSC deemed the assessment not suitable for stock status determination and management advice.

Stock assessments were conducted for seven reef fish stocks using the Data Limited Methods Tool (DLMTool; SEDAR 49 2016). This method allows the setting of overfishing limit (OFL)

[13] http://www.nmfs.noaa.gov/sfa/fisheries_eco/status_of_fisheries/status_updates.html
[14] www.gulfcouncil.org
[15] www.sedarweb.org

and acceptable biological catch (ABC) based on limited data and life history information, but does not provide assessment-based status determinations. Data were requested for the following stocks but it was determined not enough information was available to complete an assessment even using the DLMTool. These stocks are not experiencing overfishing based on annual harvest remaining below the OFL, but no overfished status determination has been made (Table 3.3.1). Lane snapper was the only stock with adequate data to be assessed using the DLMTool methods resulting in OFL and ABC recommendations by the SSC.

The remaining species within the Reef Fish FMP have not been assessed at this time. Therefore, their stock status is unknown (Table 3.3.1). For those species that are listed as not undergoing overfishing, that determination has been made based on the annual harvest remaining below the OFL. The gray snapper stock assessment is final (SEDAR 51 2018) and is currently awaiting SSC review in May 2018. No other unassessed species are scheduled for a stock assessment at this time.

Table 3.3.1. Status of species in the Reef Fish FMP grouped by family.

Common Name	Scientific Name	Stock Status		Most recent assessment or SSC workshop
		Overfishing	Overfished	
Family Balistidae – Triggerfishes				
gray triggerfish	*Balistes capriscus*	Y	N	SEDAR 43 2015
Family Carangidae – Jacks				
greater amberjack	*Seriola dumerili*	Y	Y	SEDAR 33 Update 2016a
lesser amberjack	*Seriola fasciata*	N	Unknown	SEDAR 49 2016
almaco jack	*Seriola rivoliana*	N	Unknown	SEDAR 49 2016
banded rudderfish	*Seriola zonata*	Unknown	Unknown	
Family Labridae – Wrasses				
hogfish	*Lachnolaimus maximus*	N	N	SEDAR 37 2013
Family Malacanthidae – Tilefishes				
tilefish (golden)	*Lopholatilus chamaeleonticeps*	N	N	SEDAR 22 2011a
blueline tilefish	*Caulolatilus microps*	Unknown	Unknown	
goldface tilefish	*Caulolatilus chrysops*	Unknown	Unknown	
Family Serranidae – Groupers				
gag	*Mycteroperca microlepis*	N	N	SEDAR 33 Update 2016b
red grouper	*Epinephelus morio*	N	N	SEDAR 42 2015
Scamp	*Mycteroperca phenax*	Unknown	Unknown	
black grouper	*Mycteroperca bonaci*	N	N	SEDAR 19 2010
yellowedge grouper	*Hyporthodus flavolimbatus*	N	N	SEDAR 22 2011b
snowy grouper	*Hyporthodus niveatus*	N	Unknown	SEDAR 49 2016
speckled hind	*Epinephelus drummondhayi*	N	Unknown	SEDAR 49 2016
yellowmouth grouper	*Mycteroperca interstitialis*	N	Unknown	SEDAR 49 2016
yellowfin grouper	*Mycteroperca venenosa*	Unknown	Unknown	
warsaw grouper	*Hyporthodus nigritus*	N	Unknown	
*Atlantic goliath grouper	*Epinephelus itajara*	N	Unknown	SEDAR 47 2016
Family Lutjanidae – Snappers				
queen snapper	*Etelis oculatus*	N	Unknown	
mutton snapper	*Lutjanus analis*	N	N	SEDAR 15A Update 2015
blackfin snapper	*Lutjanus buccanella*	N	Unknown	
red snapper	*Lutjanus campechanus*	N	N	SEDAR 31 Update 2015
cubera snapper	*Lutjanus cyanopterus*	N	Unknown	
gray snapper	*Lutjanus griseus*	N	Unknown	
lane snapper	*Lutjanus synagris*	N	Unknown	SEDAR 49 2016
silk snapper	*Lutjanus vivanus*	Unknown	Unknown	
yellowtail snapper	*Ocyurus chrysurus*	N	N	SEDAR 27A 2012
vermilion snapper	*Rhomboplites aurorubens*	N	N	SEDAR 45 2016
Wenchman	*Pristipomoides aquilonaris*	N	N	SEDAR 49 2016

Note: *Atlantic goliath grouper is a protected grouper (i.e., ACL is set at zero) and benchmarks do not reflect appropriate stock dynamics.

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 0.2^{y-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 3.3.2).

Table 3.3.2. 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 sea turtle species (Kemp's ridley, loggerhead, green, leatherback, and hawksbill), fish species (Gulf sturgeon, Nassau grouper, smalltooth sawfish, giant manta ray, and oceanic whitetip shark), and 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.

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 is not likely to jeopardize the continued existence of sea turtles 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*). In memoranda dated September 29, 2016, and March 6, 2018, NMFS has requested a reinitiation of Section 7 consultation on the continued authorization of reef fish fishery to address new species listed under the ESA (i.e., Nassau grouper, green sea turtle North Atlantic and South Atlantic DPSs, giant manta ray, and oceanic whitetip shark). In these requests, NMFS determined that allowing the fishery to continue during the reinitiation period would not violate Section 7(a)(2) and 7(d) of the ESA .

Brief overviews of the marine mammals, sea turtles, and 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 amendments [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).

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.

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 1.2-1.4ºC 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 3.3.3 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 3.3.3. 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	CO_2	Greenhouse CH_4	Gas N_2O	Total CO_{2e}**
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 CO_2 equivalent (CO_2e) emission estimates represent the number of tons of CO_2 emissions with the same global warming potential as one ton of another greenhouse gas (e.g., CH_4 and N_2O). Conversion factors to CO_{2e} are 21 for CH_4 and 310 for N_2O.

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).

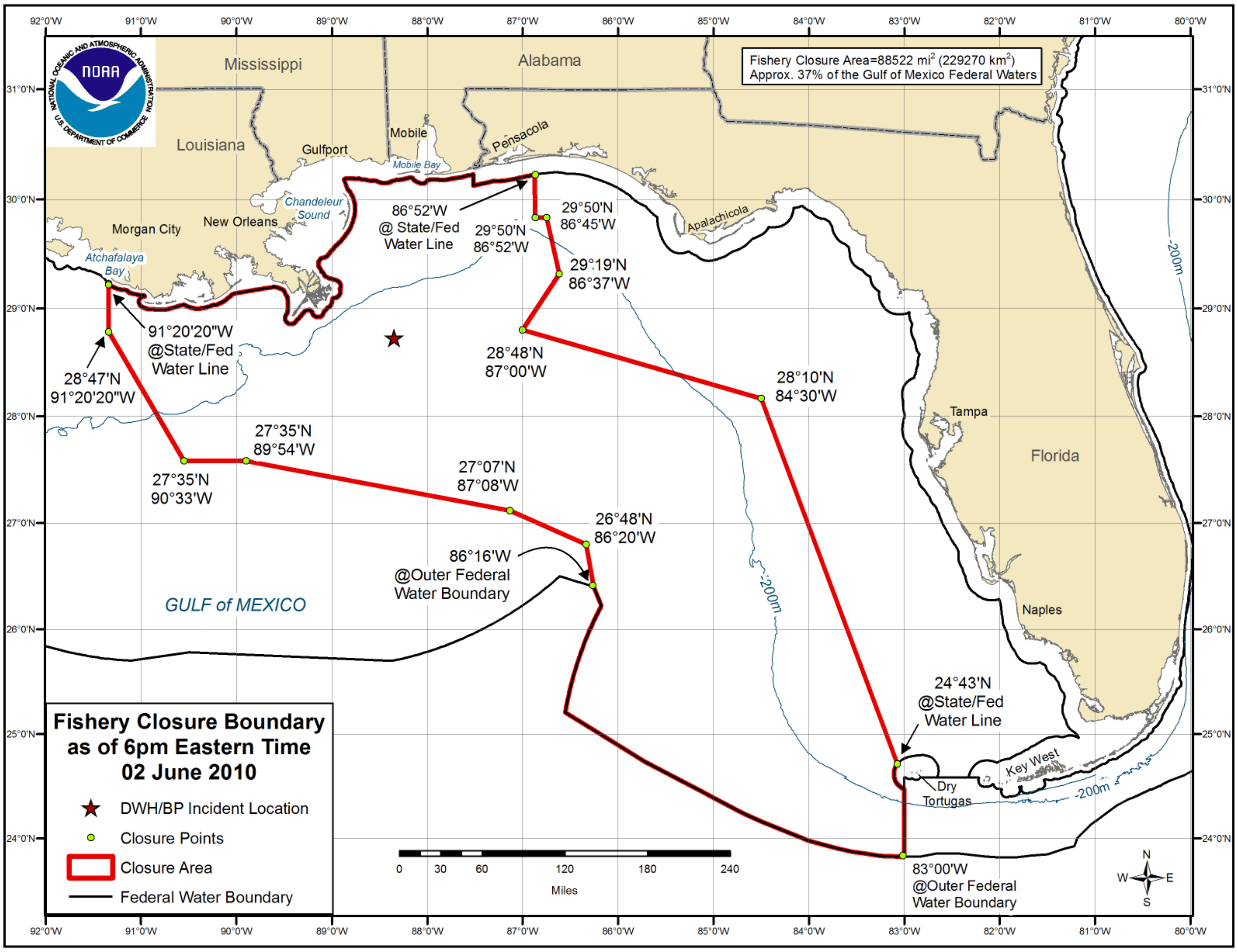


Figure 3.3.1. Fishery closure at the height of the *Deepwater Horizon* MC252 oil spill.

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. A portion of the description of the social environment as pertains to total fishing effort for both commercial and recreational fishing engagement 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 are little data available for the red drum fishery at the community level and it is 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

The locations of commercial reef fish harvest by all gear types are depicted in Figure 3.5.1.1 (Overstreet et al. 2017) and show a concentration of the largest harvests in the eastern Gulf. This is consistent with the homeports of many federally permitted commercial reef fish vessels as seen in the subsequent figures.

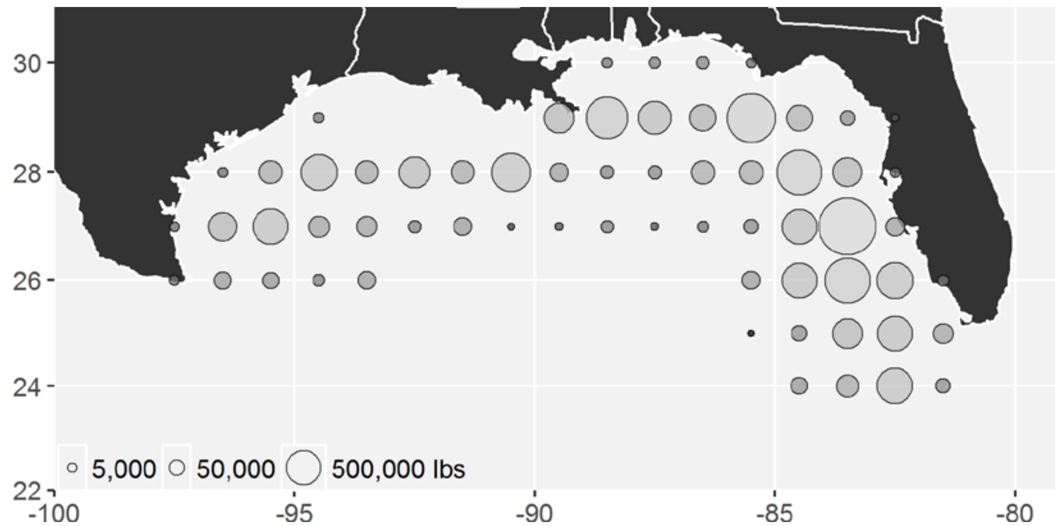


Figure 3.5.1.1. Distribution of Gulf reef fish harvest by area fished for 2014.
Source: Overstreet et al. 2017, commercial logbook data.

Commercial and recreational fishing engagement and reliance are measures of fishing activity at the county and community level from federal fisheries datasets including the Accumulated Landings System (ALS) with dealer addresses added for commercial fishing engagement and the Marine Recreational Information Program MRIP for recreational fishing engagement (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 including the value of those landings. Recreational engagement uses 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 within MRIP and other databases). 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 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

Florida, Louisiana, and Texas have at least one Gulf coastal county with either medium high or high engagement in commercial fishing (Figure 3.5.1.2). These are counties that have a substantial amount of socio-economic activity devoted to commercial fishing and would 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 do not have a coastal county that scores high or medium high for commercial fishing reliance. Florida's Panhandle and Louisiana's Delta region have several counties/parishes 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.

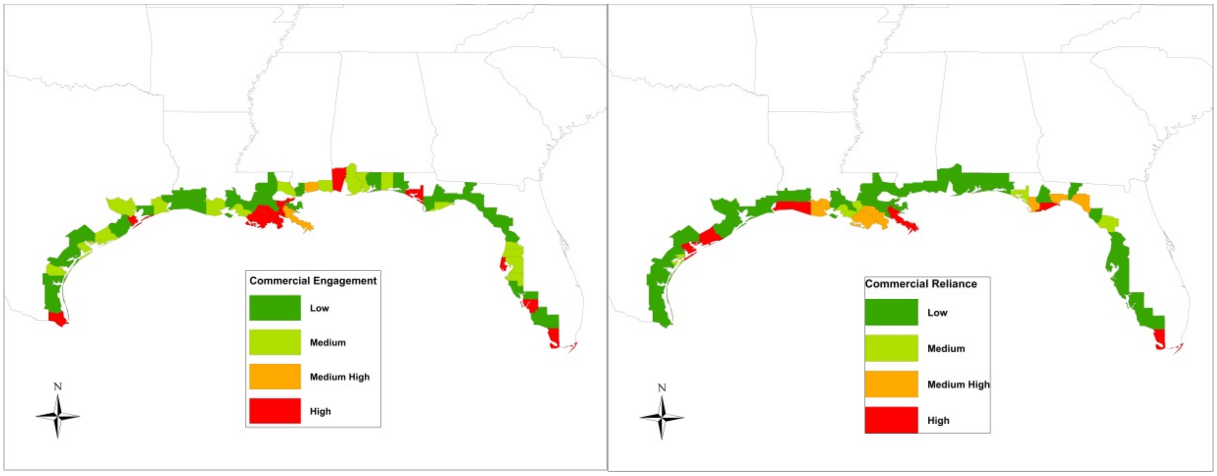


Figure 3.5.1.2. County commercial fishing engagement and reliance 2014.
Source: SERO, Community Social Vulnerability Indicators Database 2014.

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.

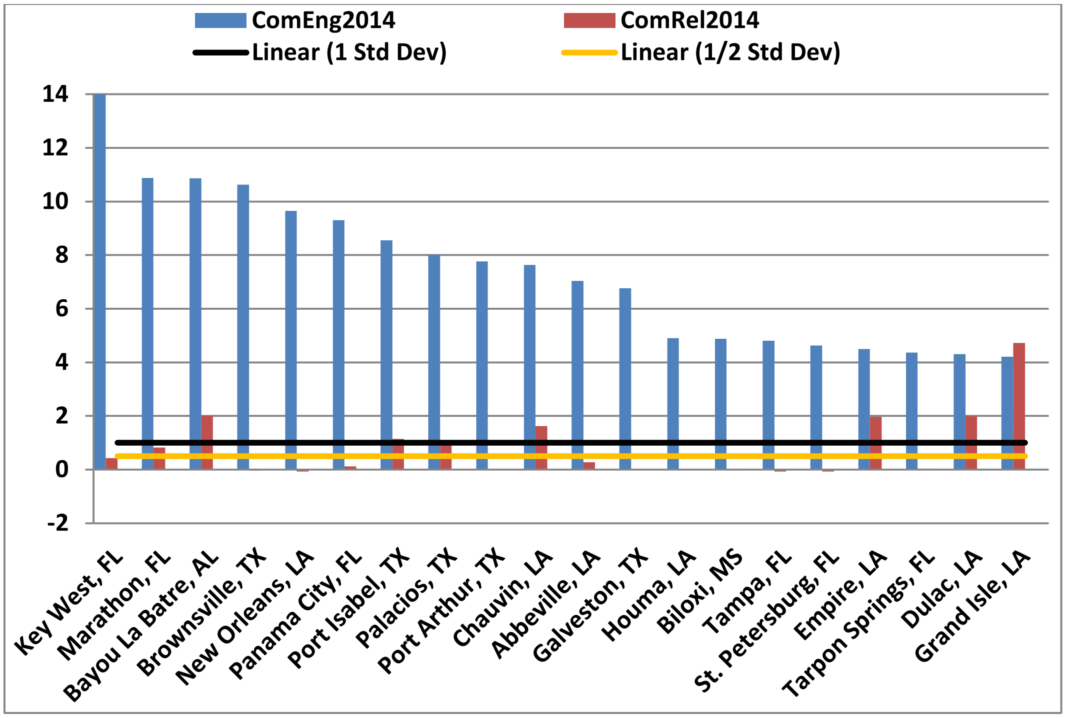
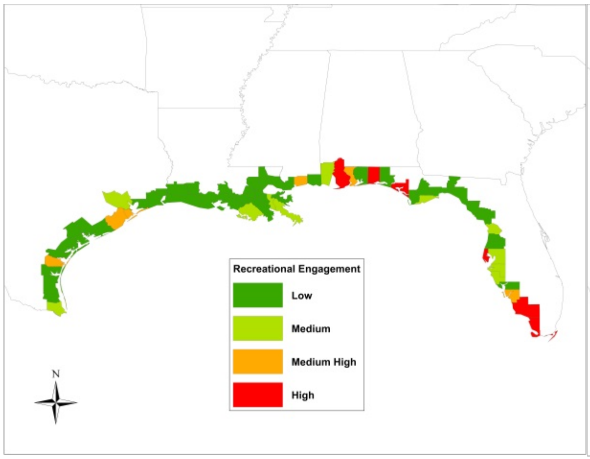


Figure 3.5.1.3. Top 20 commercial fishing communities' engagement and reliance.
Source: SERO, Community Social Vulnerability Indicators Database 2014.

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, which represents a high volume of landings. 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

Except for Louisiana, each Gulf state has a coastal county with either medium high or high engagement in recreational fishing (Figure 3.5.1.4). 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 Gulf coast has 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.



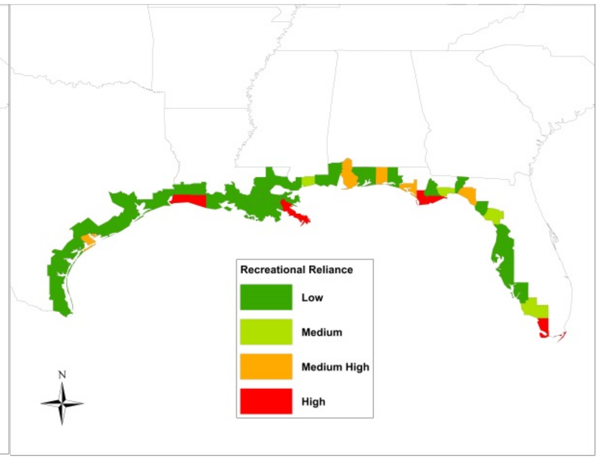


Figure 3.5.1.4. County recreational fishing engagement and reliance 2014.
Source: SERO, Community Social Vulnerability Indicators Database 2014.

Reef fish and red drum 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 and red drum. 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 or red drum. 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.

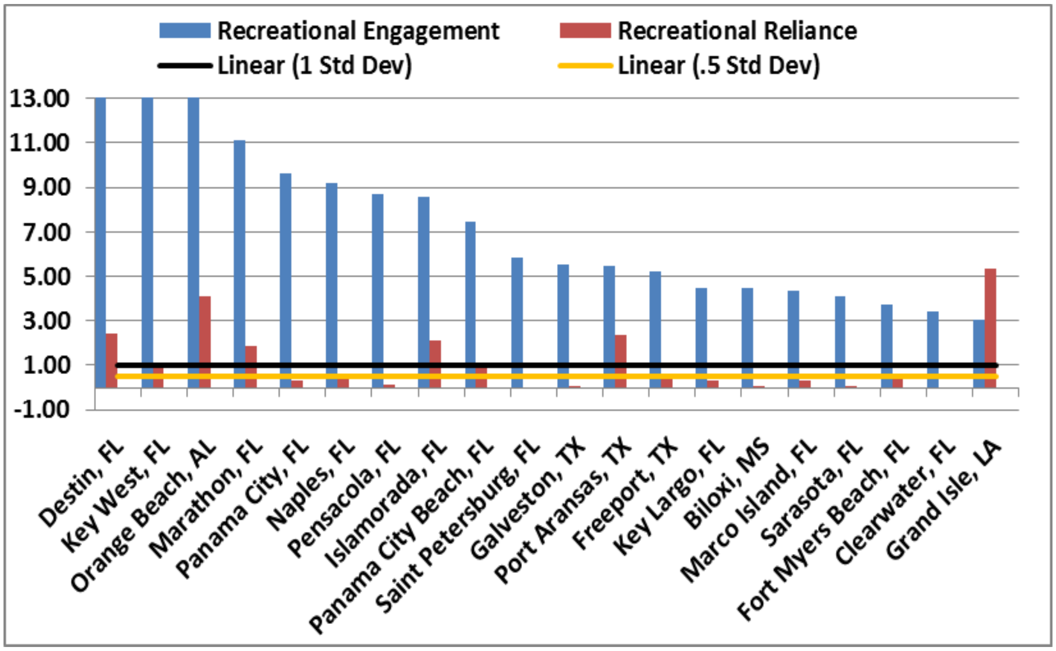


Figure 3.5.1.5. Top 20 recreational fishing communities' engagement and reliance.
Source: SERO, Community Social Vulnerability Indicators Database 2014.

3.5.2 Reef Fish Permits

Table 3.1.1.1 provides the number of commercial Gulf reef fish permits by state and Table 3.1.1.4 provides the number and percentage of vessels with a charter/headboat permit for Gulf reef fish, including historical captain endorsements, by state, as of February 2018. The general trend for both commercial and for-hire reef fish permits has been downward from 2006 through 2016 (Figure 3.5.2.1).

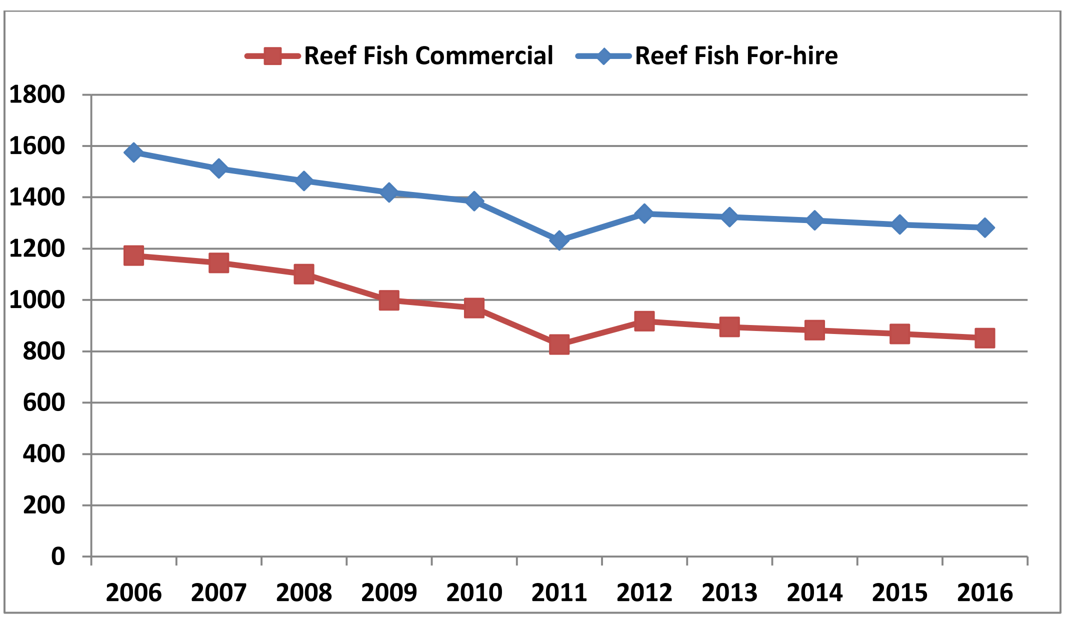


Figure 3.5.2.1. Total number of reef fish permits for both commercial and for-hire from 2006-2016.

Source: SERO Permits office 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.

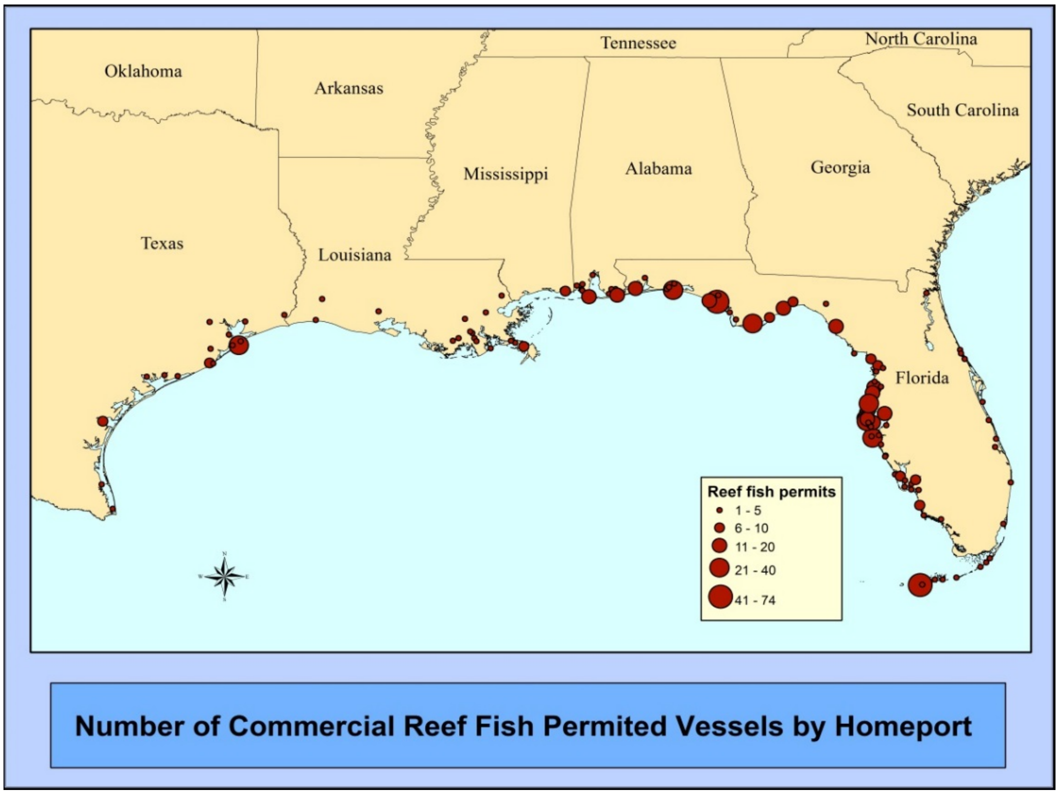


Figure 3.5.2.2. Distribution of commercially permitted reef fish vessels for Gulf States by community.
Source: NMFS Southeast Regional Office permits office, September 20, 2016.

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 (Table 3.1.1.4), 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
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.

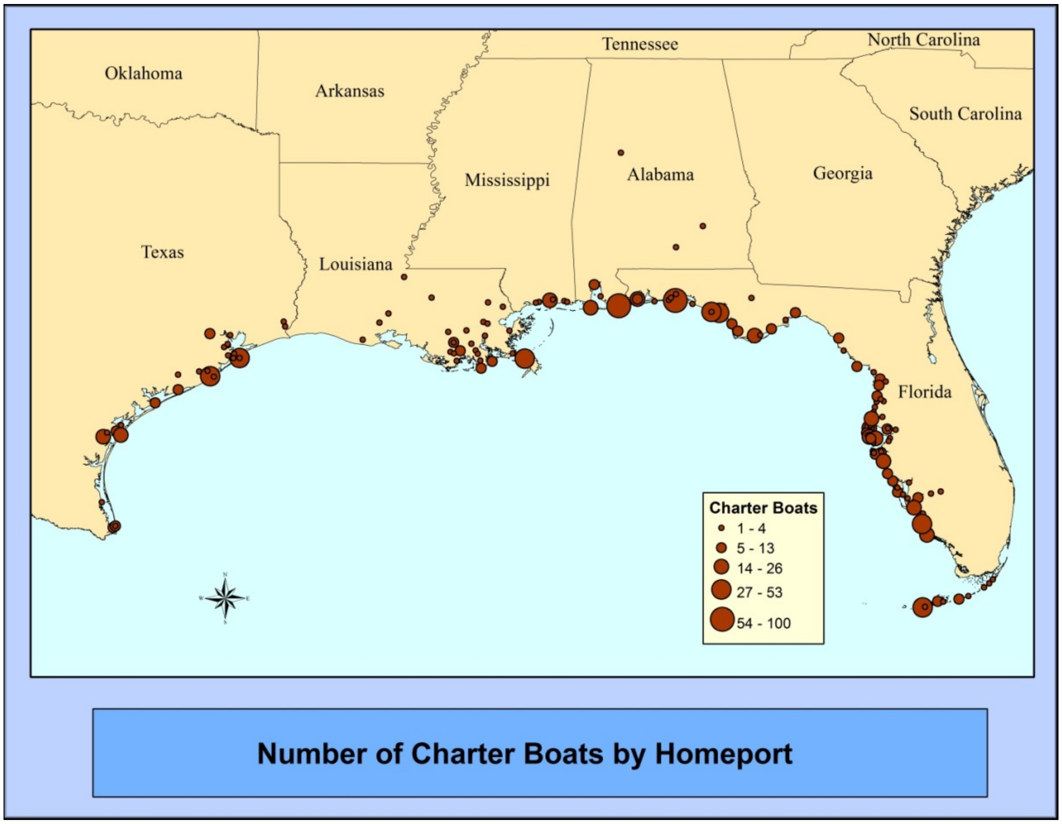


Figure 3.5.2.3. Distribution of charter vessels with federal for-hire permits for Gulf reef fish in Gulf states by community.
Source: NMFS Southeast Regional Office permits office, September 20, 2016.

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.

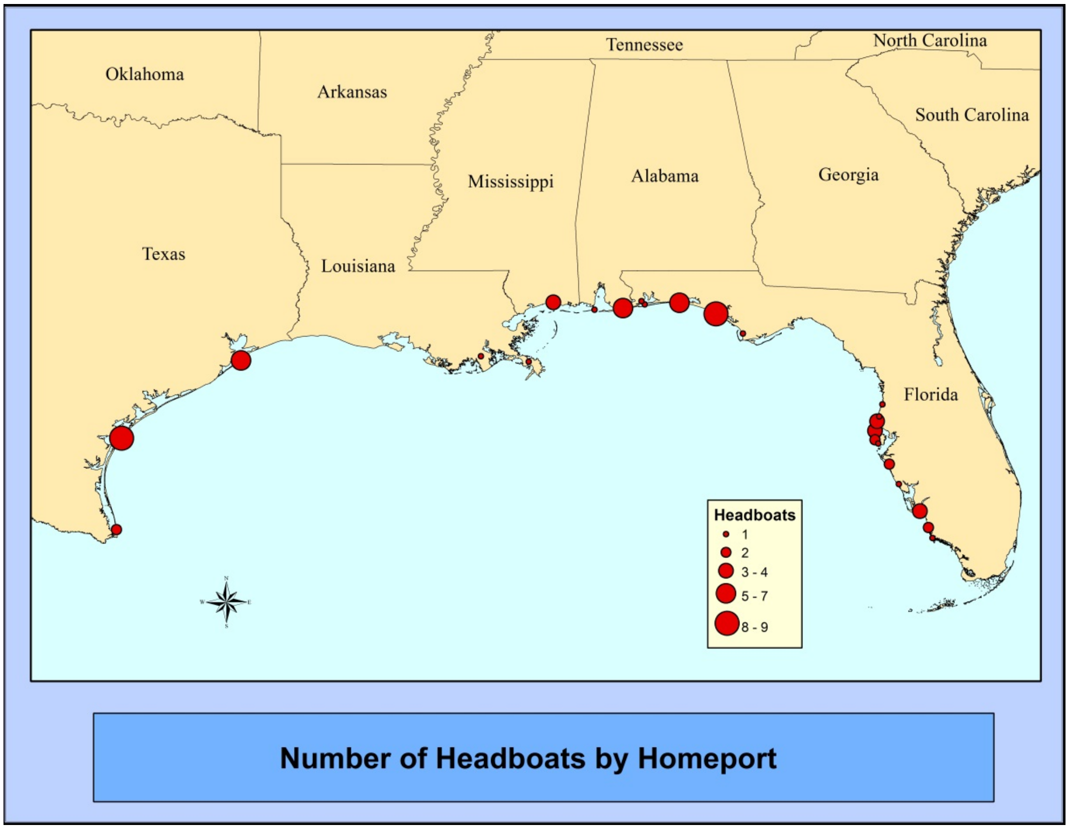


Figure 3.5.2.4. Distribution of headboats with federal for-hire permits for Gulf reef fish by community.
Source: NMFS Southeast Regional Office permits office, September 20, 2016.

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.

The actions in this amendment would not affect any particular population differently based on race, ethnicity, or income status. Thus, disproportionate impacts to environmental justice populations are not expected to result from any of the actions in this amendment (see sections 4.1.4, 4.2.4, 4.3.4, and 4.4.4). Nevertheless, the lack of impacts on EJ populations cannot be assumed. Finally, there are no known claims for customary usage or subsistence consumption of any of the species managed under the IFQ programs by any population including tribes or indigenous groups.

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 Fishery Conservation and Management Act (Magnuson-Stevens Act) (16 U.S.C. 1801 *et seq*.). It was originally enacted in 1976 as the Fishery Conservation and Management Act. 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 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 line 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 an annual 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 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 for six reef fish stocks that have had stock assessments, and produced MSY proxies that were used by the assessment scientists and the Gulf of Mexico Fishery Management Council’s (Council) Scientific and Statistical Committee (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 the fishing mortality rate (F) corresponding to a spawning potential ratio (SPR) of 30% ($F_{30\%SPR}$). However, the Gulf of Mexico Fishery Management Council (Council) has not specified the MSY proxies in the fishery management plan (FMP). **Alternative 1** (No Action) 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 fishing effort or the effects thereof 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 fewer adverse effects on the physical environment.

Sub-action 1.2 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 (ACL/AM) 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 1.1 and Sub-action 1.3.

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 three-species complex as a whole. This would be an actual harvest number (e.g., 1,000,000 pounds whole weight) rather that 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 fewer adverse effects 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 fewer adverse effects 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 fewer adverse effects 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 methods 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 fewer adverse effects 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 methods 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 fewer adverse effects 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 1.3 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 five and 20 stocks, depending on how many stocks are selected for inclusion in stock complex MSY proxies in *Sub-action 1.2*.

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 to the physical environment 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 to the physical environment. Thus $F_{20\%SPR}$ could result in the greatest adverse effects, with successively fewer adverse effects for $F_{30\%SPR}$, $F_{40\%SPR}$, and $F_{50\%SPR}$. This only is true if a stock assessment is conducted. Otherwise, the effects would be no different than those in **Alternative 1**. If a data-limited method is selected, this would place a limit on harvest relative to **Alternative 1**, and would therefore have fewer adverse effects 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 Fishery Management Plan for the Red Drum Fishery of the Gulf of Mexico) 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 gear 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 Council's 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 at 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 at 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 fork length; 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), vermilion 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 portion of the reef fish 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 FMP concluded authorization of the Gulf reef fish fishery managed in the Reef Fish 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 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** (No Action) **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 Review). 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.

Sub-action 1.2 would establish MSY proxies for stock complexes that were created in the Generic ACL/Accountability Measure (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 1.1 and Sub-action 1.3. **Alternatives 2-6** select the MSY values for the five different complexes identified in 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 ponds whole weight) rather that 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 fewer adverse impacts to the biological/ecological environment than if either of these alternatives is not selected, or the reductions were applied to a single stock under **Alternative 1**.

Sub-action 1.3 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 (No Action) 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

Under **Alternative 1** (No Action)**,** the MSY proxy for assessed stocks in this group (black grouper, yellowedge grouper, mutton snapper, yellowtail snapper, and tilefish) would 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**, would not be 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 $F_{50\%\ SPR}$. For the gonochoristic species, **Alternative 3** would set the MSY proxy as the yield at $F_{40\%\ SPR}$. 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 1.2

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 1.3

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 $F_{20\%\ SPR}$ to the yield at $F_{50\%\ SPR}$. **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 $F_{20\%\ SPR}$ would be the least conservative proxy and the yield at $F_{50\%\ SPR}$ 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

Although additional effects are not usually expected from retaining **Alternative 1** (No Action), the lack of stock status determination criteria is not consistent with National Standard 1 (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 six 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 species (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 1.2

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 1.3

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 $\mathbf{F_{20\%\ SPR}}$ (least conservative) to the yield at $\mathbf{F_{50\%\ SPR}}$ (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 would 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 1.1-1.3 would not result in added regulations, there would not be any immediate effect on the administrative environment from rulemaking.

Sub Action 1.1 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 1.2 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 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 1.3 would establish an MSY proxy for data-limited stocks unless a stock is included in a stock complex in *Sub-action 1.2*, and that complex is selected by the Council to have an MSY proxy for the complex as a whole, or for an indicator species within the complex. This includes between five and 20 stocks, depending on how many stocks are selected for inclusion in stock complex MSY proxies. **Alternative 1** would leave the MSY proxy officially undefined for all stocks and would 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 fishing mortality rate options ($F_{20\%SPR}$, $F_{30\%SPR}$, $F_{40\%SPR}$, or $F_{50\%SPR}$) or a proxy of an actual poundage 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 effects, with successively fewer adverse effects 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 the National Marine Fisheries Service (NMFS). Actions to control harvest by the Council and NMFS are mostly routine and conducted through the Council system established by the Magnuson-Stevens Fishery Conservation and Management Act (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. This action does not affect the gear used and therefore has no direct effect 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 effect on the physical environment.

Under all 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 effects to the physical environment than any of the alternatives that set an MSST.

Alternative 2 would apply the $(1\text{-}M)*B_{MSY}$ (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 short-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 a natural mortality rate which is 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 effects 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 fewer adverse effects could occur on stocks with a low natural mortality rate.

Alternative 3 would apply to 0.75*B_{MSY} (or proxy) formula to all currently undefined stocks. Relative to **Alternative 1**, this alternative would have fewer 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 fewer adverse effects for stocks with a natural mortality rate greater than 0.25 (approximately nine stocks).

Alternative 4 would set MSST at 0.50*B_{MSY}, which is the lowest MSST allowed under the NS1 guidelines. Relative to **Alternative 1**, this alternative would have fewer 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 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 potential for negative effects 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 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 because of a more stringent 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 NS1 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. A less efficient approach would occur under **Alternative 1** (No Action), 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 $0.75*B_{MSY}$. 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 $(1-M)*B_{MSY}$. **Alternative 4** is the least conservative MSST of $0.5*B_{MSY}$ 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 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 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 effect 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 effect 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 current MFMT definitions are based on fishing mortality rates, i.e., the F at a level equal to the MFMT (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 F, 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 quantity or severity 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 F, 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 quantity or severity 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 data-limited methods, there will be a cap on the level of fishing effort, and therefore fewer adverse effects 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 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 plan, **Alternative 3** will result in less fishing effort and fewer 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 would retain the existing MFMT definitions. 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 would 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 would have the same effects on the biological/ecological environment. However, for stocks that are in a rebuilding plan, MFMT would be set at $F_{REBUILD}$, which is the fishing mortality rate that would rebuild the stock in 10 years or less, or within the maximum time period allowed. $F_{REBUILD}$ would never be greater than the $F_{MSY\ Proxy}$, and would generally be lower. Therefore, for stocks in a rebuilding program, **Alternative 3** would be more beneficial than **Alternative 2** for to 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 Sustainable Fisheries Act 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 SSC. 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 fishing morality (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 effects 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, which is derived from the OFL and ABC, which are derived from the MSY proxy selected in Action 1, or in previous amendments. There would be no change to the current effects 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 F, then OY would be the yield when fishing at some percentage of the F_{MSY} proxy. If the MSY proxy is an actual harvest yield based on a data-limited method, OY would be some percentage 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, or 50%, resulting in the lowest OY, the smallest amount of fishing effort, and the fewest adverse effects 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 effects 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 effects that either **Option 2a** or **Option 2b**. In summary, the level of adverse effects 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 fewer adverse effects 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 fewer adverse effects 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 biomass (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** is 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 would account for more relevant factors than either of those alternatives. In particular, **Alternative 3** would 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** (No Action) 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 $F_{MSY\ Proxy}$ (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 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** (No Action), 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 $F_{MSY\ Proxy}$ at which OY would be defined for all reef fish species. It has been assumed that setting OY at some percentage below MSY or its proxy will result in long term benefits because there would be less chance of a stock moving into an overfished status. Without knowing what economic or social benefits are foregone however, it is difficult to determine whether OY is truly being attained. **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** (No Action), the OY definition would be maintained for seven stocks. 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.

<u>*Other Fishery related actions*</u> - 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

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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
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Christopher Liese	Economist	Reviewer	SEFSC
Mandy Karnauskas	Fishery biologist	Reviewer	SEFSC
Clay Porch	Fishery biologist	Reviewer	SEFSC
Ryan Rindone	Fishery biologist	Reviewer	GMFMC
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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
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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.

<u>Administrative Procedures Act</u>

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 generally 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 requires a 30-day delay from the time a final rule is published until it takes effect unless one of the exceptions applies.

<u>Coastal Zone Management Act</u>

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.

<u>Data Quality Act</u>

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. Species covered under the ESA are discussed in Chapter 3.

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. Species covered under the MMPA are discussed in Chapter 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.

Executive Orders

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.

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APPENDIX B. ALTERNATIVES CONSIDERED BUT REJECTED

Sub-action 1.1. Red snapper

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

Alternative 2. The MSY proxy for red snapper shall be

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

Discussion:

In February 2014 the Council instructed staff to begin an amendment process to revise the current yield at $F_{26\%\ SPR}$ MSY proxy for red snapper. That action was included in the draft amendment as Sub-action 1.1. 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 $F_{26\%\ SPR}$) for Gulf of Mexico (Gulf) red snapper (GMFMC 2015).

Recently, a report by Goethel et al. (2018) evaluated the selection of MSY-based reference points for fisheries with high discards and uncertain recruitment. The report used red snapper as a case study. It concluded that the SPR most closely associated with red snapper global MSY (i.e., the MSY that can be achieved under ideal selectivity with no discards or discard mortality) was between 24% SPR and 38% SPR depending upon the steepness values assumed for the stock-recruit curve (steepness values of 1.00 – 0.70 were evaluated). These results were provided to the Council at its April 2018 meeting. The Council concluded that, because the current MSY proxy of the yield at $F_{26\%\ SPR}$ is within this range, albeit at the lower end, three was no need to consider changing it, and the Council voted to move this section to Considered but Rejected.

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APPENDIX C. SUMMARIES OF PUBLIC COMMENTS RECEIVED

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

APPENDIX D. METHODOLOGY FOR ESTABLISHING STOCK COMPLEXES

The following is a condensed version of the discussion on stock complexes included in the Generic ACL/AM Amendment (GMFMC 2011a). For a more detailed description of the analysis, refer to the analysis report by Farmer et al. (2010).

Traditionally, management measures have been implemented using MSY proxies in species-specific stock assessments. However, red drum and many of the stocks in the Fishery Management Plan (FMP) for the Reef Fish Resources in the Gulf of Mexico (Reef Fish FMP) have not had stock assessments and are unlikely to be assessed in the near future. In these cases, the National Standard 1 (NS1) guidelines allow an MSY proxy to be assigned to a stock complex under certain conditions. Stock complex is defined as a group of stocks that are sufficiently similar in geographic distribution, life history, and vulnerabilities to the fishery such that the impact of management actions on the stocks is similar. Stocks may be grouped into complexes for various reasons, including where stocks in a multispecies fishery cannot be targeted independent of one another and MSY cannot be defined on a stock-by-stock basis; where there are insufficient data to measure their status relative to status determination criteria (SDC); or when it is not feasible for fishermen to distinguish individual stocks among their catch.

Analysis of the relationships between reef fish stocks was conducted by Farmer et al (2010) for purposes of establishing the stock complexes in the Generic ACL/AM Amendment (GMFMC 2011a), and used here.

The objectives of the National Marine Fisheries Service (NMFS) stock groupings analysis specified in Farmer et al. (2010) were threefold: 1) To determine whether species assemblages can be identified in the Gulf of Mexico (Gulf) among the managed Reef Fish FMP species, 2) To determine if these assemblages are consistent between commercial and recreational fisheries, and 3) To develop species complexes that are "…sufficiently similar in geographic distribution, life history, and vulnerabilities to the fishery such that the impact of management actions on the stocks is similar" per NS1.

Methods

Following Lee and Sampson (2000), multiple statistical techniques were used to identify species assemblages: 1) species life history and depth of occurrence, 2) percent landings and percent trips by dataset, 3) dimension reduction and hierarchical cluster analyses based on life history; abundance; and presence-absence, 4) correlation matrices, 5) nodal analyses, and 6) maps of species distributions. These results were synthesized across analyses to develop potential species complexes for ACL management sufficiently similar in geographic distribution, life history, and vulnerabilities to the fishery such that the impact of management actions on the stocks would be similar.

Life History and Landings Data

Life history parameters were assembled from peer-reviewed literature, Southeast Data Assessment and Review (SEDAR) reports, unpublished data from the NMFS Panama City Laboratory, Stock Assessment and Fishery Evaluation reports, and from FishBase (Froese and Pauly 2014). Data from the Gulf of Mexico (Gulf) were used whenever possible. Depth of occurrence records were assimilated from FishBase, with minimum and maximum depths of occurrence recorded (Froese and Pauly 2014).

Commercial logbook, commercial observer, headboat logbook, recreational survey, and fishery-independent bottom longline data were used to evaluate similarities in spatial and temporal patterns of fisheries exploitation in the Gulf for species in the Reef Fish FMP. Commercial logbook records (SEFSC logbook data, accessed 6 May 2010) summarize landings on a trip level, with information for each species encountered including landings (in pounds), primary gear used, and primary area and depth of capture. Depth of capture is an important consideration when evaluating similarities in fisheries vulnerability and is only available in logbook records from 2005 onward, reported as a mean depth of capture, by species captured. It should be noted that a single depth of fishing is reported for each species per trip, although they may be encountered at numerous depths during multiple sets, and even within a single drifting longline set. Additionally, depth is occasionally misreported in fathoms rather than feet.

For the purposes of these analyses, logbook landings were summarized by species, year, month, gear type, statistical area, and depth. Trip-level adjustments were made to black grouper and gag landings to account for geographic differences in misidentification rates following recommendations from SEDAR 10 (2006). Year and month were defined by the date the fish were landed. Vertical line (e.g., handline and electric rig) and longline gear types were evaluated separately. Area fished was based on the 21 Gulf commercial logbook statistical areas (Figure 1). Depth of capture was aggregated into atmospheric pressure bins (e.g., 33 ft = 2 atm, 66 ft = 3 atm, etc.). Records with no reported depth or area of capture were removed from consideration; these represented approximately 9% of the total available records for both the longline and vertical line clusters. Overall, 27,566 longline and 121,767 vertical line commercial logbook records from 2005-2009 were evaluated.

For the commercial logbook data, separate analyses were conducted for commercial longline and commercial vertical line gear types. Landings were binned by month to maximize the variety of species landed while still capturing temporal trends in abundance. Fishermen will typically make multiple sets on a trip, sometimes in geographically distant areas, targeting different species. Binning by area and depth (commercial) reduced the probability of grouping species caught during the same time period that would likely not co-occur during any given set due to disparate geographic distributions.

In July 2006, NMFS implemented a mandatory reef fish observer program (RFOP) to characterize the reef fish fishery operating in the U.S. Gulf of Mexico. The mandatory RFOP provides general fishery bycatch characterization, estimates managed finfish discard and release mortality levels, and estimates protected species bycatch levels. The RFOP provides set-level information on species encountered on trips using bottom longline, electric (bandit) reel, and handlines. Overall, 140,204 records representing 9,031 sets from 2005-2009 were evaluated.

The recreational headboat sector of the reef fish fishery was evaluated using headboat survey logbook data (Southeast Region Headboat Survey data, accessed 19 April 2010) reported by headboat operators. Headboats are large, for-hire vessels that typically accommodate 20 or more anglers on half or full day trips. Headboat records are arranged similar to commercial logbook records, and contain trip-level information on number of anglers, trip duration, date, area fished, and landings (number fish) and releases (number fish) of each species. Headboat landings and encounters (landings plus releases) were summarized by species, year, month, trip duration, and area fished. Trip duration was considered the best proxy for depth fished, as trips of longer duration are more likely to go farther offshore. Area fished was aggregated at the most common reporting level (1° latitude by 1° longitude). As with the commercial fishery data, area fished is self-reported and this introduces error into the analysis. Additionally, vessels fishing in multiple areas during a trip would be constrained by the current data form to select one area fished for the trip, which limits the spatial precision of the analysis. Records with no geographic area reported (~3%) were removed from consideration. Overall, 121,334 headboat records from 2004-2009 were evaluated.

The private, rental, and for-hire charter components were evaluated using data from the Marine Recreational Fisheries Statistics Survey (MRFSS) dockside intercept records. MRFSS intercepts collect data on port agent observed landings ('A' catch) and angler reported landings ('B1' catch) and discards ('B2' catch) in numbers by species, two-month wave (e.g., Wave 1 = Jan/Feb, … Wave 6 = Nov/Dec), area fished (inland, state, and federal waters), mode of fishing (charter, private/rental, shore), and state (west Florida, Alabama, Mississippi, and Louisiana). All MRFSS intercepts from the Gulf from 2000-2009 were aggregated by year, wave, mode, and area fished; computing a catch-per-angler-per-trip by species for the whole catch (e.g., 'A'+'B1'+'B2' catch). Overall, 64,782 dockside intercept records from 2000-2009 were evaluated.

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